

Maintaining Marine Diesel Engines

A Diesel Engine and Gasoline Engine May Look Alike—Large Hunks of Metal in the Bilge of the Boat that Make Noise, Blow Smoke, and Make The Boat Go, But there are Significant Differences that Must be Understood if Each is to be Maintained Properly. One Thing that Both Types of Engines Have in Common: If They are Ignored, Sooner or Later the Owner Will be Faced With a Whopping Repair Bill...

According to almost anyone who makes a living fixing engines, a marine diesel that looks like its in bad shape probably is in bad shape. Oil streaks, discolored paint (indicating excessive heat), frayed belts, and gunk in the bilge are a neglected engine's plea for help. Rule one, then, is spend some time cleaning your engine and getting to know where the various parts are located. Maybe keeping an engine clean and bright won't help it run better or last longer, but it's a start.

Fuel System

Keeping the engine clean may be a start, but keeping the fuel clean is essential—the key to a healthy diesel. “Clean fuel, clean fuel, clean fuel” should be the mantra of every diesel owner. The reason healthy fuel is so important has to do with its injectors, which are delicate instruments that spray fuel into the combustion chamber in a precise, ultra-fine mist. Even microscopic specks of dirt or water can eventually wreck injectors, the combustion process, the engine, and your account balance.

Water in the fuel is equally bad news. Water will be turned to steam as it enters the engine and can blow the heads off of injectors. Water also mixes with sulfur in the fuel to form sulfuric acid, which causes internal parts to rust when the engine is idle for extended periods. Finally, water has the potential to spawn microorganisms, which multiply like tiny little bunnies and clog the fuel system.

You'll get at least some dirt and water in the tank at the fuel dock, even at the best marinas. Condensation in your fuel tank will add more water. Fortunately, filters have been developed that can keep the fuel healthy and the engine humming if these filters are maintained.

Most engines have two built-in fuel filters: a large primary filter and then a smaller secondary filter to trap ultra-fine particles of dirt and water that were missed by the primary filter. Many larger diesels also have a second primary filter with a cross-over switch that allows the filter to be changed while underway.

The elements in the primary and secondary filters should be changed routinely, at least once a season or more depending on the manufacturer's

recommendations. Dirt that makes it past the primary filter to the secondary filter is worrisome, since it is an indication that some dirt may have also made its way into the engine. Newer primary fuel filters typically have a clear bowl so that water will be readily apparent and can be drained off as necessary. With older filters you'll have to open the drain to see (and smell) what comes out. With either type of filter, whenever fuel/water is drained the filter should be primed with fuel or the system may have to be bled. Always carry spare filter elements for both the primary and secondary filters.

Two other techniques used by some skippers to protect fuel include using a funnel with a fine mesh or, better yet, a multi-stage filter to trap dirt when they fill the tank and then adding a biocide to inhibit the formation of microbes.

When you're inspecting the filters, look at the fuel lines occasionally. Aged fuel lines can be as dangerous on diesel engines as they are on gasoline engines. According to the BOAT/U.S. Marine Insurance Claim files, leaks in the fuel lines are the most frequent cause of diesel fires (*Seaworthy*, January 1990). Flexible fuel lines get hard and brittle as they age and must be replaced. Steel injection lines can corrode and develop leaks, and should also be examined and replaced as necessary.

Air Filters

Clean air, lots of it, is essential to the combustion of diesel fuel. Several thousand cubic feet of air (a lot) is required to burn one gallon of fuel, and all of that air passing through the engine is bound to carry some dirt. Even a few specks ingested into the cylinders can score the walls, which is why your engine has an air cleaner.

Should the air cleaner become partially blocked with dirt it will cause the engine to lose power and burn more fuel. With a turbocharger, any loss of air could damage oil seals. Evidence that this is happening includes black exhaust smoke, overheating, and loss of power. An air cleaner that is badly clogged can stop the engine.

Despite their importance to the engine's health, air cleaners on diesels don't have to be cleaned very often (unless you do your boating near a big city), which means they tend to be forgotten on many boats. A filter that looks dirty must either be cleaned or, in the case of paper or some foam filters, replaced.

Turbochargers

With the engine turned off, check to see if the turbocharger has any play or doesn't turn easily, which are indications that it needs to be replaced. Never let a turbo blanket become oily, dirty, or cracked—it is a fire hazard! Renew the blanket routinely (check your manual).

Examining the Oil

Changing the oil frequently is especially important with diesel engines, which run at higher temperatures and under heavier loads than their gasoline-powered counterparts. Diesels produce a lot of carbon and acid, which is why the oil looks sooty and has a burnt smell after only a few hours of operation. Using an oil blended for diesels helps to compensate for the carbon and acids.

You may learn something about the engine's condition by sticking a finger under the filler cap. Black goop is bad; it means you (or the boat's previous owner) haven't been diligent about changing the oil routinely. Also, look for water under the cap. Some moisture is to be expected, but too much could be indicating a blown head gasket, cracked cylinder head, or a corroded cylinder liner. If you run the engine, look at the oil's color; a creamy color indicates excessive water in the oil. Consult a mechanic.

Other things to look for include pulling the lube oil dipstick on the oil-lubrication sump, if there is one, and check the oil level. Some fuel in the oil is to be expected, but too much fuel indicates a lack of maintenance and maybe a damaged shaft seal in the injection pump or faulty pump plunger(s), depending on the type of pump you have. If you're not sure how much fuel is too much, call the mechanic. The condition must be corrected or the fuel will effect the oil's lubricity and increase bearing and journal wear.

Cooling System

Unless you operate your boat in a swimming pool (clean and well filtered), you're diesel should have a sea strainer, preferably one with a clear bowl that is readily accessible. Inspect the strainer regularly and clean out any debris (close the seacock first). The impeller is another critical component in the cooling system that should be inspected periodically. Cracks at the base of impeller blades indicate that the impeller needs replacing. An impellar will usually last longer if you take it out over the winter to prevent its taking a set. Should the impellar fail, broken blades must be located or water flow to the engine could be blocked. It's also a good idea to keep a spare impeller aboard.

Many diesels have both a raw and freshwater cooling system; others are cooled solely by raw water—water brought into the engine via an intake in the boat's hull. Problems typically occur on the raw water side of the cooling system, especially if the boat is used in saltwater. Joe Joyce, the Service Manager for Westerbeke, says an area that is often overlooked by boat owners is the heat exchanger, which gradually becomes clogged with debris and restricts the flow of water. He says this is especially likely if there is no sea strainer in the raw water intake.

To make sure water flow isn't being restricted, take the removable end off of the heat exchanger and clear out any debris that is blocking the passages. While you're there, examine the pencil zinc. A zinc that is more than half wasted away should be replaced. If the zinc is gone, shut the intake, take off the hose, and look for corrosion on the hose nipple, which indicates electrolysis has been at work in the raw water cooling system. If the zinc has been gone long enough, bronze surfaces may look pinkish. Don't use the engine until a mechanic has been consulted.

Exhaust hoses should also be removed from the elbows to check for corrosion inside the elbow, as well as excessive amounts of carbon on the exhaust pipe. Too much carbon (it should be fairly clean) indicates the engine has been used frequently at slow speeds (on displacement hulls) or has been lugging (on planing hulls). Either way, there is a good chance the valves and piston rings are also fouled. This practice of running a diesel at low RPMs also reduces compression and increases condensation, all of which shorten a diesel's life and makes the remainder of your life more miserable. Check your engine manual and operate at the RPM recommended by the manufacturer. The manual will probably also recommend running the diesel at a fast idle for at least five minutes at the dock before getting underway and also running it at idle for several minutes before it is shut off. This is especially important on turbo-charged engines.

Hoses, Seals, and Belts

Grip the exhaust hose immediately behind the riser; you should feel even resistance for 2' to 2 1/2' from the exhaust elbow. If the cooling system has been running too hot, you'll typically feel soft spots. Even if the engine has been run at normal operating temperatures, however, hoses will still dry out eventually—look for hard spots and cracking—and need to be replaced.

On the freshwater side, coolant that looks muddy may be indicating heat transfer problems. An oily slick could be caused by a leaky head gasket, allowing oil to blow into the cooling system. Take a look at the freshwater pump; leaking water from the drain hole means it needs a new seal. Finally, belts that have more than 1/2" play need to be tightened. As a general rule, if a belt is below the wheel groove it needs to be replaced.

Transmissions

If you check the transmission fluid, look for either a reddish or straw color, either of which indicates a healthy transmission. Fluid that has turned black, however, could be indicating a worn clutch (most likely) or a transmission that has been run while low on oil.

Move the shift lever back and forth. If it seems stiff, the problem may be a worn or binding cable. Take the cable off and move the shift lever on the transmission back and forth by hand. If it moves easily, the problem is in the cable. If it is stiff, the problem is with the transmission (sorry).

A transmission oil cooler, if your engine has one, needs to be replaced about every six years. The only indication that an oil cooler needs replacing is a sheen on the water behind the boat when the engine is raw water cooled or in the coolant when the engine is freshwater cooled.

Engine Mounts

As neoprene mounts age, they dry out and begin cracking and sagging. Aging mounts cause increased vibration and engine misalignment. This seems to happen most often on small diesels, which have greater torsion loads and tend to vibrate more. Joe Joyce says he tells Westerbeke owners to examine mounts carefully after about five or six seasons. If fuel has been spilled on a mount, he says, it will deteriorate that much sooner.

Starting and Running the Engine

Starting a diesel will often tell you as much about its condition as running a diesel. Diesels should fire up quickly, at least in warm weather. Diesels that continue cranking and cranking and cranking whenever they are started often have compression problems, although hard starting can also be caused by fuel system problems or using fuel with a low cetane rating.

Exhaust smoke, by itself, may or may not be indicating a problem. Even healthy diesels produce smoke; some models produce more smoke than others. If you see smoke at start-up and then occasionally while the engine is running, don't worry, it's probably normal combustion. Black smoke can also be caused by a clogged air filter. But clouds of smoke billowing out of the exhaust, accompanied by an oil slick astern, may be indicating a much more serious problem. If the injectors aren't doing their job, fuel dribbles into the combustion chamber and isn't burned off completely. The unburned fuel will sometimes float behind the boat like bubbly black pancakes.

Testing Diesel Fuel

One of the most common headaches for new skippers of used boats is caused by microbes forming in diesel fuel that had been sitting for many months while the boat was for sale. Idleness encourages condensation, which is what microbes need for spawning. When a buyer is finally found, the engine may start during the survey and run OK for awhile, but the first time the boat and the fuel tank get bounced around, the gunk gets stirred up, filters become clogged, and fuel is cut off to the engine. If you're buying a used boat, it is worthwhile to have a

mechanic inspect the diesel itself and open the fuel tank inspection port, if there is one, or maybe take off the fuel sender to look for gunk in the fuel. Microbe levels can also be tested with a kit, according to Steve Fisher at Amoco Oil's Tech Service Dept. A sample is taken and smeared on a slide to see if it changes color. Fisher says comparing the color with a chart will not only tell the owner if there's a "bug" problem, but also tell how severe it is. At \$80 for eight tests, the kit isn't cheap but it's a bargain if it prevents even one breakdown. (Metal Working Equipment and Chemicals Co., PO Box 990, 34 Main St., Lake Placid, NY 12946; Telephone: (518) 523-2355 (518) 523-2355.)

If fuel is bad, changing the filter, draining and cleaning the tank, and adding new fuel should remedy the problem. Filtering services can rejuvenate old fuel, which, on larger boats, may be more cost effective than paying to dispose of old fuel and buying fresh fuel.