

**The fuel system.** A fuel injection pump is an incredibly precise piece of equipment that can be disabled by even microscopic pieces of dirt or traces of water. It is also the single most expensive component of an engine, and about the only one that is strictly off-limits to the amateur mechanic. Attempts to solve problems invariably make matters worse. It is therefore of vital importance to be absolutely fanatical about keeping the fuel clean. Yet so many boatowners treat their fuel systems with indifference. According to CAV, one of the world's largest manufacturers of fuel injection equipment, 90% of diesel engine problems result from contaminated fuel.

The diesel fuel flowing through a fuel injection system acts as a lubricant, with the degree of lubricity varying according to grade and quality. There is no way that quality can be checked outside of a laboratory. However, it is worth noting that in the United States and other parts of the world, two grades are commonly available—No. 1 and No. 2. No. 1 has a lower viscosity, and is commonly used in the wintertime in cold climates. It has less lubricity than No. 2, reducing the life of moving parts such as injection pumps and injectors. In general, if you have a choice, use No. 2 (except in a really cold

climate). Engines built before 2001 may benefit from the addition to the diesel of a diesel fuel conditioner (see the Modified Fuel and Oil Supplies sidebar).

**Contaminated fuel.** Fuel can be contaminated by dirt, water, and bacteria. Even minute particles of dirt can lead to the seizing of injection-pump plungers or to scoring of cylinders and plungers. If the dirt finds its way to the injectors, it can cause a variety of equally damaging problems, such as plugged or worn injector nozzles.

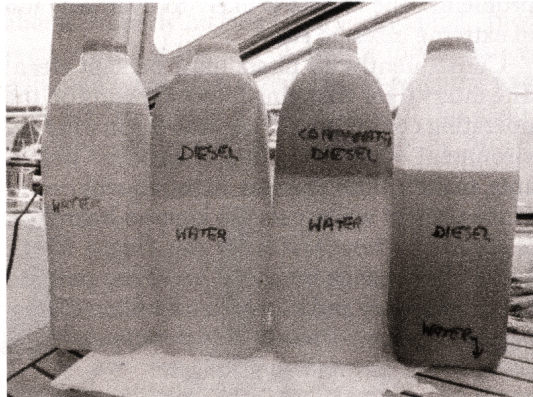
Water in the fuel opens another can of worms. It leads to a loss of lubrication of injection equipment, resulting in engine seizure. In the combustion chamber, water causes misfiring and generally lowers performance. In addition, water droplets in an injector can turn to steam in the high temperatures of a cylinder under compression. This happens with explosive force, which can blow the tip clean off an injector! Raw fuel is then dumped into the cylinder, washing out the film of lubricating oil, while the injector tip rattles around, beating up the piston and valves.

During extended periods of shutdown, which are quite common with most boat engines, water in the fuel system will also cause rust to form on critical parts. Note that two of the more common sources of substantial amounts of water in the fuel are *fuel tank vents located where they can get submerged when a boat is well heeled or in large following seas (Figure 9-4A) and/or a poor seal on a deck-fill fitting* (all too often deck fills are placed close to the low point on side decks where standing water can accumulate). If you're having a new boat built, it is worth ensuring that any vents and deck fills will not be underwater on any point of sail.

Water also accumulates in tanks from condensation on exposed tank surfaces any time the tanks are less than full. Every time there is a change in ambient temperature, humid marine air moves in and out of the tank through the vent. This moisture intrusion can be prevented by installing a desiccant filter in the vent line (e.g., from H2Oout—Figure 9-4B). These are not expensive. Once the dessicant is saturated, it can be dried out and used again.

Bacteria can grow in even apparently clean diesel fuel, creating a slimy, smelly film that plugs filters, pumps, and injectors. The microbes mostly live in the fuel-water interface, requiring both liquids to survive (anaerobic bacteria), and less commonly at the surface (aerobic bacteria). They find excellent growth conditions in the dark, quiet, nonturbulent environment found in many fuel tanks. The best protection is a fuel tank designed so that any water can be removed (see Figure 9-9). As a backup, two types of bio-

**FIGURE 9-4A.** All this water came through a fuel tank vent fitting during a rough two-day passage.



**FIGURE 9-4B.** Desiccant filter in the fuel tank vent line. When dry, the crystals are blue; when saturated, they turn pink, indicating it is time to dry them out.

