Choosing the Right Outboard

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Operators who use medium- or high-powered outboard motors in commercial applications face a rapidly changing set of choices, the result of EPA emissions regulations and developing technology designed to improve performance and fuel economy.

As you're probably aware, federal law requires an overall reduction in the amount of pollutants each manufacturer's line of motors releases into the environment so that by the year 2006 total hydrocarbons must have declined by 75% and nitrogen oxides by 33%. The source of most of these pollutants? The good-old carbureted two-stroke engine.

If you review your high school auto shop notes you'll recall that the beauty of the **two-stroke** is that it is cheap, lightweight, and simple. It has no valves; the intake and exhaust ports open at the same time so that each cylinder is exhausting and sucking in a fresh fuel/air charge simultaneously. The bad part is that a goodly portion of the fresh charge goes straight out the exhaust port without burning, pumping vaporized raw gasoline directly into the environment. Contrary to popular belief, most of the "smoke" produced by a two-stroke isn't burned lube oil, it's unburned fuel.

Honda's engines are "2006 compliant" because they are all four-stroke design which, as you recall, uses valves to admit the fuel/air charge after blocking the exhaust outlet. In part because of the EPA rules, and in part because of the phenomenal success Honda has enjoyed with its clean, quiet, smooth-running four-strokes, most of the other manufacturers have come out with four-stroke models in the smaller horsepower ranges. A few years back Honda introduced 90, 115, and 130 hp engines, and Yamaha countered with 80, 100, and 115 hp four-stroke models. The Yamaha 115 and Honda 115 and 130 are electronically fuel-injected; the others have carburetors. All are smooth, clean, and reliable.

Claims of four-stroke efficiency are not exaggerated. Independent tests show that a four-stroke outboard consistently burns only 40-50% of the fuel of a comparable power two-stroke at cruising speeds, and only a fifth as much at idle.

However, the four-stroke weighs 15% more and costs 50% more. Because each cylinder fires only on every second revolution, four-strokes tend to be a bit less peppy than their two-stroke competitors, and tend to operate 500-700 rpm faster to achieve similar performance.

Industry talk is that both Honda and Yamaha are developing four-strokes in the 200-225 hp range, although at this writing neither company is announcing a debut date. Considering that a Honda 130 weighs in at around 500 lb, and lists at over $11,000, these are likely to be big, expensive motors.

Other makers are taking a different approach to meet EPA pollution standards and consumer demand for improved economy. They have developed variants on a type of two-stroke known as **"direct fuel injection" or DFI.** A DFI two-stroke doesn't have a carburetor and the incoming fuel/air charge is not pumped through the crankcase and sucked into the cylinder while the intake and exhaust ports are open. Instead, it has an injector—somewhat like that of a diesel or a multi-port fuel injection car engine—that meters and forces fuel under pressure directly into the combustion chamber after the exhaust ports are closed. The result is nearly complete burning of the fuel and smoother operation, even at low rpms.

OMC, Mercury, and Yamaha are building V-4 and V-6 DFI engines in ratings from 130 to 225 hp.

The difference is more than merely technical. Testing by manufacturers and independent technical organizations shows that across the board DFI engines use half the fuel of comparable carbureted two-strokes, or less, at idling and trolling speeds, and at least 20% less at cruising and top speeds. And the erratic stutter of a two-stroke at low speed is eliminated; DFI engines are smooth at idle or trolling speed since each cylinder fires on every revolution. While still not quite as clean or fuel-efficient as a four-stroke, they are relatively lightweight and powerful.

DFI is not the same as **electronic fuel injection (EFI),** which employs an electronic metering device in place of a carburetor. Two-stroke EFI engines, such as those made by Suzuki, show some efficiency advantage over carbureted engines, but generally have the same characteristics of carbureted two-strokes.

Each of the three big players in two-stroke outboards has taken a different approach to DFI. OMC's Evinrude engines use a system developed by a German firm, called Ficht Ram Injection (OMC's other brand, Johnson, retains the carbureted two-stroke technology, at least for now). Mercury/Mariner licenses an Australian technology called OptiMax. Yamaha is a latecomer in the field, having introduced its system, called High Pressure Direct Injection (HPDI), for the first time in the 2000 model.

Performance of the three systems is remarkably similar, but technically they differ. The Ficht system employs an electronic solenoid injector on each cylinder, controlled by an electronic control unit (ECU) that synthesizes information from 11 different sensors on the engine to determine the correct amount and timing of fuel injected, and ignition timing. An engine-driven pump moves fuel from the tank to the engine, an electric pump sends it to the injectors at 25 psi, and the injectors force it into the combustion chamber at 250 psi. A throttle body controls the air flow to the cylinder and an oil injector behind the throttle body mixes lube oil with the air being sucked into the crankcase.

The OptiMax system is similar but uses two sequential injectors per cylinder, one to pre-mix gas and pressurized air and the other to inject the mixture into the cylinder at 90 psi. A belt-driven pump pressurizes the air. An oil pump sprays oil directly onto the connecting rods. The ECU and injection system are standard automotive units.

Yamaha's HPDI employs two fuel pumps to bring fuel to the high pressure pump, which sends it to the injectors at 700 psi. The ECU makes adjustments based on input from eight engine sensors. Yamaha's ignition system uses conventional spark plugs, as opposed to specialized plugs developed specifically for the other two engines. Ficht and Optimax plugs are pricey, $12-$25 each.

All these pumps, control units, sensors, and injectors make DFI engines somewhat more complex and expensive than carbureted engines. Are they also more troublesome? OMC had a lot of problems with the early Ficht engines, so many that the company distributed retrofit upgrade units to owners of '98 and '99 model year engines, and redesigned some elements of the engines in subsequent years. Some, though fewer, problems have been reported by owners of OptiMax engines, and Yamaha's HPDI is still so new that it's too early to tell whether problems will emerge.

(The independent, subscription-supported publication *Powerboat Reports* among other things tracks complaints directed at motor manufacturers. The magazine has done numerous performance and efficiency tests of new-generation motors and has chronicled the Ficht odyssey. The journal's editors say that despite those problems already documented, they expect that in the long run DFI engines will prove more reliable than their carbureted predecessors, in part because many outboard ills result from carbon buildup, which is minimized by use of engine sensors and ECUs.)

Clearly, DFI engines require clean fuel, which is a problem in some locations, and a good fine-pore water separator filter between tank and engine is essential.

While it often seems that the outboard industry is more interested in futuristic styling and "hole shot" speed, commercial users require durability and longevity. So, how long can you expect a new outboard to last? It's too soon to tell about the DFI units, but in general industry people say that well maintained outboards have been good for an average of about 1,500 engine hours, with some individual units going 2,500 or more. Unlike diesel builders, outboard motor companies don't test their engines for longevity, or if they do they don't release the results to the public.

Note the proviso "well-maintained." Most outboards don't last even that long because of overheating, lack of lubrication, or collision with hard objects, all the result of operator inattentiveness.

Honda does test its motors to ensure that they last at least 2,000 hours, but the company claims to have testimonials from commercial and military users who have put 9,000, 10,000, and even 15,000 hours on their motors. Honda acknowledges that such longevity is possible only with "ritualistic maintenance." Indications are that four-stroke engines are likely to outlast modern two-strokes, in part because of the better cooling of the four-stroke design, and superior lubrication of the closed crankcase.

The builder's faith in the durability of its engines is reflected in part by the length of the standard warranty: Honda's is three years on their biggest models, while OMC and Mercury cover the first two years. Yamaha covers their HPDI engines for two years and their four-strokes for three years. Suzuki and Tohatsu/Nissan warranties are three years and two years, respectively. Both companies make carbureted and electronic fuel injection engines but don't currently make a DFI model. (These warranties do not apply to commercial users.)

A nifty thing about outboards is that if you ever should actually wear one out, you can simply replace the powerhead. A rebuilt powerhead, which is something like an automotive short block, costs about a third of the price of a new engine

The powerhead is only half the story in outboards, however, and some makes are known for the strength and durability of their lower units. Many fishermen base their engine selections more on their experience with the overall durability of a company's motors than on specific technical details of a particular engine. Dealers report that, for example, despite all the good news concerning the clean and fuel efficient new models on the market, Alaska commercial fishermen are still picking Yamaha carbureted two-strokes over other motors by a wide margin.

This may be the last model year those units (and many other carbureted two-strokes) will be available, since they don't meet the EPA emission standard for 2002. Some users no doubt are buying up the last motors on the market to ensure that they can continue to use what they know and trust. ❖