# Diesel Engines: Making Sense from Specs

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Technology and marketing are changing every aspect of fishing vessels, and propulsion is no exception. Traditionally diesel engines were heavy, slow turning, and reliable; but advances in engineering have created engines that are lightweight, high speed, and, hopefully, still reliable. There is so much hype in engine marketing that sometimes it is difficult to separate the fact from the hyperbole.

Take, for example, fuel efficiency. Despite the appealing claims by various manufacturers, all diesels use about the same amount of fuel for a given horsepower output. It's determined by the laws of thermodynamics. All of them burn one gallon of fuel per hour for roughly each 18-20 hp of output. Two-cycle engines like most Detroit Diesel models are marginally less efficient, while turbo-charged and after-cooled or inter-cooled four-cycle models and the new electronically controlled engines are slightly more efficient. The key factor is actual output, not rated horsepower. Fuel consumption of any engine varies widely depending on load and rpm, and propulsion efficiency is much more a result of hull shape, propeller size, and operator habits than make of engine.

Take, also, durability. Since some diesels go 20,000 hours between overhauls, you may be dismayed to find that the lightweight, high-speed, turbo diesel in your gillnetter is ready for a rebuild after only 4,000 hours or less. It's not the hours on an engine; it's how much fuel you put through it, and at what speed and load, that determine how long it will last. A high-output engine running at or near its rated power will consume fuel much more quickly than the same engine loafing along, but both will wear out after burning the same amount of fuel. Some manufacturers are now rating engine service life in thousands of gallons.

Prospective engine buyers have to consider such factors as overall dimensions, weight, price, availability of service and parts, and recommendations from owners; and it pays to understand a bit about diesel engineering.

Engine spec sheets typically contain graphs that illustrate engine performance characteristics. *Horsepower* is the first factor most shoppers look for, but there are several different kinds.

*Brake horsepower* is relatively meaningless because it is measured at the flywheel, before deductions for water pumps, transmissions and other power drains. *Crankshaft horsepower* includes deductions for water pumps and other integral power drains, and is what goes into the transmission. *Shaft horsepower* is what actually drives your boat after transmission losses are deducted. Shaft horsepower curves usually start to level off at around 70% to 80% of rated output, which means that a lot more fuel is consumed—and heat and noise produced—to get you that last 20% of power.

Diesels can produce more power for a short time than they can sustain over a long period without overheating or self-destructing, so marine engines typically have three ratings: *continuous*, which is the maximum power output the engine can sustain indefinitely; *medium duty* or *work boat*, which is what the engine can produce intermittently or from 40% to 80% of the time up to a certain number of hours per year; and *light duty or pleasure boat*, which generally includes full load up to 8% or 10% of the time. Continuous ratings don't apply to fish boats; heavy displacement draggers or seiners should use medium duty ratings and smaller, and seasonally operated boats like gillnetters can operate under light duty specifications.

*Propeller demand* is the amount of power the drive train actually draws from the engine, and is well below the above theoretical power curves due to propeller inefficiencies. This curve shows how much horsepower the engine is actually producing at any given rpm.

Torque is the turning force applied to the prop shaft, measured in foot-pounds. Torque increases gradually with engine speed up to about 60% to 80% of rated horsepower, and then actually starts to decrease. Many operators believe that an engine is properly sized if the boat achieves cruising speed when the engine runs at the rpms that produce maximum torque.

*Fuel consumption* is simply gallons per hour, based on the propeller curve. Brake-specific fuel consumption is expressed in pounds of fuel per horsepower per hour, and can be used to compare the relative fuel efficiencies of different makes and models. It tends of be lowest in the middle part of an engine's speed range.

Other terms help a buyer understand what they're getting:

*Turbo-charging* boosts power-to-weight ratio, and slightly increases fuel efficiency (2% to 3%) by using the expanding exhaust gas to drive a turbine which forces more air into the cylinders. *After-coolers* and *inter-coolers* cool the turbo-charged air, increasing its density, which also increases power output and fuel economy. Of course, turbo-chargers are expensive devices, and the additional output they produce may reduce engine life.

*Wet* or *dry liners* are sleeves in the cylinders that can be replaced, making overhauls less expensive and allowing the engine to be overhauled any number of times. Some diesels are *linerless*, and cylinders have to be bored for an overhaul like a gas engine.

Engine companies make a lot of ad copy over combustion chambers, and each type has its advantages and disadvantages. To achieve complete burning, the fuel sprayed into the cylinder must mix thoroughly with the air charge, and there are several designs to facilitate this. *Pre-combustion* and *swirl* chambers are separate hollows in the head above or to the side of the main cylinder, into which the fuel is injected in a manner that creates turbulence. Combustion begins in the separate chamber and spreads to the main cylinder. This design makes better use of the oxygen in the air and produces more power for their displacement, but requires higher compression ratios (up to 23:1) and needs glowplugs for cold-weather starting. In *direct injection* engines, the fuel goes directly into the combustion chamber and is mixed by turbulence created by an irregular shape cast into the piston head. They start more easily, have lower compression ratios (as low as 16:1) which promote longer life, and are more thermally efficient, but they draw less oxygen from the air charge and produce less power for their displacement. ❖