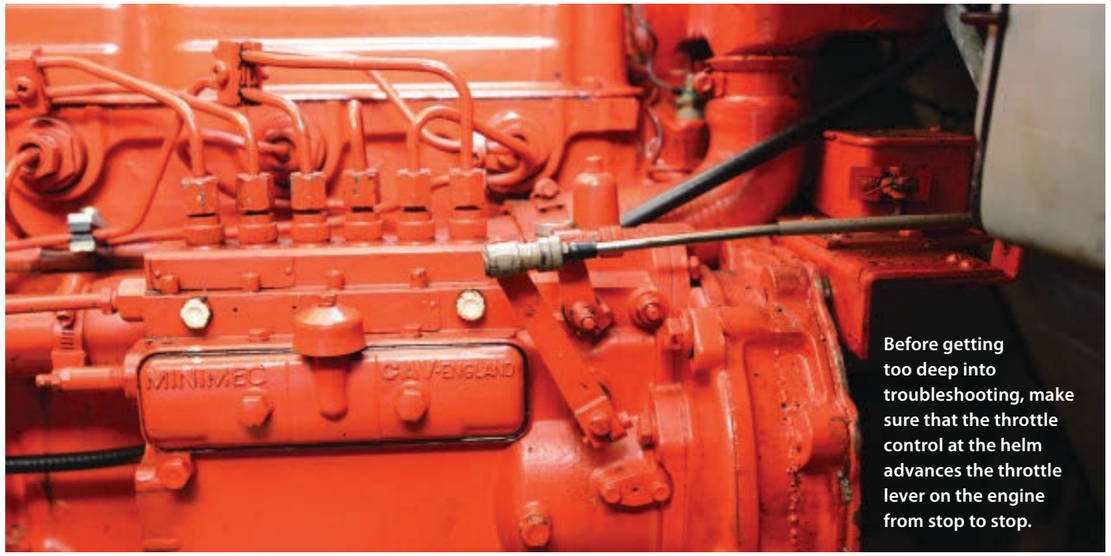
Troubleshooter

BY STEVE ZIMMERMAN

Wide Open



Before getting too deep into troubleshooting, make sure that the throttle control at the helm advances the throttle lever on the engine from stop to stop.

Steve Zimmerman

Wide open throttle (WOT) seems to strike fear into the heart of many boat owners. Most of the time when I ask, people will tell me they never run their engines wide open out of concern that they will abuse or damage them. The engine manufacturers sure don't see it that way. Although it varies from brand to brand and among models within each manufacturer, each engine has a rating that applies to running at maximum rpm. One John Deere model spec reads this way: "This rating is for applications that use full power for no more than 30 minutes out of each eight hours and cruising speed the remainder of the eight hours, and do not operate for the remaining 16 hours of the day." Cummins puts it this way: "This power rating is intended for infrequent use in variable load applications where full power is limited to one hour out of every eight hours of operation. Also, reduced power operation must be at or below cruise speed (rpm)." Some MAN engines are rated to run at full throttle 100% of the time, up to 1,000 hours per year.

I am not suggesting that you run your engine at WOT for hours on end. It is interesting that with cars we gauge wear on how many miles, but on marine engines most of us view engine longevity in relation to hours of running. Marine engine manufacturers focus on yet another standard: gallons of fuel burned. A 3208 CAT, for example, is rated for 30,000 gallons of fuel burned. Certainly the harder you run your engine, the more gallons per mile it will consume, and that translates to a shorter engine life. So it's all about finding a balance between fuel economy, reliability, and longevity. Occasionally running at WOT can improve reliability.

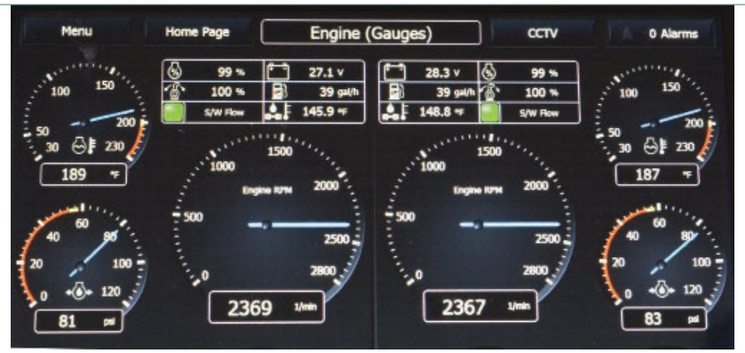
If the people who designed, manufactured, sold, and warranted your engine have no objection to running it wide open within specified time frames, then why should you? An exception might be an older engine that has been chronically operated at low rpm for years, but for all others occasionally pushing your engine to WOT offers several benefits:

- On a new engine, inability to reach WOT can void your warranty. The engine, boat, and prop must be matched so that the targeted maximum rpm can be attained.
- If you cannot reach WOT, then you cannot access the maximum power of the engine in an emergency. On some engines, coming up 100 rpm short of WOT might cost you 10% of the rated maximum power.
- Running at WOT can reveal issues that might be masked at lower rpm. The engine should be able to run at maximum without overheating. If it does overheat, then the system is marginal and needs attention. Other issues might also surface. This procedure provides a "stress test" of sorts to help reveal engine health issues.
- Running at WOT provides a valuable baseline to monitor the engine's performance. Repeating the test at a later date might show a decline in rpm or speed, or an increase in temperature. Any change in performance points to a change in conditions, and one of those conditions might be the health of your engine.

DOCKSIDE TESTING

Let's imagine that after checking the specs for your engine you determine that the maximum rated rpm is 2,800. You find that while underway the engine achieves only 2,720. Now what? Before embarking on a search for missing revs, we have to make sure we are seeing accurate numbers.

On most diesel engines, the tachometer calculates engine rotation based on data gathered from the engine-driven alternator. Through a calculation and calibration process, the tach picks up pulses from the alternator and converts that information to a good estimate of rpm. This estimate can vary from true engine speed and it is helpful to confirm your readings at each station. By placing a piece of reflective tape on the flywheel, a digital laser tachometer can be used to obtain accurate readings. The actual rpm should be compared to each onboard tachometer at varying rpm. You might learn that at 2,200 rpm, the pilothouse tach reads 2,150 and the fly bridge tach reads 2,225. If WOT should be 2,800, the gauge might read 2,720 while the actual rpm could be 2,800. On some newer common rail engines the tach obtains the data directly from the flywheel and the display will always be accurate. If the laser tach shows 2,800, then your work is done, even if the helm console reads less.



Digital tachs read directly from the flywheel and report accurately. These engines, rated at 2,300 WOT, are exceeding the rating modestly. Once fully loaded, the boat will top out close to 2,300.

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What if the laser tach confirms the instrument panel reading and you are short of the target?

First, you have to make sure that when you push the throttle lever at the helm as far as it will go, the throttle lever on the engine advances as far as it can go. In some cases, the linkage has not been set up properly and the engine never receives the full-throttle message from the helm. With the engine off, have someone advance the throttle from minimum to maximum. On the engine find the place where the cable attaches. There will be a lever that travels from one stop to another stop and it should hit both. If not, the linkage must be adjusted. On computer-controlled engines the throttle advances electronically. If the throttle lever advances properly, then you're on to the next test.

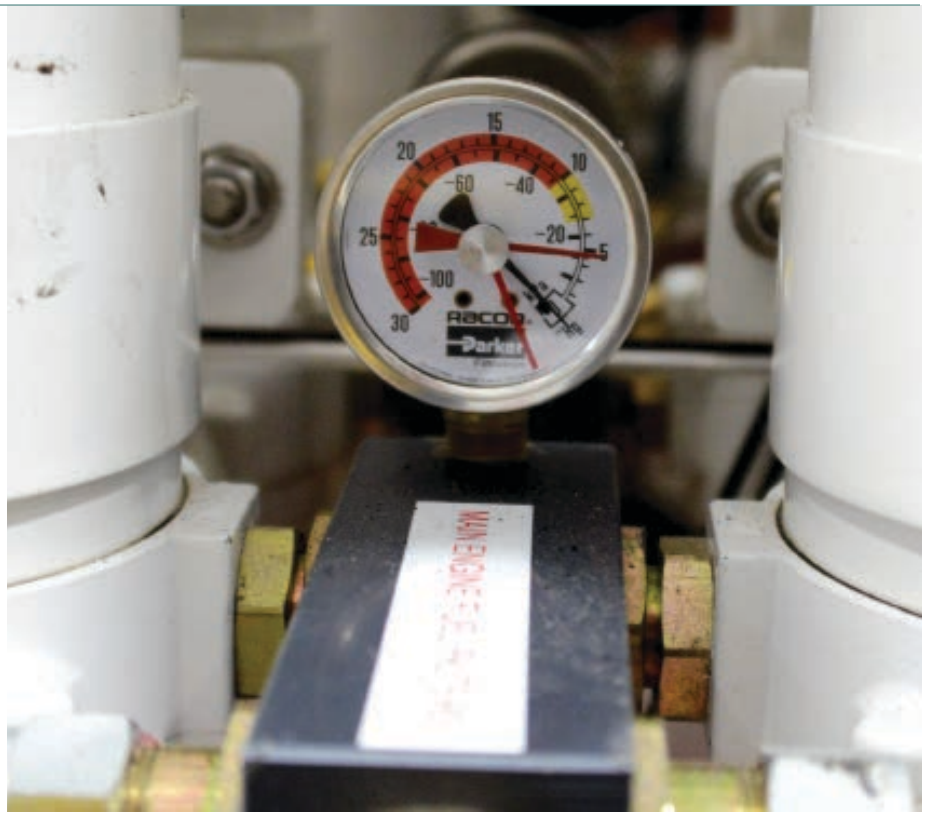
Just as the engine has a rating for maximum rpm underway (loaded), it has a rating for maximum, no-load rpm. In other words, with the engine in neutral, the throttle and rpm should advance to the rated number. It terrifies most boat owners, but momentarily running the throttle up to maximum in neutral will not harm the engine. If the engine fails to reach the rated rpm in neutral (often referred to as high idle maximum), you have all but ruled out an oversized or fouled propeller as the cause. If it does reach the rated high idle rpm, the problem is not in the throttle control.

Right: *A digital tach like this one can be used to check the accuracy of the helm tachometer reading.*

TESTING UNDERWAY

Once you have verified the accuracy of the tachometer and the full travel of the throttle, you can turn your attention to other possibilities. If your engine cannot reach the rated WOT, here are the most likely causes: restricted air supply, restricted fuel supply, increased drag, or an improperly sized propeller. Let's take a look at each possibility.

Air Supply: You may have a restriction in the supply of air into the engine room, or a dirty filter on the engine. Checking air supply is easy: Run the boat at high rpm, say, 200 below maximum. While watching the tachometer, have a crewmate open an exterior door and an engine compartment hatch. If the rpm increases, then the ventilation into the engine room is inadequate. If the rpm does not change, you might



Restrictions in the fuel supply often show up on the vacuum gauge at the primary fuel filter. Reset the tracer needle (red) after each run. The needle will remain at the high reading for each day's run and can point to a clogged filter or some other restriction in the fuel lines.

have a problem in the air filter and you will need to inspect its condition. Beyond that, matters become more complicated, as components, such as intercooler and turbo chargers, come into play.

Fuel System: Your fuel filter should have a vacuum gauge with a tracer needle that shows the highest reading experienced since you reset it (it should be set back to zero each morning). In a previous article, we looked into the details of fuel filtration and noted that when the vacuum pressure reaches about 7", it is time for a filter change. If your filters look good, it is possible you have contaminants blocking the pickup tube in your fuel tank. In order to rule out the pickup tube, the fuel lines, and the fuel filter, it might be necessary to bypass all of those components by running the engine off of a small portable fuel supply. Make sure you have a clean container and clean fuel, since you will be bypassing your primary fuel filter. If the engine still misses the desired rpm, restricted fuel supply probably does not cause it. Keep in mind that diesel engines cycle a lot more fuel than they burn. Depending on the engine you might be pulling 70 gph or more. Make sure you have ample supply fuel for the test.

Drag: Increased drag adds load to your engine. Let's assume you normally cruise at 8 knots at 1,500 rpm and burn 4 gph. Now imagine that you tow a barge behind your boat. This increased load will require more horsepower to achieve the same speed and you increase the horsepower by advancing the throttle. With this increase in load, the engine will require something like 2,200 rpm and 12 gph to achieve 8 knots. You won't be towing any barges, but a fouled bottom or prop creates the same effect. Even bottom paint on a propeller, applied coarsely, can rob you of 25 rpm or so. That's why it is best to perform a WOT test after the boat has been hauled and the bottom cleaned, painted, or both. You want to minimize the variables so that you have a solid, repeatable set of baseline conditions. If you are not sure, hire a diver or short-haul the boat.

If the boat and running gear have not fouled, you might be looking at a failing Cutless bearing or poor engine alignment. As bearings age, the rubber can start to deteriorate, binding the shaft. You should be able to rotate your propeller with one hand–if it feels stiff you need to check the bearings and the alignment. A failing bearing can easily rob you of 100 revs or more by increasing the load through an increase in friction. Gross misalignment can do the same.

Props: If everything else checks out, it is time to turn your attention to the prop itself. If the boat has never reached the rated WOT during your term of ownership, the prop might be improperly sized. Engine manufacturers and prop shops use software programs to develop recommendations. These programs take into account the engine, transmission, hull design, weight, and more. In my experience, all of those calculations produce an educated guess. The prop must be installed and the boat sea trialed. In many cases the prop will need to be tweaked to hit the targeted rpm. A boat with a clean bottom, reconditioned prop, and modest load should slightly exceed the desired WOT target, by 25 to 50 rpm.

LEARNING FROM YOUR RPM

By establishing a reliable baseline–an engine that reaches the maximum rated rpm under normal conditions, without overheating–you create a valuable reference point for checking your engine's health. Any reduction in performance from this baseline points to a developing problem that might be hidden under normal cruising conditions. Most manufacturers rate their engines to run at full load for roughly one hour out of every eight. I am not suggesting that level of operation, but rather running it for 15 minutes at full load several times each season. Create a log and fill in basic numbers such as rpm, speed, coolant temperature, and lube oil pressure. By looking for variations over time you just might catch a maintenance chore before it becomes a cruise killer. ■