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Marine Engine Cooling Systems:

Improved Performance Opportunity

How The Conventional Marine Cooling System Can Compromise Engine Performance

As a supplier of cooling system components to the motorsports industry, we constantly strive to help our customers maximize the performance of their engines. This consideration not only includes power, but also fuel efficiency, responsiveness, reduced emissions, and engine life. Across the board, all of the high performance engine builders and race engineers we serve at Vapor Trail Racing generally agree that the optimum operating temperature for their engines, defined as coolant temperature out of the engine, is within a range of 185-205 F (ask your engine builder). It was surprising to us to discover that high performance marine engines are usually operated at 160 F, knowing from our experience that this temperature compromises all of these five aspects of engine performance.

A few well placed telephone calls quickly produced the logical explanation of why these engines are run at cooler temperatures. As we learned, the better systems incorporate a closed cooling loop through the engine to keep the harmful seawater out of the engine (Good!). This cooling loop dissipates heat at a heat exchanger by contacting a crossflow of sea water (Good!). Engine operating temperature is then controlled by throttling the flow of seawater through the heat exchanger (Bad!). Temperatures over 160 F in the heat exchanger cause the seawater to internally scale and damage the heat exchanger, impairing its vital performance.

Where does the scale come from? The high Total Dissolved Solids (TDS) level of seawater (+36,000 ppm) causes the problem. As the temperature of seawater is elevated, instability occurs, and the calcium and magnesium tend to precipitate to the hot metal (Just like hard water scaling hot water pipes in a home. Ask your *Culligan Man*.). Heat is the catalyst for scale. This scale forms an insulating barrier on the heat exchanger, blocking the heat transfer from the engine coolant to the seawater, eventually plugging the seawater passages. Obviously, scaling the boat's heat exchanger must be avoided.

An Improved Cooling Approach which can Improve Marine Engine Performance

The big picture is that the engine (and the driver) would be happier operating at 185-205 F. Conversely, the heat exchanger would be happier to run cooler, the cooler the better.

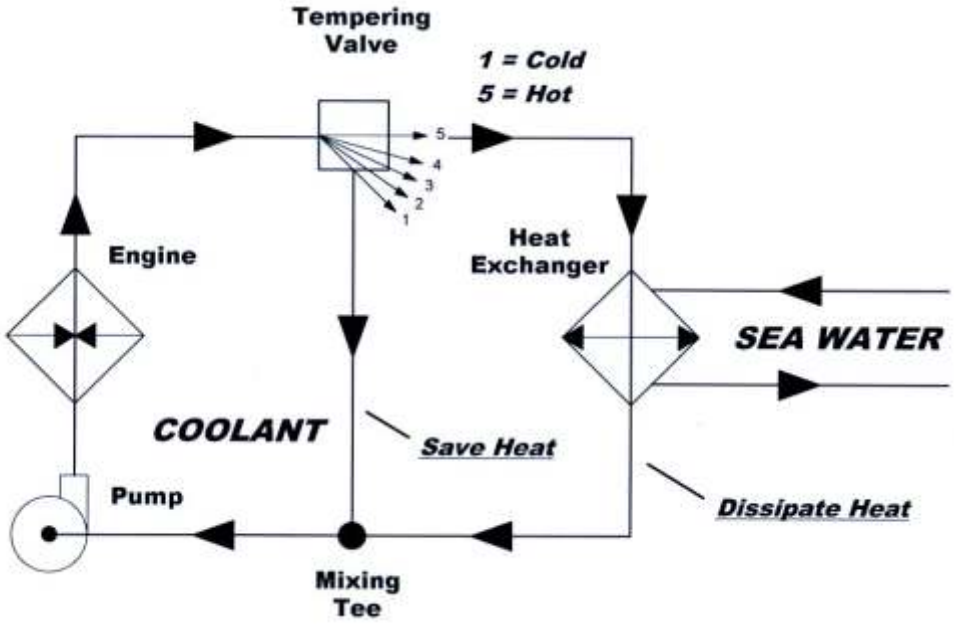
So . . . . GIVE THE ENGINE AND HEAT EXCHANGER SOME SPACE!

HERE'S HOW IT'S DONE: Install an *automatic tempering valve* between the engine and the heat exchanger which provides an alternate secondary by-pass flow circuit around the heat exchanger. This valve will automatically split the flow between the two flowpaths and send a proportional sidestream flow of coolant through the heat exchanger as per the engine's real time need to dissipate BTU's (Heat). This valve will allow the engine to continually operate at its optimum temperature, in all situations, while simultaneously lowering the operating temperature of the heat exchanger by eliminating the need to throttle and slow the flow of seawater.

(see these systems at product line / temp control

GO WATERLESS! Switching to a *modern synthetic coolant* like propylene glycol offers additional benefits to the cooling system. Waterless means no rust, no scale, no corrosion, and, no electrolysis. It also can't freeze and damage the engine. And on the hot side, the boiling point has now been elevated to 370 F! Any possible boilover situation has now been avoided.

Closed Loop Marine Engine Cooling System With Automatic Tempering Valve



The Tempering Valve operates KINETICALLY and AUTOMATICALLY.
It senses the temperature of the coolant coming from the engine and selects one of five diverting positions:

Position # 1 =	100 % By-Pass	0 % Heat Exchanger
Position # 2 =	75 % By-Pass	25 % Heat Exchanger
Position # 3 =	50 % By-Pass	50 % Heat Exchanger
Position # 4 =	25 % By-Pass	75 % Heat Exchanger
Position # 5 =	0 % By-Pass	100 % Heat Exchanger

HOT Coolant from the By-Pass, and COOL Coolant from the Heat Exchanger are Combined at the Mixing Tee and returned to the Engine.