

## **2-Micron Primary Filters – what the experts say**

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*Editors Note: This very illuminating "White Paper" started as an e-mail thread. An owner of a boat with Cummins diesel engines remarked Cummins Factory mechanic had made a notation in the log book advising the previous owner to "only run 10-micron filters in the Racor primary filters." He was very explicit – 2-micron filters should NOT be used. There is an active urban myth about using 2-micron filters, despite the fact that most diesel manufacturers specifically advise against using 2-micron filters, advising it may cancel warranty obligations for certain types of fuel-delivery engine failures.*

**The following is from Bob Senter, currently with Alaska Diesel and previously with John Deere marine propulsion. He has over 25 years working with diesel engines and their manufacture.**

"Regarding the previous Cummins mechanic's note to use 10-micron primary filters, the owner should have listened attentively. He was given good information.

"The miserable urban lore of 2-micron primary filters is showing signs no of going away. I talked with Steve D'Antonio at TrawlerFest Poulsbo about this, wondering how the subject managed to get turned inside out. Much to my surprise, it seems we're both on the same page. He thinks there has been quite a lot of misinterpretation, too.

"First, and most importantly in this discussion: To my knowledge, no diesel engine manufacturer supports the concept of using 2 micron primary filtration. My inclination is to go with these company's well researched engineering based recommendations - if only to avoid warranty claims and unhappy customers. The engineers I've met are neither backward nor uninformed about boats and marine engines. Conversely, the primary requirement of boat ownership is not an engineering degree, but a checkbook.

"Placing a 2-micron element upstream of the engine predictably results in a dramatically accelerated rate of restriction and filter plugging, LONG before the normal service interval. This is often misinterpreted as resulting from a contaminated fuel tank that needs cleaning and polishing. Or, perhaps it is perceived as a need to install an on-board fuel polishing system. I'm sure local marine businesses appreciate these self-induced "service opportunities", so there's at least some benefit. (Just a tech note here: Many modern high pressure common rail diesels and even old Detroit Diesel 2-cycle engines pump over 100 gallons per hour of fuel per hour, per engine, so they do a very respectable job of polishing the fuel by themselves.)

"These days, fuel filter media is usually composed of plastic impregnated paper with millions of tiny electrostatically punched holes in it. Microscopically speaking, it functions as a colander, as in "cooking pasta". Dirt in the fuel, viewed microscopically, is variously sized gravel. The filters' micron rating is nominal, not exact. In reality, many of the holes are partially plugged by debris in a very short time, leaving a matrix of MUCH smaller holes to filter the debris. In other words, your 10 or 30 micron primary filter turns into a much finer filter almost immediately. The job of the secondary filter is to remove most of the particles of a size that could damage the fuel injection components. Most Tier II emissions high pressure fuel system engines use a 2-micron filter in the secondary filter.

"At this point, we need to challenge the Holy Grail logic of a "single point of failure". **Fuel filters are routine service items, *not failure items***; they don't break - most on-engine secondary fuel filters can be changed and the air bled out in less than 5 minutes. The average boat owner can't change a Racor element that fast, start to finish. If you're really serious about this argument, then you would never buy a boat with engines that have difficult fuel filter service issues. Same comment applies to primary filter physical locations.

"Engineers typically size the primary and secondary filters so that they will load up at approximately the same rate. The unspoken truth of the "single point of failure", e.g. 2-micron primary filter concept, is that owners begin to believe that the primary does all the work and the secondary just goes along for the ride. If only this were true. Since the elements are paper, eventually, they will soften when ignored and exposed to (ever present) water, ultimately resulting in the trapped dirt and water being released downstream, contaminating the expensive fuel system components. Changing the Racor element is only half the job - you still must change the secondary filter(s) on schedule. *This is not optional or subject to interpretation.*

"Now, on to the myth of vacuum gauges. OK, the gauges may work properly, but the users seldom do. The only time the gauge is meaningful is at full load rated speed - this is when the problems manifest and precisely when you don't want to have problems. How many operators know the difference between inches HG (of mercury) and PSI (pounds per square inch) or what the operating characteristics of their engine are at a specific point? Long before you hit the red zone on Racor's vacuum gauge, the fuel injection pump will experience problems resulting from restricted fuel flow. These problems could be excessive fuel temperatures in the pumps, air bubbles or hydraulic timing advance erratic operation - sometimes all three. A diaphragm type fuel transfer pump may fail prematurely when badly restricted. All of these are much more expensive, onerous problems than simply changing the secondary on-engine filter. By the way, Racor's website has a very illuminating graph showing fuel flow vs. restriction – it goes nearly vertical at about the time the gauge needle gets into the yellow zone.

"Then there's the idea of "pressurizing the system". Placing a low pressure transfer or priming pump ahead of a 2-micron primary filter accomplishes an unexpected result: the operator goes from receiving some warning symptoms of impending filter plugging to receiving absolutely no warning at all - the engine just stops when you need it most. Personal experience speaking. I have verified this in my own boat....in front of a ferry.

"Finally, empirical testing, the basis of science, means proving your theory. When I crossed the Atlantic with the Nordhavn Atlantic Rally boats in June 2004, I counseled all 18 boat owners with exactly the same advice on fuel filters and service you've seen written here. In **every case**, the owners who followed the recommendations to use 10 or 30 micron Racor primary filters and change them on schedule experienced NO fuel related issues, even when they received bad fuel in Ft. Lauderdale. I also suggested they save the 2-micron elements for their fuel polishing systems. A few owners disagreed with this advice and enjoyed the experience of changing Racors in deeply rolling, diesel sloshed, and blistering hot 135 degree engine rooms. Somewhere, I read a quote I still love: "Wisdom comes with experience; and, experience comes from bad judgment".