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## Introduction

And I thought you knew all of this stuff - Tons already written on this site <http://boatdiesel.com/> about fuel filtration, gimmicks, and the like - many individual postings, a few very long threads, and a few good articles.

But in a nutshell, "Algae-X" and "Fuel Mag" are some of those "magic magnet" contraptions, "RCI" is one of those "spinning" devices, and Multi-Stage Fuel filtration is filtering in series with progressively finer filtration from large to small ( maybe 30/20, 10/7 and 3/2 mics) . No "gizmo's" no "magic," just proven mechanical filtration using the most modern filtration product available. BTW, if you are into fuel "gizmo's", this link is a winner...

<http://www.epa.gov/otaq/consumer/reports.htm>

And more important, there is NO such thing as "too much" or "too clean" concerning diesel fuel filtration when one really thinks about it. All you have to do to confirm this is to do some injector seat inspections at 2000 hours on some good running engines. This will tell you who has the minimum fuel filtration that gets by, and the ones who really have clean fuel.

## The Overview of the Marine Fuel System

Because of the changing requirements of the modern "Common Rail" fuel systems that are showing up w/ the new Tier 2 marine diesel engines, it's time to revisit this subject to be sure ours readers have the most up to date and field tested information available to protect their investment. Much of the information below has been part of other postings and small articles I've put together, but I thought it would be best to try and bring some of the older info into this and blend it in with some new ideas and information. I would also like to point out that all of this information is derived from a conglomeration of 10's of thousands of hours of field operation, 100's of thousands of gallons of fuel filtration with our proven systems, and from keeping up on the latest requirements and data from popular engine and filter manufactures.

There are some very important points to understand about the overall selection of YOUR filtration system, and listed below are some of them that seem to be the least understood and may require some additional thought before you make the choice:

- The **Total Fuel Flow** of your engine-not just the max rated fuel burn. It's real typical to have a diesel engine rated at 300 HP (16 GPH max fuel consumption at rated WOT) but have a fuel flow of 60 GPH-1 gallon per minute ! Your entire fuel delivery and filtration system needs to be sized for the max fuel flow and not just maximum fuel consumption.
- The **Tankage or Holding Methods** your vessel-older fuel tanks will typically have something in the fuel tank that that you do not want your engine to burn or get anywhere near the "on-engine" or last chance filter that is part of the engine fuel system. Whether it is be some type of growth (algae), accumulated "mud" (diesel fines, sludge build-up, etc), rust flakes (from older steel/iron tanks), water, internal tank coatings that are deteriorating, or ???, there is always something in there that should not make it past your OFF-ENGINE / PRIMARY fuel filter system. Remember this for later.
- Your **Application and Use** - Using your vessel for the weekends and making 150 mile round trips 10-20 times a year is very different than working your vessel 20 days a month 10 months out of the year. Big fuel burners will typically need larger capacity fuel filters to keep maintenance intervals to an acceptable level, but anyone will benefit from more filtration capacity as it will eventually pay dividends by not clogging as easily when you (finally) get that lousy tank of fuel.



Commercially proven Multi-Stage System meeting strict common rail fuel requirements - 20 year old fuel tanks, 1000 hours later, approx 60,000 gallons of fuel thru these filters, and ZERO issues

- The **Fuel Injection System Requirements** of your engine - Every manufacturer of diesel engines have certain MINIMUM requirements for the quality of the fuel that is fed to the engine. Cleanliness is next to godliness when we talk fuel injection as there is no such thing as "too clean".. So, after spending 10's of thousands of \$\$ on either a new boat or a repower, why would not spending a few \$100 more by upgrading the "minimum" of fuel filtration equipment that is typically part of the supplied equipment list in just about every boat I see, not be a wise investment? Adding an additional layer of fuel filtration protection and using the most modern filtration media available will always be the best money spent for long term reliability for any fuel supply system on a diesel engine-and that applies to your truck and RV too. Things have improved much since the days of cellulose or treated cellulose media typical of most replacement fuel filter elements.



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## Multi-Stage Filtration

(As I see it, all filtration before the engines "last chance" fuel filter is "primary" regardless of what you have in place)

So what is "Multi-Stage filtration??

To me, proper fuel filtration for the type of marine vessels generally discussed in the forums at <http://boatdiesel.com/>, all comes down to using a simple multi-stage filtration set-up (a minimum of 3 distinct stages/ components) starting with largest practical and effective mechanical spin-on filter with around a 20-30 micron rating. This is your PRIMARY fuel filter (part of the entire "primary system" which is before your engine) and we call them "bulk separators" or "mud filters". In actuality, the first part of this primary line of defense can not only remove most of the mud and crud, algae and diesel fines, and extend filter maintenance many times, it can also remove copious amounts of water, but this will depend upon the type of primary filter you use and HOW YOU maintain it. And BTW, a Racor 900 or 1000 w/ a 30 mic element could also qualify as a "bulk separator" in my book, although I consider its proper long term maintenance is rather messy and very time consuming.

Our preference for a proven Primary or Bulk Separator fuel filter?? In 95% of our work, the Fleetguard "spin-on" FF5013 is the ticket as it offers a 20 mic BETA rating, a flow rate of 100 GPH clean ½" Hg pressure drop, has a built-in water drain, has no "plastic" bowls to leak or discolor, and has proven itself to do the job. For super high capacity, we use the Fleetguard FS 1218 - About a 250 GPH flow rate, has a "crud capacity" of about 7 times that of a Racor 1000, and has all the best needed features for use as a high capacity Primary bulk separator.

### Our second stage of the "Multi-Stage" fuel filter system

After this primary line of defense comes your main fuel water separator, your Racor 900 or 1000 ( if you feel the need to have "Racor" on your boat) , or other type of quality fuel water separator. We prefer a Fleetguard FS19596, FS 1000, or FS1015 - listed in order of overall capacity and filtering quality - that has the largest capacity practical, using the most modern 7-10 mic media specifically developed for water separation. Notice I didn't mention the Racor FG 500 as I consider it too small (capacity wise) for anything over about 75 HP. What you choose here is usually governed by what the builder or past owner installed. And again, CAPACITY is



Basic Filter Dimensions




Major YUK



More Major YUK

the main key, as all of the issues that I have seen over years with problems in the fuel system and/or failed fuel components, is more or less related to the capacity, along w/ system component design and/or maintenance of this filter , and not the chosen micron size of the element, be it 2, 10, or 30 micron.

Our current choice for a properly designed and proven system is to use a Fleetguard FS1000 for the second part of the Multi-Stage system. The FS1000 Fuel/Water Separator was designed specifically to combat wear and corrosion in Electronic Injection Engines "EUI" technology. The FS1000 contains high performance synthetic media, "Stratapore" developed and made exclusively by Fleetguard, consisting of five bonded layers of multi-stage media. These are one layer of cellulose, three layers of melt-blown polyester and an additional protective layer. By itself, the FS1000 achieves performance previously obtained only with primary/secondary filter systems.

Click on images for larger view 



Racor 1000 w/ HD FS1218 Fleetguard primary bulk separator - Good for 700 hp



Simple Multi-Stage -  
Excellent choice for 90% of all vessels



Simple and effective Multi-Stage Fuel Filter System. No messy & leaky bowls to deal with...



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## Upgrades for new Common Rail Fuel Injection & Problem Fuel Systems

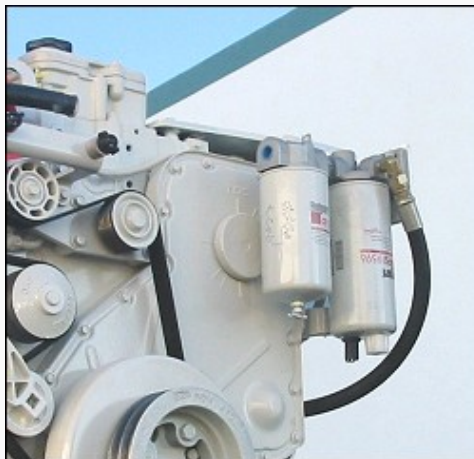
Earlier, I mentioned "Common Rail" fuel systems, so I'd like to point out some issues that will now become important for all to understand.. First is that this fuel delivery design is now being used in many production hi-performance diesels for both on and off highway use. The design and idea has been around for decades, but it's use and current development has taken a major leap in the last year or so. With COMMON RAIL fuel pressures going well above 20,000 PSI from the pump to the "common rail" and all the way to the injector itself, a small amount of contamination, or especially water, that makes it to the pump and/or the injector will take on a whole new meaning.


In the past, many injection pumps have survived a teaspoon of water over an hour or so of operation, and still continue to march (although they may not be 100%). An injector may or may not have survived this water (usually not) , but typically, only a tip would go with no or minimum of damage to the engine and/or your pocket book. Let that teaspoon of water (or even 1/10 of a teaspoon) or the smallest amount of contamination get to the new common rail pumps, and it will most likely be an instantaneous major mechanical component failure ( your \$2000+ fuel pump), along with a good chance of having an injector stick open that instantly starts dumping vast volumes of fuel to the cylinder or cylinders. This leads to everything from a major fuel / engine overload , scuffing cylinders, cracked/melted pistons, etc, all happening in just a few seconds. You could think of it as a serious engine run-away. Talk about why fuel filtration needs to be reevaluated with this new technology. And , that's why re-education is needed and why you'll will find that all companies that use common rail are requiring new and very strict filtration criteria.

One way Cummins has addressed these new filtration requirements is by requiring a WIF sensor "WATER IN FUEL" (two supplied per engine), that MUST be installed in the primary fuel filter (s) or "primary system" of the vessel for each engine. Besides that, they require a 10 MIC (minimum) primary filtration (meaning that you must use a 10 mic filter BEFORE the engine and this filter MUST meet certain minimum requirements:


### Primary Fuel Water Separator Specifications

(minimum)	
●	10 micron filter rating.
●	Separator must have a 36 gram minimum capacity per SAE J1905.
●	98.7% efficiency using ISO A2 test dust per SAE J1985 test methods.



Multi-Stage Common Rail Fuel Injection protection - FF 5013 and FS 19596 w/ WIF Sensor 



Complete On-engine Multi-Stage system w/ WIF Sensor and 2 mic "Last Chance" filter-required for Common Rail Fuel Injection specs - We prefer to call your "on-engine" factory supplied fuel filter as a "Last Chance" filter, as that's what it really is !! 

- Filter must remove 95% (or more) coarse water droplets over the life of the filter, per SAE1488.

BTW, these are the MINIMUM requirements - Ask yourself, is that what you really want??

And, the new requirement for "last chance" fuel filtration on the engine is now 2 mic and this filter must also meet very strict requirements. Currently, Cummins is using a Fleetguard FF 5488 on all of the QSB's, QSC's and QSL's as the on-engine final fuel filter. A quick check w/ Fleetguard yielded this info: 2 mic Stratapore high performance media w/ 19 grams of dirt holding capacity, .95" Hg pressure drop/100 GPM clean w/ a 203PSI burst pressure rating. In case you don't know much about filters, that's a "filter" that doesn't let much past it, but then again, it needs to be supplied w/ a specific quality of pre-filtered fuel. In fact, and this point must be understood. These systems are so particular as to fuel quality, you must NEVER pre-fill these filters before installation. You must let the pre-filtered fuel from your off-engine fuel system do that for you thru the priming mechanism built in the engine.

So, where does all this leave us at this point?? Will this scare away many from this technology because these new engines are so particular as to fuel quality? It may, in some cases, because many out there are perfectly happy with their current era of engines, and "new" stuff is just too scary or expensive to deal with. But for anyone buying new engines, they need to be aware of these upgraded requirements and have a thorough understanding of what needs to be accomplished with fuel filtration.

And just like before, these requirements are a minimum to get by (typical boat builders usually supply the "minimum" in order to just meet requirements). The basics are easily met and can easily be engineered into a new boat or repower, but to add that extra level of security, extra measures need to be taken so there is plenty of room for error ( like getting a lousy tank of fuel, or having water drip thru a deck fill or down a fuel tank vent) and still not have any problems.



Basic Common Rail Fuel Multi-Stage system with WIF sensor - 100% Cummins, 100% simple, and 100% effective



Water Absorbing Filter Media

Another filter we are using as the primary bulk separator, are elements specifically designed for water absorption. "Cimtek" <http://www.cim-tek.com/index.asp> have developed filtration products specifically for problem systems and where extra protection may be needed. Good technology, good reading on their site, and they also private label their filters for many large companies including Parker (Racor). That speaks volumes to me. We will typically add a third filter to the primary or Multi-Stage system using a water absorbing bulk separator if some has large amounts of water in his tanks and needs extra protection.



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### Can you have "Too Much" filtration ??

I am not one to argue another author's ideas on fuel filtration when I think someone is suggesting (in so many words) that fuel that is cleaner, is better. So, I 100% agree it would be very difficult to say that "too much" fuel filtration is possible with the fuel injection equipment used w/ these 60-80HP per liter diesels today, so having fuel "too clean" may not be applicable anymore. But, of course there are practical limits as to a filtering system that filters to well beyond needed cleanliness, and I will suggest that maybe something along the lines of practicality might be missing in many ideas written on the subject.

This is what should be conveyed and understood about "too clean"...

Actually, filtering down to a nominal 2 mic level probably could have some quantifiable benefits (injector seat & injection plunger/cam wear), even for and an engine that does not require that level of filtration. But this is not the reason I sell replacement injection pumps a couple of times a year and rebuilt injectors about 10 times a year. It's because of water contamination, and the fact that the operator only relied on his 1st line of defense (typically a "RACOR") and the marketing hype around it that led to complacency regarding fuel quality... So, I'm not going to argue about whether filtering below manufacturers' specs has a benefit - what I'll argue is the way most people filter fuel. And, that typically is that the vessel and / or operator is relying on a single filter to remove water and contaminants before he sends that "filtered" fuel to his on-engine "last chance fuel filter" - This is a major mistake in judgment as to think that the last chance filter will save him. We hope to convince our customers that a well designed fuel system will deliver fuel to the engine, and to it's "on-engine fuel filter", that is all ready clean enough that he is not relying on this "last chance" filter to save him.



My thoughts, experience, and reasoning will never change about using multi-stage "primary filtration" and making sure you have the filtering capacity to get you through a lousy tank of fuel, or maybe two. With the advent of "common rail" fuel injection, just the slightest amount of water that makes it to the pump and/or injector will now have catastrophic consequences for not only your fuel system components, but could also take-out the engine.

### Some RACOR Thoughts

A Racor 1000 can have very acceptable capacity when used w/ a 300-600 HP engine in typical recreational service. Use that same filter on a 200-400 HP diesel in an application that runs 2000-5000 hours per year, and in many/most cases if this unit used as the only filter before the engine, this widely used filter has unacceptable life between maintenance intervals. My point here is that designed flow rate of a filter should not be the only reason for selecting filter size but rather needs to be chosen based upon the application and vessel current use, and past fuel problem history (if any) of the vessel.

As many operators will confirm from personal experience, servicing a "Racor" can be a challenge if you want to try and keep the bowl clear and clean. Lots of parts, seals and just a plain hassle and extremely messy to deal with. But, get it clean once, install a bulk separator in front of it, and you'll see a noticeable change in the maintenance of the Racor over the next few years, along w/ giving you that added layer of protection. Also, more times than not, I have seen the bowl on a Racor so dirty that its effective use as a "visual" has become totally worthless. My preference and experience is not to rely on a "visual" at all, but to drain a sample of fuel before you use your vessel. Maybe that reasoning comes from my training as a military pilot way back when, but for sure its merit cannot be questioned. Also, adding a WIF sensor is easy on the Racors and a few other types of filters. The factory Cummins VDO panels and harnesses are all ready set up with WIF circuitry/alarms, so if water has been an issue, you really do not have an excuse not to hook it up.



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## Practical Fuel Filtration to 2 MIC

Now that you have convinced yourself that you want that 2 mic filtration regardless of the engines requirements (I have no issue with that), but let's do it in a practical fashion.

The last thing we want is to have that 2 mic filter to be hit with the crud coming from the tank. Filtering to 2 mic BEFORE the fuel gets to the engine may become a maintenance nightmare unless you have extremely large capacity in both unrestricted flow and element size, but would still have NO PRACTICAL sense to it if using only a Racor 1000 w/ a 2 mic element. It may be fine for a few hours of running ( a few to me is at least 50) , but most likely will lead to fuel restriction problems quickly. Running a pair of these (switch-able parallel), will certainly extend the time between element changes, but seems to be another impractical solution... The last chance filter on your typical engine is in the 5-10 mic range, and should be fed with clean fuel-no argument as we believe that filter should stay clean for at least 500 hours or more.

But again, if you want more practical assurance of delivering clean fuel to your engine (which is a GOOD thing) , filter before your Racor, or add another in series, but filter your fuel in micron stages (60 / 30 / 20 / 15 /10 / 5 / 2 mics ) as this is how practical filtering is done in all industries or applications. And, as with the addition of any more filtration, your choice of plumbing, and capacity and pressure drop across the total system when clean, needs to be accounted for. Even my own "basic" sizes for fuel suction hoses for applications that only needed 1/2" in the past, are now being re-evaluated as many may now need 5/8" id (or larger) hose because of stricter fuel filter requirements needed by newer engines.

Properly set-up, it is very easy to install a practical 3 or 4 stage fuel filter system that has a pressure drop across the entire set of filters of less than 3" HG at a flow of 75GPH or higher, and one that gives extended service intervals. But do this in reverse order with smaller sized filters in front, you'll now have a system that will "clog" well before it should and will be much more expensive and time consuming to maintain or diagnose. A vacuum gage installed just after the last suction side filter will tell you when to change filters, but will have "less meaning" unless the filtering is done in correct order, from large to small. And, if your vessel use really dictates even more filtering capacity, then double up by paralleling two identical systems or by paralleling the primary - "primaries" only.

What I'm trying to get across is PRACTICAL fuel filtration - "filtering done in stages" - that has been proven to be effective long before I came along, but has been reinforced over the years from my own experience. My main customers are fuel burners of well over 5,000 gallons per year per engine, with some approaching 40,000+ gallons per year, so this is where I come from, NOT from something "I read" ...

For a typical 8-12 L marine engine w/ flow rates of around 75 GPH and someone who wants to use a simple and very effective multi-stage fuel system or a "primary fuel system" before feeding fuel to his engine last chance fuel filter, using the Fleetguard FF5013 in combination with a FS 1000 is a proven and very effective system. For a simple upgrade to this, using the new FS 19596 with a built-in WIF sensor ( this is a new filter that fits/replaces where the FS1000 does, has more dirt holding capacity, and is a 7-8 mic hi-performance unit rated at 90GPH w/ a minimum pressure drop), he can't go wrong. This combo is miles ahead in capacity, quality, safety of delivering clean fuel, and ease of use, compared to a Racor 1000.



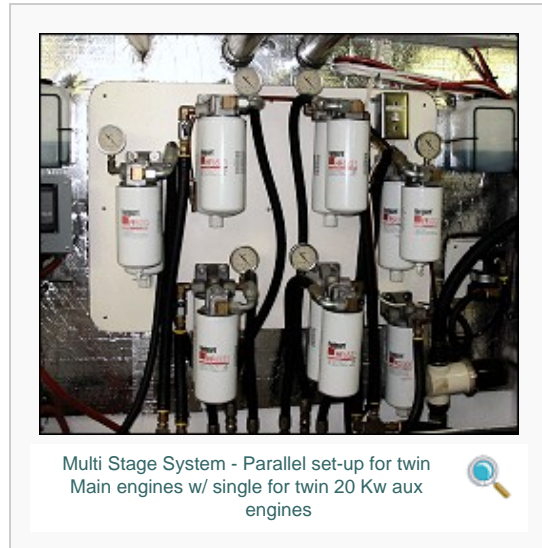


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## Vacuum Gages and Fuel System Restriction

Installing a vacuum gage in your fuel delivery system is a worth while option and will pay for itself quickly when its function is understood by the boat operator.

Restriction or "Fuel Pressure Drop" across a filter is a function of fuel flow vs. restriction or "clogging" of the filter. A well designed fuel filter system, which includes all the types of fittings, hoses, valves, and "other things" incorporated into the finished system, should start out CLEAN under 3" of Hg restriction, when measured in-between the lift pump and the last "off engine filter". We typically mount the gage on or after the last filter in the primary Multi-Stage system because of convenience, and the fact that we do not consider the fuel line and fittings (if properly sized) between the last filter and the lift pump to be of any consequence in the overall restriction of the system.



My field work over the past 20 years has shown that "most" diesels with properly operating lift pumps and fuel systems can tolerate about 10"-15" of mercury (Hg) restriction before starving for fuel... Again, always put your vacuum gauge after your "off engine" fuel filters, but before any pumps. And in actual operation, you will find that a good Multi-Stage system will clog 2-3 primaries (FF5013) before the FS 1000 needs replacing - The vacuum gage will tell to that as that is what multi-stage is all about.



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### More reading and thoughts about modern fuel filtration

"Microns" or Micron Ratings:

Now this is a term that carries some serious weight when selecting a fuel filter. Seems that average Joe is more impressed by the smaller the number, than the method used to measure or give the filter this "rating", the quality and type of media used within the filter, and the capacity of the fuel filter( dirt/water holding capacity).

Hmmm, rated 60 GPH with a 2 mic element-sounds way overkill to me considering my engine only has 300 HP and burns 16 GPH at WOT. This is where Joe has missed the big picture.

The "micron rating" of fuel filters is a very simple way of allowing someone to select just one of the requirements for filtration. Our experience with marine fuel systems has proven to us that the nominal micron rating is not the best way of choosing correct filtration. Micron rating should only be used to categorize the media since the most fuel filter ratings were developed based on single-pass efficiency tests using uniform spherical particles as a system contaminant. In real life, diesel fuel contains contaminants of various sizes ranging from sub micron to 100's of microns in size.

Keep this very important point in mind when you only think "micron rating" when choosing a filter - NEVER will you find a fuel filter with a rating of 10 microns, 2 microns, etc., that will stop 100% of the particles larger that this nominal rating. NEVER... What you will find with a quality filter is:

- 1) Beta Ratio micron rating
- 2) Fuel flow vs. pressure drop rating when clean
- 3) Dirt holding capacity vs fuel flow-pressure drop
- 4) "Free" and "Emulsified" water separation ratings
- 5) Ratings / specifications from SAE, ISO and other world recognized organizations
- 6) Other important parameters concerning collapse and pressure ratings, etc., that were developed in conjunction with a specific requirement from an engine manufacturer.

Keep in mind that Cummins, specifically, does not recognize micron ratings as significant and specifically recommends the use of "Beta ratio" in selecting a filter to meet system requirements. I am certain many engine manufactures are of the same as to their requirements.

More help follows if you want to get real serious about fuel filtrations basics:

A "NO BS" guide to filtration and what it all about - Trust me, no "gizmos" here!! [http://wfc2.xapnet.com/filtration\\_basics/index.php](http://wfc2.xapnet.com/filtration_basics/index.php)

FRAM ( those "auto guys") also makes it easy to understand some basics about microns and "BETA" test methods <http://www.fram.com/pdf/FluidFilterRating.pdf>



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## Tips for Your Selection of a Fuel Filter System

In all cases, regardless of how one decides to set up fuel filtration system, give these ideas / fuel system tips some thought, or keep them for future reference... And if someone has a few ideas to add, please don't be shy as this is one of the main premises behind these forums "sharing information and ideas so all can benefit".

A few pointers below to help YOU make the right decisions....

- 1)** It's always best to either draw your fuel from the bottom of the tank (you want the crap in your filters and not sitting in the bottom waiting to get stirred up in the first bad weather), OR have a drainable fuel tank sump, OR BOTH.
- 2)** Be sure the fuel lines, valves and fittings that feed your filters do not restrict the flow or allow air to enter the system. Choosing the next size of filter in capacity ratings will assure you of a longer time between clogging.
- 3)** A vacuum gage installed just before a fuel lift pump will more that pay for itself if installed correctly and its operation is understood by the operator. The use of a vacuum gage adds "science" as to when to change your filters.
- 4)** An in-line sight glass or clear piece of vinyl hose (temporary) installed in the fuel line is one of the best tools for addressing fuel / air leaks in a fuel system when troubleshooting .
- 5)** Always be sure the filters you choose to use are sized in stages with the largest capacity and nominal mic rating closer to the fuel tank. "Multi-Stage", remember??
- 6)** Be sure your "return fuel system" cannot be shut off when switching tanks or at any time during engine operation.
- 7)** If the engine fuel system design allows the use of a submerged return line, consider this as a worthwhile addition to the fuel system. But, also read your engine installation requirements as not all systems recommend this, although MOST DO.
- 8)** Fuel transfer: With multiple tanks and the need to transfer fuel with an electric pump, putting an old fashion type spring wound timer w/ normally open electrical contacts ( available thru many home improvement stores and industrial supplies) will save you from the many embarrassments that typically occur by pumping fuel into the bilge or overboard due to overfilling. I rarely recommend using return fuel for fuel transfer because of typical flow rates above 60 GPH in many cases, it is easy to "forget" about the valve you messed with a hour ago. We prefer using a 12 VDC electric pump with flows around 30-50 GPH with a fuel filter on the suction side of the pump (FF5013), w/ 60 minute timer. Not only will you not forget, you will be



Easy View Vacuum Gages



Multi-Stage w/ Racor's and fuel transfer polishing system

"polishing" your fuel in the best way - with the boat "rocking and rolling". Need 50 gallons moved from port to starboard?? Just the right twist and your done !!

**9)** If you really want to know what type of ugly stuff is in your fuel tank and how good your filters are really working, cut open your "on-engine" spin-on and take a look. This is the one method that will let an operator really find out what is getting thru to his last chance filter on the engine. Cutting open filter in your Primary system, will tell you what's really in the fuel tank.

**10)** If you have "Racor Phobia", but tired of the mess having to take apart your Racor Bowl to clean it out, put a bulk separator spin-on in front of it. You'll be amazed a year down the road at the difference.

**11)** Be sure none of your fuel tank vent lines contain a "low spot" - you want them to drain completely when the boat is static or in motion. If they can run forward and rise at the same time, this is always a better choice for routing. With large wing tanks, it is usually best to vent on the inside top and fwd edge of each tank. This allows the tanks to vent better if the boat starts to heel during filling.

**12)** A properly installed sight gage on your fuel tanks is the best assurance of knowing how much fuel you really have.

**13)** When building / designing a fuel system w/ many pipe thread type fittings, manifolds, etc. consider the use of a 100% solids epoxy for the "pipe dope". Many installations cannot tolerate even the slightest "sweat" of diesel on a fitting. We started this practice about 15 years ago, and we never get a "call back"... Grey "Marine Tex" and some Simpson (ET-22) products do a great job and will never let you down, besides being easy to use and clean up.



Simple and very effective upgrade for Racor's - Adding a bulk separator as the primary



"No Diesel Sweat" - Fuel Manifold w/ 100% epoxied fittings / threads



Multi-Stage & John Deere / Luger --Good Friends!!

In closing, multi-step "Multi-Stage" filtration is the most effective and simple way to protect modern diesels from the contaminants found in fuel systems. To quote "Alaska Diesel," (you know, those Luger and Northern Light guys,) "Forcing fuel to go through even three separate, progressively finer filters is cheap insurance." ....

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