Installing a daytank and fuel scrubbing system
door Pieter van Wingerden May, 2005*

**zie opmerking webredactie, aan het eind van deze tekst*

I installed the Fuel Scrubbing System with Daytank for two reasons: 1. Problems with a brand new Espar dieselheater; 2. To improve the boat's safety by avoiding fuel problems.

1. Problems with a brand new Espar dieselheater
In May 2004 I installed a brand new Eberspaecher (Espar) D2 Airtronic dieselheater. I had a D3L heater before, installed in 1982, that worked fine until finally,after intensive use, the ventilator motor gave up and other breakdowns could have been expected. Besides that, I found that the D3L, operating without a thermostat, was dimensioned too big for the boat.

The D2 was sold to me with a small simple in-line fuel filter and since the D3L had also functioned with a similar filter, direct from the main fuel tank, I installed the D2 in the same way.

After about three and a half months the D2 gave up the ghost. It wouldn't ignite anymore. The diagnosis was a complete coaled burning chamber. Roton Industries on Granville Island in Vancouver offered a warranty repair. The D2 functioned again. To prevent future problems I was advised, either to modify the thermostat or to run the heater on Kerosene.

I could not accept the proposals. Modifying the thermostat would have meant no regulation anymore, i.e. running on high all the time only. Burning Kerosene would have meant a separate tank with a complicate and messy refilling procedure.

The heater is now running on Racor (2 micron) prefiltered and dry fuel since May 2005 and worked flawless until the end of September. For testing purposes it actually ran more and longer than the beautiful summer in British Columbia required.

I was also aware of the fact that the smaller D2 could be more sensitive to it's environment and therefore made some changes. The main improvement was to minimise the resistance in the exhaust system.

2. To improve the boat's safety by avoiding fuel problems
The thought about an engine that quits at a moment you need it most is a horror vision to me. In the articles I red on this subject in most of cases the cause was a clogged fuel filter while sailing in rough weather with a nearly empty fuel tank. Under these circumstances ,

switching to a second (spare) filter ,may sound logic but how long do you think it will take this filter to be blocked as well. If you are lucky you are still able to enter a safe harbour.

Even more articles I red on the subject fuel treatment.Translating these articles to the fuel consumption on a Fisher 30 (maybe 200 litres per season) I came to the conclusion that in the first place I am always using detoriated diesel and in the second place I can forget about having a clean tank (despite biocides etc.).

I do have a sump with a drain valve on the main tank and at every start and end of the season I drain about a litre. Most of the times there is only a few drops of water and some undefined flakes in the glass.

Triggered by an article on this subject by Robert Chave on the Yahoo Fisher Group Website I started to look for a concept.

I bought a transparent 25 litres dieselfuel tank from Vetus because this tank fits perfect beside the engine (55cm long, 40cm high and about 20cm deep). The price was about 160 Euro. As I received the tank I was a little sceptic about the fittings. Simple grommets pressed into the holes of the tank and barbed hose connectors just pressed into these grommets. For reasons I will explain hereafter I was not sure whether the system would build up a small pressure in this tank and was afraid that these connectors would start to leak. The Vetus people in Schiedam (Holland) assured me that the connections would be OK. I took the safer way and, also because I had the possibilities, I made my own fittings out of brass with NBR (Nitril) O-ring sealings. If you do not have a lath or somebody who knows somebody who has a lath than you maybe better look for a custom made nylon tank with rigid welded connections. Do not forget to have an opening of about 5cm diameter made, which will be capped after you have mounted the micro floatswitch into the tank. The tank was supplied with nylon fabric belts to wall-mount the tank but I replaced them by 2 mm thick copper strips which made the mounting easier.

I already had a new Racor 220R2 filter with a capacity of 20Gph and a 2 micron filter element.

The next step was to find a suitable additional fuel transfer pump. Most of the pumps I found on the internet were too big (rated around 90 Gph). I finally found one in the NAPA (automotive parts) U.S. catalogue in the range of abt. 30 Gph. As I wanted to order this one from NAPA Canada ,I was told that the pump was not available in Canada but I could have the type E8153 which is a 12V continuous duty pump with 30Gph (equivalent to about 2 litres per minute) with a max. pressure of 10-14psi (1bar = 14psi). The price was about C$85 and came with 14NPT to 3/8" hose barbs.

My main concern was ,that in the system I could not mount a separate connection on the maintank for the fuel return hose of the daytank. On the Fisher 30 you can hardly reach the top of the tank, not to mention the attempt to mount a fitting.

The fuel return of the daytank, with a rate of 2 litres per minutes, had to go in addition to the already existing engine fuel return via the existing return hose. On my boat this hose has quite an outer diameter but inside measured 1/4" only. To be sure, I made a test and poured the content of a 2 litre cola bottle into a 1/4" funnel. Just by gravity it passed the funnel in about 50 seconds. I have an Isuzu 40HP 4LC1 engine and I think that the injectors are not cooled by the diesel fuel, supplied by the fuel pump on the engine, so I could expect that the fuel return of the engine is not that much. Albeit, I am using the existing fuel return hose for both returns. I built a hose connector in which the overflow of the daytank is injected in under an angle of about 30 degrees and the engine fuel return in a straight line to prevent eventual whirls that could obstruct the free flow of the engine return fuel. You may also use a simple "Y" hose connector with the base of the Y pointing to the main tank. You may think that this is a bit thinking too far but I don't have my boat next door and, coming on board and installing new systems, it should possibly function right away.

I do not think that under these circumstances there will be overpressure in the daytank. With this NAPA pump the 200 litres of the maintank will pass the Racor prefilter in about two hours time , so while underway your are continuous cleaning your fuel. If it is true that the Racor filter also spins the water out of the fuel it will now certainly do so with the NAPA pump going over the capacity of the filter. The former, lower fuel flow trough the Racor filter by the engine fuel pump may not have shown this effect.If it is also true that the bacteria in the maintank, who live for about 6-8 weeks, will now be "stored", dead or alive in the filter cartridge since they are about 2 microns big.

The principal of the system is shown in the attached schematic, which I think explains itself. The two service valves are implanted for the air bleeding of the whole system. One valve closes the overflow of the daytank to the maintank and the other one acts as a bypass valve for the pump. I planned this bypass valve in the system because I did not know in advance of what type the pump finally would be. As I checked the NAPA pump, I learned that you can blow through the pump (in flowing direction) with no 12Volts applied. Blowing in the opposite direction you find the path blocked. With this type of pump you do not need the bypass because you can pull the fuel out of the maintank with the priming pump on the Racor filter, right trough the NAPA pump, until the Racor filter is filled. If you pull the piston of this little pump (which is built in the filter) slowly back and forth in a straight line it works fine.

You might want to have this bypass valve installed if ,the pump you are using, goes far above the capacity of your fuel return hose. By opening the valve you will be able to regulate the Gph actually flowing to your daytank. The rest of the fuel than circulates in the bypass circuit.

Coming so far I thought it would be a good idea to have a vacuum meter connected to the second output of the Racor filter so that money can be saved by changing the cartridge of the filter when it is necessary only. I did not buy the vacuum meter from Racor (abt. C$120) but a normal 0 to –1 bar vacuum meter from Conrad Electronics in Europe. A hydraulic shop will have them as well and you will pay around C$20. I used the West Marine catalogue to copy the values Racor recomments for the cartridge exchange and marked those values with coloured tape on the dial of the meter.

If you start the system with a new cartridge you may notice that the vacuum meter shows a low reading. In my case –0.12 bar (abt. 1psi). This is caused by the fact that the pump capacity is higher than the Racor capacity. If you want to have a zero reading with a new cartridge you can adjust this by slightly opening the pump's bypass valve or, you simply add the initial vacuum reading to the vacuum value for cartridge replacement.

On the small system's control panel you find the components to control the fuel transfer pump as well as the alarm circuit and the vacuum meter. Since the daytank is mounted under the Pilothouse floor boards there must be some kind of alarm, indicating that the daytank's fuel level sinks. All the components were obtained from Conrad Electronics (which I think is also represented in Holland). Using LED's in circuits now a day is simple because steady or blinking LED's are made with built-in resistances for a voltage range from 9-15Volts.

On the panel you find two switches. One for the fuel pump control (automatic-off-manual) and one for the alarm circuit (automatic-off-test). Normal position is both on automatic. In this position the fuel transfer starts as you start the engine and the alarm is ON. The position "manual" is used for the initial filling of the daytank as well as topping of the daytank since the Espar heater also uses fuel out of the daytank. In port, the alarm will sound about every second or third day while using the heater.

An old rule in electronics is: the more components in a circuit , the higher the probability of failure will be. Translated into the above it means that the fuel transfer pump may show a failure and here I want to point out that, with the system I still can be trapped by a clogged

filter but I will still have 6 gallons of clean and dry fuel on which I can steam 6-9 hours, time enough to look for a safe harbour or anchorage or if the weather permits, to look after the problem. The fuel transfer pump is a cheap off-the-shelf product and despite the label reads "not for aviation or marine use" it will do the job on a Fisher.

You can meet engine problems for other reasons, like belts and rawwater pumps, but that is a matter of maintenance.

Bleeding the complete system
After the system is installed and connected to the maintank, you have to fill the daytank. The NAPA fuel transfer pump may not run dry. Proceed as follows:

Open the main valve on the main fuel tank, open the bleeding valve on the Racor filter and start to pump until you see the Racor is filled. Close the vent screw and continue to pump fuel into the Fuel pump. A few strokes more and you might see the fuel flowing in the daytank. You may now switch the fuel transfer pump to manual and wait till the daytank is full and the overflow to the maintank starts.

Switch the pump off and close the overflow service valve on the daytank. If you continue to pump the priming pump on the Racor filter you will start to build up some pressure in the daytank, forcing the fuel to flow to the fine filter on the engine. Therefore the output of the fine filter should be opened by disconnecting the hose to the engine fuel pump. Reconnect this hose as soon you see some fuel is coming out of the fine filter.

Bleeding the hose from daytank to Espar can be done in the same way by opening the Espar fuel valve and disconnecting the fuel hose from the metering pump on the heater and pump the fuel until here. Reconnect the hose again. Finally close the priming pump on the Racor Filter and do not forget to open the return valve on the daytank.In my case the engine started at the turn of the key, the Espar took a second cycle to start

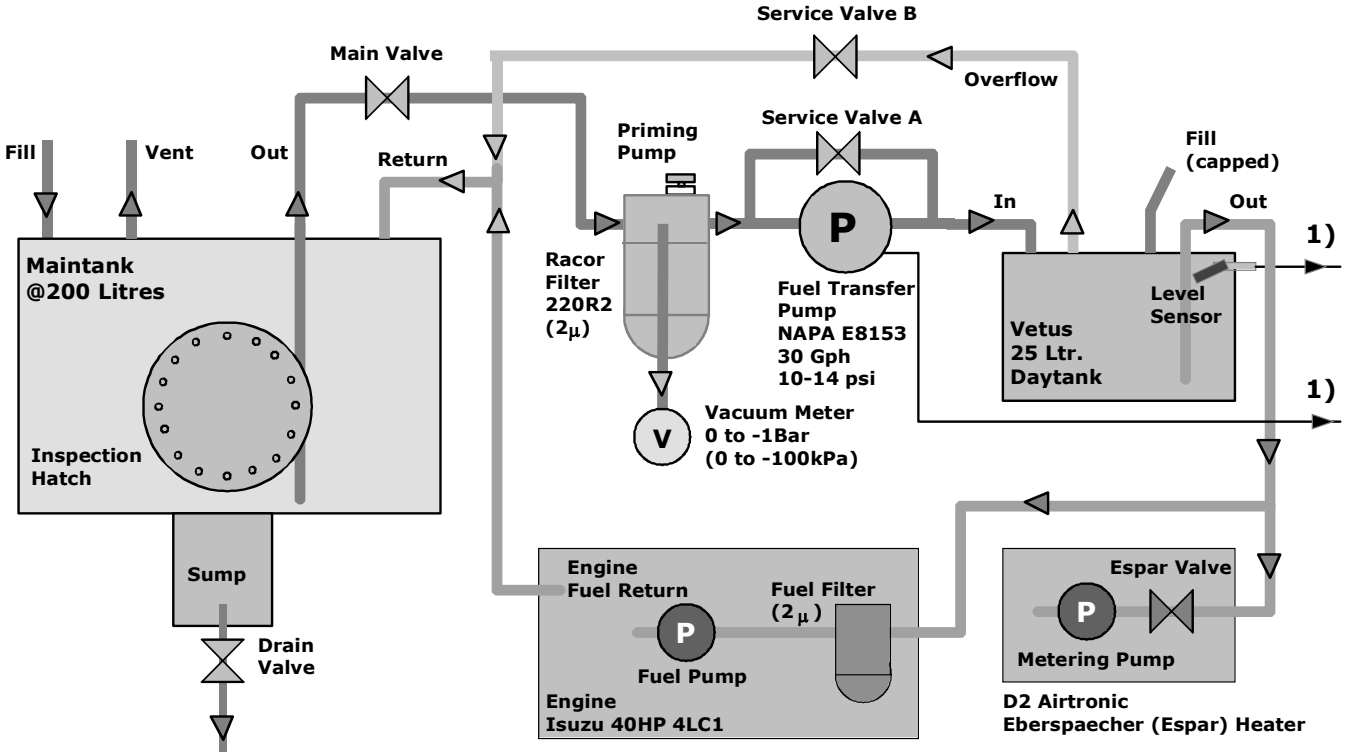
Attached you will find the system as a principle, the wiring diagram and some pics.

I want to say thanks to Robert Chave and Cees Roos for their inputs and advise.

Pieter van Wingerden
Seepaert, 1976 F30, hull 136
Snug Cove, Bowen Island (49 23N, 123 20W)

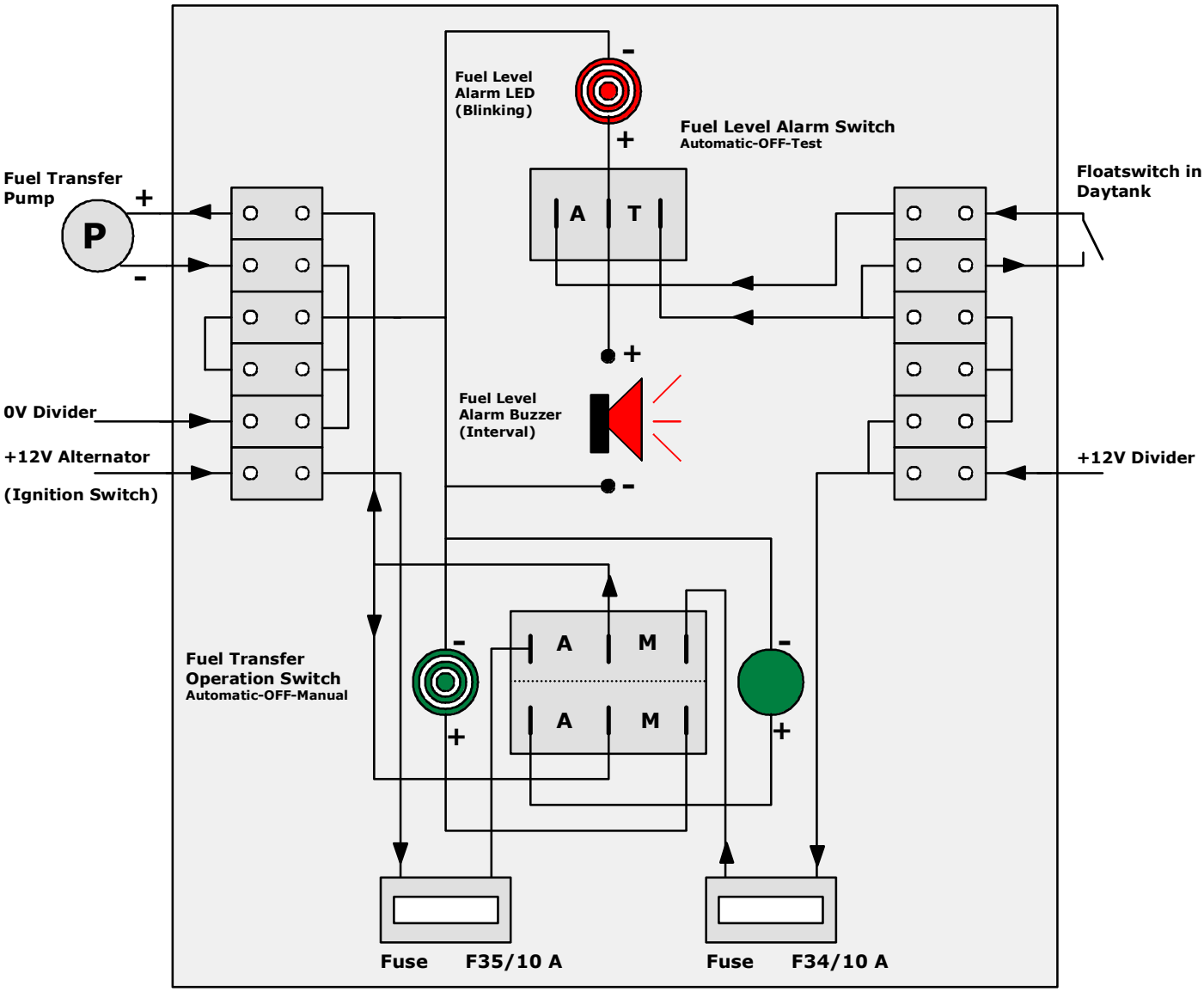
Opmerking redactie: Pieter van Wingerden is enige tijd geleden overleden. Hij was lid van de Fisherownersgroup North America. Zijn boot Seepaert is nog steeds varend.
Webredactie FS voorjaar 2016

Zie schema’s hierna!



1) Electrical connections to "Fuel Transfer and Daytank Sensor Panel".

Schematic Fuel System (May 2005)



Red Blinking LED: Fuel Transfer interrupted.
Green Fixed LED: Automatic Fuel Transfer.
Green Blinking LED: Manual Fuel Transfer.

Possible Failures:

Red Blinking LED (while engine running): Main Fueltank empty, Glogged Racor Pre-filter, Defective Fuel Transfer Pump or Fuse F34 blown.

Red Blinking LED (while in Port): Eberpächer Heater fuel consumption triggered the Daytank Sensor.

No Green Fixed LED while Fuel Tranfer Switch is in "Automatic" : Fuse F34 blown or +12VDC from Alternator is missing (check for corrosion on Alternator 12VDC connector).

No Green Blinking LED while Transfer Switch is in "Manual" : Fuse F35 blown or +12VDC from +12VDC Divider of House Battery is missing.

Floatswitch of Daytank Sensor: Full Daytank shows OPEN Switch.
Fuel Level about 6 cm under full Daytank shows CLOSED Switch.

Fuel Transfer and Daytank Sensor Panel (May 2005)

Fuel Level Alarm sounds:

1. Engine running and Fuel Transfer fails.
   Possible Reasons: Empty Main Tank, defective Transfer Pump, glogged Racor Filter or Fuse F34 blown.

   Fuel for about 6-8 hrs steaming is still left in the Daytank!

2. Engine stopped and Espar used enough fuel out of the Daytank to activate the Fuel Level Sensor. Switch to "Manual" transfer to top off the Daytank.
   This prevents condensation in the tank.

Normal Position of the Switches:

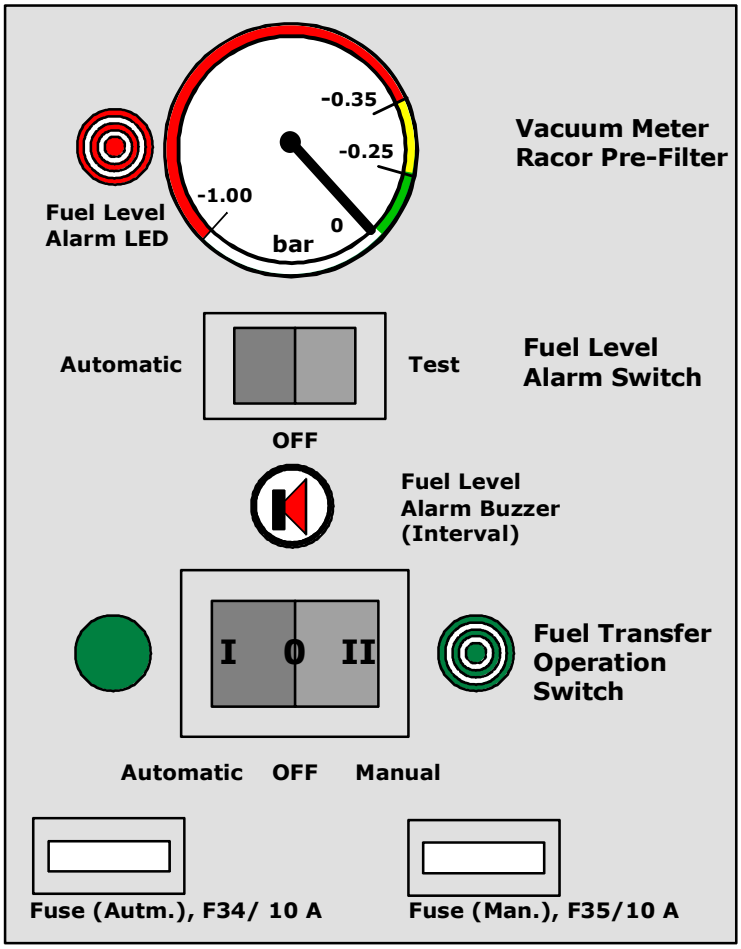
Both on Automatic.

Fuel Transfer:

The pump gets 12VDC from the Alternator via Ignition Switch with Transfer Switch in position "Automatic".

The pump gets 12VDC from the 12VDC Divider (House Battery) while the Transfer Switch is in position "Manual".

There is a separate Fuse for each of the 12VDC connections.



Fuel Transfer and Daytank Sensor Panel (March 2005)