Diesel fuel consumption measurement on vehicles

Gain better control on fuel consumption and save money!

The DFM system enables high accurate measurement of the diesel engine consumption of any vehicle like **trucks, buses, construction machinery, agricultural machinery, riverboats or diesel locomotives.**

Up to date, more than 20'000 systems have proven its reliability in the hard practice. Under some conditions fuel cost savings of up to 20 % or even more could be achieved.

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Your benefits

If you have a good access to the fleet owners or to the maintenance market of some of the mentioned vehicles, you could increase your business portfolio by acting as DFM “system partner”. You could take benefit from the expertise of your employees without high investment.
We provide you with well-proven instrumentation and sales tools, and you care for the professional installation, start up and service of the DFM diesel fuel measuring systems.

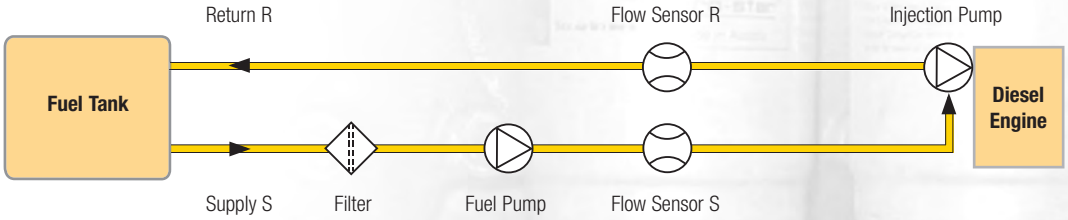
The Benefits of your customers

Find out with your potential customer by entering his vehicles operation data into a provided calculation tool and read out how much money your customer can save and how many month it will take for the pay-off (ROI return on invest). With this fair and transparent procedure your customer can decide how fast he wants to proceed.

Application

The system DFM is made to measure the real fuel consumption of Diesel operated engines. It may be used exclusively for this type of application with Diesel fuel.

Principle of engine consumption measurement



Diesel engines are generally operated with a circulating fuel supply system. The supply line feeds the fuel from the tank through a fuel filter and a fuel-feeding pump to the high-pressure fuel injection pump on the engine. The supply quantity is always larger than the maximum engine consumption. The excessive fuel flows back through the return line into the tank.

Example for engine consumption and flow rates in supply and return pipe

Supply S — **150 l/h**

Engine consumption: - max. / full power — **70 l/h**

- min. / idle — **5 l/h**

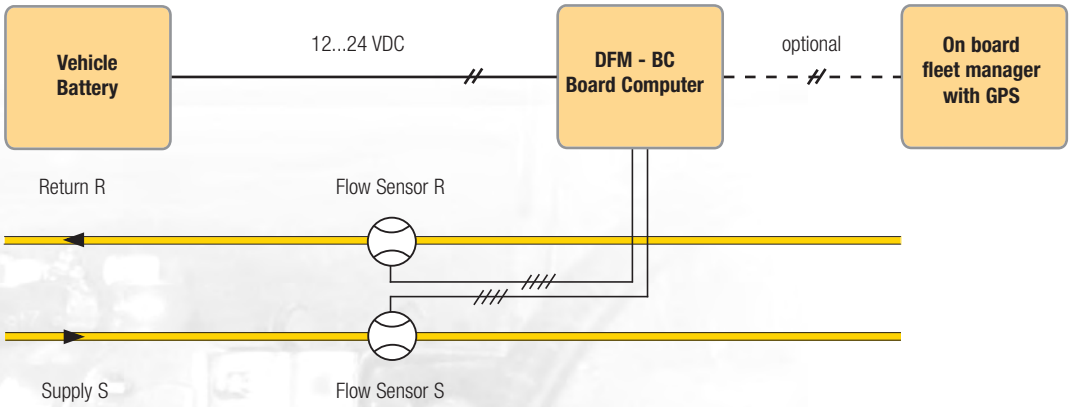
Flow rates in DFM sensors - Supply — **150 l/h**

- Return — **80 - 145 l/h**

80 l/h **145 l/h**

The engine consumption corresponds to the supply volume minus return volume. This operation condition is the reason why the flow sensors have to be chosen according to the supply flow rate and not according to the max. engine consumption. Both sensors, supply and return, shall always have the same size.
The DFM Diesel Fuel Measuring System measures the real engine consumption. By measuring the inlet and outlet of the engine it will prove if any fuel is used for other reason. DFM sensors are volumetric flow meters with a high accuracy. They are connected to a Board Computer DFM-BC, which is calculating all relevant values from the supply and the return line and displaying the real engine consumption.

Information on fuel consumption



The board computer has a pulse output for the consumption that can be used as an input for a fleet manager or GPS system.

Your contribution

In order to achieve an accurate measurement of engine fuel consumption, a thorough understanding of the measuring principle and the right positioning of the DFM within the fuel system is essential. It is also important to understand what kind of questions may come up and how to solve them.
Your customer would like to place his vehicle in front of the workshop and picking it up later on with a perfect installed and started DFM Diesel Fuel Measuring System. Some very successful companies made the installation at the customer's location at a time the vehicle was not needed for the daily business.

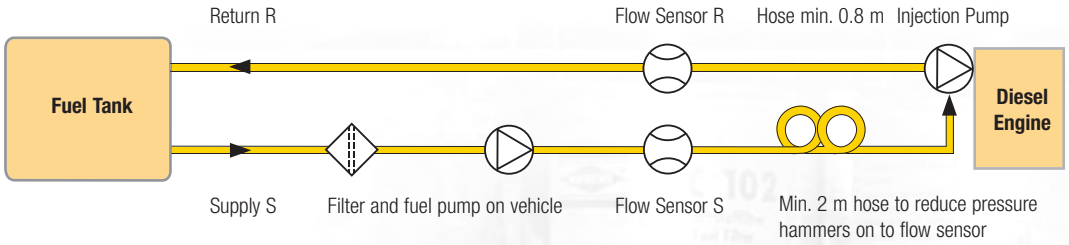
Installation conditions for the two flow sensors

- The sensors have to be always protected by a fuel filter. The max. mesh size depends on the sensor size. The original truck filter is ideal for all sensor sizes.
- If the sensors are marked with S and R, install the S-sensor in the SUPPLY and the R-sensor in the RETURN pipe.
- The arrow on the sensors must show in the flow direction.
- The sensors must be absolutely free of gas inclusions.
- High pressure hammers from injection pump have to be avoided on flow sensors.

Installation Principles

The position of installing the supply and the return flow sensor is defined by your specialists. They will have to take into account specific vehicle piping and all aspects in order to achieve a perfect flow measurement. Aquametro as specialist in flow measurement can give some non-binding ideas.
None of the information stated above releases planners, installers and operators from their own careful and comprehensive assessment of the system configuration in terms of functional capability and operational safety.

Principle for installation on pressure side of fuel feeding pump (upstream):



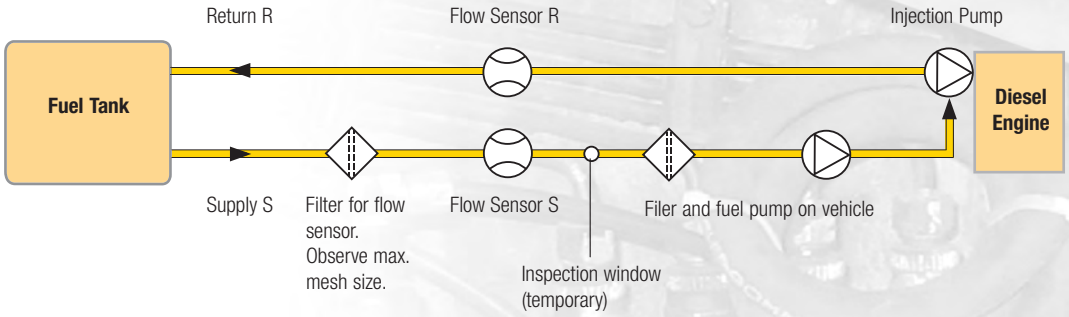
Example of an installation with increased length of hose connections

Important: Avoid heavy pressure hammers on flow sensors
Both flow sensors have to be protected from possible high frequency pressure hammers from engines injection pump. The pressure peaks may reach up to 100 Hz and 8 bar. Protection can be made by:

- Avoiding straight connections from flow sensors to the injection pump.
- Using smooth fuel hose.
- Increasing distance between flow sensors and injection pump.

If flow sensors must be installed close to the injection pump, protection can be achieved by placing about 2 m of flexible hose in between. To save installation space, the hose can be wound up.

Principle for installation on suction side of fuel feeding pump (downstream):



Important: Avoid inclusion of gas
If the SUPPLY flow sensor must be installed upstream of the fuel feeding pump, low pressure may occur due to additional components or impurities in the filter. When diesel fuel is exposed to low pressure of approximately -0.35 bar (depending also on temperature), formation of gas may occur which will create foam in the pipe. Such a situation has to be avoided because it would lead to a substantial measuring error.

For this reason it is recommended to check the flow condition at the outlet of the supply flow sensor with a (temporary) inspection window. The fuel must be absolutely free of any gas or bubbles.

Be careful with multiport filters where the filter also functions as a reservoir as well. The return side of the meter must be connected between the injection pump and the filter. Some systems use the “open injector technology”. Their return lines often contain air inclusions that make the system unsuitable for this type of measurement. Maybe a de-air device could improve the condition, but this should be tested.

Installation of Board Computer

The board computer DFM-BC can be mounted in the drivers cabine either visible on the dashboard or inside below.

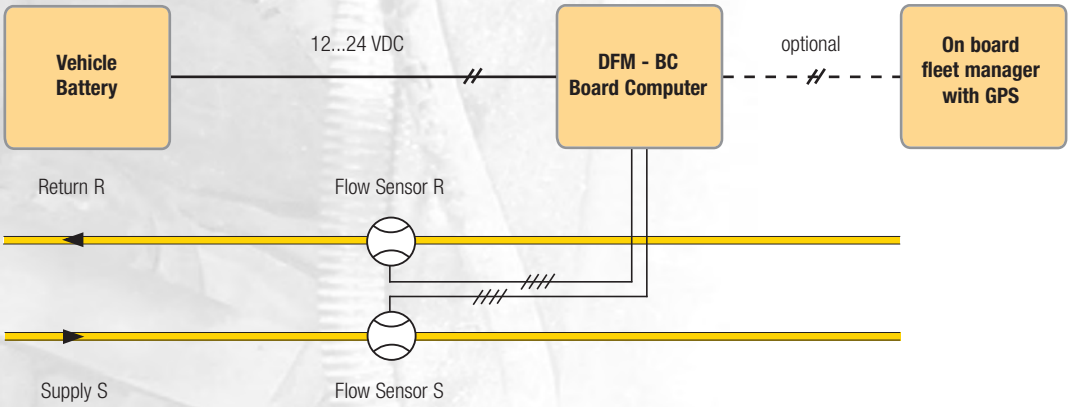
Easy mounting:
Use Velcro® tape or any adhesive tape.

Professional mounting:
Screw optional mounting bracket to the desired place.

Electrical installation

The flow sensors shall be connected to the board computer DFM-BC or any comparable device providing a filtered and stabilized voltage. They must never be connected directly to the vehicle battery.

Electrical connections of board computer and flow sensors

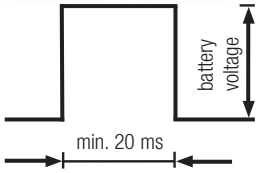


Connection of 2 single sensors (DFM8S, DFM20S, DFM25S) or of one double sensor (DFM8D) to the board computer.

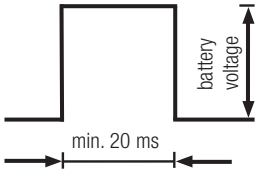
Vehicle battery

12 or 24 VDC

Sensor signal



Output signal (optional) for GPS or Fleet Manager



Settings on Board Computer

Follow board computer manual for final wiring and start up. If flow sensors are larger than size DN 8, then you have to select correct sensor size prior to start of accurate measuring.

Sealing of system

After all settings have been made, it is recommended to seal all relevant hydraulic and electrical connections. A difference between the engine consumption and the invoiced fuel quantity could be detected by the DFM measuring device. The seals would help to prove in case of manipulations. A quantity of warranty stickers is supplied with the board computer.

Quality control of installed systems

We provide you with the form “Installation Report”. For your own files and better quality control please fill in one report for every vehicle that you set up and send a copy to the distributor.

Specification and Technical Data

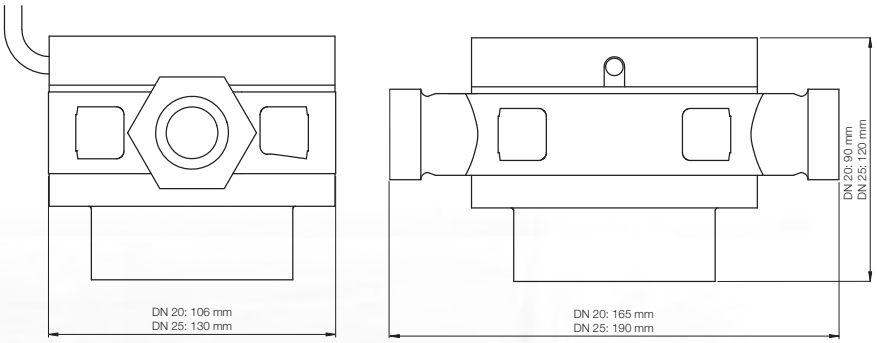
Flow sensors		**DN 8**	**DN 20**	**DN 25**
Max supply flow rate Qn [1]	l/h	180 (135)	1000 (1000)	2000 (2000)
Max. engine consumption approx.	l/h	100	600	1200
Min. flow rate at measuring point approx. [1]	l/h	20 (4)	100 (30)	200 (75)
Max. operating pressure	bar	16	16	16
Approx. pressure drop at Qn	mbar	150	150	150
Max. measuring error per sensor		± 1 %	± 0.5 %	± 0.5 %
repeatability		± 0.2 %	± 0.1 %	± 0.1 %
Operating temperature	° C	-20...+80	-20...+80	-20...+80
Ambient temperature	° C	-40...+125	-40...+125	-40...+125
Max. filter mesh size	mm	0.100	0.100	0.250
Protection class according to IEC 60529		IP 66	IP 66	IP 66
Hydraulic connections		M14x1.5mm	G 1”	G 1 ¼”
Recommended connectors:	size	M14x1.5mm	G 3/4”	G 1”
	part number	80447	81166	81169
Cable 6 x 0.5 mm², outer dia. 6.2 mm, length 7.5 m		included	included	included
Safety: Vehicle approved for vibration, shock and electrical immision and emission.		yes	yes	yes

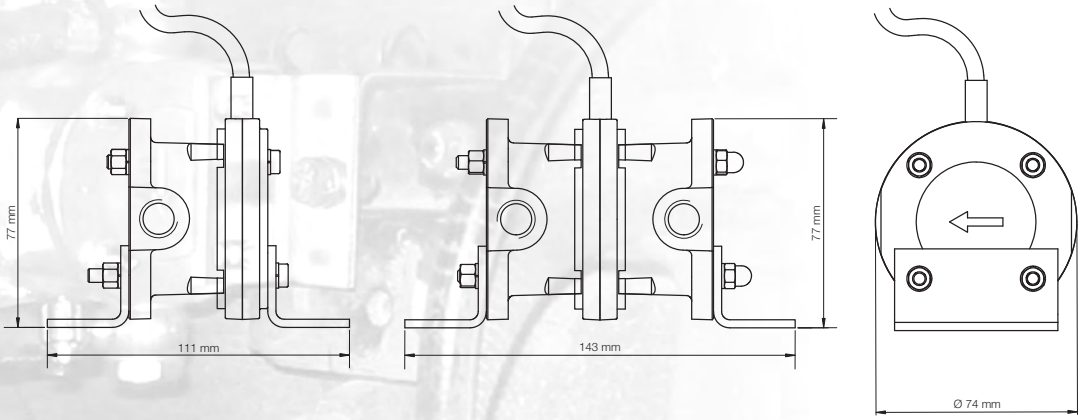
Board Computer	
Power supply	12…24 VDC direct from vehicle battery
Registration	100.000.000 litres
Scale value	Default for DN 8 = 80 pulses per liter
Temperature	Ambient –10 ... +70 °C,
Protection class	IP 54 according to IEC 60529
Electrical connection	Power supply with cable 2 x 0.75 mm², 2 m supplied Cable outer diameter 5.0 mm

[1] Differential measurement (direct consumption measurement)

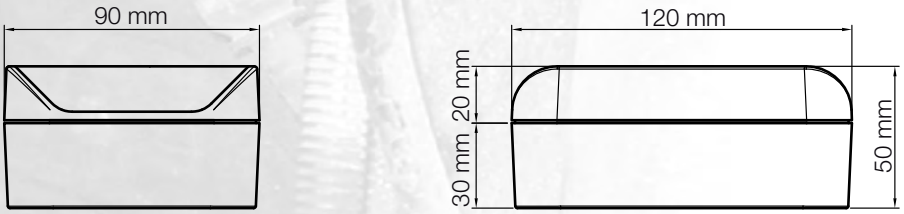
Dimensional drawing / Mounting holes

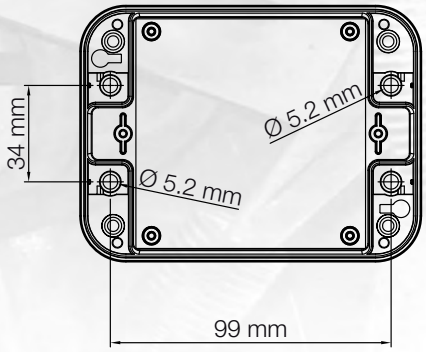
Flow Sensors





Board Computer





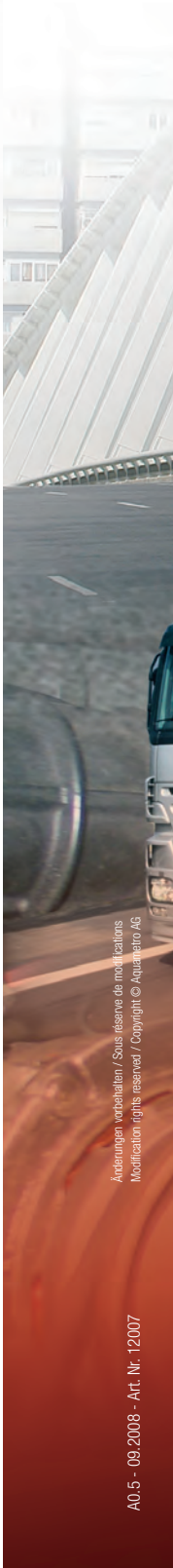
Warranty

All Aquametro products are produced under high quality levels and ISO 9001 standards. Every single flow sensor is submitted to an accuracy test that is documented in a test protocol. The test benches used for this process are under constant control of the Swiss and the German authorities (METAS and PTB). The electronic products have to pass an individual quality test. Therefore Aquametro guarantees for the Product Quality (perfect material, machining and function) of every delivered product. Further details are specified in our terms of business.

As Aquametro does not have a direct influence to the Installation and Application Quality we cannot take any responsibility for this part.

Ordering information

Description	Type	Part. no.
Diesel fuel flow sensor DN 8D (double)	DFM8D	94465
Diesel fuel flow sensor DN 8S (single)	DFM8S	94464
Diesel fuel flow sensor DN 20S (single)	DFM20S	94466
Diesel fuel flow sensor DN 25S (single)	DFM25S	94467
Board Computer	DFMBC	94476
Hose Connector for DN 8 (M14 x 1.5mm)	DFM8S/D	80447
Pipe Connector for DN 20	VSR 3/4"	81166
Pipe Connector for DN 25	VSR 1"	81169



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