

Application Bulletin - 124

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# FUEL CONSUMPTION MEASUREMENT

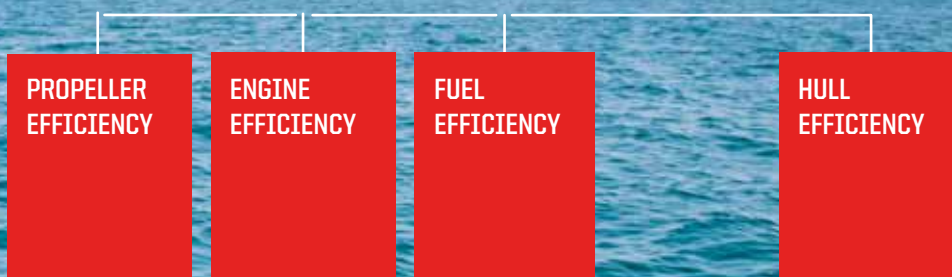


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## Reduce fuel costs and emissions

Due to the increasing awareness of the impact of exhaust emissions on the environment, combined with the continued increases in fuel costs, there is great need for reduction in fuel consumption. This has led to a high demand for accurate measurement systems to monitor the fuel consumption per engine. Real-time measurement and trend analysis of fuel consumption provide helpful information for ship owners, ship managers and crew about the influences of their actions on the consumed fuel. VAF Instruments offers various kinds of systems for the most accurate measurement and analysis of fuel consumption. For the large variety in fuel systems, VAF Instruments offers a dedicated fuel consumption measurement system and diverse monitoring and management solutions.

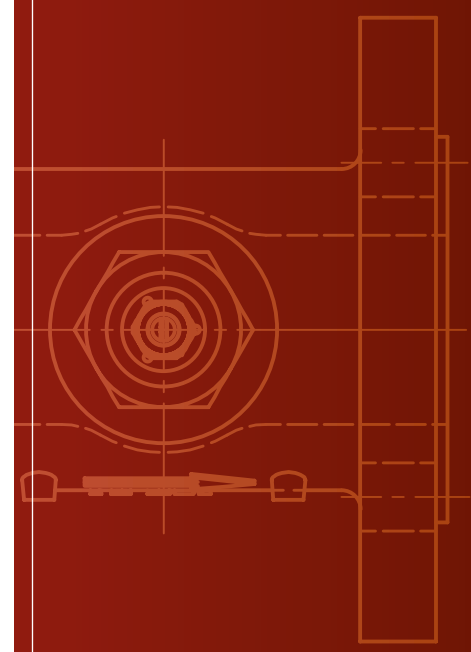
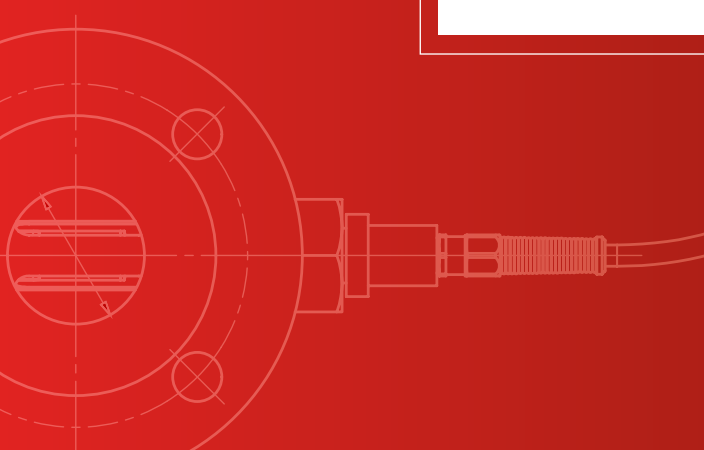


## Where can fuel consumption be measured?

Fuel consumption measurement can be performed in engine-driven installations in all kinds of power and propulsion plants. Various types of fuel can be measured, such as heavy fuel oil, marine diesel oil or fuels. Depending on the design of the fuel system and the preferences of the customer one or multiple Flowmeters can be used in combination with dedicated flowcomputers to obtain the most accurate measurements.

## High accuracy & quality

VAF Instruments has gained experience in the development, production and application of precision measuring instruments for (fuel) flow measurement since 1938. The very high accuracy (down to 0.1%) and high repeatability (0.05%) of the Flowmeters are not affected by pressure, viscosity or temperature of the fuel. In addition the design of the systems is very robust and easy to operate, making it ideal for use in the typical environmental conditions on board ships and power plants. Depending on the specifications and requirements, a large variety of counters, computers and Flowmeters with integrated temperature sensors is available. VAF Instruments' products are especially designed to fit the demanding environment in the maritime industry and are the result of many years of extensive research.





## Real time measurement

In most fuel systems fuel is circulated over the engine with a flow rate which is higher than the maximum fuel consumption. When the engine consumes fuel, this is taken out of the circulation circuit. To maintain the fuel flow in the circulation system, new fuel is added. Directly measuring this fuel flow between tank and circulation system is therefore the easiest and most accurate solution.

In situations where these measurements are not possible or give too little information, for example when there is no closed circulation circuit or in case of multiple consumers, it is necessary to measure all fuel lines separately and calculate the differences to obtain the fuel consumption. Since there is also a temperature difference between supply and return flow, compensation for temperature is necessary.

When measuring the fuel consumption over an engine, it is often necessary to install one Flowmeter in the fuel supply line towards the engine and one Flowmeter in the fuel return line. In such system it is absolutely necessary to have temperature compensation for the calculation of the fuel consumption, because the volume flow is temperature dependent and there is a temperature difference between the fuel in the supply line and the fuel in the return line.

When not compensating for these temperature effects there will be a decreased accuracy in the calculated volume. This inaccuracy is almost 1% for each 10°C temperature difference when not compensated. Because the circulation flow is in general 2,5 to 5 times the maximum fuel consumption, this means that the error on the calculated fuel consumption will also at least be multiplied by 2,5 to 5.

## Mass Flow Measurement

In general fuel is bought in tonnes therefore, to be consistent, fuel consumption is preferably monitored in kilograms. Smart usage of existing components of the fuel system in combination with an upgrade of the viscosity sensor enables mass flow measurement.

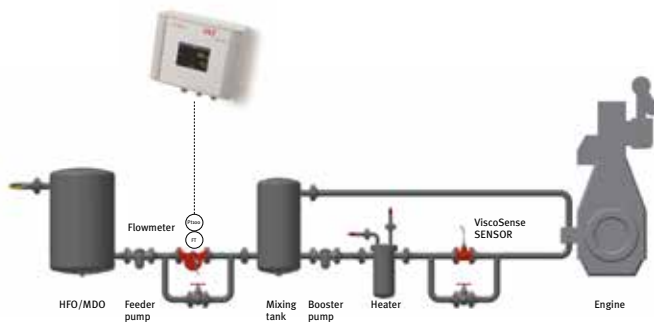
VAF Instruments offers a cost effective solution combining the strengths of two of the most installed sensors in the maritime industry. The PT2 Flowmeter allows for simultaneous flow and temperature measurements. The ViscoSense®3D is based on the proven ViscoSense® technology and offers density, viscosity and temperature measurements.

Fuel consumption measurement by PT2 Flowmeters in combination with density measurement by the ViscoSense®3D system enables mass flow measurements with highest accuracy, reliability and repeatability.

## Typical system arrangements

### Single Flowmeter system

A single Flowmeter system provides the most accurate fuel consumption measurement, measuring the fuel flow that is added to the circulation system. Temperature compensation can be used if the volume at a specified reference temperature is required, to ensure correct and comparable results.

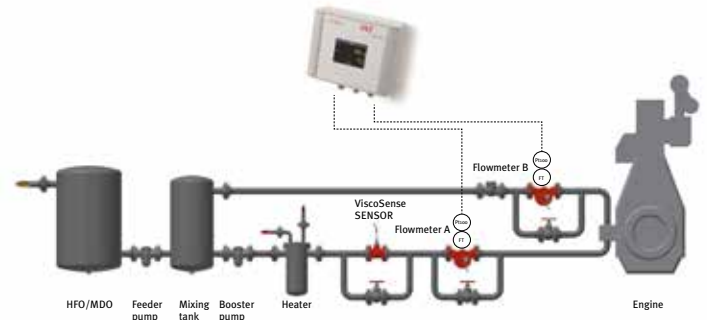


### Supply and return Flowmeter system

When it is not possible to measure the fuel consumption with a single Flowmeter, the consumption can be calculated from the difference between the fuel supply and return flow. For this layout the volume flow and the actual temperature from both supply and return should be measured and the difference calculated real-time.

A typical system consists of Flowmeters with integrated PT100, and a flow computer displaying information about the supply and return fuel flow, temperatures, the actual-temperature compensated- fuel consumption and totals.

VAF Instruments offers a wide range of flow computers to meet the demands and requirements for the displayed information and data output.

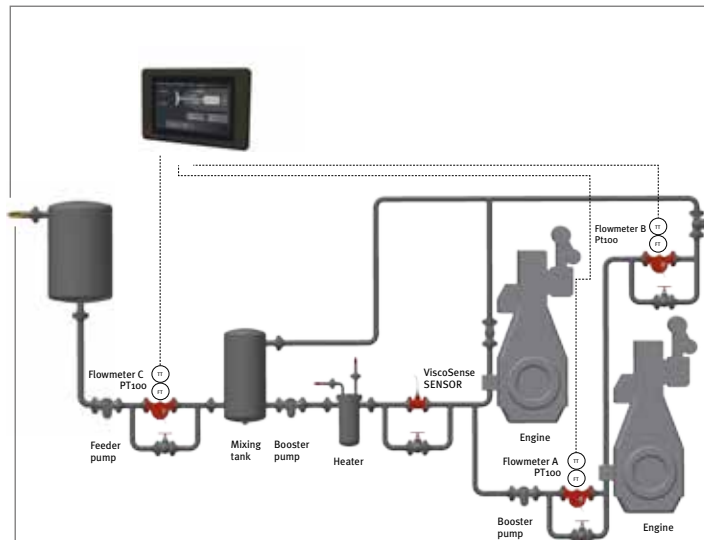


### FCM2 flow computer

For visualisation of the measured data in combination with a single Flowmeter or in a supply/return system, VAF Instruments advises the FCM2 flow computer. This computer includes temperature compensation calculation. Furthermore it can be connected to the ViscoSense®3D for mass flow calculations.

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### Uni-fuel system

In uni-fuel systems there are multiple engines being supplied from the same fuel treatment system, for example both main engine and auxiliary engine(s). If information about fuel consumption for each engine(group) is needed, separate supply and return Flowmeter systems should be installed.

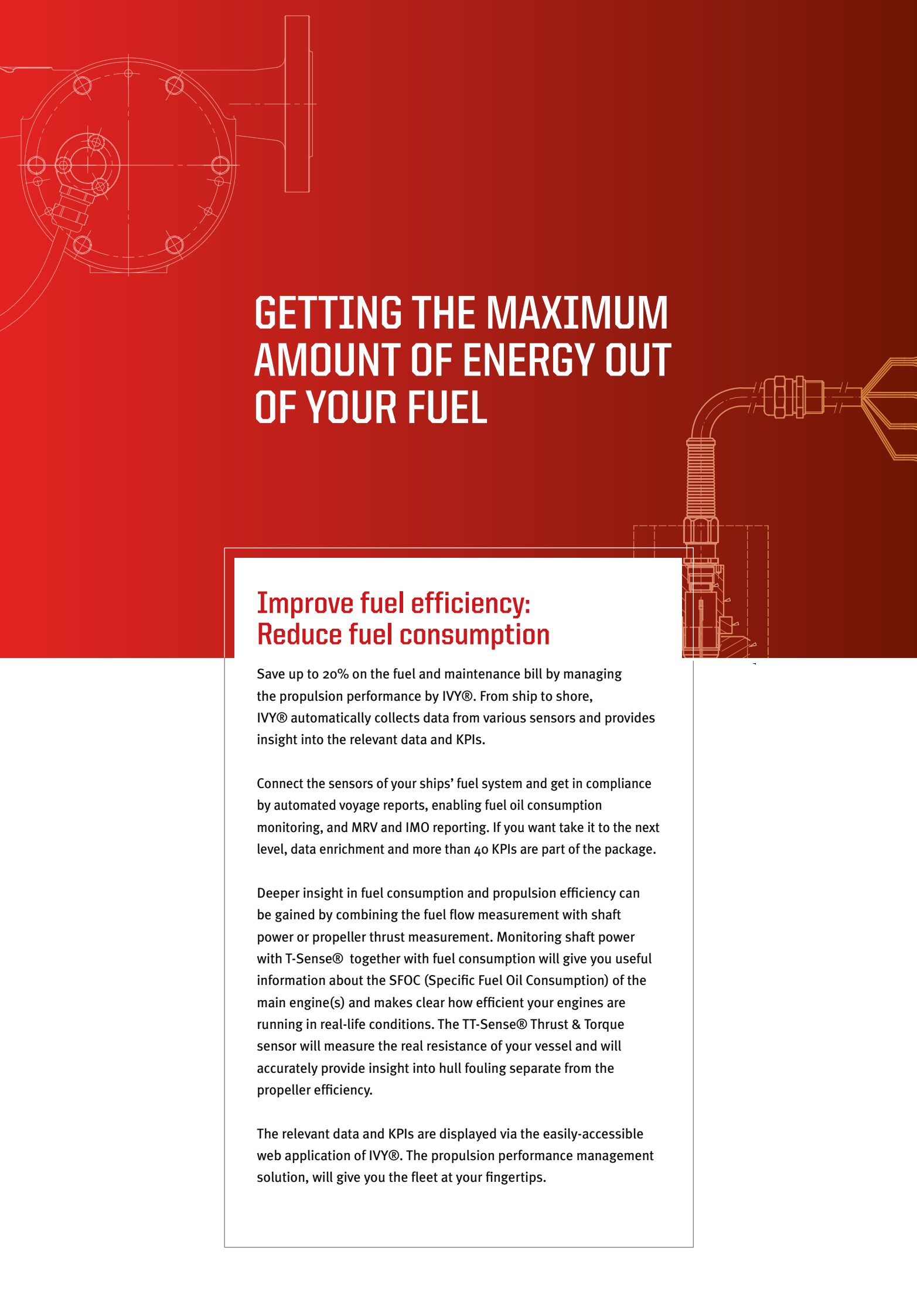
Another solution is using a setup consisting of three Flowmeters, strategically placed. For this solution a single Flowmeter is placed between day-tank and the fuel circulation system to measure the total fuel consumption. Additional Flowmeters will be installed in the fuel supply and return lines from the auxiliary engine(s), measuring the consumption of this engine(s) only. By subtraction the consumption data from the other engine is calculated.

### Propulsion Efficiency Monitor (PEM)4

For monitoring of the fuel consumption data VAF Instruments has developed the PEM4 propulsion efficiency monitor. On its large touch screen display all important information is available at a glance. The intuitive navigation through the different screens offers not only real-time consumption data (compensated for temperature differences), but also other valuable information. For example the average fuel consumption over a specified period of time can be given. Also the system can make automatic distinction between different fuel types. The system is able to monitor up to 12 Flowmeters (8 separate consumers) and can additionally be connected to speedlog or GPS to obtain the specific fuel consumption per nautical mile.

Connecting the PEM4 with the innovative ViscoSense®3D provides mass flow monitoring.





# GETTING THE MAXIMUM AMOUNT OF ENERGY OUT OF YOUR FUEL

## Improve fuel efficiency: Reduce fuel consumption

Save up to 20% on the fuel and maintenance bill by managing the propulsion performance by IVY®. From ship to shore, IVY® automatically collects data from various sensors and provides insight into the relevant data and KPIs.

Connect the sensors of your ships' fuel system and get in compliance by automated voyage reports, enabling fuel oil consumption monitoring, and MRV and IMO reporting. If you want take it to the next level, data enrichment and more than 40 KPIs are part of the package.

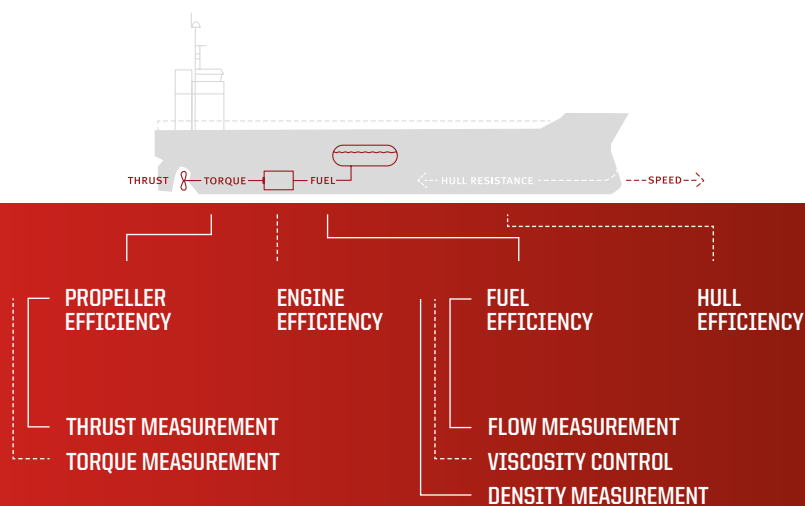
Deeper insight in fuel consumption and propulsion efficiency can be gained by combining the fuel flow measurement with shaft power or propeller thrust measurement. Monitoring shaft power with T-Sense® together with fuel consumption will give you useful information about the SFOC (Specific Fuel Oil Consumption) of the main engine(s) and makes clear how efficient your engines are running in real-life conditions. The TT-Sense® Thrust & Torque sensor will measure the real resistance of your vessel and will accurately provide insight into hull fouling separate from the propeller efficiency.

The relevant data and KPIs are displayed via the easily-accessible web application of IVY®. The propulsion performance management solution, will give you the fleet at your fingertips.

### VAF Instruments B.V.

VAF Instruments is the most preferred supplier of the top 100 shipyards and market leader in maritime measurement systems. Since 1938, VAF Instruments has gained a worldwide reputation as a specialist in developing and manufacturing measurement and control systems for the maritime and process industry. Our mission is to develop innovative and accurate measurement systems to maximize efficiency, improve operational excellence and reduce the environmental impact of these operations.

With agents around the globe, VAF Instruments has a worldwide network. Over 70 representatives are specialised in VAF Instruments' products and solutions. Please feel free to contact us or one of our representatives, any time, any place.



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