



# ViscoSense<sup>®</sup> 3D

Viscosity & Density Measurement  
Enabling Mass Flow Measurement

774

Product Bulletin

[WWW.VAF.NL](http://WWW.VAF.NL)

TO BE  
REALLY  
SURE

# Introduction

Most of the operating costs of a ship are fuel related. Therefore it is very important to use fuel in the most efficient way. Calculated Carbon Aromaticity Index (CCAI) is the index for the ignition quality of residual fuel oil and is calculated from density and viscosity of the fuel. The measurement and control of the viscosity and density ensures an improved combustion efficiency preventing engine damage and reduction of fuel and maintenance costs.

## Viscosity, Density and temperature measurement

ViscoSense®3D is a highly accurate sensor with a superior measuring principle based on the proven ViscoSense® technology. The sensor offers density, viscosity and temperature measurements. Furthermore, in combination with VAF Instruments PT2 Flowmeters, this measurement system is a cost effective solution for mass flow measurement.

## Viscosity control

A large variation in the quality and composition of fuel oil makes the behavior of the fuel oil at higher temperatures difficult to predict. An optimal viscosity is needed for the best possible atomization of HFO in the engine and thus the fuel will be burned completely without remaining deposits.

## Mass flow measurement

In general fuel is bought in metric tonnes. Therefore, to be consistent, fuel consumption is more and more 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.

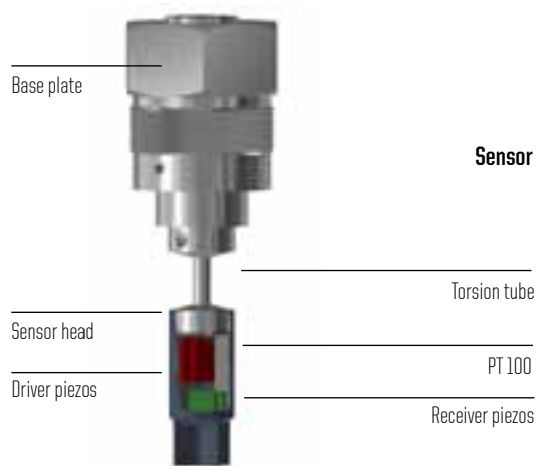
## For the maritime industry

After many years of research ViscoSense®3D is based on proven and patented ViscoSense® technology and especially designed for the maritime industry. VAF Instruments has decades of experience in viscosity measurement, is the worldwide market leader in measurement and control systems and specialist for the maritime and process industry.

To maximize efficiency, improve operational excellence and reduce the environmental impact of shipping, VAF Instruments develops innovative and highly accurate measurement and control systems. 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.

# Principle of operation

ViscoSense®3D is able to measure inline the actual dynamic viscosity and density of a large range of liquids. The unique measuring principle of ViscoSense®3D is based on a torsional vibration of a pendulum in liquid. The measured damping of this piezo-driven vibration is directly related to the viscosity. A built-in temperature sensor is used to measure the temperature at the same location where the viscosity is measured. The sensor head is equipped with a cross vane through which a small amount of fluid is increasing the mass moment of inertia. The frequency of the pendulum, which is dependent on the mass moment of inertia, is now directly related to the density of the fluid.



## Reliability

Due to the operating principle based on a torsional vibration, the measurement is insensitive to unwanted external influences. Flow velocity, flow direction and pulsations have no effect on the sensor operation. The robust sensor is designed to operate under the most difficult conditions in which a faultless and stable viscosity and density measurement is required.

## Cost-effective operation

The ViscoSense®3D sensor is developed to measure viscosity and density without interruptions and with low operating costs. Since the sensor does not actually move, it is not subject to wear and therefore it ensures a long lifetime and a maintenance free operation. The non-stick surface of the pendulum in combination with a smooth edged design makes the sensor highly insensitive to fouling and easy to clean. The sensor is calibrated for life and the high accuracy will be kept without the necessity of re-calibration. Due to its compact design the sensor is suitable for easy installation in any new or retrofit system.

## Cost-effective solution

To enable mass flow measurement, only a small upgrade of your current fuel system is required.



One ViscoSense®3D can be combined with multiple Flowmeters in the same fuel system, independent of configuration. Fuel consumption measurement by PT2 Flowmeters in combination with density measurement by the ViscoSense®3D is a cost-effective solution that enables mass flow measurements with highest accuracy, reliability and repeatability.

## Features and benefits

As a result of the torsional vibration technique, the flow velocity has no effect on the measurement. External vibrations have no influence on the ViscoSense®3D. In practice the smooth edged design of the sensor makes the system highly insensitive to fouling and easy to clean. In addition the closed-loop controlled torsional vibration principle is independent of ageing of piezo material, ensuring a long term stable and accurate measurement.

### Features

### Benefits

<b>Stable and accurate in-line measurement</b>	Optimal burning efficiency and fuel consumption Engine damage prevention and reduced maintenance
<b>Torsional vibration measuring principle</b>	Reliable under all circumstances Not influenced by vibrations, flow velocity or dirt particles
<b>No moving parts</b>	No preventive maintenance required Low operating costs
<b>Minimal load on components</b>	No ageing and wear effects
<b>Stainless steel 316L pendulum</b>	No wear due to corrosion Durable
<b>Smooth edged pendulum</b>	Insensitive to adherence
<b>Compact light-weight construction</b>	Easy to install
<b>Calibrated for life</b>	Long and trouble-free operation
<b>Type approval from all major classification authorities</b>	To be implemented directly on any ship without additional costs

# Technical specification

## Sensor

Viscosity range	0-25/50 mPa.s (other ranges on request, max. 1000 mPa.s)
Density range	750-1100 g/l (other ranges on request)
Temperature range	0-200°C
Maximum operating temperature	180°C
Temperature transmitter	PT100 element
Viscosity accuracy	± 2% instantaneous or 0.5 mPa.s
Density accuracy	± 0.1% instantaneous or 1 g/l
Temperature accuracy	± 1°C
Sensor material	Stainless steel 316L / Ni-alloy
Coating material	Diamond Like Carbon (DLC)
Protection class	IP65
Cable length	5 m integrated
Weight	1 kg

## Interface box

Viscosity, density and temperature output	Isolated active output 4-20 mA, current loop, max. load 400Ω
Bus	Modbus over TCP/IP: all measuring data
Power Supply	100-230 VAC, 50-60 Hz (fluctuations should not exceed 10% of the nominal voltage)
Power consumption	6 Watt
Response time	Depending on application
Resolution	0,1 mPa.s and 1 g/l
Ambient temperature	-20-55 °C
Humidity range	0-95% RH
Protection class	IP66
Mounting	Wall mounting
Installation category	I acc. IEC 1010-10
Pollution degree	I acc. IEC 664
Weight	2 kg



Interface box

## Housing

<b>Material</b>	Ductile iron
<b>Flange connections</b>	Standard DN50 (2"), DIN, ANSI or JIS; other sizes on request
<b>Pressure rating</b>	PN40
<b>Weight</b>	10 kg
<b>Diameter</b>	max. flow m <sup>3</sup> /h
<b>DN 50</b>	20
<b>DN 65</b>	34
<b>DN 80</b>	51
<b>DN 100</b>	80



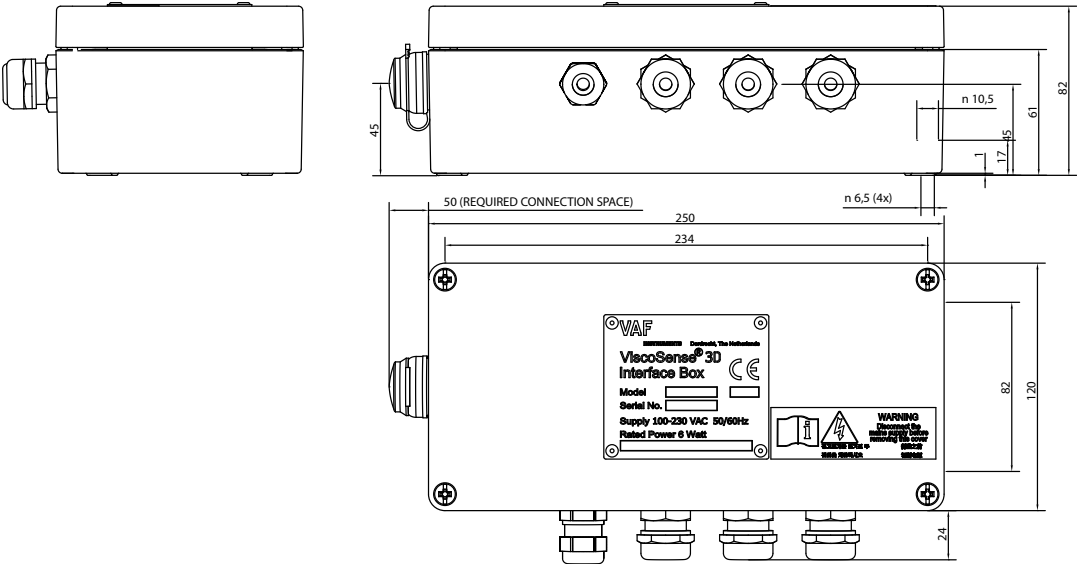
ViscoSense® Housing



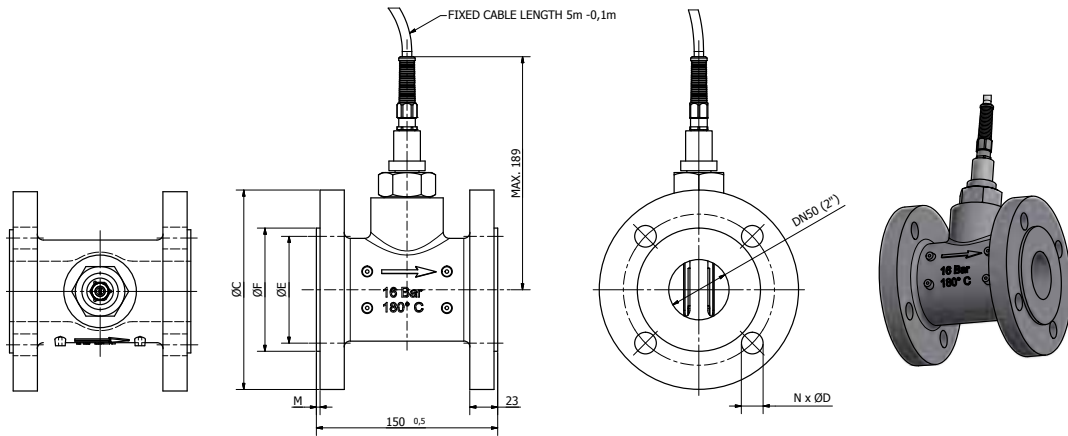
For Viscotherm replacement a retrofit housing is available.  
Please refer to Information Bulletin 732.

# Dimensions

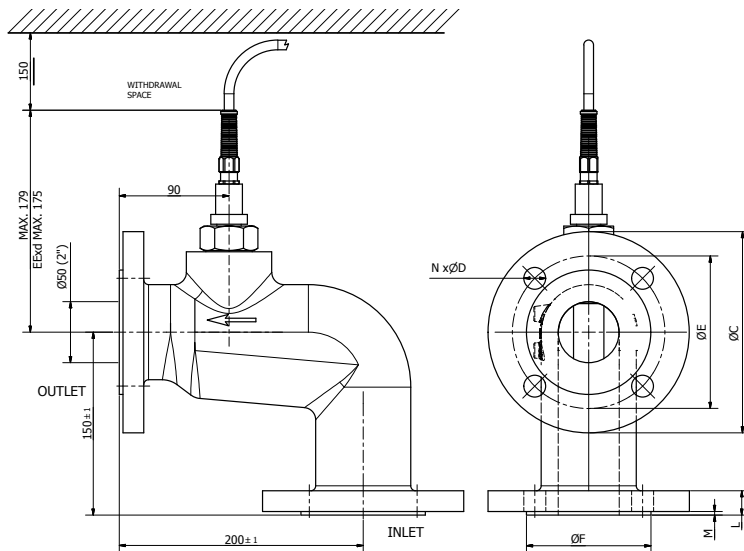
## Interface box



## Sensor housing



## Sensor housing for ViscoSense®



## Sensor housing for Viscotherm replacement

### Quotation and ordering information

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1.	<b>Basic system designation:</b> ViscoSense®3D			
2.	<b>Application:</b>	<input type="radio"/> fuel viscosity and density measurement	<input type="radio"/> fuel viscosity control	<input type="radio"/> Viscotherm® retrofit
		<input type="radio"/> ViscoSense® retrofit	<input type="radio"/> other fluid (please indicate specifications):	
3.	<b>Viscosity range:</b>	<input type="radio"/> 0 - 25 mPa.s	<input type="radio"/> 0 - 50 mPa.s	<input type="radio"/> special:
4.	<b>Density range:</b>	750-1100 g/l		
5.	<b>Flow rate</b> [m³/h]:			
6.	<b>Nominal diameter of piping:</b>			
7.	<b>Controller type:</b>			
	<input type="radio"/> electronic with viscosity control + temperature indication		<input type="radio"/> electronic with viscosity control + temperature control	
8.	<b>Viscosity reading on electronic controller:</b>	<input type="radio"/> mPa.s	<input type="radio"/> cSt	
9.	<b>Flange type:</b>	<input type="radio"/> DIN PN [bar]	<input type="radio"/> ANSI RF [lbs]	<input type="radio"/> JIS [K]
10.	<b>Optional extras:</b>			
	<input type="radio"/> remote viscosity and/or density indicator			
	<input type="radio"/> remote viscosity and/or density indicator with alarm contacts			
	<input type="radio"/> remote temperature indicator			
	<input type="radio"/> remote temperature indicator with alarm contacts			
	<input type="radio"/> inspection by classification bureau			
	bureau name:			
	tagging of all system components:			
	<input type="radio"/> paper tags	<input type="radio"/> stainless steel tags		
11.	<b>Control valve:</b>			
	actuation	<input type="radio"/> electric	<input type="radio"/> pneumatic	
	medium	<input type="radio"/> steam	<input type="radio"/> thermal oil	
	body material:	<input type="radio"/> ductile iron	<input type="radio"/> steel	
	flange connections:	<input type="radio"/> DIN PN [bar]	<input type="radio"/> ANSI RF [lbs]	<input type="radio"/> JIS [K]
12.	<b>Nominal diameter of piping:</b>			
13.	<b>Inlet pressure</b> [bar]:			
14.	<b>Nominal flow rate</b> (for steam in kg/h, liquids in m³/h):			
15.	<b>Allowable pressure drop across valve</b> (max. 1 bar):			
16.	<b>Specific gravity of medium</b> (water = 1,0):			

Name:

Place and date:

For further information see relevant Product Bulletins or [www.vaf.nl](http://www.vaf.nl)

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