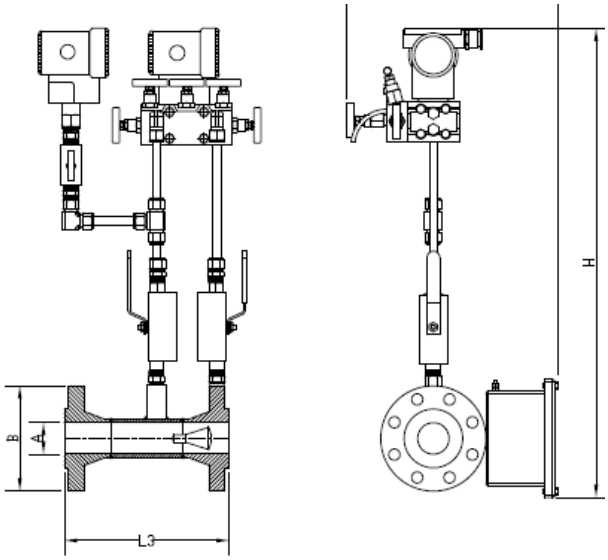
ESMER Water-in-Oil Meter

Technology Overview

ESMER WIO Meter measures the flow rates of individual phases in two-phase oil-water production lines (*). ESMER WIO is based on a cone differential meter which also acts as a capacitance sensor.

(*) ESMER WIO measures oil-water mass flow rate as well as water composition.

ESMER WIO works in the range 0-50% water cut and can tolerate up to 5 % GVF within its accuracy specification. ESMER WIO is particularly suitable for use in production lines and in the liquid leg of separators. Effect of oil density and temperature is taken into account in the factory calibration of the meter. Field measurements are automatically compensated for changes in oil density and temperature Salinity does not affect the measurement made by ESMER WIO Meter – which is based on the characterisation of the dielectric property of the fluid – see below.

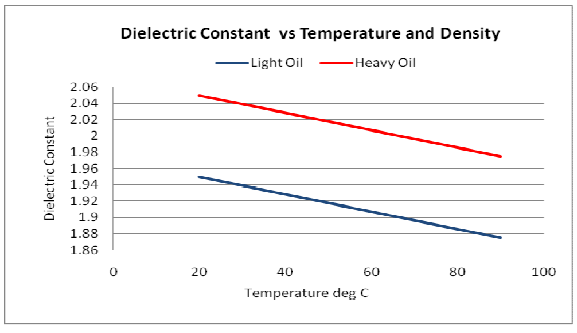


Size (600# RF)	A	B	L3	W	H	Weights [kg]
2"	49,3	165,1	252	515	885	53
3"	73,7	209,6	350	560	930	65
4"	97,3	273,1	450	623	993	90
6"	146,3	355,6	634	706	1076	138
10"	247,7	508	1013	858	1228	260

ESMER WIO field unit makes two primary measurements which are combined in the flow computer to provide the oil flow rate in mass or volumetric units. The primary measurements are those of dielectric constant (water composition) and differential pressure across the cone (mass flow rate).

Parameters Effecting Water Composition Measurement

The measurement is based on the characterisation of the dielectric constant of the fluid. The dielectric constant of a material is a measure of its ability to transmit electrical potential energy. A dielectric material has poor conductivity, but it can hold a charge with an applied electric field. Dielectric constant is affected by the following parameters.



Frequency of the applied electric field: The value of the dielectric constant varies with the frequency of the applied electric field, but below 106 Hz the dielectric constant is virtually independent of frequency.

Temperature: Dielectric contant decreases with increasing temperature. The typical decrease in dielectric constant for hydrocarbon oils is about 0.0013 or 0.05% per degree Celsius.

Density: Dielectric constant increases with density. Dielectric will vary in the range 2.0 – 2.4 depending on on API gravity.

Gases: Have relatively small dielectric constants, typically 1.00xx, where xx represents typical variation between gas dielectric constants in the third and fourth decimal places.

Water: has a large and temperature-dependent dielectric constant. Typical decrease in dielectric constant for water is 0.37% per degree Celsius.

Vacuum	1.00
Metals	Infinite
Gases	1.00xx
Water	87.9 (0 degC) to 55.5 (100 degC)
Hexane	1.8865 (20 degC)
Cyclohexane	2.0243 (20 deg C)
Benzene	2.285 (20 degC)
Hydrocarbon lubricating oils	2.1 to 2.4 (room temperature)

Dielectric Constant of Common Materials

Parameters Effecting the Differential Pressure Across the Cone

- The discharge coefficient (determined at the factory loop test) will be affected by any significant changes in the viscosity and density of the fluids in the field.
- Care must be taken to purge trapped gas from the impulse tubes.
- Cone geometry can undergo changes over long period of use.

Accuracy

Chart shows best and worst cases for oil flow rate measurement accuracy (combined error from the two underlying independent measurements of liquid flow rate and water composition).

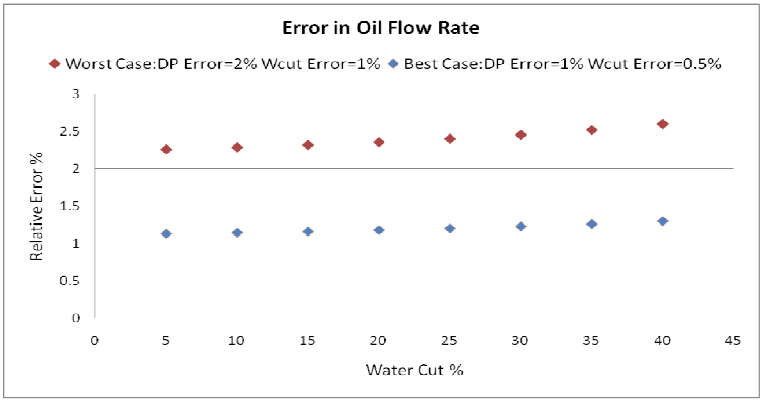
Best case:

- Liquid flow rate: 1 % (relative)
- Water cut : 0.5% (absolute)

Worst case:

- Liquid flow rate: 2 % (relative)
- Water cut : 1% (absolute)

Best and worst case will depend on the mis-match between density and viscosity of the oil phase used for calibration and the fluid in the field.



Specification

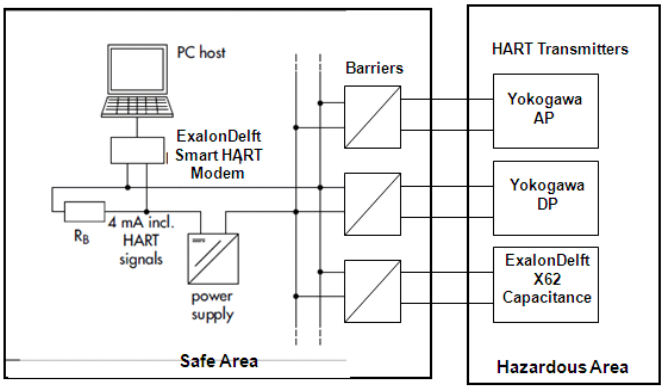
Calibration Inputs (standing data):

- API Density
- Viscosity

Outputs:

The following outputs are provided:

- Liquid flow rate (mass / volume)
- Water composition (volume fraction)
- Oil flow rate (mass / volume)
- Pressure
- Temperature



ESMER Water Cut Meter Wiring Block Diagram

Operating Envelope

- Water cut : 0 – 40%
- GVF: up to 5 %
- API gravity No limitation (subject to pre-calibration)
- Viscosity 25 – 3000 cp (if it flows it can be measured !)

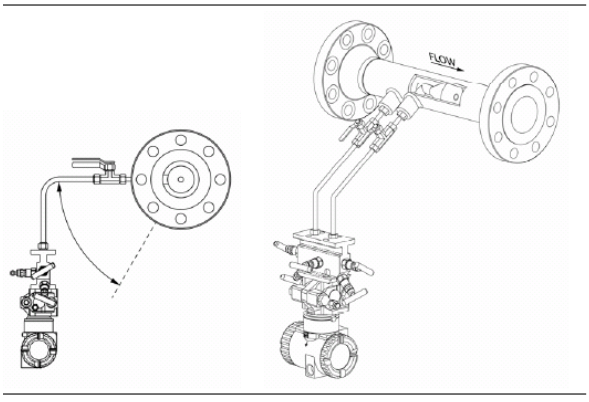
Limits

- Ambient temperature: -40 to 85℃
- Process temperature: -40 to 120℃
- Process pressure: Maximum 100 bara

Mechanical and Electrical

- Pipe Diameter Customer specification
- Materials: Customer specification
- Flange connections: Customer specification
- Certification: EEx ia IIC T4/T6
- Power Supply: 24 VDC or 110/220 VAC

Optimum liquid service installation of ESMER WIO Meter is shown in the diagram on the right.



Transmitters

ESMER WIO uses the following oil industry standard transmitters.

- DP Yokogawa
- AP Yokogawa
- Temperature Thermocouple
- Capacitance ExalonDelft X62

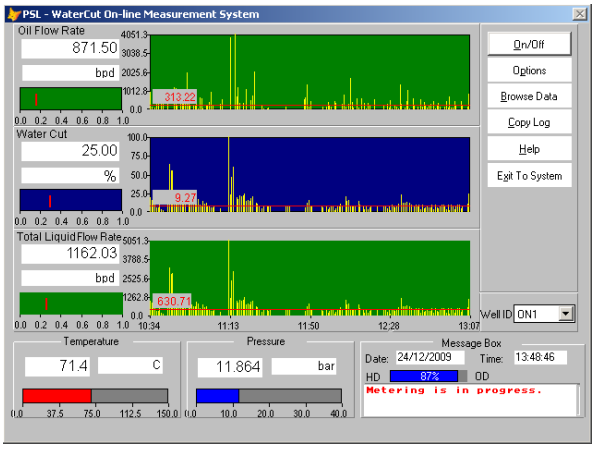
Flow Computer

The signals are processed in low power consumption computer installed on the flow line or an industrial PC in the safe area, Measurements can be transmitted via the SCADA interface

- Hazardous Area : Beckhoff CX1010 microprocessor in field enclosure Zone 1
- Safe area: 19" Rack mount industrial PC
- Software: ESMER WaterCut Metering Software
- Comms Protocol: Modbus, HART

Software

ESMER WIO is founded on a user friendly Windows based software package which handles all the data acquisition and measurement tasks (including auto-compensation for field effects of temperature, composition and density). Measurements are displayed in real-time strip charts and saved in a database, Diagnostic and reporting functions are available. Measurements can also be transmitted in analog or digital form via Ethernet and serial ports under a number of protocols.



ESMER Water-in-Oil User Interface

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