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 particularly suited for the exit leg of separators.

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 20 % GVF.

ESMER WIO is particularly suitable for use in production lines and in the liquid leg of separators.

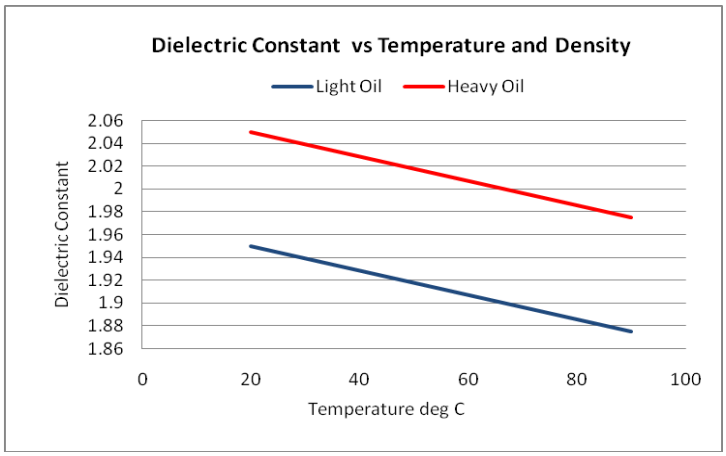
Field measurements are automatically compensated for changes in oil density and temperature.

Salinity does not affect the measurement made by ESMER WIO Meter – since the measurements is based on the characterisation of the dielectric property.

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 Affecting 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

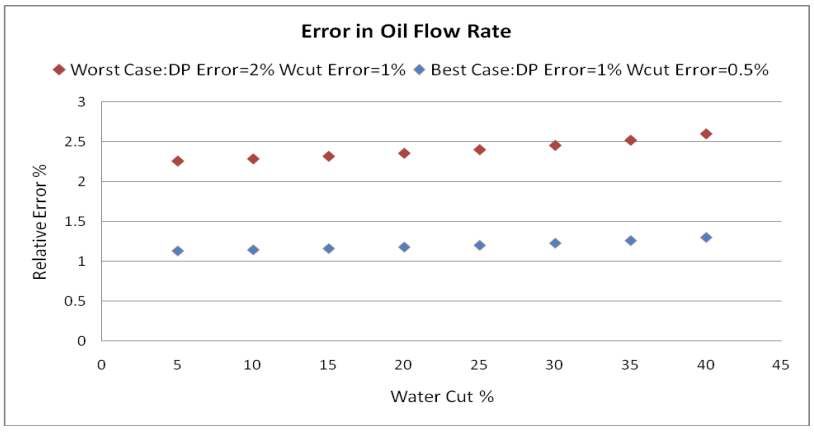
Parameters Affecting the Differential Pressure Across the Cone

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.

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)
- Temperature

Operating Envelope

Water cut :	0 – 40%
GVF:	up to 20 %
API gravity:	No limitation
Viscosity:	25 – 3000 cp

Limits

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

Mechanical and Electrical

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

Size 600 RF	LxWxH cm	Weight kg
2”	25x50x88	53
3”	35x55x94	65
4”	45x65x100	90
6”	65x70x110	140
10”	100x85x125	260

Transmitters

ESMER WIO uses the following oil industry standard transmitters.

DP	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 (alternative options). Measurements can be transmitted to SCADA by MODBUS.

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

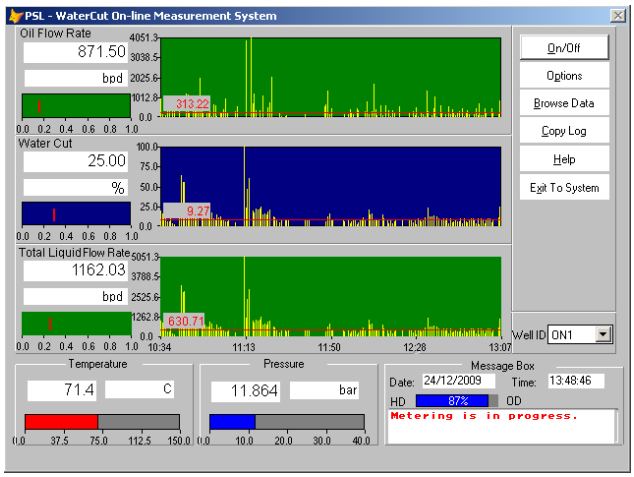
ESMER WIO is founded on a user friendly Windows based software package which handles all the data acquisition and measurement tasks.

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 be transmitted by HART or MODBUS protocol.



ESMER Water-in-Oil User Interface

Petroleum Software Ltd
http://www.petroleumsoftware.co.uk