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Roxar MPFM 2600 M

Wellhead Monitoring Solution

Direct wellhead monitoring has never been easier than with the Roxar MPFM 2600 M. The Roxar MPFM 2600 M is designed to continuously monitor a well stream, allowing operators to optimize production with a minimum of cost and interruptions.

"I need to increase production efficiencies while continuing to focus on the bottom line. If my wells are changing behavior, days or even weeks can pass by before I notice a potentially costly issue. Well testing contracts are way too expensive for my wells and I just need a simple tool to monitor my well streams on a continuous basis."

Ease of use and installation

The Roxar MPFM 2600 M is designed to be installed as close as possible to the wellhead and it offers direct, continuous measurements of the multiphase flow. The Roxar MPFM 2600 M is an excellent tool for operators who want to monitor their wells for gas breakthrough and increase or decrease of their liquid and gas flow rates. All this is offered with a simple inline, full bore, non-intrusive metering device. The meter is built on the field proven Roxar ZECTOR® technology platform. Installation and maintenance of the meter has been made straightforward such that operators are always in charge of their well flow monitoring devices. Another important advantage is that the meter does not make use of a radioactive source. There is no approval and maintenance of a radioactive source certificate.

Challenging economic environments

With a continuous focus on cost efficiencies, oil and gas operators are looking for alternatives to monitor their wells efficiently and reduce their operating costs. Installation of the 2600 M makes expensive well testing contracts, test lines and manifolds redundant and offers a cost-effective solution.

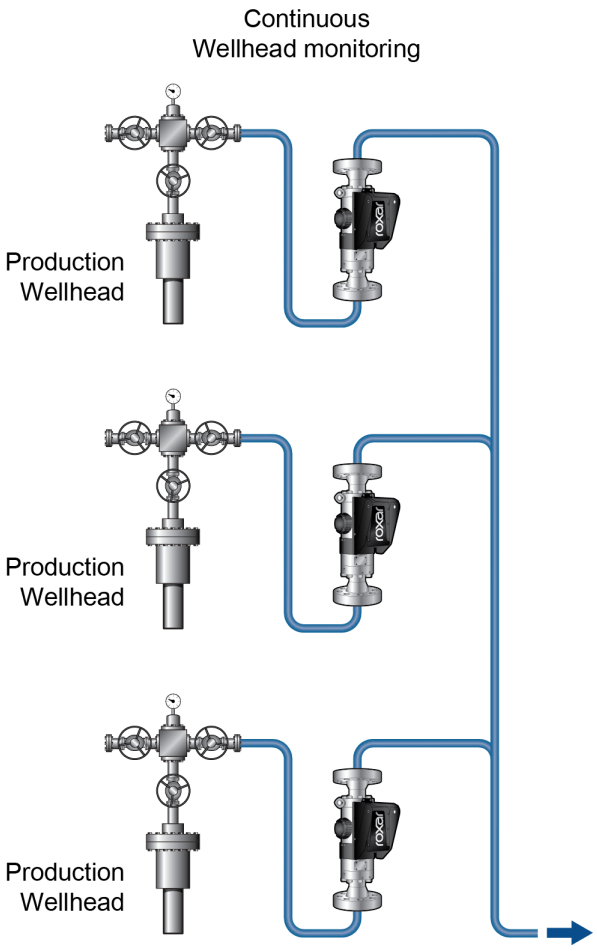
One meter per well philosophy

Well testing, by periodically routing a well through a test separator, results in sporadic data and causes interruption of the flow. In addition, test lines, manifolds and test separators add significantly to the overall cost of the development of an oil field. Continuous monitoring of the wells offers the operator a tool for early detection of changes in the flow rates and for quick preventative actions.

"I want a monitoring solution that tells me online and continuously how my well is performing. A solution where I do not have to touch my money-making-good performing wells and that assures immediate actions can be taken if water cut increases on some of my wells."

The Roxar MPFM 2600 M, in combination with the Roxar Fieldwatch software, offers a hardware and software solution to monitor a complete oil field from a well stream point of view.

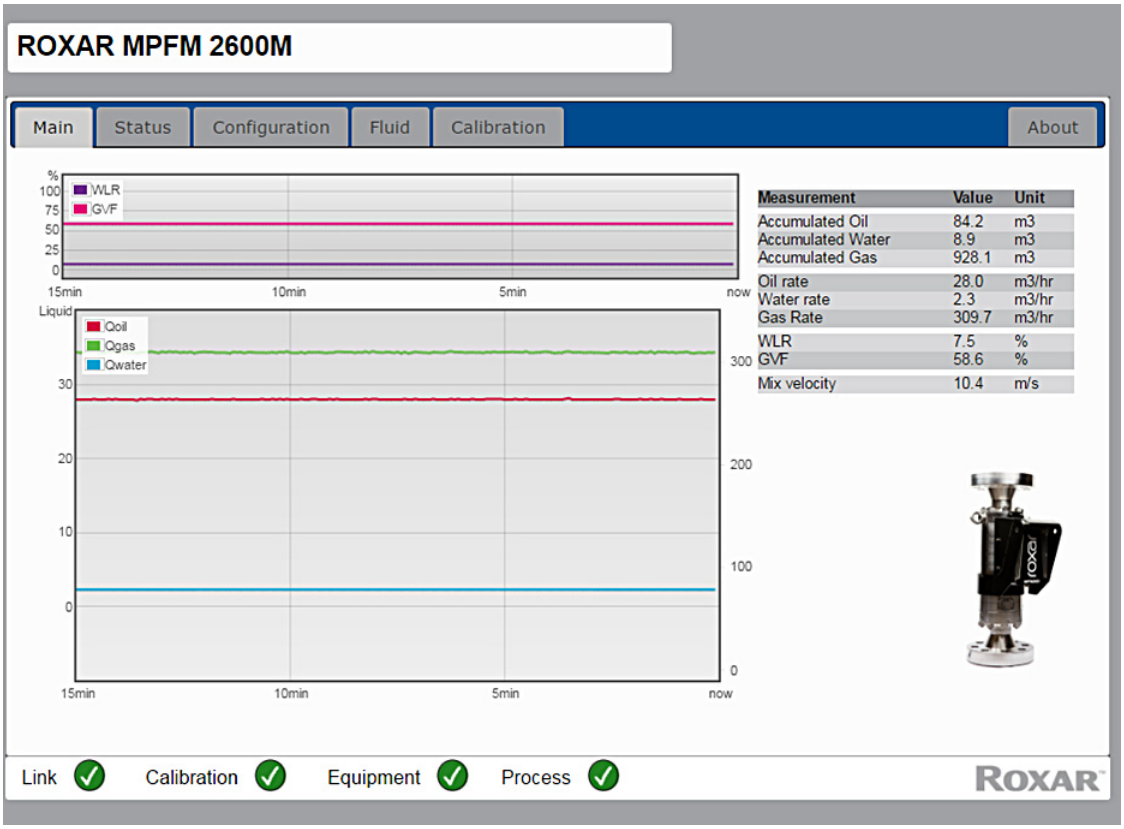
Simple inline calibration assures that a measurement base line is established and that changes to this baseline are monitored accurately without the need for complex configuration and input data that is difficult to obtain.



Configuration and inline calibration tool

The MPFM 2600 M comes with an easy to use configuration and calibration software tool. This allows the end user to efficiently set up the multiphase meter and establish the measurement base line. For setting up the MPFM 2600 M for a well stream, all that is required is a water cut sample or a Gas Oil Ratio (GOR) input as a starting point. During the calibrated cycle, the meter analyzes the well stream using the field proven ZECTOR technology platform and determines the calibrated point. From this point onwards, the meter tracks any changes to the flow rates of oil, water, gas, GOR and water liquid ratio. The configuration software runs in a web browser and connects to the flow computer using TCP/IP network or serial connection.

In addition to the non-gamma measurement model, the operator can select Fixed WLR or Fixed GOR models. This provides increased possibilities for analyzing the changes that have occurred over time and increase the possibilities of validating the meter's readings. For example, in cases where the meter is installed on a well with very stable GOR conditions, this information can be used on Fixed GOR model to improve the accuracy of the Water Liquid Ratio (WLR) output. Whenever the flow drifts from its operating point, the meter indicates the need for recalibration and a simple procedure ensures that a new base line is established for continuous monitoring and well performance verification.



Operating principle

The Roxar Multiphase Meter 2600 M applies a combination of electrical impedance measurements to determine phase factions and cross-correlation technology to determine flow velocity. These measurement principles have been used by Roxar for more than 25 years and in over 1,500 meter installations around the world. The result is a meter than accurately characterizes flow and provides a cost-effective way of monitoring the well stream.

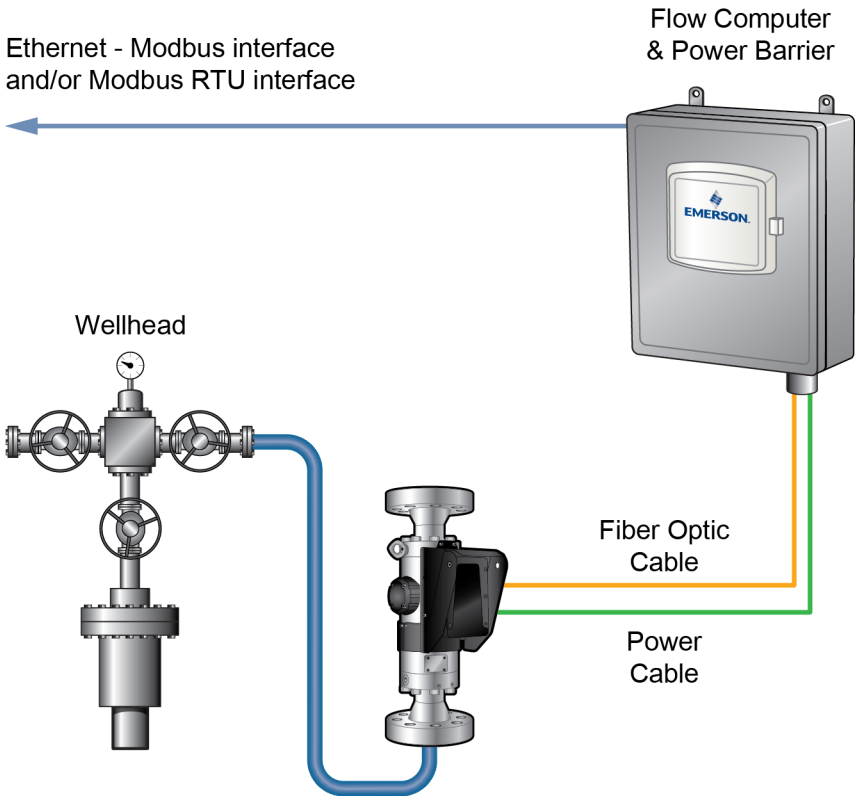
Installation requirements

Installation in the flow line

The Roxar MPFM 2600 M comes with standard ANSI flanges in various pressure classes and sizes. The spool is flanged into the flow line after a blind T. The flow through the meter should be vertical upwards flow. To make sure the flow has enough velocity for the optimal performance, the Roxar MPFM is typically a size smaller than the flow line.

Flow computer and barrier installation

The flow computer and barrier are DIN rail mountable units that can be placed in nearby RTU cabinets. Two cables from the flow computer to the 2600M meter are required: a fiber optic cable and an intrinsic safe power cable. The distance between the meter and the flow computer should not exceed 200 meter unless special cables are used. The flow computer and barrier can also be installed in a Roxar fully assembled flameproof/explosion proof enclosure with power supply, glands and cable terminals. Such an enclosure can be installed in a hazardous zone (Zone 1) while the MPFM 2600 M meter itself is suitable for hazardous zone 0 (intrinsically safe).



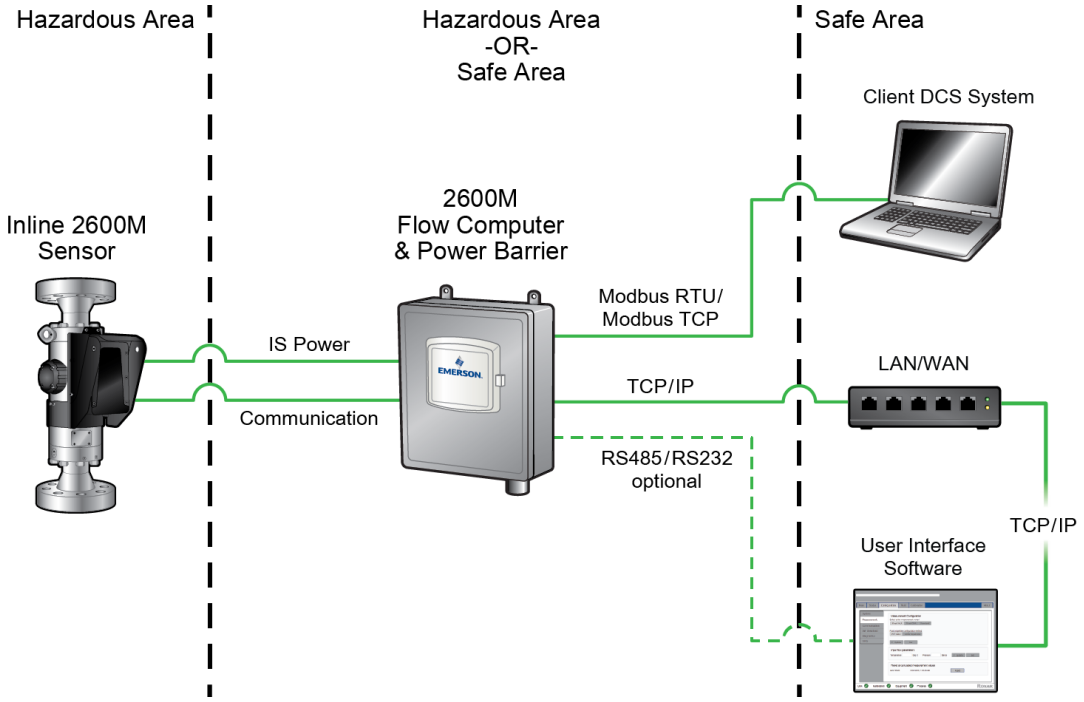
The following table provides additional considerations for the MPFM 2600 M meter. Note that V= Recommended and X= Cannot be used.

MPFM 2600 M aspects for consideration	MPFM 2600 M Wellhead Monitoring	Traditional well testing solutions
Ease of installation	V	X
Reduced costs for well testing contracts	V	X
Early detection of well flow changes/ continuous monitoring/no interruptions	V	X
Full bore, non-intrusive, low pressure drop(1)	V	X
Ease of communication and electrical interfacing	V	X
Reduced costs for test lines and test separators	V	X
Remote and unmanned operations	V	X
Valuable online, real-time and continuous data for production and reservoir management	V	X
Reduced HS&E risks (for example, less human interventions)	V	X

(1) The small reduction in pipe inner diameter and the inlet piping will cause some pressure drop, but much less than in traditional venturi meters.

Connectivity

Two RS485 serial ports (Modbus RTU) and one Ethernet connection (Modbus TCP) are available. The configuration and calibration tool is built to support multi-user access through a common web browser. The tool runs on a standard Windows PC or Windows server in the same network as the flow computer. This program communicates with the meter via Modbus RTU or TCP and with the user's web browser using the HTTP Protocol (standard web browser). The configuration and calibration tool supports all operations intended to be performed by the end user. This includes setup, inline calibration, software upgrade and monitoring.



Pressure and temperature measurements

Since the Roxar MPFM 2600 M does not make use of a Venturi dP measurement or traditional density measurements, cost driving transmitters, temperature probes, pressure tappings, manifolds and block valves are not part of the device. For monitoring of changes and reporting flow rates at actual conditions, pressure and temperature measurements may not be required. However in some cases, pressure and temperature input to the meter can be an advantage.

- When the dominant phase of the liquid is water and the temperature of the fluids are changing. A temperature input assures that the water conductivity is calculated correctly.
- When the flow rates are to be reported in standard conditions, the MPFM 2600 M can convert the flow rates to standard conditions if pressure and temperature are known. The MPFM 2600 M can convert to standard conditions using equations of state with PVT tables or black oil mode approach.

Since most wellheads and/or chokes are already equipped with pressure and temperatures transmitters, this data can be written directly to the flow computer through a HART interface or via a serial connection. Note that P and T data can be easily written to the meter manually using the configuration tool. The MPFM 2600 M can optionally be delivered with an integrated temperature pocket and T- transmitter.

Applications

The MPFM 2600 M assures high accuracy trending and robust detection of sudden changes in the well stream. The MPFM 2600 M can operate in various multiphase flow conditions. In extreme low gas volume fraction (GVF 0-15%), it can be used as a tool for water cut trenching. Additionally, at higher GVF the flow rates of gas, oil and water can be monitored.

In the table shown below, note that V= Recommended and X= Cannot be used.

Application questions	GVF 0-15%	GVF 15-85%(1)
Water cut trending and water break through monitoring(2)	V	V
Gas break through and monitoring	V	V
Flow rate trending and monitoring	X	V
Flow rate measurement of oil, water and gas flow rate(3)	X	V

(1) Extending water cut measurements above 85% GVF requires full PVT characterization of the produced hydrocarbons or fixed GOR input. Alternatively, a gamma density system can be retrofitted to the MPFM 2600 M (option for upgradeable version).

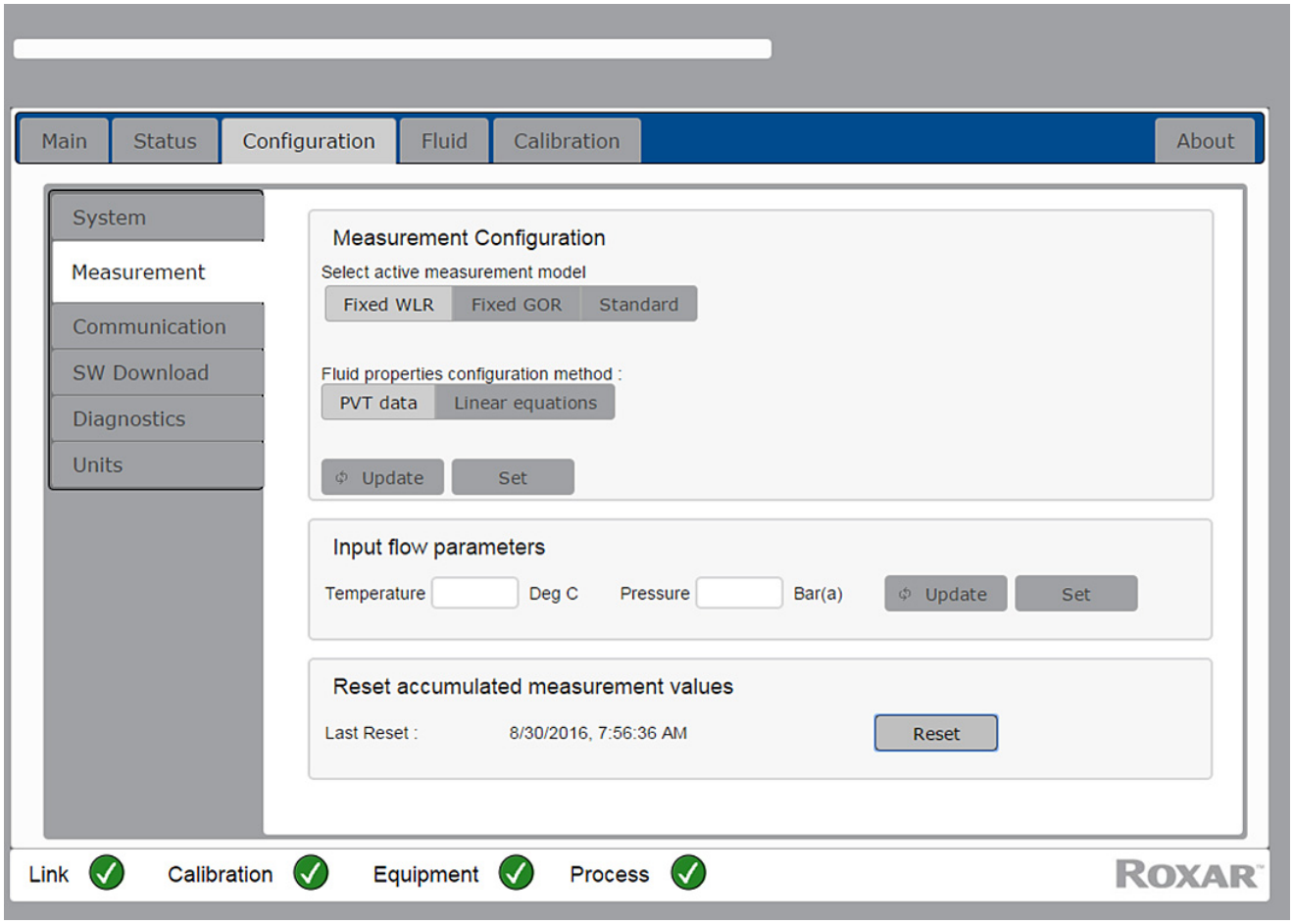
(2) Water dominant streams require input of water salinity and temperature measurements. Temperature probe and T-transmitter can be part of the MPFM 2600 M (optional).

(3) The Roxar MPFM 2600 M is designed for low to medium GVF ranges (0-855) and single well applications with relatively stable flow regimes, It is not designed for multi-well testing applications or commingled flows. The MPFM 2600 M requires an inline WLR or GOR calibration around the start operating point.

Multi-model verification

The MPFM 2600 M performs three full multiphase calculations simultaneously in different operating models. The first model calculates flow rates on the assumption that the GOR is stable. The second model calculates the well flow rates on the assumption that the water cut is stable and the third model measures both gas fraction and water cut dynamically. One model can be selected as leading for the output by the operator. The MPFM 2600 M monitors gas and liquid ratio and water cut for all three models simultaneously in the background and the operator can set the thresholds for initiating a new calibration cycle.

In the calibration screen shown below, the deviation of WLR and gas fraction compared to the latest calibration point is shown for all three models.



The set up procedure is as follows.

1. Set up the meter with a known Water cut or GOR.
   - Enter Water cut or GOR.
   - MPFM 2600 M calculates the rates and fractions.
   - Accept results.
   - Choose operating model.
2. Set the thresholds for recalibration.
3. Start monitoring the well.

Specifications - Roxar MPFM 2600

System performance and characteristics

Item	Characteristics
Operating range	MPFM 2600 M 0-100% water in liquid ratio (WLR) 0-85% gas volume fraction (GVF)
Meter sizes	2”, 3” and 4”
Installation	Vertical upwards flow
Design pressure	Standard: ANSI 300#, 600#, 900# and 1500# (up to 3,750 psi).
Design temperature	- 4°F to + 266°F (- 20°C to + 130°C)
Input requirements	Oil permittivity for low water cut wells, water salinity and temperature for high water cut wells, pressure and temperature to convert to standard conditions, set up value of WLR or GOR for inline calibration.
Typical uncertainty	10% relative uncertainty on liquid and gas flow rates* 5% absolute uncertainty on water cut
Repeatability	<2%

* Between 15%-85% GVF, Total flow velocity between 5-25 m/s

Mechanical and electrical components

Item	Characteristics
Meter body wetted parts materials	Duplex UNS 31803 Super Duplex UNS 32760 Stainless Steel UNS 31600 Alloy 625 UNS N06625
Flange connection	ANSI flanges
Sensor technology	Electrical impedance, and Roxar ZECTOR technology
Flow computer	Roxar MPFM Flow Computer MKIII Roxar 2600 Power Barrier
Power supply	10-36 VDC, 85-264 VAC Power consumption: 20 W
Communication interface	RS-232/RS-485/Ethernet Communication protocol: Modbus RTU or TCP
Flow computer mounting	■ SS 316 or Aluminum Ex d housing for hazardous area installations ■ Rack mountable or wall mountable stainless steel enclosure for outdoor use and safe area installations
Electrical certification	ATEX, IECEx, CSA C/US and EAC
Temperature measurements	Optional: PT-100 Thermo pocket and Rosemount 644 T-transmitter

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