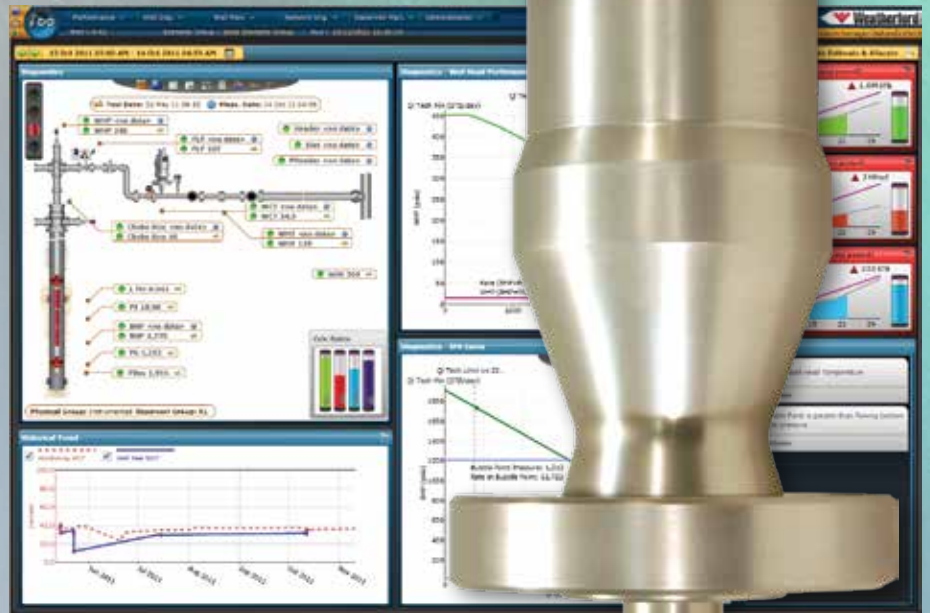




Weatherford®

Red Eye® Subsea Water-Cut Meter for Multiphase Applications



Continuous, accurate, and reliable water-cut readings

Continuous, accurate, and reliable water-cut readings for the life of your oil or gas well

Weatherford is drawing on the performance of the successful Red Eye MP water-cut meter and taking it to the seafloor. Designed to handle the harsh subsea environment, the Red Eye subsea water-cut meter provides robust measurement in oil or gas wells. In addition, the meter can measure relative concentrations of water and typical hydrate inhibitors such as methanol.

With its advanced technology, the Red Eye subsea water-cut meter provides extremely sensitive water-onset detection and is unaffected by changes in salinity, hydrogen sulfide (H₂S) or carbon dioxide (CO₂) content. The unit is not required to correct for changes in these parameters, unlike other technologies. Also the hardware is ruggedized and marinized to accommodate stringent requirements of subsea applications.

Because of its compact, cost-effective design, you can easily justify a Red Eye subsea meter on each well to measure water cut, recognize water breakthrough, provide a redundant water-cut measurement to multiphase meters, directly measure hydrate inhibitors in the flowline, or trend water behavior in the reservoir.

Red Eye MP Water-Cut Meter

- 15 kpsi (103 MPa); API 2 1/16-in. flange
- 10,000-ft (3,048-m) seawater depth
- Subsea-instrumentation-interface standardization (SIIS) level-two or level-three communications
- Onboard raw-data storage (2 years) and remote firmware-upgrade support



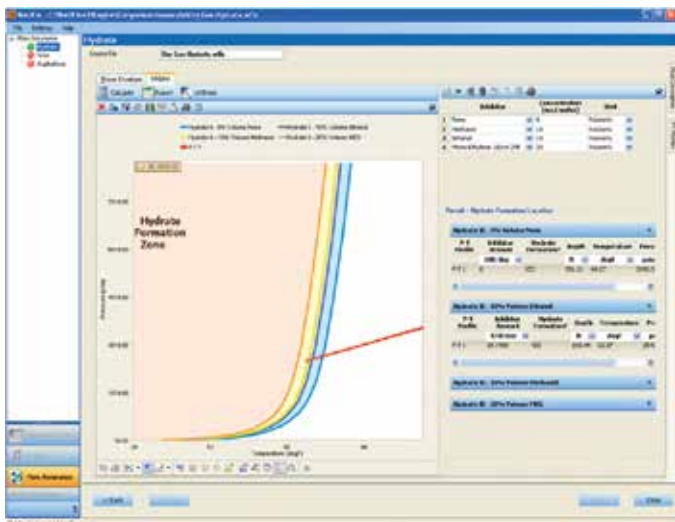
Industry's only full-range multiphase water-cut meter

Weatherford has redefined the water-cut meter market by creating a device that measures water-cut and water-methanol concentration without being affected by the presence of free gas. There is no need to know how much gas is present (gas volume fraction) or the pressure-volume-temperature (PVT) properties of the gas, which makes the meter easy to configure and operate.

By measuring key wavelengths in the near-infrared (NIR) spectrum, the Red Eye subsea water-cut meter can easily distinguish water, methanol, and liquid hydrocarbon. At one key wavelength, water-based absorption is more than 2,500 times greater than any other component in the stream. This remarkable sensitivity enables the meter to detect water at or below 0.25 bbl/MMscf. The unit can also determine if there is insufficient liquid to make an accurate water-cut measurement, which prevents user from taking incorrect action based on inaccurate readings.

Red Eye advantages

- Nonnuclear
- 0 to 100% water-cut detection
- Accurate water-cut in 0 to 99.5% gas void fraction (GVF)
- Low power requirement
- Minimal communication bandwidth required
- Lifespan of 25 or more years
- Mounting options: on the tree or flowline
- Minimal intrusion into the pipeline



Typical plot



Typical Applications

The Red Eye subsea water-cut meter is a reservoir management and production optimization tool. Its optimal use is on dedicated flowlines where individual wells can be monitored. The meter can be mounted upstream or downstream from the choke, in the jumper, or on the manifold skid. The sensor probe projects into the flowstream, so it cannot be used in a pigged line.

Gas wells

The capability to work in high-gas streams makes the Red Eye product the first practical stand-alone water-cut meter for wet-gas wells. It is insensitive to changes in water- and condensate-density changes.

Water breakthrough

The unit has an extra optical channel that is extremely sensitive to the presence of water, which enables the meter to directly measure minute changes in low concentrations of water. By trending this measurement, the user can detect if and when water breakthrough occurs.

Hydrate-inhibitor measurement

Because the meter measures methanol and other hydrate inhibitors, it provides a valuable part of a flow-assurance (FA) solution. By monitoring relative concentrations of oil, water, and inhibitor, you know if you are injecting too much or too little inhibitor and can implement a more efficient and cost-effective FA solution.

Oil wells

Red Eye technology was originally developed for oil wells, and all its capabilities for surface wells remain or have been enhanced for the subsea version. The meter can monitor and adjust its power output as needed, can monitor its own health, and can be recalibrated or receive new firmware remotely.

Redundancy measurement

The Red Eye subsea meter can be used as a redundant water-cut measurement device as a backup to a subsea multiphase flowmeter (MPFM). Typically, water cut is the most difficult measurement for an MPFM to make. If knowing water-cut measurement is crucial, an operator can use the Red Eye subsea meter with the MPFM to provide redundant measurement for this critical parameter.

Virtual metering and flow-assurance software support

Some of the most critical inputs for virtual metering (VM) and FA software applications are the direct measurements provided by the Red Eye subsea water-cut meter. The addition of this meter to any subsea production system enables the user to better implement these software packages.



Specifications

Measurement

Range	Water Cut	Additional Measurements
$0 < x < 20\%$ GVF	0 to 100% $\pm 2\%$ ^a	Methanol-water-oil concentration ^b Slug detection Water detection ^c
$20\% < x < 95\%$ GVF	0 to 100% $\pm 5\%$ ^a	Methanol-water-oil concentration ^b Slug detection Water detection ^c
$> 95\%$ GVF	0 to 100% $\pm 10\%$ ^a	Methanol-water-oil concentration ^{bc} Slug detection Water-fraction tracking Water detection ^d

^aError given in absolute terms.

^bMethanol or any common hydrate inhibitor

^cMethanol-water concentration measurement uncertainty $\pm 10\%$

^dWater detection limit is 0.25 bbl/MMscfd.



Specifications (continued)

Hardware

Operation pressure rating (psi, MPa)	15,000 103
Temperature rating (°F, °C)	-40 to 302 -40 to 150
Water-depth rating (ft, m)	10,000 3,048
Flange type	2 1/16-in. API 6BX
Material	Alloy 925 (INCOLOY® 925 and Hastelloy® C276)
Weight (lb, kg)	178 80.8
Probe length	To customer requirements
Canister dimensions, diameter × length (in., mm)	6.3 × 21.5 160 × 546
Electronics chamber	Argon filled, 1 atmosphere (ATM)
Design life	25 years
Electronics operating temperature range (°F, °C)	-4 to 158 (-20 to 70) ambient
Input voltage range	18 to 30 VDC
Power consumption	<ul style="list-style-type: none"> • <10 watts (6 watts typical) • SIIS—medium power rating
Power-supply topology	Redundant power input supported
Communication topology	SIIS Level2—CANopen®, Level 3—Ethernet, RS422/485 Redundant communications supported
Data storage	2 yr, 1 sec, 2 Gb in local flash memory
Connector configuration options	<ul style="list-style-type: none"> • MKII fitting • ODI • Tronic

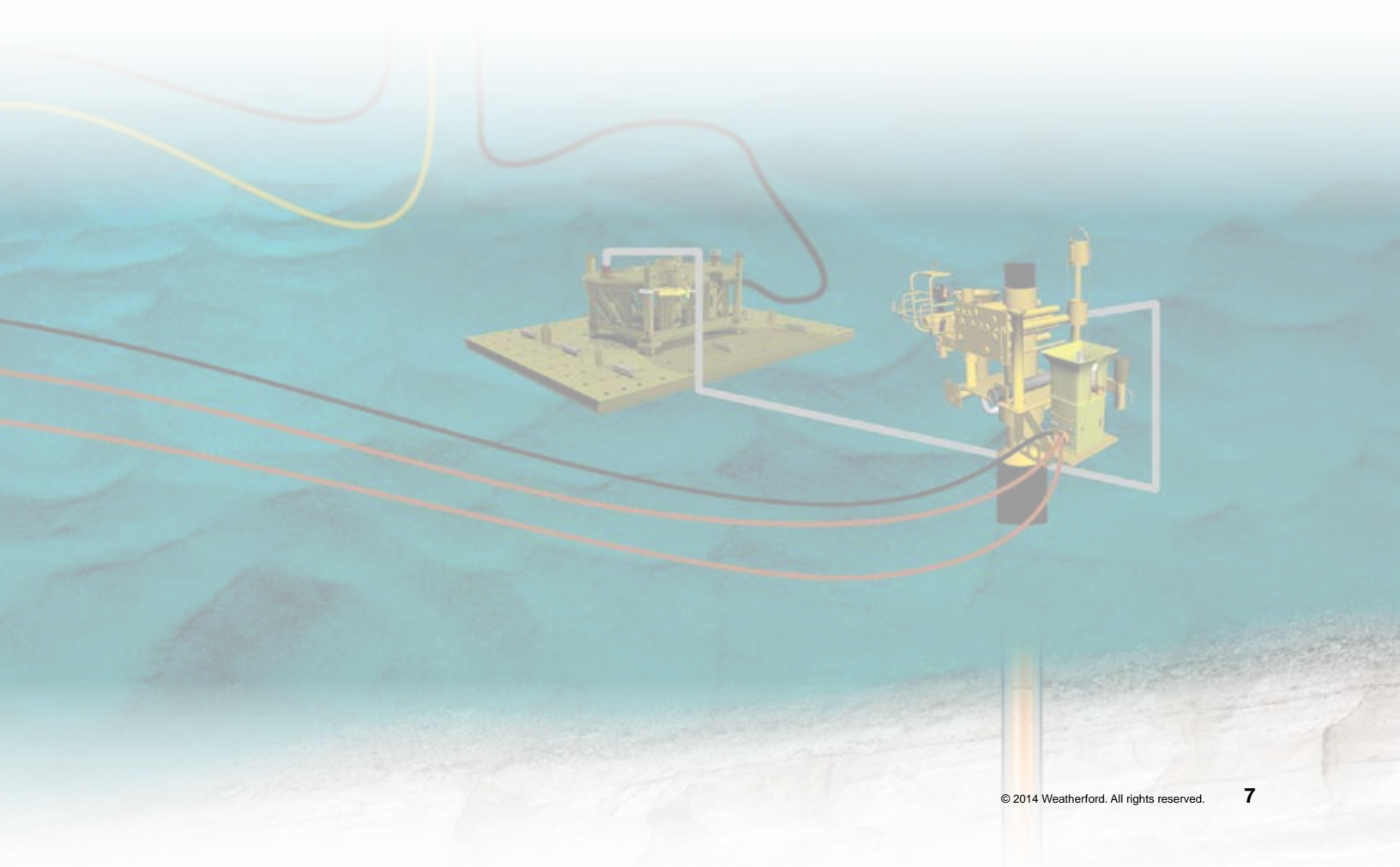
INCOLOY, Hastelloy, and CANopen are registered trademarks of their respective companies.



Codes and Standards

The following codes and standards were used in the development and qualification of the meter.

- ISO 13628-4 Petroleum and natural gas industries— Design and operation of subsea production systems— Part 4: Subsea wellhead and tree equipment
- ISO 13628-6 Petroleum and natural gas industries— Design and operation of subsea production systems— Part 6: Subsea production control systems
- ISO 13628-8 Petroleum and natural gas industries— Design and operation of subsea production systems— Part 8: Remotely operated vehicle (ROV) interfaces on subsea production systems
- NACE MR0175/ISO15156 Petroleum and natural gas industries—Materials for use in H₂S-containing environments in oil and gas production
- ISO 10423 Petroleum and natural gas industries— Drilling and production equipment—Wellhead and Christmas tree equipment
- API 17D Specification for subsea wellhead and Christmas tree equipment
- API 17F Specification for Subsea Production Control Systems
- API 17N Subsea production system reliability and technical risk management
- API 6A Specification for wellhead and Christmas tree equipment
- SIIS joint industry group recommendations/guidelines





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Water-cut measurements in multiphase flow

Weatherford provides worldwide service and support from more than 600 locations in approximately 100 countries. To find out more about our Red Eye subsea water-cut meter, contact an authorized Weatherford representative or visit weatherford.com.



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