ForeSite® Sense Flowmeter

Delivers accurate, real-time flow-rate measurements of oil, gas, and water

Applications

- Real-time monitoring of in-situ and standard flow rates
- Allocation of zonal and commingled production in multizone intelligent completions
- Optimization of production in conjunction with inflow control valves (ICVs) and inflow control devices (ICDs)
- Real-time identification and localization of production or injection anomalies
- Reduction of surface well tests and surface facilities
- Offshore platform, subsea, land, and remote locations
- Determination of well productivity index

Features and Benefits

- Optical measurement provides excellent long-term stability and no measurement drift.
- The flowmeter is intrinsically safe, with no downhole electronics.
- Low component count, no moving parts, and passive sensors make the in-well optical flowmeters highly reliable, which reduces the need for costly replacements.
- Noninvasive design protects sensors from exposure to well fluids.
- Nonintrusive design provides full through-bore access, preventing flowing pressure loss and ensuring high resilience to erosion and corrosion.
- High turndown ratio—at least three times more than Venturi-based flowmeters—allows broader flow measurement range.
- Bidirectional flow measurement capability enables cross-flow detection in multizone completion and service change from producer to injector or vice versa with no change to the flowmeter.
- The rugged, shock-resistant design is safe for hostile well environments, including perforating and stimulation operations.
- Optical flowmeters measure single-phase gas and/or liquid in water-alternating gas (WAG) injector applications, two-phase gas/liquid (G/L), two-phase liquid/liquid (L/L), and three-phase gas/liquid/liquid (G/L/L) flows with no change to the hardware and software.
- Flow measurement is not affected by solid content in the fluid; that makes the flowmeter an ideal tool for wells with sand production.
- Instrument enclosures for controlled environments such as remote, desert, arctic, jungle, and unmanned platform installations, are ATEX Zone 2, Zone 1, and EMC certified.

The ForeSite Sense in-well optical flowmeter is safe for hostile well environments, including perforating and stimulation operations.

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Features and Benefits (continued)

- Subsea installations are enabled with direct fiber-in-umbilical connection for distances up to 100 miles (160 kilometers).
- Real-time software offers integrated pressure-volume-temperature (PVT) for volume conversions and reports flow rates at standard and/or downhole conditions.
- The flowmeter is integrated with the Weatherford Reservoir Monitoring System (RMS), which offers numerous options for data interface, storage, and analysis.

Tool Description

The ForeSite Sense flowmeter delivers accurate, real-time measurements of in-situ and standard flow rates of oil, gas, and water. This in-well optical flowmeter is capable of measuring zonal and commingled phase flow rates and identifying production and injection anomalies, thus enabling better production and reservoir management decisions.

The state-of-the-art, fullbore optical flowmeter has been designed with low complexity and passive components downhole and with active electronic equipment on the surface to ensure high reliability and measurement accuracy. The flowmeter is deployed as a part of the production tubing and with one or two Weatherford optical pressure and temperature (P/T) gauges ported to tubing and/or annulus. Each flowmeter is designed to fit specific completion requirements and is available in standard tubing sizes from 2-3/8 to 5-1/2 in. Other sizes are available on request.

In-well optical flowmeter technology is based on flow velocity and speed-of-sound (SoS) measurements, which are used to determine the total flow rate and phase volume fractions in the flowing mixture. Velocity and SoS measurements are based on tracking of individual eddies convecting with the flow and their sound waves propagating in both directions. Signals are processed by a dedicated flow computer that is within the surface instrumentation and attached to the in-well flowmeter via optical cable.

Because they can be used in many applications, in-well optical flowmeters are key components of real-time monitoring for production optimization. Weatherford in-well optical flowmeters have been used in many installations, including multizone oil producers, high-rate gas/condensate wells, two-phase oil/water applications, multizone water-alternating-gas (WAG) injectors, and field-wide installations with a combination of these applications. Weatherford has also developed a new-generation acoustic-tolerant flowmeter system for use in intelligent wells with ICVs.

The noninvasive design of the flowmeter provides full through-bore access and protects sensors from exposure to well fluids.

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Flowmeter Options

Weatherford offers three in-well optical flowmeter options. Each option has two versions: an acoustic-tolerant version targeted for intelligent wells with ICVs and a high-sensitivity version targeted for quieter wells without ICVs.

- The single-phase flowmeter (1PTM) is designed for zonal allocation in water, gas, or WAG injectors. An integrated P/T gauge is recommended, but not compulsory.
- The two-phase flowmeter (2PTM) is designed for L/L or G/L measurements and comes with an integrated optical P/T gauge.
- The three-phase flowmeter (3PTM) is designed for G/L/L measurements. This is a two-phase flowmeter with a secondary P/T gauge installed above the flowmeter to resolve the three phases.

Auxiliary Measurement Options

- One or two integrated optical P/T gauges can be connected and ported to annulus and/or tubing. Optical flowmeters and P/T gauges share one optical cable and a single dry-mate optical connector.
- Multiple optical sensors can be connected on a single cable for completion-design flexibility: flow can be combined with P/T, seismic, distributed temperature sensing (DTS), and array temperature sensing (ATS).
- The flowmeter mandrel can have cable bypass slots for control lines.

Specifications

Standard Sizes and Minimum Flow Rates for In-Well Optical Flowmeters

Size	Weight	Minimum ID	Maximum ID	Standard OD	Minimum Flow Rate
2 3/8 in.	4.0 to 5.8 lbm/ft (5.95 to 8.63 kg/m)	1.867 in. (47.4 mm)	2.041 in. (51.8 mm)	4.375 in. (111.1 mm)	960 B/D (153 m^3/D)
2 7/8 in.	6.4 to 8.6 lbm/ft (9.52 to 12.80 kg/m)	2.259 in. (57.4 mm)	2.441 in. (62.0 mm)	4.875 in. (123.8 mm)	1,400 B/D (225 m^3/D)
3 1/2 in.	9.2 to 10.2 lbm/ft (13.69 to 15.18 kg/m)	2.922 in. (74.2 mm)	2.992 in. (76.0 mm)	5.500 in. (139.7 mm)	2,350 B/D (375 m^3/D)
4 1/2 in.	12.75 to 15.1 lbm/ft (18.97 to 22.47 kg/m)	3.758 in. (95.5 mm)	3.958 in. (100.5 mm)	6.500 in. (165.1 mm)	3,900 B/D (620 m^3/D)
5 1/2 in.	17 to 20 lbm/ft (25.30 to 29.76 kg/m)	4.778 in. (121.4 mm)	4.892 in. (124.3 mm)	7.500 in. (190.5 mm)	6,300 B/D (1,000 m^3/D)

Notes: Flowmeter technology is applicable to any pipe size; dimensions can be designed to client specifications.
Minimum flow rates are based on 1 m/s water flow under standard conditions; for gas or multiphase flow, contact Weatherford for detailed analysis.
Standard ODs are without cable bypass or integrated P/T gauge.

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Specifications (continued)

Flowmeter Performance and Ratings

Single-phase volumetric flow rate uncertainty, % of measurement	±1
Multiphase total volumetric flow rate uncertainty, % of measurement	±5
Gas phase volumetric flow rate uncertainty in multiphase stream, % of measurement	±10
Liquid phase volumetric flow rate uncertainty in multiphase stream	±5% of measurement for GVF < 30% ±20% of total flow rate for 30% < GVF < 90% ±5% of total flow rate for GVF > 90%
Water-in-liquid ratio (WLR) uncertainty in multiphase stream, % of measurement	±10 for GVF < 30%
Turndown ratio (maximum to minimum flow rate)	> 25
Minimum measurable flow velocity in water (Gas minimum measurable velocity varies with pressure.)	3 ft/sec (0.9 m/s)
Standard pressure rating[1]	10,000 psi (690 bar)
High pressure rating[1]	14,500 psi (1,000 bar)
Standard operating temperature	77 to 257°F (25 to 125°C)
High-temperature operating temperature	77 to 302°F (25 to 150°C)
Standard storage temperature	–58 to 257°F (–50 to 125°C)
High-temperature storage temperature	–58 to 302°F (–50 to 150°C)
Standard material	Super duplex 25 chrome
High-pressure material	INCONEL® 718
Vibration	15 g rms, random 10 to 2,000 Hz (Nav Mat)
Shock	100 g 10 ms half-sine
Maximum tension and compression load	Contact Weatherford
Connections (pin × pin)	Premium connections are manufactured to client specifications.
Maximum fiber step-out length[2]	100 mi (160 km)
Fiber-optic connection	3-pin dry-mate or splice

[1] Pressure rating depends on flowmeter size, material, and options. Contact Weatherford for pressure rating of a specific design.
[2] Maximum stepout length depends on well design.

* INCONEL is a registered trademark of the Special Metals Corporations group of companies.

ForeSite® Sense Flowmeter

Optical Pressure and Temperature Gauge

The ForeSite Sense optical pressure and temperature (P/T) gauge provides permanent reservoir monitoring in moderate to ultra-extreme well conditions. The gauge can be combined with multiple ForeSite Sense Optics gauges or other optical gauges on a single fiber or cable, which provides comprehensive multiparameter downhole sensing for well production, injection, storage, and monitoring.

The optical P/T gauge uses Weatherford optical-glass Bragg-grating sensor and glass-to-metal penetrator technologies for ultra-extreme well conditions. The gauge has minimal parts and no in-well electronics. It is immune to electromagnetic interference, which enables functionality while using other electrical completion components.

The P/T gauge is suitable for high-value wells. It delivers stable, reliable, high-resolution measurements with no measurable drift. The design has undergone extensive HALT testing to confirm continuous operation in harsh environments.

Features and Benefits

- The flowmeter pressure and temperature gauge delivers stable measurements with no measurable drift, which reduces uncertainty of absolute pressure and temperature measurements over the life of the field.
- The gauge withstands impact, vibration, and significant pressure surges. It has undergone extensive mechanical-shock and vibration survivability and highly accelerated life test (HALT) testing.
- The gauge has a minimal number of components and no moving parts, which reduces potential failure modes, increases tool life, and decreases maintenance costs.
- The gauge is electronically passive, and has no electronics downhole, which increases system reliability and stability.
- Reservoir pressure data is available on demand, reducing well interventions and production shut-ins.
- Improved cable-to-gauge integration exceeds the full strength of the downhole cable for continued data delivery in the harshest environments.
- The ForeSite Sense Optics gauge enables short-term operation at pressures up to 30,000 psi (206.8 MPa), which facilitates use during critical well-stimulation operations.

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Optical Pressure and Temperature Gauge (continued)

Options

- Multiple pressure and temperature measurements per fiber
- Single- or dual-configuration per mandrel
- Tubing or annulus sensing with universal pressure foot
- Multiple gauges on a common optical fiber for multizone applications
- Integration with optical flowmeter, distributed temperature sensing (DTS), and distributed acoustic sensing (DAS) technologies enable simultaneous acquisition on a single fiber or cable

Specifications

Operational Performance

Maximum temperature	392°F (200°C)
Calibrated temperature	77 to 392°F (25 to 200°C)
Calibrated pressure range	Atm to 20,000 psi (Atm to 137.9 MPa)
Over pressure	24,000 psi at 392°F (165.5 MPa at 200°C)
Collapse pressure at room temperature (RT)	> 24,000 psi (> 165.5 MPa)
Burst pressure at RT	> 30,000 psi (> 206.8 MPa)
Minimum storage temperature	-40°F (-40°C)
Update rate	1 sec, no limit

Pressure Metrology

Accuracy	± 3 psi (± 0.02 MPa)
Resolution*	≤ 0.05 psi (≤ 0.0003 MPa)
Long-term stability/yr	< 0.5 psi/yr at 392ºF (< 0.003 MPa at 200ºC)

Temperature Metrology

Accuracy	± 0.18°F (± 0.1°C)
Resolution, RMS	≤ 0.036°F (≤ 0.02°C)
Long-term stability/yr	< 0.18 at 392°F (< 0.1 at 200°C)

Mechanical

Material	Inconel® 718
Outside diameter	0.875 in. (22.2 mm)
Length	13 in. (330 mm)

Shock and Vibration Data

Vibration	15 G_{rms} [20 to 2,000 Hz (NavMat)]
Shock	100 g, 9 ms half sine
Drop	500 g, 1 ms half sine
Thermal shock/min	53.6°F (12°C)

*Depends on update rate

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Optical Downhole Cable

The ForeSite Sense optical downhole cable provides a high-performance signal pathway for downhole pressure, temperature, and seismic measurements. This cable accommodates up to four single- or multi-mode fibers in any combination. Its fibers support distributed temperature sensing (DTS) and distributed acoustic sensing (DAS), as well as Bragg grating pressure and temperature gauges, multi-point temperature arrays, flowmeters, and seismic accelerometers. The Bragg grating sensors can be multiplexed on a single fiber, and a downhole cable splitter enables further multi-zone sensing architectures for enhanced production-monitoring capabilities.

The optical downhole cable is engineered for reliable performance throughout the life of the well. The proprietary design incorporates an ultra-premium fiber-protection system that guards against cable stresses and degradation to eliminate the need for periodic replacement.

This protection system also helps maintain the factory-calibrated temperature-profiling measurement throughout the life of the well. The cable can be supplied with hydrogen-resistant fibers that prevent long-term degradation of the optical system caused by hydrogen intrusion.

The standard 1/4-in. outside diameter (OD) cable is compatible with all Weatherford optical completion components, including connectors, splitter assemblies, sensors, and wellhead-pressure barriers. Weatherford accommodates a range of cross-coupling clamping variations and provides a choice of final encapsulation materials and configurations, such as 0.43 × 0.43 in (11 × 11 mm) square or 0.43 in (11 mm) round, or flatpack packaging.

Features and Benefits

- Multi-fiber design enables multi-parameter measurements in the wellbore, which reduces the number of wellhead penetrations and monitoring system complexity.
- Cable compatibility with all Weatherford sensing products facilitates monitoring system design flexibility and reduces overall system cost.
- Cable packaging is identical to other in-well hydraulic and instrument lines, which enables use of standard handling and installation techniques.
- Flexible cable can pass through wellheads, packers, and other in-well completion equipment to reduce installation time and costs.

ForeSite® Sense Flowmeter

Optical Downhole Cable

Specifications

Construction

Model	Extreme		Thermal
Cable size	1/4 in. (6.35 mm)		
Wall thickness	0.028 in. (7.112 mm)	0.035 in. (0.889 mm)	0.035 in. (0.889 mm)
Optical fibers	Up to 4 fibers[a], single-mode or multi-mode		
Inner metal tube	304 Stainless steel		
Buffer	AA1070 Aluminum		None
Outer armor tube: INCOLOY® 825* OD × wall	0.25-in. OD × 0.028 in. wall (6.35 mm OD × 7.112 mm wall)	0.25-in. OD x 0.035 in. wall (6.35 mm OD × 0.889 mm wall)	

Mechanical Properties

Weight in air	0.1 lb-ft (0.1488 kg-m)	0.11 lb-ft (0.1637 kg-m)	
Working pressure	20,000 psi (1,379 bar)	25,000 psi (1,724 bar)	
Collapse pressure	>30,000 psi (2,068 bar)	>35,000 psi (2,413 bar)	>30,000 psi (2,068 bar)
Burst pressure	20,000 psi (1,379 bar)	25,000 psi (1,724 bar)	15,000 psi (1,034 bar)
Maximum tensile load	1,500 lb (680 kg)	2,000 lb (907 kg)	
Maximum splice-free length	27,000 ft (8,229 m)	10,000 ft (3,048 m)	

Environmental Specifications

Maximum operating temperature[b]	392°F (200°C)		572°F (300°C)
Minimum storage temperature	-40°F (-40°C)		
Pressure range	Atm to 20,000 psi (1,379 bar)	Atm to 25,000 psi (1,724 bar)	Atm to 20,000 psi (1,379 bar)

[a] Thermal may have more fibers on a case-by-case basis. Custom optical fiber configurations can include any combination of single-mode or multi-mode optical fibers.
[b] DTS temperature range will depend on optical fiber selection.

* Incoloy is a registered trademark of Special Metals Corporation.

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Optical Dry Mate Connector

The ForeSite Sense optical dry mate connector provides low-loss, reliable optical connections for permanent well-monitoring applications. The pressure-testable design allows for a seal verification test after mating on the rig floor to ensure proper connection and improve the integrity and reliability of the optical monitoring system. The connector has an integral locking mechanism based on a scalloped nut design to prevent loosing and back-off during operation. The scallop nut design reduces the time for connection and eliminates the need for locking wires, which can be wrongly applied on the rig floor.

The optical dry mate connector complies with industry standards for instrumentation connectors. It has been fully qualified through extensive testing including vibration, shock and drop, thermal cycling, and mate/de-mate cycling. The connector has also been qualified through combined stress testing including tensile load tests while pressurized to 22,000 psi (1,517 bar) and combined thermal and pressure cycling to 22,000 psi (1,517 bar) and 302°F (150°C).

The connector integrates with Weatherford downhole optical cables, the connector can be mated on the rig floor, minimizing rig time. The connector can house up to 3 optical fibers (any combination of singlemode and multimode) and is designed to function with ForeSite Sense optical cable and all ForeSite Sense solutions. The low loss optical connector also provides optical continuity for DAS (distributed acoustic sensing) applications.

Features and Benefits

- Nonelectrical design is intrinsically safe and has minimal effect on completion design and installation.
- Metal-to-metal primary seal eliminates leaks, enhancing system integrity and reliability.
- Three pin connector supports three optical fibers to accommodate any combination of single mode and multimode optical fibers for added versatility.
- Low optical loss and optical back reflection enhance optical system performance and optimize management of optical budget.
- Inconel 718 construction suits most well types.

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Optical Dry Mate Connector

Specifications

Parameter:	Value and conditions:
Insertion loss, L_I	0.5 dB max
Single-mode return loss, L_R Multimode return loss, L_R	-45 dB max -35 dB max
Number of channels	3
Optical fiber type	Single-mode and multimode
Maximum operating pressure	20,000 PSI (1,379 bar)
Maximum over pressure	22,000 PSI (1,517 bar)
Minimum storage temperature	-40°F (-40°C)
Minimum operating temperature	32°F (0°C)
Maximum operating temperature	302°F (150°C)
Random vibration	10g RMS, 20 Hz – 2 kHz
Mechanical shock/drop	100 g, 9 ms half sine pulses 500 g, 1 ms half sine pulses
Overall length	4.607 in. (117mm)
Outer diameter	1.062 in. (27mm)

ForeSite® Sense Flowmeter

Optical Wellhead Outlet

The ForeSite Sense optical wellhead outlet (OWHO) organizes the feed-through and exit of optical cable from a platform or land wellhead. With over 500 units installed to date, the OWHO provides a robust secondary pressure barrier at the wellhead to the primary in-well pressure containment system and a proven, reliable optical interface between downhole optical cable and surface cabling systems.

Weatherford offers multiple OWHO solutions to suit client requirements. The OWO is rated for standard service and can be customized for sour or corrosive service. The base model OWHO-10 is rated to 10,000 psi (689.5 bar) and 302°F (150°C) continuous operation, and allows up to four optical feed-throughs. The high-pressure OWHO-15 can accommodate up to four optical fiber feed-throughs and operates in environments up to 15,000 psi (1,034.2 bar) and 392°F (200°C). For extreme environments, the OWHO-15X model additionally meets API 6FB fire test requirements. The OWHO-6T operates in thermal environments up to 527°F (275°C) at a reduced pressure of 6,000 psi (414 bar).

The OWHO is typically manufactured to suit client requirements in terms of compatibility with flange size and material specifications. It has an extensive track record for installations worldwide in land and platform settings.

Features and Benefits

- Proven high pressure optical feed-throughs operate in harsh environments, providing a significant performance margin when the OWHO is operated at wellhead conditions.
- Durable construction of 17-4 alloy steel delivers reliability throughout the duration of production operations.
- Metal-to-metal seals prevent leaks to ensure high pressure system integrity.
- Post-installation testing capacity of all seals allows confirmation of pressure integrity.

ForeSite® Sense Flowmeter

Optical Wellhead Outlet

Specifications

Model	OWHO-6T	OWHO-10	OWHO-15	OWHO-15X
Maximum operating pressure	6,000 psi (414 bar)	10,000 psi (689 bar)	15,000 psi (1,034 bar)	
Maximum operating pressure*	9,000 psi (620 bar)	15,000 psi (1,034 bar)	22,500 psi (1,552 bar)	
Operating temperature	527°F (275°C)	302°F (150°C)	392°F (200°C)	347°F (175°C)
Fiber capacity (SM or MM)	4		3	
Material	17-4 Alloy Steel (typically)			
Overall length**	9 in. (229 mm)	6.75 in. (172 mm)	9 in. (229 mm)	
Service	Rated and certified for standard service (sour available)			
Certification	Det Norske Veritas			
Compliance	API 6a PSL 3 and NACE-MR0175			API 6FB
Number of seals	2 barriers in every leak path between valve clock and exterior			
Seal testing	Post Installation testing capability, all seals			

*Determined as per API 6A, section 7.3.2
** Length measured without the flange/adapter

ForeSite® Sense Flowmeter

Flowmeter Instrumentation

ForeSite Sense flowmeter instrumentation units are installed at the wellhead and can be linked remotely (via network) to a reservoir monitoring system (RMS) control room or linked directly to an adjacent instrumentation unit. The units have the ability to serially monitor up to eight flowmeters, which is advantageous for multi-zone and pad-level applications.

Features and Benefits

- Serial monitoring of up to eight flowmeters reduces the cost and complexity for multizone and pad-level applications.
- ATEX Zone-2 approved design enables operations in flammable gas atmospheres, which provides enhanced safety at the wellhead.

Options

- System configuration depends on the selected flowmeter design.
  - The acoustic-tolerant version is optimal for intelligent wells with inflow control valves (ICVs).
  - The high-sensitivity version is optimal for quieter wells without ICVs.
- The number of available flowmeter channels is 1, 2, 4, and 8.
- The cold weather version is rated to operating temperatures as low as -40°F (-40°C). The standard version is rated to operating temperatures as low 5°F (-15°C).
- The system is Zone-2 ATEX rated; Zone-1 ATEX rating is available upon request.

Specifications

General

Flowmeter monitoring capability	Up to 8
Operating temperature range	-40 to 131°F (-40 to 55°C) 5 to 131°F (-15 to 55°C)
Update rate	90 sec per measurement
Units of measure	SI (metric), Imperial, custom
Output options	RMSwh dependent

Physical

Dimensions (W × H × D)	24 in. × 30 in. × 8 in. (762 mm × 610 mm × 203 mm)
Weight	152 lb (68.9 kg) or 144 lb (65.3 kg)

ForeSite® Sense Flowmeter

Flowmeter Instrumentation

Specifications (continued)

Electrical Power

24 VDC nominal	230 to 240 Vac (required for heaters) 18 to 36 Vdc
Maximum current	0.87 A @ 230 Vac or 3.33 A @ 18 Vdc
Power consumption	200 W (2 x 100W heaters) or 60 W

Environmental

Temperature range	-4 to 149°F (-20 to 65°C)
Relative humidity	95%, noncondensing
Operational vibration	1 g peak, 5 Hz to 100 Hz, 0.1 oct/min 90 minutes per axis, 3 axes
Operational shock	10 g and 20 g, 11-ms, half-sine shock 3 shocks, ± per direction, 3 axes (10G), 2 axes (20G)
Transportation vibration	3.0 GRMS, random NAVMAT P9492
Certification	ATEX Zone 2 (Zone 1 available on request)

ForeSite® Sense Flowmeter

Flowmeter Instrumentation

The ForeSite Sense flowmeter instrumentation system provides permanent and continuous serial measurement of volumetric phase flow rates. Used with in-well optical flowmeters, the system monitors multiple flowmeters through an optical switch. The bidirectional flow capabilities of the in-well flowmeters enable the system to measure injection, production, and cross-flow rates with the same well configuration.

Features and Benefits

- Serial monitoring of up to eight flowmeters reduces the cost and complexity for multizone and pad-level applications.
- Passive optical-sensing of the flowmeter allows bidirectional flow monitoring, which enables cross-flow detection in multi-zone completions and service changes from producer to injector (or vice versa) with no change to the flowmeter or instrumentation.
- Functionality with the Weatherford reservoir monitoring system (RMS) instrumentation supports integrated pressure and temperature monitoring from the same system.
- Direct fiber-in-umbilical connection enables subsea installation distances up to 100 miles (160 kilometers).

Options

- System configuration depends on the selected flowmeter design.
- The acoustic-tolerant version is optimal for intelligent wells with ICVs.
- The high-sensitivity version is optimal for quieter wells without ICVs.
- The production and reservoir monitoring system supports up to 50 flowmeter channels.

Specifications

General

Flowmeter monitoring capability	Up to 50
Operating temperature range	41 to 104°F 5 to 40°C
Update rate	90 seconds per measurement
Storage capacity	Network attached storage (NAS) with RAID functionality
Units of measure	SI (metric), Imperial, custom

Electrical Power

Voltage (VAC)	90 to 132 or 180 to 264
Frequency, single phase (Hz)	47 to 63
Power consumption, typical	1.2A @ 115 VAC (138 VA) 0.6A @ 230 VAC (138 VA) 60 W
Power consumption, maximum	2.0A @ 90 VAC

ForeSite® Sense Flowmeter

Flowmeter Instrumentation

Specifications (continued)

Physical

Dimensions	16.75 in. × 7 in. × 20 in. 426 mm × 178 mm × 508 mm
Electro optic module (EOM) weight	23.75 lb 10.77 kg
Power supply weight	13.2 lb 5.99 kg

Environmental

Storage temperature range	-4 to 149°F -20 to 65°C
Relative humidity	10 to 90%, non-condensing
Operational Vibration	1g peak, 5 Hz-100 Hz, 0.1 oct/min 90 minutes per axis, 3 axes
Operational Shock	10g and 20g, 11-ms, half-sine shock 3 shocks, ± per direction, 3 axes
Transportation vibration	3.0 G_{RMS}, random NAVMAT P9492
Certification	IEC 61000, EN 61000