

WellWatcher Flux

Multizonal reservoir monitoring system

APPLICATIONS

- Sandface monitoring for
 - production and injection profiles
 - well cleanup efficiency
 - out-of-zone injection
 - stimulation efficiency
- B-annulus monitoring
- Subsea distributed temperature monitoring
- Detection of
 - GOR change
 - gas and water breakthrough
 - crossflow between zones and wells
- Determination of fluid allocation and volumetrics

BENEFITS

- Fewer interventions due to reduced need to run production logging tools
- Immediate corrective actions due to continuous real-time monitoring
- Reduced time and costs due to simplified subsea interface architecture
- Enhanced production management and recovery due to improved reservoir surveillance

FEATURES

- Single wellhead penetration for multiple gauge stations and temperature arrays
- Precise temperature resolution
- Long-term trend accuracy due to measurement stability
- Debris-immune wireless power and telemetry transmitted across stages via inductive couplers
- Proprietary telemetry for bidirectional data communication
- Up to 60 sensors per array
- Multiple arrays per well
- Immunity to ESP electrical noise

The WellWatcher Flux* multizonal reservoir monitoring system acquires high-resolution distributed temperature measurements and discrete pressure and temperature measurements along the zones of interest. The system extends monitoring into lower completions by using field-proven inductive coupling techniques. The system has particular applicability to subsea wells and multistage completions, and the data obtained can be used to characterize the reservoir and optimize production and reservoir depletion.

Quartz pressure and temperature gauge stations

WellWatcher Flux system stations house the WellWatcher Extend* high-resolution dual-sensor PT gauge, which provides pressure and temperature readings from the well above or below the production packer.

Distributed temperature array

Arrays of miniaturized, hermetically sealed digital temperature sensors provide an array of temperature measurements that have a resolution 100 times higher than that obtained by optical fiber. The sensors are based on platinum resistive temperature detection technology and have a resolution of 0.0054 degF [0.003 degC] at a 1-min sample rate and an accuracy of 0.18 degF [0.1 degC].

Array architecture

All the sensors on an array are connected on sections of a single ¼-in electric cable. Each array holds up to 60 sensors, each spaced at least 5 ft [1.5 m] apart, with a maximum length of 1,640 ft [500 m] for a full array. Multiple arrays can be installed across multiples zones of interest in each well.

Power and telemetry

Bidirectional high-rate power and telemetry are provided by a single permanent twisted-pair electric cable and inductive coupling, simplifying installation and requiring only a single wellhead penetration.

Inductive coupling

An inductive coupler integrated into the tubing or the casing enables wireless communication and power transmission between the completion stages. The couplers are not affected by debris, and they eliminate the need for downhole wet-mate connections.

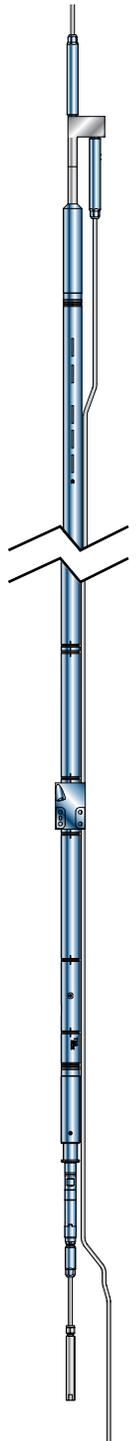
Proven downhole gauge technology

The WellWatcher Flux system is designed with the most advanced and proven gauge technology available. Long-term reliability results from multiple features:

- high-temperature-rated multichip module electronics and quartz sensors
- proprietary telemetry for bidirectional communication
- onboard system for monitoring and diagnostics
- Intellitite* downhole dual-seal dry-mate connector
- firmware download capabilities.

Data analysis of flow profiles

A surface acquisition system transmits data using industry-standard protocols to the operator's location anywhere in the world, where real-time analysis and thermal modeling enable flow profiles to be monitored, characterized, and managed without intervention or the choking back of production.



WellWatcher Flux system pressure and temperature gauge station.

WellWatcher Flux



The WellWatcher Flux system station is inspected in a vice during manufacturing.

Temperature Sensor Specifications

Working temperature rating, degF [degC]	32 to 302 [0 to 150]
Working pressure rating, psi [MPa]	20,000 [137.9]
Test pressure rating, psi [MPa]	22,000 [151.7]
Storage temperature, degF [degC]	-40 to 160 [-40 to 71]
Sensor diameter, in [mm]	0.6575 [16.7]
Sensor length, in [mm]	15.6 [397]
Flow-wetted material	HASTALLOY® C276, INCONEL® 718
Design life, years	10 at 302 degF [150 degC]
Service	H ₂ S
Sensor type	Resistance temperature detector
Max. number of sensors per array	60
Metrology initial accuracy, degF [degC]	0.18 [0.1]
Metrology resolution at 1-min sample rate [†] , degF [degC]	0.0054 [0.003]
Metrology standard deviation of drift, degF [degC]/year	0.071 [0.04]
Sampling rate, s	60
Power for array, W	3 (for 60 sensors)
Multipoint serial communication	RS-485 at 2,400 baud
Min. spacing between sensors, ft [m]	5 [1.5]
Max. array length, ft [m]	1,640 [500] for 60 sensors, longer for fewer sensors
Control line OD, in [mm]	0.25 [6.35], with encapsulation 0.43 [11]
Field splice type supported	Intellitite downhole dual-seal dry-mate connector

[†] Higher resolutions can be obtained by sampling less frequently.

Pressure and Temperature Quartz Gauge Specifications

Working pressure, psi [MPa]	20,000 [137.9]
Working temperature, degF [degC]	-13 to 302 [-25 to 150]
Length, in [mm]	110 (including cable heads and Y-block)
Diameter, in [mm]	1.25 [3,175] (except radial connection)
Flow-wetted material	MR0175
Service	H ₂ S
Typical power consumption, W	3 at 302 degF [150 degC]
Design life, years	10 at 302 degF [150 degC]
Number of gauges in single station	0, 1, or 2
Sensor pressure port reading options	Tubing, annulus, control line
Pressure drift, psi/year	3.5 at 302 degF [150 degC]
Initial pressure accuracy, psi [kPa]	4 [22.5] (over full range)
Pressure resolution, psi [kPa]	0.01 [0.07] at 1 s
Calibrated range, psi [kPa]	Atmospheric to 20,000 [137,895]
Initial temperature accuracy, degF [degC]	0.9 [0.5]
Temperature resolution, degF [degC]	0.018 [0.01]
Calibrated temperature range, degF [degC]	41 to 302 [5 to 150]
Max. transmission length (with repeater), ft [m]	>30,000 [>9,000]

slb.com/Flux