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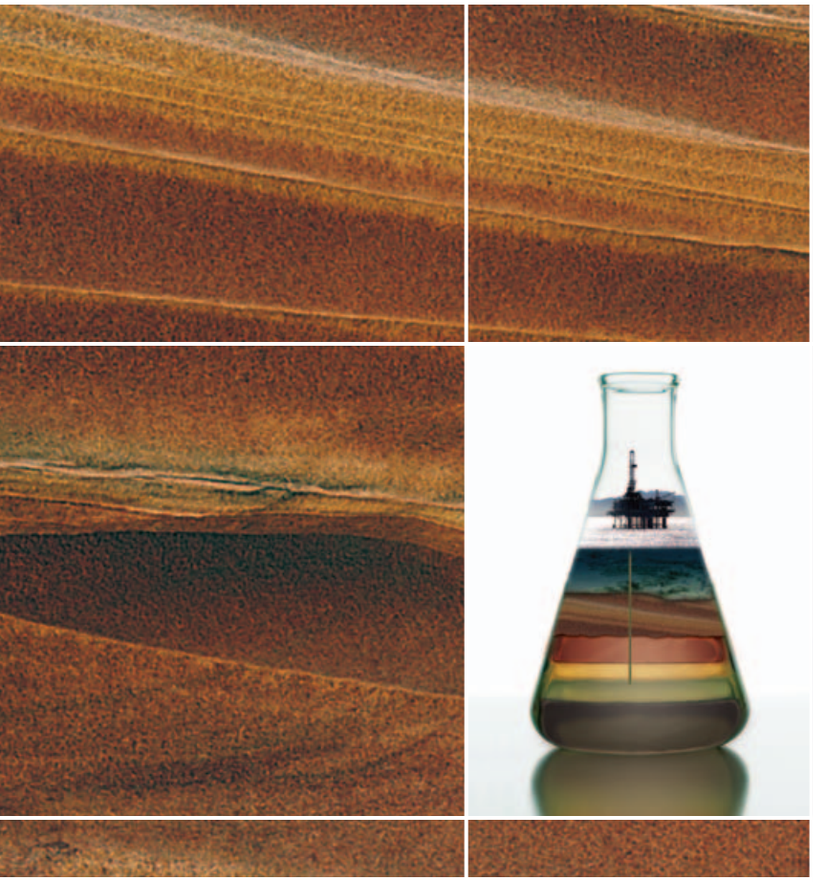
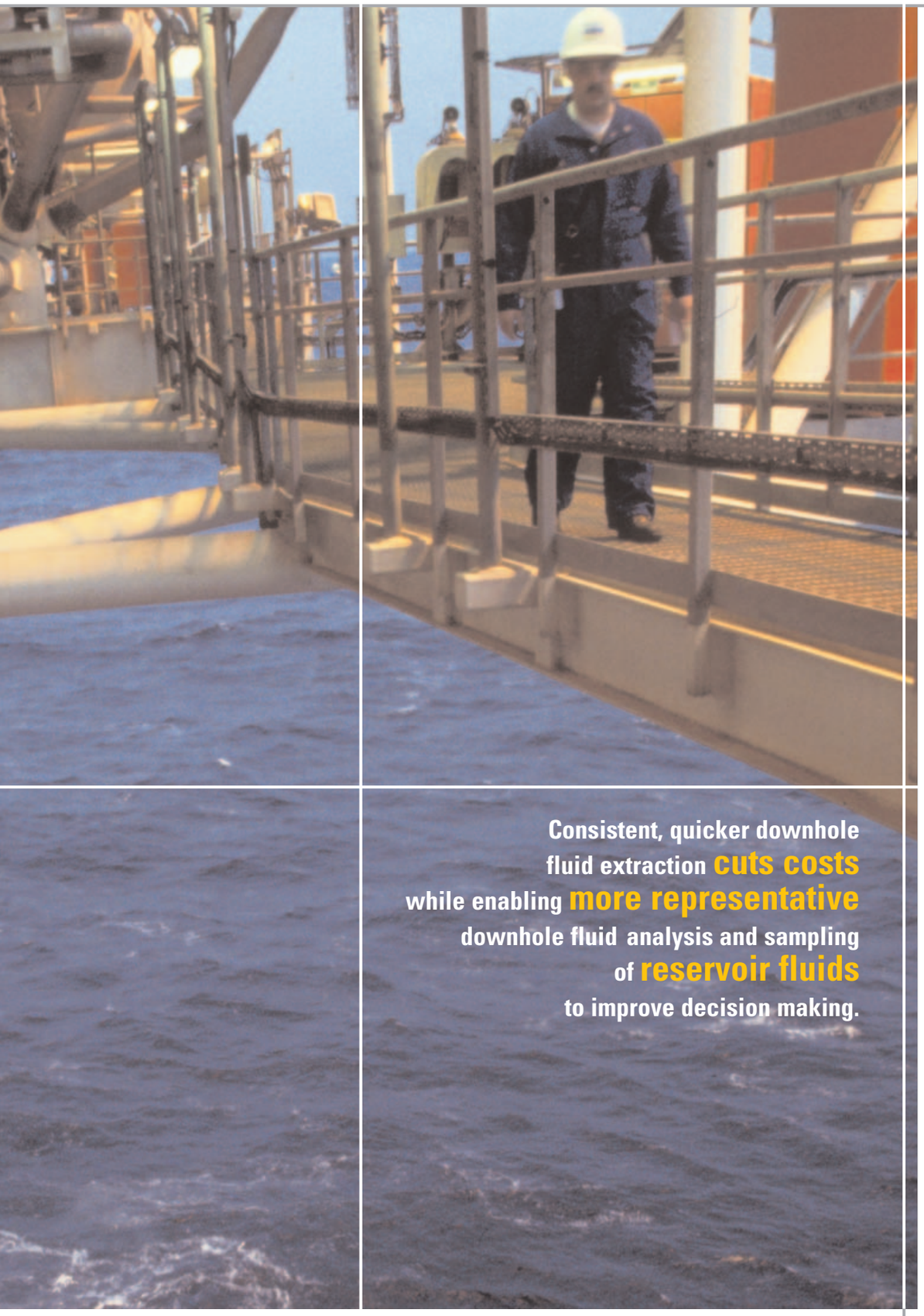


Quicksilver Probe

The **fluid purity** you need, in a **fraction** of the time

Quicksilver Probe



Consistent, quicker downhole fluid extraction **cuts costs** while enabling **more representative** downhole fluid analysis and sampling of **reservoir fluids** to improve decision making.

Focused fluid extraction efficiently delivers the ultralow-contamination fluids you need for Fluid Profiling* characterization of reservoir fluid properties and quantification of their variation and for sampling.

Quicksilver Probe* extraction has been proven in reservoir conditions around the world. Read the case studies to learn more.

- **Less than 3% contamination in the deepwater Gulf of Mexico**
- **Contamination-free sampling offshore Norway with environmental restrictions**
- **Ultradeep water with less than 1% contamination**
- **Complex, mature fields in the Middle East**
- **Viscous oils in wells drilled with oil-base mud**
- **Formation water in wells drilled with water-base mud**

Game-changing fluid-acquisition technology

Quicksilver Probe focused fluid extraction acquires reservoir fluids downhole with unprecedented purity and in a fraction of the time needed for conventional sampling and fluid characterization techniques.

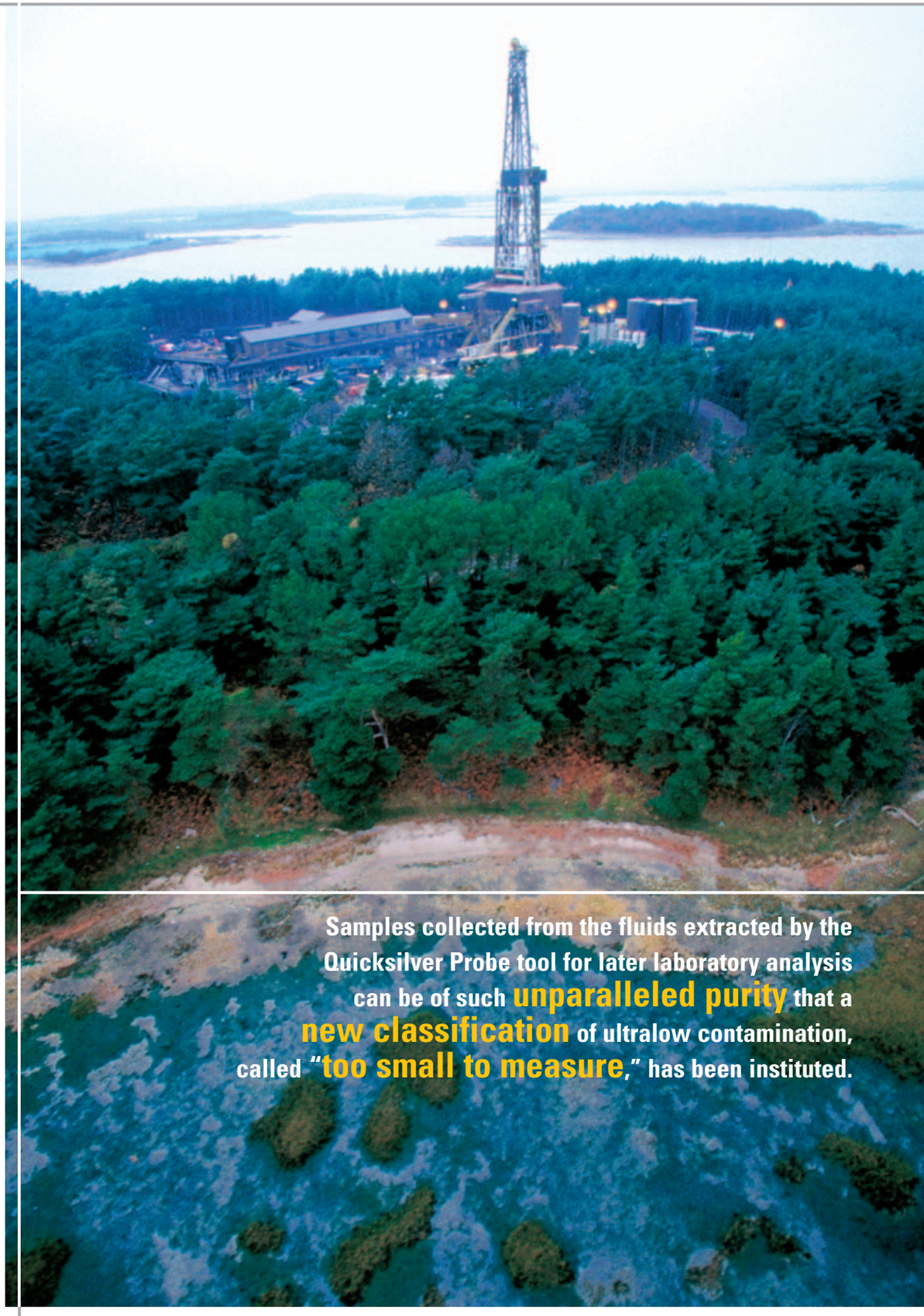
Only reservoir fluids acquired with ultralow or no contamination can accurately provide key information about the fluid properties of a hydrocarbon reservoir, such as GOR, saturation pressure, density, and viscosity. Reliable characterization of reservoir fluid properties during the early stages of exploration and development is critical for understanding fluid composition, estimating reserves, and optimizing production through the design of the well completion and facilities, especially in deepwater operations. Similar benefits toward improving and extending recovery are gained in mature fields.

However, obtaining clean, representative fluids with conventional openhole sampling techniques typically requires long pumping times, with increased rig time and associated costs and a greater risk of downhole tool sticking. Even then, the contamination resulting from deep invasion by miscible drilling-fluid filtrate may still be above the limit acceptable for analytically valid fluid characterization. And if the mudcake is poorly formed, pumping does not remove contamination but causes borehole fluid to continue to invade the formation. Another common approach, using high pumping rates to remove the contaminated fluid, can damage the formation.

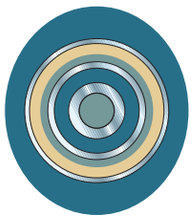
QUICKER, CLEANER FLUID EXTRACTION

Innovative Quicksilver Probe wireline technology focuses the fluid flow to efficiently separate contaminated fluids from pure formation fluid early in the fluid-extraction process. The result is cleaner, purer fluid with minimal contamination and obtained in much less time than compared with traditional probe-type wireline formation testers.

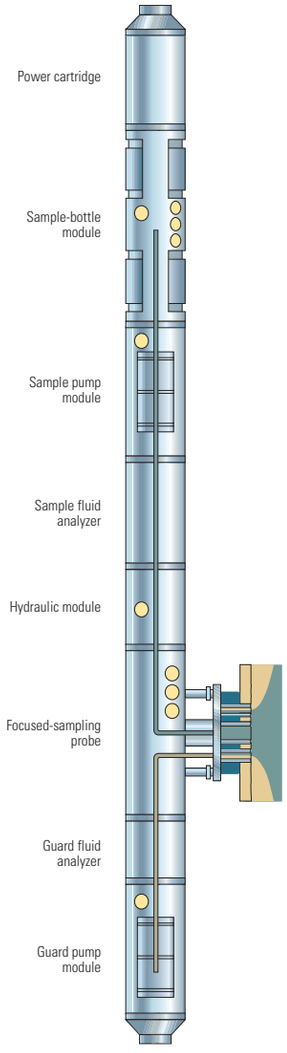
The novel probe design of the Quicksilver Probe tool divides the fluid flow from the reservoir into two paths, with the central extraction area isolated from the surrounding "guard" area around the perimeter. The two probe areas are arranged concentrically, with each probe connected to an independent pump and separate flowline. The pumps run at different rates that exploit the filtrate/fluid viscosity contrast and permeability anisotropy of the reservoir. The higher intake velocity created at the surrounding guard probe directs contaminated fluid into a preferential flowpath toward the perimeter, while the pure formation fluid drawn into the central extraction probe is available for fluid profiling and sampling. Spectroscopic analyzers determine the composition of the fluid in each flowline, and the pump rates can be adjusted as necessary to achieve and maintain extracted fluid purity.

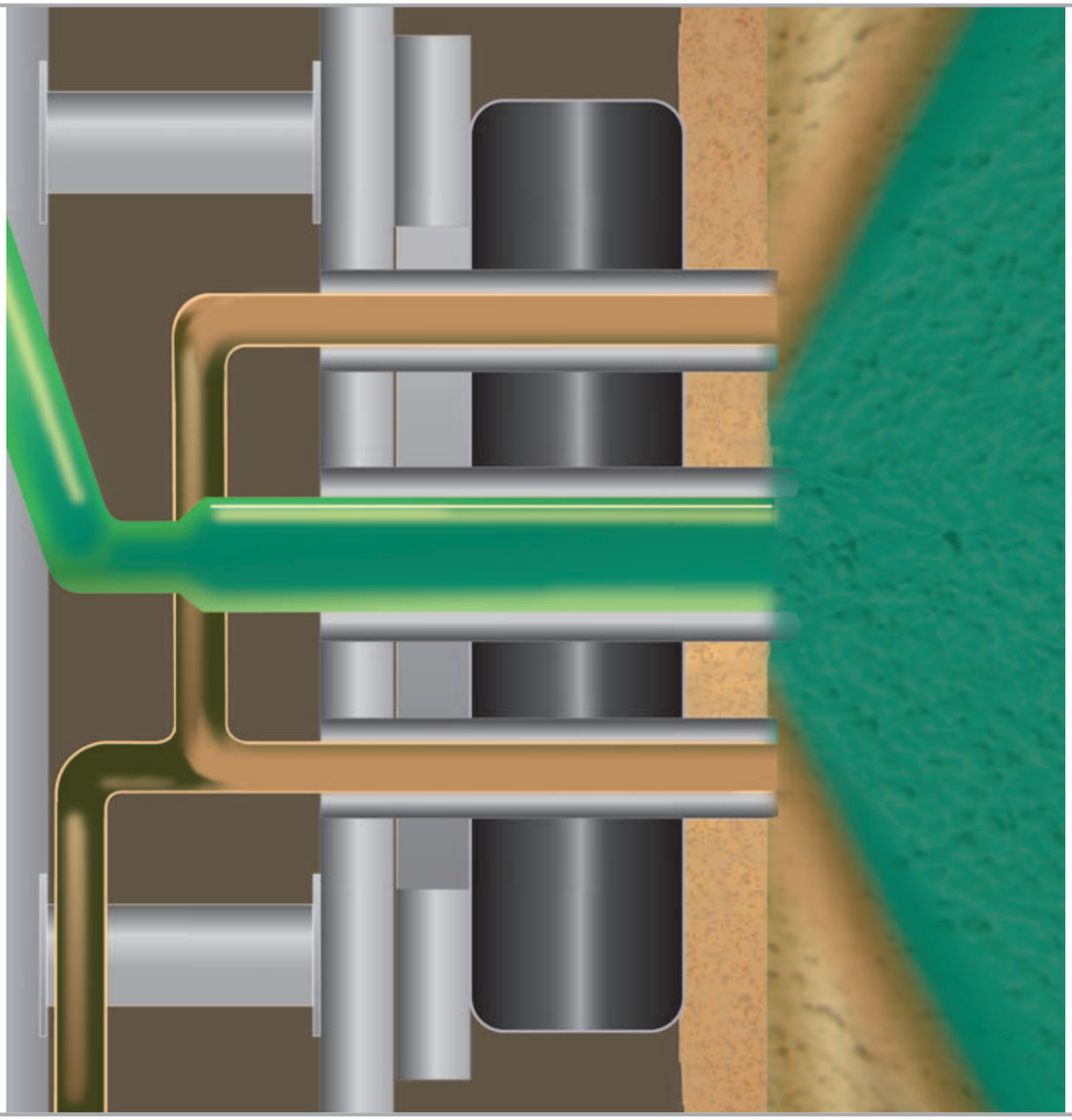


Samples collected from the fluids extracted by the Quicksilver Probe tool for later laboratory analysis can be of such unparalleled purity that a new classification of ultralow contamination, called "too small to measure," has been instituted.



The Quicksilver Probe tool has two concentric probes (left), with the guard probe surrounding the central fluid-extraction probe. Each probe has an independent pump and separate flowline. Packers surround and separate the probes and seal against the borehole wall (below). Although commingled contaminated fluid initially flows into both probes, in a short time the flow is separated to draw filtrate (light brown) into the guard flowline and formation fluid (green) into the extraction line. The contamination level of the extracted fluid decreases quickly with time to an acceptable level.





As fluids enter the Quicksilver Probe tool, contaminated fluids flow downward through the guard fluid analyzer and pump while clean fluids flow upward through the extraction fluid analyzer and pump modules to the collection and storage module. Tool configuration, such as the pump location, can be changed for different jobs.

REAL-TIME DOWNHOLE INSIGHT

The Quicksilver Probe focused extraction technique sets new standards in speed and purity across a broad range of hydrocarbons, from condensate to heavy oil, even in oil-base mud (OBM). It can also be used to provide new understanding of the properties of formation water, such as corrosiveness, scaling potential, and salinity.

Downhole fluid analysis can be added to the toolstring to complement Quicksilver Probe spectroscopic flowline monitoring. The fluid purity achieved by Quicksilver Probe extraction is key to accurate analysis using the new InSitu Family* quantitative measurements of formation fluid properties in open hole at reservoir conditions. Delivered in familiar log format, the InSitu Family sensor measurements comprehensively

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profile fluids downhole to produce a truer picture of the reservoir, from fluid composition to grading and compartmentalization. This dynamic information minimizes uncertainty, for example, in confirming sampling candidates in real time while the tool is on station.

PROVEN RELIABILITY

High-pressure, high-temperature (HPHT) environments are challenging for wireline sampling and testing operations, especially where OBM makes long pumping times necessary. More time in the hole increases the likelihood of tool sticking, which in turn involves lengthy and expensive fishing operations. Sample quality is similarly threatened by the increased chance of tool malfunctioning or failure related to extended exposure. As demonstrated by its extensive deployment record, the Quicksilver Probe tool reduces the risk of HPHT sampling operations because it decreases fluid cleanup time, minimizes tool exposure to extreme conditions and sticking, and improves the resulting sample quality.

Measurement Specifications

	Quicksilver Probe Tool
Output	Ultralow-contamination extracted formation fluids, flowline pressure, resistivity, and temperature
Logging speed	Stationary
Range of measurement	CQG* gauge: 750 to 15,000 psi [5 to 103 MPa]
	25,000-psi high-pressure Quartzdyne® gauge: 0 to 25,000 psi [0 to 172 MPa]
	Resistivity: 0.01 to 20 ohm.m
	Temperature: –67 to 350 degF [–55 to 177 degC]
Resolution	CQG gauge: 0.008 psi [55 Pa] at 1.3-s gate time
	25,000-psi high-pressure Quartzdyne gauge: 0.01 psi/s [69 Pa/s]
	Resistivity: 0.001 ohm.m
	Temperature: 0.01 degF [0.05 degC]
Accuracy	CQG gauge: ±(2 psi [13,789 Pa] + 0.01% of reading)†
	25,000-psi high-pressure Quartzdyne gauge: 0.02% of full scale
	Resistivity: ±5% of reading
	Temperature: ±1.0 degF [±0.5 degC]
Mud type or weight limitations	None
Combinability	Fully integrates with MDT* Modular Formation Dynamics Tester system and InSitu Family sensors
Special applications	Downhole fluid analysis at reservoir conditions and reservoir fluid profiling

† Includes fitting error, hysteresis, repeatability, and some allowance for sensor aging; the corresponding percentages of the pressure reading account for the incertitude of the calibration equipment.

Mechanical Specifications

	Quicksilver Probe Tool
Temperature rating	350 degF [177 degC]
Pressure rating	20,000 psi [138 MPa]
	High-pressure version: 30,000 psi [207 MPa]
Borehole size—min.	6 in [15.24 cm]
Borehole size—max.	14 in [35.56 cm]
Outside diameter	4.75 in [12.07 cm]
	While sampling: 5 in [12.70 cm]
	High-pressure version: 5.25 in [13.34 cm]
	High-pressure version while sampling: 5.25 in [13.34 cm]
Length	Probe module: 8.48 ft [2.58 m]
Weight	308 lbm [140 kg]
	High-pressure version: 351 lbm [159 kg]
Tension	160,000 lbf [711,710 N]
Compression†	85,000 lbf [378,100 N]

†At 15,000 psi [103 MPa] and 320 degF [160 degC]. The compressive load is a function of temperature and pressure.

8 case studies inserted here

TIME. PURITY. POSSIBILITY.

- **The Quicksilver Probe method recovers formation fluid in a fraction of the time required for conventional methods.**
- **Extracted formation fluids are virtually contamination free.**
- **Fluid Profiling analysis and sampling provide new insight because of the purity of the reservoir fluid in the flowline.**

Quicksilver Probe

FOCUSED FLUID EXTRACTION

New standards in speed and purity

Virtually contamination-free fluid recovery

Providing answers in HPHT wells

Creating opportunities for Fluid Profiling fluid property characterization and quantification of variation and for sampling

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