



PhaseSampler

Multiphase Fluid Sampling and Analysis



Difficult questions

Capturing truly representative samples of multiphase fluids in live flowline conditions is the ideal for improving the accuracy of flow rate measurements. But achieving that ideal has been an elusive goal—until now.

Today, Schlumberger PhaseSampler* multiphase sampling services can answer the most difficult phase-related questions without prior separation of the oil, gas, and water phases. Unlike traditional sampling techniques, PhaseSampler technology enables the phases to be sampled and analyzed in line—from the actual flow in the pipe—and eliminates the problems associated with phase separation.

This new system is an important step change in the way multiphase fluids are understood and managed. The result? Much more certain measurements in challenging environments and for complex and unconventional fluids.





BREAKTHROUGH IN INNOVATION

The PhaseSampler service, along with the PhaseTester* portable multiphase flowmeter, is part of the Schlumberger multiphase well testing solution, which has been acknowledged worldwide as groundbreaking, state-of-the-art technology. Multiphase well testing provides a quicker, more efficient way to test wells and provides critical well diagnostic information without complex conventional testing operations.

The PhaseTester flowmeter is based on Vx[†] technology, which uses a multienergy gamma ray meter with no moving parts. The flowmeter provides performance improvements over traditional flow testing methods, including faster and more efficient operations. In addition, it

offers an excellent dynamic response to fluctuating flows, requires little or no stabilizing time, and operates efficiently at high pressures and high temperatures and in gas condensates, slugs, foam, and emulsions.

PhaseSampler and PhaseTester services provide the best live flow rate and basic fluid property measurements available in the oilfield today. Combined, they generate complementary measurements that for the first time enable the full potential of multiphase well testing to be realized.

By adding the innovative PhaseSampler system to existing Schlumberger technologies—proven in the field for more than a decade—multiphase well testing has truly come of age. Indeed, a new era has begun for the evaluation, development, and operation of wells and—as wells and reservoirs become more complex—for increasingly difficult challenges.

THE TECHNOLOGY AT WORK

The PhaseSampler system hardware consists of three basic elements: sampling probes that are positioned in the main pipe of the flowmeter, a phase-segregating sample chamber, and a fluid properties measurement apparatus. These components are compatible with the PhaseTester portable multiphase flowmeter. The system can also be attached conveniently to PhaseWatcher[†] fixed multiphase well production monitoring equipment if an appropriate liquid sampling port is available—without increasing the footprint.

The probes are positioned in a special configuration across the flow path to allow the collection of multiphase samples. The phase-representative samples are obtained by displacing the unwanted phases from the PhaseSampler sampling

chamber with a hydraulically activated piston and monitoring the displacement with phase-discriminating optical probes in the sample path. This sampling cycle can be repeated until the required phase sample volume is isolated in the chamber. The entire process is performed under temperature and pressure control to keep the sample at thermodynamic equilibrium. The sample is then placed in a flash apparatus, where the basic fluid properties can be measured or, if preferred, transferred into a conventional shipping bottle and shipped to a pressure, volume, temperature (PVT) laboratory for analysis.

Three PhaseSampler probes are positioned in a special configuration across the flow path to allow the collection of multiphase samples.

The PhaseSampler system has demonstrated its reliability in characterizing the properties of fluids ranging from heavy oils to gas condensates. By reducing uncertainties associated with variations in pressure, temperature, and effluent composition over time, the PhaseSampler system provides a powerful solution for improving the overall accuracy of flow rate measurements.

Before: Uncertainty

Understanding fluid behavior requires solving equations related to fluid flow properties—PVT and others—of the three phases. The information is used to determine the potential life and capacity of a reservoir and the optimal strategies for further exploration, development, and production. Two traditional models for measuring the fluid properties, black oil (BOM) and equation-of-state (EOM), require some data to be approximated.

Black oil model

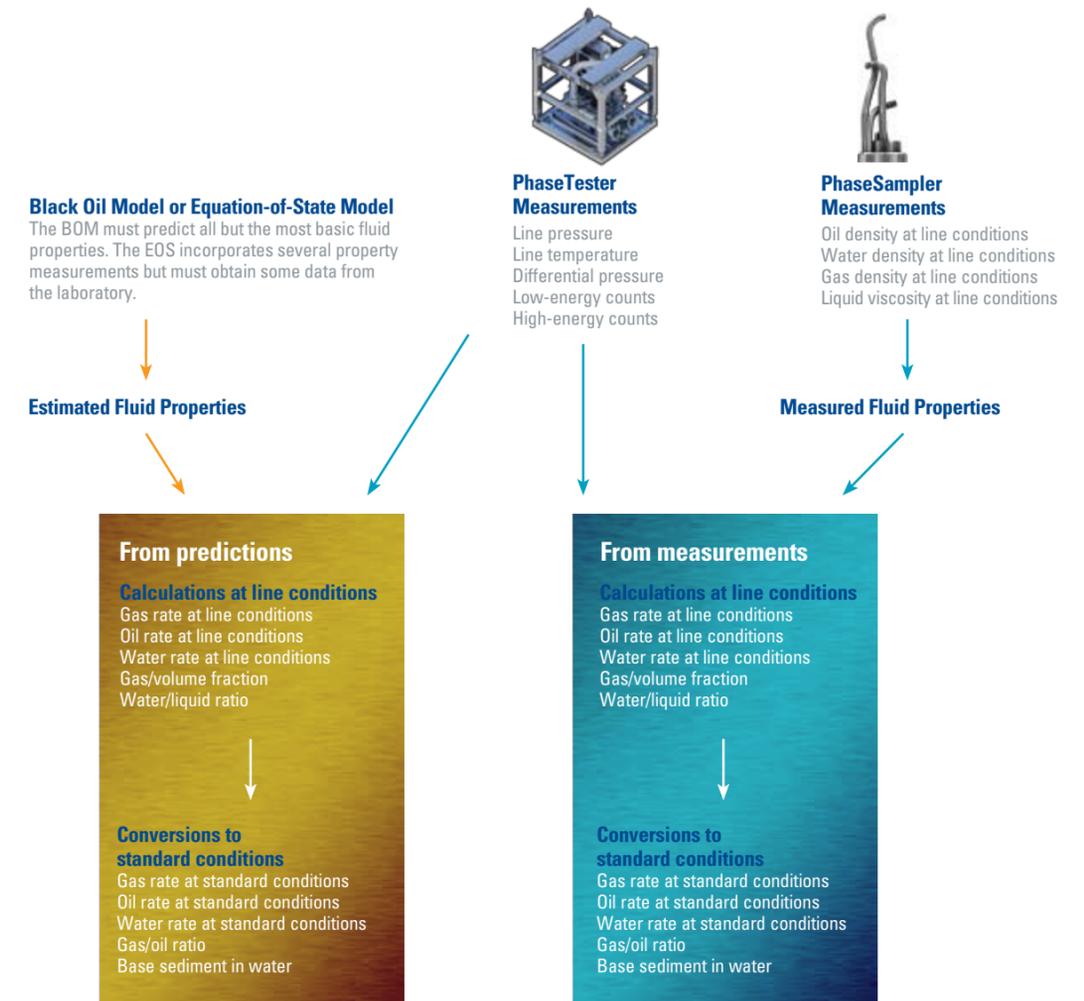
The BOM uses only the most basic fluid properties in its calculations. Other fluid properties must be predicted. In addition, BOM calculations require the use of volumetric conversion factors, which are derived from empirical correlations and have a significant margin of error. The results of this model, therefore, are uncertain. Moreover, the model is not practical for fluids such as heavy oils and gas condensates, which require correlations for their accuracy.

Equation-of-state model

The EOS model incorporates more property measurements than those used with the BOM. However, because the information comes from PVT laboratory data, this approach is limited when well fluids have not been fully analyzed, PVT data reports are old, wells are commingled, or reservoirs are depleted. In such cases, some approximation of the data is involved, and thus the results, like those for the BOM, are uncertain.

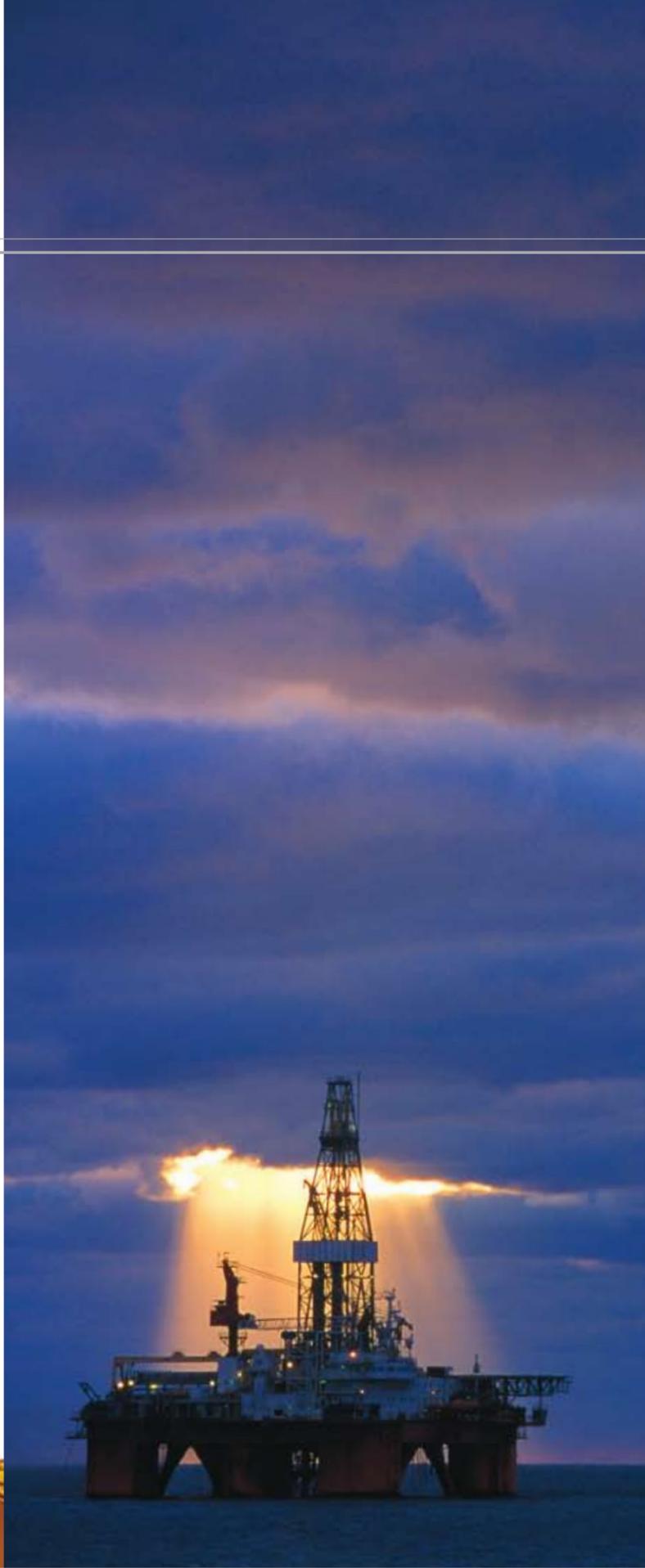
OBTAINING FLUID PROPERTY MEASUREMENTS

Fluid property modeling predicts fluid behavior. Specifically, it provides density and viscosity information for line-condition calculations and allows line condition flow rates and ratios to be converted into standard-condition rates and ratios.



Direct answers

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Now: Much more certainty

With the PhaseSampler system, all fluid properties—including densities at line conditions, shrinkage factors, expansion factors, and solution ratios—are analyzed in real time at the wellsite for an immediate understanding of the fluid properties. Volumetric conversion factors are not involved. Samples obtained in line remain in thermodynamic equilibrium, making them ideal for more-detailed PVT and compositional analyses in the laboratory, such as fluid profiling for production studies. The results are therefore more detailed and certain than flow information derived from the BOM and EOS models. PhaseSampler measurements provide immediate well diagnostics and faster well performance trend analyses.



Phase Tester Measurements

- Line pressure
- Line temperature
- Differential pressure
- Low-energy counts
- High-energy counts



PhaseSampler Measurements

- Oil density at line conditions
- Water density at line conditions
- Gas density at line conditions
- Liquid viscosity at line conditions

Measured Fluid Properties

From measurements

Calculations at line conditions

- Gas rate at line conditions
- Oil rate at line conditions
- Water rate at line conditions
- Gas/volume fraction
- Water/liquid ratio

Conversions to standard conditions

- Gas rate at standard conditions
- Oil rate at standard conditions
- Water rate at standard conditions
- Gas/oil ratio
- Base sediment in water



Advantages

SYSTEM KEY ADVANTAGES

The PhaseSampler system provides a powerful solution for improving the overall accuracy of flow rate measurements. As a result, you can now be more certain than ever that you have the measurements necessary to reduce risks and make fast, effective decisions.

Advantages and benefits provided by the PhaseSampler system:

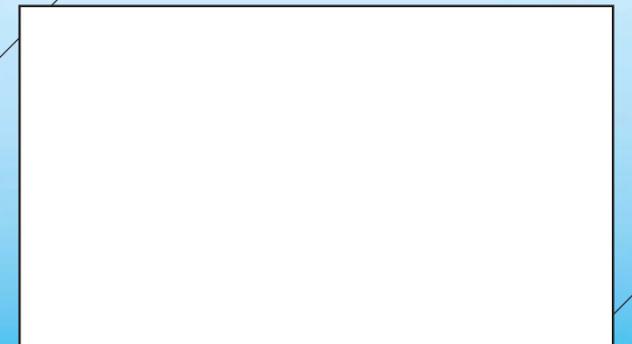
- Immediate results for onsite control
- Rapid response time and analyses
- High-quality samples for remote testing
- Accurate results under any oilfield conditions
- Improved fluid characterization
- Improved well diagnostics
- Enhanced installation and operation safety
- Separation-free sampling
- Sampling that is unaffected by changes in flow rate, phase holdup, continuous phase flow, and pressure regime
- Increased flow rate certainty

Additional advantages derived from Vx technology:

- Elimination of fluid disposal
- Reduced gas flaring
- High-resolution data from continuous data
- Minimal footprint and onsite installation needs
- Reduced costs through efficiency and simplified logistics
- Little or no stabilization time

Situations in which the PhaseSampler system is particularly valuable:

- Measurement of fluids such as volatile oils, heavy oils, and gas condensates
- Insufficiently precise separation methods
- Limited available power





Comprehensive PhaseSampler multiphase sampling and analysis services generate measurements that enable the full potential of multiphase well testing to be realized. Whenever you must be sure you have the fluid property measurements necessary to reduce risk and make fast, effective decisions, PhaseSampler services help you be certain.

Be certain.

www.slb.com/PhaseSampler

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