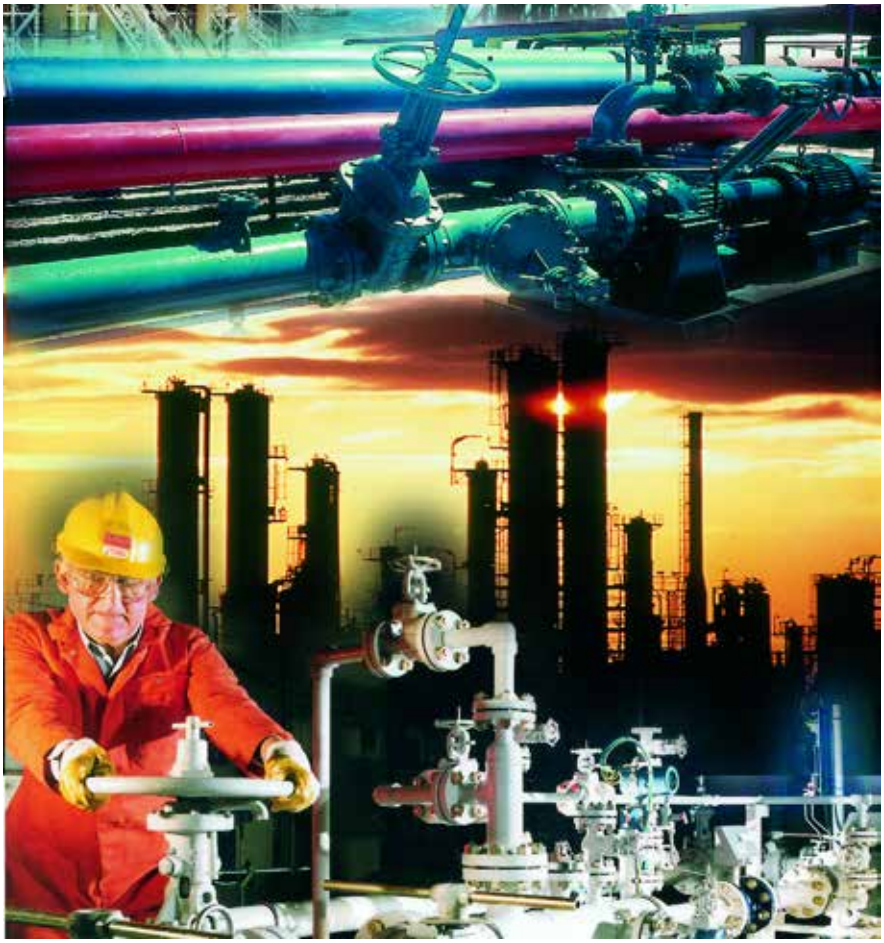
CAMERON

TECHNICAL SPECIFICATIONS

JISKOOT Crude Oil Sampling



With the current high price of crude oil, many oil companies and refiners are focusing on how new technology can reduce costly measurement errors. Different value is placed on 100,000 barrels of crude oil if it contains 0.5% water compared to 1.5%. Poor quality measurement will mask these figures and have a significant impact on profits.

Many companies are now investing in improvements to custody transfer and quality measurement systems based upon the significant savings that can be made. In a recent comparative test, Cameron sampling technology saved one refinery over $380,000 in the first three months of deployment!

As well as considerable savings, an accurate sampling system can also deliver a rapid return on investment, providing advanced audit and management tools to improve supplier relations.

In order to achieve representative sampling, the international sampling standards (ISO 3171, API 8.2) require the completion of six steps. The standards state that failure to comply with ANY of these will invalidate the sample.

Six Steps to Representative Sampling

1. Location of the Sampling System

The location of the sampling system relative to the custody transfer position can be critical to the accuracy of the sampling operation. The volume of the pipeline between the custody transfer position and the sample position is often called the line fill. This volume can be relevant if the line fill is substantial relative to the batch volume and if the properties of the line fill are expected to differ from the bulk batch properties.

Ideally the sampling system should be located at the custody transfer point, but in many cases (such as marine loading/unloading) it is not possible to do this and ensure sufficient mixing at all flow rates. Samples taken at these transfer locations normally do not comply with the standards. Because the flow turndown also prohibits the use of a static mixer and causes problems with flow measurement resolution, the sampling system is normally installed at a more suitable onshore location where it samples the line fill.

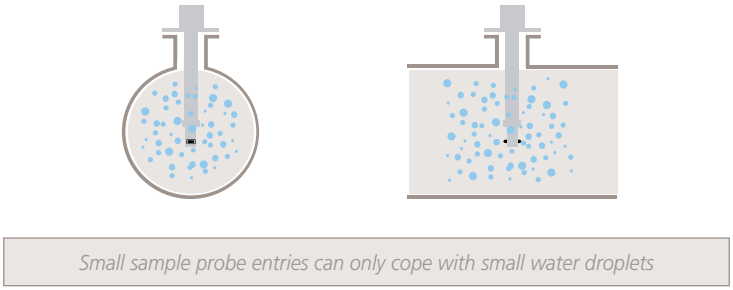
2. Mixing and Dispersion

Where water is present in oil, the concentration across a pipeline varies depending on velocity and fluid properties. The most important step in sampling is to ensure that the fluids at the point of sample extraction are well mixed and representative of a cross section of the whole pipeline.

Samples must be extracted from a single point in the center of the pipeline using a sampler inlet significantly larger than the average water droplet. Sampler inlet size directly affects accuracy. The larger the inlet, the lower the measurement uncertainty.

3. Representative Sampling

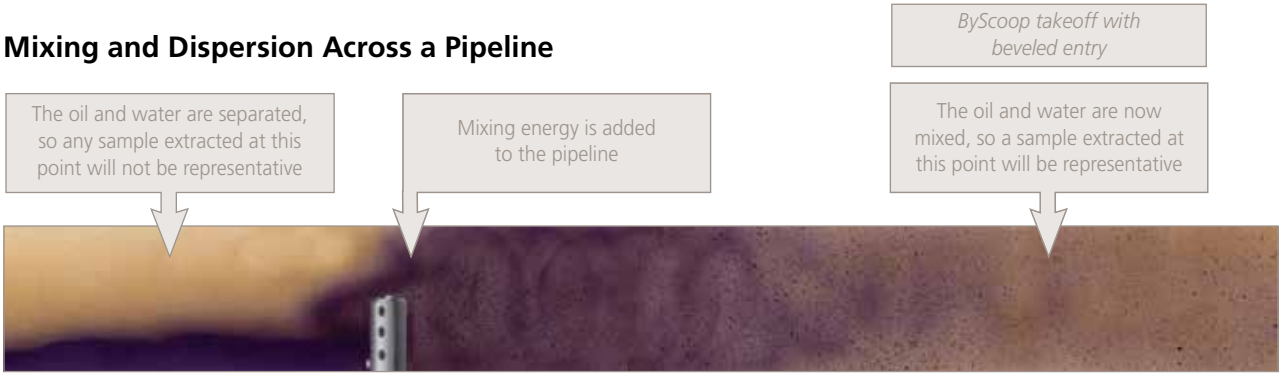
Water content and flow rate often vary widely. To ensure representativity, sample grabs must be taken proportional to the flow. Grabs must be repeatable, irrespective of density, viscosity, or pressure variations. Each must be small (typically 1 cc) to enable enough grabs to be taken to pick up slugs of water. The inlet to a sampler should be beveled, profiled, or have a



Small sample probe entries can only cope with small water droplets

Large sample probe entries can cope with both droplets and large water droplets

Mixing and Dispersion Across a Pipeline



pitot to avoid sample bias. Control systems must validate equipment performance (called performance factor) throughout the batch and provide alarms in the event of error to allow backup action to be taken.

4. Handling and Mixing

Grab samples are discharged into a batch sample receiver, which must be suitable for duty. Constant pressure receivers are normal for high vapor pressure or unstabilized fluids, and constant volume receivers are used for stabilized crude oil or condensate. Ultimately a sub-sample will be removed from the receiver for analysis. To maintain representativity, the contents of the receiver must be mixed before the sub-sample is removed. Receivers must have no dead pockets or fluid traps and should include connections to enable the use of an external mixer to avoid the loss of light ends.

5. Laboratory Analysis

Analysis determines the final value of the whole sampling process. Failure to analyze the sample correctly can invalidate all the previous steps. Karl Fischer titration is the preferred method. Laboratory analysis is covered by separate standards (i.e., IP 386).

6. Proving Performance

The performance of a sampling system should be validated by proving using water injection after installation. The method for performing this is defined in the standards. Proving can be independently witnessed or certified to provide customers, suppliers, or customs officials with a guarantee of compliance.

The Options

JISKOOT™ offers three main types of sampling systems. The system selected will depend on the required accuracy level of the sample, the installation space available, and the level of natural mixing in the pipeline. The systems are:

In-Line Probe Sampling System

The in-line sampling system is a probe sampling system. It is the simplest of all the sampling systems and is used when sample accuracy is less important. The probe is inserted into the pipeline through a seal housing and valve, which allows removal under line conditions. Sample grabs are discharged into sample receivers ready for analysis. A safe or hazardous area sample controller controls the system.

Fast Loop Sampling System

Highly accurate and simple to maintain, the fast loop sampling system is mounted in a pumped bypass/fast loop. A fast loop system is more accurate than an in-line probe sampler system due to the larger inlet size. The system uses a pumped 1" or 2" bypass loop flowing in parallel with the main pipeline.

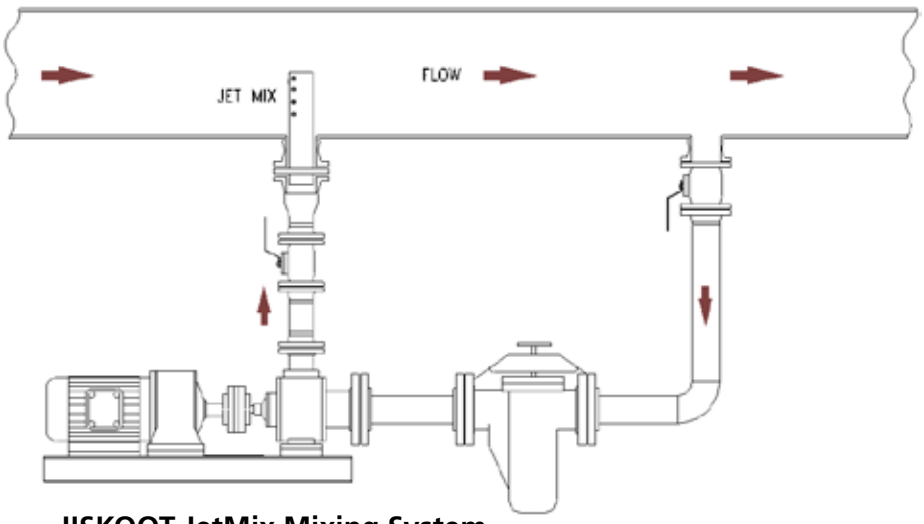
CoJetix® Sampling System

The CoJetix sampling system is the most accurate system for liquid hydrocarbon sampling for custody transfer or allocation measurement. It combines the benefits of the fast loop system with a JISKOOT mixing system (see below) to provide a highly reliable and representative sample with extremely low uncertainty.

JetMix® Mixing System

The JISKOOT JetMix mixing system is used as part of the CoJetix sampling system to provide mixing to nonhomogenous pipeline contents. The JetMix creates pipeline mixing with a C1/C2 ratio of greater than 0.9 (the level of required mixing as outlined by the sampling standards) across a wide range of flow rates with no pressure drop.

For further details of the above systems, please see individual systems brochures.



JISKOOT JetMix Mixing System

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CoJetix System	Fast Loop System	In-Line Probe System
		
Uncertainty: ≤ 0.025%	Uncertainty: ≤ 0.035%	Uncertainty: ≤ 0.118%
Facts: • Highest accuracy sampling system • ROI in 4 to 6 months • Low environmental risk and maintenance cost • Low cross-contamination risk • Density, watercut, etc., can be incorporated • Can be installed by hot tap • Removable for pigging	• High accuracy sampling system • Low environmental risk and maintenance cost • No cross-contamination risk • Density, watercut, etc., can be incorporated • Can be installed by single hot tap • Removable for pigging	• Can be installed by single hot tap • Removable for pigging • Cabinet must be mounted close to pipeline • Mechanical samplers in the pipeline must be removed for service • Cross-contamination risk
Applications: • Where mixing is needed and if flow turndown is more than 3:1 • High value/throughput facilities or sites with large quality exposure • High RVP fluids or light condensates	• Where mixing is not needed or a static mixer is suitable • High value/throughput facilities or sites with large quality exposure	• Where mixing is not needed or a static mixer is suitable
Sampler Inlet: 		
Typical Size: 250 x 150 mm Typical Area: 37,500 mm²	Typical Size: 33.5 mm Typical Area: 881 mm²	Typical Size: 22 x 8 mm Typical Area: 176 mm²

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