Liquid Hydrocarbon Measurement Uncertainty Calculations

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Introduction

This document provides a methodology for calculating the uncertainty in the measurement of liquid hydrocarbons by flow measurement systems. Specifically, uncertainty performance expressions are developed for positive displacement and Coriolis meter types under API *Manual of Petroleum Measurement Standards* (*MPMS*) Chapter 5 for measuring hydrocarbons by volume. This includes ancillary devices, processes, and measurements used to calculate a net standard volume (NSV) such as pressure, temperature, density, and sediment and water (S&W). This document was written to determine if the performance of a given measurement device is in compliance with an acceptable level of uncertainty, either pre-installation or after the installation is in service. If this is not the case, the measurement device, its installation, or maintenance practices, etc. can be upgraded to meet the desired uncertainty performance criterion. Techniques are described to assess the uncertainty contribution of individual components of measurement systems and the overall measurement facility's measurement uncertainty. By following the guidance and calculation procedures of this document, cost-effective measurements of appropriate quality can be achieved. In most cases, the rigorous requirements of industry standards intended for allocation and custody transfer quality measurements can be reduced and still achieve the desired measurement uncertainty required. For this document, a measurement system is comprised of meters, provers, and the associated devices to calculate a NSV.

This document addresses the most common liquid measurement devices in use at the time of its development and allows for updating for new devices in the future. This does not advocate the use of these devices or preclude the utilization of other types of devices, provided the targeted performance is achieved.

Liquid Hydrocarbon Measurement Uncertainty Calculations

1 Scope

This document provides guidelines for the calculation of uncertainty for field stored and transported hydrocarbon liquids. Special emphasis is placed on the measurement uncertainty of crude oils measured at tanks, by lease automatic custody transfer (LACT), and alternative measurement systems.

2 Terms and Definitions

For the purposes of this document, the following definitions apply.

2.1
accuracy
The closeness of agreement between a measured quantity value and a true quantity value of a measurand.

2.3
calibration
A set of operations that establish, under specified conditions, the relationship between the values indicated by a measuring device and the corresponding known values indicated when using a suitable measuring standard.

2.12
metering or measurement system
A combination of primary, secondary, and/or tertiary measurement components necessary to determine the flow rate.

2.14
performance
The response of a measurement device to influence parameters such as operating conditions, installation effects, and fluid properties.

2.16
uncertainty
The range or interval within which the true value is expected to lie with a stated degree of confidence. Describes the range of deviation between a measured value and the true value, expressed as a percentage. For example, a device with an accuracy of 2 % would have an uncertainty of ±2 %.

3 Performance Characteristics and Measurement by Meter Type

3.1 General

The primary purpose of a liquid hydrocarbon meter for any application is to measure the flow. The uncertainty of measurement depends on the measurement equipment selected for the application, proper installation of the equipment, the ability to inspect, verify, or calibrate the various measurement system components, and the frequency of those maintenance activities. The performance of the meter may also depend on the piping configuration and compensation for variability of operating pressure, temperature, and fluid composition. It is important to recognize individual influence parameters and their effect on the measurement. Since the principle of operation and differing influence parameters have varying degrees of influence by meter type, it is important to identify and define the significant influence factors for the meter to determine the total or combined measurement uncertainty.