Manual of Petroleum Measurement Standards
Chapter 12—Calculation of Petroleum Quantities

Section 2—Calculation of Petroleum Quantities Using Dynamic Measurement Methods and Volumetric Correction Factors

Part 5—Calculation of Base Prover Volume by Master Meter Method

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FOREWORD

This multi-part publication consolidates and presents standard calculations for the measurement of petroleum liquids using turbine or displacement meters. Units of measure in this publication are in International System (SI) and United States Customary (US Customary) units consistent with North American industry practices.

This standard has been developed through the cooperative efforts of many individuals from industry under the sponsorship of the American Petroleum Institute and the Gas Processors Association.

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Chapter 12—Calculation of Petroleum Quantities

Section 2—Calculation of Petroleum Quantities Using Dynamic Measurement Methods and Volumetric Correction Factors

PART 5—CALCULATION OF BASE PROVER VOLUMES BY MASTER METER METHOD

1 Purpose

1.1 When most of the older standards were written, mechanical desk calculators were widely used for calculating measurement documentation, and tabulated values were used more widely than is the case today. Rules for rounding and the choice of how many figures to enter in each calculation step were often made on the spot. As a result, different operators obtained different results from the same data.

1.2 This multi-part publication consolidates and standardizes calculations pertaining to metering petroleum liquids using turbine or displacement meters and clarifies terms and expressions by eliminating local variations of such terms. The purpose of standardizing calculations is to produce the same unbiased answer from the given data. For different operators to obtain identical results from the same data, the rules for sequence, rounding and discrimination of figures (or decimal places) must be defined.

2 Scope

2.1 This part provides standardized calculation methods for the quantification of liquids and the determination of base prover volumes under defined conditions, regardless of the point of origin or destination or units of measure required by governmental customs or statute. The criteria contained in this document allows different entities using various computer languages on different computer hardware (or manual calculations) to arrive at identical results using the same standardized input data.

2.2 This document also specifies the equations for computing correction factors, rules for rounding, including the calculational sequence, and discrimination levels to be employed in the calculations. No deviations from these specified equations are permitted, since the intent of this document is to establish a rigorous standard.

3 Organization of Standard

This standard is organized into five separate parts. Part 1 contains a complete general introduction to dynamic measurement calculations. Part 2 focuses on the calculation of metered quantities for measurement tickets. Part 3 applies to the calculation of meter factors in proving operations and proving reports. Part 4 applies to the determination of base prover volumes by the water draw method and Part 5 explains the calculation steps required to determine base prover volume by the master meter method.

3.1 PART 1—INTRODUCTION

3.1.1 The base (reference or standard) volumetric determination of metered quantities is discussed, along with the general terms required for solution of equations.

3.1.2 General rules for rounding of numbers, including field data and intermediate calculational numbers and discrimination levels, are specified.

3.1.3 For the proper use of this standard, prediction of the density of the liquid in both flowing and base conditions is discussed.

3.1.4 An explanation of the principal correction factors associated with dynamic measurement is presented.

3.2 PART 2—CALCULATION OF METERED QUANTITIES

3.2.1 The application of this standard to the calculation of metered quantities is presented, for base volumetric calculations in conformance with North American industry practices.

3.2.2 Recording of field data, rules for rounding, discrimination levels, calculational sequences, along with a detailed explanation of the calculation steps, are all specified, together with appropriate flow charts and a set of example calculations. These examples can be used as an aid in checking out the procedures for any computer calculation routines that are developed on the basis of the requirements stated in this standard.

3.3 PART 3—PROVING REPORTS

3.3.1 The application of this standard to the calculation of proving reports is presented for base volumetric calculations in conformance with North American industry practices. Proving reports are utilized to calculate meter correction factors and/or performance indicators. The

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