Manual of Petroleum Measurement Standards Chapter 4.9.1

Introduction to the Determination of the Volume of Displacement and Tank Provers

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Provers are precise, volumetric standards that are used to verify the accuracy of liquid flow meters. Both displacement and tank provers are used to prove a meter to obtain its meter factor. The base volume of a displacement or tank prover, determined by calibration, is an essential requirement in the determination of these meter factors. The accuracy of a meter factor is limited by several considerations, as shown below.

— equipment performance;

— observation errors;

— prover volume calibration errors;

— calculation errors.

Prover volumes used to calibrate meters are determined by calibration and not by theoretical calculation. Volumetric provers shall have an exact reference volume determined by a recognized method of calibration. Techniques for the determination of this reference volume include the waterdraw, master meter, and gravimetric methods of calibration. API *MPMS* Chapters 4.9.2, 4.9.3, and 4.9.4 are used to accurately determine the calibrated volume of meter provers.

U.S. Customary and Metric (SI) Units

This standard presents U.S. Customary (USC) units. Where International System (SI) are not presented, they can be referenced in Annex D. Implementation of either system of units in a calibration can be limited by a method's individual standard. The system of units to be used is typically determined by contract or regulatory requirements.

National Metrology Institutes

Throughout this document, issues of traceability are addressed by references to the National Institute of Standards and Technology (NIST). However, other appropriate national metrology institutes can be referenced.

Safety Considerations

There is no intent to cover safety aspects of conducting the work described in this standard, and it is the duty of the user to be familiar with all applicable safe work practices.

Introduction to the Determination of the Volume of Displacement and Tank Provers

1 Scope

Chapter 4, Section 9 covers all the procedures required to determine the field data necessary to calculate a base prover volume (BPV) of either displacement provers or volumetric tank provers. It will enable the user to perform all the activities necessary to prepare the prover, conduct calibration runs, and record all the required data necessary to calculate the base volumes of displacement and tank provers. Evaluation of the results and troubleshooting of many calibration problems are also discussed.

This component, Chapter 4, Section 9, Part 1, is the introduction, and contains all those relevant aspects that are general in nature, yet essential and applicable to all the different methods of calibration. Therefore, each subsequent part, which describes a specific method of prover calibration, shall be used with Part 1. Together, the two parts contain all the information that is essential to complete the required method of calibration.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API *MPMS* Chapter 4.2, *Displacement Provers*

API *MPMS* Chapter 4.7, *Field Standard Test Measures*

API *MPMS* Chapter 4.8, *Operation of Proving Systems*

API *MPMS* Chapter 4.9, *Methods of Calibration for Displacement and Volumetric Tank Provers Part 2—Determination of the Volume of Displacement and Tank Provers by the Waterdraw Method of Calibration*

API *MPMS* Chapter 4.9, *Methods of Calibration for Displacement and Volumetric Tank Provers Part 3—Determination of the Volume of Displacement Provers by the Master Meter Method of Calibration*

API *MPMS* Chapter 4.9, *Methods of Calibration for Displacement and Volumetric Tank Provers Part 4—Determination of the Volume of Displacement and Tank Provers by the Gravimetric Method of Calibration*

API *MPMS* Chapter 5 (all sections), *Metering*

API *MPMS* Chapter 12.2.4, *Calculation of Petroleum Quantities Using Dynamic Measurement Methods and Volumetric Correction Factors, Part 4—Calculation of Base Prover Volumes by Waterdraw Method*

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply. Terms of more general use may be found in API *MPMS* Chapter 1, *Online Terms and Definitions Database*.

3.1
base prover volume
BPV
The volume of the prover at base conditions as shown on the prover calibration certificate.