

Manual of Petroleum Measurement Standards Chapter 4—Proving Systems

Section 7—Field Standard Test Measures

THIRD EDITION, APRIL 2009

REAFFIRMED: JUNE 20, 2014



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Measurement Coordination Department

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Foreword

This edition of this standard consolidates the latest changes and improved technology in field standard test measures since it was first published in October 1988. Units of measurement in this standard are U.S. customary (USC) units and metric (SI) 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 (API) and with the assistance of the National Institute of Standards and Technology (NIST).

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Introduction

The primary purpose of a field standard test measure is to provide a standardized volume, used for the calibration of displacement and tank provers, when calibrated by the waterdraw method. A field standard test measure is a vessel fabricated to meet specific design criteria and calibrated by a National Metrology Institute (NMI). The NMI of the United States is the National Institute of Standards and Technology (NIST). Throughout this document, issues of traceability are addressed by reference to NIST. All field standard test measures used for prover calibrations in the United States shall have a current "Report of Calibration," issued by NIST.

In countries other than the United States, other NMIs may be used. On some occasions, the same test measure may be calibrated by two or more different NMIs for use in different countries, e.g. NIST and the Canadian Standards Agency (CSA) may both calibrate the same test measure. Calibrations by different NMIs may result in different volumes. Typically, this is due to different reference conditions, procedures, methods (gravimetric vs volumetric), calibration fluids and drain times.

Chapter 4—Proving Systems

Section 7—Field Standard Test Measures

1 Scope

This standard details the essential elements of field standard test measures by providing descriptions, construction requirements, as well as inspection, handling, and calibration methods. Bottom-neck scale test measures and prover tanks are not addressed in this document. The scope of this standard is limited to the certification of “delivered volumes” of test measures.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies.

API Manual of Petroleum Measurement Standards (MPMS) Chapter 1, Vocabulary

API MPMS Chapter 4.2, Displacement Provers

API MPMS Chapter 4.4, Tank Provers

API MPMS Chapter 4.8, Operation of Proving Systems

API MPMS Chapter 4.9, Methods of Calibration for Displacement and Volumetric Tank Provers

API MPMS Chapter 7, Temperature Determination

API MPMS Chapter 11, (all sections) Physical Properties Data

API MPMS Chapter 12, (all sections) Calculation of Petroleum Quantities

API MPMS Chapter 13, (all sections) Statistical Aspects of Measuring and Sampling

NIST Calibration Services for Liquid Volume ¹, *Quality System Manual QM-IV-8361 for the Liquid Volume Calibration Services*

NIST Handbook 105-3, *Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures, Part 3: Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards*

NIST Special Publication 250-72, *NIST Calibration Services for Liquid Volume*

NIST Technical Note 1297 (1994), *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*

NOTE All references in this standard are to the most current NIST documents. More current revisions of these documents may replace those listed above. Refer to the NIST web address: www.nist.gov/fluid_flow or <http://ts.nist.gov/weightsandmeasures/pubs.cfm> for the most current documents.

3 Terms and Definitions

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

3.1

borosilicate glass

A glass with a low coefficient of thermal expansion.

¹ National Institute of Standards and Technology, 100 Bureau Drive, Stop 3460, Gaithersburg, Maryland 20899, www.nist.gov

3.2

calibrated volume

Also defined as the field standard test measure base volume (BMV); the delivered volume of a field standard test measure, at its reference temperature, between its defined “full and empty” levels.

3.3

calibration

A set of operations which 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.

3.4

cessation of main flow

During the draining of a field standard test measure, the moment when the full discharging water stream “breaks” and becomes a small trickle.

3.5

clingage

The film of liquid that adheres to the inside surface of a field standard test measure after it has been drained and is considered empty.

3.6

contained volume

The volume of liquid (at the reference temperature) held by field test measure filled to the zero reference mark. It is larger than the delivered volume due to clingage of liquid to the inside walls of the test measure. It is also the volume of liquid necessary to fill a clean, dry, empty, test measure to the zero reference mark on the neck scale. “Contained volume” was previously described as “to contain.” The contained volume *is not used* in the calibration of provers.

3.7

delivered volume

The volume of liquid (at the reference temperature) that exits a test measure when it is emptied from its full condition and drained in accordance with the prescribed draining time. In previous standards and certifications’ “delivered volume” was described as “to deliver.” The delivered volume is the only volume used in the calibration of provers.

3.8

field standard test measure

A volumetric, non-pressurized, cylindrical, metal container, with a cylindrical neck containing a gauge glass and scale. Designed to stringent specifications, it “contains” or “delivers” an exact volume between a fixed bottom or a bottom shut-off valve and an upper-neck scale reading.

3.9

high-resolution type

A field standard test measure designed with a smaller-diameter neck, which is used to achieve greater neck volume resolution. This type of test measure is also called “high-sensitivity” or “high-accuracy.”

3.10

reference temperature

The temperature at which the test measure is intended to “contain volume” or to “deliver volume” at its nominal capacity.

3.11

slicker-plate test measure

A vessel similar to a field standard test measure, except it has no sight glass and neck scale. It is filled so that the liquid just extends above the top of the neck, due to surface tension, where the excess is sheared off by sliding a transparent plate across the top of the neck. Slicker-plate test measures are *not used* in the calibration of provers.