# Manual of Petroleum Measurement Standards Chapter 4—Proving Systems

## Section 4—Tank Provers

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# FOREWORD

Chapter 4 of the *Manual of Petroleum Measurement Standards* was prepared as a guide for the design, installation, calibration, and operation of meter proving systems commonly used by the majority of petroleum operators. The devices and practices covered in this chapter may not be applicable to all liquid hydrocarbons under all operating conditions. Other types of proving devices that are not covered in this chapter may be appropriate for use if agreed upon by the parties involved.

The information contained in this edition of Chapter 4 supersedes the information contained in the previous edition (First Edition, May 1978), which is no longer in print. It also supersedes the information on proving systems contained in API Standard 1101, *Measurement of Petroleum Liquid Hydrocarbons by Positive Displacement Meter* (First Edition, 1960); API Standard 2531, *Mechanical Displacement Meter Provers*; API Standard 2533, *Metering Viscous Hydrocarbons*; and API Standard 2534, *Measurement of Liquid Hydrocarbons by Turbine-Meter Systems*, which are no longer in print.

This publication is primarily intended for use in the United States and is related to the standards, specifications, and procedures of the National Institute of Standards and Technology (NIST). When the information provided herein is used in other countries, the specifications and procedures of the appropriate national standards organizations may apply. Where appropriate, other test codes and procedures for checking pressure and electrical equipment may be used.

For the purposes of business transactions, limits on error or measurement tolerance are usually set by law, regulation, or mutual agreement between contracting parties. This publication is not intended to set tolerances for such purposes; it is intended only to describe methods by which acceptable approaches to any desired accuracy can be achieved. Chapter 4 now contains the following sections:

Section 1, “Introduction”
Section 2, “Conventional Pipe Provers”
Section 3, “Small Volume Provers”
Section 4, “Tank Provers”
Section 5, “Master-Meter Provers”
Section 6, “Pulse Interpolation”
Section 7, “Field-Standard Test Measures”
Section 8, “Operation of Proving Systems”

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Suggested revisions are invited and should be submitted to the Measurement Coordinator, American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

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# Chapter 4—Proving Systems

## Section 4—Tank Provers

## 1 Introduction

Throughout this chapter a prover tank shall be considered an open or closed volumetric measure that generally has a graduated top neck and may have a graduated bottom neck. The volume is established between a shut-off valve or bottom-neck graduation and an upper-neck graduation.

The requirements in this chapter are intended for crude oil and refined petroleum products. Meter proving requirements for other fluids should be appropriate for the overall custody-transfer accuracy and should be agreeable to the parties involved.

## 2 Scope

This chapter specifies the characteristics of stationary (fixed) or portable tank provers that are in general use and the procedures for their calibration. Guidelines are provided for the design, manufacture, calibration and use of new and/or replacement tank provers, and are not intended to make any existing tank provers obsolete.

More specific design criteria are available in NIST[1] Handbook 105-3, *Specifications and Tolerances for Graduated Neck-Type Volumetric Field Standards* (includes Provers, per Section 1.1 of NIST 105-3). Consideration must also be given to the requirements of any weights and measures authority that may be involved.

## 3 Referenced Publications

The current editions of the following standards, codes, and specifications are cited in this chapter:

API

*Manual of Petroleum Measurement Standards*

| | |
|---|---|
| Chapter 1 | *Vocabulary* |
| Chapter 4 | *Proving Systems* |
| Chapter 5 | *Metering* |
| Chapter 7 | *Temperature Determination* |
| Chapter 11 | *Physical Properties Data* |
| Chapter 12 | *Calculation of Petroleum Quantities* |
| Chapter 13 | *Statistical Aspects of Measuring and Sampling* |

NIST[1]

| | |
|---|---|
| Handbook 105-3 | *Specifications and Tolerances for Graduated Neck-Type Volumetric Field Standards* |

[1]National Institute of Standards and Technology, Gaithersburg, Maryland 20899.

## 4 Equipment

### 4.1 GENERAL CONSIDERATIONS

All components of the tank prover installation, including connecting piping, valves, and manifolds, shall be in accordance with applicable pressure codes.

Once a closed tank prover is on stream, it becomes part of the pressure system. Provisions should be made for expansion and contraction, vibration, reaction to pressure surges, and other process conditions. Consideration should be given to the installation of valving to isolate the tank prover from line pressure when the system is not in use or during maintenance.

All closed tank provers should be equipped with vent and drain connections.

Provisions should be made for the disposal of liquids and/or vapors that are drained or vented from the tank prover. The disposal may be accomplished by pumping liquids or vapors back into the system or by diverting them to a collecting point.

Blind flanges or valve connections should be provided on either side of a double block-and-bleed valve in the tank prover piping system. These connections can serve as locations for proving portable meters or as a means of calibrating the tank prover by the master-meter or waterdraw method.

### 4.2 VALVES

All valves used in a tank prover system that can provide or contribute to a bypass of liquid around the tank prover or the meter or to leakage between the tank prover and the meter shall be double block-and-bleed valves, or the system shall be provided with valves and piping that are the equivalent. A method for checking leakage in the valve system is required.

### 4.3 WIRING AND CONTROLS

All wiring devices and controls shall conform to the applicable codes.

Electrical controls and components should be located in a convenient place for operation and maintenance.

### 4.4 SAFETY DEVICES

Safety relief valves, with discharge piping and leak detection facilities, shall be installed to control thermal expansion of the liquid in the tank prover and its connecting piping while they are isolated from the main stream. Automatic and remote controls should be protected with lockout switches or circuits or both between remote and local panel locations to prevent accidental remote operation while a unit is being controlled locally.