THE INSTITUTE OF PETROLEUM

PETROLEUM MEASUREMENT MANUAL

# PART X
Meter Proving

## SECTION 7

## CALIBRATION OF REFERENCE METERS USED FOR GANTRY METER PROVING

## SUB-SECTION 7.1

## SMALL VOLUME PROVER METHOD

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**Petroleum Measurement Manual, Part X: Meter Proving**
**Section 7: Calibration of Reference Meters Used for Gantry Proving.**

## Addendum

This section of the Petroleum Measurement Manual was published as two sub-sections:

- 7.1: Small Volume Prover Method (1996)
- 7.2: Volumetric and Gravimetric Tank Method (1999)

Both sub-sections refer to the fact that a reference meter should be calibrated on each specific type of product that will be measured by the gantry meters to be proved by the reference meter. Despite this, it is acknowledged that reference meters have sometimes been calibrated on products similar to those on which they will subsequently be used, and a fixed correction applied to the meter factor to account for the change in performance of the meter.

Recent research, sponsored by the Institute of Petroleum, has demonstrated the magnitude of the errors that may be generated by following this approach.

Reference PD meters are, on occasions, calibrated on gas oil and then used on ultra low sulphur diesel (ULSD), with a meter factor correction of 0,1% applied to obtain the meter's performance on ULSD. Tests on six reference PD meters showed significant variations in performance between individual meters, with the result that the use of a fixed correction of 0,1% would have produced metering errors of up to 0,07% at 2250 l/min (the maximum flow rate), with larger errors at lower flow rates.

Similar performance variations between individual meters were noted with motor spirit. Such variations will lead to significant errors when a reference PD meter is calibrated on a motor spirit substitute and a fixed meter factor correction applied to establish its performance on motor spirit.

The recommendation in the original documents, that a reference meter should be calibrated on each specific type of product on which it will subsequently be used, is therefore reinforced by the results of recent IP research.

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**Annexes**

# FOREWORD

Measurement accuracy is essential for the sale, purchase and handling of petroleum products. It reduces the likelihood of disputes between buyer and seller and facilitates the control of losses. Accurate measurement demands the use of calibration equipment with accuracy traceable to national or international standards and the adoption of standard procedures.

The Petroleum Measurement Committee of the Institute of Petroleum is responsible for the production and maintenance of standards and guides covering the various aspects of static and dynamic measurement of petroleum. These are issued as separate Parts and Sections of the Institute's *Petroleum Measurement Manual*, which was first published in 1952.

Membership of the IP working panels is made up of experts from the oil industry, equipment manufacturers, cargo inspectors and government authorities. Liaison is maintained with parallel working groups of the Committee on Petroleum Measurement of the American Petroleum Institute, and is extended as necessary to embrace other organizations concerned with quantitative measurement in other countries and in other industries.

Users are invited to send comments, suggestions, or details of experience with this issue to:

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The *Petroleum Measurement Manual* is widely used by the petroleum industry and has received recognition in many countries by consumers and the authorities. In order to promote their wide adoption internationally, it is the policy to submit selected standards through the British Standards Institute to Technical Committee TC 28 - Petroleum Products and Lubricants - of the International Organization for Standardization (ISO/TC 28) as potential International Standards.

A full list of the Parts and Sections of the *Petroleum Measurement Manual* (PMM) is available on request from the Institute of Petroleum.

*Note*

The IP *Petroleum Measurement Manual* is recommended for general adoption but shall be read and interpreted in conjunction with weights and measures, safety and other regulations in force at the particular location where it is to be applied. Such regulatory requirements shall have precedence over the corresponding clauses in the Manual except where the requirements of the Manual are more rigorous, when its use is recommended. The Institute disclaims responsibility for any personal injury or loss or damage to property, howsoever caused, arising from the use or abuse of any Part or Section of the Manual.

# ACKNOWLEDGEMENTS

This Part of the Petroleum Measurement Manual was prepared by a Working Group drawn from the Commercial Metering Committee, PM-D-4, which is part of the Institute's Petroleum Measurement Committee structure.

Members of the Working Group associated with production of the standard were:-

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# INTRODUCTION AND SCOPE

Recommended procedures for the proving of gantry meters are provided in Part X of the IP Petroleum Measurement Manual, Sections 2 and 5, which describe the use of reference meters and volumetric proving tanks as traceable reference measurement standards.

While the earlier sections of Part X of this Manual provide general guidance on the various methods of reference meter calibration, no detailed procedures for calibration have hitherto been available. Methods for the calibration of reference meters include the use of gravimetric facilities within calibration laboratories, or the use of volumetric proving tanks or pipe provers under either laboratory or field conditions.

This sub-section of the Petroleum Measurement Manual has been prepared to provide guidance for the calibration, using small volume provers (SVPs), of reference meters specifically used for proving loading gantry meters. A principal requirement for this application is that the proving be carried out, wherever practicable, using the actual grades of product metered by the gantry meters, in order to minimise measurement uncertainty associated with the use of different viscosity test liquids.

This procedure for calibration of the reference meter using SVPs may therefore differ from that described in other Parts of the Petroleum Measurement Manual dealing with other applications of small volume provers and their calibration.

Small volume provers provide a closed system method of meter calibration that may be used in the field. They offer the advantage that comparatively small volumes of actual metered products are used in the operation.

This document describes the selection and calibration of equipment and the operational procedures and calculation routines that are recommended when using SVPs. Procedures for the calibration of reference meters with volumetric proving tanks will be detailed in a future sub-section 7.2 of Part X of the Petroleum Measurement Manual.

It should be noted that the method described herein is intended only for use with refined products that are loaded into non-pressurised road or rail vehicles via gantry meters. It is not intended for use with products such as live crude oil or liquefied petroleum gases.

The use of the verb 'shall' in this document indicates an action that is required to be observed in order to achieve the high standards of measurement accuracy and traceability achievable by this procedure.