INTERNATIONAL STANDARD

**ISO 7278-4**

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# Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters —

## Part 4:
Guide for operators of pipe provers

*Hydrocarbures liquides — Mesurage dynamique — Systèmes d'étalonnage des compteurs volumétriques —*

*Partie 4: Manuel de référence pour les opérateurs de tubes étalons*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7278-4 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 2, *Dynamic petroleum measurement*.

ISO 7278 consists of the following parts, under the general title *Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters*:

— *Part 1: General principles*

— *Part 2: Pipe provers*

— *Part 3: Pulse interpolation techniques*

— *Part 4: Guide for operators of pipe provers*

— *Part 5: Small volume provers*

Annex A of this part of ISO 7278 is for information only.

## Introduction

All measuring instruments which have to meet a standard of accuracy need periodic calibration – that is to say, a test or series of tests has to be performed in which readings obtained from the instrument are compared with independent measurements of higher accuracy. Petroleum meters are no exception. Nearly all those used for the purpose of selling or assessing taxes, by national laws, need proving at intervals, and when there is a large amount of money at stake they are likely to be calibrated quite frequently. In the petroleum industry the term 'proving' is used to describe the procedure of calibrating volume meters on crude oil and petroleum products.

The most usual way to prove a meter is to pass a quantity of liquid through it into an accurate device for measuring volume, known as a prover. With very small meters the proving device may be a volumetric flask or similarly shaped vessel of metal with an accurately known volume. There are, for instance, standard measuring vessels which can be used to prove the meters incorporated in gasoline dispensing pumps at roadside filling stations. If the pump dial registers 10,2 litres when enough gasoline has been delivered to fill a 10 litre vessel, it is evident that the meter is over-reading by 2 %.

In a large metering installation, where a single meter can be passing thousands of litres per second, the situation is much more complicated. The measuring elements of the meters generally do not drive mechanical dials graduated in units of volume like a gasoline dispenser, but instead cause a series of electrical pulses to be generated which are registered by electrical counters. With meters of this type the purpose of proving is to determine the relationship between the number of pulses generated/counted and the volume passed through the meter – a relationship which varies with the design and size of the meter and can be affected by flowrate and liquid properties.

Another difficulty is that where the meters are in a pipeline the flow through these large meters usually cannot be stopped and started at will. Consequently, both the meters and the prover have to be capable of being read simultaneously and 'on the fly', that is, while liquid is passing through them at a full flowrate. The proving is complicated still further by the effects of thermal expansion and compressibility on the oil, and that of thermal expansion and elastic distortion under pressure on the steel body of the prover.

This part of ISO 7278 is concerned with only one class of provers, known as pipe provers, which are used very widely where meters for crude oil and petroleum products have to be proved to the highest possible standards of accuracy. In principle, a pipe prover is only a length of pipe or a cylinder whose internal volume has been measured very accurately and having a well-fitted piston (or a tightly-fitted sphere acting like a piston) inside it, so that the volume swept out by the piston or sphere can be compared with the meter readout while a steady flow of liquid is passing through the meter and prover in series. In practice, however, various accessories must be added to the simple pipe-and-piston arrangement to produce a prover that will work effectively.

# Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters —

# Part 4:
Guide for operators of pipe provers



## 1 Scope

This part of ISO 7278 provides guidance on operating pipe provers to prove turbine meters and displacement meters. It applies both to the types of pipe prover specified in ISO 7278-2, which are referred to here as “conventional pipe provers”, and to other types referred to here as “compact pipe provers” or “small volume provers”.

It is intended for use as a reference manual for the operation of pipe provers, and also for use in staff training. It does not cover the detailed differences between provers of broadly similar types made by different manufacturers.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7278. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7278 are encouraged to investigate the possibility of applying the most recent editions of the International Standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2714:1980, *Liquid hydrocarbons — Volumetric measurement by displacement meter systems other than dispensing pumps*.

ISO 2715:1981, *Liquid hydrocarbons — Volumetric measurement by turbine meter systems.*

ISO 4124:1994, *Liquid hydrocarbons — Dynamic measurement — Statistical control of volumetric metering systems.*

ISO 4267-2:1988, *Petroleum and liquid petroleum products — Calculation of oil quantities — Part 2: Dynamic measurement.*

ISO 7278-2:1988, *Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters — Part 2: Pipe provers.*

ISO 7278-3:1998, *Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters — Part 3: Pulse interpolation techniques.*

## 3 Principles

### 3.1 Ways of expressing a meter’s performance

The object of proving meters with a pipe prover is to provide a number with (usually) four or five significant digits – such as 1,002 9, 0,999 8, or 21 586 which can afterwards be used to convert the readout of the meter into an accurate value of the volume passed through the meter.