SLOVENSKI STANDARD
SIST EN ISO 7278-2:2023

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Merilni sistemi za nafto - 2. del: Načrtovanje, kalibracija in delovanje merilnika cevi (ISO 7278-2:2022)

Petroleum measurement systems - Part 2: Pipe prover design, calibration and operation (ISO 7278-2:2022)

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Flüssige Kohlenwasserstoffe - Dynamische Messung - Prüfsysteme für volumetrische Messgeräte - Teil 2: Rohrprüfer (ISO 7278-2:2022)

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Systèmes de mesurage des produits pétroliers - Partie 2: Conception, étalonnage et fonctionnement des tubes étalons (ISO 7278-2:2022)

Ta slovenski standard je istoveten z: **EN ISO 7278-2:2022**

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75.180.30	Oprema za merjenje prostornine in merjenje	Volumetric equipment and measurements

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EUROPEAN STANDARD

NORME EUROPÉENNE

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Petroleum measurement systems - Part 2: Pipe prover design, calibration and operation (ISO 7278-2:2022)

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European foreword

This document (EN ISO 7278-2:2022) has been prepared by Technical Committee ISO/TC 28 "Petroleum and related products, fuels and lubricants from natural or synthetic sources" in collaboration with Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin” the secretariat of which is held by NEN.

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INTERNATIONAL STANDARD

ISO 7278-2

Second edition
2022-11

Petroleum measurement systems —

Part 2:
Pipe prover design, calibration and operation

Systèmes de mesurage des produits pétroliers —

Partie 2: Conception, étalonnage et fonctionnement des tubes étalons

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 2, *Measurement of petroleum and related products,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 19 *Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 7278-2:1988), which has been technically revised. It also cancels and replaces the first edition of ISO 7278-4:1999, the content of which has been incorporated.

The main changes are as follows:

— The content and scope now covers the design of pipe provers given in ISO 7278-2:1988 and the guidance for operators given in ISO 7278-4:1999, which will be withdrawn.

— The different types of pipe prover designs and operating methods have been defined and described.

— The variety of operational methods and the means to apply them to flowmeter calibration of different relative sizes has been described.

— The design, calibration and use of small volume (compact) prover designs has been included.

— The document has been changed from a normative document to a guidance document to reflect best practices.

— The document takes into account changes in practice described in alternative standards produced by the American Petroleum Institute (API) and the Energy Institute (EI).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

In the petroleum industry the term “proving” is used to refer to the calibration of devices used in the measurement of quantities of crude oils and petroleum products. Proving uses specified methods to show, or prove, that the result falls within specified acceptance criteria. Proving provides an assurance that the resultant measurement provides an acceptable uncertainty for the duty.

A pipe prover, otherwise called a displacement prover, is a volumetric reference device providing a calibration reference standard for flowmeters with an electronic pulsed output. The fluid remains contained within the piping system and proving can be carried out dynamically at various flowrates and pressures without interruption to the flow.

Pipe provers are used extensively within petroleum industry to provide in situ calibration of flowmeters used for fiscal, custody transfer and pipeline integrity applications. They are used with both crude and refined oils and products but may be used with many other fluids within and outside the petroleum industry.

A pipe prover consists of a length of pipe, a section of which has had its internal volume determined by calibration. A displacer, usually a piston or a tightly fitting sphere or ball, travels along this section of pipe displacing an accurately determined volume of liquid. This volume can be compared with an equivalent volume measured by the flowmeter under test.

The calibrated volume of the prover is established by the detection of the displacer passing along the calibrated section of pipe. Detectors sense the passage of the displacer indicating the start and end of travel through the calibrated section. The detectors trigger the counting of pulses produced by a flowmeter using electronic counters or counters within a flow computer. As the pulses represent the volume measured by the associated flowmeter, a calibration is achieved through the relationship with the calibrated volume of the pipe prover.

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Pipe provers are of different designs and are manufactured with a wide range of pipe diameters and volumes. They are available for use as part of a fiscal measurement system in fixed locations and as mobile reference devices.

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Any type of flow meter giving a pulsed output may be calibrated however the volume, design and type of the prover may impose limitations on the type and size of meter which would be compatible.

This document describes the design, construction, calibration and use of pipe provers primarily used for the calibration, proving and verification of flowmeters used for liquid petroleum products and may be applied to other liquid applications requiring a high standard of measurement accuracy.

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Petroleum measurement systems —

Part 2:
Pipe prover design, calibration and operation

WARNING — The use of this document may involve hazardous materials, operations and equipment. This document does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices.

1 Scope

This document provides descriptions of the different types of pipe provers, otherwise known as displacement provers, currently in use. These include sphere (ball) provers and piston provers operating in unidirectional and bidirectional forms. It applies to provers operated in conventional, reduced volume, and small volume modes.

This document gives guidelines for:

— the design of pipe provers of each type;

— the calibration methods;

— the installation and use of pipe provers of each type;

— the interaction between pipe provers and different types of flowmeters;

— the calculations used to derive the volumes of liquid measured (see Annex A);

— the expected acceptance criteria for fiscal and custody transfer applications, given as guidance for both the calibration of pipe provers and when proving flowmeters (see Annex C).

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This document is applicable to the use of pipe provers for crude oils and light hydrocarbon products which are liquid at ambient conditions. The principles apply across applications for a wider range of liquids, including water. The principles also apply for low vapour pressure, chilled and cryogenic products, however use with these products can require additional guidance.

2 Normative references

There are no normative references.

3 Terms, definitions, symbols and units

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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3.1.1
accuracy
closeness of the agreement between a measured quantity value and a true quantity value of a measurand

Note 1 to entry: The concept "measurement accuracy" is not a quantity and should not be given a numerical value. The quantitative expression of accuracy should be in terms of uncertainty. "Good accuracy" or "more accurate" implies small measurement error. Any given numerical value should be taken as indicative of this.

[SOURCE: ISO/IEC Guide 99:2007; 2.13, modified —Note 1 to entry modified; Notes 2 and 3 deleted.]

3.1.2
adjustment
set of operations carried out on a measuring system so that it provides prescribed indications corresponding to given values of a quantity to be measured

Note 1 to entry: Adjustment should not be confused with calibration which is a prerequisite for adjustment.

Note 2 to entry: After adjustment, a recalibration is usually required.

[SOURCE: ISO/IEC Guide 99:2007; 3.11, modified — Note 1 deleted; Notes 1 and 2 to entry shortened.]

3.1.3
batch
proving batch
set of consecutive proving runs that is deemed to be necessary to derive both a mean value of volume, *meter factor* (3.1.22) or *K-factor* (3.1.19), suitable for subsequent use and may also be used as an indication of the repeatability of the measurements

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Note 1 to entry: A batch may consist of multiple *runs* or one *run* (3.1.38) of a significant number of multiple *passes* (3.1.24).

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3.1.4
block-and-bleed valve
double-block-and-bleed valve
twin seal valve
high integrity valve with double seals and provision for detecting leakage past either seal

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3.1.5
calibration
set of operations that establish, under specified conditions, the relationship between quantities indicated by an instrument and the corresponding values realized by standards

Note 1 to entry: Calibration should not be confused with adjustment of a measuring system.

Note 2 to entry: *Proving* (3.1.27) is used in the oil industry and has the same meaning but can include a check of the results against specified acceptance criteria.

[SOURCE: ISO Guide 99:1993[1)]; 6.11, modified.]

3.1.6
calibrated volume
base volume
volume of a prover between detectors, or of a volumetric measure between a top and bottom datum, as determined by calibration and expressed at standard conditions

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3.1.7
cavitation
phenomenon related to, and following, *flashing* (3.1.14), where vapour bubbles or voids form and subsequently collapse or implode

Note 1 to entry: Cavitation causes significant measurement error and also potentially causes damage to the pipes, valves and meter components through erosion.

3.1.8
cyclic distortion
periodic variation in the pulse frequency generated by a meter caused by mechanical asymmetry within the meter and accessories

Note 1 to entry: See also *intra-rotational linearity* (3.1.18).

Note 2 to entry: Examples of accessories are calibrators and temperature compensators, mechanical or electronic.

3.1.9
detectors
devices set to directly, or indirectly, sense the passage of the *displacer* (3.1.11) hence indicating each end of the calibrated volume

3.1.10
discrimination
ability of a measuring instrument to respond to small changes in the value of the input

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3.1.11
displacer
sphere or a piston used to sweep out the calibrated volume between the *detectors* (3.1.9) of a pipe prover

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3.1.12
correction factor
numerical factor by which the uncorrected result of a measurement at the measured conditions is multiplied

Note 1 to entry: Correction factors to standard conditions are used to convert a volume at observed conditions to the volume at another (standard) condition.

3.1.13
error
measured quantity value minus a reference quantity value

Note 1 to entry: Relative error is error divided by a reference value. This can be expressed as a percentage.

[SOURCE: ISO/IEC Guide 99:2007, 2.16, modified — Notes 1 and 2 deleted; new Note 1 to entry added; and admitted terms "measurement error" and "error of measurement" deleted.]

3.1.14
flashing
phenomenon which occurs when the line pressure drops to, or below, the vapour pressure of the liquid, allowing gas to appear from solution or through a component phase change

Note 1 to entry: Vapour pressure of the fluid can increase with increasing temperature.

Note 2 to entry: Flashing is often due to a local pressure drop caused by an increase in liquid velocity, and generally causes significant measurement error.

Note 3 to entry: The free gas produced remains for a considerable distance downstream of the meter even if pressure recovers.

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