

<b>STN</b>	<b>Systémy na meranie ropy</b> <b>Časť 2: Navrhovanie, kalibrácia a prevádzkovanie</b> <b>potrubných meračov (ISO 7278-2: 2022)</b>	<b>STN</b> <b>EN ISO 7278-2</b>  65 6052
------------	---	---

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

Táto norma obsahuje anglickú verziu európskej normy.  
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 02/23

Obsahuje: EN ISO 7278-2:2022, ISO 7278-2:2022

Oznámením tejto normy sa ruší  
STN EN ISO 7278-2 (65 6052) zo septembra 2001

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN ISO 7278-2**

November 2022

ICS 75.180.30

Supersedes EN ISO 7278-2:1995

English Version

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

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

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

This European Standard was approved by CEN on 28 October 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

**EN ISO 7278-2:2022 (E)**

<b>Contents</b>	<b>Page</b>
<b>European foreword.....</b>	<b>3</b>

## **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.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2023, and conflicting national standards shall be withdrawn at the latest by May 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 7278-2:1995.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

## **Endorsement notice**

The text of ISO 7278-2:2022 has been approved by CEN as EN ISO 7278-2:2022 without any modification.

# INTERNATIONAL STANDARD

**ISO**  
**7278-2**

Second edition  
2022-11

---

---

## **Petroleum measurement systems — Part 2: Pipe prover design, calibration and operation**

*Systèmes de mesure des produits pétroliers —*

*Partie 2: Conception, étalonnage et fonctionnement des tubes étalons*



Reference number  
ISO 7278-2:2022(E)

© ISO 2022

**ISO 7278-2:2022(E)****COPYRIGHT PROTECTED DOCUMENT**

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b>	<b>v</b>
<b>Introduction</b>	<b>vi</b>
<b>1 Scope</b>	<b>1</b>
<b>2 Normative references</b>	<b>1</b>
<b>3 Terms, definitions, symbols and units</b>	<b>1</b>
3.1 Terms and definitions	1
3.2 Symbols and units	8
<b>4 Design classification of pipe provers</b>	<b>9</b>
4.1 Common features	9
4.2 Sphere provers	11
4.2.1 General	11
4.2.2 Unidirectional sphere provers	11
4.2.3 Bidirectional sphere provers	13
4.3 Piston provers	15
4.3.1 General	15
4.3.2 Unidirectional piston provers	16
4.3.3 Bidirectional piston provers	16
<b>5 Operational classification of provers</b>	<b>16</b>
5.1 General	16
5.2 Conventional prover	17
5.3 Reduced volume prover	18
5.4 Small volume prover	18
<b>6 Design</b>	<b>20</b>
6.1 General considerations	20
6.2 Prover barrel	21
6.2.1 End chambers (launch and receive chambers)	21
6.2.2 Run-in length	22
6.2.3 Prover pipe or barrel	22
6.2.4 Internal finish	22
6.3 Proprietary small volume piston provers	23
6.4 Sizing of provers	24
6.4.1 General	24
6.4.2 Calibrated volume	25
6.4.3 Length between detectors	25
6.4.4 Diameter and Velocity	26
6.4.5 Pressure loss	26
6.5 Displacers	27
6.5.1 General	27
6.5.2 Spheres	27
6.5.3 Pistons	28
6.6 Displacer Velocity	28
6.6.1 General	28
6.6.2 Minimum velocity	28
6.6.3 Maximum velocity	29
6.7 Detectors	29
6.8 Prover valves	30
6.9 Additional design considerations	31
<b>7 Ancillary equipment</b>	<b>32</b>
7.1 Overview of temperature and pressure measurement	32
7.2 Temperature measurement	32
7.3 Pressure measurement	33
7.4 Calibration connections	33

**ISO 7278-2:2022(E)**

7.5	System control.....	34
<b>8</b>	<b>Pulse interpolation.....</b>	<b>34</b>
<b>9</b>	<b>Installation.....</b>	<b>34</b>
9.1	Mechanical installation.....	34
9.1.1	General.....	34
9.1.2	Fixed provers.....	37
9.1.3	Mobile provers.....	37
9.2	Electrical installation.....	38
9.3	Other installation recommendations.....	38
<b>10</b>	<b>Traceability.....</b>	<b>38</b>
<b>11</b>	<b>Calibration.....</b>	<b>40</b>
11.1	General.....	40
11.2	Calibration circuits and equipment.....	40
11.3	Water draw calibration method.....	42
11.3.1	Description.....	42
11.3.2	Volumetric measure as reference.....	43
11.3.3	Gravimetric as reference.....	45
11.4	Master meter calibration method.....	47
11.5	Sequential master meter method.....	50
11.6	Concurrent master meter method.....	51
11.7	Calibration procedures.....	51
<b>12</b>	<b>Operation to prove a flowmeter.....</b>	<b>52</b>
12.1	Setting up a prover.....	52
12.2	Mobile prover prior to arrival on site.....	52
12.3	Mobile prover on arrival on site.....	52
12.4	Stabilizing temperature.....	53
12.5	Periodical checks of factors affecting accuracy.....	53
12.6	Meter proving operation.....	53
12.7	Preliminary assessment of the results.....	54
12.8	Fault finding.....	55
<b>13</b>	<b>Safety.....</b>	<b>55</b>
13.1	General.....	55
13.2	Permits.....	56
13.3	Opening end chambers and removing a displacer.....	56
13.4	Special precautions when proving with LPG.....	56
13.5	Fire precautions.....	57
13.6	Miscellaneous safety precautions.....	57
13.7	Safety records.....	57
	<b>Annex A (informative) Calculations.....</b>	<b>59</b>
	<b>Annex B (informative) Selecting a prover volume for a flowmeter.....</b>	<b>70</b>
	<b>Annex C (informative) Acceptance criteria and performance specification.....</b>	<b>72</b>
	<b>Annex D (informative) Troubleshooting.....</b>	<b>83</b>
	<b>Annex E (informative) Sphere or detector replacement and twin pairs of detectors.....</b>	<b>89</b>
	<b>Annex F (informative) Pulse interpolation.....</b>	<b>91</b>
	<b>Annex G (informative) Alternative designs.....</b>	<b>95</b>
	<b>Annex H (informative) Calibration procedures.....</b>	<b>97</b>
	<b>Annex I (informative) Example of prover calibration certificate.....</b>	<b>102</b>
	<b>Bibliography.....</b>	<b>107</b>



## 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.

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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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](http://www.iso.org/members.html).

## ISO 7278-2:2022(E)

### 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.

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.

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.

# 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](#)).

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.

**koniec náhľadu – text ďalej pokračuje v platenej verzii STN**