



BSI Standards Publication

Water meters for cold potable water and hot water

Part 2: Test methods

National foreword

This British Standard is the UK implementation of EN ISO 4064-2:2017+A11:2022. It is derived from ISO 4064-2:2014. It supersedes BS EN ISO 4064-2:2014, which is withdrawn.

The start and finish of text introduced or altered by amendment A11 is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A11 is indicated by A11 A11.

The UK participation in its preparation was entrusted to Technical Committee CPI/30/7, Volume flow-rate methods.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

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Amendments/corrigenda issued since publication

Date	Text affected
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English Version

Water meters for cold potable water and hot water - Part
2: Test methods (ISO 4064-2:2014)

Compteurs d'eau potable froide et d'eau chaude -
Partie 2: Méthodes d'essai (ISO 4064-2:2014)

Wasserzähler zum Messen von kaltem Trinkwasser
und heißem Wasser - Teil 2: Prüfverfahren (ISO 4064-
2:2014)

This European Standard was approved by CEN on 11 May 2017.

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European foreword

The text of ISO 4064-2:2014 has been prepared by Technical Committee ISO/TC 30 “Measurement of fluid flow in closed conduits” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 4064-2:2017 by Technical Committee CEN/TC 92 “Water meters” the secretariat of which is held by SNV.

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of an identical text or by endorsement, at the latest by November 2017, and conflicting national standards shall be withdrawn at the latest by November 2017.

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

This document supersedes EN ISO 4064-2:2014.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directives, see informative Annex ZA, which is an integral part of this document.

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Endorsement notice

The text of ISO 4064-2:2014 has been approved by CEN as EN ISO 4064-2:2017 without any modification.

European foreword to Amendment A11

This document (EN ISO 4064-2:2017/A11:2022) has been prepared by Technical Committee CEN/TC 92 “Water meters” the secretariat of which is held by SNV.

This Amendment to the European Standard EN ISO 4064-2:2017 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2023, and conflicting national standards shall be withdrawn at the latest by June 2023.

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Annex ZA
(informative)

Relationship between this European Standard and the essential requirements of Directive 2014/32/EU aimed to be covered

This European Standard has been prepared under a Commission's standardization request Mandate to CEN and CENELEC for standardisation in the field of measuring instruments "M/374 EN" to provide one voluntary means of conforming to essential requirements of Directive 2014/32/EC EU of the European Parliament and the Council of 26 February 2014 on measuring instruments (Text with EEA relevance).

Once this standard is cited in the Official Journal of the European Union under that Directive 2014/32/EU, compliance with the normative clauses of this standard given in Table ZA.1 and application of the edition of the normatively referenced standards as given in Table [ZA.2] confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive 2014/32/EU, and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Annex I of Directive 2014/32/EU.

Essential Requirements (ERs) of Directive 32/2014/EU Annex I Essential Requirements Note: Amended by Directive 2015/13/EU		Clause(s)/subclause(s) of this EN	Qualifying remarks/Notes
I.1.1 and 1.2 Allowable errors, Rated operating conditions		7.4 4	
I.1.3.1 Climatic environments, temperature limits		8.2 8.3 8.4	
I.1.3.2 Mechanical environments		8.6 8.7	
I.1.3.3 Electromagnetic environments		8.5 8.8 8.9 8.10 8.11 8.12 8.13 8.14 8.15 8.16	

I.1.3.4 Other influences		8.5.2 8.5.3 8.5.4	
I.1.4.1 Basic rules for testing		7.2.2 7.4.2 7.4.3 7.4.4 7.4.5 7.4.6 8.1	
I.1.4.2 Ambient humidity		4 8.4	
I.2 Reproducibility			
I.3 Repeatability		7.4.4	
I.4 Discrimination and sensitivity		6.4.3.6	
I.5 Durability		7.11	
I.6 Reliability		7.11	
I.7.1 Fraudulent use		6.2 6.4.4 7.12	
I.7.2 Suitable for use		6.4.3 7 8	
I.7.3 Unduly biasing		7.4 8.17	
I.7.5 Robustness and suitability of materials		7 8	
I.7.6 Allow for control after placing on the market		6.4.3 6.4.4 Annex A	
I.9.1 Inscriptions		6.4.2	Addressed
I.9.5 Scale interval for the measurand		6.4.3.6.2.1	Addressed

I.9.7 Unit of measurement		Not addressed in EN ISO 4064-2	Addressed in EN ISO 4064-1, 6.7.1.2
I.9.8 Marking properties		6.4.2	Addressed
I.10.1 Display or hard copy		6.4.3	Addressed
I.10.2 Reading properties		6.4.3.1	Addressed
I.10.5 Properties of display for remote reading		6.4.3	Addressed
I.12 Conformity evaluation		9	Addressed also in EN ISO 4064-1, 3.6 and 7.3
Specific Requirements of Annex III for WATER METERS (MI-001)	Specific Requirements of Annex MI-001 for WATER METERS	Clause(s)/subclause(s) of this European Standard	Qualifying remarks/Notes
MI.1 Values of flow rate range Note: addresses amendment of Directive 2015/13/EU		7.4	
MI.2 Temperature range of the water		7.5 7.6	
MI.3 Relative pressure of the water		7.3 7.7	
MI.4 Nominal value of AC voltage supply and limits of DC supply		8.5	
MI.5 MPE ± 2 % for water temperature ≤ 30 °C for flow rate between Q2 (included) and Q4		7.4.5	
MI.5 MPE ± 3 % for water temperature > 30 °C for flow rate between Q2 (included) and Q4		7.4.5	
MI.6 MPE ± 5 % for any water temperature for flow rate between Q1 and Q2 (excluded)		7.4.5	
MI.6 Non exploitation of MPE		7.4.5 10.1.4	Not covered
MI.7.1.1 Electromagnetic immunity		8.1.3 8.12 8.13	
MI.7.1.2 Condition after electromagnetic disturbance		8.1.3 8.12 8.13	
MI 7.1.3 Critical change value		8.1.3	

		8.12 8.13	
MI 7.2.1 Variation of measurement after durability		7.11	
MI 7.2.2 Error of indication after durability		7.11	
MI.8.1 Meter able to be installed in defined position		7.4.2.2.7.5	
MI.8.2 Meter is not designed to measure reverse flow		7.8	
MI.9 Cubic metre		6.4.3.2	

Table ZA.2 — Applicable Standards to confer presumption of conformity as described in this Annex ZA

Column 1 Reference in Clause 2	Column 2 International Standard Edition	Column 3 Title	Column 4 Corresponding European Standard Edition
ISO 4064-1:2014 OIML R 49-1:2013	ISO 4064-1:2014	Water meters for cold potable water and hot water — Part 1: Metrological and technical requirements	EN ISO 4064-1:2017 EN ISO 4064-1:2017/A11:2022
ISO 4064-3:2014 OIML R 49-3:2013	ISO 4064-3:2014	Water meters for cold potable water and hot water — Part 3: Test report format	EN ISO 4064-3:2017
ISO/IEC Guide 98-3:2008	ISO/IEC Guide 98-3:2008	Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)	None For applicable standard edition see Column 2
IEC 60068-2-1	IEC 60068-2-1:2007	Environmental testing — Part 2-1: Tests — Test A: Cold	EN 60068-2-1:2007
IEC 60068-2-2	IEC 60068-2-2:2007	Environmental testing — Part 2-2: Tests — Test B: Dry heat	EN 60068-2-2:2007
IEC 60068-2-30	IEC 60068-2-30:2005	Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30:2005
IEC 60068-2-31	IEC 60068-2-31:2008	Environmental testing — Part 2-31: Tests — Test Ec: Rough handling shocks,	EN 60068-2-31:2008

		primarily for equipment-type specimens	
IEC 60068-2-47	IEC 60068-2-47:2005	Environmental testing — Part 2-47: Tests — Mounting of specimens for vibration, impact and similar dynamic tests	EN 60068-2-47:2005
IEC 60068-2-64	IEC 60068-2-64:2008+AMD1:2019	Environmental testing — Part 2-64: Tests — Test Fh: Vibration, broadband random and guidance	EN 60068-2-64:2008+AMD1:2019
IEC 60068-3-4	IEC 60068-3-4:2001	Environmental testing — Part 3-4: Supporting documentation and guidance — Damp heat tests	EN 60068-3-4:2002
IEC 60654-2	IEC 60654-2:1979	Operating conditions for industrial process measurement and control equipment — Part 2: Power	EN 60654-2:1997
IEC 61000-2-1	IEC TR 61000-2-1:1990	Electromagnetic compatibility (EMC) — Part 2: Environment — Section 1: Description of the environment — Electromagnetic environment for low-frequency conducted disturbances and signaling in public power supply systems	None For applicable standard edition see Column 2
IEC 61000-2-2	IEC 61000-2-2/AMD2:2018	Electromagnetic compatibility (EMC) — Part 2-2: Environment — Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage power supply systems	EN 61000-2-2/A2:2019 And EN 61000-2-2:2002/A1:2017
IEC 61000-4-1	IEC TR 61000-4-1:2016	Electromagnetic compatibility (EMC) — Part 4-1: Testing and measurement techniques — Overview of IEC 61000-4 series	None For applicable standard edition see Column 2
IEC 61000-4-2	IEC 61000-4-2:2008	Electromagnetic compatibility (EMC) — Part 4-2: Testing and	None

		measurement techniques — Electrostatic discharge immunity test	For applicable standard edition see Column 2
IEC 61000-4-3	IEC 61000-4-3:2020	Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio frequency, electromagnetic field immunity test	EN 61000-4-3:2006 and EN IEC 61000-4-3:2020 and EN 61000-4-3:2006/A2:2010 and EN 61000-4-3:2006/IS1:2009 And EN 61000-4-3:2006/A1:2008 (all Active!)
IEC 61000-4-4	IEC 61000-4-4:2012 LRV	Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test	EN 61000-4-4:2012
IEC 61000-4-5	IEC 61000-4-5:2014+AMD1:2017 CSV	Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test	EN 61000-4-5:2014/A1:2017
IEC 61000-4-6	IEC 61000-4-6:2013	Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6:2014/AC:2015
IEC 61000-4-11	IEC 61000-4-11:2020 RLV	Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11:2004/A1:2017 And EN IEC 61000-4-11:2020/AC:2020-06
IEC 61000-6-1	IEC 61000-6-1:2016 RLV	Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial	EN IEC 61000-6-1:2019

		and light-industrial environments	
IEC 61000-6-2	IEC 61000-6-2:2016 RLV	Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments	None For applicable standard edition see Column 2
OIML D 11:2004		General requirements for electronic measuring instruments	
OIML G 13		Planning of metrology and testing laboratories	

The documents listed in the Column 1 of table [ZA.2], in whole or in part, are normatively referenced in this document, i.e. are indispensable for its application. The achievement of the presumption of conformity is subject to the application of the edition of Standards as listed in Column 4 or, if no European Standard Edition exists, the International Standard Edition given in Column 2 of table [ZA.2].

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard. 

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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.

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, www.iso.org/directives.

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

The committees responsible for this document are Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 7, *Volume methods including water meters* and OIML Technical Subcommittee TC 8/SC 5 *Water meters*.

This fourth edition of ISO 4064-2 cancels and replaces the third edition (ISO 4064-2:2005), which has been technically revised. Provisions of the third edition are addressed in ISO 4064-5:2014.

ISO 4064 consists of the following parts, under the general title *Water meters for cold potable water and hot water*:

- *Part 1: Metrological and technical requirements*
- *Part 2: Test methods*
- *Part 3: Test report format*
- *Part 4: Non-metrological requirements not covered in ISO 4064-1*
- *Part 5: Installation requirements*

This edition of ISO 4064-2 is identical with the corresponding edition of OIML R 49-2, which has been issued concurrently. OIML R 49-2 was approved for final publication by the International Committee of Legal Metrology at its 48th meeting in Ho Chi Minh City, Vietnam in October 2013 and will be submitted to the International Conference on Legal Metrology in 2016 for formal sanction.

Water meters for cold potable water and hot water —

Part 2: Test methods

1 Scope

This part of ISO 4064|OIML R 49 is applicable to the type evaluation and initial verification testing of water meters for cold potable water and hot water as defined in ISO 4064-1:2014|OIML R 49-1:2013. OIML Certificates of Conformity can be issued for water meters under the scope of the OIML Certificate System, provided that this part of ISO 4064|OIML R 49, ISO 4064-1:2014|OIML R 49-1:2013 and ISO 4064-3:2014|OIML R 49-3:2013 are used in accordance with the rules of the System.

This part of ISO 4064|OIML R 49 sets out details of the test programme, principles, equipment and procedures to be used for the type evaluation, and initial verification of a meter type.

The provisions of this part of ISO 4064|OIML R 49 also apply to ancillary devices, if required by national regulations.

The provisions include requirements for testing the complete water meter and for testing the measurement transducer (including the flow or volume sensor) and the calculator (including the indicating device) of a water meter as separate units.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4064-1:2014|OIML R 49-1:2013, *Water meters for cold potable water and hot water — Part 1: Metrological and technical requirements*

ISO 4064-3:2014|OIML R 49-3:2013, *Water meters for cold potable water and hot water — Part 3: Test report format*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

IEC 60068-2-1, *Environmental testing — Part 2-1: Tests — Test A: Cold*

IEC 60068-2-2, *Environmental testing — Part 2-2: Tests — Test B: Dry heat*

IEC 60068-2-30, *Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-31, *Environmental testing — Part 2-31: Tests — Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-47, *Environmental testing — Part 2-47: Tests — Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-2-64, *Environmental testing — Part 2-64: Tests — Test Fh: Vibration, broadband random and guidance*

IEC 60068-3-4, *Environmental testing — Part 3-4: Supporting documentation and guidance — Damp heat tests*

IEC 60654-2, *Operating conditions for industrial process measurement and control equipment — Part 2: Power*

IEC 61000-2-1, *Electromagnetic compatibility (EMC) — Part 2: Environment — Section 1: Description of the environment — Electromagnetic environment for low-frequency conducted disturbances and signaling in public power supply systems*

IEC 61000-2-2, *Electromagnetic compatibility (EMC) — Part 2-2: Environment — Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage power supply systems*

IEC 61000-4-1, *Electromagnetic compatibility (EMC) — Part 4-1: Testing and measurement techniques — Overview of IEC 61000-4 series*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*

OIML D 11:2004, *General requirements for electronic measuring instruments*

OIML G 13, *Planning of metrology and testing laboratories*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4064-1:2014|OIML R 49-1:2013 apply.

4 Reference conditions

All applicable influence quantities, except for the influence quantity being tested, shall be held at the following values during type evaluation tests on a water meter. However, for influence factors and

disturbances for electronic water meters, it is permissible to use the reference conditions defined in the applicable IEC standard:

Flow rate:	$0,7 \times (Q_2 + Q_3) \pm 0,03 \times (Q_2 + Q_3)$
Water temperature:	T30, T50 is $20\text{ °C} \pm 5\text{ °C}$ T70 to T180 is $20\text{ °C} \pm 5\text{ °C}$ and $50\text{ °C} \pm 5\text{ °C}$ T30/70 to T30/180 is $50\text{ °C} \pm 5\text{ °C}$
Water pressure:	Within rated operating conditions (see ISO 4064-1:2014 OIML R 49-1:2013, 6.4)
Ambient temperature range:	15 °C to 25 °C
Ambient relative humidity range:	45 % to 75 %
Ambient atmospheric pressure range:	86 kPa to 106 kPa [0,86 bar to 1,06 bar]
Power supply voltage (mains AC):	Nominal voltage, $U_{\text{nom}} \pm 5\%$
Power supply frequency:	Nominal frequency, $f_{\text{nom}} \pm 2\%$
Power supply voltage (battery):	A voltage V in the range $U_{\text{bmin}} \leq V \leq U_{\text{bmax}}$

During each test, the temperature and relative humidity shall not vary by more than 5 °C or 10 %, respectively, within the reference range. The reference conditions are permitted to deviate from the defined tolerance values during the performance tests if evidence can be given to the body responsible for type approval that the type of meter under consideration is not affected by the deviation of the condition in question. The actual values of the deviating condition, however, shall be measured and documented as part of the performance test documentation.

5 Symbols, units and equations

Equations, symbols and their units, concerning the calculation of the error (of indication) of a water meter used in this part of ISO 4064|OIML R 49, are given in [Annex B](#).

6 External examination

6.1 General

During the external examination, all relevant values, dimensions, and observations shall be recorded.

NOTE 1 For presentation of the results of type examinations, see [Clause 11](#).

NOTE 2 The relevant subclauses of ISO 4064-1:2014|OIML R 49-1:2013 are shown in parentheses in the following.

6.2 Object of the examination

To verify that a water meter meets the requirements of ISO 4064-1:2014|OIML R 49-1:2013 with respect to the design of the indicating device, the marking of the meter and the application of protection devices.

6.3 Preparation

Linear measurements that have to be taken of a meter shall be made using traceable, calibrated measuring devices.

The actual or apparent dimensions of the scales of the indicating device shall be taken without removing the meter lens or disassembling the meter.

NOTE A travelling microscope (cathetometer) can be used to measure the width, spacing and height of the scale divisions and the height of the numerals.

6.4 Examination procedures

6.4.1 General

The following aspects of a meter design shall be examined on at least one meter from the sample.

Either the same meter sample may be used for all the external examinations or different meters from the samples submitted may be used for some of the examinations.

6.4.2 Marks and inscriptions (ISO 4064-1:2014|OIML R 49-1:2013, 6.6)

- a) Verify that a place is provided for affixing the verification mark which is visible without dismantling the water meter.
- b) Verify that the water meter is clearly and indelibly marked with the information presented in ISO 4064-1:2014|OIML R 49-1:2013, 6.6.2.
- c) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.6.1 and 6.6.2 (r) in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3 Indicating device (ISO 4064-1:2014|OIML R 49-1:2013, 6.7)

6.4.3.1 Function (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.1)

- a) Verify that the indicating device provides an easily read, reliable and unambiguous visual indication of the indicated volume.
- b) Verify that the indicating device includes visual means for testing and calibration.
- c) If the indicating device includes additional elements for testing and calibration by other methods, e.g. for automatic testing and calibration, record the type(s) of device.
- d) If the meter is a combination meter with two indicating devices, [6.4.3](#) applies to both indicating devices.
- e) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.1 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.2 Unit of measurement, symbol, and its placement (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.2)

- a) Verify that the indicated volume of water is expressed in cubic metres.
- b) Verify that the symbol m³ appears on the dial or immediately adjacent to the numbered display.
- c) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.2 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.3 Indicating range (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.3)

- a) Verify that the indicating device is able to record the indicated volume in cubic metres given in ISO 4064-1:2014|OIML R 49-1:2013, Table 5 corresponding to the permanent flow rate Q_3 without passing through zero.

- b) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.3, in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.4 Colour coding for indicating devices (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.4)

- a) Verify that either:
- 1) the colour black is used to indicate the cubic metre and its multiples; and
 - 2) the colour red is used to indicate sub-multiples of a cubic metre; and
 - 3) the colours are applied either to the pointers, indexes, numbers, wheels discs, dials or aperture frames;
- or other means of indicating the cubic metre are used in which there is no ambiguity in distinguishing between the primary indication and alternative displays, e.g. sub-multiples for verification and testing.
- b) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.1.4, in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.5 Types of indicating device (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.2)

6.4.3.5.1 Type 1 — Analogue device (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.2.1)

- a) If a type 1 indicating device has been used, verify that volume is indicated by:
- either continuous movement of one or more pointers moving relative to graduated scales;
 - or continuous movement of one or more circular scales or drums, each passing an index.
- b) Verify that the value expressed in cubic metres for each scale division is of the form 10^n , where n is a positive or a negative whole number or zero, thereby establishing a system of consecutive decades.
- c) Verify that each scale is either graduated in values expressed in cubic metres or accompanied by a multiplication factor ($\times 0,001$; $\times 0,01$; $\times 1$; $\times 10$; $\times 100$; $\times 1\ 000$, etc.).
- d) Verify that the rotational movements of the pointers or circular scales are clockwise.
- e) Verify that the linear movement of the pointers or scales is from left to right.
- f) Verify that the movement of the numbered roller indicators is upwards.
- g) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.2.1, in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.5.2 Type 2 — Digital device (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.2.2)

- a) Verify that the indicated volume is given by a line of digits, appearing in one or more apertures.
- b) Verify that the advance of one digit is completed while the digit of the next immediately lower decade changes from 9 to 0.
- c) Verify that the actual or apparent height of the digits is at least 4 mm.
- d) For non-electronic devices:
- 1) verify that the movement of the numbered roller indicators (drums) is upwards;

- 2) if the lowest value decade has a continuous movement, verify that the aperture is large enough to permit a digit to be read without ambiguity.

For electronic devices:

- 3) verify that for non-permanent displays the volume can be displayed at any time for at least 10 s;
- 4) check the entire display visually in the following sequence:
 - i) for seven segment type verify that all the elements can be correctly displayed (e.g. an “eights” test),
 - ii) for seven segment type verify that all the elements can be blanked (a “blanks” test),
 - iii) for graphical displays use an equivalent test to verify that display faults cannot result in any digit being misinterpreted,
 - iv) verify that each step of the sequence lasts at least 1 s.
- e) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.2.2 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.5.3 Type 3 — Combination of analogue and digital devices (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.2.3)

- a) If the indicating device is a combination of type 1 and 2 devices, verify that the respective requirements of each apply (see [6.4.3.5.1](#) and [6.4.3.5.2](#)).
- b) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.2.3 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.6 Verification devices — First element of an indicating device — Verification interval (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3)

6.4.3.6.1 General requirements (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.1)

- a) Verify that the indicating device has the means for visual, non-ambiguous verification testing and calibration.
- b) Note whether the visual verification display has a continuous or a discontinuous movement.
- c) Note whether, in addition to the visual verification display, the indicating device includes provisions for rapid testing by the inclusion of complementary elements (e.g. star wheels or discs), providing signals through externally attached sensors. Note the relationship, stated by the manufacturer, between the visual indication of volume and the signals emitted by these complementary devices.
- d) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.1 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.6.2 Visual verification display (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.2)

6.4.3.6.2.1 Value of the verification scale interval (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.2.1)

- a) Verify that the value of the verification scale interval, expressed in cubic metres, is of the form 1×10^n , or 2×10^n , or 5×10^n , where n is a positive or negative whole number, or zero.
- b) For analogue and digital indicating devices with continuous movement of the first element, verify that the verification scale interval is formed from the division into 2, 5 or 10 equal parts of the interval between two consecutive digits of the first element.

- c) For analogue and digital indicating devices with continuous movement of the first element, verify that numbering is not applied to the divisions between consecutive digits of the first element.
- d) For digital indicating devices with discontinuous movement of the first element, the verification scale interval is the interval between two consecutive digits or incremental movements of the first element.
- e) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.2.1 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.6.2.2 Form of the verification scale (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.2.2)

- a) If the indicating device has continuous movement of the first element, check that the apparent scale spacing is not less than 1 mm and not more than 5 mm.
- b) Verify that the scale consists of:
 - either lines of equal thickness not exceeding one-quarter of the scale spacing and differing only in length;
 - or contrasting bands of a constant width equal to the scale spacing.
- c) Verify that the apparent width of the pointer at its tip does not exceed one-quarter of the scale spacing.
- d) Verify that the apparent width of the pointer at its tip does not exceed 0,5 mm.
- e) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.2.2, in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

6.4.3.6.2.3 Resolution of the indicating device (ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.2.3)

- a) Note the value of the verification scale interval, δV m³
- b) Calculate the actual volume V_a in m³ passed during 1 h 30 min at the minimum flow rate Q_1 , from

$$V_a = Q_1 \times 1,5$$
- c) Calculate the resolution error ε_r of the indicating device, expressed as a percentage, from:

- 1) for continuous movement of the first element:

$$\varepsilon_r = \frac{0,5\delta V + 0,5\delta V}{V_a} \times 100\%$$

$$= \frac{\delta V}{V_a} \times 100\%$$

- 2) For discontinuous movement of the first element:

$$\varepsilon_r = \frac{\delta V + \delta V}{V_a} \times 100\%$$

$$= \frac{2\delta V}{V_a} \times 100\%$$

- d) Verify that for accuracy class 1 meters, the value of the verification scale interval is small enough to ensure that the resolution error ε_r of the indicating device does not exceed 0,25 % of the actual volume required during 1 h 30 min at the minimum flow rate, Q_1 .

$$\varepsilon_r \leq 0,25\%$$

- e) Verify that for accuracy class 2 meters, the verification scale interval is small enough to ensure that the resolution error ε_r of the indicating device does not exceed 0,5 % of the actual volume required during 1 h 30 min at the minimum flow rate, Q_1 .

$$\varepsilon_r \leq 0,5 \%$$

- f) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.7.3.2.3 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

When the display of the first element is continuous, an allowance shall be made for a maximum error in each reading of not more than half of the verification scale interval.

When the display of the first element is discontinuous, an allowance shall be made for a maximum error in each reading of not more than one digit of the verification scale.

6.4.4 Protection devices (ISO 4064-1:2014|OIML R 49-1:2013, 6.8)

- a) Verify that the water meter includes protection devices as specified in ISO 4064-1:2014|OIML R 49-1:2013, 6.8.
- b) Complete the section reference ISO 4064-1:2014|OIML R 49-1:2013, 6.8.1 and 6.8.2.3 in ISO 4064-3:2014|OIML R 49-3:2013, 4.4.1.

7 Performance tests for all water meters

7.1 General

During the performance tests, all relevant values, dimensions and observations shall be recorded.

NOTE 1 For presentation of the results of type evaluation tests see [Clause 11](#).

NOTE 2 The relevant sub-clauses of ISO 4064-1:2014|OIML R 49-1:2013 are shown in parentheses in the following.

7.2 Required conditions for all tests

7.2.1 Water quality

Water meter tests shall be carried out using water. The water shall be that of the public potable water supply or shall meet the same requirements.

The water shall not contain any substance which might damage the meter or adversely affect its operation. It shall not contain air bubbles.

If water is being recycled, measures shall be taken to prevent residual water in the meter from becoming harmful to human beings.

7.2.2 General rules concerning test installation and location

7.2.2.1 Freedom from spurious influences

Test rigs shall be so designed, constructed, and used, that the performance of the rig itself shall not contribute significantly to the test error. To this end, high standards of rig maintenance, plus adequate supports and fittings, are necessary to prevent vibration of the meter, the test rig, and its accessories.

The test rig environment shall be such that the reference conditions of the test are met (see [Clause 4](#)).

During the tests, the gauge pressure at the outlet of each water meter shall be at least 0,03 MPa (0,3 bar) and shall be sufficient to prevent cavitation.

It shall be possible to carry out test readings rapidly and easily.

7.2.2.2 Group testing of meters

Meters are tested either individually or in groups. In the latter case, the individual characteristics of the meters shall be precisely determined. The presence of any meter in the test rig shall not contribute significantly to the test error of any other meter.

7.2.2.3 Location

The environment chosen for meter tests shall be in accordance with the principles elaborated in OIML G 13 and shall be free from disturbing influences (e.g. ambient temperature, vibration).

7.3 Static pressure test (ISO 4064-1:2014|OIML R 49-1:2013, 4.2.10)

7.3.1 Object of the test

To verify that the water meter can withstand the specified hydraulic test pressure for the specified time without leakage or damage.

7.3.2 Preparation

- a) Install the meters in the test rig either singly or in groups.
- b) Bleed the test rig pipework and the water meters of air.
- c) Ensure that the test rig is free from leaks.
- d) Ensure that the supply pressure is free from pressure pulsations.

7.3.3 Test procedure

7.3.3.1 In-line meters

- a) Increase the hydraulic pressure to 1,6 times the maximum admissible pressure (MAP) of the meter and hold it for 15 min.
- b) Examine the meters for physical damage, for external leaks and for leaks into the indicating device.
- c) Increase the hydraulic pressure to twice the MAP and hold this pressure level for 1 min.
- d) Examine the meters for physical damage, for external leaks and for leaks into the indicating device.
- e) Complete the test report in ISO 4064-3:2014|OIML R 49-3:2013, 4.5.1.

Additional requirements:

- 1) Increase and decrease the pressure gradually without pressure surges.
- 2) Apply only the reference temperatures for this test.
- 3) The flow rate shall be zero during the test.

7.3.3.2 Concentric meters

The test procedure in [7.3.3.1](#) also applies to pressure testing of concentric water meters; however, the seals located at the concentric meter/manifold interface (see example in [Figure E.1](#)) shall also be tested

to ensure that undisclosed internal leaks between the inlet and outlet passages of the meter do not occur.

When the pressure test is carried out, the meter and manifold shall be tested together. Requirements for testing concentric meters may vary according to the design; therefore an example of a test method is shown in [Figures E.2](#) and [E.3](#).

7.3.4 Acceptance criteria

There shall be no leakage from the meter or leakage into the indicating device, or physical damage, resulting from any of the pressure tests specified in [7.3.3.1](#) and [7.3.3.2](#).

7.4 Determination of intrinsic errors (of indication) (ISO 4064-1:2014|OIML R 49-1:2013, 7.2.3)

7.4.1 Object of the test

To determine the intrinsic errors (of indication) of a water meter and the effects of the meter orientation on the error (of indication).

7.4.2 Preparation

7.4.2.1 Description of the test rig

The method specified here for determining the meter errors (of indication) is the so-called “collection” method, in which the quantity of water passed through a water meter is collected in one or more collecting vessels and the quantity determined volumetrically or by weighing. Other methods may be used, provided the requirements of [7.4.2.2.6.1](#) are met.

The checking of the errors (of indication) consists in comparing the volume indications given by the meter under reference conditions against a calibrated reference device.

For the purpose of these tests, at least one meter should be tested without its temporary ancillary devices attached (if any) unless the device is essential for the testing of the meter.

The test rig consists, typically, of:

- a) a water supply (non-pressurized tank, pressurized tank, pump, etc.);
- b) pipework;
- c) a calibrated reference device (calibrated volumetric tank, weighing system, reference meter, etc.);
- d) means for measuring the time of the test;
- e) devices for automating the tests (if required);
- f) means for measuring water temperature;
- g) means for measuring water pressure;
- h) means to determine density, if necessary;
- i) means to determine conductivity, if necessary.

7.4.2.2 Pipework

7.4.2.2.1 Description

Pipework shall include:

- a) a test section in which the meter(s) is (are) placed;
- b) means for establishing the desired flow rate;
- c) one or two isolating devices;
- d) means for determining the flow rate;

and if necessary:

- e) means for checking that the pipework is filled to a datum level before and after each test;
- f) one or more air bleeds;
- g) a non-return device;
- h) an air separator;
- i) a filter.

During the test, flow leakage, flow input and flow drainage shall not be permitted either between the meter(s) and the reference device or from the reference device.

7.4.2.2.2 Test section

The test section shall include, in addition to the meter(s):

- a) one or more pressure tapplings for the measurement of pressure, of which one pressure tapping is situated upstream of, and close to, the (first) meter;
- b) means for measuring the temperature of the water close to the entry to the (first) meter.

The presence of any pipe components or devices placed in or near the measuring section shall not cause cavitation or flow disturbances capable of altering the performance of the meters or causing errors (of indication).

7.4.2.2.3 Precautions to be taken during tests

- a) Check that the operation of the test rig is such that, during a test, the actual volume of water that flows through the meter(s) is equal to that measured by the reference device.
- b) Check that the pipe (e.g. the swan-neck in the outlet pipe) is filled to the same datum level at the beginning and at the end of the test.
- c) Bleed all air from the interconnecting pipework and the meter(s). The manufacturer may recommend a procedure that ensures that all air is bled from the meter.
- d) Take all precautions necessary to avoid the effects of vibration and shock.

7.4.2.2.4 Special arrangements for the installation of meters

7.4.2.2.4.1 Avoidance of erroneous measurements

The following reminder of the most frequent causes of erroneous measurements and the necessary precautions for the installation of water meters on the test bench is prompted by the need to achieve a test installation in which:

- a) the hydrodynamic flow characteristics cause no discernible difference to the meter functioning when compared with hydrodynamic flow characteristics which are undisturbed; and
- b) the expanded uncertainty of the method employed does not exceed the stipulated value (see [7.4.2.2.6.1](#)).

7.4.2.2.4.2 Need for straight lengths of pipe or a flow straightener

The accuracy of non-volumetric water meters can be affected by upstream disturbance caused, for example, by the presence of bends, tees, valves or pumps.

In order to counteract these effects:

- a) the meter shall be installed in accordance with the manufacturer's instructions;
- b) the connecting pipework shall have an internal diameter matched to the relevant meter connection; and
- c) if necessary, a flow straightener shall be installed upstream of the straight pipe length.

7.4.2.2.4.3 Common causes of flow disturbance

A flow can be subject to two types of disturbance: velocity-profile distortion and swirl, both of which may affect the errors of indication of a water meter.

Velocity-profile distortion is typically caused by an obstruction partially blocking the pipe, e.g. the presence of a partly closed valve or a misaligned flange joint. This can easily be eliminated by careful application of installation procedures.

Swirl can be caused by two or more bends in different planes or by a single bend in combination with an eccentric reducer or partially closed valve. This effect can be controlled either by ensuring an adequate length of straight pipe upstream of the water meter, or by installing a flow straightening device, or by a combination of the two. However, where possible, these types of pipework configurations should be avoided.

7.4.2.2.4.4 Volumetric water meters

Some types of water meter, e.g. volumetric water meters (i.e. involving measuring chambers with mobile walls), such as oscillating piston or nutating disc meters, are considered insensitive to upstream installation conditions; hence no special conditions are required.

7.4.2.2.4.5 Meters employing electromagnetic induction

Meters employing electromagnetic induction as a measuring principle may be affected by the conductivity of the test water.

The conductivity of the water used for testing this type of meter should be within the operational range of conductivity specified by the meter manufacturer.

7.4.2.2.4.6 Other measuring principles

Other types of meter may require flow conditioning when measuring the errors of indication and in such cases the manufacturer's recommended installation requirements shall be followed (see [7.10](#)).

These installation requirements should be reported in the type approval certificate for a water meter.

Concentric meters that are proven to be unaffected by manifold configuration (see [7.4.2.2.4.4](#)) may be tested and used with any suitable manifold arrangement.

7.4.2.2.5 Errors of test commencement and termination

7.4.2.2.5.1 General

Adequate precautions shall be taken to reduce the uncertainties resulting from operation of test rig components during the test.

Details of the precautions to be taken are given in [7.4.2.2.5.2](#) and [7.4.2.2.5.3](#) for two cases encountered in the "collection" method.

7.4.2.2.5.2 Tests with readings taken with the meter at rest

This method is generally known as the standing-start-and-finish method.

Flow is established by opening a valve, situated downstream of the meter, and it is stopped by closure of this valve. The meter is read when the registration is stationary.

Time is measured between the start of the opening movement of the valve and the close of the closing movement. While flow is beginning and during the period of running at the specified constant flow rate, the error (of indication) of the meter varies as a function of the changes in flow rate (the error curve).

While the flow is being stopped, the combination of the inertia of the moving parts of the meter and the rotational movement of the water inside the meter may cause an appreciable error to be introduced in certain types of meter and for certain test flow rates.

It has not been possible, in this case, to determine a simple empirical rule which lays down conditions so that this error may always be negligible.

In case of doubt, it is advisable:

- a) to increase the volume and duration of the test;
- b) to compare the results with those obtained by one or more other methods, and in particular the method specified in [7.4.2.2.5.3](#), which eliminates the causes of uncertainty given in the preceding.

For some types of electronic water meters with pulse outputs that are used for testing, the response of the meter to changes in flow rate may be such that valid pulses are emitted after closure of the valve. In this case, means shall be provided to count these additional pulses.

Where pulse outputs are used for testing meters, the correspondence of the volume indicated by the pulse count to the volume displayed on the indicating device shall be checked.

7.4.2.2.5.3 Tests with readings taken under stable flow conditions and diversion of flow

This method is generally known as the flying-start-and-finish method.

The measurement is carried out when flow conditions have stabilized.

A switch diverts the flow into a calibrated vessel at the beginning of the measurement and diverts it away at the end.

The meter is read while in motion.

The reading of the meter is synchronized with the movement of the flow switch.

The volume collected in the vessel is the actual volume passed.

The uncertainty introduced into the volume may be considered negligible if the times of motion of the flow switch in each direction are identical within 5 % and if this time is less than 1/50 of the total time of the test.

7.4.2.2.6 Calibrated reference device

7.4.2.2.6.1 Expanded uncertainty of the value of measured actual volume

When a test is conducted, the expanded uncertainty in the determination of the actual volume passing through a water meter shall not exceed one-fifth of the applicable maximum permissible error for type evaluation and one-third of the applicable maximum permissible error for initial verification.

NOTE The uncertainty of the measured actual volume does not include a contribution from the water meter.

The estimated uncertainty shall be made according to ISO/IEC Guide 98-3:2008 with a coverage factor, $k = 2$.

7.4.2.2.6.2 Minimum volume of the calibrated reference device

The minimum volume permitted depends on requirements determined by the test start and end effects (timing error), and the design of the indicating device (value of the verification scale interval).

7.4.2.2.7 Major factors affecting the measurement of errors (of indication)

7.4.2.2.7.1 General

Variations in the pressure, flow rate and temperature in the test rig, and uncertainties in the precision of measurement of these physical quantities, are the principal factors affecting the measurement of the errors (of indication) of a water meter.

7.4.2.2.7.2 Supply pressure

The supply pressure shall be maintained at a constant value throughout the test at the chosen flow rate.

When testing water meters which are designated $Q_3 \leq 16 \text{ m}^3/\text{h}$, at test flow rates $\leq 0,1 Q_3$, constancy of pressure at the inlet of the meter (or at the inlet of the first meter of a group being tested) is achieved if the test rig is supplied through a pipe from a constant head tank. This ensures an undisturbed flow.

Any other methods of supply shown not to cause pressure pulsations exceeding those of a constant head tank may be used (e.g. a pressurized tank).

For all other tests, the pressure upstream of the meter shall not vary by more than 10 %. The maximum uncertainty ($k = 2$) in the measurement of pressure shall be 5 % of the measured value.

The estimated uncertainty shall be made according to ISO/IEC Guide 98-3:2008 with a coverage factor, $k = 2$.

Pressure at the entrance to the meter shall not exceed the maximum admissible pressure for the meter.

7.4.2.2.7.3 Flow rate

The flow rate shall be maintained at a constant value throughout the test at the chosen value.

The relative variation in the flow rate during each test (not including starting and stopping) shall not exceed:

$\pm 2,5$ % from Q_1 to Q_2 (exclusive);

$\pm 5,0$ % from Q_2 (inclusive) to Q_4 .

The flow rate value is the actual volume passed during the test divided by the time.

This flow rate variation condition is acceptable if the relative pressure variation (in flow to free air) or the relative variation of pressure loss (in closed circuits) does not exceed:

± 5 % from Q_1 to Q_2 (exclusive);

± 10 % from Q_2 (inclusive) to Q_4 .

7.4.2.2.7.4 Temperature

During a test, the temperature of the water shall not change by more than 5 °C.

The maximum uncertainty in the measurement of temperature shall not exceed 1 °C.

7.4.2.2.7.5 Orientation of water meter(s)

- a) If the meters are marked “H”, mount the connecting pipework with the flow axis in the horizontal plane during the test (indicating device positioned on top).
- b) If the meters are marked “V”, mount the connecting pipework with the flow axis in the vertical plane during the test:
 - 1) at least one meter from the sample shall be mounted with the flow axis vertical, with flow direction from bottom to top;
 - 2) at least one meter from the sample shall be mounted with the flow axis vertical, with flow direction from top to bottom;
- c) If the meters are not marked “H” or “V”:
 - 1) at least one meter from the sample shall be mounted with the flow axis vertical, with flow direction from bottom to top;
 - 2) at least one meter from the sample shall be mounted with the flow axis vertical, with flow direction from top to bottom;
 - 3) at least one meter from the sample shall be mounted with the flow axis at an intermediate angle to the vertical and horizontal (chosen at the discretion of the body responsible for type approval);
 - 4) the remaining meters from the sample shall be mounted with the flow axis horizontal.
- d) Where the meters have an indicating device which is integral with the body of the meter, at least one of the horizontally mounted meters shall be oriented with the indicating device positioned at the side and the remaining meters shall be oriented with the indicating device positioned at the top.
- e) The tolerance on the position of the flow axis for all meters, whether horizontal, vertical or at an intermediate angle, shall be $\pm 5^\circ$.

Where fewer than four meters are presented to test, supplementary meters shall be taken from the basis population or the same meter shall be tested in different positions.

7.4.3 Combination meters

7.4.3.1 General

For a combination meter, the test method specified in [7.4.2.2.5.3](#), in which readings of the combination meter are taken at an established flow rate, ensures that the change-over device is functioning correctly for both increasing and decreasing flow rates. The test method specified in [7.4.2.2.5.2](#), in which readings of the meter are taken at rest, should not be used for this test as it does not allow the determination of the error (of indication) after regulating the test flow rate for decreasing flow rates for combination meters.

7.4.3.2 Test method for the determination of change-over flow rates (ISO 4064-1:2014|OIML R 49-1:2013, 7.2.3)

- a) Starting from a flow rate that is less than the change-over flow rate Q_{x2} , the flow rate is increased in successive steps of 5 % of the assumed value of Q_{x2} until flow rate Q_{x2} is achieved as defined in ISO 4064-1:2014|OIML R 49-1:2013, 3.3.6. The value of Q_{x2} is taken as the average of the values of indicated flow rate just before and just after change-over occurs.
- b) Starting from a flow rate that is greater than the change-over flow rate Q_{x1} , the flow rate is decreased in successive steps of 5 % of the assumed value of Q_{x1} until flow rate Q_{x1} is achieved as defined in ISO 4064-1:2014|OIML R 49-1:2013, 3.3.6. The value of Q_{x1} is taken as the average of the values of indicated flow rate just before and just after change-over occurs.
- c) Complete the test report in ISO 4064-3:2014|OIML R 49-3:2013, 4.5.2.

7.4.4 Test procedure

- a) Determine the intrinsic errors (of indication) of a water meter (in the measurement of the actual volume), for at least the following flow rates, the error at each flow rate being measured three times for 1), 2) and 5) and twice for the other flow rate ranges:
 - 1) Q_1 to $1,1Q_1$;
 - 2) Q_2 to $1,1Q_2$;
 - 3) $0,33 \times (Q_2 + Q_3)$ to $0,37 \times (Q_2 + Q_3)$;
 - 4) $0,67 \times (Q_2 + Q_3)$ to $0,74 \times (Q_2 + Q_3)$;
 - 5) $0,9Q_3$ to Q_3 ;
 - 6) $0,95Q_4$ to Q_4 ;and for combination meters:
 - 7) $0,85Q_{x1}$ to $0,95Q_{x1}$;
 - 8) $1,05Q_{x2}$ to $1,15Q_{x2}$.

NOTE Three points are always required for 1), 2) and 5), since it is at these flow rates that the repeatability is calculated.

- b) Test the water meter without its supplementary devices attached (if any).
- c) During a test, hold all other influence factors at reference conditions.
- d) Measure the errors (of indication) at other flow rates if the shape of the error curve indicates that the MPE may be exceeded.
- e) Calculate the relative error (of indication) for each flow rate in accordance with [Annex B](#).

f) Complete the test report in ISO 4064-3:2014|OIML R 49-3:2013, 4.5.3.

Where the initial error curve is close to the maximum permissible error at a point other than at Q_1 , Q_2 or Q_3 , if this error is shown to be typical of the meter type, the body responsible for type approval may choose to define an additional flow rate for verification to be included in the type approval certificate.

It is recommended that the characteristic error curve for each water meter be plotted in terms of error against flow rate, so that the general performance of the water meter over its flow rate range can be evaluated.

The meter shall be tested at the reference temperature(s) given in [Clause 4](#). Where there are two reference temperatures, the tests shall be done at both temperatures. The MPE appropriate to the test temperature shall apply.

7.4.5 Acceptance criteria

- a) The relative errors (of indication) observed for each of the flow rates shall not exceed the maximum permissible errors given in ISO 4064-1:2014|OIML R 49-1:2013, 4.2.2 or 4.2.3. If the error observed on one or more meters is greater than the maximum permissible error at one flow rate only, then if only two results have been taken at that flow rate, the test at that flow rate shall be repeated; the test shall be declared satisfactory if two out of the three results at that flow rate lie within the maximum permissible error and the arithmetic mean of the results for the three tests at that flow rate lies within the maximum permissible error.
- b) If all the relative errors (of indication) of a water meter have the same sign, at least one of the errors shall not exceed one-half of the maximum permissible error. In all cases, this requirement shall be applied equitably with respect to the water supplier and the consumer (see also ISO 4064-1:2014|OIML R 49-1:2013, 4.3.3, paragraphs 3 and 8).
- c) The standard deviation for [7.4.4](#) a) 1), 2) and 5) shall not exceed one-third of the maximum permissible errors given in ISO 4064-1:2014|OIML R 49-1:2013, 4.2.2 or 4.2.3.

7.4.6 Interchange test on all types of cartridge meters and meters with exchangeable metrological modules (ISO 4064-1:2014|OIML R 49-1:2013, 7.2.7)

7.4.6.1 Object of the test

To confirm that the cartridge meters or meters with exchangeable metrological modules are insensitive to the influence of connection interfaces produced in series production.

7.4.6.2 Preparation

Two cartridge meters or exchangeable metrological modules and five connection interfaces are selected from the number of meters presented for approval.

Correct matching of a cartridge meter with a connection interface or an exchangeable metrological module with a connection interface, respectively, shall be checked prior to test. Moreover, the matching of the required marking on a cartridge meter or an exchangeable metrological module and a connection interface shall be checked. Adaptors are not permitted.

7.4.6.3 Test procedure

- a) Two cartridge meters or exchangeable metrological modules shall be tested in five connection interfaces of every compatible interface type, resulting in 10 accuracy curves for each type of compatible interface. The test flow rates shall be in accordance with the specifications in [7.4.4](#).
- b) During a test, hold all other influence factors at reference conditions.
- c) Calculate the relative error of indication for each flow rate in accordance with [Annex B](#).

- d) Complete the test report in ISO 4064-3:2014|OIML R 49-3:2013, 4.5.4.

7.4.6.4 Acceptance criteria

- a) All accuracy curves shall be positioned within the MPE at all times.
- b) Error variation within the five tests shall be within 0,5 times MPE if standard connection interfaces are being used, within 1,0 times MPE if identical connection interfaces with identical connection dimensions to the standard interfaces but with different body shapes and flow patterns (valve meter and tap meter connection interfaces) are being used.

7.5 Water temperature test (ISO 4064-1:2014|OIML R 49-1:2013, 4.2.8)

7.5.1 Object of the test

To measure the effects of water temperature on the errors (of indication) of a meter.

7.5.2 Preparation

Apply the installation and operational requirements specified in [7.4.2](#).

7.5.3 Test procedure

Measure the error (of indication) of at least one meter at flow rate Q_2 with the inlet temperature held at $10\text{ °C} \pm 5\text{ °C}$ for temperature classes T30 to T180 and $30\text{ °C}^{+5\text{ °C}}_{0\text{ °C}}$ for temperature classes T30/70 to T30/180. All other influence factors are maintained at reference conditions.

Measure the error (of indication) of at least one meter at flow rate Q_2 with the inlet temperature held at the maximum admissible temperature (MAT) (ISO 4064-1:2014|OIML R 49-1:2013, Table 1) of the meter with a tolerance of $^{0\text{ °C}}_{-5\text{ °C}}$ and all other influence factors maintained at reference conditions.

- a) Calculate the relative error (of indication) for each inlet water temperature in accordance with [Annex B](#).
- b) Complete the test report in ISO 4064-3:2014|OIML R 49-3:2013, 4.5.5.

7.5.4 Acceptance criteria

The relative error (of indication) of the meter shall not exceed the applicable maximum permissible error.

7.6 Overload water temperature test (ISO 4064-1:2014|OIML R 49-1:2013, 7.2.5)

7.6.1 Object of the test

To verify that a meter's performance is not affected after exposure to an elevated, overload, water temperature, as required in ISO 4064-1:2014|OIML R 49-1:2013, 7.2.5.

This test only applies to meters with a MAT $\geq 50\text{ °C}$.

7.6.2 Preparation

Apply the installation and operational requirements specified in [7.4.2](#).

The test is to be performed on at least one meter.

7.6.3 Test procedure

- a) Expose the meter to a flow of water at the reference flow rate at a temperature of $MAT +10\text{ °C} \pm 2,5\text{ °C}$ for a period of 1 h after the meter has reached temperature stability.
- b) After recovery, measure the error (of indication) of the meter at flow rate Q_2 at the reference temperature.
- c) Calculate the relative error (of indication) in accordance with [Annex B](#).
- d) During the test, the reference conditions for all other influence quantities shall be maintained.
- e) Complete the test report in ISO 4064-3:2014|OIML R 49-3:2013, 4.5.5.

7.6.4 Acceptance criteria

- a) The meter functionality with regard to volume totalization shall remain unaffected.
- b) Additional functionality, as indicated by the manufacturer, shall remain unaffected.
- c) The error (of indication) of the meter shall not exceed the applicable MPE.

7.7 Water pressure test (ISO 4064-1:2014|OIML R 49-1:2013, 4.2.8)

7.7.1 Object of the test

To measure the effects of internal water pressure on the errors (of indication) of a meter.

7.7.2 Preparation

The installation and operational requirements specified in [7.4.2](#) shall apply.

7.7.3 Test procedure

Measure the error (of indication) of at least one meter at a flow rate of Q_2 with the inlet pressure held firstly at 0,03 MPa (0,3 bar) ($^{+5\%}_0$) and then at the maximum admissible pressure (MAP) ($^0_{-10\%}$).

- a) During each test, all other influence factors shall be maintained at reference conditions.
- b) Calculate the relative error (of indication) for each inlet water pressure in accordance with [Annex B](#).
- c) Complete the test report in ISO 4064-3:2014|OIML R 49-3:2013, 4.5.6.

7.7.4 Acceptance criteria

The relative errors (of indication) of the meter shall not exceed the applicable maximum permissible error.

7.8 Reverse flow test (ISO 4064-1:2014|OIML R 49-1:2013, 4.2.7)

7.8.1 Object of the test

To verify that a meter satisfies the requirement of ISO 4064-1:2014|OIML R 49-1:2013, 4.2.7 when reverse flow occurs.

A meter which is designed to measure reverse flow shall record the reverse flow volume accurately.

A meter which allows reverse flow, but which is not designed to measure it, shall be subjected to reverse flow. The errors shall subsequently be measured for forward flow, to check that there is no degradation in metrological performance caused by reverse flow.