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Water meters for cold potable water and hot water —

Part 2: Test methods

Compteurs d'eau potable froide et chaude —

Partie 2: Méthodes d'essai

Reference number
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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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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 i*n 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 °C ± 5 °C
	T70 to T180 is 20 °C ± 5 °C and 50 °C ± 5 °C
	T30/70 to T30/180 is 50 °C ± 5 °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_{nom} ± 5 %
Power supply frequency:	Nominal frequency, f_{nom} ± 2 %
Power supply voltage (battery):	A voltage V in the range $U_{bmin} \leq V \leq U_{bmax}$

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 m^3 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 (×0,001; ×0,01; ×1; ×10; ×100; ×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 m^3 passed during h 30 min at the minimum flow rate Q_1, from

$V_a = Q_1 \times 1{,}5$

c) Calculate the resolution error εr 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