INTERNATIONAL RECOMMENDATION

OIML R 49-1

Edition 2024 (E)

Water meters for cold potable water and hot water.

Part 1: Metrological and technical requirements

Compteurs d'eau potable froide et d'eau chaude.

Partie 1: Exigences métrologiques et techniques

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Contents

Foreword

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This edition of OIML R 49-1 is the equivalent to the corresponding edition of ISO 4064-1, developed by the joint OIML TC 8/SC 5 *Water meters* and ISO/TC 30/SC 7 *Volume methods including water meters* Working Group. OIML R 49-1 was approved for final publication by the International Committee of Legal Metrology at its 59th meeting in 2024. It supersedes the previous version of OIML R 49 dated 2013 and will be submitted to the International Conference on Legal Metrology in 2025 for formal sanction.

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Water meters for cold potable water and hot water

Part 1: Metrological and technical requirements

1. Scope

This part of OIML R 49 specifies the metrological and technical requirements for water meters for cold potable water and hot water flowing through a fully charged, closed conduit. These water meters incorporate devices which indicate the accumulated volume.

In addition to water meters based on mechanical principles, this International Recommendation applies to devices based on electrical or electronic principles, and mechanical principles incorporating electronic devices, used to measure the volume of cold potable water and hot water.

This International Recommendation also applies to electronic ancillary devices. Ancillary devices are optional. However, it is possible for national or regional regulations to render some ancillary devices mandatory in relation to the utilization of water meters.

Note: Any national regulations apply in the country of use.

2. Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this International Recommendation. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4064-2:2024|OIML R 49-2:2024[4], *Water meters for cold potable water and hot water – Part 2: Test methods*

3. Terms and definitions

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

Note 1: This terminology conforms to that used in ISO/IEC Guide 99:2007|OIML V 2-200:2012[1] OIML V 1[7] and OIML D 11[8] Modified versions of some terms defined in References [1], [7] and [8] are listed here.

Note 2: The following terms are referenced in the other parts of the ISO 4064| OIML R 49 series but are not cited within the main body of this Recommendation: *tariff control device* (3.1.9), *pre-setting device* (3.1.10), *meter for two constant partners* (3.1.12), *in-line meter* (3.1.13), *cartridge meter connection interface* (3.1.21), *meter with exchangeable metrological module* (3.1.22), *connection interface for meters with exchangeable metrological modules* (3.1.24), *non-adjustable water meter* (3.1.25), *adjustable water meter* (3.1.26), *initial intrinsic error* (3.2.7), *resolution of a displaying device* (3.2.14), *overload flow rate* (3.3.3), *transitional flow rate* (3.3.4), *combination meter changeover flow rate* (3.3.6), *minimum admissible temperature* (3.3.7), *maximum admissible temperature* (3.3.8), *working pressure* (3.3.11), *test flow rate* (3.3.13), *nominal diameter* (3.3.14), *temperature stability* (3.4.8), *preconditioning* (3.4.9), *recovery* (3.4.11), *automatic checking facility* (3.5.5), *permanent automatic checking facility type P automatic checking facility* (3.5.6), *intermittent automatic checking facility type I automatic checking facility* (3.5.7), *non-automatic checking facility type N checking facility* (3.5.8).

Note 3: Attention is drawn to the fact that the term "verification" or "initial verification" is equivalent to the term "conformity assessment" in the context of application of the European Measuring Instruments Directive.

3.1. Water meter and its constituents

3.1.1.

water meter
instrument intended to measure, memorize, and display the volume of water passing through the *measurement transducer* (3.1.2) at *metering conditions* (3.2.11)

Note 1: A water meter includes at least a measurement transducer, a calculator (including adjustment or correction devices, if present) and an indicating device. These three devices can be in different housings.

Note 2: A water meter may be a combination meter (see 3.1.16).

Note 3: In this Recommendation a water meter is also referred to as a “meter”.

3.1.2.

measurement transducer
part of the meter that transforms the *flow rate* (3.3.1) or volume of water to be measured into signals which are passed to the *calculator* (3.1.4) and includes the *sensor* (3.1.3)

Note: The measurement transducer may function autonomously or use an external power source and may be based on a mechanical, electrical or electronic principle.

3.1.3.

sensor
element of a meter that is directly affected by a phenomenon, body or substance carrying a quantity to be measured

[SOURCE: ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 3.8, [1], modified — "meter" replaces "measuring system"; original note removed; original examples removed, “*Note*” added.]

Note: For a water meter, the sensor may be a disc, piston, wheel or turbine element, the electrodes on an electromagnetic meter, or another element. The element senses the flow rate or volume of water passing through the meter and is referred to as a "flow sensor" or "volume sensor".

3.1.4.

calculator
part of the meter that transforms the output signals from the *measurement transducer(s)* (3.1.2) and, possibly, from associated measuring instruments and stores the results in memory until they are used

Note 1: The gearing is considered to be the calculator in a mechanical meter.

Note 2: The calculator may be capable of communicating both ways with ancillary devices.

3.1.5.

indicating device
part of the meter that provides an indication corresponding to the volume of water passing through the meter

Note 1: For the definition of the term “indication”, see ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 4.1, [1] .

Note 2: In this Recommendation, the volume of water passing through the meter refers to the accumulated volume.

3.1.6.

adjustment device
part of the meter that allows an adjustment of the meter such that the error curve of the meter is generally shifted parallel to itself to fit in the envelope of the *maximum permissible error(s)* (3.2.5)

Note: For the definition of the term “adjustment of a measuring system”, see ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM)3.11, [1].

3.1.7.

correction device
device connected to or incorporated in the meter for automatic correction of the volume of water at *metering conditions* (3.2.11), by taking into account the *flow rate* (3.3.1) and/or the characteristics of the water to be measured and the pre-established calibration curves

Note: For the definition of the term “correction”, see ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 2.53, [1].

3.1.8.

ancillary device
device intended to perform a specific function, directly involved in elaborating, transmitting or displaying measured values

Note 1: For the definition of “measured value”, see ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 2.10, [1].

Note 2: The main ancillary devices are:

a) zero-setting device;

b) price-indicating device;

c) repeating indicating device;

d) printing device;

e) memory device;

f) tariff control device;

g) pre-setting device;

h) self-service device;

i) flow sensor movement detector (for detecting movement of the flow sensor before this is clearly visible on the indicating device);

j) remote or automatic reading device (which may be incorporated permanently or added temporarily).

Note 3: Depending on national regulations, ancillary devices may be subject to legal metrological control.

3.1.9.

tariff control device
device that allocates measured values into different registers depending on tariff or other criteria, each register having the possibility to be read individually

3.1.10.

pre-setting device
device that permits the selection of the quantity of water to be measured and which automatically stops the flow of water after the selected quantity has been measured

3.1.11.

associated measuring instrument
instrument connected to the *calculator* (3.1.4) or the *correction device* (3.1.7) for measuring a quantity, characteristic of water, with a view to making a correction and/or a conversion

3.1.12.

meter for two constant partners
meter that is permanently installed and only used for deliveries from one supplier to one customer

3.1.13.

in-line meter
type of meter that is fitted into a closed conduit by means of the meter end connections provided

Note: The end connections may be flanged or threaded.

3.1.14.

complete meter
meter whose *measurement transducer* (3.1.2), *calculator* (3.1.4), and *indicating device* (3.1.5) are not separable

3.1.15.

combined meter
meter whose *measurement transducer* (3.1.2), *calculator* (3.1.4), and *indicating device* (3.1.5) are separable

3.1.16.

combination meter
meter comprising one large meter, one small meter, and a changeover device that, depending on the magnitude of the *flow rate* (3.3.1) passing through the meter, automatically directs the flow through either the small or the large meter, or both

Note: The meter reading is obtained from two independent totalizers, or from one totalizer which adds up the values from both meters.

3.1.17.

equipment under test
EUT
complete meter (3.1.14), sub-assembly or *ancillary device* (3.1.8) that is subjected to a test

3.1.18.

concentric meter
type of meter that is fitted into a closed conduit by means of a manifold

Note: The inlet and outlet passages of the meter and the manifold are coaxial at the interface between them.

3.1.19.

concentric meter manifold
pipe fitting specific to the connection of a *concentric meter* (3.1.18)

3.1.20.

cartridge meter
type of meter that is fitted into a closed conduit by means of an intermediate fitting called a connection interface

Note 1: The inlet and outlet passages of the meter and the connection interface are either concentric or axial (see OIML R 49-4), [5].

3.1.21.

cartridge meter connection interface
pipe fitting specific to the connection of an axial or concentric *cartridge meter* (3.1.20)

3.1.22.

meter with exchangeable metrological module
meter comprising a connection interface and an *exchangeable metrological module* (3.1.23) from the same *type approval* (3.4.13)

3.1.23.

exchangeable metrological module
self-contained module comprising a *measurement transducer* (3.1.2), a *calculator* (3.1.4) and an *indicating device* (3.1.5)

3.1.24.

connection interface for meters with exchangeable metrological modules
pipe fitting specific to the connection of exchangeable metrological modules

3.1.25.

non-adjustable water meter
water meter (3.1.1) whose indication cannot be altered in any way (e.g. without changing the internal dimensions and/or method of operation), and which has no *adjustment device* (3.1.6) or *correction device* (3.1.7).

Note 1: This category should also include mechanical meters with an internal adjustment device where the adjustment cannot be altered at initial verification stage as the meter would need to be dismantled.

Note 2: The meter should not have a correction device, *i.e.* the indicating device of the meter should either be purely mechanical or be electronic but with a constant multiplying factor applied to the indication and set to the same value for all meters (such as a device which counts the number of rotations of the shaft and multiplies by a fixed value to give total volume passed).

3.1.26.

adjustable water meter
water meter (3.1.1) that is connected to or incorporates an adjustment and/or *correction device* (3.1.7)

3.1.27.

software-controlled water meter
water meter (3.1.1) that incorporates and utilizes legally relevant software modules.

3.2. Metrological characteristics

3.2.1.

actual volume
V_a
total volume of water passing through the meter, disregarding the time taken

Note 1: This is the measurand.

Note 2: The actual volume is calculated from a reference volume as determined by a suitable measurement standard, taking into account differences in metering conditions, as appropriate.

3.2.2.

indicated volume
V_i
volume of water indicated by the meter, corresponding to the actual volume

3.2.3.

primary indication
indication which is subject to legal metrological control

3.2.4.

error
measured quantity value minus a reference quantity value

[SOURCE: ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 2.16, [1], modified — “error” replaces “measurement error”; original notes removed; “*Note 1*” added, “*Note 2*” added.]

Note 1: For the application of this part of ISO 4064|OIML R 49, the indicated volume is considered as the measured quantity value and the actual volume as the reference quantity value. The difference between indicated volume and actual volume is referred to as: error (of indication).

Note 2: In this Recommendation, the error (of indication) is expressed as a percentage of the actual volume, and is equal to: $\frac{(V_{\mathrm{i}} - V_{\mathrm{a}})}{V_{\mathrm{a}}} \times 100\,\%$

3.2.5.

maximum permissible error
MPE
extreme value of measurement *error* (3.2.4), with respect to a known reference quantity value, permitted by specifications or regulations for a given meter

[SOURCE: ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 4.26, [1], modified — "meter" replaces "measurement, measuring instrument, or measuring system"; original notes removed]

3.2.6.

intrinsic error
error (3.2.4) of a meter determined under *reference condition(s)* (3.4.5)

[SOURCE: OIML D 11:2013, 3.8, [8], modified — "a meter" replaces "indication"]

3.2.7.

initial intrinsic error
intrinsic error (3.2.6) of a meter as determined prior to *performance test(s)* (3.4.6) and *durability* (3.2.10) evaluations

[SOURCE: OIML D 11:2013, 3.9, [8], modified — "meter" replaces "measuring instrument"]

3.2.8.

fault
difference between the *error* (3.2.4) (of indication) and the *intrinsic error* (3.2.6) of a meter

[SOURCE: OIML D 11:2013, 3.10, [8], modified — "of indication" placed in parentheses; "meter" replaces "measuring instrument"; original notes removed]

3.2.9.

significant fault
fault (3.2.8) greater than the value specified in this part of ISO 4064|OIML R 49

Note 1: See 5.1.2, which specifies the value of a significant fault.

3.2.10.

durability
ability of a meter to maintain its performance characteristics over a period of use

[SOURCE: OIML D 11:2013, 3.18, [8], modified — "meter" replaces "measuring instrument"]

3.2.11.

metering conditions
conditions of the water, the volume of which is to be measured, at the point of measurement

EXAMPLE Water temperature, water pressure.

3.2.12.

first element of an indicating device
element which, in an *indicating device* (3.1.5) comprising several elements, carries the graduated scale with the verification scale interval

3.2.13.

verification scale interval
lowest value scale division of the *first element of an indicating device* (3.2.12)

3.2.14.

resolution of a displaying device
smallest difference between displayed indications that can be meaningfully distinguished

[SOURCE: ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 4.15, [1], modified – "Note 1" added]

Note: For a digital indicating device, this is the change in the indication when the least significant digit changes by one step.

3.3. Operating conditions

3.3.1.

flow rate
Q
$Q = \mathrm{d}V/\mathrm{d}t$ where V is *actual volume* (3.2.1) and t is the time taken for this volume to pass through the meter

Note: ISO 4006:1991 [3], 4.1.2 prefers the use of the symbol q_V for this quantity, but Q is used in this Recommendation as it is well established in the industry.

3.3.2.

permanent flow rate
Q_3
highest *flow rate* (3.3.1) within the *rated operating condition(s)* (3.4.4) at which the meter is to operate within the *maximum permissible error(s)* (3.2.5)

Note: In this Recommendation, flow rate is expressed in m^3/h. See 4.1.3.

3.3.3.

overload flow rate
Q_4
highest *flow rate* (3.3.1) at which the meter is to operate for a short period of time, within the *maximum permissible error(s)* (3.2.5), while maintaining its metrological performance when it is subsequently operating within the *rated operating condition(s)* (3.4.4)

Note: the definition of short period of time can vary between economies and/or applications, but for example 2 hours in a 24 hours period.

3.3.4.

transitional flow rate
Q_2
flow rate (3.3.1) between the *permanent flow rate* (3.3.2) and the *minimum flow rate* (3.3.5) that divides the flow rate range into two zones, the upper flow rate zone and the lower flow rate zone, each characterized by its own *maximum permissible error(s)* (3.2.5)

3.3.5.

minimum flow rate
Q_1
lowest *flow rate* (3.3.1) at which the meter is to operate within the *maximum permissible error(s)* (3.2.5)

3.3.6.

combination meter changeover flow rate
Q_x
flow rate (3.3.1) at which the flow in the larger meter stops with decreasing flow rate (Q_{x1}) or starts with increasing flow rate (Q_{x2})

3.3.7.

minimum admissible temperature
mAT
minimum water temperature that a meter can withstand permanently, within its *rated operating condition(s)* (3.4.4), without deterioration of its metrological performance

Note: mAT is the lower of the rated operating conditions for temperature.

3.3.8.

maximum admissible temperature
MAT
maximum water temperature that a meter can withstand permanently, within its *rated operating condition(s)* (3.4.4), without deterioration of its metrological performance

Note: MAT is the upper of the rated operating conditions for temperature.

3.3.9.

maximum admissible pressure
MAP
maximum internal pressure that a meter can withstand permanently, within its *rated operating condition(s)* (3.4.4), without deterioration of its metrological performance

3.3.10.

working temperature
T_w
water temperature in the pipe measured upstream of the meter

3.3.11.

working pressure
p_w
average water pressure (gauge) in the pipe measured upstream and downstream of the meter

3.3.12.

pressure loss
Δp
irrecoverable decrease in pressure, at a given *flow rate* (3.3.1), caused by the presence of the meter in the pipeline

3.3.13.

test flow rate
mean *flow rate* (3.3.1) during a test, calculated from the indications of a calibrated reference device

3.3.14.

nominal diameter
DN
alphanumeric designation of size for components of a pipework system, which is used for reference purposes

Note 1: The nominal diameter is expressed by the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections.

Note 2: The number following the letters DN does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

Note 3: In those standards which use the DN designation system, any relationship between DN and component dimensions should be given, e.g. DN/OD or DN/ID.

3.4. Test conditions

3.4.1.

influence quantity
quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result

[SOURCE: ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM) 2.52, [1], modified – original examples and notes removed; “EXAMPLE” added]

EXAMPLE The ambient temperature of the meter is an influence quantity, whereas the temperature of the water passing through the meter affects the measurand.

3.4.2.

influence factor
influence quantity (3.4.1) having a value which ranges within the *rated operating condition(s)* (3.4.4) of a meter specified in this part of ISO 4064|OIML R 49

[SOURCE: OIML D 11:2013, 3.15.1, [8], modified — "meter" replaces "measuring instrument"; "specified in this part of ISO 4064|OIML R 49" is added; original notes removed]

3.4.3.

disturbance
influence quantity (3.4.1) having a value within the limits specified in this part of ISO 4064|OIML R 49, but outside the specified *rated operating condition(s)* (3.4.4) of the meter

[SOURCE: OIML D 11:2013, 3.15.2, [8], modified — "this part of ISO 4064|OIML R 49" replaces "the applicable International Recommendation"; "meter" replaces "measuring instrument"; original notes removed; “Note 1” added]

Note: An influence quantity is a disturbance if the rated operating conditions for that influence quantity are not specified.

3.4.4.

rated operating condition
ROC
operating condition requiring fulfilment during measurement in order that a meter perform as designed

[SOURCE: ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 4.9, [1], modified — "requiring fulfilment" replaces "that must be fulfilled"; "meter" replaces "measuring instrument or measuring system"; “Note” replaces the original note]

Note: The rated operating conditions specify intervals for the flow rate and for the influence quantities for which the errors (of indication) are required to be within the maximum permissible errors.

3.4.5.

reference condition
operating condition prescribed for evaluating the performance of a meter or for comparison of measurement results

[SOURCE: ISO/IEC Guide 99:2007|OIML V 2-200:2012 (VIM), 4.11, [1], modified — "meter" replaces "measuring instrument or measuring system"; original notes removed]

3.4.6.

performance test
test intended to verify whether the *equipment under test* (3.1.17) is able to accomplish its intended functions

[SOURCE: OIML D 11:2013, 3.21.4] [8]

3.4.7.

durability test
test intended to verify whether the *equipment under test* (3.1.17) is able to maintain its performance characteristics over a period of use

[SOURCE: OIML D 11:2013, 3.21.5] [8]

3.4.8.

temperature stability
condition in which all parts of the *equipment under test* (3.1.17) have a temperature within 3 °C of each other, or as otherwise specified in the relevant specification of its final temperature

3.4.9.

preconditioning
treatment of the *equipment under test* (3.1.17) with the objective of eliminating or partially counteracting the effects of its previous history

Note: Where called for, this is the first process in a test procedure.

3.4.10.

conditioning
exposure of the *equipment under test* (3.1.17) to an environmental condition (*influence factor* (3.4.2) or *disturbance* (3.4.3) in order to determine the effect of such a condition on it

3.4.11.

recovery
treatment of the *equipment under test* (3.1.17), after *conditioning* (3.4.10), in order that its properties can be stabilized before measurement

3.4.12.

type evaluation
systematic examination and testing of the performance of one or more specimens of an identified type of measuring instruments against documented requirements, the results of which are contained in the evaluation report, in order to determine whether the type may be approved

3.4.13.

type approval
decision of legal relevance, based on the evaluation report, that the type of a measuring instrument complies with the relevant statutory requirements and is suitable for use in the regulated area in such a way that it is expected to provide reliable measurement results over a defined period of time

3.5. Electronic and electrical equipment

3.5.1.

electronic device
device employing electronic sub-assemblies and performing a specific function, usually manufactured as a separate unit and capable of being tested independently

Note: An electronic device may be a complete meter or a part of a meter, e.g. as defined in 3.1.1 to 3.1.5 and 3.1.8.

3.5.2.

electronic sub-assembly
part of an *electronic device* (3.5.1), employing *electronic component(s)* (3.5.3) and having a recognizable function of its own

3.5.3.

electronic component
smallest physical entity that uses electron or hole conduction in semi-conductors, gases or in a vacuum

3.5.4.

checking facility
facility that is incorporated in a meter and which enables significant *fault(s)* (3.2.8) to be detected and acted upon

[SOURCE: OIML D 11:2013, 3.19, [8], modified — "meter" replaces "measuring instrument"; “Note 3” added]

Note 1: Typically, checking facilities detect and act upon:

— incorrect functioning of a specific device of the meter, and/or

— disturbed communication between specific devices of the meter.

Note 2: “Act upon” refers to any adequate response by the measuring instrument (for example: a luminous signal, an acoustic signal, interruption or blocking of the measurement process, etc.).

Note 3: The checking of a transmission device aims to verify whether all the information which is transmitted (and only that information) is fully received by the receiving equipment.

3.5.5.

automatic checking facility
checking facility (3.5.4) that operates without the intervention of an operator

[SOURCE: OIML D 11:2013, 3.19.1] [8]

3.5.6.

permanent automatic checking facility
type P automatic checking facility
automatic checking facility (3.5.5) that operates at each measurement cycle

[SOURCE: OIML D 11:2013, 3.19.1.1, [8], modified — Synonym presentation]

3.5.7.

intermittent automatic checking facility
type I automatic checking facility
automatic checking facility (3.5.5) that operates at certain time intervals or per fixed number of measurement cycles

[SOURCE: OIML D 11:2013, 3.19.1.2, [8], modified — Synonym presentation]

3.5.8.

non-automatic checking facility
type N checking facility
checking facility (3.5.4) that requires the intervention of an operator

[SOURCE: OIML D 11:2013, 3.19.2, [8], modified — Synonym presentation]

4. Metrological requirements

4.1. Values of Q_1, Q_2, Q_3, and Q_4

4.1.1. The flow rate characteristics of a water meter shall be defined by the values of Q_1, Q_2, Q_3, and Q_4.

4.1.2. A water meter shall be designated by the numerical value of Q_3 in m^3/h and the ratio Q_3/Q_1.

4.1.3. The value of Q_3 , expressed in m^3/h, shall be chosen from the following list:

1	1.6	2.5	4	6.3
10	16	25	40	63
100	160	250	400	630
1 000	1 600	2 500	4 000	6 300

The list may be extended to higher or lower values in the series.

4.1.4. The value of the ratio Q_3/Q_1 shall be chosen from the following list:

40	50	63	80	100
125	160	200	250	315
400	500	630	800	1 000

The list may be extended to higher values in the series.

Note: The values in 4.1.3 and 4.1.4 are taken from ISO 3[2], R 5 and R 10 lines, respectively.

4.1.5 The ratio Q_2/Q_1 shall be 1.6.

4.1.6 The ratio Q_4/Q_3 shall be 1.25.

4.2. Accuracy class and maximum permissible error

4.2.1. General

A water meter shall be designed and manufactured such that its errors (of indication) do not exceed the maximum permissible errors (MPEs) as defined in 4.2.2 or 4.2.3under rated operating conditions.

A water meter shall be designated as either accuracy class 1 or accuracy class 2, according to the requirements of 4.2.2 or 4.2.3.

The meter manufacturer shall specify the accuracy class.

Note: Guidance for in-service meter MPE is provided in Annex C

4.2.2. Accuracy class 1 water meters

The MPE for the upper flow rate zone ($Q_2 \leq Q \leq Q_4$) is ±1 %, for temperatures from 0.1 °C to 30 °C, and ±2 % for temperatures greater than 30 °C.

The MPE for the lower flow rate zone ($Q_1 \leq Q < Q_2$) is ±3 % regardless of the temperature range.

4.2.3. Accuracy class 2 water meters

The MPE for the upper flow rate zone ($Q_2 \leq Q \leq Q_4$) is ±2 %, for temperatures from 0.1 °C to 30 °C, and ±3 % for temperatures greater than 30 °C.

The MPE for the lower flow rate zone ($Q_1 \leq Q < Q_2$) is ±5 % regardless of the temperature range.

4.2.4. Meter temperature classes

The meters fall under water temperature classes corresponding to the various ranges, chosen by the manufacturer from the values given in Table 1.

The water temperature shall be measured at the inlet of the meter.

Table 1 -— Meter temperature classes

Class	mAT °C	MAT °C
T30	0.1	30
T50	0.1	50
T70	0.1	70
T90	0.1	90
T130	0.1	130
T180	0.1	180
T30/70	30	70
T30/90	30	90
T30/130	30	130
T30/180	30	180

4.2.5. Water meters with separable calculator and measurement transducer

The calculator (including indicating device) and the measurement transducer (including flow sensor or volume sensor) of a water meter, where they are separable and interchangeable with other calculators and measurement transducers of the same or different designs, may be the subject of separate type approvals. The MPEs of the combined indicating device and measurement transducer shall not exceed the values given in 4.2.2 or 4.2.3 according to the accuracy class of the meter.

4.2.6. Relative error of indication

The relative error (of indication) is expressed as a percentage, and is equal to:

$$\frac{(V_\mathrm{i} - V_\mathrm{a})}{V_\mathrm{a}} \times 100\,\% \qquad (1)$$

where V_a is as defined in 3.2.1 and V_i is as defined in 3.2.2.

4.2.7. Reverse flow

The manufacturer shall specify whether or not a water meter is designed to measure reverse flow.

If a meter is designed to measure reverse flow, the volume passed during reverse flow shall either be subtracted from the indicated volume or the meter shall record it separately. The MPE of 4.2.2 or 4.2.3 shall be met for both forward and reverse flow. For meters designed to measure reverse flow, the permanent flow rate and the measuring range may be different in each direction.

If a meter is not designed to measure reverse flow, the meter shall either prevent reverse flow or it shall withstand accidental reverse flow at a flow rate up to Q_3 without deterioration or change in its metrological properties for forward flow.

4.2.8. Water temperature and water pressure

The requirements relating to the MPEs shall be met for all temperature and pressure variations occurring within the rated operating conditions of a water meter.

4.2.9. Absence of flow or of water

The water meter totalization shall not change in the absence either of flow or of water.

4.2.10. Static pressure

A water meter shall be capable of withstanding the following test pressures without leakage or damage:

a) 1.6 times the maximum admissible pressure applied for 15 min;

b) twice the maximum admissible pressure applied for 1 min.

4.3. Requirements for meters and ancillary devices

4.3.1. Connections between electronic parts

The connections between the measurement transducer, the calculator and the indicating device shall be reliable and durable in accordance with 5.1.4 (see B.2).

These provisions shall also apply to connections between the primary and secondary devices of electromagnetic meters.

Note: Definitions of primary and secondary devices of electromagnetic meters are given in ISO 4006[3].

4.3.2. Adjustment device

A meter may be provided with an electronic adjustment device, which may replace a mechanical adjustment device.

4.3.3. Correction device

A meter may be fitted with correction devices; such devices are always considered as an integral part of the meter. The whole of the requirements which apply to the meter, in particular the MPEs specified in 4.2, are therefore applicable to the corrected volume at metering conditions.

In normal operation, non-corrected volume shall not be displayed.

A water meter with correction devices shall satisfy the performance tests of A.5.

All the parameters which are not measured and which are necessary for correcting shall be contained in the calculator at the beginning of the measurement operation. The type approval certificate may

prescribe the possibility of checking parameters which are necessary for correctness at the time of verification of the correction device.

The correction device shall not allow the correction of a pre-estimated drift, e.g. in relation to time or volume.

Associated measuring instruments, if any, shall comply with the applicable International Standards or OIML International Recommendations. Their accuracy shall be good enough to permit the requirements on the meter to be met, as specified in 4.2.

Associated measuring instruments shall be fitted with checking facilities (see B.6).

Correction devices shall not be used for adjusting the errors (of indication) of a water meter to values other than as close as practical to zero, even when these values are within the MPEs.

Conditioning of the water at flow rates below Q_1 by means of a moving device, e.g. spring-loaded flow accelerator, shall not be permitted.

4.3.4. Calculator

All parameters necessary for the elaboration of indications that are subject to legal metrological control, such as a calculation table or correction polynomial, shall be present in the calculator at the beginning of the measurement operation.

The calculator may be provided with interfaces permitting the coupling of peripheral equipment. When these interfaces are used, the hardware and software of a water meter shall continue to function correctly and the metrological functions of the meter shall not be capable of being affected.

4.3.5. Indicating device

The indicating device shall display the volume either continuously, periodically or on demand. It shall be readily available to read.

4.3.6. Ancillary devices

In addition to the indicating devices specified in 6.7.2, a water meter may include the ancillary devices specified in 3.1.8.

Where national regulations permit, a remote reading device may be used for testing and verification and for remote reading of a water meter, provided that other means guarantee the satisfactory operation of the water meter.

The addition of these devices, either temporary or permanent, shall not alter the metrological characteristics of the meter.

5. Water meters equipped with electronic devices

5.1. General requirements

5.1.1. A water meter equipped with electronic devices shall be designed and manufactured in such a way that significant faults do not occur when it is exposed to the disturbances specified in A.5.

5.1.2. A significant fault shall have a value not less than one half of the MPE in the upper flow rate zone.

The following faults are not considered to be significant faults:

a) faults arising from simultaneous and mutually independent causes in the meter itself or in its checking facilities;

b) transitory faults, i.e. temporary variations in the indication which cannot be interpreted, memorized or transmitted as a measurement result.

5.1.3. A water meter with electronic devices shall be provided with checking facilities, see 3.5.4 definition, selected from Annex B. The meter manufacturers shall declare which checking facilities are provided with the meter.

All water meters equipped with checking facilities shall prevent or detect reverse flow, as specified in 4.2.7.

5.1.4. A water meter is presumed to comply with the requirements in 4.2 and 5.1.1 if it passes the design inspection and performance tests specified in 7.2.12.1 and 7.2.12.2 in the following conditions:

a) the number of meters submitted shall comply with 7.2.2;

b) at least one of these meters is submitted to the whole set of tests;

c) no meter fails any test.

5.1.5. Sampling interval

For electronic water meters the sampling interval shall be appropriate in order to support the user application and billing period and not exceed 10 seconds. The sampling interval range shall be indicated in the product documentation available to the user or indicated on the meter, either physically inscribed or via menus accessible on the display.

Note: For billing periods of 1 month or longer, the influence of a sampling interval of 10 seconds or less has been found to have no significant impact on the averaged error of the meter [10]

5.1.6. Test mode

Electronic water meters or mechanical water meters incorporating an electronic indicating device may be placed into a specific mode of operation called test mode. The test mode shall not alter the ability of the meter to meet the acceptance criteria of any performance tests specified in this International Recommendation and in ISO 4064-2:2024 and may only differ from the specifications set out in this International Recommendation and in ISO 4064-2:2024 for the following aspects:

— Switch the resolution of the indicating device to achieve or exceed requirements of 6.7.3.2.3

— Switch to a shorter sampling interval than in service operation to achieve or exceed requirements of 6.7.3.2.3, 7.2, 7.3

— Activate output transmission in pulses or digital data format to the test laboratory data acquisition system

The test mode may only be used during tests requiring determination of the error (of indication) of the meter. Following the use of test mode for testing purposes the meter shall be able to be placed into an operational/service mode and sealed.

The manufacturer shall provide the necessary equipment and/or procedures to the test laboratories and national authorities to enable them to initiate the test mode.

5.1.7. Software requirements

For software-controlled water meters, the requirements of Annex D shall apply.

5.2. Power supply

5.2.1. General

Three different kinds of basic power supplies for water meters with electronic devices are covered by this Recommendation:

a) external power supply;

b) non-replaceable battery;

c) replaceable battery.

These three types of power supplies may be used alone or in combination. The requirements for each type of power supply are specified in 5.2.2 to 5.2.4.

5.2.2. External power supply

5.2.2.1. A water meter with electronic devices shall be designed such that in the event of an external power supply failure (AC or DC), the meter indication of volume just before failure is not lost, and remains accessible for a minimum of one year.

The corresponding memorization shall occur at least either once per day or for every volume equivalent to 10 min of flow at Q_3.

5.2.2.2. Any other properties or parameters of a meter shall not be affected by an interruption of the electrical supply.

During short-time voltage interruptions or reductions, the meter shall continue to operate accurately or employ the use of checking facilities to respond to any significant fault caused by the interruption or reduction.

Compliance with this requirement does not necessarily ensure that the meter continues to register volume during a longer-term power supply failure.

Note 1: Refer to ISO 4064-2:2024/OIML R 49-2:2024 clause 8.8 for short-time voltage interruptions and reductions.

Note 2: For the purposes of this clause, a 'power supply failure' is considered to be an interruption or reduction of voltage supply for a period of time greater than that specified in ISO 4064-2:2024/OIML R 49-2:2024, clause 8.8.

5.2.2.3. The power supply connections at a meter shall be capable of being secured from tampering.

5.2.2.4. Nominal value of mains voltage and frequency

The manufacturer shall declare the nominal value of mains voltage and frequency.

5.2.3. Non-replaceable battery

5.2.3.1 The manufacturer shall ensure that the expected lifetime of the battery is such that a meter functions correctly for at least one year longer than the operational lifetime of the meter.

5.2.3.2 A low battery or exhausted battery indicator or a meter replacement date shall be indicated on the meter. If the register display gives an indication of "low battery", there shall be at least 180 days of useful life for the register display from the time "low battery" indication is displayed to end of life.

Note: It is anticipated that a combination of specified maximum allowable total volume registered, displayed volume, indicated operational lifetime, remote reading, extreme temperatures and, if necessary, water conductivity will be considered when specifying a battery and during type evaluation.

5.2.4. Replaceable battery

5.2.4.1 Where the electrical power supply is a replaceable battery, the manufacturer shall give precise rules for the replacement of the battery.

5.2.4.2 A low battery or exhausted battery indicator or a battery replacement date shall be indicated on the meter. If the register display gives an indication of "low battery", there shall be at least 180 days of useful life for the register display from the time "low battery" indication is displayed to end of life.

5.2.4.3 The properties and parameters of a meter shall not be affected by the interruption of the electrical supply when the battery is replaced.

Note: It is anticipated that a combination of specified maximum allowable total volume registered, displayed volume, indicated operational lifetime, remote reading, extreme temperatures and, if necessary, water conductivity will be considered when specifying a battery and during type evaluation.

5.2.4.4 Replacement of the battery shall be carried out in a way that does not necessitate breaking the seal required for statutory metrological inspections.

5.2.4.5 The battery compartment shall be capable of being secured from tampering.

6. Technical requirements

6.1. Materials and construction of water meters

6.1.1 A water meter shall be manufactured from materials of adequate strength and durability for the purpose for which it is to be used.

6.1.2 A water meter shall be manufactured from materials which shall not be adversely affected by the water temperature variations, within the working temperature range (see 6.4).

6.1.3 All parts of a water meter in contact with the water flowing through it shall be manufactured from materials which are conventionally known to be non-toxic, non-contaminating, and biologically inert and according to national regulations.

6.1.4 The complete water meter shall be manufactured from materials which are resistant to internal and external corrosion or which are protected by a suitable surface treatment.

6.1.5 A water meter indicating device shall be protected by a transparent window. A cover of a suitable type may also be provided as additional protection.

6.1.6 Where there is a risk of condensation forming on the underside of the window of a water meter indicating device, the water meter shall incorporate devices for prevention or elimination of condensation.

6.1.7 A water meter shall be of such design, composition, and construction that it does not facilitate the perpetration of fraud.

6.1.8 A water meter shall be fitted with a metrologically controlled display. The display shall be readily accessible to the customer, without requiring the use of a tool.

6.1.9 A water meter shall be of such design, composition, and construction that it does not exploit the MPE or favour any party.

6.2. Adjustment and correction

6.2.1 A water meter may be fitted with an adjustment device, and/or a correction device. Any adjustment and/or correction shall be performed in such a way as to adjust the errors (of indication) of the water meter to values as close as practical to zero so that the meter may not exploit the MPE or systematically favour any party.

6.2.2 If these devices are mounted on the outside of the water meter, provision for sealing shall be made (see 6.8.2).

6.3. Installation conditions

Note: ISO 4064-5[6] specify requirements for meter installation.

6.3.1 The water meter shall be installed such that it is completely filled with water under normal conditions.

6.3.2 Under specific installation conditions, a strainer or filter, fitted at the inlet of a meter or in the upstream pipeline, may be required.

Installation engineers should note that solid particles collect in a water meter, e.g. following work on the pipework upstream from the meter.

Note: National regulations can apply. See also ISO 4064-5:2024[6], 6.3.

6.3.3 Provision may be made on a water meter to allow it to be correctly levelled during installation.

Note: This can be a flat vertical or horizontal surface against which a temporary or permanent level indicating device (e.g. a spirit level) can be placed.

6.3.4 If the accuracy of a water meter is affected by disturbances in the upstream or downstream pipeline (e.g. due to the presence of bends, valves or pumps), the water meter shall be provided with a sufficient number of straight pipe lengths, with or without a flow straightener, as specified by the manufacturer, so that the indications of the installed water meter meet the requirements of 4.2.2 or 4.2.3 with respect to MPEs and according to the accuracy class of the meter.

6.3.5 A water meter shall be able to withstand the influence of disturbed velocity fields as defined in the test procedures in ISO 4064-2:2024|OIML R 49-2:2024. During the application of these flow disturbances, the error (of indication) shall meet the requirements of 4.2.2 or 4.2.3.

Where a water meter may be manufactured and supplied with different lengths (as declared by the manufacturer), the meter with the shortest length shall be tested in order to demonstrate compliance with the requirements of 4.2.2 or 4.2.2. Some types of water meter which have been proven to be unaffected by flow disturbances upstream and downstream of the meter may be exempted from this test by the body responsible for type approval. A meter manufacturer shall specify the flow profile sensitivity class in accordance with Table 2 and Table 3.

Any specific flow conditioning section, including straightener and/or straight lengths, to be used shall be prescribed by the manufacturer.

Table 2 — Sensitivity to irregularity in the upstream velocity field classes (U)

Class	**Required straight length** ×DN	**Straightener needed**
U0	0	No
U3	3	No
U5	5	No
U10	10	No
U15	15	No
U0S	0	Yes
U3S	3	Yes
U5S	5	Yes
U10S	10	Yes

Table 3— Sensitivity to irregularity in the downstream velocity fields classes (D)

Class	Required straight length ×DN	Straightener needed
D0	0	No
D3	3	No
D5	5	No
D0S	0	Yes
D3S	3	Yes

6.4. Rated operating conditions

The rated operating conditions for a water meter shall be as reported in Table 4.

Table 4 — Rated operating conditions for a water meter

Flow rate range:	Q_1 to Q_3 inclusive.
Ambient temperature range:	+5 °C to +55 °C.
Water temperature range:	refer to Table 1.
Ambient relative humidity range:	0 % to 100 %, except for remote indicating devices where the range shall be 0 % to 93 %.
Pressure range:[a]	0.03 MPa (0.3 bar) to at least 1 MPa (10 bar), except for meters of DN ≥ 500, where the maximum admissible pressure (MAP) shall be at least 0.6 MPa (6 bar).
[a] The unit bar may be used where national regulations permit.	

6.5. Pressure loss

The pressure loss[1] through a water meter, including its filter or strainer and/or straightener, where either of these forms an integral part of the water meter, shall not be greater than 0.063 MPa (0.63 bar) between Q_1 and Q_3.

The pressure loss class is selected by the manufacturer from the values in Table 5 (which follow ISO 3[2], R 5): for a given pressure loss class, the pressure loss through a water meter, including its filter or strainer and/or straightener, where either of these forms an integral part of the water meter, shall not be greater than the specified maximum pressure loss between Q1 and Q3. Meters with non return devices may be tested for pressure loss without such devices being fitted where they do not form an integral part of the water meter.

A concentric meter, of any type and measuring principle, shall be tested together with its respective manifold.

Table 5— Pressure-loss classes

Class	Maximum pressure loss	
	MPa	bar
Δp 63	0.063	0.63
Δp 40	0.040	0.40
Δp 25	0.025	0.25
Δp 16	0.016	0.16
Δp 10	0.010	0.10

Straighteners, as specified in 6.3, are not considered to be integral parts of a meter.

For some meters, over the flow rate range $Q_1 \leq Q \leq Q_3$, the highest pressure loss does not occur at Q_3.

6.6. Marks and inscriptions

6.6.1 A place shall be provided for affixing the verification mark(s) (see OIML V 1:2022, 3.04), which shall be visible without dismantling the water meter after it has been placed on the market or put into use.

6.6.2 A water meter shall be clearly and indelibly marked with the following information, either grouped or distributed, on the casing, the indicating device dial, an identification plate or the meter cover, if it is not detachable. These markings shall be visible without dismantling the water meter after the instrument has been placed on the market or put into use.

Note: In the case of a combination meter, the markings in the following refer to the combination meter considered as a single meter.

a) Unit of measurement.

b) Accuracy class, where it differs from accuracy class 2.

c) Numerical value of Q_3 and the ratio Q_3/Q_1: if the meter measures reverse flow and the values of Q_3 and the ratio Q_3/Q_1 are different in the two directions, both values of Q_3 and Q_3/Q_1 shall be inscribed; the direction of flow to which each pair of values refers shall be clear. The ratio Q_3/Q_1 may be expressed as R, e.g. “R160”. If the meter has different values of Q_3/Q_1 in horizontal and vertical positions, both values of Q_3/Q_1 shall be inscribed, and the orientation to which each value refers shall be clear.

d) Type approval sign according to national regulations.

e) Name or trademark of the manufacturer.

f) Year of manufacture, the last two digits of the year of manufacture, or the month and year of manufacture.

g) Serial number (as near as possible to the indicating device).

h) Direction of flow, by means of an arrow (shown on both sides of the body or on one side only provided the direction of flow arrow is easily visible under all circumstances).

i) Maximum admissible pressure (MAP)[1)] if it exceeds 1 MPa (10 bar) or 0.6 MPa (6 bar) for DN ≥500.

j) Letter V and/or H, if the meter can only be operated in the vertical position and/or horizontal position with the indicating device positioned on the top.

k) The temperature class as specified in Table 1 where it differs from T30.

l) The pressure loss class where it differs from Δp 63.

m) The installation sensitivity class where it differs from U0/D0.

For a water meter with electronic devices, the following additional inscriptions shall be applied where appropriate.

n) For an external power supply: the voltage and frequency.

o) For a replaceable battery: the latest date by which the battery shall be replaced.

p) For a non-replaceable battery: the latest date by which the meter shall be replaced.

q) Environmental classification.

r) Electromagnetic environmental class.

The environmental classification and electromagnetic environmental class may be given on a separate datasheet, unambiguously related to the meter by a unique identification, and not on the meter itself.

An example of the required marks and inscriptions for a meter without electronic devices follows.

EXAMPLE A meter with the following characteristics:

— Q_3 = 2.5 m^3/h;

— Q_3/Q_1 = 200;

— horizontal mounting;

— temperature class 30;

— pressure loss class Δp 63;

— maximum admissible pressure: 1 MPa (10 bar);

— flow profile sensitivity class U0/D0

— serial number: 123456;

— year of manufacture: 2008;

— manufacturer ABC,

would be marked as follows:

Q_3 2.5; R200; H; → ; 123456; 08; ABC

6.7. Indicating device

6.7.1. General requirements

6.7.1.1. Function

The indicating device of a water meter shall provide an easily read, reliable, and unambiguous visual indication of the indicated volume. A combination meter may have two indicating devices, the sum of which provides the indicated volume.

The indicating device shall include visual means for testing and calibration.

The indicating device may include additional elements for testing and calibration by other methods, e.g. for automatic testing and calibration.

6.7.1.2. Unit of measurement, symbol, and its placement

The indicated volume of water shall be expressed in cubic metres. The symbol m^3 shall appear on the dial or immediately adjacent to the numbered display.

If units of measurement outside the SI are required or allowed by a country's national regulations, these units of measurement shall be considered acceptable for indications in that country. In international trade, the officially agreed equivalents between these units of measurement and those of the SI shall be used.

6.7.1.3. Indicating range

The indicating device shall be able to at least display the indicated volume in cubic metres given in Table 6 without passing through zero. When the displayed volume exceeds the water meter indicating range, the display shall pass through zero.

Table 6— Indicating range of a water meter

Q_3	**Minimum indicating range**
m^3/h	m^3
$Q_3 \leq 6.3$	9 999
$6.3 < Q_3 \leq 63$	99 999
$63 < Q_3 \leq 630$	999 999
$630 < Q_3 \leq 6\,300$	9 999 999

Table 6 may be expanded to larger values of Q3.

6.7.1.4. Colour coding for indicating devices

The colour black should be used to indicate the cubic metre and its multiples.

The colour red should be used to indicate sub-multiples of a cubic metre.

These colours shall be applied to either pointers, indexes, numbers, wheels, discs, dials or to the aperture frames.

Other means of indicating the cubic metre, its multiples and its sub-multiples may be used for a water meter provided there is no ambiguity in distinguishing between the primary indication and alternative displays, e.g. sub-multiples for verification and testing.

6.7.2. Types of indicating device

Any of the following types shall be used.

6.7.2.1. Type 1 — Analogue device

The indicated volume is indicated by continuous movement of

a) one or more pointers moving relative to graduated scales, or

b) one or more circular scales or drums each passing an index.

The value expressed in cubic metres for each scale division shall be of the form 10^n, where n is a positive or negative whole number or zero, thereby establishing a system of consecutive decades. Each scale shall either be graduated in values expressed in cubic metres or accompanied by a multiplication factor (×0.001; ×0.01; ×0.1; ×1; ×10; ×100; ×1 000, etc.).

Rotational movement of the pointers or circular scales shall be clockwise.

Linear movement of pointers or scales shall be left to right.

Movement of numbered roller indicators (drums) shall be upwards.

6.7.2.2. Type 2 — Digital device

The indicated volume is given by a line of adjacent digits appearing in one or more apertures. The advance of a given digit shall be completed while the digit of the next immediately lower decade changes from 9 to 0. The apparent height of the digits shall be at least 4 mm.

For non-electronic devices:

a) movement of numbered roller indicators (drums) shall be upwards;

b) if the lowest value decade has a continuous movement, the aperture shall be large enough to permit a digit to be read unambiguously.

For electronic devices:

c) either permanent or non-permanent displays are permitted — for non-permanent displays, the volume shall be able to be displayed at any time for at least 10 s;

d) the meter shall provide visual checking of the entire display which shall have the following sequence:

    1) for seven segment type displaying all the elements (e.g. an “eights” test);

    2) for seven segment type blanking all the elements (a “blanks” test);

    3) for graphical displays an equivalent test to demonstrate that display faults cannot result in any digit being misinterpreted.

Each step of the sequence shall last at least 1 s. This display test is initiated after a command by the user interface or is part of the cycling procedure that shows the different display modes.

6.7.2.3. Type 3 — Combination of analogue and digital devices

The indicated volume is given by a combination of type 1 and type 2 devices and the respective requirements of each shall apply.

6.7.3. Verification devices — First element of an indicating device — Verification scale interval

6.7.3.1. General requirements

Every indicating device shall provide means for visual, non-ambiguous verification testing and calibration.

The visual verification display may have either a continuous or a discontinuous movement.

In addition to the visual verification display, an indicating device may include provisions for rapid testing by the inclusion of complementary elements (e.g. star wheels or discs), providing signals through externally attached sensors. Such a provision may also be used for leak detection.

6.7.3.2. Visual verification displays

6.7.3.2.1. Value of the verification scale interval

The value of the verification scale interval expressed in cubic metres shall be of the form: 1×10^n, 2×10^n or 5×10^n, where n is a positive or negative whole number, or zero.

For analogue and digital indicating devices with continuous movement of the first element, the verification scale may be formed from the division into 2, 5 or 10 equal parts of the interval between two consecutive digits of the first element. Numbering shall not be applied to these divisions.

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.

6.7.3.2.2. Form of the verification scale

On indicating devices with continuous movement of the first element, the apparent scale spacing shall be not less than 1 mm and not more than 5 mm. The scale shall consist of either:

a) lines of equal thickness not exceeding one-quarter of the scale spacing and differing only in length; or

b) contrasting bands of a constant width equal to the scale spacing.

The apparent width of the pointer at its tip shall not exceed one-quarter of the scale spacing and in no case shall it be greater than 0.5 mm.

6.7.3.2.3. Resolution of the indicating device

The subdivisions of the verification scale shall be small enough to ensure that the resolution error of the indicating device does not exceed 0.25 % for accuracy class 1 meters, and 0.5 % for accuracy class 2 meters, of the volume passed during 90 min at the minimum flow rate Q_1.

Additional verification elements may be used provided that the uncertainty of reading is not greater than 0.25 % of the test volume for accuracy class 1 meters and 0.5 % of the test volume for accuracy class 2 meters and that the correct functioning of the register is checked.

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 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.

Note: See ISO 4064-2:2024|OIML R 49–2:2024, 6.4.3.6.2.3 for the calculation of the resolution error.

6.7.3.3. Combination meters

For combination meters with two indicating devices, 6.7.3.1 and 6.7.3.2 apply to both indicating devices.

6.8. Protection devices

6.8.1. General

A water meter shall include protection devices which can be sealed so as to prevent, both before and after correct installation of the water meter, dismantling or modification of the meter, its adjustment device or its correction device, without damaging these devices. In the case of combination meters, this requirement applies to both meters.

The display of the total quantity supplied or the displays from which the total quantity supplied can be derived shall not be resettable while the meter is in service to a single customer.

6.8.2. Electronic sealing devices

6.8.2.1. When access to parameters that influence the determination of the results of measurements is not protected by mechanical sealing devices, the protection shall fulfil the following provisions.

a) Access shall only be allowed to authorised people, e.g. by means of a code (password) or of a special device (e.g. a hard key). The code shall be capable of being changed.

b) It shall be possible for evidence of an intervention to be available for a period of time as defined in national regulations. The record shall include the date and a characteristic element identifying the authorized person making the intervention [see a)]. If deletion of a previous intervention is necessary to permit a new record, the oldest record shall be deleted.

6.8.2.2. For meters with parts which may be disconnected one from another by the user and which are interchangeable, the following provisions shall be fulfilled:

a) it shall not be possible to access parameters that participate in the determination of results of measurements through disconnected points unless the provisions in 6.8.2.1 are fulfilled;

b) interposing any device which may influence the accuracy shall be prevented by means of electronic and data-processing securities or, if this is not possible, by mechanical means.

6.8.2.3 For meters with parts which may be disconnected one from another by the user and which are not interchangeable, the provisions of 6.8.2.2 shall apply. Moreover, these meters shall be provided with devices or means which do not allow them to operate if the various parts are not connected according to the approved type. They shall be provided with a device that prevents any measurement after any unauthorized disconnection and subsequent reconnection by the user.

7. Metrological controls

7.1. Reference conditions

All influence quantities, except for the influence quantity being tested, shall be held to their reference conditions. The reference conditions (including their tolerances) are given in ISO 4064-2:2024|OIML

R 49-2:2024, clause 4. Values are specified for flow rate, water temperature, water pressure, ambient temperature, ambient relative humidity, and ambient atmospheric pressure.

7.2. Type evaluation and approval

7.2.1. External examination

Before undergoing type evaluation tests, each type of water meter submitted shall be examined externally to ensure that it complies with the provisions of the relevant preceding clauses of this part of ISO 4064|OIML R 49.

7.2.2. Number of samples

The evaluation tests shall be made on the minimum number of samples of each type shown in Table 7 as a function of the water meter designation Q_3 of the type presented.

The body responsible for type evaluation may request further specimens.

Table 7— Minimum number of water meters to be tested

Meter designation	**Minimum number of meters to be tested for all meter types, excluding the tests required for meters with electronic devices**
Q_3	
m^3/h	
$Q_3 \leq 160$	3
$160 < Q_3 \leq 1\,600$	2
$1\,600 < Q_3$	1

The requirements of 4.2.2 or 4.2.3 shall apply to all the meters tested, according to the accuracy class of the meter.

For type approval of a water meter with electronic devices, five samples shall be supplied for the tests specified in Annex A, which may be different samples from those supplied for other testing, with at least one meter being subjected to all the appropriate tests. The same meter shall be subjected to all testing, except in circumstances where not doing so can be justified by the organization performing the type evaluation.

7.2.3. Errors (of indication)

The errors (of indication) of a water meter (in the measurement of the actual volume) shall be determined at least at the following nominal flow rates:

a) Q_1;

b) Q_2;

c) $0.35\ (Q_2 + Q_3)$;

d) $0.7\ (Q_2 + Q_3)$;

e) Q_3;

f) Q_4;

and for combination meters:

g) 0.9 Q_{x1};

h) 1.1 Q_{x2}.

The errors (of indication) observed for each of the above flow rates shall not exceed the MPEs given in 4.2.2 or 4.2.3.

Note 1: See ISO 4064-2:2024|OIML R 49–2:2024, 7.4.4 for the permitted flow rate ranges and ISO 4064-2:2024|OIML R 49–2:2024, 7.4.4 and 7.4.5 for the required number of measurements at each flow rate.

Meters shall be tested in the orientations corresponding to their marking or lack thereof.

Note 2: See ISO 4064-2:2024|OIML R 49–2:2024, 7.4.2.2.7.5 for testing orientations.

7.2.4. Repeatability

A meter shall be repeatable: the standard deviation of three measurements at the same flow rate shall not exceed one-third of the MPEs given in 4.2.2 or 4.2.3. Tests shall be carried out at nominal flow rates of Q_1, Q_2, and Q_3.

7.2.5. Overload water temperature

A water meter with MAT ≥ 50 °C shall be capable of withstanding a water temperature of MAT + 10 °C for 1 h. The test is specified in ISO 4064-2:2024|OIML R 49-2:2024, 7.6.

7.2.6. Durability

7.2.6.1. General

A water meter shall undergo the durability tests specified in ISO 4064-2:2024|OIML R 49-2:2024, 7.11.

After each of these tests, the errors of the water meter shall again be measured at the flow rates given in 7.2.3 and the criteria given in 7.2.6.2 or 7.2.6.3 shall be applied.

The orientation(s) of a meter on test shall be set with reference to the meter orientation(s) claimed by the manufacturer.

Note: For families of meters, refer to Annex D of ISO 4064-2:2024|OIML R 49-2:2024 for meter selection.

7.2.6.2. Accuracy class 1 water meter

For an accuracy class 1 water meter, the variation in the error (of indication) curve shall not exceed 2 % for flow rates in the lower flow rate zone ($Q_1 \leq Q < Q_2$), and 1 % for flow rates in the upper flow rate zone ($Q_2 \leq Q \leq Q_4$).

For flow rates in the lower flow rate zone ($Q_1 \leq Q < Q_2$), the error (of indication) curve shall not exceed a maximum error limit of ±4 % for all temperature classes. For flow rates in the upper flow rate zone ($Q_2 \leq Q \leq Q_4$), the error (of indication) curve shall not exceed a maximum error limit of ±1.5 % for meters of temperature class T30 and ±2.5 % for all other temperature classes.

For the purpose of these requirements the mean values of the errors (of indication) shall apply.

7.2.6.3. Accuracy class 2 water meter

For an accuracy class 2 water meter, the variation in the error (of indication) curve shall not exceed 3 % for flow rates in the lower flow rate zone ($Q_1 \leq Q < Q_2$), and 1.5 % for flow rates in the upper flow rate zone ($Q_2 \leq Q \leq Q_4$).

For flow rates in the lower flow rate zone ($Q_1 \leq Q < Q_2$), the error (of indication) curve shall not exceed a maximum error limit of ±6 % for all temperature classes. For flow rates in the upper flow rate zone ($Q_2 \leq Q \leq Q_4$), the error (of indication) curve shall not exceed a maximum error limit of ±2.5 % for meters of temperature class T30 and ±3.5 % for all other temperature classes.

For the purpose of these requirements the mean values of the errors (of indication) shall apply.

7.2.7. Interchange error

It shall be demonstrated that cartridge meters and exchangeable metrological modules for water meters with exchangeable metrological modules are independent of the connection interfaces they are made for as far as their metrological performance is concerned. The cartridge meters and exchangeable metrological modules shall be tested in accordance with the test laid down in ISO 4064-2:2024|OIML R 49-2:2024, 7.4.6.

The orientation(s) of a meter on test shall be set with reference to the meter orientation(s) claimed by the manufacturer.

7.2.8. Static magnetic field

It shall be demonstrated that a water meter is not affected by a static magnetic field. A test shall apply to all water meters where the mechanical components may be influenced by a magnetic field, and for all meters with electronic components. The test is specified in ISO 4064-2:2024|OIML R 49-2:2024, 7.12. The purpose of the test is to ensure compliance with the provisions of 4.2 in the presence of static magnetic fields.

7.2.9. Documentation

7.2.9.1 The application for type approval of a water meter or a calculator (including indicating device) or a measurement transducer shall include the following documents:

a) a description giving the technical characteristics and the principle of operation;

b) a drawing or photograph of the complete water meter or calculator or measurement transducer;

c) a list of the parts with a description of their constituent materials when these parts have a metrological influence;

d) an assembly drawing with identification of the different parts;

e) for meters fitted with correction devices, a description of how the correction parameters are determined;

f) a drawing showing the location of seals and verification mark(s);

g) a drawing of regulatory markings;

h) for combination meters that comprise approved meters, the test reports for those meters;

i) optionally, a user guide and installation manual.

7.2.9.2 In addition, the application for type approval of a water meter with electronic devices shall include:

a) a functional description of the various electronic devices;

b) a flow diagram of the logic, showing the functions of the electronic devices;

c) any document or evidence which shows that the design and construction of the water meter with electronic devices comply with the requirements of this part of ISO 4064:2024|OIML R 49:2024, in particular 5.1. See Annex B for checking facilities information.

7.2.9.3 The applicant seeking type approval shall provide the body responsible for the evaluation with a meter or a calculator (including indicating device) or a measurement transducer which is representative of the final type, in addition to the sample(s) provided as per 7.2.2.

Additional specimens of the type may be considered necessary by the body responsible for the type evaluation to estimate the reproducibility of the measurements.

7.2.10. Type approval certificate

The following information shall appear on the type approval certificate or in its annexes:

a) name and address of the recipient of the certificate;

b) name and address of the manufacturer, if it is not the recipient;

c) type and/or commercial designation;

d) sufficient information to identify the meter type, e.g. drawing, photograph or description;

e) principal metrological and technical characteristics;

f) type approval mark;

g) period of validity;

h) environmental classification, if applicable (see A.2);

i) information on the location of marks for type approval, initial verification and sealing (e.g. a picture or drawing);

j) list of documents accompanying the type approval certificate;

k) specific remarks.

When applicable, the version of the metrological part of the evaluated software shall be indicated in the type approval certificate or in its annexes (technical file).

7.2.11. Modification of an approved type

7.2.11.1 The recipient of the type approval shall inform the body responsible for the approval of any modification or addition which concerns an approved type.

7.2.11.2 Modifications and additions shall be subject to a supplementary type approval when they influence, or are likely to influence, the measurement results or a meter's regulatory conditions of use. The body that approved the initial type shall decide to what extent the examinations and tests specified in the following shall be carried out on the modified type in relation to the nature of the modification.

7.2.11.3 If the body that approved the initial type judges that the modifications or additions are not likely to influence the measurement results, this body shall allow, in writing, the modified meters to be presented for initial verification without granting a supplementary type approval.

A new or supplementary type approval shall be issued whenever the modified type no longer fulfils the provisions of the initial type approval.

7.2.12. Type evaluation of a water meter with electronic devices

7.2.12.1. Design inspection

In addition to the requirements specified in the preceding paragraphs, a water meter with electronic devices shall be subject to design inspection. This examination of documents aims at verifying that the design of electronic devices and their checking facilities, if applicable, comply with the provisions of this part of ISO 4064|OIML R 49, 5 in particular. It includes:

a) an examination of the mode of construction and of the electronic sub-systems and components used, to verify their appropriateness for their intended use;

b) consideration of faults likely to occur, to verify that in all considered cases these devices comply with the provisions of 5.1. See Annex B for checking facilities information;

c) verification of the presence and effectiveness of the test device(s) for the checking facilities, if required.

7.2.12.2. Performance

7.2.12.2.1. General

A water meter shall comply with the provisions of 4.2 and 5.1.1 with regard to influence quantities.

7.2.12.2.2. Performance under the effect of influence factors

When subjected to the effect of influence factors as provided for in Annex A, a water meter shall continue to operate correctly and the errors (of indication) shall not exceed the applicable MPEs.

7.2.12.2.3. Performance under the effect of disturbances

When subjected to external disturbances as provided for in Annex A, a water meter shall continue to operate correctly, or significant faults shall be detected and acted upon by means of a checking facility.

7.2.12.2.4. Equipment under test

Where the electronic devices form an integral part of a water meter, tests shall be carried out on the complete water meter.

If the electronic devices of a water meter are in a separate housing, their electronic functions may be tested independently of the measurement transducer of the water meter by simulated signals representative of the normal operation of the meter, in which case the electronic devices shall be tested in their final housing.

In all cases, ancillary devices may be tested separately.

7.3. Initial verification

7.3.1. In general, only water meters which have been approved either as complete meters or as separately approved calculator (including indicating device) and measurement transducer (including flow or volume sensor), subsequently assembled into a combined meter, shall be eligible for initial verification.

Any special requirements for initial verification testing, detailed in the type approval certificate, shall be applied.

7.3.2. A water meter shall undergo the initial verification tests indicated in the following. This verification shall be carried out after type approval has been granted.

The water meter shall be shown to be capable of withstanding the following test pressure without leakage or damage: 1.6 times the maximum admissible pressure applied for 1 min (ISO 4064-2:2024|OIML R 49-2:2024, 10.1.2).

7.3.3. Water meters of the same size and the same type may be tested in series; however, in this case the requirement of ISO 4064-2:2024|OIML R 49-2:2024, 10.1.3, step d) concerning water meter outlet pressure shall be met for each water meter and there shall be no significant interaction between water meters.

Upstream and downstream straight lengths (and straighteners if required) shall be in accordance with the flow profile sensitivity class of the meter.

7.3.4. The errors (of indication) of a water meter in the measurement of actual volume shall be determined for at least the following nominal flow rates:

a) Q_1;

b) Q_2;

c) Q_3;

d) for combination meters, 1.1 Q_{x2}.

Note: See ISO 4064-2:2024|OIML R 49-2:2024, 10.1.3, step g) for the permitted flow rate ranges.

However, depending on the shape of the error curve, additional flow rates may be specified in the type approval certificate.

During a test, the water temperature shall be as required in ISO 4064-2:2024|OIML R 49-2:2024, 10.1.3, step e).

All other influence factors shall be held within the rated operating conditions.

7.3.5. The errors (of indication) determined at each of the above flow rates shall not exceed the MPEs given in 4.2.2 or 4.2.3 and shall not exploit the MPE or systematically favour any party.

Annex A
(Mandatory)

Performance tests for water meters with electronic devices

A.1 General

This annex defines the programme of performance tests intended to verify that water meters with electronic devices can perform and function as intended in a specified environment and under specified conditions. Each test indicates, where appropriate, the reference conditions for determining the intrinsic error.

These tests supplement any other prescribed test.

When the effect of one influence quantity is being evaluated, all other influence quantities are to be held relatively constant, at values close to reference conditions (see 7.1 and ISO 4064-2:2024|OIML R 49-2:2024, 4).

A.2 Environmental classification

See OIML D 11:2013 [8].

For each performance test, typical test conditions are indicated which correspond to the climatic and mechanical environmental conditions to which a water meter is usually exposed.

Water meters with electronic devices are divided into three classes according to climatic and mechanical environmental conditions:

— class B for fixed meters installed in a **b**uilding;

— class O for fixed meters installed **o**utdoors;

— class M for **m**obile meters.

However, the applicant for type approval may indicate specific environmental conditions in the documentation supplied to the body responsible for type approval, based on the intended use of the instrument. In this case, the testing laboratory shall carry out performance tests at severity levels corresponding to these environmental conditions. If type approval is granted, the data plate shall indicate the corresponding limits of use. Manufacturers shall inform potential users of the conditions of use for which a meter is approved.

A.3 Electromagnetic environments

Water meters with electronic devices are divided into two electromagnetic environments:

— E1 — residential, commercial and light industrial;

— E2 — industrial.

A.4 Type evaluation and approval of a calculator

A.4.1 When an electronic calculator (including indicating device) is submitted for separate type approval, type evaluation tests shall be conducted on the calculator (including indicating device) alone, simulating different inputs generated by appropriate standards (e.g. calibrators).

A.4.2 Accuracy tests on the indications of measurement results are required. For this purpose, the error obtained on the indication of the result is calculated considering that the true value is the one which takes into account the value of the simulated quantities applied to inputs of the calculator and using standard methods for calculation. The MPEs are those given in 4.2.

Note: An appropriate MPE for a calculator is 1/10 of the MPE of a complete meter. However, this is not a requirement. The requirement is given in 4.2.5.

A.4.3 The examinations and tests for electronic instruments specified in 7.2.12 shall be performed.

A.5 Performance tests

The tests indicated in Table A.1 involve the electronic part of a water meter or its devices and may be carried out in any order.

Table A.1— Tests involving the electronic part of a water meter or its devices

ISO 4064-2:2024|OIML R 49-2:2024, subclause	Test	Characteristic under test	Conditions applied
8.2	Dry heat	Influence factor	MPE
8.3	Cold	Influence factor	MPE
8.4	Damp heat, cyclic	Disturbance	Significant fault
8.5.1	Mains voltage variation	Influence factor	MPE
8.5.1	Mains frequency variation	Influence factor	MPE
8.5.2	Low voltage of internal battery (not connected to the mains power)	Influence factor	MPE
8.6	Vibration (random)	Disturbance	Significant fault
8.7	Mechanical shock	Disturbance	Significant fault
8.8	AC mains voltage dips, short interruption voltage variations	Disturbance	Significant fault
8.9	Bursts on signal, data and control lines	Disturbance	Significant fault
8.10	Bursts (transients) on AC and DC mains	Disturbance	Significant fault
8.11	Electrostatic discharge	Disturbance	Significant fault
8.12	Radiated electromagnetic fields	Disturbance	Significant fault

ISO 4064-2:2024|OIML R 49-2:2024, subclause	Test	Characteristic under test	Conditions applied
8.13	Conducted electromagnetic fields	Disturbance	Significant fault
8.14	Surges on signal, data and control lines	Disturbance	Significant fault
8.15	Surges on AC and DC Mains power lines	Disturbance	Significant fault
8.16	Static magnetic field	Influence factor	MPE
8.17	Absence of flow test	Disturbance	Significant fault
8.18	Mains power frequency electromagnetic fields test	Disturbance	Significant fault

Annex B
(Informative)

Checking facilities

B.1 Action of checking facilities

The detection by the checking facilities of significant faults shall result in the following actions, according to the type.

For checking facilities of type P or type I:

a) there shall be automatic correction of the fault; or

b) only the faulty device shall stop if a water meter without that device continues to comply with the regulations; or

c) there shall be a visible or audible alarm; this alarm shall continue until the cause of the alarm is resolved. Once the cause of the alarm is resolved the alarm may be reset either manually or automatically.

In addition, when a water meter transmits data to peripheral equipment, the transmission shall be accompanied by a message indicating the presence of a fault. (This requirement is not applicable to the application of disturbances specified in A.5.)

The instrument may also be provided with devices to estimate the volume of water having passed through the installation during the occurrence of the fault. The result of this estimate shall not be capable of being mistaken for a valid indication.

Note: The transmission of the alarm and repeated measured values from a meter to the remote station need not be secured if the measured values are repeated at that station.

B.2 Checking facilities for the measurement transducer

B.2.1 The objective of these checking facilities is to verify the presence of the measurement transducer, its correct operation and the correctness of data transmission.

The verification of correct operation includes detection or prevention of reverse flow. However, it is not necessary for the detection or prevention of reverse flow to be operated electronically.

B.2.2 When the signals generated by the flow sensor are in the form of pulses, each pulse representing an elementary volume, the pulse generation, transmission and counting shall fulfil the following tasks:

a) correct counting of pulses;

b) detection of reverse flow, if necessary;

c) checking of correct function.

This may be done by means of:

1) three-pulse system with use of either pulse edges or pulse status;

2) double-pulse line system with use of pulse edges plus pulse status;

3) double-pulse system with positive and negative pulses depending on the flow direction.

These checking facilities shall be of type P.

It shall be possible during type evaluation to verify that these checking facilities function correctly:

i) by disconnecting the transducer; or

ii) by interrupting one of the sensor's pulse generators; or

iii) by interrupting the electrical supply of the transducer.

B.2.3 For electromagnetic meters only, where the amplitude of the signals generated by the measurement transducer is proportional to the flow rate, the following procedure may be used.

A simulated signal with a shape similar to that of the measurement signal is fed into the input of the secondary device, representing a flow rate between the minimum and maximum flow rates of a meter. The checking facility shall check the primary and the secondary device. The equivalent digital value is checked to verify that it is within predetermined limits given by the manufacturer and consistent with the MPEs. This checking facility shall be of type P or type I. For type I facilities, checking shall occur at least every 5 min.

Note Following this procedure, additional checking facilities (more than two electrodes, double signal transmission, etc.) are not required.

B.2.4 The maximum permissible cable length between primary and secondary devices of an electromagnetic meter, as defined in ISO 6817:1992, [6] shall be not more than 100 m or not more than the value L expressed in metres according to the following formula, whichever is smaller:

$$L = \frac{k\sigma}{fC} \quad \text{(B.1)}$$

where

k is equal to 2×10^{-5} m;

σ is the conductivity of the water, in S/m;

f is the field frequency during the measuring cycle, in Hz;

C is the effective cable capacitance per metre, in F/m.

It is not necessary to fulfil these requirements if the manufacturer's solutions ensure equivalent results.

B.2.5 For other technologies, checking facilities providing equivalent levels of security remain to be developed.

B.3 Checking facilities for the calculator

B.3.1 The objective of these checking facilities is to verify that the calculator system functions correctly and to ensure the validity of the calculations made.

No special means are required for indicating that these checking facilities function correctly.

B.3.2 The checking facilities for the functioning of the calculation system shall be of type P or type I. For type I the checking shall occur at least either once per day or for every volume equivalent to 10 min of flow at Q_3. The objective of this checking facility is to verify that:

a) the values of all permanently memorized instructions and data are correct, by such means as:

   1) summing up all instruction and data codes and comparing the sum with a fixed value;

   2) line and column parity bits (longitudinal redundancy check and vertical redundancy check);

   3) cyclic redundancy check (CRC 16);

   4) double independent storage of data;

   5) storage of data in “safe coding”, e.g. protected by checksum, line and column parity bits;

b) all procedures of internal transfer and storage of data relevant to the measurement result are performed correctly, by such means as:

   1) write–read routine;

   2) conversion and re-conversion of codes;

   3) use of “safe coding” (checksum, parity bit);

   4) double storage.

B.3.3 The checking facilities for the validity of calculations shall be of type P or type I. For type I the checking shall occur either at least once per day, or for every volume equivalent to 10 min of flow at Q_3.

This consists of checking the correct value of all data related to the measurement whenever these data are internally stored or transmitted to peripheral equipment through an interface. This check may be carried out by such means as parity bit, check sum or double storage. In addition, the calculation system shall be provided with a means of controlling the continuity of the calculation programme.

B.4 Checking facility for the indicating device

B.4.1 The objective of this checking facility is to verify that the primary indications are displayed and that they correspond to the data provided by the calculator. In addition, it aims at verifying the presence of the indicating devices when they are removable. These checking facilities shall have either the form as defined in B.4.2 or that as defined in B.4.3.

B.4.2 The checking facility of the indicating device is of type P; however, it may be of type I if a primary indication is provided by another device.

Means may include, for example:

a) for indicating devices using incandescent filaments or light emitting diodes, measuring the current in the filaments;

b) for indicating devices using fluorescent tubes, measuring the grid voltage;

c) for indicating devices using multiplexed liquid crystals, output checking of the control voltage of segment lines and of common electrodes, so as to detect any disconnection or short circuit between control circuits.

The checks mentioned in 6.7.2.2 are not necessary.

B.4.3 The checking facility for the indicating device shall include type P or type I checking of the electronic circuits used for the indicating device (except the driving circuits of the display itself); this checking facility shall meet the requirements of B.3.3.

B.4.4 It shall be possible during type evaluation to determine that the checking facility of the indicating device is working, either:

a) by disconnecting all or part of the indicating device; or

b) by an action which simulates a failure in the display, such as using a test button.

B.4.5 Although the continuous display of volume is not mandatory (see 4.3.5), interruption of the display shall not interrupt the action of checking facilities.

B.5 Checking facilities for ancillary devices

An ancillary device (repeating device, printing device, memory device, etc.) with primary indications shall include a checking facility of type P or type I. The aim of this checking facility is to verify the presence of the ancillary device, when it is a necessary device, and to verify correct functioning and correct transmission.

B.6 Checking facilities for the associated measuring instruments

Associated measuring instruments shall include a checking facility of type P or type I. The aim of this checking facility is to ensure that the signal given by these associated instruments is inside a predetermined measuring range.

EXAMPLE Four wire transmission for resistance type temperature sensors; control of the driving current for 4 mA –20 mA pressure sensors.

Annex C
(Informative)

Permissible errors in service and subsequent verification

The MPEs of a water meter while in service should be twice the MPEs given in 4.2.2 or 4.2.3 according to the accuracy class of the meter. Although subsequent verification is not covered in the scope of this part of ISO 4064|OIML R 49, historically this has been found to be reasonable.

Subsequent verification should be applied in accordance with national regulations for legal metrology.

Annex D
(Mandatory)

Requirements for software-controlled water meters

D.1 Overview

The requirements set out in this annex are based on OIML D 31:2023 [9]. The requirements specified in this annex apply:

— Only to the legally relevant parts of a water meter, e.g. software, parameters, the measured quantity value, measurement result and measurement data; and

— Equally to non-dynamic and dynamic modules of legally relevant software.

The manufacturer is responsible for producing water meters and legally relevant software that conforms to the approved type and the documentation submitted for type evaluation.

Means described in D.2.1 and D.3.1 shall be provided to allow for the evaluation of conformity.

The terms used in this annex conform to the terms and definitions specified in OIML D 31:2023 [9].

D.2 General requirements

D.2.1 Software identification

Legally relevant software modules of a water meter and/or its components shall be clearly and uniquely identified with the software version. The identification may consist of more than one part, but at least one part shall be dedicated to the legal purpose.

The identification shall be inextricably linked to the software itself and shall be displayed or printed either:

a) on command;

b) during operation; and/or

c) at start up for a water meter that can be turned off and on again.

If an electronic sub-assembly/device has neither a display nor a printer, the identification shall be sent via a communication interface in order to be displayed/printed on another electronic sub-assembly/device.

As an exception, an imprint or indelible sticker of the software identification on the instrument/electronic device shall be an acceptable solution if it satisfies all of the following conditions:

d) the user interface does not have any control capability to activate the indication of the software identification on the display, or the display does not technically allow the identification of the software to be shown (analogue indicating device or electromechanical counter);

e) the instrument/electronic device does not have an interface to communicate the software identification; and

f) after production of the instrument/electronic device, a change of the software is not possible, or only possible if the hardware or a hardware component is also changed.

In this case, the manufacturer of the hardware component is responsible for ensuring that the software identification is correctly marked on the concerned instrument/electronic device. If the software is modified in any way, a new software identification is required.

The software identification and the means of identification shall be stated in the [OIML certificate / type approval certificate]. Instructions on how to display or print the software identification shall be in the [OIML certificate / type approval certificate].

Each water meter in use shall conform to the approved type. The software identification enables surveillance personnel and persons affected by the measurement to determine whether the water meter under consideration conforms to the approved type.

D.2.2 Correctness of metrological algorithms and functions

The measuring algorithms and functions of the water meter and/or its components shall be appropriate and functionally correct.

It shall be possible to evaluate algorithms and functions either by:

a) Analysis of the documentation and validation of the design (AD)

b) Verification by functional testing of metrological functions (VFTM); and/or

c) Verification by functional testing of software functions (VFTSw).

All legally relevant metrological algorithms, functions and parameters shall be documented. No hidden or undocumented functions or parameters shall exist.

D.2.3 Software securing and protection

Software shall be protected in such a way that evidence of any intervention (e.g. software updates, parameters changes) shall be available (e.g. in an audit trail, see D.2.4). Software shall be secured against unauthorised modification, loading, or changes by swapping the memory device.

Mechanical sealing or other technical means may be necessary to secure measuring instruments. Audit trails are considered to be part of the legally relevant software and should be protected as such.

Only clearly documented functions (see D.2.5) may be activated by the user interface, which do not influence the metrological characteristics of the instrument.

Parameters that fix the legally relevant characteristics of the water meter shall be protected against unauthorised modification. Legally relevant parameters shall be secured and protected in such a way that evidence of modifications and intervention shall be available.

In the case of dynamic software modules of legally relevant software with predefined parameters, these shall be considered as a part of the software and treated as such. This entails logging of all parameter changes in an audit trail.

If applicable it shall also be possible to transmit the current parameter settings and data containing evidence of interventions to the verification software.

D.2.4 Audit trails

Audit trails and event counters are part of the legally relevant software and shall be secured and protected as such. It shall not be possible to delete or inadmissibly change the data of the audit trail or event counter and it shall not be possible to exchange the audit trails or the value of the event counter when the software is updated.

The audit trail shall contain at minimum the following information:

a) timestamp of the event or intervention;

b) the nature of the event or intervention;

c) the success/failure of the intervention or update;

d) in the case of a software update:

   1) software identification of the installed version;

   2) software identification of the previous installed version;

e) in the case of a parameter change:

   1) identification of the changed parameter;

   2) the old and new values of the changed parameter; and

f) the identification of the downloading party if available.

The audit trail or value of the event counter shall be displayed or printed on command and, if applicable, transmitted to the verification software. The [OIML certificate / type approval certificate] shall describe how the audit trail or the value of the event counter may be displayed or printed and specify if the audit trail or event counter is part of a remote verification procedure.

The storage device for the audit trail shall have a sufficient capacity to ensure that the information is available for the life of the meter. If the audit trail has no more capacity an appropriate response is required i.e., either the oldest entry may be deleted, or no other update or parameter change shall be possible without breaking a metrological seal.

D.2.5 Prevention of misuse

A water meter shall be constructed in such a way that possibilities for unintentional, accidental, or intentional misuse are minimal. Only clearly documented functions are allowed to be activated by the user and communication interfaces, which shall be realised in such a way that it does not facilitate fraudulent use.

All inputs from the user interface shall be handled by a protective interface. Any function that can be activated by the user interface shall:

a) be clearly documented; and

b) not be able to inadmissibly influence the legally relevant characteristics of the water meter.

All inputs from communication interfaces shall be handled by a protective interface. Any function that can be activated through a communication interface shall:

c) be clearly documented; and

d) not be able to influence the legally relevant characteristics of the water meter remotely such as through a remote verification procedure or a software download.

The presentation of the measurement result shall be accessible and unambiguous for all parties affected by the measurement result.

D.2.6 Support of fault and defect detection

Software may be involved in the checking facilities used for the detection of faults and defects and to act upon significant faults and significant defects or to prevent them from occurring. In such a case, this software is considered legally relevant.

If software is involved in the detection of significant faults or significant defects, the software-controlled water meter shall be made inoperative automatically, or automatically raise an alarm. The alarm may be visual, audible or transmittable to the person in control of the water meter (i.e. the water utility company). The alarm shall continue until such time as an authorised person takes action to resolve the fault or defect, the water meter acts upon the fault or defect, or it is otherwise resolved.

The documentation to be submitted for type evaluation shall contain a list of parameters and their valid and controlled ranges which may generate faults and which will be detected by the software including the expected reaction and, if necessary for understanding the detection algorithm, its description.

D.3 Requirements specific for configurations

D.3.1 Specification and separation of legally relevant components and interfaces

D.3.1.1 General

This requirement applies if the water meter and/or its components or software modules have interfaces for communicating with other electronic devices, with the user, or with other (non-legally relevant) software modules next to the legally-relevant components/modules.

Legally-relevant components of a water meter – whether software or hardware – shall not be inadmissibly influenced by other components of the measuring system.

D.3.1.2 Separation of constituents of a measuring system

Components of a water meter that perform functions which are legally relevant shall be identified, clearly defined, and documented. These form the legally relevant part of the measuring system.

It shall be demonstrated that the legally-relevant functions and data of components cannot be inadmissibly influenced by commands received via an interface. This implies that there is an unambiguous assignment of each command to all initiated functions or data changes in the component.

D.3.1.3 Separation of software modules

All software modules (programs, subroutines, objects, etc.) that perform legally relevant functions or that contain legally relevant data domains form the legally relevant software part of a water meter. This part shall be made identifiable as described in D.2.1.

If the separation of the software modules is not possible, the software is legally-relevant as a whole.

If the legally relevant software part communicates with other software parts, a software interface shall be defined implemented. All communication shall be performed exclusively via this interface. The legally relevant software part and the interface shall be clearly documented. All legally relevant functions and data domains of the software shall be described to enable a type approval authority to decide on correct software separation.

The interface consists of program code and dedicated data domains. Defined coded commands or data are exchanged between the software parts by storing to the dedicated data domain by one software part and reading from it by the other. Reading and writing program code is part of the software interface.

The data domain forming the software interface, including the code that exports from the legally-relevant part to the interface data domain and the code that imports from the interface to the legally relevant part, shall be clearly defined and documented. The declared software interface shall not be circumvented.

There shall be an unambiguous assignment of each command to all initiated functions or data changes in the legally relevant part of the software. Commands that communicate through the software interface shall be declared and documented. Only documented commands are allowed to be activated through the software interface. The manufacturer shall state the completeness of the documentation of commands.

Where legally relevant software has been separated from non-relevant software, the legally relevant software shall have priority using the resources over non-relevant software. The measurement task (realised by the legally relevant software part) shall not be delayed or blocked by other tasks.

When dynamic modules of legally relevant software have facilities for continuous learning that allow dynamic parameter changes during use, the manufacturer shall clarify the facilities and its priorities to the whole legally relevant software, especially in reference to the measuring functions.

D.3.2 Shared indications

Software that realises the indication of measurement values and other legally-relevant information belongs to the legally-relevant part.

A display or printout may be employed for presenting both information from the legally relevant part of the software and other information. The information generated by the legally relevant information shall always be readable, and clearly distinguishable from other information.

D.3.3 Data storage

D.3.3.1 General

Hardware and software, whether incorporated into the water meter or connected to it externally, that is intended to be used for the storage of measurement results and/or measurement data shall be subject to the requirements specified in D.3.3.1 to D.3.3.3.

The measurement result and measurement data includes all associated data necessary for future legally relevant use (see OIML D 31:2023 [9] for relevant terms and definitions).

D.3.3.2 Protection of stored data

Stored measurement results and measurement data shall be protected to guarantee the authenticity, integrity and, if necessary, correctness of the information concerning the time of measurement. Where timestamps are required, they shall either be read from an internal clock or synchronized with legal time. The setting of the time and date shall be secured.

The software that displays or further processes measurement results and measurement data shall check the authenticity and integrity of the data after having read them from storage.

Software modules that prepare measurement results and measurement data for storage, or that check data after reading are considered part of the legally relevant software.

If a modification or corruption is detected, the stored measurement results and measurement data shall be discarded or marked unusable.

D.3.3.3 Automatic storage

Measurement results and measurement data shall be stored automatically.

The storage device shall have sufficient permanency to ensure that measurement results and measurement data are not corrupted under normal storage conditions. There shall be sufficient memory storage for the intended application.

D.3.3.4 Deletion of stored data

It shall not be possible to delete the accumulated volume measured and indicated by the water meter.

D.3.4 Data transmission

D.3.4.1 General

If applicable, hardware and software, whether incorporated into the water meter or connected to it externally, that is intended to be used for the transmission of measurement results and/or measurement data shall be subject to the requirements specified in D.3.4.1 and D.3.4.2.

The measurement result and measurement data includes all associated data necessary for future legally relevant use (see OIML D 31:2023 [9] for relevant terms and definitions).

Requirements concerning the transmission of measurement results and/or measurement data via communication networks are subject to national regulations.

Note: In some jurisdictions transmission of data via communication networks is not subject to legal metrology requirements. National regulations may instead specify compliance with data transmissions standards such as EN 13757 *Communication systems for meters*.

D.3.4.2 Protection of transmitted data

Transmitted measurement results and measurement data shall be protected to guarantee the authenticity, integrity and, if necessary, correctness of the information concerning the time of measurement. Where timestamps are required, they shall either be read from an internal clock or synchronized with legal time. The setting of the time and date shall be secured.

The software that displays or further processes measurement results and measurement data shall check the authenticity and integrity of the data after having received them from a transmission channel.

Software modules that prepare measurement results and measurement data for transmission, or that check data after reading or receiving are considered part of the legally relevant software.

If a modification or corruption is detected, the transmitted measurement results and measurement data shall be discarded or marked unusable.

When transferring measurement results and measurement data through an open network, it is necessary to apply cryptographic methods. Confidentiality keys employed for this purpose shall be kept secret and secured in the water meter, electronic devices, or sub-assemblies involved in the transmission. Means shall be provided whereby these keys can only be input or read if a seal is broken.

Transmitted measurement results and measurement data shall be traceable back to the measurement process and water meter (or component) that generated them.

D.3.4.3 Transmission delay or interruption

Measurement results and measurement data (such as the accumulated totalized volume) shall not be inadmissibly influenced by a transmission delay or interruption. If network services become unreliable or unavailable, no measurement results and measurement data shall be lost.

D.3.5 Indications from dynamic modules of legally relevant software

Where water meters incorporate or are dependent upon dynamic modules of legally relevant software, this information shall be indicated and made available to any parties interested in the measurement result(s) produced by that water meter.

Where a measurement result is the product of a measurement process that incorporates or is dependent upon dynamic modules of legally relevant software, the indication of the measurement result shall include information regarding the use of those modules in the measurement process. This may be achieved by the use of a short statement, clearly understood markings, symbols or other indications.

Where measurement data is produced as a result of algorithms of dynamic modules of legally relevant software, the measurement data shall be marked or indicated as such.

D.4 Maintenance and reconfiguration

D.4.1 General

Only versions of legally-relevant software that conform to the approved type are allowed for use.

In addition, download and installation of legally relevant software is allowed if the requirements in the download procedures described in either D.4.2 or D.4.3 are met.

The use of verified updates, traced updates and required download procedure(s) are subject to national regulations.

D.4.2 Verified update

A verified update is the procedure of changing software (i.e. exchange with another approved version or re-installation of an existing version) in a verified device or component after which the subsequent verification by an authorised person is necessary.

The software to be updated can be loaded locally, i.e. directly on the water meter or remotely via a network. A seal needs to be broken for the update to take effect.

Loading and installation may be two different steps or combined into one, depending on the needs of the technical solution.

Means shall be implemented to check the effectiveness of the update (e.g. in-person inspection).

After the update of the legally-relevant software of a water meter, the water meter is not allowed to be employed for legal purposes before a verification of the water meter has been performed and the securing means have been renewed.

D.4.3Traced update

A traced update is the procedure of changing software in a verified device or component after which the subsequent verification by a responsible person on site is not necessary. This means the traced update shall not affect existing parameters or the accuracy of the measurement. The following conditions shall apply:

a) Traced update of software shall be automatic. Upon completion of the update procedure, the software protection environment shall be at the same level as required by the [OIML certificate / type approval certificate].

b) Technical means shall be employed to guarantee the authenticity of the loaded software.

c) Technical means shall be employed to ensure the integrity of the loaded software, i.e. that it has not been inadmissibly changed before loading.

d) Appropriate technical means shall be employed to ensure that traced updates are adequately traceable within the water meter.

e) If the loaded software fails the authenticity check, the water meter shall discard it and use the previous version of the software or switch to an inoperable mode.

f) The water meter shall have a sub-assembly/electronic device for the user or owner to express his/her consent. It shall be possible to enable and disable this sub-assembly/electronic device, e.g. by means of a switch that can be sealed or by a parameter. If the sub-assembly/electronic device is enabled, each download shall be initiated by the user or owner. If it is disabled, no activity by the user or owner is necessary to perform a download.

g) If the requirements of a) through f) cannot be fulfilled, it is still possible to update the legally non-relevant software part. In this case, the following requirements shall be met:

    1) there is a distinct separation between the legally relevant and non-relevant software according to D.3.1;

    2) the whole legally-relevant software part cannot be updated without breaking a seal; and

    3) it is stated in the [OIML certificate / type approval certificate] that updating of the legally non-relevant part is acceptable.

An audit trail shall be employed to ensure that traced updates of legally relevant software are adequately recorded and traceable within the water meter for subsequent verification and surveillance or inspection. The water meter shall be capable of presenting the recorded data upon request from an authorised person. The traceability means and records are part of the legally-relevant software and shall be protected as such. See D.2.4 and D.2.5 for specific requirements.

D.5 Software documentation

All program functions shall be explained in the documentation of the water meter, including relevant data structures and software interfaces of the legally relevant part of the software that is implemented in the water meter. All commands and their effects shall be completely described in the software documentation.

The manufacturer shall submit all such documentation to allow for a reasonable evaluation of the legally relevant software. The documentation shall include:

a) a description of the legally-relevant software and how the requirements are met;

b) a list of the software modules that belong to the legally-relevant part;

c) a declaration that all legally relevant functions are included in the description;

d) a description of the software interfaces of the legally-relevant software part and of the commands and data flows via this interface, including a statement of completeness;

e) a description of the generation of the software identification;

f) the software identification and instructions for obtaining it from a water meter in use;

g) a list of parameters to be protected and a description of protection means;

h) a description of suitable system configuration and minimal required resources;

i) a description of security means of the operating system (password, etc. if applicable);

j) a description of the (software) protection method(s);

k) an overview of the system hardware, e.g. topology block diagram, type of computer(s), type of network, etc. Where a hardware component is deemed legally-relevant or where it performs legally relevant functions, this should also be identified;

l) a description of the user interface, menus, and dialogues;

m) a list of commands of each hardware interface of the water meter / electronic device(s) / sub-assembly(ies), including a statement of completeness;

n) a description of the accuracy of the algorithms (e.g. volume calculation, rounding algorithms, etc.);

o) if realised in the software:

    1) a description of the audit trail and instructions on how to access the audit trail;

    2) a list of durability errors that are detected by the software and a description of the detecting algorithms;

    3) a list of faults and/or defects that are detected and a description of the detecting algorithm;

p) a description of data sets stored or transmitted; and

q) the operating manual.

Annex E

Comparison table

(Informative)

OIML R 49-1:2024		OIML R 49-1:2013		Remarks
Ref.	**Description**	**Ref.**	**Description**	
3	Terms and definitions			Notes 1 to 3 added.
3.1.5	indicating device	3.1.5	indicating device	New note added. *Note 2:* In this International Standard, the volume of water passing through the meter refer to the accumulated volume.
3.1.22	meter with exchangeable metrological module	3.1.22	meter with exchangeable metrological module	Definition changed. meter comprising a connection interface and an exchangeable metrological module (3.1.23) from the same type approval (3.4.13)
3.1.25	non-adjustable water meter	3.1.25	non-adjustable water meter	New definition. meter whose indication cannot be altered in any way (e.g. without changing the internal dimensions and/or method of operation), and which has no adjustment device or correction device. *Note 1:* This category should also include mechanical meters with an internal adjustment device where the adjustment cannot be altered at initial verification stage as the meter would need to be dismantled. *Note 2:* The meter should not have a correction device, i.e. the indicating device of the meter should either be purely mechanical or be electronic but with a constant multiplying factor applied to the indication and set to the same value for all meters (such as a device which counts the number of rotations of the shaft and multiplies by a fixed value to give total volume passed).

3.1.26	adjustable water meter	3.1.26	adjustable water meter	New definition. Meter that is connected to or incorporates an adjustment and/or correction device.
3.1.27	=	3.1.27	software-controlled water meter	New definition. water meter (3.1.1) that incorporates and utilizes legally relevant software modules
3.3.3	overload flow rate	3.3.3	overload flow rate	New note added. *Note 1:* the definition of short period of time can vary between economies and/or applications, but for example 2 hours in a 24-hour period.
3.5.4	checking facility	3.5.4	checking facility	Notes changed. *Note 1:* Typically, checking facilities detect and act upon: • incorrect functioning of a specific device of the measuring instrument, and/or • disturbed communication between specific devices of the measuring instrument. *Note 2:* "Act upon" refers to any adequate response by the measuring instrument (for example: a luminous signal, an acoustic signal, interruption or blocking of the measurement process, etc.).
3.6	Use of certain terms within the European Economic Area		=	Deleted. Moved to Note 3 in under clause 3 Terms and definitions
5.1.3	Water meters equipped with electronic devices	5.1.3	Water meters equipped with electronic devices	Requirement changed. A water meter with electronic devices shall be provided with checking facilities, see 3.5.4 definition, selected from Annex B. The meter manufacturers shall declare which checking facilities are provided with the meter.
5.1.5	Sampling interval	-	-	New requirement. For electronic water meters the sampling interval shall be appropriate in order to support the user application and billing period and shall not exceed 10 seconds. The sampling interval range shall be indicated in the product documentation available to the user or indicated on the meter, either physically inscribed or via menus accessible on the display.

				Note: For billing periods of 1 month or longer, the influence of a sampling interval of 10 seconds or less has been found to have no significant impact on the averaged error of the meter.
5.1.6	Test mode	-	-	New requirement. Electronic water meters or mechanical water meters incorporating an electronic indicating device may be placed into a specific mode of operation called test mode. The test mode shall not alter the ability of the meter to meet the acceptance criteria of any performance tests specified in this part of the standard and in OIML R 49-2 and may only differ from the specifications set out in this part of the standard and in OIML R 49-2 for the following aspects: Switch the resolution of the indicating device to achieve or exceed requirements of 6.7.3.2.3. Switch to a shorter sampling interval than in service operation to achieve or exceed requirements of 6.7.3.2.3, 7.2, 7.3. Activate output transmission in pulses or digital data format to the test laboratory data acquisition system. The test mode may only be used during tests requiring determination of the error (of indication) of the meter Following the use of test mode for testing purposes the meter shall be able to be placed into an operational/service mode, sealed and verified as required by national regulations. The manufacturer shall provide the necessary equipment and/or procedures to the test laboratories and national authorities to enable them to initiate the test mode.
5.1.7	Software requirements	-	-	New requirement. For software-controlled water meters, the requirements of Annex D shall apply.
5.2.2.2	External power supply	5.2.2.2	External power supply	Requirements and notes changed. Any other properties or parameters of a meter shall not be affected by an interruption of the electrical supply. During short-time voltage interruptions or reductions, the meter shall continue to operate accurately or employ the use of checking facilities to respond to any significant fault caused by the interruption or reduction. Compliance with this requirement does not necessarily ensure that the meter continues to register volume during a longer-term power supply failure.

				Note 1: Refer to OIML R 49-2, 8.8 for short-time voltage interruptions and reductions. *Note 2:* For the purposes of this clause, a 'power supply failure' is considered to be an interruption or reduction of voltage supply for a period of time greater than that specified in OIML R 49-2, 8.8.
5.2.2.4	Nominal value of mains voltage and frequency The manufacturer shall declare the nominal value of mains voltage and frequency.	-	-	New requirement. Nominal value of mains voltage and frequency. The manufacturer shall declare the nominal value of mains voltage and frequency.
6.2	Adjustment and correction	6.2	Adjustment and correction	Requirement changed.
6.5	Pressure loss	6.5	Pressure loss	Requirement changed. New addition: "Meters with non return devices may be tested for pressure loss without such devices being fitted where they do not form an integral part of the water meter. A concentric meter, of any type and measuring principle, shall be tested together with its respective manifold".
6.6.2 j)	Marks and inscriptions	6.6.2 j)	Marks and inscriptions	Requirement changed. Letter V and/or H, if the meter can only be operated in the vertical position and/or horizontal position with the indicating device positioned on the top.
6.7.1.3	Indicating range	6.7.1.3	Indicating range	New requirement. New addition: "When the indicated volume has reached the maximum value given in Table 5, the displays shall roll past zero".
6.7.2.2	Type 2 — Digital device	6.7.2.2	Type 2 — Digital device	Requirement changed. New addition:

				"This display test is initiated after a command by the user interface or is part of the cycling procedure that shows the different display modes".
7.2.3	Errors (of indication)	7.2.3	Errors (of indication)	Requirement changed. Deleted: "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 MPE. In all cases this requirement shall be applied equitably with respect to the water supplier and the consumer (see also 4.3.3, paragraphs 3 and 8). If a meter is" New addition in *Note 1:* "shall be tested in the orientations corresponding to their marking or lack of."
7.2.6.1	General	7.2.6.1	General	Requirement changed. Deleted: "simulating service conditions."
7.3.5	-	7.3.5	-	Requirement changed. The errors (of indication) determined at each of the above flow rates shall not exceed the MPEs given in 4.2.2or 4.2.3 and shall not exploit the MPE or systematically favour any party.
-	-	7.3.6	-	Requirement deleted.
Annex A.5	Performance tests Table A.1	Annex A5	Performance tests Table A.1	Two new test requirements in Table A.1: 8.16Static magnetic field 8.17Absence of flow test
Annex B	Checking facilities	Annex B	Checking facilities	Changed from "Mandatory" to "Informative".
Annex B.1	Action on checking facilities	Annex B.1	Action on checking facilities	Deleted from Annex B.1 The visible or audible alarm is not allowed in the case of two constant partners, non-resettable and non-prepaid measurements, where checking facilities are used, unless this alarm is transferred to a remote station.

Annex D.2.3	=	Annex B.2.3	=	Note changed to sentence
Annex B.5	Checking facilities for ancillary devices	Annex B.5	Checking facilities for the associated measuring instruments	New clause heading added
Annex D	Requirements for software-controlled water meters	-	-	New Normative Annex.

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[3] ISO 4006:1991, *Measurement of fluid flow in closed conduits — Vocabulary and symbols*

[4] ISO 4064-2:2024 │OIML R 49-2:2024, *Water meters for cold potable water and hot water — Part 2: Test methods*

[5] OIML R 49-4:2024, Water meters for cold potable water and hot water. Part 4: Type evaluation report format

[6] ISO 6817:1992, *Measurement of conductive liquid flow in closed conduits — Method using electromagnetic flowmeters*

[7] OIML V 1:2022, *International vocabulary of terms in legal metrology* (VIML)

[8] OIML D 11:2013, General requirements for measuring instruments — Environmental conditions

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