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ISO 4064-3

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Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water —

Part 3: Test methods and equipment

Mesurage de débit d'eau dans les conduites fermées en pleine charge — Compteurs d'eau potable froide et d'eau chaude — Partie 3: Méthodes et matériels d'essai

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 4064-3 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 7, *Volume methods including water meters*.

This third edition cancels and replaces the second edition (ISO 4064-3:1999), which has been technically revised, as well as cancelling and replacing ISO 7858-3:1992.

ISO 4064 consists of the following parts, under the general title *Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water*:

— *Part 1: Specifications*

— *Part 2: Installation requirements*

— *Part 3: Test methods and equipment*

Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water —

Part 3: Test methods and equipment

1 Scope

This part of ISO 4064 specifies the test methods and means to be employed in determining the principal characteristics of water meters.

This part of ISO 4064 is applicable to cold potable water and hot water concentric and combination meters, which can withstand maximum admissible working pressures (MAP) equal to at least 1 MPa (10 bar) 0,6 MPa (6 bar) for meters ⩾ DN 500 mm and a maximum admissible temperature for cold potable water meters of 30 °C and for hot water meters of up to 180 °C, depending on the class.

This part of ISO 4064 also applies to water meters based on electrical or electronic principles and to water meters based on mechanical principles incorporating electrical devices, used to meter the actual volume flow of cold potable water and hot potable water.

In the case where water meters have a permanent flowrate of less than 160 m^3/h, in order to meet individual test laboratory limitations the test schedule may make provisions for modification of the reference conditions, when testing specifically for endurance or for performance under influence quantities.

NOTE Attention is drawn to the fact that national legislation may apply in the country of use, which will take precedence over the provisions of this part of ISO 4064.

2 Normative references

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

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 286-2, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 4064-1:2005, *Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water — Part 1: Specifications*

ISO 4064-2, *Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water — Part 2: Installation requirements*

ISO 5168, *Measurement of fluid flow — Procedures for the evaluation of uncertainties*

ISO 7005-2, *Metallic flanges — Part 2: Cast iron flanges*

ISO 7005-3, *Metallic flanges — Part 3: Copper alloy and composite flanges*

ISO *Guide to the expression of uncertainty in measurement (GUM), 1995*

IEC 60068-1:1988, *Environmental testing — Part 1: General and guidance*

IEC 60068-2-1:1974, *Environmental testing — Part 2 Tests. Tests A: Cold*

IEC 60068-2-2:1993, *Environmental testing — Part 2: Tests. Tests B: Dry heat*

IEC 60068-2-30:1980, *Environmental testing — Part 2 Tests. Test Db and guidance: Damp heat, cyclic (12h + 12h cycle)*

IEC 60068-2-31:1993, *Environmental testing — Part 2 Tests. Test Ec: Drop and topple, primarily for equipment-type specimens*

IEC 60068-2-47:1999, *Environmental testing — Part 2-47:Test: — Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests*

IEC 60068-2-64:1993, *Environmental testing — Part 2: Test methods — Test Fh: Vibration, broad-band random (digital control) and guidance*

IEC 60068-3-1:1974, *Environmental testing — Part 3: Background information — Section One: Cold and dry heat tests*

IEC 60068-3-4:2001, *Environmental testing — Part 3-4: Supporting documentation and guidance — Damp heat tests*

IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 2: Electrostatic discharge immunity test. Basic EMC Publication*

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

IEC 61000-4-4:1995, *Electromagnetic Compatibility (EMC) — Part 4-5: Testing and Measurement Techniques — Surge Immunity Tests*

IEC 61000-4-5:1995, *Electromagnetic Compatibility (EMC) — Testing and measurement techniques — Part 4-5: Surge immunity test*

IEC 61000-4-11:1994, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests*

ENV 50204:1995, *Radiated electromagnetic field from digital radio telephones. Immunity test*

OIML D 4:1981, *Installation and storage conditions for cold water meters*

OIML D 11:1994, *General requirements for electronic measuring instruments*

OIML G 13:1989, *Planning of metrology and testing laboratories (P 7)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4064-1 and the following apply.

3.1
combination meter changeover flowrate with decreasing flow
Q_{x1}
flowrate occurring when the pressure drop in the combination meter increases suddenly in parallel with a cessation of flow in the larger meter and a visible increase in flow in the smaller meter

3.2
combination meter changeover flowrate with increasing flow
Q_{x2}
flowrate occurring when the pressure drop in the combination meter decreases suddenly in parallel with a start-up of flow in the larger meter and a visible reduction in the flow in the smaller meter.

3.3
relative error
ε
error, expressed as a percentage, defined by the equation:

$$\varepsilon = \frac{V_i - V_a}{V_a} \times 100$$

where

V_i is the indicated volume;

V_a is the actual volume.

NOTE More detail is provided in Annex A. ISO 4064-1 gives the maximum permissible errors.

3.4
test flowrate
mean flowrate calculated from the indication of the calibrated reference device and the test duration

4 Requirements common to all tests

4.1 Preliminary requirements

Before starting testing, a written test programme shall be compiled, and shall include, e.g. a description of the tests for the determination of measurement error, pressure loss and wear resistance. The programme may also define the necessary levels of acceptability and stipulate how the test results should be interpreted.

4.2 Water quality

Water meter tests shall use water. The water shall be that of the public potable water supply or shall meet the same requirements. If water is being recycled, measures shall be taken to prevent residual water in the meter from becoming harmful to human beings.

The water shall not contain anything capable of damaging the meter or adversely affecting its operation. It shall not contain air bubbles.

4.3 Other reference conditions

All other applicable influence quantities, except for the influence quantity being tested, shall be held at the following values during pattern approval tests on a water meter:

Flowrate:	$0{,}7 \times (Q_2 + Q_3) \pm 0{,}03 \times (Q_2 + Q_3)$
Ambient temperature range:	15 °C to 25 °C [1)]
Ambient relative humidity range:	45 % to 75 % [1)]
Ambient atmospheric pressure range:	86 kPa to 106 kPa (0,86 bar to 1,06 bar)
Power supply voltage (mains a.c.):	Nominal voltage (U_{nom}) ± 5 %
Power supply frequency:	Nominal frequency (f_{nom}) ± 2 %
Power supply voltage (battery):	A voltage V in the range; $U_{bmin} \leqslant V \leqslant U_{bmax}$
Working water temperature:	See ISO 4064-1:2005, 5.4.1, Table 5
Working water pressure:	200 kPa (2 bar)

During each test, the temperature and relative humidity shall not vary by more than 5 °C or 10 % respectively within the reference range.

4.4 Location

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

5 Tests to determine errors of indication

5.1 General

The method described in this part of ISO 4064 to determine measurement errors is the so-called “collection” method in which the quantity of water passed through the water meter is collected in one or more collecting vessels and the quantity determined volumetrically or by weighing. Other methods may be used, provided the accuracy levels of testing stated in this part of ISO 4064 be attained.

Checking facilities of electronic devices is included in this section.

5.2 Principle

The checking of the measurement error consists of comparing the indications given by the meter under test against a calibrated reference device.

5.3 Description of the test bench

The test bench typically consists of:

a) a water supply (mains, non-pressurized tank, pressurized tank, pump, etc.);

b) pipework;

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1) When the ambient temperature and/or ambient relative humidity exceed the above-mentioned ranges, the effect on the error of indication shall be taken into account.

c) a calibrated reference device (calibrated tank, reference meter, etc.);

d) means for measuring the time of the test;

e) devices for automating the test;

f) means for measuring water temperature;

g) means for measuring water pressure;

h) means for determining density, if necessary;

i) means for determining conductivity, if necessary.

5.4 Pipework

5.4.1 Description

Pipework shall include:

a) a test section in which the meter(s) is (are) placed;

b) means for establishing the desired flowrate;

c) one or two isolating devices;

d) means for determining the flowrate;

and, if necessary:

e) one or more air bleeds;

f) a non-return device;

g) an air separator;

h) a filter;

i) means for checking that the pipework is filled to a datum level before and after test.

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

The pipework shall be such that at the outlet of all meters a positive pressure exists of at least 0,3 bar at any flowrate.

5.4.2 Test section

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

a) one or more pressure tappings for the measurement of pressure, of which one pressure tapping is situated upstream of, and close to, the (first) meter;

b) if necessary, means for measuring the temperature of the water at the entry to the (first) meter.

None of the pipe components or devices placed in the measuring section shall cause cavitation or flow disturbances capable of altering the performance of the meters or causing measurement errors.

5.4.3 Precautions to be taken during tests

The operation of the test bench shall be such that the quantity of water which has flowed through the meter(s) equals that measured by the reference device.

Checks shall be made to ensure that pipes (e.g., the swan neck in the outlet pipe) are filled to the same datum level at the beginning and at the end of the test.

Air shall be bled from the interconnecting pipework and the meter(s).

All precautions shall be taken to avoid the effects of vibration and shock.

5.4.4 Special arrangements for the installation of certain types of meter

5.4.4.1 Principles

The provisions of the following subclauses address the most frequent causes of error and the necessary precautions for the installation of water meters on the test bench and are prompted by the recommendations of OIML D 4, which aims to help achieve a test installation where:

a) the hydrodynamic flow characteristics cause no discernible difference to the meter functioning when compared with hydrodynamic flow characteristics which are undisturbed;

b) the overall error of the method employed does not exceed the stipulated value (see 5.5.1).

5.4.4.2 Need for straight lengths of pipe or a flow straightener

The accuracy of non-volumetric water meters can be affected by upstream and downstream disturbances caused by the presence and location of elbows, tees, valves or pumps, etc.

In order to counteract these effects, the meter under test (MUT) shall be installed between straight lengths of pipe. The internal diameters of the upstream and downstream connecting pipework shall be the same as the internal diameter of the water meter's connecting ends. Moreover, it may be necessary to put a flow straightener upstream of the straight length.

5.4.4.3 Common causes of flow disturbance

Flow can be subject to two types of disturbance, namely velocity profile distortion and swirl, both of which can affect the accuracy of the water meter.

See ISO 4064-2 for details of installation requirements.

5.4.4.4 Volumetric water meters

Volumetric water meters (i.e., involving measuring chambers with mobile walls), such as oscillating piston and nutating disc meters, are considered insensitive to upstream installation conditions; hence no special recommendations are required.

5.4.4.5 Velocity type water meters

Velocity type water meters are sensitive to flow disturbance, which can cause significant errors, but the way installation conditions affect their accuracy has not yet been clearly determined.

5.4.4.6 Other measuring principles

Other types of meter may or may not require flow conditioning for accuracy tests. If required, manufacturers' recommendations shall be used during testing. Those recommendations shall be included in the pattern approval documents.

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

Concentric meters that are proven to be unaffected by manifold configuration (typically of the volumetric type – see 5.4.4.4) may be tested and used with any suitable manifold arrangement.

5.4.4.7 Electromagnetic induction meters

Meters employing the principle of electromagnetic induction may be affected by the conductivity of the test water. The test water should have a conductivity within the range of values specified by the manufacturer.

5.4.5 Test commencement and determination of errors

5.4.5.1 Principles

Adequate precautions shall be taken to reduce the uncertainties resulting from the operation of the test bench components during the test. Details of the precautions to be taken are given in 5.4.5.2 and 5.4.5.3 for two cases encountered in the "collection" method.

5.4.5.2 Tests with readings taken with the meter at rest

The flow is established by opening a valve situated downstream of the meter, and is stopped by the closure of this valve. The meter should be read after registration stops.

Time is measured between the start of the opening movement of the valve and the close of the closing movement.

While flow begins, and during the period of running at the specified constant flowrate, the error of indication of the meter varies as a function of the changes in flowrate (measurement error curve).

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

NOTE In this case, it has not been possible to determine a simple empirical rule, which lays down conditions so that this error may always be discounted as negligible. Certain types of meter are particularly sensitive to such error.

In case of doubt, it is advisable:

a) to increase the volume and duration of the test;

b) to compare the results with those obtained by one or more other methods, and in particular the method described in 5.4.5.3, which eliminates the causes of uncertainty given above.

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

Where pulse outputs are used for testing meters, a check shall be made that the volume indicated by the pulse count corresponds to the volume displayed on the indicating device within the accuracy of registration.

5.4.5.3 Tests with the readings taken under stable flowrate conditions and diversion of flow

The measurement is carried out when the flow conditions have stabilized.

A switch diverts the flow into a calibrated vessel at the beginning of the measurement and diverts it away at the end. The meter is read while in motion.

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

The volume collected in the vessel is the volume passed.

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

NOTE For combination meters the test method described in 5.4.5.3 in which readings of the combination meter are taken at an established flowrate, ensures that the change-over device is functioning correctly for both increasing and decreasing flowrates. The test method described in 5.4.5.2, in which readings of the meter are taken at rest, does not allow the determination of the error of registration after regulating the test flowrate for decreasing flowrates for combination meters.

5.4.5.4 Test method for the determination of change-over flowrates

See definitions of combination meter change-over flowrates Q_{x1} and Q_{x2} given in Clause 3.

Starting from a flowrate that is less than the change-over flowrate, Q_{x2}, the flowrate is increased in successive steps of 5 % until the flowrate Q_{x2} is reached. The value of Q_{x2} is taken as the average of the values of indicated flowrate just before and just after change-over occurs.

Starting from a flowrate that is greater than the change-over flowrate, Q_{x1}, the flowrate is decreased in successive steps of 5 % until the flowrate Q_{x1} is reached. The value of Q_{x1} is taken as the average of the values of indicated flowrate just before and just after change-over occurs.

5.5 Calibrated reference device

5.5.1 Overall uncertainty of the actual volume

When a test is conducted, the expanded uncertainty of the actual volume shall not exceed 1/5 of the applicable maximum permissible error (MPE) for pattern approval, and 1/3 of the applicable MPE for initial verification and subsequent verifications.

The evaluation and expression of uncertainty shall be made in accordance with ISO 5168 and the ISO Guide to the expression of uncertainty in measurement (GUM), with a coverage factor k of 2.

5.5.2 Minimum volume (volume of the calibrated vessel if this method is used)

The minimum volume permitted depends on requirements determined by the test start and end effects and the design of the indicating device (verification scale division) (see ISO 4064-1).

5.6 Meter reading

It is accepted that the maximum interpolation error for the scale does not exceed half a scale division per observation. Thus in the measurement of a volume of flow delivered by the water meter (consisting of two observations of the water meter), the total interpolation error can reach one scale division.

For digital indicating devices with discontinuous changes of the verification scale, the total reading error is one digit.

5.7 Major factors affecting the determination of errors of indication

NOTE Variations in the pressure, flowrate and temperature in the test bench, as well as uncertainties in the precision of measurement of these physical quantities, are the principal factors affecting the measurement of the errors of indication of a water meter.

5.7.1 Pressure

The pressure shall be maintained at a nominally constant value throughout the test at the chosen flowrate.

For testing water meters, which are designated $Q_3 \leqslant 16$, at test flowrates $\leqslant 0{,}10\ Q_3$, the constancy of pressure at the inlet of the meter (or at the inlet of the first meter of a series being tested) is achieved if the test bench is supplied through a pipe from a constant head tank. This ensures an undisturbed flow.

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

For all other tests, the pressure upstream of the meter shall not vary by more than 10 %.

The maximum uncertainty in the measurement of pressure shall be 5 % of the measured value.

Pressure at the inlet to the meter shall not exceed the maximum admissible working pressure (MAP) of the meter.

5.7.2 Flowrate

The flowrate shall be maintained nominally constant at the chosen value throughout the test.

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

- ± 2,5 % from Q_1 to Q_2 (not inclusive);
- ± 5,0 % from Q_2 (inclusive) to Q_4.

The flowrate value is the volume passed during the test divided by the time.

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

- ± 5 % from Q_1 to Q_2 (not inclusive);
- ± 10 % from Q_2 (inclusive) to Q_4.

5.7.3 Temperature

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

The uncertainty in the measurement of temperature shall not exceed ± 2 °C.

5.7.4 Orientation of meter during error measurements

The position of the meters (spatial orientation) shall be as indicated by the manufacturer and they shall be mounted in the test rig as appropriate.

If the meters are marked “H”, the connecting pipework shall be mounted with the flow axis in the horizontal plane during the test (indicating device positioned on top).

If the meters are marked “V”, the connecting pipework shall be mounted with the flow axis in the vertical plane during the test (inlet on lower end).