INTERNATIONAL STANDARD

ISO 4064-3

Second edition
1999-05-01

Measurement of water flow in closed conduits — Meters for cold potable water —

Part 3:
Test methods and equipment

Mesurage de débit d'eau dans les conduites fermées — Compteurs d'eau potable froide —

Partie 3: Méthodes et matériels d'essai

Reference number
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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

International Standard ISO 4064-3 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid in closed conduits*, Subcommittee SC 7, *Volume flowrate methods*.

This second edition cancels and replaces the first edition (ISO 4064-3:1983), which has been technically revised.

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

— *Part 1: Specifications*

— *Part 2: Installation requirements*

— *Part 3: Test methods and equipment*

Annex A forms a normative part of this part of ISO 4064.

Measurement of water flow in closed conduits — Meters for cold potable water —

Part 3: Test methods and equipment

1 Scope

This part of ISO 4064 is applicable to meters for cold potable water, as defined in clause 1 of ISO 4064-1. It specifies the test methods and means to be employed in determining the principal characteristics of water meters.

NOTE 1 ISO 4064-1 deals with terminology, technical and dimensional characteristics, metrological characteristics and pressure loss. ISO 4064-2 deals with installation requirements.

NOTE 2 Legal requirements take precedence over the specifications of this part of ISO 4064. In particular, it should be noted that in countries where legal requirements specify that the tests are to be carried out in accordance with the rules of the International Organization of Legal Metrology (OIML), for example for pattern approval and initial verification of water meters, OIML recommendation R 49 should be followed.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 4064. For dated references, subsequent amendments to, or revisions of, this publication do not apply. However, parties to agreements based on this part of ISO 4064 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4064-1:1993, *Measurement of water flow in closed conduits — Meters for cold potable water — Part 1: Specifications*.

3 Terms and definitions

For the purposes of this part of ISO 4064, the following terms and definitions apply.

3.1
measurement error
meter error, conventionally expressed as relative error, calculated as a percentage, and equal to:

$$\frac{V_i - V_c}{V_c} \times 100$$

where

V_c is the value accepted as true of the volume passed;

V_i is the volume indicated by the water meter at the time of measurement of the same volume, both expressed in the same units.

NOTE ISO 4064-1 specifies the maximum permissible errors.

3.2
test flowrate
mean flowrate calculated from the indication of the calibrated reference device

4 Requirements common to all tests

4.1 Preliminary requirements

Before starting a test, a written test programme shall be compiled, and shall include, for example, 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.

Two of the most common forms of test programme, viz. pattern approval and initial verification, are given in clause 9 by way of example.

4.2 Water quality

Water-meter tests shall be made with 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 General rules concerning test installation and location

4.3.1 Freedom from spurious influences

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

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

4.3.2 Group testing of meters

Meters are tested individually or in groups. In the latter case the individual characteristics shall be precisely determined. Interaction between meters, and between test rigs, shall be eliminated.

When meters are tested in series, the pressure at the exit of each shall be sufficient to prevent cavitation.

4.3.3 Temperature of the water during the tests

The results of the tests are acceptable without temperature correction, provided that the water temperature in the meter is between 0 °C and 30 °C during the tests.

In no part of the test rig shall the temperature fall below 0 °C.

4.3.4 Location

During the tests, the location chosen for them shall be isolated from any other activity (for example, manufacture, repairs, etc.) or disturbing influences (for example, ambient temperature, vibration).

5 Determination of measurement error

5.1 Principle

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 stated in this part of ISO 4064 are attained.

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

5.2 Description of the test rig

The test rig consists of:

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

b) pipework;

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

d) means for measuring the time of the test.

Devices for automating the testing of water meters are permissible.

5.3 Pipework

5.3.1 Description

Pipework shall include:

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

b) means to establish 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.

During the test, flow leakage, flow input and flow drainage shall be permitted neither between the meter(s) and the reference device nor from the reference device.

The pipework shall be such that in the upper part of the meter a positive pressure exists of at least 0,05 bar, even at zero flowrate.

5.3.2 Test section

The test section shall include, 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.

The different devices placed in the measuring section shall not cause cavitation or flow disturbances capable of altering the performance of the meters or causing measurement errors.

5.3.3 Precautions to be taken during tests

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

It shall be checked that pipes (for example, the swan-neck in the outlet pipe) are filled to the same extent 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.

5.3.4 Special arrangements for installation of certain types of meter

5.3.4.1 Principle

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

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

b) the overall error of the method employed does not exceed the stipulated value (see 5.4.1).

5.3.4.2 Need for straight lengths of pipe or a flow straightener

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

In order to counteract these effects, the meter shall be installed for test in a straight length. The connecting pipework shall have the same internal diameter as the hole in the connection of the meter. It may, moreover, be necessary to put a flow straightener upstream of the straight length.

5.3.4.3 Common causes of flow disturbance

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

Velocity-profile distortion is typically caused by an obstruction partially blocking the pipe, for instance the presence of a partly closed valve or a misaligned flange joint. This can easily be eliminated.

Swirl is caused mainly by two or more bends in different planes. This effect can be controlled either by ensuring an adequate length of straight pipe upstream of the water meter, or by installing a straightening device, or by a combination of the two.

5.3.4.4 Volumetric water meters

Volumetric water meters (that is, involving measuring chambers with mobile walls), such as oscillating piston meters, are considered insensitive to upstream installation conditions; hence no special conditions are required.

5.3.4.5 Velocity-type water meters

Certain velocity-type water meters are sensitive to flow disturbance, which can result in significant errors, but the way installation conditions affect their accuracy has not yet been clearly determined. It is simply recommended to avoid, as far as possible, the presence of bends, pumps, taper pieces and changes in the diameter of pipework immediately upstream, and to position the meter to afford the maximum possible straight length of pipe upstream and downstream.

5.3.5 Errors of test commencement and termination

5.3.5.1 Principle

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

Details of the precautions to be taken are given in 5.3.5.2 and 5.3.5.3 for two cases encountered in the "collection" method.

5.3.5.2 Tests with readings taken with the meter at rest

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

Time is measured between the beginning of the movement of the valve at opening and at the beginning of closure.

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

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

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

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 5.3.5.3, which eliminates the causes of uncertainty given above.

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

The measurement is carried out when flow conditions have stabilized.

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

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

The volume collected in the vessel is the volume passed.

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

5.4 Calibrated reference device

5.4.1 Overall error of the method employed

For pattern approval and initial verification, the total error in the method used for the determination of the volume of water passed through the water meter shall not exceed 1/10 of the relevant maximum permissible error.

5.4.2 Minimum volume (volume of the calibrated vessel is used in this method)

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

5.5 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.

In the absence of other requirements, the maximum error in the reading of the volume indicated by the meter shall not exceed 0,5 %.

The effects of a possible cyclic distortion on the reading of the meter (visual or automatic) shall be negligible.

5.6 Major factors affecting measurement-error checks

5.6.1 General

Variations in the pressure, flowrate and temperature in the test rig, and uncertainties in the precision of measurement of these physical quantities, are the principal factors affecting the measurement-error test results.

5.6.2 Pressure

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

For testing water meters which are designated N $\leqslant$ 10, at test flowrates $\leqslant$ 0,10 q_p, 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 rig is supplied through a pipe from a constant head tank. This ensures an undisturbed flow.

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

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 entrance to the meter shall not exceed the nominal pressure for the meter.

5.6.3 Flowrate

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

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

± 2,5 % from q_{min} to q_t (not inclusive);

± 5,0 % from q_t (inclusive) to q_s.

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_{min} to q_t (not inclusive);

± 10 % from q_t (inclusive) to q_s.

5.6.4 Temperature

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

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

5.7 Interpretation of results

5.7.1 Single test

Where the test programme specifies a single test, the meter shall pass this test if the measured error does not exceed the maximum permissible error at the chosen flowrate.

5.7.2 Replicate tests

Where the test programme specifies that the test shall be repeated, the programme shall specify the rules to be applied for combining the errors obtained.

The meter passes this test if the error resulting from this combination does not exceed the maximum permissible error at the chosen flowrate.

6 Pressure tests

6.1 Principle

The water meter shall withstand a specified hydraulic test pressure for a specified time without leakage or damage.

6.2 Precautions to be taken during the tests

The test rig and the meter shall be suitably bled of air.

The test rig shall be leakproof.

Pressurizing shall be carried out gradually without pressure surges.

7 Pressure-loss tests

7.1 Principle

The pressure loss of a water meter as defined in ISO 4064-1 is obtained by the method specified below.

This method of pressure-loss testing is a reference method. Other methods may be used on condition that the values of the pressure loss obtained are equal to those obtained by the reference method.

The pressure loss of the water meter may be determined from measurements of the static differential pressure across the water meter at the stipulated flowrate.

Pressure tappings situated in the walls of the pipe fitted up- and downstream of the water meter are used for the measurement of the static differential pressure.

The pressure-loss tests shall take into account any pressure recovery downstream of the meter by suitably locating the downstream pressure tapping (see 7.2.1.2). The results of the tests shall take account of the pressure recovery, and shall also compensate as necessary for the lengths of pipe between the pressure tappings (see 7.3).

7.2 Equipment for pressure-loss test

7.2.1 General

The equipment needed to carry out pressure-loss tests consists of a measuring section of pipework containing the water meter under test and means for producing the stipulated constant flowrate through the meter. The same constant flowrate means as that employed for the measurement-error tests described in clause 5 is generally used for pressure-loss tests.

7.2.2 Measuring section

The up- and downstream pipe lengths, with their end connections and pressure tappings, plus the water meter on test, constitute the measuring section.

7.2.2.1 Internal diameter of measuring section

The up- and downstream pipe lengths in contact with the water meter shall have the same internal diameter as the meter connection, so as to avoid hydraulic discontinuities. The pipe internal diameters shall be specified by the meter manufacturer.

A difference in the diameter of the connecting pipework and that of the meter may result in a measurement uncertainty incompatible with the precision desired.

7.2.2.2 Measuring-section straight lengths

Up- and downstream of the meter, and up- and downstream of the pressure tappings, straight lengths of pipe shall be provided in accordance with Figure 1, where D is the internal diameter of the pipework of the measuring section.

7.2.2.3 Design of measuring-section pressure tappings

Pressure tappings of similar design and dimension shall be fitted to the inlet and outlet pipes of the measuring section.

Pressure tappings may consist of holes drilled through the wall of pipe or be in the form of an annular slit in the pipe wall, in either case perpendicular to the pipe axis. There should be at least four such pressure-tapping holes, equally spaced in one plane around the pipe circumference. Examples of both types of pressure tapping are described in 7.2.1.4 (see Figures 2, 3 and 4).

Four or more pressure-tapping holes may be interconnected by means of tee-shaped connectors which connect up the pressure tappings, forming an annulus to give a true mean static pressure at the pipe cross-section. Other means, such as a ring or balance chamber, may also be used.

7.2.2.4 Pressure tappings, hole and slit details

Holes drilled through the wall of the pipe (see Figures 2 and 4) shall be perpendicular to the pipe axis, and the diameter d of the holes shall not exceed $0{,}08D$ and shall preferably be less than 4 mm. The diameter of the holes shall remain constant for a distance of not less than two diameters before breaking into the pipe. The holes drilled through the pipe wall shall be free from burrs at the edges where they break through into the inlet and outlet pipe bores. Edges shall be sharp, that is, neither radiussed nor chamfered.

Slits shall be perpendicular to the pipe axis and shall have dimensions as follows (see Figure 3):

— width i equal to or less than $0{,}08D$ and less than 4 mm;

— depth k greater than $2\ i$.

7.2.2.5 Measurement of static differential pressure

Each group of pressure tappings in the same plane shall be connected by a leak-free tube to one limb of a differential-pressure measuring device, for example, a manometer. Provision shall be made for clearing air from the installation.

7.3 Test procedure

7.3.1 Principle (see Figure 5)

The method consists in measuring the static differential pressure (ΔP_2) between the pressure tappings of the measuring section with the meter present, and deducting from it the pressure loss (ΔP_1) of the up- and downstream pipe lengths measured at the same flowrate in the absence of the meter.

7.3.2 Determination of pressure loss attributable to pipe lengths (measurement 1)

The pressure loss of the up- and downstream pipe lengths (ΔP_1) may be determined prior to the tests proper, and checked periodically. This is done by joining the up- and downstream pipe faces together in the absence of the meter (carefully avoiding joint protrusion into the pipe bore or misalignment of the two faces), and measuring the pressure loss of the pipe measuring section for each test flowrate.

The absence of water meter will shorten the measuring section. If telescopic sections are not fitted on the test rig, the gap may be filled by inserting, at the downstream end of the measuring section, either a temporary pipe of the same length and internal diameter as the pipe lengths, or the water meter itself.

7.3.3 Measurement and calculation of the actual ΔP of the water meter (measurement 2)

At the same test flowrates used to determine the pipe pressure losses, in the same installation, with the same pressure tappings and the same manometer but with the water meter in position, the differential pressure (ΔP_2) across the metering section shall be measured.

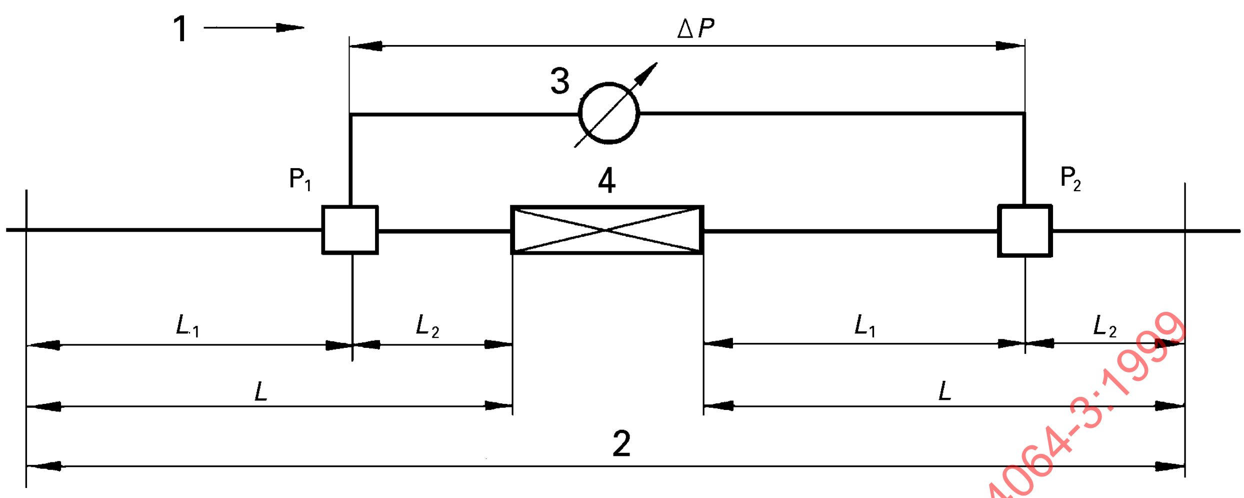
The actual pressure loss (ΔP) of the water meter at a given flowrate is calculated by making the subtraction $\Delta P = \Delta P_2 - \Delta P_1$

The value arrived at may be converted to the pressure loss corresponding to the q_s of the water meter by reference to the formula given in 10.3.2.5.

NOTE If the flowrates with and without the meter present differ, they may be adjusted to the same value by the square law formula.

7.4 Maximum uncertainty

The maximum uncertainty in the results of the measurement of pressure loss shall be ± 5 %. The uncertainty is estimated to lie at the 95 % probability level.



Key

1 Flow direction

2 Measuring section

3 Differential manometer

4 Water meter

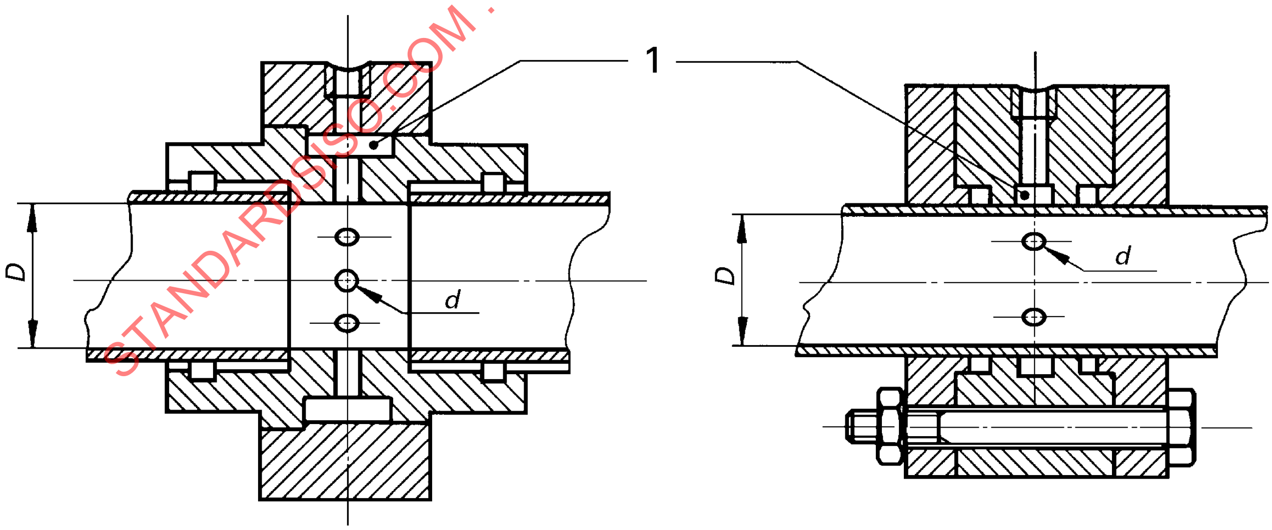
NOTE P_1 and P_2 are the planes of pressure tapping;

$L \geqslant 15D$;

$L_1 \geqslant 10D$;

$L_2 \geqslant 5D$.

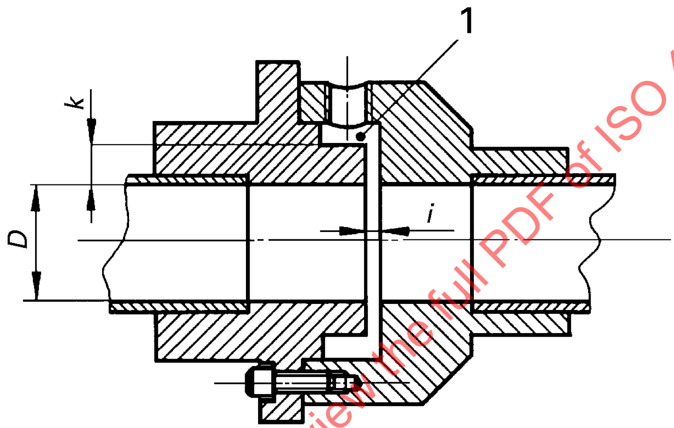
Figure 1 — Layout of the measuring section



Key

1 Ring chamber

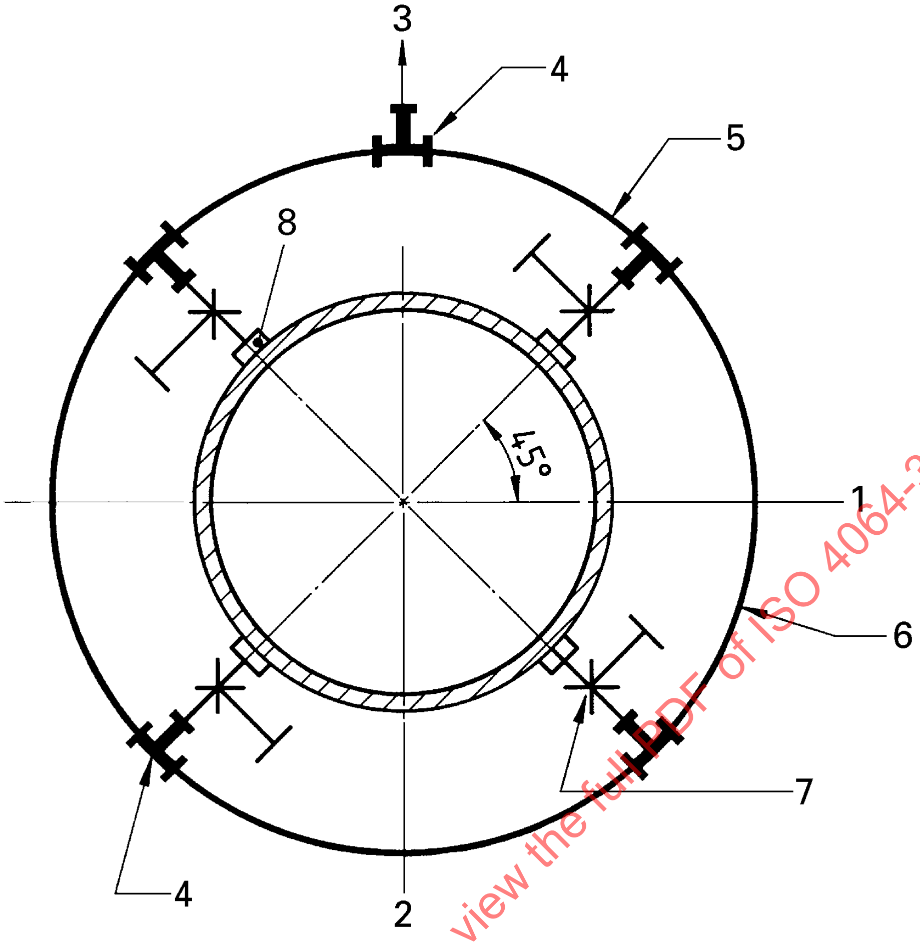
Figure 2 — Example of drilled-hole type of pressure tapping with ring chamber, suitable for small/medium diameter test sections



Key

1 Ring chamber

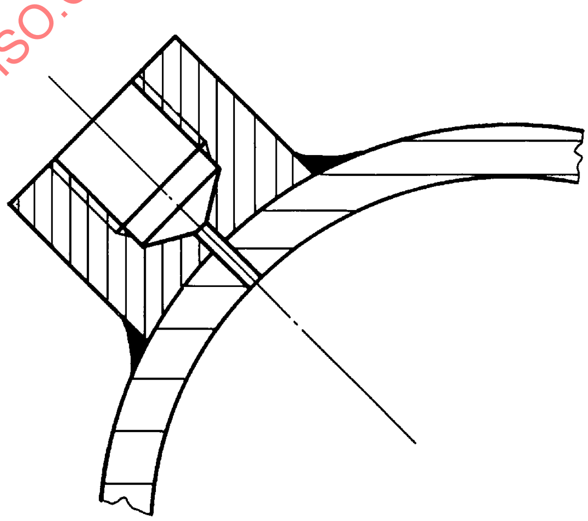
Figure 3 — Example of slit type of pressure tapping with ring chamber, suitable for small/medium diameter test sections



Key

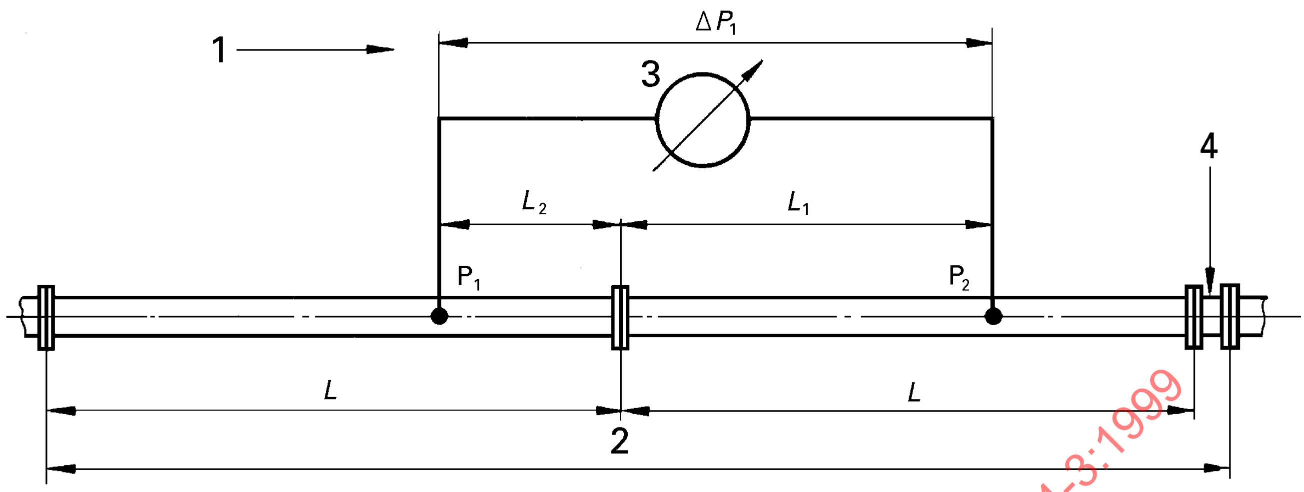
1 Horizontal axis
2 Vertical axis
3 To manometer
4 Tee
5 Flexible hose or copper pipe
6 Loop giving mean static pressure
7 Isolating cock
8 Pressure tapping (see detail)

a) Cross-section through pipe and pressure tapping



b) Detail of pressure tapping and boss

Figure 4 — Example of drilled-hole type of pressure tapping with loop mean static pressure interconnections, suitable for medium/large diameter test sections



Key

1 Flow direction

2 Measuring section

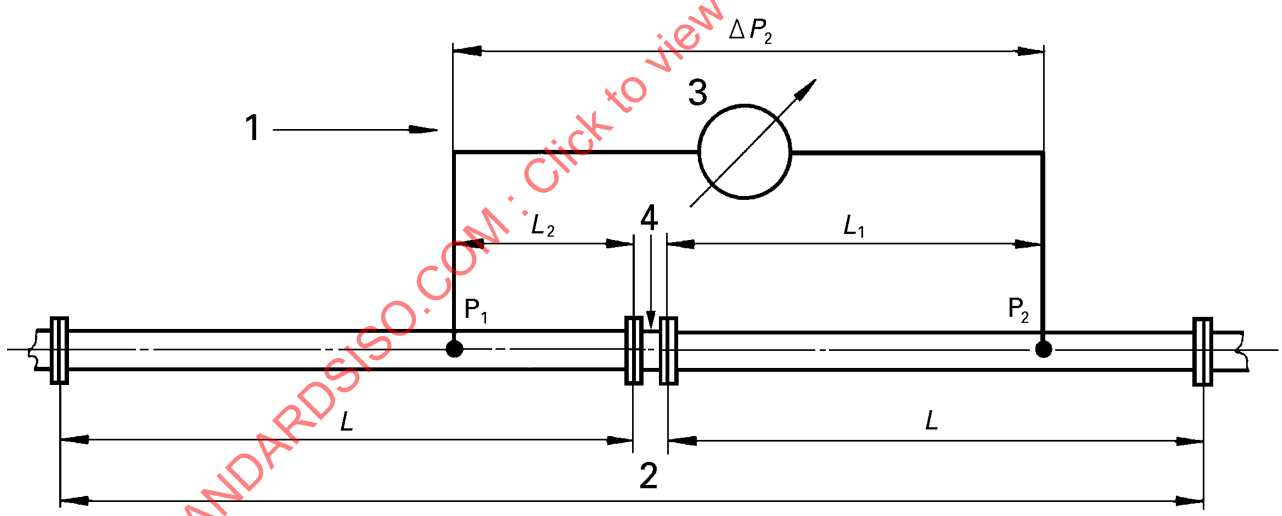
3 Differential manometer

4 Water meter in downstream position or temporary pipe

ΔP_1 is the pressure loss of up- and downstream pipe lengths not including water meter

$\Delta P_1 = (\Delta PL_2 + \Delta PL_1)$

a) Measurement 1 (see 7.3.2)



Key

1 Flow direction

2 Measuring section

3 Differential manometer

4 Water meter

ΔP_2 is the pressure loss of up- and downstream pipe lengths including water meter

$\Delta P_2 = (\Delta PL_2 + \Delta PL_1 + \Delta P_{meter})$

$\Delta P_2 - \Delta P_1 = (\Delta PL_2 + \Delta PL_1 + \Delta P_{meter}) - (\Delta PL_2 + \Delta PL_1)$

$= \Delta P_{meter}$

b) Measurement 2 (see 7.3.3)

Figure 5 — Procedure for pressure-loss measurement

8 Accelerated wear tests

8.1 Continuous flow tests

8.1.1 Principle

The tests consist of subjecting the meter to constant flowrates.

For the convenience of laboratories, the test can be divided up into periods of at least 6 h.

8.1.2 Description of the installation

The installation consists of:

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

b) pipework.

8.1.3 Pipework

8.1.3.1 Description

In addition to the meter or meters to be tested, the pipework comprises:

a) a flow-regulating device;

b) one or two isolating devices;

c) a device for measuring the water temperature at the meter inlet;

d) means for checking the flowrate and duration of the test.

If the pipework ends in the open air, that end shall be located at a higher level than the upper part of the meter.

The different devices shall not cause cavitation phenomena.

8.1.3.2 Precautions to be taken

The meter and connecting pipes shall be suitably bled of air.

8.1.4 Tolerance on flowrate

The flowrate shall be kept constant throughout the test at a predetermined level.

The relative variation of the flowrate values during each test shall not exceed ± 10 % (except when starting and stopping).

8.1.5 Tolerance on test timing

The specified duration of the test is a minimum value.

8.1.6 Tolerance on discharged volume

The volume indicated at the end of the test shall not be less than that determined from the product of the theoretical flowrate of the test and the theoretical duration.

To satisfy this condition, sufficiently frequent corrections to the flowrate shall be made.

8.2 Discontinuous flow tests

8.2.1 Principle

The test consists of subjecting the meter to a large number of starting and stopping cycles of short duration, the constant test flowrate phase of each cycle being kept at the same flowrate throughout the duration of the test (see 8.2.4).

For the convenience of laboratories, the test can be divided up into periods of at least 6 h.

8.2.2 Description of the installation

The installation consists of:

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

b) pipework.

8.2.3 Pipework

8.2.3.1 Description

The meters can be arranged in series or in parallel, or the two systems can be combined.

In addition to the meter(s), the piping system consists of:

a) one flow-regulating device (per line of meters in series, if necessary);

b) one or more isolating devices;

c) a device for measuring the temperature of the water upstream of the meters;

d) devices for checking: the flowrate, the duration of cycles and the number of cycles;

e) one or more flow-interrupting devices (one per line of meters in series).

If the pipework ends in the open air, that end shall be located at a higher level than the upper part of the meter.

The various devices shall not cause cavitation phenomena or other causes of parasitic wear of the meter(s).

8.2.3.2 Precautions to be taken

The meter and connecting pipes shall be suitably bled of air.

The flow variation during the repeated opening and closing operations shall be progressive, so as to prevent water hammer.

8.2.4 Flow

The relative variation of the flow value shall not exceed ± 10 % outside the opening, closing and stoppage periods.

8.2.5 Cycles

8.2.5.1 Phases

A complete cycle comprises the following four phases:

a) a period from zero to test flowrate;

b) a period at constant test flowrate;

c) a period from the test flowrate to zero;

d) a period at zero flowrate.

The test programme shall specify the number of cycles, the duration of the four phases of a cycle, and the total volume to be discharged.

8.2.5.2 Tolerance on test timing

The tolerance on the specified duration of each phase shall not exceed ± 10 %.

The tolerance on the total test duration shall not exceed ± 5 %.

8.2.5.3 Tolerance on the number of cycles

The number of cycles shall not be less than that stipulated, but shall not exceed this number by more than 1 %.

8.2.6 Tolerance on discharged volume

The volume discharged throughout the test shall be equal to half the product of the theoretical test flow times the total theoretical duration of the test (operating periods plus transient and stoppage periods with a tolerance of ± 5 %).

This precision can be obtained by sufficiently frequent corrections of the instantaneous flows and operating periods.

9 Test report

9.1 General rules

9.1.1 Principle

The work carried out by the testing laboratory shall be covered by a report which accurately, clearly and unambiguously presents the test results and all relevant information.

The results and conditions concerning the initial verification tests on water meter shall be kept for the period of time legally specified in each country. For pattern approval tests, the records of the tests shall be kept for the length of time the approval is valid.

The report on the approval tests for a type of meter and the register concerning the initial checking tests shall contain:

a) a precise identification of the test laboratory and the meter tested;

b) exact details of the conditions during which the various tests were carried out;

c) the results and conclusions of the tests.

9.1.2 Identification data to be included in all reports and test registers

The report on pattern approval tests for a particular type, and the register concerning the initial verification tests, shall include as a minimum:

a) identification of testing laboratory:

— name and address;

b) identification of meter tested:

— name and address of the manufacturer or the trademark used;

— metrological class and meter designation N;

— year of manufacture and the individual works number of the meter tested;

— type or model (only in the case of approval tests for a particular type).

9.2 Pattern approval test report — Required contents

9.2.1 Test procedure, test results and conclusions — Information required

The pattern approval test report shall contain, as a minimum, in addition to a reference to ISO 4064, the information tabulated in Tables 1 and 2.

Table 1 — Test procedure and results

Type of test	Clause and subclause	Information required for pattern approval test report
All tests		Date of testing
Measurement-error tests	5	For each test flowrate: — flowrate; — water pressure; — water temperature; — characteristics of the calibrated reference device; — indicated readings of the meter and the calibrated reference device.
Pressure tests	6	Values of each test pressure applied and time for which it was maintained.
Pressure-loss tests	7	For each test flowrate: — maximum water temperature; — flowrate; — meter upstream pressure; — pressure loss.
Accelerated wear tests	8	
— Continuous tests	8.1	Timetable of tests carried out: at least every 24 h, or once for every shorter period if test is so subdivided: — maximum pressure; — maximum temperature; — flowrate; — meter reading at start and end of test.
— Discontinuous tests	8.2	Timetable of tests carried out: at least every 24 h, or once for every shorter period if test is so subdivided: — maximum pressure; — maximum temperature; — flowrate; — duration of four phases of the cycle of discontinuous tests (see 8.2.5); — number of cycles; — meter reading at start and end of test.

Table 2 — Test conclusions

Type of test	Clause or subclause	Information required for pattern approval test report
Measurement-error tests	5	Measurement error at each test flowrate Measurement-error curve
Pressure tests	6	State if results satisfactory or not
Pressure-loss tests	7	Pressure loss at overload flowrate q_s.
Accelerated wear tests	8	Measurement-error test values and measurement-error curves determined before and after each accelerated wear test defined by the test programme. For each individual meter, measurement-error curves determined before and after each accelerated wear test shall be plotted on the same graph in such a manner that the variations in measurement error, with respect to the maximum permissible errors, are established. The scale of the ordinate of this graph shall be at least 10 mm/%. The scale of the abscissa shall be logarithmic.

9.2.2 Administrative requirements

The pattern approval test report shall also include:

a) a statement to the effect that the test report relates only to the samples tested;

b) signature of the officer accepting technical responsibility for the test report;

c) date of issue of the test report.

9.2.3 Additions to test report

Additions to a test report after issue shall be made only by a further document marked: "Supplement to test report — Serial No. ...", and shall meet the relevant requirements of the preceding subclauses.

9.2.4 Publication of test report

When issued, the test report shall only be reproduced in its entirety.

9.3 Initial verification register — Required content

These mentions are:

a) date;

b) serial number of the meter;

c) results of the tests;

d) reference to a description of the test rig.

10 Examples of test programme

10.1 General

Water meters are subjected to a variety of different test programmes. This clause describes, by way of examples, test programmes which have been incorporated into OIML Recommendation R 49 for pattern approval and initial verification.

The examples are essentially similar to that Recommendation, but certains parts have been elaborated to give a more detailed explanation of the manner in which the tests are to be performed.

10.2 Pattern approval

10.2.1 Description

Pattern approval consists in verifying that the characteristics of one model of meter conform to the standards and regulations in force.

This approval consequently requires that samples of the model fulfil the requirements of the test programme.

A pattern approval test programme is described below.

10.2.2 Number of meters to be tested

The pattern approval tests are carried out on a minimum number of water meters of each model as given in the following table as a function of the meter designation N of the model submitted.

Table 3 — Number of meters to be tested

Meter designation N	Number of meters
$N \leqslant 100$	3
$100 < N \leqslant 1\,000$	2
$1\,000 < N$	1

The number of water meters in Table 3 may be regarded as the minimum to be tested; the authority responsible for pattern approval may request testing of additional water meters.

10.2.3 Programme of approval

10.2.3.1 Tests to be carried out

Before tests commence, the water meters are inspected to ensure that they conform to the technical characteristics described in ISO 4064-1, to the regulations in force, and also to the specifications and drawings submitted when approval was requested.

The tests include the following, carried out in the order indicated:

a) pressure tests;

b) determination of the error curves as a function of flowrate;

c) pressure loss tests;

d) accelerated wear tests.

10.2.3.2 Pressure tests

The requirement for these tests is that each meter withstand, without leakage or seepage through the walls, and without damage, a pressure equal to:

a) 16 bar or 1,6 times the nominal pressure if it exceeds 10 bar, applied for a period of 15 min; and

b) 20 bar or two times the nominal pressure, applied for a period of 1 min.

10.2.3.3 Determination of the error curve as a function of flowrate

Test methods and equipment used to determine the error of the meter at a given flowrate are as described in clause 5.

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

The effect of pressure is investigated.

The errors in the indication of the water meters (in the measurement of volume flow) are determined at at least seven flowrates, five of which are as follows:

a) between q_{min} and 1,1 q_{min};

b) between q_t and 1,1 q_t;

c) between 0,45 q_p and 0,5 q_p;

d) between 0,9 q_p and q_p;

e) between 0,9 q_s and q_s.

The test flowrate is the mean flowrate calculated from the indications of the calibrated reference device.

For pattern approval tests, the test is declared satisfactory if the error determined at each flowrate is situated within or at the limits of the tolerance band.

If the error determined lies outside the tolerance band, the test may be continued. It shall then be repeated twice. If the arithmetical mean of the three tests is situated within or at the limits of the tolerance band, the test is declared satisfactory.

10.2.3.4 Tests to determine pressure loss

Test methods and equipment used to determine pressure loss are as described in clause 7.

The value of pressure loss is determined so that the water meter may be classified in accordance with ISO 4064-1 (see 10.2.2.5 below).

10.2.3.5 Tests to determine accelerated wear

The water meter is subjected to an endurance test simulating service conditions.

In addition to periods of extended running at specified flowrates, water meters which are designated N $\leqslant$ 10 are subjected to intermittent tests in which the water meter is operated for a short period at a flowrate given in the test programme, followed by a period of rest.

An example of an accelerated wear test is given in Table 4.

Table 4 — Example of accelerated wear test

Meter designation N	Test flowrate	Type of test	Number of interruptions	Duration of pauses s	Period of operation at test flowrate	Duration of start-up and rundown
N $\leqslant$ 10	q_p	Discontinuous	100 000	15	15 s	0,15 (N) [a] (minimum 1 s)
	2 q_p	Continuous			100 h	
N > 10	q_p	Continuous			800 h	
	2 q_p	Continuous			200 h	

[a] (N) is the number equal to the value of N.