	Technical Specification for the Verification and Inspection of Water Meters	S/N	CNMV 49
		Rev.	5

1.This Technical Specification is enacted pursuant to Paragraph 2, Articles 14 and 16 of the Weights and Measures Act.

2. The date of promulgation, document number, date of enforcement and content of amendment are listed as follows:

Rev.	Date of Promulgation	Document No.	Date of Enforcement	Content of Amendment
1	03.18.2003	No. 09240002620	04.01.2003	
2	03.25.2005	No. 09440001090	04.01.2005	Added the dynamic test method by referring to CNS 14866
3	06.25.2008	No. 09740003350	07.01.2008	Revised as per CNS 14866
4	12.23.2015	No. 10440018050	07.01.2016	1. Amending the terms amd definition to harmonize with the technical specification for type approval. 2. Adding the minimum water volume for verification and inspection for vortex water meters. 3. Specifying the maximum useable span 8 years for water meters with meter designation N < 15 or nominal size not greater than 40 mm and no subsequent verification for those water meters passed the maximum useable span.
5	01.12.2024	No. 11240202140	01.12.2024	Revised as per Technical Specification for Type Approval of Water Meters

3. The technical specifications are laid down by referring to the standards below:

OIML R49-1:2013	Water meters for cold potable water and hot water. Part 1: Metrological and technical requirements
OIML R49-2:2013	Water meters for cold potable water and hot water. Part 2: Test methods
CNS 13979	Vortex flow meter（07/09/2013）

Date of Promulgation	Bureau of Standards, Metrology and Inspection, Ministry of Economic Affairs	Date of Enforcement
12 01 2024		**12 01 2024**

1. Scope

1.1 This technical specification applies to cold potable water meters based on mechanical principle, electrical or electronic principle, and mechanical principles incorporating electronic devices, used to measure the volume of cold potable water, but not applies to water meters for fire protection.

1.2 The applicable conditions of the above water meter are as follows:

1.2.1 The connection method shall be to screw type or flange type, and its inlet and outlet located on both sides of the water meter.

1.2.2 Nominal diameter range is from 13 mm to 300 mm.

1.2.3 Permanent flow rate is from1.6 m^3/h to 1000 m^3/h.

1.2.4 The value of the ratio of permanent flow rate to minimum flow rate is from 50 to 400 (Vortex meter is suitable from 10 to 40).

1.2.5 The maximum admissible pressure is equal to or less than 1 MPa.

2. Definitions of terms

2.1 Water meter

Instrument intended to measure continuously, memorize, and display the volume of water passing through the measurement transducer at metering conditions. The indicating device and the water meter shall be inseparable

2.1.1 Volumetric meter

Device, fitted into a closed conduit, which consists of chambers of known volume and a mechanism driven by the flow, whereby these chambers are successively filled with water and then emptied. By counting the number of these volumes passing through the device, the indicating device totals the volume flow.

2.1.2 Velocity meter

Device, fitted into a closed conduit which consists of a moving element set in motion directly by the velocity of the water flow. The movement of the moving element is transmitted by mechanical or other means to the indicating device, which totals the volume flow.

2.1.3 Woltmann meter

Device consisting of a helical blade that rotates about the axis of flow in the meter.

2.1.4 Single-jet and multi-jet meters

Devices consisting of a turbine rotor rotating about the axis perpendicular to the flow of water in the meter. The meter is called a single-jet meter if the jet impinges at a single place on the rotor’s periphery, and a multi-jet if the jet impinges simultaneously at several points around the periphery of the rotor.

2.1.5 Vortex meters

Devices comprising a bluff body in the water flow to detect the vortices frequency after the bluff body continuously and integrating an indicator which total the volume flow.

2.2 Indicating device

Device displaying the flow volume.

2.3 Metrological characteristics

2.3.1 Actual volume, V_a

Total volume of water passing through the meter, disregarding the time taken. 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.

2.3.2 Indicated volume, V_i

Volume of water indicated by the meter, corresponding to the actual volume.

2.3.3 Primary indication

Indication which is subject to legal metrological control.

2.3.4 Error

Measured quantity value minus a reference quantity value. 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.

In this Technical Specification, the error (of indication) is expressed as a percentage of the actual volume, and is equal to

$$\frac{V_i - V_a}{V_a} \times 100\ \%$$

2.3.5 Maximum permissible error, MPE

Extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given meter.

2.4 Operating conditions

2.4.1 Flow rate, Q

$Q = \mathrm{d}V/\mathrm{d}t$ where V is actual volume and t is time taken for this volume to pass through the meter. The flow rate is expressed in m^3/h.

2.4.2 Minimum flow rate, Q_1

Lowest flow rate at which the meter is to operate within the maximum permissible errors.

2.4.3 Transitional flow rate, Q_2

Flow rate between the permanent flow rate and the minimum flow rate that divides the flow rate range into two zones, the upper flow rate zone ($Q_2 \leq Q \leq Q_4$) and the lower flow rate zone ($Q_1 \leq Q < Q_2$), each characterized by its own maximum permissible errors.

2.4.4 Permanent flow rate, Q_3

Highest flow rate within the rated operating conditions at which the meter is to operate within the maximum permissible errors.

2.4.5 Overload flow rate, Q_4

Highest flow rate at which the meter is to operate for a short period of time within the maximum permissible errors, while maintaining its metrological performance when it is subsequently operating within the rated operating conditions..

2.4.6 First element of an indicating device

Element which, in an indicating device comprising several elements, carries the graduated scale with the verification scale interval.

2.4.7 Verification scale interval

Lowest value scale division of the first element of an indicating device.

2.4.8 Maximum admissible pressure, MAP

Maximum internal pressure that a meter can withstand permanently, within its rated operating conditions, without deterioration of its metrological performance.

2.4.9 Pressure loss, $\triangle_P$

Pressure loss cased by the presence of a water meter in the pipeline at a given flowrate.

2.4.10 Nominal diameter, DN

Alphanumeric designation of size for components of a pipework system, which is used for reference purposes.

2.4.11 Nominal pressure, PN

Numerical designation which is a rounded number for reference purposes. All equipment of the same nominal size (DN) and designated by the same PN number shall have compatible mating dimensions.

3. Metrological requirements

3.1 Values of Q_1, Q_2, Q_3, and Q_4

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

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

1.6 2.5 4 6.3 10

16 25 40 63 100

160 250 400 630 1000

3.1.3 The value of the ratio $Q3/Q1$ shall be chosen from the following list: (Among them, values ≤ 40 are only applicable to the vortex flow meter)

3.1.4 The ratio $Q2/Q1$ shall be 1.6.

3.1.5 The ratio $Q4/Q3$ shall be 1.25.

3.2 Accuracy class and maximum permissible error

The water meter shall be designed and manufactured such that its errors (of indication) do not exceed the maximum permissible errors (MPEs) as defined in Table 1 under rated operating conditions. The accuracy class is classified as class 1 or class 2. The manufacturer shall specify the accuracy class.

Table 1 Accuracy grades and tolerances

flow rate	MPE	
	class 1	class 2
$Q_1 \leq Q < Q_2$	±3 %	±5 %
$Q_2 \leq Q \leq Q_4$	±1 %	±2 %

4. Technical requirements

4.1 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.

4.2 The transparent lid of a water meter shall be transparent and clear, and must not be loosened when pressed by hand. The top lid of the water meter shall be opened equal to or more than 120 degrees.

4.3 Volumetric and velocity multi-jet meters shall be equipped with appropriate strainers at the lnlet.

4.4 The shell of a water meter should not be coated with wax, soluble glass or any other leak proof material; the shell of a water meter should be free of sags, crests, scratches or any traces of repair. A position shall be reserved for the lead seal.

However, the interior and exterior of the shell of a big water meter with a nominal size of not less than 50 mm may be coated with rustproof paint or powder coating.

4.5 The appearance of the water meter should comply with the following requirements:

4.5.1 The water meter size should be marked on the lid exterior center and the side of water meter, e.g. 13 mm.

4.5.2 The direction of flow (→) shall be marked on both sides of the water meter.

4.5.3 Name or trademark of the manufacturer shall be marked on one side of water meter exterior or on the indicating device.

4.5.4 The serial number should be marked on the edge of meter exterior.

4.5.5 The indication range (maximum capacity of accumulation) and numbers of meter shall be marked on the indicating device.

4.5.6 The model number and type approval number shall be marked on the indicating device clearly, but this does not apply to those not subject to type approval.

4.5.7 The validity period of verification shall be marked on the edge of the upper shell.

4.5.8 The installation direction (H) shall be marked on both sides of water meter or on the indicating device of water meter. The vortex water meters are excluded.

4.5.9 A water meter shall be clearly and indelibly marked with the information of numerical value of Q_3, the ratio Q_3/Q_1, accuracy class, the pressure loss class and nominal pressure. If the meter measures reverse flow and the values of Q_3 and the ratios Q_3/Q_1 are different in the two directions, both values of Q_3 and Q_3/Q_1 shall be inscribed.

4.5.10 The flow profile sensitivity class should be marked in a prominent place.

4.6 The gear chamber of dry water meters shall be watertight.

4.7 After verified and sealed, the measurement errors or zero-setting of water meters shall not be able to be adjusted by external methods or devices. If the meter is provided with a zero-setting device for special purposes, the zeroing position shall be zeroed upon operation, but the totaling device shall not be zeroed.

5. Indicating device

5.1 Functions:

The indicating device of a water meter shall provide an easily read, reliable, and unambiguous visual indication of the indicated volume. The indicating device shall display the volume either continuously, periodically or on demand. The indicating device shall include visual means for testing and verification. The indicating device may include additional elements for testing by other methods.

5.2 Unit of measurement, symbol and its placement:

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

5.3 Indicating range

The indicating device shall be able to record the indicated volume in cubic metres given in Table 2.

Table 2 Indicating range of a water meter

Q_3, m^3/h	Indicating range (minimum values), m^3
$Q_3 \leq 6.3$	9 999
$6.3 < Q_3 \leq 63$	99 999
$63 < Q_3 \leq 630$	999 999
$630 < Q_3 \leq 1\ 000$	9 999 999

5.4 Color coding for indicating devices

(a) Non-electronic digital indicator: The color black should be used to indicate the cubic metres and its multiples. The color red should be used to indicate sub-multiples of a cubic metres. These colors shall be applied to either pointers, indexes, numbers, wheels, discs, dials or to the aperture frames.

(b) Electronic digital indicator: The color black should be used to indicate the cubic metres and its multiples.

5.5 Types of indicating device

5.5.1 Type 1 – Analogue device:

The indicated volume is indicated by continuous movement of the following (a) and (b)

(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 1×10^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.

5.5.2 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.

(a)For non-electronic devices: Movement of numbered roller indicators (drums) shall be upwards. If the lowest value decade has a continuous movement, the aperture shall be large enough to permit a digit to be read unambiguously.

(b)For electronic devices: 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.

5.5.3 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.

5.5.4 Verification scale interval

5.5.4.1 Every indicating device shall provide means for visual, non-ambiguous verification testing. The visual verification display may have either a continuous or a discontinuous movement.

5.5.4.2 Verification scale interval: The indicator element with the smallest decimal number, and its smallest decimal scale value is called the verification scale interval. 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 and convert the recorded data into numerical data.

5.5.4.3 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.

5.5.4.4 Form of the verification scale:

(a) 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.

(b) On indicating devices with non-continuous movement of the first element, the verification scale interval is the interval between two consecutive digits or incremental movements of the first element.

5.5.5 The minimum verification scale of the indicating device shall meet the requirements in Table 3.

Table 3 Minimum subdivisions value

Accuracy	continuous	discontinuous,
Class 1	1.5 Q_1×0.25 %	1.5 Q_1×0.125 %
Class 2	1.5 Q_1×0.5 %	1.5 Q_1×0.25 %

(a) If the minimum verification scale is continuous, an allowance shall be made for a maximum error in each reading of not more than half the verification scale interval.

(b) If the minimum verification scale is discontinuous, an allowance shall be made for a maximum error in each reading of not more than one digit of the verification scale.

6. Verification, Inspection and maximum permissible errors

6.1 Verification and inspection equipment: A certificate is required to identify the traceability and uncertainty of the system of the verification equipment.

6.1.1 Necessary equipment:

(a)It can be the volume method or the weighing method. The expanded uncertainty of the equipment used shall not exceed one-third of the MPE, and the coverage factor of the estimated uncertainty is k=2.

(b) The accuracy of the measurement error of the minimum division value should be less than 1/500 of the verified and inspected water volume, and its capacity range should be set according to the Q_3 value and Q_3/Q_1 ratio of the verified and inspected water meter.

6.1.2 Pressure test device: The device shall be able to pressurize up to more than 2 MPa for pressure test use.

6.1.3 Timer device: The device shall equip with minimum scale value less than 0.2 seconds.

6.2 Static pressure test : Every water meter shall be able to endure pressure test up to 1.6 times the maximum admissible pressure applied for 1 min without leakage or damage. For a water meter with a dry indicating device, water should not be immersed in the upper gear chamber and the indicating device.

6.3 Meters are tested either individually or in groups. In the latter case, the straight lengths between the meters shall be enough. The presence of any meter in the test rig shall not contribute significantly to the test error of any other meter. During the tests, the gauge pressure at the outlet of each water meter shall be at least 0.03 MPa (0.3 bar).

6.3.1 Testing method with readings taken with the flow passing the meter still

(1) After the water meter is installed, water shall be put in to vent the air out from the water meter and piping system, then setting verifying flow rate by adjusting the outlet cock (valve).

(2) Prior to putting in water for verification, the meter's indicating value and its standard equipment's indicating value shall be recorded.

(3) After the water volume for verification has passed, the outlet cock (valve) of the system shall be closed so as to avoid backflow, then closing the inlet cock immediately, record the meter's indicating value and the necessary equipment's value after the water flow completely stops.

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

(1) After completing the installation of the water meter, water shall be put in to vent the air out from the water meter and piping system, then setting verifying flow rate by adjusting the outlet cock (valve).

(2) Prior to putting in water for verification, the meter's indicating value and the necessary equipment's indicating value shall be recorded.

(3) The test procedure is carried out after the flow reaches steady. The flow is diverted into a calibrated vessel at the beginning of the procedure and diverted it away at the end. The meter is read while the flow passing. The reading of the meter is synchronized with the movement of the flow diverting. The volume collected in the vessel is the volume passed. The uncertainty of the collected volume may be considered negligible if the times deviation of each flow diverting is less than 5% and the diverting time is less than 1/50 of the total time of the procedure.

6.4 Flow-rate and minimum passed water volume for verification and inspection

6.4.1 Verification flow point Q

(1) $Q_1 \leq Q \leq 1.1\ Q_1$ ◦

(2) $Q_2 \leq Q \leq 1.1\ Q_2$ ◦

(3) $0.9\ Q_3 \leq Q \leq Q_3$ ◦

Among them, 1 % of the water meters applied for verification shall be sampled and tested for error at the verification flow point $Q_1 \leq Q \leq 1.1\ Q_1$, and at least 1 meter shall be tested.

6.4.2 Tests method with readings taken with the flow passing the meter still

The minimum water volume for verification and inspection = The minimum meter scale value multiplied by 200, which shall not be less than the volume accumulated from 2.5 minutes of flow.

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

The relative variation of the flow–rate for verification shall be within the range of 5 %.

The minimum water volume for verification and inspection = The minimum meter scale value multiplied by 200, which shall not be less than the volume accumulated from 1 minute of flow

6.5 Error are specified in Table 1.

6.6 The maximum permissible errors for inspection of water meters are twice the maximum permissible errors for verification.

6.7 Valid period of verification

The valid period of verification for water meters is eight years, starting from the date of the very beginning of next month of obtaining the verification certification.

6.8 Maximum useable span

The maximum useable span for meters with $Q_3 \leq 16$ or nominal size not greater than 40 mm is 8 years after passing initial verification; however, for the maximum useable span for meters with $Q_3 > 16$ or nominal size greater than 40 mm is 10 years after passing initial verification. To apply for subsequent verification for meter that over its maximum useable span is not allowed.

7. Verification marks

7.1 The verification marks shall be pressed with lead sealing between the metal wire and the opening of the outer case lead sealed through the lock. Also, the words “valid period of verification year month” shall be printed on the edge of the upper outer case.

7.2 For a large meter with the designation of $Q_3 > 16$ or a nominal size greater than 40 mm passing the subsequent verification, the maximum useable span shall be additionally marked on the edge of the meter’s upper outer case.

8. Implementation date：This specification will come into effect from now on. However, if the correction according to the fourth edition of the technical specification for type approval of water meters has not been completed before December 31, 2027, as notified by the dedicated weights and measures authority, the following provisions shall apply:

(1)The specification before the amendment is implemented will apply before December 31, 2027.

(2) The dedicated weights and measures authority has received the application for amendment to the fourth edition of the technical specification for type approval of water meters before December 31, 2027. If the review is completed after that date, the specification before the implementation of the amendment will apply before the review is completed.