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METROLOGICAL VERIFICATION REGULATION
OF THE PEOPLE'S REPUBLIC OF CHINA

JJG 162-2019

Cold portable water meters

饮用冷水水表

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Verification regulation of cold portable water meters

1 Scope

This Regulation applies to the initial verification, subsequent verification, in-use inspection of cold portable water meters.

The cold portable water meter referred to in this Regulation is a water meter, which has a temperature grade T30 and T50, measures cold portable water flowing through a closed full pipe, including water meters whose working principle is based on mechanical principle, water meters whose working principle is based on electronic or electromagnetic principle, water meters based on mechanical principle with electronic device.

2 Normative references

This Regulation makes reference to the following documents:

JJG 164 Verification regulation of standard facilities for liquid flowrate

JJG 643 Verification regulation of flow standard facilities by master meter method

JJG 1113 Verification regulation of verification facility for water meters

JJF 1777-2019 Program of pattern evaluation of cold potable water meters

For any dated references, only the dated version applies to this Regulation; for any undated referenced document, its latest version (including all amendments) applies to this Regulation.

3 Terms and units of measurement

3.1 Terms

3.1.1 Water meter

Under measurement conditions, an instrument used to continuously measure, record, and display the volume of water flowing through the measurement transducer.

Note: The water meter includes at least one measurement transducer, a calculator (including adjustment or correction device if any), and an indicating device. The three can be placed

An indication value controlled by legal metrology.

Note: If there is a repeated indication, the initial indication of the measurement result is the primary indication.

3.1.13 Permanent flow rate (Q_3)

The maximum flow rate under rated working conditions. At this flow rate, the water meter shall work normally and meet the maximum allowable error requirements.

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

3.1.14 Overload flow rate (Q_4)

The maximum flow rate that requires the water meter to meet the maximum allowable error requirements in a short period of time and then maintain the metering characteristics under rated working conditions.

Note: The reference definition of "short period of time" here is "no more than 1 h in a day and no more than 200 h in a year".

3.1.15 Minimum flow rate (Q_1)

The minimum flow rate that requires the water meter to work within the maximum allowable error.

3.1.16 Transitional flow rate (Q_2)

The flow rate that appears between the common flow rate and the minimum flow rate, dividing the flow range into two zones: "high flow zone" and "low flow zone", each with a specific maximum allowable error.

Note: $Q_1 \leq Q < Q_2$ is usually called "low flow zone"; $Q_2 \leq Q \leq Q_4$ is called "high flow zone".

3.1.17 Combination meter changeover flow rate (Q_x)

The flow rate Q_{x1} when the large water meter stops working as the flow rate decreases, or the flow rate Q_{x2} when the large water meter starts working as the flow rate increases.

Note: For the structural features of combination water meters, see D.2.2.5 in Appendix D.

3.1.18 Maximum allowable (working) pressure (MAP)

The maximum internal pressure, that the water meter can withstand under rated working conditions without deteriorating the metering characteristics.

3.1.19 Working temperature (T_w)

The water temperature in the pipe as measured upstream of the water meter.

Note: Water meters are divided into two temperature grades: T30 and T50, according to the applicable working temperature range. T30 means the working temperature range is (0.1 ~ 30) °C; T50 means the working temperature range is (0.1 ~ 50) °C.

3.1.20 Working pressure (p_w)

The average water pressure (gauge pressure) in the pipe, as measured upstream and downstream of the water meter.

3.1.21 Test flow rate

The average flow rate during the test calculated based on the indication of the calibrated reference device.

Note: In this Regulation, the test flow rate is the verification flow rate.

3.1.22 Nominal diameter (DN)

The alphanumeric designation of the size of the piping system components, which is for reference only.

Note:

- 1 The nominal diameter consists of the letters DN followed by a dimensionless integer, which indirectly represents the actual size of the inner or outer diameter of the connection end in millimeters.
- 2 The number followed by the letters DN does not represent a measurable value and shall not be used in calculations, except as otherwise provided in the relevant recommendations.
- 3 In the recommendations on the use of the DN marking system, any relationship between DN and component size can be given in the form of DN/OD (outer diameter) or DN/ID (inner diameter).

3.1.23 Rated operating condition

The operating conditions that need to be met during measurement in order for the water meter to work according to the design performance.

3.1.24 Electronic device

A device that uses electronic components and performs specific functions, usually made into an independent unit and can be tested separately.

3.1.25 Converter of mechanical-electric signal

The water meter shall be marked with the type approval sign and number of the measuring instrument in a prominent position.

Newly manufactured water meters shall have an exit-factory inspection certificate.

6.1.2.2 Marking of measuring instruments

The water meter shall clearly and permanently indicate the following information on the housing, the dial or nameplate of the indicating device, the inseparable cover, either centrally or dispersedly:

- a) Unit of measurement.
- b) Accuracy grade, which may not be marked if it is grade 2.
- c) Values of Q_3 and Q_3/Q_1 : If the water meter can measure reverse flow and the values of Q_3 and Q_3/Q_1 are different in the case of forward and reverse flow, THEN, the values of Q_3 and Q_3/Q_1 shall be described according to the corresponding flow direction. The ratio Q_3/Q_1 may be expressed as R, such as "R160". If the Q_3/Q_1 values of the water meter in the horizontal and vertical orientations are different, both Q_3/Q_1 values shall be described according to the corresponding installation orientation of the water meter.
- d) Manufacturer's name or registered trademark.
- e) Year and month of manufacture, with the year being at least the last two digits.
- f) Serial number.
- g) Flow direction (marked on both sides of the water meter housing, OR on only one side if the arrow indicating the flow direction can be easily seen in any case).
- h) MAP, if it exceeds 1 MPa for DN500 or below and exceeds 0.6 MPa for DN500 or above, it shall be marked.
- i) Letter V or H, wherein V means that the water meter can only be installed in a vertical position (perpendicular to the ground), H means that the water meter can only be installed in a horizontal position, no marking means that the water meter can be installed in any orientation.
- j) Temperature level, if it is T30, it can be left unmarked.
- k) Pressure loss level, if it is Δp_{63} , it can be left unmarked.
- l) Flow field sensitivity level, if it is U_0/D_0 , it can be left unmarked.

For water meters with electronic devices, the following additional information needs to be indicated in appropriate places:

Q₃ 2.5, R200, H, →, U10/D5, 123456, 1705, ABC.

6.1.2.3 Other explanatory information related to the use of the water meter shall be indicated in the operating instructions and other accompanying documents. If the type approval document of the water meter specifies additional verification flow points, the relevant requirements shall be recorded in the accompanying documents.

6.1.3 Seal

6.1.3.1 The water meter shall have a protective device with a seal or a closed structure, to ensure that before and after correct installation of water meter, it cannot disassemble or change the water meter and its adjustment device, correction device, related measuring instruments, without damaging the protective device or the seal of the protective device. The verification sign and protective seal of the water meter shall be applied to the part that can be seen without opening or disassembling the water meter.

6.1.3.2 For the water meter with electronic devices, if it can modify the parameters that affect the measurement results through buttons or communication interfaces, it shall adopt electronic seals. Only authorized personnel are allowed to access the parameters through passwords or special equipment (such as keys); the passwords shall be changeable.

6.1.3.3 Water meters in use on site shall be installed in accordance with the manufacturer's requirements. Reliable sealing protection devices shall be provided for the connection parts that are not allowed to be disassembled by themselves.

6.2 Functions of electronic devices

6.2.1 For water meters with electronic devices, it shall explain various functions related to user use and operation in the instruction manual and other accompanying documents. The modifiable parameters stored in the electronic device that affect the measurement results, such as sensor coefficient, instrument coefficient, signal equivalent, correction coefficient, etc., shall be available on the nameplate or accompanying documents of the water meter and related measuring instruments.

6.2.2 Electronic devices can have one or more functions in 3.1.9, among which repeated indication, rate control, preset, etc. are related to the primary metering indication; its function directly participated in trade settlement shall be controlled by legal measurement; all functions shall remain normal under rated working conditions.

6.2.3 For mechanical water meters with electronic devices, the electronic indication shall maintain a correct correspondence with the mechanical primary indication; the error of mechanical-electric conversion shall comply with the provisions of Table 5.

the verification time needs to be extended to control the uncertainty introduced by the reading error within a reasonable range.

7.3.4.5 Verification procedure

a) Installation

- 1) Install the water meter on the verification device, according to the requirements and installation orientation specified by the manufacturer, ensuring that the length of the upstream and downstream measuring sections of the water meter is not less than the length of the straight pipe section specified by the manufacturer. For water meters with multiple installation orientations, they shall be installed according to the actual use orientation.
- 2) When the working pressure before and after the water meter can be guaranteed to be between 0.03 MPa and MAP, meanwhile there is no obvious mutual influence between the front and rear water meters, water meters of the same model and specification can be installed in series.
- 3) The flow axis of the measuring section and the water meter shall be consistent to avoid the adverse effects of flow disturbances. If necessary, a flow straightener shall be installed upstream of the measuring section.
- 4) When verifying a coaxial water meter, a matching manifold shall be used to install it on the verification device.
- 5) When verifying a plug-in water meter and an interchangeable metering module water meter, a dedicated connection interface shall be used to install it on the verification device.
- 6) When calibrating a combined water meter, the various components of the water meter shall be correctly connected.
- 7) Volumetric water meters are not sensitive to upstream installation conditions and have no special requirements except for the manufacturer's recommendations.

b) Start-stop method

The start-stop method is operated according to the following procedures:

- 1) Install the water meter on the verification device.
- 2) Pass water within the rated flow range of the water meter, to remove the air in the meter and the verification device pipeline. When the water meter needs to be pre-operated or powered on for preheating, it shall be performed according to the manufacturer's instructions. If the manufacturer has no instructions,

confirm that the water meter works normally under a stable flow rate.

- 3) Keep the upstream water inlet valve of the water meter in a fully open state. Close the flow regulating valve downstream of the water meter, to stop the water flow completely. Put the device's metering standard in a working waiting state.
- 4) The water meter is in a stationary state. Take the water meter reading when the indicating device is not moving. When the water meter output signal is used for verification, the instrument receiving the verification signal shall indicate that the water meter's output signal is at zero, such as the pulse counter indicating a value of zero and no pulse accumulation.
- 5) Open the flow control valve, to adjust the flow to the flow value of the verification point. When opening the flow, avoid generating an impact flow exceeding Q_4 . Also, avoid too long a flow adjustment time so that the water meter works in the non-constant flow interval for too large a proportion of the total verification time, thereby introducing unreasonable measurement uncertainty.
- 6) After the water meter flows through the specified verification water volume, close the flow control valve to stop the water flow completely.
- 7) When the water meter is in a stationary state, take the water meter reading when the indicating device is not moving; read the reading of the measuring standard. The volume of water collected in the container is the actual volume flowing through the water meter. When the water meter's output signal is used for verification, the instrument receiving the verification signal shall indicate that the water meter's output signal is at zero, such as the pulse counter indication value remains unchanged and there is no pulse accumulation.
- 8) If necessary, use a timer to measure the time from opening the flow control valve to closing the flow control valve, to verify whether the test flow is controlled within the specified allowable range.
- 9) Calculate the indication error of the water meter according to formula (3).
- 10) Repeat steps 3) ~ 9) to complete the verification of all flow points.

Additional notes:

- The relative change of flow rate during constant flow shall not exceed $\pm 2.5\%$ in the low flow zone and $\pm 5\%$ in the high flow zone.
- When the water flow stops, the inertia of the moving parts of the water meter combines with the rotational movement of the water in the water meter, which may cause obvious errors in some types of water meters and some

reading error is controlled within a reasonable range, the verification signal shall be used instead of the manual reading.

- When the resolution of the verification signal is too low, or the maximum collection volume of the collection container cannot ensure that the verification signal reading and the verification device switching are kept in negligible synchronization, the pulse counting time representing the water meter reading and the verification time of the device shall be measured separately, so that the actual volume measured by the device can be corrected to the volume, which is consistent with the water meter's reading time according to the two time differences. The indication error is calculated according to formula (4).
- To ensure that the uncertainty introduced by low-resolution pulse counting is small enough, the pulse counting and timing instruments shall record the number of pulses in a complete cycle and the corresponding time.
- The verification time shall not be less than the shortest measurement time of the device.
- For the convenience of recording and calculation, the water meter's reading or indication can be expressed in liters (L).

Note: When the standard uncertainty of the verification signal reading, as introduced by the measurement asynchrony, is not greater than 1/3 of the combined standard uncertainty of the measurement result, the asynchrony between the water meter and the device can be ignored.

d) Flowrate-time method

The flowrate-time method is operated according to the following procedures:

- 1) Install the water meter on the verification device.
- 2) Run water within the rated flow range of the water meter, to remove the air in the meter and the verification device pipe. When the water meter needs to be pre-operated or powered on for preheating, it shall be performed according to the manufacturer's instructions. If the manufacturer does not provide instructions, confirm that the water meter works normally under a stable flow rate.
- 3) Adjust the flow rate of the verification device to the verification point flow value; put the device's metering standard in a working waiting state, so that the water meter's verification signal is in a normal output state.
- 4) The verification device starts the measurement instruction, so that the device's control system synchronously receives the metering standard signal and the

water meter's verification signal. When the synchronization requirement cannot be met, the control system shall measure the time corresponding to the reception of each signal, so that the actual volume measured by the device can be corrected to the volume, which is consistent with the water meter's reading time according to the two time differences.

- 5) After the water meter flows through the specified verification water volume, the verification device starts the stop measurement instruction, so that the device's control system stops receiving the metering standard's signal and the water meter's verification signal; stops measuring time.
- 6) When the synchronous measurement is met, the water meter's indication error is calculated according to formula (3). When the synchronous measurement is not met, the water meter's indication error is calculated according to formula (4).
- 7) Repeat steps 3) ~ 6), to complete the verification of all flow points.

Additional Notes:

- Devices with automatic control functions shall also meet the above procedures 3) ~ 6).
- The verification time shall not be less than the shortest measurement time of the device.
- For the convenience of recording and calculation, the water meter's reading or indication can be in liters (L).

7.3.4.6 Additional instructions for verification of combination water meter

Combination water meters shall generally be verified using the switch method. When there is a verification signal output, the flowrate-time method can also be used for verification, to ensure that the water meter's conversion device works normally under both increased and decreased flow conditions. During verification, the readings of the large water meter, small water meter, metering standard shall be read separately at the same time. The water meter indication value is the sum of the large water meter and small water meter's indication values. When synchronous measurement cannot be achieved, the verification signal shall be used instead of manual reading; the method specified in the additional instructions of 7.3.4.5c) shall be used.

7.3.4.7 Calculation formula

- a) Calculation of indication error that meets synchronous measurement

When the water meter and the device meet synchronous measurement, the indication error is calculated according to formula (3).

The water density ρ can be directly measured by a water densitometer, OR it can be obtained by the density lookup method in Appendix E.

During the verification process, when the water temperature changes by no more than 2 °C, the water density ρ can be calculated using the result of one measurement. When the water temperature changes by more than 2 °C, it shall be re-measured.

7.3.4.8 Number of verifications

Each verification flow point is generally verified once.

When the indication error of only one flow point exceeds the maximum allowable error, the verification shall be repeated at this flow point, to obtain two more results. If two of the three verification results at the flow point are within the maximum allowable error range, meanwhile the arithmetic mean of the three verification results also falls within the maximum allowable error, the flow point shall be deemed to have passed the verification.

7.3.4.9 Determination of indication error verification results

The indication error verification results can only be determined to be qualified, when the indication errors and their signs of all verification flow points meet the requirements of 5.2.

7.3.4.10 In-use inspection of indication error

The in-use inspection of water indication error shall be carried out in accordance with the provisions of Appendix A.

7.4 Handling of verification results

A verification certificate shall be issued for water meters that have passed the verification. For water meters with a nominal diameter of DN25 or less, only a verification certificate may be issued and applied to a conspicuous position on the water meter.

A verification result notice shall be issued for water meters that have failed the verification. For water meters that have already been applied with a verification certificate, the verification certificate shall also be cancelled. The verification result notice shall include a description of the verification failure items.

The inner page format of the verification certificate and the verification result notice is as shown in Appendix C.

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