ČESKÝ METROLOGICKÝ INSTITUT

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Executive summary for the EC *(not part of this legislation)*

Water flow quantity meters—water meters that are intended for uses other than residential, commercial and light industry are placed on the market and put into use in the Czech Republic as specified measuring instruments following type approval and initial validation pursuant to Act No 505/1990 on metrology, as amended.

The subject of this notified regulation is to lay down metrological and technical requirements for these measuring instruments. This regulation also stipulates tests for type approval and verification.

This regulation does not cover measuring instruments placed on the market and into operation pursuant to Directive 2014/32/EU (MID).

(End of executive summary.)

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PUBLIC DECREE

As the authority with substantive and territorial jurisdiction for stipulating metrological and technical requirements for specified measuring instruments and stipulating test methods for type approval and verification of legally specified instruments pursuant to § 14(1) of Act No 505/1990, on metrology, as amended (hereinafter the 'Metrology Act'), and in accordance with the provisions of § 172 et seq. of Act No 500/2004, the Code of Administrative Procedure (hereinafter the 'CAP'), the Czech Metrology Institute (hereinafter the 'CMI') commenced ex officio proceedings on 22January2016 pursuant to § 46 of the CAP, and, based on supporting documents, issues the following:

I.

DRAFT GENERAL MEASURE

number: 0111-OOP-C051-16

defining metrological and technical requirements for specified measuring instruments, including testing methods for the type approval and verification of those instruments:

'Water flow quantity meters—water meters that are intended for uses other than residential, commercial and light industry'

With respect to relevant EU legislation and national legislation of the Czech Republic, instruments for measuring water flow quantity are a type of measuring instrument that from the perspective of the scope of authority of this legislation is split into two groups with respect to being placed on the market and into circulation, as follows:

a) water meters for residential, commercial and light industry;

b) water flow quantity meters for uses other than residential, commercial and light industry.

In the case of water meters pursuant to (a), the process for placing them on the market and into operation, including metrological requirements for meters and their test methods, are governed by special legislation[1].

In the case of water flow quantity meters pursuant to point (b), this legislation stipulates metrological and technical requirements, and test methods applied when being placed into circulation, i.e. during type approval pursuant to Chapter 5 and during initial verification pursuant to Chapter 6, and test methods during subsequent verification pursuant to Chapter 7, performed after measuring instruments have been put into circulation.

1 Basic definitions

For the purposes of this Measure of a General Nature, terms and definitions according to VIM and VIML[2] and the terms and definitions below apply:

1.1
water flow quantity meter, water meter

a device intended for continuous measurement, recording and display of the volume of water that has flowed through the measuring transducer under measurement conditions

1.2
flow rate

the ratio of the volume of water that has flowed through the water meter to the amount of time during which this volume flowed through the water meter; it is expressed in m^3/h

1.3
minimum flow rate Q_1

the lowest flow rate for which the water meter is required to operate within the limits of maximum permissible errors

NOTE Minimum flow rate was formerly designated q_{min} or Q_{min} (provisions concerning Q_1 therefore apply in a similar manner to q_{min} or Q_{min}).

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[1] Government Regulation No 120/2016 stipulating technical requirements for measuring instruments (hereinafter the 'Government Regulation') implementing Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to measuring instruments (MID)

[2] TNI 01 0115 International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM) and International Vocabulary of Legal Metrology (VIML) are part of the technical harmonisation compendium ‘Terminology in the field of metrology’, which is publicly available at www.unmz.cz.

1.4
transient flow rate Q_2

a flow rate that lies between the permanent flow rate Q_3 and the minimum flow rate Q_1 and that splits the flow rate range into two regions, the 'lower flow rate region' and the 'upper flow rate region', each characterised by its own maximum permissible errors

NOTE The transitional flow rate was formerly designated q_t or Q_t (provisions concerning Q_2 therefore apply in a similar manner to q_t or Q_t).

1.5
permanent flow rate Q_3

the highest flow rate under rated operating conditions under which the water meter is required to operate within the limits of maximum permissible errors

NOTE The permanent flow rate was formerly designated q_p, Q_p, q_n or Q_n (provisions concerning Q_3 therefore apply in a similar manner to q_p, Q_p, q_p or Q_n).

1.6
overload flow rate Q_4

the maximum flow rate during which the water meter is required to operate within the limits of maximum permissible errors for a short amount of time, while its metrological function remains preserved, when it subsequently operates within its range of rated operating conditions

NOTE The overload flow rate was formerly designated q_s, Q_s or Q_{max} (provisions concerning Q_4 therefore also apply in a similar manner to q_s, Q_s or Q_{max}).

1.7
test flow

average flow during a test, calculated from indications on a calibrated reference device

1.8
nominal diameter (DN)

an alphanumeric designation for the size of a part of a pipe system, used for reference purposes; it consists of the letters DN followed by a dimensionless whole number that indirectly applies to the size of the opening or outer diameter of end connectors in mm

1.9
minimum allowable pressure (mAP) and maximum allowable pressure (MAP)

the minimum and maximum pressure of liquid that the water meter can resist on a permanent basis within the range of rated operating conditions without degrading its metrological functions.

NOTE The minimum allowable pressure and maximum allowable pressure are the lower and upper limit of rated operating conditions for operating pressure.

1.10
minimum allowable temperature (mAT) and maximum allowable temperature (MAT)

the minimum and maximum operating temperature that the water meter can resist on a permanent basis within the range of rated operating conditions without degrading its metrological functions

NOTE The minimum allowable temperature and maximum allowable temperature are the lower and upper limit of rated operating conditions for operating temperature.

2 Metrological requirements

The same metrological requirements which were decisive in the placement of water meters on the market will be applied during their verification.

2.1 Rated operating conditions

The operating conditions for a water meter type must be stipulated by the manufacturer.

Range of rated operating conditions:

a) the water temperature range must comply with at least the following conditions:
   - from 0.1 °C to 30 °C for water meters for cold water; or
   - from 30 °C to 90 °C for water meters for hot water; or
   - the water meter can be designed to operate in both ranges;

b) the range of relative operating water pressure is from 0.03 MPa (0.3 bar) to at least 1 MPa (10 bar) (for meters with DN ≥ 500, the maximum allowable pressure must be at least 0.6 MPa (6 bar));

c) for a power supply the nominal value of AC voltage or limit values of DC voltage must be stipulated.

2.2 Measuring range

The water flow rate range must meet the following conditions:

- Q_3 (expressed in m^3/h) must be chosen from the values in Table 1.

Table 1 – Values of Q_3 expressed in m^3/h

1.0	1.6	2.5	4.0	6.3
10	16	25	40	63
100	160	250	400	630
1,000	1 600	2 500	4 000	6 300

This list of values can be extended toward higher or lower values in the range.

- Q_3/Q_1 ('R') ≥ 40, must be chosen from the values in Table 2.

Table 2 – Values of the ratio Q_3/Q_1 ('R')

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

This list of values can be extended toward higher values in the range.

- $Q_2/Q_1 = 1.6$;
- $Q_4/Q_3 = 1.25$.

2.3 Maximum permissible error

The manufacturer of the measuring instrument must specify accuracy class 1 or accuracy class 2.If the accuracy class is not specified, the maximum permissible error as per 2.3.1.2 and 2.3.2.2 applies.

2.3.1 Maximum permissible error in the lower region of flow rate

2.3.1.1 Accuracy class 1

The maximum permissible error in volume delivered during a flow rate equal to or higher than the minimum flow rate Q_1 and up to but not including the transient flow rate Q_2 is ±3 % for water of any temperature.

2.3.1.2 Accuracy class 2

The maximum permissible error in volume delivered during a flow rate equal to or higher than the minimum flow rate Q_1 and up to but not including the transient flow rate Q_2 is ±5 % for water of any temperature.

2.3.2 Maximum permissible error in the upper region of flow rate

2.3.2.1 Accuracy class 1

The maximum permissible error in volume delivered during a flow rate equal to or higher than the transient flow rate Q_2 and up to and including the overload flow rate Q_4 is as follows:

±1 % for water of temperature ≤ 30 °C;

±2 % for water of temperature > 30 °C.

2.3.2.2 Accuracy class 2

The maximum permissible error in volume delivered during a flow rate equal to or higher than the transient flow rate Q_2 and up to and including the overload flow rate Q_4 is as follows:

±2 % for water of temperature ≤ 30 °C;

±3 % for water of temperature > 30 °C.

2.3.3 Evaluation of measuring instrument errors

A water meter must not exploit the maximum permissible error or systematically favour either side.

If all errors within the limits of the meter's measuring range have the same sign during this verification, at least one of the errors must not exceed one half of the maximum permissible error.

2.4 Measuring instrument classification

2.4.1 Measuring instrument pressure class

The minimum allowable pressure (mAP) must be 0.030 MPa (0.3 bar).

Measuring instruments are classified by a maximum allowable pressure (MAP) class that corresponds to values in the range MAP 6 (only for DN ≥ 500), MAP 10, MAP 16, MAP 25, and MAP 40 chosen by the manufacturer. A water meter must be capable of resisting internal pressure according to the relevant pressure class and must be tested with the appropriate test.

2.4.2 Measuring instrument temperature class

Measuring instruments are classified by water temperature class corresponding to various ranges selected by the manufacturer:

- water meters specified only by the maximum allowable temperature (MAT) as T30, T50, T70, T90, T130, and T180;
- water meters specified by the minimum allowable temperature (mAT) and the maximum allowable temperature (MAT) as T30/90, T30/130, and T30/180.

2.4.3 Classes of sensitivity of the current profile

The water meter must be capable of resisting the effect of abnormal velocity fields caused by baffles. The manufacturer of the meter must specify the current profile sensitivity class:

a) in front of the meter:
   - U0, U3, U5, U10, and U15 without a current rectifier;
   - U0S, U3S, U5S, and U10S with a current rectifier;

b) past the meter:
   - D0, D3, and D5 without a current rectifier;
   - D0S and D3S with a current rectifier;

where the value expresses the required straight length as a multiple of DN.

Every section that modifies current, including rectifiers and/or straight sections, that is to be used, must be completely defined by the manufacturer and is considered auxiliary equipment connected to the tested meter type.

2.4.4 Pressure drop

The maximum pressure drop between Q_1 and Q_3 must not be greater than 0.063 MPa (0.63 bar). This value includes any filter or rectifier. The class must be selected from among the following:ΔP 63, ΔP 40, ΔP 25, ΔP 16, and ΔP 10, where the number means the highest pressure drop in bars times a hundred.

Concentric meters of any type or measurement principle must be tested together with their appropriate collection pipes.

2.5 Other important metrological properties

2.5.1 Absence of flow

The volume indicated by the water meter must not change in the absence of either flow or of water.

2.5.2 Backflow

For meters designed to measure backflow, the permanent flow rate and the measurement range may be different in each direction.

The manufacturer must specify whether the meter is designed to measure backflow. If it is, the backflow volume must either be subtracted from the indicated volume or it must be recorded separately. The maximum permissible error pursuant to Articles 2.3.1 and 2.3.2 must be met for both forward flow and backflow.

Water meters that are not designed to measure backflow must either prevent backflow or must be capable of resisting chance backflow up to Q_3 without any deterioration or changes in their metrological properties for forward flow.

3 Technical requirements

Technical requirements for water meters intended for use in areas other than residential, commercial and light industry are adopted from harmonised standards where relevant.

The same technical requirements that were decisive in placing water meters into circulation will be applied during their verification.

3.1 Size of the meter and overall dimensions

The size of a water meter is designated by its nominal diameter (DN).A minimum thread size is established for instruments with threaded end-connections.

3.2 Indicator

The indicator of a water meter must facilitate easy reading, and reliable and unambiguous visualisation of the indicated volume. Combined water meters may have two indicators, the sum of which provides the indicated volume.

The indicator may contain elements for testing using other methods, for example for automatic testing.

Water volume must be indicated in cubic metres. The 'm^3' symbol must be shown on the numerical display or immediately adjacent to it. The indication range specified in Table 3 must make it possible to record the indicated volume in cubic metres without crossing zero.

Table 3 – Water meter indication range

Q_3 (m^3/h)	**Indication 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
$630 < Q_3 \leq 6\,300$	9 999 999

Every indicator must be equipped with means of visual and clear testing when verifying the control element.

The size of the verification scale interval must not exceed:

- 0.25 % of the volume that flows through in 90 minutes during the minimum flow rate Q_1 for accuracy class 1; and
- 0.5 % of the volume that flows through in 90 minutes during the minimum flow rate Q_1 for accuracy class 2.

3.3 Electronic device counter

The counter may be equipped with an interface that allows connection of other devices. If these interfaces are used, the water meter's hardware and software must continue to operate properly and it must be impossible to influence its metrological properties.

3.4 Auxiliary devices

Aside from indicators, a water meter may contain auxiliary devices. Addition of these devices, either temporary or permanent, must not change the meter's metrological properties.

An auxiliary device may be used to detect activity of a flow sensor earlier displayed on the indicator.

3.5 Software

Software that is critical for the metrological characteristics of electronic equipment, termed legally relevant software, must be readily identifiable and must be secured. Easy software identification must

be possible. Identification and security must be in accordance with the current version of the WELMEC 7.2, 2015[3] guide.

3.6 Ambient conditions

3.6.1 Climactic and physical environment

For water meters that use electronic devices, climactic and physical environment classes are defined:

- Class B for fixed meters installed in buildings;
- Class O for fixed meters installed outdoors;
- Class M for mobile meters.

3.6.2 Electromagnetic environment

For water meters with electronic devices intended for use in areas other than residential, commercial and light industry, electromagnetic environment class E2 for an industrial environment applies.

The water meter must be immune to electrical and electromagnetic interference or it must respond to it in a defined manner, e.g. by reporting an error, inhibition of measurement, etc. It also must not emit unwanted electromagnetic fields.

3.7 Power

The manufacturer specifies how a water meter with electronic devices is powered.

Water meters with electronic devices must be designed so that if the external power source (AC or DC) fails, the volume indicated by the meter immediately prior to the fault is not lost, and remains accessible for at least one year. Relevant storage in memory must take place at least once a day, or after every volume equivalent to 10 minutes of flow at Q_3.All other properties or parameters of the meter must not be affected by changes in electrical power or its interruption.

The internal battery, if one is used, must ensure that if there is an external power failure the meter operates for at least one month under normal measurement conditions. Battery lifespan must be marked on the meter.

The manufacturer must prove that the specified lifespan of a non-replaceable battery guarantees proper operation of the meter for at least one year more than the meter's operating lifespan.

In the case of a replaceable battery, the meter's properties and parameters must not be affected by a power interruption when the battery is being replaced. This does not apply to measurement and recording of flow while the battery is being replaced. Battery lifespan must be marked on the meter.

3.8 Correction devices

Water meters may be equipped with correction devices in order to reduce (indication) errors as much as possible to zero. Such devices are always considered an integral part of the meter that must comply with all relevant tests and requirements.

3.9 Materials and construction

A water meter must be made of materials whose strength and lifespan is appropriate to the water meter's purpose. Materials must not be negatively affected by changes in water temperature within the operating temperature range, must be resistant to internal and external corrosion or protected with a suitable surface treatment, and at the same time all parts of the water meter that come into contact with

[3] WELMEC 7.2, 2015:Software Guide (Measuring Instruments Directive 2014/32/EU) – *publicly available at* www.welmec.org

the water that is flowing through it must be made of materials that are non-toxic, uncontaminated and biologically inert.

The water meter's indicator must be protected by a transparent window and can also be additionally protected by a suitable lid. The water meter must contain a device to eliminate the effects of condensation where there is a risk of condensation forming on the inner face of the water meter indicator window.

3.10 Protection from solid particulates

If the water meter's accuracy is susceptible to being affected by the presence of solid particulates in the water, it may be equipped with a rectifier or filter.

3.11 Meter security and fraud protection

3.11.1 Mechanical protective devices

Water meters must contain protective devices that must be sealed in such a way that after being sealed, before and after the water meter has been correctly installed, there is no way the meter can be disassembled or modified or its settings changed using an adjustment apparatus without damaging the seal or protective devices.

3.11.2 Electronic sealing devices

If access to modification of parameters that affect measurement results is not protected mechanically, then access must be protected electronically using codes, passwords, etc., and simultaneously at least the last activity must be stored in memory. In the case of interchangeable parts and disconnection of parts that are not interchangeable, the insertion of any parts that could affect measurement results must be prevented.

3.12 Grounding of induction water meters

In order to ensure measurement accuracy and prevent galvanic corrosion, the electrodes of an induction water meter and the measured liquid must be electrically connected and grounded. Even though in general this means of grounding is water, individual installation instructions from the manufacturer for special meter designs must be followed.

3.13 Liquid conductance

If the electrical conductivity of the liquid can affect measurement results, the manufacturer must stipulate a requirement for minimum operating conductivity.

The conductivity of test water for testing inductance water meters must comply with requirements in the type-approval certificate, if it was type-approved.

4 Water meter labelling

The water meter must be clearly and visibly marked with information pursuant to Article 4.1, so that

a) it is grouped together on one data plate; or
b) placed in various places on the casing, the indicator numerical display, the ID plate or on the meter lid, if it is not removable.

4.1 Markings on the meter

The water meter must be clearly and visibly marked with the following information:

- unit of measurement: cubic metre;
- accuracy class;

- the numerical value of Q_3;
- the ratio Q_3/Q_1 (with the prefix 'R', e.g. R160);
- a type-approval mark pursuant to the Metrology Act;
- the name or trade mark of the manufacturer and postal address;
- the year of manufacture; at least the last two digits of the year of manufacture or the month and year of manufacture;
- serial number (as close as possible to the indicator);
- the direction of flow (depicted on both sides of the unit, or only on one side with an arrow indicating the direction of flow that is easily visible under all circumstances);
- the maximum allowable pressure, if different from 1 MPa (10 bar) or 0.6 MPa (6 bar) for DN ≥ 500;
- the letter 'V' or 'H' if the meter can work only in a vertical or horizontal position;
- the temperature class, if is not T30;
- the pressure drop class, if it is not ΔP 63;
- the class of sensitivity to irregularities in the velocity field, if different from U0D0.

For water meters with electronic devices, the following additional labels must be used, where appropriate:

- for an external power supply: voltage and frequency;
- for replaceable batteries: the latest date by which the battery should be replaced;
- for non-replaceable batteries: the latest date by which the meter should be replaced;
- the environmental class (climactic and physical);
- electromagnetic environment class E2;
- output signals for auxiliary devices (type/level), if they exist.

4.2 Official mark placement

Official mark placement is stipulated by the type-approval certificate.

The water meter must also have a location for placing the (main) official mark, which must be visible without disassembling the water meter.

5 Type approval of the meter

Type approval pursuant to the Metrology Act applies only to water flow quantity meters for uses other than residential, commercial and light industry.

During the type-approval process for water flow quantity meters, the environmental conditions to which the water meters will be exposed must be taken into account. Environmental classification must correspond to ambient climactic, physical, electrical and electromagnetic conditions for use of these water meters.

5.1 In general

The type-approval process for a water meter includes the following tests and activities:

a) an external inspection;

b) functional tests for all water meters:
   - using static pressure;
   - by determining basic error;
   - using test water temperature;

- by overheating using water;
- by water pressure;
- by backflow;
- by pressure loss;
- by current interference;
- of lifespan;
- by magnetic field;
- of the water meter's auxiliary devices;

c) additional functional tests for electronic water meters and mechanical meters with inserted electronic devices:

- tests of resistance to environmental influences of water meters with electronic devices;
  - by dry heat;
  - by cold;
  - by cyclical wet heat;
  - by random vibrations (only for mobile meters);
  - by impact (only for mobile meters);
- tests of the electromagnetic compatibility (EMC) of water meters with electronic devices;
  - by changing supply voltage;
  - of immunity to dips and short interruptions and AC voltage variations;
  - of immunity to transients/bursts on signal lines;
  - of immunity to transients/bursts in AC and DC grids;
  - of immunity to electrostatic discharge;
  - of immunity to radiated electromagnetic fields;
  - of immunity to electromagnetic fields caused by power lines;
  - of immunity to transient surges on signal, data and control lines;
  - of immunity to transient surges on AC and DC power lines;
  - by static magnetic field;
  - by the absence of flow;
- a check of the software used in the water meter with an electronic device.

Only a water meter type comprising a measuring sensor, counter and indicator providing primary indication may be approved. However, the water meter may have several indicators and/or auxiliary devices making up a remote output system, which may also be subject to type approval.

No adjustment of the meter is allowed during type-approval tests. If modifications are made, all tests already performed that could be affected by the modification must be repeated.

5.2 External inspection

The external inspection of the water meter assesses the following:

- completeness of the required technical documentation;
- the conformity of the metrological and technical characteristics specified by the manufacturer in the documentation with the requirements under this regulation as referred to in Chapters 2, 3 and 4;
- the completeness and condition of the water meter in accordance with the specified technical documentation;
- a description of the water meter's software version (if software is used).

5.3 Functional tests

5.3.1 Reference conditions

All suitable influencing quantities, aside from influencing quantities that arise during testing, must be maintained within the following values during type-approval testing of the water meter:

Reference flow rate: $0.7 \times (Q_2 + Q_3) \pm 0.03 \times (Q_2 + Q_3)$

The relative change in flow rate during every test (except for starting and stopping) must not exceed:

±2.5 % for flow rates $Q_1 \leq Q < Q_2$;

±5.0 % for flow rates $Q_2 \leq Q \leq Q_4$.

Operating temperature (of water):	for T30 and T50 meters:	(20 ± 5) °C;
	for T70 to T180 meters:	(20 ± 5) °C and (50 ±5) °C;
	for T30/90 to T30/180 meters:	(50 ± 5) °C.

The water temperature during testing must not change by more than 5 °C. The maximum uncertainty of temperature measurement must not exceed ±1 °C.

Water pressure in front of the meter must not change during the test by more than 10 %; it must not exceed the meter's maximum allowable pressure (MAP) and the maximum uncertainty of pressure measurement (or pressure drop) must be ±5 % of the measured value.

Ambient temperature range:	15 °C to 25 °C
Ambient relative humidity range:	45 % to 75 %
Ambient atmospheric pressure range:	86 kPa to 106 kPa (0.86 bar to 1.06 bar)
Supply voltage (AC grid):	nominal voltage U_{nom} ± 5 %
Supply frequency:	nominal frequency f_{nom} ± 2 %
Supply voltage (battery):	voltage U_b within the range: $U_{bmin} \leq U_b \leq U_{bmax}$

During each test, the temperature must not change by more than 5 °C and relative humidity must not change by more than 10 % within the limits of the reference range.

5.3.2 Test equipment

Test equipment for testing water meters must be equipped with a reference standard with valid metrological traceability, or relevant international acceptance. The extended measurement uncertainty of the true volume indicated by the test equipment must not exceed $^1/_5$ of the water meter's maximum permissible error.

To determine the measurement error of the tested water meter, the 'collection' method is used: the water flowing through the water meter is collected in one or more containers and its amount is determined volumetrically or by weighing. Other methods may be used assuming they meet requirements for extended uncertainty of measurement of true volume. The measurement error is the difference between the measured value of the volume indicated by the tested water meter minus the indication on the calibrated test equipment under reference conditions.

The stipulated minimum volume that must flow through the water meter during the test depends on requirements determined by a test of the effects of starting and stopping (time error) and the type and construction of the indicator (the value of the verification scale interval).

Meters are tested either individually or in groups. In the latter case, the individual properties of the meter must be precisely determined. Mutual influences between the meters and the test equipment must be eliminated. If meters are tested in a series, the pressure at the outlet of each meter must be sufficient to prevent cavitation.

5.3.3 Static pressure test

The tightness of the water meter and its resistance to damage at test water pressure according to the chosen maximum allowable pressure class are tested.

The test is performed at a flow rate equal to zero. The water pressure must be set to 1.6× the maximum allowable pressure (MAP) for 15 minutes and then 2× the maximum allowable pressure (MAP) for 1 minute. For concentric meters the static pressure test must be performed on the meter and collection pipes together.

During or after completion of the test, there must be no visible leak from the meter, leak from the indicator or physical damage to the water meter due to testing.

5.3.4 Determining basic error (of indication)

The basic measurement error of the water meter is determined at the reference operating water temperature pursuant to Article 5.3.1 and at specified positions; three times at flow rates 1), 2), and 5) and twice at other flow rates:

1) between Q_1 and $1.1Q_1$;
2) between Q_2 and $1.1Q_2$;
3) between $0.33(Q_2 + Q_3)$ and $0.37(Q_2 + Q_3)$;
4) between $0.67(Q_2 + Q_3)$ and $0.74(Q_2 + Q_3)$;
5) between $0.9Q_3$ and Q_3;
6) between $0.95Q_3$ and Q_4;

and for combined water meters:

7) between $0.85Q_{x1}$ and $0.95Q_{x1}$;
8) between $1.05Q_{x2}$ and $1.15Q_{x2}$.

Errors found for each flow rate must not exceed the maximum permissible error. If an error found on one or more meters is greater than the maximum permissible error at only one flow rate, then:

- if only two results were determined at this flow rate, the test at the given flow rate must be repeated;
- the test must be declared satisfactory if two of three results lie within the limits of the maximum permissible error and the arithmetic mean of the results of three tests at this flow rate is less than or equal to the maximum permissible error.

The standard deviation for a basic error at flow rates of Q_1, Q_2, and Q_3 must not exceed ⅓ of the maximum permissible errors.

Water meter errors found at each of the given flow rates must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2 under conditions of Article 2.3.3.

5.3.5 Test of the effect of test water temperature

The effect of water temperature on water meter error is determined at a flow rate of Q_2 with incoming temperature maintained at:

(10 ± 5) °C for temperature classes T30 to T180;

(30^{+5}_{0}) °C for temperature classes T30/90 to T30/180.

The effect of water temperature on water meter error is determined at a flow rate of Q_2 with incoming temperature maintained at the water meter's maximum allowable temperature (MAT) and a tolerance of $(^{0}_{-5})$ °C.

Temperature of the incoming water relative to the relevant temperature class are specified in Table 4.

Table 4 - Test water temperature

Temperature class	T30	T50	T70	T90	T130	T180	T30/90	T30/130	T30/180
Test water temperature	10 °C	10 °C	10 °C	10 °C	10 °C	10 °C	30 °C	30 °C	30 °C
	30 °C	50 °C	70 °C	90 °C	130 °C	180 °C	90 °C	130 °C	180 °C

Errors found at each of the given test water temperatures must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

5.3.6 Test by overheating water

This test is used for water meters with a maximum allowable temperature MAT ≥ 50 °C.

Once the water meter has achieved thermal stability, it is exposed to water flow at the reference flow rate at the maximum allowable temperature MAT +10 °C ± 2.5 °C for one hour. After recovery the water meter's error at a flow rate of Q_2 at the reference temperature is determined.

The water meter error must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

5.3.7 Test by water pressure

The influence of internal water pressure on water meter error is tested. Measurement error is determined for at least one water meter at a flow rate of Q_2 with incoming water pressure maintained first at 0.03 MPa (0.3 bar) ($^{+5\,\%}_{0\,\%}$), and then at maximum allowable pressure (MAP) ($^{0\,\%}_{-10\,\%}$).

The water meter error for each prescribed pressure at the water meter inlet must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

5.3.8 Backflow test

Water meter operation is tested during backflow.

5.3.8.1 Water meters designed to measure backflow

Water meters designed to measure backflow must precisely record the volume of backflow. The following tests must be performed with backflow:

a) an accuracy test:
   1) between Q_1 and $1.1Q_1$;
   2) between Q_2 and $1.1Q_2$;
   3) between $0.9Q_3$ and Q_3.

   The water meter error at any of the flow rates must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

b) a pressure drop test pursuant to Article 5.3.9;

c) a test of sensitivity to current profile pursuant to Article 5.3.10;

d) a durability test pursuant to Article 5.3.11.

Test results must satisfy Articles 5.3.9, 5.3.10, and 5.3.11.

5.3.8.2 Meters not designed to measure backflow

A meter that permits backflow but is not designed to record it must be subjected to backflow. Errors must then be determined for forward flow to check that backflow has not negatively affected metrological functions.

The water meter is subjected to backflow of $0.9Q_3$ for one minute.

The water meter error is then determined for the following forward flow ranges:

1) between Q_1 and $1.1Q_1$;
2) between Q_2 and $1.1Q_2$;
3) between $0.9Q_3$ and Q_3.

The water meter error at any of the flow rates must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

5.3.8.3 Meters designed to prevent backflow

A meter designed to prevent backflow is subjected to its maximum allowable pressure at the outlet connection and measurement errors are then determined for forward flow to find out whether the effects of pressure on the water meter had not negatively affected metrological functions.

The water meter is subjected to maximum allowable pressure under backflow for one minute. During the test, valves are checked for any significant leaks.

The water meter error is then determined for the following forward flow rates:

1) between Q_1 and $1.1Q_1$;
2) between Q_2 and $1.1Q_2$;
3) between $0.9Q_3$ and Q_3.

The water meter error at any of the flow rates must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

5.3.9 Pressure drop test

Pressure drop is measured for the pressure drop class.

The meter's maximum pressure drop is determined at any flow rate between Q_1 and Q_3.

The measured pressure drop at any flow rate within the limits of specified operating conditions must not exceed the maximum pressure drop value corresponding to the class declared by the manufacturer.

5.3.10 Flow disturbance tests

The influence of installation conditions on water meter error is tested. This test is not appropriate for water meters that are not sensitive to installation conditions.

The error is determined at flow rates between $0.9Q_3$ and Q_3 for three types of baffles situated in front of and past the water meter at distances specified by the manufacturer, at most however 15× DN in front of the meter and 5× DN past the meter.

The water meter error for any of the baffles must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

5.3.11 Durability tests

The tests must be performed in the following order:

a) a discontinuous flow test at Q_3 (for water meters with $Q_3 \leq 16$ m^3/h);
b) a continuous test at Q_3 (for water meters with $Q_3 > 16$ m^3/h);
c) a continuous test at Q_4.

5.3.11.1 Discontinuous flow test

The test is performed to verify the water meter's immunity to cyclic flow conditions under conditions specified in Table 5.The test consists of subjecting the meter to the specified number of flow start and stop cycles over a short time, where each constant test flow phase is maintained at the specified flow rate for the entire duration of the test.

The water meter error pursuant to Article 5.3.4 is determined prior to commencing the discontinuous test and after it is completed.

The change in the error curve must not exceed:

a) for accuracy class 1:
   2 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and
   1 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$);

b) for accuracy class 2:
   3 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and
   1.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$);

i.e. for every flow rate, the error obtained prior to the test is subtracted from the error obtained after the test.

For purposes of stipulating these requirements, the average values of errors for each flow rate must be used, and the water meter error must not exceed the maximum error limit value:

a) for accuracy class 1:
   ±4 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and
   ±1.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for T30 meters; or
   ±2.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for meters other than T30.

b) for accuracy class 2:
   ±6 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and
   ±2.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for T30 meters; or
   ±3.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for meters other than T30.

5.3.11.2 Continuous flow test

The water meter's immunity is tested under constant, continuous, permanent flow Q_3 or overload flow Q_4 pursuant to conditions specified in Table 5.

The change in the error curve must not exceed:

a) for accuracy class 1:
   2 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and
   1 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$);

b) for accuracy class 2:
   3 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and
   1.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$);

i.e. either:

I. for every flow rate, the error obtained prior to the test is subtracted from the error obtained after the test—this applies to a continuous flow test at Q_3; or

II. for every flow rate, the error obtained prior to the discontinuous flow test, or the continuous flow test at Q_3, from the error obtained after the continuous flow test at Q_4.

The water meter error is determined via an accuracy test pursuant to Article 5.3.4.

For purposes of stipulating these requirements, the average values of errors for each flow rate must be used—the error must not exceed the maximum error limit value:

a) for accuracy class 1:

±4 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and

±1.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for T30 meters; or

±2.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for meters other than T30.

b) for accuracy class 2:

±6 % for flow rates in the lower region ($Q_1 \leq Q < Q_2$); and

±2.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for T30 meters; or

±3.5 % for flow rates in the upper region ($Q_2 \leq Q \leq Q_4$) for meters other than T30.

Table 5 - Durability tests

Temperature class	**Permanent flow rate Q_3**	**Flow rate test**	**Test water temperature ±5 °C**	**Test type**	**Number of interruptions**	**Pause duration**	**Duration of activity at test flow rate**	**Start and stop duration**
T30 and T50	$Q_3 \leq$ 16 m³/h	Q_3	20 °C	Discontinuous	100 000	15 s	15 s	$0.15Q_3$ (s) with a minimum of 1 s
		Q_4	20 °C	Continuous	-	-	100 h	-
	Q_3 >16 m³/h	Q_3	20 °C	Continuous	-	-	800 h	-
		Q_4	20 °C	Continuous	-	-	200 h	-
All other classes	$Q_3 \leq$ 16 m³/h	Q_3	50 °C	Discontinuous	100 000	15 s	15 s	$0.15Q_3$ (s) with a minimum of 1 s
		Q_4	0.9× MAT	Continuous	-	-	100 h	-
	Q_3 >16 m³/h	Q_3	50 °C	Continuous	-	-	800 h	-
		Q_4	0.9× MAT	Continuous	-	-	200 h	-

continued

Table 5 – completion

Temperature class	**Permanent flow rate Q_3**	**Flow rate test**	**Test water temperature ±5 °C**	**Test type**	**Number of interruptions**	**Pause duration**	**Duration of activity at test flow rate**	**Start and stop duration**
Combined meters	Q_3 >16 m³/h	$Q \geq 2Q_{x2}$	20 °C	Discontinuous	50 000	15 s	15 s	3 s to 6 s
Combined meters (where a small meter was not pre-approved)	Q_3 >16 m³/h	$0.9Q_{x1}$	20 °C	Continuous	-	-	200 h	-

5.3.12 Electromagnetic field tests

This is tested in accordance with Article 5.6.10.

5.3.13 Tests of the water meter's auxiliary devices

The influence of permanently or temporarily inserted auxiliary devices on the water meter error is tested.

The water meter error must be determined with temporarily inserted auxiliary devices, for example for purposes of testing or data transmission. The water meter error must not exceed the maximum permissible error specified in Articles 2.3.1 and 2.3.2.

For permanently inserted and temporarily inserted auxiliary devices, the volume indication from auxiliary devices must be checked to determine whether their reading does not differ from the reading on the primary indicator. Volume indication from an auxiliary device(s) must not differ from the indication on the visual display by more than the value of the verification scale interval.

5.4 Functional tests for electronic water meters and mechanical meters with inserted electronic devices

These functional tests supplement tests specified in Article 5.3, and are applied to compact water meters, removable water meter parts and auxiliary devices.

During each test, typical test conditions are established that correspond to the climactic, mechanical and electrical conditions in the environment to which water meters are exposed. Corresponding classification of the water meter into classes must take place in accordance with Chapter 3.6.1 and 3.6.2.

For test purposes, the tested device must be classified into one of cases A to E, and the following requirements must apply:

Case A: performance of the test is not required.

Case B: the tested device is a compact meter; the test must be performed with water in the volume or flow sensor and with the meter operating as designed.

Case C: the tested device is a measurement transducer; the test must be performed with water in the volume or flow sensor and with the meter operating as designed.

Case D: the tested device is an electronic counter including indicator or auxiliary device; the test must be performed with water in the volume or flow sensor and with the meter operating as designed.

Case E: the tested device is an electronic counter including indicator or auxiliary device; the test may be performed with simulation of measurement signals without water in the volume or flow sensor.

5.5 Tests of resistance to environmental influences

5.5.1 Dry (non-condensing) heat test

The water meter is subjected to the reference flow rate pursuant to Article 5.3.1 and the water meter error is determined under the following test conditions:

- at an air temperature of (20 ± 5) °C, prior to preliminary stabilisation of the tested device;
- at an air temperature of (55 ± 2) °C, following preliminary stabilisation of the tested device at this temperature for 2 h;
- at the reference air temperature of (20 ± 5) °C, after the tested device has recovered following the preceding test.

The water meter error for any of these conditions must not exceed values specified in Article 2.3.2, and all of the functions of the tested device must operate as designed.

5.5.2 Cold test

The water meter is subjected to the reference flow rate pursuant to Article 5.3.1 and the water meter error is determined under the following test conditions:

- at an air temperature of (20 ± 5) °C, prior to preliminary stabilisation of the tested device;
- at an air temperature of (+5 ± 3) °C for fixed meters installed in a building (environmental class B) or (−25 ± 3) °C for fixed meters installed in an outdoor environment (environmental class O) and for mobile meters (environmental class M), following stabilisation of the tested device at this temperature for 2 h;
- at the reference air temperature of (20 ± 5) °C, after the tested device has recovered.

The water meter error for any of these conditions must not exceed values specified in Article 2.3.2, and all of the functions of the tested device must operate as designed.

5.5.3 Cyclic wet (condensing) heat test

Following preliminary stabilisation, the water meter is subjected to two temperature cycles over a 24-hour period between the lower temperature (25 ± 3) °C and the higher temperature:

- (55 ± 2) °C for fixed meters installed in an outdoor environment (environmental class O) and for mobile meters (environmental class M); or
- (40 ± 2) °C for fixed meters installed in a building (environmental class B).

The relative humidity is maintained above 95 % during temperature changes and during the low-temperature phase, and above (93 ± 3) % during the higher temperature phases. The power supply is switched on during the test.

Once the water meter has recovered, its error at the reference flow rate is determined.

The water meter error must not exceed values specified in Article 2.3.2, and all of the functions of the tested device must operate as designed.

5.5.4 Random vibration test

This test applies only to mobile meters.

The water meter is installed in the position in which it is routinely used, and random vibrations are applied to the tested device over a frequency range of 10 Hz to 150 Hz, in three mutually perpendicular axes, for at least 2 minutes per axis. During the test the power supply is switched on and the following conditions must be met:

- total RMS:7 m/s^2;
- ASD of 10 to 20 Hz:1 m^2/s^3,
- ASD of 20 to 150 Hz:-3 dB/octave.

Once the water meter has recovered, its error at the reference flow rate is determined.

NOTES
RMS Root mean square
ASD Acceleration spectral density

The difference between the indication before and after the test must not exceed ½ the maximum permissible error specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.5.5 Impact test

This test applies only to mobile meters.

The water meter must be placed on a hard surface in its normal position for use, and dropped on one bottom edge, with the opposite edge of the water meter being 50 mm above the hard surface; however, the angle between the bottom of the water meter and the test surface must not exceed 30°.The impact must be repeated on each bottom edge. The power supply is switched off during the test.

Once the test has been completed and the water meter has recovered, its error at the reference flow rate is determined.

The difference between the indication before and after the test must not exceed ½ the maximum permissible error specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6 Electromagnetic compatibility (EMC) tests

5.6.1 Change of supply voltage

5.6.1.1 Water meters powered directly from the grid (AC) or via an adapter (AC/DC)

The test verifies the influence of a static deviation of an AC mains power source.

During the test the following are applied:

- upper mains voltage limit U_{nom} + 10 %;
- upper mains frequency limits f_{nom} + 2 %;
- lower mains voltage limit U_{nom} − 15 %;
- lower mains frequency limits f_{nom} + 2 %.

The water meter error is determined during test conditions at the reference flow rate.

The water meter error must not exceed values specified in Article 2.3.2, and all of the functions of the tested device must operate as designed.

5.6.1.2 Water meters powered directly by an external DC power supply or by primary DC batteries

The test verifies the influence of a static deviation of a DC power source.

During the test the following are applied:

- the maximum operating voltage of the battery, as specified by the water meter's manufacturer, for the battery or DC voltage for which the water meter was manufactured for automatic detection of high-level conditions for external DC power;
- the minimum operating voltage of the battery, as specified by the water meter's manufacturer, for the battery or DC voltage for which the water meter was manufactured for automatic detection of low-level conditions for external DC power.

The water meter error is determined during test conditions at the reference flow rate.

The water meter error must not exceed values specified in Article 2.3.2, and all of the functions of the tested device must operate as designed.

5.6.1.3 Interruption of battery power

This test applies only to meters that use replaceable batteries.

The battery is removed for one hour and then reconnected. The meter's operation must then be examined in detail.

The value of the total or stored values must remain unchanged and all functions of the tested device must operate as designed.

5.6.2 Immunity to dips and short interruptions and AC voltage variations

During the application of a power interruption, power must be interrupted for 250 cycles (50 Hz) and 300 cycles (60 Hz).At least 10 repetitions must be performed with an interval of at least 10 seconds between each group of interruptions. Interruptions are repeated for the entire duration of the time needed to determine the water meter error.

During application of a voltage dip, voltage must be reduced to 0 % or 70 % for 0.5 cycle, 1 cycle, or 25 cycles (50 Hz)/30 cycles (60 Hz) depending on the type of test being performed. Ten repetitions must be performed with an interval of at least 10 seconds between each group of dips.

The difference between the water meter error obtained during the application of voltage dips and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6.3 Immunity to transients/bursts on signal lines

Transient voltage spikes are applied, with a double exponential waveform. The duration of the transients must be 15 ms and the rate of repetition of the transient must be 5 kHz. A voltage of 1 kV is used for environmental class E2.

The difference between the water meter error obtained during the application of transients and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6.4 Immunity to transients/bursts in AC and DC grids

Transient voltage spikes are applied, with a double exponential waveform. The duration of the transients must be 15 ms and the rate of repetition of the transient must be 5 kHz. A voltage of 2 kV is used for environmental class E2.

The difference between the water meter error obtained during the application of transients and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6.5 Immunity to electrostatic discharge

During one test, 10 direct (contact) discharges are applied with a test voltage of 6 kV to metal parts of the case at intervals of at least 10 seconds between discharges and 10 indirect (air) discharges with a test voltage of 8 kV in the horizontal connection plane and 10 indirect discharges for each of various positions in the vertical connection plane.

The difference between the water meter error determined during the application of electrostatic discharges and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6.6 Immunity to radiated electromagnetic fields

The test must be performed in the presence of interference in the 26 MHz to 2 000 MHz frequency range at a field intensity of 10 V/m for environmental class E2.

The difference between the water meter error measured during the application of each carrier frequency band and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6.7 Immunity to electromagnetic fields caused by power lines

The test involves exposure to conducted electromagnetic fields in the 0.15 MHz to 80 MHz frequency range at an RF amplitude of 10 V for environmental class E2.

The difference between the water meter error measured during the application of each carrier frequency band and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6.8 Immunity to transient surges on signal, data and control lines

The test verifies the influence of transient surges if they are multiplied on I/O and communication ports, and if these lines are longer than 30 m, or on lines installed outside the building regardless of their length. The surges must be applied in line-to-line with a transient voltage of 1 kV and in line-to-ground with a transient voltage of 2 kV for environmental class E2.

The difference between the water meter error obtained during the application of transient voltage surges and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed.

5.6.9 Immunity to transient surges on AC and DC power lines

The test verifies the influence of transient surges if they are multiplied on mains power, and if these lines are longer than 30 m, or on lines installed outside the building regardless of their length. The surges must be applied in line-to-line with a transient voltage of 1 kV and in line-to-ground with a transient voltage of 2 kV for environmental class E2.

The difference between the water meter error obtained during the application of transient voltage surges and the error determined prior to the test under reference conditions must not exceed one half of the value specified in Article 2.3.2, or the tested device must detect a significant error while all of its functions continue to operate as designed. *If you want commas, they have to be in all paragraphs. They aren't in the standard.*

5.6.10 Static magnetic field

The test must use a permanent ring magnet that has the following magnetic properties:

- remanence:385 mT to 400 mT
- coercivity:100 kA/m to 140 kA/m
- magnetic field intensity measured less than 1 mm from the surface:90 kA/m to 100 kA/m
- magnetic field intensity measured 20 mm from the surface:20 kA/m

The permanent magnet is placed into contact with the water meter in a position where the effect of the magnetic field is capable of causing an error that exceeds the maximum permissible error and affects the water meter's correct operation. This location depends on the type and design of the water meter, or is based on prior experience; various magnet positions may be investigated.

The water meter error must not exceed values specified in Article 2.3.2, and all of the functions of the tested device must operate as designed.

5.6.11 Absence of flow test

This test verifies changes in water meter indication in the absence either of flow for 15 minutes, or of water for 15 minutes.

The water meter's indication during each test interval must not change by more than the value of the verification scale interval.

5.7 Software check

The software check is covered by special legislation[3].

6 Initial verification

Initial approval pursuant to the Metrology Act applies only to water flow quantity meters for uses other than residential, commercial and light industry and meters after repair.

The same metrological requirements which were decisive in the placement of water meters into circulation will be applied during their verification.

6.1 Overview of tests conducted

During initial verification the following activities and tests are performed:

a) visual inspection;

b) functional tests:
   - a static pressure test;
   - an accuracy test.

6.2 Visual inspection

A visual inspection is performed to assess whether:

- the meter submitted for verification and its parts conform to the approved type, and attention must be paid to checking labelling pursuant to Chapter 4;
- the meter is not physically damaged and its metal parts bear no traces of corrosion;
- the condition and lifespan of power supply batteries satisfy the verification period.

If the measuring instrument fails to meet visual inspection requirements, no further tests are performed.

6.3 Functional tests

6.3.1 Test equipment

Test equipment pursuant to Article 5.3.2 is used, and the extended uncertainty of volume measurement indicated by the test equipment must not exceed $^1/_3$ the water meter's maximum permissible error.

6.3.2 Static pressure test

The tightness of the water meter and its resistance to damage at test water pressure according to the chosen maximum allowable pressure class are tested.

The test is performed at a flow rate equal to zero. The water pressure must be equivalent to at least 1.6× the maximum allowable pressure (MAP) for 1 minute. For concentric meters the static pressure test must be performed on the meter and collection pipes together.

During or after completion of the test, there must be no visible leak from the meter, leak from the indicator or physical damage to the water meter due to testing.

6.3.3 Accuracy test

Water meter measurement errors must be determined for at least the following three flow rates:

- between Q_1 and $1.1Q_1$;
- between Q_2 and $1.1Q_2$;

- between $0.9Q_3$ and Q_3.

Additional flow rates may be specified in the type-approval certificate.

The test water temperature during meter verification must be the following depending on temperature class:

T30, T50:(20 ± 10) °C

T70 to T180:(20 ± 10) °C and temperature (50 ± 10) °C

T30/90 to T30/180:(50 ± 10) °C

Errors found at each of the above-mentioned flow rates must not exceed the maximum permissible error specified in Articles 2.3.3. and 2.3.2 under conditions specified by Article 2.3.3.

For water meters with permanent flow rate $Q_3 > 20$ m^3/h classified in any temperature class, a test water temperature of (20 ± 10) °C can be used. Errors found at each of the above-mentioned flow rates must not exceed the maximum permissible errors

- at a flow rate greater than or equal to the minimum flow rate Q_1 and up to but not including the transient flow rate Q_2, positive or negative, 5 %; and
- at a flow rate greater than or equal to the transient flow rate Q_2 and less than or equal to the overload flow rate Q_4, positive or negative, 2 %;

under conditions specified in Article 2.3.3.

7 Subsequent verification

Subsequent verification, i.e. every verification of a meter performed after initial verification, is performed pursuant to this article.

The same metrological requirements which were decisive in the placement of water meters into circulation will be applied during their verification.

7.1 Overview of tests conducted

During subsequent verification the following activities and tests are performed:

a) visual inspection;

b) functional tests:
   - a static pressure test;
   - an accuracy test.

7.2 Visual inspection

A visual inspection is performed to assess whether:

- the meter submitted for verification conforms to the approved type, and attention must be paid to checking labelling pursuant to Chapter 4;
- the meter is not physically damaged and its metal parts bear no traces of corrosion;
- for water meters with an electronic indicator, the meter did not lose volume indication prior to disconnection of power in the place of use, and has remained accessible pursuant to Article 3.7;
- the condition and lifespan of power supply batteries satisfy the verification period.

If the measuring instrument fails to meet visual inspection requirements, no further tests are performed.

7.3 Functional tests

7.3.1 Test equipment

The test equipment requirements are the same as in Article 6.3.1.

7.3.2 Static pressure test

The static pressure test is performed using the same procedure as for initial verification pursuant to Article 6.3.2.

7.3.3 Accuracy test

The accuracy test is performed using the same procedure as for initial verification pursuant to Article 6.3.3.

Errors found at each of the above-mentioned flow rates must not exceed the maximum permissible error specified in Articles 2.3.3. and 2.3.2 under conditions specified by Article 2.3.3.

7.4 A check of the water meter during the verification validity period in the installation location

The check verifies whether the water meter operating as the specified measuring instrument complies with the metrological and technical requirements of this Measure of a General Nature, is correctly installed and complies with requirements for measurement accuracy during operation. This check is performed only if it is technically feasible.

7.4.1 Tests to be performed

A check of the water meter in its installation location during its verification validity period comprises:

- a visual inspection of the tested water meter and its installation;
- preliminary operating tests;
- leak checks;
- accuracy tests.

7.4.2 Visual inspection

A visual inspection is performed to assess whether:

- the tested water meter is the same as the approved type pursuant to the Metrology Act;
- it is properly installed and is not physically damaged;
- information on the water meter is in accordance with the type-approval mark pursuant to the Metrology Act;
- it is duly secured by official marks and installation seals.

In the case of water meters that have failed the visual inspection, this fact is recorded in the test report with sufficient specification of the concrete non-compliance. The water meter test continues.

7.4.3 Test equipment

The following test equipment is used to test a water meter in its installation location:

- a technically suitable reference standard flow meter with verified metrological traceability, with metrological parameters that correspond to the tested water meter, and with a regulation valve; or
- reference standard measuring containers with a regulation valve for setting the flow rate during the test, which must have a verification scale interval of 0.01 L for volumes up to and including 10 L, and 0.03 L for volumes greater than 10 L, with 4 mm scale spacing;
- a connection hose with a suitable connection to the outlet of the pipe system and a container regulation valve;

- a thermometer with verified metrological traceability and accuracy of ±1 °C.

The measurement uncertainty of the entire test apparatus is at most $^1/_3$ of the water meter's maximum permissible error.

7.4.4 Tightness test

A flow quantity reference standard is connected to the tested water meter to one outlet of the water pipe using a connection hose. All other outlets must be closed.

The tested water meter is left as is, so that its current condition and any effects of installation remain preserved during the test.

The tightness of the shut-off valve is checked, and of all other valves and outlets from the water system that could cause leaks of the measured water between the tested water meter and the reference standard. It must be ensured that all water that flows through the tested water meter also flows through the reference standard.

The hose connection is checked visually for absence of leaks.

7.4.5 Preliminary operating test

The test is performed for at least 5 minutes at maximum achievable flow from the water system. During the test, the water system is checked to ensure it has no air pockets.

7.4.6 Accuracy test

The accuracy test must be performed at a minimum flow rate Q_1 and transient flow rate Q_2 calculated from the water meter's markings and at maximum achievable flow rate from the water system, which must be at least within the range of ($2\times Q_2$ to Q_3).The test flow rates for a test of water meter accuracy at the installation location are as follows:

a) minimum flow rate Q_1 of the tested water meter, the average flow rate during the test must be within the range (Q_1 to $1.1\times Q_1$);
b) transient flow rate Q_2 of the tested water meter, the average value during the test must be within the range (Q_2 to $1.1\times Q_2$);
c) maximum achievable flow rate, the average value during the test must be within the range ($2\times Q_2$ to Q_3).

If a flow rate of $2\times Q_2$ cannot be achieved due to the water meter being unsuitable for the specific installation and due to water pressure at the installation location, this fact will be recorded in the test report.

If even a flow rate of Q_1 cannot be achieved, this fact will also be recorded in the test report, and the test is ended.

The water temperature during a test of a cold-water meter, i.e. with water of temperature (0.1 to 30) °C, and during a test of a hot-water meter, i.e. with water of temperature (30 to 90) °C, is measured with a thermometer with an accuracy of ±1 °C.

The minimum volume that must flow through the water meter during the test depends on requirements determined by a test of the effects of starting and stopping (time error) and the type and construction of the indicator.

During the accuracy test, at least one measurement must be performed at each test flow rate. Errors found at each of the above-mentioned flow rates must not exceed double the maximum permissible errors specified in Articles 2.3.3. and 2.3.2.

The accuracy test may be performed using the collection or volume method.

7.4.6.1 Collection method

During an accuracy test performed using the collection method, the amount of water flowing through the water meter is collected in a measuring container and its amount is determined on the measuring container's scale.

The error is determined by comparing the volume indicated by the tested water meter with the water volume indications on the measuring container.

The flow rate Q_1, Q_2, and the maximum achievable flow rate from the water system pursuant to Article 7.4.6(a) to (c) is set by adjusting the regulation valve on the measuring container inlet.

7.4.6.2 Volume method

During an accuracy test performed using the volume method, the volume that has passed through the water meter is compared with the volume that has passed through a flow quantity reference standard, for example an induction flow meter, with valid calibration. The induction flow meter must be calibrated, including calming sections (of minimum length 10*D* before the meter and 5*D* past the meter) with maximum permissible error 0.6 %.Calibration uncertainty must not exceed ±0.2 %.

Water pressure at the reference standard outlet must be set using the outlet hose. The pressure past the reference standard must be at least 5 kPa (0.05 bar) even at zero flow rate (corresponds to a water column of 0.5 m).

The flow rate Q_1, Q_2, and the maximum achievable flow rate from the water system pursuant to Article 7.4.6(a) to (c) is set by adjusting one of the regulation valves on the outlet past the reference standard with calming sections.

7.4.6.3 Evaluation of the results of an accuracy test in the installation location

If the water meter fails the external inspection or accuracy test, it is considered to be in non-compliance with stipulated requirements.

8 Measuring instrument check

When examining measuring instruments pursuant to § 11a of the Metrology Act at the request of a person who may be affected by an incorrect measuring instrument, please proceed according to Chapter 7, with the exception of the last sentence of Article 7.2.The maximum permissible error used is double the maximum permissible errors pursuant to Articles 2.3.1 and 2.3.2.

9 Notified standards

To specify metrological and technical requirements for measuring devices and to specify verification and type-approval test methods stemming from this Measure of a General Nature, the CMI notifies Czech technical standards, other technical standards or technical documents of international or foreign organisations or other technical documents containing detailed technical requirements (hereinafter ‘notified standards’).The CMI shall publish a list of these notified standards attached to the relevant measures, together with the general measure, in a manner accessible to the public (on www.cmi.cz).

Compliance with notified standards or parts thereof is considered, to the extent and under the conditions stipulated by a general measure, to be compliance with the requirements stipulated by this measure to which these standards or parts thereof apply.

Compliance with notified standards is one way of demonstrating compliance with the requirements. These requirements may also be met by using another technical solution guaranteeing an equivalent or higher level of protection of legitimate interests.

II.

GROUNDS

The CMI issues, pursuant to § 14(1)(j) of the Metrology Act, toward the implementation of § 6(2), § 9(1), § 9(9) and § 11a(3) of the Metrology Act, this General Measure, stipulating metrological and technical requirements for the specified measuring instruments and test methods for the type approval and verification of the specified measuring instruments—'Water flow quantity meters—water meters that are intended for uses other than residential, commercial and light industry'.

Decree No 345/2002, stipulating measuring instruments for mandatory verification and measuring instruments subject to type approval, as amended, classifies this type of measuring instrument among measuring instruments subject to type approval and verification under item 1.3.9 a), b), c), d) and e) in the Annex 'List of Specified Measuring Device Types'.

This legislation (General Measure) will be notified in accordance with Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 defining a procedure for the provision of information in the field of technical regulations and of rules on Information Society services.

III.

INSTRUCTIONS

In accordance with § 172(l), in conjunction with § 39(l) CAP, the CMI has stipulated a time limit for comments of 30 days as of the date of posting on the official notice board. Comments submitted after this time limit will not be considered.

The persons concerned are hereby invited to comment on this draft Measure of a General Nature. With a view to the provisions of § 172(4) CAP, the comments shall be submitted in writing.

In accordance with § 174(l) CAP in conjunction with § 37(l) CAP, it must be clear who is making the comments, which measure of a general nature they concern, how it contradicts legislation or how the measure of a general nature is inaccurate, and they must be signed by the person making them.

The supporting documents for this draft General Measure may be consulted at the Czech Metrology Institute, Legal Metrology Department, Okružní 31, 638 00 Brno, after making arrangements by telephone.

This general measure shall be posted for 15 days.

...…….....

RNDr. Pavel Klenovský

Director-General

Person responsible for accuracy: Mgr. Tomáš Hendrych

Posted on:

Signature of the authorised person confirming posting:.....

Removed on:

Signature of the authorised person confirming removal:.....