



SLOVENSKI STANDARD
SIST EN 14154-3:2005+A2:2011
01-julij-2011

Vodomeri - 3. del: Preskusne metode in oprema

Water meters - Part 3: Test methods and equipment

Wasserzähler - Teil 3: Prüfverfahren und -einrichtungen

Compteurs d'eau - Partie 3: Méthodes et équipement d'essai

Ta slovenski standard je istoveten z: EN 14154-3:2005+A2:2011

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ICS:

91.140.60 Sistemi za oskrbo z vodo Water supply systems

SIST EN 14154-3:2005+A2:2011 **en,de**

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 14154-3:2005+A2

April 2011

ICS 91.140.60

Supersedes EN 14154-3:2005+A1:2007

English Version

Water meters - Part 3: Test methods and equipment

Compteurs d'eau - Partie 3: Méthodes et équipement
d'essai

Wasserzähler - Teil 3: Prüfverfahren und -einrichtungen

This European Standard was approved by CEN on 26 July 2004 and includes Amendment 1 approved by CEN on 6 March 2007 and Amendment 2 approved by CEN on 22 February 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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Foreword

This document (EN 14154-3:2005+A2:2011) has been prepared by Technical Committee CEN/TC 92 "Water meters", the secretariat of which is held by SNV.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2011 and conflicting national standards shall be withdrawn at the latest by October 2011.

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

This document includes Amendment 1, approved by CEN on 2007-03-06 and Amendment 2, approved by CEN on 2011-02-22.

This document supersedes A2 EN 14154-3:2005+A1:2007 A2.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1 and A2 A2.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

The standard consists of 3 parts. The other parts are:

- Part 1: *General Requirements* standards.iteh.ai/catalog/standards/sist/311fd53-c94a-4fce-8917-04349445994e/sist-en-14154-3-2005a2-2011
- Part 2: *Installation and conditions of use*

In developing a new Standard, CEN/TC 92 aimed to harmonise it with existing standards and recommendations for water meters, to accommodate new technologies and anticipating the requirements of the Directive 22/2004 EC on Measuring Instruments.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EN 14154-3:2005+A2:2011 (E)**1 Scope**

This document applies to water meters intended for residential, commercial, light industrial and industrial use, and specifies the test parameters and the test methods for water meters, irrespective of the design technologies, as specified in [EN 14154-1:2005+A2](#), used to meter the actual volume of clean cold potable water or heated water, flowing through a fully charged, closed conduit. These water meters shall incorporate devices, which indicate the integrated volume.

In the case where water meters having a value of $Q_3 > 160 \text{ m}^3/\text{h}$, the test schedule may make provisions for modification of the Reference Conditions, to meet individual test laboratory limitations, when testing specifically for endurance or for performance under Influence Quantities.

Meters thus tested shall be marked so as to unambiguously indicate part compliance with this document. To augment this marking the meter manufacturer shall, in addition, be obliged to fully disclose the specific non compliance(s) due to the test laboratory limitations.

2 Normative references

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

[EN 14154-1:2005+A2:2011](#), *Water meters — Part 1: General requirements*

[EN 14154-2:2005+A2:2011](#), *Water meters — Part 2: Installation and conditions of use*

EN 60068-1:1994, *Environmental testing — Part 1: General and guidance*

EN 60068-2-1:1993, *Environmental testing — Part 2: Tests, Test A: Cold*

EN 60068-2-2:1993, *Environmental testing — Part 2: Tests, Test B: Dry heat*

EN 60068-2-30:1999, *Environmental testing — Part 2: Tests — Test Db and guidance: Damp heat, cyclic ((12 + 12) h cycle)*

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

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

EN 60068-2-64:1994, *Environmental testing — Part 2: Test methods — Test Fh: Vibration, broad-band random (digital control) and guidance*

EN 60068-3-1:1999, *Environmental testing — Part 3: Background information, Section 1: Cold and dry heat tests*

EN 61000-4-2:1995, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

EN 61000-4-3:1996, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

EN 61000-4-4:1995, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test*

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

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

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

ISO 4185, *Measurement of fluid flow in closed conduits — Weighing method*

OIML D4, *Installation and Storage Conditions for Cold Water Meters*

OIML D7, *The Evaluation of Flow Standards and Facilities Used for Testing Water Meters*

OIML P7, *Planning of Metrology and Testing Laboratories*

3 Reference conditions

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

Flowrate: $0,7 \times (Q_2 + Q_3) \pm 0,03 \times (Q_2 + Q_3)$

Working (water) temperature: For meters T30 and T50: $(20 \pm 5) ^\circ\text{C}$;

For meters $T \geq 70$: $(50 \pm 5) ^\circ\text{C}$

Working (water) pressure:

200 kPa (2,0 bar)

Ambient temperature range:

15 °C to 25 °C*

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Ambient relative humidity range:

45 % to 75 %*

Ambient atmospheric pressure range:

86 kPa to 106 kPa (0,86 bar to 1,06 bar)

Power supply voltage (mains a.c.):

Nominal voltage (U_{nom}) ± 5 %

Power supply frequency:

Nominal frequency (f_{nom}) ± 2 %

Power supply voltage (battery):

A voltage U in the range; $U_{min} \leq U \leq U_{max}$

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

* Here the ambient temperature and/or ambient relative humidity exceed the above-mentioned ranges, the effect on the error (of indication) shall be taken in account.

4 Administrative and external examination for approval programme

The meter and its technical documentation shall be examined before entering the rest of the test program. The administrative examination shall demonstrate that the water meter fulfils the respective requirements of Clause 4 of [\[A2\] EN 14154-1:2005+A2:2011 \[A2\]](#), which can be verified by administrative work and shall show that the meter is manufactured in conformity with it.

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The following documents shall be examined, as far as is relevant, for the respective water meter:

- general description of the water meter and its working principle;
- conceptual design, general assembly drawings;
- subassemblies drawings, circuits, etc.;
- metrological characteristics claimed;
- indicated device and dial drawings;
- security sealing plan drawings;
- list of mechanical components and materials;
- list of electronic components and specifications;
- description of the software;
- descriptions and explanations, necessary to understanding the above, including the operation of the instrument;
- results of design calculations examinations etc.;
- test reports.

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The following aspects of the meter design shall be examined on at least one meter sample:

- meter designation; [SIST EN 14154-3:2005+A2:2011](https://standards.iteh.ai/catalog/standards/sist/311fd53-c94a-4fce-8917-04349445994e/sist-en-14154-3-2005a2-2011)
- meter size and overall dimensions, <https://standards.iteh.ai/catalog/standards/sist/311fd53-c94a-4fce-8917-04349445994e/sist-en-14154-3-2005a2-2011>
- meter end connections;
- indicating device;
- supplementary devices;
- protection devices: verify that the water meter includes protection devices, which can be sealed to prevent, both before and after correct installation, dismantling or modification of the meter or its adjustment device, without damaging these devices.

5 Performance tests for approval programme

5.1 General requirements for the test installation

5.1.1 Location

The environment chosen for the meter tests shall be in accordance with the principles elaborated in OIML P7 document, "Planning of Metrology and Testing Laboratories", and shall be free from unintended disturbing influences, for example ambient temperature variation and vibration.

Annexes C and E give detailed requirements for the test installation and equipment.

5.1.2 Test water

5.1.2.1 Quality

Water meter tests shall be conducted with water of the public potable water supply or shall meet the same requirements.

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

NOTE If water is being recycled, measures shall be taken to prevent residual water in the meter from becoming harmful to human beings.

5.1.2.2 Pressure

The water pressure upstream of the meter shall not vary, during the test, by more than 10 %.

Pressure at the entrance to the meter shall not exceed the MAP for the meter.

The maximum uncertainty in the measurement of pressure (or pressure loss) shall be ± 5 % of the measured value.

5.1.2.3 Flow rate

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

— $\pm 2,5$ % from Q_1 to Q_2 (not inclusive);

— $\pm 5,0$ % from Q_2 (inclusive) to Q_4 .

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

5.1.2.4 Temperature

The temperature of the water during the test shall not change by more than 5 °C.

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

5.1.3 Calibrated reference device

5.1.3.1 Overall uncertainty of the actual volume

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

The uncertainty shall be estimated according to the "Guide to the expression of uncertainty in measurement" with a coverage factor of $k = 2$.

5.1.3.2 Minimum volume of the calibrated reference device

The minimum volume permitted depends on requirements determined by the test starting and stopping effects (timing error), and the type and design of the indicating device (value of the verification scale interval).

5.1.4 Freedom from spurious influences

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

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The test rig environment shall be such that the reference conditions of the test are met.

As part of the validation process, periodic intercomparisons between test rigs shall be carried out in accordance with OIML International Document D 7.

5.1.5 Group testing of meters

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

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

5.2 Static pressure test**5.2.1 Object of test**

To verify that the water meter can withstand the specified hydraulic test pressure, without leakage or damage, according to its Maximum Admissible Pressure (MAP) class (see 5.1.2 of [EN 14154-1:2005+A2:2011](#)).

5.2.2 Preparation

- a) Install the meters in the test rig either singularly or in batches;
- b) bleed the test rig pipe-work and the water meter of air;
- c) ensure that the test rig is free from leaks;
- d) ensure that the supply pressure is free from pressure pulsations.

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5.2.3 Test procedure <https://standards.iteh.ai/catalog/standards/sist/311fd53-c94a-4fce-8917-04349445994e/sist-en-14154-3-2005a2-2011>

5.2.3.1 In-line meters

- a) Increase the hydraulic pressure to $1,6 \times \text{MAP}$ of the meter and hold it for 15 min;
- b) examine the meters for physical damage, for external leaks and for leaks into the indicating device;
- c) increase the hydraulic pressure to $2 \times \text{MAP}$ and hold it for 1 min. The flowrate shall be zero during the test;
- d) examine the meters for physical damage, for external leaks and for leaks into the indicating device.

Additional requirements:

- e) increase and decrease the pressure gradually without pressure surges;
- f) apply only the reference temperature for this test.

5.2.3.2 Concentric meters – seal integrity test

The test procedure in 5.2.3 also applies to pressure testing of concentric water meters; however the seals located at the concentric meter/manifold interface, shall also be tested to ensure that undisclosed internal leaks between the inlet and outlet passages of the meter do not occur.

When the pressure test is carried out the meter and manifold shall be tested together.

A pressure of $2 \times \Delta P$ is applied to the meter inlet side of the seal.

The equipment and method for testing concentric meters may vary according to the design therefore an example of a test method is given in the informative Annex B.

5.2.4 Acceptance criteria

There shall be no visible leakage from the meter or leakage into the indicating device, or physical damage, resulting from any of the pressure tests described in 5.2.3.1 and 5.2.3.2.

5.3 Determination of intrinsic errors (of indication)

5.3.1 Object of test

To verify that the meter complies with the requirements in 7.6 of A_2 EN 14154-1:2005+A2:2011 A_2 and the effects of the meter orientation on the error (of indication).

5.3.2 Preparation

The method described here for determining the meter errors (of indication) is the so-called "collection" method, in which the quantity of water passed through the water meter is collected in one or more collecting vessels and the quantity determined volumetrically or by weighing, as described in Annex C. Other methods may be used, provided the requirements of uncertainty are met.

The checking of the errors (of indication) consists in comparing the volume indications given by the meter under reference conditions against a calibrated reference device.

For the purpose of these tests, the meter should be tested without its temporary supplementary devices attached (if any). Tests to determine the influence of attaching temporary supplementary devices to the meter are described in 5.10.

5.3.2.1 Orientation of water meter(s)

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

- a) if the meters are marked 'H' mount the connecting pipework with the flow axis in the horizontal plane during the test (indicating device positioned on top);
- b) if the meters are marked 'V' mount the connecting pipework with the flow axis in the vertical plane during the test;
- c) if the meters are not marked either 'H' or 'V':
 - 1) at least one meter from the sample shall be mounted with the flow axis vertical, with flow direction from bottom to top;
 - 2) at least one meter from the sample shall be mounted with the flow axis vertical and flow direction from top to bottom;
 - 3) at least one meter from the sample shall be mounted with the flow axis at an intermediate angle to the vertical and horizontal (chosen at the discretion of the approving authority);
 - 4) the remaining meters from the sample shall be mounted with the flow axis horizontal;
 - 5) where the meters have an indicating device, which is integral with the body of the meter, at least one of the horizontally mounted meters, shall be oriented with the indicating device positioned at the side and the remaining meters shall be oriented with the indicating device positioned at the top;
- d) the tolerance on the position of the flow axis for all meters, whether horizontal, vertical or at an intermediate angle, shall be $\pm 5^\circ$.

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NOTE In the case of the meters, where the number of meters presented to test is less than four, supplementary needed meters will be taken from the basis population or the same meter will be submitted to different positions test.

5.3.2.2 Concentric meters

Some types of water meter, e.g. volumetric water meters (that is, involving measuring chambers with mobile walls), such as oscillating piston or nutating disc meters, are considered insensitive to upstream installation conditions and so can be assembled to any manifold design.

5.3.3 Test procedure

a) Determine the intrinsic errors (of indication) of the water meter (in the measurement of the actual volume), shall be determined for at least the following seven flowrates, the error (of indication) at each flowrate being determined twice:

- 1) between Q_1 and $1,1 Q_1$;
- 2) between $0,5 (Q_1 + Q_2)$ and $0,55 (Q_1 + Q_2)$ (for $Q_2/Q_1 > 1,6$);
- 3) between Q_2 and $1,1 Q_2$;
- 4) between $0,33 (Q_2 + Q_3)$ and $0,37 (Q_2 + Q_3)$;
- 5) between $0,67 (Q_2 + Q_3)$ and $0,74 (Q_2 + Q_3)$;
- 6) between $0,9 Q_3$ and Q_3 ;
- 7) between $0,95 Q_4$ and Q_4

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Where the initial error curve is close to the maximum permissible error at a point other than at Q_1 , Q_2 or Q_3 , if this error can be shown to be typical of the meter type, the approving authority may choose to define an alternative flowrate for initial verification in the pattern approval certificate.

- b) Test the water meter without its supplementary devices (if any) attached;
- c) during a test hold all other influence factors at reference conditions;
- d) measure the errors (of indication) at other flowrates if required, depending on the shape of the error curve;
- e) calculate the relative error (of indication) for each flowrate.

5.3.4 Acceptance criteria

- a) The errors observed for each of the seven flowrates shall not exceed the maximum permissible errors. If the error observed on one or more meters is greater than the maximum permissible error at one flowrate only, the test at that flowrate shall be repeated. The test shall be declared satisfactory if two out of the three results lie within the maximum permissible error and the arithmetic mean of the results for the three tests at that flowrate is less than or equal to the maximum permissible error;
- b) if all the errors (of indication) of the water meter have the same sign, at least one of these errors shall not exceed one half of the maximum permissible error. In all cases this requirement shall be applied equitably with respect to the water supplier and the consumer.

5.4 Error (of indication) tests

5.4.1 Object of test

To verify that the meter complies with the requirements in ^{A1} Clause 8 of ^{A2} EN 14154-1:2005+A2:2011 ^{A2}.

5.4.2 Preparation

Apply the installation and operational requirements described in 5.3.2.

5.4.3 Test Procedure

- a) Take the intrinsic error of the water meter for the defined flowrate(s);
- b) apply the influence quantity to be tested;
- c) the error (of indication) of the meter at the defined flowrate(s) shall be taken as the arithmetic mean of the “*n*” error measurements during or after exposure to influence quantities, where “*n*” is at least one but may be increased at the request of the manufacturer, prior to the test;
- d) during a test hold all other influence quantities at reference conditions. Reference pressure may be less than 0,2 MPa (2,0 bar) provided that this pressure is kept constant during all tests.

5.4.4 Acceptance criteria

The arithmetic mean of the “*n*” error measurements shall not exceed the prescribed acceptance criteria for that influence quantity.

5.4.5 ^{A2} Interchange test on all types of cartridge and meters with exchangeable metrological units

<https://standards.iteh.ai/catalog/standards/sist/311fd53-c94a-4fce-8917-04349445994e/sist-en-14154-3-2005a2-2011>

5.4.5.1 Object of test

To confirm that the cartridge meters and meters with exchangeable metrological units are insensitive to the influence of connection interfaces produced in series production.

5.4.5.2 Preparation

2 cartridge meters or exchangeable metrological units and 5 connection interfaces to be additionally selected from the number of meters presented for approval sample selection. (EN 14154-1)

Additionally 5 connection interfaces the cartridge meters or exchangeable metrological units are supposed to be compatible with to be selected and tested as well.

Correct matching of cartridge meter with connection interface or exchangeable metrological unit and connection interface respectively to be checked prior to test. Also the matching of the required marking on cartridge meter or exchangeable metrological unit and connection interface has to be checked. Adaptors – see definition in EN 14154-2:2005+A2:2010, 5.1.3.1 – are not permitted.

5.4.5.3 Test procedure

2 cartridge meters or exchangeable metrological units to be tested in 5 connection interfaces of every compatible interface type, resulting in 10 accuracy curves for each type of compatible interface. Test flow rates according to the definition in 5.3.3 of this European Standard.

5.4.5.4 Acceptance criteria

All accuracy curves shall be positioned within MPE at all times.