BRITISH STANDARD

BS EN
14154-1:2005
+A2:2011

Water meters —

Part 1: General requirements

ICS 91.140.60

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 14154-1:2005+A2:2011. It supersedes BS EN 14154:2005, which is withdrawn.

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A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Foreword

This document (EN 14154-1:2005+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of an identical text or by endorsement, at the latest by October 2011 and conflicting national standards shall be withdrawn at the latest by October 2011.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 2011-01-03.

This document supersedes ▌A2⟩ EN 14154-1:2005+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 2: *Installation and conditions of use*

— Part 3: *Test methods and equipment*

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.

In respect of potential adverse affects on the quality of water intended for human consumption, caused by the product covered in this standard:

1. This standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU of EFTA;

2. It should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

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.

1 Scope

This document applies to water meters intended for residential, commercial, light industrial and industrial use, and specifies the requirements and certification procedures for water meters, irrespective of the design technologies 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.

This document also applies to water meters based on electrical or electronic principles, and to water meters based on mechanical principles incorporating electronic devices, used to meter the actual volume flow of cold potable water or heated water. It provides metrological requirements for electronic ancillary devices when they are subject to metrological control. As a rule the ancillary devices are optional. However national or international regulations make some ancillary devices mandatory in relation to the utilisation of the water meter.

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 1333:1996, *Pipework components — Definition and selection of PN*

〉A2〈 EN 14154-2:2005+A2:2011 〉A2〈, *Water meters — Part 2: Installation and condition of use*

〉A2〈 EN 14154-3:2005+A2:2011 〉A2〈, *Water meters — Part 3: Test methods and equipment*

EN ISO 228-1:2000, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 6708:1995, *Pipe components — Definition and selection of DN (nominal size) (ISO 6807:1995)*

ISO 3:1973, *Preferred numbers — Series of preferred numbers*

ISO 7005-2:1988, *Metallic flanges — Part 2: Cast iron flanges*

ISO 7005-3:1988, *Metallic flanges — Part 3: Copper alloy and composite flanges*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
water meter (OIML R49-1:2000)
an instrument intended to measure continuously, memorise and display the volume of water passing through it within rated operating conditions

NOTE A meter includes at least a measurement transducer, a calculator (including adjustment or correction devices if present) and an indicating device. These three devices may be in different housings.

3.2
in-line meter (OIML R49-2:2001)
a type of water meter fitted into a closed conduit by means of the meter end connections (either threaded or flanged) provided

3.3
complete meter (OIML R49-2:2001)
a meter which does not have separable measurement transducer (including flow sensor) and calculator (including indicating device)

3.4
combined meter (OIML R49-2:2001)
a meter which has separable measurement transducer (including flow sensor) and calculator (including indicating device)

3.5
combination meter (ISO 7858-1:1998)
an in-line type of water meter comprising one large flowrate meter, one small flowrate meter, and a changeover device that, depending on the magnitude of the flowrate passing through the meter, automatically directs the flow through either the small or large meter or both

Meter reading is obtained from two independent totalizers or 1 totalizer which adds up the values from both water meters.

3.6
concentric meter (OIML R49-2:2001)
a type of water meter fitted into a closed conduit by means of an intermediate fitting called a manifold. The inlet and outlet passages of the meter and the manifold, at the interface between them, are coaxial

3.7
concentric meter manifold (OIML R49-2:2001)
the pipefitting specific to the connection of a concentric meter

〚A2〛 **3.8**
cartridge meter
type of water meter fitted into a closed conduit by means of an intermediate fitting called a connection interface

NOTE The inlet and outlet passages of the meter and the connection interface are either concentric or axial as detailed in EN 14154-2:2005+A2:2011, Annex B.

3.9
cartridge meter connection interface
pipefitting specific to the connection of an axial or concentric cartridge meter

3.10
meters with exchangeable metrological unit
meter with $Q_3 \geq 16$ m^3/h comprising a connection interface and an exchangeable metrological unit, from the same pattern approval, i.e. from the identical manufacturer as a matter of principle

3.11
exchangeable metrological unit
self contained unit comprising a measurement transducer and an indicating device or alternatively a calculator including indicating device where applicable

3.12
connection interfaces for meters with exchangeable metrological units
pipefitting specific to the connection of exchangeable metrological units 〚A2〛

3.13
measurement transducer (OIML R49-1:2000)
a part of the meter which transforms the flow or the volume of the water to be measured into signals which are passed to the calculator. It can be based on a mechanical or an electrical or an electronic principle. It may be autonomous or use an external power source

NOTE For the purposes of this document, the measurement transducer includes the flow sensor or volume sensor.

3.14
flow sensor or volume sensor (OIML R49-1:2000)
that part of the water meter (such as a disc, piston, wheel, turbine element, or electromagnetic coil) which senses the flowrate or volume of water passing through the meter

3.15
calculator (OIML R49-1:2000)
a part of the meter which receives the output signals from the transducer(s) and, possibly, from associated measuring instruments, transforms them and, if appropriate, stores the results in memory until they are used. In addition, the calculator may be capable of communicating both ways with ancillary devices

3.16
indicating device (OIML R49-1:2000)
a part of the meter which displays the measurement results either continuously or on demand

NOTE A printing device which provides an indication at the end of the measurement is not an indicating device.

3.17
sub-assembly (OIML R49-2:2001)
the measurement transducer, (including flow sensor) and the indicating device (including calculator) of a combined meter

3.18
adjustment device (OIML R49-1:2000)
a device incorporated in the meter, that only allows the error curve to be shifted generally parallel to itself, with a view to bringing errors (of indication) within the maximum permissible errors

3.19
correction device (OIML R49-1:2000)
a device connected to or incorporated in the meter for automatically correcting the volume at metering conditions, by taking into account the flowrate and/or the characteristics of the water to be measured (e.g. temperature and pressure) and the pre-established calibration curves. The characteristics of the water to be measured may either be measured using associated measuring instruments, or be stored in a memory in the instrument

3.20
ancillary device (OIML R49-1:2000)
a device intended to perform a particular function, directly involved in elaborating, transmitting or displaying measurement results

The main ancillary devices are:

— zero setting device;

— price indicating device;

— repeating indicating device;

— printing device;

— memory device;

— tariff control device;

— pre-setting device; and

— self service device.

3.21
associated measuring instruments (OIML R49-1:2000)
instruments connected to the calculator, the correction device or the conversion device, for measuring certain quantities which are characteristic of water, with a view to making a correction and/or a conversion

3.22
primary indication
indication, (displayed, printed or memorized), which is subject to legal metrological control

3.23
first element of the indicating device (OIML R49-1:2000)
the element which, in an indicating device comprising several elements, carries the graduated scale with the verification scale interval

3.24
verification scale interval (OIML R49-1:2000)
the lowest value scale division of the first element of the indicating device

3.25
equipment under test (EUT) (OIML R49-2:2001)
a complete water meter, a sub-assembly of a water meter or an ancillary device.

3.26
actual volume, V_a (OIML R49-1:2000)
total volume of water passing through the water meter, disregarding the time taken. This is the measurand

3.27
indicated volume, V_i (OIML R49-1:2000)
volume of water indicated by the meter, corresponding to the actual volume

3.28
flowrate, Q (OIML R49-1:2000)
quotient of the actual volume of water passing through the water meter and the time taken for this volume to pass through the water meter. It is expressed in m^3/h

3.29
minimum flowrate, Q_1 (OIML R49-1:2000)
the lowest flowrate at which the water meter is required to operate within the maximum permissible error

3.30
transitional flowrate, Q_2 (OIML R49-1:2000)
flowrate which occurs between the permanent flowrate Q_3 , and minimum flowrate Q_1, that divides the flowrate range into two zones, the “upper zone” and the “lower zone”, each characterized by its own maximum permissible error

3.31
permanent flowrate, Q_3 (OIML R49-1:2000)
the highest flowrate within the rated operating conditions, at which the water meter is required to operate in a satisfactory manner within the maximum permissible error

3.32
overload flowrate, Q_4 (OIML R49-1:2000)
the highest flowrate at which the water meter is required to operate, for a short period of time, within its maximum permissible error, whilst maintaining its metrological performance when it is subsequently operated within its rated operating conditions

3.33
combination meter change-over flowrate, Q_x (ISO 7858-1:1998)
change-over flowrate Q_{x1} occurs at decreasing flowrates when the pressure drop in the combination meter increases suddenly in parallel with a cessation of flow in the larger meter and a visible increase in the flow in the smaller meter

Change-over flowrate Q_{x2} occurs at increasing flowrates when the pressure drop in the combination meter decreases suddenly in parallel with a start-up of flow in the larger meter and a visible reduction in the flow in the smaller meter.

3.34
test flowrate (OIML R49-2:2001)
the mean flowrate during a test, calculated from the indications of a calibrated reference device. The quotient of the actual volume passing through the water meter divided by the time for that volume to pass through the water meter

3.35
Maximum Permissible Error (MPE) (OIML R49-1:2000)
extreme values of the relative error (of indication) of a water meter permitted by this document

3.36
error of indication (VIM:1993, 5.20 adapted)
indicated volume minus the actual volume

3.37
relative error, ε (VIM:1993, 3.12 adapted)
error (of indication) divided by the actual volume

3.38
intrinsic error (OIML R49-1:2000)
the error (of indication) of a meter determined under reference conditions

3.39
initial intrinsic error (OIML R49-1:2000)
the intrinsic error of a water meter as determined prior to all performance tests

3.40
fault (OIML R49-1:2000)
the difference between the error of indication and the intrinsic error of a water meter

3.41
significant fault (OIML R49-1:2000)
a fault, the magnitude of which is greater than one half of the MPE in the upper zone

EXAMPLE If the MPE is ± 2 %, the value of the significant fault is a fault which absolute value is larger than 1 %.

The following are not considered to be significant faults:

— faults arising from simultaneous and mutually independent causes in the water meter itself or in its checking facilities; and

— transitory faults being momentary variations in the indication which cannot be interpreted, memorised or transmitted as a measurement result.

3.42
influence quantity (VIM:1993, 2.7)
quantity that is not the measurand but that affects the result of measurement

3.43
influence factor (OIML R49-1:2000)
influence quantity having a value within the Rated Operating Conditions (ROC) of the water meter, as specified in this document

3.44
disturbance (OIML R49-1:2000)
an influence quantity having a value within the limits specified in this document, but outside the specified Rated Operating Conditions (ROC) of the water meter

NOTE An influence quantity is a disturbance if for that influence quantity the Rated Operating Conditions are not specified.

3.45
Rated Operating Conditions (ROC) (VIM:1993, 5.5 adapted)
conditions of use giving the range of values of the influence factors, for which the errors (of indication) of the water meter are required to be within the MPE

For an influence quantity, the ranges of values within ROC are limited by Lower Rated Conditions (LRC) and Upper Rated Conditions (URC).

3.46
Reference Conditions (RC) (VIM:1993, 5.7 adapted)
set of reference values, or reference ranges of influence quantities, prescribed for testing the performance of a water meter, or for the intercomparison of results of measurements

For an influence quantity, the reference value is within the Rated Operating Conditions.

3.47
Limiting Conditions (LC) (VIM:1993, 5.6 adapted)
extreme conditions which a water meter can withstand without damage and without degradation of its metrological characteristics when it is subsequently operated under its Rated Operating Conditions

NOTE The limiting conditions for storage, transport and operation may be different.

For an influence quantity, two limiting conditions may be defined, the Lower Limiting Condition (LLC) and Upper Limiting Condition (ULC).

3.48
working pressure, P_w (OIML R49-1:2000)
the average water pressure in the pipe, measured upstream and downstream of the water meter

3.49
minimum Admissible working Pressure (mAP) and Maximum Admissible working Pressure (MAP)
the minimum admissible working pressure mAP and the maximum admissible working pressure (MAP) are respectively the minimum and maximum pressures that a water meter can withstand permanently within Rated Operating Conditions, without deterioration of its metrological performance

mAP and MAP are respectively the lower and upper limits of the rated operating conditions for working pressure.

3.50
working temperature, T_w (OIML R49-1:2000)
the average water temperature in the pipe, measured upstream and downstream of the water meter

3.51
minimum Admissible working Temperature (mAT) and Maximum Admissible working Temperature (MAT)
the minimum admissible working temperature and the maximum admissible working temperature are respectively the minimum and maximum temperatures that a water meter can withstand permanently at a given internal pressure, without deterioration of its metrological performance

mAT and MAT are respectively the lower and upper limits of the rated operating conditions for working temperature.

3.52
pressure loss, ΔP (OIML R49-1:2000)
the head loss, at a given flowrate, caused by the presence of the water meter in the pipeline

3.53
upper limiting pressure
highest pressure at which a water meter operates for a short period of time without deteriorating

3.54
Nominal Diameter (DN) (EN ISO 6708:1995)
an alphanumeric designation of size for components of a pipe work system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number, which is indirectly related to the physical size in mm of the bore, or outside diameter of the end connections

3.55
Nominal Pressure (PN) (EN 1333:1996)
a numerical designation, which is a convenient rounded number for reference purposes

NOTE All equipment of the same nominal size (DN) designated by the same PN number shall have compatible mating dimensions.

3.56
electronic device (OIML R49-1:2000)
a device employing electronic sub-assemblies and performing a special function. Electronic devices are usually manufactured as separate units and are capable of being tested independently

NOTE Electronic devices, as defined above, may be complete meters or parts of meters.

3.57
electronic sub-assembly (OIML R49-1:2000)
a part of an electronic device, employing electronic components and having a recognizable function of its own

3.58
electronic component (OIML R49-1:2000)
the smallest physical entity which uses electron or hole conduction in semi-conductors, gases, or in a vacuum

3.59
checking facility (OIML R49-1:2000)
a facility which is incorporated in a water meter with electronic devices and which enables significant faults to be detected and acted upon

NOTE The checking of a transmission device aims at verifying that all the information which is transmitted (and only that information) is fully received by the receiving equipment.

3.60
automatic checking facility (OIML R49-1:2000)
a checking facility operating without the intervention of an operator

3.61
permanent automatic checking facility (type P) (OIML R49-1:2000)
an automatic checking facility operating during the entire measurement operation

3.62
intermittent automatic checking facility (type I) (OIML R49-1:2000)
an automatic checking facility operating at certain time intervals or per fixed number of measurement cycles

3.63
non-automatic checking facility (type N) (OIML R49-1:2000)
a checking facility which requires the intervention of an operator

3.64
power supply device (OIML R49-1:2000)
a device which provides the electronic devices with the required electrical energy, using one or several sources of AC or DC

4 Technical characteristics

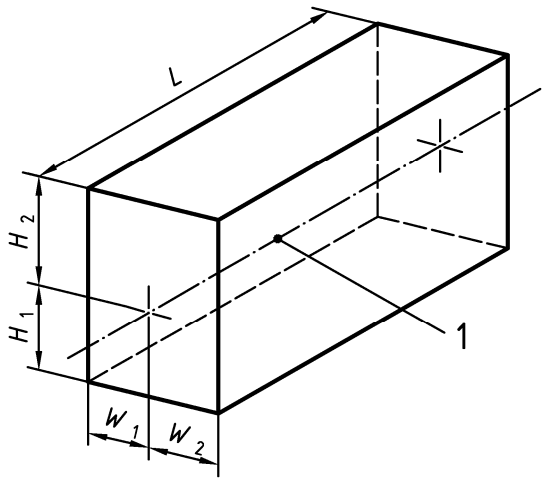
4.1 Meter size and overall dimensions

4.1.1 Meter size

The meter size is characterised by the nominal diameter (DN). For each meter size there is a corresponding fixed set of overall dimensions (see Figures 1 and 2). The dimensions are given in Tables 1, 2 and 3. For threaded meter end connections the minimum dimensions for the thread are given in [A2] Table 8 [A2].

4.1.2 Dimensions of in-line meters

Meter dimensions are defined by a cuboid into which the water meter fits (see Figure 1 and Table 1 and Table 2). The orientation of the cuboid is defined by the pipe axis and by the prescribed or the preferred downward direction, if such exists. To achieve the necessary overall length adapter pieces may be fitted.



H_1, H_2, L, W_1 and W_2 define the height, length and width respectively of a cuboid within which the water meter can be contained (the cover being at right angles to its closed position).

H_1, H_2, W_1 and W_2 are maximum dimensions.

L is a fixed value with specified tolerances.

NOTE 1 Where there is a separate indicating device or calculator, the overall size specified in Figure 1 applies only to the housing of the measurement transducer (flow sensor).

NOTE 2 Flange diameter sizes of in-line meters with flanges may lay outside the W and/or H sizes of the cuboid.

Key

1 Pipe axis

Figure 1 — In-line meter dimensions

Table 1 — In-line meter dimensions (preferred dimensions)

Dimensions in mm

DN	L (preferred)	W_1, W_2	H_1	H_2
15	165	65	60	220
20	190	65	60	240
25	260	85	65	260
32	260	85	70	280
40	300	105	75	300
50	200			
65	200			
80	200			
100	250			
125	250			
150	300			
200	350			
250	450			
300	500			
400	600			
500	600			
600	800			
≥ 800	1,25 × DN			

Table 2 — Combination meter dimensions

Dimensions in mm

DN	L (preferred)	W_1, W_2
50	300	220
65	300	240
80	350	260
100	350	350
125	350	350
150	500	400
200	500	400

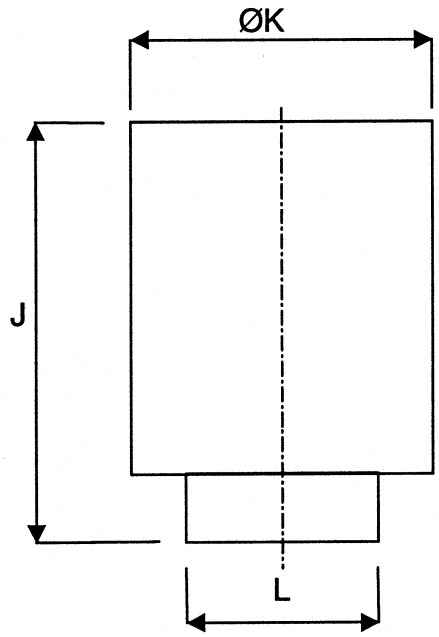
Tolerance on lengths for Tables 1 and 2:

Length	Tolerance
DN 15 to DN 40	$^{0}_{-2}$ mm
DN 50 to DN 300	$^{0}_{-3}$ mm
DN 350 to DN 400	$^{0}_{-5}$ mm
Tolerances on lengths for meters greater than DN 400 shall be agreed upon between user and manufacturer.	

NOTE For a table with alternative lengths see Annex B

4.1.3 Dimensions of concentric meters

Meter dimensions for concentric meters are defined by a cylinder into which the water meters fits. (see Figure 2 and Table 3).



NOTE Where there is a separate indicating device or calculator, the overall size specified in Figure 2 applies only to the housing of the measurement transducer.

Figure 2 — Concentric meter dimensions

Table 3 — Concentric meter dimensions

Maximum dimensions in mm

	L	*J*	*ϕ K*
Type 1	(G 1½ B) [a]	220	110
Type 2	(G 2 B) [a]	220	135
[A2] *deleted text* [A2]			
[a] Metric or Whitworth threading at the choice of the manufacturer.			

The relative annex in [A2] EN 14154-2:2005+A2 [A2] gives a set of figures, which is one of many solutions at the choice of the manufacturer.

J and K define respectively the height and diameter of a cylinder enclosing the meter.

4.1.4 [A2] Dimensions of cartridge meters

Meter dimensions for cartridge meters are defined by a cylinder into which the water meter fits (see Figure 2 and Table 4).

Table 4 — Cartridge meter dimensions

Maximum dimensions in millimetres

Dimension	*L*	*J*	*ØK*
	90	200	150
J and K define respectively the height and diameter of a cylinder enclosing the meter.			

[A2]

4.1.5 [A2] Dimensions of exchangeable metrological units

Figure 5 to Figure 9 show examples of meters with exchangeable metrological units:

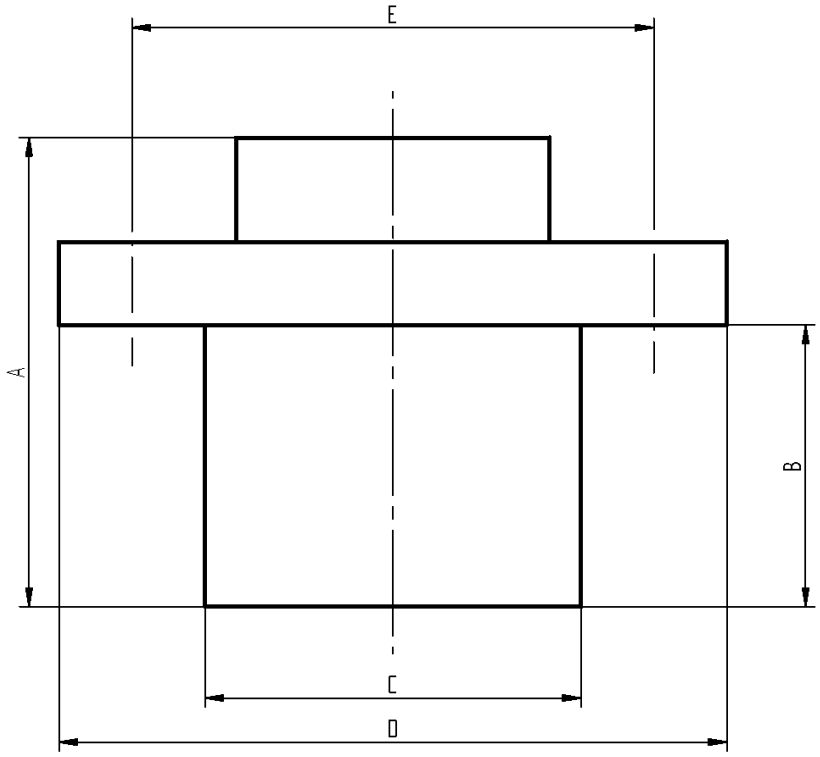


Figure 3 — Dimensions of exchangeable metrological units – meters with horizontal or vertical flow pattern (WP or WS)

Table 5 — Exchangeable metrological units dimensions – meters with horizontal flow pattern (WP)

Maximum dimensions in millimetres

DN	A	B	C	D	E
40	210	125	125	190	147
50	210	125	125	190	147
65	210	125	125	190	147
80	235	147	145	190	180
100	235	147	145	190	180
125	235	147	145	190	180
150	370	252	210	290	245
200	370	258	220	290	276
250	370	258	220	290	276
300	370	258	220	290	276

Table 6 — Exchangeable metrological units dimensions - meters with vertical flow pattern (WS)

Maximum dimensions in millimetres

DN	A	B	C	D	E
50	232	150	130	160	170
65	250	168	130	202	170
80	270	177	166	250	218
100	310	204	168	252	218
150	425	290	255	345	292
200	440	340	280	400	360

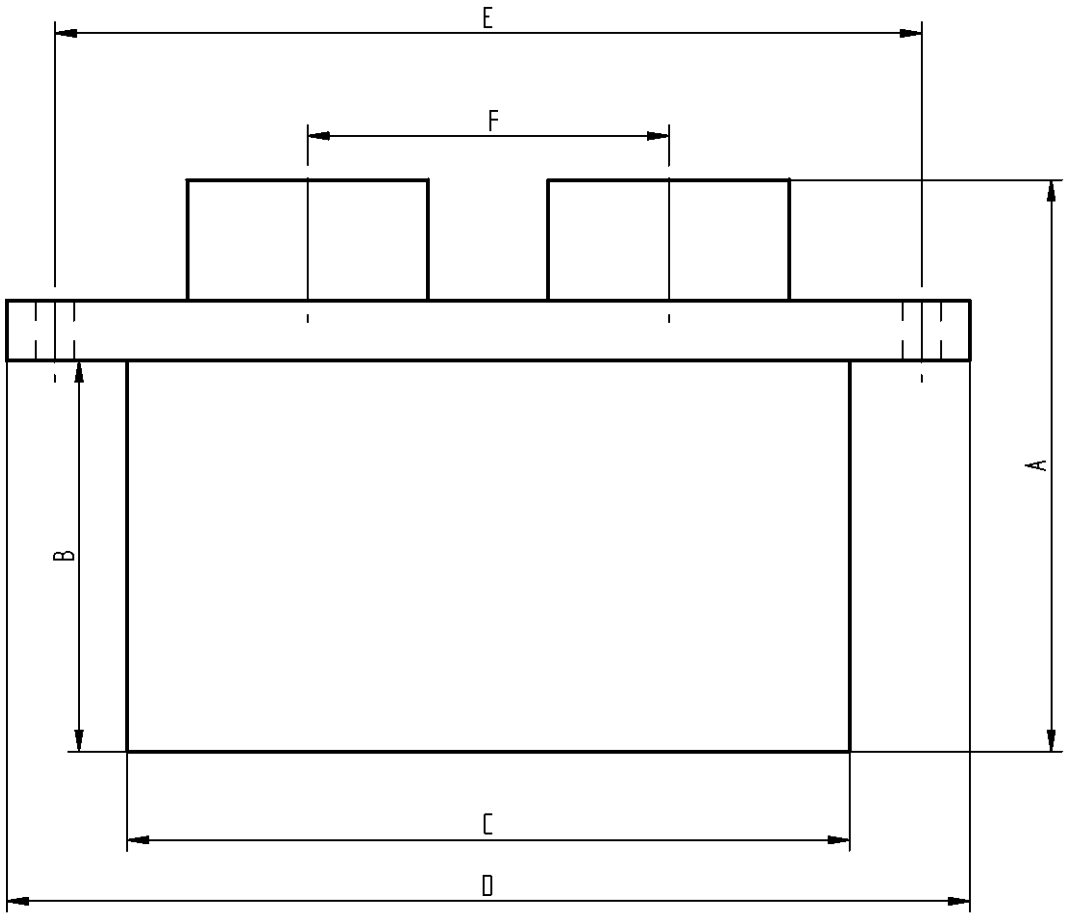


Figure 4 — Dimensions of exchangeable metrological units - Combination meters

Table 7 — Exchangeable metrological units dimensions - Combination meters

Maximum dimensions in millimetres

DN	A	B	C	D	E	F
50	310	195	260	300	266	150
65	345	215	260	330	280	150
80	365	235	260	320	290	150
100	385	255	260	335	300	150

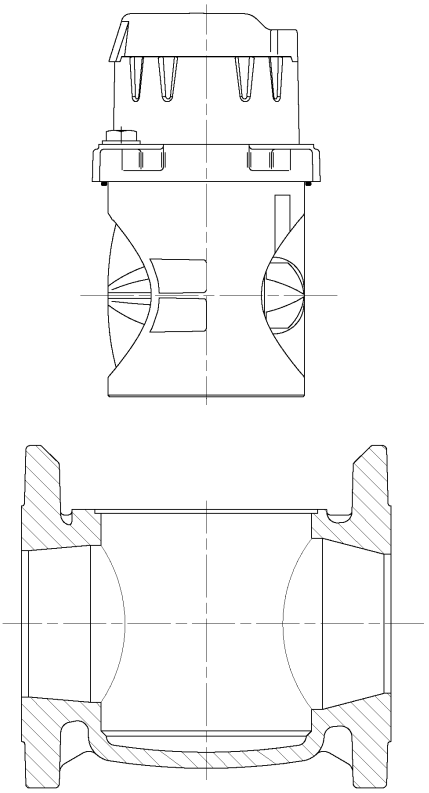


Figure 5 — Meter with exchangeable metrological unit - Axial flow pattern

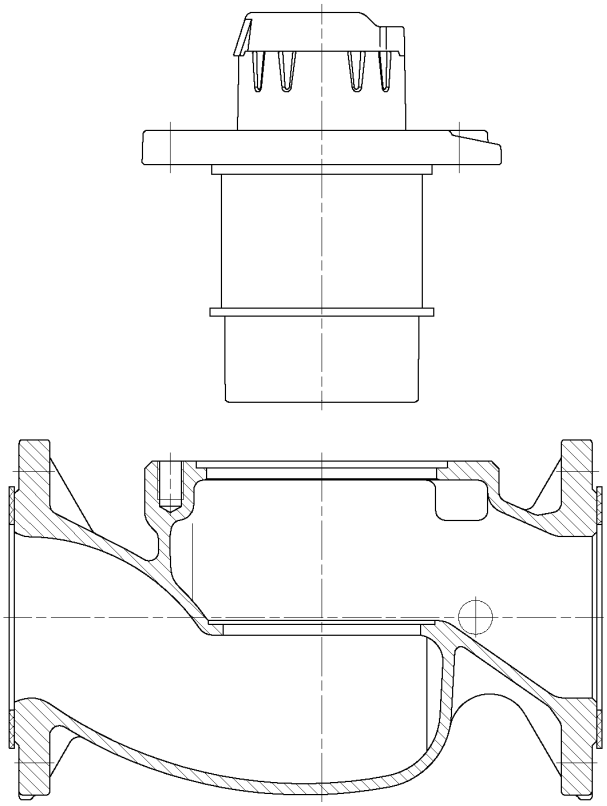


Figure 6 — Meter with exchangeable metrological unit – Vertical flow pattern

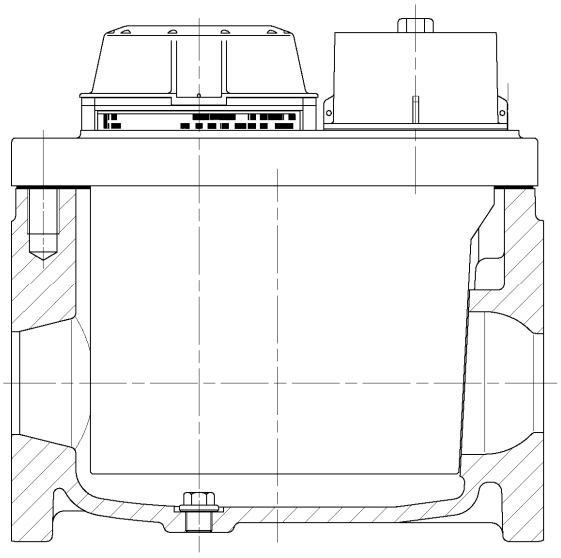


Figure 7 — Meter with exchangeable metrological unit - Axial flow pattern, combination meter

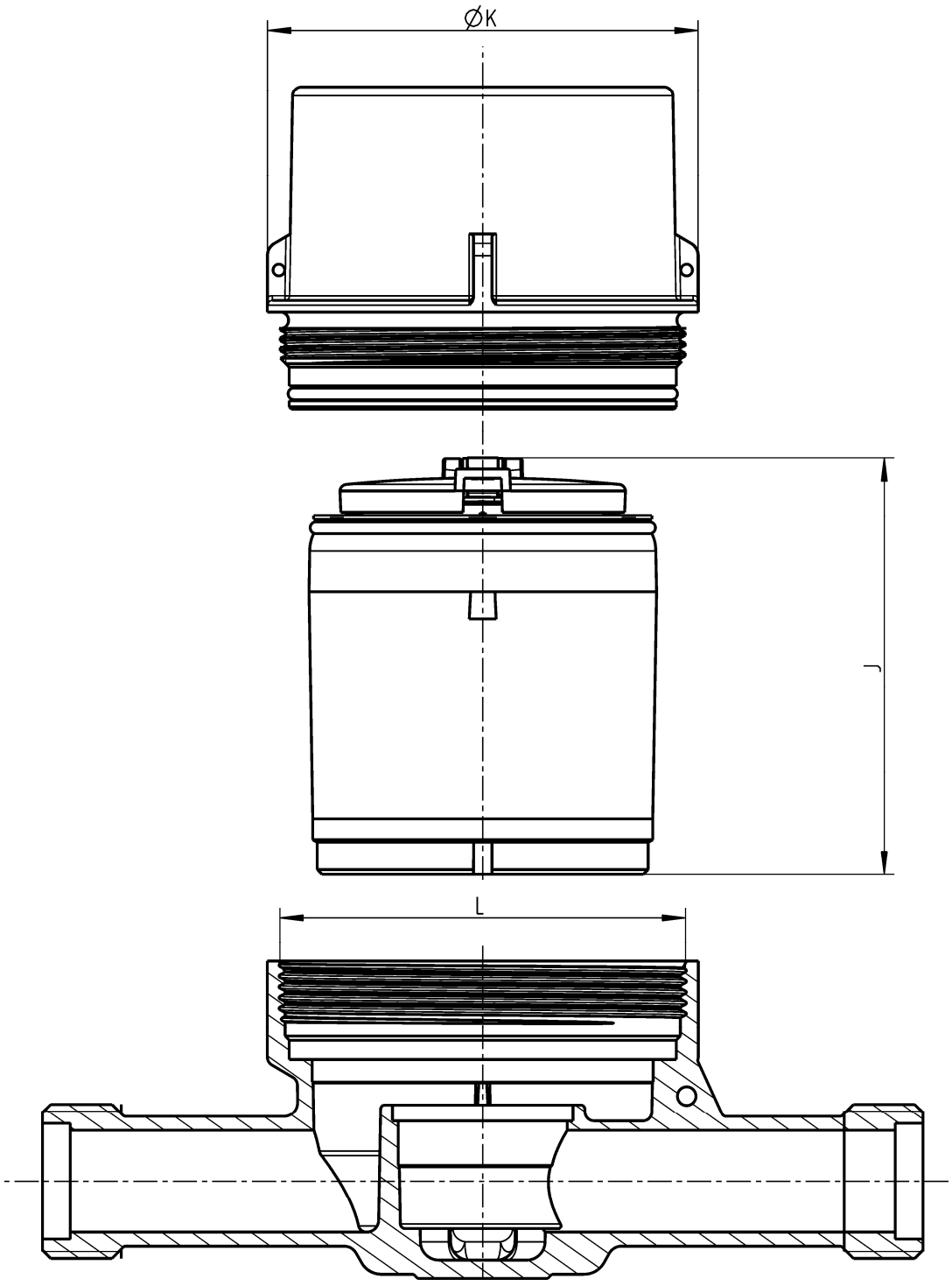


Figure 8 — Meter with exchangeable metrological unit - Concentric flow pattern, inferential

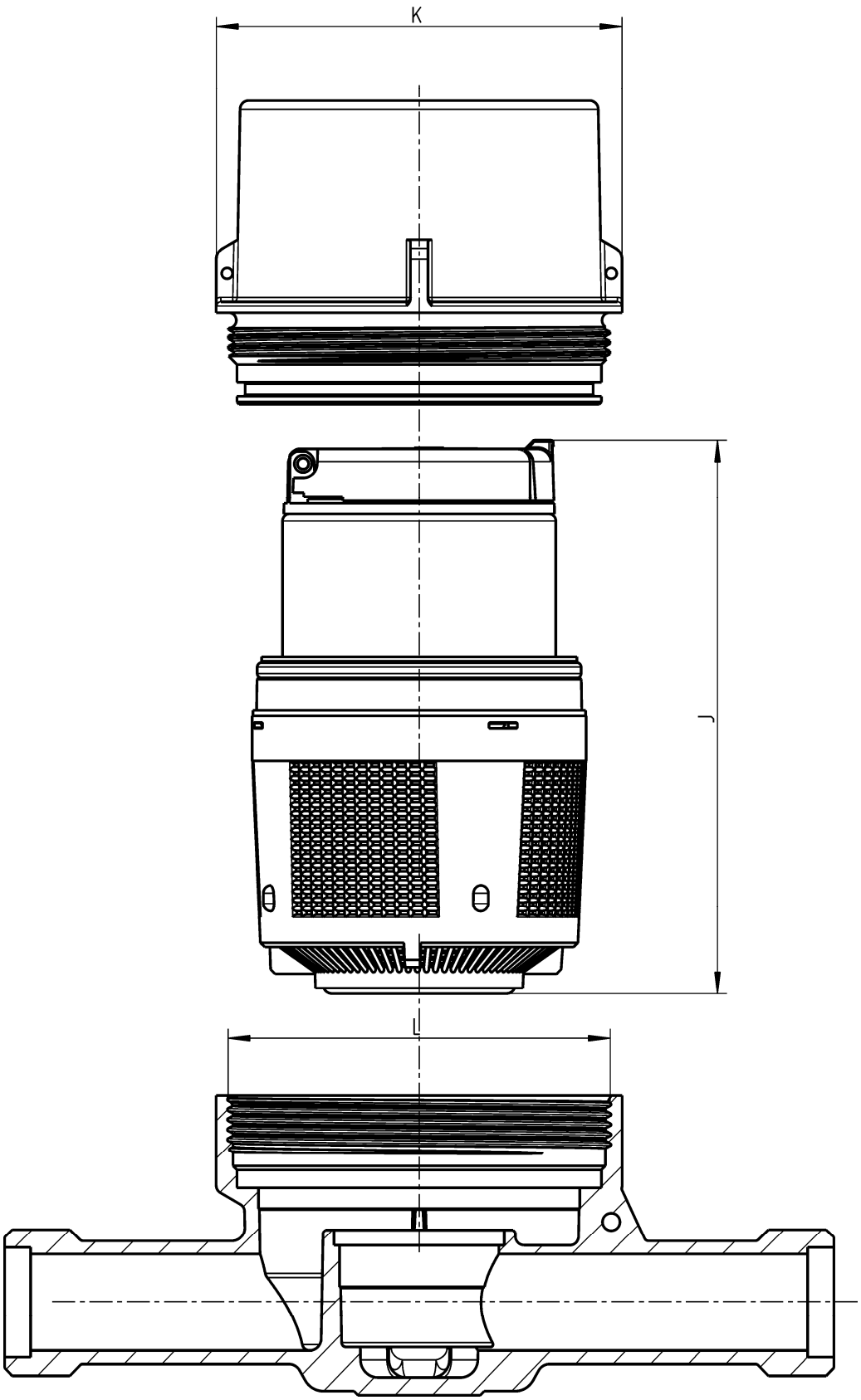


Figure 9 — Meter with exchangeable metrological unit - Concentric flow pattern, volumetric ⟨A2⟩

4.2 [A2] Meter end connections [A2]

4.2.1 Connections interfaces

[A2] Five meter to conduit connection interfaces are standardised:

a) connection of meters to conduit with male threads;

b) connection of meters to conduit with flanges;

c) connection of meters to a concentric manifold;

d) connection of meters to a concentric, axial or vertical connection interface;

e) connection of meters by means of bolting between two (conduit) flanges. [A2]

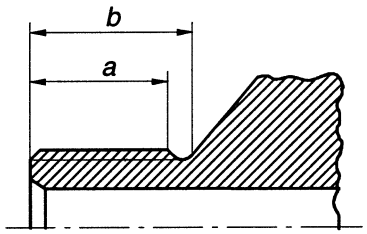
4.2.2 [A2] Threaded end connections [A2]

The thread shall comply with EN ISO 228-1:2000, Class B. Acceptable minimum thread dimensions are indicated in [A2] Table 8 [A2]. [A2] Figure 10 [A2] defines dimensions a and b.

[A2] Table 8 — Threaded and connections dimensions for inline-meters [A2]

Minimum dimensions in mm

Thread	*a*	*b*
G $^3/_4$ B	10	12
G 1 B	12	14
G 1 $^1/_4$ B	12	16
G 1 $^1/_2$ B	13	18
G 2 B	13	20
G 2$^1/_2$ B	14	22



[A2] Figure 10 — Threaded end connections for inline-meters [A2]

4.2.3 Flanged connection

Flanged end connections shall comply with ISO 7005-2 and ISO 7005-3 for a nominal pressure corresponding to that of the water meter.

NOTE The manufacturer shall provide a reasonable clearance behind the rear face of the flange to allow access for installation and removal.

4.2.4 Connection for bolting in between flanges

Meters suitable for bolting between two (conduit) flanges shall be suitable to fit in between two flanges.

4.2.5 Dimensions for manifold(s) for concentric meters

Examples of manifolds for concentric meters are shown in an Annex A of [A2] EN 14154-2:2005+A2:2011 [A2].

[A2] **4.2.6** Connection interfaces for concentric or axial cartridge meters and connection interfaces for axial and axial/vertical meters with exchangeable metrological units are shown in EN 14154-2:2005+A2:2011, Annexes A, B and C. [A2]

4.3 Indicating device

4.3.1 General requirements

4.3.1.1 Function

The indicating device of the water meter shall provide an easily read, reliable and unambiguous visual indication of the indicated volume.

The indicating device may include elements for testing and calibration by other methods, e.g. for automatic testing and calibration.

4.3.1.2 Unit of measurement, symbol and its placement

The volume of water shall be indicated in cubic metres. The symbol **m^3** shall appear on the dial or immediately adjacent to the numbered display.

4.3.1.3 Indicating range

The indicating range shall fulfil provisions formulated in [A2] Table 9 [A2]:

[A2] Table 9 [A2] — Indicating range of a water meter

Q_3 (m^3/h)	Indicating range (minimum values) (m^3)
$Q_3 \leq 6{,}3$	9 999
$6{,}3 < Q_3 \leq 63$	99 999
$63 < Q_3 \leq 630$	999 999
$630 < Q_3 \leq 6\,300$	9 999 999

4.3.1.4 Colour coding for indicating devices

The colour black should be used to indicate the cubic metre and its multiples.

The colour red should be used to indicate sub-multiples of a cubic metre.

These colours shall be applied to either the pointers, indexes, numbers, wheels, discs, dials or aperture frames.

Other means of indicating the cubic metre, its multiples and its sub-multiples may be used, provided there is no ambiguity in distinguishing between the integer part and the decimal part of the volume.

4.3.1.5 Electronic indicating device

The totalizing device shall provide a reliable, clear and unambiguous reading of the volume of water measured.

A non-permanent display is permitted, even during measuring, however it shall be possible to display the volume upon request at any time. If the display is non-permanent, the volume indication time shall be at least ten seconds.

When the totalizing device is capable of displaying additional information, this information shall be displayed without ambiguity.

NOTE This condition could be satisfied if, for example, an extra indication indicates the exact nature of the further information currently displayed, or if each display is controlled by a separate button.

A feature shall be included which enables the correct operation of the display to be checked, for example, by successive display of the various characters. Each step of the sequence shall last at least one second.

The decimal part of the reading expressed in cubic metres need not necessarily be displayed on the same displaying device as the whole unit part. In such a case, the reading shall be clear and without ambiguity (an extra indication of flow shall be displayed on the indicator).

The value may be read, for example:

— using two separate displaying devices on the totalizing device;

— in two successive steps on the same displaying device;

— using a removable indicating device enabling the decimal part display to be read. In such a case a permanent device shall show that the meter is counting with a suitable resolution. The manufacturer shall provide information on the meter about the approximate resolution of this permanent indicating device.

4.3.2 Types of indicating device

4.3.2.1 Type 1 – Analogue device

The indicated volume is indicated by continuous movement of:

f) one or more pointers moving relative to graduated scales;

g) one or more circular scales or drums each passing an index.

The value expressed in cubic metres for each scale division shall be of the form 10^n, where n is a positive or negative whole number or zero, thereby establishing a system of consecutive decades. Each scale shall be either graduated in values expressed in cubic metres or accompanied by a multiplying factor (x 0,001; x 0,01; x 0,1; x 1; x 10; x 100; x 1000; etc.).

Rotational movement of the pointers or circular scales shall be clockwise.

Linear movement of points or scales shall be left to right.

Movement of numbered roller indicators (drums) shall be upwards.

4.3.2.2 Type 2 – Digital device

The indicated volume is given by a line of adjacent digits appearing in one or more apertures. The advance of a given digit shall be completed while the digit of the next immediately lower decade changes from 9 to 0.

Movement of numbered roller indicators (drums) shall be upwards.

The lowest value decade may have a continuous movement, the aperture being large enough to permit a digit to be unambiguously read.

The apparent height of the digits shall be at least 4 mm.

4.3.2.3 Type 3 – Combination of analogue and digital devices

The indicated volume is given by a combination of types 1 and 2 devices and the respective requirements of each shall apply.

4.3.3 Verification devices – First element – Verification scale interval

Every indicating device shall provide means for visual, non-ambiguous verification testing and calibration through a first element.

The visual verification display may have either a continuous or a discontinuous movement.

In addition to the visual verification display, an indicating device may include provisions for rapid testing by the inclusion of complementary elements (e.g. stars, wheels or discs), providing signals through externally attached sensors.

4.3.3.1 Visual verification displays

4.3.3.1.1 Value of the verification scale interval

The value of the verification scale interval expressed in cubic metres, shall be of the form: 1×10^n, or 2×10^n, or 5×10^n, where ***n*** is a positive or negative whole number, or zero.

For analogue and digital indicating devices with continuous movement of the first element, the verification scale may be formed from the division into 2, 5 or 10 equal parts of the interval between two consecutive digits of the first element. Numbering shall not be applied to these divisions.

For digital indicating devices with discontinuous movement of the first element the verification scale interval is the interval between two consecutive digits or incremental movements of the first element.

4.3.3.1.2 Form of the verification scale

On indicating devices with continuous movement of the first element, the apparent scale spacing shall not be less than 1 mm and not more than 5 mm. The scale shall consist of:

— either, lines of equal thickness not exceeding one-quarter of the scale spacing and differing only in length;

— or, contrasting bands of a constant width equal to the scale spacing.

The apparent width of the pointer at its tip shall not exceed one-quarter of the scale spacing and in no case shall it be greater than 0,5 mm.

4.3.3.1.3 Resolution of the indicating device

The verification scale shall not exceed 0,5 % of the volume corresponding to 1 hour 30 minutes at the minimum flowrate, Q_1.

4.4 Water meters which utilise electronic devices

4.4.1 Checking facilities

In addition to complying with the performance tests specified in 8, meters equipped with checking facilities shall pass a design inspection.

Checking facilities are only mandatory for meters used for prepayment or for water meters which are not permanently installed for a customer.

According to national regulations, or to their functions, permanently installed prepayment meters may or may not be subjected to this requirement on checking facilities.

EXAMPLE Checking facilities are not mandatory for domestic water meters not used for prepayment.

The requirements for checking facilities are laid down in normative Annex A.

4.4.2 Power supply

Three different kinds of basic power supplies for water meters that utilise electronic devices are covered by this document:

— external power supply;

— non-replaceable battery;

— replaceable battery.

These three types of power supplies may be used alone or in combination. The requirements for each type of power supply are covered by the following paragraphs.

4.4.2.1 External power supply

Water meters with electronic devices shall be designed such that in the event of an external power supply failure (AC or DC), the meter indication of volume just before failure is not lost, and remains accessible for a minimum of one year. The corresponding memorisation shall occur at least either once per day or for every volume equivalent to 10 minutes of flow at Q_3.

Any other properties or parameters of the meter shall not be affected by a variation in, or an interruption of the electrical supply. This shall be tested according to the corresponding tests laid down in [A2] EN 14154-3:2005+A2 [A2].

NOTE Compliance with this clause will not necessarily ensure that the water meter will continue to register the volume consumed during a power supply failure.

An internal battery shall ensure that the meter operates for at least one month in total when external power supply failure occurs, under normal metering conditions. The lifetime of this battery, allowing for the number of years idle and the one month of usage in the event of the external power supply failure, corresponding to number of years of stockage plus one month of functioning, shall be indicated on the meter.

4.4.2.2 Non-replaceable battery

The manufacturer shall demonstrate that the indicated lifetime of the battery guarantees that the meter functions correctly for at least one year longer than the operational lifetime of the meter.

NOTE It is anticipated that a combination of maximum allowable volume, displayed volume, indicated operational lifetime, remote reading and extreme temperature will be considered when specifying a battery and during pattern approval.

4.4.2.3 Replaceable battery

Where the electrical power supply is a replaceable battery, the manufacturer shall give precise rules for the replacement of the battery.

The replacement date of the battery shall be indicated on the meter. The replacement of the battery shall be indicated on the meter and providing the possibility to indicate the next date of replacement after replacing the battery.

The properties and parameters of the meter shall not be affected by the interruption of the electrical supply when the battery is replaced. This requirement will not necessarily ensure that the meter will continue to register the water volume consumed whilst the battery is being replaced. This shall be tested according to the corresponding test as laid down in [A2] EN 14154-3:2005+A2 [A2].

NOTE It is anticipated that a combination of maximum allowable volume, displayed volume, indicated operational lifetime, remote reading and extreme temperature will be considered when specifying a battery and during pattern approval.

The operation of replacing the battery may be carried out in a way that does not necessitate breaking the statutory metrological seal. When the battery can be removed without breaking the statutory metrological seal the battery compartment shall be protected by a tamper proof device, such as a seal authorised by the meter manufacturer or controlling authority.

Alternatively, where the breaking of the statutory metrological seal is necessary to replace the battery the national metrology body may require that the replacement of the seal is undertaken either by itself or another approved body.

4.4.3 Correction device

Water meters may be fitted with correction devices. Such devices are always considered as an integral part of the meter. The whole of the requirements that apply to the meter, in particular the MPE's specified in 7.6, are therefore applicable to the corrected volume at metering conditions.

In normal operation, corrected volume shall be displayed.

The aim of a correction device is to reduce the errors (of indication) to as close to zero as possible. Water meters with correction devices shall satisfy the performances tests of [A2] EN 14154-3:2005+A2 [A2].

All the parameters which are not measured and which are necessary for correcting shall be contained in the calculator at the beginning of the measurement operation.

NOTE The pattern approval certificate may prescribe the possibility of checking parameters, which are necessary for correctness at the time of verification of the correction device.

The correction device shall not allow the correction of a pre-estimated drift, for example in relation to time or volume.

4.4.4 Calculator

All parameters necessary for the elaboration of indications that are subject to legal metrological control, such as a calculation table or a correction polynomial, shall be present in the calculator at the beginning of the measurement operation.

The calculator may be provided with interfaces permitting the coupling of peripheral equipment. When these interfaces are used, the water meter's hardware and software shall continue to function correctly and its metrological functions shall not be capable of being affected.

4.4.5 Ancillary device

In addition to the indicating devices already described in 4.3.2, a water meter may include ancillary devices. The addition of these devices, either temporary or permanent, shall not alter the metrological characteristics of the meter.

An ancillary device may be used to detect activity of the flow sensor before this is clearly visible on the indicating device. Where national regulations permit, this device may be used for testing, verification and remote reading of the water meter, provided that other means guarantee the satisfactory operation of the water meter.

4.5 Materials and construction

The water meter shall be manufactured from materials of adequate strength and durability for the purpose for which the water meter is to be used.

The water meter shall be manufactured from materials, which shall not be adversely affected by the water temperature variations, within the working temperature range.

All parts of the water meter in contact with the water flowing through it shall be manufactured from materials, which are conventionally known to be non-toxic, non-contaminating and biologically inert[1)].

The complete water meter shall be manufactured from materials, which are resistant to internal and external corrosion, or which are protected by a suitable surface treatment.

1) National regulations shall apply.

The water meter indicating device shall be protected by a transparent window. A cover of suitable type may also be provided as additional protection.

The water meter shall incorporate devices to eliminate the effects of condensation, where there is a risk of condensation forming on the underside of the window of the water meter indicating device.

4.6 Protection against solid particles

If the accuracy of the water meter is likely to be affected by the presence of solid particles in the water, (turbine and displacement type water meters, for example), it should be provided with a strainer or filter.

4.7 Reverse flow

For meters designed to measure reverse flow, the permanent flowrate and the measuring range may be different in each direction.

The manufacturer shall specify whether the meter is designed to measure reverse flow. If it is, the reverse flow volume shall either be subtracted from the indicated volume, or it shall be separately recorded. The MPE of 7.6.3 and 7.6.4 shall be met for forward and reverse flow.

Water meters not designed to measure reverse flow shall either prevent it, or shall be capable of withstanding an accidental reverse flow without any deterioration, or change in their metrological properties for forward flow.

4.8 Meter security and protection against fraud

Considerations of water meter security and protection against fraud concern only the meter including primary indications.

4.8.1 Mechanical protection devices

Water meters shall incorporate protective devices that can be sealed in such a way that after sealing, both before and after the water meter has been correctly installed, there is no possibility of dismantling or altering the meter or its calibration adjustment device without damaging the seal or the protective devices.

4.8.2 Electronic sealing devices

4.8.2.1 Access

When access to modify parameters that influence the determination of the results of measurements is not protected by mechanical sealing devices, the protection shall fulfil the following provisions:

— access shall only be allowed to authorised people e.g. by means of a code (keyword) or a special device (e.g. a hard key). The code shall be capable of being changed; and

— at least the last intervention shall be memorised. The record shall include the date, which may be externally provided, and a characteristic element identifying the authorised person making the intervention. The traceability of the last intervention shall be assured for at least two years, if it is not overwritten on the occasion of a further intervention. If it is possible to memorise more than one intervention and if deletion of a previous intervention shall occur to permit a new record, the oldest record shall be deleted.

4.8.2.2 Inter-changeable parts

For meters with parts, which may be disconnected one from another by the user and which are inter-changeable the following provisions shall be fulfilled:

— it shall not be possible to modify parameters that participate in the determination of results of measurements through disconnected points unless the provisions in 4.8.2.1 are fulfilled;

— interposing any device which may influence the accuracy shall be prevented by means of electronic and data processing securities or, if this is not possible by mechanical means.

4.8.2.3 Disconnection of parts

For meters with parts which may be disconnected one from another by the user and which are not inter-changeable, the provisions of 4.8.2.2 shall apply. Moreover, these meters shall be provided with devices, which do not allow them to operate if the various parts are not connected according to the manufacturers' configuration.

NOTE Disconnections, which are not allowed by the user may be prevented, for example by means of a device that prevents any measurement after disconnecting and reconnecting.

5 Meter classification

5.1 Meter pressure classes

5.1.1 Admissible water pressure

The water pressure shall be measured upstream of the meter inlet for MAP evaluation and downstream of the meter outlet for mAP evaluation.

The minimum admissible pressure (mAP) shall be 30 kPa (0,3 bar).

The meters form maximum admissible pressure classes corresponding to the various MAP values of the following ISO series, chosen by the manufacturer, as shown in [A2] Table 10 [A2].

[A2] Table 10 [A2] — Water pressure classes

Class	**MAP** (bar)	**Reference condition** (bar)
MAP 6 (only for DN ≥ 500)	6	2
MAP 10	10	2
MAP 16	16	2
MAP 25	25	2
MAP 40	40	2

5.1.2 Internal pressure

The water meter shall be able to withstand the internal pressure according to the respective class derived from [A2] Table 10 [A2]. This shall be tested according to the corresponding test as laid down in [A2] EN 14154-3:2005+A2 [A2].

5.1.3 Concentric meters

The requirement in 5.1.2 also applies to pressure testing of concentric water meters; however the seals located at the concentric meter/manifold interface, this 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 loss test is carried out the meter and manifold shall be tested together.

5.2 Meter temperature classes

The meters form water temperature classes corresponding to the various ranges, chosen by the manufacturer, as shown in [A2] Table 11 [A2].

The water temperature shall be measured at the inlet of the meter.

The water temperature ranges are selected by the meter manufacturer from the values given in [A2] Table 11 [A2].

[A2] Table 11 [A2] — Temperature classes

Class	mAT (°C)	MAT (°C)	Reference condition (°C)
T30	0,1	30	20
T50	0,1	50	20
T70	0,1	70	20 ; 50
T90	0,1	90	20 ; 50
T130	0,1	130	20 ; 50
T180	0,1	180	20 ; 50
T30/70	30	70	50
T30/90	30	90	50
T30/130	30	130	50
T30/180	30	180	50

5.3 Flow profile sensitivity classes

The water meter shall be able to withstand the influence of abnormal velocity fields as defined in the test procedures in [A2] EN 14154-3:2005+A2 [A2]. During the application of these flow disturbances the error (of indication) shall meet the requirements of 7.6.

The meter manufacturer shall specify the flow profile sensitivity class in accordance with [A2] Tables 12 and 13 [A2], based on the results of the relevant tests specified in [A2] EN 14154-3:2005+A2 [A2].

Any flow conditioning section, including straightner and/or straight lengths, to be used shall be entirely defined by the manufacturer and is considered to be an auxiliary device linked to the type of the meter examined.

[A2] Table 12 [A2] — Sensitivity to the irregularity in the upstream velocity fields classes (U)

Class	Required straight lengths (x DN)	Straightener needed
U0	0	No
U3	3	No
U5	5	No
U10	10	No
U15	15	No
U0S	0	Yes
U3S	3	Yes
U5S	5	Yes
U10S	10	Yes

[A2] Table 13 [A2] — Sensitivity to the irregularity in the downstream velocity fields classes (D)

Class	Required straight lengths (x DN)	Straightener needed
D0	0	No
D3	3	No
D5	5	No
D0S	0	Yes
D3S	3	Yes

5.4 Pressure loss

The maximum pressure loss within Rated Operating Conditions (ROC) shall not exceed 63 kPa (0,63 bar). This includes any filter or strainer.

The pressure loss class is selected by the manufacturer from the values of the following R 5 of ISO 3:1973 as indicated in [A2] Table 14 [A2].

Concentric meters, of any type and measuring principle, shall be tested together with its respective manifold.

[A2] Table 14 [A2] — Pressure-loss classes

Class	Maximum pressure-loss (bar)
ΔP 63	0,63
ΔP 40	0,40
ΔP 25	0,25
ΔP 16	0,16
ΔP 10	0,10

6 Marking

A place shall be provided on water meters for affixing the main verification mark, which shall be visible without dismantling the water meter.

The water meter shall be clearly and indelibly marked with the following information, either grouped or distributed on the casing, the indicating device dial, an identification plate, or on the meter cover if it is not detachable:

— unit of measurement: cubic metre (see 4.3.1.2);

— the numerical value of Q_3;

— the ratio Q_3/Q_1, (preceded by “R”, i.e. “R160”);

— the ratio Q_2/Q_1, where it differs from 1,6;

— the maximum admissible pressure if it differs from 1 MPa (10 bar)[2)];

— direction of flow (shown on both sides of the body; or on one side only provided the direction of flow arrow will be easily visible under all circumstances);

— the letter V or H, if the meter can only be operated in the vertical or horizontal position;

— the temperature class, where it differs from T30;

— pressure loss class, where it differs from ΔP 63;

— classes on sensitivity to irregularities in velocity field[3)];

— the name or trademark of the manufacturer;

— year of manufacture (last 2 digits) and serial number (as near as possible to the indicating device);

— the pattern approval sign according to European regulations;

— climatic and mechanical environment severity level[3)];

— EMC Class[3)];

— output signals for ancillary devices (type/levels) if any;

— external power supply requirements: voltage – frequency.

In cases where the electrical power supply is by battery:

— the latest date that the battery is to be replaced shall be indicated on the meter in case of a replaceable battery;

— the latest date that the meter is to be replaced shall be indicated on the meter in case of a fixed internal battery.

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2) The unit bar may be used where national regulations permit.

3) This information may be given on a separate datasheet, unambiguously related to the meter by a unique identification.

Other information may be indicated, but shall be displayed without ambiguity to the mandatory elements. When an optional volume indication is not subject to legal control, the inscription shall be clearly defined.

An example for a meter with:

— Q_3 = 2,5 m^3/h;

— Q_3/Q_1 = 200;

— Q_2/Q_1 = 1,6;

— horizontal mounting;

— temperature Class 30;

— pressure loss Class ΔP 63;

— maximum admissible pressure: 1 MPa (10 bar);

— serial number: 123456;

— year of manufacture: 2 000;

— manufacturer Alpha-Omega,

is: **Q_3 2,5 ; R200 ; H ; 123456 ; 00 ; αΩ.**

7 Metrological characteristics

7.1 Permanent flowrate (Q_3)

The numeric value of the permanent flowrate, Q_3, expressed in cubic meters per hour (m^3/h) shall be chosen from the line R 5 of ISO 3:1973:

1,0	1,6	2,5	4,0	6,3
10	16	25	40	63
100	160	250	400	630
1000	1600	2500	4000	6300

This list may be extended to higher or lower values in the series.

For the transition period of 5 years, the following figures in brackets will be permitted:

(1,5) ; (3,5) ; (6) ; (15) ; (20).

7.2 Measuring range

The measuring range for the flowrate is defined by the ratio Q_3/Q_1. The values to be chosen from the line R 10 from ISO 3:1973:

[A2] *deleted text* [A2]						40	50	63	80
100	125	160	200	250	315	400	500	630	800

This list may be extended to higher values in the series.

For the transition period of 5 years, the following figures in brackets will be permitted:

Q_3/Q_1 = (15) ; (35) ; (60) ; (212).

7.3 Relationship between permanent flowrate (Q_3) and overload flowrate (Q_4)

The overload flowrate is defined by:

Q_4/Q_3 = 1,25.

7.4 The relationship between transitional flowrate (Q_2) and minimum flowrate (Q_1)

The transitional flowrate is defined by:

Q_2/Q_1 = 1,6.

For the transition period of 5 years, the following figures in brackets will be permitted:

Q_2/Q_1 =(1,5) ; (2,5) ; (4) ; (6,3).

7.5 Reference flowrate

The flowrate to be used as reference flowrate is defined by the following formula:

$0{,}7 \times (Q_2 + Q_3) \pm 0{,}03 \times (Q_2 + Q_3)$.

7.6 Maximum permissible error

7.6.1 Sign of the error

If all the errors within the measuring range of the water meter have the same sign, at least one of the errors shall be less than one half of the Maximum Permissible Error (MPE).

7.6.2 Relative error, ε

The relative error is expressed as a percentage, and is equal to:

$$\varepsilon = \frac{(V_i - V_a)}{V_a} \times 100$$

where

V_i is the indicated volume;

V_a is the actual volume.

7.6.3 MPE lower flow range

The maximum permissible error, positive or negative, on volumes delivered at flowrates between the minimum flowrate (Q_1) (included) and the transitional flowrate (Q_2) (excluded) is 5 % for water having any temperature.

7.6.4 MPE upper flow range

The maximum permissible error, positive or negative, on volumes delivered at flowrates between the transitional flowrate (Q_2) (included) and the overload flowrate (Q_4) (included) is:

2 % for water having a temperature ≤ 30 °C;

3 % for water having a temperature > 30 °C.

7.6.5 Maximum permissible errors in service

The maximum permissible errors of a water meter while in service shall be twice the maximum permissible errors given in 7.6.3 and 7.6.4.

7.6.6 Absence of flow

In the absence either of flow either of water, the indication of volume shall not change. This shall be tested according to the corresponding test as laid down in A2 EN 14154-3:2005+A2 A2.

7.7 Meters with subassemblies

For meters composed of 2 or more devices placed in separate housings that are declared to fulfil different severity levels, the devices shall be tested one by one at the declared severity levels while the rest of the devices are operating at reference conditions. If the electronic devices of a water meter are in a separate housing, they may be tested independent of the water meter, by simulated signals representative of the normal operation of the meter, in which case the electronic devices shall be tested.

When a subassembly is interchangeable with (an) other(s), the manufacturer shall demonstrate at the pattern approval procedure that this replacement operation does not affect the metrology of the instrument. In such cases, each subassembly can be presented separately for verification.

For tests carried out separately, the MPE values for the model (and not for each individual instrument) shall be as follows:

— X % of the MPE of the meter for the totalising device;

— Y % of the MPE of the meter for the measuring device.

The sum of X and Y shall be equal to 100. However, in the case X is under 10, Y can be up to 100.

These values shall be defined for each model and referred to in the pattern approval certificate. In the case of electronic adjustments, the decision can provide for an offset of these values.

If the instrument has a dedicated power supply adapter, it shall be considered as part of the instrument and tested with it.

The volume for each test is the greatest of the following values:

— smallest volume permitted within the allowed uncertainty;

— volume resulting from minimum test duration.

X an Y values (if applicable) are required in the documentation.

8 Meter performance requirements

Water meters shall be designed and manufactured such that their errors (of indication) do not exceed the Maximum Permissible Errors (MPE) as defined in 7.6 under relevant Rated Operating Conditions.

Water meters, which utilise electronic devices, shall be designed and manufactured in such a way that significant faults do not occur when they are exposed to the disturbances specified in [A2] EN 14154-3:2005+A2 [A2].

A suggested performance test programs for water meters is listed in Informative Annex C of this document.

8.1 Measurement error tests

It shall be demonstrated that the water meter is able to fulfil the requirements on relative error (of indication). Meters shall be tested in accordance with the corresponding tests laid down in [A2] EN 14154-3:2005+A2 [A2].

8.2 [A2] Interchange error tests

It shall be demonstrated that cartridge meters and exchangeable metrological units for water meters with exchangeable metrological units are independent of the connection interfaces they are made for as far as their metrological performance is concerned. The cartridge meters and exchangeable metrological units shall be tested in accordance with the corresponding tests laid down in EN 14154-3:2005+A2:2011, 5.4.5. [A2]

8.3 Pressure tests

It shall be demonstrated that the water meter is able to fulfil the requirements on internal pressure. Meters shall be tested in accordance with the corresponding tests laid down in [A2] EN 14154-3:2005+A2 [A2].

8.4 Pressure loss tests

It shall be demonstrated that the water meter is able to fulfil the requirements on maximum pressure loss. Meters shall be tested in accordance with the corresponding tests laid down in [A2] EN 14154-3:2005+A2 [A2].

8.5 Overload temperature tests

For water meters with MAT $\geq$ 50 °C, it shall be demonstrated that these meters are able to fulfil the requirements on overload temperature test as laid down in [A2] EN 14154-3:2005+A2 [A2].

8.6 Climatic and mechanical environment

This document defines 3 different classes for water meters:

Class B for fixed meters installed in a building;

Class C for fixed meters installed outdoors;

Class I for mobile meters.

The manufacturer shall define the appropriate class for which he is seeking pattern approval before the testing is started. For each class there is one level of severity of each climatic and mechanical environment requirement.

The severity levels for each environmental requirement are defined in [A2] Table 15 [A2].

[A2] Table 15 [A2] — Severity levels

	Classes		
	B	**C**	**I**
Dry heat	3	3	3
Cold	1	3	3
Damp heat cyclic	1	2	2
Vibration	-	-	2
Mechanical shock	-	-	2

The water meter shall be able to withstand the appropriate environmental influence conditions listed here. This shall be tested in accordance with the corresponding test as laid down in [A2] EN 14154-3:2005+A2 [A2].

— Dry heat;

— Cold;

— Damp Heat, Cyclic;

— Vibration (random);

— Mechanical shock.

8.7 Electromagnetic environment

This document defines 2 different electromagnetic environmental classes for water meters:

— Class E1 for residential, commercial and light industry environment;

— Class E2 for industrial environment.

The manufacturer shall define the appropriate class for which he is seeking pattern approval before commencing any test.

The water meter shall be able to withstand the appropriate electromagnetic influence conditions listed here. This shall be tested in accordance with the corresponding test as laid down in [A2] EN 14154-3:2005+A2 [A2].

— Electrostatic discharge;

— Radiated radio frequencies electromagnetic field;

— Surge immunity;

— Electrical fast transient/burst.

8.8 Static magnetic field

The water meter shall be able to withstand the influence of a static magnetic field. This shall be tested according to the corresponding test as laid down in [A2] EN 14154-3:2005+A2 [A2].

8.9 Endurance

It shall be demonstrated that the water meter is able to fulfil the appropriate endurance requirements according to the permanent flowrate Q_3 and the overload flowrate Q_4 of the meter, simulating service conditions, as listed in [A2] Table 16 [A2]. For meters designed to measure reverse flow the requirements apply to both flow directions.

[A2] Table 16 [A2] — Endurance tests

Temperature Class	Permanent flowrate Q_3	Test flow--rate	Test water temperature ± 5 °C	Type of test	Number of interruptions	Duration of pauses	Period of operation at test flowrate	Duration of start-up and rundown
T30 and T50	$Q_3 \leq 16$ m^3/h	Q_3	20 °C	Discontinuous	100 000	15 s	15 s	0,15 [Q_3] [a] s with a minimum of 1 s.
		Q_4	20 °C	Continuous	-	-	100 h	-
	$Q_3 > 16$ m^3/h	Q_3	20 °C	Continuous	-	-	800 h	-
		Q_4	20 °C	Continuous	-	-	200 h	-
Combination meters	$Q_3 > 16$ m^3/h	$Q \geq 2 \times Q_x$	20 °C	Discontinuous	50 000	15 s	15 s	3 to 6 s [b]
All other classes	$Q_3 \leq 16$ m^3/h	Q_3	50 °C	Discontinuous	100 000	15 s	15 s	0,15 [Q_3] [a] s with a minimum of 1 s.
		Q_4	0,9 × MAT	Continuous	-	-	100 h	-
	$Q_3 > 16$ m^3/h	Q_3	50 °C	Continuous	-	-	800 h	-
		Q_4	0,9 × MAT	Continuous	-	-	200 h	-

[a] [Q_3] is the number equal to the value of Q_3 expressed in m^3/h.

[b] This test is an additional test to be performed only for combination meters after the continuous endurance

The orientation(s) of the meters on test shall be set with reference to the meter orientation(s) claimed by the manufacturer.

9 Metrological control

9.1 Pattern approval

Before undergoing Pattern Approval tests, each submitted pattern of water meter shall be inspected externally to ensure that it complies with the provisions of the relevant preceding clauses.

9.1.1 Extent of pattern approval

Pattern approval may only be granted to a water meter consisting of a measurement transducer, a calculator and an indicating device carrying the primary indication. However, the water meter may have several indicating devices and/or auxiliary devices forming a remote output system, which at the request of the supplier may also be the subject of pattern approval procedures.

9.1.2 Objective of pattern approval

The tests performed during the pattern approval procedure are intended to verify that meters of the model whose approval is requested comply with the requirements stated in this document.

No adjustment of the meter is allowed during pattern approval tests. If modifications are made, all previously performed tests, likely to be affected by the modifications, shall be repeated.

9.1.3 Number of meters to be tested

The meters shall be selected at random from a number of meters supplied by the applicant. The number of meters to be submitted and tested is indicated in [A2] Table 17 [A2].

9.1.4 Test verdict

A water meter pattern will comply with the requirements of this document, if the results of each test which apply to it, is satisfactory.

[A2] Table 17 [A2] — Number of meters to be tested

Flowrate (m^3/h)	Number of meters to be submitted	Number of meters to be tested
$Q_3 \leq 4$	30	3
$4 < Q_3 \leq 16$	20	3
$16 < Q_3 \leq 160$	10	3
$160 < Q_3 \leq 1\,600$	5	2
$Q_3 > 1\,600$	2	1
NOTE Additional samples may be required for meters equipped with electronic devices or for testing meters in all position(s).		

The remaining meters not selected in the series cannot be selected later for repeating failed tests.

9.2 Initial verification

9.2.1 General

Only water meters which have been approved either as complete meters or as compatible sub-assemblies, separately approved, and subsequently assembled into a complete meters shall be eligible for initial verification, except in cases where the metrological authority allows separately approved sub-assemblies to be substituted in service. In these cases it shall be proven during pattern examination that such substitutions will not result in the combined maximum permissible errors exceeding the respective maximum permissible errors for a complete water meter.

Water meters of the same size and the same pattern may be tested in series; however in this case, the water pressure at the outlet of the last meter in line shall be greater than 30 kPa (0,3 bar). There shall be no significant interaction between water meters.

9.2.2 Static pressure test

A test shall be performed, the results of which are capable of demonstrating leakproof performance, equivalent to an applied pressure of at least 1,6 MAP for one minute.

9.2.3 Error (of indication) measurements

The errors of indication of the water meters in the measurement of actual volume shall be determined for at least the following three flowrates:

between Q_1 and 1,1 Q_1 ;

between Q_2 and 1,1 Q_2 ;

between 0,9 Q_3 and Q_3.

Additional flowrates may be specified in the Pattern Approval certificate.

The errors ascertained at each of the above flowrates shall not exceed the maximum permissible errors given in 7.6.3 and 7.6.4.

9.2.4 Water temperature of tests

For meters:

T 30, T 50: any temperature between 0,1 and 30 °C.

T70 T180: any temperature between 0,1 and 30 °C and 50 °C ± 5 °C.

T30/70 T30/180: 50 °C ± 5 °C.

unless additional temperatures have been accepted after tests and when they are noted in the approval certificate.

Annex A
(normative)

Checking facilities

A.1 Action of checking facilities

The detection of significant faults by checking facilities of types Intermittent (I) or Permanent (P) shall result in the following actions:

— automatic correction of the fault; or

— stopping only the faulty device when the water meter without that device continues to comply with the regulations; or

— a visible or audible alarm; this alarm shall continue until its cause is suppressed In addition, when a water meter equipped with electronic totalizing devices transmits data to ancillary devices, the transmission shall be accompanied by a message indicating the presence of a fault.

NOTE 1 The 3rd hyphen is not applicable for the disturbances specified in [A2⟩ EN 14154-3:2005+A2 ⟨A2].

A visible or audible alarm is not allowed for any meter, which is to be permanently installed for a customer, unless this alarm is transferred to a remote station.

NOTE 2 The transmission of the alarm and repeated measured values from the meter to the remote station need not be secured with checking facilities, if the measured values are repeated at that station.

The meter may be provided with additional devices to estimate the amount of water having passed through it during the occurrence of a fault. The result of this estimate shall be displayed in such a way that it cannot be mistaken for a valid indication.

A.2 Checking facilities for the measurement transducer

These checking facilities shall verify the presence of the transducer, its correct operation and the integrity of data transmission.

Correct operation includes detection of reverse flow or preventing the reverse flow. However it is not necessary that detection or preventing of reverse flow be operated electronically.

A.2.1 Pulse input solutions

When the signals generated by the flow sensor are in the form of pulses, each pulse representing an elementary volume, the pulse generation, transportation and counting shall fulfil the following tasks:

1) correct counting of pulses;

2) detection of reverse flow, if necessary;

3) checking of correct function.

This may be done for instance by means of:

— three-pulse-system with use of either pulse edges or pulse status;

— double-pulse-system with use of pulse edges plus pulse status;

— double-pulse-system with positive and negative pulsar depending on the flow direction.

These checking facilities shall be of type P.

It shall be possible during pattern approval to check that these checking facilities function correctly by:

— disconnecting the transducer; or

— interrupting one of the sensor's pulse generators; or

— interrupting the electrical supply of the transducer.

A.2.2 Other technologies

For other technologies, checking facilities providing equivalent levels of security remain to be developed.

A.3 Checking facilities for the calculator

These checking facilities shall ensure that the calculator functions correctly and that the calculations are valid.

No specific requirements are prescribed in this part of the document for ensuring that these checking facilities function correctly.

The checking of the correct functioning and the correct calculation of the calculation system shall be of types P or I.

In the latter case, the checking shall occur at least every day or for each volume, equivalent to a flowrate of Q_4 flowing for ten minutes whichever occurs first.

A.3.1 Checking of correct functioning

The checking facilities for the calculator shall verify that:

a) the values of all permanently memorised instructions and data are correct, for instance by means of:

   — summing up all instruction and data codes and comparing the sum with a fixed value or;

   — line and column parity bits Longitudinal Redundancy Check (LRC) and Vertical Redundancy Check (VRC); or

   — Cyclic Redundancy Check (CRC 16); or

   — double independent storage of data; or

   — storage of data in "safe coding", for example protected by checksum, line and column parity bits.

National authorities are free to accept other approach than checking facilities for this paragraph a).

b) All procedures of internal transfer and storage of data relevant to the measurement result are performed correctly, by means of:

— write-read routine; or

— conversion and reconversion of codes; or

— use of "safe coding" (check sum, parity bit); or

— double storage.

A.3.2 Checking of the validity of calculations

This consists of checking the correct value of all data related to the measurement whenever these data are internally stored or transmitted to peripheral equipment through an interface; this check may be carried by such means as parity bit, check sum or double storage, etc.

In addition, the calculator shall be provided with means of controlling the continuity of the calculation program.

A.4 Checking facility for the indicating device

The checking facility for the indicating device shall verify that the primary indications are displayed and correspond to the data provided by the calculator. In addition, where the indicating devices are removable in normal use, it shall also verify their presence.

These checking facilities shall either have the form as defined in A.4.1 or the form as defined in A.4.2.

It shall be possible during pattern approval to determine that the checking facility of the indicating device is working, either:

— by disconnecting all or part of the indicating device; or

— by an action which simulates a failure in the display, such as using a test button.

Interruptions of a non-permanent display shall not interrupt the action of checking facilities.

A.4.1 First possibility

This checking consists in checking the complete indicating device. The checking facility of the indicating device is of type P.

However; it may be of type I if a primary indication is provided by another device.

Means may include, for example:

— for indicating devices using incandescent filaments or LED's, measuring the current in the filaments;

— for indicating devices using fluorescent tubes, measuring the grid voltage;

— for indicating devices using multiplexed liquid crystals, output checking of the control voltage of segment lines and of common electrodes, so as to detect any disconnection or short circuit between control circuits.

When the provision in A.4.1 is fulfilled, the requirement on correct functioning of the display in 4.3.1.5 does not have to be fulfilled.

A.4.2 Second possibility

This checking consists in checking the electronic circuit only, in addition to the general requirement of correct functioning of the display in 4.3.1.5.

The checking facility for the indicating device shall include type I or type P checking of the electronic circuits used for the indicating device (except the driving circuits of the display itself). This checking shall meet the requirements in A.1. The type I may be used if a primary indication is provided by another device.

A.5 Checking facilities for ancillary devices

An ancillary device with primary indications shall include a checking facility. This checking facility shall verify the presence of the ancillary device, when it is a necessary device, and verify the correct functioning and the correct transmission of data from the calculator to the ancillary device.

A.6 Checking facilities for the associated measuring instruments

Associated measuring instruments shall include a checking facility of type P or I. The aim of this checking facility is to ensure that the signal produced by these associated instruments is within their specified measuring range.

In case of type I, the checking shall occur at least every day or for each volume equivalent to a flowrate with Q_4 flowing for 10 min. whichever occurs first.

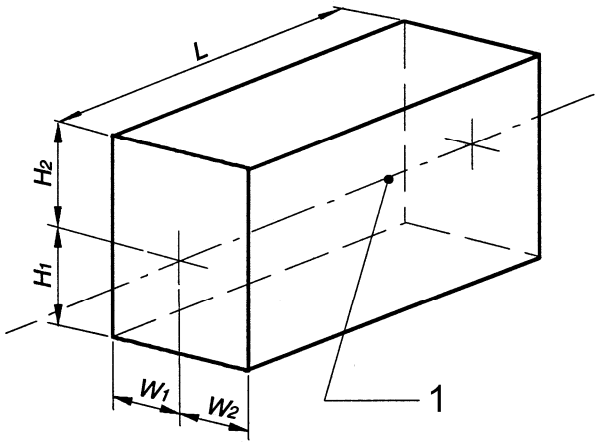
EXAMPLES

— four wire transmission for external resistive sensors;

— control of the driving current for 4-20 mA pressure sensors.

Annex B
(normative)

In-line meter dimensions (including alternative lengths)



Key

1 Pipe axis

Figure B.1

Table B.1 — In-line meter dimensions (including alternative lengths)

(dimensions in mm)

DN	L		W_1, W_2	H_1	H_2
	Preferred	**Alternatives**			
15	165	80, 85, 105, 110, 115, 130, 135, 145, 170, 175, 190, 200, 220.	65	60	220
20	190	105, 110, 115, 130, 135, 165, 175, 200, 220.	65	60	240
25	260	110, 150, 175, 200, 220.	85	65	260
32	260	110, 150, 175, 200, 270, 300.	85	70	280
40	300	200, 220, 260, 270.	105	75	300
50	200	250, 270, 275, 300, 345.			
65	200	300.			
80	200	225, 300, 350, 425.			
100	250	280, 350, 360, 375, 450, 650.			
125	250	275, 300, 350, 375, 450.			
150	300	325, 350, 450, 500, 560.			
200	350	400, 500, 600.			
250	450	600, 800.			
300	500	800.			
400	600	500, 550, 800.			
500	600	500, 625, 680, 770, 900, 1000.			
600	800	750, 820, 920, 1200.			
≥ 800	1,25 × DN	DN			

Table B.2 — Combination meter dimensions (including alternative lengths)

Dimensions in mm

DN	L		W_1, W_2
	Preferred	Alternatives	
50	300	270, 432, 560, 600	220
65	300	650	240
80	350	300, 432, 630, 700	260
100	350	360, 610, 750, 800	350
125	350	850	350
150	500	610, 1 000	400
200	500	1 160, 1 200	400

Table B.3 — Tolerance on lengths

Length	Tolerance
DN 15 to DN 40	$^{0}_{-2}$ mm
DN 50 to DN 300	$^{0}_{-3}$ mm
DN 350 to DN 400	$^{0}_{-5}$ mm
Tolerances on lengths for meters greater than DN 400 shall be agreed upon between user and manufacturer.	

The overall length of a combination meter may be a fixed dimension or may be adjustable by means of a sliding coupling. In this case, the minimum possible adjustment of the meter overall length shall be $\pm$ 15 mm relative to the nominal value of L.

Because of the wide variation in the height of the various types of combination meters it has not been possible to standardize these dimensions.

Annex C
(informative)

Table of rated operating, limiting and references conditions

Table C.1

Influence quantity	Lower Limiting Conditions (LLC) or lower disturbance test value	Lower Rated Conditions (LRC)	Reference Conditions (RC)	Upper Rated Conditions (URC)	Upper Limiting Conditions (ULC) or upper disturbance test value	Uncertainty of measurement
Flowrate: Uni-directional meter	$-Q_3 \le q \le 0$	$Q_1\ ^{+10}_{0}$ %	$0{,}7 \times (Q_2 + Q_3) \pm$ $\pm\ 0{,}03 \times (Q_2 + Q_3)$	$Q_3\ ^{0}_{-5}$ %	$Q_4\ ^{0}_{-5}$ %	
Bi-directional meter in every direction	0	$Q_1\ ^{+10}_{0}$ %	$0{,}7 \times (Q_2 + Q_3) \pm$ $\pm\ 0{,}03 \times (Q_2 + Q_3)$	$Q_3\ ^{0}_{-5}$ %	$Q_4\ ^{0}_{-5}$ %	
Relative pressure of water	-	30 kPa (0,3 bar)	0,2 MPa (2 bar)	MAP	2 MAP	± 5 %
Temperature of water:						± 2 °C
T30 and T50	0,1 °C	10 °C	20 °C	30 °C	50 °C	
T70-T180	0,1 °C	30 °C	20 °C and 50 °C	MAT	MAT + 10 °C	
T30/70-T30/180	0,1 °C	30 °C	50 °C	MAT	MAT + 10 °C	
Temperature of air for meter in operation	-	+ 5 °C : level 1 - 25 °C : level 3	20 °C	55 °C : level 3	-	± 2 °C
AC voltage	-	U_{nom} -15 %	U_{nom}	U_{nom} + 10 %	-	± 2 %
AC frequency	-	f_{nom} - 2 %	f_{nom}	f_{nom} + 2 %	-	0,5 %
DC main voltage	-	U_{nom} -15 %	U_{nom}	U_{nom} + 10 %	-	± 2 %
DC battery voltage	-	U_{min}	U_{nom}	U_{max}	-	
Short time power reductions	100 % for 100 ms 50 % for 200 ms	-	-	-	-	
Electrical bursts	-	-	-	-	1 kV	
Electrostatic discharge	-	-	-	-	6 kV contact mode 8 kV air mode	
Radiated radio frequency, electromagnetic fields	26-500 MHz 3 V/m 80 % AM, 1 kHz sine wave	-	-	-	500-1 000 MHz 10 V/m 80 % AM, 1 kHz sine wave	
Surge transients signal DC line	-	-	-	-	0,5 kV	
Surge transients power AC line	-	-	-	-	Common mode: 2 kV Differential mode: 1 kV	
Static magnetic test	-	-	-	-	50 kA/m at distanced ≤ 1 mm from face	

Unless otherwise indicated in this table or in ⟦A2⟩ EN 14154-3:2005+A2 ⟨A2⟧, the set-point values for the influence quantities shall be complied with during the tests with a tolerance of ± 5 % and an uncertainty of 1/5 of this value. The tolerance for set-point temperatures is ± 5 °C.

Annex D
(informative)

Test program

Program 1: All meters.

Program 2: One meter, after Program 1.

Program 3: One meter, after Program 1(only for meters with electronic devices).

Program 4: All meters, after Programs 1 and 2 (and 3, if applicable). Alternatively program 4 may be performed on an additional number of meters according to [A2] Table 16 [A2].

Table D.1

TIME (Indic.)	PROGRAM 1 (Hydraulic performances)	PROGRAM 2 (Mechanical environment)	PROGRAM 3 (Electric/Climatic environment)	PROGRAM 4 (Endurance performances)
Week 1	Administrative examination Static pressure Flowrate (horizontal) Irregularity in velocity fields (horizontal) Pressure loss			
Week 2	Influence of water pressure Influence of water temperature Water temperature Zero flowrate Reverse flowrate *Flowrate Q_1 -Q_4* *(+ additional positions)* [a] *Flow disturbances* *Reverse flow disturbances* *Reverse pressure loss* **END OF PROGRAM 1**			
Week 3		Mechanical shock Vibration Static magnetic field Index legibility **END OF PROGRAM 2**	Dry heat Dry cold Damp heat, cyclic Variation AC power supply Variation DC power supply Interruption in battery supply Short time power reductions	Endurance (horizontal)
Week 4			Fast transients bursts Electrostatic discharges Electromagnetic HF fields Surge transients **END OF PROGRAM 3**	
Week 11				Flowrate Q_1 - Q_4 (horizontal) *Endurance* *(+ additional positions)* [a] *Endurance (reverse flowrate)* *Flowrate Q_1 - Q_4* *(+ additional positions)* [a]
Week 20				**END OF PROGRAM 4**
Notes	*Tests indicated in Italics:*	Test depending of meter type. By agreement, supplementary meters may be selected in order to reduce the test timings. [a] To ensure evaluation of performance under all orientations.		

Within the a.m. test programs the tests listed can be performed in any order.

Annex ZA
(informative)

[A1] Relationship between this European Standard and the Essential Requirements of EU Directive 22/2004/EC on Measuring Instruments

This European Standard has been prepared under a Mandate given by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 22/2004/EC on Measuring Instruments.

Once this standard is cited in the Official Journal of the [A2] European Union [A2] under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Tables ZA.1 and ZA.2 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 22/2004/EC on Measuring Instruments
Relevant clauses for water meters intended for Residential and Commercial use

Clause(s)/subclause(s) of this European Standard	**Essential Requirements (ERs) of Directive 22/2004/EC Annex I Essential Requirements**	**Qualifying remarks/Notes**
7.6.3, 7.6.4, 8	I.1.1 and 1.2 Allowable errors, Rated operating conditions	5 % between Q1 and Q2 2 % between Q2 and Q4 for T° < 30 °C (3 % for T° > 30 °C)
[A2] 8.6 [A2]	I.1.3.1 Climatic environments Upper and lower temperature limits	Classes B or C
[A2] 8.6 [A2]	I.1.3.2 Mechanical environments M1, M2, M3	Not applicable for residential use.
[A2] 8.7 [A2]	I.1.3.3 Electromagnetic environments E1, E2, E3	Class E1
8	I.2 Reproduceability	
8	I.3 Repeatablility	
8	I.4 Discrimination and sensitivity	
[A2] 8.9 [A2]	I.5 Durability	
8 and 9	I.6 Reliability	
Clause(s)/subclause(s) of this European Standard	Suitability	
4.8 and [A2] 8.8 [A2]	I.7.1 Fraud	

Table ZA.1 (*continued*)

Definition 5 and 8	I.7.2 Suitable for use and not to require unreasonable demands of user to obtain correct measuring results	Meter Pressure Classes MAP 10 to MAP 16 Meter Temperature Classes T30 to T90 and T30/70 to T30/90 Flow Profile sensitivity U0 to U15 and U0S to U10S and D0 to D5 and D0S to D3S Climatic and Mechanical Environment B, C, Electromagnetic Environment E1
4.7, 7.6.4 and 7.6.6	I.7.3 Unduly biasing	Reverse flow MPE at Q4 Absence of flow
-	I.7.4 Insensitivity to small fluctuations of measurand at constant value	Not applicable
4.5, [A2] 8.3 ⟨A2], [A2] 8.5 ⟨A2], [A2] 8.6 ⟨A2], [A2] 8.7 ⟨A2] and [A2] 8.9 ⟨A2]	I.7.5 Robustness and suitability of materials	
4.3 and 4.4	I.7.6 Allow for control after placing on the market. Special equipment or software used	
Clause(s)/subclause(s) of this European Standard	Protection against corruption	
4.4.5 and 4.8	I.8.1 Not to be influenced in any admissible way	Ancillary device Meter Security and Protection against Fraud
4.8	I.8.2 Securing of hardware components	
4.8	I.8.3 Securing and identification of software Evidence of intervention	
4.8	I.8.4 Measurement data adequately protected against corruption	
4.8	I.8.5 Total quantity supplied (basis for payment) not to be reset	
Clause(s)/subclause(s) of this European Standard	Information to be borne by and to accompany the instrument	
6	I.9.1 Inscriptions	

Table ZA.1 (*continued*)

6	I.9.2 Packaging and accompanying documents (if any) suitably marked	
5 and 6	I.9.3 Information on operation (unless simplicity makes this unnecessary	
-	I.9.4 Individual instruction manual not necessary in some cases.	Not applicable
4.3.3.1	I.9.5 Scale interval for the measurand	
4.3.1.2	I.9.6 Unit of measurement	
6	I.9.8 Markings to be clear, non-erasable, unambiguous and non transferable	
Clause(s)/subclause(s) of this European Standard	Indication of result	
〚A2〛 3.20 〈A2〉, 〚A2〛 3.22 〈A2〉 and 4.3	I.10.1 Display or hard copy	
4.3	I.10.2 Clear and unambiguous and easy reading	
-	I.10.3 Hard-copy or print easy legible and non erasable	Not applicable
-	I.10.4 Direct sales trading transactions	Not applicable
4.3 and 4.5	I.10.5 Utility measurement instrument with possibility for remote reading, must have metrologically controlled display of measurement result accessible for consumer without tools	
Clause(s)/subclause(s) of this European Standard	Further processing of data to conclude trading transaction	
-	I.11.1 Other than utility measuring instrument to record in durable way the measurement result and information to identity the transaction when -measurement is non-repeatable - normally one of trading partners is absent	Not applicable
-	I.11.2 Availability of durable proof of measurement result available on request when measurement is concluded.	Not applicable

Table ZA.1 (*continued*)

Clause(s)/subclause(s) of this European Standard	Conformity evaluation	
9	I.12 Design of measuring instrument to allow for evaluation of conformity with requirements of Directive 22/2004/EC	
Clause(s)/subclause(s) of this European Standard	Annex MI-001 WATER METERS Rated Operating Conditions	
[A2] 3.29 [A2], [A2] 3.30 [A2], [A2] 3.31 [A2] and [A2] 3.32 [A2].	MI.Definitions (MI-001)	
7.2, 7.3 and 7.4	MI.1 Values of flow rate range	Q3/Q1 = 10 .. 800 Q2/Q1 = 1,6. Q2/Q1 =(1,5) ; (2,5) ; (4) ; (6,3).5 years Q4/Q3 = 1,25.
5.2	MI.2 Temperature range of the water	[A2] Table 11 [A2]
5.1	MI.3 Relative pressure of the water	(mAP) shall be 0,3 bar. MAP 10, 16, 25, 40
4.4.2, 6 and Annex C	MI.4 For power supply nominal value of AC voltage supply and limits of DC supply	
Clause(s)/subclause(s) of this European Standard	Maximum Permissible Error (MPE)	
7.6.4	MI.5 MPE $\pm$ 2 % for water temperature $\leq$ 30 °C for flow rate between Q2(included) and Q4	
7.6.4	MI.5 MPE ±3% for water temperature > 30 °C for flow rate between Q2 (included) and Q4	
7.6.3	MI.6 MPE ± 5 % for any water temperature for flow rate between Q1 and Q2(excluded)	

Table ZA.1 (*concluded*)

Clause(s)/subclause(s) of this European Standard	Permissible effect of disturbances Electromagnetic immunity	
A2 3.41 A2 and A2 8.7 A2	MI.7.1.1 Electromagnetic immunity Effect of disturbance is such that: - change of measurement result not greater than critical change value - indication of measurement result cannot be interpreted as valid result (i.e. momentary variation)	Partly Critical change value in MI.7.1.1 has two possibilities – EN 14154 covers only the first Subjected to discussion on future review of the standard (note: Same for OIML R49)
A2 8.7 A2	MI.7.1.2 After electromagnetic disturbance the meters shall - recover to operate within MPE - have all measurement results safeguarded - allow recovery of all measurement data before disturbance	
Clause(s)/subclause(s) of this European Standard	Suitability	
6	MI.8.1 Meter able to be installed in any position unless clearly marked otherwise	
4.7	MI.8.2 Meter is designed to measure reverse flow - reverse flow volume subtracted from cumulated volume or separately recorded	
4.7	MI.8.2 Meter is not designed to measure reverse flow shall either - prevent reverse flow - or able to withstand accidental reverse flow	
Clause(s)/subclause(s) of this European Standard	Units of measurement	
4.3.1.2	MI.9 Cubic metre	

Table ZA.2 — Correspondence between this European Standard and Directive 22/2004/EC on Measuring Instruments
Relevant clauses for water meters intended for Light Industrial use

Clause(s)/subclause(s) of this European Standard	Essential Requirements (ERs) of Directive 22/2004/EC Annex I Essential Requirements	Qualifying remarks/Notes
7.6.3, 7.6.4, 8	I.1.1 and 1.2 Allowable errors, rated operating conditions	5 % between Q1 and Q2. 2 % between Q2 and Q4 for T° < 30 °C (3 % for T° > 30 °C)
[A2] 8.6 [A2]	I.1.3.1 Climatic environments Upper and lower temperature limits	Classes B or C
[A2] 8.6 [A2]	I.1.3.2 Mechanical environments M1, M2, M3	Class B, or C or I
[A2] 8.7 [A2]	I.1.3.3 Electromagnetic environments E1, E2, E3	Class E1
8	I.2 Reproduceability	
8	I.3 Repeatablility	
8	I.4 Discrimination and Sensitivity	
[A2] 8.9 [A2]	I.5 Durability	
8 and 9	I.6 Reliability	
Clause(s)/subclause(s) of this European Standard	Suitability	
4.8 and [A2] 8.8 [A2]	I.7.1 Fraud	
Definition 5 and 8	I.7.2 Suitable for use and not to require unreasonable demands of user to obtain correct measuring results.	Meter Pressure Classes Meter MAP 10 to MAP 16 Temperature Classes T30 to T90 and T30/70 to T30/90 Flow Profile sensitivity U0 to U15 and U0S to U10S and D0 to D5 and D0S to D3S Climatic and mechanical environment B, C, Electromagnetic Environment E1
4.7, 7.6.4 and 7.6.6	I.7.3 Unduly biasing	Reverse flow MPE at Q4 Absence of flow
-	I.7.4 Insensitivity to small fluctuations of measurand at constant value	Not applicable

Table ZA.2 (*continued*)

4.5, [A2] 8.3 [A2], [A2] 8.5 [A2], [A2] 8.6 [A2], [A2] 8.7 [A2] and [A2] 8.9 [A2]	I.7.5 Robustness and suitability of materials	
4.3 and 4.4	I.7.6 Allow for control after placing on the market. Special equipment or software used	
Clause(s)/subclause(s) of this European Standard	Protection against corruption	
4.4.5 and 4.8	I.8.1 Not to be influenced in any admissible way	Ancillary device meter security and protection against fraud
4.8	I.8.2 Securing of hardware components	
4.8	I.8.3 Securing and identification of software Evidence of intervention	
4.8	I.8.4 Measurement data adequately protected against corruption	
4.8	I.8.5 Total quantity supplied (basis for payment) not to be reset	
Clause(s)/subclause(s) of this European Standard	Information to be borne by and to accompany the instrument	
6	I.9.1 Inscriptions	
6	I.9.2 Packaging and accompanying documents (if any) suitably marked	
5 and 6	I.9.3 Information on operation (unless simplicity makes this unnecessary)	
-	I.9.4 Individual instruction manual not necessary in some cases	Not applicable
4.3.3.1	I.9.5 Scale interval for the measurand	
4.3.1.2	I.9.6 Unit of measurement	
6	I.9.8 Markings to be clear, non-erasable, unambiguous and non transferable	
Clause(s)/sub-clause(s) of this EN 14154-1	Indication of result	
[A2] 3.20 [A2], [A2] 3.22 [A2] and 4.3	I.10.1 Display or hard copy	
4.3	I.10.2 Clear and unambiguous and easy reading	
-	I.10.3 Hard-copy or print easy legible and non erasable	Not applicable

Table ZA.2 (*continued*)

-	I.10.4 Direct sales trading transactions	Not applicable
4.3 and 4.5	I.10.5 Utility measurement instrument with possibility for remote reading, must have metrologically controlled display of measurement result accessible for consumer without tools.	
Clause(s)/subclause(s) of this European Standard	Further processing of data to conclude trading transaction	
-	I.11.1 Other than utility measuring instrument to record in durable way the measurement result and information to identity the transaction when - measurement is non-repeatable - normally one of trading partners is absent	Not applicable
-	I.11.2 Availability of durable proof of measurement result available on request when measurement is concluded.	Not applicable
Clause(s)/subclause(s) of this European Standard	Conformity evaluation	
9	I.12 Design of measuring instrument to allow for evaluation of conformity with requirements of Directive 22/2004/EC	
Clause(s)/subclause(s) of this European Standard	Annex MI-001 WATER METERS Rated Operating Conditions	
⟦A2⟧ 3.29 ⟨A2⟩, ⟦A2⟧ 3.30 ⟨A2⟩, ⟦A2⟧ 3.31 ⟨A2⟩ and ⟦A2⟧ 3.32 ⟨A2⟩	MI.Definitions (MI-001)	
7.2, 7.3 and 7.4	MI.1 Values of flow rate range	Q3/Q1 = 10 .. 800 Q2/Q1 = 1,6. Q2/Q1 =(1,5) ; (2,5) ; (4) ; (6,3).5 years Q4/Q3 = 1,25.
5.2	MI.2 Temperature range of the water	⟦A2⟧ Table 11 ⟨A2⟩
5.1	MI.3 Relative pressure of the water	(mAP) shall be 0,3 bar. MAP 10, 16, 25, 40
4.4.2, 6 and Annex C	MI.4 For power supply nominal value of AC voltage supply and limits of DC supply	

Table ZA.2 (*continued*)

Clause(s)/subclause(s) of this European Standard	Maximum Permissible Error (MPE)	
7.6.4	MI.5 MPE ± 2 % for water temperature ≤ 30 °C for flow rate between Q2 (included) and Q4	
7.6.4	MI.5 MPE ± 3 % for water temperature > 30 °C for flow rate between Q2 (included) and Q4	
7.6.3	MI.6 MPE ± 5 % for any water temperature for flow rate between Q1 and Q2 (excluded)	
Clause(s)/subclause(s) of this European Standard	Permissible effect of disturbances Electromagnetic immunity	
A2 3.41 A2 and A2 8.7 A2	MI.7.1.1 Electromagnetic immunity Effect of disturbance is such that: - change of measurement result not greater than critical change value - indication of measurement result cannot be interpreted as valid result (i.e. momentary variation)	Partly Critical change value in MI.7.1.1 has two possibilities – EN14154 covers only the first. Subjected to discussion on future review of the standard. (note: Same for OIML R49)
A2 8.7 A2	MI.7.1.2 After electromagnetic disturbance the meters shall -recover to operate within MPE -have all measurement results safeguarded -Allow recovery of all measurement data before disturbance	
Clause(s)/subclause(s) of this European Standard	Suitability	
6	MI.8.1 Meter able to be installed in any position unless clearly marked otherwise	
4.7	MI.8.2 Meter is designed to measure reverse flow - reverse flow volume subtracted from cumulated volume or separately recorded	

Table ZA.2 (*concluded*)

4.7	MI.9 Meter is not designed to measure reverse flow shall either - prevent reverse flow - or able to withstand accidental reverse flow	
Clause(s)/subclause(s) of this European Standard	Units of measurement	
4.3.1.2	MI.9 Cubic metre	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard. 〈A1〉

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