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Meters for irrigation water

Compteurs pour l'eau d'irrigation

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Contents

Page

Foreword

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The committee responsible for this document is ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 18, *Irrigation and drainage equipment and systems*.

Meters for irrigation water

1 Scope

This International Standard applies to water meters intended for irrigation use (herein after referred to as water meters), regardless of the water quality used for this purpose, and specifies the requirements and certification procedures for water meters, irrespective of the design technologies used to meter the actual volume of cold water or heated water flowing through a fully charged closed conduit. These water meters incorporate devices which indicate the integrated volume.

This International Standard 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 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 utilization of the water meter.

2 Normative references

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

ISO 4064-1:2005, *Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water — Part 1: Specifications*

ISO 4064-2:2005, *Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water — Part 2: Installation requirements*

ISO 9644, *Agricultural irrigation equipment — Pressure losses in irrigation valves — Test method*

ISO 286-2, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

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

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

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

3.1
water meter
instrument intended to measure continuously, store, and display the volume of water passing through the measurement transducer at metering conditions

Note 1 to entry: A water 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.

[SOURCE: OIML R49-1:2006, 2.1.1, modified — The second note is not included here.]

3.2
indicating device
part of the meter that provides an indication corresponding to the volume of water passing through the meter

3.3
actual volume
V_a
total volume of water passing through the meter

Note 1 to entry: The actual volume is calculated from a reference volume as determined by a suitable measurement standard taking into account differences in metering conditions, as appropriate.

[SOURCE: OIML R49-1:2006, 2.2.1, modified — The phrases “disregarding the time taken” and “This is the measurand” have been removed from the definition.]

3.4
indicated volume
V_i
volume of water indicated by the meter, corresponding to the actual volume

[SOURCE: OIML R49-1:2006]

3.5
flow rate
Q
volume of water flowing through a device per unit time

3.6
minimum flow rate
Q_1
lowest flow rate at which the meter is required to operate within the maximum permissible error

3.7
transitional flow rate
Q_2
flow rate between the permanent flow rate ≥ 100 ≥ 10 and the minimum flow rate ≥5 that divides the flow rate range into two zones, the “upper zone” and the “lower zone”, each characterized by its own maximum permissible error

3.8
permanent flow rate
Q_3
highest flow rate under normal service conditions at which the meter is required to operate in a satisfactory manner within the maximum permissible error

3.9
overload flow rate
Q_4
highest flow rate at which the water meter is designed to operate for a short period of time within its maximum permissible error, whilst maintaining its metrological performance when it is subsequently operated under normal service conditions

3.10
test flow rate
mean flow rate during a test, calculated from the indications of a calibrated reference device

3.11
error
measured quantity value minus a reference quantity value

$$\frac{V_i - V_a}{V_a} \times 100\,(\%)$$

3.12
maximum permissible error
MPE
extreme value of error permitted by this International Standard

3.13
working pressure
P_w
average water pressure in the pipe measured upstream of the meter

3.14
durability
ability of a meter to maintain its performance characteristics over a period of use

3.15
metering conditions
conditions of the water, the volume of which is to be measured, at the point of measurement

EXAMPLE Water temperature, water pressure.

3.16
maximum admissible pressure
MAP
maximum internal pressure that the meter can withstand permanently, within its rated operating conditions, without deterioration of its metrological performance

Note 1 to entry: MAP is equivalent to Nominal Pressure (PN).

3.17
working temperature
T_w
average water temperature in the pipe, measured upstream and downstream of a water meter

[SOURCE: OIML R49-1:2006]

3.18
minimum and maximum admissible temperature
mAT, MAT
minimum and maximum water temperatures that a meter can withstand permanently, within its rated operating conditions, without deterioration of its metrological performance

Note 1 to entry: mAT and MAT are respectively the lower and upper of the rated operating conditions (ROC).

[SOURCE: OIML R49-1:2006, 2.3.7]

3.19
pressure loss
difference in pressure due to water flow between two specified points in a system or in part of a system

3.20
limiting condition
extreme condition that a meter is required to withstand without damage, and without degradation of its specified metrological properties, when it is subsequently operated under its rated operating conditions

3.21
nominal diameter
DN
numerical designation used to indicate the size of a gated pipe approximately equal to the outside diameter of the pipe

3.22
influence variable
quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result

3.23
influence factor
influence variable having a value within the rated operating conditions specified for a water meter

3.24
rated operating condition
ROC
operating condition that must be fulfilled during measurement in order that a meter performs as designed

Note 1 to entry: The rated operating conditions specify intervals for the flow rate and for the influence parameters for which the errors are required to be within the maximum permissible errors.

[SOURCE: ISO/IEC Guide 99:2007, 4.9, modified — In the definition, the phrase "measuring instrument or measuring system" has been changed to "meter". The note is different.]

3.25
reed contact unit
assembly containing contact blades, some or all of magnetic material, hermetically sealed in an envelope and controlled by means of externally generated magnetic field (e.g. a pulse generator)

3.26
measuring state
state when the switch is closed

3.27
bounce
momentary re-opening of a contact after initial closing, or a momentary closing after initial opening

3.28
bounce time
interval of time between the instant of the first closing (or opening) and the instant of the final closing (or opening) of the reed contact unit

3.29
operate position time
interval of time between the instant the reed contact unit is in the operate position and the instant of the removal of the applied magnetic field to the contact

Note 1 to entry: It includes the closing bounce time in a normally open contact or the opening bounce time in a normally closed contact.

4 Metrological characteristics

4.1 Maximum permissible error (MPE)

4.1.1 Formulation

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

$$\varepsilon = \frac{(V_i - V_a)}{V_a} \times 100 \ (\%) \tag{1}$$

where

V_i is the indicated volume;

V_a is the actual volume.

4.1.2 Limits

The maximum permissible error, positive or negative, on volumes delivered at flow rates (Q) between the minimum flow rate (Q_1) (included) and the transitional flow rate (Q_2) (excluded) is 5 %.

The maximum permissible error, positive or negative, on volumes delivered at flow rates between the transitional flow rate (Q_2) (included) and the overload flow rate (Q_4) (included) is 2 %.

— $Q_1 \leq Q < Q_2$, MPE ≤ 5 %

— $Q_2 \leq Q \leq Q_4$, MPE ≤ 2 %

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.

When any accessory part is sold with the water meter, as for instance a control valve, the error shall be calculated for any position of the accessory, not altering the metrological characteristics of the water meter.

The maximum permissible error declared by the manufacturer is intended for any recommended installation configuration.

4.2 Metrological characteristics

4.2.1 Permanent flow rate (Q_3)

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

1,0	1,6	2,5	4,0	6,3
10	16	25	40	63
100	160	250	400	630
1 000	1 600	2 500	4 000	6 300

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

4.2.2 Measuring range

The measuring range for the flow rate is defined by the ratio Q_3/Q_1. The values shall be chosen from the following list:

10	12,5	16	20	25	31,5	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.

4.2.3 Relationship between permanent flow rate (Q_3) and overload flow rate (Q_4)

The overload flow rate is defined by:

$$Q_4/Q_3 = 1{,}25 \tag{2}$$

4.2.4 Relationship between transitional flow rate (Q_2) and minimum flow rate (Q_1)

The transitional flow rate is defined by:

$$Q_2/Q_1 = 1{,}6 \tag{3}$$

e.g. $Q_3 = 100$; $Q_3/Q_1 = 10$ (R10); $Q_2/Q_1 = 1{,}6$; $Q_4/Q_3 = 1{,}25$

where

Q_3 = 100 m^3/h;

Q_1 = 10 m^3/h;

Q_2 = 16 m^3/h;

Q_4 = 125 m^3/h.

5 Technical characteristics

5.1 General specifications

The water meters shall be made so that they

a) guarantee their design useful lifetime and exclude fraud possibility, and

b) fulfil the requirements of this International Standard, under rated operating conditions.

Additional specifications are the following.

— A water meter measures continuously, records and displays the integrated volume of water passing through the measurement transducer.

NOTE A water meter includes at least a measurement transducer, a calculator, and an indicating device.

— The manufacturer shall specify in the instruction manual the conditions in which the meter can operate in the event of reversal of the flow direction.

— Other ancillary functions of output and input of information (remote reading, prepayment, etc.) may be included provided they do not affect the performance of the meters as defined in this International Standard.

— The meter will preferably be designed in such a way as to present as little disturbance as possible to the water flow and any solid materials it may transport.

— The meter shall be designed such that its operation cannot be affected by a magnetic field as defined in ISO 4064-1:2005, 7.2.7.

5.2 Rated operating conditions

The rated operating conditions for a water meter shall be as follows:

a) ambient temperature range (T_{amb}): 0,1 °C ≤ T_{amb} < 50 °C;

b) pressure (P): P < MAP (maximum admissible pressure);

c) water temperature range [working temperature (T_w)]: 0,1 °C ≤ T_w < 30 °C;

d) flow rate range (Q): Q_1 (minimum flow rate) < Q ≤ Q_3 (permanent flow rate);

e) power supply voltage (mains a.c.): nominal voltage (U_{nom}) ± 5 %;

f) power supply frequency: nominal frequency (f_{nom}) ± 2 %;

g) power supply voltage (battery): a voltage, U, in the range: U_{bmin} ≤ U ≤ U_{bmax}.

5.3 Materials

The water meter shall be fabricated with materials with a resistance and stability suitable for its use.

The meter shall be fabricated using materials which are resistant to internal and external corrosion, and, if required, will be protected by the application of an appropriate surface treatment.

Water temperature variations within the working temperature range will not adversely affect the materials used.

5.4 Indicating device

5.4.1 Function

The indicating device shall always guarantee easy reading of volumes without ambiguity.

5.4.2 Unit of measurement

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

5.4.3 Indicating range

This requirement is set in Table 1:

Table 1 — Indicating range

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

5.4.4 Colour coding for indicating devices

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

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

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

It is allowed to use other manner of indicating the volume for electronic water meters, provided the volume is expressed in cubic metres, and there is no ambiguity in distinguishing between the primary indication and alternative displays, e.g. sub-multiples for verification and testing.

5.5 Reverse flow

For meters designed to measure reverse flow, the permanent flow rate 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 maximum permissible error of 4.1.2 shall be met for forward and reverse flow.

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

5.6 Sealing and security

5.6.1 Meter security and protection against manipulations

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

5.6.2 Mechanical protection devices

Water meters shall incorporate protective devices, such as seals, that prevent the water meter from being disassembled or altered without permanently damaging the seal or the protective device.

5.6.3 Electronic sealing devices

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 provisions described in ISO 4064-1:2005, 5.8.3.

5.7 Other devices

Water meters can incorporate other devices as, for example, reed switches. In such case, the manufacturer shall ensure that the devices don't affect the metrological characteristics of the water meter and that such devices have full compatibility with the water meter.

For example, in order to ensure full compatibility between a reed contact unit and a water meter, the manufacturer can carry out the tests described in Annex A.

6 Metrological requirements

6.1 Indicating error

The water meters shall be designed so that their indicating errors do not exceed the MPE defined in 4.1.2, under rated operating conditions.

6.2 Internal pressure

The water meters shall withstand the internal pressure they are designed to, while in service, without any significant influence on the performance characteristics, leaks, exudation, or permanent deformation. This pressure value is named maximum admissible pressure.

The water meters are classified in function of the MAP declared by the manufacturer, as shown in Table 2:

Table 2 — Water pressure classes

Class	Maximum admissible pressure	
	(MPa)	(bar)
Maximum admissible pressure 6	0,6	6
Maximum admissible pressure 10	1,0	10
Maximum admissible pressure 16	1,6	16
Maximum admissible pressure 25	2,5	25
Maximum Admissible pressure 40	4,0	40

6.3 Flow profile sensitivity classes

The water meter shall be able to withstand the influence of abnormal velocity profiles as defined in the test procedures of 7.5. During the application of these flow disturbances, the error shall meet the requirements of 4.1.2.

The water meter manufacturer shall specify the flow profile sensitivity class in accordance with Tables 3 and 4, based on the results of the relevant tests specified in 7.5.

Any flow conditioning section, including straightener and/or straight pipe 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 water meter examined.

Table 3 — Sensitivity to the irregularity in the upstream velocity profiles classes (U)

Class	Required straight pipe 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

Table 4 — Sensitivity to the irregularity in the downstream velocity profiles classes (D)

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

6.4 Pressure loss

The maximum pressure loss within rated operating conditions shall not exceed 63 kPa (0,63 bar), between Q_1 and Q_3. This includes pressure loss in any filter or strainer.

The pressure loss class is selected by the manufacturer from values taken from the following table:

Table 5 — Pressure-loss classes

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

NOTE Maximum head loss can differ and be higher to the Q_3 corresponding head loss.

7 Performance tests

7.1 General conditions for the tests

7.1.1 Water quality

Conduct water meter tests using water from the public clean water supply or water that meets the same requirements.

Ensure that the water does not contain anything capable of damaging the water meter or adversely affecting its operation. Avoid entrapped air.

7.1.2 Reference conditions

Table 6 — Reference conditions

Condition	Admissible range
Water temperature range	4 °C to 35 °C
Working (water) pressure range	0,03 MPa to 1 MPa except DN > 500 that is 0,6 MPa
Ambient temperature range	4 °C to 35 °C
Ambient relative humidity range	35 % to 75 %
Ambient atmospheric pressure range	86 kPa to 106 kPa (0,86 bar to 1,06 bar)

7.1.3 Pressure

Ensure that the water pressure upstream of the water meter does not vary, during the test, by more than 10 %.

Ensure that the pressure at the entrance to the water meter does not exceed the maximum admissible working pressure (P_w) for the water meter.

During the test, the pressure at the water meter outlet shall be, at least, 0,03 MPa (0,3 bar).

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

The estimated uncertainty shall be made according to Reference [4] in measurement with a coverage factor, $k = 2$.

7.1.4 Flow rate

Ensure that the relative variation in the flow rate during each test (not including starting and stopping) does not exceed:

— ±2, 5 % from Q_1 to Q_2 (not inclusive);

— ±5, 0 % from Q_2 (inclusive) to Q_4.

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

7.1.5 Temperature

Ensure that the temperature of the water during the test does not change by more than 5 °C.

Ensure that the maximum uncertainty in the measurement of temperature does not exceed ± 1 °C.