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BSI Standards Publication

Gas meters - Diaphragm gas meters

bsi.

National foreword

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Gaszähler - Balgengaszähler

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European foreword

This document (EN 1359:2017) has been prepared by Technical Committee CEN/TC 237 “Gas meters”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2018, and conflicting national standards shall be withdrawn at the latest by January 2018.

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

This document supersedes EN 1359:1998.

This document 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.

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

Significant changes from the previous editions include:

— conformity with the MID 2014/32/EU regarding declared errors of the same sign and testing Q_{min} at the minimum and maximum declared gas temperatures;

— corrosion protection restructured;

— endurance testing for residential meters revised to reflect better the in-service life;

— provision for meters with electronic indexes and integrated valves, and requirements for additional functionalities as given in EN 16314;

— adhesion testing of labels.

Annex B has been restructured to give additional requirements for meters provided with a built-in gas temperature conversion device.

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

1 Scope

This European Standard specifies the requirements and tests for the construction, performance, safety and production of class 1,5 diaphragm gas meters (referred to as meters). This applies to meters with co-axial single pipe, or two pipe connections, that are used to measure volumes of fuel gases, which are within the limits of test gases of the 1st, 2nd and 3rd families described in EN 437. The meters have maximum working pressures not exceeding 0,5 bar and maximum actual flow rates not exceeding 160 m^3h^{-1} over a minimum ambient temperature range of −10 °C to 40 °C and a gas temperature range as specified by the manufacturer with a minimum range of 40 K.

This standard applies to meters with and without built-in temperature conversion that are installed in locations with vibration and shocks of low significance (see MID Annex 1 Chapter 1.3.2 (a), class M1). It also applies to meters in:

— closed locations (indoor or outdoor with protection as specified by the manufacturer) both with condensing humidity, or with non-condensing humidity;

or, if specified by the manufacturer:

— open locations (outdoor without any covering) both with condensing humidity and with non-condensing humidity;

— in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings (see MID Annex 1 Chapter 1.3.3 (a), class E1).

Unless otherwise stated, all pressures given in this document are gauge pressure.

Requirements for electronic indexes, batteries, valves incorporated in the meter and other additional functionalities are given in EN 16314.

Unless otherwise stated in a particular test, the tests are carried out on meters that include additional functionality devices intended by the manufacturer.

Clauses 1 to 9 and Annexes B and C are for design and type testing only.

NOTE The content of OIML Publication 'International Recommendation R 137' has been taken into account in the drafting of this standard.

If no specific requirements are given for test equipment, the instruments used should be traceable to a national or international reference standard and the uncertainty (2σ) should be better than 1/5 of the maximum value of the parameter to be tested. For differential results the repeatability (2σ)/resolution should be better than 1/5 of the maximum value of the parameter to be tested.

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.

EN 549, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 16314:2013, *Gas meters - Additional functionalities*

EN 60730-1:2011, *Automatic electrical controls for household and similar use - Part 1: General requirements (IEC 60730-1:2011)*

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

EN ISO 1518-1, *Paints and varnishes - Determination of scratch resistance - Part 1: Constant-loading method (ISO 1518-1)*

EN ISO 2409, *Paints and varnishes - Cross-cut test (ISO 2409)*

EN ISO 2812-1:2007, *Paints and varnishes - Determination of resistance to liquids - Part 1: Immersion in liquids other than water (ISO 2812-1:2007)*

EN ISO 4628-2, *Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 2: Assessment of degree of blistering (ISO 4628-2)*

EN ISO 4628-3:2016, *Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 3: Assessment of degree of rusting (ISO 4628-3:2016)*

EN ISO 4892-2:2013, *Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 4892-2:2013)*

EN ISO 6270-1, *Paints and varnishes - Determination of resistance to humidity - Part 1: Continuous condensation (ISO 6270-1)*

EN ISO 6272-2, *Paints and varnishes - Rapid-deformation (impact resistance) tests - Part 2: Falling-weight test, small-area indenter (ISO 6272-2)*

EN ISO 9227:2012, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227)*

EN ISO 11664-4, *Colorimetry - Part 4: CIE 1976 L*a*b* Colour space (ISO 11664-4)*

ISO 834-1, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 5168, *Measurement of fluid flow — Procedures for the evaluation of uncertainties*

ISO 7005-1:2011, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
air
air of density approximately 1,2 kgm^{-3}

3.1.2
gas volume meter
instrument designed to measure, memorize and display the volume of a fuel gas that has passed through it

3.1.3
diaphragm gas meter
gas volume meter in which the gas volume is measured by means of measuring chambers with deformable walls

3.1.4
actual flow rate
flow rate at the gas pressure and gas temperature conditions prevailing in the gas distribution line in which the meter is fitted, at the meter inlet

3.1.5
working pressure
difference between the pressure of the gas at the inlet of the meter and the atmospheric pressure

3.1.6
maximum working pressure
upper limit of the working pressure for which the meter has been designed, as declared by the manufacturer and marked on the meter data plate

3.1.7
pressure absorption
difference between the pressure measured at the inlet and outlet connections of the meter whilst the meter is operating

3.1.8
external leak tightness
leak tightness of the gas carrying components of the gas meter with respect to the atmosphere

3.1.9
error of indication
E
value that shows the relationship in percentage terms of the difference between the volume indicated by the meter and the volume that has actually passed through the meter, to the latter volume

Note 1 to entry: Error of indication, as a percentage, is calculated using the Formula (1):

$$E = 100\frac{V_i - V_c}{V_c} \tag{1}$$

where

V_i is the indicated volume

V_c is the volume which has actually passed through the meter.

3.1.10
normal condition of use
condition referring to the meter operating:

— at a pressure up to the maximum working pressure (with or without a flow of gas);

— within the range of flow rates;

— within the ambient and gas temperature range;

— with the distributed gas

3.1.11
base condition
fixed condition (temperature and pressure) to which a volume of gas is converted

3.1.12
cyclic volume
volume of gas corresponding to the working cycle of the gas meter

Note 1 to entry: This means that all the moving components, except for the indicating device and the intermediate transmissions, resume for the first time the position they occupied at the beginning of the cycle.

3.1.13
distributed gas
gas locally available

3.1.14
metering conditions
condition of the gas at the point of measurement

Note 1 to entry: E.g. temperature and pressure of the measured gas.

3.1.15
temperature conversion device
device which converts the volume measured to a corresponding volume at the base gas temperature

Note 1 to entry: The volume at base gas temperature, V_b in cubic metres (m^3) is given by the equation

$$V_b = \frac{T_b}{T} \times V \qquad (2)$$

where

V is the volume at metering conditions, in cubic metres (m^3);

T is the gas temperature at metering conditions, in Kelvin (K);

T_b is the base gas temperature, in Kelvin (K).

3.1.16
meter error curve
plot of average error of indication against actual flow rate

3.1.17
class 1,5 meter
meter which has an-MPE at production-of:

±3 % where $Q_{min} \leq Q < Q_t$

and

±1,5 % where $Q_t \leq Q \leq Q_{max}$

3.1.18
MPE
maximum permissible error for a class 1,5 diaphragm gas meter

3.1.19
MPE-Initial
maximum permissible error for a Class 1,5 diaphragm gas meter before testing in accordance with this standard

3.1.20
MPE-Subsequent
maximum permissible error for a Class 1,5 diaphragm gas meter following the completion of specific individual tests within this standard

3.2 Symbols

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

3.2.1
$\boldsymbol{Q}$
volume flowrate
actual flow of gas passing through the diaphragm gas meter

3.2.2
$\boldsymbol{Q_{min}}$
minimum flowrate
lowest flowrate at which the gas meter provides indications that satisfy the requirements regarding MPE

3.2.3
$\boldsymbol{Q_t}$
transitional flowrate
flowrate occurring between the maximum and minimum flowrates at which the flowrate range is divided into two zones, the 'upper zone' and the 'lower zone', each zone having a characteristic MPE

3.2.4
$\boldsymbol{Q_{max}}$
maximum flowrate
highest flowrate at which the gas meter provides indications that satisfy the requirements regarding MPE

3.2.5
Q_r
overload flowrate
highest flowrate at which the meter operates for a short period of time without deteriorating

3.2.6
V
cyclic volume

3.2.7
p_{max}
maximum working pressure

3.2.8
t_b
base gas temperature

3.2.9
t_m
ambient temperature

3.2.10
t_g
gas temperature

3.2.11
t_{sp}
specified centre temperature for meters with temperature conversion

3.2.12
g_n
nominal gravitational acceleration

4 Working conditions

4.1 Flow range

The flow rate range shall be one of those given in Table 1.

Table 1 — Flow rate range

Q_{max} m³h⁻¹	Q_{min} m³h⁻¹	Q_t m³h⁻¹	Q_r m³h⁻¹
2,5	0,016	0,25	3,0
4	0,025	0,4	4,8
6	0,04	0,6	7,2
10	0,06	1,0	12,0
16	0,1	1,6	19,2
25	0,16	2,5	30,0
40	0,25	4,0	48,0
65	0,4	6,5	78,0
100	0,65	10,0	120,0
160	1	16,0	192,0

A gas meter may have a lower value for the minimum flow rate, Q_{min}, than that shown in Table 1, but this lower value shall be equal to one of the values shown in the table or to a decimal submultiple of these values.

NOTE The values given in Table 1 ensure conformity with the requirements of the MID for a minimum ratio Q_{max} to Q_{min} of 150:1.

4.2 Maximum working pressure

Unless required otherwise for a particular test, all meters shall be capable of meeting the requirements up to the maximum working pressure of the meter, P_{max}, which shall be declared and shall be marked on the index plate of the meter.

4.3 Temperature range

All meters shall be capable of meeting the requirements for a minimum ambient temperature range of −10 °C to 40 °C and a minimum gas temperature range of 40 K (see 7.1.3) and a minimum storage temperature range of −20 °C to 60 °C (see 6.5). The gas temperature range shall be within the ambient temperature range.

The gas temperature range and the ambient temperature range shall be declared and shall be marked on the index plate of the meter.

The manufacturer may declare a wider ambient temperature range using a minimum temperature of −10 °C, −25 °C or −40 °C and a maximum temperature of 40 °C, 55 °C or 70 °C and/or a wider storage temperature range. The meter shall be capable of meeting the requirements over this declared wider range.

4.4 Climatic environment

Meters that conform to the requirements of this standard are deemed suitable for installation in closed locations (indoor or outdoor with protection as specified by the manufacturer) with condensing or non-condensing humidity.

If the manufacturer declares that the meter is also suitable for installation in open locations (outdoor without any protection) with condensing or non-condensing humidity, it shall meet the requirements of Annex C.

4.5 Installation orientation

The meter shall be designed for installation upright as specified by the manufacturer.

5 Metrological performance

5.1 Errors of indication

5.1.1 Requirements

When tested by the method given in 5.1.2 a) the individual errors of indication of the meter shall be within the initial permissible error (MPE-Initial) limits specified in Table 2.

Table 2 — Maximum permissible errors

Flow rate m^3h^{-1}	**Maximum permissible errors**	
	Initial	**Subsequent**
$Q_{min} \leq Q < Q_t$	±3 %	±6 %
$Q_t \leq Q \leq Q_{max}$	±1,5 %	±3 %

The meter, including any additional functionality devices intended by the manufacturer, shall have the error adjusted as close to zero as the adjustments allow, without systematically favouring any party.

After the meter has been subjected to other influences, given in the individual clauses of this standard, the average of the errors of indication of the meter shall either:

— not vary from the average of the initial errors of indication by more than that allowed by those clauses or;

— be within the error limits specified within those clauses;

whichever is applicable, when tested by the methods given in 5.1.2 b), 5.1.2 c or 5.1.2 d).

5.1.2 Test procedure — Errors of indication

a) Thermally stabilize the meter to be tested for a minimum of 4 h at the temperature of the test laboratory and carry out the error of indication test using air at laboratory temperature.

   Immediately before commencing the test, pass a quantity of air equal to at least 50 cyclic volumes of the meter under test, through the meter under test at a flow rate of Q_{max}.

   Carry out this test six times at each of the flow rates Q_{min}, 3 Q_{min}, 0,1 Q_{max}, 0,2 Q_{max}, 0,4 Q_{max}, 0,7 Q_{max} and Q_{max}, ensuring that the flow rates between each individual test are different (i.e. it is not permissible to carry out consecutive tests at the same flow rate).

   Pass a volume of air, the actual volume of which is measured by a traceable standard, through the meter under test and note the volume indicated by the meter index. The minimum volume of air to be passed through the meter under test is specified by the manufacturer and agreed with the Accredited test house.

   Calculate the six errors of indication at each of the flow rates using the equation given in 3.1.9. Calculate the mean of each of the six errors of indication and record the results as the meter error curve.

b) Thermally stabilize the meter to be tested for a minimum of 4 h at the temperature of the test laboratory and carry out the error of indication test using air at laboratory temperature.

   Pass a volume of air, the actual volume of which is measured by a traceable standard, through the meter under test and note the volume indicated by the meter index. The minimum volume of air to be passed through the meter under test is specified by the manufacturer and agreed with the Accredited test house.

   Carry out this test three times at each of the flow rates Q_{min}, 3 Q_{min}, 0,1 Q_{max}, 0,2 Q_{max}, 0,4 Q_{max}, 0,7 Q_{max} and Q_{max}; ensure that the flow rates between each individual test are different (i.e. it is not permissible to carry out consecutive tests at the same flow rate).

   Calculate the three errors of indication at each of the flow rates using the equation given in 3.1.9. Calculate the mean of the three errors of indication and record the results as the meter error curve.

c) Thermally stabilize the meter to be tested for a minimum of 4 h to the temperature of the test laboratory and carry out the error of indication test using air at laboratory temperature.

   Pass a volume of air, the actual volume of which is measured by a traceable standard, through the meter under test and note the volume indicated by the meter index. The minimum volume of air to be passed through the meter under test is specified by the manufacturer and agreed with the Accredited test house.

   Carry out this test three times at each of the flow rates 0,1 Q_{max}, 0,4 Q_{max} and Q_{max}, ensuring that the flow rates between each individual test are different (i.e. it is not permissible to carry out consecutive tests at the same flow rate).

   Calculate the three errors of indication at each of the flow rates using the equation given in 3.1.9. Calculate the mean of the three errors of indication and record the results as the meter error curve.

d) Thermally stabilize the meter to be tested for a minimum of 4 h to the temperature of the test laboratory and carry out the error of indication test using air at laboratory temperature.

   Pass a volume of air, the actual volume of which is measured by a traceable standard, through the meter under test and note the volume indicated by the meter index. The minimum volume of air to be passed through the meter under test is specified by the manufacturer and agreed with the Accredited test house.

   Carry out this test three times at each of the flow rates Q_{min}, 0,1 Q_{max}, 0,4 Q_{max} and $Q_{max,}$ ensuring that the flow rates between each individual test are different (i.e. it is not permissible to carry out consecutive tests at the same flow rate).

   Calculate the three errors of indication at each of the flow rates using the equation given in 3.1.9. Calculate the mean of the three errors of indication and record the results as the meter error curve.

5.2 Pressure absorption

5.2.1 Requirements

The mean pressure absorption of a meter over at least one cyclic volume, with a flow of air with a density of 1,2 kgm^{-3}, at a flow rate equal to Q_{max}, shall not exceed the values given in Table 3.

Table 3 — Pressure absorption

Q_{max} m^3h^{-1}	Maximum permissible values for mean pressure absorption	
	Initial mbar	**Subsequent** mbar
2,5 to 16 inclusive	2	2,2
25 to 65 inclusive	3	3,3
100 and 160	4	4,4

5.2.2 Test procedure — Pressure absorption

Supply the meter under test with a flow of air at a flow rate equal to Q_{max} for a minimum of 10 cycles. Measure the differential pressure across the meter for at least one cyclic volume using a suitable measuring instrument, accurate to 0,1 mbar.

The distance between the pressure test points and the meter connections shall not exceed three times the nominal connection diameter.

Record the differential pressures over at least one measuring cycle, and calculate the mean value.

5.3 Starting flow rate

5.3.1 Requirements

When tested by the method given in 5.3.2, the starting flow rate shall not be greater than those specified in Table 4.

Table 4 — Starting flow rates

Q_{max} m^3h^{-1}	**Maximum starting flow rate** dm^3h^{-1}
2,5	3
4 and 6	5
10	8
16 and 25	13
40	20
65 and 100	32
160	50

5.3.2 Test procedure — Starting flow rate

Run the meter under test at Q_{max} for 10 min, using air at laboratory temperature.

NOTE This test does not check the metrological characteristics of the meter.

Leave the meter under test at rest for a period of 2 h to 4 h. Do not add lubricant for the test.

Connect the meter under test in series with, and upstream of, a flow measuring instrument of known accuracy and traceability, and a flow regulating device accurate to two decimal places.

Check the leak tightness of the complete test apparatus and supply air at ambient temperature up to a maximum pressure of 2 mbar and maintain the flow rate at the maximum allowable starting flow rate. At this maximum starting flow rate, ascertain that the meter under test registers continuously for at least one cyclic volume.

Record the result as pass or fail.

5.4 Metrological stability

5.4.1 Requirements

The errors of indication found at each of the specified test flow rates shall not differ by more than 0,6 %.

5.4.2 Test procedure — Metrological stability

Using the calculated errors of indication, obtained when carrying out the initial error of indication test in 5.1.2 a) at flowrates 0,1 Q_{max}, 0,2 Q_{max}, 0,4 Q_{max}, 0,7 Q_{max} and Q_{max}, check that for each flowrate the spread of the six individual results is within 0,6 %.

Record the result as a pass or fail.

5.5 Overload flow rate

5.5.1 Requirements

After exposure to an overload flow rate of Q_r as given in Table 1, the error of indication shall remain within the MPE-Initial limits specified in Table 2.

5.5.2 Test procedure — Overload flow rate

Supply 1 meter with air for 1 h at a flow rate of Q_r. Determine the error of indication as specified in 5.1.2 c).

Record the result as a pass or fail.

5.6 Environment and humidity

5.6.1 Requirements

NOTE Test methods for meters suitable for use in open locations are given in Annex C.

After testing in accordance with 5.6.2, the error of indication shall remain within the MPE-Initial limits as specified in Table 2 and the index and markings shall remain legible.

5.6.2 Test procedure — Environment and humidity

Test one meter for error of indication in accordance with 5.1.2 c) and then in accordance with EN ISO 6270-1 for a duration of 120 h. Then retest the meter for error of indication in accordance with 5.1.2 c) and visually inspect it for legibility of the index and the markings.

Record the result as a pass or fail.

5.7 Influence of other devices attached to the meter

5.7.1 Requirements

If any device (e.g. an additional functionality device covered by EN 16314) that the manufacturer permits to be connected to the meter influences its metrological performance, then this influence shall be less than 1/5th MPE.

5.7.2 Test procedure — Influence of other devices

Test 1 meter 10 times for error of indication at Q_t, varying the flow rate between each test by at least 0,05 Q_{max}. Then attach the influencing device to the meter and determine the error of indication at Q_t again 10 times. Calculate the mean of each set of results. The difference between the means of the 2 errors of indication shall be less than 1/5th MPE.

Report the result as pass or fail.

5.8 Cyclic volume

5.8.1 Requirements

The cyclic volume of any meter at base conditions shall be within ± 5 % of the cyclic volume indicated on the index plate.

5.8.2 Test procedure — Cyclic volume

The possible range of cyclic volume is determined by multiplying the value of the volume corresponding to one complete revolution of the test element, or the value of the smallest scale interval, by the transmission ratio of the measuring device to the indicating device, at the extreme of the transmission gear ratios.

Report the result as pass or fail.

6 Construction and materials

6.1 General

No additional lubricants shall be required during the life of the meter.

The meter connections shall be fitted with suitable non-sealing plugs or covers to prevent the entry of foreign matter during transit and storage.

Production requirements for the meter are given in Annex A.

6.2 Resistance to interference

6.2.1 Mechanical interference

6.2.1.1 Requirement

The meter shall be constructed in such a way that any mechanical interference capable of affecting the measuring accuracy causes permanently visible damage to the meter or the verification or protection marks.

6.2.1.2 Test

By visual inspection.

Report the result as pass or fail.

6.2.2 Electromagnetic interference

The meter shall conform to the requirements of EN 16314:2013, 4.1.2.

6.3 Robustness

6.3.1 General

Meters meeting the requirements of 6.3 are suitable for use in locations with vibration and shocks of low significance; e.g. they can be floor mounted or fastened to light supporting structures and will be subject to negligible vibrations and shocks including, but not limited to local blasting or pile driving activities, or slamming doors.

6.3.2 Meter case

The external surface of the meter case, which is in direct contact with the ambient air, and the internal surface of the meter case, which is in direct contact with the gas, shall be of sufficient thickness to meet the requirements of this standard.

6.3.3 External leak tightness

6.3.3.1 Requirements

The meter shall be leak tight under normal conditions of use. When tested in accordance with 6.3.3.2, no leakage shall be observed.

6.3.3.2 Test procedure — External leak tightness

Test the meter in three stages as follows:

a) Pressurize the meter under test, at normal laboratory temperature, with air to 25 mbar and carry out the test given in either 6.3.3.2 a) or 6.3.3.2 b).

b) Then pressurize the meter under test, at normal laboratory temperature, with air to a minimum of 1,5 times the declared maximum working pressure and not less than 350 mbar and carry out the test given in either 6.3.3.2 a) or 6.3.3.2 b).

c) Then allow the pressure to reduce to atmospheric pressure, then re-pressurize the meter under test, at normal laboratory temperature, with air to 25 mbar and carry out the test given in either 6.3.3.2 a) or 6.3.3.2 b).

For each stage test by either:

i) immerse the meter without its index in water and observe it for leakage for 30 s after any external trapped air has been dispersed, after which no leakage should be observed, or

ii) use any equivalent procedure utilizing calibrated and certificated test equipment with a declared resolution and full traceability.

Record the results of all three tests and report as pass or fail.

6.3.4 Resistance to internal pressure

6.3.4.1 Requirements

Resistance to internal pressure tests shall be carried out with no interruptions to the gas flow including, but not limited to, valves in the open position.

When tested in accordance with the method given in 6.3.4.2, any residual deformation of the unpressurized meter case shall not exceed 0,75 % of the linear dimension over which it is measured. After the test, the meter case shall remain leak tight in accordance with 6.3.3.

6.3.4.2 Test procedure — Resistance to internal pressure

Pressurize the meter under test, at normal laboratory temperature, with air or water to a minimum of 1,5 times the declared maximum working pressure and not less than 350 mbar.

Maintain the test pressure for 30 min and then release.

Ensure that the rate of pressurization or depressurization does not exceed 350 mbar.s^{-1}.

Record the result as pass or fail.

6.3.5 Meter case sealing

6.3.5.1 Requirements

Mechanical means for sealing shall be provided for the gas-containing components of the meter case, where the failure of any seals and/or adhesives can cause external leakage, e.g. at the junction of the top and bottom case of the meter.

6.3.5.2 Test procedure — Meter case sealing

Conduct a visual inspection of a fully assembled meter case to confirm the presence of appropriate mechanical means of sealing.

Record the result as pass or fail.

6.3.6 Connections

6.3.6.1 Orientation

6.3.6.1.1 Requirements

The connections of meters with top mounted two pipe connections shall have the centrelines of these connections within 1° of vertical, with respect to the horizontal plane of the meter.

The distance between the centrelines of the connections, measured at the free end of the connections, shall be within ± 0,5 mm of the nominal distance between centrelines, or within ± 0,25 % of the nominal distance between centrelines, whichever is the greater, and the centrelines shall be within 1° of being parallel.

The free ends of the connections shall be level within 2 mm, or within 1 % of the nominal distance between the centrelines of the connections, whichever is the greater, with respect to the horizontal plane of the meter.

6.3.6.1.2 Test procedure — Orientation

Take measurements using appropriate instruments, capable of measuring to an accuracy better than that required in 6.3.6.1.1.

Record the result as pass or fail.

6.3.6.2 Threads and flanges for single and two pipe meters

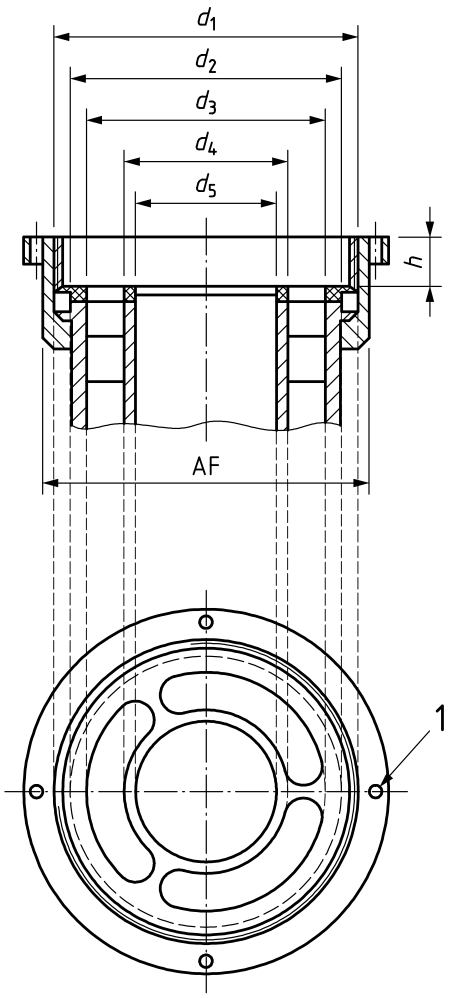
6.3.6.2.1 Requirements

The threads of threaded meter connections on two pipe meters shall be as specified by the meter manufacturer.

Flanges of flanged meter connections shall have dimensions which are in accordance with one of the types of flange given in ISO 7005-1:2011, Table 10 as declared by the meter manufacturer.

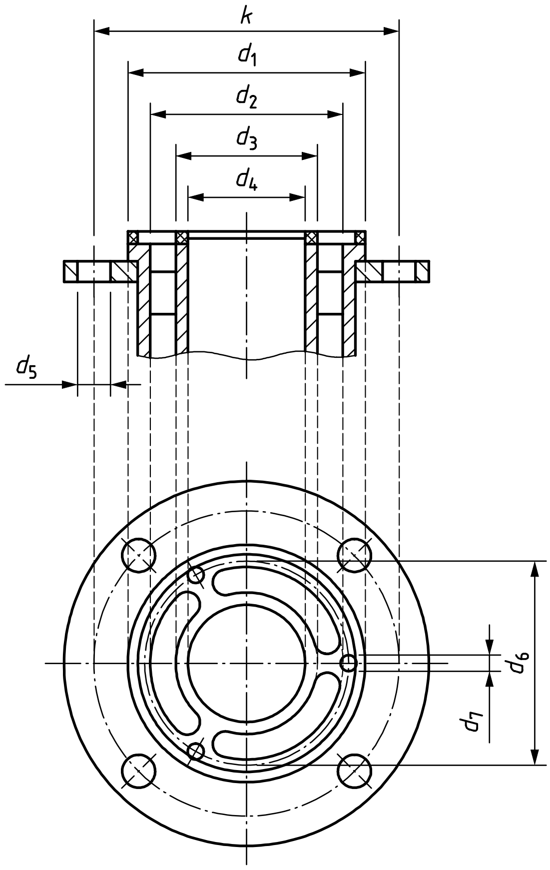
NOTE The fact that the dimensions are taken from ISO 7005-1:2011, Table 10 (the PN 10 table) does not denote that the meter has a pressure rating of 10 bar.

The connections of meters having a co-axial single pipe connection shall be in accordance with Figure 1a or b.



Q_{max} m^3h^{-1}	d_1[a]	d_2	d_3	d_4	d_5	h	AF
≤ 10	G2	54	46	32	26	9_{0}^{+3}	65
16/25	G2 3/4	76,5	63	48	41	9_{0}^{+4}	90
[a] designation for threads to EN ISO 228-1							

1a) Co-axial single pipe screw connections



Q_{max} m^3h^{-1}	d_1	d_2	d_3	d_4	d_5	d_6	d_7	No. of holes (d_7)	*K*	No. of bolt holes
40	98	82	60	50	12	75	2,6	3	125	4
65	158	114	82,5	68	18	139	3	3	180	8
100	188	133	95	77	18	160	3	3	210	8
160	240	194	133	113	22	217	3	4	270	8

1b) Co-axial single pipe flanged connections

Key

d diameter of the indicated dimension

k diameter between the centres of the bolt holes

1 sealing hole

AF across flats

h height of the indicated dimension

Figure 1 — Co-axial single pipe connections

6.3.6.2.2 Test procedure — Threads and flanges for single and two pipe meters

Measurements are taken using appropriate instruments capable of measuring to an accuracy better than that required in 6.3.6.2.1.

6.3.6.3 Strength

6.3.6.3.1 Torque

6.3.6.3.1.1 Requirements

The meter connection shall be subjected to the appropriate torque specified in Table 5, in accordance with 6.3.6.3.1.2 and shall then conform with the following:

— external leak tightness (see 6.3.3);

— any residual rotational deformation of the meter connection shall not exceed 2°.

Table 5 — Torque and bending moment

Nominal connection diameter		**Torque value** Nm	**Bending moment, M** Nm
Inches	DN		
1/2	15	50	10
3/4	20	80	20
1	25	110	40
1 1/4	32	110	40
1 1/2	40	140	60
2	50	170	60
2 1/2	65	170	60
3	80	170	60
4	100	170	60
5	125	170	60

6.3.6.3.1.2 Test procedure — Torque

Firmly support the case of the meter under test and apply the appropriate torque value to each connection in turn using a suitable torque wrench.

Report the result as pass or fail.

6.3.6.3.2 Bending moment

6.3.6.3.2.1 Requirements

Each meter shall be subjected to the bending moment given in Table 5 in accordance with 6.3.6.3.2.2 and, during and after the test, the meter shall remain leak tight in accordance with 6.3.3.

Before the bending moment test, the meter under test shall be tested in accordance with the method given in 5.1.2 d).

After the test, the residual deformation of the connections shall not exceed 5°.

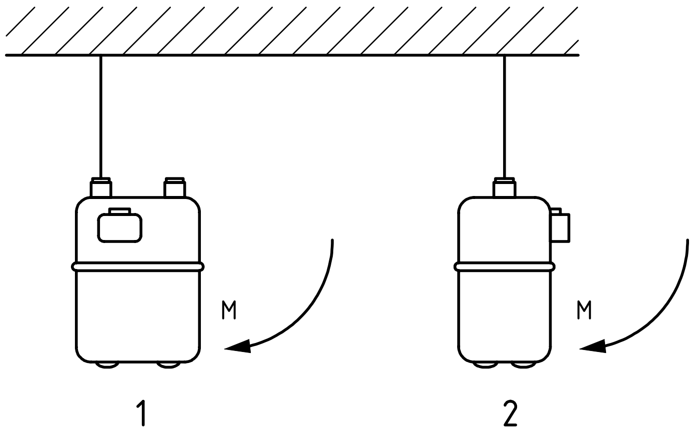
After the bending moment test, the meter under test shall be retested in accordance with the method given in 5.1.2 d). The errors of indication shall be within the allowed MPE-Subsequent limit given in Table 2.

6.3.6.3.2.2 Test procedure — Bending moment

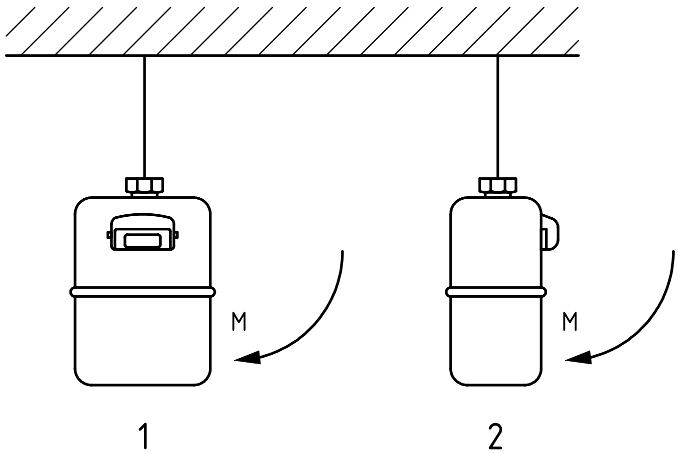
Rigidly support the meter under test by one of its connections (see Figure 2 a) and b)) and subject to the appropriate bending moment for a period of 2 min. Use different meters for the lateral test(s) and the fore and aft test.

In the case of the meter under test being a two pipe meter, repeat the lateral bending moment test on the other meter connection, but for the fore and aft test, support the meter by both connections.

Report the result as pass or fail.



a) Two pipe



b) Co-axial

Key

1 lateral

2 fore and aft

M bending moment

Figure 2 — Arrangement for bending moment test

6.3.7 Resistance to vibration

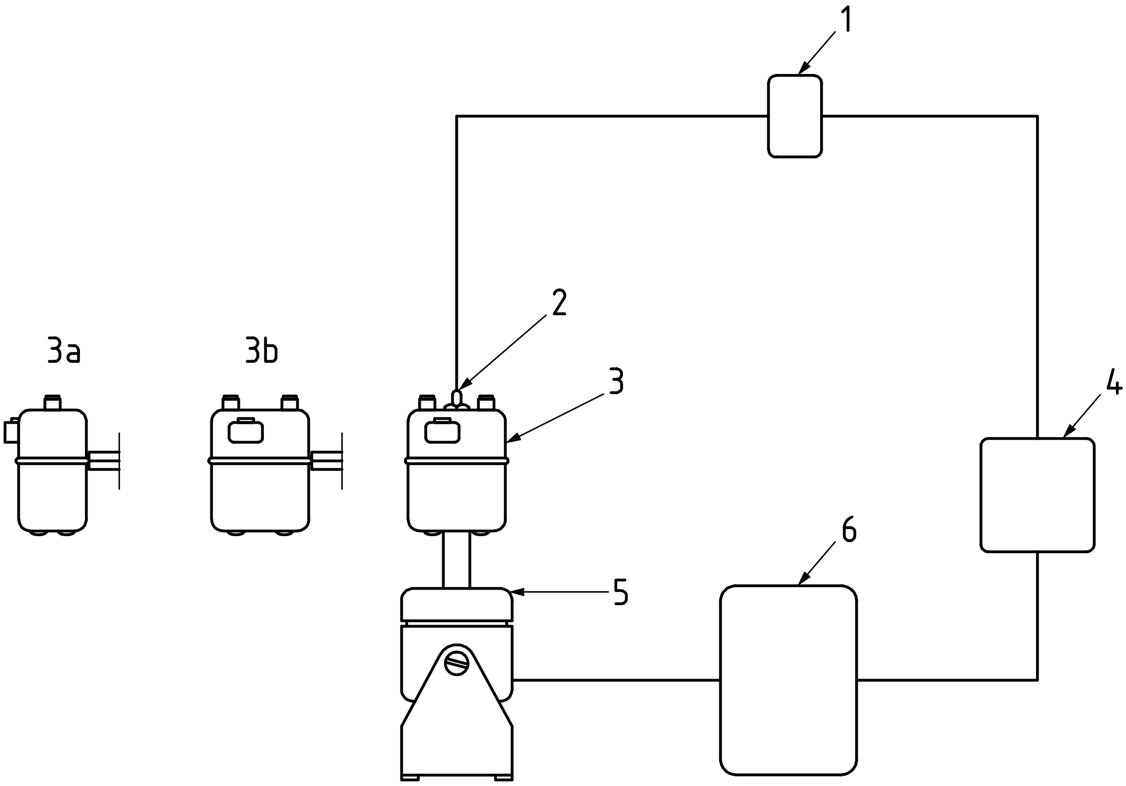
6.3.7.1 Requirements

The resistance to vibration is determined by vibrating the meter under test using an electrodynamic shaker.

The meter shall remain leak tight and its error of indication shall be within the MPE-Initial limits given in Table 2, before and after being subjected to the vibration test described in 6.3.7.2.

6.3.7.2 Apparatus

The apparatus described in Figure 3 shall be used to undertake the test.



Key

1 charge amplifier, used to condition the output from the piezoelectric transducer (2)

2 accelerometer (piezoelectric transducer)

3 meter under test (vertical plane), mounted to spindle of electrodynamic shaker (5)

3 a) meter under test (fore and aft plane)

3 b) meter under test (lateral plane)

4 automatic vibration exciter control, capable of being used in a sweeping mode in which the frequency is cycled between a pair of selected frequencies, alternately increasing and decreasing

5 electrodynamic shaker, driven by an amplified sine wave from a voltage generator

NOTE The head of the shaker can be rotated through 90° for fore and aft and planes (see 3a) and 3b))

6 power amplifier, suitable for amplifying the power of the accelerometer

Figure 3 — Layout of the vibration test apparatus

6.3.7.3 Test procedure

Carry out the error of indication test specified in 5.1.2 c), to ensure that the accuracy of the meter under test is within the maximum permissible initial error limits given in in Table 2 and confirm that the meter under test is leak tight, by carrying out the test described in 6.3.3.

Secure the meter under test to the vibration test rig, as shown in Figure 3, using a horizontal clamp across the top of the meter.

The clamping force should be sufficient to restrain the meter under test without causing damage or distortion to the meter case.

Subject the meter under test to a swept frequency of between 10 Hz and 150 Hz (±5 %) at a sweep rate of 1 octave per min with a peak acceleration of $2\,g_n$ (±5 %), for 20 sweeps in the vertical plane, 20 sweeps in the fore-aft plane and 20 sweeps in the lateral plane. The displacement amplitude shall be limited to 0,35 mm.

Recheck the error of indication of the meter under test by carrying out the test specified in 5.1.2 c) and confirm the leak tightness by carrying out the test described in 6.3.3.2.

NOTE An octave is a band of frequency where the upper frequency limit of the band is exactly twice the lower limit, e.g. 10 Hz to 20 Hz, 20 Hz to 40 Hz, 40 Hz to 80 Hz and 80 Hz to 160 Hz. Therefore, the time taken to sweep from 10 Hz to 100 Hz at a sweep rate of 1 octave per minute is 3 min 15 s.

Report the result as pass or fail.

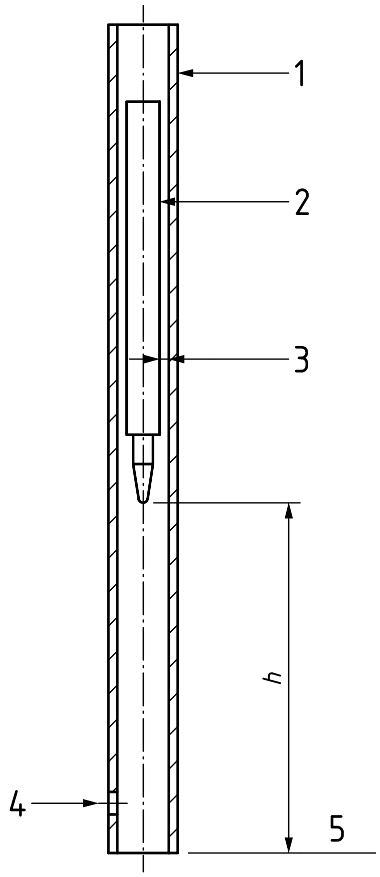
6.3.8 Resistance to impact

6.3.8.1 Requirements

After being subjected to an impact load using the method described in 6.3.8.2 and 6.3.8.3 the meter shall remain leak tight when tested in accordance with 6.3.3.

6.3.8.2 Apparatus

The test apparatus consists of a hardened steel hemispherical tipped striker and a rigid smooth-bore tube in which the striker is capable of sliding freely (see Figure 4).



Key

1 smooth bore rigid tube

2 hardened hemispherical tipped striker, mass 3 kg

3 radial clearance (0,5 ± 0,25 mm)

4 vent hole

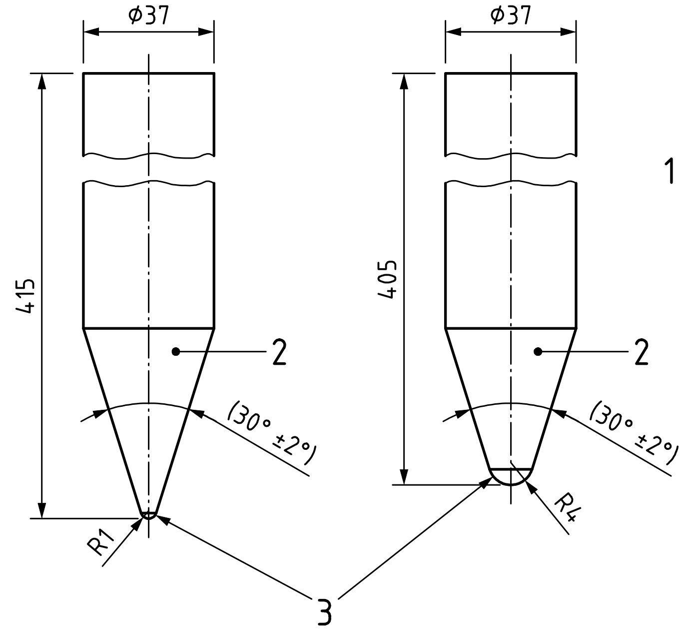
5 meter level

h height in mm above the test area (see 6.3.8.3)

Figure 4 — Impact test apparatus

The total mass of the striker is 3 kg. There are two sizes of striker tip, one with a radius of 1 mm, the other with a radius of 4 mm (see Figure 5).

Dimensions in millimetres



Key

1 striker, total mass 3 kg

2 steel tip, angle 30° ± 2°

3 hardened steel ball; R1 = 1 mm radius, R4 = 4 mm radius

Figure 5 — Typical hemispherical tipped strikers used in impact test

6.3.8.3 Test procedure

Use each size of striker tip during the test, but do not subject any test area on any one meter sample to more than one impact. If the same area is selected for testing with each size of striker tip, use a second meter sample.

For each strike, rigidly support the meter under test on a firm base with the intended area of impact. This can be any area of the meter case, providing the striker can hit the case perpendicular to the chosen plane. Place the end of the guide tube on the chosen impact area of the meter under test. Allow the striker to fall freely and vertically through the tube onto the test area. The striker tip falls from a height of h mm above the test area, where:

a) for the 1 mm striker, h is 100 mm, producing an impact energy of 3 J; and

b) for the 4 mm striker, h is 175 mm, producing an impact energy of 5 J.

Report the result as pass or fail.

6.3.9 Resistance to mishandling

6.3.9.1 Requirements

The meter shall withstand the handling required during its transport and installation. Before testing in accordance with 6.3.9.2, the meter under test shall conform to the following:

a) after testing in accordance with 5.1.2(c), the errors of indication are within the allowed MPE-initial limit given in Table 2;

b) after testing in accordance with 5.2.2, the pressure absorption is within the allowed initial maximum permissible pressure absorption given in Table 3;

c) after testing in accordance with 6.3.3.2 the requirements of 6.3.3.1 for external leak tightness shall be met.

After undergoing the mishandling test described in 6.3.9.2, the meter under test shall conform to the following requirements:

i) when retested in accordance with 5.1.2 c), the meter's errors of indication are within the allowed MPE-Subsequent limit given in Table 2;

ii) when retested in accordance with 5.2.2 the average pressure absorption is within the subsequent maximum permissible value given in Table 3;

iii) when retested in accordance with 6.3.3.2 the meter still meets the requirements for external leak tightness in 6.3.3.1.'

6.3.9.2 Test procedure — Resistance to mishandling

Hold the meter under test, with no packaging, in the upright position (in its horizontal plane), and drop vertically, from rest, on to a flat, hard, horizontal surface from a height as given in Table 6. The heights given refer to the distance from the bottom of the meter under test to the surface onto which it will fall.

Table 6 — Drop height

Q_{max} m^3h^{-1}	**Height of dropping** m
up to 10	0,5
16 to 65	0,3
100 and 160	0,2

Report the result as pass or fail.

6.4 Corrosion protection

6.4.1 General

Meters to which only decorative coatings (i.e. coatings not intended to contribute to corrosion protection) are to be applied shall be tested before application of the coating. Such decorative coatings shall not adversely affect the corrosion resistance of the meter.

All parts of meters shall be able to resist any corrosive substances contained in the internal and external atmospheres that they can expect to be exposed to during normal conditions of storage and use.

All tests shall be performed on the gas-containing components themselves or on sample plaques.

Sample plaques shall only be used in place of a component if no forming operations are carried out on the component after the protective finish is applied.

Sample plaques, if used, shall be 100 mm × 100 mm, their thickness being that of the component they are replacing.

The finishes on items supplied for test shall have been fully dried and cured.

Attack on the edges or up to 2 mm from the edge of sample plaques shall be ignored if the component it replaces has no exposed edges when installed in the finished meter.

6.4.2 External corrosion

6.4.2.1 Scratch resistance of the protective coating

When tested using the method given in EN ISO 1518-1 using a loading of 19,5 N, corrodible base material shall not be exposed.

Where a metallic protective coating is applied directly onto a metal surface, the indicator lamp will light without any penetration of the surface. In this case the surface shall be visually inspected for penetration.

6.4.2.2 Adhesion of the protective coating

When tested using the method given in EN ISO 2409, the result shall be less than classification 2 given in EN ISO 2409.

6.4.2.3 Impact resistance of the protective coating

When tested using the method given in ISO 6272-2 for impact resistance using a falling height of 0,5 m and with the depth of the indentation limited to 2,5 mm, there shall be no cracking or loss of adhesion of the protective coating.

During the test, place the surface of the test piece which would normally be the outside surface of the meter, so that it faces upwards.

6.4.2.4 Chemical resistance of the protective coating

When tested in accordance with EN ISO 2812-1:2007, Clause 8 using a test period of 168 h, the result shall be less than that given as ratio density 2/size 2 given in EN ISO 4628-2, and the degree of corrosion of the base material shall not be greater than that given as R_i 1 in EN ISO 4628-3:2016, Table 1.

The liquids of EN ISO 2812-1:2007, A.2.2 and A.3.1 as well as 5 % aqueous solution of sodium salts of sulfated broadcut primary alcohol, chain length C9 to C13 pH values 6,5 to 8,5 shall be used.

6.4.2.5 Resistance to salt spray

The sample used for this test shall be a complete meter for sizes of meter having a Q_{max} of up to and including 10 m^3h^{-1} and a representative part of the meter, which include at least one connection, for meters above this size.

When tested in accordance with EN ISO 9227, using a salt solution with the pH-Value given in EN ISO 9227:2012, 3.2.2 (neutral salt spray test), the sample shall be exposed to the salt spray over 500 h and the degree of corrosion of the base material shall not be greater than that given as *R*i 1 in EN ISO 4628-3:2016, Table 1.

6.4.2.6 Resistance to humidity

The sample used for this test shall be a complete meter for sizes of meter having a Q_{max} of up to and including 10 m^3h^{-1} and a representative part of the meter, which includes at least one connection, for meters above this size.

When tested in accordance with EN ISO 6270-1 using a test duration of 500 h, any blistering of the coating shall be less than that given as the ratio density 2/size 2 EN ISO 4628-2, and the degree of corrosion of the base material shall be not greater than that given as *R*i 1 in EN ISO 4628-3:2016, Table 1. The test shall be carried out on representative parts of the meter, e.g. deep-drawn parts, which should be cut out of a sample meter.

Report the result as pass or fail.

6.4.3 Internal corrosion

6.4.3.1 Adhesion of the protective coating

When tested in accordance with 6.4.2.2, the result shall be less than classification 2 given in EN ISO 2409.

6.4.3.2 Impact resistance of the protective coating

When tested in accordance with 6.4.2.3, there shall be no cracking or loss of adhesion of the protective coating at the side, which is normally the inner side.

6.4.3.3 Chemical resistance of the protective coating

When tested in accordance with 6.4.2.4, the blistering of the protective coating shall be less than that given as the ratio density 2/size 2 in EN ISO 4628-2, and the degree of corrosion of the base material shall not be greater than that given as R_i 1 in EN ISO 4628-3:2016, Table 1.

6.4.3.4 Resistance to humidity

When tested in accordance with 6.4.2.6 using a test duration of 48 h, any blistering of the coating shall be less than that given as the ratio density 2/size 2 in EN ISO 4628-2, and the degree of corrosion of the base material shall not be greater than that given as R_i 1 in EN ISO 4628-3:2016, Table 1.

6.5 Resistance to storage temperature range

6.5.1 Requirements

Before and after testing in accordance with 6.5.2 the meter shall be within the MPE-Initial error limits specified in Table 2.

6.5.2 Test procedure — Resistance to storage temperature range

For each meter under test (see Table 10):

— Over a period of at least 2 h bring the meter under test to a temperature of −20 °C, or lower if declared by the manufacturer, and maintain it at this temperature for 3 h with no gas flowing through it.

— Over a period of at least 2 h return the meter to normal laboratory ambient temperature and test it in accordance with 5.1.2 c).

— Over a period of at least 2 h bring the meter under test to a temperature of 60 °C, or higher if declared by the manufacturer, and maintain it at this temperature for 3 h with no gas flowing through it.

— Over a period of at least 2 h return the meter to normal laboratory ambient temperature and test it in accordance with 5.1.2 c).

Report the result as pass or fail.

6.6 Optional features

6.6.1 Pressure measuring point

6.6.1.1 Requirements

If a pressure measuring point is provided on the meter it shall:

— be fixed by mechanical means (i.e. not only relying on solder, brazing or adhesive) ;

— have a hole, through the pressure measuring point, the diameter of which shall be less than 1 mm; and

— after carrying out tests specified in 6.6.1.2 the meter shall remain leak tight when tested in accordance with 6.3.3.2.

6.6.1.2 Test procedure — Pressure measuring point

Measure the diameter of the hole through the pressure measuring point.

Test the meter for leak tightness in accordance with 6.3.3.2.

Apply a torque of 8 Nm to the body of the pressure measuring point in a clockwise and anti-clockwise direction and then release. Drop a mass of 0,5 kg from a height of 250 mm, through a vertical tube of 40 mm maximum diameter on to the outer extremity of the body diameter of the pressure measuring point.

Recheck the meter under test for leak tightness in accordance with 6.3.3.2.

Report the result as pass or fail.

6.6.2 Electrical insulating feet

6.6.2.1 Requirements

If insulating feet are provided on the meter, there shall be a minimum of 4 and they shall give a minimum clearance of 5 mm at the base of the meter.

After carrying out the test specified in 6.6.2.2, the electrical resistance measured shall not be less than 100 kΩ.

Whilst carrying out the 650 V AC test specified in 6.6.2.2, there shall be no breakdown of the insulation.

6.6.2.2 Test procedure — Electrical insulating feet

Place the meter under test on a flat metal plate and apply a potential of 500 V DC between the metal plate and each meter connection in turn for 60 s. Measure the electrical resistance between the metal plate and each connection successively.

Then apply a potential of 650 V AC between the metal plate and each meter connection, successively, for 60 s.

Report the result as pass or fail.

6.6.3 Magnetic index drive

6.6.3.1 Requirements

If a magnetic index drive is provided on the meter, the torque transmission of the magnetic drive unit shall be at least three times that required to drive the index when all of the index digits are in motion (i.e. all the nines to all the zeros) and when measured after the index has been operated to record an equivalent volume of gas to that passing through the meter during the entirety of any endurance test carried out on the meter.

NOTE Additional devices, such as reed switches, are considered to be part of the index.

6.6.3.2 Test procedure — Magnetic index drive

Run a new index assembly, which has been supplied by the manufacturer, with the reading being approximately all the nines minus a reading equivalent to an equivalent volume of gas to that passing through the meter during the endurance test. The test is run until the reading is all the nines. Measure the torque to move the index drives to the all zeros position. Compare this measured torque with the available torque of the magnetic drive unit of the meter under test.

Report the result as pass or fail.

6.6.4 Devices to prevent the registration of reverse flow

6.6.4.1 Requirements

Meters fitted with a device to prevent the registration of reverse flow shall not allow the registration of more than 5 cyclic volumes when subjected to reverse flow.

6.6.4.2 Test procedure — Devices to prevent the registration of reverse flow

Note the index of the meter under test. Connect a source of pressure of 20 mbar to the meter outlet, the meter inlet being open to atmosphere. Observe the index until it has stopped decreasing and again note the reading of the index.

Calculate the registration of reverse flow as the initial index reading noted minus the final index reading noted.

Report the result as pass or fail.

6.6.5 Devices to prevent reverse flow

6.6.5.1 Requirements

Meters fitted with a device to prevent reverse flow shall not pass a reverse flow of more than 2,5 % of Q_{max} (e.g. for a meter having a Q_{max} of 6 m^3h^{-1}, reverse flow shall not exceed 0,15 m^3h^{-1}).

6.6.5.2 Test procedure — Devices to prevent reverse flow

Connect a source of pressure to the meter outlet, via a flow measurement device, so that the pressure at the meter outlet is 20 mbar with the meter inlet open to the atmosphere. Measure the average reverse flow through the meter under test using the flow measurement device.

Report the result as pass or fail.

6.6.6 Resistance to high temperatures

6.6.6.1 Requirements

Where the manufacturer declares that the meter is resistant to high temperatures, the meter shall conform to the following requirement and shall be marked in accordance with 8.1.

Remove the battery prior to testing at high temperature.

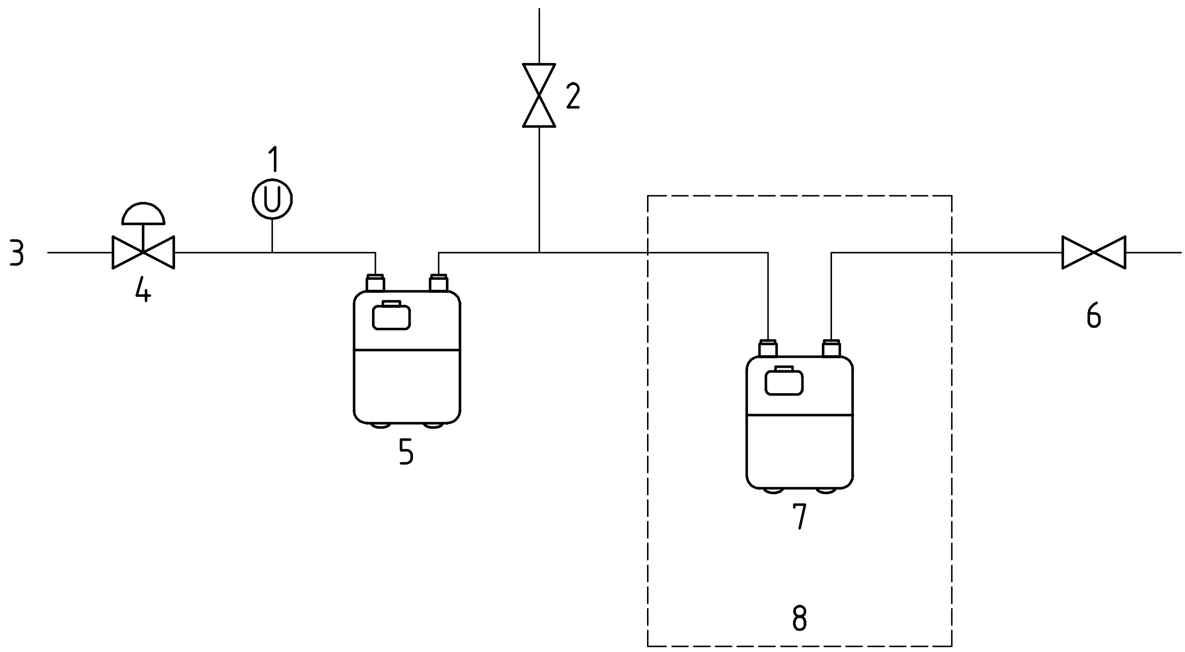
NOTE To avoid blocking of the outlet connections by condensation of materials distilled from the internal components of the meter under test, it is preferable to carry out the test on an empty meter case, supplied as such by the manufacturer. If this is not possible, the outlet pipe of the apparatus can be inclined downwards and a safety tap for the removal of condensation products installed upstream of the bleed valve.

When tested in accordance with 6.6.6.2, the leakage rate of the meter case shall not exceed 150 dm^3h^{-1} for meters of size up to and including those having a Q_{max} of 40 m^3h^{-1}, or 450 dm^3h^{-1} for meters of sizes Q_{max} of 65 m^3h^{-1} and above.

6.6.6.2 Apparatus

Furnace, capable of allowing an ambient temperature rise conforming to the curve defined in ISO 834-1. The internal dimensions of the furnace shall allow the installation of the meter under test and its connections to be in identical positions to those used in practice.

Pressure regulator, capable of maintaining a constant pressure equal to 100 mbar during the complete test.



Key

1 manometer
2 bleed valve
3 inlet
4 pressure regulator
5 check meter
6 air purge valve
7 meter (or meter box) under test
8 furnace

Figure 6 — Example of a high ambient temperature test apparatus

6.6.6.3 Test procedure — Resistance to high ambient temperatures

Connect the meter (or the meter case) under test to the inlet and outlet connections and install the assembly in the centre of the furnace using supports if necessary (see Figure 6).

NOTE 1 Where an empty meter case is being tested, it is necessary to take into account the mass of the metering apparatus and, if necessary, a metal weight piece equivalent to the mass of the metering apparatus is to be put on the case.

With the bleed valve closed, pressurize the meter under test to 100 mbar with nitrogen and verify its tightness.

NOTE 2 100 mbar is the test pressure for resistance to high ambient temperatures which can be confused with P_{max}.

With the meter under the nitrogen test pressure, increase the temperature of the furnace in accordance with the temperature rise curve of ISO 834-1.

When the temperature at the coldest point of the meter under test reaches 650 °C, set the furnace temperature to maintain a constant temperature of 650 °C for a period of 30 min.

During the complete test, maintain the pressure in the meter under test at the test pressure by means of the bleed valve. Record the leakage rate as registered using metering periods not exceeding 5 min.

Calculate the leakage as the metered nitrogen volume divided by the measuring time.

Report the result as pass or fail.

6.6.7 Diaphragm gas meters provided with a built-in gas temperature conversion device

Requirements and tests for diaphragm gas meters provided with a built-in gas temperature conversion device are given in Annex B.

6.6.8 Additional functionalities

Requirements for additional functionalities and batteries are given in EN 16314:2013.

7 Mechanical performance

7.1 Meter assembly

7.1.1 General

Samples of the meter shall conform to the durability requirement in 7.1.2.

7.1.2 Durability

7.1.2.1 Requirements

Meters subjected to the endurance test shall be fitted with their indexes.

All sample meters shall meet the following requirements prior to undergoing the endurance test given in 7.1.2.2:

a) the error of indication shall be within the MPE-Initial limits given in Table 2 when tested in accordance with 5.1.2 b);

b) following retesting for pressure absorption in accordance with 5.2.2, the pressure absorption shall be not more than that given in the initial maximum permissible pressure absorption column of Table 3.

During and on completion of the endurance test given in 7.1.2.2, if test method option 1 (see Table 7) has been used, all meters shall meet the following requirements:

i) the error of indication shall be within the MPE-Subsequent limits given in Table 2 when tested in accordance with 5.1.2 b);

ii) the endurance error values over the flow range of Q_t to Q_{max}, shall not differ by more than 2 % from the initial corresponding value;

iii) following retesting for pressure absorption in accordance with 5.2.2 the average pressure absorption is within the subsequent maximum permissible value given in Table 3.;

iv) the external leak tightness shall be in accordance with 6.3.3.

During and on completion of the endurance test given in 7.1.2.2, if test method option 2 (see Table 7) has been used, all meters shall meet the requirements of i), ii), and iii) of above except that one meter is allowed to be outside the specified limits. All meters shall pass the leak tightness test in accordance with 6.3.3.

7.1.2.2 Endurance tests

7.1.2.2.1 General

The number of meters used for the endurance test is given in Table 7.

Table 7 — Number of meters to be used for the endurance test

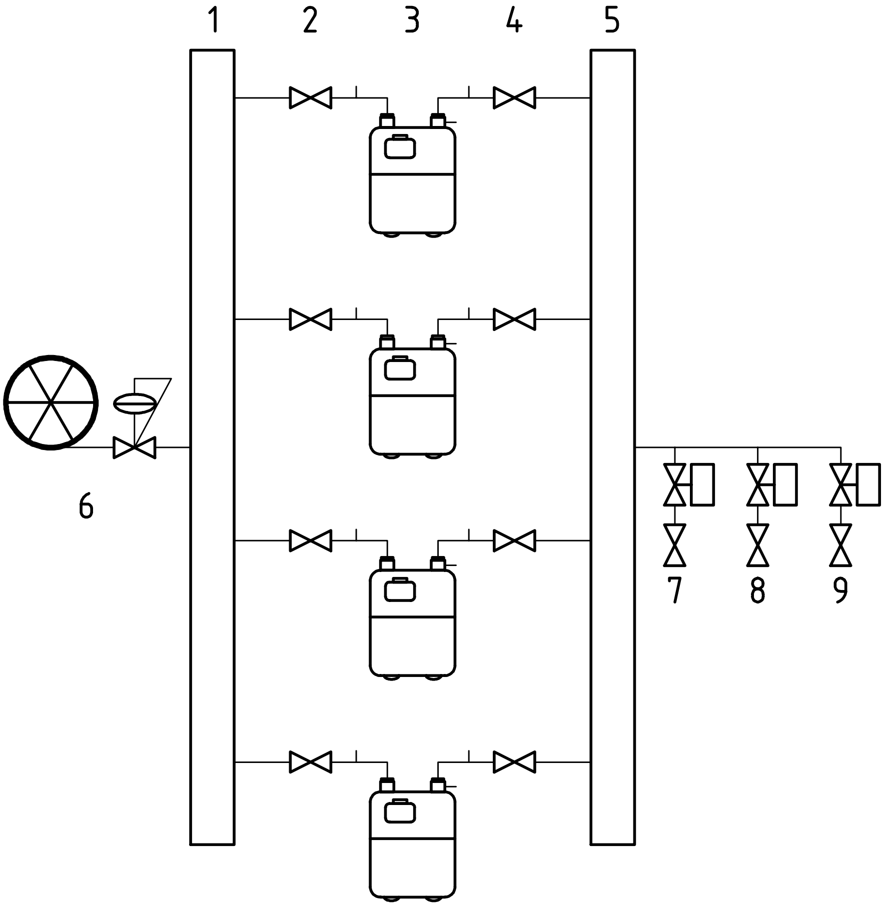
$\boldsymbol{Q}_{\mathbf{max}}$ m^3h^{-1}	**Number of meters to be tested**	
	Option 1	Option 2
up to 10 inclusive	3	6
16 to 160 inclusive	2	4

Meters with Q_{max} less than or equal to 10 m^3h^{-1} shall be tested in accordance with the cycling test procedure given in 7.1.2.2.2. Meters with Q_{max} greater than 10 m^3h^{-1} shall be tested in accordance with the constant flow test procedure given in 7.1.2.2.3.

7.1.2.2.2 Test procedure – Endurance by cycling

This test shall be used for meters with a Q_{max} of less than or equal to 10 m^3h^{-1}.

Determine the error of indication of the meters under test with air using the tests given in 5.1.2 b). Exercise the meters in a cycling test rig (an example is shown in Figure 7) using air at a temperature between 5 °C and 40 °C and pressure between 20 mbar to 25 mbar for a duration of 450 000 cycles. During the test the maximum temperature variation shall be ± 10 °C and the maximum pressure variation ± 3 mbar.



Key

1 inlet manifold
2 ball valve
3 meter under test
4 gate valve (balancing)
5 outlet manifold
6 low pressure air source
7 solenoid with gate valve set to 1/3 Q_{max}
8 solenoid with gate valve set to 1/3 Q_{max}
9 solenoid with gate valve set to 1/3 Q_{max}

Figure 7 — Example of an endurance test rig for cycling

Remove the meters under test from the exercise rig after 25 000, 150 000, 300 000 and 450 000 cycles and determine their error of indication, using the same equipment as was used for the initial error of indication check.

Cycle the meter for a nominal 16 s as shown in Figure 8 for randomly generated times within the following:

Cycle a)

— 2/3 of Q_{max}; for (5 ± 1) s

— 1/3 of Q_{max}; for (3 ± 1) s

Cycle b)

— 3/3 of Q_{max}; for (5 ± 1) s

— 0 flow for (3 ± 1) s

and continue with the same profile for a total of 450 000 cycles.

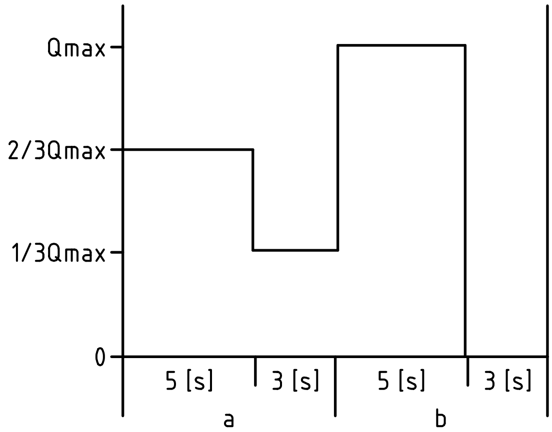


Figure 8 — Profile of a 16 s cycle

The solenoid valves shall be as close as possible to the outlet manifold and the response time of each valve shall be less than 100 ms.

The balancing valve (4) shall be at the outlet of each meter and within 5 DN of the outlet manifold (5).

The manual device used to adjust the flow rate shall be placed at the outlet of the meters.

The nominal diameter of each valve shall be chosen so that the flow velocity is less than or equal to 5 $m.s^{-1}$ when calculated with the nominal diameter of the valve.

A data acquisition module and associated software shall be used to determine the sequencing of the cycling and the number of cycles completed between interim registration accuracy checks.

The capacity of the air source shall guarantee a pressure drop less or equal to 3 mbar during cycling.

The flow speed in the inlet pipe shall be less or equal to 5 $m.s^{-1}$.

The pressure in the inlet pipe shall be verified before each test.

The flow speed in the outlet pipework shall be less than or equal to 5 $m.s^{-1}$ and the maximum volume, in dm^3, shall be 1/3 of the Q_{max} value of the meter under test, in m^3h^{-1} multiplied by the number of meters under test.

NOTE The flow control can be determined by using each meter under test.

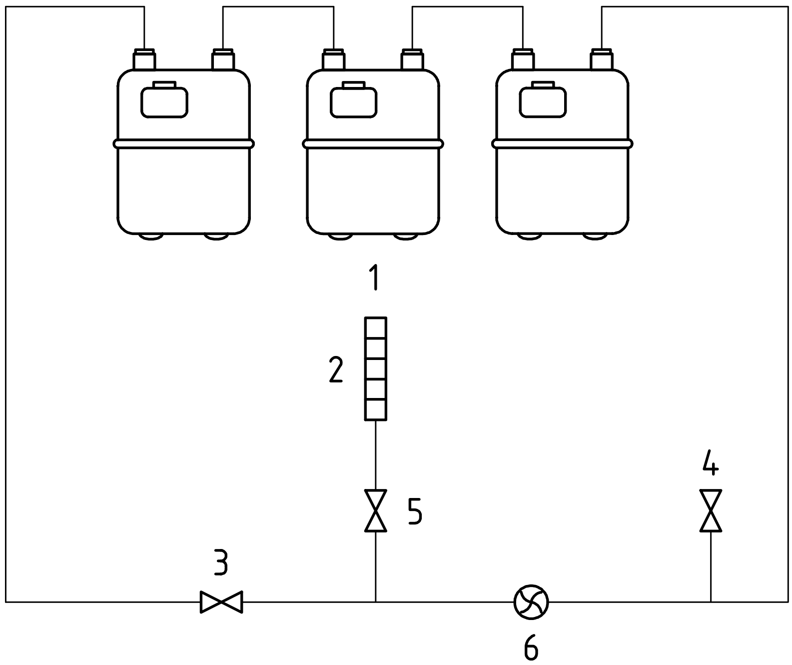
7.1.2.2.3 Test procedure — Endurance at Q_{max}

This test shall be used for meters with a Q_{max} greater than 10 m^3h^{-1}.

The number of meters used for the endurance test is given in Table 7.

Determine the error of indication of the meters under test with air using the tests given in 5.1.2 b), exercise the meters in a test rig (an example is shown in Figure 9), using a distributed gas (see 3.1.13), at a temperature between 15 °C and 25 °C and at a pressure not exceeding the maximum working pressure for a period of 5 000 h at Q_{max}.

Remove the meters under test from the exercise rig after 0,05 V_{tot}, 0,4 V_{tot}, 0,7 V_{tot} and V_{tot}, (where V_{tot} is equal to the total volume of gas which will have passed through a meter if the meter is run at Q_{max} for 5 000 h), and determine their error of indications on air, using the same equipment as was used for the initial error of indication check and under the same ambient conditions.



NOTE 1 The flow through the meters on test is regulated by the use of control valve (3) and a stopwatch.

NOTE 2 The gas passes into the test rig via a control valve (4) where it is circulated through the meters by a suitable circulating pump or blower.

NOTE 3 In order to maintain a fresh supply of gas through the circuit, control valve (5) is regulated to provide an exhaust flow of approximately 0,1 % Q_{max}.

Key

1 meters under test
2 flow meter
3 control valve
4 control valve
5 control valve
6 circulating blower

Figure 9 — Example of an endurance test rig at Q_{max}

When removing the meters from the exercise rig, prior to carrying out each error of indication check, immediately purge with 3 m^3 of air and cap the ports to avoid the ingress of moisture.

Record the constituents of the distributed gas in the certification test report.

7.1.3 Meter error of indication at declared gas temperature limits

7.1.3.1 Requirements

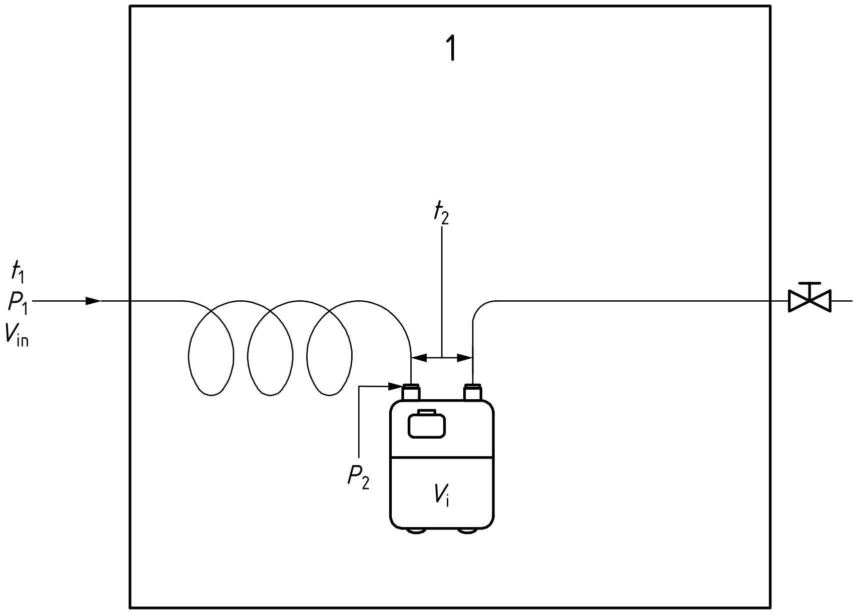
Over the gas temperature range declared by the manufacturer, between the flow rates of Q_{min} and Q_{max}, the errors of indication of meters shall be within the maximum permissible initial limits given in Table 2.

7.1.3.2 Test procedure — Meter error of indication at declared gas temperature

Install the meter to be tested in a temperature controlled chamber which is supplied with air at normal laboratory temperature, t_1, in °C, with a constant pressure not exceeding the maximum working pressure of the meter under test and a relative humidity such that its dew point is at least 10 K lower than the test temperature.

Lower and maintain the temperature of the chamber to $\left(-10_{0}^{+2}\right)$ °C, or lower if declared by the manufacturer.

Pass the air through a heat exchanger, so that the temperature of the air entering the meter is the minimum gas temperature declared by the manufacturer, and then into the meter under test (see Figure 10).



Key

1 temperature controlled air chamber

Figure 10 — Example of a test rig for test at declared gas and ambient temperature limits

The test temperature t_2, in °C, is the mean value of the temperature measured at the inlet and outlet of the meter.

After verifying that the temperature t_2 is stable within the above limits, i.e. $\left(-10_{0}^{+2}\right)$ °C, check the error of indication of the meter under test using the method given in 5.1.2 d), except that the above temperature is maintained, using the equation given below.

Verify that this error of indication is within the MPE-Initial limits given in Table 2.

Raise the temperature of the chamber and maintain at $\left(40_{-2}^{0}\right)$ °C, or higher if declared by the manufacturer

Pass the air through a heat exchanger, so that the temperature of the air entering the meter is the maximum gas temperature declared by the manufacturer and then into the meter under test (see Figure 10).

After verifying that the temperature t_2 is stable within the above limits, i.e. $\left(40_{-2}^{0}\right)$ °C or higher, check the error of indication of the meter under test using the method given in 5.1.2 d), except that the above temperature is maintained, using Formulae (3) and (4):

$$V_c = V_{in} \cdot \frac{T_2}{T_1} \cdot \frac{P_1}{P_2} \tag{3}$$

where

- V_c is the actual volume passed through the meter, in m³;
- V_{in} is the actual volume passed into the temperature controlled chamber, in m³;
- T_1 is (t_1 + 273,15), in Kelvin;
- T_2 is (t_2 + 273,15), in Kelvin;
- P_1 is absolute pressure measured at the inlet of the temperature controlled chamber, in Pa;
- P_2 is the mean value of absolute pressure measured at the meter inlet, in Pa.

and

$$E = \frac{V_i - V_c}{V_c} \cdot 100 \tag{4}$$

where

- E is the error indication, expressed as a percentage;
- V_i is the volume indicated by the meter, in m³;
- V_c is the actual volume passed through the meter, in m³.

Verify that this error of indication is within the MPE-Initial limits given in Table 2.

7.1.4 Error of indication subject to declared ambient temperature limits

7.1.4.1 Requirements

Over the ambient temperature range declared by the manufacturer, between the flow rates of Q_{min} and Q_{max}, the errors of indication of meters shall remain within the MPE-Subsequent limits given in Table 2.

7.1.4.2 Test procedure

Check the error of indication of the meter under test using the method given in 5.1.2 d).

Verify that this error of indication is within the maximum permissible initial errors given in Table 2.

Install the meter to be tested in a temperature controlled chamber which is supplied with air at normal laboratory temperature, t_1, in °C, with a constant pressure not exceeding the maximum working pressure of the meter under test and a relative humidity such that its dew point is at least 10 K lower than the test temperature.

Lower and maintain the temperature of the chamber to $\left(-10_{0}^{+2}\right)$ °C, or lower if declared by the manufacturer.

Pass the air through a heat exchanger, so that the temperature of the air entering the meter is the minimum ambient temperature declared by the manufacturer and then into the meter under test (see Figure 10).

Run the meter for 22 h at $Q_{\max}$ at the manufacturer's declared minimum ambient temperature (see 4.3). On completion of this running period raise the temperature of the chamber and maintain at $\left(40_{-2}^{0}\right)$ °C, or higher if declared by the manufacturer.

Pass the air through a heat exchanger then into the meter under test so that the temperature of the air entering the meter is at the maximum ambient temperature declared by the manufacturer (see Figure 10).

Run the meter for 22 h at $Q_{\max}$ at the manufacturer's declared maximum ambient temperature (see 4.3).

On completion of this running period check the error of indication of the meter under test using the method given in 5.1.2 d).

Verify that this error of indication is within the MPE-Subsequent limits given in Table 2.

7.2 Index

7.2.1 Construction details

7.2.1.1 Requirements

Meters shall be fitted with a metrologically controlled mechanical or electronic index. The index shall be easily readable without the use of tools.

In addition to the requirements given in 7.2, an electronic index shall also conform to the requirements of EN 16314:2013, Annex C.

The index shall operate satisfactorily for the normal life of the meter under normal conditions of use.

The index shall be non-resettable, non-volatile and protected with a metrological seal.

An index shall have at least a sufficient number of numerals to ensure that the volume passed during 8 000 h at a flow rate of $Q_{\max}$ does not return all of the numerals to their original positions.

The numerals shall indicate in cubic metres, decimal multiples or sub-multiples of a cubic metre. The symbol m^3 shall be marked on the index plate/display close to the number wheels of the index.

The numerals indicating the sub-multiples of the cubic metre shall be clearly distinguishable from the other numerals and they shall be separated from the other numerals by a clearly marked decimal sign.

In cases in which the last numeral indicates in decimal multiples of a cubic metre, the index plate shall be marked with either:

— one or more fixed zeros as appropriate, after the last numeral; or

— the indication x10, x100 etc., in such a way that the reading is always given in cubic metres.

The minimum height of the numerals for the metrological data shall be 4 mm and the minimum width shall be 2,4 mm.

Indexes shall be designed in such a way that testing the meters can be carried out with sufficient accuracy in a reasonable time and the resolution of the index shall conform to Table 8.

It shall be possible to read the index clearly and correctly, within an angle of 15° from normal to the window, within the ambient temperature range of −10 °C to 40 °C, or greater if declared by the manufacturer.

Table 8 — Resolution of meter index

Q_{max} m^3h^{-1}	Numbering every dm^3	Maximum scale interval of a mechanical index dm^3	Maximum resolution of an electronic index
up to 10 inclusive	1	0,2	The increment of the test element or pulse shall occur at least every 60 s at Q_{min}
16 to 100 inclusive	10	2	
160	100	20	

For a mechanical index, a complete revolution of a drum shall, during the last tenth of its travel, i.e. from 9 to 0, cause the advance of the next higher drum by one unit.

NOTE For a mechanical index, the test element can be a continuously moving drum bearing a scale, where each subdivision on the drum is regarded as an increment of the test element.

For an electronic index, the maximum resolution shall be achieved without any special equipment or software and may be activated in a test mode, in which case it shall be described in the operational manual. In case there is no specific test element available the least significant digit of the indicating device is considered as a test element. If a meter with an electronic index is constructed in such a way that the signal of the measuring part is produced in discrete steps this internal resolution shall be equivalent or more accurate than the increment of the test element.

EXAMPLE Diaphragm gas meters with an electronic index, with a maximum flow rate Q_{max} of 6 m^3h^{-1} and a minimum flow rate of 40 dm^3h^{-1} need to have a test element of at least 40/60 = 0,67 dm^3. Also the resolution of the transfer of the rotation of the measuring part into electronic pulses needs to be at least 0,67 dm^3/pulse.

7.2.1.2 Test

Conduct a visual inspection to check conformance to 7.2.1.1.

7.2.2 Index windows and surround

7.2.2.1 Requirements

The index window and its surround shall be made of materials which shall withstand the impact test given in 7.2.2.2 and shall be held firmly in position, both as supplied, and after being subjected to the ageing test given in 7.3.5.

7.2.2.2 Test procedure — Index windows and surround

Drop a solid steel ball of 25 mm diameter 3 times from a height of 350 mm on to the centre of the index window, normal to its plane, whilst the window, fitted in the meter as in operation, is maintained at a temperature of (−5 ± 1) °C.

7.3 Diaphragms and components in the gas path

7.3.1 Requirements for diaphragms and non-rubber components in the gas path

The diaphragms shall remain flexible and leak tight when the meter is operated normally.

Diaphragms and other non-rubber components in the gas path shall be able to resist the effects of constituents of the gaseous atmosphere in which they operate and shall be resistant to ageing throughout the normal life of the meter.

If, after testing one meter in accordance with 7.3.3, one meter in accordance with 7.3.4 and one meter in accordance with 7.3.5, the meters are found to conform to the requirements of those clauses, the diaphragms and other components shall be deemed to be satisfactory.

Each diaphragm shall be clearly marked to enable traceability.

7.3.2 Requirements for rubber components in the gas path

Rubber/elastomeric components with the exception of the diaphragms shall be deemed acceptable if they conform to EN 549 or the requirements of 7.3.1.

7.3.3 Toluene/iso-octane vapour test

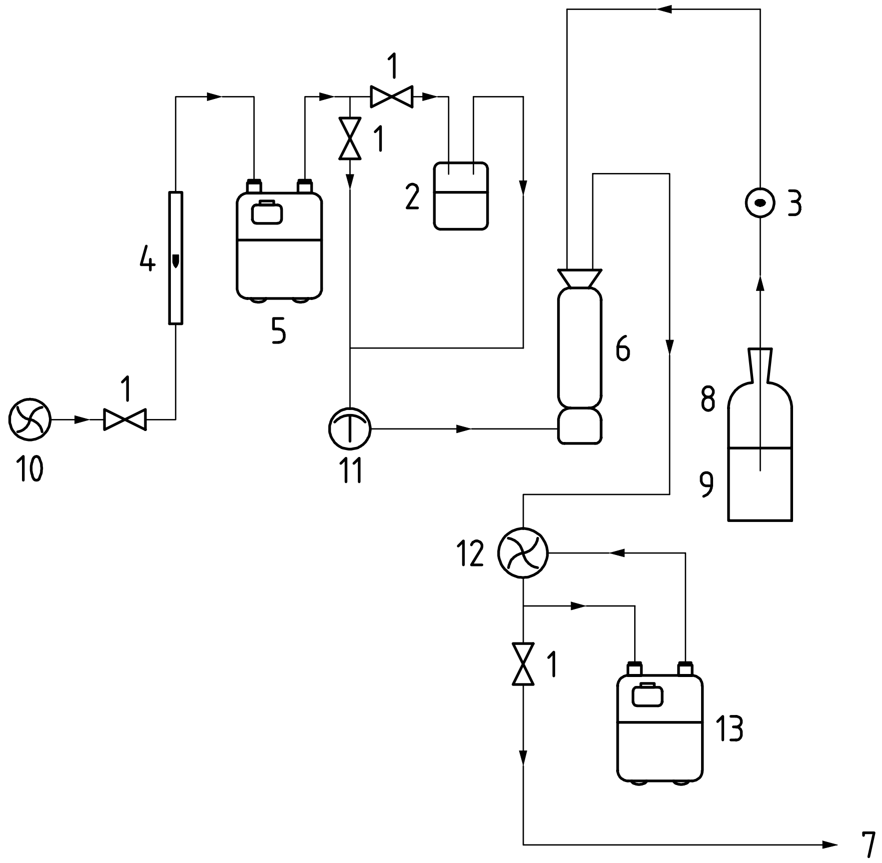
7.3.3.1 Requirements

Before testing in accordance with 7.3.3.4.2 and 7.3.3.4.3, the error of indication, using air, shall be within the MPE-Initial limits given in Table 2, when tested in accordance with 5.1.2 c). At the end of each 7 day period during Test 1, given in 7.3.3.4.2, the error of indication, when checked by the method given in 5.1.2 c), shall not have changed by more than 3 % from that determined at the start of the test.

On completion of Test 2, given in 7.3.3.4.3, the error of indication, when checked by the method given in 5.1.2 c), shall be within the MPE-Initial limits given in Table 2.

7.3.3.2 Apparatus

An example of typical apparatus is given in Figure 11.



Key

1 valve(s)
2 water reservoir for moisture adjustment
3 micro-metering pump
4 rotameter
5 meter for volume test
6 vaporization tower filled with alternate layers of glass beads and cotton fabric and surrounded by a blanket
7 exhaust
8 toluene/iso-octane reservoir
9 solvent addition
10 blower
11 hygrometer
12 circulating blower
13 meter under test

Figure 11 — Typical apparatus for toluene/iso-octane vapour test

The apparatus consists of the following components:

a) **meter exercise rig**, open to atmosphere, fitted with a suitable circulating pump or blower.

b) **nitrogen supply** with a flow rate measurement capability (flow meter, meter or both).

c) **relative humidity control,** comprising a water reservoir and valves capable of giving a relative humidity of (65 ± 10) %. The relative humidity is measured by a hair or paper hygrometer or by a moisture meter.

d) **solvent addition**: the toluene/iso-octane mixture is added to the top of the vaporization tower by means of a micro-metering pump. The tower has a bottom diffuser plate and is filled with alternate layers of small glass beads and cotton fabric (or other material) to give a large surface area. The tower is surrounded with a heating blanket, which produces a high temperature at the blanket/tower interface to speed up vaporization.

7.3.3.3 Reagents

7.3.3.3.1 Toluene/iso-octane mixture with nitrogen

Prepare a mixture 3 % by volume of a 30 % toluene/70 % iso-octane mixture with nitrogen by carefully mixing 95,4 ml toluene with 346,5 ml iso-octane and adding 441,9 ml of this mixture to 2 240 l of nitrogen carrier gas. This is equivalent to 0,197 $ml.l^{-1}$ of carrier gas.

NOTE The actual amount of solvent to be added to the system is dependent on the carrier gas flow rate and the conditions inside the tower.

7.3.3.4 Procedure — Toluene/iso-octane vapour test

7.3.3.4.1 General

Allow the toluene/iso-octane mixture (see 7.3.3.3.1) to percolate down the tower and vaporize. Introduce the carrier gas, at a controlled flow rate, through the diffuser at the bottom of the tower where it picks up the vaporized solvent. Pass the gaseous mixture into the exercise rig where it is circulated through the meter under test. A fresh supply of solvent is continuously added to give a stable concentration.

Ensure steady-state conditions. Steady-state is considered to be attained if the movement in registration between two consecutive tests is less than the uncertainty of measurement as calculated using ISO 5168, or if there is a reverse in the movement over a period of 14 days (336 h).

When removing the meter from the exercise rig in order to check the error of indication at the seven day intervals, the meter ports shall be sealed to prevent the ingress of air until the error of indication is about to be checked.

Use the same equipment for the initial meter error of indication check as for the intermediate and final error of indication checks.

7.3.3.4.2 Test 1 — Toluene/iso-octane vapour test

Exercise the meter under test with nitrogen, to which approximately 3 % by gaseous volume of a 30 % toluene/70 % iso-octane mixture has been added (see 7.3.3.3.1), for a maximum of 42 days (1 008 h) at (20 ± 2) °C, (65 ± 10) % relative humidity and a flow rate of not less than 0,25 Q_{max}.

The error of indication of the meter under test is checked every 7 days (168 h), using air, until a steady-state of error of indication is attained.

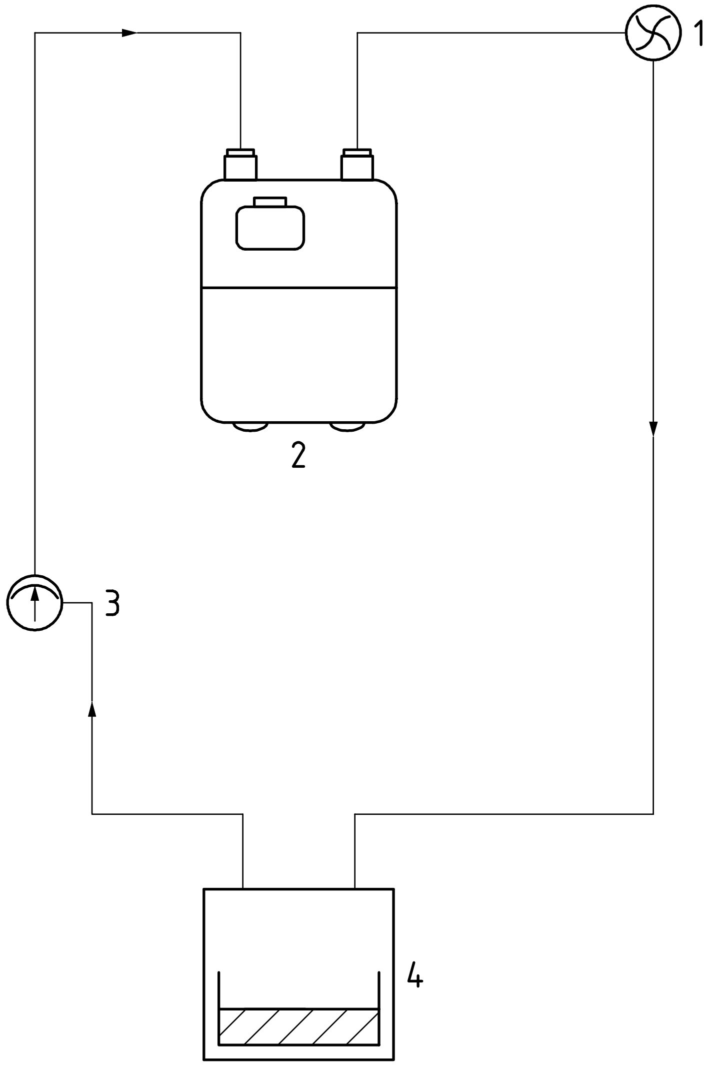
7.3.3.4.3 Test 2 — Toluene/iso-octane vapour test

After Test 1, exercise the meter under test with air for a further period of 7 days (168 h) at (20 ± 2) °C, (65 ± 10) % relative humidity and a flow rate of not less than 0,25 Q_{max}. Check the error of indication of the meter under test using air.

7.3.4 Water vapour test

Carry out the error of indication test, specified in 5.1.2 c), to ensure that the accuracy of the meter under test is within the limits of the MPE-Initial limits given in Table 2.

Connect the meter to a water vapour test rig (see Figure 12).



Key

1 circulating blower
2 meter under test
3 hygrometer
4 saturated solution for humidity control

Figure 12 — Example of apparatus for water vapour test

In Figure 12, the meter (2) is shown connected to a test rig which consists of a closed circuit containing a suitable circulating pump or blower (1), a chamber containing either a saturated solution of potassium acetate (CH_3COOK) to give a relative humidity of 20 % at 20 °C, or a saturated solution of potassium hydrogen sulphate ($KHSO_4$) to give a relative humidity of 86 % at 20 °C (4), and a hygrometer with a range of 0 % to 100 % relative humidity (3).

Exercise the meter with air having a relative humidity of less than 20 % for 7 days (168 h) at (20 ± 2) °C and a flow rate of not less than 0,25 Q_{max}. At this point check the error of indication of the meter under test, using the method specified in 5.1.2 c), to confirm that the error of indication is within ± 1,5 %.

On completion of this low humidity performance test, exercise the meter with air having a relative humidity of (85 ± 5) % for a maximum of 42 days (1 008 h) at (20 ± 2) °C and a flow rate of not less than 0,25 Q_{max}. Check the meter error of indication every 7 days (168 h), using air and the method given in 5.1.2 c), until a steady-state of error of indication is attained (see 7.3.3.4). At this point check the meter error of indication using the method given in 5.1.2 c), to confirm that the error of indication has not changed by more than 3 % from that determined at the start of the test.

Exercise the meter with air having a relative humidity of less than 20 % for at least 7 days (168 h) at (20 ± 2) °C and a flow rate of not less than 0,25 Q_{max}.

Carry out the error of indication test, using air at normal laboratory conditions, as specified in 5.1.2 c), to confirm that the accuracy of the meter is still within the MPE-Initial limits are given in Table 2.

7.3.5 Ageing

7.3.5.1 Requirement

Following the ageing test given in 7.3.5.2, the error of indication shall be within the MPE-Subsequent limits given in Table 2.

7.3.5.2 Test

Test the meter as specified in 5.1.2 c) using a temperature selected by the manufacturer from the appropriate values given in Table 9.

Exercise the meter, together with its index, at the temperature selected by the manufacturer, on air at the same temperature and at a regulated flow rate of between 0,2 Q_{max} and 0,3 Q_{max} for the appropriate time period given in Table 9.

Table 9 — Temperature/times of ageing periods

Temperature °C	**Time period** Days
70 ± 2	50
60 ± 2	100
50 ± 2	200

On completion of the test, return the meter to normal laboratory temperature and carry out the error indication test, as specified in 5.1.2 c), to ensure that the accuracy of the meter is within the MPE-Subsequent limits given in Table 2.

8 Marking

8.1 All meters

Each meter shall be marked with at least the following information, either on the index or on a separate data plate. All markings shall be in a clearly visible position and shall be durable under the normal conditions of the meter. Each meter shall be marked with at least:

a) the type approval mark and number (if appropriate);

b) the identification mark or name of the manufacturer;

c) the serial number of the meter;

d) year of manufacture;

e) the maximum flow rate, Q_{max} (m^3h^{-1});

f) the minimum flow rate, Q_{min} (m^3h^{-1});

g) the maximum working pressure, pmax (bar);

h) the nominal value of the cyclic volume, V (dm^3);

i) the number and date of this standard i.e. EN 1359:2017

j) ambient temperature range, if greater than −10 °C to 40 °C, e.g. tm = −25 °C to 40 °C (see 4.3);

k) gas temperature range if different to the ambient temperature range, e.g. tg = −5 °C to 35 °C;

l) accuracy class of the meter, i.e. Class 1,5;

m) any additional marking required by the Annexes of this standard;

n) such additional marking as is required by legislation e.g. the number of type or design examination certificates and marking showing conformance with legislation.

If the meter is resistant to high ambient temperatures (see 6.6.6) it shall be marked additionally with T.

If the meter is declared suitable for use in an open environment (see 4.4) it shall be marked additionally with H3.

8.2 Two-pipe meters

Meters with two-pipe connections shall be clearly and permanently marked with the direction of flow by means of an arrow between the connections.

8.3 Durability and legibility of marking

8.3.1 Requirements

When inspected visually, all labels shall remain securely fixed, in that their edges shall not lift from the backing surfaces, and the markings on the meter, the index and index plate when viewed through the index window and any separate data plate if fitted, shall remain legible after being subjected to the tests given in 6.3.7, 6.4.2.5, 6.5, 7.3.5, 8.3.2 and 8.3.3.

8.3.2 Ultraviolet exposure test

When tested in accordance with the ultraviolet exposure test, all labels shall conform to the requirements of 8.3.1.

Expose the window of the indicating device and the name plate to the effects of ultraviolet radiation for 5 periods, each of 8 h duration, using a suspended sun lamp which has been used for a minimum of 50 h and not more than 400 h with a light source which has the same radiation spectrum as a Xenon lamp with a low transmission below 290 nm.

The test equipment shall provide an energy of at least 765 $W.m^{-2}$ over the entire surface of the tested items.

Ensure the surrounding air is not confined and is free to circulate and regulated at (43 ± 3) °C.

After each exposure except the last, immerse completely the items in distilled water for 16 h and then clean and dry with cotton wool.

8.3.3 Indelibility

All markings on the external surface of the meter, which can be touched when the meter is in normal use, shall conform to the requirements of EN 60730-1:2011, Annex A.

8.3.4 Adhesion

8.3.4.1 General

Adhesive metrology labels or seals shall be tamper-evident. Manual removal shall result in damage which prevents re-application.

When inspected visually, all labels shall remain securely fixed, in that:

a) the edges shall not lift from the backing surfaces;

b) the label shall not become detached, crazed or blistered; and

c) the markings on the meter, the index and index plate when viewed through the index window and any separate data plate if fitted, shall remain legible after being subjected to the tests given in 6.3.7, 6.4.2.5, 6.4.2.6, 6.5, 7.3.5, 8.3.2 and 8.3.3.

8.3.4.2 Requirements

The peel adhesion, measured as the force required to remove the marking label, shall be greater than (0,4 ± 0,04) $N.mm^{-1}$.

8.3.4.3 Test

Carry out the following test at (20 ± 3) °C.

Apply a finished label to the finished meter surface or a sample of the same finished meter material by pressing half the label area to the surface, with the remaining half folded back through 180°.

Allow the adhesive to condition for a minimum of 48 h at (20 ± 3) °C.

Apply a traction of 300 mm/min^{-1} separation rate to the unattached portion of the label, for example using a dynamometer.

Record the force (peel adhesion) at which the label loses adhesion or breaks.

Provided that all the attached area of the label continues to adhere to the surface, it is admissible for the label to break during the test.

9 Meters supplied for testing

9.1 General

For type testing of meters, 12 to 16 individual meters are generally required, depending on the size of the meter, depending on Table 7. By agreement with the manufacturer, more meters can be supplied, to enable a speeding up of the test procedure.

An example of a testing regime is given in Table 10. Each meter can be subject to several tests as shown in the appropriate column of Table 10.

Table 10 — Example of test regime

Clause		**Number of meters**																					
		1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**See Note 1**	**1**	**1**	**1**	**1**	**1**	**1**	**Max 6**	**1**	**1**	**1**	**1**	**1**	**6**
5.1.2 a or B.2	Errors of indication	X																					
5.1.2 b or B.2	Errors of indication																X						
5.1.2 c or B.2	Errors of indication		X			X	X		X									X	X	X	X		
5.2	Pressure absorption	X							X														
5.3	Starting flow rate	X																					
5.4	Metrological stability	X																					
5.5	Overload flow rate	X																					
5.6 or C.1	Environment and humidity		X																				
5.7	Influence of other devices attached to meter			X																			
5.8	Cyclic volume	X																					
6.2	Resistance to interference				X																		
6.3.3	External leak tightness					X	X	X	X														
6.3.4	Resistance to internal pressure					X																	
6.3.5	Meter case sealings					X																	
6.3.6	Connections					X																	
6.3.7	Resistance to vibrations						X																
6.3.8	Resistance to impact							X															
6.3.9	Resistance to mishandling								X														

Clause		Number of meters																					
		1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**See Note 1**	**1**	**1**	**1**	**1**	**1**	**1**	**Max 6**	**1**	**1**	**1**	**1**	**1**	**6**
6.4.2	External corrosion									See Note 1													
6.4.3	Internal corrosion																						
6.5	Resistance to storage temperature range										X												
6.6.1	Pressure measuring point											Y											
6.6.2	Electrical insulating feet											Y											
6.6.3	Magnetic index drive												Y										
6.6.4	Devices to prevent the registration of reverse flow													Y									
6.6.5	Devices to prevent reverse flow														Y								
6.6.6	Resistance to high temperatures															Y							
7.1.2 or B.2.4	Durability																X						
7.1.3 or B.2.1	Meter error of indication at declared gas temperature limits																	X					
7.1.4 or B.2.2	Error of indication subject to declared ambient temperature limits																	X					
7.2	Index								X														
7.3.3	Toluene/iso-octane vapour test																		X				
7.3.4	Water vapour																			X			
7.3.5	Ageing																				X		
8 or B.3	Marking	X																					
8.3 or C.2	Durability and legibility of marking						X		X		X												

Clause		Number of meters																					
		1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**See Note 1**	**1**	**1**	**1**	**1**	**1**	**1**	**Max 6**	**1**	**1**	**1**	**1**	**1**	**6**
B.2.3	Error of indication where the gas and ambient temperatures are not equal																					Y	
C.1	Humidity																					Y	
C.2	Weathering																	Y					

Note 1 Several plaques or meters are required for testing to 6.4 corrosion protection.

Note 2 In comparison to EN 1359:1998, B.2.3 is now a requirement.

Note 3 “X” indicates those tests which are applicable to all meters and “Y” indicates those extra tests which are applicable if an optional extra is fitted to the meter.

Annex A
(normative)

Production requirements for gas meters

A.1 General

Meters shall be constructed in accordance with this standard, i.e. EN 1359:2017 and shall be manufactured under an appropriate quality management system.

NOTE 1 Systems conforming to the EN ISO 9000-series or an equivalent quality system standards, including traceability of critical components are considered appropriate quality management systems.

This quality system shall be applied to the construction and testing requirements of this European Standard.

NOTE 2 Attention is drawn to national legislation, statutory and regulatory requirements pertaining to the country in which the meter is used.

NOTE 3 National regulations may constitute compliance with the requirement for a quality system.

NOTE 4 National regulations may require that some inspection and testing of the measuring accuracy have to be witnessed and accepted by an authorized and competent person.

The meter error shall be adjusted as close to zero as the adjustment and MPEs allow, without favouring any party.

A.2 Technical requirements

A.2.1 General

There shall be documented production test procedures, which shall include external leak tightness, error of indication, pressure absorption, markings, test medium (if other than air) and acceptance and rejection criteria. Every meter shall be tested for external leak tightness to 1,5 p_{max} as follows.

Pressurize the meter at normal laboratory temperature with air to a minimum of 1,5 times the declared maximum working pressure and carry out the test given in either A.2.1 a) or A.2.1 b).

a) immerse the meter without its index in water and observe it for leakage for 30 s after any external trapped air has been dispersed, after which no leakage should be observed, or

b) use any equivalent procedure utilizing calibrated and certificated test equipment with a declared resolution and full traceability.

Record as pass or fail for each meter.

A.2.2 Verification of conformity at the temperature of the test laboratory

Meters which meet the requirements of MPE-Initial limits given in Table 2) or B.2.1.1 for gas meters with a built in temperature conversion device, and the initial maximum pressure absorption given in Table 3 at flow rates of Q_{min}, 0,2 Q_{max} and Q_{max} shall be deemed to meet the metrological requirements.

The test equipment shall be traceable to a national or international reference standard and the uncertainty (2σ) shall be better than 1/3 of the maximum value of the parameter to be tested.

Verification of conformity with the metrological requirements can be done either:

a) by examination and testing of every meter;

b) by statistical verification of conformity with the metrological requirements.

If tests are carried out on a statistical basis then the product control tests shall be carried out on lots of finished components using sampling procedures based on attributes, with:

— level of quality corresponding to a probability of acceptance of 95 %, with a non-conformity of less than 1 %;

— limit quality corresponding to a probability of acceptance of 5 %, with a non-conformity of less than 7 %.

If tests are conducted at different flow rates to those specified above, the assurance shall be at least equal to that obtained by the tests given in A.2.2.

NOTE For modules D or H1 of the MID a method based on variables can also be used.

A.2.3 Meters with a built-in gas temperature conversion device

Meters meeting the requirements of A.2.2 and the following shall be deemed to meet the metrological requirements.

A random sample meets the requirements of the MPE-Initial limits given in B.2.1.1, reduced by 0,5 % at flow rates of Q_{min}, 0,2 Q_{max} and Q_{max} at temperatures of $t_{min}{}^{+2}_{0}$ °C and $t_{max}{}^{0}_{-2}$ °C. The sampling plan shall be in accordance with Table A.1. The inspection lot shall be of a homogeneous production produced in no more than 10 consecutive working days. All sample size meters shall pass the test.

When an electronic temperature sensor is used, the random sample can be tested in the meter without flow at the temperatures of $t_{min}{}^{+2}_{0}$ °C and $t_{max}{}^{0}_{-2}$ °C. After thermal stabilization, the temperature sensor shall not deviate by more than 2 °C from the reference temperature.

If tests are conducted at different flow rates to these the assurance shall be at least equal to that obtained by the tests mentioned above.

Table A.1 — Sampling plan for meters with built-in gas temperature conversion device

Lot size	Sample size
1 to 150	3
151 to 1 200	5
1 201 to 35 000	8

The period of manufacture shall be traceable from the serial number and all relevant quality records shall relate either to a period of manufacture or a serial number. Such records shall be retained by the manufacturer for a minimum of five years.

A.3 Declaration of conformity

The manufacturer shall provide a declaration of conformity to this Standard.

NOTE ISO/IEC 17050-1 gives guidance for a supplier's declaration of conformity.

A.4 Provision of information

The manufacturer shall make available for each meter, or group of meters, the installation, operation, testing and maintenance manuals in written form, or electronic format including the name and address of the manufacturer and the date of issue, in a language which can be easily understood by end users, as determined by the Member State concerned, giving appropriate information including:

NOTE 1 It is the responsibility of the manufacturer to make available any amendments and revisions to this information.

— safe use;

— gas family;

— rated operating conditions;

— battery (where field replaceable);

— meter calibration results;

— installation conditions;

— instructions for operation, installation, and testing.

Instructions for installation shall include a requirement for the meter to be level after installation.

Groups of identical measuring instruments used in the same location or used for utility measurements do not necessarily require individual instruction manuals.

NOTE 2 National standards, national legislation, or work instructions provided to meter installers can make the provision of installation or other instructions unnecessary or unwelcome. Information can be prepared but only supplied on request in most instances.

EXAMPLE Position, closed or open locations, condensing or with non-condensing humidity

— mechanical and electromagnetic environment classes;

— safety requirements concerning commissioning and de-commissioning procedures;

— safety requirements on filling/discharge of gas of/from the meter;

— statement if a maintenance is necessary and a relevant instruction;

— hazards arising from misuse and particular features of the design when appropriate;

— conditions for compatibility with interfaces;

— provisions, if any, for transport and handling;

— position(s) of seals.

Annex B
(normative)

Diaphragm gas meters provided with a built-in gas temperature conversion device

B.1 Scope

This annex specifies requirements and tests for meters provided with a built-in gas temperature conversion device.

The base gas temperature t_b is defined as 0 °C (273,15 K), 15 °C (288,15 K) or 20 °C (293,15 K).

All meters fitted with such conversion devices shall conform to B.2.1, B.2.2, B.2.3, B.2.4 and B.3. The clauses of this annex replace or supplement the relevant clauses in the main body of this standard. All other clauses of the main body of this standard apply to all meters.

B.2 Metrological performance

B.2.1 Errors of indication at declared gas temperature range

B.2.1.1 General

NOTE This requirement and test replace 5.1, 7.1.3 and 7.1.4.

The manufacturer shall choose the base condition from those given in B.1.

For meters with temperature conversion the MPE-Initial limits shall be increased from the values given in Table 2 by 0,5 % in a range of 30 °C, extending symmetrically around the temperature t_{sp} specified by the manufacturer that lies between 15 °C and 25 °C. Outside this range, an additional increase of 0,5 % is permitted in each interval of 10 °C.

For meters with temperature conversion the MPE-Subsequent limits are twice the above MPE-Initial limits.

The meter error shall be adjusted as close to zero as the adjustment and MPEs allow, without favouring any party. This requirement has no effect on the MPE-Subsequent limits.

B.2.1.2 Requirements

The individual errors of indication of a meter with temperature conversion shall be within MPE-Initial limits given in B.2.1.1.

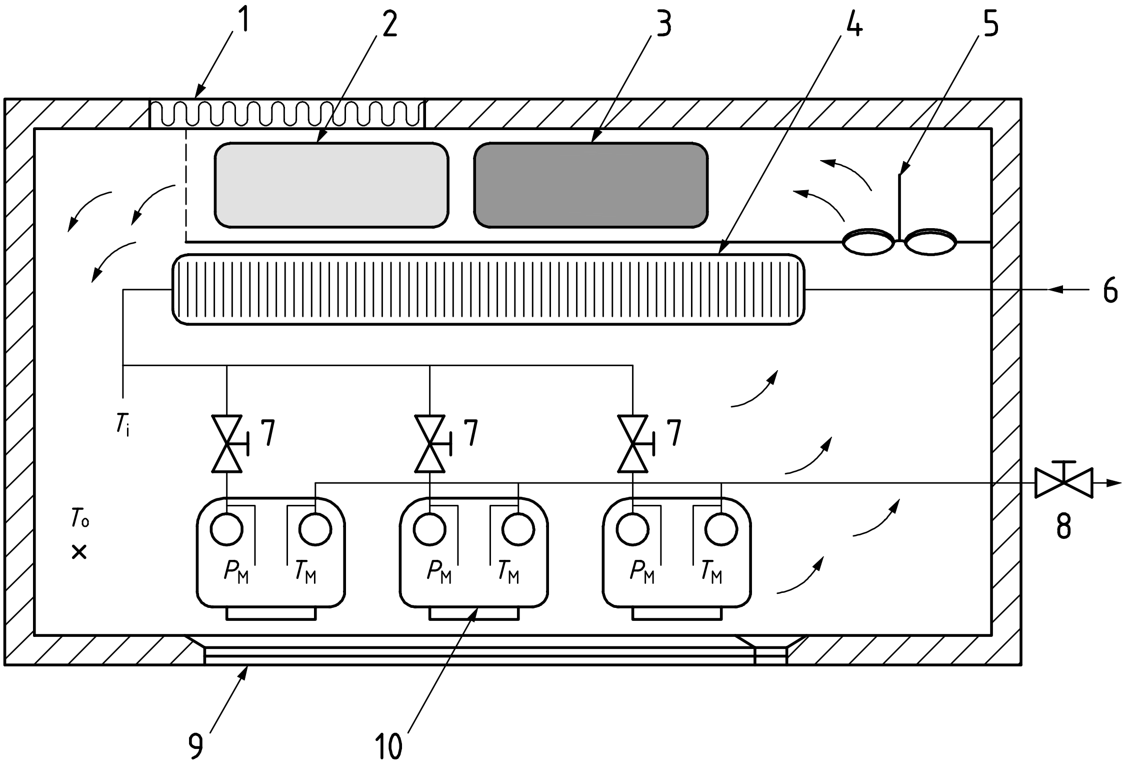
The errors of indication found at temperature t_{sp} as given in B.2.1.3 shall not differ by more than 0,6 % at each of the specified flowrates between Q_t and Q_{max}.

When tested using the flowrates and the method given in B.2.1.3 the error of indication of the meter shall be within the MPE-Initial limits for the temperature used.

B.2.1.3 Test procedure

Immediately before starting the test, pass a quantity of test air equal to at least 50 cyclic volumes of the meter under test, through the meter under test at a flow rate of Q_{max}.

Place the meter under test in a test rig (an example of which is shown in Figure B.1) and pass a volume of air through the meter, the actual volume of which is measured by a reference standard, and note the volume indicated by the meter index. The minimum volume of air to be passed through the meter under test is specified by the manufacturer and agreed with an accredited test house.



Key

1 insulation
2 heating element
3 cooling element
4 heat exchanger
5 fan
6 air from reference standard
7 meter inlet flow control valve
8 outlet flow control valve
9 three layer thermal window
10 gas meter

Figure B.1 — Example of test rig for declared gas and ambient temperatures tests

Determine the error of indication of the meter 6 times at a temperature of t_{sp} ± 1 °C at flowrates of Q_{min}, 3 Q_{min}, 0,1 Q_{max}, 0,2 Q_{max}, 0,4 Q_{max}, 0,7 Q_{max} and Q_{max}, but the flowrates between each individual test shall be different (i.e. do not carry out consecutive tests at the same flowrate).

Calculate the six errors of indication at each of the flowrates using the equation below. Calculate the mean of the six individual errors of indication at each flow rate and record the results as the meter error curve.

Verify that this error of indication is within the maximum permissible initial errors given in B.2.1.1.

Using the calculated errors of indication, obtained when carrying out the error of indication test at flowrates 0,1 Q_{max}, 0,2 Q_{max}, 0,4 Q_{max}, 0,7 Q_{max} and Q_{max}, check that for each flowrate the spread of the 6 individual results is within 0,6 %.

The error of indication of the meter is then determined 3 times at temperatures of $t_{\min}{}_{0}^{+2}$ °C, and $t_{\max}{}_{-2}^{0}$ °C, at flowrates of $Q_{\min}$, 0,1 $Q_{\max}$, 0,4 $Q_{\max}$ and $Q_{\max}$.

The errors of indication are determined by changing the flow rate, first in the increasing direction then in the decreasing direction and finally again in the increasing direction.

At each test temperature, make sure that the temperatures of the test gas (dried air), the meter and the temperature inside the temperature controlled cabinet are within 1 K.

Stabilize the temperatures after each change of temperature, and keep within ± 0,5 K during the measurement periods.

Calculate the three errors of indication for each temperature and flow using the equation below. Calculate the mean of the three errors of indication and record the results as the meter error curve.

Verify that this error of indication is within the maximum permissible initial errors given in B.2.1.1.

$$E = \left(\frac{V_{\mathrm{M}}}{V_{\mathrm{R}}} \times \frac{T_{\mathrm{R}}}{T_{\mathrm{B}}} \times \frac{P_{\mathrm{M}}}{P_{\mathrm{R}}} - 1 \right) \times 100 \tag{B.1}$$

where

E is the error of indication, expressed as a percentage;

V_{M} is the volume registered by the test meter in cubic metres (m^3);

V_{R} is the volume registered by the reference meter in cubic metres (m^3);

T_{R} is the temperature of the reference meter in kelvin (K);

T_{B} is the base temperature in kelvin (K);

P_{M} is the absolute pressure of the test meter inlet in pascal (Pa)

P_{R} is the reference absolute pressure of the reference meter in pascal (Pa).

B.2.2 Error of indication subject to declared ambient temperature limits

B.2.2.1 Requirements

Over the ambient temperature range declared by the manufacturer, between the flow rates of $Q_{\min}$ and $Q_{\max}$, the errors of indication of meters shall remain within the MPE-Subsequent limits given in B.2.1.1 throughout the expected life of the meter when tested according the method given in B.2.2.2.

B.2.2.2 Test procedure

Determine the error of indication of the meter under test 3 times at a temperature of t_{sp} ± 1 °C at flowrates of $Q_{\min}$, 0,1 $Q_{\max}$, 0,4 $Q_{\max}$ and $Q_{\max}$, using the method given in B.2.1.3.

Verify that this error of indication is within the maximum permissible initial errors given in B.2.1.1.

Install the meter to be tested in a temperature controlled chamber which is supplied with:

— air at normal laboratory temperature;

— a constant pressure not exceeding the maximum working pressure of the meter under test; and

— a relative humidity such that its dew point is at least 10 K lower than the test temperature.

Lower and maintain the temperature of the chamber to $\left(-10^{+2}_{0}\right)$ °C, or lower if declared by the manufacturer.

1 Pass the air through a heat exchanger, so that the temperature of the air entering the meter is the minimum ambient temperature declared by the manufacturer and then into the meter under test (see Figure B.1). Run the meter for 22 h at Q_{max} at the manufacturer's declared minimum ambient temperature (see 4.3). On completion of this running period raise the temperature of the chamber and maintain it at $\left(40^{0}_{-2}\right)$ °C, or higher if declared by the manufacturer.

Pass the air through a heat exchanger so the temperature of the air entering the meter is the maximum ambient temperature declared by the manufacturer and then into the meter under test (see Figure B.1).

Run the meter for 22 h at Q_{max} at the manufacturer's declared maximum ambient temperature (see 4.3).

On completion of this running period, determine the error of indication of the meter under test 3 times at a temperature of t_{sp} ± 1 °C at flowrates of Q_{min}, 0,1 Q_{max}, 0,4 Q_{max} and Q_{max}, using the method given in B.2.1.3.

Verify that this error of indication is within the MPE-Subsequent limits given in B.2.1.1.

B.2.3 Error of indication where the gas and ambient temperatures are not equal

B.2.3.1 Requirements

The errors of indication of the meter shall be within the MPE-Subsequent limits given in B.2.1.1 between the flow rate Q_t and Q_{max} when the ambient temperature differs by 20 °C from the gas temperature.

B.2.3.2 Test procedure

Carry out the following test in a laboratory ambient temperature T_m of (20^{+5}_{0}) °C.

Place the meter under test in a test rig (see Figure B.2). Carry out the test using a meter at T_m ± 1 °C for the duration of the test and using dry air at a flowing temperature of $T_i = (T_m + 20°C) ± 1°C$. The difference in laboratory temperature at the test meter and at the reference standard shall not exceed 1 K.

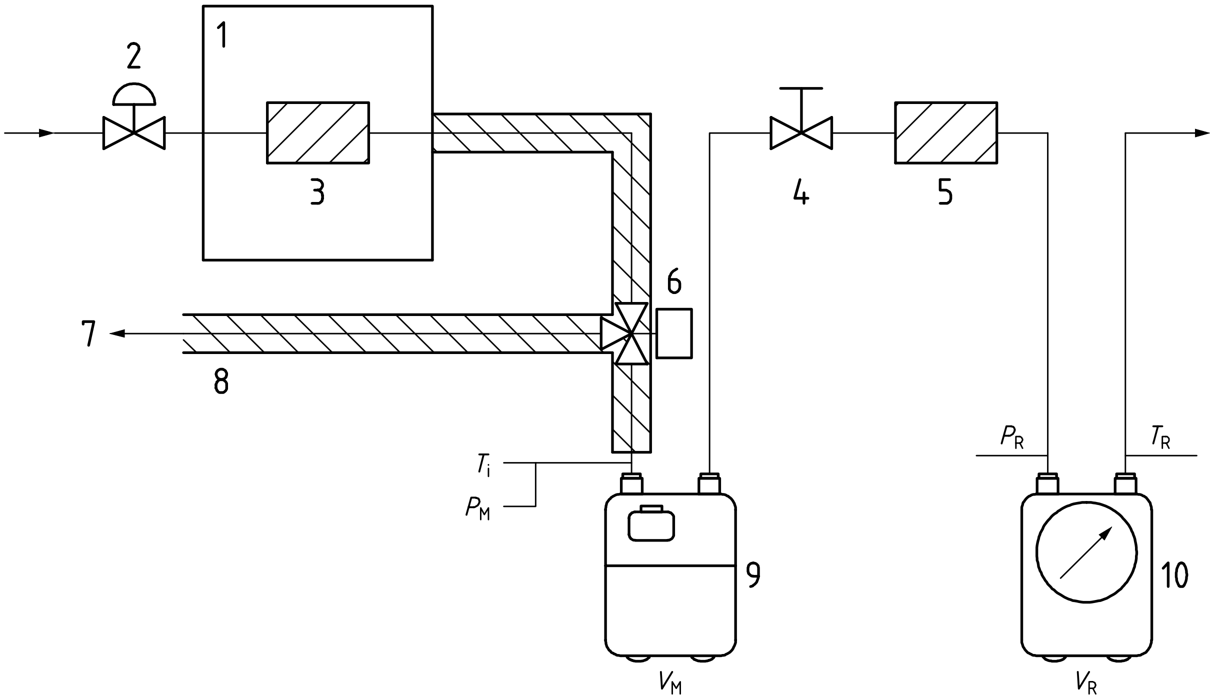
Stabilize operating conditions before the volume measurements are taken. Determine the volume indicated and passed for each of the flowrates 0,1 Q_{max}, 0,4 Q_{max} and Q_{max}. Calculate the error in the volume indicated by the equation given in B.2.1.3.

Repeat the test, but using dry air at a flowing temperature, T_i, of (0^{+5}_{0}) °C and a meter in an ambient temperature, T_m, of T_i + (20 ± 1) °C.

NOTE Alternatively the test can be performed while using the following temperature conditions:

— air flowing temperature, T_i, at (20^{+5}_{0}) °C and the meter ambient temperature, T_m, at (T_i + 20°C) ± 1 °C;

— air flowing temperature, T_i, at (20^{+5}_{0})°C and the meter ambient temperature, T_m, at $T_i - 20^{0}_{-2}$ °C.



Key

1 temperature controlled cabinet
2 pressure regulator
3 heat exchanger
4 flow regulator valve
5 heat exchanger
6 three way valve with actuator
7 exhaust
8 insulated pipework
9 meter under test
10 reference meter

Figure B.2 — Example of test rig used for tests where the temperature at the meter inlet is not equal to the ambient temperature of the air surrounding the meter

B.2.4 Durability

B.2.4.1 Requirements

Meters subjected to the endurance test shall be fitted with their indexes.

All sample meters shall meet the following requirements prior to undergoing the endurance test given in B.2.4.2:

a) the error of indication shall be determined 3 times at a temperature of t_{sp} ± 1 °C at flow rates of Q_{min}, 3 Q_{min}, 0,1 Q_{max}, 0,2 Q_{max}, 0,4 Q_{max}, 0,7 Q_{max} and Q_{max} using the method given in B.2.1.3, and shall be within the MPE-Initial limits given in B.2.1.1.

   The error of indication shall then be determined twice at the flowrates of Q_{min}, 0,1 Q_{max}, 0,4 Q_{max} and Q_{max} for the declared gas temperature range. The error of indication of the meter shall be within the MPE-Initial limits given in B.2.1.1 for the temperature used, when tested at temperatures by the method given in B.2.1.3.

b) the pressure absorption shall be not more than that given in the initial maximum permissible absorption column of Table 3 at the temperature of t_{sp}.

During and on completion of the endurance test given in B.2.4.2, if test method option 1 of Table 7 has been used, all meters shall meet the following requirements.

i) The error of indication shall be determined 3 times at a temperature of t_{sp} ± 1 °C at flow rates of Q_{min}, 3 Q_{min}, 0,1 Q_{max}, 0,2 Q_{max}, 0,4 Q_{max}, 0,7 Q_{max} and Q_{max}, and shall be within the MPE-Subsequent limits given in B.2.1.1, by using the method given in B.2.1.3.

ii) The error of indication shall then be determined twice at the flowrates of Q_{min}, 0,1 Q_{max}, 0,4 Q_{max} and Q_{max} for the declared temperature range. The error of indication of the meter shall be within the MPE-Subsequent error limits given in B.2.1.1 for the temperature used, when tested at temperatures by the method given in B.2.1.3.

iii) The endurance error value over the flow range of Q_t to Q_{max}, shall not differ by more than 2 % from the initial corresponding value for the temperature of t_{sp}.

iv) The pressure absorption is within the subsequent maximum permissible value given in Table 3, following retesting for pressure absorption in accordance with 5.2.2 at the temperature of t_{sp}.

v) The external leak tightness shall be in accordance with 6.3.3.

During and on completion of the endurance test given in B.2.4.2, if test method option 2 of Table 7 has been used, all meters shall meet the requirements of i), ii) and iii) of this subclause except that one meter is allowed to be outside of the specified limits. All meters shall pass the leak tightness test in accordance with 6.3.3.

The number of meters used for the endurance test is given in Table 7.

B.2.4.2 Endurance tests

B.2.4.2.1 General

Meters with Q_{max} less than or equal to 10 m^3h^{-1} shall be tested in accordance with the cycling test procedure given in B.2.4.2.2. Meters with Q_{max} greater than 10 m^3h^{-1} shall be tested in accordance with the constant flow test procedure given in B.2.4.2.3.

The number of meters tested shall be in accordance with Table 7.

B.2.4.2.2 Test procedure - Endurance by cycling

After determining the error of indication of meters under test with air at the temperature and flowrates given in B.2.4.1 a), and the pressure absorption given in B.2.4.1 b), exercise the meters in a test rig and the test procedure given in 7.1.2.2.

B.2.4.2.3 Test procedure - Endurance at Q_{max}

This test shall be used for meters with a Q_{max} of greater than 10 m^3h^{-1}.

After determining the error of indication of meters under test with air at the temperature and flowrates given in B.2.4.1 a), and the pressure absorption given in B.2.4.1 b), exercise the meters in a test rig and the test procedure given in 7.1.2.2.

B.3 Marking

Each meter shall be marked with the following information in addition to that listed in Clause 8, either on the index or on a separate data plate:

a) the base gas temperature expressed as, for example, t_b = 15 °C;

b) manufacturer specified centre temperature expressed as, for example, t_{sp} = 20 °C;

c) an indication of the converted volume expressed as V_b.

Annex C
(normative)

Tests for meters to be used in open locations

C.1 Humidity

C.1.1 Requirements

These tests replace the equivalent tests given in 5.6.

After testing in accordance with C.1.2 the error of indication shall remain within the MPE-Initial limits specified in Table 2 or B.2.1.1 and the index and markings shall remain legible.

C.1.2 Test

The error of indication shall be tested in accordance with 5.1.2 c). For meters with a built-in gas temperature conversion device the meter shall be tested 3 times at the flow rates of 0,1 Q_{max}, 0,4 Q_{max} and Q_{max} using the method of B.2.1.3.

One meter shall be tested for error of indication and shall then be tested in accordance with EN ISO 6270-1 for a duration of 340 h. The meter shall then be retested for error of indication and shall be visually inspected for legibility of the index and the markings.

Report the result as pass or fail.

C.2 Weathering

C.2.1 Requirement

This test replaces the equivalent tests given in 8.3.

All markings on the meter, the index and index plate when viewed through the index window and any separate data plate, if fitted, shall remain easily legible after being subjected to the test given in C.2.2.

Total colour difference measured in accordance with EN ISO 11664-4 shall be inside the following limits:

$\Delta L^* \leq 7$

$\Delta a^* \leq 7$

$\Delta b^* \leq 14$

Light transmission in accordance with ASTM D1003 shall have Haze ≤ 15 %.

C.2.2 Test

One meter shall be exposed to artificial weathering and to artificial radiation for 66 days in accordance with EN ISO 4892-2 and the parameters in Table C.1 (see EN ISO 4892-2:2013, Table 4, Cycle no 1). Prior to exposure, measurements shall be made to enable the test criteria to be assessed.

Table C.1 — Exposure to artificial radiation

Test Cycle	Wavelength/ lamp type	Irradiance	Black panel temperature
8 h dry	UVA 340 (type 1A)	0,76 $W.m^{-2}.nm^{-1}$ at 340 nm	60 ± 3 °C
4 h condensation		UV lamps off	50 ± 3 °C

Following exposure the meter shall be visually inspected for legibility. All markings on the meter, the index and index plate when viewed through the index window and any separate data plate, if fitted, shall remain legible. When tested in accordance with EN ISO 11664-4 the requirements for colour difference and transmission of light shall be met.

Report the result as pass or fail.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2014/32/EU Measuring Instruments Directive aimed to be covered

This European standard has been prepared under a Commission's standardization request M/541 to provide one voluntary means of conforming to the *essential requirements of Directive* 2014/32/EU Measuring Instruments Directive.

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1 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 2014/32/EU Measuring Instruments Directive

Essential Requirements (ERs) of Directive 2014/32/EU			**Clause(s)/subclause(s) of this EN**	**Remarks/Notes**
ANNEX 1				
1		Allowable errors under rated operating conditions		
	1.1	Within MPE – no disturbance	5.1, 6.6.7, 7.1.3, 7.1.4, B.2.1, B.2.2	Covered for class 1.5
	1.2	Within MPE – disturbance	6.2, 6.3, 6.6.7, 6.3.9, B.2.3	Covered for class 1.5
	1.3	Specify climatic, mechanical and EM environment		
	1.3.1	Climatic environments	1, 4.3, 4.4, 5.6, 7.1.4, 8.3, Annex C,	Covered for class 1.5
	1.3.2	Mechanical environments	1, 6.3.7	Covered Only M1
	1.3.3	Electromagnetic environments	1, 6.2.2, 6.6.8, 7.2.1.1	Covered Only E1
	1.3.4	Other influence quantities	N/A	Covered Because any such quantities are not seen
	1.4.1	Basic rules	Whole standard,	Covered
	1.4.2	Ambient humidity	5.6	Covered

Essential Requirements (ERs) of Directive 2014/32/EU			**Clause(s)/subclause(s) of this EN**	**Remarks/Notes**
2		Reproducibility	N/A	Covered Because these meters are permanently installed in one location
3		Repeatability	5.4	Covered
4		Discrimination and sensitivity appropriate for measurement task	5.3	Covered
5		Sufficient durability for intended task	5.2, 6.6.7, 7.1.2, 7.3, B.2.4	Covered
6		Reliability	Whole standard	Covered
7		Suitability		
	7.1	Design discourages fraudulent use and minimizes unintentional misuse	6.2, 8.2	Covered
	7.2	Designed to be suitable for its intended use and working conditions. User friendly.	5.2, 7.2	Covered
	7.3	The errors of a utility measuring instrument at flows or currents outside the controlled range shall not be unduly biased	N/A	Covered Because N/A
	7.4	Where a measuring instrument is designed for the measurement of values of the measured that are constant over time, the measuring instrument shall be insensitive to small fluctuations of the value of the measurand, or shall take appropriate action	N/A	Covered because these meters are not used for measurand which are constant over time
	7.5	Robust and materials suitable for intended use	6.3 6.4, 7.2.2, 7.3	Covered

Essential Requirements (ERs) of Directive 2014/32/EU			Clause(s)/subclause(s) of this EN	Remarks/Notes
	7.6	A measuring instrument shall be designed so as to allow the control of the measuring tasks after the instrument has been placed on the market and put into use	7.2.	Covered
8		Protection against corruption		
	8.1	Measurement cannot be affected by feature of instrument, connection of external or communicating device	5.7	Covered
	8.2	Critical hardware components secure or tampering is evident	6.2	Covered
	8.3	Critical software shall be identified and secure. Identification readily available. Tampering evidenced for “reasonable” time	1, 6.6.8, 7.2.1.1	Covered
	8.4	Data and critical parameters protected against corruption	1, 6.6.8, 7.2.1.1	Covered
	8.5	Display cannot be reset during use	7.2.1	Covered
9		Information of/accompanying		
	9.1	Shall bear manufacturer’s mark or name and information in respect of its accuracy. Where applicable data on conditions of use, identity marking, number of type examination certificate	8.1, B.3	Covered
	9.2	If too small, information placed on packaging	N/A	Covered Because all relevant information id marked on the meter

Essential Requirements (ERs) of Directive 2014/32/EU			**Clause(s)/subclause(s) of this EN**	**Remarks/Notes**
	9.3	Accompanied by information on rated operating conditions, climatic, mechanical and EM environment classes, instruction operation and maintenance etc.	8.1, A.4	Covered
	9.4	Utility meters do not require individual instruction manuals	A.4	Covered
	9.5	Decimal scale interval	7.2	Covered
	9.6	Material measure	N/A	Not Covered Because the instrument is not a material measure
	9.7	Units of measurement	7.2.1	Covered
	9.8	Durability of marking	5.6, 8.3, Annex C	Covered
10		Indication of result		
	10.1	Display	7.2	Covered
	10.2	Clear indication	7.2, 8, B.3	Covered
	10.3	Hard copy	N/A	Not Covered Because these meters are not designed for a hard copy
	10.4	Direct trading	N/A	Not Covered Because these meters are not used for direct trading
	10.5	Indicator required	7.2	Covered
11		Further processing of data		
	11.1	Durable record	N/A	Not Covered Because it is a utility meter
	11.2	Durable proof	N/A	Not Covered Because it is a utility meter
12		Conformity evaluation	Whole standard	Covered
		Annex IV		
Part 1		Specific requirements gas meters		

Essential Requirements (ERs) of Directive 2014/32/EU			**Clause(s)/subclause(s) of this EN**	**Remarks/Notes**
1		Rated operating conditions		
	1.1	Flow-rate	1, 4.1, 5.5	Covered But only for class 1,5
	1.2	T > 40 gas	1, 4.3	Covered
	1.3	Gas family/MOP	1, 4.2, 3.1.6, 6.3.3, 7.1.2, 7.3, 8.1(g), A4	Covered
	1.4	T > 50 climatic	4.3	Covered
	1.5	Limits of dc supply	N/A	Not covered Because no external power supply required
2		Maximum permissible errors		
	2.1	MPE	5.1	Covered
	2.2	MPE TC	B.2.1	Covered
3		Permissible effects of disturbances		
	3.1	EMC	1, 6.6.8, 7.2.1.1	Covered
	3.2	Flow disturbances	N/A	Covered Because these meters are not sensitive to flow disturbances
4		Durability		
	4.1	Durability – Class 1,5 meter	7.1.2, B.2.4	Covered
	4.2	Durability – Class 1,0 meter	N/A	Not Covered Because this standard does not address class 1,0 m
5		Suitability		
	5.1	Mains power	N/A	Not Covered Because no external power supply required
	5.2	Battery power	1, 6.6.8, 7.2.1.1, A.4	Covered
	5.3	8 000 h	7.2	Covered
	5.4	Any position	A.4	Covered
	5.5	Test element	7.2	Covered

Essential Requirements (ERs) of Directive 2014/32/EU			**Clause(s)/subclause(s) of this EN**	**Remarks/Notes**
	5.6	Flow direction marked	8.2, A.4	Covered
6		Units	7.2, B.3	Covered
Part II		Specific requirements – Volume conversion devices	N/A	Not Covered Because Part II applies to a volume conversion device as sub-assembly
7		Base conditions for converted quantities	N/A	Not Covered Because Part II applies to a volume conversion device as sub-assembly
8		Maximum permissible error	N/A	Not Covered Because Part II applies to a volume conversion device as sub-assembly
9		Suitability	N/A	Not Covered Because Part II applies to a volume conversion device as sub-assembly
Part III		Putting into use and conformity assessment		
	10 (a) (b) (c)	Putting into use	N/A	Not Covered Because it is Member States responsibility
		Conformity assessment	N/A	Not Covered Because it is Member States responsibility

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Bibliography

EN 437, *Test gases — Test pressures — Appliance categories*

EN ISO/IEC 17050-1, *Conformity assessment - Supplier's declaration of conformity - Part 1: General requirements (ISO/IEC 17050-1:2004, corrected version 2007-06-15)*

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