INTERNATIONAL

RECOMMENDATION

OIML R 6

Edition 1989 (E)

General provisions for gas volume meters

Dispositions générales pour les compteurs de volume de gaz

OIML R 6 Edition 1989 (E)

ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION
OF LEGAL METROLOGY

Foreword

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International Recommendations and Inter-national Documents are published in French (F) and English (E) and are subject to periodic revision.

This publication – reference OIML R 6 (E), edition 1989 – was developed by the Reporting Secretariats SP 6-Sr 1 *"Diaphragm gas meters"* and SP 6-Sr 2 *"Gas meters with rotating pistons. Non-volumetric gas meters"* and the Pilot Secretariat SP 6 *"Measurement of gas"**. It was sanctioned by the International Conference of Legal Metrology in 1988 and supersedes the previous edition dated 1978.

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* *Note*: This publication is now under the responsibility of TC 8/SC 8 "*Gas meters*".

EXPLANATORY NOTE

The purpose of a gas meter is to determine a “quantity” of gas - ideally its mass, because it is the mass of gas delivered which determines its value. However, the property of the gas which is most easily sensed is its volume at the conditions of temperature and pressure at which it passes through the meter (the metering conditions). All gas volume meters produce a signal which is intended to be proportional to that volume, and all such meters (except some diaphragm meters) indicate that quantity. The error of the indication is defined in relation to the conventional true volume of the gas under the metering conditions.

However, many meters also process the signal in an attempt also to indicate a quantity which is more nearly proportional to the mass of the gas, by means of a conversion device. The conventional true value of the measurand is then not necessarily the mass or a quantity proportional to the mass ; it is the quantity which would be indicated if the arithmetical operations which the conversion device is designed to apply were correctly applied to a signal correctly representing the conventional true volume at metering conditions. That operation is one of three possible kinds:

(a) the application of Charles' law to compute a volume at a given base temperature and the pressure at metering conditions ;

(b) the application of the ideal gas law to compute a volume at a given base temperature and a given base pressure (base conditions) ;

(c) the application of the known properties of the real gas to compute the volume at base conditions.

The maximum permissible errors for a meter of a given type increase with increasing sophistication of conversion, (a) being the least sophisticated and (c) the most.

However, due to improved conversion the desired objective of determining the quantity of gas is most accurately achieved with the meters having the largest maximum permissible errors.

TERMINOLOGY

References to VIM apply to the International vocabulary of basic and general terms in metrology, 1984 edition.

T.1. Working range of a gas volume meter

The range of the flowrates of gas limited by the maximum flowrate Q_{max} and the minimum flowrate Q_{min}.

T.2. Cyclic volume of a gas volume meter (V)

The volume of gas corresponding to the working cycle of the gas volume meter, i.e. to all the movements of the moving components which, except for the indicating device and the intermediate transmissions, resume for the first time the position they occupied at the beginning of the cycle.

This 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.

T.3. Test element

A device to enable precise reading of the gas volume.

T.4. Metering conditions and base conditions

T.4.1 Metering conditions

Conditions of the gas, the volume of which is to be measured, at the point of measurement (examples: temperature and pressure of the measured gas).

T.4.2 Base conditions

Conditions to which the measured volume of gas is converted (examples base temperature and base pressure).

Note: Metering and base conditions relate to the volume of gas to be measured or indicated only and should not be confused with “rated operating conditions” and “reference conditions” (VIM 5.05 and 5.07), which refer to influence quantities.

T.5. Conversion device

A device which converts the volume measured at the metering conditions to a volume at base conditions.

Note: The type of conversion may be:

a) temperature only;

b) temperature and pressure ;

c) temperature and pressure with correction for deviations from the ideal gas law.

T.6. Working pressure

The difference between the absolute pressure of the gas to be measured at the inlet of the gas volume meter and the atmospheric pressure.

T.7. Pressure absorption

The difference between the pressures at the inlet and outlet of the gas volume meter while the gas is flowing.

Note: In some gas volume meters the pressure recovery is not complete at the outlet flange and it may be necessary to measure the pressure absorption at a point in the downstream pipe. This point shall be specified in the Recommendation particular to that type of gas meter.

T.8. Output drive constant

The value of the volume corresponding to one complete revolution of the shaft of the output drive ; this value is determined by multiplying the value of the volume corresponding to one complete revolution of the test element by the transmission ratio of the indicating device to this shaft.

T.9. Transitional flowrate (Q_t)

The flowrate at which the maximum permissible error changes in value.

T.10. Electronic gas meter

A gas meter equipped with electronic devices.

Note: For the purposes of this Recommendation auxiliary equipment, as far as it is subject to metrological control, is considered to be part of the gas meter, unless the auxiliary equipment is approved and verified separately.

T.11. Electronic device

A device employing electronic components and performing a specific function. Electronic devices are usually manufactured as separate units and are capable of being independently tested.

Note: An electronic device, as defined above may be a complete gas meter or part of a gas meter.

T.12. Error (of indication)

The indication of a gas meter minus the (conventional) true value of the measurand. (VIM 5.24)

Note: Errors (E) are expressed in relative values by the ratio (expressed as a percentage) of the difference between the indicated value (V_1) and the conventional true value (V_c) of the volume of the test medium which has passed through the gas meter, to this latter value:

$$E(\%) = 100\,\frac{V_i - V_c}{V_c}$$

T.13. Intrinsic error

The error of a gas meter used under reference conditions. (VIM 5.27)

T.14. Initial intrinsic error

The intrinsic error of a gas meter as determined prior to performance tests and durability evaluations.

T.15. Fault

The difference between the error of indication and the intrinsic error of a gas meter.

Notes: 1. Principally a fault is the result of an undesired change of data contained in or flowing through an electronic gas meter.

2. From the definition it follows that in this Recommendation a "fault" is a quantity with a numerical value.

T.16. Significant fault

T.16.1. A fault greater than 0.5 of the maximum permissible error on initial verification.

T.16.2. The following faults are considered not to be significant, even if they exceed the significant fault :

(a) faults arising from simultaneous and mutually independent causes in the gas meter itself or in its checking facilities ;

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

T.17. Durability error

The difference between the intrinsic error after a period of use and the initial intrinsic error of a gas meter.

T.18. Significant durability error

T.18.1. The significant durability error is specified in the particular Recommendation.

T.18.2. Durability errors are not relevant, even if they exceed the significant durability error, where the indications cannot be interpreted, memorized or transmitted as measurement results.

T.19. Influence quantity

A quantity which is not the subject of the measurement but which influences the value of the measurand or the indication of the gas meter. (VIM 2.10)

T.19.1. Influence factor

An influence quantity having a value within the normal operating conditions of the gas meter.

T.19.2. Disturbance

An influence quantity not being an influence factor.

T.20. Normal operating conditions

Conditions of use, giving the range of values of influence quantities for which the metrological characteristics are intended to lie within the specified maximum permissible errors.

T.21. Reference conditions

A set of specified values of influence factors fixed to ensure valid intercomparison of results of measurements. (adapter from VIM 5.07)

T.22. Performance

The ability of the gas meter to accomplish the intended functions.

T.23. Durability

The ability of the gas meter to maintain its performance characteristics over a period of use.

T.24. Checking facility

A facility which is incorporated in a gas meter and enables significant faults to be detected and acted upon.

Note: By "acted upon" is meant any adequate response by the gas meter.

T.25. Durability protection feature

A feature which is incorporated in a gas meter and which enables durability errors in excess of the significant durability error to be detected and acted upon.

T.26. Test

A series of operations intended to verify the compliance of the equipment under test (EUT) with certain requirements.

T.26.1. Test procedure

A detailed description of the test operations.

T.26.2. Test programme

A description of a series of tests for a certain type of equipment.

T.26.3. Performance test

A test to verify whether the EUT is able to accomplish its intended functions.

T.26.4. Durability test

A test to verify whether the EUT is able to maintain its performance characteristics over a period of use.

GENERAL PROVISIONS FOR GAS VOLUME METERS

1. Field of application

This Recommendation prescribes the general requirements which all gas volume meters to which it applies shall meet. Additional requirements are prescribed in the OIML Recommendations particular to the type of gas volume meter concerned.

This Recommendation applies to the following types of gas volume meters :

1.1. Positive displacement gas meters (volumetric gas meters) : diaphragm gas meters, rotary piston gas meters.

1.2. Inferential gas meters : turbine gas meters.

1.3. Gas volume meters other than those mentioned in points 1.1 and 1.2, when a separate OIML Recommendation refers to this Recommendation.

Note : In this Recommendation gas volume meters are referred to as "gas meters".

2. Construction

2.1. General

Gas meters shall be designed and manufactured in such a way that they do not exceed maximum permissible errors under normal operating conditions of temperature as specified in point 9.2 (a) and over the ranges of temperature and pressure of the measured gas (metering conditions) as claimed by the manufacturer.

2.2. Materials

Gas meters shall be made of sound materials changing little with age and sufficiently resistant to corrosion and to the attacks of the gases for which the gas meters are intended to be used and their possible condensates.

2.3. Soundness of cases

The cases of gas meters shall be gas-tight up to the maximum working pressure of the gas meters.

If meters are to be installed in the open air they shall be impermeable to runoff water.

2.4. Protection against external interference

Gas meter shall be constructed in such a way that any mechanical interference capable of affecting the measuring accuracy results in permanently visible damage to the gas meter or to the verification mark or protection mark.

2.5. Direction of the gas flow

On gas meters where the indicating device registers positively for one direction only of the gas flow, this direction shall be indicated by an arrow. This arrow is not required if the direction of the gas flow is determined by the construction.

The particular Recommendations may also prescribe a device that prevents the functioning of the gas meter when the gas flow is in the direction opposite to that intended for measuring.

2.6. Metrological properties

At a flowrate equal to Q_{max} a gas meter shall be able to function continuously for a time fixed by the particular Recommendations without the changes in its metrological properties exceeding the limits fixed by these requirements.

3. Additional devices

3.1. Gas meters may be fitted with :

a) prepayment devices,

b) integral pulse generators, the outlets of which shall bear an indication of the value of one pulse in the form:
"1 imp. $\triangleq$ … m^3 (or dm^3)" or
"1 m^3 $\triangleq$ … imp.",

c) a built-in conversion device,

d) a built-in self-checking and possibly self-adjusting device.

These devices are regarded as forming an integral part of the gas meter ; they shall have been installed in the gas meter at the time of pattern approval and initial verification.

3.2. Gas meters may be fitted with output drive shafts which should be taken to include drive shafts or other facilities for operating detachable additional devices. The torque which the gas meters are required to produce in order to drive the additional devices fitted shall not produce any changes in the gas meter indication greater than the values specified in the particular Recommendations.

3.2.1. If there is only one drive shaft, it shall be characterized by an indication of its constant (C) in the form "1 tr $\triangleq$ ... m^3 (or dm^3)", of the maximum permissible torque in the form "M_{max} = ... N · mm", and of the direction of rotation.

Note : " tr " is the abbreviation of the French word " tour ", which means : revolution.

3.2.2. If there are several drive shafts, each shaft shall be characterized by the letter M with subscript in the form : "M_1, M_2, . . . M_n", as well as by an indication of its constant in the form "1 tr $\triangleq$ ... m^3 (or dm^3)" and of the direction of rotation.

The following formula shall appear on the gas meter, preferably on the data plate :

$$k_1 M_1 + k_2 M_2 + \ldots + k_n M_n \leq A \text{ N} \cdot \text{mm}$$

where :

A is the numerical value of the maximum permissible torque applied to the drive shaft with the highest constant, where the torque is applied only to this shaft ; this shaft shall be characterized by the symbol M_1,

k_i (i = 1 ; 2 ; ... n) is a numerical value determined as follows : $k_i = \frac{C_1}{C_i}$,

M_i (i = 1 ; 2 ; ... n) represents the torque applied to the drive shaft characterized by the symbol M_i,

C_i (i = 1 ; 2 ; ... n) represents the constant for the drive shaft characterized by the symbol M_i.

3.2.3. When not connected to an attachable additional device, the exposed ends of the drive shafts shall be suitably protected.

3.2.4. The connection between the measuring device and the intermediate gearing shall not be broken or altered if a torque of three times the permissible torque as indicated in points 3.2.1 and 3.2.2 is applied.

4. Markings

4.1. Each gas meter shall bear, in a group, either on the face plate, or on a special data plate, the following markings

a) the pattern approval sign of the gas meter, if appropriate,

b) the maker's trade mark or his trade name,

c) the serial number of the gas meter and its year of manufacture,

d) the designation of the gas meter; this designation is in the form of the capital letter G, followed by a number fixed in the particular Recommendations,

e) the maximum flowrate : Q_{max} = ... m^3/h,

f) the minimum flowrate : Q_{min} = ... m^3/h (or dm^3/h),

g) the maximum working pressure : P_{max} = ... MPa (or kPa or Pa or bar or mbar),

h) for volumetric gas meters, the nominal value of the cyclic volume : V = ... m^3 (or dm^3),

i) the range of the metering conditions in which the gas meter is required to work within the specified maximum permissible errors, expressed as :

t_m = ... — ... °C,

p_m = ... — ... MPa (or kPa or Pa or bar or mbar),

j) if required, a commercial designation of the gas meter, a special serial number, the name of the gas distributor, the name of the repairer and the year of repair.

These markings shall be directly visible, easily legible and indelible under normal conditions of use of the gas meters.

4.2. The particular Recommendations may prescribe other markings, such as the nature of the gas to be measured.

4.3. Without special authorization, the use of any marking other than those prescribed in the pattern approval document, unless required by other national regulations, is prohibited.

5. Indicating devices and test element

5.1. Indicating device

5.1.1. General provisions

5.1.1.1. Gas meters shall be equipped with an indicating device directly indicating the volume of gas measured.

The indicating device shall indicate the volume of the measured gas in cubic metres. The symbol "m^3" shall appear on the face plate.

The scale interval shall not exceed 1 m^3 or the volume passed during one hour at Q_{min}, whichever is the greater.

5.1.1.2. The indicating device may be :

a) a mechanical indicating device as meant in point 5.1.2,

b) an electromechanical or electronic indicating device as meant in point 5.1.3, c) a combination of a) and b).

5.1.1.3. The indicating device shall correspond to one of the following possibilities :

a) the gas meter has one indicating device displaying the volume at metering conditions. The symbol "m^3" shall appear on the face plate,

b) the gas meter has two indicating devices, one displaying the volume at metering conditions, the other displaying the volume at base conditions. The symbol "m^3" shall appear on the face plate, accompanied by the specification of those base conditions, expressed as :

t_b = ... °C (or K),

P_b = ... MPa (or kPa or Pa or bar or mbar).

It shall be clear and unambiguous as to which of the indicating devices these markings relate.

Notes: 1. The values chosen for base conditions shall preferably be: 0 °C, 15 °C or 20 °C and 101.325 kPa.

2. One display may be used for both indications.

c) a diaphragm gas meter with a built-in temperature conversion device may have only one indicating device displaying the volume at base conditions. The symbol "m^3" shall appear on the face plate, accompanied by the specification of the base temperature, expressed as :

$$t_b = \ldots \text{ °C}$$

Note : The values chosen for base temperature shall preferably be : 0 °C, 15 °C or 20 °C.

5.1.1.4. The indicating device shall be so designed that the reading is by simple juxtaposition.

5.1.2. Mechanical indicating device

5.1.2.1. A mechanical indicating device shall consist of drums ; the last element (i.e. the one with the smallest scale interval) may however be an exception to this rule.

Note: It appears that in certain countries the mandatory use of drums in mechanical indicating devices causes, at present, great difficulty. In consequence, these countries are, provisionally, in need of requirements for indicating devices with pointers. It is recommended that for this purpose they apply the requirements in Annex A of this Recommendation.

5.1.2.2. Where the indicating device includes drums showing decimal submultiples of the cubic metre, these drums shall be separated by a clear decimal sign from those showing cubic metres. The decades after the decimal sign shall be clearly distinguished from those in front of the decimal sign.

5.1.2.3. Where the last drum shows a decimal multiple of the cubic metre, the face plate shall bear :

a) either one (or two, or three, etc.) fixed zero(s) after the last drum,

b) or the marking : "× 10" (or "× 100", or "× 1000", etc.), so that the reading is always in cubic metres.

5.1.2.4. A mechanical indicating device shall have at least a sufficient number of drums to ensure that the volume passed during 2000 hours at maximum flowrate does not return all the drums to their initial positions.

5.1.2.5. The diameter of the drums shall be at least 16 mm.

5.1.2.6. The advance by one unit of a figure of any order shall take place completely while the figure of an order immediately below passes through the last tenth of its course.

5.1.2.7. A mechanical indicating device shall be easily removable if such removal is necessary for verification.

5.1.3. Electromechanical or electronic indicating device

5.1.3.1. Electromechanical or electronic indicating devices shall be nonresetable and shall be nonvolatile (i.e. must be able to show the last correct indication after the device has recovered from an intervening power failure).

5.1.3.2. The provisions of points 5.1.2.2, 5.1.2.3 and 5.1.2.4 are applicable accordingly to electromechanical and electronic indicating devices.

5.2. Test element

5.2.1. General provisions

5.2.1.1. Gas meters shall be designed in such a way that they may be verified with sufficient accuracy in a reasonably short time. For this purpose they shall be constructed either with an integral test element or with arrangements permitting the connection of a portable test unit.

5.2.1.2. If a gas meter has two indicating devices as permitted in point 5.1.1.3(b), each indicating device shall have a test element, in order to verify the performance of the conversion device with sufficient accuracy in a reasonably short time.

5.2.2. Test element of a mechanical indicating device

5.2.2.1. The integral test element may consist of the last element of the mechanical indicating device in one of the two following forms :

a) a continuously moving drum bearing a scale,

b) a pointer moving over a fixed dial with a scale, or a disk with a scale moving past a fixed reference mark. The diameter of the graduated scale shall at least be 16 mm.

5.2.2.2. On the numbered scale of a test element referred to in point 5.2.2.1(b) the value of one complete revolution of the pointer shall be indicated in the form "1 tr $\triangleq$ ... m^3 (or dm^3)". The beginning of the scale shall be indicated by the figure zero.

5.2.2.3. The scale spacing shall not be less than 1 mm and shall be constant throughout the whole scale.

5.2.2.4. The scale interval must be in the form 1×10^n, 2×10^n, or 5×10^n m^3 (n being a positive or negative whole number or zero).

5.2.2.5. The scale marks shall be fine and uniformly drawn.

In the case where the scale interval is in the form 1×10^n, or 2×10^n m^3 all the lines representing multiples of 5, and where the scale interval is in the form 5×10^n m^3 all the lines representing multiples of 2, shall be distinguished by being longer than the other lines.

The scale marks shall be sufficiently fine to permit accurate and easy reading.

5.2.2.6. The test element may be provided with a scale mark which stands out in contrast to the scale and is of sufficient size to allow automatic photoelectric scanning. This scale mark shall not obscure the graduation and its presence shall not be detrimental to the accuracy of reading.

5.2.3. Pulse generator used as test element

5.2.3.1. A pulse generator may be used as a test element if it complies with the requirements of points 5.2.3.2 to 5.2.3.6.

5.2.3.2. The value of one pulse, expressed in units of volume, shall be marked on the gas meter. This value shall comprise at least 6 significant figures, unless it is equal to an integer multiple or decimal fraction of the unit of volume indicated on the face plate of the indicating device.

5.2.3.3. The pulse value shall be calculated from the transmission ratio between the indication of the gas meter and the location where the pulses are generated.

The manufacturer shall, at verification, submit documentation by which the calculation of the pulse value can be checked.

5.2.3.4. The gas meter shall be constructed in such a way that, prior to initial verification, the calculated pulse value as specified can be checked experimentally with an uncertainty not greater than 0.05 %.

5.2.3.5. If a removable pulse generator is used it shall be possible to attach and remove this pulse generator easily.

If the gas meter needs to supply a torque to drive the removable pulse generator, this torque shall have a negligible influence on the performance of the gas meter. The removable pulse generator is considered to comply with this requirement if the influence is less than 0.1 % at a flowrate equal to 0.1 Q_{max}.

5.2.3.6. Measures shall be taken to prevent the cyclic volume of the gas meter having an influence on the accuracy of the verification.

Note : This can be accomplished by counting a number of pulses that matches an integer multiple of the cyclic volume, or by measuring a volume large enough to make the influence negligible.

6. Maximum permissible errors

6.1. The values of the maximum permissible errors are fixed in the particular Recommendations; they are valid for the authorized direction of flow.

6.2. If the gas meter has two indicating devices, one reading the volume at metering conditions and the other the volume at base conditions, the values of the maximum permissible errors apply to the indicating device for the volume at metering conditions. The difference in the errors of indication determined from both indicating devices shall not be more than the value specified in the following table:

(Temporary note: The values given in the table are subject to harmonisation with those for external conversion devices, to be developed by SP 6-Sr 9).

Type of conversion	maximum difference in error (%)			
	on initial verification		in service	
	conditions		conditions	
	ref.	nonref.	ref.	nonref.
temperature	0.5	1.0	0.7	1.5
temperature and pressure	0.8	1.3	1.2	1.9
temperature and pressure and ideal gas law deviations	1.0	1.5	1.5	2.2

The reference conditions as specified in point 9.2 (a) are applicable. Nonreference conditions are normal operating conditions as specified in point 9.2 (a), other than reference conditions.

Notes : 1. It may be possible to use one display for both indications.
2. In-service values are recommended values.

6.3. For a gas meter as meant in point 5.1.1.3(c) the conventional true value at the metering temperature shall be converted to the volume at base temperature. The particular Recommendation may specify larger maximum permissible errors for this type of gas meter.

7. Pressure absorption

The maximum permissible values of pressure absorption may be fixed if appropriate by the particular Recommendations.

8. Location of verification and protection marks

8.1. General provision

The location of the marks shall be chosen in such a way that the dismantling of the part sealed by one of these marks results in permanently visible damage to this mark.

8.2. Data plate

Gas meters shall have a special location for applying the verification mark ; removal of the data plate shall result in permanently visible damage to this mark.

8.3. Other locations

Locations for verification or protection marks shall be provided on every gas meter:
a) on all plates which bear information prescribed by this Recommendation and/or by the particular Recommendations,
b) on all parts of the case which cannot be otherwise protected against interference likely to affect the accuracy of the measurement,
c) on the connection with the detachable additional devices referred to in point 3.2.3.

PROVISIONS FOR ELECTRONIC GAS VOLUME METERS

This chapter specifies the general technical and metrological requirements for electronic gas meters, as they are defined in this Recommendation, in view of the application of electronics.

9. Application conditions for electronic gas meters

9.1. Classification for environmental conditions

Gas meters are classified according to their intended use under various environmental conditions, into the following classes

Class B: This class applies to enclosed locations, having only low levels of vibration and shock.

Class C: This class applies to locations having a general open air climate and only low levels of vibration and shock.

Class F: This class applies to locations having a general open air climate and medium levels of vibration and shock.

9.2. Influence factors

(a) temperature :
normal operating conditions : Class B : between – 10 °C and + 40 °C
Classes C and F : between – 25 °C and + 55 °C
reference condition : a value between 15 and 25° C

(b) relative humidity :
normal operating conditions : ≤ 93 %
reference condition : a value between 40 and 60 %

(c) variations in the mains power supply :
normal operating conditions : the specified severity level (see Annex B)
reference condition : no variation

(d) external magnetic fields :
normal operating conditions : test conditions specified in point 11.5.3
reference condition : the absence of external magnetic fields.

9.3. Disturbances

(a) vibration (Class F only)

(b) shock (Class F only)

(c) power interruptions

(d) bursts

(e) electrostatic discharge

(f) electromagnetic interference.

Operating conditions : the specified severity levels (see Annex B)

Reference conditions : the absence of the disturbance.

9.4. Battery power supply

Gas meters which operate from a battery or other power source which must periodically be replaced shall indicate the need for replacement at least 90 days before power failure. Replacement of the power source shall not adversely affect the programming, metering information, or subsequent operation of the gas meter.

10. Requirements for electronic gas meters

Electronic gas meters shall comply with the following requirements, notwithstanding all other technical and metrological requirements of the appropriate International Recommendations.

10.1. General requirements

10.1.1. Electronic gas meters shall be designed and manufactured in such a way that they do not exceed maximum permissible errors under normal operating conditions.

10.1.2 Electronic gas meters shall be designed and manufactured in such a way that, when they are exposed to disturbances, significant faults do not occur.

Notes: 1. A fault equal to or smaller than the value as meant in T.16.1 is allowed irrespectively of the value of the error of indication.

2. This requirement does not prohibit the use of checking facilities.

10.1.3. The provisions of points 10.1.1 and 10.1.2 shall be met durably. Electronic gas meters shall be designed and manufactured in such a way that :

either : (a) the significant durability error is not exceeded,
or : (b) a durability error exceeding the significant durability error is detected and acted upon by means of a durability protection feature.

10.1.4 The pattern of a gas meter is presumed to comply with the provisions of points 10.1.1, 10.1.2 and 10.1.3 if it passes the examination and tests specified in point 11.5 and in the particular Recommendations.

10.1.5 The choice, whether point 10.1.3 (a) or point 10.1.3 (b) is applied, is left to the manufacturer.

10.2. Requirements for electronic gas meters fitted with durability protection features

10.2.1. It shall be possible to verify the presence and correct functioning of these features.

Note : This verification may be accomplished by means of a test button or by any other means.

10.2.2. The requirement of point 10.2.1 does not apply to gas meters or parts of gas meters for which the manufacturer claims that they comply with the provision of point 10.1.3 (a) and which are nevertheless equipped with durability protection features.

METROLOGICAL CONTROL

When, in any country, gas meters are subject to State metrological controls it is recommended that they include all or some of the following controls:

11. Pattern approval

11.1. Each pattern of a gas meter from each manufacturer is subject to the pattern approval procedure.

11.2. Without special authorization, no modification may be made to an approved pattern.

11.3. Applications for pattern approval for gas meters shall be accompanied by the following documents :

- a description of the meter giving the technical characteristics and the principle of its operation,
- a perspective drawing or photograph of the meter,
- a nomenclature of parts with a description of constituent materials of such parts,
- an assembly drawing with identification of the component parts listed in the nomenclature,
- a dimensioned drawing,
- a drawing showing the location of verification marks and seals,
- a drawing of the indicating device with adjustment mechanisms,
- a dimensioned drawing of metrologically important components,
- a drawing of the data plate or face plate and of the arrangements for inscriptions,
- where appropriate : a drawing of the additional devices,
- where appropriate : a table setting out the characteristics of the drive shafts,
- where appropriate : a list of electronic components with their essential characteristics,
- where appropriate : a description of the electronic devices with drawings, diagrams and general software explaining their construction and operation,
- where appropriate: the application for pattern approval shall be accompanied by any document or other evidence which supports the assumption that the design and construction of the electronic gas meter comply with the requirements (note : safety requirements are to be respected),
- a list of the documents submitted,
- a declaration specifying that the meters manufactured in conformity with the pattern meet the requirements for safety, particularly those concerning the maximum working pressure as indicated on the data plates.

11.4. The following particulars shall appear on the pattern approval certificate :

- the name and address of the person to whom the pattern approval certificate is issued,
- the type of the gas meter and/or commercial designation,
- the principal technical and metrological characteristics, such as the minimum flow, maximum working pressure, nominal internal diameter of the connecting pieces and, in the case of volumetric gas meters : the nominal value of the cyclic volume,

– the pattern approval sign,
– the period of validity of the pattern approval,
– for meters equipped with drive shafts :

a) the characteristics of the shaft as set out in point 3.2.1 (where there is only one drive shaft),

b) the characteristics of each shaft and the formula given in point 3.2.2 (where there are two or more drive shafts),

– the environmental classification,
– information on the location of the pattern approval sign, initial verification marks and seals (where appropriate, in the form of photographs or drawings),
– a list of the documents accompanying the pattern approval certificate,
– any special comments.

11.5. Examination and tests for electronic gas meters

Electronic gas meters shall be subjected to the following examinations and tests :

(a) examination to verify whether the gas meter complies with the provisions of point 10.1 ;

(b) performance tests to verify compliance with the provisions of point 10.1.1, regarding influence factors, and 10.1.2, regarding disturbances. During these tests the EUT shall be in an operational state (i.e. the power shall be switched on) ;

(c) durability evaluation (i.e. tests and/or other measures) to verify compliance with the provisions of point 10.1.3 ;

(d) examination and tests to verify where applicable the compliance of the electronic gas meter with the provisions of points 10.1.3 and 10.1.4.

All gas meters, whether or not equipped with checking facilities and whether or not equipped with durability protection features, are subject to the same testprogramme.

11.5.1. Performance tests (carried out prior to durability tests)

During these tests the gas meter shall comply with :

– the provision of point 10.1.1, the maximum permissible error being the maximum permissible error on initial verification,

– the provision of point 10.1.2.

11.5.2. Durability programme

During performance tests carried out after each durability test the gas meter shall comply with the provisions of point 10.1.

11.5.3. Test performance

The following tests shall be performed :

Influence factors :

(a) static temperatures, dry heat :
see Annex B, point B.1,
severity level : Class B : severity level 1
Classes C and F : severity level 2

(b) static temperatures, cold :
see Annex B, point B.2,
severity level : Class B : severity level 1
Classes C and F : severity level 2

(c) damp heat, cyclic :
see Annex B, point B.3,
severity level : Class B : severity level 1
Classes C and F : severity level 2

(d) mains power supply variations :
see Annex B, point B.4, severity level 1

(e) external magnetic fields :
Electronic gas meters shall be subject to tests in any orientation within a 50 Hz (60 Hz) alternating magnetic field equivalent to that produced by a circular coil, one meter in diameter having 400 Ampere turns.

Disturbances :

(a) vibration (Class F only) :
see Annex B, point B.5, severity level 1

(b) shock (Class F only) :
see Annex B, point B.6, severity level 1

(c) short time power reduction :
see Annex B, point B.7, severity level 1

(d) electrical bursts :
see Annex B, point B.8, severity level 1

(e) electrostatic discharge :
see Annex B, point B.9, severity level 1

(f) electromagnetic susceptibility :
see Annex B, point B.10, severity level 1.

11.5.4. Test procedures

The test procedures are specified in Annex B.

11.5.5. Equipment under test

As a rule, tests will be carried out on the complete gas meter. If the size or configuration of the gas meter does not lend itself to testing of the gas meter as a whole unit, or if only a separate device of the gas meter is concerned, the tests shall be carried out on the electronic devices, provided that, in case of tests with the devices in operation, these devices are included in a simulated measurement set-up, sufficiently representative for its normal operation.

Note : It is not intended that the gas meters or devices be dismantled for the tests.

12. Initial verification

New gas meters are subject to the procedure for initial verification. They shall comply with the relevant requirements. These requirements apply equally to subsequent verifications of repaired or readjusted gas meters.

13. Subsequent verifications

Recommended requirements for subsequent verifications may be given in the particular Recommendations.

ANNEX A

Countries which at present are in need of indicating devices with pointers may, instead of referring to point 5.1 of this Recommendation, apply to these indicating devices the following requirements ; these requirements shall be transitory.

A. Indicating devices with pointers

A.1. The face of an indicating device with pointers shall have circular scales intended for reading the volume of measured gas, each graduated into 10 divisions of the same length. The scale marks shall be numbered successively from 0 to 9, the " 0 " scale mark being at the top of the scale. The diameter of the circular scales shall be at least equal to 16 mm.

The face shall have enough numbered circular scales to indicate the volume delivered during 2000 hours working at maximum flowrate.

The symbol "m^3" shall appear on the dial.

A.2. The intermediate transmissions of the indicating device with a pointer shall be so arranged that the direction of rotation of the pointers of circular scales alternates when one considers the next circular scale of which the value, in volume, shall be ten times greater or ten times smaller.

A.3. The pointer moving at the highest speed shall be on the right hand side of the indicating device when viewed by an observer standing in front of the meter.

The direction of rotation of this pointer shall be clockwise. The value of a complete revolution of this pointer shall correspond to 10 m^3, or 100 m^3, or etc.

A.4. Each numbered circular scale shall indicate clearly and nonambiguously the value, in units of volume, corresponding to one complete revolution of its pointer. The direction of rotation of the pointer shall be indicated by means of an arrow.

A.5. Circular scales not intended to indicate the measured volume of gas (e.g. scales intended for the verification of the meter or the control of its metrological qualities) are authorized. However, these scales shall be off the geometric line on which the circular scales used for indicating the volumes of measured gas are aligned.

A circular scale not intended to indicate the volume of gas measured for use shall carry, within the circle, a clear indication of the value of the volume corresponding to one complete revolution of the pointer. The scale shall have 10 divisions of the same length, the scale marks not being numbered. An arrow shall indicate the direction of rotation of the pointer.

ANNEX B

B. Tests for electronic gas meters

B.1. DRY HEAT

Test method : Dry heat (non condensing).

Reference to standard : IEC-Publication 68-2-2, fourth edition, 1974, Basic environmental testing procedures, Part 2: Tests, Test Bd : Dry heat, for heat-dissipating EUT with gradual change of temperature.

Background information concerning dry heat tests is given in IEC-Publication 68-3-1, first edition, 1974 and first supplement 68-3-1A, 1978, Part 3: Background information, Section one : Cold and dry heat tests.

Test procedure in brief : The test consists of exposure to the specified high temperature under "free air" condition for the time specified. (The time specified is the time after the EUT has reached temperature stability).

The change of temperature shall not exceed 1 °C/min during heating up and cooling down.

The absolute humidity of the test atmosphere shall not exceed 20 g/m^3.

Prior to the test the EUT shall be calibrated under reference conditions. During the test the error of indication shall be determined several times.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severities shall apply :

Severity :	1	2
Temperature (°C) :	40	55
Duration (hours) :	2	2

B.2. COLD

Test method : Cold.

Reference to standard : IEC-Publication 68-2-1, fourth edition,1974, Basic environmental testing procedures, Part 2 : Tests, test Ad : Cold, for heat-dissipating EUT with gradual change of temperature.

Background information concerning cold tests is given in IEC-Publication 68-3-1, first edition, 1974 and first supplement 68-3-1A, 1978, Part 3 : Background information, Section one : Cold and dry heat tests.

Test procedure in brief : The test consists of exposure to the specified low temperature under "free air" condition for the time specified. (The time specified is the time after the EUT has reached temperature stability.)

The change of temperature shall not exceed 1 °C/min during heating up and cooling down.

Prior to the test the EUT shall be calibrated under reference conditions. During the test the error of indication shall be determined several times.

Detail specification : For full test details reference is made to the IECPublication mentioned above.

Test severity : The following severities shall apply :

Severity :	1	2
Temperature (°C) :	– 10	– 25
Duration (hours) :	2	2

B.3. DAMP HEAT, CYCLIC

Test method : Damp heat, cyclic.

Reference to standard : IEC-Publication 68-2-30, second edition, 1980, Basic environmental testing procedures, Part 2 : Tests, test Db : Damp heat, cyclic (12h + 12h cycle), test variant 1.

Background information concerning damp heat tests is given in IEC-Publication 68-2-28, second edition, 1980 : Guidance for damp heat tests.

Test procedure in brief : The test consists of exposure to cyclic temperature variation between 25 °C and the appropriate upper temperature, maintaining the relative humidity above 95 % during the temperature change and low temperature phases, and at 93 % ± 3 % at the upper temperature phases.

Condensation should occur on the EUT during the temperature rise.

Prior to the test the EUT shall be calibrated under reference conditions. During the test the error of indication shall be determined several times.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severities shall apply :

Severity :	1	2
Upper temperature (°C) :	40	55
Duration (cycles) :	2	2

B.4. VARIATIONS IN MAINS POWER SUPPLY

Test method : Variation in AC mains power supply (single phase).

Reference to standard : No reference to internationally accepted standards can be given at present.

Test procedure in brief : The test consists of exposure, at normal atmospheric conditions for testing, to the specified power supply condition for a period long enough to achieve temperature stability and to perform the required measurements.

Test severity : The following severity shall apply :

Severity :		1
Mains voltage (V) :	upper limit	V(nom) + 10 %
	lower limit	V(nom) – 15 %
Mains frequency (Hz) :	upper limit	f (nom) + 2 %
	lower limit	f (nom) – 2 %

Note : For a three-phase power supply the voltage variation shall apply to each phase successively.

B.5.(a) VIBRATION (RANDOM)

Test method : Random vibration.

Reference to standard : IEC-Publication 68-2-36, first edition, 1973, Basic environmental testing procedures, Part 2 : Tests, test Fdb : Random vibration/wide band - Reproducibility medium.

Background information concerning random vibration tests is given in IEC-Publication 68-2-34, 1973, Test Fd : Random vibration wide band - general requirements.

Test procedure in brief : The test consists of exposure to vibration for a time long enough to test the various functions of the EUT during the exposure. The EUT shall be tested in three mutually perpendicular axes in turn, mounted on a rigid fixture by its normal mounting means.

The EUT shall normally be mounted so that the gravitational force acts in the same direction as it would when the instrument is in use. Where the effect of gravitational force is not important the EUT may be mounted in any attitude.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severity shall apply :

Severity	:	1
Total frequency range (Hz)	:	10-150
Total RMS level ($m \cdot s^{-2}$)	:	1.6
ASD level, 10-20 Hz ($m^2 \cdot s^{-3}$)	:	0.048
ASD level, 20-150 Hz (dB/octave)	:	– 3
Number of axes	:	3
Duration per axis	:	Minimum 2 minutes in each functional mode

B.5.(b) VIBRATION (SINUSOIDAL)

(As an alternative to the random vibration test.)

Test method : Sinusoidal vibration.

Reference to standard : IEC-Publication 68-2-6, fifth edition, 1982, Basic environmental testing procedures, Part 2: Tests, test Fc : Vibration (sinusoidal).

Test procedure in brief : The EUT shall be tested by sweeping the frequency in the specified frequency range, at 1 octave/minute, at the specified acceleration level with a specified number of sweep cycles per axis. The EUT shall be tested in its three, mutually perpendicular, main axes, mounted on a rigid fixture by its normal means. It shall normally be mounted so that the gravitational force acts in the same direction as it would when the instrument is in use. Where the effect of gravitational force is not important, the EUT may be mounted in any attitude.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severity shall apply :

Severity	:	1
Frequency range (Hz)	:	10-150
Max. acceleration level (m/s^2)	:	2
Number of sweep cycles per axis	:	20

B.6. MECHANICAL SHOCK

Test method: Dropping onto a face.

Reference to standard : IEC-Publication 68-2-31, first edition, 1969, Basic environmental testing procedures, Part 2 : Tests, test Ec : Drop and topple (procedure : Dropping onto a face).

Test procedure in brief : The EUT, standing in its normal position of use on a rigid surface, is tilted about one bottom edge and is then allowed to fall freely onto the test surface. All covers shall be properly fitted.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severity shall apply :

Severity	:	1
Height of fall (*) (mm)	:	25
Number of falls (for each bottom edge)	:	2

(*) Height of fall = distance between the elevated edge and the test surface. However, the angle made by the bottom and the test surface shall not exceed 30°.

B.7. SHORT-TIME POWER REDUCTION

Test method : Short-time interruptions and reductions in mains voltage.

Reference to standard : No reference to internationally accepted standards can be given.

Test procedure in brief : A test generator suitable to reduce the amplitude of one or more half cycles (at zero crossings) of the AC mains voltage is used. The test generator shall be adjusted before connecting the EUT. The mains voltage interruptions and reductions shall be repeated ten times with an interval of at least 10 seconds.

Test severity : The following severities shall apply :

Severity	:	1a	1b
Reduction	:	100 %	50 %
Number of half cycles	:	5	10

B.8. BURSTS

Test method : Electrical bursts.

Reference to standard : IEC-Publication 801-4, 1987.

Test procedure in brief : The test consists of exposure to bursts of double exponential waveform transient voltages. Each spike shall have a rise time of 5 ns and a half-amplitude duration of 50 ns.

The burst length shall be 15 ms, the burst period (repetition time interval) shall be 300 ms. The burst generator shall have an output impedance of 50 ohm and shall be adjusted before connecting the EUT. Bursts shall be coupled to the EUT both in common mode and differential mode interference. At least 10 positive and 10 negative randomly phased bursts shall be applied in each mode. Insertion of blocking filters in the cables to the EUT may be necessary to prevent the burst energy being dissipated in the mains or in other interconnected units.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severity shall apply :

Severity	:	1
Amplitude (peak value) (kV)	:	0.5

B.9. ELECTROSTATIC DISCHARGE

Test method : Electrostatic discharge (ESD).

Reference to standard : IEC-Publication 801-2 (1984).

Test procedure in brief : The test equipment shall be in accordance with IEC-Publication 801-2.

A capacitor of 150 pF shall be charged by a suitable DC voltage source. The capacitor is then discharged through the EUT by connecting one terminal to ground (chassis) and the other via 150 ohm to surfaces which are normally accessible to the operator.

At least 10 discharges shall be applied. The time interval between successive discharges shall be at least ten seconds.

An EUT without a ground (earth) terminal shall be placed on a grounded plate which projects beyond the EUT by at least 0.1 m on all sides. The ground connection to the capacitor shall be as short as possible.

The discharge electrode shall approach the EUT until discharge occurs, and shall then be withdrawn before the next discharge.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severity shall apply :

Severity	:	1
DC voltage (kV) up to and including	:	8

B.10. ELECTROMAGNETIC SUSCEPTIBILITY

Test method: Electromagnetic fields (radiated).

Reference to standard: IEC-Publication 801-3 (1984).

Test procedure in brief : The EUT shall be exposed to an electromagnetic field strength as specified by the severity level.

The field strength may be generated in various ways :

- the stripline is used at low frequencies (below 30 MHz or in some cases 150 MHz) for small EUT's
- the long wire is used at low frequencies (below 30 MHz) for larger EUT's
- dipole antennas or antennas with circular polarization placed 1m from the EUT are used at high frequencies.

The specified field strength shall be established prior to the actual testing (without EUT in the field). At least 1m of all external cables shall be included in the exposure by stretching them horizontally out from the EUT.

The field shall be exposed in two orthogonal polarizations and the frequency range shall be scanned slowly. If antennas with circular polarization (i.e. a log-spiral or a helical antenna) are used to generate the electromagnetic field, a change in the position of the antennas is not required. When the test is carried out in a shielded enclosure to comply with international laws prohibiting interference to radio communications, care needs to be taken to control reflections from the walls. Anechoic shielding may be necessary.

At least 1 m of wiring to and from' the EUT shall be exposed.

Detail specification : For full test details reference is made to the IEC-Publication mentioned above.

Test severity : The following severities shall apply :

Severity	:	1a	1b
Frequency range (MHz)	:	0.1-500	500-1000
Field strength (V/min)	:	10	3
Modulation	:	50 % d'AM, 1 kHz square wave	

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