BRITISH STANDARD

BS EN 12405-1:2005 +A2:2010

Gas meters — Conversion devices —

Part 1: Volume conversion

ICS 91.140.80

British Standards

National foreword

This British Standard is the UK implementation of EN 12405-1:2005+A2:2010. It supersedes BS EN 12405-1:2005 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1⟩ ⟨A1]. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by [A1⟩ ⟨A1].

The UK participation in its preparation was entrusted to Technical Committee GSE/25, Gas meters.

A list of organizations represented on GSE/25 can be obtained on request to its secretary.

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

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 June 2005

ISBN 978 0 580 69600 8

Amendments/corrigenda issued since publication

Amd. No.	Date	Comments
16647	31 October 2006	Implementation of CEN amendment A1:2006
	31 January 2011	Implementation of CEN amendment A2:2010

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12405-1:2005+A2

October 2010

ICS 91.140.40

Supersedes EN 12405-1:2005

English Version

Gas meters - Conversion devices - Part 1: Volume conversion

Compteurs de gaz - Dispositifs de conversion - Partie 1: Conversion de volume

Gaszähler - Umwerter - Teil 1: Volumenumwertung

This European Standard was approved by CEN on 15 March 2005 and includes Amendment 1 approved by CEN on 6 July 2006 and Amendment 2 approved by CEN on 19 September 2010.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 12405-1:2005+A2:2010: E

Contents

Foreword

[A1⟩ This document [A2⟩ (EN 12405-1:2005+A2:2010) ⟨A2] has been prepared by Technical Committee CEN/TC 237 “Gas meters”, the secretariat of which is held by BSI.

This [A2⟩ *deleted text* ⟨A2] European Standard [A2⟩ *deleted text* ⟨A2] shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by [A2⟩ April 2011 ⟨A2], and conflicting national standards shall be withdrawn at the latest by [A2⟩ April 2011 ⟨A2].

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 2004/22 Measuring Instruments Directive (MID).

For relationship with EU Directive 2004/22, see informative Annex ZA, which is an integral part of this document. ⟨A1]

This document includes Amendment 1, approved by CEN on 2006-07-06 and Amendment 2, approved by CEN on 2010-09-19.

This document supersedes [A2⟩ EN 12405-1:2005 ⟨A2].

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

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

Due to technical developments the layout of the document has been changed and EN 12405 will appear in parts:

— Part 1: Volume conversion (this European Standard),

— Part 2: Energy conversion (in preparation),

— Part 3: Data loggers.

Further parts are under consideration, following the technical progress.

In the preparation of this European Standard, the content of OIML Publication, “International Document 11”, “International Recommendations 6” and “International Recommendations 32” and the content of member bodies' national standards on gas-volume electronic conversion devices have been taken into account.

[A1⟩ *deleted text* ⟨A1]

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

1 Scope

This European Standard specifies the requirements and tests for the construction, performance, safety and conformity of gas-volume electronic conversion devices associated to gas meters, used to measure volumes of fuel gases of the 1st and 2nd families according to EN 437.

This European Standard is intended for type testing, the detailed relevant provisions of which are given in Annex A.

Only three kinds of conversion are treated in this European Standard:

— conversion as a function of temperature only (called T conversion);

— conversion as a function of the pressure and of the temperature with constant compression factor (called PT conversion);

— conversion as a function of the pressure, the temperature and taking into account the compression factor (called PTZ conversion).

[A1) This document is not relevant to temperature conversion integrated into gas meters which only indicate the converted volume. (A1]

EN 12405-2 for energy conversion is in preparation.

Gas-volume conversion devices consist of a calculator and a temperature transducer or a calculator, a temperature transducer and a pressure transducer locally installed.

For application of this European Standard, a conversion device may be, as a choice of the manufacturer, considered as a complete instrument (Type 1) or made of separate elements (Type 2), according to the definitions given in 3.1.18.1 and 3.1.18.2.

In this last case, the provisions concerning pressure transducers, temperature sensors and temperature transducers are given in Annexes B, C and D respectively.

Any conversion device can provide an error curve correction for a gas meter.

NOTE When rendering an account to an end user the readings from the conversion device can be used in conjunction with the readings from a gas meter conforming to EN 1359, EN 12480, or EN 12261, as appropriate, or to any other appropriate and relevant international or national standard for gas meters, without prejudice of national regulations.

2 Normative references

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

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

EN 1776, *Gas supply systems — Natural gas measuring stations — Functional requirements*

[A2) *deleted text* (A2]

EN 55011, *Industrial, scientific and medical (ISM) radio-frequency equipment — Radio disturbance characteristics — Limits and methods of measurement (CISPR 11:1997, modified)*

EN 60068-2-1, *Environmental testing — Part 2: Tests — Tests A: Cold (IEC 60068-2-1:1990)*

EN 60068-2-2, *Basic environmental testing procedures — Part 2: Tests — Tests B: Dry heat (IEC 60068-2-2:1974 + IEC 60068-2-2A:1976)*

EN 60068-2-30, *Environmental testing — Part 2: Tests — Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle) (IEC 60068-2-30:1980 + A1:1985)*

EN 60068-2-31, *Basic environmental testing procedures — Part 2: Tests — Test Ec: Drop and topple, primarily for equipment-type specimens (IEC 60068-2-31:1969 + A1:1982)*

EN 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state (IEC 60068-2-78:2001)*

EN 60079-0, *Electrical apparatus for potentially explosive atmospheres — Part 0: General requirements (IEC 60079-0:2004)*

EN 60079-1, *Electrical apparatus for potentially explosive atmospheres — Flameproof enclosures "d" (IEC 60079-1:2003)*

EN 60079-2, *Electrical apparatus for potentially explosive atmospheres — Part 2: Pressurized apparatus "p" (IEC 60079-2:2001)*

[A2⟩ EN 60079-5, *Explosive atmospheres — Part 5: Equipment protection by powder filling "q" (IEC 60079-5:2007)*

EN 60079-6, *Explosive atmospheres — Part 6: Equipment protection by oil immersion "o" (IEC 60079-6:2007)* ⟨A2]

EN 60079-7, *Electrical apparatus for potentially explosive atmospheres — Increased safety "e" (IEC 60079-7:2001)*

[A2⟩ EN 60079-11, *Explosive atmospheres — Part 11: Equipment protection by intrinsic safety "i" (IEC 60079-11:2006)*

EN 60079-25, *Electrical apparatus for explosive gas atmospheres — Part 25: Intrinsically safe systems (IEC 60079-25:2003)* ⟨A2]

EN 60529, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*

[A1⟩ EN 60730-1:2000, *Automatic electrical controls for household and similar use — Part 1: General requirements (IEC 60730-1:1999, modified)* ⟨A1]

EN 60751, *Industrial platinum resistance thermometer sensors (IEC 60751:1983 + A1:1986)*

EN 60950-1, *Information technology equipment — Safety — Part 1: General requirements (IEC 60950-1:2001, modified)*

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

EN 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3:2002)*

EN 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test (IEC 61000-4-4:2004)*

[A2⟩ EN 61000-4-5, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test (IEC 61000-4-5:2005)* ⟨A2]

EN 61000-4-6, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 6: Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6:1996)*

A2⟩ EN 61000-4-8, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 8: Power frequency magnetic field immunity test (IEC 61000-4-8:1993 + A1 2001)* ⟨A2

EN 61000-4-11, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests (IEC 61000-4-11:2004)*

A2⟩ EN 61000-4-29, *Electromagnetic Compatibility (EMC) — Part 4-29: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests (IEC 61000-4-29:2000)* ⟨A2

EN ISO 12213-2:2005, *Natural gas — Calculation of compression factor — Part 2: Calculation using molar-composition analysis (ISO 12213-2:1997)*

EN ISO 12213-3:2005, *Natural gas — Calculation of compression factor — Part 3: Calculation using physical properties (ISO 12213-3:1997)*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
absolute static pressure
value of the static pressure of the gas relative to vacuum

A1⟩ **3.1.2**
base conditions
specified conditions to which the measured quantity of gas is converted ⟨A1

EXAMPLES Temperature of 273,15 K and absolute pressure of 1,013 25 bar[1] or temperature of 288,15 K and absolute pressure of 1,013 25 bar.

3.1.3
calculator
electronic device that receives the output signals from the associated gas meter and transducers and processes them

3.1.4
conversion factor
factor equal to the volume at base conditions divided by the corrected volume, or if there is no gas meter correction, equal to the volume at base conditions divided by the volume at measurement conditions

3.1.5
conventional true value (of a quantity)
value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose

3.1.6
corrected volume
volume at measurement conditions corrected for the error curve of the gas meter

3.1.7
correction
value added algebraically to the uncorrected result of a measurement to correct the systematic error

3.1.8
correction factor
numerical factor by which the measured volume is multiplied to correct it to compensate the error curve of the gas meter

3.1.9
display
element or assembly of elements of the indicating device on which the results of measurement and memorized values are displayed

3.1.10
disturbance
influence quantity having a value within the limits specified but outside the specified rated operating conditions of the measuring instrument

NOTE An influence quantity is a disturbance if the rated operating conditions for that influence quantity are not specified.

3.1.11
durability
ability of an instrument to maintain its performance characteristics over a specified period of use

3.1.12
environmental class
class referring to the ambient temperature, humidity and power supply

3.1.13
error of conversion
difference between the conversion factor C displayed by a conversion device and the conventional true value of the conversation factor C_{CV}, expressed as a percentage of the conventional true value of the conversion factor

3.1.14
error of indication
indication of a measuring instrument minus the (conventional) true value of the corresponding input quantity

3.1.15
error of the calculator unit
error of the indicated volume at base conditions V_b, when the gas volume, pressure and temperature are simulated by signals, in accordance to the manufacturer specification of interfaces

NOTE The calculator error includes all conversion errors with the exception of the pressure and temperature transducer errors (i.e. signal conditioning, Z factor calculation (if applicable), other mathematical calculations etc.).

3.1.16
error of the pressure transducer
difference between the measured output signals from the pressure transducer and the nominal signal at the applied physical value

3.1.17
error of the temperature transducer
difference between the measured output signals from the temperature transducer and the nominal signal at the applied physical value

3.1.18
gas-volume conversion device
device that computes, integrates and indicates the volume increments measured by a gas meter if it were operating at base conditions, using as inputs the volume at measurement conditions as measured by the gas meter, and other parameters such as gas temperature and gas pressure

NOTE 1 The conversion device can also compensate for the error curve of a gas meter and associated measuring transducers.

NOTE 2 The deviation from the ideal gas law can be compensated by the compression factor.

3.1.18.1
gas volume conversion device type 1 (complete system)
conversion device with specific types of transducers for pressure and temperature or for temperature only

3.1.18.2
gas volume conversion device type 2 (separate component)
conversion device with external separate transducers for pressure and temperature or for temperature only and for separate calculator, which may be approved separately

NOTE The matching of the various elements constituting a conversion device type 2 is subjected to verification.

3.1.19
indicating device
part of a measuring instrument that displays an indication (alphanumeric string)

3.1.20
influence factor
influence quantity having a value within the specified rated operating conditions of the measuring instrument

3.1.21
influence quantity
quantity that is not a measurand but that affects the result of the measurement (e.g. ambient temperature)

3.1.22
intrinsic error
error of a measuring instrument, determined under reference conditions

3.1.23
maximum operating pressure
MOP
maximum pressure at which a system can be operated continuously under normal conditions

NOTE Normal conditions are: no fault in any device or stream.

3.1.24
measurement conditions
conditions of the gas, the volume of which is measured at the point of measurement (e.g. the temperature and the pressure of the gas)

3.1.25
measuring transducer
device that provides an output quantity having a determined relationship to the input quantity

3.1.26
overpressure
maximum static pressure to which the transducer may be submitted without durable alteration of its metrological characteristics : it is set in accordance with the maximum allowable pressure

[A1) **3.1.27**
rated operating conditions
values for the measurand and influence quantities making up the normal working conditions of an instrument (A1]

[A1) *deleted text* (A1]

3.1.28
reference conditions
condition of use prescribed for testing the performance of a measuring instrument or for inter-comparison of results of measurements

3.1.29
sensor
element of a measuring instrument or measuring chain that is directly affected by the measurand

3.1.30
specified measuring range of transducers
set of values of measurands (the pressure for the pressure transducer or temperature for the temperature transducer) for which the errors of the conversion device are intended to lie within the limits specified in this European Standard

NOTE The upper and lower limits of the specified measuring range are called maximum value and minimum value respectively.

EXAMPLE maximum absolute pressure: 12 bar; minimum absolute pressure: 4 bar.

3.1.31
specified field of measurement of a conversion device
set of values at measurement conditions for which the errors of the conversion device are within specified limits

NOTE 1 A conversion device has a measuring range for every quantity that it processes.

NOTE 2 The specified field of measurement applies to the characteristic quantities of the gas that are used to determine the conversion factor.

3.1.32
static gauge pressure
value of the static pressure of the gas relative to the ambient atmospheric pressure

3.1.33
uncertainty of measurement
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

3.1.34
volume
volume without specifying whether it is a corrected volume at measurement conditions or an uncorrected volume at measurement conditions

[A1⟩ **3.1.35**
measurand
particular quantity subject to measurement

3.1.36
critical change value
value at which the change in the measurement result is considered undesirable ⟨A1]

3.2 Symbols

The symbols used in this European Standard are listed in Table 1.

Table 1 – Symbols

Symbols	Represented quantity	Units
V	volume : V_m or V_c	m^3
V_m	volume at measurement conditions	m^3
V_c	corrected volume (gas meter error)	m^3
V_b	volume at base conditions	m^3
V_{CV}	conventional true value of the volume	m^3
C	conversion factor	-
C_c	calculator conversion	-
C_f	correction factor	-
C_{CV}	conventional true value of the conversion factor	-
$f(Q)$	correction function	-
K or K'	coefficients	-
p	absolute pressure at measurement conditions	bar or MPa
p_b	absolute pressure at base conditions	bar or MPa
p_g	gauge pressure	bar or MPa
p_{CV}	conventional true value of the absolute pressure	bar or MPa
T	absolute temperature at measurement conditions	K
T_b	absolute temperature at base conditions	K
T_{min}	minimum absolute temperature	K
T_{max}	maximum absolute temperature	K
T_{CV}	conventional true value of the absolute temperature	K
Z	compression factor of the gas at measurement conditions	-
Z_b	compression factor of the gas at base conditions	-
Z_{CV}	conventional true value of the compression factor	-
p_{atm}	atmospheric pressure	bar or MPa
p_{max}	maximum absolute gas pressure	bar or MPa
p_{min}	minimum absolute gas pressure	bar or MPa
Q	flowrate	m^3/h
Q_{max}	maximum flowrate	m^3/h
Q_{min}	minimum flowrate	m^3/h
t_{am}	ambient temperature	°C
$t_{am,max}$	maximum ambient temperature	°C
$t_{am,min}$	minimum ambient temperature	°C
t	gas temperature	°C
t_{max}	maximum gas temperature	°C
t_{min}	minimum gas temperature	°C
U_{nom}	nominal supply voltage	V
f_{nom}	nominal supply frequency	Hz
e	total conversion factor error	%
e_f	error on the calculation of conversion factor	%
e_p	error on the pressure measurement	%
e_t	error on the temperature measurement	%
e_c	error on the conversion factor	%
e_v	error on the converted volume	%

3.3 [A1⟩ Classification

3.3.1 Mechanical classes

M1 This class applies to instruments used in locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.

M2 This class applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.

3.3.2 Electromagnetic environmental classes

E1 This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings.

E2 This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in other industrial buildings. ⟨A1]

4 Principle of measurement

4.1 Conversion as a function of temperature

In this case the conversion device consists of a calculator and a temperature transducer and it converts the volume to the base conditions.

The pressure is not measured, but may be included as a fixed value in the processing of the conversion factor.

The compression factor is not calculated, but may be included as a fixed value in the processing of the conversion factor.

The error of a gas volume conversion device, measuring only temperature, is calculated referring to the reference conversion factor as calculated taking into account the compression factor at a fixed set pressure and measured temperature.

The volume at base conditions is obtained from the relationship:

$$V_{\text{b}} = C \times V$$

C is the conversion factor given from the relationship:

$$C = \frac{K}{T}$$

K is a fixed value obtained from the relationship:

$$K = \frac{p}{p_b} \times T_b \times \frac{Z_b}{Z}$$

4.2 Conversion as a function of pressure and temperature

In this case, the conversion device consists of a calculator, a pressure transducer and a temperature transducer.

The compression factor may be considered as a fixed value calculated from mean measurement conditions and a determined gas composition.

The volume at base conditions is obtained by the relationship:

$$V_b = C \times V$$

C is the conversion factor given from the relationship:

$$C = K' \times \frac{p}{T}$$

K' is a fixed value obtained from the relationship:

$$K' = \frac{1}{p_\mathrm{b}} \times T_\mathrm{b} \times \frac{Z_\mathrm{b}}{Z}$$

An absolute pressure transducer shall be used for absolute pressures below 21 bar.

For absolute pressures equal to or greater than 21 bar a gauge pressure transducer may be used.

In this case the value of the atmospheric pressure shall be the average value calculated taking into account the altitude of the installation site. This value shall be preset.

4.3 Conversion as a function of pressure, temperature and deviation from the ideal gas law

In this case, the conversion device consists of a calculator, a pressure transducer and a temperature transducer.

The general requirements indicated in 4.2 shall be enforced.

The deviation from the ideal gas law is compensated by the calculation of the compression factor using an appropriate equation as a function of pressure and temperature:

$$Z = \mathrm{f}(p,T)$$

Settable gas properties and components inputs are used for the compression factor calculation.

The volume at base conditions is obtained from the relationship:

$$V_b = C \times V$$

C is the conversion factor given by the relationship:

$$C = \frac{p}{p_\mathrm{b}} \times \frac{T_\mathrm{b}}{T} \times \frac{Z_\mathrm{b}}{Z}$$

The manufacturer shall specify the method used for compression factor calculation.

An absolute pressure transducer shall be used for absolute pressures below 21 bar.

For absolute pressures equal to or greater than 21 bar, a gauge pressure transducer may be used.

In this case, the value of the atmospheric pressure shall be the average value calculated taking into account the altitude of the installation site. This value shall be preset.

4.4 Correction of the volume at measurement conditions

The object of the correction function is to compensate the error of the gas meter, as determined in the calibration certificate.

The conversion device may be able (optionally) to correct the error of the gas meter.

When using this option it shall be ensured that the error curve to be used is relevant to the actual operational conditions.

If this correction is available, it shall be integrated in the configurations stated in 4.1, 4.2 and 4.3; in those cases, the volume marked as V means V_c.

The correction function of the conversion device shall be able to correct deviations recorded when calibrating the gas meter to which it is connected.

The error of the meter will be corrected by the use of a function $f(Q)$ in such a way that for each operating point:

$$V_c = V_m \times f(Q)$$

The manufacturer shall specify the method used.

If a non-linear interpolation between the calibration points is used, the manufacturer shall provide proof that the method has a better weighted (by flow) accuracy than the linear interpolation.

The choice of the parameters shall be so that the correction function $f(Q)$ remains, at all points, definite, continuous and derivable for rates of flow between $Q_{\min}$ and $Q_{\max}$.

The correction can only be applied if the gas meter produces at least 10 pulses per second at $Q_{\min}$. Below $Q_{\min}$ no correction is allowed and above $Q_{\max}$, the correction factor shall remain at the value obtained at $Q_{\max}$.

5 Rated operating conditions

5.1 Specified field of measurement

The field of measurement of the complete instrument shall be specified by the manufacturer.

5.1.1 Specified measurement range for gas pressure

The transducer shall be calibrated over the range specified by the manufacturer which shall be at least:

$$\frac{p_{max}}{p_{min}} > 2$$

5.1.2 Specified measurement range for gas temperature

The manufacturer shall specify the gas temperature range according to the following:

- normal range: -20 °C to +50 °C;
- limited range: a minimum range of 40 °C anywhere between the limits of the normal range;
- extended range: to be specified by the manufacturer.

5.1.3 Gas characteristics

Fuel gases of the first and second families according to EN 437.

[A1⟩ The manufacturer shall indicate the:

— gas family or group;

— maximum operating pressure. ⟨A1]

5.1.4 [A1⟩ Base conditions

The manufacturer shall specify the base conditions, or range of base conditions for converted quantities. ⟨A1]

5.2 [A1⟩ Environmental conditions ⟨A1]

5.2.1 Ambient temperature range

[A1⟩ The manufacturer shall specify the ambient temperature range of the gas-volume conversion device with a minimum temperature range of 50 °C for the climatic environment, and the minimum temperature limit being either -40 °C, -25 °C, -10 °C or 5 °C, and the maximum temperature limit being either 30 °C, 40 °C, 55 °C or 70 °C. ⟨A1]

5.2.2 Humidity range

The instrument shall operate in a relative humidity range of 10 % to 93 %.

[A1⟩ The manufacturer shall indicate whether the instrument is designed for condensing or non-condensing humidity as well as the intended location for the instrument.

If designed for non-condensing humidity, the device shall meet the requirements of Test A.4.

If designed for condensing humidity, the device shall meet the requirements of Test A.5. ⟨A1]

5.2.3 [A1⟩ Mechanical environment

The manufacturer shall specify the mechanical class for which the device is intended (M1 or M2) (see 3.3.1).

5.2.4 Electromagnetic environment

The device shall be able to operate under electromagnetic environmental class E2 (see 3.3.2). ⟨A1]

5.3 Power supply

[A1⟩ The manufacturer shall specify the nominal value of the AC supply and/or the limits of DC supply.

The limits of DC supply shall be compatible with customers' requirements and/or the electricity supply of country of destination. ⟨A1]

6 Construction requirements

6.1 General

6.1.1 All the constituent elements of a gas-volume conversion device shall be constructed of materials having appropriate quality to resist the various forms of degradation which may occur under normal operating conditions as specified by the manufacturer. A gas-volume conversion device shall, in all circumstances, withstand the influence factors and disturbances defined [A1⟩ in 8.5 ⟨A1].

6.1.2 All the constituent elements of a gas-volume conversion device shall be designed in such a way that it does not degrade the accuracy of the measurement of the gas meter with which it is associated.

6.1.3 The gas-volume conversion device shall be constructed in such a way that any intervention, liable to influence the results of measurement, shall cause permanently visible damage to the conversion device or its protective seals, or set an alarm which shall be memorized in the event register. The seals shall be visibly fixed, and easily accessible.

Electronic seals shall comply with the following requirements:

— access shall only be obtained by using a password or a code [A1⟩ that can be updated or by using a specific device ⟨A1];

— the last intervention, at least, shall be registered in the memory, including date and time of intervention and a specific element to identify the intervention;

— It shall be possible to have access to the intervention(s) registered in the memory.

For gas volume conversion devices, where the given inputs may be dismantled or replaced, all connections and interfaces between the calculator and transducers or meter should be protected by separate seals to avoid the breaking of the main metrological seal in case of component replacement. Access to parameters which take part in the determination of the measured results or to the measured results themselves shall not be possible through the disconnected points, except if the conditions given in this paragraph are fulfilled.

6.1.4 The conversion factor shall be recalculated at intervals between the volume pulses not exceeding 1 min for a temperature conversion device and at intervals not exceeding 30 s for the other types of gas-volume conversion devices.

However, when no volume signal has been received from the gas meter for:

— over 1 min for a temperature conversion device; or

— over 30 s for other types,

recalculation is not required until the next volume signal is received.

6.1.5 Any interfaces and connections fitted within the conversion device allowing the connection of complementary devices shall not corrupt the metrological behaviour of the conversion device.

6.1.6 The interconnections and any interfaces between the calculator and the transducers are integral parts of the conversion device.

The manufacturer shall specify the length and characteristics of the interconnections and of any interfaces where these may affect the accuracy of measurement of the gas-volume conversion device.

6.1.7 Equipment used in hazardous areas shall meet the electrical requirements specified in the appropriate standards: [A2⟩ EN 60079-0, EN 60079-1, EN 60079-2, EN 60079-5, EN 60079-6, EN 60079-7, EN 60079-11 and EN 60079-25 ⟨A2].

6.1.8 All the constituent elements of a conversion device shall be constructed in such a way that the compatibility of electromagnetic disturbances conforms the requirements specified in EN 55011.

6.1.9 Casings shall meet the requirements concerning the security of the equipment as specified in EN 60950-1.

6.2 Casings

The casings of all the constituent elements of a conversion device shall have an ingress protection index (IP), specified in EN 60529, complying with the installation conditions specified by the manufacturer.

Any part of the conversion device designed for outdoor use and not intended to be installed in a weatherproof housing shall be at least in accordance with the severity level IP 65, specified in EN 60529.

6.3 Indications

6.3.1 General

6.3.1.1 The calculator shall be fitted with an indicating device that indicates:

- the incremented volume at base conditions V_b;
- the incremented volume at measurement conditions V_m;
- the incremented corrected volume V_c if applicable;
- the alarms' indications as defined in 6.6.

6.3.1.2 Additionally, the following information shall be indicated by a method described in 6.3.1.3:

A1⟩

- the base conditions in the form:
  - T_b = …. K;
  - p_b = …. bar; ⟨A1
- the conversion factor C;
- the compression factor Z if applicable;
- the parameter values measured by the transducers (e.g. pressure p in bar, temperature t in °C);
- the correction factor C_f if applicable;
- the correction function f(Q) if applicable;
- alarm(s) indication(s) additional to those defined in 6.6 if applicable;
- the entered data which affect the metrological result;
- gas properties used in Z computation if applicable;
- the reference to the method by which the compression factor is calculated or the constant, if applicable;
- the serial number of the transducers as appropriate;
- the upper and the lower limits of the specified measuring range of the temperature transducer in K or °C and the gauge or absolute pressure, in bar, of the pressure transducer as appropriate;
- the value of one volumetric pulse at measurement conditions in the form:
  - 1 imp ≙ … m^3 (or dm^3); or
  - 1 m^3 (or dm^3) ≙ … imp;
- the parameters for gas meter error correction curve if applicable;

— the indication of the end of life of the battery, if applicable;

[A1⟩

— the software version. ⟨A1]

— It shall also be possible, at the time of the control operations described in Annex A, to display the values of the conversion factor and of the various quantities measured or calculated.

6.3.1.3 The information shown in 6.3.1.2 shall be indicated either on:

— the indicating device of the gas volume conversion device;

— a permanently attached information plate with indelible markings;

— an external attached indicating device;

— a combination of the above.

6.3.1.4 The volume at base conditions shall be preferentially displayed.

6.3.1.5 The method by which the quantities described in 6.3.1.2 may be displayed on the indicating device of the gas volume conversion device shall take one of the following forms:

— by means of direct operator input (e.g. the depression of push buttons, whereby each quantity may be selected by sequential operator inputs or combination of operator inputs. Each operator input shall select the current value of the quantity. If after 255 s there has been no operator input, the display shall revert to showing the volume at base conditions, or to visualising V_b by a simple operation (e.g. the depression of a push button);

— by means of automatic and sequential scrolling through the quantities that may be continuous, or initiated by an operator input. In this case the display shall show each parameter for 5 s and the volume at base conditions shall be shown every 15 s.

6.3.1.6 The identification and the unit of each quantity or parameter that can be indicated shall be clearly shown next to or upon the display unit of the calculator.

EXAMPLE Volume at base conditions, V_b, …m^3.

6.3.1.7 The scale interval of the display of the volume at base conditions shall be of the form 10^n units of volume. The value of the scale interval shall be clearly stated in the vicinity where the volume at base conditions is displayed.

6.3.1.8 The indicating device shall have at least 8 significant digits.

6.3.2 Electronic indicating device

6.3.2.1 The device indicating the volume at base conditions shall be provided with means for checking to ensure that the display is operating correctly.

6.3.2.2 The minimum height of the numerals for the display of converted volume V_b shall be 4 mm and the minimum width shall be 2,4 mm.

6.3.2.3 It shall be possible to read the index clearly and correctly, within an angle of 15° from normal to the window.

6.3.2.4 When all the digits of the indicating device are not used for the indication of the volume, every unused digit to the left of the significant digit shall indicate zero.

6.4 Inputs for volume conversion

The volume conversion device shall have an input that shall be able to process a signal from the associated gas meter. The input shall respond to every pulse in such a manner that no pulses are gained or lost by the volume conversion device.

The manufacturer shall specify the pulse input characteristic of the gas volume conversion device and the maximum frequency.

For a conversion device type 2, the interfaces between the calculator unit and the transducer shall be specified in terms of all parameters that may influence that measurement.

NOTE Meters can often be subject to considerable periods of time where there is no gas flow. During such periods, conventional LF and HF pulse outputs will, in effect, be operating at 0 Hz. Conversely, at maximum throughput, a typical meter's LF output could rise to 2 Hz and its HF output up to 5 kHz or higher. Any pulse input circuitry in a volume conversion device will have to be capable of dealing with such frequency ranges.

6.5 Battery powered conversion device

6.5.1 All the constituent elements of the conversion device powered by (a) replaceable battery(ies) shall work [A1⟩ for a minimum of five years ⟨A1] without replacing the battery(ies) under the following conditions:

— maximum of all frequency inputs;

— $t_{amb,min}$;

— p_{max} and $T_{min.}$

The manufacturer shall indicate the estimated life time of the battery in the above conditions.

The manufacturer shall specify the type of the battery and whether the battery can be changed in a hazardous area and if so, under which conditions.

NOTE These conditions do not take into account the consumption [A1⟩ from any output and communication ports ⟨A1].

The battery compartment should make provisions to prevent unauthorised access. Batteries shall be replaced only after the breaking of a seal different from the metrological seal.

6.5.2 An indication shall be provided when 10 %, or less, of the life, or estimated life of the battery is remaining.

When the estimated life is calculated, the calculation shall be done taking into account the actual operating conditions specified by the manufacturer of the conversion device.

6.5.3 A battery exchange (if the battery is replaceable) shall be possible without breaking any metrological seals of the conversion device.

During the battery exchange the following information shall be retained:

— the volume at base conditions;

— the volume at measurement conditions;

— the corrected volume if applicable;

— the alarms' indications;

— the entered data which affect the metrological results;

— the last intervention, at least, as specified in 6.1.3.

The battery specified by the manufacturer shall be used.

6.6 Security devices and alarms

6.6.1 The devices shall be capable of detecting:

— if any of the measured or calculated values is outside the specified measurement ranges;

— if the instrument operates outside the limits of validity of the computing algorithm;

— if any of the electrical signals are outside the range of the input(s) of the calculator;

— an expiring battery.

With the exception of an expiring battery, as long as such a defective operation is detected by the conversion device, any further increase of the volume at base conditions shall not be permitted. The recording of volume at measurement conditions and, if applicable, the corrected volume shall continue to operate.

The resetting of the cleared alarm shall be possible only if the cause of the alarm has been eliminated. The reset device shall be capable of being sealed.

6.6.2 If the calculator is capable of estimating the amount of gas passed through the installation during the duration of the faulty condition(s), provision shall be taken to prevent the confusion between estimated values and the calculated volume at base conditions.

Substitute values shall be memorized/indicated separately.

EXAMPLE Stored in a different memory from the one specified in 6.6.3.

6.6.3 The information specified in 6.5.3 shall be memorized at least every hour and retained during an interruption, of whatever kind; computation shall resume with the values retained at the moment of an interruption. The memory shall be able to retain all the specified data for up to six months.

After an interruption or a failure and the restoration of values retained at the moment of interruption or failure, the conversion device shall be capable of restarting automatically.

6.6.4 The parameters used in the processing of the measurements, or intended to identify the constituent parts of the conversion device, shall be incapable of being changed except by a person authorized to make such changes. Those parameters shall be verifiable. Any change of the parameters shall:

— either entail the breaking of the conversion device's seals;

— or be recorded by the conversion device, together with an identifier specific to the person making the change and the date of the change.

6.6.5 [A1) Operation of alarms shall be tested in accordance with A.16. (A1]

7 Installation requirements

7.1 General

The installation requirements shall be as specified in EN 1776.

The conversion device and the transducers shall be installed in a manner appropriate to the conditions necessary for their effective use. The installation and the presence of the conversion device shall not affect the measurement of volume at measurement conditions by the gas meter with which it is associated.

The conversion device and the transducers shall only be used in climatic conditions that are in accordance with the specified environmental classes.

The compatibility of the output of the gas meter and the input of the conversion device shall be verified. [A1) In addition it shall be verified that the display (converted and unconverted readings) shall have at least a sufficient number of numerals to ensure that the volume passed during 8 000 hours at the meter's flow rate of Q_{max} (and at the maximum likely conversion factor) does not return all of the numerals to their original position. (A1]

The installation in hazardous or potentially hazardous areas shall be done in conformity with [A2) EN 60079-0, EN 60079-1, EN 60079-2, EN 60079-5, EN 60079-6, EN 60079-7, EN 60079-11 and EN 60079-25 (A2].

The connections of transducers shall be done in accordance with manufacturers' requirements.

7.2 Temperature transducer

The purpose of the temperature transducer is to measure the gas temperature at measurement conditions.

It shall be possible to verify, on site, the temperature transducer.

7.3 Pressure transducer

The pressure transducer shall be connected to the pressure tapping (marked p_m) of the gas meter, if available.

In order to avoid the introduction of errors caused by variations in atmospheric pressure, a transducer of absolute pressure shall be used. Nevertheless, a gauge pressure transducer may be used if its minimum operating absolute pressure is equal or greater than 21 bar.

It shall be possible to verify, on site, the pressure transducer.

8 Performance

8.1 Reference conditions

The reference conditions are those given in 5.1, supplemented by the following:

— ambient temperature: 20 °C ± 3 °C and the actual temperature shall not change by more than ± 1 °C during a test;

— ambient relative humidity : 60 % ± 15 % and this relative humidity shall not change by more than 10 % during a test;

— AC mains powered equipment:

  — supply voltage nominal values;

  — supply frequency nominal values;

— DC mains powered equipment:

  — supply voltage nominal values;

— battery powered equipment:

  — supply voltage nominal values.

These reference conditions are used for the tests described in A.2.

8.2 Rated operating conditions

See Clause 5.

8.3 Maximum permissible errors

8.3.1 General

8.3.1.1 Conversion devices type 1

For conversion devices type 1, the maximum permissible errors (*MPE*) expressed as relative values, applicable to the volume at base conditions or to the conversion factor ⟦A1⟩ shall be as specified ⟨A1⟧ in Table 2.

The error of the gas meter is not taken into account.

⟦A1⟩ Table 2 — Maximum permissible errors (%) for conversion device type 1

Indication or element	Reference conditions	Rated operating conditions
Main indication for PT and PTZ conversion	0,5	1
Main indication for T conversion	0,5	0,7

⟨A1⟧

8.3.1.2 Conversion devices type 2

For conversion devices type 2, the maximum permissible errors (*MPE*) expressed as relative values, applicable to the various indications or the various separated elements, ⟦A1⟩ shall be as specified ⟨A1⟧ in Table 3.

The error of the gas meter is not taken into account.

Table 3 — Maximum permissible errors (%) for conversion device type 2

⟦A2⟩

Indication or element	Reference conditions	Rated operating conditions
Main indication (e_c) for PT and PTZ conversion	0,5	1
Calculator (e_f)	0,2	0,3
Temperature (e_t)	0,1	0,2
Pressure (e_p)	0,2	0,5
Main indication for T conversion only	0,5	0,7

⟨A2⟧

According to the regulations in force, the metrological control may concern the main indication and/or the characteristic values of the gas, taking account of the constitution of the instrument (complete device – separate elements) and the relevant metrological control operation.

The *MPE*s related to the calculator are to be considered only when it is subjected to a separate control.

8.3.2 Error of conversion

The percentage error e_c on the conversion factor is defined by the equation:

$$e_{c} = \frac{(C - C_{CV})}{C_{CV}} \times 100$$

The allowed error is given by:

$$e_{c} \leq MPE$$

8.3.3 Specific errors for a gas-volume conversion device, type 2

Specific errors exist for each component part of a gas-volume conversion device, type 2, (i.e. calculator, pressure transducer and temperature transducer). These errors are defined by the relationships:

$$e_{f} = \frac{(C_{c} - C_{CV})}{C_{CV}} \times 100$$

$$e_{p} = \frac{(p - p_{CV})}{p_{CV}} \times 100$$

$$e_{t} = \frac{(T - T_{CV})}{T_{CV}} \times 100$$

[A1⟩ The ⟨A1] values of e_f,e_p and e_t shall be verified during the accuracy test defined in A.2.

The allowed combined error is given by:

$$|e| = |e_{f}| + |e_{p}| + |e_{t}| \leq MPE$$

The requirements related to the accuracy of the main indication shall be met.

8.4 Conditions of matching the constituent elements of a conversion device type 2

The matching of the constituent elements of a conversion device type 2 shall comply with the following requirements:

a) each of all the elements shall be approved and verified separately;

b) the complete assembly shall be subjected to a verification concerning:

- the configuration;
- the data and signals transmission;
- the maximum error of the type 2 conversion device, which shall be within the *MPE* of the main indication according to Table 3;

c) the rated operating conditions of the assembly shall be deemed as being equal to the common part of the measure ranges of each of the constituent elements of the conversion device;

d) the transducers shall be mounted under the conditions specified in the type approval certificate, and according to the manufacturer's instructions;

e) if a transducer is capable of generating and transmitting an alarm to the calculator, the conversion device shall handle this as an alarm.

8.5 Influence factors

- Ambient temperature (dry heat and cold): test defined in A.3;
- Damp heat, steady state: test defined in A.4;
- Cyclic damp heat: test defined in A.5;
- Electrical power variations: test defined in A.6;
- Effects of vibrations: test defined in A.12;
- Effects of shocks: test defined in A.13.

The relevant requirements are given in Table 4.

8.6 Disturbances

- Short time power reductions, for mains powered equipment: test defined in A.7;
- Electrical bursts: test defined in A.8;
- Electromagnetic susceptibility: test defined in A.9;
- Electrostatic discharges: test defined in A.10;
- Overload of pressure: test defined in A.11;
- Overload of pressure (mechanical): test defined in A.14;

[A2⟩

- Short time DC power variations: test defined in A.18;
- Surges on supply lines and/or signal lines: test defined in A.19;
- Power frequency magnetic field: test defined in A.20. ⟨A2]

The relevant requirements are given in Table 4.

8.7 Durability

After a period of use corresponding to an accelerated ageing, as defined in A.15, the relevant requirement shall be as given in Table 4.

8.8 [A1⟩ Repeatability

The application of the same measurand under the same conditions of measurement shall result in the close agreement of 6 successive measurements (see A.17).

The test shall be carried out with one gas during the accuracy test, at p_{min} and T (see Table A.1).

The difference between the measurement results shall meet the requirement given in Table 4. ⟨A1⟩

8.9 ⟨A1⟩ Reliability

A measuring instrument shall be designed to reduce as far as possible the effect of a defect that would lead to an inaccurate measurement result, unless the presence of such a defect is obvious. ⟨A1⟩

9 Tests of conformity

9.1 Verification of the construction requirements

Construction requirements, as stated in Clause 6, are verified on one sample in accordance with the specifications given in A.1.

9.2 Verification of the performance requirements

9.2.1 Test conditions

⟨A2⟩ The device shall meet the requirements specified in Table 4.

Table 4 — List of relevant tests

Clause	Tests	Acceptance criteria	Timing	Test procedure
A.2	Accuracy	*MPE*	D	PR1
A.3	Ambient temperature	*MPE*	D	PR2
A.4	Damp heat, steady state	*MPE*	BDA	PR3
A.5	Cyclic damp heat	*MPE*	BA	PR3
A.6	Electrical power variation	*MPE*	BD	PR3
A.7	Short time AC power reductions	Δe < *MPE*	BD	PR4
A.8	Electrical bursts	Δe < *MPE*	BD	PR4
A.9	Electromagnetic immunity	Δe < *MPE*	BD	PR4
A.10	Electrostatic discharges	Δe < *MPE*	BD	PR4
A.11	Overload of pressure	Δe < *MPE*	BA	PR5
A.12	Random vibrations	*MPE*	BA	PR3
A.13	Shocks	Δe < *MPE*	BA	PR4
A.14	Overload of pressure (mechanical)	operable	A	PR4
A.15	Durability	Δe < 0,5 *MPE*	BA	PR2
A.16	Alarms operation	operable	D	PR4
A.17	Repeatability	Δe < *MPE*/3	D	PR2
A.18	Short time DC power variations	Δe ≤ *MPE*	BD	PR4
A.19	Surges on supply lines and/or signal lines	Δe ≤ *MPE*	BA	PR4
A.20	Power frequency magnetic field	Δe ≤ *MPE*	BD	PR4

Test procedure: PR1, PR2, PR3, PR4 (See Annex A)
Timing: B: Before, D: During, A: After
Δe: see Annex E
For the acceptance criteria, Δe needs to be compared with MPE given in Tables 2 and 3.

The tests shall be performed using reference instruments traceable to national standards. The uncertainties shall be determined, including those arising from their use, and shall not exceed one fifth of the maximum permissible errors.

The conventional true value of the compression factor shall be computed according to EN ISO 12213-3:2005 or outside the limits of this method, with the methods described in EN ISO 12213-2:2005. When used with first family gases it is necessary to check this against a first family gas calculation method.

Following the type approval of a gas-volume conversion device, any modification(s) to the device shall be validated with tests relevant to the modification(s). A complete set of tests per modification is not required. A2⟩

9.2.2 Samples of gas volume conversion device type 1 required for testing

⟨A2 The number of samples to be tested is indicated in the tables below, according to the number of variants. Each gas volume conversion device tested shall satisfy the performance requirements specified in Clause 8.

The following provisions have to be taken into account:

a) a conversion device may be offered with a choice of different pressure ranges (and/or temperature ranges). Each pressure (and/or temperature) range will invariably be due to the use of different pressure (and/or temperature) transducers. In addition, it may be that the manufacture uses several transducer suppliers, all providing transducers with the same measurement range.

   In this clause, "variant" refers to each different type of transducer, or combination of, transducers howsoever caused.

b) if the conversion device is intended to be used for T conversion and PT conversion, or for T conversion and PTZ conversion, an additional sample shall be submitted for test.

If the number of variants is higher or equal to 2 the number of samples applicable to the testing procedure shall be adapted in accordance with the characteristics of the different types of transducers.

The methods are illustrated through the three different cases as follows:

Case 1:

Where the number of variants is equal to 1 the number of samples shall be at least as given in Table 5:

Table 5 — Conversion devices type 1: test samples where only one variant of device is available (case 1)

Recommended sequence in which tests are carried out		**Sample S1**	**Sample S2**	**Sample S3** [a]
Clause	**Test**			
A.2	Accuracy	X	X	X
A.16	Alarms’ operation	X		X
A.17	Repeatability	X		X
A.3	Ambient temperature	X		X
A.4	Damp heat, steady state	X		X
A.5	Cyclic damp heat	X		X
A.6	Electrical power variation	X		X
A.7	Short time AC power reductions	X		X
A.8	Electrical bursts	X		X
A.9	Electromagnetic immunity	X		X
A.10	Electrostatic discharges	X		X
A.18	Short time DC power variations	X		X
A.19	Surges on supply lines and/or signal lines	X		X
A.20	Power frequency magnetic field	X		X
A.11	Overload of pressure	X		X
A.12	Random vibrations	X		X
A.13	Shocks	X		X
A.14	Overload of pressure (mechanical)	X		X
A.15	Durability		X	

[a] If necessary, see provision b) above.

Case 2:

Where the conversion device includes only one type of pressure transducer (e.g. transducer from the same supplier and from the same family) but the pressure transducer is available for three different measuring ranges R1, R2 and R3. In this case, the test samples are in accordance with Table 6.

Table 6 — Conversion devices type 1: test samples where there are three ranges of pressure transducers from the same family (case 2)

Recommended sequence in which tests are carried out		Sample range R1	Sample range R2	Sample range R3
Clause	**Test**			
A.2	Accuracy	X	X	X
A.16	Alarms’ operation	X	X	X
A.17	Repeatability	X	X	X
A.3	Ambient temperature	X	X	X
A.4	Damp heat, steady state	X	X	X
A.5	Cyclic damp heat	X		
A.6	Electrical power variation	X		
A.7	Short time AC power reductions	X		
A.8	Electrical bursts	X		
A.9	Electromagnetic immunity	X		
A.10	Electrostatic discharges	X		
A.18	Short time DC power variations	X		
A.19	Surges on supply lines and/or signal lines	X		
A.20	Power frequency magnetic field	X		
A.11	Overload of pressure	X	X	X
A.12	Random vibrations	X		
A.13	Shocks	X		
A.15	Durability		X	
A.14	Overload of pressure (mechanical)	X	X	X

Case 3:

Where the conversion device includes three types of pressure transducers (P1, P2, P3) from different suppliers and/or different families? In this case, the test samples are in accordance with Table 7.

Table 7 — Conversion devices type 1: test samples where there are three different pressure transducers from different families (case 3)

Recommended sequence in which tests are carried out		Sample with P1	Sample with P2	Sample with P3
Clause	Test			
A.2	Accuracy	X	X	X
A.16	Alarms' operation	X	X	X
A.17	Repeatability	X	X	X
A.3	Ambient temperature	X	X	X
A.4	Damp heat, steady state	X	X	X
A.5	Cyclic damp heat	X	X	X
A.6	Electrical power variation	X	X	X
A.7	Short time AC power reductions	X	X	X
A.8	Electrical bursts	X	X	X
A.9	Electromagnetic immunity	X	X	X
A.10	Electrostatic discharges	X	X	X
A.18	Short time DC power variations	X	X	X
A.19	Surges on supply lines and/or signal lines	X	X	X
A.20	Power frequency magnetic field	X	X	X
A.11	Overload of pressure	X	X	X
A.12	Random vibrations	X	X	X
A.13	Shocks	X	X	X
A.15	Durability	X	X	X
A.14	Overload of pressure (mechanical)	X	X	X

(A2)

9.2.3 Samples of gas volume conversion devices type 2 required for testing

As a conversion device type 2 is composed of separate elements, each element is tested separately.

For each constituent of the conversion device (pressure or temperature transducer, temperature sensor), the specifications regarding the number of test samples and the recommended test sequence are given in the corresponding annexes (see B.5.3, C.7.3, D.5.3).

The calculator is considered as an element with only one variant; the requirements in Tables 5 and 6 are applicable, with the exception of the testing concerning the overload of pressure which are not performed on the calculator (A.11 and A.14).

9.3 Test report

Model test reports are given (A1) in Annex C for PRT sensors, in Annex E for conversion devices, and in Annex F for associated transducers (A1), as applicable.

10 Marking

(A1) Each conversion device shall be marked with the following information in legible characters which are permanently visible meeting the requirements of Annex A of EN 60730-1:2000:

a) type approval mark and number;

b) identification mark or name of the manufacturer;

c) serial number of the instrument and the year of manufacture;

d) hazardous area classification of the gas-volume conversion device, if applicable;

e) *MPE* at reference conditions.

The following indications shall also either be marked or be listed on the packaging and in the documentation:

f) base conditions in the form:

— T_b = ... K;

— p_b = ... bar;

g) extreme temperatures of the environmental class in the form:

— $t_{amb,max}$ = ... °C;

— $t_{amb,min}$ = ... °C;

h) for Type 1 conversion devices, the extreme gas pressures in the form:

— p_{max} = ... bar;

— p_{min} = ... bar;

i) for Type 1 conversion devices, the extreme gas temperatures in the form:

— T_{max} = ... °C;

— T_{min} = ... °C;

j) IP code;

k) an indication of the reference to Part 1 of this standard "EN 12405-1".

11 [A1⟩ Installation and operating instructions

The device shall be accompanied by information in written form or electronic format in a language acceptable by the user.

Each device, or group of devices, shall be delivered with installation, operation and maintenance manuals which are easily understandable, giving appropriate instructions on:

— name and address of manufacturer;

— rated operating conditions;

— mechanical and electromagnetic environment classes;

— upper and lower temperature limit, whether condensation is possible or not;

— whether the device is suitable for use outdoors or not;

— instructions for installation, maintenance, repairs, permissible adjustments;

- estimated period of time over which the metrological characteristics of the device are maintained;
- instructions for correct operation and any special conditions of use;
- conditions for compatibility with interfaces, sub-assemblies or measuring instruments.

Groups of identical measuring instruments used in the same location or used for utility measurement do not necessarily require individual instruction manuals. ⟨A1

Annex A
(normative)

Type test

A.1 General conditions

A.1.1 General

The constituent elements of a gas-volume conversion device shall be operating during all the tests. When the gas volume conversion device includes an error curve correction of the associated gas meter, the correction factor shall be fixed to 1 for all the tests. The correction error curve has to be tested independently. This test is not included in the pattern approval.

The input signal, which represents the volume at metering conditions and comes from the meter with which the gas-volume conversion device is associated, shall be simulated in accordance with the specifications of 6.4.

This volume shall be simulated so that it represents the greater of 1 000 pulses or 1 000 times the value of the least significant digit of the volume at measurement conditions. Nevertheless, for disturbance tests, this value can be increased according to the duration of the test.

For the accuracy tests, the values of p_{max}, T_{max} and p_{min}, T_{min} shall be approximated values, respectively by lower values and upper values, or the level defined for activate the alarm shall be increase to prevent the activation of the alarms, except for the specific alarm tests.

When test procedures require a test at reference conditions before the application of the influence factors or disturbances, the test under reference conditions performed at the end of the previous test can be used for that purpose.

The length of the connection cables shall be the length specified by the manufacturer. If the maximum length specified is more than 3 m, a minimum length of 3 m can be used.

A.1.2 Additional conditions specific to gas volume conversion devices type 1

All the tests shall be performed on the complete conversion device including the calculator, the transducers and the connection cables. During the tests, if necessary, the volume at metering conditions is simulated with an adapted test facility.

A.1.3 Additional conditions specific to gas-volume conversion devices type 2

In addition to the specifications given in A.1.1, the constituent elements of a conversion device type 2 shall be tested separately as follows:

- the transducers and thermometer sensors are tested according their respective specifications given in Annexes B, C and D;
- the calculator is tested according this annex, with the following particular restrictions:
  - the overload tests according A.11 and A.14 are not carried out on the calculator;
  - for all tests performed, pressure and temperature values are simulated by signal inputs. The signals shall be generated using reference instruments traceable to national standards. The uncertainties shall be determined, including those arising from their use, and shall not exceed one fifth of the maximum permissible errors.

A.1.4 Test procedures

A.1.4.1 Test procedure 1 (PR1*)*

A.1.4.1.1 Test conditions

This test procedure is applicable for the accuracy test. It is performed under reference conditions as defined in 8.1.

For the compression factor calculation, three gas compositions specified as Gas 1, Gas 3 and Gas 6 in Annex C of EN ISO 12213-2:2005 and EN ISO 12213-3:2005 shall be used.

A.1.4.1.2 Performance of the test

The test consists in the determination of the error of the gas-volume conversion device at the specified points. The error is determined on the conversion factor or on the volume at base conditions as described below.

A.1.4.1.2.1 T conversion

The accuracy test has to be performed at 3 points of gas temperature, T_{min}, T and T_{max} where:

$$T \approx \frac{T_{max} + T_{min}}{2}$$

At this point the error shall be calculated for V_b. For the other points (T_{min} and T_{max}), the error can be determined for the conversion factor *C*.

A.1.4.1.2.2 PT and PTZ conversion

The accuracy test has to be performed at each point of Table A.1 and according to the methodical arrangement (1 to 15). In addition, the error shall be calculated on V_b for the point 8 of Table A.1. For all the other points, the error can be determined for the conversion factor *C*.

Table A.1

	p_{min}	p_2	p_3	p_4	p_{max}
T_{min}	**1** ⇒	**2** ⇒	**3** ⇒	**4** ⇒	**5** ⇓
T	⇓ **10**	⇐ **9**	⇐ **8**	⇐ **7**	⇐ **6**
T_{max}	**11** ⇒	**12** ⇒	**13** ⇒	**14** ⇒	**15**

where

$$T \approx \frac{T_{max} + T_{min}}{2}$$

$$p_2 \approx \frac{3p_{min} + p_{max}}{4}$$

$$p_3 \approx \frac{p_{min} + p_{max}}{2}$$

$$p_4 \approx \frac{3p_{max} + p_{min}}{4}$$

The set point of temperature and pressure shall be within ± 4 % of the calculated value.

A.1.4.2 Test procedure 2 (PR2)

The test procedure PR2 corresponds to the test procedure PR1, but carried out with one gas composition, the one for which the results of the test A.2 are the worst, at reference conditions or rated operating conditions depending on the test.

A.1.4.3 Test procedure 3 (PR3)

The test procedure 3 is the same as procedure 2 but it has to be applied on a limited number of points (see Table A.2).

Table A.2

	p_{min}	p_{max}
T_{min}	1 ⇒	2 ⇓
T_{max}	4 ⇐	⇐ 3

The error shall be calculated on the volume at base conditions for the point 3 of Table A.3. For all the other points, the error can be determined for the conversion factor *C*.

A.1.4.4 Test procedure 4 (PR4)

The test procedure 4 is the same as procedure 2 but it has to be applied on one single point, to be chosen inside the specified field of measurement of the conversion device.

At this point the error shall be calculated on the volume at base conditions.

A.1.4.5 Test procedure 5 (PR5)

The test procedure 5 is the same as procedure 2 but has to be applied on five points (see Table A.3), corresponding to the points 6 to 10 of Table A.1. The error is determined only for the conversion factor *C*.

Table A.3

	p_{min}	p_2	p_3	p_4	p_{max}
T	5	⇐ 4	⇐ 3	⇐ 2	⇐ 1

A.1.5 Verification of the construction requirements

The verification of the construction requirements given in 6.1 to 6.5 is carried out by visual inspection, measurements and all relevant checks which assess conformity to the required specifications.

The compliance to 6.6 is verified through the test defined in A.16.

A.2 Accuracy tests under reference conditions

A.2.1 Objective

The objective is to verify that the instrument conforms to maximum permissible errors specified in this European Standard under reference conditions.

A.2.2 Reference to documents

Not applicable.

A.2.3 Procedure

The test procedure is the PR1 as defined in A.1.4.1.

A.2.4 Acceptance criteria

All functions shall operate as designed.

At each test point and each measurement the error shall be within the maximum permissible errors specified in 8.3 for reference conditions.

A.3 Effect of ambient temperature

A.3.1 Objective

The objective is to verify that the instrument conforms to specifications of this European Standard under conditions of ambient temperature (dry heat and cold).

A.3.2 Reference to documents

EN 60068-2-1.

EN 60068-2-2.

EN 60068-3-1.

A.3.3 Procedure

The test procedure is the PR2 as defined in A.1.4.2.

The value of the ambient temperature shall be the upper and the lower values of the environmental class as defined in 5.2.1 [A1) *deleted text* (A1].

A.3.4 Acceptance criteria

All functions shall operate as designed.

At each test point and each measurement the error shall be within the maximum permissible errors specified in 8.3 in the column "rated operating conditions" of Table 2 or Table 3, as appropriate.

A.4 Effect of damp heat, steady state test

A.4.1 Objective

The objective is to verify that the instrument conforms to the specifications of this European Standard under conditions of high humidity and constant temperature.

A.4.2 Reference to documents

EN 60068-2-78.

A.4.3 Procedure

The test procedure is the PR3 as defined in A.1.4.3.

The test consists of an exposure to a constant temperature equal to the upper temperature of the environmental class and to a constant relative humidity of 93 % for 4 days.

The performance of the test shall be so that no condensation of water occurs on the gas-volume conversion device.

The test procedure PR3 shall be performed three times:

- at reference conditions, before the increase of temperature;
- at the end of the upper temperature phase;
- at reference conditions, after the decrease of temperature.

A.4.4 Acceptance criteria

All functions shall operate as designed.

At each test point and each measurement, before, during and after the test, the error shall be within the maximum permissible errors specified in 8.3 for reference conditions and for rated operating conditions respectively.

A.5 Effect of damp heat, cyclic test

A.5.1 Objective

The objective is to verify that the instrument conforms to the specifications of this European Standard under conditions of cyclic damp heat.

A.5.2 Reference to documents

EN 60068-2-30.

A.5.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

The test consists of an exposure to cyclic temperature variation between temperature at reference conditions and the upper temperature of the environmental class. During the temperature change and the low temperature phases, the humidity shall be maintained above 95 % and during the upper temperature phases, the humidity shall be maintained above 93 %.

During the test, [A1) condensation shall occur (A1].

The conversion device is non-operational when the influence factor is applied.

The tests shall be performed 2 times:

- at reference conditions, before the cyclic variations;
- at reference conditions, after the cyclic variations.

A.5.4 Acceptance criteria

All functions shall operate as designed.

At each test point and each measurement, before and after the test, the error shall be within the maximum permissible errors specified in 8.3 for reference conditions.

A.6 Electrical power variation

A.6.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of varying AC mains power supply, varying DC mains power supply or battery supply.

A.6.2 Reference to documents

EN 61000-4-11 for mains power supply.

No reference to European or International Standards can be given at the moment for battery power supply.

A.6.3 Procedure

The test procedure is the PR3 as defined in A.1.4.3.

The test consists of exposure to power variation while the gas-volume conversion device operates.

For AC power supply the test is performed at 4 conditions of the mains supply, according to the methodical arrangement of Table A.4 (1 to 4).

Table A.4

Condition	Frequency	Voltage
1	f_{nom}	1,10 U_{nom}
2	f_{nom}	0,85 U_{nom}
3	1,02 f_{nom}	U_{nom}
4	0,98 f_{nom}	U_{nom}

For battery supply or DC mains power supply the voltage shall be fixed at the minimum and maximum value specified by the equipment manufacturer.

A.6.4 Acceptance criteria

All functions shall operate as designed.

At each test point and each measurement the error shall be within the maximum permissible errors specified in 8.3 for rated operating conditions.

A.7 Short time power reductions

A.7.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of short time power reductions.

A.7.2 Reference to documents

EN 61000-4-11, severity level 2.

A.7.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

Before the application of the disturbance, the error shall be determined.

During the test, the mains voltage shall vary as defined in the above standard. For each variation, the error shall be determined.

A.7.4 Acceptance criteria

All functions shall operate as designed.

The error determined before the application of the disturbance shall be within the MPE at reference conditions.

The difference between the errors registered before and during the application of the disturbance shall not exceed the maximum permissible error at reference conditions as given in 8.3.

A.8 Electrical bursts

A.8.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of electrical burst on mains power supply (AC or DC) and on in/out connections for signals or commands.

A.8.2 Reference to documents

EN 61000-4-4, severity level 3. (More details to be specified from MID or from D11).

A.8.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

Before the application of the disturbance, the error shall be determined.

During the application of the disturbance, the error shall then be determined.

A.8.4 Acceptance criteria

All functions shall operate as designed.

The error determined before the application of the disturbance shall be within the MPE at reference conditions.

The difference between the errors registered before and during the application of the perturbation shall not exceed the maximum permissible error at reference conditions as given in 8.3.

A.9 Electromagnetic susceptibility

A.9.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of electromagnetic fields.

A.9.2 Reference to documents

EN 61000-4-3, severity level 3.

EN 61000-4-6, severity level 3.

A.9.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

Before the application of the disturbance, the error shall be determined.

During the application of the disturbance, the error shall then be determined.

A.9.4 Acceptance criteria

All functions shall operate as designed.

The error determined before the application of the disturbance shall be within the MPE at reference conditions.

The difference between the errors registered before and during the application of the perturbation shall not exceed the maximum permissible error at reference conditions as given in 8.3.

A.10 Electrostatic discharges

A.10.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of electrostatic discharges.

A.10.2 Reference to documents

EN 61000-4-2, severity level 4.

A.10.3 Procedure

The test includes the paint penetration method, if appropriate. For direct discharges, the air discharge shall be used where the contact discharge method cannot be applied.

The test procedure is the PR4 as defined in A.1.4.4.

Before the application of the disturbance, the error shall be determined.

During the application of the disturbance, the error shall then be determined.

A.10.4 Acceptance criteria

After the test, all functions shall operate as designed.

The error determined before the application of the disturbance shall be within the MPE at reference conditions.

The difference between the errors registered before and during the application of the perturbation shall not exceed the maximum permissible error at reference conditions as given in 8.3.

A.11 Overload of pressure (only for type 1 and pressure transducers)

A.11.1 Objective

The objective is to verify the compliance with the provisions of this European Standard after an overload of pressure on the pressure transducer.

A.11.2 Reference to documents

No reference to European or International Standards can be given at the moment.

A.11.3 Procedure

The test procedure is the PR5 as defined in A.1.4.5.

The errors shall be determined before and after the application of the overload of pressure.

The overload of pressure is applied to the pressure transducer in the following conditions:

— value of the overload: 1,25 times the upper value of the specified measuring range of the transducer;

— duration of application: 30 min;

— relaxation time: 30 min.

A.11.4 Acceptance criteria

All functions shall operate as designed.

The difference between the errors registered before and after the application of the disturbance shall not exceed the maximum permissible error at reference conditions as given in 8.3.

A.12 Effect of vibrations

A.12.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of random vibrations.

A.12.2 Reference to documents

EN 60068-2-64, severity level 2.

A.12.3 Procedure

The test procedure is the PR3 as defined in A.1.4.3.

The conversion device is non-operational when the influence factor is applied.

The tests shall be performed 2 times:

— at reference conditions, before the application of the vibrations;

— at reference conditions, after the application of the vibrations.

A.12.4 Acceptance criteria

All functions shall operate as designed.

At each test point and each measurement, before and after the test, the error shall be within the maximum permissible errors specified in 8.3 for reference conditions.

A.13 Effect of shocks

A.13.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of shocks.

A.13.2 Reference to documents

EN 60068-2-31, severity level 2.

A.13.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

The tests shall be performed 2 times:

— at reference conditions, before the application of the shocks;

— at reference conditions, after the application of the shocks.

A.13.4 Acceptance criteria

After the test, all functions shall operate as designed.

At each test point and each measurement, before and after the test, the error shall be within the maximum permissible errors specified in 8.3 for reference conditions.

A.14 Overload of pressure (mechanical)

A.14.1 Objective

The objective is to verify that the instrument can resist to an overload of pressure without being destroyed.

A.14.2 Reference to documents

No reference to European or International Standards can be given at the moment.

A.14.3 Procedure

The test consists on exposing the pressure transducer to an overload of pressure, according Table A.5, during 15 min.

Table A.5

Maximum operating pressure of the network *MOP* (bar)	**Test pressure (bar) greater than**
MOP > 40	1,15 *MOP*
16 < *MOP* ≤ 40	1,20 *MOP*
5 < *MOP* ≤ 16	1,30 *MOP*
2 < *MOP* ≤ 5	1,40 *MOP*
0,1 < *MOP* ≤ 2	1,75 *MOP*
MOP ≤ 0,1	2,50 *MOP*

A.14.4 Acceptance criteria

Following the test, a leakage test shall be performed to check that the pressure containing part of the pressure transducer has not breached.

A.15 Durability

A.15.1 Objective

The objective is to simulate an ageing of the instrument and to verify that the instrument conforms to specifications of this European Standard over a period of use.

A.15.2 Reference to documents

No reference to European or International Standards can be given at the moment.

A.15.3 Procedure

First, the test procedure PR2 shall be performed under reference conditions as specified in A.1.4.2.

Then, the gas-volume conversion device shall be exposed to cyclic variations of ambient temperature between the minimum and the maximum temperatures of the environmental class.

The variations of ambient temperature are defined as following:

— definition of the cycle: the instrument is exposed to the maximum temperature of the environmental class during 1 week, then to the minimum temperature of the environmental class during 1 week;

— number of cycles: 2 cycles;

— total test duration: 4 weeks.

The variations between the maximum and the minimum ambient temperatures shall be performed by steps of $10\ K \cdot h^{-1}$.

After a stabilization of 24 h at reference conditions, the test procedure PR2 shall be performed again.

A.15.4 Acceptance criteria

All functions shall operate as designed.

At each test point and each measurement, the absolute value of the difference between the error before the durability test and the error after the durability test shall not exceed 0,5 of the maximum permissible error at reference conditions.

A.16 Alarms operation

A.16.1 Objective

The objective is to simulate a situation where each of the characteristic quantities of the conversion device in turn goes outside its specified field of measurement (specified measurement range) and to verify that the alarms operate in accordance with the relevant specifications of this European Standard.

A.16.2 Reference to documents

No reference to European or International Standards can be given at the moment.

A.16.3 Procedure

The test consists in reaching the set points (limits of the specified measurement ranges) by increasing then decreasing the chosen parameter, in order to verify the operation of the alarms and the correct resetting of the calculator back to its normal operation as soon as the value of the chosen parameter comes back in its declared operating range. It is important to check that the incrementation of the calculator is stopped as long as one parameter is in an alarm state and that the incrementation restarts when the cause of the alarm has been eliminated.

A.16.4 Acceptance criteria

All alarms have to be completely checked: nature, date, hours of the beginning and end of the alarm.

It is verified that the calculator is provided with a device to allow to detect and put in evidence the alarms. This alarm indication shall remain in operation till the intervention of an authorized person (code, keyboard, …).

A.17 [A1) Repeatability

A.17.1 Objective

The objective is to verify that the results of the application of the same measurand under the same conditions of measurement are in close agreement.

A.17.2 Reference to standards

No reference to European or International Standards can be given at the moment.

A.17.3 Procedure

The test consists in carrying six successive measurements with one gas during the accuracy test, at p_{min} and $T \approx \frac{T_{max} + T_{min}}{2}$.

The test procedure is the PR2 as defined in A.1.4.2.

A.17.4 Acceptance criteria

The difference between the results of six successive measurements shall not exceed one third of MPE at reference conditions. ⟨A1]

A.18 [A2⟩ Short time DC power variations

A.18.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of short time DC power variations.

NOTE This test is applicable to low voltage D.C. power ports of equipment supplied by external D.C. networks. It does not apply to self contained volume conversion devices powered for example by an internal battery.

A.18.2 Reference to standards

EN 61000-4-29, severity level 1.

A.18.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

Before the application of the disturbance, the error shall be determined.

During the test, the mains voltage shall vary as defined in the above standard. For each variation, the error shall be determined.

A.18.4 Acceptance criteria

All functions shall operate as designed.

The error determined before the application of the disturbance shall be within the MPE at reference conditions as given in 8.3.

The difference between the errors registered before and during the application of the disturbance shall not exceed the MPE at reference conditions. ⟨A2]

A.19 [A2⟩ Surges on supply lines and/or signal lines

A.19.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of electrical surges on AC/DC main supply, signal and communication lines.

A.19.2 Reference to standards

EN 61000-4-5, severity level 3.

A.19.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

Before the application of the disturbance, the error shall be determined.

During the test, the surges are applied as defined in the above standard. After the test, the error shall be determined.

A.19.4 Acceptance criteria

All functions shall operate as designed.

The error determined before the application of the disturbance shall be within the MPE at reference conditions as given in 8.3.

The difference between the errors registered before and after the application of the disturbance shall not exceed the MPE at reference conditions. ⟨A2⟩

A.20 ⟨A2⟩ Power frequency magnetic field

A.20.1 Objective

The objective is to verify the compliance with the provisions of this European Standard under conditions of a significant influence of the power magnetic field.

A.20.2 Reference to standards

EN 61000-4-8, severity level 5.

A.20.3 Procedure

The test procedure is the PR4 as defined in A.1.4.4.

Before the application of the disturbance, the error shall be determined.

During the test, the power frequency magnetic field (50 Hz or 60 Hz) is generated as defined in the above standard. For each disturbance, the error shall be determined.

A.20.4 Acceptance criteria

All functions shall operate as designed.

The error determined before the application of the disturbance shall be within the MPE at reference conditions as given in 8.3.

The difference between the errors registered before and during the application of the disturbance shall not exceed the MPE at reference conditions. ⟨A2⟩

Annex B
(normative)

Pressure transducers

B.1 Scope

This annex specifies the requirements and tests for the construction, performances, safety and conformity of the pressure transducers associated to electronic gas-volume conversion devices.

Any pressure transducer may include a correction relative to temperature.

A static pressure transducer may be fitted with a setting device to adjust the specified measurement range.

B.2 Rated operating conditions

B.2.1 Specified measurement range for pressure

The measurement range of the pressure transducer shall be specified by the manufacturer, in accordance with 5.1.1.

B.2.2 Environmental class

The transducer shall comply with the requirements as per 5.2.1 and 5.2.2.

B.2.3 Power supply

The power supply conditions are those given in 5.3.

B.3 Construction requirements

B.3.1 General

The relevant requirements are those given in 6.1.

In addition, the transducer shall be sealed in such a way that the sensor element cannot be changed without breaking the sealing.

If the pressure transducer is fitted with a setting device to adjust the specified pressure range, this shall be sealed.

B.3.2 Casings

The relevant requirements are those given in 6.2.

B.3.3 Indications

B.3.3.1 General

B.3.3.1.1 If the pressure transducer is provided with an indicator, it shall indicate at least the measured gas pressure in the measurement conditions.

This indicator is not intended to be used for metrological purposes. As such, it shall bear a legend clearly visible to the user, to indicate that it is not controlled when it gives a measurement result visible to the user.

B.3.3.1.2 The identification and the unit of each value or parameter that can be indicated shall be clearly displayed next to or upon the display of the measured value.

B.3.3.1.3 The scale interval of the pressure shall be of the form 10^n units of pressure (*n* whole number, positive or negative). The value of the scale interval shall be clearly stated close to the main value display.

B.3.3.2 Electronic indicating device

B.3.3.2.1 The device indicating the measured pressure shall be provided with means of control to ensure that the display is operating correctly.

B.3.3.2.2 The minimum height of the numerals for the display shall be 4 mm and the minimum width 2,4 mm.

B.3.3.2.3 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.

B.3.3.2.4 When all the digits of the indicating device are not used for the indication of the pressure, every unused digit to the left of the significant digit shall indicate zero.

B.4 Performances

B.4.1 Reference conditions

Reference conditions are those given in 8.1.

B.4.2 Rated operating conditions

See B.2.

B.4.3 Maximum permissible errors

The maximum permissible errors applicable to pressure are specified in Table 3 in 8.3.1.2.

B.4.4 Influence factors

The influence factors are those given in 8.5.

For each influence factor, the pressure transducer shall comply with the *MPE* requirements at rated operating conditions, as given in Table 3.

B.4.5 Disturbances

Disturbances are those given in 8.6.

The difference between the errors registered before, during or after the application of the disturbance shall not exceed 0,5 *MPE* at reference conditions, as given in Table 3.

B.4.6 Durability

After a period of use corresponding to an accelerated ageing, as defined in A.15, the deviation between errors before and after ageing shall be lower than or equal to 0,5 *MPE* as given in Table 3.

B.5 Tests of conformity

B.5.1 Test conditions

The tests shall be performed using reference instruments traceable to national standards where the uncertainties are known, including those arising from their use, and do not exceed one fifth of the maximum permissible errors.

B.5.2 Tests

The list of the relevant tests is the one given as Table 4, with the following modification: test A.2 is performed with any test gas (only one gas), at three different temperatures (t_{min}, t_{max}, $t_{at\ reference\ conditions}$).

Following the type approval, any modification to the pressure transducer shall be validated with significant tests relevant to the modification. A complete set of tests per modification is not required.

B.5.3 Sample of pressure transducers required for testing

For one presented variant of the pressure transducer, the conformity tests as per B.5.2 shall be carried out on the number of samples and following the chronology as defined in Table 5.

NOTE For the meaning of "variant", see 9.2.3.

If the number of variant (*N*) is higher or equal to 2, the number of samples and the corresponding chronology applicable to the testing procedure should be adapted as stated in 9.2.3. Nevertheless, according to the differences from a variant to another, the testing procedure may be simplified.

Each pressure transducer tested shall comply with the performance requirements specified in B.4.

B.6 Marking

Each pressure transducer shall be permanently marked at least with the following information, in legible and visible characters:

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

b) the identification mark or name of the manufacturer;

c) the serial number of the instrument and the year of manufacture;

d) the transducer denomination;

e) the adjusted specified measurement range (pressure, temperature if appropriate);

f) the static operating rated pressure;

g) the extreme temperatures of the environmental class in the form:

— $t_{amb,max}$ = ... °C;

— $t_{amb,min}$ = ... °C ;

h) the hazardous area classification of the pressure transducer, if applicable;

i) an indication of the reference to this European Standard "EN 12405-1".

Annex C
(normative)

Platinum resistance thermometer sensors

C.1 Scope

This annex specifies the requirements and tests for the construction, performance, safety and conformity of resistance thermometer sensors (so called hereafter PRT) having one sensing element made of platinum, intended for measuring temperatures in the ranges given in 5.1.2.

A PRT is the sensing element of a resistance thermometer with its wire leads and protective sheath. It is designed to be placed in a thermowell.

This annex also sets out the methods and general provisions of the equipment for verifying the PRT. It applies neither to the devices for measuring resistance, nor to indicating devices.

NOTE The preferred nominal resistances are 100 Ω, 500 Ω and 1 000 Ω. For other types of temperature sensors, the relevant provisions from this annex should be applied.

C.2 Operating rated conditions

C.2.1 Specified measurement range for temperature

The measurement range of the PRT shall be specified by the manufacturer, in accordance with 5.1.2.

C.2.2 Environmental class

The PRT shall meet the requirements as per 5.2.1 and 5.2.2.

C.3 Construction requirements

The PRT shall be protected from corrosion, the ingress of moisture, and mechanical and thermal stresses.

The PRT is preferably fitted with 4 leads. The cable resistance will influence the metrological behaviour of the temperature measurement. This influence shall be taken into account at the initial verification.

The electrical insulation resistance shall be at least 100 MΩ.

The heat dissipation shall be less than or equal to 0,1 mW.

C.4 Performances

C.4.1 The nominal resistance R_0 of a PRT at 0 °C shall be not less than 100 Ω, and not higher than 1 000 Ω.

C.4.2 PRT with a nominal resistance R_0 of 100 Ω shall comply to the metrological requirements of EN 60751 as defined for PRT of Class A.

PRT with a nominal resistance R_0 different from 100 Ω shall comply to the requirements of this annex.

C.4.3 The maximum permissible deviation between the true *t* and the temperature calculated from the resistance R_t of the PRT is given by:

$$\pm\left(0{,}15\ ^\circ\mathrm{C} + 2{,}0\times10^{-3}\cdot|t|\right) \text{ (class A)}$$

where

$|t|$ is the [A1) *deleted text* (A1] value of the temperature, expressed in degrees Celsius.

Deviations shall be calculated according to C.7.4.

C.4.4 The ratio $W_{100} = R_{100} / R_0$ of the PRT shall not be lower than 1,385. There is no upper limit set up for W_{100}.

C.5 Marking

C.5.1 Required markings

Each PRT shall bear the following markings on the protective sheath or on a label attached to it:

a) type designation;

b) serial number;

c) nominal resistance at 0 °C;

d) range of operating temperatures;

e) class A;

f) manufacturer's trade mark;

g) year and month of manufacture;

h) identification of the leads.

NOTE 1 If these indications are given in the form of symbols, they shall be presented in the above order.

NOTE 2 A PRT may bear additional markings, provided they did not lead to any confusion with the required indications above.

C.5.2 Verification mark

The official verification mark shall be placed on the protective sheath of the PRT or on a label attached to it.

C.6 Metrological verifications

C.6.1 Type approval

PRT types with a nominal resistance R_0 of 100 Ω shall comply with the requirements of EN 60751.

Other types shall comply with the requirements of this annex.

No modification can be made to an approved type without a special authorisation.

C.6.2 Initial verification

New PRT shall be submitted to an initial verification and subjected to a calibration aiming at determining their errors as well as other metrological characteristics.

C.7 Verification procedure

C.7.1 Visual inspection

The visual inspection is intended to ensure that the PRT and more precisely its protective sheath do not show any trace of deterioration or defects visible to the naked eye. This inspection also verifies that the PRT complies with administrative requirements (marking, verification mark, …).

C.7.2 Type testing (type approval)

PRT are submitted to the following type testing:

a) electric isolation resistance;

b) resistance accuracy, with a minimum of 4 test points:

— at 0 °C;

— at reference temperature (20 °C);

— at a temperature lower than t_{min} at a temperature higher than or equal to t_{max};

c) thermal response time;

d) self-heating;

e) immersion error;

f) thermo-electric effect;

g) stability at limit temperatures;

h) effect of temperature cycling;

i) drop test;

j) vibration test.

These tests are carried out in accordance with the corresponding clauses of EN 60751.

The results of the type testing are registered in a test report which may be laid out as given in Table C.1.

C.7.3 Samples of PRT required for testing

Conformity tests as per C.7.2 shall be carried out on the number of samples and following the chronology as defined in Table 5, with the exception of overload tests (A.11 and A.14) which are not performed on the temperature sensors.

C.7.4 Initial verification

The resistance calibration of the thermometer shall be within the tolerance values specified in C.4.3, in accordance with the test conditions as defined in the corresponding clause of EN 60751.

The test is carried out at three temperatures suitably chosen over the working range of the thermometer, including 0 °C and the reference temperature.

Table C.1

<table>
<tr><th colspan="4">Test report of a resistance thermometer sensor</th></tr>
<tr><td rowspan="2">Serial Number</td><td colspan="3">Manufacturer</td></tr>
<tr><td colspan="3">Customer</td></tr>
<tr><td>Temperature range</td><td>Accuracy Class A</td><td colspan="2">Measuring current</td></tr>
<tr><th colspan="2">Technical characteristic</th><th>Reference value</th><th>Actual value</th></tr>
<tr><td colspan="2">1. Electrical insulation resistance between the sensing element and the protective sheath</td><td></td><td></td></tr>
<tr><td colspan="2">2. Thermal stability</td><td></td><td></td></tr>
<tr><td colspan="2">3. Thermal resistance at the temperature of 0 °C (R_0)</td><td></td><td></td></tr>
<tr><td colspan="2">4. Relative resistance at the temperature of 100 °C (W^I_{100})</td><td></td><td></td></tr>
<tr><td colspan="2">5. Deviation from the nominal value W^I_{100} at the temperature of 100 °C</td><td></td><td></td></tr>
<tr><td colspan="2">6. Deviation from the nominal resistance at
- 0 °C
- 20 °C
- $t \leq t_{min}$
- $t \geq t_{max}$</td><td></td><td></td></tr>
<tr><td colspan="2">7. Thermal response time</td><td></td><td></td></tr>
<tr><td colspan="2">8. Resistance to vibration, mechanical shock and shaking</td><td></td><td></td></tr>
<tr><td colspan="2">9. Resistance to variations of temperature and humidity of the environment</td><td></td><td></td></tr>
<tr><td>Date :</td><td colspan="3">Evaluator:</td></tr>
</table>

Annex D
(normative)

Temperature transducers

D.1 Scope

This annex specifies the requirements and tests for the construction, performances, safety and conformity of the temperature transducers associated to electronic gas-volume conversion devices.

A temperature transducer may be fitted with a setting device to adjust the specified measurement range.

D.2 Rated operating conditions

D.2.1 Specified measurement range for temperature

The measurement range of the temperature transducer shall be specified by the manufacturer, in accordance with 5.1.2.

D.2.2 Environmental class

The transducer shall comply with the requirements as per 5.2.1 and 5.2.2.

D.2.3 Power supply

The power supply conditions are those given in 5.3.

D.3 Construction requirements

D.3.1 General

The relevant requirements are those given in 6.1.

In addition, the transducer shall be sealed in such a way that the sensor element cannot be changed without breaking the sealing.

If the temperature transducer is fitted with a setting device to adjust the specified temperature range, this shall be sealed.

D.3.2 Casings

The relevant requirements are those given in 6.2.

D.3.3 Indications

D.3.3.1 General

D.3.3.1.1 If the temperature transducer is provided with an indicator, it shall indicate at least the measured gas temperature in the measurement conditions.

This indicator is not intended to be used for metrological purposes. As such, it shall bear a legend clearly visible to the user, to indicate that it is not controlled when it gives a measurement result visible to the user.

D.3.3.1.2 The identification and the unit of each value or parameter that can be indicated shall be clearly displayed next to or upon the display of the measured value.

D.3.3.1.3 The scale interval of the temperature shall be of the form 10^n units of temperature (n whole number, positive or negative). The value of the scale interval shall be clearly stated close to the main value display.

D.3.3.2 Electronic indicating device

D.3.3.2.1 The device indicating the measured temperature shall be provided with means of control to ensure that the display is operating correctly.

D.3.3.2.2 The minimum height of the numerals for the display shall be 4 mm and the minimum width 2,4 mm.

D.3.3.2.3 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.

D.4 Performances

D.4.1 Reference conditions

Reference conditions are those given in 8.1.

D.4.2 Rated operating conditions

See D.2.

D.4.3 Maximum permissible errors

The maximum permissible errors applicable to temperature are specified in Table 3.

D.4.4 Influence factors

The influence factors are those given in 8.5.

For each influence factor, the temperature transducer shall comply with the *MPE* requirements at rated operating conditions, as given in Table 3.

D.4.5 Disturbances

Disturbances are those given in 8.6.

The difference between the errors registered before, during or after the application of the disturbance shall not exceed 0,5 *MPE* at reference conditions, as given in Table 3.

D.4.6 Durability

After a period of use corresponding to an accelerated ageing, as defined in A.15, the deviation between errors before and after ageing shall be lower than or equal to 0,5 *MPE* as given in Table 3.

D.5 Tests of conformity

D.5.1 Test conditions

The tests shall be performed using reference instruments traceable to national standards where the uncertainties are known, including those arising from their use, and do not exceed one fifth of the maximum permissible errors.

D.5.2 Tests

The list of the relevant tests is the one given as Table 4, with the exception of overload tests (A.11 and A.14) which are not performed on the temperature transducers.

Following the type approval, any modification to the temperature transducer shall be validated with significant tests relevant to the modification. A complete set of tests per modification is not required.

D.5.3 Sample of temperature transducers required for testing

For one presented variant of the temperature transducer, the conformity tests as per D.5.2 shall be carried out on the number of samples and following the chronology as defined in Table 5.

NOTE For the meaning of "variant", see 9.2.3.

If the number of variant (N) is higher or equal to 2, the number of samples and the corresponding chronology applicable to the testing procedure should be adapted as stated in 9.2.3. Nevertheless, according to the differences from a variant to another, the testing procedure may be simplified.

Each temperature transducer tested shall comply with the performance requirements specified in D.4.

D.6 Marking

Each temperature transducer shall be permanently marked at least with the following information, in legible and visible characters:

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

b) the identification mark or name of the manufacturer;

c) the serial number of the instrument and the year of manufacture;

d) the transducer denomination;

e) the adjusted specified measurement range;

f) the operating rated temperature;

g) the extreme temperatures of the environmental class in the form:

h) $t_{amb,max}$ = ... °C;

i) $t_{amb,min}$ = ... °C ;

j) the hazardous area classification of the temperature transducer, if applicable;

k) an indication of the reference to this European Standard "EN 12405-1".

Annex E
(informative)

Model type test report for conversion devices

E.1 General

E.1.1 General remarks

This annex is applicable to Type 1 conversion devices, as well as to calculators of Type 2 conversion devices.

In this annex, the index "read" means that the given value is read on the calculator.

E.1.2 Number of pages

Number of pages of the report:

E.1.3 Laboratory's identification

Name and address:

Accreditation:

E.1.4 Applicant

Name and address:

E.1.5 Identification of device(s) submitted for testing

Trade mark:

Model:

Type (1 or 2):

Serial number:

Environmental range:

Specified measuring ranges:

Mains power voltage:

Volume input at metering conditions:
frequency of pulses:
value of one pulse:

Other identification elements:

Description of the sealing:

Marks on the sealing:

E.2 Accuracy tests under reference conditions

E.2.1 Ambient temperature during the test

t_{amb} =

E.2.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.2.3 Test results

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

Gas temperature: T =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_4															
p_3															
p_2															
p_{min}															

Gas temperature: T_{max} =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

E.3 Ambient temperature

E.3.1 Effect of dry heat

E.3.1.1 Ambient temperature during the test

t_{amb} =

E.3.1.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.3.1.3 Test results

Gas temperature: T_{min} =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_V (%)
p_{max}															
p_4															
p_3															
p_2															
p_{min}															

Gas temperature: $T_{max} =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_V (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

E.3.2 Effect of cold

E.3.2.1 Ambient temperature during the test

$t_{amb} =$

E.3.2.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.3.2.3 Test results

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_v (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

Gas temperature: T =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_v (%)
p_{max}															
p_4															
p_3															
p_2															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_v (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

E.4 Effect of damp heat, steady state test

E.4.1 Ambient temperature during the test

t_{amb} =

E.4.2 Test equipment used

Description:

Identification:

Uncertainty:

Traceability:

E.4.3 Test results

E.4.3.1 Before the application of the test

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

E.4.3.2 During the application of the test

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

E.4.3.3 After the application of the test

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

E.5 Effect of damp heat, cyclic test

E.5.1 Ambient temperature during the test

t_{amb} =

E.5.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.5.3 Test results

E.5.3.1 Before the cyclic test

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
P_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

E.5.3.2 After the cyclic test

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

E.6 Electrical power variation

E.6.1 AC power supply

E.6.1.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.6.1.2 Test results

E.6.1.2.1 Variation in voltage

Frequency: f_{nom} =

Voltage: U = 1,10 U_{nom} =

Gas temperature: T_{min} =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

Gas temperature: T_{max} =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

Voltage: U = 0,85 U_{nom} =

Gas temperature: T_{min} =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

E.6.1.2.2 Variation in frequency

Voltage: U_{nom} =

Frequency: f = 1,02 f_{nom} =

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

Frequency: f = 0,98 f_{nom} =

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

E.6.2 DC power supply or battery supply

E.6.2.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.6.2.2 Test results

Voltage: $U = U_{max}$ =

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

Voltage: $U = U_{min} =$

Gas temperature: $T_{min} =$

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{max}															
p_{min}															

Gas temperature: $T_{max} =$

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_C (%)	e_V (%)
p_{min}															
p_{max}															

E.7 Short time power reductions

E.7.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.7.2 Test results

E.7.2.1 Before the application of the perturbation

Gas temperature: $T =$

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	E_{C1} (%)	E_{V1} (%)
p															

E.7.2.2 During the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c2} (%)	e_{v2} (%)
p															

E.7.2.3 Error shift calculation

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_c = e_{c2} - e_{c1}$ (%)	$\Delta e_v = e_{v2} - e_{v1}$ (%)
p									

E.8 Electrical bursts

E.8.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.8.2 Test results

E.8.2.1 Mains power

E.8.2.1.1 Before the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c1} (%)	e_{v1} (%)
p															

E.8.2.1.2 During the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c2} (%)	e_{v2} (%)
p															

E.8.2.1.3 Error shift calculation

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_c = e_{c2} - e_{c1}$ (%)	$\Delta e_v = e_{v2} - e_{v1}$ (%)
p									

E.8.2.2 In/out connections

E.8.2.2.1 Before the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c1} (%)	e_{v1} (%)
p															

E.8.2.2.2 During the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c2} (%)	e_{v2} (%)
p															

E.8.2.2.3 Error shift calculation

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_c = e_{c2} - e_{c1}$ (%)	$\Delta e_v = e_{v2} - e_{v1}$ (%)
p									

E.9 Electromagnetic immunity

E.9.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.9.2 Test results

E.9.2.1 Before the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c1} (%)	e_{v1} (%)
p															

E.9.2.2 During the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c2} (%)	e_{v2} (%)
p															

E.9.2.3 Error shift calculation

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_c = e_{c2} - e_{c1}$ (%)	$\Delta e_v = e_{v2} - e_{v1}$ (%)
p									

E.10 Electrostatic discharges

E.10.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.10.2 Test results

E.10.2.1 Before the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c1} (%)	e_{v1} (%)
p															

E.10.2.2 During the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c2} (%)	e_{v2} (%)
p															

E.10.2.3 Error shift calculation

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_c = e_{c2} - e_{c1}$ (%)	$\Delta e_v = e_{v2} - e_{v1}$ (%)
p									

E.11 Effect of an overload of static pressure

E.11.1 Ambient temperature during the test

$t_{amb} =$

E.11.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.11.3 Test results

E.11.3.1 Before the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	e_{c1} (%)
p_{max}												
p_4												
p_3												
p_2												
p_{min}												

E.11.3.2 After the application of the perturbation

Gas temperature: $T =$

p	p_{cv} simulated or applied	T_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	e_{c2} (%)
p_{max}												
p_4												
p_3												
p_2												
p_{min}												

E.11.3.3 Error shift calculation

p	p_{cv} simulated or applied	T_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_c = e_{c2} - e_{c1}$ (%)
p_{max}							
p_4							
p_3							
p_2							
p_{min}							

E.12 Effect of vibrations

E.12.1 Ambient temperature during the test

t_{amb} =

E.12.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.12.3 Test results

E.12.3.1 Before the application of the test

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_V (%)
p_{min}															
p_{max}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_V (%)
p_{max}															
p_{min}															

E.12.3.2 After the application of the test

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_V (%)
p_{min}															
p_{max}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_c (%)	e_v (%)
p_{max}															
p_{min}															

E.13 Effect of shocks

E.13.1 Ambient temperature during the test

t_{amb} =

E.13.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.13.3 Test results

E.13.3.1 Before shocks

Gas temperature: T =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c1} (%)	E_{v1} (%)
p															

E.13.3.2 After the application of the perturbation

Gas temperature: T =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c2} (%)	e_{v2} (%)
p															

E.13.3.3 Error shift calculation

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_c = e_{c2} - e_{c1}$ (%)	$\Delta e_v = e_{v2} - e_{v1}$ (%)
p									

E.14 Mechanical resistance to overload of static pressure

E.14.1 Ambient temperature during the test

$t_{amb} =$

E.14.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.14.3 Test results

Any external leakage:

Yes	
No	

Insert a cross as applicable

E.15 Durability

E.15.1 Ambient temperature during the test

$t_{amb} =$

E.15.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.15.3 Test equipment used

E.15.3.1 Before durability

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c11} (%)	e_{v11} (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

Gas temperature: T =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c12} (%)	e_{v12} (%)
p_{max}															
p_4															
p_3															
p_2															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c13} (%)	e_{v13} (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

E.15.3.2 After durability

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c21} (%)	e_{v21} (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

Gas temperature: T =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c22} (%)	e_{v22} (%)
p_{max}															
p_4															
p_3															
p_2															
p_{min}															

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	V_{cv} simulated or applied	p_b	T_b	Z_b calculated	Z_{cv} calculated	C_{cv} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{c23} (%)	e_{v23} (%)
p_{min}															
p_2															
p_3															
p_4															
p_{max}															

E.15.3.3 Error shift calculation

Gas temperature: T_{min} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_{c1} = e_{c21} - e_{c11}$ (%)	$\Delta e_{v1} = e_{v21} - e_{v11}$ (%)
p_{max}								
p_4								
p_3								
p_2								
p_{min}								

Gas temperature: T =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_{c2} = e_{c22} - e_{c12}$ (%)	$\Delta e_{v2} = e_{v22} - e_{v12}$ (%)
p_{max}								
p_4								
p_3								
p_2								
p_{min}								

Gas temperature: T_{max} =

p	p_{cv} simulated or applied	T_{cv} simulated or applied	C_{cv} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_{c3} = e_{c23} - e_{c13}$ (%)	$\Delta e_{v1} = e_{v23} - e_{v13}$ (%)
p_{max}								
p_4								
p_3								
p_2								
p_{min}								

E.16 A1⟩ Alarms operation

E.16.1 Ambient temperature during the test

t_{amb} =

E.16.2 Test equipment used

Description:

Identification:

E.16.3 Test results

E.17 Repeatability

Gas composition:

p =

T =

	1	2	3	4	5	6
C						
C_{cv}						
e						

$e_{max} - e_{min}$ =

⟨A1

E.18 A2⟩ Short time DC power variations

E.18.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.18.2 Test results

E.18.2.1 Before the application of the perturbation

Gas temperature: *T* =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{C1} (%)	e_{V1} (%)
p															

E.18.2.2 During the application of the perturbation

Gas temperature: T =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{C2} (%)	e_{V2} (%)
p															

E.18.2.3 Error shift calculation

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	C_{CV} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_C = e_{C2} - e_{C1}$ (%)	$\Delta e_V = e_{V2} - e_{V1}$ (%)
p									

A2⟩

E.19 ⟨A2 Surges on supply lines and/or signal lines

E.19.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.19.2 Test results

E.19.2.1 Before the application of the perturbation

Gas temperature: T =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{C1} (%)	e_{V1} (%)
p															

E.19.2.2 After the application of the perturbation

Gas temperature: T =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{C2} (%)	e_{V2} (%)
p															

E.19.2.3 Error shift calculation

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	C_{CV} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_C = e_{C2} - e_{C1}$ (%)	$\Delta e_V = e_{V2} - e_{V1}$ (%)
p									

A2⟩

E.20 ⟨A2 Power frequency magnetic field

E.20.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

E.20.2 Test results

E.20.2.1 Before the application of the perturbation

Gas temperature: T =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{C1} (%)	e_{V1} (%)
p															

E.20.2.2 During the application of the perturbation

Gas temperature: T =

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	p_b	T_b	Z_b calculated	Z_{CV} calculated	C_{CV} calculated	C_{read}	p_{read}	T_{read}	Z_{read}	V_{read}	e_{C2} (%)	e_{V2} (%)
p															

E.20.2.3 Error shift calculation

p	p_{CV} simulated or applied	T_{CV} simulated or applied	V_{CV} simulated or applied	C_{CV} calculated	C_{read}	Z_{read}	V_{read}	$\Delta e_C = e_{C2} - e_{C1}$ (%)	$\Delta e_V = e_{V2} - e_{V1}$ (%)
p									

A2

Annex F
(informative)

Model type test report for associated transducers

F.1 General

F.1.1 General remarks

This informative annex is applicable to both pressure and temperature transducers.

In this annex, the "x" given in the various tables stands for pressure or temperature, as appropriate.

F.1.2 Number of pages

Number of pages of the report:

F.1.3 Laboratory's identification

Name and address:

Accreditation:

F.1.4 Applicant

Name and address:

F.1.5 Identification of device(s) submitted for testing

Trade mark:

Model:

Type :

Serial number:

Environmental range:

Specified measuring ranges:

Mains power voltage:

Other identification elements:

Description of the sealing:

Marks on the sealing:

F.2 Accuracy tests under reference conditions

F.2.1 Ambient temperature during the test

t_{amb} =

F.2.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.2.3 Test results

x	x_{cv}	x	error %
x_{min}			
x_2			
x_3			
x_4			
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.3 Ambient temperature

F.3.1 Effect of dry heat

F.3.1.1 Ambient temperature during the test

t_{amb} =

F.3.1.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.3.1.3 Test results

x	x_{cv}	x	error %
x_{min}			
x_2			
x_3			
x_4			
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.3.2 Effect of cold

F.3.2.1 Ambient temperature during the test

t_{amb} =

F.3.2.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.3.2.3 Test results

x	x_{cv}	x	error %
x_{min}			
x_2			
x_3			
x_4			
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.4 Effect of damp heat, steady state test

F.4.1 Ambient temperature during the test

$t_{amb} =$

F.4.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.4.3 Test results

F.4.3.1 Before the application of the test

x	x_{cv}	x	error %
x_{min}			
x_{max}			
x_{max}			
x_{min}			

F.4.3.2 During the application of the test

x	x_{cv}	x	error %
x_{min}			
x_{max}			
x_{max}			
x_{min}			

F.4.3.3 After the application of the test

x	x_{cv}	x	error %
x_{min}			
x_{max}			
x_{max}			
x_{min}			

F.5 Effect of damp heat, cyclic test

F.5.1 Ambient temperature during the test

t_{amb} =

F.5.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.5.3 Test results

F.5.3.1 Before the application of the test

x	x_{cv}	x	error %
x_{min}			
x_{max}			
x_{max}			
x_{min}			

F.5.3.2 After the cyclic test

x	x_{cv}	x	error %
x_{min}			
x_{max}			
x_{max}			
x_{min}			

F.6 Electrical power variation

F.6.1 AC power supply

F.6.1.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.6.1.2 Test results

F.6.1.2.1 Variation in voltage

Frequency: f_{nom} =

Voltage: U = 1,15 U_{nom} =

x	x_{cv}	x	error %
x_{min}			
x_{max}			

Voltage: U = 1 U_{nom} =

x	x_{cv}	x	error %
x_{max}			
x_{min}			

Voltage: U = 0,85 U_{nom} =

x	x_{cv}	x	error %
x_{min}			
x_{max}			

F.6.1.2.2 Variation in frequency

Voltage: U_{nom} =

Frequency: f = 1,02 f_{nom} =

x	x_{cv}	x	error %
x_{max}			
x_{min}			

Frequency: f = 0,98 f_{nom} =

x	x_{cv}	x	error %
x_{min}			
x_{max}			

F.6.2 DC power supply or battery supply

F.6.2.1 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.6.2.2 Test results

Voltage: $U = U_{max} =$

x	x_{cv}	x	error %
x_{min}			
x_{max}			

Voltage: $U = U_{min} =$

x	x_{cv}	x	error %
x_{max}			
x_{min}			

F.7 Short time power reductions

F.7.1 Ambient temperature during the test

$t_{amb} =$

F.7.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.7.3 Test results

F.7.3.1 Before the application of the perturbation

	x_{cv}	x	error e_1 %
x			

F.7.3.2 During the application of the perturbation

	x_{cv}	x	error e_2 %
x			

F.7.3.3 Error shift calculation

	x_{cv}	x	$(e_2\text{-}e_1)$ %
x			

F.8 Electrical bursts

F.8.1 Ambient temperature during the test

t_{amb} =

F.8.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.8.3 Test results

F.8.3.1 Mains power

F.8.3.1.1 Before the application of the perturbation

	x_{cv}	x	error e_1 %
x			

F.8.3.1.2 During the application of the perturbation

	x_{cv}	x	error e_2 %
x			

F.8.3.1.3 Error shift calculation

	x_{cv}	x	$(e_2\text{-}e_1)$ %
x			

F.8.3.2 In/out connections

F.8.3.2.1 Before the application of the perturbation

	x_{cv}	x	error e_1 %
x			

F.8.3.2.2 During the application of the perturbation

	x_{cv}	x	error e_2 %
x			

F.8.3.2.3 Error shift calculation

	x_{cv}	x	$(e_2\text{-}e_1)$ %
x			

F.9 Electromagnetic immunity

F.9.1 Ambient temperature during the test

t_{amb} =

F.9.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.9.3 Test results

F.9.3.1 Before the application of the perturbation

	x_{cv}	x	error e_1 %
x			

F.9.3.2 During the application of the perturbation

	x_{cv}	x	error e_2 %
x			

F.9.3.3 Error shift calculation

	x_{cv}	x	$(e_2\text{-}e_1)$ %
x			

F.10 Electrostatic discharges

F.10.1 Ambient temperature during the test

t_{amb} =

F.10.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.10.3 Test results

F.10.3.1 Before the application of the perturbation

	x_{cv}	x	error e_1 %
x			

F.10.3.2 During the application of the perturbation

	x_{cv}	x	error e_2 %
x			

F.10.3.3 Error shift calculation

	x_{cv}	x	(e_2-e_1) %
x			

F.11 Effect of an overload of static pressure

This clause is not applicable to temperature transducers.

F.11.1 Ambient temperature during the test

t_{amb} =

F.11.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.11.3 Test results

F.11.3.1 Before the application of the perturbation

x	x_{cv}	x	error e_1
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.11.3.2 After the application of the perturbation

x	x_{cv}	x	error e_2
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.11.3.3 Error shift calculation

x	x_{cv}	x	$(e_2 - e_1)$
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.12 Effect of vibrations

F.12.1 Ambient temperature during the test

t_{amb} =

F.12.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.12.3 Test results

F.12.3.1 Before the application of the test

x	x_{cv}	x	error %
x_{min}			
x_{max}			
x_{min}			

F.12.3.2 After the application of the test

x	x_{cv}	x	error %
x_{min}			
x_{max}			
x_{min}			

F.13 Effect of shocks

F.13.1 Ambient temperature during the test

t_{amb} =

F.13.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.13.3 Test results

F.13.3.1 Before shocks

	x_{cv}	x	error e_1 %
x			

F.13.3.2 After shocks

	x_{cv}	x	error e_2 %
x			

F.13.3.3 Error shift calculation

	x_{cv}	x	$(e_2$-$e_1)$ %
x			

F.14 Mechanical resistance to overload of static pressure

This clause is not applicable to temperature transducers.

F.14.1 Ambient temperature during the test

t_{amb} =

F.14.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.14.3 Test results

Any external leakage:

Yes	
No	

Insert a cross as applicable

F.15 Durability

F.15.1 Ambient temperature during the test

t_{amb} =

F.15.2 Test equipment used

Description:

Identification:

Uncertainty of the global test equipment:

Traceability:

F.15.3 Test results

F.15.3.1 Before durability

x	x_{cv}	x	error e_1
x_{min}			
x_2			
x_3			
x_4			
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.15.3.2 After durability

x	x_{cv}	x	error e_2
x_{min}			
x_2			
x_3			
x_4			
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.15.3.3 Error shift calculation

x	x_{cv}	x	$(e_2 - e_1)$
x_{min}			
x_2			
x_3			
x_4			
x_{max}			
x_4			
x_3			
x_2			
x_{min}			

F.16 [A1⟩ Repeatability

T_{amb} =

	1	2	3	4	5	6
x						
x_{cv}						
e						

⟨A1]

Annex ZA
(informative)

A1⟩ Relationship between this European Standard and the Essential Requirements of EU Directive 2004/22 Measuring Instruments Directive

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

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in 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.

A2⟩ Table ZA.1 — Correspondence between this European Standard and Directive 2004/22 Measuring Instruments Directive

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive …			Qualifying remarks/Notes
			ANNEX I	
	1		Allowable errors under rated operating conditions	
5, 8.3.1		1.1	Within MPE – no disturbance	
8.6, 9.2.1		1.2	Within MPE – disturbance	
5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.3		1.3	Specify climatic, mechanical and EM environment	
5.2.1, 5.2.2		1.3.1	Climatic environments	
3.3.1, 5.2.3, 9.2.1		1.3.2	Mechanical environments	
3.3.2, 5.2.4, 9.2.1		1.3.3	Electromagnetic environments	
9.2		1.3.4	Other influence quantities	
9.2.1		1.4.1	Basic rules	
5.2.2		1.4.2	Ambient humidity	
N/A	2		Reproducibility	
8.8	3		Repeatability	
9	4		Discrimination and sensitivity appropriate for measurement task	
8.7	5		Sufficient durability for intended task (see….)	
6.6, 8.9	6		Reliability	
	7		Suitability	

Table ZA.1 — *(continued)*

6.1.3		7.1	Design discourages fraudulent use and minimises unintentional misuse.	
6.1, 6.2, 6.3		7.2	Designed to be suitable for its intended use and working conditions. User friendly.	
6.1.3, 6.6.1, 8.5		7.3	The errors of a utility measuring instrument at flows or currents outside the controlled range shall not be unduly biased.	
N/A		7.4	Where a measuring instrument is designed for the measurement of values of the measurand 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.	
6.1, 6.2		7.5	Robust and materials suitable for intended use	
6.1.3, 6.6, 7.2, 7.3		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.	
	8		Protection Against Corruption	
6.1.2, 6.1.5, 6.1.8, 6.4		8.1	Measurement cannot be affected by feature of instrument, connection of external or communicating device.	
6.1.3, 6.6		8.2	Critical hardware components secure or tampering is evident.	
6.1.3, 6.6		8.3	Critical software shall be identified and secure. Identification readily available. Tampering evidenced for ‘reasonable’ time.	
6.6, 6.1.3		8.4	Data and critical parameters protected against corruption.	
6.1.3, 6.6.4		8.5	Display cannot be reset during use.	
	9		Information on/accompanying	
10		9.1	Shall bear manufacturers mark or name and information in respect of its accuracy. Where applicable data on conditions of use, identity marking, number of type examination certificate.	
10		9.2	If too small, information placed on packaging	Also electronically displayed on the calculator

Table ZA.1 — *(continued)*

11		9.3	Accompanied by information on rated operating conditions, climatic, mechanical and EM environment classes. instruction operation and maintenance etc.	
11		9.4	Utility meters do not require individual instruction manuals.	
6.3.1.6, 6.3.1.7		9.5	Decimal scale interval	
N/A		9.6	Material measure	As ER for other kind of equipment
3.2 (Table 1)		9.7	Units of measurement	
10		9.8	Durability of marking	
	10		Indication of result	
6.3.2		10.1	Display	
6.3.2.2, 6.3.2.3		10.2	Clear indication	
N/A		10.3	Hard copy	
N/A		10.4	Direct trading	
6.3.1.1, 6.3.1.2, 6.3.1.3		10.5	Indicator required	
	11		Further processing of data	
N/A		11.1	Durable record	
N/A		11.2	Durable proof	
whole standard	**12**		Conformity evaluation	
	Annex MI-002			
	Part I		**Specific requirements gas meters**	
	1		Rated operating conditions	
N/A		1.1	Flow-rate	Only for meters
5.1.2		1.2	T>40 gas	
5.1.3		1.3	Gas family/MOP	
5.2.1		1.4	T>50 climatic	
5.3		1.5	Nominal value of AC supply or limits of DC supply	

Table ZA.1 — *(continued)*

	2		Maximum permissible errors	
N/A		2.1	MPE	
N/A		2.2	MPE TC	Only for meters
	3		Permissible effects of disturbances	
9.2.1 (A.6, A.7, A.8, A.9, A.10, A.18, A.19, A.20)		3.1	EMC	
N/A		3.2	Flow disturbances	
N/A	**4**		Durability	
N/A		4.1	Durability – Class 1.5 meters	Only for meters
N/A		4.2	Durability – Class 1 meters	Only for meters
	5		Suitability	
5.3, 6.6.3		5.1	Mains power	
5.3, 6.5		5.2	Battery power	
6.3.1.7, 6.3.1.8, 7.1		5.3	8 000 hours	
11		5.4	Any position	
N/A		5.5	Test element	Only for meters
N/A		5.6	Flow direction marked	
3.2, Table 1, 6.3.1.6	**6**		Units	
	Part II		**Specific requirements – Volume conversion devices**	
10 f), 5.1.4	**7**		Base conditions for converted quantities	
8.3.1	**8**		Maximum permissible error	
6.6, A.16	**9**		Suitability	

Table ZA.1 — *(continued)*

	Part III		**Putting into use and conformity assessment**	
	10		Putting into use	
		(a)		Member states to decide
		(b)		Member states to decide
		(c)		Member states to decide
N/A			Conformity assessment	

⟨A2⟩

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

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