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شرکت ملی گاز ایران

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امور تدوین استانداردها

IGS

مشخصات فنی خرید

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دستگاه الکترونیکی تصحیح کننده حجم گاز کنتورهای گاز

Gas Meters , Gas Volume Electronic Conversion Device (PTZ)

دفترمدیرعامل

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ابلاغ مصوبه هیأت مدیره

مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۹۹۷ مورخ ۱۴۰۱/۱۱/۰۲ هیات مدیره، نامه شماره گ۹/۱۶۸۶۱۱/۰۰۰ مورخ ۱۴۰۱/۱۰/۱۴ آن مدیریت درمورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

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IGS-M-IN-106(1)

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Foreword

This standard specification is intended to be mainly used by N.I.G.C. and contractors, and has been prepared base on interpretation of recognized standards and technical documents, as well as knowledge, backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Specification (IGS) are prepared, reviewed and amended by technical standard committees within NIGC standardization division of research and technology management and submitted to "the standards council of NIGC" for approval.

IGSs are subjected to revision, amendment or withdrawal, if required, and thus the latest edition of IGS shall be checked / inquired by NIGC'S users.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation or conflicts between this specification and other applicable standards, codes, procedure or well-known manufacturer's specifications must be resolved in writing by the user or its representative through Manager, Engineering Department or standardization division of NIGC.

The technical standard committee welcomes comments and feedbacks from concerned or interested corporate and individuals about this standard, and may revise this document accordingly based on the received feedbacks.

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General Definitions

Throughout this standard the following definitions, where applicable, should be followed:

1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.

2- "COMPANY": refers to National Iranian Gas Company (NIGC).

3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.

4- "SHALL ": is used where a provision is mandatory.

5- "SHOULD": is used where a provision is advised only.

6- "MAY": is used where a provision is completely discretionary.

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Contents

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1. SCOPE

This standard together with the appendices specifies the minimum requirements and tests for the construction, performance, design, material, safety and conformity of gas – volume electronic conversion devices associated to gas meters, used to Measure volumes of natural gases. (Fuel gas composition is according to IGS-M-CH-033)
Only second kinds of conversion is treated in this standard:
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 and of the temperature and taking into account the compression factor (called PTZ conversion)
For application of this document, 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 3.1.20.1 and 3.1.20.2.
Gas – volume conversion devices consist of a calculator, a temperature transducer
And a pressure transducer locally installed.
This standard is according to EN 12405-1:2021 (E) but with the following requirements, which have been mention at this standard.
Note: Base conditions in this standard are: P_b = 1.01325 bar (14.696 psia) and T_b = 15.56 °C (60 °F)

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2. REFERENCE

Throughout this standard the following standards and cods are referred to
EN 12405-1:2021: Gas meters conversion devices part 1: volume conversion
IGS-CH- 033(0): 2004: Quality Specification for Pipeline Natural Gas

3. DEFINITIONS

3.1 absolute static pressure
Value of the static pressure of the gas relative to vacuum
3.1.1 adjustment
Set of operations carried out on a measuring system so that it provides prescribed indications corresponding to give values of a quantity to be measured
3.1.2Base conditions
Fixed conditions to which a volume of gas is converted (e.g. base gas temperature 273, 15 K plus 15 K at base gas pressure of 1 013, 25 mbar)
3.1.3 Calculator
Electronic device that receives the output signals from the associated gas meter and transducers and processes them.

3.1.4conversion facto

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

Device which shows information from the meter (e.g. liquid crystal that display registers, volume or flags)

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 1 to entry: 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 CCV, expressed as a percentage of the conventional true value of the conversion factor

3.1.14 error of indication

Value which shows the relationship in percentage terms of the difference between the volume indicated by

the meter and the volume which has actually flowed through the meter, to the latter value

Note 1 to entry:

$$E = 100 \frac{Vi - Vc}{Vc}$$

where

Vi is the indicated volume;

Vc is the volume which has actually flowed through the meter.

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3.1.15 error of the calculator unit

Error of the indicated volume at base conditions Vb, when the gas volume, pressure and temperature are

Simulated by signals, in accordance to the manufacturer specification of interfaces

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

Note 2 to entry: The deviation from the ideal gas law can be compensated by the compression factor.

3.1.19.1 Gas volume conversion device type 1 (complete system)

Conversion device with specific types of transducers for pressure and temperature or for temperature only

3.1.19.2 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 1 to entry: The matching of the various elements constituting a conversion device type 2 is subjected to verification.

3.1.20 indicating device

Part of a measuring instrument that displays an indication (alphanumeric string)

3.1.21 influence factor

Influence quantity having a value within the specified rated operating conditions of the measuring instrument

3.1.22 Influence quantity

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

3.1.23 intrinsic error

Error of a measuring instrument, determined under reference conditions

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3.1.24 maximum operating pressure MOP

Maximum pressure at which a system can be operated continuously under normal conditions

Note 1 to entry: Normal conditions are: no fault in any device or stream.

3.1.25 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)

3.1.26 measuring transducer

Device that provides an output quantity having a determined relationship to the input quantity

Note 1 to entry: The transducer can include a transmitter that provides an output to the calculator.

3.1.27memory

Element which stores digital information

3.1.28 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

3.1.29 rated operating conditions

Values for the measurand and influence quantities making up the normal working conditions of an instrument

3.1.30 reference conditions

Condition of use prescribed for testing the performance of a measuring instrument or for inter-comparison of results of measurements

3.1.31 sensor

Element of a measuring instrument or measuring chain that is directly affected by the measurand

3.1.32 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 1 to entry: 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.

3.1.33 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 to entry: A conversion device has a measuring range for every quantity that it processes.

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

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3.1.34 static gauge pressure

Value of the static pressure of the gas relative to the ambient atmospheric pressure

3.1.35 uncertainty of value

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

3.1.36 volume

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

3.1.37 measurand

Particular quantity subject to measurement

3.1.38 critical change value

Value at which the change in the measurement result is considered undesirable

3.2 Symbols

For the purposes of this document, the symbols listed in Table 1 apply.

Table 1 — Symbols

Symbols	Represented quantity	Units
V	volume: Vm or Vc	m3
Vm	volume at measurement conditions	m3
Vc	corrected volume (gas meter error)	m3
Vb	volume at base conditions	m3
VCV	conventional true value of the volume	m3
C	conversion factor	-
Cc	calculator conversion	-
Cf	correction factor	-
CCV	conventional true value of the conversion factor	-
f(Q)	correction function	-
K or K'	coefficients	-
p	absolute pressure at measurement conditions	bar or MPa
pb	absolute pressure at base conditions	bar or MPa
pg	gauge pressure	bar or MPa
pCV	conventional true value of the absolute pressure	bar or MPa
T	absolute temperature at measurement conditions	K
Tb	absolute temperature at base conditions	K
Tmin	minimum absolute temperature	K
Tmax	maximum absolute temperature	K
TCV	conventional true value of the absolute temperature	K
Z	compression factor of the gas at measurement conditions	-
Zb	compression factor of the gas at base conditions	-
ZCV	conventional true value of the compression factor	-
patm	atmospheric pressure	bar or MPa
pmax	maximum absolute gas pressure	bar or MPa
pmin	minimum absolute gas pressure	bar or MPa
Q	flowrate	m3/h
Qmax	maximum flowrate	m3/h
Qmin	minimum flowrate	m3/h
tam	ambient temperature	°C

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tam, max	maximum ambient temperature	°C
tam, min	minimum ambient temperature	°C
t	gas temperature	°C
tmax	maximum gas temperature	°C
tmin	minimum gas temperature	°C
Unom	nominal supply voltage	V
fnom	nominal supply frequency	Hz
e	total conversion factor error	%
ef	error on the calculation of conversion factor	%
ep	error on the pressure measurement	%
et	error on the temperature measurement	%
ec	error on the conversion factor	%
ev	error on the converted volume	%

3.3 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.

Test listed in A.12 and A.13 are only required for Mechanical class M2.

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.

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4. REQUIEMENTS

4.1 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:

$Z = f(p, T)$

Settable gas properties and components inputs are used for the compression factor calculation. The volume at base conditions is obtained from relationship:

$V_b = C \times V$

Where C is the conversion factor given by the relationship:

$C=\frac{P}{Pb} \times Tb/T \times Zb/z$

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.

4.2 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; in those cases, the volume marked as V means VC.

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 nonlinear 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 Qmin and Qmax of the gas meter.

The correction can only be applied if the gas meter produces at least 10 Hz at Qmin. Below Q_{min}, the correction function shall remain at the value obtained at Qmin or equal to 1 and above Q_{max}, the correction factor shall remain at the value obtained at Qmax.

4.3 Rated operating conditions

4.3.1Specified field of measurement

4.3.1.1General

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

4.3.1.2 Specified measurement range for gas pressure

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

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

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4.3.1.3 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.

4.3.1.4 Gas characteristics

Fuel gases of the first and second families according to EN 437:2018. The manufacturer shall indicate the:

-gas family or group;

-maximum operating pressure.

4.3.1.5 Base conditions

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

4.4 Environmental conditions

4.4.1 Ambient temperature range

The manufacturer shall specify the ambient temperature range of the gas-volume conversion device according to the following possibilities:

a) Normal ranges:

– Class 1: from +5 °C to +30 °C;

– Class 2: from -10 °C to +40 °C;

– Class 3: from -25 °C to +55 °C;

b) Other range specified by the manufacturer.

4.4.2 Humidity range

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

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.

4.4.3 Mechanical environment

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

4.4.4 Electromagnetic environment

The manufacturer shall specify the electromagnetic environmental class E2 (see 3.3.2).

4.5 Power supply

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.

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4.6 Construction

4.6.1General

4.6.1.1 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.

4.6.1.2 The conversion devices shall be used for natural gas according to IGS-M-CH-033.

4.6.1.3 The gas-volume conversion device shall be constructed in such a way that any interference and 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 that can be updated or by using a specific device;

-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.

NOTE more information on seals can be found in WELMEC 11.3.

4.6.1.4 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.

4.6.1.5 Any interfaces and connections fitted within the conversion device allowing the connection of complementary devices shall not corrupt the metrological behavior of the conversion device shall be able to support standard Modbus protocol for monitoring system (corresponding to inquiry)

4.6.1.6 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.

4.7 Equipment used in hazardous areas shall meet the electrical requirements specified in the appropriate standards: EN IEC 60079-0:2018, EN 60079-1:20143), EN 60079-2:2014, EN 60079-5:2015, EN 60079-6:2015, EN 60079-7:2015, EN 60079-11:2012, EN 60079-25:20104).

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4.8 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 55011:20161).

4.9 Casings shall meet the requirements concerning the security of the equipment as specified in EN 60950-1:20067).

4.10 Casings

The casings of all the constituent elements of a conversion device shall have an ingress protection index (IP 65), specified in EN 60529:19915), 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 60529:19915).

All additional components forming the measuring chain (interfaces, signal convertors, power supply, cabling, etc.) shall be protected according to EN 1776:2015.

4.11 Indications

4.11.1 General

4.11.1.1 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 4.14.

4.11.1.2 Additionally, the following information shall be indicated by a method described in 4.11.1.3:

- The base conditions in the form:
- Tb = …. K;
- p_b = …. bar;
- 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 = … m3 (or dm3); or
- 1 m3 (or dm3) = … imp;
- The parameters for gas meter error correction curve if applicable;
- The indication of the end of life of the battery, if applicable;

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- The software version and its intrinsic identification.
- It shall also be possible, at the time of the control operations described in Annex a (EN12405-1), to display the values
Of the conversion factor and of the various quantities measured or calculated.

4.11.1.3 The information shown in 4.11.1.2 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.

4.11.1.4 The volume at base conditions shall be preferentially displayed.

4.11.1.5 The method by which the quantities described in 4.11.1.2 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 visualizing 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.

4.11.1.6 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, Vb …m3.

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

4.11.1.8 The indicating device shall have at least 8 significant digits. The number of bits used for the internal calculation shall be enough to guarantee the accuracy of the measurement.

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4.12 Electronic indicating device

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

4.12.2 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.

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

4.12.4 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.

4.12.5 The number of digits shall allow the on-site verification.

4.12.6 Software embedded in the calculator should fulfil requirements defined in appropriate and relevant international or national reference standards.
NOTE WELMEC Guide 7.2 and extension I may be used.

4.12.7 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.

The parameters which contribute to the calculation of Z (for example the parameters of gas composition) may be changed also remotely, tracking the change by recording the old value of each modified parameter in the event register. For this, the reset of the event register shall be sealed.

The VCD shall at least provide, without any supplementary device, the date of the last reset of the event register.

NOTE 1 WELMEC 7.2 may be used for remote change management.

The EVCD relevant software, including metrological software, may be upgraded. It shall be possible to view on the display the software version in use at that time.

NOTE 2 the EVCD relevant software may be upgraded conforming to WELMEC 7.2 Extension D. For this, methods for the traceability of relevant software download should comply with WELMEC 7.2 Clause D4.

NOTE 3 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.

4.13 Battery powered conversion device

4.13.1 The manufacturer shall declare the service life of the battery for a typical usage profile and the

Conditions under which the tests are undertaken. The typical usage profile shall cover at minimum the following:

- Frequency for all inputs;
- Ambient range with % of time spent at $t_{amb,min}$;
- Interval of acquisition for pressure and temperature;
- Communication time for all ports;
- Pulse outputs configuration.

The service life of the battery dedicated for the metrological function for this typical usage profile shall be greater than 5 years.

Where the same battery is used to operate the metrological part of the meter and the additional functionalities, the manufacturer shall also declare the measures that have been taken to protect the metrological part.

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.

The battery compartment should make provisions to prevent unauthorized access.

Batteries shall be replaced only after the breaking of a seal different from the metrological seal.

4.13.2 Only an indication shall be provided when 10 %, or less, of the life, or estimated life of the battery is remaining. All functions shall nevertheless be preserved.

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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.
The VCD shall maintain the full functionality until the battery reaches the “expiring level”, defined by the manufacturer. When reaching the “expiring level”, the VCD may lose any or all of its functionality, including measurement. When the “expiring level” is reached, the information specified in 6.5.3 shall be memorized.
EXAMPLE Non Volatile Ram - NVRAM may be stated as retention area and values input may be auto recoverable.
4.13.3 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.

4.14 Security devices and alarms
4.14.1 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;
- If the correction function is activated and the flowrate is below Q_{min};
- 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 sealed.
4.14.2 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 4.14.3.
4.14.3 The information specified in 4.13.3 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.
4.14.4 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

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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.

4.14.5 Operation of alarms shall be tested in accordance with A.16.

5. Performance TEST

5.1 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.

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5.2 Maximum permissible errors

5.2.1 General

5.2.1.1 Conversion in general

The conversion device shall be adjusted to meet the requirements of the MPEs given in either Table 2 or Table 3. Compliance with the MPEs given in Table 2 or Table 3 shall be checked after adjustment of the device. Additionally, each conversion device shall have the error adjusted as close to zero as the adjustments allow, without systematically favoring any party. The adjustment shall be carried out either in the factory or on site.

5.2.1.2 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 shall be as specified in Table 2. MPEs shall not be exploited and the acceptance criteria are specified in A.2.4.
The error of the gas meter is not taken into account.

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

5.2.1.3 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, shall be as specified in Table 3. The MPEs applicable to the volume at base conditions or to the conversion factor shall not be exploited and the acceptance criteria are specified in A.2.4.

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

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

Indication or element	Reference conditions	Rated operating conditions
Main indication (ec) for PT and PTZ conversion	±0,5	±1
Calculator (ef)	±0,2	±0,3
Temperature (et)	±0,1	±0,2
Pressure (ep)	±0,2	±0,5
Main indication for T conversion only	±0,5	±0,7

5.3 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.

5.4 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;
- 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.

The relevant requirements are given in Table 4.

5.5 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.

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5.6 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 pmin and T (see Table A.1).

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

5.7 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. Therefore the measuring instrument shall have an alarm system designed according to 6.6.

6. Tests of conformity

6.1 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.

6.2 Verification of the performance requirements (type tests)

6.2.1 Test conditions

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

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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(EN12405-1)) Timing: B: Before, D: During, A: After Δe: see Annex E (EN12405-1) 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 12213-3:2009 or outside the limits of this method, with the methods describe in EN ISO 12213-2:2009. 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.

NOTE In application of 4.4.2, test A.4 is performed for non-condensing humidity device, and test A.5 for condensing humidity device. Tests A.12 and A.13 are carried out only for M2 class.

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

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.21	Optional functionality "correction of a gas meter"	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. If there are more than 3 different measuring ranges, then additional columns are added with the same tests as in R3.

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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.21	Optional functionality "correction of a gas meter"	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

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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
A.2	Accuracy	X	X	X
A.16	Alarms' operation	X	X	X
A.21	Optional functionality "correction of a gas meter"	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

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6.2.3 Test report

Model test reports are given in Annex C (EN12405-1) for PRT sensors, in Annex E (EN12405-1)(for type1) for conversion devices, and in Annex F (EN12405-1) for associated transducers, as applicable.

6.2.4 Conversion Devices (as a sub-assembly)

Component / Description	Securing necessary	Remark
Housing against opening	Yes	• Unless the metrological relevant parts Are secured inside the housing. • Unless the housing cannot be opened without damaging the housing to such an extent that the housing cannot be reused.
P- and T- transmitters housing against	Yes	opening
Connection of P- and T- transmitters to piping against removal	No*	the
Connection between gas meter with the conversion device	No*	Under MID sealing between the gas meter and conversion device is not required.
Inscriptions	Yes	Unless the inscriptions are permanently placed onto the meter.

Interfaces (in- and outputs) for legal purposes	Yes	
Interfaces (in- and outputs) for other purposes	Yes	Unless the utility meter cannot be influenced through the interface
Connection between different parts of the conversion device not integrated in one housing	Yes	
Connection to the legally relevant indicating device	Yes	
Connection between P- and T device with conversion device	Yes	In case the connection of the sensors is protected by the housing, no specific extra sealing is necessary
Legal part of software	Yes	
Software / Parameter settings For example but not limited to: configuration of registers gas composition and parameters for compressibility calculation Setting of correction devices (curve fitting,) Programmed pulse factor	Yes	
Resetting of registers	Yes	See 5.1.1 for the conditions under which a soft-Ware seal is allowed.
Removable batteries	No*	
External power supply	No*	
* However it is advisable that an installation seal1 is applied		

7. Marking

Each conversion device shall be marked with the following information in legible characters which are permanently visible meeting the requirements of EN 60730-1:20166), Annex A (EN12405-1):

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;

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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.

Where the instrument of dimensions too small or of composition too sensitive to carry the required information, the packaging, if any, and accompanying documents shall be appropriately marked.

8. PACKING & PACKAGING

8.1 All electronic and pneumatic instruments shall be packed in accordance with given instructions and must be suitably protected to withstand one year transit conditions and to give recommendation for a further two years storage under site conditions.

8.2 Electrical panels and instruments for export delivery shall be packed to provide full protection against physical damage and atmospheric attack during transit and possible min. 2 years under adverse storage conditions.

8.3 The package seller shall remain fully responsible for selecting suitable materials for packing and for the efficiency of the packaging.

8.4 The package seller shall provide written instruction for the removal of protective coatings on devices.

8.5 Shroud the instrument or panel which shall be thoroughly cleaned, dry and free from rust and shall be totally enclosed in a polyethylene shroud after sharp projections on the instrument or panel have been padded. Silica gel or other approved desiccant shall be strapped inside the shroud, but shall not come into contact with the paintwork. After the desiccant is strapped into position, the open ends of the shroud shall be heat sealed, only leaving an opening large enough for the insertion of an air extracting pipe. After extraction, of the air from the shroud, the opening shall be completely sealed.

8.6 Securing instruments or panels inside packing case 1) the instrument or panel shall be completely secured by wooden battens faced with suitable rubber or other shock absorbing material. 2) Wood wool and other similar materials shall not be used. 3) Hay and straw shall not be used.

8.7 Sealing of packing case after nailing, joints in the case shall be sealed with suitable sealing compound and the outside bound with steel strapping if required.

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

8.9 Each meter shall be put in a plastic bag.

8.10 Each plastic bag shall be housed in a cardboard box.

8.11 The meters inside the box must be controlled by a shock absorber.

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8.12 The cardboard boxes shall be housed in wooden cases according to NIGC packing instructions under protection, packing, marking and dispatching.

9. DOCUMENTATIONS

Supplier is required to complete and sign the attached data sheet(s) and as well as 2 sets of the following documentation in English together with technical quotation:

9.1 All technical information and original copies of printed catalog(s)

9.2 Full Parts list catalogue(s)

9.3 General drawing(s) showing outline dimensions

9.4 Manuals for installation, commissioning, operation and maintenance.

9.5 Material test certificates of each parts of meter.

9.6 Type test certificates.

9.7 Factory testing reports

9.8 ATEX certificate

9.9 IP certificate

9.10 QAN certificate

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Data sheet(Informative)

Gas volume conversion device

Item	Subject	To be filled by designer	To be filled by manufacturer /supplier
1	Conversion device kind	PTZ	
2	Conversion device type	Type 1	
3	Communication output	Optical & RS -232 & RS-485	
4	No. of optical cables	One cables for 30 NO V.C.	
5	Display	Graphical LCD with Backlight	
6	Metrological approvals	Type test[1]☐ MID[2]☐ Note1: Domestic productions are required to have a type test certificate. Note2: Foreign productions of both tests are required.	
7	Calculation mode	AGA NX19☐ AGA8 G1 OR G2☐ AGA 8-DC ☐ SGERG 88 ☐	AGA NX19☐ AGA8 G1 OR G2☐ AGA 8-DC ☐ SGERG 88 ☐
8	Volume measuring unit	Standard cubic meters per hour(SCMH)	
9	Pressure Sensor (standard ranges)	0.8-5.2bar(a)☐ 2-10 bar(a) ☐ 4-20 bar(a) ☐ 7-35 bar(a)☐ 14-70 bar(a)☐ etc. ☐	0.8-5.2bar(a)☐ 2-10 bar(a) ☐ 4-20 bar(a) ☐ 7-35 bar(a)☐ 14-70 bar(a)☐ etc. ☐
10	Enclosure material	Polycarbonate☐ metal☐ etc[3]. ☐ Note3:manufacturer shall describe and to be finalized after company approval	Polycarbonate ☐ metal☐ etc[3]. ☐ Note3: manufacturer shall describe and to be finalized after company approval
11	Protection class	At least IP65(Enclosure & external sensors)	
12	parameters that mentioned	Hourly: minimum 3900 records Daily :minimum 250 records Monthly: 25 monthly records.	
13	Power supply	DC☐ Battery☐	DC☐ Battery☐
14	Battery specification	Standard lithium battery (D-SIZE 3.6 V) with at least 5 years life time. 16 Ah☐ 17Ah☐ 19Ah☐	Standard lithium battery (D-SIZE 3.6 V) with at least 5 years life time. 16 Ah☐ 17Ah☐ 19Ah☐
15	Protection class	Intrinsically safety: EExia-IIC T4/T3 (Enclosure & external sensors) ☐ Intrinsically safety: EExia-IIB T4/T3 (Enclosure & external sensors) ☐	
16	Maximum permissible error	0.5%(at reference condition)	
17	Digital INPUT/OUTPUT	At least 3 channels	

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18	Operating condition	Ambient temperature: Class 1: from +5 °C to +30 °C ☐ Class 2: from -10 °C to +40 °C ☐ Class 3: from -25 °C to +55 °C ☐ Other range ☐	Ambient temperature: Class 1: from +5 °C to +30 °C ☐ Class 2: from -10 °C to +40 °C ☐ Class 3: from -25 °C to +55 °C ☐ Other range specified by the manufacturer☐
19	Ability to adjust and correct the error between VC & meter	Yes☐ No☐	Yes☐ No☐
20	Accessory for installation	such as bracket, stand plate, pressure sensor stray and etc.(minimum stainless steel)	
Manufacturer signature and stamp			

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