	Technical Specification of Type Approval for Diaphragm Gas Meters	S/N	CNPA 31
		Rev.	3

1. This Technical Specification is enacted pursuant to Paragraph 3, Articles 25 of the Weights and Measures Act.

2. The date of promulgation, document number, date of enforcement and content of the amendment are listed as follows:

Rev.	Date of Promulgation	Document No. (Ching-Piao-Szu-Tsu)	Date of Enforcement	Content of Amendment
1	2003-11-19	No. 09240008950	2004-01-01	
2	2016-09-05	No.10540016080	2019-09-05	Referring to OIML R 137-1 & 2:2012, adding the provisions on the maximum working pressure and other features to meet the metrology requirement. Adding the testing on pressure features for gas meters with maximum working pressure over 10 kPa. Revising the items of marks and the inscriptions on the name plate, deleting the maximum working pressure, applicable temperature and pressure from name plate. Corresponding to the testing capacity of the constant temperature, revising the applicable maximum measurable range for temperature.
3	2017-10-27	No.10640006480	2018-01-01	Adding the manufacture year on the name plate.

3. This specification is formulated with use to the following specifications:

OIML R6	General provisions for gas volume meters	(1989(E))
OIML R31	Diaphragm gas meters	(1995(E))
CNS 14741	Diaphragm type gas meter with micro computers for nature gas use	(2003(E))

Date of Promulgation	Bureau of Standards, Metrology and Inspection Ministry of Economic Affairs	Date of Enforcement
2017-10-27		**2018-01-01**

CONTENTS

1. Scope: This technical specification applies to diaphragm gas meters (hereinafter referred to as the “gas meter”), that are gas volume meters in which the gas flow is measured by means of measuring chambers with deformable walls, including gas meters with a built-in temperature conversion device.

2. Definition

2.1 Flow-rate (Q)

The gas volume flows over the gas meter within unit time.

2.2 Maximum flow-rate (Q_{max})

The upper limit of flow-rate that gas meter applies within specified error.

2.3 Minimum flow-rate (Q_{min})

The lower limit of flow-rate that gas meter applies within specified error.

2.4 Transitional flow-rate (Q_t)

The flow-rate the maximum permissible error changes in value.

2.5 Flow-rate range

The range of the flow-rates of gas limited by the maximum flow-rate Q_{max} and the minimum flow-rate Q_{min}.

2.6 Maximum permissible error

The extreme values of the error (positive and negative) permitted by the legal requirements.

2.7 Maximum pressure (P_{max})

The upper limit operating pressure of a gas meter does not over the MPEs.

2.8 Minimum pressure (P_{min})

The lower limit operating pressure of a gas meter does not over the MPEs..

2.9 Working pressure range(P_m)

The range of the pressure of operating pressure that limited by the maximum operating pressure and minimum operating pressure.

2.10 Working temperature range(P_m)

The range of the temperature of operating pressure that limited by the maximum operating pressure and minimum operating pressure.

2.11 Pressure loss

The pressure different between the outlet and inlet of a gas meter while gas flowing.

2.12 Indicating device

A device provides an indication corresponding to the volume of gas passing the through the gas meter.

2.13 Integrating value

The accumulated gas volume the indicating device displays.

2.14 Durability

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

2.15 2.14 Value of a given air volume quantity

Measured gas volume specified to ensure gas-meter's instrument error.

2.16 Cyclic volume of gas meter

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

2.17 Test element

A device that enable precisely reading of the gas volume.

2.18 Built-in temperature conversion device

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

2.19 Pressure absorption

With a flow of air of density 1.2 kg/m ^{3} as a medium, at a flow-rate equal to Q_{max}, the pressure loss averaged over a measuring cycle of a gas meter as the total pressure absorption.

2.20 Electronic indicating device

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

2.21 Diaphragm type gas meter micro computers

The measuring unit and safety detection control unit associate the diaphragm type gas meter microcomputer. The safety-standard test-controlling unit is composed by fuel gas flow-rate sensor, fuel gas blocking valve, fuel gas pressure sensor, seismic sensor, abnormal state judging standard microcomputer motherboard and lithium battery, etc.

3. Range of flow-rates

3.1 The authorized values of maximum flow-rates and the corresponding values of the upper limits of the minimum flow-rates are given in Table 1.

Table 1

Q_{max} m^3/h	Upper limit of Q_{min} m^3/h
1	0.016
1. 6	0.016

2. 5	0.016
4	0.025
6	0.040
10	0.060
16	0.100
25	0.160
40	0.250
65	0.400
100	0.650
160	1.000
250	1.600
400	2.500
650	4.000
1000	6.500

3.2 A gas meter may have a lower value for the minimum flow-rate than that shown in Table 1, but this lower value shall be one of the values shown in the table or a decimal sub-multiple of one of these values.

4. Details of construction

4.1 For each gas meter the difference between the calculated values of the cyclic volume and the nominal value (V) of this volume, indicated on the gas meter, shall not exceed 5% of the latter at reference conditions.

4.2 Gas meter may be provided with a device to prevent the measuring device from functioning whenever the gas is flowing in an unauthorized direction.

4.3 Additional devices

4.3.1 If the gas meter is equipped with prepayment devices, those devices should not influence the function of the gas meter.

4.3.2 If the gas meter is equipped with pulse generators, then it should label the pulse number of unit volume.

4.3.3 If the gas meter is equipped with safety detection control unit and the maximum flow-rate is below 16m3/h, it should comply with the requirements of CNS 14741 and not to affect the metrological function of the gas meter.

5. Indicating device and test element

5.1 General

For a gas meter equipped with an indicating device (index) with an integral test element (testing dial or drum) the following conditions apply.

The standard deviation of the results of a series of at least thirty consecutive

measurements of a volume of air equal to ten times the nominal cyclic volume (or, twenty times when ten times the nominal cyclic volume is less than the volume corresponding to one revolution of the test element), carried out under identical conditions at a flow-rate of the order of 0.1 Q_{max}, shall not exceed the values given in Table 2. The test will be carried out on one of the meters supplied for type approval.

Table 2

Q_{max} m^3/h	Maximum standard deviation dm^3
1 to 10 inclusive	0.2
16 to 100 inclusive	2
160 to 1000 inclusive	20

Note: The test, to be carried out only in the course of type approval, is intended to assess the repeatability of gas meter and to ascertain that the resolution of the test element matches the need for testing.

5.2 Test element of a mechanical indicating device

5.2.1A mechanical indicating device may be equipped with either an integral test element according to the provisions of the followings or a device which allows the fitting of a removable test element. The last digit of integrated test element in the indicating device must contain one or two of the two following forms:

a. a continuously moving drum bearing a scale.

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

5.2.1.1 On the numbered scale of a test element, the value of one complete revolution of the pointer shall be indicated in the form (1 revolution ……m^3 (or dm^3)). The beginning of the scale shall be indicated by the figure zero.

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

5.2.1.3 The scale interval must be in the form 1x10n, 2x10 n or 5x10 n m3 (n being a positive or negative whole number or zero).

5.2.1.4 The scale marks shall be fine and uniformly drawn. In the case where the scale interval is in the form 1x10n or 2x10 n m3 all the lines representing multiples of 5, and where the scale interval is in the form 5x10 n m3 all the lines representing multiples of 2, shall be distinguished by being longer than the others lines. The scale marks shall be sufficiently fine to permit accurate and easy reading.

5.2.1.5 The test element may be provided with a scale mark which stands out in contrast to the scale and is of sufficient size to allow automatic photoelectric scanning. The scale mark shall not obscure the graduation. If proper, the index mark can replace “zero” value. And its presence shall not be detrimental to the

accuracy of reading.

5.2.1.6. An indicating device shall have a sufficient number to ensure that the volume passed during 1000 hours at maximum flow-rate does not return to its initial positions.

5.2.2. An integral test element of mechanical indicating device shall have a maximum scale interval and a scale numbering as specified in Table 3.

Table 3

Q_{max} m^3/h	Maximum scale interval dm^3	Numbering every dm^3
1 to 10 inclusive	0.2	1
16 to 100 inclusive	2	10
160 to 1000 inclusive	20	100

5.3 Test element of electronic indicating device

5.3.1 Electronic indicating devices shall be non-resettable and shall be nonvolatile (i.e. must be able to show the last correct indication after the device has recovered from an intervening power failure).

5.3.2 It must use cubical meters or 10n (n is integer) to encode Where the measured values include 10n (n is negative integer) of the cubic meter, they shall be separated by a clear decimal sign from those showing cubic meters. And if the lowest digit is 10n (n is positive integer) of the cubic meter, then there are fixed digits of zero (s) after it (or the making: x10, x100 or x1000), so that the reading is always in cubic meters..

5.3.3 Sight level of displayed digits should not be less than 4 mm.

5.3.4 For digit upgrading (except the lowest digit), the upper digit should be changed concurrently or before the lower digit next to it has changed to zero (0).

5.3.5 It shall have at least a sufficient number to ensure that the volume passed during 1000 hours at maximum flow-rate does not return to their initial positions.

5.3.6 Electronic indicating device may be equipped with either an integral test element according to the provisions of the followings or a device which allows the fitting of a removable test element. The last digit of integrated test element must be:

a. a continuously moving drum bearing a scale.

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

5.3.6.1 The test element may be provided with a scale mark which stands out in contrast to the scale and is of sufficient size to allow automatic photoelectric scanning. The scale mark shall not obscure the graduation. If proper, the index

mark can replace "zero" value. And its presence shall not be detrimental to the accuracy of reading.

5.3.6.2 The moveable test element means the impulse-reading device.

5.3.7 An integral test element of mechanical indicating device shall have a maximum scale interval and a scale numbering as specified in Table 3.

5.4 Gas meters with built-in temperature conversion device

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

$$t_b = \ldots ^oC$$

Note: The values chosen for base temperature shall preferably be 15 ^oC. Additionally, the maximum permissible errors specified in Table 4 shall be increased by ± 0,5 % in an interval of 10 ℃, extending symmetrically around a temperature specified by the manufacturer. The specified temperature shall be between 15 ℃ and 25 ℃. The resulting interval shall be within the range of temperature of the metering conditions indicated on the data plate of the gas meter. The specified temperature should be on the data plate, expressed as:

$$T_{sp} = \ldots ^oC$$

6. Maximum permissible errors

6.1 With air of a density of 1.2 kg/m^3 as a test medium, under the conditions laid down as the followings, the maximum permissible errors on type approval are given in Table 4.

Table 4

Flow-rate	Maximum permissible error	
	Type approval	In service
$Q_{min} \le Q < 0.1Q_{max}$	±3%	-6%, +3%
$0.1Q_{min} \le Q \le Q_{max}$	±1.5%	±3%

6.1.1 The instrument error of measuring must be expressed by percentage to the relative value; i.e., the ratio of deviation between the indicated value of gas meter and standard value made from standard element, then divided by the standard value made from standard element:

$$\text{Error (\%)} = \frac{(\text{Indicated value} - \text{standard value})}{(\text{standard value})} \text{X}\,100\,(\%)$$

6.1.2 The reference density applied to calculate instrument error in measuring air volume is 1.2 kg/m^3 (*).

6.1.3 The maximum permissible error is correct in the correct flowing direction.

(*) In normal atmosphere condition, the ambient air in lab conforms to this condition.

6.2 On type approval of a meter the absolute value of each meter error shall not exceed 1% at flow-rates between $0.1Q_{min}$ and Q_{max}, where these errors are all of the same sign.

6.3 For a gas meter with a temperature conversion device and equipment with one indicating device as specified in 5.4, the conventional true value of the volume at the metering temperature shall be converted to the volume at base temperature. The following provisions shall apply.

6.3.1 The maximum permissible errors specified in Table 4 shall be increased by ±0.5% in an interval of 10 ℃, extending symmetrically around a temperature specified by the manufacturer. The specified temperature shall be between 15 ℃ and 25 ℃. The resulting interval shall be within the range of temperature the metering conditions indicated on the data plate of the gas meter.

6.3.2 Within the range of temperature of metering conditions indicated on the data plate of the gas meter but outside the interval defined in 6.3.1, the maximum permissible error specified in Table 4 shall be increased by ±1.0 %.

6.3.3 Compliance with the requirements of 6.3.1 and 6.3.2 shall be test at temperatures not more than 2 ℃ from the upper and lower limits of the specified intervals.

7. Pressure absorption

The total pressure absorption of a gas meter, averaged over a measuring cycle, with a flow of air of density 1.2 kg/m^3, at a flow-rate equal to Q_{max}, shall not exceed the values given in Table 5.

Table 5

Flow-rate	Maximum permissible values for average total pressure absorption (equipped with safety detection control unit)
1 to 10 inclusive	200 (242)
16 to 65 inclusive	300 (330)
100 to 1000inclusive	400 (440)

8. Type approval

8.1 Application for type approval

At the same time as the type sample is submitted, the applicant shall place as the request of the authority responsible for the examination in conformity with the type.

8.2 General requirement on mechanical feature

8.2.1 The type and the sample gas meters shall comply with the provisions of clauses 3, 4, 5, 6 and 7 of this technical specification. The gas meters shall be submitted to the testing procedure for type approval as specified in Annex A.

8.2.1.1The errors of the sample gas meters shall be determined at seven flowrates evenly distributed over the working range.

8.2.1.2At flow-rates equal to or is greater than 0.1 Q_{max}, the errors shall be determined independently at least six times, by varying the flowrate between each consecutive measurement. The difference between any two errors found at each test flow rate shall not exceed 0.6%.

8.2.2 In addition, the difference between the minimum and maximum of the mean error curve as a function of the flow-rate shall not exceed 2% for the range 0.1 Q_{max} and Q_{max}.

8.2.3 Endurance test: proceeding the durability test under ambient pressure

8.2.3.1The endurance test shall be carried out:

- for gas meters with Q_{max} from 1 to 16 m^3/h (included): at the maximum flow-rate, using gas for which the gas meter is intended to be used.
- For gas meters with $Q_{max} \geq 25 m^3/h$: as far as possible at the maximum flow-rate, using gas for which the gas meter is intended to be used; the flow-rate during the test shall be at least equal to 0.5 Q_{max}.

.If the manufacturer demonstrates that the diaphragm of the gas meter is sufficiently insensitive to the gas compositions, the approving authority may decide to perform the endurance test with air.

8.2.3.2The duration of the endurance test shall be as follows:

- For gas meters with Q_{max} from 1 to 16 m3/h (included): 2,000 hours; the endurance test may be discontinuous but shall be completed within 100 days;
- For gas meters with Q_{max} from 25 to 1000 m3/h (included): such that each gas meter measures a volume corresponding to 2,000 hours of operation of the gas meter at maximum flow-rate: the test shall be completed within 180 days.

8.2.4 After the endurance test the gas meters shall comply with the following requirements.

8.2.4.1The error curve shall be within the maximum permissible in-service errors as specified in Table 4.

8.2.4.2The difference between the minimum and maximum of the mean error curve as a function of the flow-rate shall not exceed 3% for the range 0.1 Q_{max} and Q_{max}.

8.2.4.3 The mean absolute value of errors over the range 0.1 Q_{max} and Q_{max} shall not vary by more than 1%.

8.2.5 If the gas meter is equipped with safety detection control unit and the maximum flow-rate is below16 m^3/h, then this unit shall be test specified in CNS 14741, Section 8 except 8.10.

8.3 Requirement of pressure concerned feature

If the nominal maximum working pressure is over 10 kPa, the pressure concerned feature test shall be performed other than the requirements listed in 8.2.

8.3.1 The test for pressure concerned feature shall follow the sequence as the initial

errors under ambient pressure, initial errors under constant pressure, durable operation under constant, the final errors under constant pressure and the final errors under ambient pressure. The testing procedures shall be as specified in Annex A.

8.3.2 The initial errors under ambient pressure

The sample for type approval shall be tested under working condition with three different flow-rates to measure the initial errors under ambient pressure.

8.3.2.1 The sample shall be tested with three different flow-rates and each flow-rate shall be tested for at least six times to decide the errors. The difference of errors between any two tests for the same flow-rate shall not exceed 0.6 %.

8.3.2.2 Among the six different flow-rates, the difference between the mean errors for any two specific flow-rates shall not be over 2 %.

8.3.3 The initial errors under constant pressure.

The sample for type approval shall be tested under maximum working pressure with three different flow-rates to measure the initial errors under constant pressure.

8.3.3.1 The sample shall be tested with three different flow-rates and each flow-rate shall be tested for at least six times to decide the errors. The difference of errors between any two tests for the same flow-rate shall not exceed 0.6 %.

8.3.3.2 Among the six different flow-rates, the difference between the mean errors for any two specific flow-rates shall not be over 2 %.

8.3.4 Endurance test: proceeding the durability test under ambient pressure

8. 3.4.1 The endurance test shall be carried out with maximum nominal working pressure the test media shall be clean air.

8. 3.4.2 The duration of the endurance test is 500 hours. The duration can be divided. However the testing procedure shall be completed in 35 days.

8.3.5 The acceptance criteria for the endurance test shall be as following requirement.

8.3.5.1 The error curve shall be within the maximum permissible in-service errors as specified in Table 4.

8.3.6 The final errors under constant pressure.

The sample for type approval shall be tested under maximum working pressure with three different flow-rates to measure the initial errors under constant pressure.

8.3.6.1 When implement the testing procedure increase the flow-rate continuously and take the measurement errors at three different flow-rates. Then decrease the flow-rate continuously and take the measurement errors at the same flow-rate during increasing flow-rate. The error for each flow-rate is the average of twice measurement errors.

8.3.6.2 The difference between the maximum mean value of errors and the minimum different flow-rate shall not beyond more than 3%.

8.3.7 The final errors under ambient pressure

8.3.7.1 When implement the testing procedure increase the flow-rate continuously and take the measurement errors at three different flow-rates. Then decrease the flow-rate continuously and take the measurement errors at the same flow-rate during increasing flow-rate. The error for each flow-rate is the average of twice measurement errors.

8.3.7.2 The difference between the maximum mean value of errors and the minimum

different flow-rate shall not beyond more than 3%.

8.4 Modification of a previously approved type

When an approved gas meter is submitted for approval due to the type modified, the dedicated weighs and measures authority decides whether the requirement in 8.1 to 8.3 applicable and the applied extend based on the modifications.

Annex A

Test procedures for type approval examination of diaphragm gas meters

A.1 Test room and test installation

A.1.1 General

A.1.1.1 The test room shall be set up so that gas meters can be tested in a correct and efficient way.

A.1.1.2 The test room shall be clean and in good order. Engines and other noise-producing machines should be placed outside the test room.

A.1.2 Ambient conditions

A.1.2.1 The average ambient temperature is defined as the arithmetic mean of the following temperatures:

- The ambient temperature near the reference standard(s).
- The ambient temperature around the meter to be tested.
- The air temperature at the air inlet of the test installation.
- The ambient temperature near the place in the test room where the meters to be tested are stored prior to examination.

Note: The meters to be tested may also be stored in a neighboring room with the same temperature conditions.

A.1.2.2 The conditions of the test room air shall be sufficiently stable. This demands at least that:

- The average ambient temperature does not vary by more than 4^{o}C per 12 hours and by not more than 2 ^{o}C per hour.
- The difference between any two temperatures mentioned in A.1.2.1 does not exceed 2 ^{o}C.

A.1.2.3 If the following requirements are met the meters may be tested without applying a correction for temperature differences between the reference meter and the meter to be tested:

- The air used to test the meters is at ambient conditions,
- The average ambient temperature does not vary by more than 2^{o}C per 12 hours and by not more than 0.5 ^{o}C per hour.
- The difference between any two temperatures mentioned in A.1.2.1 does not exceed 0.5 ^{o}C.

In all other cases corrections for temperature differences shall be made (see A.1.3.3).

A.1.2.4 It shall be established that stable conditions are reached before the start of the first test and that they are maintained until immediately after the last test.

A.1.2.5 During measurements the temperature in the test room shall be checked at least

once a day.

A.1.2.6 the barometric pressure in the laboratory should be measured at least once a day.

A.1.3 Test installation

A.1.3.1 Test air

A.1.3.1.1 The test air shall be clean and free from dust and oil.

A.1.3.1.2 The temperature of the test air shall be within 0.5 ^{o}C of the average ambient temperature.

A.1.3.1.3 The relative humidity shall be such that condensation is avoided at all times.

A.1.3.2 Pressure measurement

A.1.3.2.1 Pressure tappings for meters under test shall be located one pipe diameter upstream of the meter inlet and one pipe diameter downstream of the meter outlet, or the pressures actually measured shall be verified to be correct indications of the pressures at the above-mentioned locations.

A.1.3.2.2 there shall be a straight length of at least one pipe diameter upstream of the inlet pressure tapping and one downstream of the outlet pressure tapping.

Each straight length shall be of the same nominal size as the inlet or outlet, respectively.

A.1.3.2.3 The holes for pressure tappings shall be perpendicular to the pipe axis. They shall have a diameter of at least 3 mm. The tappings shall not protrude into gas flow. The inside wall of the pipe near the pressure tapping shall be smooth and free from burrs.

A.1.3.2.4 The pressure measuring device used to monitor the average pressure absorption of the meter under test shall allow the normal variations in pressure over the meter to be averaged.

A.1.3.3 Temperature measurement

The temperature representative of the measured gas volume should be measured at the outlet of the meter under test.

A.1.3.4 Leakage

Periodically the test installation should be extensively tested for leakage, both externally, i.e. into or out of the installation, and internally, i.e. through valves, etc. These leakage tests should be performed with the minimum or maximum operating pressure of the installation whichever is applicable. The rate of leakage shall be smaller than the greater of the following values:

- 0.1% of the minimum flow-rate for which the installation is intended to be used;
- 100 cm^3/h.

A.1.3.5 Series testing

If meters are to be tested in series, there should be no interaction between the meters. This condition may be verified by testing every meter of the series once at each position in the line.

A.1.4 Reference standards

A.1.4.1 The test installation shall be equipped with reference standards that are suitable for the testing of diaphragm gas meters. The working range of the reference standards shall match that of the meters to be tested.

A.1.4.2 Manometers, thermometers, and reference volume flow standards used to measure parameters that enter into the calculation of any quantity in connection with pattern approval or with initial verification shall have calibration certificates traceable to national or international standards.

A.1.4.3 The certificates mentioned in A.1.4.2 shall cover the range for which the instruments are used and shall report the calibration uncertainty.

A.1.4.4 The laboratory shall at all times be able to specify type A and type B uncertainties in the determination of gas meter error. The uncertainties shall be calculated according to the *Guide to the expression of uncertainty in measurement* (1993 edition) and the overall (expanded) uncertainty shall be calculated with a coverage factor k = 2.

A.1.4.5 The overall uncertainty of the test equipment for type approval shall be or at less one fifth of the maximum permissible errors for gas meters, taken from the applicable values of Table 4.

A.2 Type approval

A.2.1 Documents and meters to be submitted

A.2.1.1 The applicant shall submit the documents listed below:

- a description of the meter giving the technical characteristics and the principle of its operation
- a perspective drawing or photograph of the meter
- a nomenclature of parts with a description of constituent materials of such parts
- an assembly drawing with identification of the component parts listed in the nomenclature
- a dimensioned drawing.
- a drawing showing the locations of verification marks and seals
- a drawing of indicating device with adjustment mechanisms
- a dimensioned drawing of metrologically important components
- a drawing of the data plate or face plate and of the arrangements for inscriptions
- a drawing of the additional devices
- a table setting out the characteristics of the drive shafts
- a list of electronic components with their essential characteristics
- a description of electronic devices with drawings, diagrams and general software explaining their construction and operation
- a list of the documents submitted

- a test report specifying that the meters manufactured in conformity with the requirements for safety.

  1. The ambient atmosphere in Taiwan area has higher salt content; besides, the operation life of gas meter is above ten years, material applied to in outer shell and inner portion that will directly contact to fuel gas should be anticorrosive material or surface-coated by anti-corrosion treatment. Therefore, if applying the metallic material defined in CNS 14741, Section 5 and Table 1 or equivalent one, it then is no need to perform the test defined in CNS 14741, Section 8.29.1.(3) and the competent unit can directly check the conformity of material list submitted in the application. Yet, if material applied isn't in the acceptable anticorrosive material list, it then requires performing the test defined in CNS 14741, Section 8.29.1.(3). For non-metallic material, it should apply the test defined in CNS 14741, Section 8.29.2.
  2. Material connecting to the fuel-gas-supplying portion should be able to withstand the external impact under normal operation. Applicant should provide the shock test report under the testing condition defined in CNS 14741, Section 8.13.

A.2.1.2 The applicant shall submit a number of meters for examination as specified in Section 8.2 with a quantity defined in Section 8.1, Table 6.

A.2.1.3 The documents shall be examined to verify that they are in agreement with the meters submitted.

A.2.2 General examination

A.2.2.1 The markings and inscriptions on the meters shall be examined. The range of flow-rates indicated shall comply with 3.1.

Gas meters may be fitted with:

(a) prepayment devices

(b) integral pulse generator, the outlets of which shall bear an indication of the value of one pulse in the form:

"1 imp. ……m^3 (dm^3)"

or "1 m^3 (dm^3) ……imp."

(c) a built-in temperature compensator device.

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

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

(e) additional equipment (correcting equipment, recording equipment and supplementary indication equipment etc.). Add them according to the requirements applied in type approval procedures.

Each gas meter shall bear, either on the data plate, or on a special data plate,

the following markings:

a- the type approval number.

b- the maker's trade mark or his trade name.

c- the type number and serial number.

d- metrological gas name.

e- the range of working pressure P_m = …kPa (or Pa).

f- the flow-rate range: the maximum and minimum flowrate defined in Table 1, the unit is m^3/h.

g- for volumetric flow meter, the normal value of the cyclic volume: V = …m^3 (or dm^3).

h- the maximum permissible pressure deviation between meter inlet and outlet; the symbol is ΔP_{max} = …kPa (orPa).

i- the range of temperature t_m = …^oC.

j- the nominal diameter (inside diameter of inlet and outlet, expressed by mm).

k- inlet and outlet orientations.

l- if built-in temperature compensator is installed, label the base temperature t_b = …^oC and specific temperature t_{sp} = …^oC.

m- if required, a commercial brand name of the gas meter, a special serial number and the name of the gas distributor .

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

A.2.2.2 The places provided for verification marks and protection marks shall be checked.

Location of verification and protection marks

A.2.2.2.1 General Provision

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

A.2.2.2.2 Data plate

Gas meters shall have a special location for applying the verification mark. And it's unable to dismantle this brand without destroying the certification mark.

A.2.2.3 The test element(s) shall be checked as specified in section 5.

A.2.2.4 The meters to be tested shall be ready for operation as specified in the manufacturer's operating instructions.

A.2.2.5 Meters having additional devices shall be checked to ensure that these devices are correctly connected and that they conform to the documents supplied by the manufacturer (see also A.2.4 and A.2.5).

A.2.3 Initial performance test at ambient conditions

A.2.3.1 Error curve

The error curve of gas meters that nominal maximum working pressure does not greater than 10 kPa.

A.2.3.1.1 Meters shall be stabilized at the temperature of the test room.

A.2.3.1.2 Meters shall be installed on the test installation as specified in the manufacturer's operation instructions. Pipes connected to the inlet and outlet of the meter shall be of at least the same nominal sizes as those of the meter connections.

A.2.3.1.3 After a meter is installed on the test installation it shall be brought to the minimum or maximum gauge pressure of the test installation, whichever is applicable. After temperature stabilization the leak rate shall be as specified in A.1.3.4.

A.2.3.1.4 Before starting the first series of test, the meter shall be run at maximum flow-rate. The volume passed through the meter shall be at least fifty times the cyclic volume of the meter. The actual duration of running in may depend on the time that has elapsed since the meter was last in operation.

A.2.3.1.5 The error curve of all meters submitted shall be determined at a minimum of seven flow-rates. These flow-rates shall include:

Q_{max}, 0.7 Q_{max}, 0.4 Q_{max}, 0.2 Q_{max}, 0.1 Q_{max}, 3 Q_{min}, and Q_{min}.

A.2.3.1.6 The meter should be tested with a volume of air that equals an integer multiple of the cyclic volume of the meter. If this is not possible the volume of air passing through the meter should be chosen so that the influence of the periodic variation of the working cycle is less than 0.2% for the tests at flow-rates equal to or greater than 0.1 Q_{max} and 0.4% for the tests at flow-rate less than 0.1 Q_{max}.

A.2.3.1.7 If a number of meters are tested in series the average inlet pressure at each meter shall be measured in order to account for the effect on the measured volume of the decreasing pressure in the test line.

A.2.3.1.8 The error at each flow-rate shall be determined as the mean value of the errors measured. For flow-rates Q_{min} and 3 Q_{min}, the error shall be determined twice, once with decreasing flow-rate and once with increasing flowrate. For flowrates equal to or greater than 0.1 Q_{max}, the error shall be determined at least six times, thrice with decreasing flow-rate and thrice with increasing flowrate.

A.2.3.1.9 The errors at each flow-rates shall be within the maximum permissible errors specified in 6.1 and 6.2.

A.2.3.2 During the test at Q_{max} the pressure differential between the inlet and the outlet of the meter shall be read to check that the average total pressure absorption of the meter complies with clause 7.

A.2.3.3 In order to detect mechanical wear occurring during the endurance test the

pressure absorption at Q_{min} shall be determined.

A.2.3.4 The indication of each of the meters submitted shall be determined as specified in 8.2.1.2.

A.2.4 Performance test at mean ambient temperatures

A.2.4.1 When a meter without a built-in temperature conversion device is designed to be used at temperature other than reference conditions, the meter performance shall be checked over the range of working temperatures indicated on the meter. The meters shall be tested at least at the following temperatures:

- a temperature at 0 ^{o}C of the minimum metering temperature;
- a temperature at 50 ^{o}C of the minimum metering temperature;
- a temperature within 5 ^{o}C of the maximum and minimum working temperature;
- the range of the metering conditions in which the gas meters required to work within the specified maximum permissible errors, expressed as:

t_m = …— …^{o}C

p_m = …— …MPa (or kPa or Pa)

A.2.4.2 The temperature of the ambient conditions of the meter and of the test air at the meter inlet shall be the same within 1 ^{o}C, and the metering temperature at the meter to be tested shall be kept constant within 0.5 ^{o}C at a given temperature setting.

If at other temperature conditions, it needs to make correction on the temperature deviation.

The temperature shall be fully stabilized before testing at a given temperature. The temperature shall be measured.

Note: The referenced standard shall always run at a temperature for which its calibration is valid. The humidity of the test air shall be such that no condensation occurs.

A.2.4.3 The test shall be performed at the following flow-rate:

0.2 Q_{max}, 0.7 Q_{max} and Q_{max}

A.2.4.4 The errors shall be determined twice, once with decreasing flow-rate and once with increasing flow-rate.

A.2.4.5 The errors at each test temperatures shall be within the maximum permissible errors on initial verification as specified in 6.1 and 6.2.

A.2.5 Additional devices

A.2.5.1 If the meter is equipped with a prepayment device it shall be verified that this device has no significant influence on the meter performance.

A.2.5.2 If the meter is equipped with a pulse generator, its correct operation and the number of pulses per unit volume shall be checked.

A.2.6 Built-in temperature conversion device

A.2.6.1 General

A.2.6.1.1 All tests specific to the temperature conversion device shall be carried out on the same sample size as used for the type approval of non-converting meters (see A.2.1.2).

A.2.6.1.2 The meters shall be tested at the various constant temperatures as specified in A.2.6.2.

A.2.6.2 Temperature tests

A.2.6.2.1 The meters shall be tested as specified in A.2.4.2 and A.2.4.3. The test temperatures shall be the temperatures that follow from 6.3.3. Test shall be carried out with increasing and decreasing temperatures.

A.2.6.2.2 The errors at each test temperature shall be within the maximum permissible errors on initial verification as specified in clause 6.

A.2.7 Endurance test (see 8.2.3 and 8.2.4)

A.2.7.1 If the endurance tests are carried out outside the laboratory of the approving authority, the meters shall be completely sealed.

A.2.7.2 The main components of the gas measured during the endurance test shall be known.

A.2.7.3 The ambient condition should not be more severe than the normal operating conditions of the meter.

A.2.7.4 For each meter, the meter reading at the beginning and at the end of the endurance test shall be noted. The indication of the measured volume shall be verified as being compatible with the measured flowrate and the duration of the test.

A.2.7.5 Final error curve

A.2.7.5.1 The final error curve shall be determined as soon as possible but no later than 48 hours after termination of the endurance test. During the time interval between termination and the determination of the error curve the meters shall remain shut off.

A.2.7.5.2 To conditions and procedure for the determination of the final error curve shall be those of the initial performance test, as specified in A.2.3. The error shall be determined twice, once with decreasing flow-rate and once with increasing flow-rate. The tests shall be carried out on the same test installation used to determine the initial error curve.

A.2.7.5.3 The shift of the mean error curve shall be within the tolerances specified in 8.2.4.

A.2.7.6 If the pressure absorption at Q_{min} has changed significantly the meter shall be examined for the possible cause.

A.2.8 Testing for pressure concerned feature

A.2.8.1. The initial errors under ambient pressure, initial errors under constant pressure shall meet the following requirement.

A.2.8.1.1 The gas meter under test shall reach thermal equilibrium with the temperature inside the laboratory.

A.2.8.1.2 The installation of the gas meter under test shall follow the manufacturer's instruction. The connection fit to the inlet and outlet of the gas meter under test shall have the same nominal diameter as the gas meter under test.

A.2.8.1.3 After the gas meter under test connected to the test equipment regulates the pressure to the applicable maximum working pressure. The gas leakage rate shall as the rate specified in A.1.3.4 after the temperature reach steady.

A.2.8.1.4 Before implement the test allow the test media passing through the gas meter under test with the maximum working flow-rate until the passing volume more than 50 times of the cyclic volume. The duration of real operating may depend on interval that the gas meter under test being operating. During the testing, the difference between the indication of pressure and the setting value shall be within ± 5 %.

A.2.8.1.5 The error curve of the gas meter under test shall be decided by three flow-rates, i.e. Q_{max}, $0.7Q_{max}$ and $0.2Q_{max}$.

A.2.8.1.6 The gas volume for test shall be integral number of the cyclic volume of the gas meter under test.

A.2.8.2 The main components of the gas measured during the endurance test shall be known.

A.2.8.3 The ambient condition should not be more severe than the normal operating conditions of the meter.

A.2.8.4 For each meter, the meter reading at the beginning and at the end of the endurance test shall be noted. The indication of the measured volume shall be verified as being compatible with the measured flow-rate and the duration of the test.

A.2.8.5 Final error curve

A.2.8.5.1 The final error curve shall be determined as soon as possible but no later than 48 hours after termination of the endurance test. During the time interval between termination and the determination of the error curve the meters shall remain shut off.

A.2.8.5.2 To conditions and procedure for the determination of the final error curve shall be those of the initial performance test, as specified in A.2.3. The error shall be determined twice, once with decreasing flow-rate and once with increasing flow-rate. The tests shall be carried out on the same test installation used to determine the initial error curve.

A.2.8.5.3 The shift of the mean error curve shall be within the tolerances specified in 8.2.4.

A.2.8.6 If the pressure absorption at Q_{min} has changed significantly the meter shall be examined for the possible cause.

Annex B

Test report format for the evaluation of diaphragm gas meters

B.1 General

B.1.1 Application no. : (new/modification)

Manufacturer :

Applicant :

Representative :

B.1.2 General information on the gas meter(s)

Q_{max} (m^3/h)	Q_{min} (m^3/h)	P_m (bar)	V (dm^3)

Type of display : mechanical/electromechanical/LCD/LED/…

Number of drums/figures :

Additional devices :

- prepayment device : Yes/No
- pulse generator : Yes/No …pulse/m^3 or m^3/pulse

Built-in temperature conversion device: Yes/No

- one indicating device : ( )
- two indicating devices : ( )

B.1.3 Overall result of the type evaluation

Overall result of type evaluation	+/- (*)
1. Documents and meters submitted	
2. General inspection	
3. Initial performance test	
4. Additional devices	
5. Built-in temperature conversion device	
6. Endurance test	

(*) mark + when the result meets the requirements
mark – when the result does not meet the requirements
mark N/A when the evaluation does not applicable

Final result

B.2 Document and meters submitted

B.2.1 List of documents submitted (A.2.1.1)*

Declaration of conformity with safety regulations: yes/no

(*) References are to clauses of this specification unless otherwise stated.

B.2.2 List of meters submitted (A.2.1.2)

Q_{max}	Manufacturer's series number

B.2.3 Meters and documents compatible (A.2.1.3): yes/no

B.3 General examination

B.3.1 Inscriptions on the meters (A.2.2.1)

B.3.1.1 Display panel/data plate

- Approval sign of the gas meter :
- Maker's trade mark/trade name :
- Serial number and year :
- Q_{max} : m^3/h
- Q_{min} : m^3/h
- V : dm^3
- t_m : …— … ^oC
- P_m : MPa, kPa, Pa

B.3.1.2 Additional devices

- Pulse generator : pulse/ m^3 or m^3/pulse

B.3.1.3 Conversion devices

- t_b : ^oC
- t_{sp} : ^oC
- P_b : MPa, kPa, Pa

B.3.1.4 Other indications

- Symbol「m^3」 : yes/no
- Flow direction indication : yes/no

B.3.2 Check on locations of sites for verification and protection marks(A.2.2.2)

B.3.3 Indicating device(s), test element(s) (A.2.2.3)

Indicating device(s), test element(s)	+/-
General construction	
Test element	
Diameter drums/dials	
Reading of indicating device	
Advance of figure	
Removal of indicating device	

B.3.4 Reading of indicating device

Flow-rate (appr. 0.1 Q_{max}) : m^3/h

Air volume per measurement : dm^3

Tolerance : dm^3

Indicated volume (V_i) :

Mean indicated volume

$V_m = \Sigma V_j/30$: dm^3

$$\text{Standard Deviation (S.D.)} = \sqrt{\frac{\sum (V_m - V_i)^2}{29}}$$

Result.

Test No.	Indicated volume $V_1(dm^3)$	$V_m - V_i(dm^3)$	$(V_m - V_i)^2$
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

B.4 Initial performance test

Ambient conditions t = °C ± °C

RH = %

P_{amb} = kPa

B.4.1 Error curve(A.2.3.1)

Running in: m^3 at m^3/h

Flowrate m^3/h	Test volume m^3, dm^3	Errors%						Maximum difference%
		1	2	3	4	5	6	
Q_{max}								
$0.7Q_{max}$								
$0.4Q_{max}$								
$0.2Q_{max}$								
$0.1Q_{max}$								
$3Q_{min}$								
Q_{min}								

Flowrate m^3/h	Mean error %	Mpe %	Result +/-
Q_{max}			
$0.7Q_{max}$			
$0.4Q_{max}$			
$0.2Q_{max}$			
$0.1Q_{max}$			
$3Q_{min}$			
Q_{min}			

General result for error curve：

B.4.2 Average total pressure absorption at Q_{max}: Pa

(A.2.3.2)

Tolerance : Pa

B.4.3 Pressure absorption of Q_{min} : Pa

(A.2.3.3)

Result pressure absorption

B.4.4 Constant temperature test (A2.4)

Metering temperature: ^{o}C

Flow-rate m^3/h	Tested volume dm^3	error %	Test volume dm^3	error %
$0.2Q_{max}$				
$0.7Q_{max}$				
Q_{max}				

Metering temperature: ^{o}C

Flow-rate m^3/h	Test volume dm^3	error %	Test volume dm^3	error %
$0.2Q_{max}$				
$0.7Q_{max}$				
Q_{max}				

Result constant temperature test

B.5 Additional devices

B.5.1 Prepayment device

Influence of prepayment device on meter performance

B.5.2 Pulse generator

Correct operation

Number of pulse per unit volume correct

B.6 Built-in temperature conversion device

B.6.1 List of meters submitted

Q_{max}	Manufacturer's serial number

Indicated temperature range : t_m = / ^oC

Base temperature : t_b = ^oC

Specified temperature : t_{sp} = ^oC

B.6.2 Constant temperature tests (A.2.6.2)

Test temperature: ^oC

^oC

^oC

B.6.2.1 Increasing temperature

Flow-rate m^3/h	t = ^oC error %		t = ^oC error %		t = ^oC error %	
	Up	Down	Up	Down	Up	Down
$0.2Q_{max}$						
$0.7Q_{max}$						
Q_{max}						
mpe %						

B.6.2.2 Decreasing temperature

Flow-rate m^3/h	t = ^oC error %		t = ^oC error %		t = ^oC error %	
	Up	Down	Up	Down	Up	Down
$0.2Q_{max}$						
$0.7Q_{max}$						
Q_{max}						
mpe %						

Result constant temperature test

B.7 Endurance test (8.2.3, 8.2.4)

B.7.1 Meter completely sealed

B.7.2 Test medium: gas, component : mol % CO_2

mol % N_2

mol % CH_4

mol % C_2H_6

Relative humidity : %

B.7.3 Ambient conditions at test site

Ambient temperature : / ^{o}C

B.7.4 Data endurance test

Flow-rate : m^3/h

Duration : hours

Meter number. (max. flow-rate (m^3/h))	Meter reading m^3		Measured volume
	at beginning	at end	m^3

Date and time of termination endurance test:

B.7.5 Final error curve

Date and time of determination of error curve:

Flow-rate m^3/h	Test volume (m^3)	error (%)		Mean error (%)	Shift (%)	mpe (%)	Result +/-
		1	2				
Q_{max}							
$0.7Q_{max}$							
$0.4Q_{max}$							
$0.2Q_{max}$							
$0.1Q_{max}$							
$3Q_{min}$							
Q_{min}							

General result for error curve shift

B.7.6 pressure absorption at Q_{min} : Pa

Change : Pa

B.7.7 Average total pressure absorption at Q_{max} : Pa

Change : Pa

Annex C

The test report format of Diaphragm gas meter on Requirement of pressure concerned feature

C1. General requirement

C.1.1Applicant information

Application No:

Manufacturer:

Applicant:

C.1.2 General Information of gas meter:

Type:

Serial No:

Type Approval No:

- Q_{max} : m^3/h
- Q_{min} : m^3/h
- V : dm^3
- t_m : …— … ^oC
- P_m : …— … kPa

C.1.3 The overall result of pressure concerned feature

overall result of pressure concerned feature	+/-(*)
Initial error under ambient pressure	
Initial error under constant pressure	
Final error under constant pressure	
Final error under ambient pressure	

(*) mark + when the result meets the requirements

mark – when the result does not meet the requirements

Final Result

C.2 Initial error under ambient pressure

C.2.1. Environment condition

t = ^oC ± ^oC

RH = %

P_{amb} = kPa

C.2.2. Initial error curve under ambient pressure (A.2.8.1)

Operation: m^3 with flow-rate: m^3/h

error curve

Floe-rate m^3/h	Passing volume m^3	Error %						Maximum deviation %
		1	2	3	4	5	6	
Q_{max}								
$0.7Q_{max}$								
$0.2Q_{max}$								

error curve

Floe-rate m^3/h	Passing volume m^3	Error %	Maximum deviation %
Q_{max}			
$0.7Q_{max}$			
$0.2Q_{max}$			

General result of initial error curve under ambient pressure

C.3 Initial error under constant pressure

C.3.1 environment condition

t = $^oC \pm$ ^oC

RH = %

P_{amb} = kPa

C.3.2 Initial error curve under ambient pressure (A.2.8.1)

Applied pressure: kPa

Operation: m^3 with flow-rate: m^3/h

error curve

Floe-rate m^3/h	Passing volume m^3	Error %						Maximum deviation %
		1	2	3	4	5	6	
Q_{max}								
$0.7Q_{max}$								
$0.2Q_{max}$								

error curve

Floe-rate m^3/h	Passing volume m^3	Error %	Maximum deviation %
Q_{max}			
$0.7Q_{max}$			
$0.2Q_{max}$			

General result of initial error curve under ambient pressure

C.4Endurance test

C.4.1The gas meter under test shall be so sealed that no air could pass through the inlet or outlet.

C.4.2The test media shall be clean air and the relative humidity shall be recorded.

Relative humidity: %.

C.4.3The ambient condition of test site

Ambient temperature: ^{o}C

C.4.4Data of the Endurance test

Applied pressure: kPa

Flow-rate: m^3/h

Duration: hour

Serial No.	Reading of indicator		Passing volume
Maximum flow-rate m^3/h	Initial	final	m^3

The date/time of start and end of the endurance test:

C.4.5Final error curve

The date/time of the final error curve decided:

flow-rate m^3/h	Passing volume m^3	Error %		Mean error %	MPE %	Result+/-
		1	2			
Q_{max}						
$0.7Q_{max}$						
$0.2Q_{max}$						

General result of the deviation of error curve

C.5The final error under constant pressure

C.5.1 environment condition

t = $^{o}C \pm$ ^{o}C

RH = %

P_{amb} = kPa

C.5.2 final error curve under constant pressure (A.2.8.3)

Applied pressure: kPa

Operation: m^3 with flow-rate: m^3/h

Final error curve under constant pressure

flow-rate m^3/h	Passing volume m^3	Error %		Mean error %	MPE %	Result+/-
		1	2			
Q_{max}						

$0.7Q_{max}$						
$0.2Q_{max}$						

General result of initial error curve under ambient pressure

C.6 The final error under ambient pressure

C.6.1 environment condition

t = $^{o}C \pm$ ^{o}C

RH = %

P_{amb} = kPa

C.6.2 final error curve under constant pressure (A.2.8.3)

Operation: m^3 with flow-rate: m^3/h

flow-rate m^3/h	Passing volume m^3	Error %		Mean error %	MPE %	Result+/-
		1	2			
Q_{max}						
$0.7Q_{max}$						
$0.2Q_{max}$						

Final error curve under constant pressure