	Technical Specification for Verification and Inspection of Diaphragm Gas Meters	S/N	CNMV 137
		Rev.	1

1. This Technical Specification is developed pursuant to the stipulations in Paragraph 2 of Articles 14 and Paragraph 2 of Articles 16 in the Weights and Measures Act.

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

Rev.	Date of Promulgation	Document No.	Date of Enforcement	Content of Amendment
1	Jun. 2, .2003	No. 09240005160	Jul. 1, 2003	
2	May 1, 2006	No. 09540001570	Jul. 1, 2007	Revised according to related OIML requirements.
3	Nov. 18, 2010	No. 09940005810	Jan. 1, 2011	1. When conducting re-verification on meters that passed initial verification before the implementation of type approval, meters shall be sampled and tested for their errors at flow rate 3 Q_{min} as required for meters that have been subject to type approval. 2. Amending the requirements of errors for flow rates between 0.1 Q_{max} and Q_{max} with same positive or negative signs of errors.
4	Sep. 2, 2014	No. 10340007390	Sep. 2, 2014	1. For gas meters with Q_{max} greater than 16 m^3/h that are not subject to type approval, the test for errors at flow rate 3 Q_{min} is no longer conducted. 2. For gas meters with Q_{max} not greater than 16 m^3/h that passed initial verification before the implementation of type approval, the test for errors at flow rate 3 Q_{min} is maintained. For gas meters with Q_{max} greater than 16 m^3/h, the test for errors at flow rate 3 Q_{min} is no longer conducted with reference to those procedures for gas meters that are not subject to type approval.
5	Feb. 21, 2018	No. 10740000820	July 1, 2018	1. For effective management, year of manufacture and history of repair are added as mandatory marking items. 2. To regulate the external airtight test in accordance with the claimed maximum working pressure of gas meters, the leakage rate of external airtight and the submitted documents required for verification are revised. 3. For effective use of verification resources, the determination of pass or fail for errors at flow rate 3 Q_{min} is revised.

				4. In consideration of the material of seal may change with the progress of technology and the requirement of environmental protection, the material of seal is widened and no longer limited to lead.
6	Feb. 27, 2024	No. 11350001330	July 1, 2024	1. Referring to the specification for type approval of diaphragm gas meters (CNPA 137) promulgated on Feb. 6, 2023, amending the existing CNMV 31. 2. Changing the serial number and the revision of this specification from CNMV 31, rev.5 to CNMV 137, rev.1.

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

OIML R6 General provisions for gas volume meters （1989（E））

OIML R31 Diaphragm gas meters （1995（E））

OIML R137-1&2 Gas meters （2012（E））

Date of Promulgation	Bureau of Standards, Metrology and	Date of Enforcement
February 27, 2024	Inspection, Ministry of Economic Affairs	July 1, 2024

1. Scope: This technical specification applies to diaphragm gas meters (hereinafter referred "gas meters") subject to verification and inspection in which the volume of gas flow is measured by means of measuring chambers with deformable films, including any other (electronic) devices that may be attached to the gas meters.

2. Definition

2.1 Cyclic volume

The volume of gas corresponding to one full revolution of the moving part(s) inside the gas meter.

2.2 Error

The quantity value of a measurand minus quantity value of a reference (relative error).

2.3 Maximum permissible error (MPE)

The extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measuring instrument.

2.4 Accuracy class

The class of gas meter that meets stated metrological requirements to keep measurement errors within specified limits under specified operating conditions.

2.5 Rated operating conditions

The conditions of use giving the range of values of the measurand and the influence quantities, for which the errors of the gas meter are required to be within the limits of the maximum permissible error.

2.6 Flow rate, Q

The quotient of the actual quantity of gas passing through the gas meter and the time taken for this quantity to pass through the gas meter.

2.7 Maximum flow rate, Q_{max}

The highest flow rate at which a gas meter is required to operate within the limits of its maximum permissible error, whilst operated within its rated operating conditions.

2.8 Minimum flow rate, Q_{min}

The lowest flow rate at which a gas meter is required to operate within the limits of its maximum permissible error, whilst operated within its rated operating conditions.

2.9 Transitional flow rate, Q_t

The flow rate which occurs between the maximum flow rate Q_{max} and the minimum flow rate Q_{min} that divides the flow rate range into two zones, the "upper zone" and the "lower zone", each characterized by its own maximum permissible error.

2.10 Flow rate range

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

2.11 Minimum and maximum working temperature, t_{min} and t_{max}

The minimum and maximum gas temperature that a gas meter can withstand, within its rated operating conditions, without unacceptable deterioration of its metrological performance.

2.12 Working temperature range, t_m

The temperature range that is allowed when a gas meter works within the maximum permissible error.

2.13 Minimum and maximum working pressure, P_{min} and P_{max}

The minimum and maximum internal pressure that a gas meter can withstand, within its rated operating conditions, without deterioration of its metrological performance.

2.14 Working pressure range, P_m

The range that is between the maximum working pressure and the minimum working pressure.

2.15 Static pressure loss or pressure differential, ΔP

The pressure difference between the inlet and the outlet of a gas meter when gas is flowing.

2.16 Pressure absorption

The difference between the pressures at the inlet and outlet of the gas meter while the gas is flowing. Using air with density about 1.2 kg/m^3 as the medium, the average pressure loss in one measurement cycle at flow rate Q_{max} is taken as the total pressure absorption.

2.17 Value of a given air volume quantity

The specified air volume that has been passing through the gas meter to measure the error.

3. Check of external appearance

3.1 Gas meters shall be clearly marked with the following items on easy scrutiny spot:

(1) Type approval number.

(2) Name of the manufacturer.

(3) Type number and serial number.

(4) Metrological gas name.

(5) Accuracy class (other than class 1.5).

(6) Maximum flow rate: expressed as Q_{max} = …m^3/h.

(7) Minimum flow rate: expressed as Q_{min} = …m^3/h

(8) Transitional flow rate: expressed as Q_t = …m^3/h for which is not equal to 0.1 Q_{max}.

(9) Working temperature range: expressed as t_{min} – t_{max} =… - … ℃ or t_m= … - … ℃

(10) Working pressure range: expressed as P_{min} – P_{max} = … - … kPa or P_m =… - … kPa.

(11) Pulse values of HF and LF outputs: expressed as L / pulse (dm^3 / pulse or m^3 / pulse) or pulse / L (pulse / dm^3 or pulse / m^3) for gas meters equipped with pulse generators.

(12) Indication of flow direction: expressed by an arrow symbol.

(13) Year of manufacture: expressed by 4 digits of the year of C.E., or year of the Republic Era.

(14) Value of the cyclic volume: expressed as V = …dm^3 (or m^3)

(15) Maximum permissible pressure difference between inlet and outlet: expressed as ΔP_{max} =…Pa (or kPa).

(16) Nominal diameter (inside diameter of inlet and outlet): expressed by mm.

(17) History of repair: expressed by trademark of manufacturer and year of repair.

In addition to the above-mentioned markings, the nominal voltage and nominal frequency, expressed as U_{nom} = ⋯V and f_{nom} = ⋯Hz separately, should be marked for gas meter with external power supply and electronic indicating device; the latest date by which the battery is replaced should be marked (In case an automatic alarm indicates when the battery life is below 10%, the above markings

are not required) or the remaining battery capacity should be displayed as required for gas meter with replaceable battery and electronic indicating device.

In case of the application for re-verification Subparagraph 1, 9, 10, 13, 15 and 17, Paragraph 1 need not to be marked for gas meters not subject to type approval or that passed initial verification before the implementation of type approval.

In case of the application for re-verification Subparagraph 13, Paragraph 1 is not applicable to gas meters with Q_{max} not greater than 16 m^3/h that passed initial verification before June 30, 2018.

3.2 Indicating devices

The mechanic indicating device of a gas meter should be provided with scale marks which stand out in contrast to the scale (i.e. the silver line) and the electronic indicating device should be provided with function to display test or verification mode.

In case the gas meter has a combination of mechanic and electronic indicating devices and both indicating devices can show the consumed gas volume synchronically, their indicated quantities should be identical.

3.3 Characteristics of flow rate

The maximum flow rate, the upper limits of the corresponding transitional flow rate and the minimum flow rate for a gas meter are given in Table 1.

Table 1

Q_{max} m^3/h	Upper limit of Q_t m^3/h	Upper limit of Q_{min} m^3/h
1	0.10	0.016
1.6	0.16	0.016
2.5	0.25	0.016
4	0.40	0.025
6	0.60	0.040
10	1.0	0.060
16	1.6	0.100
25	2.5	0.160
40	4.0	0.250
65	6.5	0.400
100	10	0.650
160	16	1.000
250	25	1.600
400	40	2.500
650	65	4.000
1000	100	6.500

4. Verification, inspection and maximum permissible errors

4.1 The traceability of the equipment for verification and inspection is required.

4.2 Prior to verification or inspection, gas meters shall be placed at least 12 hours in the place where the verification is implemented.

4.3 External airtight test

4.3.1 For gas meter with maximum working pressure not greater than 10 kPa: block the outlet of gas meter; conduct the test with air pressure of 10 kPa, and hold for 3 minutes; the leakage rate shall be less than 67 Pa / min.

4.3.2 For gas meter with maximum working pressure greater than 10 kPa: block the outlet of gas meter; conduct the test with maximum working pressure, and hold for 3 minutes; the leakage rate shall be less than 2%.

4.3.3 In case of application for verification, the applicants and the measuring instrument enterprises entitled to conduct self-verification shall submit or prepare quality report/certificate, which shall be in compliance with the requirements of Section 4.3.1 or 4.3.2 and issued by testing labs accredited by accreditation bodies of ILAC MRA, original manufacturers of said gas meters or enterprises holding business license of repair for measuring instruments, and relevant supporting documents in accordance with the quantity of gas meters to be tested. If necessary, the dedicated weights and measures authority should check the external airtight of these gas meters.

4.4 Pressure absorption test

The total pressure absorption of a gas meter, averaged over a measuring cycle, at flow rate of air with density about 1.2 kg/m^3 as Q_{max}, shall not exceed the value given in Table 2.

Table 2

Maximum flow rate m^3/h	Maximum permissible average value for total pressure absorption (including safety reference detection control unit) Verification Pa	Maximum permissible average value for total pressure absorption (including safety reference detection control unit) Inspection Pa
1 to 10 (inclusive)	200 (242)	220 (242)
16 to 65 (inclusive)	300 (330)	330 (363)
100 to 1000 (inclusive）	400 (440)	440 (484)

4.5 Flow rates of verification, inspection, and collected gas volume for error test

The error test of a gas meter for verification and inspection is conducted at specified flow rates and minimum collected volumes listed in Table 3. The

difference between the actual flow rate and the flow rate listed in Table 3 shall not be greater than 5%.

For gas meters with Q_{max} not greater than 16 m^3/h that are subject to type approval, the error test shall be conducted one by one at flow rate Q_{max} and 0.2 Q_{max}. Besides, 5% of the gas meters applied for verification shall be sampled and tested for error at flow rate 3 Q_{min}. If the quantity of the gas meters applied for verification is less than 100, it is counted as 100. In case anyone of the samples failed the test, the original samples should be re-tested. If anyone of them failed the test again, the whole batch of gas meters shall be rejected.

For gas meters with Q_{max} greater than 16 m^3/h that are not subject to type approval, all meters shall be verified one by one for error test at flow rates Q_{max} and 0.2 Q_{max}.

For gas meters with Q_{max} not greater than 16 m^3/h that passed initial verification before the implementation of type approval, all meters for re-verification shall be conducted error test one by one at flow rate Q_{max} and 0.2 Q_{max}. Besides, 5% of the gas meters for re-verification shall be sampled and tested for error at flow rate 3 Q_{min}. If the quantity of meters applied for re-verification is less than 100, it is counted as 100. In case anyone of the samples failed the test, the original samples should be re-tested. If anyone of them failed the test again, the whole batch of gas meters shall be rejected.

For gas meters with Q_{max} greater than 16 m^3/h that passed initial verification before the implementation of type approval, all meters shall be conducted error test one by one at flowrate Q_{max} and 0.2 Q_{max} when apply for re-verification.

Table 3

Maximum flow rate (m^3/h)	Verification and inspection flow rate m^3/h			Minimum collected gas volume for verification and inspection dm^3		
	Q_{max}	0.2 Q_{max}	3 Q_{min}	Q_{max}	0.2 Q_{max}	3 Q_{min}
1	1	0.20	0.048	50	20	10
1.6	1.6	0.32	0.048	50	20	10
2.5	2.5	0.50	0.048	50	30	10
4	4	0.80	0.075	70	50	20
6	6	1.20	0.120	120	70	30
10	10	2.00	0.180	200	100	50
16	16	3.20	0.30	500	300	100
25	25	5.00	0.48	800	400	200
40	40	8.00	0.75	1200	600	300
65	65	13.00	1.20	2000	1000	500
100	100	20.00	1.95	4000	2000	1000

160	160	32.00	.300	8000	4000	2000
250	250	50.00	4.80	12000	6000	3000
400	400	80.00	7.50	20000	10000	5000
650	650	130.00	12.0	32000	16000	8000
1000	1000	200.00	19.5	60000	30000	15000

4.6 Calculation of error

The error of a gas meter shall be expressed by percentage, i.e., the ratio of the difference between the indicated value as volume of air flowing through the gas meter and the value as volume of air flowing through the standard divided by the value of air flowing through the standard.

$$\text{Error (\%)} = \frac{\text{(Indicated value – standard value)}}{\text{Standard value}} \text{ x 100 (\%)}$$

(1) When a wet gas meter is used as standard, the standard value V_s is defined as follows.

$(V_s) = V_{WG} \times CF(Q) \times C_T \times C_P$

V_{WG}：Volume of air flowing through wet gas meter

$CF(Q)$：Correction function of instrument error for the wet gas meter

C_T：Temperature correction quantity between standard and gas meter

C_p：Pressure correction quantity between standard and gas meter

(2) When sonic nozzle is used as standard, the standard value V_s is defined as follows.

$$(V_s) = \frac{C_d \times A^* \times C^* \times P_0 \times t}{\sqrt{\overline{R}T_o/M} \times \rho(T_m, P_m)}$$

C_d：Discharge coefficient of sonic nozzle

A^*：Cross-sectional area at throat

C^*：Critical flow function of sonic nozzle

P_0：Stagnation pressure at the upstream of sonic nozzle

T_0：Stagnation temperature at the upstream of sonic nozzle

t： Collection time of air volume for verification

$\overline{R}$ ：Universal gas constant

M：Molecular mass of air

$\rho(T_m, P_m)$ ：Air density at T_m and P_m, in which T_m and P_m stand for the temperature and pressure of the meter under test respectively

4.7 Maximum permissible errors for verification and inspection of a gas meter

When tested with air whose density is about 1.2 kg/m^3, the maximum permissible errors for verification and inspection shall conform to the stipulations given in Table 4.

Table 4

Flow rate m^3/h	Verification (Inspection)	
	Accuracy class	
	1.0	1.5
$Q_{min} \leq Q < Q_t$	± 2 % (± 4 %)	± 3 % (- 6 %, + 3 %)
$Q_t \leq Q \leq Q_{max}$	± 1 % (± 2 %)	± 1.5 % (± 3 %)

4.8 The period of validity for verification, unless otherwise specified, is from the day of a verification compliance mark affixed to the gas meter to the first day of the following month of the next 10 years.

In case of verification for gas meters with Q_{max} not greater than 16 m^3/h that passed initial verification before the implementation of type approval, the period of validity for verification is from the day of a verification compliance mark affixed to the gas meter to the first day of the following month of the next 5 years, and will be implemented from July 1, 2026.

5. Verification compliance marks

5.1 The verification compliance mark shall be attached with metal wire (plate) and sealed at the opening of the shell on the body of a gas meter. The duration of validity for verification shall also be clearly marked on the front of the meter.

6. Implementation date：This specification will come into effect from July 1, 2024. However, if the correction according to the technical specification for type approval of diaphragm gas meters has not been completed before December 31, 2027, the specification before the amendment is implemented will be applicable to gas meters with Q_{max} not greater than 16 m^3/h that are subject to type approval.