	Technical Specification for the Verification and Inspection of Air to Liquid Volumetric Ratio (A/L) Measuring Instruments	S/N	CNMV 206
		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. (Ching-Piao-Szu-Tsu)	Date of Enforcement	Content of Amendment
1	June 23, 2021	No. 11040003600	Oct. 1, 2021	

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

(1) NIEA A211.71B	Testing method of air to liquid volumetric ratio for recovery systems installed at gasoline dispensing facilities	(2006)
(2) BS EN 12480	Gas meters -Rotary displacement gas meters	(2015)
(3) OIML R 137-1&2	Gas meters	(2012)
(4) ISO 9300	Measurement of gas flow by means of critical flow of Venturi nozzles	(2005)

Date of Promulgation	Bureau of Standards, Metrology and Inspection, Ministry of Economic Affairs	Date of Enforcement
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1. Scope

1.1 This technical specification applies to air to liquid volumetric ratio (hereinafter referred to as "A/L") measuring instruments for law enforcement subject to verification and inspection.

1.2 The A/L measuring instruments are volumetric instruments used to determine A/L for recovery systems installed at gasoline dispensing facilities, and are composed of host and connecting devices. The host consists of rotary gas meter, micromanometer and displaying device, and the connecting devices include tight fitting adapter and air-tight flexible tubing.

2. Definition

2.1 Air to Liquid Volumetric Ratio (A/L)

The ratio obtained with dividing the volume of recovered air mixture by the volume of dispensed gasoline.

2.2 Rotary gas meter

A type of gas meters which uses rigid chamber formed between the meter’s internal housing and its rotating impellers to measure, record and display the volume of gas passing the gas meter.

2.3 Displaying device

The device which displays the measurement results, either continuously or on demand.

2.4 Cyclic volume

The volume of gas corresponding to one full revolution of the moving parts inside the gas meter.

2.5 Error

The ratio of the difference between the indicated value of gas flowing through the A/L measuring instrument and the value obtained from the measurement standard divided by the value obtained from the measurement standard. (relative error)

2.6 Maximum Permissible Error (MPE)

The extreme values of the error that is permitted by the legal requirements.

2.7 Resolution

The smallest difference between displayed indications that can be meaningfully distinguished.

2.8 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.

2.9 Maximum flow rate (Q_{max})

The highest flow rate at which a gas meter is required to operate within the limits of its MPE.

2.10 Minimum flow rate (Q_{min})

The lowest flow rate at which a gas meter is required to operate within the limits of its MPE.

2.11 Transitional flow rate (Q_t)

The flow rate value occurring between the maximum flow rate Q_{max} and the minimum flow rate Q_{min}, at which the flow rate range is divided into two zones, the "upper zone" and the "lower zone". Each zone has a characteristic MPE.

2.12 Working temperature range (T_m)

The temperature range that a gas meter can withstand within the MPE.

2.13 Working pressure range (P_m)

The pressure range that a gas meter can withstand within the MPE.

2.14 Nominal diameter (D)

The inside diameter of inlet and outlet of a gas meter.

3. Construction

3.1 A/L measuring instruments shall be marked with the following information that are clearly and indelibly on easy scrutiny spot:

(1) Manufacturer’s name or trademark.

(2) Product model and serial number.

(3) Cyclic volume: expressed as V = ⋯ dm^3.

(4) Resolution of rotary gas meter: expressed as R = ⋯ dm^3.

(5) Maximum flow rate and minimum flow rate: expressed as Q_{max} = ⋯ dm^3/min and Q_{min} = ⋯ dm^3/min respectively.

(6) Working temperature range: expressed as T_m = ⋯ ℃ — ⋯ ℃.

(7) Working pressure range: expressed as P_m = ⋯ kPa — ⋯ kPa.

(8) Flow direction of gas: marked with ⇨.

(9) Nominal inside diameter of inlet and outlet (at least 19 mm): expressed as D_i = ⋯ mm and D_o = ⋯ mm respectively.

(10) Year of manufacture: expressed as 4 digits of the year of C.E.

(11) Transition flow rate: expressed as Q_t = ⋯ dm^3/min.

3.2 The flow rate range of rotary gas meter located in A/L measuring instrument shall cover 11.8 dm^3/min to 120 dm^3/min and its resolution shall be better than 0.25 dm^3. The displaying device shall be capable of indicating the total quantity of gas (dm^3 or L) and its significant digit shall be accurate to 2 decimal places. The pressure range of micromanometer shall cover 1245 Pa and its resolution shall be better than 1 Pa.

4. Verification, inspection and MPE

4.1 The verification and inspection equipments and the ancillary equipments incorporated as part of the execution of the test procedure shall be suitable for testing of the A/L measuring instruments.

4.2 The traceability of verification and inspection equipments is required

The calibration of measurement references shall be valid and its traceability to international or national measurement standards shall be proven.

4.3 The expanded uncertainty of determination of errors at different flow rates of the verification and inspection equipments of the A/L measuring instrument shall be less than or equal to one-third of the applicable MPE.

4.4 Prior to verification or inspection, the A/L measuring instruments under test shall be placed at least 12 hours in the place where the test is implemented.

4.5 Leak detecting function test

Connect the fuel gun with the adapter, then connect the flexible tubing with the outlet of the A/L measuring instrument, and block the inlet of the A/L measuring instrument.

For positive pressure test, a pressure of 1245 Pa is generated inside the A/L measuring instrument by using a micro-pressure generating device. The pressure shall be not less than 1230 Pa after 3 minites.

For negative pressure test, a vacuum pressure of 1245 Pa is generated inside the A/L measuring instrument by using a vacuum generating device. The vacuum pressure shall be not less than 1230 Pa after 3 minites.

4.6 Flow rate and given gas volume quantity for verification and inspection

When implement verification and inspection, the errors of the A/L measuring instrument shall be determined at specified flow rates and minimum given gas volume quantity listed in Table 1. The difference between actual flow rates and flow rates listed in Table 1 should not be greater than 5%.

Table 1

Flow rate (dm^3/min)	Minimum given gas volume quantity (dm^3)
11.8	50
24	100
48	100
72	100
96	120
120	120

4.7 Calculation of errors for the A/L measuring instrument

The errors shall be expressed as relative values in percentage, i.e., the ratio of the difference between the indicated value of gas flowing through the A/L measuring instrument and the standard value of the measurement standard divided by the standard value of the measurement standard. The reference conditions of the standard value of the measurement standard are the absolute pressure at the inlet and the temperature at outlet of the A/L measuring instrument.

$$\text{Error (\%)} = \frac{\text{indicated value } (V_m) - \text{standard value } (V_s)}{\text{standard value } (V_s)} \text{ x } 100\%$$

When sonic nozzle is used as measurement standard, the standard value V_s is defined as follows.

$$V_s = \frac{C_{\mathrm{d}} \times A^* \times C^* \times P_0 \times t}{\sqrt{\bar{R}T_0/M} \times \rho(T_{\mathrm{m}}, P_{\mathrm{m}})}$$

C_d：Discharge coefficient of sonic nozzle
A^*：Cross-section area at throat of sonic nozzle
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 for verification
$\bar{R}$ ：Universal gas constant
M：Molecular weight of air
P_m：Absolute pressure at the inlet of the A/L measuring instrument
T_m：Absolute temperature at the outlet of the A/L measuring instrument
$\rho(T_m, P_m)$ ：Air density under T_m and P_m

4.8 MPE for verification and inspection of A/L measuring instrument

When tested with air under normal temperature and pressure at different flow rates, the MPE for verification and inspection shall conform to the stipulations given in Table 2.

Table 2

Flow rate (Q)	MPE for verification and inspection
$Q_{min} \leq Q < Q_t$	± 2 %
$Q_t \leq Q \leq Q_{max}$	± 1 %

4.9 Validity period of the verification

The validity period of the verification is starting from the date on which the verification mark is attached, to six months after the first day of the month following the month of the date on which the verification mark is attached.

5. Verification mark

5.1 The verification mark shall be attached on the host, tight fitting adapter and air-tight flexible tubing of the A/L measuring instrument respectively. The validity period of the verification should mark at easy scrutiny spot on the host.