

	Technical Specification of Verification and Inspection for Liquefied Petroleum Gas Flow Meters			S/N	CNMV 201															
				Rev	2															
<p>1. This Technical Specification is developed pursuant to Paragraph 2, Articles 14 and Paragraph 2, Article 16 of the Weights and Measures Act.</p> <p>2. The date of promulgation, document number, date of enforcement and content of the amendment are listed as follows :</p> <table border="1"> <thead> <tr> <th>Rev.</th> <th>Date of Promulgation</th> <th>Document No. (Ching-Piao-Szu-Tsu)</th> <th>Date of Enforcement</th> <th>Content of Amendment</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2003-05-29</td> <td>No. 09240005130</td> <td>2003-07-01</td> <td> <ul style="list-style-type: none"> 1. Add terminologies and definition. 2. Specification of equipments verification and inspection is expressed in the Appendix. 3. Add mass flow master meter method as verification method and delete comparison method. </td> </tr> <tr> <td>2</td> <td>2012-10-24</td> <td>No. 10140006170</td> <td>2013-07-01</td> <td> <ul style="list-style-type: none"> 4. Specify the minimum test flow-rate as 20L/min and the minimum test volume as 20L. 5. In compliance with the minimum test volume as 20L, change the Maximum Permissible Errors to $\pm 1\%$. 6. Change lead seal to seal. </td> </tr> </tbody> </table>						Rev.	Date of Promulgation	Document No. (Ching-Piao-Szu-Tsu)	Date of Enforcement	Content of Amendment	1	2003-05-29	No. 09240005130	2003-07-01	<ul style="list-style-type: none"> 1. Add terminologies and definition. 2. Specification of equipments verification and inspection is expressed in the Appendix. 3. Add mass flow master meter method as verification method and delete comparison method. 	2	2012-10-24	No. 10140006170	2013-07-01	<ul style="list-style-type: none"> 4. Specify the minimum test flow-rate as 20L/min and the minimum test volume as 20L. 5. In compliance with the minimum test volume as 20L, change the Maximum Permissible Errors to $\pm 1\%$. 6. Change lead seal to seal.
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1. Scope: This specification applies to liquefied petroleum gas flow meters (hereafter LPG meters) subject to verification and inspection.

2. Terminologies

2.1 Flow Rate (Q)

Quotient of the actual volume of liquefied petroleum gas (hereafter LPG) passing through the LPG meter and the time taken for this volume to pass through the meter.

2.2 Maximum Flow Rate (Q_{max})

Highest flow rate at which the LPG meter is required to operate within the maximum permissible error.

2.3 Minimum Flow -Rate (Q_{min})

Lowest flow rate at which the LPG meter is required to operate within the maximum permissible error.

2.4 Flow Rate Range

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

2.5 Maximum Permissible Error

The extreme value for an error permitted by the legal requirements.

2.6 Maximum Pressure (P_{max})

Maximum LPG pressure LPG that a LPG meter can withstand.

2.7 Minimum Pressure (P_{min})

Minimum LPG pressure LPG that a LPG meter can withstand.

2.8 Pressure Range

The range limited by the maximum pressure and the minimum pressure.

2.9 Indicating Device

Parts of the LPG meter that continuously displays the measurement results, including the volume and price.

2.10 Temperature Conversion Device (Temperature compensation)

The device that converts the volume of LPG measured at the measurement temperature into the volume at the base temperature, 15°C.

2.11 Pre-Setting Device

The device that presets the volume or total price to automatically stop the flow of LPG as the preset quantity is reached.

2.12 Gas Separator

The device that continuously separates and removes air or gas in LPG.

2.13 Adjustment Device

The device incorporated in the meter, which only allows the error curve to be shifted generally parallel to itself, with a view to bring relative errors within the maximum permissible error.

3. Construction

3.1 The indicating device of a LPG meter shall indicate the measuring unit or symbol; the measuring unit is "liter" and the symbol is "L".

3.2 The LPG meter shall be marked with the following items clearly on easy identify place:

- (1) Manufacturer's name or trademark.

- (2) Model and instrument number.
 - (3) Minimum scale interval.
 - (4) Maximum pressure.
 - (5) Maximum flow rate.
 - (6) Equipment with temperature conversion device shall indicate the range of the conversion (compensation) temperature range.
- 3.3 The graduation lines, numbers and other markings on a LPG meter shall be correct, clear and hard to be erased.
- 3.4 The pricing device for a LPG meter shall be clearly marked with unit, unit price and total price.
- 3.5 The zero setting device shall set the indicating device of the LPG meter to zero prior to each operation; if a pricing device is provided, the total price displayed shall also be set to zero.
- 3.6 The indicating device (zero setting device excluded) on a LPG meter shall not be equipped with any mechanism to change the indication by external equipment.
- 3.7 The counting mechanism of the indicating device on a LPG meter shall be progressive on a decimal system, without interruption or overlap.
- 3.8 The count and the indicated value of a cycle for the indicating device on a LPG meter shall be a positive or negative power of 1 or 10.
- 3.9 On the indicating device of a LPG meter, the minimum scale interval shall not be more than 0.01L.
- 3.10 A LPG meter equipped with a pre-setting device shall be clearly marked with operation instructions.
- 3.11 A LPG meter equipped with coins insertion or prepaid cards reading device shall be able to automatically indicate the monetary value being paid and the corresponding quantity of LPG.
- 3.12 A LPG meter equipped with a real time transfer cards or credit cards reading device shall be able to display the correct gas quantity and the corresponding monetary cost as the filling is stopped.
- 3.13 A LPG meter equipped with two or more sets of filling lines sharing one indicating device those two or more filling lines shall not be able to operated simultaneously.
- 3.14 The volume-adjusting device, indication error adjusting device and temperature conversion device (temperature compensation device) for a LPG flow meter shall not be able to be adjusted after being verified and sealed.
4. Auxiliary Device
- Liquefied petroleum gas meter shall have the following auxiliary devices:
- (1) Filter.
 - (2) Gas Separator.
 - (3) Anti-vaporizing Device. (LPG shall be remained in liquefied during the metering process.)
 - (4) Pressure gauges for the pressure of gas and liquid.
 - (5) Filling hose and nozzle for LPG.
5. Specification of the Verification and Inspection equipments:
- Verification and inspection equipment shall have been calibrated with traceability. The relevant certification regulations are listed in Appendix A and B.
6. Maximum Permissible Error of Verification and Inspection:

- 6.1 Before implementing the verification or inspect the indicating error of a LPG meter, circulate LPG through more than one time. Then take two different flow-rates between 20L/min and the maximum flow-rate with master meter method or weighing method to implement verification or inspection.
- 6.2 The indicated value of LPG meter and the standard value of the verification equipments shall be converted to the values at temperature 15°C as calculation basis.
- 6.3 At first, fill up LPG into the pressure vessel and make sure the vapor of LPG filling up the pressure vessel when the weighing method used to implement verification or inspection. Follow up with filling petroleum gas vapor, and then fill up with not less than 20L of LPG and not more than approximately 85% capacity of pressure vessel. Take the weight of the pressure vessel with LPG by a standard weighing instrument, the temperature and density of the LPG in the vessel by a standard densitometer designated for LPG, and calculate the mass of LPG. The formula of calculation the indicating error is listed in Appendix A.
- 6.4 When the master meter method is used to implement the verification or inspection, the volume to be measured shall be more than 20 L. The formula of calculation the indicating error is listed in Appendix B.
- 6.5 The measured indicating error shall be expressed in relative error (percentage). It is the Quotient of the Difference of the indicated value of the volume passing the LPG meter and the standard value and the standard value. The formula of calculation is as below:
- $$\text{indicating error}\% = \frac{\text{indicated value of LPG meter} - \text{standard value}}{\text{standard value}} 100 \%$$
- 6.6 The maximum permissible errors of verification of verification on LPG meter are $\pm 1.0\%$.
- 6.7 The maximum permissible errors of verification of inspection of LPG meter are 1.5 times that of verification.
- 6.8 For a LPG meter with pre-setting device, the indicating errors after filling process shall meet the maximum permissible error of verification and inspection respectively.
7. Verification Compliance Marks
- 7.1 The verification compliance marks for LPG meter is located at flow rate adjustment device (including volume adjustment device, equipment error adjustment device and temperature difference compensation device) and then shall be sealed with metal wire. Furthermore, a verification compliance tag shall be affixed to the front of the LPG meter.
- 7.2 The validity period for verification is one year, commencing from the day when the verification compliance mark is affixed to the LPG meter and expiring on the first day of the month next to the next year.

Appendix A The Specification of Equipments of Verification and Specification for Weighing Method
and Calculation Formula of Indicating Error

Table 1 Specification of Equipments for Weighing Method

Verification Equipment	Capacity/Range	Resolution
LPG vessel	30 L	NA
Weighing Instrument	30 kg	10 g
Densimeter	0.5 g/cm ³ to 0.65 g/cm ³ 0 °C to 40 °C	0.002 g/cm ³ 1 °C
Thermometer	0 °C to 50 °C	1 °C

Calculation Formula of indicating error:

$$E = \frac{V_{FD,REF} \times [1 + \beta(P_1 - P_e)] - \frac{M_m}{\rho_{REF}}}{\frac{M_m}{\rho_{REF}}} \times 100 \%$$

- E : Percentage of indicating error percentage of the LPG meter under tested (%).
 $V_{FD,REF}$: Indicated volume of the LPG meter under tested (L).
 M_m : Mass of the measured LPG, weighed by standard weighing instrument (kg).
 ρ_{REF} : Density of saturated LPG at the reference temperature corresponding to the temperature for the LPG to pass the LPG meter (g/cm³).
 P_1 : Pressure for the LPG to pass the LPG meter (kgf/cm²).
 P_e : Pressure for LPG at equilibrium state corresponding to the temperature for the LPG to pass the LPG meter (kgf/cm²).
 β : Compressibility coefficient for LPG, 0.00035/ (kgf/cm²).

Appendix B The Specification of Equipments of Verification and Specification for Master Meter
Method and Equation to Calculate Equipment Error

Table 2 Specification of Equipments for Mass Flow Meter Method

Verification Equipment	Range	Resolution
Master flow meter	≥60 L/min	0.01 L
Densitometer	0.5 g/cm ³ to 0.65 g/cm ³	0.002 g/cm ³
Thermometer	0 °C to 50 °C	0.1 °C
Pressure gauge	0 kPa to 2500 kPa	50 kPa

Equations to calculate standard volume and equipment error:

$$V_{S,REF} = \frac{M_m \times MF}{\rho_{REF}}$$

$$E = \frac{V_{FD,REF} - V_{S,REF}}{V_{S,REF}} \times 100 \%$$

- E : Equipment error percentage for the inspected LPG meter (%).
 $V_{S,REF}$: Capacity for the LPG meter at the reference temperature 15 °C (L).
 $V_{FD,REF}$: Capacity for the inspected LPG meter (L).
 M_m : Mass of the inspected LPG, calculated by standard weighing instrument (kg).
 MF : Correction factor for the LPG meter.

ρ_{REF} : Density of saturated LPG at the reference temperature corresponding to the temperature for the LPG to pass the LPG meter (g/cm^3).