Guideline for

Revalidation of LPG Fuel Tanks

for LPG Vehicles

Dec 2004

Gas Authority EMSD

FORWARD

Under the Gas Safety (Gas Supply) Regulations, liquefied petroleum gas vehicle fuel cylinders (hereafter referred as LPG fuel tanks) have to be examined and tested (i.e. revalidated) every 5-year to ascertain whether they are safe to be used.

This document delineates the essential safety features of the LPG fuel tank of an LPG vehicle and provides general guideline for competent persons to conduct revalidation test and examination of LPG fuel tanks. This Guideline should be read in conjunction with the Code of Practice for Hong Kong LPG Industry Module 1 on LPG Compounds and Cylinder Stores, as well as the Gas Safety Ordinance (Cap. 51) and its subsidiary regulations.

Competent persons should consult the manufacturer for specific operation, maintenance and testing requirements of the LPG fuel tanks and associated equipment. Enquiry on this document should be addressed to the Gas Standards Office of Electrical and Mechanical Services Department.

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APPENDICES

SECTION 1 INTRODUCTION AND SCOPE

1.1 Introduction

This Guideline is prepared by the Gas Standards Office of Electrical & Mechanical Services Department giving general guidance on the revalidation test and examination of LPG fuel tanks of LPG fuelled vehicles.

1.2 Scope

This Guideline describes the major safety features of LPG fuel tanks and stipulates the minimum requirements to facilitate competent persons in carrying out revalidation test and examination of LPG fuel tanks.

SECTION 2 STATUTORY REQUIREMENTS

2.1 According to Regulation 8(2) of the Gas Safety (Gas Supply) Regulations (Cap. 51B), the owner of an LPG cylinder shall not use the cylinder to contain LPG unless the cylinder has been tested and examined not less than once in the 5 years period immediately preceding such use to ascertain whether the cylinder is safe to be so used. The owner shall therefore employ a competent person to carry out test and examination of the LPG fuel tank at least once every 5 years.

2.2 Test and examination for revalidation of LPG fuel tanks shall be supervised and certified by a competent person (Class 1). He/She shall ensure that testers carry out inspection and testing of LPG fuel tanks in the prescribed manners, and certify that tested LPG fuel tanks meet the required standards.

SECTION 3 ESSENTIAL SAFETY FEATURES OF LPG FUEL TANKS

3.1 General

3.1.1 This section describes the functions of the essential safety features of an LPG fuel tank.

3.1.2 A typical schematic diagram of the fuel system of an LPG vehicle is shown in Appendix A for reference.

3.1.3 All LPG fuelled vehicles used in Hong Kong are of dedicated LPG vehicles manufactured from Original Equipment Manufacturer (OEM). Components used shall comply with the technical specifications of the vehicle manufacturers.

3.2 Automatic fill limiter

An automatic fill limiter is a device installed in the LPG fuel tank, which shall automatically terminate filling when a predetermined liquid level (i.e. 85%) in the fuel tank is reached. It ensures sufficient vapour space for expansion of LPG. Filling shall be shut off before the maximum permitted filling level is exceeded.

3.3 Content gauge

Content gauge gives a visual indication of the liquid content in the LPG fuel tank. It shall be fitted on the LPG fuel tank and provide reading at the dashboard.

3.4 Excess-flow valve

An excess flow valve is usually installed at the outlet connection of the LPG fuel tank. It is normally in open position and shall close automatically when the flow in a specified direction exceeds a predetermined limit under abnormal conditions (e.g. pipe rupture) to protect against leakage of LPG.

3.5 Non-return valve (Check valve)

Non-return valve is a device to permit fuel flow in only one direction and prevent the flow in the opposition direction. It is fitted close to the inlet connection of the LPG fuel tank as well as the filling connection at the vehicle body to allow for LPG flow in a single direction only. They shall protect against backflow of liquid LPG in the event of an accident.

3.6 Pressure relief valve (Safety relief valve)

Pressure relief valve is a valve which shall automatically discharge LPG to the atmosphere when a pre-determined pressure inside the fuel tank is reached. It is connected to the vapour space of the LPG fuel tank with discharge setting suitable for the maximum design pressure of the LPG fuel tank to relieve the excessive pressure in the event of an accident or fire.

3.7 Manual shut-off valve (Service valve)

Manual shut-off valve is a manually operated valve. It is provided at outlet connection of the LPG fuel tank for shutting off the LPG supply from the tank in events of accident, maintenance or long time parking of the LPG fuelled vehicle.

SECTION 4 DETACHMENT AND TRANSPORT OF LPG FUEL TANK

4.1 An LPG fuel tank shall first be detached from the vehicle before the fuel tank is delivered to a competent person (Class 1) for revalidation test and examination. The detachment work shall be carried out by a competent person (Class 6) in an approved LPG vehicle workshop.

4.2 LPG in the fuel tank shall be depleted as far as practicable through normal consumption before the tank is detached from the vehicle.

4.3 Appropriate fixture or support shall be provided for fixing the position of the fuel tank properly during transportation.

4.4 In accordance with Regulation 25(2) of the Gas Safety (Gas Supply) Regulations, no person shall use a motor vehicle to carry on a road any combination of LPG cylinders which have a combined water capacity of not less than 130 litres, unless the vehicle is a cylinder wagon with a valid permit. Therefore, if it is necessary to transport two or more detached LPG fuel tanks (i.e. combined water capacity of not less than 130 litres) at the same time, a cylinder wagon approved by the Gas Authority shall be used. The volume capacities of the LPG fuel tanks of various models are listed in Appendix B.

SECTION 5 SITE FOR PURGING, TEST AND EXAMINATION

5.1 The competent person (Class 1) shall ensure that the site for carrying out purging, testing and examination of LPG fuel tanks is safe, well-ventilated and suitable for such work.

5.2 Purging of LPG fuel tanks shall be carried out in an open area at ground level.

5.3 The site shall be easily accessible for transport of LPG fuel tanks and emergency services.

5.4 The site and its associated facilities shall be designed to facilitate gas dispersion in the event of LPG releases and to minimise the risk of escaped LPG from being ignited before dispersed or diluted.

5.5 Conspicuous warning signs and emergency instructions in both English and Chinese shall be posted at the site.

5.6 Drains, gullies and pits shall be avoided at the site or in the immediate vicinity of the site. Where a gully or drain is unavoidable, the opening shall either be securely covered or the drain suitably sealed.

5.7 Adequate working area shall be provided at the site for purging, testing and examination of the LPG fuel tank.

5.8 The floor level of the site relative to the surrounding ground contours and levels shall be such that the floor does not constitute a depression in which heavier-than-air vapour could accumulate.

5.9 Area within 1.5m in all directions of the LPG fuel tank (except after purging out of service and before purging into service) shall be classified as zone 1 hazardous area. Area beyond 1.5m but within 4.5m in all directions of the LPG fuel tank (except after purging out of service and before purging into service) shall be classified as zone 2 hazardous area.

5.10 Electrical equipment should, as far as possible, be located in safe or non-hazardous areas. Electrical equipment for use in classified zones shall be certified by approved bodies such as BASEEFA in accordance with BS EN 50018 and BS EN 60079 or equivalent.

5.11 No source of ignition and flammable materials shall be present at the site or at its vicinity. Flare stack for flaring of residual LPG in the LPG fuel tank shall only be used in safe or non-hazardous area under safe and controlled manner.

5.12 Permanent conspicuous markings shall be made on the floor to indicate the areas where the flare stack and the LPG fuel tank under purging shall be placed.

5.13 If there is or are kept at the site any container(s) (including any LPG fuel tanks, domestic LPG cylinders, etc) with aggregated nominal water capacity over 130 litres, the site is classified as a notifiable gas installation (NGI) under the Gas Safety Ordinance (Cap. 51). Prior approval from the Gas Authority shall be obtained on the construction and use of the NGI, and relevant requirements under the Module 1 (LPG Compounds and Cylinder Stores) of Code of Practice for Hong Kong LPG Industry shall also be complied with.

5.14 Any other requirements as recommended by the Director of Fire Services shall also be complied with.

SECTION 6 SCOPE OF TEST AND EXAMINATION

6.1 General

6.1.1 Test and examination for revalidation of LPG fuel tanks shall be supervised and certified by a competent person (Class 1). He/She shall ensure that testers carry out inspection and testing of LPG fuel tanks in the prescribed manners, and certify that tested LPG fuel tanks meet the required standards.

6.1.2 All parts of the LPG fuel tank and its associated components shall be inspected and, if necessary, replaced, to ensure satisfactory condition in accordance with the manufacturers' instruction and recommendation.

6.1.3 Appropriate fixture or support shall be provided for positioning the LPG fuel tank properly to facilitate purging, testing and examination work. The fixture or stand shall be properly constructed to avoid making damages or scratches to the fuel tank.

6.1.4 Appropriate personal protective clothing and safety equipment including flammable gas detector shall be used by personnel involved in purging, testing and examination of LPG fuel tank. Appropriate safety measures shall be taken.

6.1.5 Fire fighting equipment including fire extinguisher and fire hose shall be made available at the vicinity where purging of LPG fuel tank is carried out.

6.2 Purging Out of Service

6.2.1 To avoid any hazardous situations, the LPG fuel tank must be purged out of service before any inspection, examination and test are carried out.

6.2.2 Purging of residual LPG from the LPG fuel tank shall be performed in a safe and controlled manner.

6.2.3 A flare stack with a permanent pilot, located in a safe or non-hazardous area, shall be connected to a suitable vapour connection of the LPG fuel tank for flaring of the residual LPG.

6.2.4 The flaring process shall be attended to at site at all times.

6.2.5 Care shall be taken to ensure complete removal of LPG before terminating the flaring process. When flaring is complete, the fuel tank shall be further purged with inert gas (e.g. nitrogen) or potable water to expel any residual traces of LPG.

6.2.6 Transfer of the residual LPG in liquid form from the LPG fuel tank to another container is not allowed unless the installation for liquid transfer, which is classified as a NGI, has been approved by the Gas Authority and the liquid transfer process is carried out by a registered gas supply company in accordance with the Gas Safety Ordinance and its subsidiary regulations.

6.3 External Visual Inspection

6.3.1 If necessary, the LPG fuel tank shall be cleaned for removing any tar, oil or other foreign matters from its external surface. Care shall be taken to avoid damaging the LPG fuel tank.

6.3.2 The entire surface of the LPG fuel tank shall be inspected for dents, cuts, bulges, cracks, corrosion and other defects. The competent person (Class 1) shall determine whether the surface condition of the LPG fuel tank is suitable for further servicing.

6.4 Internal Visual Inspection

6.4.1 Residual liquid, loose scale, and any other foreign matters from the interior shall be removed.

6.4.2 LPG fuel tank shall be inspected internally for any sign of corrosion or other defects that may affect its integrity. LPG fuel tank showing signs of internal corrosion, unless these signs are just surface rust, shall be scrapped.

6.4.3 If cleaning is required, care shall be taken to avoid damaging the LPG fuel tank walls. LPG fuel

tank shall be re-inspected after cleaning.

6.5 Hydraulic Test

6.5.1 The PRV, fill limiter, content gauge, and all other valves as appropriate, shall be detached from the LPG fuel tank and replaced with blank covers before the hydraulic test. All connections and joints on the LPG fuel tank and associated testing pipework shall be leak tight.

6.5.2 Pressure gauges used in the hydraulic test shall be checked at regular intervals and in any case not less frequently than once a month. These pressure gauges shall also be calibrated at least once per year by independent calibration body. Proper records of checking/calibration shall be maintained.

6.5.3 If power-operated hydraulic test pump is used, a device shall be fitted to the test equipment to ensure that no LPG fuel tank is subjected to pressure in excess of its test pressure by more than 10% or 0.2 MPa, whichever is the lesser.

6.5.4 Before applying pressure, the external surface of the LPG fuel tank shall be in such condition that any leak can be detected. The LPG fuel tank shall be positioned so that the welds are visible during the test.

6.5.5 The LPG fuel tank shall be hydraulically tested at 1.5 times of its design pressure for integrity, unless otherwise specified by its design code. The specified hydraulic test pressures for the LPG fuel tanks of various models are listed in Appendix B.

6.5.6 The LPG fuel tank shall be fully filled with the test liquid (i.e. potable water). Care shall be taken to expel all air bubbles inside the tank and associated testing pipework. Hydraulic pressure in the LPG fuel tank shall be gradually increased until the test pressure is reached.

6.5.7 After the test pressure becomes stable, it shall be maintained for at least 1 minute, unless otherwise specified by its design code.

6.5.8 There shall be no sign of pressure decay during the hydraulic test, and the fuel tank shall not show any leakage or permanent distortion (e.g. abnormal expansion).

6.6 Test and Examination of Associated Safety Devices

The following safety devices shall be examined and/or tested, and if necessary, replaced, to ensure their proper conditions in accordance with the manufacturer's recommendation before re-assembling onto the LPG fuel tanks.

6.6.1 Pressure Relief Valve (PRV)

The PRV shall activate at a pressure specified by the respective design code. The specified activation pressures of the LPG fuel tank PRVs of various models are listed in Appendix B. The PRV shall be examined and tested to ensure its proper function to activate at the specified pressure. The activation pressure of the PRV during the test shall be recorded.

6.6.2 Excess Flow Valve (EFV)

The EFV shall be thoroughly examined and tested to ensure its proper function to stop excess flow during abnormal conditions.

6.6.3 Automatic Fill Limiter

The automatic fill limiter shall be thoroughly examined and tested to ensure its proper function to stop refilling at 85% LPG tank level.

6.6.4 Content Gauge

The content gauge shall be thoroughly examined to ensure its proper function.

6.7 Re-assembling of devices and valves

6.7.1 As soon as practicable after hydrostatic pressure testing, the LPG fuel tank shall be drained and positively dried by purging with a suitable dry gas to prevent corrosion.

6.7.2 It shall be ensured that all the devices/valves are in satisfactory conditions before they are assembled onto the LPG fuel tank. New sealing materials (i.e. gaskets, O-rings, etc) shall be used and optimum torque necessary to ensure a seal between the devices/valves and the LPG fuel tank shall be applied.

6.7.3 It shall be ensured that all the devices/valves are fitted in correct orientation and function properly after re-assembling.

6.8 Pneumatic Leak Test

6.8.1 The LPG fuel tank re-assembled with valves and devices shall be leak tested to a pressure as specified by its design code (see Appendix B), by air or inert gas (e.g. nitrogen). The leak test shall be capable of detecting any leak from any part of the LPG fuel tank and its associated devices.

6.8.2 All connections and joints shall be carefully checked with soap solution for leakage.

6.9 Rejection and Scrapping of LPG fuel tank

6.9.1 The decision to reject an LPG fuel tank may be taken by the competent person Class 1 at any stage during the test and examination process.

6.9.2 The competent person (Class 1) shall notify in writing the owner of the LPG fuel tank, the responsible approved LPG vehicle workshop and the Gas Authority of the result of the test and examination, and that the rejected LPG fuel tank is unsafe to contain LPG and shall not be so used. The rejected LPG fuel tank shall be rendered unserviceable so that it cannot be put back into service as a pressure vessel. The competent person (Class 1) shall inform the Gas Authority in writing after the rejected tank has been rendered unserviceable.

SECTION 7 FINAL OPERATIONS

7.1 Purging Into Service

7.1.1 After satisfactory completion of all the examinations and tests as mentioned above, inert gas (e.g. nitrogen) shall be added to the LPG fuel tank until all oxygen in the tank is removed (as indicated by gas detector).

7.1.2 Vapour LPG shall then be introduced gradually into the LPG fuel tank from lower portion to replace all the inert gas. A flare stack with a permanent pilot, located in a safe or non-hazardous area, shall be connected to the upper portion of the tank for flaring of the LPG/inert gas.

7.1.3 Care shall be taken to ensure complete removal of the inert gas. For example, a stable flame at the flare stack shall be obtained before terminating the flaring process. Prior approval by the Gas Authority shall be obtained if flaring is not employed for purging into service.

7.2 Marking

A new information plate indicating the particulars of the revalidation as specified in Appendix C shall be securely fixed on the LPG fuel tank at a clearly visible location.

7.3 Certification

Test and examination report of the LPG fuel tank, using the proforma at Appendix D, shall be duly completed by the competent person (Class 1) and sent to the Gas Authority within 7 working days. Copies (certified by the competent person (Class 1)) of the report shall be provided to the owner of the LPG fuel tank as well as the responsible approved vehicle workshop.

7.4 Re-filling

7.4.1 The revalidated LPG fuel tank may be carried to an LPG filling station for refilling of LPG.

7.4.2 To ensure safety, appropriate fixture or support shall be provided for positioning the fuel tank and associated filler hose properly during refilling.

7.4.3 A valid test and examination report with satisfactory results shall be presented to the filling station operator for inspection.

7.4.4 Details of the LPG fuel tank as well as the names of the responsible approved LPG vehicle workshop and competent person (Class 6) shall be made available to the filling station operator for record.

7.4.5 The LPG fuel tank shall not be filled more than 20% full.

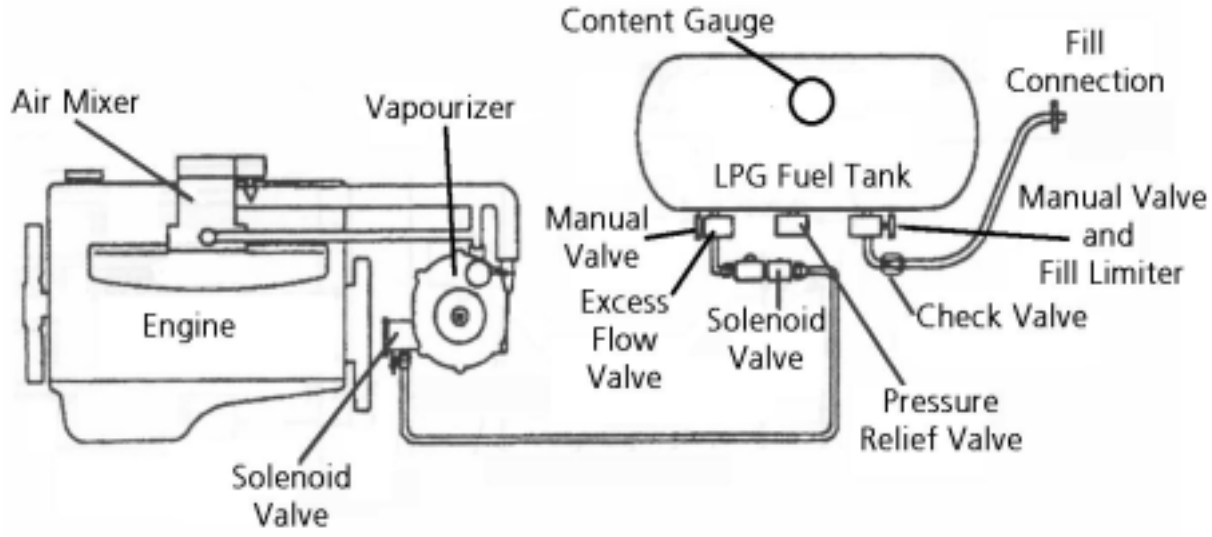
7.5 Re-assembling of LPG Fuel Tank on Vehicle

7.5.1 After satisfactory completion of the revalidation and purging into service, the LPG fuel tank can be re-assembled onto the LPG fuelled vehicle.

7.5.2 The assembling work shall be carried out by a competent person (Class 6) in an approved LPG vehicle workshop.

Appendix A

Schematic Diagram of the Fuel System of LPG Vehicle



Appendix B

Volume Capacity and Pressure Specifications for LPG Fuel Tanks

	Volume Capacity	Fuel Tank Hydraulic Test Pressure	Pressure Relief Valve Activation Pressure	Pneumatic Leakage Test Pressure
Toyota Crown (Taxi)	95.5 L	2.9 MPa	1.96 – 2.32 MPa	1.74 MPa
Nissan Cedric (Taxi)	103.5 L	2.9 MPa	1.96 – 2.32 MPa	1.74 MPa
Toyota Coaster (Light Bus)	122 L	2.9 MPa	1.96 – 2.32 MPa	1.74 MPa

Appendix C

Specifications for New Information Plate on Re-validated LPG Fuel Tank

1. After satisfactory completion of the revalidation test and examination, each LPG fuel tank shall be provided with a permanent and legible information plate with the following information:

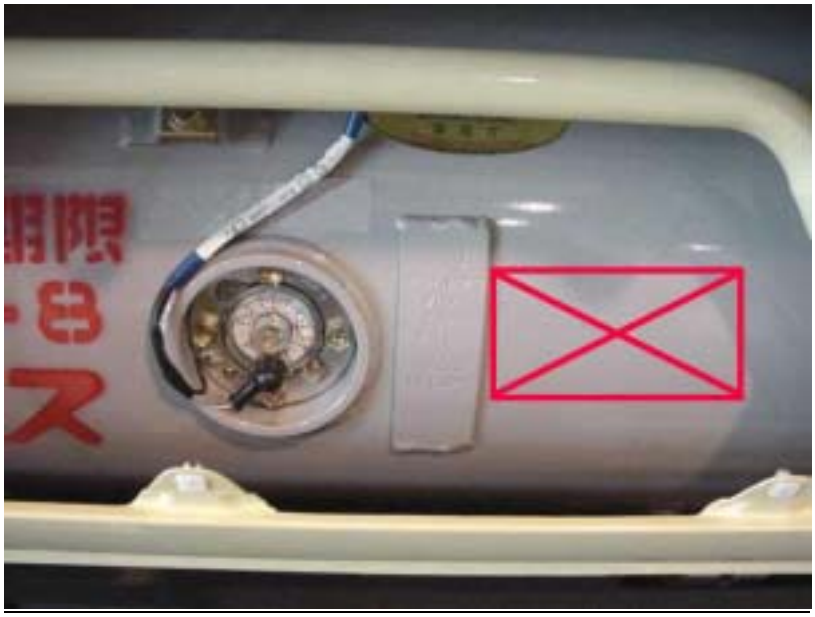
   Tank Serial No.:
   Test Date:
   Test Pressure:
   Tested by: (Full name of the operator who perform the test)
   Certified by (CP 1): (Full name of the CP1)

2. The information plate shall be made of metallic material, e.g. aluminium, stainless steel, etc. It shall have a minimum size of 50 x 100 mm with minimum thickness of 0.5 mm. The markings on the plate shall not be less than 3 mm in height and shall where possible be 6 mm in height as shown below.

3. The information plate shall be attached securely to the LPG fuel tank at a clearly visible location as indicated on the pictures below.

Location for the New Information Plate for Toyota LPG Taxi

Location for the New Information Plate for Nissan LPG Taxi



Location for the New Information Plate for Toyota LPG Light Bus

Appendix D

Test and Examination Report of LPG Fuel Tanks for LPG Vehicles under Regulation 8 of The Gas Safety (Gas Supply) Regulations, Cap.51
氣體安全(氣體供應)規例(第51章) 第8條所規定
石油氣車輛的石油氣燃料缸試驗及檢驗報告

To : The Gas Authority
致：氣體安全監督

GasSO Ref :
氣體標準事務處檔號： GSO/GPS/032/06/04

The Competent Person (Class 1) should duly complete this form and submit the original report with photos of the test to the Gas Authority within 7 working days after the test. The Competent Person (Class 1) should also give copies (certified by the Competent Person (Class 1)) of this report to the responsible approved LPG vehicle workshop and the LPG fuel tank owner for record.
第1類勝任人士須填妥本表格，並在測試後7個工作天內，將本表格的正本連同試驗程序的照片呈交氣體安全監督。本表格的副本(經第1類勝任人士簽署核實)亦須交予負責進行測試的獲批准石油氣車輛維修工場和石油氣燃料缸擁有人，以作記錄。

LPG Fuel Tank S/N. 石油氣瓶編號	Last Test Date 上次檢驗日期	Vehicle Registration Mark 車輛登記號碼	Chassis Number/V.I. Number 車身底盤號碼/車輛識別號碼

Name of Approved LPG Vehicle Workshop
for detachment of the LPG fuel tank (with company chop):
拆除石油氣燃料缸的獲批准石油氣車輛維修工場名稱：
(請蓋上公司印鑑) _____

Competent Person
(Class 6):
第6類勝任人士： _____

Date :
日期： _____

External Examination **外部檢驗**	Pass/Fail* 及格/不及格*	**Examination of Associated Fittings (including Excess Flow Valve, Fill Limiter and Level Gauge)** **組件檢驗（包括溢流控制閥、注氣限制器及液位計）**	In proper condition / Not in proper condition* 狀況良好/狀況不良好*
Internal Examination **內部檢驗**	Pass/Fail* 及格/不及格*		
Pressure Relief Valve **壓力放洩閥** S/N. 編號： (_____)	Activated at: 洩放壓力: _____(kPa) Pass/Fail* 及格/不及格*	**Pneumatic Leak Test** **氣密測試**	Test Pressure: 測試壓力: _____(kPa) Pass/Fail* 及格/不及格*
Hydrostatic Test **液壓測試**	Test Pressure: 測試壓力: _____(kPa) Pass/Fail* 及格/不及格*	**New Info. Plate Securely Fixed** **新的資料名牌已穩固地裝上**	Yes/No* 是/否*
Future Usage **未來用途**	Vehicle Installation / Spare / Others * - Please specify: 車輛安裝 / 後備用途 / 其他* - 請說明：		
Remarks **備註**			

* Delete as appropriate *請刪去不適用者

I certify that the above LPG fuel tank has been satisfactorily tested and examined under my supervision in accordance with the Gas Standards Office's requirements in order to comply with Regulation 8 of the Gas Safety (Gas Supply) Regulations and that the LPG fuel tank is safe to contain LPG.
茲證明上述石油氣燃料缸在本人監督下，已依照氣體標準事務處就《氣體安全(氣體供應)規例》第8條規定所訂的要求，完成以上試驗及檢驗，結果令人滿意及確定使用這個石油氣燃料缸盛載石油氣是安全的。

Location of Testing:
試驗地點： _____

Company Chop :
公司蓋章： _____

Test / Exam By:
測試人： _____

Company Name :
公司名稱： _____

Certified by Competent Person (Class 1):
發證人(第1類勝任人士)： _____

Test Date :
測試日期： _____

Signature :
簽署： _____