

CODE OF PRACTICE  
FOR  
HONG KONG LPG INDUSTRY

Module 2

Underground LPG Pipework

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## Module 2 LPG Underground Pipework

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## PREFACE

This document is the second in a series of modules as the Code of Practice for the LPG industry in Hong Kong. The other 7 modules are:

Module 1 LPG Compounds and Cylinder Stores

Module 3 Handling and Transport of LPG in Bulk by Road

Module 4 Aboveground Distribution Pipes, Service Risers, Downers and Ring Mains

Module 5 Domestic Installations

Module 6 Non-Domestic Installations

Module 7 Operating Procedures for Emergencies for LPG Compounds and Piped-cylinder Stores

Module 8 Operating Procedures for Emergencies for Installations outside LPG Compound/Stores.

Module 2 lays down recommended practice for the design, installation, operation and maintenance of underground pipework carrying LPG, at medium or low pressure, from LPG storage installations to users (see Module 1). It encompasses the pipe, fittings and associated work. This Module shall be read in conjunction with the Gas Safety Ordinance (Cap. 51) and subsidiary regulations (See [Appendix A](#) for reference).

The basis for development of this document is the Standard Practice Manuals prepared by Congas (Volume 1 & 2), the Code of Practice by the LP Gas Association in U.K. and the safety requirements issued by the Gas Standards Office. Comments from the Gas Standards Office, the latest thinking of the industry and other recognized national standards have also been reviewed in updating the requirements.

The manual has been prepared jointly by the Gas Standards Office and the LPG Safety and Technical Committee represented by the registered gas supply companies in Hong Kong LPG Industry.

While this Module tends to be specific in important aspects affecting safety and reliability, it shall be seen as offering guidance to engineers, operators and other users who will continue to exercise judgement and skill in the fulfillment of their obligations. It shall be borne in mind that practice may need changes with emerging technology and experience. The requirements listed in this document shall not be regarded as a set of rigid guidelines that cannot be changed. It is expected that the document will be reviewed and updated as required.

## SECTION 1 INTERPRETATION OF TERMS

**Casing Pipe** – A pipe which protects an enclosed LPG pipe from external mechanical loading.

**Listed Competent Person** - A person who meets the acceptance criteria as listed in Appendix B and, upon application to Gas Standards Office, is assessed as fully competent to inspect/certify LPG installation, testing and maintenance work.

**Competent person** - A person who is competent by virtue of his/her training and substantial practical experience to perform/supervise/inspect LPG installation, testing and maintenance work.

**Gas Authority** - The authority appointed under Section 5 of the Gas Safety Ordinance (Cap. 51).

**Gas Main** - Gas main as defined under the Gas Safety Ordinance (Cap.51).

**Gas Standards Office (GasSO)** - An office within government which is under the control of the Gas Authority to administer the Gas Safety Ordinance.

**Heat-fusion** - A technique using a combination of temperature and force to cause two melting surfaces to flow together to produce a joint. Homogenous fusion bonding occurs when the joint cools below the fusion temperature.

**Hot work** - Welding or the use of any flame or electric arc or the use of any equipment likely to cause heat, flame or spark. It also includes caulking, chipping, drilling, rivetting and any other heat producing operation, unless it is carried out in such a way to keep the temperature of the tools and the work below 100°C.

**Installation pipe** -Installation pipe as defined under the Gas Safety Ordinance (Cap.51).

**LPG** - Liquefied petroleum gas as defined under the Gas Safety Ordinance (Cap. 51).

<b>LPG pressure, High</b>	- A pressure of more than 69 kPa
<b>Medium</b>	- A pressure of more than 6.9 kPa but not more than 69 kPa
<b>Low</b>	- A pressure of not more than 6.9 kPa

**Major Gas Emergency** – “major gas emergency” as defined under the Gas Safety (Registration of Gas Supply Companies) Regulations (Cap.51).

**Medium Density Polyethylene Pipe (MDPE)** - PE pipe made of medium density (0.926 to 0.940 g/cm<sup>3</sup>) polyethylene plastics moulding and extrusion materials.

**Polyethylene** - A polymer, a type of plastic material, that is prepared by the polymerization of ethylene as the primary monomer, with comonomers such as butene or hexene.

**Polyethylene (PE) pipe** - Pipe made of polyethylene plastics moulding and extrusion materials.

**Public Road** - The road as defined in Road Traffic Ordinance (Cap. 374)

**Purging** - Replacing the content in a system by a different medium before putting the system into or out of service.

**Redundant pipework** - Pipework that is not needed for receiving or supplying LPG.

**Saddle fusion** - A heat-fusion technique of joining PE pipe by melting the base of the saddle fitting while simultaneously melting a matching pattern on the surface of the pipe, joining these two molten surfaces together, and allowing the joint to cool.

**Slit defect** - Defects in PE butt fusion joints with separation caused by lack of fusion as can be seen from the surface as a slit at the interface.

**Squeeze-off** - A procedure to stop the flow of gas in PE pipe by compressing the pipe until the flow of gas inside stops. This is normally used for the purposes of downstream repair and maintenance.

**Standard Dimensional Ratio (SDR)** - A ratio of the specified outside diameter over the specified minimum wall thickness of PE pipe

**Transition fitting** - A fitting connecting PE pipe to metallic pipe.

## SECTION 2 OBJECTIVES & SCOPE

### 2.1 Objectives

2.1.1 This Module has been prepared as a general outline of basic safety standards to be followed by registered gas supply companies, registered gas contractors or owners of NGIs so as to ensure, in carrying on their business, the health and safety at work of their employees and to conduct their operations in a safe manner so that members of the public are not exposed to undue risks from gas.

### 2.2 Scope

2.2.1 This Module covers the design, installation, operation and maintenance of underground pipework carrying LPG, normally at medium or low pressure, from LPG compounds or cylinder stores to buildings (see Module 1). It encompasses the pipe, fittings and associated work.

2.2.2 The design and installation requirements in this Module shall, unless specified otherwise, apply to new underground pipework and does not apply to replacement of existing pipework. The operation and maintenance shall apply to all new and existing pipework.

**Note:** *SI units shall be used for new pipework. Other units are also permitted with SI unit in brackets.*

### 2.3 Regulations and References

2.3.1 All underground pipework shall comply with statutory safety requirements. Particular reference shall be made to:

The Gas Safety Ordinance (Cap. 51)

The Gas Safety (Gas Quality) Regulations (Cap. 51)

The Gas Safety (Gas Supply) Regulations (Cap. 51)

The Gas Safety (Installation and Use) Regulations (Cap. 51)

The Gas Safety (Registration of Gas Supply Companies) Regulations (Cap. 51)

The Gas Safety (Miscellaneous) Regulations (Cap. 51)

The Gas Safety (Registration of Gas Supply Companies) Regulations (Cap.51)

The Road Traffic Ordinance (Cap. 374)

Code of Practice - Avoiding danger from gas pipes (published by GasSO)

**2.3.2** This Module makes reference to the following publications (latest editions of these publications shall be used as far as possible):

**API - American Petroleum Institute**

API 5L, Specification for Line Pipe

**ANSI - American National Standards Institute**

B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24

B16.11, Forged Fittings, Socket-Welding and Threaded

B36.10M, Welded and Seamless Wrought Steel Pipe

**ASTM - American Society for Testing and Materials**

A 47, Standard Specification for Ferritic Malleable Iron Castings

A 53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A 193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

A 194, Standard Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both

A 395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

**BSI - British Standards Institute**

BS 21, Pipe threads for tubes and fittings where pressure-tight joints are made on the threads

BS 1387, Specification for Screwed and Socketed Steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads

BS 1560, Circular pipe flanges for valves and fittings for the petroleum industry(for steel)

BS 1600, Specification for Dimensions of steel pipe for the petroleum industry

BS 1965, Specification for Butt-welding pipe fittings for pressure purposes

BS 3799, Specification for Steel pipe fittings, screwed and socket welding for the petroleum industry

BS 4882, Specification for Bolting for flanges and pressure containing purposes

BS 7281, Specification for polyethylene pipes for the supply of gaseous fuels

BS 7336, Specification for polyethylene fusion fittings with integral heating element(s) for use with polyethylene pipes for the conveyance of gaseous fuels

BS 7361, Specification for Cathodic Protection Part 1. Code of Practice for land and marine applications

### **CGA -Canadian Gas Association**

CAN/CGA B149.2, Propane Installation Code

OCC-1-85, Recommended Practice for the control of external corrosion on buried or submerged metallic piping systems

### **LPGA – Liquefied Petroleum Gas Association, UK (formerly LPGITA-Liquefied Petroleum Gas Industry Technical Association)**

No.22, LPG piping system - design and installation

### **NACE - National Association of Corrosion Engineers**

RP-01-69, Control of External Corrosion on Underground or Submerged Metallic Piping Systems

**NFPA - National Fire Protection Association**

NFPA 58, Liquefied Petroleum Gas Code

**IGEM – Institution of Gas Engineers and Managers**

IGE/TD/3, Distribution Mains, Recommendations on Transmission and distribution Practice

## SECTION 3 DESIGN

### 3.1 General Requirements

**Note:** *A typical design of underground LPG pipe with adequate cover is shown in Appendix C2.*

- 3.1.1 Pipework shall be installed at location free from abnormal mechanical loading. Where such adverse factors exist, the pipe shall be protected (in compliance with Gas Safety (Gas Supply) Regulation 17 (5)) by extra protection (see Section 3.5) and/or corrosion protection (see Section 3.7) where appropriate.
- 3.1.2 Installation pipe shall not be laid under foundations of a building or under the footings of a load bearing wall in compliance with the Gas Safety (Installation and Use) Regulations 17(4).
- 3.1.3 Pipework shall not be installed through basements, sewers or similar underground structures unless suitably protected by sleeving as shown in Appendix E or other means accepted by the Gas Authority.
- 3.1.4 Underground pipe shall be designed to withstand anticipated loading during service including internal pressure, external soil/traffic and buoyancy loading, if applicable.
- 3.1.5 For piping material other than those specified in 3.3.1 and 3.3.2, design working temperature shall cover the range of -10°C to 40°C.
- 3.1.6 Mains that are installed along or across public road shall comply with the requirements of the Guidance Note for Laying of Underground LPG Pipes Along or Across Public Roads - Gas Safety (Gas Supply) Regulation 17 (4) as per Appendix D.
- 3.1.7 Valves shall be installed at the upstream of special obstacle/road crossings, major branch-off, at maximum interval such that the volume being isolated does not exceed the volume equivalent to 130 litres liquid LPG at its working pressure along the pipe in built up area to provide sectioning; and at locations to cater for known future development of the pipe system.
- 3.1.8 Pressure tap/purge point should be installed on long pipework, especially on each side of a valve.

**3.1.9** Permanent anchorage shall be made on pipework above 100mm nominal diameter and laid in a slope of 30 degree or above and operating at pressures exceeding 75 mbar (1 psig). Ground anchor blocks may be used if additional anchorage is required.

**3.1.10** Joints in underground pipework shall be readily accessible for inspection unless of a type specifically designed for the purpose, e.g. welded joints or polyethylene fusion joints. The number of joints in pipes should be kept to a minimum. Screw and flanged joints below ground shall be avoided as far as practicable.

## **3.2 Sizing and Routing**

**3.2.1** The size of pipework shall be selected after consideration of the expected demand of gas supply, customer type, diversity of usage, available source pressure, acceptable pressure drops and the required minimum terminal pressure.

**3.2.2** The routing shall be selected taking into account the possibility of physical damage particularly from the loadings caused by vehicles or mobile equipment.

**3.2.3** The minimum separation distance between LPG pipes and any buildings opening or pathway to low level shall be 1m, except for the connection to riser.

**3.2.4** Clearance from other known buried utilities (e.g. electrical cables) to the LPG underground pipe shall be maintained at not less than 300 mm to allow for access for maintenance where reasonably practicable.

**3.2.5** The separation clearance as per Section 3.2.4 may be reduced for crossing other utilities, subject to adequate protection being provided e.g. by pipe-in-pipe system or by protective plate/slab (see Sections 3.5.2 & 3.5.3).

**3.2.6** Route plans on 1:1000 or larger scale map should be used to design and record the underground pipe routing.

**3.2.7** For easy access in future, the pipe route should generally be located in common ground, at the front of premises and parallel with other utility services. Routes should be chosen that create minimal disturbance of made-up surfaces. LPG pipe should avoid being in same trench or in close proximity with electric cables, water/drain pipes, fuel pipes and pipes containing other flammables/chemicals to avoid being affected by them.

**3.2.8** The routing of LPG pipes should avoid proximity to voids, pits, cellars and unventilated spaces, where reasonably practicable.

### **3.3 Materials and Jointing**

#### **3.3.1 Steel Pipe and Fittings**

**3.3.1.1** High and intermediate pressure LPG underground steel pipe shall be of seamless steel conforming to BS3601 or ASTM A53 or A106 Schedule 80 or equivalent. Medium pressure LPG underground steel pipe shall be of heavy grade steel conforming to BS 1387 or equivalent. Low pressure pipework shall be of medium or heavy grade steel conforming to BS1387 or equivalent.

**3.3.1.2** Use of cast-iron pipe shall not be permitted.

**3.3.1.3** Valves and fittings shall be suitable for maximum working pressure of the piping system.

**3.3.1.4** Steel flanges and flanged fittings shall conform to ASME B 16.5, BS 1560 or equivalent and bolting conforming to ASTM A 193, ASTM A 194, BS 4882 or equivalent.

**3.3.1.5** Pipe to pipe joints above 50 mm shall be butt-welded or socket welded or flanged.”

**3.3.1.6** Steel butt-welded fittings shall conform to BS1965 or equivalent. Steel socket-welded fittings shall conform to ANSI B16.11, BS 3799 or equivalent.

**3.3.1.7** Welding of steel pipe should be performed by skilled operators certified by a testing company.

**3.3.1.8** Pipe joints up to and including 50 mm nominal diameter may be threaded. Threaded pipes and fittings shall be of same form. Compression union shall not be used.

**3.3.1.9** Pressure containing metal parts of valves shall be steel, ductile (nodular) iron, malleable iron, or brass. Ductile iron shall meet the requirements of ASTM A 395 or equivalent and malleable iron shall meet the requirements of ASTM A 47 or equivalent. All materials used, including valve seat discs, packing, seals and diaphragms, shall be resistant to the action of LPG.

#### **3.3.2 Polyethylene Pipe and Fittings**

**3.3.2.1** Polyethylene (PE) pipe shall be of medium density (MDPE) and shall comply with BS 7281 or equivalent.

- 3.3.2.2** PE pipe shall have a standard dimensional ratio of 17.6 or smaller.
- 3.3.2.3** PE material and pipe coatings are degraded by prolonged exposure to direct sunlight and hence should be avoided. If storage for prolonged period is required, the PE pipe should be covered with suitable opaque cover sheet.
- 3.3.2.4** PE pipe and fittings shall be joined by heat fusion, electrofusion, or mechanical methods. Such joining methods shall be compatible with the materials being joined.
- 3.3.2.5** PE electrofusion fittings shall conform to BS 7336 or equivalent.
- 3.3.2.6** Jointing shall be in accordance with manufacturer's procedures and instructions.
- 3.3.2.7** Fusion jointing should not be carried out within a distance of 1.5 times the pipe diameter from location where squeeze-off has previously taken place. The squeeze-off location shall be marked permanently on the pipe and squeeze off shall not be repeated at the same location.
- 3.3.2.8** Joints in PE pipe shall be made with specially designed fusion tools and ancillary equipment.
- 3.3.2.9** Mechanical joints can be used for PE when fusion methods are impracticable or unsuitable, or for the transition from PE to metallic pipe.
- 3.3.2.10** For connecting PE pipe to steel flanged valves, properly designed flanged transition fittings shall be used. For changing direction or sizes of PE pipe, properly designed PE branched tees, reduced branch tees or reducers shall be used where applicable.
- 3.3.2.11** For PE pipe installation, PE pipe shall connect to metal pipe at the point of emerging from the ground. The transition fittings shall be located below ground or the PE pipe shall emerge for a short distance before the transition fitting provided that the aboveground section is suitably protected against ultraviolet light and mechanical damage by steel, glass reinforced plastic, housing enclosure or other equivalent sleeving.
- 3.3.2.12** Polyethylene gas pipe shall adopt a yellow or black external colour for easy identification and differentiation from other underground utility facilities commonly used in Hong Kong.

**3.3.2.13** Operators should be trained under a formal programme to cover the execution of PE jointing procedures and should be examined before carrying out such work and re-assessed periodically afterwards.

### **3.4 Depth of Cover**

**3.4.1** Unless extra protection as per section 3.5 is provided to overcome practical difficulties, LPG pipes shall be laid at a minimum depth of 600 mm within private property and under footpaths where there is no likelihood of traffic; or 1000 mm under carriageway measured from the road surface to the top of the pipe.

### **3.5 Extra Protection**

#### **3.5.1 General**

**3.5.1.1** An LPG pipe that is laid without sufficient depth shall be protected with extra protection such as pipe-in-pipe system, steel plate, concrete slab, or other methods approved by GasSO.

#### **3.5.2. Pipe-in-Pipe System**

*Note: Typical design of pipe-in-pipe arrangement is shown in Appendix C*

**3.5.2.1** Casing pipe may be used to provide mechanical protection and/or facilitate the replacement of LPG pipe in future. Casing pipe shall be suitably sized. It shall be made of steel materials.

**3.5.2.2** LPG pipe shall be held clear of the casing pipe by properly designed insulators, supports or centering devices.

**3.5.2.3** Casing pipe under carriageway shall be of sufficient length and strength so as to minimize the external loading on the LPG pipe.

**3.5.2.4** Valve pit for casing pipe should be located 1.5 m away from any building opening.

#### **3.5.3 Protective Plate/ Slab**

**3.5.3.1** Concrete slabs not less than 40 mm thick, or steel plates not less than 3 mm thick at a height of 100 to 300 mm above the LPG pipe/casing pipe can be used to protect it against damage.

**3.5.3.2** The LPG pipe shall be embedded in sand or soil and be compacted with backfill materials firmly and evenly before making good the road surface.

**Note:** *Extra-protection applicable are summarized in table below:*

Depth of cover	Under Pavement			Under carriageway		
	less than 600 mm	600 mm to less than 1000 mm	more than 1000 mm	less than 600 mm	600 mm to less than 1000 mm	more than 1000 mm
<b>Protection in non-public road</b>	plate or slab or pipe-in-pipe	not required	not required	pipe-in-pipe with plate or slab	pipe-in-pipe	not required
<b>Protection in public road</b>	pipe-in-pipe with steel plate or slab	with steel plate or slab	not required	Not allowed	pipe-in-pipe with steel plate or slab	pipe-in-pipe with steel plate or slab

### 3.6 Sleaving

**3.6.1** Where pipe passes through a solid wall (e.g. the wall of the valve pit, basement or poorly ventilated area), the pipe shall be sleeved. Sleeve shall extend to a minimum length of 20 mm beyond a wall. For pipe emerging from underground to aboveground, pipe sleeve shall also extends aboveground to a minimum length of 150mm beyond the transition.

**Note:** *Typical design of a sleeving arrangement is shown in Appendix E.*

**3.6.2** For PE pipe, anti-shear sleeves of adequate length shall be used to protect pipe up to and including 63 mm diameter against bending stresses, at:

- a) PE pipe adjacent to PE/steel transition fittings and PE branch pipes;
- b) service branch connections to metal pipes of 63 mm or greater; and
- c) valves, to react against operating torques unless the valve is suitably anchored.

**Note:** *Sleeves are not required at electrofusion couplings due to the support and reinforcement imparted by the heating wires and extended socket length.*

**3.6.3** Sleeve shall be of a material which is continuous, non-porous and protected against corrosion (e.g. polyethylene, galvanized steel or other suitable materials).

**3.6.4** Sleeve shall be filled at each end to the carrier pipe with a flexible water resistant compound (e.g. mastic or silicone compound) and shall be finished to the structure with a suitable building material e.g. cement mortar.

**3.6.5** Whenever possible, no pipe joint should be installed inside any sleeve.

**3.6.6** The minimum size of the sleeve shall be:

<b>Pipe nominal size</b>	<b>Minimum nominal size of sleeve</b>
15 mm	25 mm
20 mm	32 mm
25 mm	40 mm
32 mm	50 mm
40 mm	65 mm
50 mm	75 mm
75 mm	100 mm
100 mm	150 mm

**3.6.7** The section of the metallic pipe enclosed by sleeve should have external corrosion protective coating.

### **3.7 Corrosion Protection**

#### **3.7.1 General**

**3.7.1.1** Underground steel pipe shall be suitably protected against corrosion by suitable external coating and wrapping. Cathodic protection may also be utilized.

#### **3.7.2 Coating and Wrapping**

**3.7.2.1** Coatings shall be applied to steel pipe and fittings to insulate the external metal surface from their immediate environment.

**3.7.2.2** Coatings for pipe shall be epoxy based or polyurethane based or polyethylene based to provide protection.

**3.7.2.3** Wrapping material shall be of the following types:

a) pressure sensitive tapes; or

b) grease based tapes.

Wrapping overlap should be greater than 50%.

**3.7.2.4** Where pipework rises out of the ground, the wrapping shall extend to at least 20 mm above the sleeve pipe.

**3.7.2.5** For valves and fittings, grease, denso paste or equivalent materials should be used as coating material.

**3.7.2.6** Application of the coating/wrapping materials shall follow the recommendations from the suppliers.

### **3.7.3 Cathodic Protection**

**3.7.3.1** Cathodic protection may apply to steel pipe and fittings. The design of which shall follow BS7361 or NACE RP0169 or CGA OCC-1 or equivalent.

## **3.8 Ground Settlement**

**3.8.1** Where metallic underground pipe is installed in area of possible differential settlement and connects with/attaches to rigid structure, flexible connection or settlement loop or similar method shall be employed to absorb the stress caused by the differential settlement. Typical example of a settlement loop connection is shown in Appendix I.

**3.8.2** When a settlement loop is used, the leg length of the settlement loop shall follow the table (based on yield strength of 172 N/mm<sup>2</sup> for BS 1387 tubes and tubulars) below:

Leg length (mm)	Differential ground settlement (mm)						
	150	225	300	375	450	525	600
Nominal pipe size (mm)							
25	1321	1626	1880	2083	2286	2489	2642
40	1600	2956	2235	2489	2743	2997	3175
50	1778	2184	2489	2794	3099	3353	3556
75	2134	2642	3048	3454	3759	4064	4369
100	2591	3150	3658	4064	4470	4826	5182
150	2642	3200	3708	4115	4521	4877	5232

**3.8.3** When flexible connection is used, it shall be made of material suitable for LPG and be protected by stainless steel braid. The design pressure of the flexible connection shall be at least two times the maximum working pressure of the system.

## SECTION 4 INSTALLATION

### 4.1 General

- 4.1.1** Installation of LPG underground pipework shall be carried out or supervised by competent persons in accordance with regulation 16 of Gas Safety (Gas Supply) Regulation.
- 4.1.2** Steel pipe shall be laid as straight as possible. Where bends and offsets are required, they shall be made with 45° or 90° standard fittings except as allowed by Section 4.1.3. Mitred welds shall not be used.
- 4.1.3** For non-standard angles of steel pipe, cold bends may be used. Bends shall be made only from heavy grade pipe and with appropriate bending shoes (former) of bending radius not less than 8 times the outside diameter of the pipe. Pipe joint shall not be located in the bending portion.
- 4.1.4** For changes in direction for PE pipe, it is permissible to use cold bending around a minimum radius of 15 times the pipe diameter for plain pipe or 25 times the pipe diameter for plain pipe with sockets, joints or fitting on the bend. Standard pipe fittings shall be used for sharp bending.
- 4.1.5** Underground valves shall be:
- a) installed in valve pits; or
  - b) fitted with spindle access flaps suitably marked and identified
- “T” wrenches for operation shall be provided where appropriate.
- 4.1.6** Sectional isolating valves shall be installed on ring systems to allow isolation of sections for inspection, repair or maintenance with minimum supply interference.
- 4.1.7** Materials delivered to site shall be properly handled and protected from damage.
- 4.1.8** During installation, precautions shall be taken to prevent dirt from entering the pipe internal.
- 4.1.9** For underground PE pipe, protection plates as per section 3.5.3 shall be installed over the pipe to protect it from external damage if necessary.

- 4.1.10 Pipe running parallel to inhabited buildings should be kept at least 1m away from the openings of buildings.
- 4.1.11 Anchor blocks, if installed, should not be attached directly to valves and fittings, nor should they encase mechanical joints.
- 4.1.12 Welding should be completed aboveground wherever possible to allow convenient inspections.
- 4.1.13 Equipment for fusion jointing of polyethylene pipe should be checked in accordance with manufacturer's recommendations and instructions.
- 4.1.14 PE pipe installation shall be inspected during construction. Heat fusion operations shall be monitored to check that the correct procedures are followed.
- 4.1.15 Fusion joints for PE pipe shall be checked for proper bead width, freedom from contamination, slit defects and lack of fusion in accordance with the manufacturer's specifications.
- 4.1.16 Each contractor shall have supervisor to monitor and ensure the quality of installation work at site.
- 4.1.17 A short length at the ends of steel pipes may be left uncoated, to facilitate field welding. These areas should be given temporary protection to prevent corrosion during transport and storage.
- 4.1.18 Where cathodic protection is installed, regular inspections shall be made to ensure that no metallic contact exists between the metal casing pipe and the steel LPG pipe.

## **4.2 Coating & Wrapping**

- 4.2.1 Pressure testing and examination of joints shall be carried out before pipe joints are wrapped.
- 4.2.2 Before coating and/or wrapping, steel pipe shall be clean and smooth. Coating manufacturer's instructions shall be followed where applicable.
- 4.2.3 Welded joints and fittings shall be coated with a brush-applied corrosion resistant coating, air dried before wrapping.

- 4.2.4** The wrapping procedure for pipe shall be as follows:
- a) wrapping operations shall be undertaken on a continuous basis from one end of the pipe through to the other.
  - b) tapes shall be applied manually or by using a proprietary hand-operated wrapping machine; and
  - c) tapes shall be applied with a minimum overlap of greater than 50% to, in effect, give double wrapping.
- 4.2.5** Steel pipe should be laid in a manner that the damage to the protective coating is minimized.
- 4.2.6** Prior to backfilling the trench, the coating and wrapping should be inspected and repaired, if necessary.
- 4.3 Trench Work**
- 4.3.1** Excavation work and all pre-construction precautions shall follow relevant Government regulations and safety precautions especially the “Code of practice - Avoiding danger from gas pipes” (published by GasSO).
- 4.3.2** Trenches shall be excavated to the appropriate depth (See section 3.4) and the pipe shall rest on firm and even ground or laid on a bed of sand or other suitable fine material.
- 4.3.3** Excavated material or granular material may generally be used for pipe surround if they are free from stones.
- 4.3.4** No hard pointed rocks, stones shall be placed within 75mm of the pipe.
- 4.3.5** No fluid detrimental to the long-term strength of PE shall be used on PE pipes and fittings.
- 4.3.6** Backfill material should be well compacted to avoid trench settlement which in turn will affect the pipe support .

#### **4.4 Pipe Identification**

**4.4.1** Marker tape or suitable marking shall be laid between 100 to 300 mm above the crown of the pipe or on top of protective plate/slab (if installed) to:

- a) facilitate future location; and
- b) indicate to operators of excavation equipment the existence of a buried gas pipe.

**4.4.2** For PE pipe, additional metallic tracing tape or wire shall be installed. For details, please see “Code of Practice— Avoiding danger from gas pipes” (published by GasSO).

**4.4.3** The location of underground valves shall be clearly indicated by the use of distinguishing paint, or markers or indicating plate so that they are readily identified for operation under emergency conditions.

**4.4.4** PE pipe marking shall be in accordance with BS7281 or equivalent.

#### **4.5 Records & Drawings**

**4.5.1** As-built drawings shall be prepared for all underground pipes and kept for the life of the site. The following information shall be marked on the drawings:

- a) Pipe diameter
- b) Operating pressure
- c) Pipe routing
- d) Depth of cover
- e) Location of valve pit

Where PE pipe are laid, these should be shown in record drawing annotated “PE”.

**4.5.2** The following records shall be kept for new underground gas pipe system:

- a) Specification of piping

- b) Specification of major components
- c) Pressure test certificate
- d) Design of Cathodic Protection (CP) System (if installed) and
- e) Test certificate of the CP System (if installed)

**4.5.3** Records shall be reproducible and clearly legible for completeness, accuracy and consistency.

**4.5.4** Records shall be accessible for operation/ maintenance/ emergency and shall be available to persons undertaking construction work in the vicinity of the pipework (see “Code of Practice - Avoiding danger from gas pipes”).

## **SECTION 5 INSPECTION, TESTING & COMMISSIONING**

### **5.1 General**

- 5.1.1** Testing and commissioning shall be carried out by competent person, and be certified by Listed Competent Persons. (See Appendix B)
- 5.1.2** Written procedures should be produced and adhered to for all testing operations.
- 5.1.3** Pipework shall be pressure tested after construction and before being put into operation to ensure that it is structurally sound and gastight. In carrying out the test, precautions shall be taken to protect
- a) the person carrying out the test;
  - b) any persons working in the vicinity; and
  - c) members of the public.
- against any dangers which may arise if such pipe fails the test (see Regulation 20 of the Gas Safety (Gas Supply) Regulation).
- 5.1.4** Prior to pressure testing, the completed pipework sections shall be cleaned and free from construction debris and foreign matter.
- 5.1.5** Any pipe to be subject to a pressure test should be physically isolated from any gas supply. The responsible engineer/competent person should be present during pressurizing and depressurizing of the pipe.
- 5.1.6** Wherever the pipe under test is exposed, warning notice must be displayed and the pipe must be safely barricaded-off from the public at these positions.
- 5.1.7** During pressure testing, no person should enter the trench where the pipeline end point is located to avoid injury resulting from the possibility of end fitting failure. All test instrument should be placed above ground at least 1 m from the edge of the trench. All instrument connections to the pipe shall be securely installed.
- 5.1.8** LPG shall not be used as a test medium for testing new pipework except for the connection with existing pipework.
- 5.1.9** Except for the final test, the length of LPG pipe tested at one testing shall not exceed 500m unless there is no intermediate valve in between.

**5.1.10** For new pipe system, medium and low pressure pipework shall be tested at a minimum pressure of 103 kPa (15psig) and 69 kPa (10psig) respectively. Either pneumatic or hydraulic test is acceptable. Supply from compressed gas cylinder shall be controlled by a pressure regulator preferably with a relief valve.

**5.1.11** Time shall be allowed for temperature stabilization for pressure testing. The pipe pressure shall be adjusted to the test figure after the stabilization.

**Note:** *The time allowed for temperature stabilization depends on the ambient temperature, test medium temperature, pipe size and length. Generally this should not be less than 15 minutes.*

**5.1.12** For new pipework project, the pressure test period shall be 3 hours minimum and there shall be no sign of pressure decay during this period.

**5.1.13** For new piping system, all open ends of pipework shall be properly blanked off and inspected before testing.

**5.1.14** Pressure gauges or other pressure or leakage measuring devices shall be chosen to give the accuracy and sensitivity necessary for the test.

**Note:** *Pressure gauges should indicate the test pressure between a quarter and three quarter of full scale reading.*

**5.1.15** The pressure of the pipe shall be reduced to zero as soon as practicable after the pressure tests (see Gas Safety (Gas Supply) Regulation 20). Before dismantling any equipment, checks should be made by reading pressure gauges and operating valves on vent pipes to ensure that the test pressure has been completely released.

**5.1.16** Upon satisfactory completion of pressure tests, the pipework shall be purged into service in accordance with Section 5.3 prior to its operation.

- 5.1.17** Pipework pressure tests shall be recorded and the test report shall include the following:
- a) name of contractor and signature of the Listed Competent Person who supervised the tests;
  - b) test date;
  - c) maximum working pressure;
  - d) test pressure, medium and duration;
  - e) test results (whether test complied with the requirements); and
  - f) material, rating and specification of pipe and fittings.

A sample of the standard Pressure Test Report is attached in Appendix F.

- 5.1.18** Where practicable, consideration should be given to checking final connections by leak testing at maximum operating pressure using a suitable leak detection fluid. For PE pipe and fittings, care should be exercised that no fluid detrimental to the long-term strength of PE is used.
- 5.1.19** Where pipe strings are to be tested aboveground, the strings must be securely restrained at each end and at intervals along its length, to prevent movement during pressurization.
- 5.1.20** Test pressure should be raised under controlled conditions. While the pressure is being raised, monitoring check should be made on all mechanical joints. If any movement of the pipework occurs at any time during the test, the test should be suspended and the pressure released to allow additional reinforcements or supports made to the joints/pipework.
- 5.1.21** Calibrated pressure gauge shall be used for measuring test pressure.
- 5.1.22** Any leakage on a PE fusion joint should not be repaired and the joint should be cut away and re-made.
- 5.1.23** Leaking mechanical or screwed joints may be tightened, but not to the extent of over-stressing the bolts or threads. Joints shall be completely re-made if a first tightening fails to suppress a leak and the test shall be repeated.

## **5.2 Cathodic Protection System**

**5.2.1** The cathodic protection system shall be tested according to the procedure as specified by the piping system designer or a cathodic protection design consultant.

## **5.3 Purging into Service**

**5.3.1** The section of pipework being purged shall be isolated prior to the commencement of the purging operation

**5.3.2** Warning notices in particular "No smoking" and "No naked lights" signs should be prominently display around the work site.

**5.3.3** At least one 2.5 kg or higher capacity dry powder fire extinguisher should be available at work site.

**5.3.4** Purging and venting operation shall be manned throughout the process.

**5.3.5** Purging procedure – purging into service

**5.3.5.1** Two basic methods (i.e. ram purging, cycle purging) can be employed for the purging operation. Alternative methods may also be considered.

- a). Ram Purging - purge gas is fed continuously at one end of the pipework and the gas mixture being vent off/flared at the other end under a steady and continuous condition until the total content of the pipework is replaced by the purge gas. Other details include:
  - i. Pipework system shall be purged with inert gas such as nitrogen until the oxygen level inside the pipework is reduced to less than or equal to 11.4% by volume.
  - ii. Inert gas shall be introduced at a controlled and steady condition.
  - iii. Inert gas pressure shall be controlled and shall not be higher than the lower of 10 psi and the maximum working pressure.
  - iv. Upon the completion of inert gas purging, inert gas in the pipework system shall be purged by LPG following the same procedure.

- v. Frost forming on the underground pipe surface shall be avoided.
  - vi. Venting shall follow the procedure in section 5.3.6.
- b) Cycle Purging (i.e. Pressure and Vent) - the content inside the closed pipework system is diluted by introducing purge gas. Pressure is being increased by the purge gas and subsequently the gas mixture is vented off until the pressure of the pipework reduces to atmospheric. This process is repeated until the required dilution is achieved or the replacement by the purge gas is completed. Other details include:
- i. Cycle purging can be employed in closed system which has one vent point only and for system with dead ends.
  - ii. Purge gas shall be introduced into the system and the maximum pressure allowed in this method shall not exceed the lower of 10 psi or the maximum working pressure. The purge gas will mix with the air inside. The mixture is then vented off as per section 5.3.6.
  - iii. The oxygen level inside the pipework shall be reduced to less than or equal to 11.4% by volume.

Combination of ram and cycle purging can be used in the purging operation.

### **5.3.6. Venting**

**5.3.6.1** Two basic methods (direct vent and flaring) can be used to vent off the gas in the pipework system.

#### a). Flaring

- i. Before the flaring process, the Fire Services Department should be informed.
- ii. Flare stack shall be equipped with a proper burner and a permanent pilot.

- iii. The flare stack should be located at a safe distance at least 15m away from the LPG bulk tanks or cylinder stores, flammable material substance and within a controlled safe area.
- iv. The flare stack pipe shall be metallic and incorporated with a flame arrestor.
- v. Care shall be taken to ensure complete removal of the inert gas before terminating the flaring process. The completion of purging process may be indicated by a stable flame at the flare stack or by measuring the gas purity against calibrated chemical reagent gas detection tube.

b). Direct Vent

- i. Inert gas can be vented directly to atmosphere in well ventilated area.
- ii. LPG/inert gas or LPG/air mixture may be dispersed under proper supervision to a well ventilated area without flaring if the following conditions are met:-
  - the vent pipe is terminated at a minimum height of 2.5 m above ground level.
  - the vent pipe is located within a manned control safe area where it is cordoned off from the public and no source of ignition exists within 15 m from the controlled area.
  - gas detector shall be used to monitor the combustible gas concentration within and adjacent to the controlled area.
  - venting operation shall be stopped immediately should the reading of the gas detector exceed 10%LEL.
  - venting operation shall not be recommenced until the percentage of LEL in the controlled area fall below 10%.

**5.3.7** Direct purge of air by LPG under proper supervision is permissible provided that the purge pressure is maintained at or below maximum working pressure.

## **5.4 Purging out of Service**

- 5.4.1** The section of pipework being purged shall be isolated prior to the commencement of the purging operation.
- 5.4.2** Warning notices in particular "No smoking" and "No naked lights" signs should be prominently displayed at the work site.
- 5.4.3** At least one 2.5 kg or higher capacity dry powder fire extinguisher shall be available at work site.
- 5.4.4** Purging and venting operation shall be manned throughout the process.
- 5.4.5** Section of pipework to be purged out of service shall be depressurized by either flaring or direct vent as described in section 5.3.6.
- 5.4.6** Purging procedure - purging out of service
  - 5.4.6.1** Two basic methods (ram purging, cycle purging) can be employed for the purging operation.
    - a). Ram Purging
      - i. Before introducing air into the pipework, it shall be purged with inert gas such as nitrogen gas to form an interface so that the LEL level is less than 10% by volume.
      - ii. Inert gas should be introduced at a controlled and steady condition.
      - iii. Inert gas pressure should be controlled and shall not be higher than the lower of 10 psi and the maximum working pressure.
      - iv. Frost forming on the underground pipe surface shall be avoided.
      - v. Venting of LPG/inert gas mixture shall follow the procedure in section 5.3.6. Venting may be terminated when the LEL level inside the pipework is reduced to 5% LEL or less.

- b) Cycle Purging - the content inside the closed pipework system is diluted by introducing purge gas. Pressure is being increased by the purge gas and subsequently the gas mixture is vented off until the pressure of the pipework reduces to atmospheric pressure. The process is repeated until the required dilution is achieved or the replacement by the purge gas is completed. Other details include:
- i. Cycle purging can be employed in a closed system which has one vent point only and for system having dead ends.
  - ii. Purge gas shall be introduced into the system and the maximum applied pressure shall not exceed the lower of 10 psi and the maximum working pressure. The purge gas will mix with the LPG inside. The mixture is then vented off as per section 5.3.6.
  - iii. The LEL level inside the pipework shall be reduced to less than or equal to 5%.

Combination of ram and cycle purging may also be used.

**5.4.7.** Direct purge of LPG by air is not allowed. An interface of inert gas or water shall be used to purge LPG out of the pipework.

**Note:** *No one shall carry out any hotwork to the LPG pipework until the atmosphere inside the pipework and the surrounding atmosphere is verified to contain less than 5% of LEL of LPG.*

## **SECTION 6 OPERATION AND MAINTENANCE**

### **6.1 General**

- 6.1.1** The owner of underground LPG pipe shall have a duty to maintain and operate the pipe in a safe condition and shall employ a Listed Competent Person to inspect and test the pipe at intervals as specified in Section 6.2.1.
- 6.1.2** Maintenance work including replacement and diversion of gas pipe shall be carried out by competent persons.
- 6.1.3** For hot work on underground pipe that are being used or have been in use for carrying LPG, a work permit system incorporating control procedures shall be in place. Work permits shall be kept for a minimum of 2 years as part of the maintenance records.
- 6.1.4** When separating two sections of metallic pipework that are being used or have been in use for carrying LPG, electrical cross bonding to the two sections shall be provided prior to and during the work.
- 6.1.5** Only materials that are in accordance with the requirements of Section 3.3 shall be used for the maintenance and repair of underground LPG pipework.
- 6.1.6** LPG pipe shall be purged out of service in accordance with Section 5.4 before any maintenance work related to hotwork on the underground pipe is carried out on such pipe or before the pipe is recommissioned to carry gas (see Regulation 23 of Gas Safety (Gas Supply) Regulation).
- 6.1.7** Before recommissioning of any pipework to carry LPG, the pipework shall be properly re-instated and purged into service in accordance with Section 5.3.
- 6.1.8** All reported cases of leak or suspected leak of a LPG pipework shall be investigated promptly and appropriate actions taken.
- 6.1.9** Information for locating underground pipework and other records as per Section 4.5 shall be made readily available for maintenance work. A site plan showing the pipe route should be kept in the LPG store or local operator office.
- 6.1.10** Main underground valves should be uniquely identified to allow easy reference and to avoid mistakes during operation and maintenance.

- 6.1.11** For MDPE pipes, "squeeze-off" tools may be used which apply a controlled external force to the pipe, deforming it sufficiently to close the bore. Where the squeeze-off force is provided by means other than mechanical, the tool should be locked mechanically to protect against failure of the power source.
- 6.1.12** The minimum distance between a squeeze-off and a pipe fitting or a cut should be the greater of 450 mm or 2.5 times the PE pipe diameter. Where squeeze-off has been applied to a PE pipe, the pipe should be returned to its original form by a re-rounding tool and the position of the squeeze-off should accordingly be suitably marked. The same location should not be squeezed-off again in future.
- 6.1.13** Where connections from PE pipe to metallic pipe are close to the existing tapplings, an axial distance of the greater of 600mm or 3.5 times the nominal diameter of the larger hole, should be allowed between the centres of the two tapplings.
- 6.1.14** Where it is necessary to maintain continuity of supply, a by-pass pipe should be fitted across the affected pipe section. Any by-pass pipe should be protected from mechanical damage and from interference when the site is unattended.
- 6.1.15** When carrying out operations and maintenance, all techniques adopted shall not cause any uncontrolled release of LPG into the immediate working site environment .
- 6.1.16** Pipeline cutting and branching should be carefully pre-planned and be carried out under strict supervision, to ensure that all risks are adequately controlled.
- 6.1.17** The points at which the gas pipe has to be cut should be free from corrosion defects, hard encrustation and be thoroughly cleaned externally, to facilitate subsequent jointing.
- 6.1.18** Flame cutting should not be performed on PE pipe.
- 6.1.19** Where pipes are abandoned, a potential migration path for any leaking gas is created. All openings of the abandoned pipes should therefore be sealed and long lengths of abandoned pipes should be sectionalized.
- 6.1.20** When enquired by a party who may excavate near underground gas pipe, the owner of the underground LPG pipe shall provide relevant information to the party.

- 6.1.21** Where it is considered that any proposed works will affect underground gas pipe, the party proposing the work shall take appropriate measures to afford protection to the pipe. These measures may include decommissioning a pipe for the duration of the proposed operations, diversion of the pipe, special protection to the pipe or changes to the proposed operations.
- 6.1.22** The pipe route should be surveyed annually to check for accessibility of valve pit, condition of pipework inside the valve pit and changes along the pipe route. Leakage survey using gas detector should be carried out after abnormal incidents when pipes are susceptible to exposure or damage e.g. land subsidence, bursting of water pipes, nearby landslide. Where pipes are exposed, the condition of the pipe should also be examined and recorded.
- 6.1.23** Steel pipes may be repaired by welding carried out by qualified welders using appropriate electrodes. Care must be taken to ensure that the atmosphere is not hazardous and that the pipe material is sufficiently thick and in good condition. Appropriate corrosion protection measures should be taken once the repair has been completed.

## **6.2 Inspection and Testing**

- 6.2.1** Medium and low pressure underground pipework shall be tested at intervals not exceeding 3 years at a minimum pressure of 103 kPa (15 psig) and 69 kPa (10 psi) respectively except for those pipework which has been installed for more than 25 years, the test intervals shall not exceed 2 years. Test duration shall be not less than 30 minutes after line pressure has been stabilized.
- 6.2.2** Pressure tests shall be carried out in accordance with Section 5 upon re-instatement of disconnected/replaced pipework.
- 6.2.3** Cathodic protection system, if installed, shall be checked for its proper function at intervals not exceeding 6 months.
- 6.2.4** Aboveground identification marks, and warning signs, where installed, shall be checked to ensure that they are in place and legible.
- 6.2.5** Valve pit/chambers should be checked for accessibility, integrity, accumulation of LPG/water and be properly maintained at regular intervals.
- 6.2.6** Inspection, testing and maintenance records including those for cathodic protection system shall be kept by the owner for the service life of the pipework. Samples of the record forms are shown in Appendix G1 and G2.

### **6.3 Pipework Abandonment**

**6.3.1** Pipework which will no longer be used to carry LPG shall be decommissioned.

**6.3.2** The section of the abandoned pipework shall be decommissioned by

- a. purged out of service in accordance with section 5.4 and
- b. be disconnected from operating pipework with ends capped, plugged or effectively sealed

**6.3.3** Abandoned pipework should be removed where practicable.

**6.3.4** Pipework that is not decommissioned shall be treated as a live system.

## **SECTION 7 GAS LEAKAGE SURVEY**

### **7.1 General**

**7.1.1** Combustible gas detector or pressure drop test or combination of both may be employed for leakage survey.

**7.1.2** Other survey and test methods may be employed to help the identification of leakage location.

**7.1.3** Gas leakage survey shall only be performed by trained personnel.

#### **7.1.4 Gas Detection Methods**

a) Gas detector

The gas detector used for LPG leak detection shall be calibrated periodically to ensure accuracy.

b) Pressure drop test

i. Pipes subject to pressure drop tests shall be isolated from the other parts of the system.

ii. Maximum leak test pressure on existing facilities shall not exceed 1.5 times the maximum operating pressure.

iii. After the pressure is raised to the test pressure, the pressure source shall be isolated from the test section.

iv. If the test medium is an inert gas, purging into service and purging out of service procedures shall follow sections 5.3 and 5.4 respectively.

### **7.2 Follow-up Actions (if leakage is detected)**

**7.2.1** Upon the identification of leakage, the following action shall be taken:

a) For major leak that may constitute immediate hazard, emergency response actions shall be immediately taken.

b) For minor leak that is recognized as having no immediate hazard, a repair shall be arranged and the pipe system condition shall be monitored.

**7.2.2** For defective pipework which is commissioned for 5 years or less, the defective section should be recovered and investigated where practicable.

**7.2.3.** The owner shall record and maintain the following information for major gas leakage:

- a) date discovered, time reported and the deployment details of emergency team.
- b) name and address of the person who made the report (if available)
- c) location of and details of leakage.

A sample of the Gas Leakage Report record is shown in Appendix H.

### **7.3 Leakage Survey Record**

**7.3.1** Leakage survey records shall be kept by owner and the following information shall be included:

- a) description of system and area surveyed shown by a sketch map with layout of surrounding buildings
- b) dates, methods and results of survey
- c) names of personnel carrying out or supervising the survey

**7.3.2** For pressure drop tests performed, the following additional information shall be kept by owner:

- a) the name of company and the name of the personnel carrying out the test.
- b) test medium, pressure and duration of test,
- c) test results

**7.3.3** Gas leakage records shall be monitored and any trend of the leakage incident shall be reviewed.

**APPENDIX A RELEVANT SECTIONS IN RELATION TO THE GAS SAFETY (GAS SUPPLY) REGULATIONS**

Gas Safety (Gas Supply) Regulations	Relevant Sections in Module 2	Sections Quoted in Module 2
Reg. 2: Interpretation	1	
Reg. 16: Only competent persons to carry out work on or in relation to gas pipes	4.1, 5.1, 6.1.2	4.1.1, 5.1.1, 6.1.1, 6.1.2
Reg. 17: General safety requirements for gas pipes	3.1, 3.2	3.1.1, 3.1.4, 3.1.5, 3.1.6
Reg. 19: Protection of premises	3.1.2, 3.1.3	
Reg.20: Pressure tests on gas pipes, etc.	5.1	5.1.3, 5.1.15
Reg. 23: Purging of gas pipes	5.3, 5.4, 6.1	5.3, 5.4, 6.1.6

**APPENDIX B ACCEPTANCE CRITERIA FOR ENLISTMENT  
BY THE GAS AUTHORITY AS COMPETENT PERSON**

**Class 1(a) - Testing and certification of LPG tanks, vaporisers and mains OR  
Class 1(b) – Testing and certification of LPG cylinders**

**1. Responsibilities**

**(a) For testing and certification of LPG tanks, vaporisers and mains**

LPG Tanks

- Visual inspections of LPG tanks prior to testing.
- Supervise pressure testing of LPG tanks.
- Ensure that non-destructive testing and examination of LPG tanks are carried out in accordance with appropriate procedures and vessel codes.
- Certify that they are suitable for LPG service.

LPG Vaporisers and Mains

- Ensure that pressure testing of LPG vaporisers/mains is carried out in accordance with appropriate procedures and codes.
- Certify that tested LPG vaporisers/mains meet the required standards.

**(b) For testing and certification of LPG cylinders**

LPG Cylinders

- Ensure that LPG cylinders are inspected and tested in the prescribed manner.
- Certify that tested LPG cylinders meet the required standards.

**2. Qualification**

Corporate Member of the Hong Kong Institution of Engineers in the Mechanical, Chemical, Gas or Marine & Naval Architecture disciplines; or equivalent professional attainment such as Corporate Member of the Institution of Mechanical Engineers, Institution of Chemical Engineers, Institution of Gas Engineers and Managers or Institution of Marine Engineering, Science & Technology.

3. **Knowledge and Working Experience Required**

(a) **To carry out testing and certification of LPG tanks, vaporisers and mains**

Have full understanding of the following subjects:

- Design codes and test standards pertaining to LPG tanks, vaporisers, mains, valves and associated equipment.
- Non-destructive testing technology applicable to LPG tanks, vaporisers and mains;
- Strength of materials and other properties of materials used on LPG tanks, vaporisers and mains;
- Properties of LPG and related Codes of practices and Guidelines; and

Possess at least 1-year relevant working experience in the testing of pressure vessels.

(b) **To carry out testing and certification of LPG cylinders**

Have full understanding of the following subjects:

- Design codes and test standards pertaining to LPG cylinders and associated equipment.
- Non-destructive testing technology applicable to LPG cylinders.
- Strength of materials and other properties of materials used on LPG cylinders.
- Properties of LPG and related Codes of practices and Guidelines; and

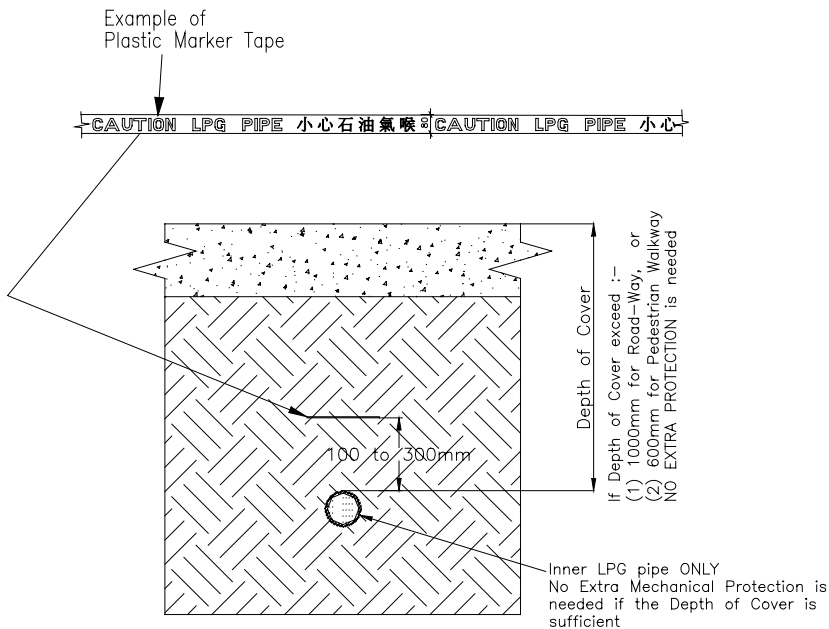
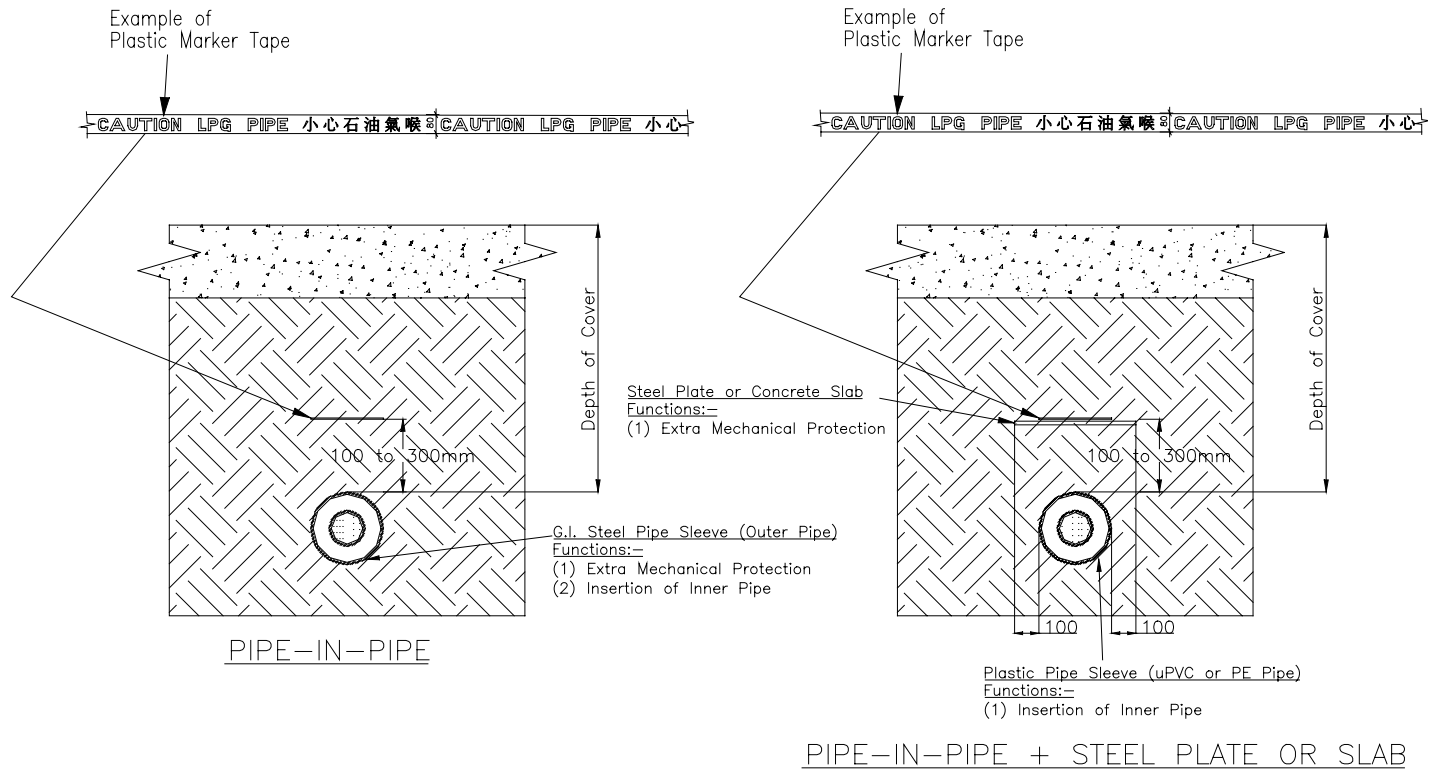
Possess at least 1-year relevant working experience in the testing of cylinders

**Notes:**

- (i) According to the interpretation as stated in the Gas Safety Ordinance (Cap 51),
- "Tank" means a bulk tank or mini-tank; "Bulk tank" means a receptacle which has a water capacity of more than 450 litres and used, or to be used, to contain liquefied petroleum gas;
- "Mini-tank" means a receptacle with a water capacity of more than 150 litres but not more than 450 litres and used, or to be used, to contain liquefied petroleum gas;
- "Vaporiser" means any equipment used, or to be used, to provide heat for the vaporisation of liquefied petroleum gas;
- "Gas main" means a pipe, other than a service pipe or installation pipe, used, or to be used, to supply gas;
- "Cylinder" means a receptacle which has a water capacity of not more than 150 litres; and used, or to be used, to contain liquefied petroleum gas.
- (ii) The applicant may submit, together with the application form, relevant documentary proof such as training records or employer references in respect of his/her training and experience in the testing of pressure vessels/ cylinders.
- (iii) The Gas Authority may require the applicant to attend an interview for verifying the appropriateness of his/her training and experience.
- (iv) For an applicant who is a Registered Professional Engineer in the Mechanical, Chemical, Gas or Marine & Naval Architecture Disciplines under the Engineers Registration Ordinance (Cap 409), interview may not be required if his/ her submitted application form is accompanied with adequate documentary proof in respect of his/ her training and experience in the testing of pressure vessels/ cylinders.
- (v) The performance of all competent person of Class 1(a) and Class 1(b) shall be subjected to the monitoring of a performance monitoring system of which details are listed in EMSD website [http://www.emsd.gov.hk/emsd/eng/pps/gas\\_pms.shtml](http://www.emsd.gov.hk/emsd/eng/pps/gas_pms.shtml).
- (vi) When a competent person ceases to practise in the gas industry for 12 months or ceases to maintain any professional qualification in Mechanical, Chemical, Gas or Marine & Naval Architecture Disciplines, his/her name may be removed from the register.
- (vii) If a competent person changes his/her employer within the gas industry or correspondence address or ceases to maintain any professional qualification in Mechanical, Chemical, Gas or Marine & Naval Architecture Disciplines, he/she shall notify the Gas Authority of the change within 28 days.



## APPENDIX C2 DEPTH OF COVER AND EXTRA MECHANICAL PROTECTION REQUIREMENTS FOR U/G LPG PIPE



PIPE WITH ADEQUATE DEPTH OF COVER

## **APPENDIX D GUIDANCE NOTES FOR LAYING OF UNDERGROUND LPG PIPES ALONG OR ACROSS PUBLIC ROADS—GAS SAFETY (GAS SUPPLY) REGULATION 17(4)**

### **1. INTRODUCTION**

Liquefied petroleum gas (LPG) is heavier than air and any leakage from underground LPG mains would fall to its lowest level and may enter into poorly ventilated voids, culverts, drains, ducts, pits and adjacent underground car parks and basements. This would then be a hazard if there was an ignition source. In view of this, underground LPG mains are generally limited to developments where the surrounding environment can be controlled. In addition, Regulation 17(4) of the Gas Safety (Gas Supply) Regulations stipulates that “*No person shall install a gas main for the conveyance of liquefied petroleum gas along or across a road.*”. A road is defined in the Gas Safety Ordinance to have the same meaning as that of the Road Traffic Ordinance, Cap. 374 which is basically a public road.

Notwithstanding specific legal requirements, there are circumstances which are considered necessary or beneficial to install some parts of a gas main along or across a public road, and therefore there is a provision under the Gas Safety (Gas Supply) Regulations for the Gas Authority to grant an exemption from the restrictions as stated. In granting an exemption, the Gas Authority must be satisfied that public safety will not be prejudiced and may specify additional conditions for compliance.

The purpose of the Guidance Note is to specify certain circumstances under which the Gas Authority may grant an exemption from the requirements of Regulation 17(4), and to outline necessary criteria for exemption so that a proponent may apply for such an exemption.

### **2. SPECIAL CIRCUMSTANCES**

The following are special circumstances under which the Gas Authority may consider granting an exemption, i.e.

(a) When a new/existing bulk installation is located at/relocated away from a development, and where the interconnecting LPG main has to be laid across or along a public road.

(b) When a new development can be supplied by a gas main laid along or across a public road from an existing reticulation system of a piped LPG development, and where the overall risk levels would be less than establishing a new notifiable gas installation.

(c) When a private road of an existing development which is supplied with piped LPG is to be taken over by Government as a public road and there is a gas main laid beneath it.

(d) When a piped gas supply is required on a specific development which includes a public road.

### **3. CRITERIA FOR EXEMPTION**

#### **3.1 Risk Consideration**

Where laying of LPG mains may lead to increase in storage inventory and/or road tanker replenishment frequency of an existing LPG compound, a quantitative risk assessment study shall be conducted to demonstrate that the overall risks are in line with the Hong Kong Government Risk Guidelines.

#### **3.2 Material**

Material for LPG mains shall be of heavy grade steel conforming to BS 1387 or equivalent. All underground LPG mains shall be of welded construction only and welded joints shall be fabricated in accordance with relevant design and welding standards. Medium density polyethylene (MDPE) pipe is an acceptable alternative for underground pipework provided that suitable precautionary measures are taken.

#### **3.3 Routing and Sizing**

Underground LPG mains shall be routed in such a way so as to prevent the possibility of leaking gas from entering into buildings, and to minimise undue interference with other utility services. The separation distance of an LPG main from buildings shall not be less than 1 m. The clearance between an LPG main and other utility services shall be 300 mm minimum. This clearance may be reduced for crossings subject to adequate protection being provided e.g. slabs and sleeving, but shall not be less than 100 mm. The operating pressure and internal diameter of an LPG main shall not be greater than 69 kPag (10psig) and 200 mm respectively.

#### **3.4 Ground Conditions**

In designing pipe routing, careful consideration shall be given to avoid possible ground settlement, subsidence, vehicular and mechanical loading. Where necessary, additional measures shall be provided to monitor and avoid possible damage resulting from adverse ground conditions.

### 3.5 Trench Preparation and Reinstatement

Underground LPG mains shall be laid on a firm and even foundation at a depth of 1 m minimum measured from the road surface to the top of the mains. The mains shall be protected against mechanical damage by means of concrete slabs or steel plates at a height of 100 mm above the main, be embedded in sand or soil and be compacted with backfill materials firmly and evenly before making good of the road surface. Where an LPG main is laid across a road, it shall be sleeved with suitably sized steel pipe and be provided with means for gas leak detection. Yellow plastic marker tape shall be laid between 100 mm and 300 mm above all LPG mains for identification and warning purposes. Additional metallic tracing tape shall be installed in the case of MDPE pipes.

### 3.6 System Protection

Isolating valve and pit shall be provided at either ends of the section of LPG main across the road and be strategically located for sections along the road. Steel mains shall be protected against corrosion by means of suitable coating, wrapping and/or cathodic protection under adverse soil conditions. The design and construction of cathodic protection system shall be carried out by experienced corrosion specialists and the system be checked periodically.

### 3.7 Record Plans

Owners of LPG mains shall maintain accurate alignment records and update as necessary. When requested, relevant information on locations of LPG mains shall be provided to persons wishing to carry out works in the vicinity of the mains.

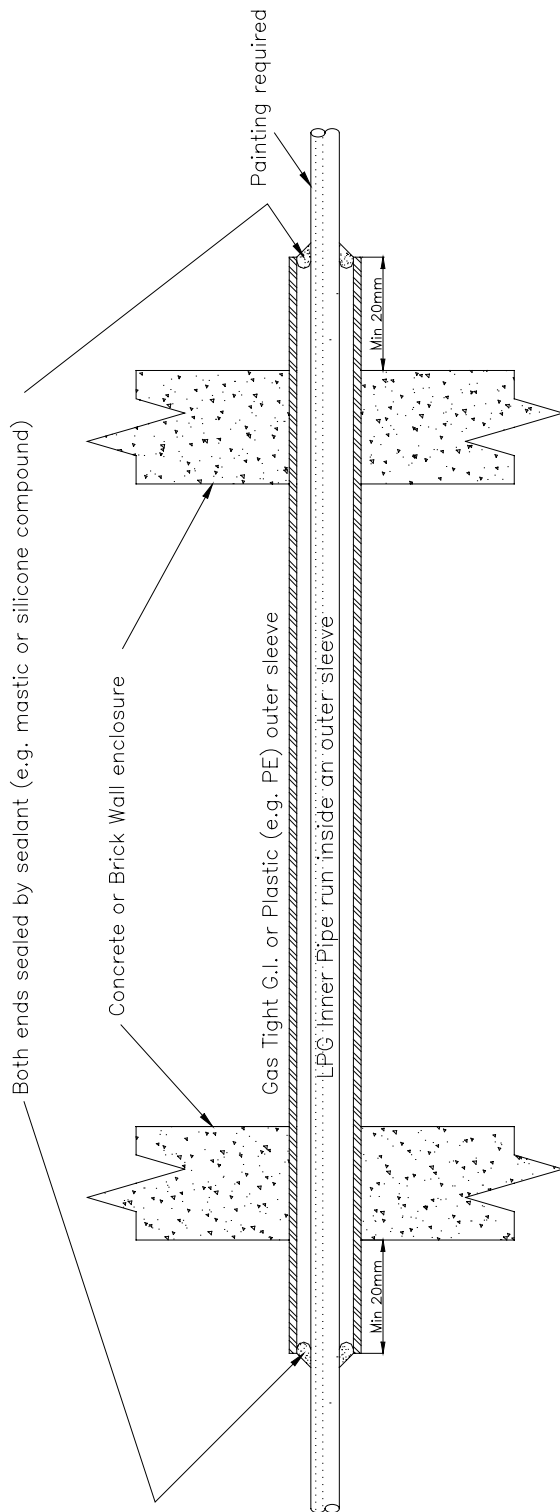
## 4. APPLICATION

In applying for exemption from Reg.17(4), the applicant shall provide justifications for such application to the Gas Authority and submit two copies of plans showing details of the proposed LPG main including operating pressure, routing, material, mode of protection and any safety provisions. The applicant shall also apply to the Director of Highways and the Director of Lands for an excavation permit and wayleave respectively.

## 5. ENQUIRIES

Any enquiry should be made to the Gas Standards Office, Electrical & Mechanical Services Department, 6/F., 98 Caroline Hill Road, Causeway Bay, Hong Kong at Tel. No. : 2808 3683 and Fax. No. 2576 5945.

## APPENDIX E SLEEVING ARRANGEMENT FOR LPG PIPE



Sleeving arrangement for LPG pipe passing through:—

- (1) Basement
- (2) Sewer
- (3) Similar U/G Structure
- (4) Other poorly ventilated enclosure

[Ref to Clause 17(2) of Gas Safety (Installation and use) Regulations]

**Appendix F: Typical Sample of LPG Underground Pipework Pressure Test Report  
(refer to 5.1.17)**

GasSO Ref. :

To : The Gas Authority

Date : \_\_\_\_\_

Location/address of LPG underground pipe : \_\_\_\_\_

I certify that all liquefied petroleum gas underground pipework installed at the above premises is constructed of suitable materials and has been tested/examined in accordance with the Gas Standards Office's requirements. All pipework has been adequately protected against corrosion in accordance with the specifications. The test/examination was carried out by \_\_\_\_\_

of \_\_\_\_\_

on \_\_\_\_\_

Details of pipework materials and tests are as follows :-

Section of Pipework	All High Pressure Liquid/ Vapour Lines	All Medium Pressure Vapour Lines	All Low Pressure Vapour Lines
Pipeline specification			
Fitting specification			
Valve material and rating			
Testing medium			
Maximum Working pressure (kPa)			
Test pressure (kPa)			
Duration of test (Hr)			

Remarks : Pressure drop observed? Yes/No.  
If 'Yes', please specify causes and remedial actions : \_\_\_\_\_

Certified by listed competent person (Class I), (name): \_\_\_\_\_ Signature : \_\_\_\_\_

Company Name : \_\_\_\_\_ Company Chop : \_\_\_\_\_

## Appendix G1 : Typical Sample of Maintenance Record of Underground Pipework (refer to 6.2.6)

### Section I Particulars of LPG U/G pipework

Location	
Owner	
Gas Supply Company	
Approx. Length of MP pipe=	
Approx. length of LP pipe	
Number of valve pits	
Date of last revalidation of pipe	
First installation date of U/G pipe	

### Section II Inspection Checklist

A	Site Condition (Visual inspection)	< >	D	Valve pit Inspection	< >
1	Signs of ground settlement along the pipe		1	Condition of pipework and fittings	
2	Condition of indication marks/warning sign*		2	Identification markings of pipework/valves/	
3	Accessibility of valve pit/chamber		3	No jam in opening / closing valve (if possible)	
4	Others		4	Others	
B	Record of Maintenance and Alterations	< >	E	Remarks/Other Information	< >
1	Revalidation testing records (once every 3 years)				
2	Alteration records				
3	Others				
C	Cathodic Protection System (if installed)	< >			
1	Record of cathodic protection system test				
2	Others				

Note : <X>cross if unsatisfactory; <✓>tick if satisfactory; <NA>\_if not applicable \* delete as appropriate

### Section III Recommendations and Remedial Work

(A) Recommendations		(B) Remedial work done by Owner	
Item	Description	Tick if Completed	Planned Completion Date

Note : Please use additional sheets if necessary

## Appendix G2 : Typical Sample of LPG Underground Pipework Revalidation Test Report (refer to 6.2.6)

Location/address of LPG pipe : \_\_\_\_\_

I certify that all liquefied petroleum gas underground pipework installed at the above premises has been revalidated in accordance with the Gas Standards Office's requirements. The test/examination was carried out by \_\_\_\_\_ of \_\_\_\_\_

\_\_\_\_\_ on \_\_\_\_\_

Details of pipework materials and tests are as follows :-

Section of Pipework	All High Pressure Liquid / Vapour Lines	All Medium Pressure Vapour Lines	All Low Pressure Vapour Lines
Testing medium			
Maximum Working pressure (kPa)			
Revalidated Testing pressure (kPa)			
Duration of test (Hr)			

Remarks : Pressure drop observed? Yes/No.  
If 'Yes', please specify causes and remedial actions : \_\_\_\_\_

Certified by listed competent person (class 1)

supervising the test : \_\_\_\_\_ Signature : \_\_\_\_\_

Company Name : \_\_\_\_\_ Company Chop : \_\_\_\_\_

**Appendix H : Typical Sample of Gas Leakage Report record  
(refer to 7.2.3)**

Ref. No \_\_\_\_\_

Date and Time of incident \_\_\_\_\_

Location \_\_\_\_\_

Nature of incident (Leakage/Fire/Explosion/)

Type of supply (Cylinder/Piped Gas/Cylinder bank/Industrial/LPG Compound)

Name of Caller \_\_\_\_\_

Contact telephone of caller \_\_\_\_\_

Other information : \_\_\_\_\_

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Follow up Actions

Emergency Team \_\_\_\_\_

Name of person contacted \_\_\_\_\_

Time of informing emergency team \_\_\_\_\_

Time arrived \_\_\_\_\_

Time completed \_\_\_\_\_ by \_\_\_\_\_

# APPENDIX I TYPICAL EXAMPLE OF SETTLEMENT LOOP CONNECTION

