

Code of Practice for

HONG KONG

LPG

INDUSTRY

## MODULE 2

Underground  
LPG Pipework

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**Code of Practice**  
**for**  
**Hong Kong LPG Industry**

**Module 2**  
**Underground LPG Pipework**

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## PREFACE

This document is the second in a series of modules issued as Code of Practice for the LPG industry in Hong Kong Special Administrative Region (HKSAR). The other modules that have been published so far include:

- LPG Compounds and Cylinder Stores
- Handling and Transport of LPG in Bulk by Road
- Operating Procedures for Emergencies for LPG Compounds and Cylinder Stores
- LPG Cylinders

This Module 2 lays down the recommended practices for the design, installation, inspection, testing and commissioning, operation and maintenance of underground pipework carrying LPG vapour at medium or low pressure from LPG compounds or cylinder stores to users. It encompasses the pipes, fittings and associated works. This Module shall be read in conjunction with the Gas Safety Ordinance (Cap. 51) and subsidiary regulations (See *Appendix A* for reference).

The first issue of this Module was prepared jointly by the Gas Standards Office of Electrical and Mechanical Services Department and the LPG Safety and Technical Committee (LPGSTC) represented by the Registered Gas Supply Companies of the LPG industry at that time, and it was published in May 2003. Since then, in December 2008, minor amendments were made regarding: (a) split of the classification of Class 1 Competent Person into Class 1a and Class 1b (in the original *Appendix B*); (b) new practices for jointing (in the original section 3.1.10) and (c) introducing a 2-year duration for retesting of pipes over 25 years old (in the original section 6.2.1).

This Issue 2 is an update to capture the changes in technology and international standards since 2003 and to incorporate the experience of the stakeholders in the local LPG industry over the past years. The basis for developing this document includes Code of Practice 22 issued by Liquid Gas UK (formerly UKLPG) of United Kingdom, NFPA 58 Liquefied Petroleum Gas Code issued by the National Fire Protection Association of USA, the safety requirements issued by the Gas Standards Office over the past years, and other international standards related to LPG pipework. Comments from the Gas Standards Office, the latest experience of the industry and the up-to-date requirements in other recognized national standards have also been reviewed and considered in updating the document.

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 fulfilment 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 rules that cannot be changed. It is expected that this document will be reviewed and updated as and when required in future.

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## SECTION 1 DEFINITION OF TERMS

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

**Competent Person** - A person who is, by virtue of his/her qualifications, training and substantial practical experience, enlisted by the Gas Standards Office to perform / supervise / inspect / certify LPG installation, testing, and maintenance work as appropriate to the class to which he / she is enlisted.

*Note: The applications for and lists of the various classes of Competent Persons and their responsibilities are obtainable from the Gas Standards Office or the EMSD website.*

**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.

**Gas supply company** – the Registered Gas Supply Company (RGSC) that is supplying LPG to the installation as defined in the Gas Safety Ordinance (Cap. 51).

**Gas Systems Contractor** – a Registered Gas Contractor who is authorized to carry out works for installation, commissioning and maintenance of LPG tanks, vaporisers, LPG pipework, pressure regulators and associated equipment in LPG compounds, cylinder stores as well as LPG mains, based on the class of Competent Person employed.

*Note: The application for and list of Gas Systems Contractor is obtainable from the Gas Standards Office or the EMSD website.*

**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, riveting 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 between 6.9 kPa and 69 kPa
<b>low</b>	- A pressure of not more than 6.9 kPa

**Note:** *These pressures are specific for LPG and not the same as those stipulated in the Gas Safety Ordinance.*

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

**Notifiable gas installation (NGI)** - An installation, as defined in the Gas Safety (Gas Supply) Regulations, including all LPG compounds, cylinder stores and vaporiser rooms.

**NGI owner** – A person or company that has been granted construction approval and approval of use of the NGI and is deemed to own the NGI for the purpose under the Gas Safety Ordinance (Cap. 51).

**Piping system** - A system made up of pipes, tubings, valves and fittings, etc., for conveying LPG in either liquid or vapour state at various pressures from one point to another.

**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.

**PE80, PE100** – PE pipe material having minimum required strength of 80 MPa and 100 MPa respectively.

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

**Purging** - Replacing the content in a system by inert gas before putting it 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

This Module has been prepared as a general outline of basic safety standards to be followed by gas supply companies, Gas Systems Contractors or NGI owners 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, inspection, testing and commissioning, operation and maintenance of underground pipework carrying LPG, normally at medium or low pressure, from LPG compounds or cylinder stores to buildings. It encompasses the pipes, fittings and associated work, but excludes installation pipes.

2.2.2 The design and installation requirements in this Module shall, unless specified otherwise, apply to new underground pipework and major alterations thereof, of which the applications for construction approval are made after the effective date of this Module. The requirements for operation and maintenance, inspection and T&C shall apply to all new and existing pipework. For cases of construction approval applications covering major alterations, the Gas Authority will review the situations case by case with NGI owners on mitigation measures for compliance.

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

### 2.3 Interpretation of Terms

In this document, the terms “shall” and “should” have the following interpretations:

2.3.1 “Shall” (required by this module) is used to indicate a requirement which, it is intended, shall be complied with in full and without deviation.

2.3.2 “Should” (recommended by this module) is used to indicate a requirement which, it is intended, should be complied with unless, after prior consideration, deviation is considered to be acceptable.

### 2.4 Regulations and References

2.4.1 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. 51A)

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

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

The Gas Safety (Registration of Gas Installers and Gas Contractors) Regulations (Cap. 51D)

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

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

The Road Traffic Ordinance (Cap. 374)

Code of Practice – Avoidance of Damage to Gas Pipes (published by GasSO)

**2.4.2** 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**

B 1.5, ACME Screw Threads

B 16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

B 16.9, Factory Made Wrought Steel Butt-welding Fittings

B 16.11, Forged Fittings, Socket-Welding and Threaded

B 36.10M, 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

D 2513, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

### **BSI - British Standards Institute**

BS EN 10226, Pipe threads where pressure-tight joints are made on the threads

BS EN 1555-2, Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) Part 2: Pipes

BS EN 1555-3, Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) Part 3: Fittings

BS EN 1555-4, Plastic piping systems for the supply of gaseous fuels – Polyethylene (PE) Part 4: Valves

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 EN 10253, Butt-welding pipe fittings

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 EN 10216-1, Seamless steel tubes for pressure purposes

BS EN 10216-5, Stainless steel tubes for pressure purposes

BS EN 10253-2, Butt-welding pipe fittings - Non alloy and ferritic alloy steels with specific inspection requirements

BS EN 10255, Non-alloy steel tubes suitable for welding and threading – Technical delivery conditions

BS EN 13636, Cathodic protection of buried metallic tanks and related piping

### **GB – China National Standard**

GB15558.2, Buried polyethylene (PE) piping systems for the supply of gaseous fuels  
燃氣用埋地聚乙烯管材

GB50028, Code for Design of City Gas Engineering 城市燃氣設計規範

GB51142, Liquefied Petroleum Gas Code 液化石油氣供應工程設計規範

### **ISO (International Standards)**

ISO 4437-2, Plastic piping systems for the supply of gaseous fuels – Part 2: Pipes

ISO TR 9080, Thermoplastic pipes for the transport of fluids – Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials

### **Liquid Gas UK (Formerly UKLPG)**

Code of Practice 22, Design, Installation and Testing of LPG Piping Systems

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

SP0169, 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, Steel and PE pipelines for gas distribution

## SECTION 3 DESIGN

### 3.1 General Requirements

**Note:** A typical design of underground LPG pipe with adequate cover is shown in Appendix B2.

- 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 3.8) where appropriate.
- 3.1.2 In accordance with Gas Safety (Installation and Use) Regulation 17(4), pipework shall not be laid under foundations of a building or under the footings of a load bearing wall.
- 3.1.3 Pipework shall not be installed through basements, sewers or similar underground structures unless suitably protected by pipe-in-pipe arrangement 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 3.3.2 and 3.3.6, 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 C.
- 3.1.7 Valves shall be installed at the upstream of special obstacles, road crossings, major branch-offs, to provide sectioning and at locations to cater for planned extensions of the pipe system.
- 3.1.8 To facilitate easy identification especially in case of emergency, valve pit covers should be adequately identified with suitable markings to indicate “LPG” and the valve number.
- 3.1.9 Pressure tap/purge point should be installed on long pipework, especially on each side of a valve.
- 3.1.10 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.

**3.1.11** The number of joints in pipes should be kept to a minimum. Screwed and flanged joints below ground should be avoided except within valve pits or essential for assembly/disassembly. An all welded or fused system is preferred for the buried portions.

## **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** If there is a basement, confined space or other underground structure closer than 3m to the LPG pipe routing, a risk assessment shall be carried out, taking into consideration of the risk of gas leak from the LPG pipe against any reasonable precautionary measures that can be incorporated.

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

**3.2.6** 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 casing system or by protective plate/slab (see Sections 3.5.2 & 3.5.3).

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

**3.2.8** 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.

**3.2.9** 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 General**

**3.3.1.1** For new pipeline installations, PE shall be used for buried sections unless justified otherwise. If steel is used, cathodic protection shall be installed.

**3.3.1.2** For substantial pipework replacement, PE shall be used for buried sections unless justified otherwise. If steel is used, extra corrosion protection or monitoring measures shall be in place.

*Note: PE material can only be used in buried pipeline sections for fire safety reasons, and protection from ultra-violet light effects. For pipeline sections that are not buried (e.g. sections going through cavity or voids), steel pipes with suitable corrosion protection measures shall be used.*

#### **3.3.2 Steel Pipes and Fittings**

**3.3.2.1** High pressure LPG underground steel pipe shall be of seamless steel conforming to BS EN 10216 or ASTM A53 or A106 Schedule 80 or equivalent. Medium pressure LPG underground steel pipe shall be of heavy grade steel conforming to BS EN 10255 or equivalent. Low pressure pipework shall be of medium or heavy grade steel conforming to BS EN 10255 or equivalent.

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

**3.3.2.3** 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.

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

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

**3.3.2.6** Pressure-containing metallic 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.

#### **3.3.3 Flanged Joints for Steel Pipes**

**3.3.3.1** 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.

- 3.3.3.2 Flanges to different standards and pressure classification shall not be mixed or interchanged. Mating flanges shall be compatible.
- 3.3.3.3 Fabrication shall leave flange faces parallel and with their bolt holes and centres in line.
- 3.3.3.4 Flange bolts shall be tightened to the required torque.
- 3.3.3.5 Gaskets shall be suitable for the duty required and be of the correct size and shape for the flanges and of a thickness suitable for the system pressure.

### 3.3.4 Welded Joints for Steel Pipes

- 3.3.4.1 Steel butt-welded fittings shall conform to BS EN 10253 or equivalent. Steel socket-welded fittings shall conform to ANSI B16.11, BS 3799 or equivalent.
- 3.3.4.2 Welding of steel pipe should be performed by skilled operators under the supervision of the Gas Systems Contractor.

### 3.3.5 Threaded Joints for Steel Pipes

- 3.3.5.1 Threaded connections may be used on proprietary items such as valves if there is no other practical alternative method of connection.
- 3.3.5.2 If galvanised pipework is used, the pipe fittings should also be galvanised.
- 3.3.5.3 Only threads to BS EN 10266 (BSP) or ANSI B.1.20.1 (NPT) shall be used where the seal is made on the thread.

**Note:** *Threads to BS EN 10266 (BSP) are not compatible with ANSI B.1.20.1 (NPT) threads even where they have the same thread pitch as their diameters and thread forms differ.*

- 3.3.5.4 The thread on the pipe must be compatible with that on the fittings.
- 3.3.5.5 All threads should be clean and correct to gauge for their length and depth.

### 3.3.6 Polyethylene Pipes and Fittings

- 3.3.6.1 Polyethylene (PE) pipes shall comply with BS EN1555-2, with polymer classification PE 80 or PE 100.
- 3.3.6.2 PE pipe shall have a standard dimensional ratio (SDR) of 17.6 or smaller for PE 80, and 11 or smaller for PE 100.



- 3.3.6.3** 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.
- 3.3.6.4** Valves used on PE pipelines shall be manufactured from plastic materials that are resistant to the action of LPG, or from metals as listed in 3.3.2.6 above. For valve manufactured from plastic material, consideration should be given to the frequency and method of valve operation, and ensure that the valve body can handle the torque resulting from the anticipated mode of operation.
- 3.3.6.5** 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.
- 3.3.6.6** PE electrofusion fittings shall conform to BS EN 1555-3 or equivalent.
- 3.3.6.7** Jointing shall be in accordance with manufacturer's procedures and instructions.
- 3.3.6.8** 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.
- 3.3.6.9** Joints in PE pipe shall be made with specially designed fusion tools and ancillary equipment.
- 3.3.6.10** Mechanical joints can be used for PE when fusion methods are impracticable or unsuitable, or for the transition from PE to metallic pipe.
- 3.3.6.11** 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.
- 3.3.6.12** 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.
- 3.3.6.13** Polyethylene gas pipe shall adopt a yellow or black with yellow stripes external colour for easy identification and differentiation from other underground utility facilities commonly used in Hong Kong.
- 3.3.6.14** The Gas System Contractor shall ensure that their installers are trained under a formal programme to cover the execution of PE jointing procedures.

### **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 1 000 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 casing system, steel plate, concrete slab, or other methods approved by GasSO.

**3.5.1.2**      Even with the extra protection, the minimum burial depth of LPG pipe shall not be less than 100mm below ground surface.

#### **3.5.2**      **Pipe Casing System**

**Note:** *Typical design of pipe casing arrangement is shown in Appendix B1.*

**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 centring 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 1.5m 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 300mm 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:

	Under Pavement			Under Carriageway		
Depth of cover	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
Protection in non-public road	plate or slab or casing pipe	not required	not required	casing pipe with plate or slab	casing pipe	not required
Protection in public road	casing pipe with steel plate or slab	with steel plate or slab	not required	Not allowed	casing pipe with steel plate or slab	casing pipe with steel plate or slab

### 3.6 Sleeving

**3.6.1** Where pipe passes through a solid wall / floor slab or when pipe emerges from underground to aboveground, the pipe shall be sleeved. This is to allow for relative movements between the pipe and the surrounding wall or ground, avoiding the building up of stress in the pipe. It also avoids the development of cracks between the pipe and the surrounding material, which can lead to accumulation of dirt and moisture, causing corrosion in metal pipes. Sleeve shall extend to a minimum length of 20 mm beyond a wall or 150 mm above ground level.

**Note:** Typical design of a sleeving arrangement is shown in Appendix D1.

**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.

Typoical design of sleeving arrangement for PE/steel transition fittings is shown in Appendix D2

- 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 The gap between the sleeve and the gas pipe shall be filled at each end 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:

Pipe nominal size	Minimum nominal size of sleeve
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 Pipe-in-Pipe System**

- 3.7.1 Pipe passing through cavity, voids or other poorly ventilated areas shall generally be avoided. If this is unavoidable, the pipe shall be within an outer pipe for the entire length inside the cavity or void.

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

- 3.7.2 The outer pipe shall be of the same material as for the gas pipe.
- 3.7.3 The ends need to be sealed against water or dirt ingress, tee points shall be provided in the outer pipe for gas detection, and the pipe shall be pressure tested as for a gas pipe. Ends of the outer pipe can be unsealed only when gas detection through the tee points is not practically feasible and adequate measures are taken to prevent gas leakage to poorly ventilated areas.

## **3.8 Corrosion Protection**

### **3.8.1 General**

**3.8.1.1** Underground steel pipe shall be suitably protected against corrosion by suitable external coating and wrapping, and an adequate cathodic protection system.

### **3.8.2 Coating and Wrapping**

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

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

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

- a) Pressure sensitive tapes; or
- b) grease based tapes.

Wrapping overlap should be greater than 50%.

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

**3.8.2.5** For metallic valves and fittings, grease, Denso paste or equivalent materials should be used as coating material.

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

### **3.8.3 Cathodic Protection**

**3.8.3.1** Cathodic protection shall be applied to underground steel pipe and fittings, the design of which shall follow BS EN 13636 or NACE SP 0169 or equivalent.

## **3.9 Ground Settlement**

**3.9.1** 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*.

**3.9.2** When a settlement loop is used, the leg length of the settlement loop shall follow the table (based on yield strength of 195 N/m<sup>2</sup> for BS EN 10255 tubes below:

<b>Leg length (mm)</b>	<b>Differential ground settlement (mm)</b>						
<b>Nominal pipe size (mm)</b>	<b>150</b>	<b>225</b>	<b>300</b>	<b>375</b>	<b>450</b>	<b>525</b>	<b>600</b>
<b>25</b>	1 321	1 626	1 880	2 083	2 286	2 489	2 642
<b>40</b>	1 600	2 956	2 235	2 489	2 743	2 997	3 175
<b>50</b>	1 778	2 184	2 489	2 794	3 099	3 353	3 556
<b>75</b>	2 134	2 642	3 048	3 454	3 759	4 064	4 369
<b>100</b>	2 591	3 150	3 658	4 064	4 470	4 826	5 182
<b>150</b>	2 642	3 200	3 708	4 115	4 521	4 877	5 232

**3.9.3** 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 forming part of a notifiable gas installation shall commence only after construction approval for the NGI has been obtained from the Gas Authority (refer to Module 1) and shall be carried out by Gas Systems Contractors with appropriate class of Competent Person employed.

**4.1.2**      Installation work shall be in accordance with the approved drawings and design requirements as stated in this Module.

**4.1.3**      The LPG pipelines shall not be used to contain any LPG unless approval of use of the NGI has been obtained from the Gas Authority (refer to Module 1), and that they have been commissioned in accordance with the requirements of Section 5.

### 4.2      General Practices

**4.2.1**      Pipes shall be cut squarely. Any burrs, shavings or spatter from cutting, threading or welding shall be removed.

**4.2.2**      Steel pipes 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 4.2.3. Mitred welds shall not be used.

**4.2.3**      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 (formers) of bending radius not less than 8 times the outside diameter of the pipe. Pipe joint shall not be located in the bending portion.

**4.2.4**      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.

**4.2.5**      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.

**4.2.6**      Sectional isolating valves shall be installed on ring systems to allow isolation of sections for inspection, repair or maintenance with minimum supply interference.

- 4.2.7** Materials delivered to site shall be properly handled and protected from damage.
- 4.2.8** During installation, precautions shall be taken to prevent dirt from entering the pipe internal.
- 4.2.9** For underground PE pipes, protection plates as per section 3.5.3 shall be installed over the pipe to protect it from external damage if necessary.
- 4.2.10** Pipes running parallel to inhabited buildings should be kept at least 1m away from the openings of buildings.
- 4.2.11** Anchor blocks, if installed, should not be attached directly to valves and fittings, nor should they encase mechanical joints.
- 4.2.12** Welding should be completed aboveground wherever possible to allow convenient inspections.
- 4.2.13** Equipment for fusion jointing of PE pipe should be checked in accordance with manufacturer's recommendations and instructions.
- 4.2.14** PE pipe installation shall be inspected during construction. Heat fusion operations shall be monitored to check that the correct procedures are followed.
- 4.2.15** 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.
- 4.2.16** Each contractor shall have a supervisor to monitor and ensure the quality of installation work on site.
- 4.2.17** 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.
- 4.2.18** 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.
- 4.3** **Coating & Wrapping**
- 4.3.1** Pressure testing and examination of joints shall be carried out before pipe joints are wrapped.
- 4.3.2** Before coating and/or wrapping, steel pipe shall be clean and smooth. Coating manufacturer's instructions shall be followed where applicable.



**4.3.3** Welded joints and fittings shall be coated with a brush-applied corrosion resistant coating, air dried before wrapping.

**4.3.4** 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.

**4.3.5** Steel pipe should be laid in a manner that the damage to the protective coating is minimized.

**4.3.6** Prior to backfilling the trench, the coating and wrapping should be inspected and repaired, if necessary.

#### **4.4**      **Trench Work**

**4.4.1** 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).

**4.4.2** 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.

**4.4.3** Excavated material or granular material may generally be used for pipe surround if they are free from stones.

**4.4.4** No hard pointed rocks, stones shall be placed within 75mm of the pipe.

**4.4.5** No fluid detrimental to the long-term strength of PE shall be used on PE pipes and fittings.

**4.4.6** Backfill material should be well compacted to avoid trench settlement which in turn will affect the pipe support.

## **4.5 Pipe Identification**

**4.5.1** 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.

**4.5.2** For PE pipe, additional metallic tracing tape or wire shall be installed. This is to facilitate the detection of buried PE pipeline using pipeline tracers. Contact terminals for the tracing tape or wire shall be readily accessible.

**4.5.3** 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.

**4.5.4** PE pipe marking shall be in accordance with BS EN 1555-2 or equivalent.

**4.5.5** Pipe routing indication on the ground surface, in the form of indication plates, engraved wordings or posts shall be installed for new pipelines.

## **4.6 Records and Drawings**

**4.6.1** 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) Depth of cover
- d) Location of valve pit

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

**4.6.2** 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)

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

**4.6.4** 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 – Avoidance of Damage to Gas Pipes”).

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

### **5.1 General**

**5.1.1** Testing and commissioning shall be carried out by Gas System Contractors with appropriate class of Competent Person employed, and be certified by Competent Persons Class 1a.

**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** For new pipe system, medium and low pressure pipework shall be tested at a minimum pressure of 300 kPa (45 psig) and 69 kPa (10 psig) 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.

**5.1.10** 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.*

**5.1.11** 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. The maximum volume of pipeline undergoing the test shall be limited to ND90 pipeline x 100 m. Longer or larger pipelines shall be tested in sections.

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

**5.1.13** 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.*

**5.1.14** 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.

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

**5.1.16** Pipework pressure tests shall be recorded and the test report shall include the following:

- a) name of contractor and signature of the Competent Person Class 1a 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*.

- 5.1.17** 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.
- 5.1.18** 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.
- 5.1.19** 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.
- 5.1.20** Calibrated pressure gauge or new gauge purchased within one year shall be used for measuring test pressure.
- 5.1.21** Any leakage on a PE fusion joint should not be repaired and the joint should be cut away and re-made.
- 5.1.22** 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 9 % 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 69 kPa (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 inlet / outlet 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 9 % 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 volume being vented is less than 23 litres
  - 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 for small pipe volume (under 23 litres) is permissible under proper supervision 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

- 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 5%.
- Inert gas should be introduced at a controlled and steady condition.
- Inert gas pressure should be controlled and shall not be higher than the lower of 10 psi and the maximum working pressure.
- 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 69 kPa (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 hot work to the LPG pipework until the atmosphere inside the pipework and the surrounding atmosphere is verified to have less than 5% of LEL .*

## 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 Competent Person Class 1a 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 Gas System Contractors with appropriate class of Competent Person employed.
- 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 4.6 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 Identification markings on underground valve pits shall be maintained to allow easy reference and to avoid mistakes during operation and maintenance.
- 6.1.11 For PE 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** For steel pipelines going through high corrosion risk areas (such as planter, pools, gardens, at close proximity to water pipe and drainage pipe, and to the sea, etc.) that are not fitted with cathodic protection, more frequent review of their conditions and monitoring for gas leakage shall be in place. These include more frequent valve pit inspection, digging trial pits at strategic locations, or employing pipeline survey methods such as DCVG (direct current voltage gradient).

**6.1.24** 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 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. The sacrificial anodes shall be replaced if the cathodic protection system is no longer adequate for corrosion protection in according to the design in clause 3.8.3.1.

**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 properly so that it does not pose a risk to the public.

- 6.3.2** Until the pipeline is certified to be gas free, it shall be treated as a gas installation and a Gas System Contractor shall be employed for the decommissioning. In particular, throughout the purging and/or flaring operations, the Competent Person of the Gas Systems Contractor shall be in full attendance on location.
- 6.3.3** 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.
- 6.3.4** Abandoned pipework should be removed where practicable.
- 6.3.5** The gas freeing of pipework shall be undertaken and recorded by a Gas Systems Contractor. A Class 1a Competent Person shall be employed to issue the gas free certificate.

## 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

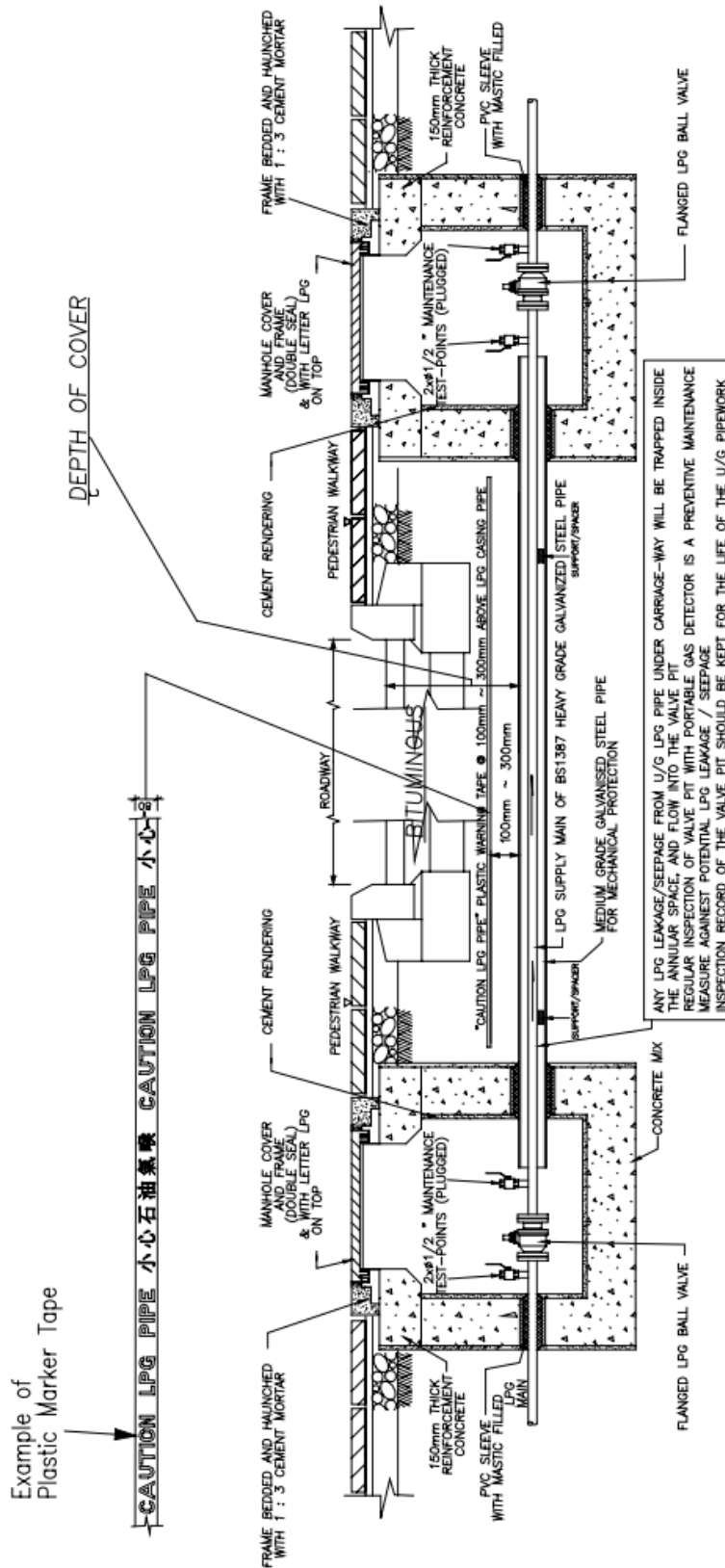
**7.3.3** Gas leakage records shall be monitored and any trend of the leakage incident shall be reviewed.



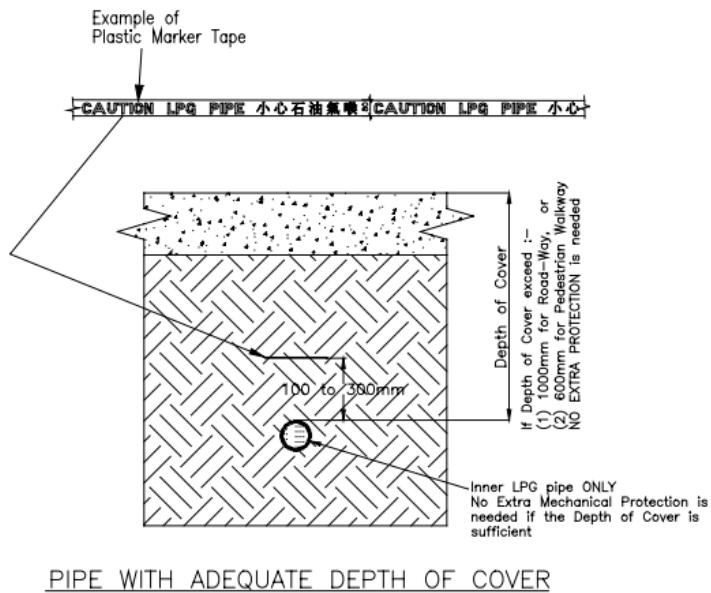
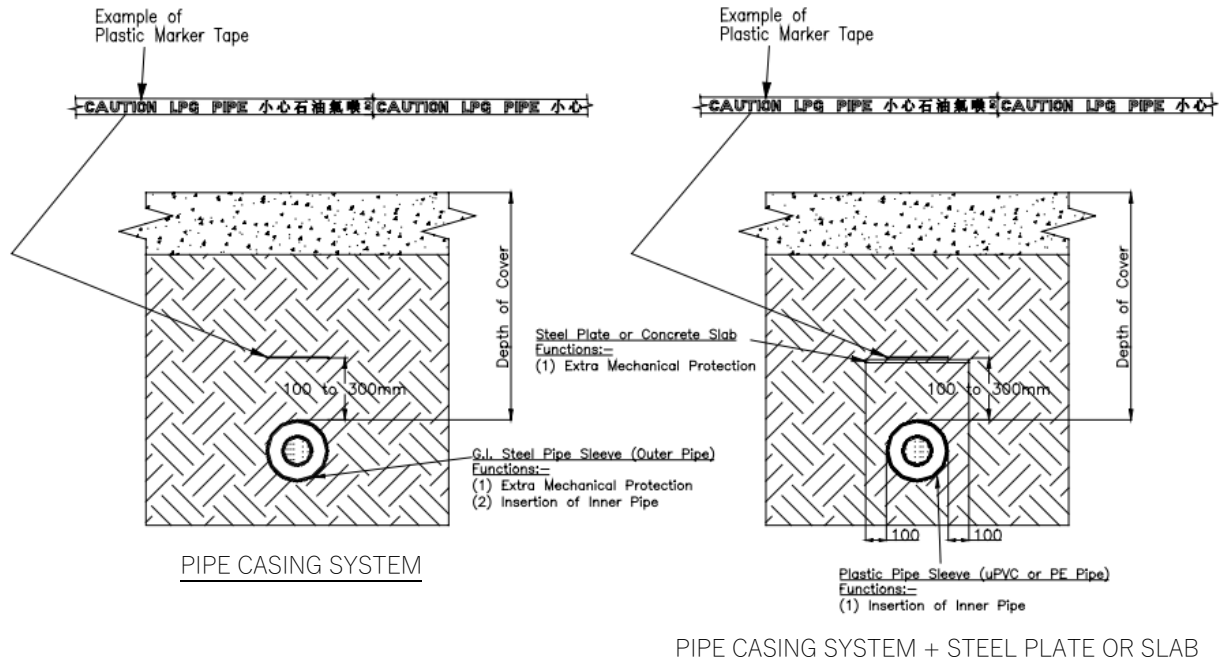
**APPENDIX A      RELEVANT SECTIONS IN RELATION TO THE GAS SAFETY (GAS SUPPLY) REGULATIONS**

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	4.1.1 5.1.1 6.1.1 6.1.2
Regulation 17: General safety requirements for gas pipes	3.1	3.1.1, 3.1.2, 3.1.4, 3.1.5, 3.1.6
Regulation 19: Protection of premises	3.1	3.1.2, 3.1.3
Regulation 20: Pressure tests on gas pipes, etc.	5.1	5.1.3, 5.1.14
Regulation 23: Purging of gas pipes	5.3 5.4 6.1	5.3 5.4 6.1.6

# APPENDIX B1 TYPICAL DESIGN FOR PIPE CASING ARRANGEMENT AND VALVE PIT UNDER CARRIAGEWAY



## APPENDIX B2 DEPTH OF COVER AND EXTRA MECHANICAL PROTECTION REQUIREMENTS FOR UNDERGROUND LPG PIPE



Note: Even with mechanical protection, depth of cover of U/G LPG pipes cannot be smaller than 100 mm

## **APPENDIX C      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 this 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 polyethylene (PE) pipe complying with BS EN 1555-2, with polymer classification PE 80 or PE 100, and with standard dimensional ratio (SDR) of 17.6 or smaller for PE 80, and 11 or smaller for PE 100.

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

Underground LPG mains shall be routed in such a way so as to prevent the possibility of leaking of 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 1m. 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. slab 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 (10 psig) 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 1m minimum measured from the road surface to the top of the main. The main 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. Metallic tracing tape or wire shall be installed to facilitate the detection of PE pipes using pipeline tracers.

### 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.

### 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.

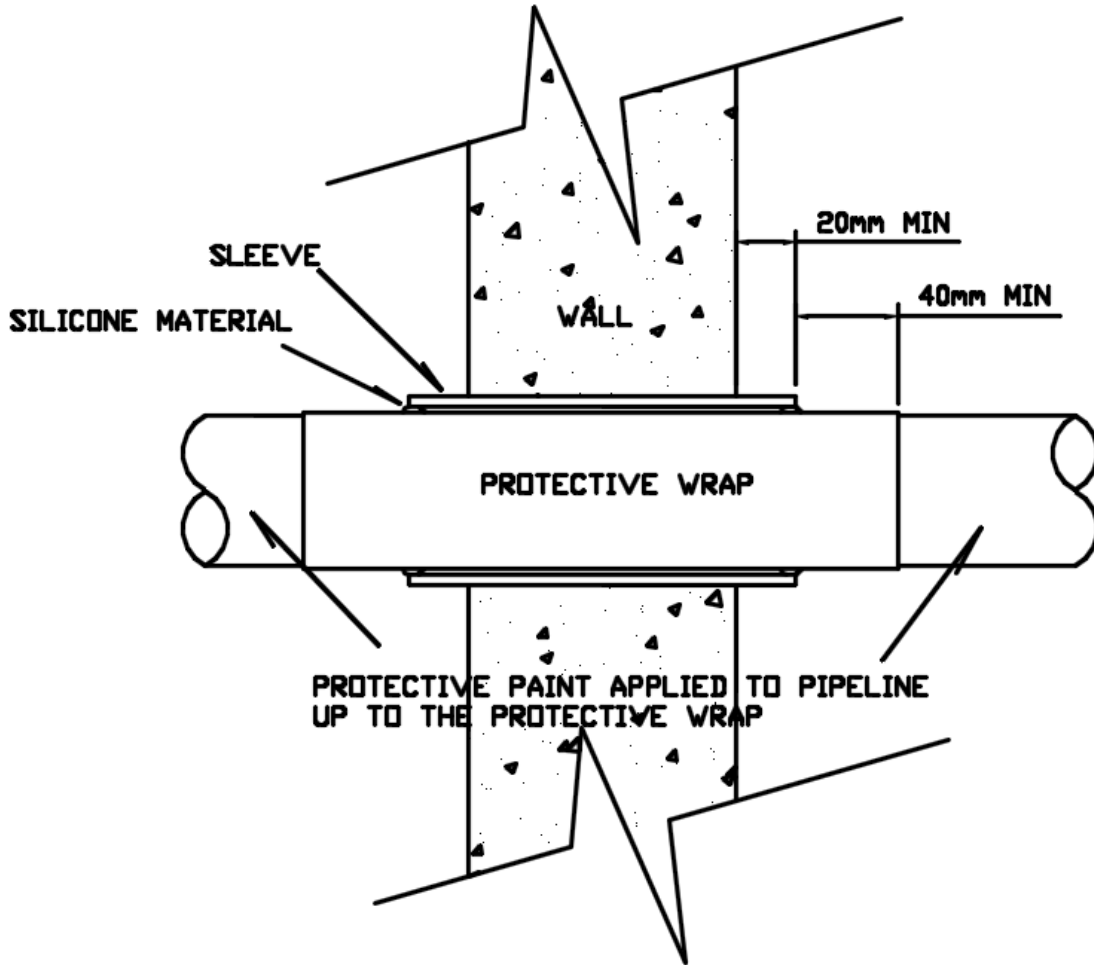
## 4. APPLICATION

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.

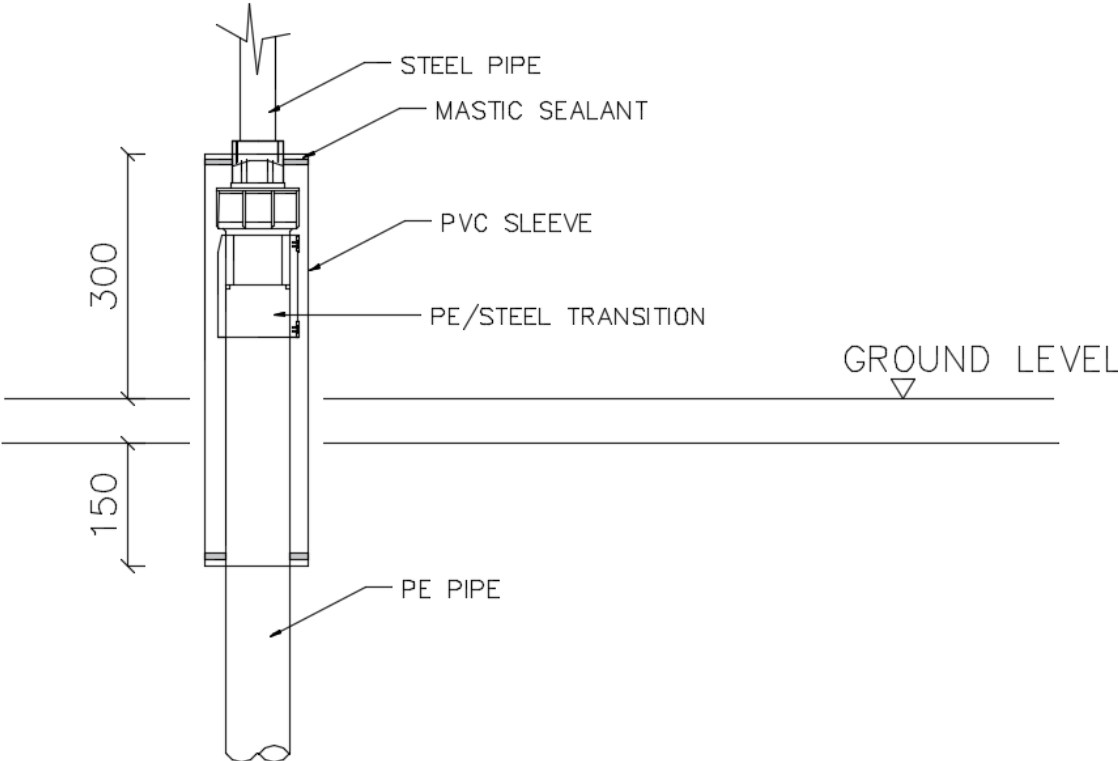
## 5. ENQUIRIES

Any enquiry should be made to the Gas Standards Office, Electrical & Mechanical Services Department, 7/F, 3 Kai Shing Road, Kowloon Bay, at Tel. No.: 2808 3683, or Fax. No. 2576 5945.

**APPENDIX D1 TYPICAL SLEEVING ARRANGEMENT FOR LPG PIPE GOING THROUGH SOLID WALLS OR FLOOR SLABS**



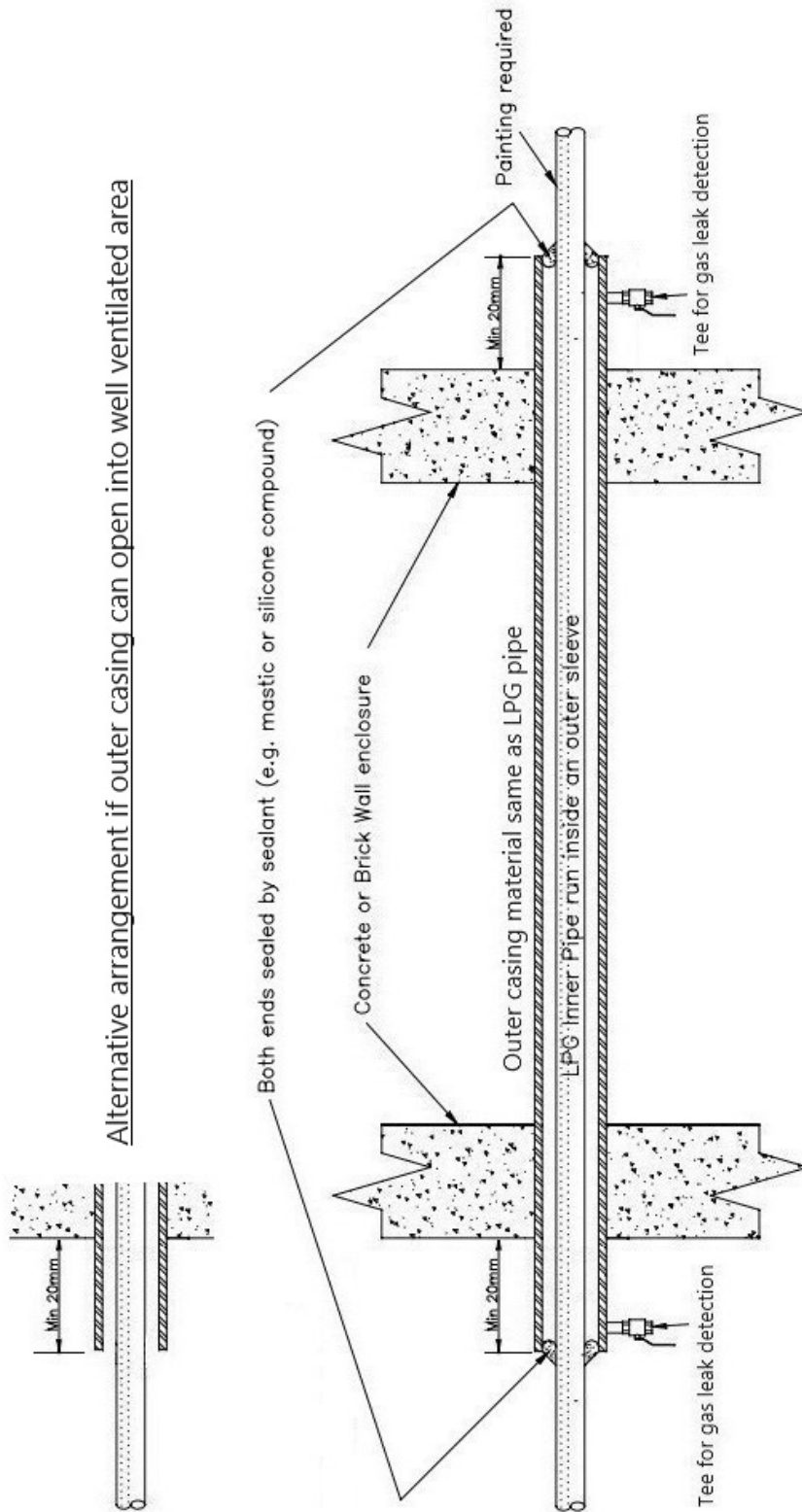
**APPENDIX D2 TYPICAL SLEEVING ARRANGEMENT FOR PE/STEEL TRANSITION FITTINGS**





**APPENDIX E**

**TYPICAL PIPE-IN-PIPE ARRANGEMENT FOR LPG PIPE GOING THROUGH POORLY VENTILATED AREAS**



Pipe-in-Pipe arrangement for LPG 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 5.1.16)**

File Ref. : EMSD/GSD-B/

**Testing and Examination of LPG Pipes (Form 108)  
under Part V of Gas Safety (Gas Supply) Regulations, Cap. 51**

To : The Gas Authority

Address of Notifiable Gas Installation: \_\_\_\_\_

Details of pipework materials and tests are as follows: (Date of Testing: \_\_\_\_\_)

Section of Pipework	All Liquid Lines	All High Pressure Vapour Lines	All Medium Pressure Vapour Lines	All Low Pressure Vapour Lines
Pipeline specification				
Fitting specification				
Valve material and rating				
Testing medium				
Working pressure (kPa)				
Test pressure (kPa)				
Duration of test (hr)				
Pressure setting of Hydrostatic Pressure Relief Valve (kPa)		N/A	N/A	N/A

Remarks : Pressure drop observed? Yes/No.

If 'Yes', please specify causes and remedial actions: \_\_\_\_\_

Test and examination was carried out by Gas Systems Contractor & RGI:

Certified by Class 1a Competent Person:

I certify that all liquefied petroleum gas 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.

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

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

Form 108 revision 05/2023

**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**

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

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

Note: Please use additional sheet if necessary

**APPENDIX G2 TYPICAL SAMPLE OF LPG UNDERGROUND PIPEWORK REVALIDATION TEST  
(refer to 6.2.6)**

GasSO Ref. :

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

Details of pipework tests are as follows:- (Date of testing: \_\_\_\_\_)

Section of Pipework	All High Pressure Liquids / 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: \_\_\_\_\_  
\_\_\_\_\_

The test/examination was carried out by Gas Systems Contractor

and RGI \_\_\_\_\_ on \_\_\_\_\_

Certified by Class 1a Competent Person

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.

Name : \_\_\_\_\_ Signature : \_\_\_\_\_

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

**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/LPGCompound)

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

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

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Follow up Action

Emergency team \_\_\_\_\_

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

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

Time arrive at the scene \_\_\_\_\_

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

**APPENDIX I TYPICAL EXAMPLE OF SETTLEMENT LOOP CONNECTION FOR UNDERGROUND STEEL PIPES**

