

GENERAL SPECIFICATION
FOR
LIQUEFIED PETROLEUM GAS INSTALLATION
IN
GOVERNMENT BUILDINGS
OF
THE HONG KONG SPECIAL ADMINISTRATIVE REGION

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BUILDING SERVICES BRANCH
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SECTION 1 – SCOPE OF SPECIFICATION

1.1 Installation covered by this Specification

1.1.1 This Specification covers the fixed and piped Liquefied Petroleum Gas Installations carried out on behalf of the Architectural Services Department of the Government of the Hong Kong Special Administrative Region.

1.1.2 The term Liquefied Petroleum Gas shall be as defined under the Gas Safety Ordinance (Cap 51), Laws of Hong Kong.

1.2 Installation to comply with the Particular Specification and Drawings.

The Liquefied Petroleum Gas Installation shall comply in every respect with the conditions of this Specification unless otherwise specified in the Particular Specification and Drawings relating to a particular project or modified by the written instructions of the Architect.

1.3 Scope of the Work

1.3.1 The scope of the Work under this Specification and the Particular Specification and Drawings relating to a particular project consists of the whole of the labour and all materials necessary to form a complete installation and such tests, adjustments, commissioning and maintenance as prescribed. It shall include not only the major items of plant and equipment shown or specified but all the incidental sundry components necessary for the complete execution of the work and for the proper operation of the installation, including the necessary labour, whether or not these sundry components are mentioned in detail in the Contract.

1.3.2 Unless otherwise specified, the Work also includes the initial supply of sufficient quantity of Liquefied Petroleum Gas for testing and commissioning, the specified quantity of Liquefied Petroleum Gas as indicated in the Particular Specification and Drawings, and the loan of Liquefied Petroleum Gas bottles. Subsequent replacement of the liquefied petroleum gas after the initial supply has been exhausted, will be provided by others. The Contractor shall be responsible for taking back his on loan bottles after the replacement has been made.

1.4 Definitions and Interpretation

In this Specification, the following words and expressions shall have meaning hereby assigned to them except when the context otherwise requires: -

“Employer”	means the Government of the Hong Kong Special Administrative Region.
“Building Contractor”	means the person, firm or company whose tender has been accepted by the Employer for building construction, including his or their personal representatives, successors and permitted assigns.
“Contract”	means the Articles of Agreement, the Tender and the acceptance thereof the Employer, Drawings, General Conditions of Contract, Special Conditions of Contract if any, Specifications and priced Bills

	of Quantities or Schedule of Rates. (The word “Contract” may also mean sub-contract as the context requires.)
“Contractor”	means the person(s), firm or company whose tender for the Liquefied Petroleum Gas installation has been accepted by the Employer and includes the Contractor’s personal representatives, successors and permitted assigns. (The word “Contractor” may also mean sub-contractor as the context requires.)
“Architect”	means the person named in the Articles of Agreement as the Architect or the Supervising Officer or such other person as may be authorised from time to time by the Director of Architectural Services and notified in writing to the Contractor to act as the Architect or the Supervising Officer for the purposes of the Contract. The person so named or authorised may be described either by name or as the holder for the time being of a public office.
“Drawings”	means the drawings referred to in the Contract and any modification of such drawings approved by the Architect and such other drawings as may be from time to time be furnished or approved in writing by the Architect.
“Standard Drawings”	means the drawings prepared by the Building Services Branch of the Architectural Services Department of Hong Kong Special Administrative Region to show detailed arrangements of the common standard installations.
“Or Equal” or “Or Similar” or “Or Equivalent”	means having similar characteristics and specification as regards type of construction, performance, safety provision, general appearance and standard of quality of manufacture and approved by the Architect.
“Competent Person”	means the person who has been recognised by the Gas Authority under Gas Safety Ordinance (Cap 51), Laws of the Hong Kong Special Administrative Region to perform or supervise or inspect or certify Liquefied Petroleum Gas installation, testing and maintenance work.
“Fire Resisting Period”	means the period of time during which the material can withstand fire as defined by the Buildings Department of the Hong Kong Special Administrative Region.
“High Pressure Stage”	means that part of the installation between the valve of the bulk storage vessel/cylinder and the inlet of the pressure regulator; the pressure range is exceeding 69 kPa.
“Medium Pressure Stage”	means that part of the installation between a first stage regulator and a second stage regulator; the pressure range is from exceeding 6.9 kPa to 69 kPa.
“Low Pressure Stage”	means that part of the installation between the second stage regulator (or the outlet of the high pressure regulator if no medium stage is used) and the inlet of the appliance, the pressure range is up to 6.9 kPa.

“LPG”	means the Liquefied Petroleum Gas as defined under the Gas Safety Ordinance (Cap 51).
“LPGA”	means the Liquefied Petroleum Gas Association of United Kingdom (previously known as Liquefied Petroleum Gas Industry Technical Association)
“NFPA”	means the National Fire Protection Association of United States
“FSD”	means the Fire Services Department of the Hong Kong Special Administrative Region.
“EMSD”	means the Electrical and Mechanical Services Department of the Hong Kong Special Administrative Region.
“BS”	means the British Standards, including British Standard Specifications and British Standard Codes of Practice, published by the British Standard Institution.
“BS EN”	means European Standard adopted as British Standard.
“ISO”	means the International Organization for Standardisation Publication
“API”	means American Petroleum Institute
“IP”	means Institute of Petroleum
“ASME”	means American Society of Mechanical Engineers
“ANSI”	means American National Standards Institute
“ASTM”	means American Society for Testing and Material
“JIS”	means Japanese Industrial Standards
“IEE”	means the Institution of Electrical Engineers of United Kingdom
“CGA”	means Canadian Gas Association
“BGC”	means Centrica Plc / BG Plc of United Kingdom (previously known as British Gas Corporation of United Kingdom)

1.5 Singular and Plural

Words importing the singular only also include the plural and vice versa where the context requires.

SECTION 2 – STATUTORY OBLIGATIONS, REGULATIONS AND SPECIFICATIONS

2.1 Installations to comply with Statutory Obligations, Regulations and Specifications

The LPG installations shall comply with, but not limited to, the following Statutory Obligations, Regulations and Specifications currently in force:

- 2.1.1 The Gas Safety Ordinance, Chapter 51, Laws of the Hong Kong Special Administrative Region and all the Gas Safety Regulations
- 2.1.2 Code of Practice for Hong Kong LPG Industry published by the Gas Authority
- 2.1.3 Gas Utilisation Code of Practice GU03, GU05, GU06 and GU09 published by the Gas Authority
- 2.1.3 Other Codes of Practice published by the Gas Authority
- 2.1.4 Codes of Practice for Minimum Fire Service Installations and Equipment published by the Government of Hong Kong Special Administrative Region
- 2.1.5 Requirements and Circular Letters of Fire Services Department of the Hong Kong Special Administrative Region
- 2.1.6 Building Regulations, Chapter 123, Laws of the Hong Kong Special Administrative Region
- 2.1.7 Dangerous Good Ordinance, Chapter 295, Laws of the Hong Kong Special Administrative Region
- 2.1.8 Electricity Ordinance, Chapter 406, Laws of the Hong Kong Special Administrative Region and the associated Electricity (Wiring) Regulations and Code of Practice
- 2.1.9 The Water Works Regulations, Chapter 102, Laws of the Hong Kong Special Administrative Region
- 2.1.10 Codes of Practice published by the Liquefied Petroleum Gas Association, United Kingdom or acceptable equivalent.
- 2.1.11 Codes and Standards published by the National Fire Protection Association (NFPA), American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society of Material Association (ASTM), United States

And

British Standard Specifications and British Standard Codes of Practice published by the British Standards Institution

And

Equivalent standard that is acceptable to the Architect and the Gas Authority when a code or standard is specified in the Specification

2.1.12 The General Specification for Electrical Installation in Government Buildings, Hong Kong issued by the Building Services Branch of the Architectural Services Department of the Hong Kong Special Administrative Region

2.1.13 The General Specification for Fire Service Installation in Government Buildings, Hong Kong issued by the Building Services Branch of the Architectural Services Department of the Hong Kong Special Administrative Region

2.2 Case of Conflict

This Specification shall be read in conjunction with the Particular Specification of the LPG Installation. In case of conflict, the following order of preference shall apply: -

2.2.1 Gas Safety Ordinance, Gas Safety Regulations and other statutory requirements

2.2.2 The Particular Specification and the Drawings

2.2.3 This Specification and the Standard Drawings

2.2.4 Code of Practice for Hong Kong LPG Industry published by the Gas Authority

2.2.5 Requirements and Circular Letters of FSD

2.2.6 Codes of Practice for Minimum Fire Service Installations and Equipment published by the Government of the Hong Kong Special Administrative Region

2.2.7 Codes of Practice issued by LPGA

2.2.8 Codes and Standards issued by NFPA, ANSI and ASME, British Standards and Codes of Practice issued by British Standards Institution or acceptable equivalent

2.3 Safety Requirements

All regulations on safety aspects issued by the Works Bureau, the Labour Department and other authorities of the Hong Kong Special Administrative Region, from time to time. Particular attention is drawn to the following:

- (1) Construction Sites (Safety) Regulations
- (2) Factories and Industrial Undertakings (Electricity) Regulations
- (3) Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations
- (4) Factories and Industrial Undertakings (Confined Spaces) Regulations
- (5) Construction Site Safety Manual issued by the Works Bureau.

2.4 Notifiable Gas Installation

LPG installation with either a storage capacity exceeding 130 litre water capacity or a liquid draw-off arrangement irrespective of the capacity or as defined by the Gas Authority is classified as notifiable gas installation. Construction approval, type approval of gas container and approval of use from Gas Authority are required for the notifiable gas installation.

2.5 Compliance with Specifications

The Tender submitted shall be deemed to be fully in compliance with the Specifications and all statutory regulations currently in force. Any deviations therefrom due to the substitution of other Standards shall be detailed in a covering letter accompanying the Tender. Any queries regarding interpretation should be addressed to the Architect before submission of the Tender.

2.6 Additional Information

Any requests for additional information, e.g. Architectural Drawings, should be addressed to the Architect before submission of the Tender.

SECTION 3 – EXECUTION OF WORKS

3.1 Registered Contractors

The Works shall be carried out by a Contractor registered with the Gas Authority in accordance with the Gas Safety Ordinance (Cap 51), Laws of Hong Kong Special Administrative Region.

3.2 The International System of Units (SI)

The International System of Units (System International d'Unites) of weights and measures shall be used for all materials and equipment.

3.3 Programme of Work

3.3.1 The Contractor shall submit a detailed programme of Works showing his intended method, stages and order of proceeding with the Work in co-ordination with the building construction programme, together with the period of time he estimated for each and every stage of Work.

The Contractor shall be responsible for the submission of drawings and other information to the Gas Authority and payment for the necessary fees in order to obtain the approval from the Gas Authority. The cost of which shall be deemed to be included in the Contract rates.

All new containers intended for use with LPG shall be approved by the Gas Authority in accordance with the Gas Safety (Gas Supply) Regulations.

3.3.2 The programme shall include the following: -

- a) Dates of order of equipment and materials.
- b) Dates of expected completion of builder's work requirements i.e. when work site is required to be ready.
- c) Dates of delivery of equipment and materials to site.
- d) Dates of commencement and completion of every stage of Work in line with the building construction programme, i.e. each floor level and/or zone area.
- e) Dates of completion, commissioning and testing.
- f) Dates of submissions and inspection by the Gas Authority.

Short term programmes showing the detailed work schedules of coming weeks and months shall also be provided to the Architect. Programmes shall be regularly updated to reflect the actual progress and to meet the obligations under the Contract.

In addition, detailed schedules showing the installation drawing submission, equipment offer submission, and commissioning and testing shall be submitted to the Architect for approval. The formats and information of the schedules shall be as required by the Architect.

3.4 Advice of Order Placed

The Contractor shall submit copies of all orders placed for major items of equipment.

3.5 Builder's Work

All builder's work including opening, holes through the building structure, partition walls and all concrete bases, supports, ducts, etc. required for the installation as shown on the Drawings will be carried out by the Building Contractor and free of charge to the Contractor. Any additional items relating to the LPG installation beyond those already included will also be carried out by the Building Contractor provided that the Contractor shall submit in good time to the Architect for approval, full details of such requirements, so that due consideration may be given before the Building Contractor commences work in the areas concerned. Following approval by the Architect, the Contractor shall be responsible for marking out the exact positions and sizes of all such works and for providing detailed information to the Building Contractor to facilitate him to carry out such work as it proceeds. The Contractor shall check that the work so executed will meet his requirement. The Contractor shall be liable for all expenses incurred which are brought about by the Contractor's failure to comply with the above requirements.

3.6 Works to be carried out by Registered Gas Installers

The LPG installation including the maintenance works shall be carried out by a Registered Gas Installer or by a trainee under the direct (on site) supervision of a Registered Gas Installer in accordance with Gas Safety Ordinance (Cap 51), Laws of Hong Kong Special Administrative Region. Such Registered Gas Installer shall be registered in the appropriate class of work with the Gas Authority under the registration scheme.

3.6.1 Tradesmen

All tradesmen must be experienced in the trade with the required training and the Works carried out shall be consistent with good practice in Hong Kong and to the satisfaction of Architect.

3.6.2 Tool and Instrument

Proper tools shall be used to carry out the Works. Appropriate and accurate testing/measuring instruments shall also be used to demonstrate the compliance of the Works with the relevant specifications and regulations. The Architect has the right to stop any work on which the correct tools or instruments are not being used.

Instruments used for acceptance tests shall be calibrated at appropriate intervals and as required in the Contract for a particular project.

3.7 Safety on Site

3.7.1 All Works shall be carried out in such a manner so as to comply with the Gas Safety Ordinance (Cap 51), the Construction Site Safety Regulations and the Factories & Industrial Undertakings under Laws of Hong Kong Special Administrative Region.

3.7.2 The Contractor shall implement a work permit system where work is required to be carried out on the installation in which LPG has been loaded (Annex 3.1 and 3.2). The Contractor shall be responsible to take every fire precautionary measures. He shall also be responsible for putting up warning signs at prominent positions on site to warn other contractors of the existence of the inflammable gases.

3.8 Warning Signs

3.8.1 The Contractor shall provide “NO SMOKING”, “LPG HIGHLY FLAMMABLE” and “LPG STORE” signs in 120 mm minimum English and Chinese characters and shall prominently display them on or adjacent to each point of entry to the LPG installation.

3.8.2 At the bulk storage vessels, at least TWO sets of the above mentioned signs shall be provided. The warning signs shall be made of sandwich plastic material with white outer layers and a black or red inner layer as required. Lettering shall be engraved on the plastic material by cutting away one of the outer layers to outline the required letters, and exposing the inner underneath. Details shall be submitted to the Architect for approval prior to engraving.

3.8.3 The Contractor shall provide and install adequate warning signs, emergency notices, operating instructions and framed schematic and line diagram in accordance with the requirement of the Gas Authority.

3.9 Colour Coding

The Contractor shall identify all LPG piping with a colour band in accordance with BS 1710. The basic identification colour shall be yellow ochre with black letters and signs on top to show the word “LPG”, the “liquid” or “vapour” phase where the piping are inside the storage compound and the direction of flow.

3.10 Label

All emergency control/valves shall be labelled to show their ON and OFF positions. The label may be in the form of a continuous roll of self-adhesive material or a permanent notice clearly marked “LPG Emergency Valve” and prominently displayed near such control/valves. Similarly, a permanent notice marked “LPG Main Control Valve” for the LPG main control valve outside the building shall also be provided.

Operating instructions shall be provided at appropriate locations to ensure safe, continuing and reliable operations. The operating instructions shall be made on a durable material and be properly fixed.

3.11 Co-ordination of Contract Works

The Contractor shall co-ordinate his proposed programme of work with that of the Building Contractor and any other contractors and sub-contractors and shall make any modification reasonably required by the Architect in order to adhere to the approved overall construction programme.

3.12 Co-operation with other Contractors

The Contractor shall co-operate at all times with the Building Contractor and all other contractors and sub-contractors in order to achieve efficient working on site.

3.13 Submission to Gas Authority

The Contractor shall make arrangement for all necessary submission to the Gas Authority for the LPG installation. This shall include, but not limited to, the application for construction approval, the application for approval of use and the application for type approval of gas container, where applicable. The Contractor shall allow the cost and allow necessary time in his program for the submission. Where the application for approval of use is made through the Architect, the Contractor shall provide relevant information, test certificates and drawings to the Architect for the submission. Copy of approval from Gas Authority obtained by the Contractor shall be submitted to the Architect.

3.14 Sample Board

Prior to the commencement of installation work, the Contractor shall submit to the Architect for approval in good time a sample board of LPG accessories proposed to be used for the Contract. Each sample shall be firmly fixed onto a rigid wooden or metal board and clearly numbered and labeled. A list shall be affixed to show the item description, make and brand, country of origin and locations of installation (if not generally used). Only samples deemed to comply with the specification shall be displayed and items shall be adequate for the whole installation unless otherwise clearly indicated as outstanding ones to be submitted later. Samples rejected by the Architect shall be replaced as soon as possible. Upon approval of all items, the Architect will endorse the list and the sample board shall be delivered by the Contractor to the site office for reference.

The following components shall be included in the sample board as a minimum. Additional items may be required by the Architect and/or specified in the Particular Specification.

- (1) pipework, fitting and support
- (2) flexible rubber hose and tubing

In addition, the Contractor shall keep on site a full list of all the equipment approved by the Architect together with the sample board. The list shall include detailed description on the make and brand of the equipment and country of origin.

SECTION 4 – INFORMATION REQUIRED FROM TENDERER

4.1 Information Furnished with Tender

The Tenderer shall complete the Equipment Schedule attached to the Tender Document and also furnish the following information, where applicable, without which the Tender will be considered incomplete :

- (1) Name of manufacturer, country of manufacture, type and catalogue number, and full technical performance detail, of all major items of equipment offered.
- (2) List of standards to which the offered equipment and materials are designed and manufactured and copies of test certificates showing compliance with the specified standards issued by recognized international testing authorities.
- (3) Illustrated technical brochures in English or Chinese showing all major items of equipment and their installation requirements.

4.2 Equipment Schedule

All equipment and materials offered by the Tenderer in the Equipment Schedule for the Works shall comply in full with the relevant Specifications and Drawings. Tenderer may include up to three alternative proposals for each item listed in the Equipment Schedule. Tenderer shall submit detailed information and technical brochures for each of the alternative proposal.

4.3 Schedule of Rate

For tenders based on Schedule of Rates, the Tenderer shall complete the Schedule of Rates attached to the Tender Document to show how the tender sum is made up.

4.4 Invalidation of Tender

Tenderer are advised that failure to furnish the above information at the time of tendering may render their tenders invalid.

4.5 Samples

Samples may be required immediately after submission of Tender and before tender recommendation or acceptance. The Tenderer shall be prepared to deliver the materials to the Architect's office and collect after examination and demonstration.

SECTION 5 – DRAWINGS AND MANUALS

5.1 Tender Drawings

The general arrangement drawings supplied with the Tender documents are provided for the Contractor's guidance and information when tendering. Should the arrangement and dimensions shown be inadequate for the Contractor to properly install the plant as specified, he shall draw the Architect's attention to the fact at the time of submitting his Tender, together with details of amendments required.

5.2 Installation Drawings

Installation drawings including manufacturer's shop drawings shall be prepared and submitted to the Architect for perusal by the Contractor in sequence with the Building Contractor's construction programme. They shall contain plan layouts, sectional drawings (elevations and plans), vertical plumbing line diagrams, schematic wiring diagrams, installation details, etc. and shall show the following particulars:

- (1) Service routings and levels relative to the structure and other services,
- (2) Plant and equipment locations with dimensions and weights,
- (3) Service joints, supports and fixing details together with their locations,
- (4) Maintenance accesses, facilities and all necessary details relating to the proper operation and maintenance of the systems.

The drawings shall include all design accessories and shall be drawn to match the materials and equipment supplied by the Contractor. Drawings showing details in spatial zones shall be prepared subsequent to proper co-ordination with the Building Contractor and other trades on site.

All drawings shall be dimensioned in S.I. units and suitably scaled to show all necessary details.

The manufacturer's shop drawings are for equipment or plant to be manufactured by a specialist manufacturing supplier away from the site. The drawings shall show detailed construction, principal dimensions and weights, clearances for maintenance, etc.

Four (4) sets of the preliminary installation drawings shall be submitted to the Architect who will then check, endorse and return two (2) sets to the Contractor for onward submission to the Fire Services Department for perusal. Work can only be commenced upon receipt of a set of drawings chopped/recorded by the Fire Services Department and written approval from the Architect. Six (6) sets of all such approved drawings shall then be submitted.

5.3 Gas Standard Office Construction Approval

The Contractor shall ensure that construction approval where necessary from the Gas Authority has been obtained prior to commencing construction work of the LPG installation on site. The Contractor shall submit installation drawings and other necessary information to the Gas Authority for construction approval.

5.4 Builder's Work Drawings

Unless otherwise agreed by the Architect, the Contractor shall submit to the Architect, within six (6) weeks of the award of the Contract, six (6) copies of drawings showing details of all builder's work required for the LPG installation, and showing all loads on beams or structures. Such drawings shall clearly indicate the details and positions of all holes, trenches and cutting required for pipework, drains, foundation plinths, ventilation requirements, etc. and construction details for equipment bases.

5.5 As-built Drawings

Supply three (3) sets of first draft prints of as-built drawings at least eight (8) weeks before the commencement of commissioning of the installation/services/equipment. Any details not available at that time (e.g. commissioning and testing results) shall be provided with the penultimate drafts.

The Architect will check the drafts and return a set of marked up copies to the Contractor within six (6) weeks from the date of submission by the Contractor, together with comments necessary for final and approved documents.

The finalised approved as-built drawings shall be in three (3) sets of microfilm, two (2) sets of computer disk, one (1) set of reproducible copy and four (4) sets of prints, and shall be submitted as soon as possible but not later than one month after the installation/services/equipment has been commissioned.

The requirements for media of as-built drawings shall also be as specified in the Contract Preliminaries.

5.6 Sizes of Drawings

Each drawing submitted shall conform approximately to one or other of the following standard sizes :

- (1) 841 x 1189 mm (AO)
- (2) 594 x 841 mm (A1)
- (3) 420 x 594 mm (A2)
- (4) 297 x 420 mm (A3)
- (5) 210 x 297 mm (A4)

5.7 Operation and Maintenance Manuals

Supply three (3) sets of the first draft of operation and maintenance manuals and the lists of recommended spare parts for one year's operation and special tools complete with prices to the Architect for comment at least fifty-six (56) days prior to the commissioning and testing of the plant and equipment. Any details not available at that time (e.g. commissioning and testing results) shall be provided with the penultimate drafts.

The Architect will check the draft and return it to the Contractor within forty-two (42) days from the date of submission by the Contractor with comments necessary for final and approved documents.

The three (3) sets of finalised manuals shall be submitted as soon as possible but not later than one month after the installation/services/equipment has been commissioned. One set of the manuals shall be the original.

The structure and contents of the operation and maintenance manual shall be as specified in the Contract Preliminaries.

The final manual shall have pages of A4 size with A3 size folded where necessary. The pages shall be good quality paper that is sufficiently opaque to avoid “see through”. The manuals shall be bound in durable loose leaf ring binders of the four ring type. Where specified, instead of ring binder, the manual shall be permanently bound and encased in durable hard covers. The manual shall have labels or lettering on the front and spine of the covers. The number of separate manual volumes required will depend on the size and complexity of the installation concerned. The Architect’s agreement is to be obtained on this at the draft manual stage.

5.8 Framed drawings on Site

On completion and before the acceptance of the LPG installation, the Contractor shall provide a framed drawing with glass cover and fix it on the wall of all the LPG stores/vaporiser rooms. The drawing shall indicate schematically all the pipe routes, positions of main controls and all sectional cocks or valves, meters, pressure testing points, etc and site layout plan to the approval of the Architect.

A log book shall be provided and kept on site recording all operational checks and maintenance.

SECTION 6 – BULK LPG STORAGE VESSELS

6.1 General

This section covers fixed LPG storage vessels of capacity in excess of 450 litres water capacity which are normally refilled on site.

6.2 Storage Vessels

6.2.1 Vessels shall be designed and constructed of steel in accordance with a recognised Pressure Vessel Code such as BS 5500 or ASME Boiler and Pressure Vessel Code Section VIII or equivalent. The Contractor shall be responsible to obtain the approval from the Gas Authority and submit the manufacturer's test certificates to prove that these standards have been fully complied with. Use of partial standards shall not be allowed.

6.2.2 Vessels shall be post-weld heat treated in accordance with the respective design codes and shall be subject to 100% radiography examination and a satisfactory "charpy" test at minimum design temperature.

6.2.3 Bulk tanks shall be designed to minimum pressure of 1.725 MPa and a minimum design temperature of -10 °C.

6.2.4 Each vessel shall be provided with a permanently fixed and clearly visible data plate that shall include as a minimum the following information:

- a) the Pressure Vessel Code,
- b) the manufacturer's name and serial number,
- c) the water capacity in kilolitres,
- d) the maximum working pressure in kPa,
- e) the date of manufacture,
- f) design temperature range in °C – minimum and maximum,
- g) date of test, pressure applied, inspection authority, and its symbol.
- h) provision of sufficient space for subsequent re-test marking.

6.2.5 The vessel supports shall be of adequate design with due consideration of the vessel shell stressing and transmission of loading to the ground.

6.2.6 Saddles, bearing or corrosion plates shall be designed in accordance with the Pressure Vessel Code to which the vessel is designed and shall be of steel. Where saddles are not welded to the vessel, bearing and/or corrosion plates shall be used. The latter shall also be used whenever there is likely to be severe corrosion between the vessel and the supporting structure.

6.2.7 Saddles shall project downward more than any other projection on the lowest part of the vessel. Where saddles are not used, the vessel supports shall be shaped to conform to the vessel shell.

- 6.2.8 For above ground vessels above 5000 litres water capacity or where piers are used as part of the vessel support, provision shall be made for securing the vessel at one end, the other being free to move as required. The end so secured shall be that to which the principal liquid and vapour lines are attached.
- 6.2.9 Underground vessels shall be secured at both ends against flotation and they shall also be secured against movement at the end to which the connections are made.
- 6.2.10 Skirts for vertical vessels shall be provided with at least two vents to prevent the accumulation of liquid or vapour.
- 6.2.11 Horizontal vessels shall be sloped slightly towards the drain connection; alternatively the liquid withdrawal connection shall be at a slightly higher level than the drain connection.
- 6.2.12 Vessels exceeding 5000 litres water capacity shall have a manhole of minimum diameter of 450 mm. The manhole in the form of extruded nozzles shall be of not less than 550 mm internal diameter. Above ground vessels of less than 5000 litres water capacity and not fitted with a manhole shall be fitted with inspection openings accessible from the top.
- 6.2.13 In addition to inlet and outlet connections, each bulk storage LPG vessel shall be provided with at least one of each of the following fittings:
- a) pressure relief valve connected directly to the vapour space,
 - b) plugged shut-off valve for connection,
 - c) a fixed maximum liquid level device and a contents gauge,
 - d) a pressure gauge connected to the vapour space,
 - e) a suitable earthing connection.
- 6.2.14 All fittings on an underground vessel shall be accessible above ground level and shall be either on the manholes or on welded extensions.

6.3 Pressure Relief Valves

- 6.3.1 Pressure relief valves shall be of tamper-proof, direct spring loaded type, and designed to start to discharge and attain full flow at pressure in accordance with the Pressure Vessel Code of the vessel. Weight loaded relief valves shall not be used. The pressure relief valve shall have the following information stamped on the valve or on a separate metal plate securely fixed to it: -
- a) the manufacturer's identification including name and catalogue or type number, and
 - b) the start to discharge pressure. Space shall be provided on the valve or the metal plate for subsequent stamping of periodic retest dates,
- 6.3.2 In the case of multiple pressure relief valves, provision made for isolating any one relief valve for testing or servicing shall ensure that the remaining relief

valves provide the full capacity. In the case of vessels fitted with single relief valves, provision shall be made for their removal for testing or servicing by the use of an automatic shut-off valve which shall be fully open by the presence of the relief valve and shall close before the relief valve is completely removed.

- 6.3.3 For above ground vessels the rate of discharge of the pressure relief valve(s) at full flow shall not be less than 300 litres/s air or that calculated according to the formula, whichever is the greater:

$$\text{Flow rate, litres/s air} = 177.637 \times (\text{Surface Area, m}^2)^{0.82}$$

- 6.3.4 For underground vessels the full flow capacity of the pressure relief valves may be reduced to not less than 30% of the capacity derived for above ground vessels.
- 6.3.5 Excess flow valves shall not be installed between the vessel and any pressure relief valve.

6.4 Vent Pipes

- 6.4.1 For above ground vessels over 5000 litres water capacity and for all underground vessels, the relief valves shall be fitted with vent pipes adequately supported and having outlets at least 2 m above the top of the vessels to which they are fitted and at least 3 m above ground level. Vent pipe outlet shall be located away from fixed sources of ignition at a minimum distance of 4.5 m. Electrical fittings within this area shall be in accordance with section 13.
- 6.4.2 Vent pipes shall be designed for the full flow characteristic of the relief valves, to allow for drainage of water and to ensure that in the case of ignition of discharging products, flame impingement on the vessel or on any adjacent vessels, piping or equipment is avoided.
- 6.4.3 Vent pipes shall be provided with loose fitting captive rain caps.
- 6.4.4 In case of vessels fitted with protective covers, the vent shall be provided to direct the discharged LPG through the relief valve away from the vessel shell.

6.5 Shut Off Valves and Emergency Valves

- 6.5.1 All liquid and vapour connections on vessels other than those for relief valves, plugged openings and those where the connection through the vessel shell is not greater than 1.4 mm, shall have fire resistant shut-off valves conforming to BS 6755 or API 607 or equivalent, capable of manual operation located as close as practicable to the vessel. Particularly, liquid and vapour withdrawal connections shall be fitted with shut-off valve completed with integral excess flow valves. Filling connection shall be fitted with shut-off valve and check valve in accordance with clauses 6.8.
- 6.5.2 Other connections to the vessel greater than 3 mm diameter for liquid and 8 mm diameter for vapour with the exception of those for relief valves and drain connections shall also be protected with an emergency valve.

6.5.3 Remotely controlled emergency valve shall be provided for large size connections of 40 mm or above. The emergency valve manual control shall be operated from a safe area and be of the “fail-safe” type.

6.6 Filling connections

6.6.1 All filling connections of a storage vessel shall be equipped with:

- a) an emergency valve, e.g. an excess flow valve, back check valve,
- b) a shut-off valve preferably capable of manual operation.

6.6.2 Filling connections shall be easily accessible, preferably within the storage fenced area, and as close to the vessel as is practice, but not directly underneath.

6.6.3 Filling connections shall be located so that the safe positioning of the delivery vehicle and its quick removal in an emergency are facilitated.

6.6.4 Offset/Remove filling connections including vapour returns, shall be clearly labelled “liquid” or “vapour” as appropriate and shall terminate about 1 m above ground and shall allow a horizontal connection to be made with the delivery hose(s).

6.7 Drain Connections

6.7.1 Drain connections designed to permit drainage to atmosphere shall be provided with a shut-off valve which is preferably not more than 50 mm nominal size. The outlet of the drain valves shall be provided with a length of piping terminating with second shutoff valve, preferably not more than 25 mm nominal size. A sufficient length of piping shall be provided downstream of the second valve to ensure that discharge will not take place beneath the vessel. The drain valve adjacent to the vessel connection shall be quick action type.

6.7.2 No drain or blow-off line shall discharge into or be in the proximity of any public drainage system or any other drainage system where this would be liable to create a hazard.

6.7.3 The outlet of the drain valve system shall be blank-flanged, plugged or otherwise secured against tampering when not in use.

6.7.4 Pipework between the drain system valves and between any valve and a blank-flange or plug etc. shall be protected by hydrostatic pressure relief valve.

6.8 Gauges

6.8.1 The content gauges shall clearly indicate whether they read in % water capacity, % rated LPG capacity or actual contents in litres, tonnes, etc. Each bulb tank shall be equipped with at least two gauges for indicating the quantity of content, one of which shall be of a fixed liquid level type.

6.8.2 Any content gauge which relies on bleeding to atmosphere shall be such that:

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- a) The bleed hole maximum opening is not larger than 1.4 mm otherwise it shall be protected by a shut-off valve and a suitable emergency valve.
 - b) It shall not be completely withdrawn in normal gauging operation.
 - c) The gland shall be capable of being repacked without withdrawing the vessel from service.
- 6.8.3 The setting of the maximum level devices shall be suitable for the grade of LPG being stored and shall indicate a maximum product level for the designed ullage at a temperature of 42.5 °C.
- 6.8.4 Temperature gauges shall be of the indirect type comprising pockets merged in contact with the vessel contents.
- 6.8.5 Pockets if temperature gauges shall be in the form of blind tubes suitable length, oil filled, permanently welded to the vessel and constructed in accordance with the Pressure Vessel Code of the vessel.
- 6.8.6 Pressure gauges shall be provided for all fixed storage vessels and connected to the vapour space of the vessel and easily readable from ground level. Pressure gauge mounting connection shall be protected either by a tapping reduced internally to a bleed hole not larger than 1.4 mm or by a suitable excess flow valve and shut off valve.

6.9 Maximum Permitted Filling Volume

The maximum permitted filling volume should be reference to the legal requirements for filling of cylinders as prescribed in the Gas Safety (Gas Supply) Regulations 10(2).

No person shall fill a tank or cylinder with LPG other than such that, at temperature of:

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- a) 47.5 °C, the tank will not be more than 97%, and the cylinder will not be more than 95%, full of LPG in liquid form; and
- b) 52.5 °C, the tank or cylinder will not be full of LPG in liquid form.

6.10 Location and Safety Distances

- 6.10.1 No underground storage vessels shall be installed in basements or open pits. Storage vessels, whether at ground level or underground shall be spaced and located in accordance with Appendix 2 of LPG Code No. 1 in which the distances given are the minimum recommended and refer to the horizontal distance in plan between the vessel and the nearest point of a specified feature, e.g. an adjacent storage vessel, building, property line, fixed point of ignition, any point of the LPG installation boundary up to which the general public legitimately have access. For underground vessels, distance from the vessel is measured from the valve assembly on the manhole cover. Dimension in column 6 of the Appendix 2 may be reduced to 0.6 m.
- 6.10.2 The distance from the valve assembly on the manhole cover and the loading/unloading point to the LPG installation boundary up to which the general public legitimately have access must be at least 3 m.

- 6.10.3 For underground storage vessels, the distance between the vessel and the LPG installation boundary must be at least 1.5 m and the concrete chamber around the underground storage vessel must be wholly within the LPG installation boundary.

6.11 Arrangement and Separation

- 6.11.1 Above ground storage vessels shall not be installed one above the other. In the case of multiple vessel installations, and where vessels are interconnected in the liquid phase, precautions must be taken to prevent both overfilling and the unintentional transfer of liquid from one vessel to another.
- 6.11.2 An LPG storage vessel shall not be installed nearer than 7 m to any vessel or bund wall of vessels containing any other inflammable liquid with a flash point below 65 °C.
- 6.11.3 The number of storage vessels in one group shall not exceed six, subject to the maximum total capacity of a group given in Appendix 2 of the LPG Code No. 1. Any vessel in one group shall be at least 8 m from any vessel in another group unless a radiation wall is erected between the groups, or adequate fixed water drenching systems are provided.
- 6.11.4 Separation kerbs for directing spillage away from vessels and other important areas shall not be higher than 380 mm.
- 6.11.5 Suitable protection must be provided to prevent possible damage to the above ground vessels and associated equipment valves, etc. by the use of crash barriers, bollards or a non-continuous kerb of not more than 380 mm in height.
- 6.11.6 Individual underground vessels of a multi-vessel system shall each be enclosed by a separate Concrete Chamber.
- 6.11.7 Underground vessels shall be protected from above ground loadings due to vehicular traffic or other cause, either by fencing off the area under which the vessels are buried or protecting them with reinforced concrete slab or other adequate cover. If the vessel area is not fenced off, the vessel manhole cover and the vessel fittings shall be protected against damage and tampering. The perimeter of the area under which the vessels are buried shall be permanently marked.

6.12 Finishes and Coating

- 6.12.1 The exterior of an underground vessel shall be covered with a coating material which shall be strongly bonded to all external surfaces of the vessel. The coating material shall have the following properties:
- a) be electrically insulating;
 - b) be inert;
 - c) be impervious to water;
 - d) possess high dielectric strength;

- e) possess adequate mechanical strength to resist damage during handling of the vessel; and
- f) have sufficient flexibility to allow for any damage due to expansion or contraction of bulk tank.

6.12.2 After coating of the vessel is completed, “holiday” test shall be carried out in accordance with section 15 of this Specification.

6.13 Cathodic Protection

Every semi-underground or underground vessel shall be provided with a cathodic protection system complete with test point (Gas Safety (Gas Supply) Regulation 12(1)). Tests on the cathodic protection system shall be made after completion of the installation and at 6 month intervals thereafter. The test results shall include the following data and shall be recorded and retained for the life of the vessel.

- a) quantity, size and location of anodes,
- b) date of installation,
- c) type of backfill material, and
- d) resistivity measurement of electrolyte.

SECTION 7 – LPG CYLINDERS

7.1 General

- 7.1.1 This section covers LPG installation using transportable, refillable cylinders, each not exceeding 130 litre water capacity but excludes the coverage of disposable cartridges.
- 7.1.2 The LPG installation may not ask for the supply of LPG cylinders. However, the LPG supplied by the Contractor shall be contained in cylinders which must have complied with the relevant British Standard Specifications or other recognized pressure vessel codes and approved by the appropriate authority of Government of Hong Kong SAR.
- 7.1.3 Refilling the transportable cylinders shall not be carried out locally at the LPG installation.

7.2 Liquid-Draw System

- 7.2.1 Installation using liquid-draw LPG cylinders shall be incorporated with a vaporiser for the production of vapour LPG, which shall subsequently be conveyed to the appliance through pressure regulator(s).
- 7.2.2 Hydrostatic pressure relief valve shall be installed on each liquid piping that can be isolated by valves.
- 7.2.3 All liquid-draw cylinder shall be conspicuously marked for clear distinction from vapour-draw cylinders.

7.3 Vapour-Draw System

Installation having vapour-draw LPG cylinder may direct feed the installation through pressure regulator(s).

7.4 Multi-Cylinders System

- 7.4.1 Multi-cylinders in cylinder banks shall be manifold together by a permanent header, which shall be linked together through changeover device to enable that only one bank cylinder will supply LPG to appliances at any one time.
- 7.4.2 Manual and automatic changeover device shall be equipped with indication for the particular bank of cylinders being in operation, and may be complete with pressure regulation device should it be used in a vapour-draw system. The operation of the changeover device shall avoid GAS ON-GAS OFF-GAS ON situation.
- 7.4.3 Connection of the cylinders to a manifold shall be made by flexible hose as specified in clause 7.4.1 and of sufficient length for easy manoeuvring of the cylinders. A flexible hose connecting to a manifold shall not be left unconnected after commissioning.
- 7.4.4 Safety Devices

- 7.4.4.1 Provision shall be incorporated into a manifold system to ensure that failure of a flexible hose connecting a cylinder to the manifold will not cause the complete loss of content from other cylinders.
- 7.4.4.2 When more than one cylinder supplying LPG to a piped gas system by means of flexible hose to a manifold system, appropriate safety devices shall be incorporated in accordance with Gas Safety (Gas Supply) Regulation 11(e) as described in Section 7.4.4.3.
- 7.4.4.3 The device consisting of a stop valve with check function shall be installed between the flexible hose and the manifold system for all cylinders. In the case of liquid withdrawal cylinders, one particular cylinder of each bank shall be installed with a stop valve with excess flow device to allow liquid LPG to flow back from the vaporiser.
- 7.4.4.4 By-pass pipework in addition to changeover device may be provided to ensure continuity of supply during maintenance. By-pass valves shall be kept closed throughout the normal operation.

7.5 Simple Domestic Installation

For domestic installation using LPG cylinder of 15 kg or less, a clip-on regulator may be connected directly to the cylinder for drawing vapour LPG to the appliance through flexible hose, rubber tubing and/or metal piping. Clip-on regulator shall be of approved type acceptable to the Gas Authority.

7.6 Storage of LPG Cylinders

- 7.6.1 The storage of LPG cylinders and the minimum separation distance to boundary building or fixed ignition source from the nearest cylinder shall be in accordance with LPGA Code of Practice No. 7.
- 7.6.2 Within a single storage, all LPG cylinders are considered to be full irrespectively of the state of their contents for the purpose of calculating the minimum separation distance.
- 7.6.3 Wherever practicable LPG cylinders shall be stored in open air with top cover of non-combustible material for weather protection and shading from direct sunshine. Where an open storage is not practicable, a purpose-built storage room shall be provided and constructed in accordance with the ventilation and explosion relief requirements in section 14 of this Specification.
- 7.6.4 The storage arrangement of cylinders in standby cylinder stores shall conform to the following:-
 - a. The gangway between palletised stacks shall be not less than 2.5 m while that between unpalletised stacks shall be not less than 1.5m.
 - b. The maximum height of a stack shall not exceed 1.6 m.

SECTION 8 – VAPORISERS

8.1 Types

- 8.1.1 Vaporisers shall be of indirect heated type without naked flame or red-heated element, and utilising water as the heating medium. All electric elements and components installed within the vaporiser, shall be of flameproof design with enclosure to BS 4683: Part 2 or equivalent, unless they are being installed elsewhere and are physically separated at least 1 m from the vaporiser.
- 8.1.2 Vaporisers of direct fuel/heated type with naked flame or of non-flameproof electrical type shall not be used.
- 8.1.3 Heating coil shall not be installed inside bulk tanks as means of vaporisation.

8.2 Capacity

The vaporiser shall have sufficient capacity to convert the liquid LPG at minus 10 °C to vapour at a temperature above the dew point at the maximum inlet pressure to the vaporiser and at the maximum demand rate from the installation.

8.3 Construction

- 8.3.1 Pressure containing component of the vaporisers shall be designed, manufactured and factory tested in accordance with a recognized Pressure Vessel Code. The design pressure of the LPG containing component shall meet the highest pressure and temperature in service. The Contractor shall be responsible for producing certificates to verify the standard of construction.
- 8.3.2 Each vaporiser shall be permanently labelled on the outer surface of the casing to display the following data: -
 - a) The design Pressure Vessel Code.
 - b) The manufacturer's name, serial number and the date of manufacture.
 - c) The maximum LPG working pressure and temperature.
 - d) The outside surface area of the pressure vessel in m².
 - e) The vaporising capacity in litre per minute or kg per hour.
 - f) The heat exchanger area in contact with liquid LPG in m².

Extra space shall be provided in the metal plate for subsequent periodic stamping of retest dates.

8.4 Functional Components and Safety Devices

- 8.4.1 Each vaporiser shall be equipped with at least the following facilities so as to ensure proper functioning and safe operation: -
 - a) Pressure relief valve in direct communication with the vapour side for an immediate and effective discharge of vapour to atmosphere at

full flow conditions in case of excess vapour pressure. The relief pressure shall be in accordance with the Pressure Vessel Code to which the vaporiser is designed and constructed, and the relief capacity shall be 3.33 times the values in clause 6.3 using the surface area of the vaporiser shell and that of the heat exchanger that is directly in contact with LPG as the total surface area.

- b) Liquid control device (such as a magnetic valve or float valve) to prevent liquid LPG from penetrating through the vaporiser to the vapour discharge pipe during heat input failure, overloading and any other abnormal condition.
- c) Non-bimetal heat input control to prevent overheating and the pressure in the vaporiser vessel from reaching the start-to-discharge pressure of the pressure relief valves. Large vaporisers with multiple heating elements may be controlled by stages by more than one thermostat for regulating the temperature.
- d) A drain off point for the LPG circuit complete with an intentionally operated control valve for the periodic drain off of oil and residue collected at the vaporiser. End of the connection shall be blanked or plugged.
- e) Water level indicator and a low water level cut off to protect the vaporiser against damage due to low water level.
- f) Gauges or other indication devices to accurately monitoring the state of liquid and vapour LPG within the vaporisation system and to keep track of the water temperature during operation.
- g) A drain valve for the water chamber.
- h) Shut-off valves at both the liquid and vapour LPG lines connecting the vaporiser to the storage vessel in accordance with Gas Safety (Gas Supply) Regulation 13. The emergency shut-off valves (Clause 10.6) provided upstream of the vaporisers shall be installed at a location as close to the vaporisers room entrance and as far away from the bulk tank as possible for access in the event of fire. Emergency shut-off valves shall be of fire-resistant type.

8.4.2 Fusible plugs and frangible discs shall not be installed in the vaporisation system.

8.5 Location of Vaporisers

8.5.1 Minimum Distance from Vaporiser to Storage Vessel

Type of Vaporiser	Storage Vessel
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Vaporiser	Above ground with no radiation wall	Underground or mounded storage vessel up to 60 tonnes
Indirect heated or flameproof electric	1.5m	1.5m

- 8.5.2 For above ground storage vessel with radiation walls which are constructed as specified in Section 12, the minimum distance shall be the same as in the table in 8.5.1, but the distance may be measured round the ends of the radiation wall. The distance between the storage vessel and the wall shall be at least 1 m but not more than 2 m. The distance between the vaporiser and the wall shall be as follows: -

Water Capacity of Storage Vessel (litre)	Minimum Distance of Vaporiser from Radiation Wall (metre)
Over 1125 to 2250	1
Over 2250 to 9000	2.5
Over 9000	Radiation wall inappropriate

- 8.5.3 Minimum Distance from Vaporiser to Building or Boundary Lines of Adjoining Property

Type of Vaporiser	Minimum Distance
Indirect heated or flameproof electric	3 m

Electrical wiring and lighting for vaporiser room shall be designed and constructed in accordance with zone 1 electrical classification.

- 8.5.4 Pressure relief valves, pressure regulators and control equipment installed near the vaporiser shall not be located at where the ambient temperature is in excess of 60°C unless they are specifically designed for higher temperature.

8.6 Drain and Vent

- 8.6.1 Liquid LPG drain valve shall be permanently connected to pipe of sufficient length and running away from the vaporiser so that discharge of liquid LPG will not take place near to the vaporiser. The pipe outlet shall be fitted with another intentional operated shut-off valve but of one size smaller than the drain valve. The point of discharge of the liquid LPG shall be so selected that the possibility of creating a hazard is minimal.
- 8.6.2 Vapour from the pressure relief valve shall be piped upward and away from the adjacent LPG storage vessels for free discharge to the atmosphere.
- 8.6.3 Vent pipes shall be designed for the full flow characteristic of the pressure relief valve.

SECTION 9 – PIPING AND FITTINGS

9.1 Material

All materials shall be compatible for use with LPG under the service conditions to which they are subjected. Pipes up to and including 13 mm nominal bore shall be steel or copper. Pipes over 13 mm nominal bore shall be of steel construction. Materials such as cast iron, aluminium or its alloys, rubber and plastic other than those specially designed for LPG shall not be used.

9.2 Steel Pipes

9.2.1 All liquid pipelines shall be Schedule 80 seamless steel pipes conforming to BS 3601 or API 5L, and of a design working pressure of 2.75 MPa.

9.2.2 All vapour pipelines at high pressure stage shall be Schedule 80 seamless steel pipe conforming to BS 3601 or API 5L or ASTM A53.

9.2.3 All vapour pipelines at medium pressure stage and below shall be of steel construction and conform to BS 1387 or ISO 65 heavy grade.

9.3 Copper Pipes

Copper pipes shall be solid drawn, of appropriate gauge to suit the working pressure of the system and shall conform to BS EN 1057 (EN 1057), suitable for connection by capillary or compression fittings to BS 864: Part 2.

9.4 Flexible Rubber Hose and Tubing

9.4.1 The flexible hoses shall conform to BS 3212 (type 2) or equivalent. It shall be designed to withstand a minimum bursting pressure of four times the maximum operating pressure or 5200 kPa whichever is higher. Corrosion resistant braiding shall be used. Each flexible hose shall be marked with "LPG" and be tagged with a label indicating the date of next replacement.

9.4.2 Emergency valves shall be installed in all liquid pipelines and in vapour pipelines at high pressure stage to which the flexible rubber hose are connected, to prevent discharge of LPG Gas in the event of hose failure. A manual shut-off valve shall be used for vapour lines designed to operate at medium pressure stage or below.

9.4.3 The flexible rubber tubing shall conform to BS 3212 (type 1) for installations up to 5 kPa. The tubing shall be of minimum practicable length and shall not exceed 2 metre. The flexible tubing shall not extend from one room to another nor pass through wall or ceiling etc. and shall be easily accessible for inspection.

9.4.4 The end fitting of the flexible rubber hose or rubber tubing shall comply with BS 5315 or the equivalent of applicable codes.

The clips, clamps or spigots used to secure flexible rubber hose or rubber tubing on the fittings shall be free from burrs and rough edges and shall not be over-tightened.

9.5 Pipe Joints

- 9.5.1 Joints in steel pipes of 50 mm nominal bore and smaller shall be welded, flanged or screwed. Steel pipe joints over 50 mm nominal bore shall be welded or welded flanged.
- 9.5.2 Joints in copper pipes shall be of compression type or sweated type silver soldered or brazed using a jointing material with a melting point exceeding 540 °C
- 9.5.3 Jointing of steel pipes by gas welding shall be in accordance with BS 2640 and welding by electric arc shall be in accordance with BS 2971. Electric arc welding shall only be used on pipes of 125 mm nominal bore or larger.
- 9.5.4 Jointing compounds for screwed connections shall be resistant to LPG and shall comply with BS 6956. The use of PTEE tape is preferable but lead or hemp shall not be used.

9.6 Pipe Fittings

- 9.6.1 Steel flanges and flanged fittings shall be to ANSI B 16.5 or BS 1560: Part 3 on liquid lines or vapour lines at high pressure stage. Flanges on vapour lines operating at medium pressure stage or below shall conform to BS 4504: Part 3. Bolting shall comply with BS 4882 or the equivalent of applicable codes.
- 9.6.2 Steel butt-welded fittings shall be to BS 1965: Part 1 or at least the same schedule thickness as the pipes for use at high pressure stage.
- 9.6.3 Steel socket-welded and screwed fittings and screwed coupling shall be to BS 3799 or equivalent standard for use at high pressure stage.
- 9.6.4 Screwed fittings for use with steel pipes to BS 1387 or ISO 65 on vapour lines operating at medium pressure or below shall conform to BS 143 or BS 1740: Part 1 or the equivalent of applicable codes.
- 9.6.5 Gaskets shall be resistant to LPG and natural rubber shall not be used.

9.7 Allowable Pressure Drops

Piping shall be sized that the pressure drop along the medium pressure stage shall not exceed 7 kPa, and that along the low pressure stage shall not exceed 0.15 kPa.

9.8 Piping Installation

- 9.8.1 Only lateral pipework inside the premises feeding the gas appliances may be allowed to be buried in floor slab. They shall be protected against corrosion and mechanical damage. Installation risers shall be carried external to the building and exposed or may be enclosed in ducts complying with CP 413.
- 9.8.2 All pipework shall be properly supported with strong hangers, anchors, brackets, saddles, guides etc. Pipe supports shall be arranged as near as possible to joints and changes of direction and each support shall take its share of load.

- 9.8.3 Supports for steel pipes shall be of mild steel, malleable iron or galvanised. Copper pipes shall be fixed by gunmetal or brass pipe clip. Brackets screwed to walls shall be secured by expanding plugs or other approved methods. The top half of the pipe clip shall be detachable without disturbing the fixing. The maximum distances of pipe supports shall be as shown in Table 7A and 7B.

Table 7A: Spacing of Support for Steel Pipe

Nominal Pipe Size (mm)	Maximum Distance between Supports (m)	
	Vertical runs	Horizontal runs
20	3	2.5
25	3	2.5
32	3	2.7
40	3.5	3
50	3.5	3
80	4.5	3
100	4.5	3
150	4.5	3
200	4.5	3

Table 7B: Spacing of Support for Copper Pipe

Nominal Pipe Size (mm)	Maximum Distance between Supports (m)	
	Vertical runs	Horizontal runs
10	1	0.5
13	1	1

- 9.8.4 Vertical pipe risers shall be adequately supported at the base to withstand the total weight of the risers and shall be protected against mechanical damage to a minimum height of 2 metres from ground level.
- 9.8.5 All vertical and horizontal pipe runs shall have adequate flexibility and facilities to compensate for thermal expansion and contraction of pipes, or mechanical stress at branch pipes.
- 9.8.6 Insulation shall be provided in the pipe support for those section of piping where cathodic protection has been provided.
- 9.8.7 All pipes shall be thoroughly cleaned and wirebrushed to remove all grease, dirt, rust, scale, and other defects before installation; and shall be protected against corrosion by wrapping, galvanising or painting as appropriate.

- 9.8.8 During the installation work in progress, all open ends of the pipework shall be blanked off with purposely made plugs or caps to keep foreign matters from entering the finished system.
- 9.8.9 Pipework laid in floor slab shall be protected by factory-bonded sheath or wrapping. The piping shall be covered to a depth of not less than 12 mm. The channel shall be cleaned of all debris, sharp edges, rubbish and surplus moisture before the pipe is embedded.
- 9.8.10 Pipework passing through wall or floors of a building, shall be wrapped and enclosed in metal sleeve for complete length through the walls or floors and sealed with a non-combustible sealing agent at both ends. The annular space between the sleeve and the pipe shall be of sufficient width to allow for the maximum movement of the pipe due to thermal expansion and contraction. No joint shall be located within the sleeve. The sleeve shall be of same material as the LPG piping. Where sleeve passes through a floor that may be wetted or a wall on which water or corrosive material may condense, the sleeve shall project at least 25 mm beyond the floor or wall finished surfaces.
- 9.8.11 A minimum clearance of 150 mm shall be maintained between the LPG pipe and electric conduits or cables.
- 9.8.12 Pipework buried underground shall be adequately protected against corrosion and mechanical damage. Pipework shall be treated with two coats of bituminous paint and wrapped with “Denso”, “Rotunda” self-amalgamating tapes, or other equal and approved wrapping for protection against corrosion. The pipeline channel shall be cleaned of all debris, rubbish and surplus moisture, and the pipe shall be supported to ensure that it is completely surround by crack free mortar.
- 9.8.13 Underground pipework outside the premises shall be buried at a depth of not less than 800 mm. In the case where gas pipes and underground electric cables are running in a common trench, a minimum clearance of 200 mm shall be maintained between the two services. Pipe markers shall be fixed to indicate the route of the buried pipelines.
- 9.8.14 Underground pipework at road crossing shall have sufficient mechanical protection to prevent crushing. The Contractor shall submit the detail of protection for approval before installation.

SECTION 10 – VALVES AND ACCESSORIES

10.1 General

- 10.1.1 Pressure containing metal parts of valves (except appliance valves), including manual positive shut-off valves, excess-flow check valves, back-flow check valves, emergency shut-off valves and remotely controlled valves (either manually or automatically operated), used in piping systems shall be of steel, ductile 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 under service conditions.
- 10.1.2 All diaphragm valves shall be fitted with renewable diaphragms. Back seating shall be provided to isolate the gland packing when the valve is open for repair or inspection. Screwed ends shall be to BS 1740: Part 1. Taper threads and flanged end shall be to BS 1560: Part 3 or BS 4504.
- 10.1.3 All valves shall be fitted in accessible positions and shall carry clear indication of the direction of operation required to open and to close the valve. Clockwise rotation of the lever or spindle shall close the valve.

10.2 Excess Flow Valves

Excess flow valves or emergency valves shall be installed in the correct flow direction and shall intend to close upon excessive discharge of vapour or liquid resulting from a downstream rupture in hoses and piping system. The flow rate for closure of the valve shall be substantially above normal service flow rate to prevent premature closing, but shall in no case exceed 1.5 time the normal service flow rate.

10.3 Non-Return Valves

Non-return valves shall be suitable for liquid or vapour use in LPG cylinders/bulk tanks or in-line application. The valve shall be fitted with soft seat for tight shut-off so that piping can be blowdown for maintenance without leakage.

10.4 Isolating Valves

Isolating valves shall be of globe type with ductile iron bodies and stainless steel stems to resist corrosion. The valve seat shall be suitable for long-lived leakproof service. Steel ball valves shall be to BS 5351.

10.5 Quick-acting Shut-off Valves

Quick-acting shut-off valves shall be of lever operation and shall design to close tight in the direction of arrow.

10.6 Emergency Shut-off Valves

A shut-off valve incorporating thermal and manual means of closing provide for remote means of closing. Emergency shut-off valves shall be provided and incorporate all of the following means of closing: -

- a) Automatic shut-off through thermal (fire) actuation. When fusible elements are used they shall have a melting point not exceeding 121 °C.
- b) Manual shut-off from a remote location.
- c) Manual shut-off at the installation.

10.7 Pressure Relief Valves

10.7.1 Pressure relief valves shall be spring-loaded and be fully automatic in operation. The valves shall have an effective rate of upward discharge to protect a system against excess pressure. The outlet vent connection shall terminate vertically with a self-detachable weatherproof cap complete with chain at least 3 m above ground level with an ultimate vertical section of minimum 2 m in length. Clause 6.3 shall also be referred for pressure relief valves for bulb LPG storage vessel.

10.7.2 Each pressure relief valve shall be plainly and permanently marked with the following: -

- a) manufacturer's identification including catalogue or type number;
- b) start to discharge pressure;
- c) certified capacity in terms of air at Standard Temperature and Pressure (STP).

10.8 Hydrostatic Relief Valves

Hydrostatic relief valves shall be installed in pipelines and hoses located between isolating valves or blank flanges when liquid LPG can be trapped to protect a system against excessive pressure caused by thermal expansion of contents. The pressure relieving device shall be fixed in such a way that it will not discharge excessive pressure endangering personnel or equipment. The valve shall have a pressure setting in the range of 2.4 MPa to 2.75 MPa and be fitted with a self-detachable weatherproof cap complete with chain. The pressure setting shall not be higher than the weakest element in the system.

10.9 Pressure Gauges

Pressure gauges shall have stainless steel case and burden tube with dials not less than 75 mm diameter. They shall be installed at high, medium and low pressure stages to indicate the service pressures. Calibration shall be in kPa. Pressure gauge connections shall be protected by a tapping reduced internally to a bleed hole not larger than 1.4 diameter or by a suitable excess flow valve and shut-off valve.

10.10 Meters

The design, material and construction of meters shall be suitable for the grade of LPG and the pressure and flow which they are to handle. The meter shall comply with the relevant parts of BS 4161 and have corrosion resistant body and shall be of maintenance-free construction. If the meter is enclosed in a box for mechanical protection, the box shall be provided with sufficient ventilation.

SECTION 11 – PRESSURE REGULATION

11.1 Pressure Ranges

The ranges of high pressure stage, medium pressure stage and low pressure stage are as defined in Clause 1.4.

11.2 Construction of Pressure Regulators/Governors

11.2.1 Pressure regulators/governors shall be compatible for use with LPG in Hong Kong SAR and designed in accordance with Gas Safety (Gas Supply) Regulation 21. The material, construction, performance and testing requirements for regulators of different pressure stages shall conform to BS3016: 1983 except otherwise specified.

11.2.2 All pressure regulators/governors shall be sealed and locked against unauthorized adjustment after final testing and commissioning.

11.3 Primary Pressure Regulator

11.3.1 The primary pressure regulator is used for reducing the system pressure from high pressure stage to medium pressure stage or directly to low pressure stage.

11.3.2 The medium pressure of the LPG system shall be as specified in the Particular Specification. The pressure chosen shall not enable the LPG to re-condense due to fluctuation of ambient temperature. Thermal insulation may be used to prevent the re-condensation and the insulation shall be impervious to the ingress of water, resistance to fire and sufficiently robust to withstand minor mechanical damage.

11.3.3 If active-monitor regulator is used, the active regulator shall be of the fail open type. The monitor regulator shall be of a fail shut type or equivalent and equipped with an external static connection and shall be set at a slightly higher pressure than that of the active regulator downstream. The external static connection shall be connected at a point free of turbulence and preferably at a minimum of 5-pipe diameter downstream.

11.3.4 All first stage pressure regulating devices shall be located as close as practicable to the storage vessel or vaporiser and shall also be adequately supported and easily accessible.

11.3.5 Isolating valves shall be provided to facilitate removal of regulator(s) and shall be installed as close as practicable to the regulator(s).

11.4 Secondary Pressure Regulator

11.4.1 The secondary pressure regulator is used for reducing the system pressure from medium pressure stage to low pressure stage and shall be capable of maintaining an outlet pressure of not exceeding 6.9 kPa. The installation shall be fully protected against effects of both over-pressure and under-pressure downstream with a need to ensure adequate reliability and continuity of supply.

11.4.2 If the primary pressure regulator is not of the active-monitor type, the secondary pressure regulator shall be equipped with slam-shut valve, under pressure shut off (UPS0) and over pressure shut off (OPSO) devices for protection against regulator malfunctioning.

11.4.3 All secondary pressure regulators and associated protective devices shall be suitable for outdoor use. They shall be able to work well at overpressure and underpressure condition and shall normally be installed outside building except otherwise specified.

11.5 Service Governor

11.5.1 The service governor is used to reduce the system pressure from low pressure stage to the operating pressure of the gas appliances connecting to it and shall be of spring-loaded type. The outlet pressure of the service governor shall be adjustable by means of a tool and shall normally be set at 3 kPa except otherwise specified. The service governor shall be capable of maintaining its outlet pressure with a maximum fluctuation of 10%.

11.5.2 The service governor shall be suitable for installation on horizontal or vertical pipe lines.

11.6 Regulators with Over Pressure and/or Under Pressure Shut Off Devices

11.6.1 The over pressure shut off (OPSO) device shall prevent excessive pressure from entering a building. The OPSO device shall close automatically and require manually reset if the regulator outlet pressure rises above a maximum set point.

11.6.2 The under pressure shut off (UPS0) device shall prevent any abnormal low inlet pressure and/or too great downstream demand. The device shall close automatically and require manual reset.

11.6.3 The OPSO and/or UPS0 device(s) may be integral with a regulator.

11.7 Regulators/Governors with Full Capacity of Internal Relief

11.7.1 Regulators/governors equipped with full capacity internal relief valve shall be capable of limiting the increase of outlet pressure of not more than 7 kPa or the maximum acceptable operating pressure of gas appliances downstream, whichever is the lower, even if the regulator is blocked open at full inlet pressure. The relief valve shall begin to operate at a pressure increase of 2 kPa at the regulator outlet and shall remain open until the over pressure condition is relieved.

11.7.2 Vent pipes shall be used to discharge the gas through the internal relief valve to freely ventilated locations when the escaping gas may constitute a hazard. Obstruction-free tubing or piping of at least 20 mm diameter shall be used and a screened vent shall be installed at the end of the vent pipe. On all installation, the cent or the end of the vent pipe must be protected from anything that may clog it.

SECTION 12 – LPG APPLIANCES

12.1 Scope of Gas Appliances

The “Gas appliances” covered in this Section are appliances designed for use by a consumer of gas for domestic, catering and commercial purposes such as heating, cooking, hot water supply, lighting, motive power or other ordinary purposes for which LPG can be used.

12.2 General Requirements

12.2.1 A gas appliance to be supplied and installed in Hong Kong and submitted to Gas Authority for approval shall be approved in accordance with Codes of Practice issued by the Gas Authority including GU03, GU05, GU06, GU09 and other codes.

12.2.2 The gas appliance shall be suitable for operation with LPG of minimum pressure of 3 kPa unless otherwise specified. All materials used for the construction of the appliance shall be fire and heat resistance, non-flammable, strong and durable for the expected conditions of intended service.

12.2.3 The gas appliance shall be robust in construction, reliable and efficient in performance and shall meet the heat output with respect to the fuel input as specified in the Particular Specification. Apart from the locally fabricated custom-built cooking appliances, all imported appliances shall comply with the safety requirements as specified in one of or an equivalent to the following standards: -

British Standards (BS)

Japanese Industrial Standards (JIS)

Deutscher Verein des Gas and Wasserfaches e.v. (DVGW)

The safety requirements for the locally fabricated units will be specified in the Particular Specification or otherwise.

12.2.4 The gas appliance shall incorporate adequate means for the removal of products of combustion as necessary.

12.2.5 The gas appliance shall incorporate facilities for drawing sufficient permanent supply of air for proper and efficient combustion.

12.2.6 The gas appliance and its associated gas fittings shall be stabilized in a secure position free from damage as effected by the foreseeable environmental dynamic conditions and accidental factors.

12.2.7 The gas appliance shall incorporate a fine control over the initial release of gas during ignition phase and shall also be capable of withstanding any undue explosion within the combustion chamber without damage to any part of the appliance in the event of ignition delay.

12.2.8 Any gas appliance requiring the supply of water and electricity shall be suitable for operation under the local supply conditions particularly with

respect to the water pressure at the uppermost floor of the building and electrical voltage, viz. 380 V 3 phase or 220 V single phase 50 Hz.

12.3 Burners and Associated Parts

- 12.3.1 Burners shall be made of robust and durable metallic alloy and capable of producing the maximum heat capacity as specified with the proper mixing of gas and air.
- 12.3.2 The burner shall be designed for maximum efficiency, even flame distribution and generating as little noise as practically allowed.
- 12.3.3 The main and pilot flames shall be protected against draughts.
- 12.3.4 The products of combustion when tested in accordance with BS5258 shall not result in a CO/CO₂ ratio in excess of 0.02. The CO/CO₂ ratio shall not exceed 0.004 after 5 minutes of operation at normal gas rate.
- 12.3.5 Ignition may be manual or automatic sparks ignition by means of battery power, mains electricity, piezo-electric device or electronic device as indicated in the Particular Specification.
- 12.3.6 Combustion chamber and heat exchanger if applicable shall be constructed of high grade thermal conductivity alloy with high heat transfer efficiency.

12.4 Outer Casing

The outer casing of the gas appliance shall be smooth with no sharp edges and insulated from heat transfer such that the contact temperature at any position shall not exceed the maximum allowable values as specified in BS5258.

12.5 Control and regulating Devices

- 12.5.1 The gas appliance shall incorporate regulating devices for supply of gas, air and water as applicable.
- 12.5.2 The inlet gas and air shall be adequately filtered from dirt and dust before being mixed for combustion. Non-return valves shall be incorporated in the separate gas and air stream such that no mixing shall be possible in either supply stream.

12.6 Forced Draught Combustion

- 12.6.1 If mechanically forced draught is employed for combustion, the flow rate of air shall be carefully designed and adjusted such that optimum combustion efficiency is achieved.
- 12.6.2 The Contractor shall be required to submit calculation verifying his selection of the blowers, fans, etc. with respect to the burners used in the offered gas appliance.
- 12.6.3 Ignition, combustion and air supply shall be properly sequenced for automatic combustion system for safe and proper purging and such as to avoid the extinguishments of the pilot or main flame during the course of operation.

12.7 Safety Devices

- 12.7.1 The gas appliance shall incorporate a reliable safety shut-off valve to the gas supply.
- 12.7.2 Suitable flame failure device shall be provided to shut off the gas supply by actuating a relay or solenoid valve if no flame is detected.
- 12.7.3 Where a thermostat is specified to control the temperature attained in a compartment of the gas appliance, a back-up overheat protective device shall also be provided to shut-off the gas supply in the event of failure of the thermostat.
- 12.7.4 A gas water heating appliance shall be provided with the low water pressure automatic gas shut-off device.
- 12.7.5 If a gas appliance is constructed with a built-in power operated flue extract system, it shall be prevented from operation if the draught fails to operate.
- 12.7.6 Wherever applicable for a gas heating appliance, safety guards shall be provided to prevent accidental contact of clothing or inflammable materials with the heat surfaces.

12.8 Flame Failure Devices and Associated Safety Shut-off Valves

- 12.8.1 The flame failure device shall be manufactured to an international acceptable standard such as JIS2103.
- 12.8.2 Wherever a flame failure device is required, the type of device and its coupling safety shut-off valves shall be incorporated in the following manner:
 -
 - a) Below 45 kW, thermo-electric type flame failure device may be used.
 - b) 45 kW to 600 kW, electronic type flame failure device coupled with one safety shut-off valve shall be provided.
 - c) 600 kW to 3 MW, electronic type flame failure device coupled with two safety shut-off valves in line shall be provided.
 - d) Above 3 MW, electronic type flame failure device coupled with two safety shut-off valves in line together with a vent in between the valves shall be incorporated.
- 12.8.3 The electronic type flame failure device specified in this Section shall operate on the principle of current rectification of the flame which in this application shall rectify an alternating current flowing between an electrode and the burner as the opposing electrode connected to the ground potential. The rectified signal so generated shall be amplified to control the operation of a gas relay or solenoid valve.
- 12.8.4 The flame failure device shall be installed in a proper position suitable for performing the required function and sheltered from over-spilling and over-heating as the circumstances prevail.

12.9 Associated Gas Installation

- 12.9.1 All the gas pipework in association with the gas appliance installation shall be carried out in accordance with Section 9 of this Specification.
- 12.9.2 All appliance with a fixed flue shall be connected to the gas supply by means of a permanently fixed rigid pipe.
- 12.9.3 Flexible rubber tubing complying with Clause 9.4 of this Specification may only be used for connecting unflued or portable appliances. Each length of connection shall not exceed 2 m. It shall not extend from one room to another nor passing through walls, ceilings etc. and shall be easily accessible for inspection and replacement. Connection to gas pipe by means of integral threaded metal ends or secured to a gas supply nozzle by crimping or using suitable hose clip as acceptable. Flexible rubber tubing shall not be exposed to temperature exceeding 50 °C.
- 12.9.4 A gas shut-off valve shall be provided at a readily accessible position at the gas inlet of the appliance.

12.10 Flues

- 12.10.1 Where a flue is required to be connected to a gas appliance, it shall be constructed and installed in conformity with BS5440: Part 1 for a rated input of up to 60 kW and British Gas Corporation publication BGC IM/11 for higher rating. Flues shall be so designed and constructed as to conduct away the products of combustion in an efficient manner.
- 12.10.2 A flue shall be readily accessible for inspection and maintenance. If it enters a brick or masonry chimney, access shall be made for inspection and maintenance of the seal between the flue pipe and the chimney.
- 12.10.3 Where a flue passes through a tiled or slated roof, the joint shall be weather-proof by using a purpose-made metal plate with a 150 mm upstand.
- 12.10.4 Where a flue passes through a ceiling, it shall be fitted with an insulating sleeve.
- 12.10.5 A flue, if required to be insulated against combustible materials, the surface temperature shall not reach 65 °C. The annular space between the metal sheets shall be packed with an approved non-combustible material not less than 25 mm thick.
- 12.10.6 A flue system incorporating electric powered exhaust draught shall have the control integrated with the gas appliance such that it shall be prevented from operation if the draught fails to operate.
- 12.10.7 If a manually operated damper is incorporated with a flue, it shall always be maintained in the fixed open position. An automatically operated damper for a flue shall be interlocked with the gas supply to the burner such that the burner shall be prevented from ignition in the event of failure of the damper when not in the open position.

12.11 Testing of Gas Appliance

- 12.11.1 Gas appliance shall be tested and commissioned in accordance with regulation 30 of Gas Safety (Installation and Use) Regulations and Code of Practice issued by the Gas Authority.

The Contractor upon completion of the installation of a gas appliance shall test the gas connection pipework for soundness. He shall examine the appliance, the gas fittings and other associated works, flue system, condition of ventilation of the room etc. for the purpose of ascertaining whether

- a) the appliance has been installed to the required standard and regulations.
 - b) the appliance has been installed in accordance with the manufacturer's instructions.
 - c) the safety controls of the appliance are in proper working order.
 - d) the supply gas pressure, water pressure, electrical voltage and frequency etc. are within the operating range of the gas appliance.
- 12.11.2 When testing the performance of the appliance, the Contractor shall verify its satisfactory operation condition with regard to the following aspects: -
- a) the safe functioning of all protective controls
 - b) the heat output of the appliance as specified in compatible with the fuel input
 - c) the correct gas/air ratio for proper combustion
 - d) the effectiveness of the flue extract system

12.12 Domestic Instantaneous Type Water Heaters

- 12.12.1 Instantaneous water heaters shall be room sealed, balanced flue type and shall be so constructed that the combustion air shall be drawn from and the flue gas conducted away outside the room by means of a concentric wallcase flue duct.
- 12.12.3 The water heater shall be of modern, compact design and pleasant appearance. It shall be capable of providing instantaneous hot water with a temperature rise of 25 °C at a minimum flow rate as specified in the Particular Specification.
- 12.12.4 The water heater shall be manufactured to the reputable international standards such as BS5386: Part 1, EN(26) or JIS S2109. Test certificates issued by an independent regulatory authority in the country of origin shall be required unless otherwise approved for use by the Gas Authority.
- 12.12.5 The water heater shall be approved by the Water Supplies Department for direct connection to the town mains. Appropriate inlet and outlet pipe fittings shall be provided for connection to the external pipes. The minimum water supply pressure required for the water heater shall not be excessive such that

it allows the installation of the water heater at the uppermost floor of the building without problem.

- 12.12.6 The water heater shall be equipped with built-in temperature regulator, flame failure detector, automatic gas shut-off valve, manual regulation valves, pilot burner and an automatic piezo-electric ignition device unless otherwise specified.
- 12.12.7 The heat exchanger and combustion chamber shall be constructed of high thermal conductivity alloy with high heat transfer efficiency.
- 12.12.8 The fan shape burner shall give even flame distribution with as little noise as practically allowed.
- 12.12.9 The outer casing shall be made of heavy gauge sheet metal, properly treated to prevent rusting and corrosion and finished in high quality white stoved enamel or equivalent. Any insulation materials used shall be free of asbestos.
- 12.12.10 The inlet pipe connections shall be arranged in such manner that the gas pipe shall be preferably positioned between the hot and cold water pipes.
- 12.12.11 Balanced flue/room-sealed water heaters shall be installed in purpose built flue aperture, the location of which shall comply with the Building (Planning) Regulation 35A and the Practice Note to Authorized Persons issued by the Building Authority.
- 12.12.12 The water heater shall be installed on the wall by means of a number of substantial bolts and nuts. The process of fixing the heater in position shall not impair the supporting structure. The indoor portion of the appliance shall be installed to allow sufficient clearance from the side walls, ceiling and other structures for maintenance or replacement. The flue duct shall be adjusted to allow effective rejection of flue gases and, if for balanced flue, to allow also sufficient inlet vents for the intake air for combustion. The portion of flue duct passing through the external wall shall be thermally insulated and sealed for weather proofing. All ducts and pipes shall be checked for cleanliness and clearance of obstacle prior to commissioning.
- 12.12.13 Fan assisted room sealed instantaneous water heater shall be provided where specified in the Particular Specification. The fan assisted heater shall be complete with built-in flue fan. The flue fan shall have an over-run time before the ignition and after shutting down of the burner in accordance with the applicable design code. The electric fan, wirings and all parts of electrical installation of the heater shall comply with the requirements of the Electricity (Wiring) Regulation and suitable for electricity supply of 220V a.c., 50 Hz. The heater shall either have a viewing window for the user to check at any time that the heater is in operation by visual observation of the flame or have an indication lamp indicating the heater is on.
- 12.12.14 Terminals for earthing or equipotential bonding shall be provided where applicable.

12.13 Domestic Type Gas Cooker

- 12.13.1 The gas cooker shall be of modern design, pleasant appearance and suitable for installation in domestic kitchen. Facilities shall contain an oven, hot plates and a grill of various ratings as specified in the Particular Specification.
- 12.13.2 The gas cooker shall comply with BS5386: Part 3 and Code of Practice GU06 relevant for use with LPG.
- 12.13.3 Unless otherwise specified, the cooker shall comprise open ring burners for the hot plates and jet burners for both the oven and grill.
- 12.13.4 All burners shall give low noise level in operation and a minimum noise in turning off to extinguish. All burners shall be regulated by “push and turn” control knobs; stable flames shall be maintained at all knob’s position. All burners shall be suitable for simmering by adjusting the control knobs.
- 12.13.5 Unless otherwise specified, the oven shall be of the internally heated type with side hinged door. The oven shall be equipped with a temperature control regulator by means of thermostat with back-up overheat gas shut-off device. A flame failure device shall be fitted to shut-off the gas supply in the event of failure of the pilot or main flame.
- 12.13.6 Solid top hot plates if specified shall be fitted with flame failure device.
- 12.13.7 Unless otherwise specified, the grill shall be of the open-fired type with the source of heat radiated from a metal fret above the food.
- 12.13.8 Ignition means to the various cooking facilities shall be specified in the Particular Specification or otherwise it will be assumed to be all manual without the use of a spark gun and to the manufacturer’s standard product. Battery if required shall be included.
- 12.13.9 Means shall be provided to cater for spillage from the burner and the spill receivers shall be designed for easy cleaning.
- 12.13.10 A storage compartment with door beneath the oven shall be provided. Means of levelling the cooker shall also be available.
- 12.13.11 The casing shall be made of heavy gauge sheet metal properly treated to prevent rusting and corrosion and finished in high quality white or cream vitreous enamel or acceptable equivalent. The casing shall be insulated internally.
- 12.13.12 The cooker shall be supplied with a standard baking tray, a roasting tin and a ring type wok adaptor suitable for 300 mm diameter nominal size Chinese Wok.
- 12.13.13 The cooker shall be positioned at sufficient distance from the adjacent wall, overlying shelves or other appliances or structures to prevent overheating of the surrounding. It shall be installed and commissioned all in accordance with the manufacture’s instructions.

SECTION 13 – HAZARD PRECAUTION AND FIRE PREVENTION

13.1 Electrical & Electrostatic Hazard Precautions

13.1.1 Area Classification

Area Classification shall be in accordance with Code of Practice for HKLPG Industry module 1, Section 5 of Code of Practice No. 1 and Section 7 of Code of Practice No. 7 of the LPGA.

13.1.2 All electrical equipment, apparatus and luminaries to be used in the designed hazardous area shall comply with the recommendations of relevant British Standard Specifications (BS5345) and shall be of a type suitable for the intended use in the appropriate zones. The Contractor shall be responsible for providing the certificates from the appropriate authority for approval before installation. All electrical equipment shall indicate clearly the type of service for which the equipment is designed, i.e. intrinsically safe or flameproof, etc.

13.1.3 Electrical wiring for flameproof installations and earthing of the power supply system shall be in accordance with the General Specification for Electrical Installation in Government Building, Hong Kong SAR.

13.1.4 With the exception of the insulation which is required to break the continuity of piping to meet the cathodic protection requirement, the Contractor shall ensure that all other LPG piping and equipment shall be electrical continuous and earthed. Continuity tests shall be carried out by the Contractor to the satisfaction of the Architect.

13.1.5 LPG piping shall not be used as electrical circuit protective conductor or earth electrode for other systems although their bonding to the circuit protective conductor may be necessary.

13.1.6 Whenever it is not contradict to the cathodic protection requirement, all bulk storage vessels shall be electrically earthed to protect against the accumulation of static electricity.

13.1.7 An earthing terminal shall be provided near the LPG filling point for the connection of the bulk tanker vehicles.

13.1.8 The earthing resistance of the LPG system shall not exceed 1 megohm.

13.2 Fire Prevention and Control

13.2.1 Fire prevention and control shall be in accordance with LPGA Code of Practice No. 3.

13.2.2 Provision of fire fighting equipment/system e.g. fire extinguishers, water drencher, etc., shall be as advised by the Director of Fire Services. The installation of these equipment/system shall be in accordance with the General Specification for Fire Service Installation in Government Buildings, Hong Kong SAR.

- 13.2.3 Fire extinguishers if required to be provided shall be of the type of 3 kg dry powder fire extinguishers or equivalent at suitable locations in accordance to the table, unless otherwise specified.

**Minimum Number of Fire Extinguishers Required
for LPG Compound, Cylinder Store and Vaporiser Room**

LPG Storage Capacity (Tonnes)	Minimum Number of Fire Extinguishers Required
LPG Compound (excluding vaporiser room)	
Up to 25	2
Above 25	3
LPG Cylinder Store (excluding vaporiser room)	
Up to 1	1
1 – 2.5	2
Above 2.5	3
Vaporiser room	1

- 13.2.4 Vessel supports excluding those 450 mm or less in height shall be constructed or protected to have a standard of fire resistance of at least two hours.
- 13.2.5 Weeds, long grass and any combustible material should be kept clear from an area within 3 m of any LPG vessel of up to 2250 litres water capacity and 6 m of larger vessels. Weed killers containing chemicals such as sodium chlorate, which are a potential source of fire danger, shall not be selected for this purpose.

SECTION 14 – CIVIL AND BUILDER’S WORKS

14.1 LPG Compound

- 14.1.1 To prevent trespassing or tampering, the LPG compound which houses the storage vessels, vaporisers, regulators, etc. shall be enclosed by fence with two means of exit preferably positioned at opposite end of the compound. The fence shall be of industrial type, at least 1800 mm high and perforated to maintain good ventilation. The solid concrete kerb for supporting the perforated fence shall form a bund to a height of not less than 150mm and not be higher than 380 mm above finished floor level.
- 14.1.2 The floor of the LPG compound shall be concreted and those parts underneath the storage vessels shall be sloped. The vicinity of the vessels shall also be free from pits and depressions other than those necessary for drainage or the containment of spillage.
- 14.1.3 Water drains, where provided, shall be of the U shape with water seal preferably situated well away from the storage area.
- 14.1.4 The support for above ground storage vessels shall be of concrete, masonry or structural steel. Supports which are higher than 380 mm shall have a fire resisting period of at least 2 hours.
- 14.1.5 A sterile area of at least 1m shall be provided and paved with concrete around the LPG compound and conspicuously marked with yellow lines on the floor.

14.2 Enclosure for LPG Cylinder/Plant

Rooms containing LPG cylinders/plant shall be well ventilated and made of non-combustible materials. The floor shall be raised with a higher level than the surrounding and shall be concreted and sloped down towards an external door which shall not be provided with kerb. The door shall be open outwards and shall not be self-locking. The walls, ceilings, roofs and doors (including door frame and hinge assembly) shall be able to withstand a static pressure of 4.8 kPa. Those parts common with other structure shall be imperforated and have a fire resisting period of 2 hours minimum. Drain shall not be provided in the room and should be avoided in the immediate vicinity i.e. within 3 m of the room. A sterile area of at least 1 m shall be provided around the cylinder room and conspicuously marked on the floor with yellow lines.

14.3 Ventilation and Explosion Relief Apertures

- 14.3.1 The natural ventilation and explosion relief requirements of the room with one external wall to 4 external walls are provided in Code of Practice for Hong Kong LPG Industry Module 1 and some typical details are indicated on BSB Standard Drawing Nos. LP-MIS-130 to LP-MIS-150. The apertures shall be situated as uniformly as practicable in the external walls.
- 14.3.2 Typical details of the construction of metal louver and wire mesh for the door, ventilation and explosion apertures are detailed on BSB Standard Drawing No. LP-MIS-160.

- 14.3.3 If the requirement for natural ventilation cannot be met, mechanical ventilation shall be provided. Typical details of the mechanical ventilation system are shown on BSB Standard Drawing No. LP-MIS-170.
- 14.3.4 LPG installations shall be provided with explosion relief apertures located in external walls, the explosion relief area shall be at least 0.07 m^2 per m^3 of enclosed volume for open vents, or at least 0.1 m^2 per m^3 of enclosed volume for louvered vents. A louvered angle shall not be in excess of 45° to horizontal. The method for calculating the “effective area of ventilation/explosion relief” shall be in accordance with Code of Practice for HK LPG Industry Module 1.
- 14.3.5 Imperforated explosion relief panels shall be used. Ventilation apertures may be included as explosion relief apertures.
- 14.3.6 LPG cylinders and/or equipment shall not be located within 150mm of ventilation apertures. Suitable measures shall be taken to prevent blockage of ventilation apertures.

14.4 Trenches

Trenches for underground pipe works shall have a minimum depth of not less than 800 mm. There shall be no pebble or small stones at the bottom of the trench. Electric cables and other services are not permitted to share the same trench.

14.5 Walls, Ceiling or Floors

Sleeves of the same material of the LPG piping shall be embedded in holes for the whole length through walls or slabs. Wall, ceilings, roofs and doors shall be designed such that if imperforated, they shall be capable of withstanding a static pressure of at least 4.8 kPa.

14.6 Radiation Walls

Radiation walls for separating the vaporisers and storage vessels /cylinders shall be substantially constructed of concrete, brick or other suitable material having a fire resisting period of not less than 2 hours in accordance with BS476. The wall shall not be more than 2.5 m high.

14.7 Warning Signs and Labels

Warning signs and emergency instructions in both English and Chinese shall be posted near each entrance on the outside wall/fence of the installation. The size of the letters shall be of 120 mm minimum in height.

SECTION 15 – TESTING AND COMMISSIONING

15.1 General

- 15.1.1 After the installation work is completed the Contractor shall test and commission the whole installation for proper and safe operation in accordance with the Building Services Branch Testing and Commissioning Procedure No. 8 (TC8) for Liquefied Petroleum Gas Installation and the procedures stipulated in the Code of Practice for HKLPG Industry Module 1.

The testing and commissioning of the installation shall be carried out by Competent Persons of the Contractor according to the Specification and the manufacturer's instruction and manuals.

The Contractor shall submit detailed testing and commissioning procedures and programme for approval by the Architect prior to the testing and commissioning of the LPG installation. The procedures include all the requirements in TC8 with other additional requirements for the installation.

The Contractor shall carry out safety test and functional test for the installation. The Contractor shall commission the installation and carry out complete performance tests for all equipment and systems installed by him in accordance with the manufacturer's instructions, the requirements of the statutory rules and regulations and to the satisfaction of the Architect. The tests shall include, but not limited to, :-

- a. factory tests where required
- b. visual inspection and checking
- c. safety tests
- d. commissioning, tuning and adjustment
- e. functional tests
- f. performance tests

- 15.1.2 All tests mentioned in Clauses from 15.2 to 15.12 shall be witnessed and certified by a "Competent Person" as defined in Clause 1.4. The Contractor shall despatch competent and experienced commissioning engineers and technicians to carry out the commissioning and testing of the installation. All labour, instrument and materials necessary for carrying out the tests and for commissioning shall be provided by the Contractor.

- 15.1.3 Before the testing and commissioning of the LPG installation, the Competent Person shall check and ensure that the fire protection system for the LPG installation, if provided, should have been tested and accepted by Fire Services Department and put into operation.

- 15.1.4 The Contractor shall ensure Approval of Use has been obtained from Gas Authority before filling up the LPG storage tank or supplying LPG cylinders for commissioning of the LPG installation. The Contractor shall submit relevant information, test certificates and drawings to the Architect for applying Approval of Use from the Gas Authority well before commissioning of the LPG installation. All submission fees, if any, shall be borne by the Contractor. The Contractor shall ensure all tests are completed and certified by the Competent Person before forwarding the relevant information to the Architect for applying Approval of Use.

- 15.1.5 Prior to testing and commissioning, the Contractor shall submit detailed procedures and a programme for commissioning and testing to the Architect for approval.
- 15.1.6 The Contractor shall make arrangement with the Gas Authority for inspection and witness of the tests, including the pressure test and 'holiday test' for the underground pipeline and storage tanks, prior to cover up/back-filling.
- 15.1.7 Prior to the test, the Contractor shall carry out commissioning which shall include but not limited to
 - a. All equipment, joints, valves, etc. shall be checked for leakage, integrity and proper function.
 - b. Pressure regulators shall be set to their lowest outlet pressure initially and gradually adjusted to their required operating pressures. The regulators shall be checked for their pressure control function over the entire range of the design conditions including shut-off capability.
 - c. LPG trap shall be checked to ensure it is filled with water.
 - d. Active and monitor regulators shall be set for the designed function
 - e. Vaporiser including the heat and level controls shall be checked for satisfactory operation.

15.2 Bulk LPG Storage Vessels

- 15.2.1 LPG storage vessels should be tested and certified by a Competent Person to prove that the vessel is up to the required standard: -
 - a) Ultrasonic/radiographic tests for examining internal flaws in accordance with the applicable design code; and
 - b) Magnetic particle or penetrant tests for examining surface flaws in accordance with BS6072.
- 15.2.2 In addition to Clause 15.2.1, the following tests shall be carried out on site by the Contractor: -
 - a) Hydraulic test at testing pressure 1.5 times of the design pressure of the storage vessels,
 - b) Commissioning pneumatic test at 700 kPa or 90% of design pressure, whichever is lower,
 - c) Paint thickness test (400µm minimum).
 - d) For underground vessels, "holiday" test after the vessel is coated.
 - e) Leak test for the connections up to a minimum pressure of 689 kPa.
- 15.2.3 Format of the test certificate shall follow Code of Practice for Hong Kong LPG Industry Module 1 issued by the GSO.

15.3 Vaporisers

- 15.3.1 Vaporisers and associated relief valves shall be hydraulic tested and certified by a Competent Person at 1.5 times of the design pressure. The components

of the vaporiser not capable of accepting the test pressure shall be isolated or removed whichever appropriate during the hydraulic test.

- 15.3.2 Satisfactory operation of liquid control and heat input control device shall be checked.
- 15.3.3 Flame failure devices, pilot and main burner systems shall be checked and adjusted to give satisfactory and safe operation.
- 15.3.4 For indirect heated vaporiser using water as heating medium, water level safety controls shall be checked for proper operation.
- 15.3.5 Format of the test certificate shall follow Code of Practice for Hong Kong LPG Industry Module 1 issued by the GSO.

15.4 Pipework Testing

15.4.1 All pipework shall be tested after construction and before being placed in operation to ensure that it is structurally sound and gas-tight. 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.

15.4.2 All pipework shall be pressure tested as follows: -

- a) All liquid lines shall be hydraulically tested at 1.1 times the HRPV setting after isolation of elements that could be damaged by the test pressure. Pressure test certificates shall state HRPV setting in addition to hydraulic test pressure.

After the hydraulic test is completed, all isolated elements shall be properly installed and the whole system shall be tested pneumatically at a minimum pressure of 689 kPa.

- b) High pressure vapour lines shall be tested either pneumatically or hydraulically at a minimum pressure of 1034 kPa.
- c) Medium and low pressure vapour lines shall be tested either pneumatically or hydraulically at a minimum pressure of 103 kPa and 69 kPa respectively.

15.4.3 Time shall be allowed for temperature stabilization during pressure testing. The line pressure shall be adjusted to the test pressure after stabilization.

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

15.4.4 For pneumatic testing, the test shall be undertaken in phases as follows: -

- a) Initially pressurize the system to 140 kPa and hold it for sufficient time to ensure that all fittings have been adequately fastened.
- b) The pressure shall then be raised in stages until the required test pressure is reached.
- c) After each pressure increase, sufficient time shall be allowed to ensure system integrity.

All exposed pipework shall be subject to annual visual examination and leak test using soap solution.

- 15.4.5 For hydraulic and pneumatic pressure test, the test period shall be of a minimum of 30 minutes and there shall be no sign of pressure decay during this period.

Note: Pressure decay indicates leakage and leaks shall then be identified by sight and sound or soap solution.

- 15.4.6 All open ends of a piping system shall be suitably blanked before testing.

- 15.4.7 Pipework pressure tests shall be recorded and the test report shall include the following: -

- a) name of Contractor, and signature of the Competent Person who supervise the tests;
- b) test date;
- c) maximum working pressure;
- d) test pressure, medium and duration;
- e) test results; and
- f) material, rating and specification of pipework and fittings.

- 15.4.8 The pressure of the pipework shall be reduced to zero as soon as is practicable after the pressure tests (see Gas Safety (Gas Supply) Regulation 20). Upon satisfactory completion of pressure tests, the pipework shall be purged into service in accordance with Section 15.12 prior to commissioning and operation of the LPG installation.

- 15.4.9 Format of the test certificate shall follow Code of Practice for Hong Kong LPG Industry Module 1 issued by the GSO.

15.5 Regulators

Regulators shall be checked for the required pressure control functioning over the required range of flows and for tight shut-off at zero flow.

15.6 Emergency Valves

All emergency valves shall be checked for proper functioning.

15.7 Pressure Relief Valves

- a) Pressure relief valves shall be calibrated and sealed by the manufacturer of the Competent Person before installation.
- b) Check shall be carried out to ensure that relief valve vent caps are in place and mobile.

15.8 Vessel Content Gauges and Fixed Maximum Liquid Level Devices

Vessel content gauges and fixed maximum liquid level devices shall be checked for correct functioning and accuracy.

15.9 Gauges

Gauges shall be checked for accuracy and proper functioning.

15.10 Earthing

Installation earthing shall be tested and test results shall be submitted.

15.11 Cathodic Protection System

The cathodic protection system shall be tested and test results shall be submitted. It shall be checked at intervals not exceeding 6 months.

15.12 Purging/Gas Filling of Vessels and Systems

The method and procedure for purging or gas filling of vessels and systems shall be in accordance with the Code of Practice for HKLPG Industry Module 1.

15.13 The Gas Authority Inspections and Witness of Tests

Additional tests and inspections, where not specified above, shall also be carried out to meet the statutory requirements to the satisfaction of the Gas Authority. The Contractor shall make all necessary applications to the Gas Authority and attend to the inspections conducted by their representatives for the purpose of these tests and inspections.

15.14 Commissioning and Testing Report

A commissioning and testing report shall be forwarded to the Architect within fourteen days after completion of commissioning and testing the installation. The report shall include the tests for the LPG appliances in section 12 where applicable.

SECTION 16 – MAINTENANCE

16.1 General Maintenance Requirements

16.1.1 The Contractor shall furnish maintenance at no cost to the Employer for the complete LPG installation for a period of twelve months from the date of completion of the Works or any section or part thereof certified by the Architect. This maintenance shall include the following services: -

- a) Emergency inspection, testing and repair,
- b) Routine maintenance
 - i) Quarterly inspection, testing and servicing.
 - ii) Annual inspection, testing and servicing.

16.1.2 The maintenance of the LPG installation shall be carried out by Competent Person of the Contractor in accordance with the Code of Practice for HKLPG Industry Module 1, this specifications and the manufacturers' instructions and manuals. All inspections, tests, servicing and repairs shall be carried out to the satisfaction of the Architect.

The Contractor shall despatch competent and experienced engineers and technicians equipped with appropriate testing instruments, tools, equipment, etc. to inspect, service, test, adjust and maintain the LPG installation in a satisfactory and safe operating condition.

16.1.3 The Contractor shall allow for carrying out 24-hour emergency and routine maintenance work at a time outside normal office hours including general holidays whenever necessary. The Contractor shall allow and prepare to provide a high level of service for the prompt rectification of the faults especially those related to safety issues.

16.1.4 All labour and materials necessary and transportation required for carrying out routine and emergency inspections, tests, repairs, replacements and maintenance services shall be included in the Contract. During the Maintenance Period, the Contractor shall supply and install at no cost to the Employer replacements for all equipment and parts which in the opinion of the Architect become unserviceable where such unserviceability is due to faulty materials, workmanship, design or installation or inadequate performance, rating and size of the Work provided by the Contractor. The Contractor shall also be responsible to replace all liquefied petroleum gas which may be lost by leakage or become unserviceable due to the aforesaid reasons.

16.1.5 The Contractor shall allow all necessary expendable materials such as cleaning fluid, oil, grease, jointing materials, abrasive anti-corrosive, touch-up paints, etc. required for the maintenance work.

16.1.6 The Contractor shall be responsible for all repairs necessary to maintain the LPG installation in a safe, reliable and operative condition at all times. The Contractor shall ensure that his servicing staff shall carry out the necessary repairs by utilising manufacturer's original replacement parts. Any

component taken down for services shall be reinstated within 2 hours or otherwise replaced by a spare unit at the Contractor's expenses.

- 16.1.7 The Contractor shall ensure minimum interruption to the functioning of the LPG installation during each inspection, testing, repair or maintenance service. Where any part of the LPG installation is out of service temporarily during the progress of work, the Contractor shall notify the client in advance and to place a suitable notice in a prominent position. This is, however, not to be construed as an authority to leave any part inoperative for an undue length of time.
- 16.1.8 The Contractor shall, as and when instructed by the Architect, repair or replace at his own cost any part of the system proved to be defective by reason of Contractor's negligence, faulty design, inadequate routine maintenance and supervision, workmanship or materials. No claim whatsoever shall be made by the Contractor for such repair or replacement if it is within the scope of the Contractor's responsibility.
- 16.1.9 After each routine inspection, testing and maintenance service, the Contractor shall furnish to the Architect within fourteen days a detailed report with details including date and time, persons carrying out the task, details of work done, follow-up actions and other requirements as stipulated below and in the Appendices.
- 16.1.10 The Contractor shall, at his own expenses, make all suitable arrangements to avoid damage to property or installations provided by others during the course of his work. The Contractor shall be responsible for all losses and claims for injury or damage to any person or property arises out of or in consequence of the execution of the maintenance and repair work.

16.2 Emergency Inspection, Tests and Repairs

- 16.2.1 Emergency service including overtime work for minor repairs and adjustment shall be included under the Contract. The Contractor shall make suitable arrangements whereby Competent Person shall be dispatched for emergency works at any time during the day or night including public holidays, whether true or false, and attending to such calls in the shortest possible time and using the quickest means of transport. In general a response time of less than one hour will be expected.
- 16.2.2 Such emergency service shall be rendered if the report involves gas leakage, explosion, fire hazard, human safety or incidental disruption of gas supply. Notification to the Contractor of the required emergency service will normally be by telephone from the Architect, his representative, or the user.
- 16.2.3 The Contractor shall submit a list with at least two names, office telephone numbers, mobile telephone numbers and pager numbers and addresses of his representatives to whom emergency service calls should be directed.
- 16.2.4 Following response to an emergency call the Contractor shall on the next working day submit a written "Emergency Service Report" to the Architect.
- 16.2.5 The Contractor shall keep a clear and legible record of all fault callout which shall indicate the date, time of callout, persons attending, brief description of the fault and subsequent time of rectification for each occasion. The record

shall be submitted to the Architect for inspection within three days upon request by the Architect and will be returned to the Contractor after perusal by the Architect but shall subsequently be submitted and kept by the Architect at the end of the Maintenance Period during the handover inspection of the installation.

16.2.6 For safety reason, the Employer reserves the right to call upon the Fire Services Department and/or the Government employed LPG Maintenance Contractor to make safe the installation. However, if this is the case, the Contractor shall be responsible for all follow-up action and for payment of all incidental costs if such remedial action is caused by the defects of the installation.

16.2.7 All necessary repairs shall be carried out with the most practicably expeditious means to ensure minimum interruption to the user.

16.3 Routine Maintenance – General

16.3.1 Before routine maintenance is carried out on site the Contractor shall obtain the Architect's agreement on the programme of routine maintenance, such as date and time taken.

16.3.2 After the routine maintenance, the Contractor shall furnish to the Architect within 14 days a test report in the format as shown in Appendices 16.1 to 16.4.

16.4 Quarterly Inspection, Testing and Servicing

The Contractor shall carry out regular, quarterly and annual inspection, testing and servicing to the installation including all statutory maintenance requirement. The quarterly inspection, testing and servicing shall include those items as listed in Part A of Appendices 16.1 to 16.4 and where LPG appliances are supplied and installed as listed in Appendix 16.5 as well.

Operational checks such as house keeping, conditions of regulators and pressure gauges, inventory level and water level of certain vaporisers, etc. shall be carried out and logged on site as appropriate to ensure safety and proper function of the system.

16.5 Annual Inspection, Testing and Servicing

16.5.1 The annual inspection, testing and servicing shall include those items as listed in Parts A and B of Appendices 16.1 to 16.4 and where LPG appliances are supplied and installed as listed in Appendix 16.5 as well.

16.5.2 The annual inspection, testing and servicing as required by Appendices 16.1 to 16.5 shall be witnessed and certified by a Competent Person. In addition, the Competent Person shall carry out test and submit the Annual Inspection Report as per Appendix 16.6 to the Gas Authority.

16.6 Handover of Liquefied Petroleum Gas Installation

16.6.1 The LPG installation will not be deemed as acceptable for handover to the Architect until the installation is in good working order and all as-built drawings, instruction and maintenance manuals, spare part list, test reports, test certificates, etc. have been submitted to the Architect.

SECTION 17 – MISCELLANEOUS

17.1 Gas Detection

- 17.1.1 Gas leakage or suspected gas leakage shall be checked by the use of a gas detector, soapy water or by smell BUT NEVER WITH A NAKED FLAME.
- 17.1.2 Work in the affected or suspected gas leakage areas shall only be resumed subject to satisfactory gas detector readings.
- 17.1.3 Inflammable gas detectors shall be used only by Competent Persons.

17.2 LPG Transfer Procedures

The following procedures should be applied before LPG is transferred from road tankers to bulk storage vessels: -

- 17.2.1 Any driving unit or electrical equipment not required and not specifically designed for the transfer operation shall not be used and be isolated.
- 17.2.2 Fire extinguishers shall be located in easily accessible positions and temporary warning notice displayed prominently.
- 17.2.3 Any accumulated static electricity on a road tanker shall be safely discharged to the earth terminal provided for this purpose before the LPG transfer connections are made.
- 17.2.4 A responsible person of the oil company shall remain both in attendance and control during all transfer operations to ensure that all the safety operation measures established by the oil company are enforced.
- 17.2.5 The road tanker shall be parked in the unloading space and shall be directly under the water sprinkler or drenching system, if provided.

17.3 Instruction, labels, signs and notices

Adequate and appropriate identification labels, emergency instructions, warning signs and line diagrams shall be provided.