

LPG Association Code of Practice

LPGA COP No 5

**Installation and maintenance of
LPG multi-cylinder systems**

August 2010

FOREWORD

The performance of LPG cylinder installations is a critical element in ensuring that gas is supplied to appliances reliably and safely. This Code of Practice has been compiled with advice and input from across the industry in New Zealand and from international authorities. The Code of Practice captures the latest knowledge and design features gained from operating experience and investigative work conducted by the LPG Association.

The purpose of this Code of Practice is to:

- 1. Assist with locating cylinders correctly**
- 2. Assist with the reduction of phthalates from LPG systems.**
- 3. Assist with the removal of condensate at the regulator.**
- 4. Assist with the selection of suitable equipment and fittings.**
- 5. Assist with recommendations on equipment maintenance.**

It should be read in conjunction with the requirements of the HSNO legislation, Pressure Equipment legislation, NZS 5261: 2003 and AS/NZS 1596: 2008.

It is intended that gas fitters will use this Code as a best practice guide for the installation and maintenance of multi-cylinder installations.

1. SCOPE, DEFINITIONS AND GENERAL

1.1 Scope

This Code of Practice sets out the requirements for installation and servicing of multi-cylinder LPG installations for both vapour and liquid withdrawal cylinders.

1.2 Definitions

For the purposes of this code the following definitions shall apply:

Accessible: Access can be gained without hazard or undue difficulty for repairs, testing, maintenance, renewal or operational purposes.

Area of high Intensity land use includes;

- (a) An area of regular habitation,
- (b) Any other hazardous substance location,
- (c) A high density traffic route,
- (d) A structure made of combustible material,

does not include an onsite non-combustible office

Area of low intensity land use includes;

- (a) An area where a person may legally be present occasionally
- (b) A public park or reserve,
- (c) A traffic route of low or medium traffic density,

Does not include an area of regular habitation

Area of regular habitation includes any dwelling, hospital, school, airport, commercial premises, office, or other area where people regularly congregate.

Authority means the Environmental Risk Management Authority (ERMA).

Automatic change-over regulator: Combination valve / first stage gas pressure regulator, fitted to a LPG multiple-cylinder installation which will automatically change over from a cylinder in use to a reserve cylinder at a predetermined pressure. May be included in a one piece automatic changeover valve assembly comprised of automatic changeover valve, first and second stage regulators and may incorporate pressure relief or over pressure shut off capability.

Breather vent: An orifice or opening designed to permit atmospheric pressure to act on the diaphragm of a regulator.

Condensate: The liquid that separates from the gas down stream of any regulator due to the reduction in temperature resulting from pressure reduction.

Condensate trap (also known as a drip leg or tailpipe) A device installed in a gas line to trap the condensate liquid

Controlled zone means an area abutting a hazardous substance location that is regulated so that:

- (a) Within the zone, the adverse effects of a hazardous substance are reduced or prevented; and
- (b) Beyond the zone, members of the public are provided with reasonable protection from the adverse effect.

Enclosure: A compartment, an enclosed area or a partitioned-off space primarily used for the installing of a gas cylinder meter, or gas pressure regulator.

ERMA: Meaning the Environmental Risk Management Authority.

Excess flow valve: A normally open valve which closes automatically when a predetermined flow rate in a particular direction has been exceeded.

Gas fitting: Has the same meaning as in the Plumbers, Gasfitters and Drainlayers Act 2006.

Gas load: The total gas consumption of all downstream appliances.

Gas pressure regulator: A device that automatically regulates the outlet pressure of the gas passing through it to a predetermined value.

Hazardous area: An area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of potential ignition sources.

HSNO means the Hazardous Substances and New Organisms Act 1996.

High density in relation to a public traffic route, means greater than medium density

LAB number: Number allocated by ERMA when a cylinder is approved.

Liquid withdrawal installation: An installation where liquid LPG is used as the fuel supply.

Location test certificate: A certificate issued by a test certifier stating that the HSNO Control requirements for a hazardous substance in that location have been met.

Lock-up pressure: The maximum pressure in an installation where the regulator has closed and when all appliances have shut down.

Low density public traffic route means up to an average per 24 hours of

- (a) 1,000-vehicles on a road; or
- (b) 50 rail wagons on a railway; or
- (c) 400 people on a waterway; or
- (d) 200 people along a public right of way

Medium density public traffic route means up to an average per 24 hours of

- (a) 5,000 vehicles on a road; or
- (b) 250 rail wagons on a railway; or
- (c) 1,800 people on a waterway; or
- (d) 900 people along a public right of way

Multi cylinder installation means any installation greater than a twin cylinder installation.

Non return valve: A valve designed to operate automatically to prevent reversal flow in a pipe or fitting.

Person in charge: In relation to a place, a hazardous substance location or a place of work means a person who is the owner, lessee, sublessee, occupier, or person in possession of the place, location or any part of it; or any other person who, at the relevant time, is in effective control or possession of the relevant part of the place or location.

Phthalates: Plasticisers mainly DOP (Diocetyl Phthalates) predominantly found in rubber hose inner liners.

POL fitting (Prest-O-Lite): The common name given for a standard union with left hand thread, used for connection to a 45 Kg cylinder.

Pigtail: A short length of flexible tube or copper pipe completed with end couplings. Use for connecting the cylinder to the manifold or the changeover valve.

Pressure: Pressure as measured above atmospheric pressure, also called gauge pressure.

Test Certifier: A person who has current approval from ERMA to issue test certificates.

Twin cylinder installation: A cylinder installation where the cylinders are connected separately to the system. Each cylinder is connected to a change over valve that can be operated manually or automatically, to change over the cylinder which is supplying LPG to the installation. Connection may be made using flexible rubber or copper pigtails, or pipe fittings.

Vapour withdrawal installation: An installation where LPG vapour is used as the fuel supply.

REFERENCED DOCUMENTS

PECPR	Health and Safety in Employment (Pressure Equipment, Cranes, and Passenger Ropeways) Regulations 1999
NZS 5261	Gas Installation
NZS 5262	Gas Appliance Safety
AS/NZS 1596	The storage and handling of LP Gas
AS/NZS 1869	Hose and hose assemblies for liquefied petroleum gases (LP Gas), natural gas and towns gas
AS/NZS 2430	Classification of hazardous areas (series)
UL 21	LP Gas Hose
UL 144,	Pressure regulating valves for LP gas
UL 252,	Compressed gas regulators
AG 205,	Regulators
NF M 88-769	Installations d'hydrocarbures liquefies en recipients

SECTION 2: LOCATION OF CYLINDERS

2.1 Cylinders

1. All cylinder locations must comply with the requirements of appendix G of NZS 5261: 2003
2. Consideration should be given to ensure that the demand of the appliances to be connected to the system can be supplied by the cylinders, see 3.18 for details on sizing the installation.

2.2 Location

1. Cylinders and associated equipment should be installed in accordance with appendix G of NZS 5261: 2003..
2. Cylinders shall be installed on a firm, level, non-combustible base, not resting on soil. The floor or base shall be constructed so that water cannot accumulate within any enclosures or recess.
3. The cylinders shall be stored upright so that the pressure relief valve is in contact with the vapour space and the safety valve discharge point shall be directed away from any other cylinder, piping, building, drain and any opening into or under a building, or any approach path used by personnel.
4. Where a cylinder installation is vulnerable to falling objects, the cylinder valves, regulator and piping shall be provided with protective guards. Particular attention shall be paid to the risks of impact or cylinder dislodgement due to ice and snow, where appropriate.
5. Where there are manoeuvring vehicles, cylinders shall be afforded suitable protection, e.g. by the use of bollards, or a fully contained, free moving frame which encapsulates all cylinder components.

2.3 Separation Distances

1. Up to 100 kg can be installed within one metre of a building provided there are no openings in the building below the top of the cylinders and within one metre of the cylinders. They can be installed against a building
2. Between 100 to 300 kg can be installed within 2 metres of a building provided the walls of the building behind the cylinders and 2 metres either side of the cylinders are vapour tight and constructed of fire resisting material. There must be no openings in the building below the top of the cylinders or within two metres from the sides of the cylinders.
3. Between 300 to 1,000 kg can be installed within two metres of a building provided the walls of the building behind the cylinders and 2 metres either side of the cylinders are vapour tight and are constructed of 60/60/60 fire resisting material.. There must be no openings in the building below the top of the cylinders or within two metres from the sides of the cylinders.
4. NZS 5261 has a minimum clearance of 150 mm above the top of any cylinder. The clearance increases to 500 mm for in-situ filled cylinders.
5. If the fire resisting material or fire rated wall cannot be provided or if the quantity is in excess of those above the following separation distance table must be used

Quantity (kg)	High intensity (m)	Low intensity (m)
Up to 100	0	0
300	2	0
500	2	2
1,000	2.5	2
2,000	3	2
5,000	5	3

For installations over 5,000 kg consultation with a test certifier is required.

2.4 Prohibited Locations:

1. Cylinders and associated equipment should not be installed in the following locations:

- (a) In an inaccessible location;
- (b) Under a stairway;
- (c) In a location where there would be no air movement across the cylinder;
- (d) Under a building, other than permitted by NZS 5261 or AS/NZS 1596
- (e) In a position that would obstruct egress from a building;
- (f) Buried in the ground; unless the cylinder and installation have been specifically designed for such an installation.
- (g) Where damage is likely to occur, unless adequate protection is provided
- (h) Beneath a fire escape route

2.5 Location Test Certificates

1. A location test certificate is required for all sites where 100 kg or more LPG is present for more than 18 hours.
2. It is the responsibility of the person in charge of the installation (usually the person who uses the gas) to obtain the location test certificate. These are renewed annually although there is provision for a certificate to be issued for up to a three year period. This is dependant on the test certifier.
3. A location test certificate can only be obtained from a test certifier. A list of test certifiers is available of the ERMA NZ website: <http://www.ermanz.govt.nz>.

2.6 Hazardous Area Zone

1. Any LPG cylinder has a hazardous zone around it. AS/NZS 2430 3.4 has examples of these zones for different situations. Note the hazardous zone does depend on how the cylinder is replenished (either exchange or in-situ fill).
2. The hazardous area zone surrounding a cylinder shall be maintained free of ignition sources. Any electrical equipment that might be installed in the hazardous zone must be rated for the zone.
3. A vehicle is not regarded as being an ignition source while it is entering or leaving a hazardous zone.

2.7 Restraint

1. All cylinders larger than 25 litres shall be secured against seismic activity by using chains and brackets or similar.
2. The brackets shall be fastened to a wall or similar robust anchorage.
3. All restraints must be capable of withstanding a steady applied load equal to four times the weight of the filled cylinder.

2.8 Security of Cylinders in Public Locations

1. Where the cylinder installation is accessible to the public, it shall be provided with a means to prevent tampering with any fittings that could lead to an escape of gas, and that is able to be locked.
2. The provision may be one of the following:
 - (a) A fully surrounding fence;
 - (b) A fence surrounding only those components requiring protection;
 - (c) A lockable enclosure.

2.9 Signage

1. HSNO signage is required on all installations storing 250 kg or more.
2. Signage details can be obtained from the gas supplier or a test certifier.

2.10 Emergency Response

1. A 2 kg dry chemical fire extinguisher is required to be available for all installations over 50 kg. The location of the extinguisher must be clearly identified and be placed within 30 metres of the installation.
2. Emergency response plans are required for all sites with 300 kg in one location. The gas supplier or a test certifier should be contacted for this information

2.11 Modifications

- 1 All modifications must comply with the requirements of this code.

2.12 Requirements for cylinder deliveries.

- 1 Cylinder installations should be located such that the delivery of gas can be made safely by one person without excessive manual handling or risk to customer's property. In situations where the following conditions cannot be satisfied, other options such as locating the cylinders remotely and piping to the installation should be considered.
 - (a) Cylinder installation must be designed to be capable of accommodating the size of cylinder intended for use.
 - (b) A minimum distance of 600mm should be provided between front of the cylinder installation and other structures to allow adequate access for the cylinder delivery to be made.
 - (c) The cylinder compound should be accessible by cylinder trolley.
 - (d) Paths should have a minimum width of 600mm.
 - (e) Steps should have a minimum of 2:1 tread depth to tread rise. Maximum tread rise should be 125mm.
 - (f) Steps should not exceed 1.5m total rise.
 - (g) Paths should not exceed 20 deg gradients.
 - (h) Total distance from cylinder delivery truck parking area and cylinder installation should not exceed 75m.
 - (i) It must be possible to legally and safely park the truck while making the delivery.
 - (j) Access route should be firm and compact even in wet conditions.
 - (k) The access route should not be over delicate or decorative surfaces such as terracotta.

2.13 Vaporisers

1. This is a specialist field and the gas supplier shall be consulted.
2. Direct fired vaporisers, i.e. those with a source of ignition, must be separated from the cylinder storage as required by the HSNO legislation. Specialist advice must be obtained from the gas supplier for these requirements.
3. Non-direct fired vaporisers can be installed in the cylinder storage area following advice from the gas supplier.

In-situ filling

1. This is a specialist field and the gas supplier shall be consulted.
2. All in-situ filling installations must comply with the following clauses of AS/NZS 1596:
 - (a) Installations for in-situ filling; and
 - (b) General precautions for tanker transfer; and
 - (c) Supervision of delivery.

SECTION 3: SELECTION AND LOCATION CRITERIA CONNECTIONS, MANIFOLDS, CHANGE-OVER VALVES AND REGULATORS

This section contained general guidelines that refer to all installations and where relevant each section will have specific requirements that apply to either vapour or liquid installations. Both the general and specific requirements must be used when selecting and building the installation.

3.1 Cylinder connections

1. All cylinder pigtails should:
 - (a) Have maximum extractable materials of no more than 2%.

- (b) Be manufactured to an appropriate Standard, such as AS 1869 or UL 21.
- (c) Be no longer than 1m.
- 2. Cylinders should be connected directly to the changeover valve assembly by copper or flexible rubber pigtails.
- 3. An excess flow valve shall be fitted immediately upstream of the piping or hose assembly. This excess flow valve may be an integral part of the POL fitting.

Vapour specific

The cylinder pigtail should be labelled as having "low extractable matters" if of flexible rubber construction.

For vapour withdrawal systems a non return valve must be fitted in the supply between each cylinder and the changeover valve, or in a manifold system between each cylinder and its manifold connection.

Liquid specific

It is recommended that an AS 2473 type 26 CGA555 valve system be used.

For exchange cylinder installations a valve should be fitted at the cylinder end of each cylinder hose and a hydrostatic relief valve installed in any section of the pipe where liquid could be trapped between valves.

Liquid installations should have manufacturer approved liquid hoses.

All valves and hoses must be suitably rated for liquid i.e. typically 2.4 MPa.

3.2 Changeover valves – vapour installations only

1. Changeover valves can be manual or automatic, and may include a non-return valve on each pigtail connection. The valve must comply with the requirements of the Authority.
2. Changeover valves may be comprised of a first & second stage regulator system in a single body, or as a combination of separate component items.

3.3 Regulators

1. Regulators should be designed to cope with the presence of condensate found in small quantities in the LPG. This design can include such things as the specification of the material used for the components in the regulator and the serviceability of the regulator. Some regulators may consist of a separate first and second stage. For this type of system a condensate trap should be installed between the first and second stage regulator as described in 3.6.

3.4 Regulator position

1. First and second stage regulators should be located outside buildings, except where an indoor location is permitted by AS/NZS 1596.
2. The regulator shall be mounted in well ventilated location.
3. If mounted externally, a durable cover shall be provided which protects the vent opening from sleet, snow, rain, ice, mud or wheel spray.
4. A support should be provided to take the weight of the pressure regulator when it is disconnected from the cylinders.
5. Rigidly fixed to an adequate support independent of the cylinder and mounted in accordance with the manufacturer's instructions.;

3.5 First stage regulator

1. The first stage regulator can be part of the change over valve, or can be fitted separately.
2. The regulator must comply with one of the following standards: UL144, UL252, AG 205, NF M 88-769, or other internationally recognized standard.
3. The regulator must comply with the requirements of the Authority.
4. The regulator and pigtails must be installed in accordance with the manufacturer's instructions regarding protection from the weather and to prevent water ingress to the vent. 5. The vent terminal of the regulator should have provision to prevent the entry of any material that could cause a blockage.

6. A provision may be provided to connect a condensate trap down stream of the first stage regulator, where the first and second stage regulators are separate items (see 3.6).
7. Consideration must be given to the total expected gas load when sizing the regulator.
8. The minimum height of the first stage regulator above the cylinders valves should be 75mm.

3.6 Condensate trap

1. Condensate traps remove condensate and prevent transfer downstream of most condensates present in the LPG.
2. A condensate trap should be installed between the first and second stage regulator if they are separate items.
3. If the regulator is the combined type then a condensate trap should be installed immediately after the regulator.
4. Condensate traps must have a vertical limb in a direct line to the first stage regulator and be of a minimum volume of $V=N \times 5.5$ where:
 - V- The volume of the vertical limb in millilitres (ml)
 - N -The number of 45kg cylinders.
- NOTE: Larger traps may be required for liquid installations using a vaporiser.
5. The trap must have a plug or other means of removing the condensate.

Examples of length of condensate trap tube for 10 and 13 mm pipe and various numbers of cylinders.

Number of 45 kg cylinders	Length 10 mm pipe	Length 13 mm pipe
Two	140 mm	88 mm
Four	280 mm	180 mm
Six	370 mm	240 mm
Eight	560 mm	350 mm

3.7 Second stage regulator

1. The regulator must comply with an internationally recognized standard.
2. The vent terminal of the regulator should have provision to prevent the entry of any material that could cause a blockage.
3. The regulator can be fitted immediately after the condensate trap or downstream (outdoors) closer to the first appliance.
4. Any incorporated pressure relief valve should start to discharge when the outlet pressure of the regulator rises at least 1kPa above set point. The relief valve should be of sufficient capacity to maintain a maximum downstream pressure in accordance with the requirements of NZS 5262 2003. The discharge capacity of the pressure relief valve on the full range of the inlet pressures should not be less than that calculated by the formula $Q = 6.5 DP$.
 - Where:
 - Q = Pressure relief valve discharge in litres per hour of air.
 - D = Diameter of regulator orifice in mm or 3, which ever is the greater.
 - P = Inlet pressure to the relief valve in kPa above the start to discharge pressure setting
5. The lock-up pressure should not exceed 1.5kpa above the declared outlet pressure of the regulator.
6. The regulator must be positioned so that it is able to be serviced in accordance with the manufacturer's recommendations

3.8 Over pressure shut off (OPSO)

1. An OPSO device uses pressure containment as an alternative to pressure relief, to protect downstream equipment from hazardous pressures, or the failure of a regulator.
2. Any OPSO device must comply with an internationally recognized standard, and should isolate the gas supply in the event of an over-pressure situation being detected.

3. The OPSO device may be installed upstream of either the first or second stage regulators, and will protect downstream equipment from excess outlet pressure from the second stage regulator.

3.9 Non-return valves – vapour withdrawal systems only

1. A non-return valve must be fitted either in each pigtail connection of the changeover valve, or as part of each pigtail.
2. The non-return valve is to ensure that LPG cannot flow across the changeover system

3.10 Excess flow valves.

1. An appropriately sized excess flow valve must be fitted to ensure that in the event of a pipe or hose failure the flow is restricted.
2. The excess flow valve can be an integral part of the pigtail assembly; or immediately after the outlet of each cylinder valve; or be internal to the cylinder.

3.11 Manifolds

1. Proprietary manifold systems must be approved by ERMA.
2. One off manifold systems require a producer statement confirming compliance with the requirements of the PECPR regulations.
3. Manifolds shall be installed so that any liquid formed in the piping will drain freely back into the cylinder. Any such liquid shall not be allowed to drain back to the regulator.

Liquid withdrawal systems

1. A pressure relief valve shall be installed on the manifold.

(The gas supplier should be consulted as they may have additional requirements for the installation).

3.12 Materials of construction

1. Pipe shall be steel complying with the following or other equivalent specifications:
Steel pipe: ASTM A106 or API 5L Grade B

3.13 Jointing methods

1. A joint subject to cylinder pressure, shall be welded to schedule 40 or 80, or screwed taper to taper, to Schedule 80 or flanged. The welder should be qualified to ASME 9, API 1104.

3.14 Pipework

1. Pipework that has an internal diameter 40 mm or less is not required to have a certificate of inspection under the PECPR regulations. However records must be held to demonstrate compliance with the PECPR requirements. Pipe work which has an internal diameter of greater than 40 mm must have a certificate of inspection under the PECPR Regulations.

3.15 Identification

1. Piping shall be identified according to its contents.

3.16 Corrosion protection

1. Steel pipe and fittings shall be painted to protect against corrosion.

3.17 Sizing the Installation

1. Piping shall be sufficient size that the operation of appliances shall not be affected by the pressure drop in any pipe.
2. The volume of gas accounted for shall be determined from either, the manufacturer's input rating, gas supplier or equipment manufacturer.
3. The total connected hourly load shall be the basis for storage and pipe sizing for all equipment that may be operating at full capacity simultaneously.

3.18 Draw off rates for general product LPG

1. As a guide a 45kg vapour withdrawal cylinder is capable of a continuous supply of 1kg/50MJ over the period of 1 hour. A 90kg cylinder is capable of a continuous supply of 100MJ over the period of one hour.
2. The instantaneous demand can exceed this rate for short periods provided the cylinder is subject to only low or no draw off for a time (called relaxation period).

3.19 Commissioning/Pressure Testing of the manifold.

1. The installation should be pressure tested up to the first stage regulator by the gasfitter prior to delivery of the cylinders. Following delivery, purging and commissioning should take place.

3.20. First Delivery of LPG.

For first time cylinder deliveries the LPG delivery personnel will connect cylinders but will leave them turned off with a suitable label attached. Only the gasfitter should turn on the supply.

SECTION 4: MAINTENANCE OF MULTI CYLINDER INSTALLATIONS

4.1 Cylinders

1. Cylinders shall not be filled unless they have been tested, certified and stamped within the last ten years.

4.2 Pigtails

1. Pigtails should be inspected visually for cracks and deterioration every time the cylinder is exchanged or filled.
2. Pigtail connections should be checked with a soapy solution every time the cylinder is changed or filled.
3. Pigtails should be replaced every five years.

4.3 Change-over Valves

1. Changeover valves should be checked for correct operation in accordance with manufacturer's recommendations or in the absence of any recommendation, at least every ten years.

4.4 First Stage Regulators

1. The first stage regulator to be checked for correct operation in accordance with the manufacturer's recommendations, or in the absence of any recommendation at least every ten years.

4.5 Second Stage Regulators

1. The second stage regulator to be checked for correct operation in accordance with the manufacturer's recommendations, or in the absence of any recommendation, at least every ten years. The rubber diaphragm and rubber seat must be inspected for deterioration and replaced if necessary.

4.6 Condensate Traps.

1. Condensate traps should be emptied whenever any work is carried out on the installation and at least every 2 years. **NOTE** For the quantities of residue expected to be found in the condensate traps, between 2 to 3 ml maximum, use disposable gloves when emptying the residue into absorbent material. The used absorbent material and the gloves can then be disposed of in general waste.
2. The condensate trap to be drained by removing the drain plug or test pressure nipple provided at intervals not exceeding two years, and at every visit of the Gas fitter.

NOTE: Before venting any trap check that there are no sources of ignition in the area and stay upwind of any vented gas.