Guide to
Good Industry Practices for LP Gas Bulk Road Tanker Management

WORLD LP GAS ASSOCIATION

The World LP Gas Association

The World LP Gas Association was established in 1987 in Dublin, Ireland, under the initial name of The World LPG Forum.

The World LP Gas unites the broad interests of the vast worldwide LP Gas industry in one organisation. It was granted Category II Consultative Status with the United Nations Economic and Social Council in 1989.

The World LP Gas Association exists to provide representation of LP Gas use through leadership of the industry worldwide.

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Guide to Good Industry Practices

LP Gas Bulk Road Tanker Management

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Chapter One

Background

The WLPGA is committed to providing independent advice to LP Gas stakeholders to ensure safety in the operation of LP Gas equipment.

The two WLPGA Guides - *Best Business Practices* and *Best Safety Practices* - have been used extensively during the last ten years all over the world to provide guidance across all areas of the LP Gas industry.

These two Guides have been designed to provide general advice to all stakeholders on best practices throughout the supply and distribution chain.

Following the success of these guides it has been decided to develop and publish more detailed advice in certain areas of the supply and distribution chain that are considered more critical and where more prescriptive advice would be helpful.

This is the third of a series of guides issued by WLPGA and this one deals with the subject of *LP Gas Bulk Road Tanker Management.* This document addresses the design, operation and maintenance requirements for both rigid and articulated LP Gas bulk road tankers.

While the WLPGA has made efforts in good faith to ensure that the information and advice contained in this report are accurate, WLPGA offers no implied warranty of merchantability or fitness for any particular purpose, nor accepts any responsibility whatsoever for any damages arising from the use of the information contained in this report.

Chapter Two

Guide to Good Industry Practices for LP Gas Bulk Road Tanker Management

Road transport operation is one of the high risk activities of a LP Gas business. An estimated 1.3m people die on the road each year and 20-50m sustain non-fatal injuries (WHO Global Status Report on Road Safety 2009). With LP Gas bulk road tankers, the risk is not only limited to road accidents but also potential leakage of LP Gas from vehicle tanks and/or ancillary equipment due to physical impact or equipment failure while on the road or during product transfer operations. Such incidents may result in serious or even catastrophic consequences.

LP Gas bulk road tanker operation is also an activity that comprises a major cost to the business. Failure to manage this properly can lead to business losses. It is therefore important that LP Gas companies manage their road transport operation efficiently and reduce the risks to As Low as Reasonably Practicable (ALARP). This can be achieved with appropriate vehicle design and engineering standards, safe operations, efficient trip planning and comprehensive and rigorous maintenance programmes combined with effective driver training programmes.

This Guide aims to provide information on good safety practices relevant to LP Gas bulk road tanker management which are adopted from widely recognize industry codes of practice and standards, as well as best practices from major LP Gas companies. It should always be used in conjunction with local/regional standards and regulations. If the requirements of the local/regional standards or regulations are less than this Guide, the latter should be adopted to ensure a higher level of safety for the LP Gas road transport operations.

This Guide applies to transporting pressurized bulk LP Gas in rigid and articulated road tankers. It does not cover the following:

- LP Gas cylinders trucks
- Swap body rigid trucks
- ISO tank containers
- Tanker to tanker product transfer
- Design of loading/unloading facilities
- Transport security

Chapter Three

Road Tanker Fleet Planning

3.1 General

Road tanker operation is usually a major activity of any LP Gas business whether this is outsourced or managed in-house. To achieve a safe and efficient road tanker operation, one critical factor is to have the correct fleet of road tankers. This will entail selecting road tankers that are (1) suitable to the operating environment, (2) have the appropriate fleet capacity and (3) have the best total cost of ownership.

3.2 Operating Environment

- The LP Gas road tankers should be designed with the necessary operational and safety features to ensure the fleet operates reliably under all operating conditions anticipated in the area of operation. This includes knowing the climatic conditions (e.g. range of temperature, level of rainfall or snowfall, etc.), type of terrain (mountainous or flat land), and type of roads (e.g. concrete or off-road).
- LP Gas road tanker fleets should also be planned based on the type of operation of the business i.e. customer delivery or bridging to LP Gas depots/filling plants.

    - Customer delivery typically involves delivering in small drop sizes using rigid trucks with own pumps and flow meters onboard. They should have a suitable turning radius to maneuver within the limited spaces found around the customer's compounds. Capacities can range from 5MT to as large as 12MT.
    - LP Gas road tankers used for bridging products to depots or filling plants are usually trailer types designed for transporting bigger quantities. Carrying capacities can be as high as 28MT depending on local/regional regulations. Product unloading is commonly achieved using the terminal/depot pumps or compressors for this type of road tanker although pumps can also be fitted on board the truck to allow them to be self-discharging.

3.3 Fleet Capacity

- LP Gas road tankers should always be designed to the maximum capacity allowed in public roads to lower the unit distribution cost. They should comply with local/regional regulations with respect to the vehicle maximum laden weight as well as the maximum axle loads. Site accessibility and road conditions should also be considered when selecting road tanker type and capacity to ensure they can be maneuvered safely while on the road or within the customer premises.
- The size of the road tanker fleet should be planned based on current demand (including seasonal fluctuations) and projected future volumes to be transported. Fleets should be planned with each truck running at least one full load a day. It is best practice to operate the trucks on more than one shift per day to increase truck utilization and reduce the number of trucks required.
- In determining the total size of the bulk LP Gas road tanker fleet, downtime for truck maintenance should be taken into consideration to ensure there is enough fleet capacity to meet delivery demand when trucks are withdrawn for planned maintenance.

This also ensures trucks are given timely maintenance to avoid unplanned breakdowns.

3.4 Total Cost of Ownership

LP Gas road tankers should not be selected on the basis of the initial capital cost alone. Initial capital cost may account for less than fifty per cent of the total cost over the whole life of the vehicle if fuel, maintenance and other operating costs are taken into account. Therefore it is important to consider the total cost of ownership when deciding on which vehicle to select. This includes the initial capital cost of the vehicle, the operating cost of the vehicle (e.g. fuel consumption, cost of spares periodic maintenance cost etc.), and the residual value on disposal over the whole life of the vehicle. The projected whole life cost can usually be made from published costs available from vehicle manufacturers and data from industry publications. The option with the lowest total cost of ownership will yield the most advantage over the whole life of the vehicle.

Chapter Four

Road Tanker Design and Specifications

4.1 General

- LP Gas road tankers may be of articulated, rigid, or rigid with a drawbar trailer design, selected to meet the operational needs of:
    - moving product in bulk between two plants - where loading/unloading operations are normally conducted using plant facilities;
    - making customer deliveries - where small volume drops are carried out using a vehicle-mounted pump and meter system.
- LP Gas road tankers must comply with local design and constructional regulations taking into account operational limitations, e.g. axle weights, gross laden weight, overall length/width, etc.
- Where local regulations do not exist or are not sufficiently comprehensive, the requirements of recognised alternative legislation, combined with limits of design offered by vehicle manufacturers, must be adopted i.e. ADR, UK LPGA COP2, etc.
- All vehicle tanks and tank equipment must be manufactured and approved to appropriate international standards, or where necessary regional or national standards.
- No repairs, additions or modifications to any electrical system or equipment should be carried out which does not meet the original manufacturer's standards.

4.2 Engine

- Compression-ignition type engines are recommended for LP Gas road tankers. These must comply with the emission standards required by local laws or regulations. Where this is not mandated by local laws or regulations, engines with the highest emission standards available for the operating market should be used i.e. Euro V.
- The engine should be located in front of the rear face of the cab. It should develop a minimum of 10 brake horsepower (BHP) per one (MT) of gross vehicle weight (laden weight) for vehicles up to 26MT and 8 BHP per MT for larger vehicles (but 10 BHP per MT if the vehicle is to be used in mountainous areas). The engine meeting these criteria should be selected on the basis of the total cost of ownership and the duty/operating environment.
- The point of entry to the air induction system must be at a high level (approximately at the top of the vehicle’s cab as generally supplied by vehicle manufacturers) and located in such a way that any LP Gas released by the bulk vehicle is unlikely to enter the engine.
- The engine oil and fuel filters must be easily accessible for maintenance purposes. They must be sited so that any oil/fuel that is spilled during replacement will not fall or run unto sensitive or hot equipment.

4.3 Exhaust System

The exhaust system must be located or shielded such that any spillage of LP Gas or fuel from the vehicle fuel system will not directly fall onto a hot part of the exhaust.

Where the exhaust system is sited forward of the back of the cab no shielding in necessary. Unlike the air induction system (see 4.2), the exhaust does not have to be located at a high level.

4.4 Electrical System

- The electrical system must be protected by proper siting within the chassis to minimize the risk of sparks occurring, mechanical damage and risk of electrical fires. The nominal circuit voltage must not exceed 24 volts and robust single pole or insulated return wiring (only where demanded by legislation) is to be used.
- Cables must be protected against impact and heat from the engine and securely fastened to prevent damage by vibration. All cables must be insulated, heavy-duty copper conductors and sized big enough to avoid overheating. Aluminum cables may be used from the battery to the starter motor provided compression type terminals are used.
- Batteries must be of a low maintenance type. They must have sufficient electrical capacity to start the vehicle's engine at temperatures as low as minus 20^{o}C. They must be protected against leakage of LP Gas and fitted with an insulated cover to prevent inadvertent contact across terminals and possible sparks. Batteries must be sited, where possible, such that adequate protection is achieved from impact in the event of a vehicle accident.
- A battery isolation master switch must be placed as close to the batteries as possible to enable all electrical circuits to be isolated - except tachographs/onboard computers/GPS and other approved protected items. It must meet Hazard Zone 2 (or ADR Annex B Part 9 as applicable) requirements. Intrinsically safe or flameproof circuits meeting Hazard Zone 1 (or ADR Annex B Part 9 as applicable) requirements may be connected to the battery side of the master switch. The master switch must be readily accessible to persons outside the vehicle and its location clearly indicated. Cab activation must also be provided to enable the driver to operate the switch without leaving his seat.
- Cigar/cigarette lighters and other power take off connections must not be fitted in the cab. If it is necessary to fit radios, telephones, etc., (on the understanding they could distract the driver) they must be permanently wired such that they can be isolated via the battery isolation master switch. This includes heated wing mirrors.
- Cab heaters, other than those operated from the water cooling system of the vehicle's engine, must not be installed, unless they are specially designed to operate as a stationary heating system suitable for hazardous goods vehicles. There must be a certificate of approval and a maintenance schedule kept with the vehicle documentation and maintenance records.
- The electrical connection between the tractor and trailer must comply with requirements of ISO 7638, ADR or equivalent. Where a rigid vehicle is to be used for drawbar trailer operations, the vehicle manufacturer must be notified so that adequate electrical connections can be provided at the rear of the vehicle. Such connections must satisfy ADR Annex B Part9.

4.5 Chassis and Chassis Equipment

- The method of mounting the tank onto the chassis must be agreed between both the tank and vehicle manufacturer to avoid operational problems.
- The chassis must be designed to withstand not only the weight of the tank with a full load of LP Gas but also when it is completely full of water in the event that vehicle tank is subjected to a hydraulic test.
- The vehicle must be fitted with a full width heavy duty steel bumper positioned at least 100mm rearward of the LP Gas tank or any other LP Gas discharging equipment sited at the rear of the tank, e.g. metering equipment.
- The bumper must be fitted with "under-run" protection, which may be achieved by the fitting of proprietary under-run protection devices or equivalent. Side under-run protection must be fitted between the rear axle and the rear bumper where there is a substantial gap. The clearance from the ground of the under-run protection is normally not more than 500mm. However, precise clearance will depend on local road and operating conditions.

- Protection guards for vehicle tank valves may be required and these should be fitted along the longitudinal chassis members using a method approved by the vehicle manufacturer.
- Where a rigid truck is to be fitted with a vehicle-mounted LP Gas delivery pump driven by engine power take off (PTO), consideration must be given in the selection of a suitable PTO unit to the power consumption requirements, the required speed (rpm) and the direction of rotation.
    - The truck must be fitted with a suitable engine speed control and stop control. These controls must be located on the kerb side of the vehicle, behind the cab. Each control must be labelled to show its operation.
- Vehicle-mounted LP Gas delivery pumps on articulated vehicles are normally driven by a hydraulic drive.

4.6 Fuel System

- The fuel tanks should be positioned in such a way that any leakage will drain into the ground without coming into contact with any hot surfaces of the vehicle.
- The capacity of the fuel tank and its operating range should be decided after taking into account normal operations and the engine fuel consumption. Long range fuel tanks (i.e. 500 litres capacity) may be considered for high average mileages where the loss of payload is offset by less frequent fuelling. Short average trip distances may not justify long range fuel tanks because of the impact on allowable load size. Excessive fuel can also add to the risk of an explosion in a fire situation.
- Adverse operating conditions may affect fuel system of the vehicle e.g. hot/cold weather, dry, arid, sandy, wet or muddy roads, etc. For example:
    - In severe cold weather, when diesel fuel waxing may occur, electrically-powered heating systems for fuel lines, filters, etc., may be required;
    - In dry, dusty conditions, a more efficient air induction filter system may be required;
    - In muddy or off road operations, a 4-wheel drive system may be required.

  Such conditions must be taken into consideration when drawing up the specifications of the road tanker.

4.7 Braking System

- Braking systems of road tankers must meet the technical requirements of applicable regulations or standards in the country. As a minimum, both rigid and articulated road tankers must be fitted with anti-lock braking systems (ABS) which helps maintain steer-ability and vehicle stability during braking, and ensures a shorter stopping distance compared to locked-wheel braking. ABS also helps reduce the likelihood of articulated trucks and trailer combinations jack-knifing.
- Vehicles operating under ADR approval are required to be fitted with not only an anti-lock braking system operating on all wheels but also a secondary “endurance” braking system operating directly on the vehicle driveshaft. Endurance braking systems (retarders) should also be considered for road tankers operating in mountainous/hilly terrain even if not covered by any regulations.
- All the braking systems must be fail-safe in the event of loss of air pressure.
- Automatic brake adjusters must be fitted to each brake (if auto-adjustment is not part of the foundation brake design).
- Adverse operating conditions may also affect braking systems (see 3.2) and these must be considered when specifying braking systems so that appropriate devices may be installed to overcome them, e.g. air dryers and insulated electrical heaters to eliminate freezing water droplets in air systems.

4.8 Speed Limitation Devices

Road tankers shall be fitted with a speed limiter that limits the maximum speeds of the vehicle to the national (or company) speed limit or lower if demanded by other regulations covering speed limiter settings.

An audible speed alarm may also be fitted at the vehicle.

4.9 Vehicle Cab Equipment

- All seats must be fitted with head restraints to minimise the risk of whiplash injuries to the head and neck.
- All road tankers shall be fitted with effective seat belts (i.e. 3-point inertia reel type seatbelt) for each occupant. The seat belt on the driver's seat should be installed so that it moves when the seat (including height) is adjusted.
- Wide-angle mirrors must be fitted to enhance the driver's view along the entire length of the vehicle. The off-side mirror must incorporate a "look down" feature that enables the driver to see the kerb. Where deemed necessary in view of the local driving conditions, additional mirrors may be fitted. Where relevant, all mirrors described in this paragraph (wide-angle, off-side and additional) must be motorised and electrically heated.
    - In some locations, technology exists to monitor these blind spots using cameras.
- Temperature and ventilation controls should be provided to ensure driver comfort while on the road. This includes air conditioning if required by temperature and humidity levels anticipated during operation.
- Sleeper cabs with complete sleeping facilities should be provided if drivers are required to stay in the cab for overnight stops.
- A 2kg capacity CO2 fire extinguisher suitable for fighting electrical/engine fires shall be fitted in the cab. It must be manufactured to an established standard, e.g. EN 3 and securely stowed and easily accessible to the driver when he is standing on the ground.
- A document holder should be fitted inside the cab, installed for easy access to the driver. This must be large enough to contain the following:
    - Driver's training certificate;
    - Vehicle ADR certificate (where required);
    - Driver's handbook with standard operating procedures;
    - A hazard warning card applicable to the load being carried (Tremcard);
    - Load details sheet.

4.10 Lighting

- In addition to standard front and rear lights and indicators, consideration should be given to equipping the vehicle with the following:
    - Two reversing lamps with beepers mounted at the rear of the vehicle, one on the near side and one on the off side.
    - Hazard warning lights mounted at the rear and front of the vehicle on both the near side and the off side.
    - Duplicate light sets mounted as high as practical on the rear bulkhead/end dish (above centre line of tank) and complying with the country legislation where specified. The high lights are to be as close to maximum width as possible, but within the circumference of the tank.
    - Two fog lights mounted at the front of the vehicle if required by weather conditions during the operation of the vehicle.
- Where ADR applies, the following must also be provided:
    - End outline marker lamps mounted one on each end of the rear bumper
    - Side marker lamps mounted in accordance with regulatory requirements, complete with dual filament bulbs to give additional flasher facility
- If deemed necessary by operational requirements e.g. delivering during hours of darkness, two work lamps may be fitted, one on either side of the hose reel.

4.11 Miscellaneous Equipment

- Anti-spray devices must be fitted to all mud wings (flaps) including those forming part of the vehicle cab.
- Audio-visual warning devices to warn passers-by that the vehicle is reversing must be fitted. Fitting of proximity sensors with audible alarm, and/or cameras, may be considered.
- Reflector strips should be fitted around the vehicle and tank to enhance visibility (subject to any local regulatory requirements or restrictions).
- Tachographs, In Vehicle Monitoring Systems (IVMS), onboard computers or Global positioning Systems (GPS) must be fitted to all vehicles for journey management purposes.
- Good quality radial tyres must be fitted on all axles of the tractor unit and trailer, of a design suitable for the chosen mode of operation (steering/drive). Tyre valves must be arranged for easy checks of tyre pressure (including valve extensions for inner twin wheels). Wheel nuts must be fitted with anti-loose (wheel nut torque) indicators. It may not be necessary to fit a spare wheel on the vehicle if reliable repair contractors are available within the range of the vehicle. This will also reduce dead weight and eliminate threat of theft of the spare wheel.
- The vehicle should carry the following:
    - A first aid kit
    - Either three heavy-duty warning cones or three warning triangles or two amber warning lights. The warning lights shall be independent of the vehicle electrics with steady, strobe or flashing operation, designed so that their use will not cause an ignition of LP Gas. (Note: the carriage of two warning lights is an ADR requirement)
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    - Two dry powder fire extinguishers of not less than 6kg capacity manufactured to EN 3 or another equivalent standard. They must be located at each side of the vehicle behind the rear axle or in another suitable and accessible location
    - Two wheel chocks of a size suitable for the diameter of the wheels and weight of the vehicle
    - Two warning notice plates indicating the following:

        “LP Gas delivery in Progress. No Smoking or Naked Flames”

Chapter Five

Tank and Tank Equipment

5.1 General

- Only tank manufacturers that can demonstrate their capability to produce to quality standards should be selected. Furthermore, manufacturers selected should also be capable of constructing the tanks to the appropriate design code and engineering details.
- It is important to ensure that manufacturers comply with the requirements of the design code and manufacturing specifications by appointing an acceptable independent inspection authority during and post manufacturing to verify compliance.
- Prior to the commencement of fabrication, both manufacturer and buyer should agree/approve the applicable design code or standards, manufacturing drawings and specifications and destructive and non-destructive testing requirements.
- All materials used i.e. metallic and non-metallic, must be suitable to the grade of LP Gas that will be contained and the operational range of temperatures and pressures anticipated. The design of the tank should minimize the use of materials.
- Diagrammatic Layouts of Piping and Equipment for LP Gas road tankers are given for information in Appendix One for Normal Rigid Chassis Type and Appendix Two for Normal Articulated Chassis Type.

5.2 Design Code

- All vehicle tanks must be designed and manufactured to recognized pressure vessel codes such as ASME Section VIII, EN 12493 or any other equivalent standards. Where there is a prescribed local or national standard for pressure vessels, the requirements must at least equal that of ASME Section VIII or EN 12493.

5.3 Design Pressure and Temperature

- The design pressure of the tank should be based on the maximum vapor pressure developed by LP Gas at the applicable reference temperature for the area of operation. This is dependent on the grade of LP Gas to be carried and for road tankers transporting different grades of LP Gas, the grade of LP Gas resulting in the highest vapor pressure should be used i.e. propane. Reference temperatures are normally specified by local/regional regulations.
- Tanks should be designed for vacuum conditions developed by the product during operation or other operational conditions. As a minimum, this should be 0.4 bar pressure unless local/regional regulations require full vacuum.
- The design temperature should range from minus 20^{o}C to +50^{o}C unless the tank is subject to more severe product or ambient temperatures.

5.4 Tank Capacity

- The maximum carrying capacity of the vehicle tank is determined by the limitations of the maximum safe filling volume of LP Gas which may be filled into the tank and/or the statutory limitations on maximum Gross Laden Weight (GLW) and individual axle weights allowed on public roads.
- The maximum quantity of LP Gas that can be filled into the tank should also take into consideration the effects of thermal expansion of LP Gas.
- For this reason LP Gas tanks must never be liquid full as any rise in temperature may cause the tank relief valve to open and release LP Gas to the atmosphere. Calculations for the maximum safe filling capacity must be based the applicable local regulations or in its absence, EN 12493 may be used.

5.5 Surge Plates

Tanks with an internal volume of over 7.5 m^3 shall be fitted with surge plates set laterally to limit any longitudinal surge of liquid LP Gas due to the acceleration of the vehicle. The plates shall be at least 2 mm thick and shall have a suitably sized manhole for full access through the tank. Openings must be provided at the top and bottom of each plate to allow for complete liquid and vapour transfer. The volume between plates should not be more than 7.5m^3.

5.6 Manholes

- Inspection manholes complying with the requirements of the design code must be provided for tanks with diameters of more than 1.8m. They must be at least 500mm in diameter and should be positioned for ease of access. Typical locations for manholes are as follows:
    - On an articulated vehicle tank - in the lower part of the head on the vertical centre line for easy access
    - On a rigid vehicle tank - on the centreline if a rotary gauge is to be considered

- The design shall be of flush type to accept a semi-ellipsoidal dished inwards cover welded to the cover flange. A handling bar shall be welded across the manhole cover.

5.7 Tank Mounting

- The tank shall be mounted unto the chassis in a method approved by the chassis manufacturer. The mounting design shall take into account the driving conditions and vibration/fatigue related aspects of the operating environment. Tanks shall be fitted with mounting brackets attached to the tank via backing plates welded to the shell. The number of mounting brackets depends on the capacity of the tank i.e. the bigger the tank, the more mounting brackets required.

- Tanks shall be mounted upon the chassis in such a way as to be capable of absorbing, under the maximum permissible load, the forces exerted by:
    - In the direction of travel, twice the total mass
    - At right angles to the direction of travel, the total mass
    - Vertically upwards, the total mass
    - Vertically downwards, twice the total mass

5.8 External Corrosion Protection

- Tanks should be protected against corrosion arising from environmental effects and these should be properly and adequately maintained.

- The external surface of the tank should be subjected to a complete shot blast operation and subsequent zinc metal spray treatment of at least 70 microns thickness or other suitable treatment to a recognised standard prior to painting.
- The final top coat of predominantly white gloss epoxy must be applied to 150 microns dry film thickness before the tank is commissioned. Other finishes may reduce normal reflection of solar radiation and therefore require a higher design temperature/pressure.

5.9 Valves and Fittings

5.9.1 General

- All valves and fittings on the vehicle should be suitable for liquid phase LP Gas at the anticipated operating pressures and temperatures. These should be installed or fitted in accordance with the manufacturer's instructions and recommendations.
- Protection against mechanical damage must be provided by design, location of barriers, and against the dangers of collision or roll-over. Mechanical barriers should not be attached to pipework or valves which they are intended to protect.
- Joints for pipework may be threaded for pipe sizes up to and including 50 mm nominal bore, or for proprietary items such as pumps, valves and meters up to 80 mm nominal bore. Larger sizes of pipe should be welded or have welded flanges.
- Threaded fittings should be made from forged carbon steel to BS 3799 or ANSI/ASME 16.11 and may require the use of heavy wall pipe. The thread on both the fitting and pipe should be tapered and of the NPT form.

5.9.2 Pressure Relief Valves

- Unless prohibited by local legislation, all tanks shall be fitted with one or more pressure relief valve. The start to discharge setting shall not be greater than the tank design condition. The combined capacity of relief valves shall meet the requirements of ADR Chapter 6 or NFPA 58 Appendix E, E.2.2.
- Pressure relief valves shall be spring loaded, flush-mounted, fully internal design and sited in the vapour phase of the tank. They must be designed in such a way that ignition of vapour discharged from the relief valve(s) cannot impinge on the tank.
- Means must be provided to prevent water and solid particles from collecting in the outlet of the valve.

5.9.3 Internal Shut-off Valve

- All connections to the tank that serve as a passageway for LP Gas in and out of the tank with more than 1.5mm diameter, other than those for pressure relief valves or permanently blanked nozzles shall be protected by an internal shut-off valve.
- The internal shut-off valve should be fire-safe, fail-safe, and normally be a closed valve directly connected to the tank. It must be designed with the closure mechanism sitting inside the tank and equipped with an excess flow valve
- The internal shut off valve shall be opened by pneumatic power taken from the vehicle braking system and incorporate a thermal fuse to ensure positive closure during a fire. It must be capable of being activated from both sides and the rear section of the vehicle for rapid shut down in case of emergency (see 5.9.4.).

5.9.4 Emergency Shutdown System

- An emergency shutdown system must be provided on the vehicle that closes the internal shut off valve and stops the engine or disengages the Power Take Off (PTO) in case of an emergency. At least three actuating buttons must be provided to separately actuate the system and these should be located at either side and at the rear section of the vehicle. Consideration should also be given to the installation of a button in the vehicle's cab

- In addition, consideration should be given to providing the capability for remote shutdown for the person controlling the delivery. Remote controls in general consist of fitting a receiver in the cab which receives and controls the commands in case of a remote signal, and a transponder which is carried by the driver. The transponder is used for distance control and will need to be suitable for use in a classified area. It is only used for customer delivery and not in loading depots where it needs to be handled as normal equipment on board of the vehicle. Storage of the transponder in the cabinet is not allowed and carrying by the driver when making a delivery is mandatory. The remotely-operated system is mandatory when deliveries are made by the driver alone and this must include a 'dead man' or 'man down' function.

5.10 Ancillary Equipment

5.10.1 Contents Gauges and Level Gauges

- Tanks should be fitted with a suitable contents gauge. If the contents are to be measured by volume there should be at least two independent measuring systems fitted on the tank, one of which must be a fixed liquid level gauge.
- Maximum fixed liquid level gauges should be set taking into account the lowest operating temperature likely to be encountered during normal operations for each grade of LP Gas that will be loaded.
- Fixed liquid level gauges should be labelled for the product they have been set.

5.10.2 Thermometers and Pressure Gauges

- If fitted, thermometers must be located to record liquid temperatures and be fitted in a sealed pocket (also called a thermowell or thermosocket) in the form of a blind tube constructed to the selected tank design code
- Pressure gauges must be of the "glycerine filled" type to minimize needle vibration. They shall be located such that they are easily readable at ground level and enter into the vapour space. A manual shut off valve must be close-coupled between the gauge and the tank aperture. The valve aperture shall be not more than 1.7mm diameter. Where gauges are located remotely (next to pumps, etc.) special care and attention needs to be given to fitting the piping that feeds the gauge.

5.10.3 Pumps

- Pumps used must be suitable for use with LP Gas and the service conditions including the maximum outlet pressure that they may be subjected to.
- The designed capacity must take into consideration the tanker size, required flow rate and delivery mode i.e. part drops or full drops. Pump discharge flow rate is critical to optimizing truck turnaround time. For tankers with capacities of up to 33,000 litres water capacity, pump nominal discharge flow rate may range from 200 litres per minute (LPM) to 350 LPM. For tankers up to 65,000 litres, nominal discharge flow rate may range from 350 LPM to 900 LPM
- In addition to any integral pump by-pass, the pipework downstream of the pump must incorporate a by-pass relief valve set at a lower differential pressure to return product to the tanker when the delivery hose-end valve is closed. The by-pass valve must be suitably sized to accommodate the pump discharge flow rate. A suitable strainer should be fitted at the inlet of the pump
- Pumps on rigid chassis vehicles may be driven by the propeller shaft directly from the vehicle PTO; the PTO must be of the constant speed type not exceeding the rating of the pump. Alternatively, a hydraulic drive can be coupled to the vehicle PTO. On articulated or drawbar trailer designs, a hydraulic drive coupled to the vehicle PTO must be used. Care must be taken to ensure that there is a match between the prime mover's PTO and the semitrailer's pump. All rotating items must be provided with protection guards.

5.10.4 Meters

- Meters must be either positive displacement or mass flow type equipped with automatic temperature compensation. Use of mass flow meters is considered best practice. All meters shall have a vapour eliminator that returns vapour back to the vehicle tank and a differential valve downstream of the meter to maintain liquid pressure and prevent vaporization.

5.10.5 Hydrostatic Relief Valves

- Where LP Gas liquid could be trapped between closed valves in external pipework, a hydrostatic relief valve shall be installed between the valves to eliminate high pressures arising from thermal expansion. Such valves shall be set to discharge at not less than 26 bar (380 pounds per square inch gauge [psig]). They must be positioned so that a release would not impinge on the tank, fittings or operator.

5.10.6 External Pipework and Pipe Fittings

- Carbon steel seamless pipe to API 5L Grade B or an equivalent must be used. Pipework should be Schedule 80 for diameters up to 40 mm and Schedule 40 for diameters greater than 40mm.
- Pipe fittings must be class 3000 or 6000 socket weld type or butt-weld type. All screwed fittings (e.g. to match proprietary equipment) shall not exceed 80mm diameter with taper connection.
- Jointing materials, thread sealants and gaskets must be compatible with liquid LP Gas. Thread sealants must be of a non-setting type and spiral wound gaskets must be fitted to the outlet connections of the tank.
- Pipework must be independently supported and must not be attached to the vehicle bumper or under-run protection. Completed pipework must be subject to the required examination and hydraulically tested according to the piping code or at least 1.5 times the maximum working pressure of the system.

5.10.7 Delivery Hoses and Hose Reel

- Delivery hoses, including those fitted to hose reel, must be a single continuous length and be electrically continuous. Hoses must comply with EN 1762 or equivalent. All hoses, including pipework hoses, must be installed with a shut-off valve at each end complete with a hydrostatic relief valve to protect the hose.
- The shut-off valve at the delivery end of the hose shall be fitted with a means of depressurisation between couplings to prove that closure is effective before the delivery hose is disconnected. Hose reels with powered rewind drives must have a means of stopping the drive by a conveniently located switch or by a designed drive clutch slip.
- Hose reel power drives must be of a pneumatically driven bobbin style and must be fitted with guards; guards must not be removed or interfered with. A pressure liable to cause hydrostatic relief valves to discharge must not occur when a hose on a hose reel is fully re-wound full of liquid LP Gas.
- Specifications for hose end couplings and tank filling connections should be standardized to ensure compatibility and to minimize the use of adaptors during tanker loading or unloading operations. ACME type couplings are commonly used. Use of self-sealing couplings (also called dry break couplings) is considered best practice as this type of coupling shuts off automatically with a minimal amount of LP Gas released when disconnected.
- Where it is necessary to use adaptors due to differing couplings on the tanker and storage tank, only one adaptor shall be used to minimize the risk of leakage.
- Couplings with left hand threads should be used for un-odourised liquid and vapour products to avoid mix up of product and must not be used for any other purpose.

5.10.8 Drive Away Prevention

- The vehicle should be provided with the means for automatic immobilization while the delivery hoses are still connected and the cabinet remains open. This can be achieved with a brake interlock that ensures the vehicle cannot move unless the hoses are correctly stowed on the vehicle.
- A fail safe interlock override system must be fitted in case of accidental cabinet opening or movement of the hoses when the vehicle is in motion.

5.10.9 **Earthing Connections**

- The tanker should be provided with a suitable flexible earth continuity wire between the tanker and the connecting tank to dissipate any electrostatic potential which may arise from vehicle movement or between the tanker, the piping, and connecting tank and the ground during loading and unloading operations. The length of the wire must at least equal the length of delivery hose and must terminate with a heavy duty alligator clip.
- The continuity between the vehicle tank and the alligator clip must not be more than 10 ohms resistance.

Chapter Six

Road Tanker Labelling

6.1 General

Trucks carrying dangerous goods are required in many countries to be clearly marked or labelled visibly with emergency information to aid fire services and/or emergency response teams to manage any incident involving the truck. All LP Gas road tankers must comply with local or regional regulations with respect to vehicle labelling. In the absence of any local or regional regulations, the requirement in this section will serve as a guide for labelling emergency warnings and identification of the contents of the vehicle.

6.2 Display of Hazard Warning Signs

- Three hazard warning panels should be displayed on the vehicle applicable to the product conveyed i.e. propane (UN 1978), butane (UN1011) and mixtures thereof (UN1075).
- One panel should be positioned at the rear of the vehicle and one on each side of the vehicle as close as is reasonably practicable to the front of the tank, all in a substantially vertical plane, and at least one meter from the ground.
- Hazard warning labels should be made of metal and be removable when the tanker no longer carries hazardous goods. This should be done only if the vehicle tank has been purged and cleaned so that it no longer creates a risk.

6.3 Details of Hazard Warning Panels

- Hazard warning panels are commonly referred to as the “hazchem” sign and must display the following details:
    - Orange colored panel with UN number
    - Danger warning sign for flammable gas
    - Emergency Action Code 2YE
    - Emergency or specialist advice contact numbers

- The emergency or specialist contact numbers must be ones that can be reached at any time of the day that the road tanker is on the road.

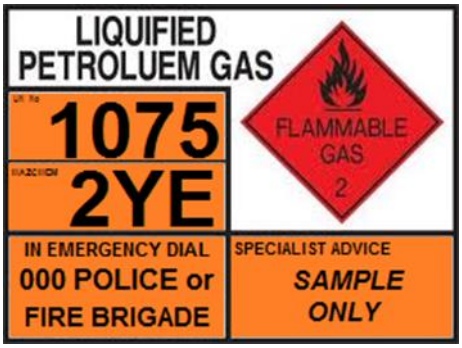


Fig. 1 Sample HAZCHEM sign for LP Gas Road Tanker

Chapter Seven

Road Tanker Operation

7.1 General

- All new or newly re-qualified LP Gas road tankers must be purged free of air before the first loading is permitted.
- Each individual prime mover (tractor), trailer or rigid chassis vehicle must be weighed prior to its first introduction into operation to prevent overfilling and ensure compliance with maximum gross laden weight and axle weights. It should be weighed in its nominally empty, gas charged condition with a full fuel tank, oil, water and discharge equipment including hoses together with an allowance for driver/driver's mate. The kerb weight and axle weights of the road tanker should be recorded
- LP Gas road tankers which have been subjected to accident damage in such a way that may affect their safety must not be returned to service until they have satisfactorily passed the necessary inspections by a Competent Person. Any repair necessary should be approved by the Notified Body responsible for periodic inspection and the carrier or his engineer must have a thorough understanding of the methods of construction contained in the relevant design codes.
- All incidents including near misses and potential incidents should be reported for any legal compliance and appropriately investigated depending on the consequence to establish root causes and corrective actions to prevent a future occurrence. Drivers should be trained on incident reporting procedures as part of their responsibilities (see 10.2).

7.2 Vehicle Inspections

- LP Gas road tankers must be checked before they are allowed to go out on the road. This is to ensure they are road worthy and compliant with requirements for safe delivery of products.
- Vehicle checks can be categorized into daily and weekly inspections and can typically be done by a trained driver with the aid of a checklist. Checklists must be signed by the driver after each inspection and filed for future reference. Any defects noted must be rectified or reported immediately.
- To ensure that the vehicle checks are done correctly, the transport supervisor should conduct random spot checks. The minimum frequency of these spot checks should be at least 20% of the fleet per quarter.
- Vehicle daily inspections should cover the following:
    - All mirrors, lights, direction indicators and reflectors are functional and clean
    - There is no external damage
    - Number plates, long vehicle plates (if required) and correct hazard warning panels are fitted and clean
    - Foot brake, hand brake and air pressures are effective
    - Horn, windscreen wipers, and reversing beepers are working
    - Windscreen is clean
    - Mechanical tachograph /electronic tachograph / onboard computer / IVMS / GPS is working and, in the case of mechanical tachographs, the time is correct
    - Seat belts are working and clean
    - Levels of engine oil, radiator, screen wash and chassis lubricating oil are correct

- The tyres are neither over- nor underinflated, the tread depth is sufficient including any spare tyres if carried, there is no obvious damage and all wheel nuts are in place, with anti-loosening (wheel nut torque) indicators
- Hoses, hose-reels and loose equipment are all secured / locked into position
- Foot valve is operational
- All liquid and vapour outlets are secure
- The transport emergency information card, "Tremcard" is correct for the product to be transported
- There are no visible leaks from the tank, pipework, rotary gauge or valves
- All fire extinguishers are present, serviceable and within test date
- All warning signs and cones are safely stowed
- The first aid kit is present and either the tamper-proof seal (if fitted) is secure or all contents are present
- The exhaust smoke emissions and noise are not excessive
- Tractor unit and semi-trailer couplings and connections are all safe and secure, including the correct locking of the fifth wheel coupling
- Trailer landing legs and winding gear are operational
- All drawbar trailer connections and hoses are secured

An outline of a 'start-of-shift' checklist will be found in Appendix Three

- Weekly inspections should include the above and the following:

  - The bonding reel / wire is in good condition with a good connector and is of the same length as the delivery hose
  - The emergency shutdown system is operational, both on the vehicle and remotely
  - All hoses are in good condition with no abrasions or excessive wear (see 8.8)
  - All adaptors and couplings are in a serviceable condition without excessive wear, with correct seals and gaskets
  - Spare seals and gaskets, suitable for the product being carried, are available
  - The mud flaps and spray shields are in good condition
  - Warning triangles and/or cones, wheel chocks and spill kits are present

  An outline of a weekly checklist will be found in Appendix Four.

7.3 Loading and Unloading Operations

7.3.1 Safety Precautions

The following safety precautions measures applies for both loading and unloading operations and must be in place before any product transfer operations commence.

- Drivers and other operatives involved in LP Gas bulk transfer operations must wear appropriate personal protective equipment (PPE) during the transfer operation. This may include the following:
  - Goggles or full face visors
  - Gauntlet design hand gloves
  - Protective foot wear
  - Safety helmet in areas prescribed by risk assessment
  - Long sleeved clothing made of 100% cotton
  - High visibility jackets/vests if there is risk of not being seen by drivers of other moving vehicles

- Smoking and other naked flames must not be allowed throughout the loading/unloading operation. All other electrical equipment not rated for the hazardous zone should be switched off.

- Transfer hoses used must be visually examined for kinks, wear or any damage. Couplings and seals should be similarly examined to ensure compatibility and for the presence of any dirt etc. before connection.
- The grade of LP Gas to be loaded or unloaded should correctly identified and the receiving tank/road tanker must be suitable and have sufficient ullage for the intended load.
- The quantity required to be loaded must not exceed the maximum safe fill capacity and/or the local statutory limitations on maximum gross laden weight of vehicles and individual axle weight allowed on public roads.
- On no account should any overloading be allowed. If the receiving tank/road tanker is inadvertently overloaded, technical/ supervisory assistance must be obtained by the driver or operatives involved to resolve the situation.
- The road tanker shall not be standing on public roads during the transfer operation. If there is no other alternative, a risk assessment must be carried out. In space restricted areas the road tanker must be able to easily be driven out without reversing.
- The road tanker must be correctly positioned, e.g. beneath water sprays, adjacent to loading /unloading connections, facing in the direction that will permit easiest exit in the event of an incident.
- Transfer operations should not be undertaken during hours of darkness without adequate (flameproof) lighting.

7.3.2 Loading Procedures

- Inspect the road tanker to ensure it is in an acceptable condition for "safe loading". It is recommended that the operators of supply terminals identify and keep a record of each road tanker following an initial examination of major safety aspects. Periodic spot-checks are recommended for subsequent entries.
- Position the road tanker at the designated loading area and engage the brake interlock. Make sure the truck is immobilized for the duration of the loading operation. Wheel chocks and barrier installations must be used if there is no interlock system provided on the road tanker.
- Connect the earthing cable of the road tanker to the gantry structure and ensure the vehicle tank is properly bonded.
- Connect the transfer hoses/loading arms. Ensure the couplings are properly connected without use of undue force before loading and check for any sign of leakage before and during loading.
- Gradually open the valves. When filling by volume monitor the level of the receiving road tanker throughout the loading operation with whatever devices are provided, to ensure that the filling requirements of section 5.4 are met. Periodic level checks and observation of the road tanker tank pressure during loading will help in identifying if the vapour return line excess flow valve has inadvertently closed. Should this occur, the operation should be stopped and the condition rectified.
- Reduce the filling rate as the maximum fill in the receiving tanker is approached to avoid overfilling.
- Stop the loading immediately when the maximum level in the receiving tanker is reached
- If a tanker is accidentally overfilled the excess LP Gas should be removed in a safe and approved procedure as soon as possible and before leaving the facility.
- Road tankers filled using a level gauge may need to be weighed after loading to ensure that they are not overloaded based on gross weight.
- Conduct a final check after disconnecting the loading lines and earthing connection to ensure all road tanker outlets are properly closed and secured and that the vehicle is in a fit and safe condition to be driven away. Anti-drive-away interlocks/installation barriers should not be disengaged until it is verified that the vehicle can be safely moved

7.3.3 Unloading Procedures

The unloading of LP Gas from a road tanker into stationary storage tanks inside the depot/terminal follows the general principles applicable to loading. Additional action is required for delivering to customer sites which include the following:

- Position the vehicle within easy reach of the transfer connection so that the hose is not under tension and/or at least one turn remains on the hose reel. The position of the road tanker should permit the driver

(or the person in control of the unloading operation) to have a clear line of sight of both the road tanker and the receiving tank.

- Carry out a pre-delivery check of the receiving tank if delivering to a customer site to ensure the facility is in order. This should include a visual check of the surroundings for any unusual or dangerous situations. A sample Pre-delivery Inspection Checklist is given in Appendix Five.
- Take out and position the fire extinguishers in such a way that they are easily accessible in case of an emergency.
- Connect the earthing cable of the road tanker to the receiving facility's earthing point. Ensure the road tanker is properly bonded.
- Connect the road tanker hose to the receiving tank fill connection. Connections should be properly made without use of undue force before unloading and checks made for any sign of leakage before and during unloading. Any leakage shall be rectified before proceeding.
- Hoses should not be located across a public footpath or pavement for unloading unless there is no alternative and where consideration of likely public activity during the time of unloading indicates it will not constitute a significant hazard. In such cases, before and during unloading, warning notices shall be prominently displayed at the front and rear of the vehicle and should state:

  "LP Gas delivery in progress. No Smoking or naked flames"

- Monitor the liquid level of the receiving tank during the unloading operation with whatever devices are provided to ensure that overfilling does not occur.
- The pumping rate should be reduced as and when the maximum permissible level in the receiving tank is approached, particularly when filling small tanks.
- The delivery shall be stopped immediately when the maximum fill level in the receiving tanks is reached.
- If a tank is accidentally overfilled any excess LP Gas shall be removed as soon as possible in a safe manner. The tank must not be left in an unsafe condition. The driver should notify his supervisor immediately in accordance with agreed procedures.
- At the completion of unloading, the following steps should be taken:
  - Close all isolating valves on the tanker
  - Close all pertinent isolating valves on the liquid fill and vapor return lines on the receiving tank
  - Disconnect and stow or reel in the delivery hoses. Any protective caps should be re-connected
  - Disconnect the earthing cable after the hoses have been removed
  - Stow the fire extinguishers and warning notices back into the road tanker
  - Disengage the brake interlocks after confirming that the road tanker is safe to move away

7.4 Journey Management

7.4.1 Trip Planning

- LP Gas road tankers do either single or multiple drops per trip and every trip should be planned properly to achieve the maximum utilisation and lowest distribution cost possible without any incident. Trip planning can be done manually if it involves a few trips per day for small fleets. For a large fleet doing many trips a day, proprietary IT scheduling tools that automate the trip planning process are available.
- Distribution costs can be minimized by ensuring the shortest distance possible for completing a trip is selected. This also results in reduced greenhouse gas emissions. For single drop deliveries i.e. point to point journeys, this can be done by simply identifying the shortest and safe route for the trip. For multiple drop trips, this may require scheduling and grouping deliveries along a certain route or area for each road tanker.
- Only the authorized routes and rest areas must be used by the driver for safety and security reasons. Authorized routes identified for each trip must take into account accident-prone areas or "black spots". Drivers must be briefed about these "black spots" and the relevant mitigating measures during "toolbox" meetings conducted prior to each journey. A de-briefing procedure for updating "black spots" should be put in place to ensure the information is always current.

- The maximum quantity possible should be unloaded for each customer every delivery. This reduces the number of trips required and hence the total distance travelled and the overall risk. Maximizing delivery quantity requires knowing or forecasting accurately the available ullage of customers' tank at the time of delivery and this typically entails several parties working together i.e. customer service, trip planners and the customer. Alternatively, telemetry can be used to monitor tank levels more systematically and accurately.

7.4.2 Driver Hours

- Driver fatigue is a common cause of road accidents as it results in reduced alertness and vigilance while driving. Many countries have regulations concerning driver hours i.e. driving and working hours and rest periods. In the absence of any local or regional regulations, the driver hours in Table 1 should be adopted to avoid driver fatigue.
- People involved in planning and scheduling road tanker journeys should ensure that trips are planned to be completed within the allowable driving hours.

Table 1 Driving Hours, Working Hours, Rest Periods

	At Any Time (Continuous)	Per Day (24 Hours)	Per 7 Days
Max. Driving Hours	4.5	9 (extendable to 10 hours up to twice in 7 days)	56
Max. Duty Hours		12	72
Max. Working Week			6 consecutive days
Min. Break	45 mins per 4.5 hours (may be split into two e.g. 15 min and 30 min breaks)	11 consecutive hours (reducible to 9 hours up to three time in 7 days)	
Min. Shift Break	36 consecutive hours when changing shift		36 consecutive hours

  - Driving hours – is the duration of actual driving activity. The total daily driving time is the accumulated driving time between the end of one daily rest period and the beginning of the following daily rest period.
  - Duty Hours – is the duration from the start to the end of the shift for the driver's duty. This includes time spent doing other work if he is not driving.
  - Break - is any period during which a driver may not carry out any driving or any other work and which is used exclusively for recuperation. A break may be taken in a moving vehicle, provided no other work is undertaken.
  - Rest Periods – an uninterrupted time where the driver may freely disposed of his time. Time spent working in other employment or under obligation or instruction, regardless of the occupation type, cannot be counted as rest, including work where the driver is self-employed.

7.5 Monitoring Fleet Performance

- The performance of the road tanker fleet should be monitored on a regular basis to know if it is operating to its desired objectives. This is achieved by collecting and monitoring key performance indicators (KPIs) such as
  - Capacity utilization
  - Time utilization
  - Tonnes per km (MT/km) delivered
  - Kilometre per litre (km/l) fuel consumption
  - Unit distribution cost
  - Unit maintenance cost

- Analysis of relevant KPIs and their trends helps in understanding better the road transport operation, focuses efforts on where to save costs and improves the “bottom line”.

Chapter Eight

Road Tanker Maintenance

8.1 General

- All road tankers must have a maintenance schedule that defines the frequency and scope of inspection for each item that is to be maintained. Local regulations, manufacturers' recommendations, vehicle age, distances travelled and operating conditions will determine the frequency of maintenance. Refer to section 8.3 for specific guidance.
- There must be a procedure for when a road tanker is taken out of service if it breaks down or a fault requiring repair is discovered. On such occasions the road tanker must be isolated and immobilized so that it cannot be used.
- The maintenance facilities must be a suitably controlled environment; it must comply with all local health and safety regulations. Third party facilities must be assessed for adequacy of equipment and availability and quality of spare parts used. If available, it is recommended to use the maintenance facilities of the original equipment manufacturer (OEM's) to ensure proper equipment and approved spare parts are used. **No routine maintenance shall be carried out on the roadside.**
- If maintenance is done by entities other than the OEM's, the mechanic/staff who maintains LP Gas road tankers must be appropriately qualified to inspect and test the vehicles. They must keep up to date with all manufacturers' design changes and receive regular refresher training.

8.2 Maintenance Precautions

- Hot work must only be carried out under a Permit to Work system. Welding on the tank shell or elsewhere on the pressure system must be only carried out by suitably qualified welders to written procedures approved by the inspection authority
- Weld repairs to the tank shell and pressure system must only be carried out after the tank and pressure system have been satisfactorily purged and cleaned to eliminate any LP Gas and a "Gas Free" certificate has been issued. Regular gas testing must be carried out at least every two hours whilst the work is in progress to ensure the tank and pressure system continue to be gas free
- If welding is carried out on the vehicle tank shell, post-weld heat-treatment in line with tank certification requirements must be performed
- A vacuum purge pressure shall not be used unless the tank data plate or other reliable documentation indicates that it has been designed to withstand full vacuum

8.3 Planned Maintenance

- General vehicle maintenance schedules (as distinct from the schedules for LP Gas-specific features such as the tank, piping, hoses, meters, etc.) must be based on the recommendations of the original equipment manufacturer (OEM). Other factors such as local legislation, the local operating environment, historical records, best estimates of maintenance costs, including downtime costs, etc., must also be considered.
- Model maintenance schedules are provided for guidance in Appendix Six. These models shall be used where advice is not available from the manufacturer e.g. for older vehicles.
- Intervals between schedules must be reviewed periodically to see whether they need adjustment for changed conditions.

To maintain an even flow of work with efficient use of labour, schedules must take account of either the time interval or distance travelled between service intervals and also account for operational planning to ensure fleet availability. Consideration should be given to the pump off times as this uses the engine and in some cases the drive shaft.

8.4 Maintenance Records

- Records of all planned maintenance must be kept using a formal, comprehensive checklist based on the maintenance schedules.
- The details of any repair work carried out, whether arising from breakdowns (i.e. unplanned maintenance) or as a result of faults detected during planned inspection and servicing must be recorded on maintenance job cards, which record the nature of the work done and the materials used.
- The manufacturers' data books plus records of all planned maintenance and repairs as described above must be kept in a vehicle history file. Drivers should have ready access to maintenance records and current defect reports.

8.5 Reviewing Maintenance Performance

- There must be regular analysis of maintenance records to establish any trends or patterns indicating poor equipment performance (e.g. faulty clutches or vehicle brakes or other part failures) or poor driving styles (e.g. more frequent replacement of brake pads on a particular vehicle, tyre wear). Causes of breakdowns and accidents should also be monitored to determine the effectiveness of the maintenance programme. Vehicle reliability and maintenance cost data should also be used when purchasing new vehicles which forms part of the total cost of ownership.

8.6 Auditing the Maintenance Program

- A competent person must audit all maintenance facilities at least every 3 years, or more frequently where judged necessary. The audit must cover HSE management, standards, technical competence and stock control.
- Where maintenance of the road tankers are carried out or managed by road transport contractors, periodic audit of the contractor’s maintenance program must be conducted to ensure it is implemented according to plan.

8.7 Pressure System Testing

8.7.1 LP Gas Tank and Piping

- The tank and pressure containing pipework must be thoroughly examined at least every six years or more frequently if required by local regulations.
- LP Gas tanks must be purged and gas freed to allow the inspecting authority to first carry out visual internal and external examinations to check for obvious defects, e.g. dents, corrosion, etc. Thereafter, the tank must be subjected to a hydraulic test at the pressure appropriate to the tank design code, followed by visual internal and external inspection. At the discretion of the inspecting authority, non-destructive testing must be performed where doubts arise from the visual inspection
- All attachment welds on the tank wall internally or externally should be subject to non-destructive testing, e.g. magnetic particle or dye penetrant crack detection tests on nozzle welds and structure attachment fillet welds.
- All other welds on tank mountings must be subjected to thorough visual inspection for cracks and/or corrosion.

Provided that such tests do not reveal the need for repair work (see below), valves, fittings and pipework must be reassembled and a pneumatic leak test must be performed to ensure pressure containment of the complete system.

8.7.2 Pressure Relief Valves

- Pressure relief valves must be replaced at the time of the above tests with equivalent new, or properly reconditioned, valves.

8.7.3 Internal Shut-off Valves

- Internal shut-off valves must be tested for full functionality and it must be confirmed that they are fully leak-tight when closed.

8.7.4 Repairs

Any repairs considered necessary as a result of these tests must be approved by the inspecting authority and carried out in accordance with the relevant design code. Such repairs must be carried out before the vehicle returns to service. After any weld repairs the tests described in 8.7.1 must be carried out before the road tanker returns to service.

8.8 Hose Inspection

- Hoses shall be subjected to a formal external visual inspection by a competent person at least once a year. The results of these inspections must be recorded.
- A hose must be rejected for LP Gas service when any external visual inspection shows:
    - That it is not an approved type for LP Gas service
    - Leakage from the hose, fittings or couplings
    - Cuts, soft spots, kinks, twists, flattening, blistering de-lamination, severe stretching or other types of permanent deformation
    - Damage to the outer protection which may have damaged the inner reinforcement or which has exposed the reinforcement to an extent that failure is likely to occur with continued use
    - Damage of reinforcing wires or braids
    - Severe corrosion, wear (e.g. hose coupling threads) or damage to flanges or couplings
- Where fitted, anti-abrasion outer covers must be inspected and reported if they are damaged, incorrectly or inadequately fixed in position. Corrective action must be taken immediately ensuring that fixing is in accordance with the supplier's instruction.
- Each hose must be tested by a competent person for electrical continuity between the shell of the tank and the free hose end coupling at intervals not exceeding 6 months. Test results must be recorded.
- Hose end couplings must be examined for excessive wear by checking that all critical dimensions, using an appropriate gauge, are within the limits specified by the manufacturer. The commonly used ACME threaded coupling must be checked for wear using proprietary Go/No-Go thread gauges.
- Hydraulic pressure testing of hoses is no longer recommended. However, if it is required by local regulations, the procedure should comply with the following:
    - Testing must be performed by trained, competent staff
    - Staff must be equipped with appropriate PPE – footwear, overalls, gloves, eye protection
    - Hydraulic testing shall be performed with either kerosene or water. If water is used, care must be taken to dry the hose thoroughly after the test has been performed
    - The test pressure shall be the maximum working pressure of the hose
    - The test pressure shall be reached in ten minutes and then maintained for a period of ten minutes
    - The pressure shall then be reduced to 1 bar gauge and then raised again to the test pressure, held for a further ten minutes and then reduced to zero

- Throughout the test, the hose must be inspected closely for signs of swelling, sweating, leakage, or other defects
- The results of the test – test fluid, test pressure, observations and signature of competent person – must be recorded
- The hose must be flushed with LP Gas before it is put back into service

- A hose which fails any of the above requirements i.e. visual inspection, coupling tolerance, electrical continuity or hydraulic test, must be taken out of service immediately and scrapped in such a way that it cannot be inadvertently be re-used for LP Gas service.

8.9 Meters

- Meters used for custody transfer must be certified annually (or more frequently if required by local regulations) to determine the level of accuracy and any change in accuracy. Meters should be tested a second time each year, but the certificate for this second test is not necessary, unless outside of tolerance. Typical procedures for meter proving can be found in the UK LP Gas Association's Code of Practice Number 19.
- Meters and their ancillary equipment must be maintained in accordance to manufacturer's instruction. Persons involved with meter maintenance must be aware of the frequency and scope of maintenance required.

8.10 Tyres

- Any tyre on the truck must be replaced if it is found to have any of the following defects:
  - The tread does not have at least 2 mm depth across the entire breadth and round the entire circumference
  - It has a break in its fabric or a cut in excess of 25 mm or 10% of the section width of the tyre, whichever is the greater, which is deep enough to reach the body cords.
  - It has a lump, tear or bulge caused by separation or partial fracture of its surface; it has any portion of the ply or cord exposed.
  - It does not have the ordinary tread pattern clearly visible at the base of the groove.
- Tyres used must be manufactured by a recognized company complying with local and/or international standards. Vulcanized tyre repairs should not be used.

Chapter Nine

Emergency Response

9.1 Emergency Plans

- Emergency plans must be developed to cover all realistic scenarios that could occur, including medical emergencies. The aim of an effective emergency response plan should be to respond in an efficient and professional manner to any foreseeable incident. A plan must observe the following priorities:
    - The safety of on-scene team members must not be compromised
    - The safety of others at or near the scene must be ensured
    - The public must be protected
    - The environment must be protected
    - The asset must be protected
- It must be planned to get a company representative to the scene of an incident as soon as possible in order to carry out an initial assessment. This is essential as in some parts of the world the emergency services lack the technical expertise to deal with LP Gas incidents. Such considerations must be built into any emergency response plan.
- Plans must be regularly reviewed, after any incident or as result of any exercise.

9.2 Emergency Response Equipment

- Dedicated emergency response equipment must be available on a 24-hour basis. It must be kept in a suitable locked vehicle or trailer, designed and organised for swift and easy access to all equipment.
- The list of equipment required for off-site emergency response and equipment maintenance schedules can be found in Appendix Seven of this guide.
- The vehicle or trailer used for emergency response must be included in the maintenance schedule. See Appendix Seven for guidance.

9.3 Emergency Exercise

- All staff who has a role in emergency plans must receive appropriate training.
- Emergency exercises must be held annually to rehearse emergency plans and to ensure that staff can fulfil their roles and to familiarise themselves with the emergency equipment.
- Emergency simulations and exercises must be designed to cover all realistic scenarios. Wherever possible, the exercises should be held with the emergency services and recovery operators.

9.4 Recovery Operators

- It is accepted practice to use vehicle recovery operators with the special skills and equipment to assist in the recovery of vehicles, e.g. mobile cranes, air bags, etc. Only approved vehicle recovery operators must be assigned, as a non-approved operator could further escalate the incident.
- The vehicle recovery operator must maintain his equipment to a high standard and it must be tested at regular intervals.
- Approved recovery operators must be audited every 12 months.
- Details of approved recovery operators must be listed in the emergency plan.

Chapter Ten

Driver Training

10.1 General

- Drivers play an important role in ensuring that the road transport operation is safe and efficient. This starts with recruiting drivers with relevant HGV driving experience and providing suitable training to upgrade their driving skills and shape their behaviour on the road.
- All newly recruited drivers must not be allowed to drive on company business until they have been assessed by a competent person to have met all the competency requirements of a driver.
- Newly recruited drivers must be assessed if medically fit to work. He must not be taking prescribed medication that will affect his driving ability.
- Driver training must comply with statutory requirements. In some countries, only government-accredited driver training providers are recognized to train drivers.
- In the absence of any statutory requirements, the requirements from 10.2 to 10.4 can be adopted to develop a driver training program. Trainers used should have the necessary experience and skills to conduct the training.

10.2 Induction Program

- Newly hired drivers, together with operatives who assist with bulk deliveries, must attend a Health, Safety and Environment (HSE) induction session before being allowed to drive on company business. The HSE induction session should cover the following topics:
    - Company policies on health, safety and environment
    - Alcohol and Drugs policy
    - Government restrictions
    - Physical characteristics and hazards of LP Gas
    - Health Safety and Environment issues (HSE) in day to day operations
    - Use of personal protective equipment
    - Mobile phone policy
    - Seatbelt policy
    - Working and Driving hours policy
    - First aid
    - Emergency procedures
    - Incident reporting procedures (including near miss and potential incidents)
    - Loading and unloading procedures
    - Customer pre-delivery inspection
    - Daily inspection of vehicles
    - Depot/terminal HSE policies and operating procedures
    - Vehicle safety features

10.3 Initial Training

- As soon as practicable and within three months of being appointed, drivers should attend a comprehensive defensive driving training course. The training should take no less than three days and can be taken in separate modules. It should include the following topics:
    - Company Road Transport Safety objectives
    - Local culture and attitude on driving
    - Local traffic regulations, road signs and markings
    - Accident black spots
    - Driving skills – technical driving and defensive driving. This must include on-the-road assessment by a mentor driver
    - Main causes of accidents and accident prevention
    - Preventing rollover incidents
    - Fatigue management

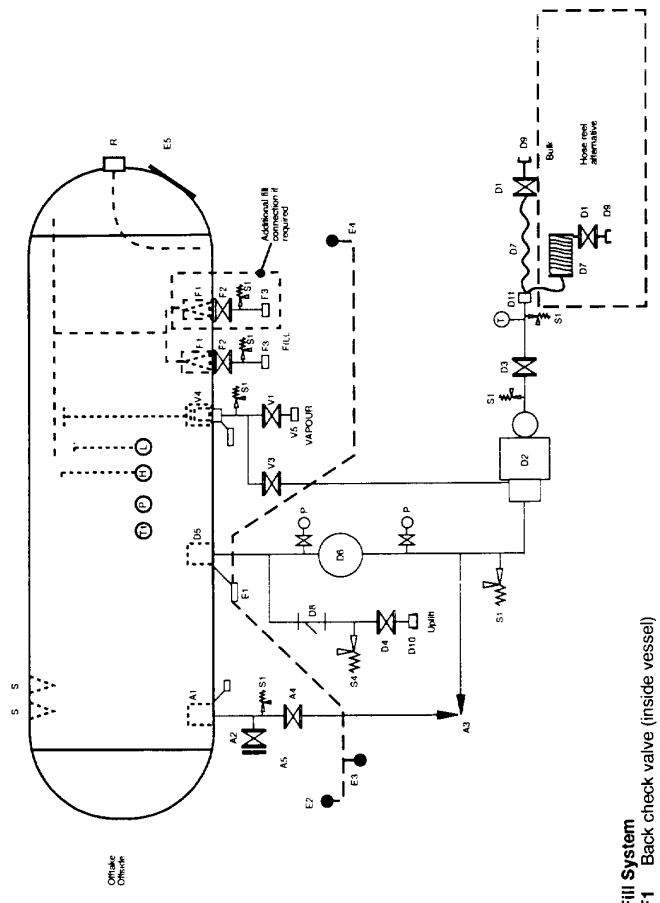
10.4 Refresher Training

- Refresher training must take place at least every two years. Training of drivers should always be planned at times of the year when it will cause the minimum of disruption to operations.
- Drivers should also be subject to refresher training when involved in an accidents arising from poor driving skills.

10.5 Training Review

Training programmes must be periodically reviewed to ensure that they remain current. Changes may be prompted by learning points from incidents, introduction of new vehicles, when loading/unloading facilities are changed, etc.

Diagrammatic Layout for Piping and Equipment for a Metered Bulk LP Gas Delivery Vehicle/Normal Rigid Chassis



Basic Operating Instructions

1 Prior to making any connections ensure that the vehicle is earthed.
2 For normal vehicle working keep valves V3 & A4 open. Do not run pump with A4 closed.
3 Unless otherwise stated all valves must be closed.
4 Prime air system (opens valves A1, D5 & V4).
5 Fill tank via connection F3. Open valve F2.
6 Vapour return
Connect hose to V5. Open valve V1.
7 Bulk delivery via meter (without vapour return)
Connect hose to delivery point. Ensure valves V3 & A4 are open. Open valves D3 & D1 slowly.
Start pump.
8 Emergency off-load. Remove A5 (blank flange or plug). Connect hose to valve A2. Ensure valve A4 is closed. Open valve A2 slowly.
9 Emergency uplift.
Connect delivery hose to F3 using necessary adaptor & hose from source to D10. Open valves F2, D1, D3 & D4.
Run pump.
10 Emergency shut-down
Operate emergency control button.
11 To secure load
Close all valves & control cabinet door
Stow hose end couplings.

Operating & Safety Equipment

Delivery System
D1 Firesafe ball valve
D2 Meter C/W strainer, vapour eliminator & temperature compensator
D3 Firesafe ball valve
D4 Firesafe ball valve
D5 Internal safety valve C/W actuator
D6 Pump
D7 Delivery hose, or hose reel
D8 Filter
D9 Hose coupling
D10 Adaptor c/w cap
D11 Excess Flow Valve

Fill System
F1 Back check valve (inside vessel)
F2 Firesafe ball valve
F3 Double check filler valve & cap

Vapour System
V1 Firesafe ball valve
V3 Firesafe ball valve
V4 Internal safety valve C/W actuator
V5 Vapour equalising valve & cap

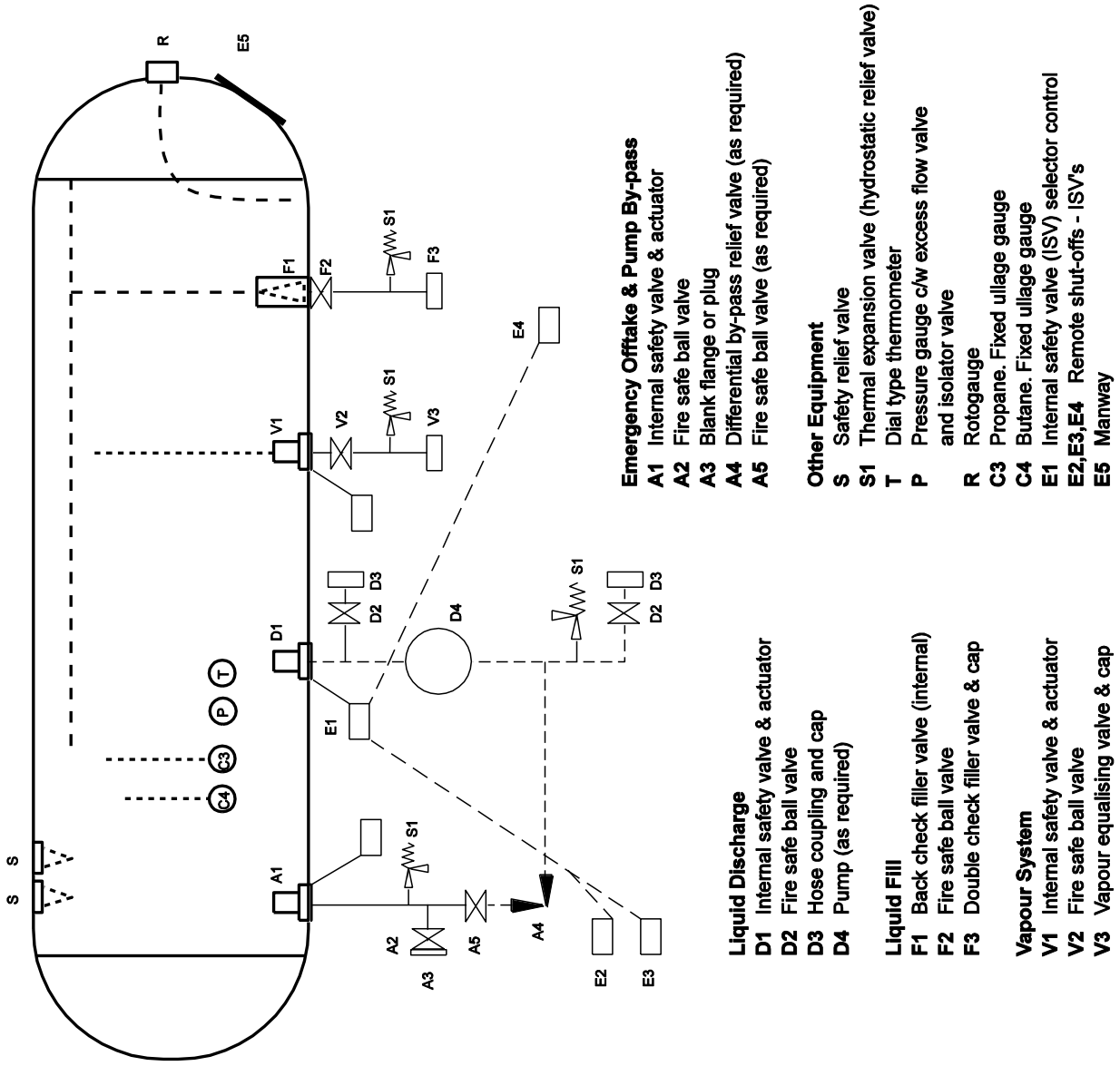
Emergency Off Take & Pump By-Pass
A1 Internal safety valve C/W actuator
A2 Firesafe ball valve
A3 Differential pressure by-pass valve
A4 Firesafe ball valve
A5 Blank flange or plug

Other Equipment
S Safety relief valve
S1 Hydrostatic relief valve C/W cap
T1 Dial 'C' type thermometer
T Thermometer
P Pressure gauge C/W excess flow valve & isolator valve

R Rotogauge
H Level gauge – butane
L Level gauge – propane
E1 Footvalve selector control
E2, E3, E4 Footvalve emergency control
E5 Manway

Appendix Two

Diagrammatic Layout of Piping and Equipment (pumped and unpumped) for Bulk LP Gas Bridging Vehicle/Normal Articulated Chassis Type



Appendix Three

Start-of-Shift Vehicle Checklist

The following is an outline of a start-of shift checklist, which can be adapted for local use by:

- Adding the necessary information to identify the vehicle and the driver or other person performing the checks
- Adding instructions about how the sheet is to be completed and to whom it must be returned
- Amending the list of items to reflect the local vehicle fleet (e.g. removing references to trailer couplings and landing legs if no articulated vehicles are operated)
- Adding details about the procedure for defect reporting
- Adding a statement that vehicles are not to be driven with any defects

ITEM:	OK	NOT OK
General Exterior Vehicle Condition (absence of damage)		
Mirrors (condition / security)		
Windscreen (condition / security)		
Windscreen Wipers, Washers (operation / condition)		
Horn, Reversing Bleeper (Camera operation if fitted)		
Brakes (pressure / operation / leaks / warning devices / instruments)		
Driving Controls – Pedals, Steering Wheel, Gear Lever (condition / operation)		
Tachograph / Onboard Computer / GPS (operation)		
Seat Belts (condition / operation)		
Fire Extinguishers (in cab / on body)		
Engine Oil, Water & Fuel (levels / leaks)		
Lights, Indicators, Reflectors (condition / operation)		
Hazard Plates, Long Vehicle Plates, Number Plates, Tremcards (condition / present)		
Trailer landing legs and winding gear		
Tyres (inflation / damage / wear)		
Wheels, Wheel Nuts, Anti loose indicators, Mud Flaps, Spray Shields (condition / security)		
Trailer Coupling & Connections (operation / condition / leaks)		
Hoses, Hose Reels, Loose Equipment (security)		
Foot Valve (condition / operation)		
Liquid & Vapour Outlets (security)		
Tank, Pipework, Rotary Gauge, Valves (condition / leaks)		
Remote shut down operation		

Vehicle Registration

Date

Driver Signature

ACTION TAKEN ON DEFECTS:

Action Required	Action Party	Date Done

Appendix Four

Weekly Vehicle Checklist

The following is an outline of a weekly checklist, which can be adapted for local use by:

- Adding the necessary information to identify the vehicle and the driver or other person performing the checks
- Adding instructions about how the sheet is to be completed and to whom it must be returned
- Amending the list of items to reflect the local vehicle fleet (e.g. removing references to trailer couplings and landing legs if no articulated vehicles are operated)
- Adding details about the procedure for defect reporting
- Adding a statement that vehicles are not to be driven with any defects

ITEM:	OK	NOT OK
Emergency Shutdown System (operation)		
Hoses (condition)		
Bonding Wire / Reel (condition / operation)		
Adaptors, Couplings, Seals, Gaskets (condition / correct types)		
Spare Seals, Gaskets (available / correct types)		
Cones / Warning Signs (present)		
First Aid Kit (present / sealed)		
Exhaust (condition / smoke)		
Trailer Landing Legs (condition / operation)		
Warning Triangles/Cones (presence/condition)		
Wheel Chocks (presence/condition)		
Spill Kits (presence/condition)		
Cylinder Containing Structure & Restraints (condition / operation)		
Tail Lifts (condition / operation)		
Drop Sides / Slip Bodies (condition / operation)		
Ropes & Straps (Packed, condition / operation)		
Remote shut down operation		

Vehicle Registration

Date

Drivers Signature

ACTION TAKEN ON DEFECTS:

Action Required	Action Party	Date Done

Appendix Five

Bulk Customer Pre-delivery Checklist

The following is a standard minimum requirement example of a pre-delivery checklist that must be completed by the driver before making a delivery to a bulk customer.

LPG Customer Site Pre-Delivery Inspection Report

Customers Name:
Account Number:
Address:

Vessel Serial Number (if more than one tank on site):

Geo Code location of delivery (if possible):

Please place a cross (X) in the appropriate box where faults or hazards are present

1. Emergency phone number displayed		11. Tank condition	
2. No Smoking sign displayed		12. Piers & foundations	
3. Grade label displayed		13. Fixed liquid level gauge	
4. Safe access to site		14. Pressure relief valve	
5. Safe conditions at site		15. Liquid fill coupling	
6. Bonding point		16. Vapour return coupling	
7. Gas leaks		17. Couplings accessible	
8. Ignition sources		18. Coupling caps fitted	
9. Flammable material		19. Fire extinguishers	
10. Overhanging trees, etc.		20. Hood locked (if required)	

Delivery must not commence until:

* **All ignition sources are removed/extinguished**

* **Customer/Driver has checked that the storage will contain the delivery**

* **You have checked that the product to be delivered is the same grade as that in the customer's tank**

Further Comments:
Driver's Name: **Date:**

Action Required:	**Action Party**	**Date Done**

Appendix Six

Vehicle Maintenance Guidelines

The inspection schedules given in this Appendix are for guidance only and may need supplementing / amending for local use. Schedules are provided for both rigid vehicles and tractor unit (Charts 1 to 3) and for semi-trailers (Charts 4 to 6). The scope of the three types of schedule is as follows:

- Schedule 'A' (approximate interval 8,000 kms.) - Lubrication of the vehicle and the examination and replacement or adjustment of parts, some of which are subject to sudden failure or require attention in the interests of safety. Intervals between 'A' schedules may be timed according to lubrication requirements, but if this interval is short, lubrication may be made the subject of an additional check
- Schedule 'B' (approximate interval 16,000 kms.) - All the maintenance tasks in 'A' with additional items that require attention at less frequent intervals
- Schedule 'C' (yearly) - All the maintenance tasks in 'A' and 'B' with a comprehensive inspection of the complete vehicle. This schedule should be timed to occur immediately before any compulsory yearly vehicle inspection required by local authorities

The frequencies quoted in Charts 1 to 6 are for guidance only. They may be adjusted based on factors such as local legislation, the local operating environment, historical records, best estimates of maintenance costs, including down-time costs, etc., must also be considered.

Chart 1 Inspection Schedule 'A' – Rigid Vehicle / Tractor Unit

Typical Inspection Frequency: Every 8,000 kms.

ITEM	INSPECTION / TESTING REQUIREMENTS
CHASSIS AND CAB	Instruments, warning lights, controls, wipers and speeds Doors, windows, locks and fittings, seats, mirrors Bonnet and wings, cab structure and panels, bumpers, body etc Lubrication, manual/automatic systems Chassis frame Fifth wheel coupling, ramp, hooks Fire extinguishers and holders Seat belt condition, operation and security Mudguards
LPG TANK AND EQUIPMENT (BULK VEHICLES)	Visual check for leaks Tank and tank mountings Hose racks, walkway, ladders and equipment boxes Foot valves, and outlet valves Interlocks
ENGINE AND CLUTCH	**Fuel System** - Leaks **Cooling System** - Hoses, fan and belts **Exhaust System** - General condition, leaks, clips **Compressor** - Oil level, pressure build up **Clutch** - Adjustment and operation **Speed Limiter** – Check in accordance with the manufacturer's instructions
TRANSMISSION	Check propeller shaft and centre bearing
STEERING	Steering box, column, ball joints Power steering, ram, oil level, hose
WHEELS AND TYRES	**Wheels** - Nut tightness (checked by position of indicators or torque wrench) and general condition of wheel **Tyres** - Pressure and wear
SUSPENSION AND AXLES	**Springs** - Leaves, holding down bolts, bracket, shackles
BRAKES	**Hand Brake and Secondary Brake** - Adjustment and operation **Foot Brake** - Linkage, pipes, hoses and diaphragms for leaks. Check master cylinder valves and servos, wheel cylinders and adjustors, drums and linings. Drain air reservoirs
ELECTRICAL	Headlamps, fog lamps, side and stop lamps, indicators, reflectors and rear markers
JOURNEY MANAGEMENT SYSTEM	Check tachograph / onboard computer / GPS in accordance with the manufacturer's instructions, including seals
PAINTWORK	Condition of paintwork and transfers
ACCIDENT DAMAGE	Accident damage outstanding
LUBRICATION	In accordance with the manufacturer's recommendations
CYLINDER VEHICLE TAIL LIFTS	Lifting mechanisms and grab rails

Chart 2 Inspection Schedule 'B' – Rigid Vehicle / Tractor Unit

Typical Inspection Frequency: Every 16,000 kms.

ITEM	INSPECTION / TESTING REQUIREMENTS
CHASSIS AND CAB	Instruments, warning lights, controls, wipers and speeds Doors, windows, locks and fittings, seats, mirrors Bonnet and wings, cab structure and panels, bumpers, body, etc. Lubrication, manual/automatic systems Chassis frame Fifth wheel coupling, turntable, hook and ramps Cargo pump and/or compressor - oil level and pressure, pipework, mountings, filters Fire extinguishers and holders Seat belt condition, operation and security Mudguards
LP GAS TANK AND EQUIPMENT (BULK VEHICLES)	Tank and tank mountings Visual check for leaks Tank fittings, meters, hoses, hose end couplings, reels, nozzles, foot valves, outlet valves (refer to section 4.8 of this standard) Pressure relief valves (refer to section 4.8) Gauges Hose racks, walkway, ladders and equipment boxes Check electrical continuity between the tank and (i), the hose-end coupling, (ii) the end of the bonding (earthing) cable, the earth tread plate (where fitted) Interlocks
ENGINE AND CLUTCH	Fuel system, including pipes, filters, fuel pump Oil system and filters Cooling system, including hoses, fans and belts Temperature control Exhaust system Compression Mountings and controls Air compressor oil level, air pressure/vacuum build up, low pressure warning Clutch adjustment and operation Check speed limiter in accordance with the manufacturer's instructions
TRANSMISSION	Gearbox mounting, oil levels, operation PTO and pump compressor drive operation Shafts and centre bearing
STEERING	Steering box, column, ball joints, bolts Power steering, ram, oil level, hoses
WHEEL AND TYRES	Check wheel nuts and condition of wheels Check wheel bearings Check tyre pressures and wear
SUSPENSION AND AXLES	**Front Axles And Springs** - Springs and holding-down bolts, shackles, brackets, shock absorbers, king pins and wheel bearings, track and alignment **Rear Axles And Springs** - Oil levels, breathers, drain holes, springs, shackles, brackets and bolts, shock absorbers, balance beams, wheel bearings, differentials and third differentials and lock

Chart 2 Inspection Schedule 'B' – Rigid Vehicle / Tractor Unit, continued

ITEM	INSPECTION / TESTING REQUIREMENTS
BRAKES	Hand brake and secondary brake Foot brake linkage, pipes, hoses and diaphragms Master cylinder valves and servos Wheel cylinders and adjusters, drums and linings Drain air reservoir
ELECTRICAL	Alternator - Security, charging Starter security and operation Wiring condition Earth check and battery isolation master switch Headlamps, fog lamps, operation and adjustment Side and stop lamps, indicators, reflectors and rear markers Batteries and clamps
JOURNEY MANAGEMENT SYSTEM	Check tachograph / onboard computer / GPS in accordance with the manufacturer's instructions, including seals
PAINTWORK	Condition of paintwork and transfers
ACCIDENT DAMAGE	Accident damage outstanding
LUBRICATION	In accordance with the manufacturer's recommendations
CYLINDER VEHICLE TAIL LIFTS	Lifting mechanisms and grab rails

Chart 3 Inspection Schedule 'C' – Rigid Vehicle / Tractor Unit

Typical Inspection Frequency: Every 40, 000 km or Annually (Minimum Frequency)

ITEM	INSPECTION / TESTING REQUIREMENTS
CHASSIS AND CAB	**Cab** - Check mounting for security and fractures. Check doors for operation, wear, security of doors and pillars. Check floor and steps for security, corrosion and wear. Check seats for condition, security. Check seat belt condition, operation and security. Check operation of instruments, warning lights, controls, and wipers. **Body** - Check position of body, security of fixings, brackets, bolts, rivets, etc. Check condition of drop sides, tailboards, floor, support pillars, cross or longitudinal members **Lubrication, Manual/Automatic Systems** – In accordance with the manufacturer's instructions **Mirrors** - Condition, security, position **Wings -** Check security, corrosion, damage and clearances Fire Extinguishers – Check security, inspection date, pressure (where relevant) **Fifth Wheel Coupling, Turntable, Hook And Ramps** – Check operation, condition, wear **Main And Cross Members** - Examine for deformation and/or fractures and/or advanced corrosion. Examine welding and bolts/rivets for soundness and security. Examine junctions for evidence of movement **Cylinder Containing Structure** – Check floors for trip hazards. Confirm that all ventilation areas are free of obstruction. Check drop sides are functioning as designed. Confirm that all metal supports are covered by wood or rubber. Check that all cylinder restraints (straps, ropes, etc.) and their anchorage points are in good condition. Check that guides for pallets are in good condition **Mudguards** – Check security and condition
LP GAS TANK AND EQUIPMENT (BULK VEHICLES)	Tank and tank mountings Visual check for leaks Tank fittings, meters, hoses, hose end couplings, reels, nozzles, foot valves, outlet valves (refer to section 4.8 of this standard) Pressure relief valves (refer to section 4.8) Gauges Hose racks, walkway, ladders and equipment boxes Check electrical continuity between the tank and (i), the hose-end coupling, (ii) the end of the bonding (earthing) cable, the earth tread plate (where fitted) **Pump/Compressor** – Check operation, security, wear at glands **Pump/Compressor Drive** – Check security, operation **Interlocks** – Check operation

Chart 3 Inspection Schedule 'C' – Rigid Vehicle / Tractor Unit, continued

ITEM	INSPECTION / TESTING REQUIREMENTS
ENGINE AND CLUTCH	**Compression** - Check **Mountings** - Check for deterioration and fractures **Fuel Tank And Systems** - Check tank mountings, straps or supports and bracket bolts. Check filler cap fitted and system free from leaks. Check pipes secure and free from damage **Comression Ignition (CI) Engine** - Replace injectors in accordance with the manufacturer's instructions, check calibration and phasing of fuel pump in accordance with the manufacturer's instructions; check fuel pump couplings and linkages for wear and mounting for security **Cooling System** - Check for leaks, fan belt tension and condition, temperature control, hoses and clips and water pump. Check radiator for security **Exhaust System** - Check for leaks, security and effectiveness of silencer **Oil and Air Filters** - Replace in accordance with the manufacturer's instructions **Speed Limiter** – Check in accordance with the manufacturer's instructions **Air Compressor** – Check oil level, air pressure/vacuum build up, low pressure warning **Clutch** - Check operation, wear, adjust pedal movement
TRANSMISSION	**Gearbox** - Check operation and condition, PTO, differentials and third differentials **Shafts** - Check wear in couplings and centre bearings shafts:
STEERING	**Steering Wheel** - Check hub, spokes and rim and movement between column and wheel. Check free movement at steering wheel **Steering Column** - Check end play in column and radial movement. Check flexible couplings **Steering Linkages** - Check excess movement at joints and all linkages and components for security and soundness. Check that full movement of wheels and tyres is not impeded **Steering Gear** - Check smoothness of operation and condition of sector shaft. Check steering box or rack and pinion housing for security and soundness. Check sector shaft or rack and pinion bushes for wear **Power Steering, Ram Type** - With engine running check ram anchorage for soundness, and ram body and hoses for leakage and damage. Check anchorage piston rod. Check unit for alignment. Check free valve travel **Power Steering, Integral Type** - Check operation
WHEELS AND TYRES	**Wheels** - Check retaining rings, stud holes, studs and nuts, wheel for distortion and wheel bearings **Tyres** - Check condition and wear
SUSPENSION AND AXLES	**Stubs** - Check amount of free movement at king pin and wheel bearings. Check stub for cracks **Spring Pins and Bushes** - Check wear at anchor brackets and shackles. Check security of bracket and pins. Examine spring mountings for excessive play **Suspension Units** - Check springs for broken leaves and weaknesses. Check security of eyes and clips. Check that springs are symmetrically located and centre bolts are intact. Check security of attachment of chassis **Air Suspension** - Check for leaks. Check levelling valves and linkages, security **Bonded Suspensions** - Check condition of bond and flexibility of element, security **Radius Arms** - Check for damage **Torsion Bar** - Check for damage **Shock Absorbers** Check for leaks and security

Chart 3 Inspection Schedule 'C' – Rigid Vehicle / Tractor Unit, continued

ITEM	INSPECTION / TESTING REQUIREMENTS
BRAKES	**Air/Vacuum Warning** - Check operation of warning device and braking effect with pressure/vacuum at warning mark **Build-up of Air/Vacuum** - Check rate of pressure vacuum build-up until warning device shuts off **Hand Brake** - Examine condition. Check side play and condition of pawl pivots, and pawl and ratchet for wear. Check movement of lever and security of lever in "on" position **Foot Brake** - Check anti-slip pad on pedal and side play in pedal. Check pedal clearance and security of pedal. Check operation of brake and pressure/vacuum gauges. Check effectiveness of servos **Hand operated Air/Vacuum Control** - Check control for leaks, security travel and damage or corrosion. Check valve unit for security **Mechanical Brake Components** - Check cables and rods for wear. Check relay levers, clevis pins, bolts, pivots, etc., for wear and free movement of system. Check wear of brake linings. Check drums for fractures and security of back plate, etc. **Brake Wheel Units** - Check for leaks, security, corrosion or damage and operation **Pipes, Master Cylinders, Reservoirs, Valves And Connections** - Check brake pipes and hoses are serviceable, free from damage, and secure. Check system for leaks. Examine air/vacuum reservoirs for security and damage and drain. Check all valves are serviceable. Check master cylinders and hydraulic reservoirs are secure and serviceable. Check tractor hoses and couplings for leaks and security **Brake Tests** - Roller brake or decelerometer test of service and secondary brakes. Gradient test of parking brake
ELECTRICAL	**Audible Warning -** Check operation and security **Wiring -** Check security, position and condition **Batteries -** Security, condition and leaks **Control Panel -** Operation of switches etc **Alternator** - Check operation, output, security **Starter** - Check operation and security **Ignition System** - Check operation **Earth and Battery Isolation Master Switch** – Check operation **Headlamps, Fog Lamps, Side and Stop Lamps, Indicators, Reflectors and Rear Markers** – Check condition, operation and adjustment
JOURNEY MANAGEMENT SYSTEM	Check tachograph / onboard computer / GPS in accordance with the manufacturer's instructions, including seals
PAINTWORK	Condition of paintwork and transfers
ACCIDENT DAMAGE	Accident damage outstanding
LUBRICATION	In accordance with the manufacturer's recommendations
CYLINDER VEHICLE TAIL LIFTS	Lifting mechanisms and grab rails

Chart 4 Inspection Schedule 'A' - Semi-Trailer

Typical Inspection Frequency: Every 8,000 kms.

ITEM	INSPECTION / TESTING REQUIREMENTS
LPG TANK AND EQUIPMENT (BULK VEHICLES)	Visual check for leaks Tank and tank mountings Hose racks, walkway, ladders and equipment boxes Foot valves, and outlet valves Interlocks
WHEELS AND TYRES	**Wheels -** Nut tightness (checked by position of indicators or torque wrench) and general wheel condition **Tyres -** Pressure and wear
SUSPENSION AND AXLES	**Springs** - Leaves, holding down bolts, bracket, shackles
BRAKES	Pipes, valves, hoses, couplings and diaphragms for leaks Linkages Adjusters, drums and linings Drain reservoir
ELECTRICAL	Wiring Lamps, indicators and rear markers
PAINTWORK	Condition of paintwork and transfers
ACCIDENT DAMAGE	Accident damage outstanding
LUBRICATION	In accordance with the manufacturer's recommendations
CYLINDER VEHICLE TAIL LIFTS	Lifting mechanisms and grab rails
MISCELLANEOUS	Fifth wheel, landing gear and legs Fire extinguishers and holders King pin Mudguards Warning instructions

Chart 5 Inspection Schedule 'B' – Semi-Trailer

Typical Inspection Frequency: Every 16,000 kms.

ITEM	INSPECTION / TESTING REQUIREMENTS
LP GAS TANK AND EQUIPMENT (BULK VEHICLES)	Tank and tank mountings Visual check for leaks Tank fittings, meters, hoses, hose end couplings, reels, nozzles, foot valves, outlet valves (refer to section 4.8 of this standard) Pressure relief valves (refer to section 4.8) Gauges Hose racks, walkway, ladders and equipment boxes Check electrical continuity between the tank and (i), the hose-end coupling, (ii) the end of the bonding (earthing) cable, the earth tread plate (where fitted) Pump/compressor operation, security, wear at glands Pump/compressor drive security, operation Interlocks
WHEELS AND TYRES	Wheel nuts and general wheel condition Wheel bearings Pressure and wear
SUSPENSION AND AXLES	Axles, arms, frames Suspension pins and bushes, shackles Springs and holding-down bolts, shock absorbers Wheel bearings, trunnion bearings
BRAKES	Pipes, valves, hose couplings and diaphragms for leakage Linkage Adjusters, drums and linings Drain reservoir
ELECTRICAL	Wiring Earth check Lamps, indicators and rear markers
PAINTWORK	Condition of paintwork and transfers
ACCIDENT DAMAGE	Accident damage outstanding
LUBRICATION	In accordance with the manufacturer's recommendations
CYLINDER VEHICLE TAIL LIFTS	Lifting mechanisms and grab rails
MISCELLANEOUS	Turntable, fifth wheel and landing gear and legs Fire extinguishers and holders King pin Mudguards Warning instructions

Chart 6 Inspection Schedule 'C' – Semi-Trailer

Typical Inspection Frequency: Every 40, 000 km or Annually (Minimum Frequency)

ITEM	INSPECTION / TESTING REQUIREMENTS
CHASSIS AND CAB	**Body** - Check position of body, security of fixings, brackets, bolts, rivets, etc. Check condition of drop sides, tailboards, floor, support pillars, cross or longitudinal members **Wings -** Check security, corrosion, damage and clearances **Cylinder Containing Structure** – Check floors for trip hazards. Confirm that all ventilation areas are free of obstruction. Check drop sides are functioning as designed. Confirm that all metal supports are covered by wood or rubber. Check that all cylinder restraints (straps, ropes, etc.) and their anchorage points are in good condition. Check that guides for pallets are in good condition. **Mudguards** – Check security and condition.
LP GAS TANK AND EQUIPMENT (BULK VEHICLES)	Tank and tank mountings Visual check for leaks Tank fittings, meters, hoses, hose end couplings, reels, nozzles, foot valves, outlet valves (refer to section 4.8 of this standard) Pressure relief valves (refer to section 4.8) Gauges Hose racks, walkway, ladders and equipment boxes Check electrical continuity between the tank and (i), the hose-end coupling, (ii) the end of the bonding (earthing) cable, the earth tread plate (where fitted) Pump/compressor operation, security, wear at glands Pump/compressor drive security, operation Interlocks
WHEELS AND TYRES	**Wheels** - Check retaining rings, stud holes, studs and nuts, wheel for distortion and wheel bearings **Tyres** - Check condition and wear
SUSPENSION AND AXLES	Check axles, frames, arms, rods, bars, etc., for security and soundness Check suspension units: pins, bushes for wear and soundness: springs for broken leaves and weakness, shackles, 'U' bolts, centre bolts, radius rods, shock absorbers, torsion bars for soundness and security Check alignment of springs Check wheel and trunnion bearings
BRAKES	Check trailer hand brake for operation, soundness and security of linkage Check brake pipes, valves, reservoirs, couplings actuators, etc., for leakage Check mechanical components for security and soundness Check thickness of linings and condition of drums Set brake adjusters Drain reservoir
ELECTRICAL	Check wiring, lamps, markers and reflectors for position, operation, security and soundness Check tractor-trailer connections and earthing
PAINTWORK	Condition of paintwork and transfers
ACCIDENT DAMAGE	Report all accident damage outstanding

Chart 6 Inspection Schedule 'C' – Semi-Trailer, continued

ITEM	INSPECTION / TESTING REQUIREMENTS
CYLINDER VEHICLE TAIL LIFTS	Lifting mechanisms and grab rails
LUBRICATION	In accordance with the manufacturer's recommendations
MISCELLANEOUS	**Fifth Wheel Coupling**: check condition and security of king pin, wear in jaws and locking device **Landing Gear And Legs** - Check operation and security Check pipes, fittings and equipment for leaks and damage Check drive system for security and soundness **Towing Hook or Eye** - Check eye or hook and pin for wear, distortion, damage, security of mounting **Fire Extinguishers and Holders** – Check security, inspection date, pressure (where relevant) **Warning Instructions** – Check presence and security

Appendix Seven

Emergency Response Equipment

A.7.1 Introduction

The following is a generic specification for the equipment required for dealing with off-site incidents involving bulk LP Gas road tankers. It may not be necessary to obtain all the equipment listed below; however, certain equipment must be available and a list of minimum requirements is also provided.

In deciding what equipment is required in a particular business, the following factors must be considered:

- What are the credible scenarios that could arise and what are the risks associated with them?
- How reliable are the emergency services?
- How many kits are required and where must they be located so that an incident can be responded to within two hours of notification?
- Are limitations imposed by the road conditions, affecting the size of the emergency response trailers?
- Could the kit be purchased and operated jointly with competitors?

A.7.2 Equipment List

The equipment that may be required is as follows:

- Personal protective equipment (PPE) - overalls, gloves, full face visors, safety helmets, ear defenders - two sets minimum
- Wet weather clothing - two sets minimum
- Hazard warning vests/jackets – two minimum
- 9 kg dry powder fire extinguishers - three minimum
- Portable gas detectors - two minimum
- First Aid kit - including a basic burns treatment kit.
- Product Transport Emergency Card(s) (Tremcard(s)) and/or Safety Data Sheet(s)
- Traffic cones or rope (brightly coloured) and stakes to cordon off the area - 6 minimum
- Hazard warning signs - two minimum
- No Smoking signs - two minimum
- Wind sock
- Earthing leads and earthing rods - four of each
- Torches (flame proof) - two minimum
- Additional lighting - air-operated halogen lamps
- Air compressor for the above (which can also be used for air-operated hand tools)
- LP Gas hose for liquid transfer - 50 metres minimum
- LP Gas hose for vapour return - 50 metres minimum
- LP Gas pump (gas oil or diesel powered) - with operating instructions
- LP Gas compressor (gas oil or diesel powered) - with operating instructions
- Full can of gas oil (for pump and compressor engines)
- Flare stack and lighter
- Water curtain and pump
- Air cushions, low and high pressure

- High pressure air hoses for both air cushions and halogen lamps
- 10 ton hydraulic jacks - two
- Timber chocks (for stabilising the tank prior to and during lifting)
- Wheel chocks - four (to provide fulcrum when lifting)
- Trailer landing leg winder handle
- Lifting strops - 12 MT capacity, 30 cm width, length to suit vehicles
- Selection of valves, adapters, hose connectors, hose end seals, washers to suit local vehicle fleet in a locked box
- Tapered wooden plugs / wedges
- Wooden or leather faced mallet
- Adjustable spanners - two
- Stilson wrenches - two
- PTFE tape
- Denso tape / adhesive tape
- Coil of hemp rope (not nylon)
- General toolkit (screw drivers, penknife, spanners, pliers, etc.) in a locked box
- General purpose grease for lubricating couplings, etc.
- Bottle of soapy water or similar leak detection fluid
- Plastic sheet - 3 metres x 3 metres minimum (useful for blocking drains by piling earth on top, placing under air cushions)
- Heavy duty plastic sacks (useful for clearing up after completion of the recovery operation) - 12
- Metal spade
- Non-metallic (e.g. polypropylene) spade
- Pick axe
- Small aluminium ladder
- Spare wheel for the trailer
- Dossier of P&IDs for all vehicles in the fleet

A.7.3 Minimum Equipment Requirements

As a minimum, the following equipment must be available:

- Personal protective equipment - overalls, gloves, eye protection, safety helmets, ear defenders - two sets minimum
- 9 kg dry powder fire extinguishers - three minimum
- Portable gas detectors - two minimum
- First Aid kit - including a basic burns treatment kit.
- Hazard warning signs - two minimum
- No Smoking signs - two minimum
- Earthing leads and earthing rods - four of each
- Torches (flame proof) - two minimum
- LP Gas hose for liquid transfer - 50 metres minimum
- LP Gas hose for vapour return - 50 metres minimum
- Either an LP Gas pump or a compressor (with operating instructions)
- Full can of gas oil or diesel (for pump and compressor engines)
- Selection of valves, adapters, hose connectors, hose end seals, washers to suit local vehicle fleet in a locked box
- Adjustable spanners - two
- Stilson wrenches - two
- PTFE tape
- General toolkit (screw drivers, penknife, spanners, pliers, etc.) in a locked box

- Bottle of soapy water or similar leak detection fluid
- Plastic sheet - 3 metres x 3 metres minimum (useful for blocking drains by piling earth on top, placing under air cushions)
- Spare wheel for the trailer
- Dossier of P&IDs for all vehicles in the fleet

A.7.4 Equipment Maintenance

Pumps

Follow the manufacturer's recommendations and/or the following:

Weekly	Visual inspection
	Check condition of inlet and exhaust, including spark arrestor
	Run for ten minutes. Flush and drain with gas oil after use
	Check gearbox lubricant
Monthly	Grease bearings
Annually	Change gearbox lubricant
	Examine for wear (if appropriate)

Compressors

Follow the manufacturer's recommendations and/or the following:

Weekly	Visual inspection
	Check condition of inlet and exhaust, including spark arrestor
	Run for ten minutes.
Monthly	Check lubricating oil
	Check operation of four way valve
	Check pressure gauge for general condition
	Check separator drain point
	Check external cleanliness of cooling surfaces
	Check safety valves
	Check belts for condition and tension
Annually	Change lubricant
	Change filter
	Dismantle and clean valves, piston rings, etc., as required
	Examine for wear (if appropriate)

Engines

Follow the manufacturer's recommendations and/or the following:

Weekly	Visual inspection
	Check condition of inlet and exhaust, including spark arrestor
	Run for ten minutes.
Monthly	Check belts for condition and tension
	Lubricate minor moving parts
	Check contents of spare fuel can
Annually	Change oil and fuel
	Change oil and fuel filters
	Change air filter
	Check for oil and fuel leaks - tighten fittings and nuts

Trailer / Vehicle

Follow the manufacturer's recommendations, general company guidelines for vehicle maintenance, local regulations.

Check monthly for water ingress.

Check the tyres regularly to ensure correct inflation pressure and condition.

Hoses

As recommended in section 7.6 of this standard..

Valves, Joints, Couplings

Monthly	Check operation and general condition Lubricate as required

Miscellaneous

Monthly	Check that all corrodible items are protected by a suitable anti-corrosion fluid Check contents against list Check torches
Six Monthly	Replace all batteries (including spares)

A.7.5 Other Points

Other points to note:

- Store the trailer / tractor under cover or in the shade
- Keep the trailer / tractor locked to prevent theft
- In warm climates, where LP Gas vapor pressure will always be high, it will probably be sufficient to have a pump alone, not a pump and a compressor
- An explosimeter must also be available, but it is best if this is not kept on the trailer in order to ensure that it is maintained.
- Short wave radios or mobile phones must always be available for maintaining contact with the incident control room and emergency services. They must only be used at distances greater than 20 metres from the incident.
- You will also need access to a crane or a winch with a competent operator and possible a low loader.

References

ADR - European Agreement concerning the international carriage of dangerous goods by road (Agréement pour le transport de marchandises Dangereuses par Route), United Nations.

UKLPG Association Code of Practice Number 2 - Safe Handling and Transport of LPG in Bulk by Road

UKLPG Association Code of Practice Number 17 - Purging LPG Vessels and Systems

UKLPG Association Code of Practice Number 19 – Liquid Measuring Systems for LPG

ASME boiler and pressure vessel code Section VIII - Pressure Vessels, American Society of Mechanical Engineers.

Model Code of Safe Practice in the Petroleum Industry: Part 9 - Liquefied Petroleum Gas Safety Code, UK Institute of Petroleum.

NFPA 58 - LP-Gas code, National Fire Protection Association.

EN 12493 Welded steel tanks for liquefied petroleum gas (LPG) - Road tankers - Design and manufacture

BS 7122 - Welded steel tanks for the road transport of liquefiable gases, British Standards Institution.

BS 476 - Fire tests on building materials and structures, British Standards Institution.

EN 3 – Portable fire extinguishers, European Committee for Standardization.

EN 166 - Personal eye protection - specifications, European Committee for Standardization.

EN 345 - Specification for safety footwear for professional use, European Committee for Standardization.

EN 397 - Industrial safety helmets, European Committee for Standardization.

EN 471 - High-visibility warning clothing for professional use - Test methods and requirements

EN 812 - Industrial bump caps, European Committee for Standardisation

EN 1762 - Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2.5 MPa) - specification, European Committee for Standardization.
WLPGA – Guidelines for Good Safety Practices in the LP Gas Industry

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