

DEP SPECIFICATION

LPG BULK ROAD, RAIL AND PIPELINE TRANSPORTATION

DEP 30.06.10.13-Gen.

February 2013

DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design of the following transportation methods and systems for pressurised liquefied petroleum gas (LPG):

- a. Transport by pipelines
- b. Transport by road tankers
- c. Transport by rail tank wagons
- d. Bulk transport in ISO containers

LPG includes commercial propane, commercial butane and mixtures thereof.

This DEP does not cover:

- a. Bulk loading/unloading facilities; see DEP 30.06.10.14-Gen.,
- b. Transfer of LPG from rail wagon to road tanker and road tanker to rail wagon,
- c. Transfer of LPG from road tanker to road tanker,
- d. Transport of LPG by sea or inland waterway,
- e. Transport of LPG by air.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2011; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
ADR	Act on the European Agreement on the transportation of dangerous goods by road
ABS	Anti-lock brake system
DN	'diametre nominal' (metric units)
DoT	Department of Transport (US)
ECOSOC	United Nations Economic and Social Council
EFV	excess flow valve
ESD	emergency shut down
FRP	fire resistant plastic
GRP	glass fibre reinforced plastic
GVW	gross vehicle weight
IMO	International Maritime Organisation
HGV	heavy goods vehicle
ISO	International Organization for Standardization
ISV	internal safety valve
ITP	inspection and test plan
IVMS	In-vehicle monitoring system
Local Competent Body	Local Competent Body is the National Regulator. Based on the Basel Convention, it is any national agency responsible under its national law for the control or regulation of a particular aspect of the transportation of hazardous materials (dangerous goods)
LODMAT	lowest one day mean average temperature
LPGITA	Liquefied Petroleum Gas Industries Technical Association UK
NDT	non destructive testing
NFPA	National Fire Protection Association
NPS	nominal pipe size (inches)
NRV	non-return valve
OEM	original equipment manufacturer
P&ID	piping and instrumentation diagram
positive closure	Tight shut off and positive closure are different. Positive closure means that when the valve is closed and the hose removed, a sealing device will ensure leakage will not occur
PRV	pressure relief valve

Term	Definition
PTFE	polytetrafluoroethylene (Teflon)
PTO	power take off
RID	Regulations on the International Transport of Dangerous Goods by Rail
ROV	remotely operated valve
RTW	rail tank wagon
TSO	tight shut off
UTS	ultimate tensile strength
VDR	vehicle data recorder
VES	vehicle E stability system

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (6).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2011. The following are the main non-editorial changes:

Section	Change
	Relevant Shell LPG business standards and design specifications were incorporated.
	Process safety requirements “SHALL [PS]” were critically reviewed and many were removed if they did not meet applicable risk criteria.
	Requirements for bulk loading/unloading facilities were moved to DEP 30.06.10.14-Gen.
	DEP title was changed from “LPG bulk transfer and transportation” to “LPG bulk road, rail and pipeline transportation” to align with revised scope.
	US Customary units were added.
1.1	Scope updated.
1.6	Content updated.
1.7	Content updated.
3.1 par 2	Addition of a SHALL [PS]
3.2.22 Par 1 Item3	Addition of a SHALL [PS]
<u>The following section numbers are for DEP version February 2011</u>	
2.4 par 3	SHALL [PS] changed to shall
2.6 par 1	SHALL [PS] changed to shall
2.7 par 1	SHALL [PS] changed to shall or content moved to another DEP
3.2.3 par 3	SHALL [PS] changed to shall or content moved to another DEP
3.2.5 par 1	SHALL [PS] changed to shall or content moved to another DEP

Section	Change
3.2.5 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.2 par 4	SHALL [PS] changed to shall or content moved to another DEP
4.2.3 par 7	SHALL [PS] changed to shall or content moved to another DEP
4.2.4 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.5 par 2	SHALL [PS] changed to shall or content moved to another DEP
4.2.5 par 3	SHALL [PS] changed to shall or content moved to another DEP
4.2.6 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.6 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.7 par 6	SHALL [PS] changed to shall or content moved to another DEP
4.2.7 par 10	SHALL [PS] changed to shall or content moved to another DEP
4.2.7 par 11	SHALL [PS] changed to shall or content moved to another DEP
4.2.7 par 11	SHALL [PS] changed to shall or content moved to another DEP
4.2.7 par 12	SHALL [PS] changed to shall or content moved to another DEP
4.2.7 par 12	SHALL [PS] changed to shall or content moved to another DEP
4.2.7 par 14	SHALL [PS] changed to shall or content moved to another DEP
4.2.8 par 2	SHALL [PS] changed to shall or content moved to another DEP
4.2.8 par 3	SHALL [PS] changed to shall or content moved to another DEP
4.2.8 par 4	SHALL [PS] changed to shall or content moved to another DEP
4.2.10.1 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.10.2 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.10.2 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.10.2 par 2	SHALL [PS] changed to shall or content moved to another DEP
4.2.10.3 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.2.11 par 2	SHALL [PS] changed to shall or content moved to another DEP
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4.2.12 par 2	SHALL [PS] changed to shall or content moved to another DEP
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4.2.13 par 4	SHALL [PS] changed to shall or content moved to another DEP
4.2.14 par 2	SHALL [PS] changed to shall or content moved to another DEP
4.2.14 par 4	SHALL [PS] changed to shall or content moved to another DEP
4.2.18 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.3.2 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.3.2 par 2	SHALL [PS] changed to shall or content moved to another DEP

Section	Change
4.3.2 par 2	SHALL [PS] changed to shall or content moved to another DEP
4.3.3 par 2	SHALL [PS] changed to shall or content moved to another DEP
4.3.4.2 par 3	SHALL [PS] changed to shall or content moved to another DEP
4.3.4.2 par 5	SHALL [PS] changed to shall or content moved to another DEP
4.3.6 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.3.6 par 2	SHALL [PS] changed to shall or content moved to another DEP
4.4.2 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.4.4 par 1	SHALL [PS] changed to shall or content moved to another DEP
4.4.5 par 3	SHALL [PS] changed to shall or content moved to another DEP
4.4.7 par 6	SHALL [PS] changed to shall or content moved to another DEP
4.4.8 par 1	SHALL [PS] changed to shall or content moved to another DEP
5.2 par 3	SHALL [PS] changed to shall or content moved to another DEP
5.2 par 7	SHALL [PS] changed to shall or content moved to another DEP
5.2 par 11	SHALL [PS] changed to shall or content moved to another DEP
5.5.1 par 5	SHALL [PS] changed to shall or content moved to another DEP
6.2.2 par 3	SHALL [PS] changed to shall or content moved to another DEP
6.2.2 par 5	SHALL [PS] changed to shall or content moved to another DEP
6.2.2 par 6	SHALL [PS] changed to shall or content moved to another DEP
6.2.2 par 12	SHALL [PS] changed to shall or content moved to another DEP
6.2.2 par 13	SHALL [PS] changed to shall or content moved to another DEP
6.3.1 par 2	SHALL [PS] changed to shall or content moved to another DEP

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://www.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (Other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

2. TRANSPORT BY PIPELINES

2.1 PIPELINE SCOPE

A pipeline is a system of pipes and other components used for the transportation of fluids, between facilities (e.g., could include jetty-depot, refinery-depot). A pipeline extends from the supply source boundary isolation valve to the first valve etc within the boundary of the receiving facility (or a more inward valve if so nominated).

2.2 PIPELINES

2.2.1 Pipeline engineering

Pipeline engineering shall be in accordance with DEP 31.40.00.10-Gen.

2.2.2 Product segregation

LPG grades should be segregated by providing each grade with its own dedicated facilities at the end of the pipeline. Non-odorised grades shall be segregated in systems designed to prevent contamination by odorant.

2.2.3 Multi-product pipelines

LPG can be handled in appropriately rated multi-product white oil pipelines.

- a. The ancillary fittings and equipment of a multi-product pipeline system shall be suitable for operation at the maximum foreseen pressure in the system.
- b. The pipeline system shall be equipped with a system to ensure that the product is under sufficient pressure to prevent LPG vaporisation in the pipeline.
- c. Mechanical separation of the different products in long pipelines will reduce the interface volume.
- d. Interface signalling equipment, e.g., gravitometer, will enable accurate interface cuts to be made thereby minimising the cuts to slops.
- e. A suitable pressure vessel (slops tank) and associated compressor to handle the interface cut are required.

For information on a method of calculating interface volumes in multi-product pipeline operations contact the Principal. Refer to (2.2.8) for details on the use of mechanical separators.

2.2.4 Corrosion protection

Pipelines above ground shall be painted in accordance with DEP 30.48.00.31-Gen. to prevent corrosion. Carbon steel buried and submerged pipelines SHALL [PS] be protected by a suitable coating and by cathodic protection. Polyethylene and polypropylene coating shall be in accordance with DEP 31.40.30.31-Gen. and fusion-bonded epoxy powder coating shall be in accordance with DEP 31.40.30.32-Gen.

Cathodic protection shall be in accordance with DEP 30.10.73.31-Gen. for buried pipelines and DEP 30.10.73.32-Gen. for offshore pipelines.

2.2.5 Access

Above ground pipelines (including pig trap installations) should be readily accessible for operation, maintenance and inspection purposes. Protection shall be provided against possible impact/collision damage where vehicle movements may occur in the vicinity of the pipeline. Buried pipelines shall be protected against the effects of superimposed loads.

2.2.6 Overpressure protection

The design and engineering of the overpressure protection systems shall comply with DEP 31.40.10.14-Gen.

2.2.7 Leak detection

Pipelines shall be provided with a suitable leak detection system in accordance with DEP 31.40.60.11-Gen.

2.2.8 Mechanical separation

Mechanical separators, such as pigs or spheres, may be used to physically separate different products in a pipeline if the line has been designed and constructed for their use.

Pigs and spheres utilise synthetic rubbers or plastic materials to make contact with the pipeline walls and provide the seal between the products. The materials shall be compatible with and resistant to the products being handled.

2.2.9 Pig trap systems

Pig trap systems shall conform to DEP 31.40.10.13-Gen.

2.2.10 Bi-directional pipeline operation

Some LPG pipeline clearing operations require a pig or a sphere to travel in the reverse direction to normal. These operations could entail replacing;

- a. water with LPG vapour;
- b. air or inert gas with LPG vapour;
- c. LPG liquid with LPG vapour.

In these cases, the pipeline shall be designed and constructed to include pig/sphere launchers/traps capable of both launching and receiving.

2.3 PIPING

2.3.1 General

Piping is the assembly, within designated plant, jetty or depot boundaries, of pipes, elbows, flanges, gaskets, fittings, valves and other components (e.g., expansion joints, strainers, devices for mixing, separating, distributing, metering and flow control). It also includes pipe supports and insulation. In general there is piping at each end of a pipeline. The requirements of DEP 31.38.01.11-Gen. shall be applied.

2.3.2 Bonding/earthing

To prevent the accumulation of static electricity, piping should be electrically continuous. Normal pipe fittings, bolted flanges, etc., are generally sufficient to ensure this.

DEP 33.64.10.10-Gen. or DEP 33.64.20.10-Gen. shall apply as applicable.

2.3.3 Thermal expansion and flexibility

Provisions shall be made to prevent excessive pressure developing in above ground liquid - filled sections of piping, which are isolated by valves or other equipment. DEP 30.06.10.12-Gen. shall apply.

3. TRANSPORT BY BULK ROAD TANKERS

3.1 GENERAL

LPG bulk road tankers shall comply with local statutory design and construction regulations for the transport of flammable gases. If local regulations do not exist, or are not sufficiently comprehensive, then a recognised standard shall be followed, e.g., ADR, US Department of Transport MC 331, UN Model Regulations, UKLPG (formerly LPGITA) Code No. 2. The more stringent requirements of the local regulations (or the selected code) and this DEP shall be applied.

LPG tankers shall comply with the minimum requirements given in (Appendix A) Table A.2 and Table A3.

The design of an LPG tanker falls into two parts: design of the tank and tank equipment and the design of the vehicle itself for safe operation with the LPG tank and equipment mounted on it. These are covered in (3.2) and (3.3) below.

3.1.1 Change of service of pressure vessels

The following cases may apply for **change of service of** pressure vessels:

- a. A tanker that has been used for another product is to be used for LPG service.
- b. A previously used pressure vessel is mounted on a different chassis / cab unit

In both cases a history of the vessel should be examined and a thorough inspection performed to ensure suitability.

3.2 TANKS AND TANK EQUIPMENT

3.2.1 General

Only approved vessel Manufacturers who have been subjected to a rigorous Contractor selection procedure, have no major non-conformances in their latest ISO 9001 audit and who have several years experience working to the required design code shall be considered for supply of LPG tanks.

All drawings, engineering and details, shall be approved by the Principal and where necessary, by an independent authority prior to manufacture.

NOTE: Unless competent to do so, approval should be given in such a manner that the responsibility for vehicle 'fit for purpose' and 'specification' compliance is left with the vehicle Supplier

Diagrammatic layouts of piping and equipment for metered bulk delivery vehicles are given for information in (Appendix B), Figures B.2 and B.3.

3.2.2 Vessel capacity and grade of product

The maximum legal carrying capacity of the vessel is determined by the gross vehicle weight (GVW) and axle load limitations set by local regulations, by the chassis the Manufacturer's maximum recommended GVW and axle loadings, and by the minimum safe ullage requirements of the product grades transported.

The vessel Manufacturer shall be advised of the grade or grades of product to be conveyed, i.e., propane or butane, mixes or any of these grades and its density and pressure characteristics.

The initial capacity of the vessel shall be based on the requirements of (3.3) taking into account chassis dimensions, wheelbase and axle weights.

The designed water capacity will depend on the product(s) to be conveyed and area of the world in which it is to operate. The purchaser shall notify the vessel Manufacturer accordingly.

3.2.3 Safe filling capacity

General - Loading and unloading involves transferring LPG from one vessel to another and to achieve this, different methods (e.g., free flow, pump, etc.) may be employed depending upon a number of factors such as:

- a. the difference and distance in elevation between supplying and receiving vessels;
- b. the pressure differential;
- c. the characteristics of the product;
- d. the design characteristics of the supplying and receiving vessels;
- e. the transfer rate required;
- f. the method of measurement, e.g., mass (mass meter or weighbridge), volume (volumetric meter or internally mounted ullage gauge).

LPGs have high volumetric coefficients of expansion compared to other liquid hydrocarbons and water. For example, at 15 °C (59 °F) the volumetric expansion of butane is 0.210 % per °C (0.117 % per °F) and the volumetric expansion of propane 0.273 % per °C (0.152 % per °F). This factor will normally constrain the maximum fill capacity.

Calculation of the safe filling capacity shall be according to the tank design code.

3.2.4 Vessel construction

The maximum overall width of any vessel and its service equipment shall not project beyond the overall width of the chassis/cab or the ISO frame in the case of a tank container.

Unless otherwise specified by local regulations, vessels shall comply with one of the following:

- a. EN 12493:2008
- b. ASME/BPVC Section XII
- c. ADR (in European countries, or countries with no applicable local regulation)
- d. JIS (Japanese industrial standard)
- e. DOT (US department of transportation)

To limit the effect of product surge on the braking efficiency of vehicles, vessels may require baffle plates to be fitted. If local regulations covering this requirement do not exist, advice should be sought from the chassis supplier. Baffles, where required, should be fitted at intervals of not more than 7500 litres (2000 gallon) water capacity.

The design of the baffle shall ensure unrestricted drainage of liquid and the interconnection of vapour spaces, and include a manway not less than 410 mm x 360 mm (16 in x 14 in). The position of the drainage cut-outs in the baffle shall allow the flow of liquid and vapour across the baffle when the vehicle is on its side or upside down.

Baffle plate thickness should be at least 2 mm (0.079 in). If double plates or sealing rings are used to support baffles the enclosed spaces so formed shall be provided with plugged sockets for monitoring the atmosphere prior to carrying out hot work.

The vessel shall be designed to ensure as low a centre of gravity as practicable. This may be carried out by low mounting feet on a rigid vehicle or the use of an eccentric cone as the front section on an articulated vehicle. Additionally, smaller diameter wheels may be employed in some circumstances.

The height of the centre of gravity of the loaded vessel (equipment and payload) shall not be greater than 95 % of the width across the outer walls of the tyres on the vehicle's rearmost supporting axle.

There shall be a space of not less than 100 mm (4 in) between the back of the cab and the foremost point of the cargo vessel.

The tank heads/ends shall be of semi-ellipsoidal or dished and flanged type whose shape shall satisfy the design code selected.

Head-to-shell attachment welds shall be of the butt-welded type.

Each tank shall be fitted with a corrosion resistant metal plate ("name plate") in accordance with EN 12493 or equivalent standard.

As a minimum, the vessel shall be blasted to Sa 2 1/2 as per ISO 8501 and coated with a zinc epoxy primer to a dry film thickness of 40 microns (1.5. mil), followed by a white gloss epoxy top coat to a total dry film thickness of not less than 110 microns (4.3 mil).

Where local requirements preclude the use of white as the main colour, this can only be done by increasing the design pressure of the vessel and relief valves and reducing the maximum safe filling capacity to take account of the additional thermal heating that can occur with non-white colours.

The paint system shall be tested and shall comply with the paint Supplier's specification and be applied by approved applicators.

3.2.5 Manholes, manhole pads and vessel nozzles

The tank rear or front head shall include an inspection manhole and cover satisfying the design code. The minimum diameter shall be 460 mm (18 in).

- NOTES:
1. For vessels procured and operated within US jurisdiction or where US industry practices are followed, un-recessed 400 mm (16 in) manholes are permissible. The basis of this is the lack of evidence of incidents in these markets associated with manhole access and that the risks of working/manufacturing a non-standard manhole are deemed to be higher than the risks associated with the reduced access associated with the smaller manhole.
 2. The latest edition of ADR requires a minimum manhole diameter of 500 mm (20 in).

The design shall be of flush type to accept a semi-ellipsoidal dished inwards cover welded to the cover flange. The manhole shall be sited:

- a. On an articulated vehicle tank - in the lower part of the head on the vertical centre line for easy access.
- b. On a rigid vehicle tank - on the centre line if a rotary ullage-type gauge is to be considered.

A handling bar, 25 mm (1 in) in diameter, shall be welded across the manhole cover.

Vessel nozzles and manhole pads shall be manufactured from forged pads with studs for flanged fittings or internal threads as appropriate. The use of pipe nozzles is prohibited.

Threaded connections, if unavoidable, shall be kept to a minimum and should not be used on piping greater than DN 50 (NPS 2) [refer to (3.2.18) for size limitations on threaded connections on proprietary equipment, e.g., pumps, meters].

3.2.6 Design pressure, temperature, load and stress

The vessel design pressure SHALL [PS] be as defined by the vessel design standard unless local approvals or regulations require otherwise. EN 12493 is the most efficient design standard for LPG vessels and preferred, if accepted, by the local competent body. Note that EN 12493 has Annex B which is normative and Annex C which is informative. Where the national competent authority in the country of use of the road tanker permits use of Annex C, the lower reference temperature, this should be used. The lower reference temperature permits a thinner vessel which is lighter, reducing overall vehicle weight and reducing vehicle journeys by delivering more product under existing vehicle size and weight constraints. There is no vessel safety reduction, as the lower temperature is applied in temperate countries and there is an overall increase in safety through reduced journeys.

Unless otherwise advised by the operator, the lower design temperature shall be the lower of LODMAT (lowest one day mean average temperature) or -20 °C (-4 °F).

All pressure vessel materials shall have suitable impact resistance at the lower design temperature, i.e., >27 Joules-Charpy at the lower design temperature.

If vessels may be subjected to a vacuum, e.g., transport of butane in sub-zero temperatures, then vessels shall be designed to withstand full vacuum conditions.

The design load and stress shall be according to the vessel design standard.

3.2.7 Vehicle type

The vessel Manufacturer shall be given the chassis drawing and notified of the nominal capacity required and the vehicle type, i.e., rigid only, rigid and drawbar trailer or articulated.

Where the vehicle is to be a rigid and drawbar trailer type, the required capacities of each part of the vehicle shall be stated and details of the drawbar trailer selected shall also be given to the tank Manufacturer.

In the case of an articulated vehicle, the tank Manufacturer shall be provided with details of the semi-trailer running gear, landing legs and king pin/rubbing plate to be used.

3.2.8 Inspection and approval

A leak test certificate shall be provided with each individual tanker. The LPG tank, its fittings, valves and pipework shall be leak tested with a suitable test medium such as air or water at a minimal pressure of 5 bar (75 psi) to ensure leak tightness.

The Manufacturer shall arrange independent inspection and supervision during construction by a notified body (such as Lloyds Register, DNV, SGS, etc.) or any other organisation recognised and certified by legislative authorities (where these exist) and acceptable to the Principal. Where possible, internationally recognised inspection agencies shall be used, in preference to solely local agencies.

The manufacturer should develop and submit an Inspection and Test Plan (ITP) for review and approval by the Principal. The inspection shall include:

- a. scrutiny and approval of constructional drawings;
- b. examination of plates for lamination, after forming and preparation for welding (shell plates and heads);
- c. code inspection requirement during fabrication;
- d. final inspection and hydrostatic test;
- e. vessel certification and identification plate stamping on completion.

The Manufacturer shall provide to the Principal two copies of the final approved inspection company's authorised inspection and test certificates for each individual vessel.

The vessel shall have a nameplate welded onto one of the vessel supports showing the following information:

- a. vessel Manufacturer's name and tank identification number;
- b. design pressure and code of construction;
- c. hydrostatic test pressure and date of initial test;
- d. water capacity (to an accuracy of 1 %);
- e. vacuum rating;
- f. lower design temperature;
- g. insurance/inspecting company's stamp of their inspecting engineers.

Space shall be provided on the nameplate so that the date and the inspection company's stamp can be added during subsequent re-tests.

A complete dossier (manufacturing data book) shall be supplied with the completed vehicle. It shall include:

- a. vessel approval documentation, see (3.2.8) above);

- b. pipe and equipment material certification;
- c. operating instructions;
- d. parts list and equipment Manufacturers' handbooks with indicated settings relevant to the specific vehicle;

NOTE: For example, relief valve and hydrostatic relief valve settings, pump bypass settings, maximum pump speed, etc.

- e. as-built piping and instrument diagram (P&ID);
- f. as-built engineering drawing of tanker;

Ancillary information; e.g., details of paint touch up, hydraulic fluid, lubrication, spares catalogue etc.

3.2.9 Mountings

Mountings used to support and anchor the vessel to the transport vehicle:

- a. shall comply with the chassis and vessel Manufacturers' recommendations;
- b. shall account for the additional stress referred to in the vessel design standard;
- c. shall be fabricated in steel that is compatible with the vessel;
- d. shall be designed as an integral attachment;
- e. shall be designed with continuous welds with adequate reinforcement to resist high stress concentrations at the attachment point;
- f. shall have electrical continuity between the vessel and fittings and the vehicle chassis.

3.2.9.1 The vessel shall be fitted with mountings attached to the vessel via backing plates welded to the shell to minimise high stress concentrations in the shell.

- a. Backing plates shall have rounded corners to avoid stress concentrations at the corners and shall be provided with vent holes.
- b. Backing plate welds shall be continuous,
- c. Mounting design shall enable the tank to be bolted directly onto the chassis by a method approved by the chassis Manufacturer.
- d. Mounting design shall take into account the driving conditions and vibration / fatigue related aspects of the operating environment.
- e. Unless required by national regulations, mounting rails (fitted the length of the vessel and mounted on the chassis rails) are not recommended due to the increased weight, height and cost implications.

3.2.9.2 Rigid chassis mounts

Tanks having an LPG capacity up to 8 tonnes (17640 lbs) shall have at least 4 mounting points (two each side) positioned adjacent to the head to shell welds. Tanks having a capacity greater than 8 tonnes (17640 lbs) shall have at least 6 mounting points (3 each side).

If spring mountings are required by the chassis manufacturer, extra backing plates should be considered from which the pump can be mounted. This will remove the need to provide a flexible joint between the tank and pump.

3.2.9.3 Articulated chassis mounts

Articulated vehicles are normally of self-supporting design eliminating the need for a full-length chassis.

Mountings shall be attached to the shell via backing plates welded directly to the shell to minimise high stress concentrations in the shell. Backing plate welds shall be continuous.