LPG TANK TRUCKS: REQUIREMENT OF SAFETY ON DESIGN/ FABRICATION AND FITTINGS

Prepared by

FUNCTIONAL COMMITTEE

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PREAMBLE

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 by Ministry of Petroleum and Natural Gas, Government of India as a knowledge center for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than three decades of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director
Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is over 100 years old. As such, various practices have been in vogue because of collaboration/association with different foreign companies and governments. Standardization in design philosophies, operating and maintenance practices remained a grey area. This coupled with feedback from some serious accidents that occurred in the past in India and abroad, emphasized the need for the industry to review the existing state-of-the-art in designing, operating and maintaining of Oil and Gas installations.

With this in view, the Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by the Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a series of self-regulatory measures aimed at removing obsolescence, standardizing and upgrading the existing standards to ensure safe operations. Accordingly, OISD constituted a number of functional committees of experts nominated from the industry to draw up standards and guidelines on various subjects.

This document on “LPG Tank Trucks: Requirements of Safety On Design / Fabrication and Fittings” was first prepared in July 1997 and was amended in October 2002. The present document is revised by the Functional Committee based on the accumulated knowledge and experience of industry members and the various national and international codes and practices.

Subsequent to release of this standard, OISD-STD-160 on "Protection to fittings mounted on existing LPG tank trucks" stands withdrawn as the same has outlived its relevance. Relevant significant clauses of OISD-STD-160 have been included in OISD-STD-159.

The figures and annexures used in the document are representative in nature.

We, at OISD, are confident that the provisions of this standard, when implemented in totality, would go a long way in ensuring safe operation of the target group of locations.

Needless to mention, this standard, as always would be reviewed based on field level experience, incident analysis and environment scanning. Suggestions from all stake holders may be forwarded to OISD.
NOTE

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These documents are intended only to supplement and not to replace the prevailing statutory requirements of PESO, DGMS, Factory Inspectorate or any other Government body which must be followed as applicable.

Where ever Acts/ Rules/ Regulation and National/ International Standards are mentioned in the standard, same relates to in-vogue version of such documents.
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S.K. PAL OISD
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1.0.0. INTRODUCTION & SCOPE

1.1.0 INTRODUCTION:

1.1.1 In view of latest revision in statutory rules, technological advancement, best practices followed in oil industry, learning from experience and accidents occurred in past, a need was felt to revise this standard. This revised standard has been prepared by a Functional Committee comprising of representatives of Oil Industry, Dept. of Explosives (Govt. of India), constituted for standardisation of the design of bullets along with material specifications, fittings, mounting etc., for transportation of LPG in bulk by road.

1.1.2 Notwithstanding above, all LPG tank trucks should meet the requirements of the Motor Vehicle Acts and Regulations and the Static & Mobile Pressure Vessels (Unfired) Rules, 2016 as amended from time to time.

1.2.0 SCOPE:

This standard covers basic requirements of safety in design / fabrication of vessels with material specifications, fittings and mountings, for transportation of LPG conforming to IS: 4576-1999(latest) in bulk by road tank trucks. This standard will be applicable for all LPG tank trucks.

1.2.1 A single code shall be adopted for materials, fabrication, inspection and testing.

1.3.0 DEFINITIONS

Approved Type: Any equipment which has specific approval for use under specified conditions by competent authority or authorised person as the case may be.

Bonding: Bonding is the process by which two electrical conducting bodies are connected using a conductor to maintain electrical continuity to prevent sparking between two conducting bodies.

Bulk Vessels: A pressure vessel used for more than 1000 liters water capacity for storage or transportation of LPG.

Bullet: A horizontal cylindrical pressure vessel used for storage or transportation of LPG by rail/ road.

Compressed Gas: Any permanent gas, liquefiable gas or gas dissolved in liquid under pressure or gas mixture which in a closed container exercises a pressure either exceeding 2.5 kg/sq.cm. abs @ 15 °C or a pressure exceeding 3.0 kg/Sq.cm. abs @ 50 °C or both.

Earthing: Earthing is the provision of a safe path of electrical current to ground, in order to protect structures, plant and equipment from the effects of stray electrical current, and electrostatics discharge.

Flammable (or inflammable): Any substance which when tested in a specified manner will ignite when mixed with air on contact with a flame and will support combustion.

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Gas-Free: It means the concentration of flammable or toxic gases or both in a pressure vessel or pipeline is within the safe limits specified for persons to enter and carry out hot work in such vessels/pipelines.

Liquefied Petroleum Gas (LPG): The term applies to a mixture of certain light hydrocarbon predominately C3 & C4, derived from petroleum & natural gas which are gaseous at ambient temperature and pressure, may be condensed to a liquid state at normal ambient temperature by the application of moderate pressure and conforming to IS: 4576 or IS: 14861 (latest).

RLW: Goods vehicle are usually classified either according to their unladen weight (ULW) or gross vehicle weight, also called registered laden weight (GVW or RLW).

Pay Load: Pay load usually refers to how much weight a truck can carry safely.

Purging: It is the act of replacing the atmosphere within a container by an inert substance in such a manner as to prevent the formation of explosive mixture.

Water Capacity: The maximum volume of water in liter that a container can hold at 15 °C.

Maximum Working Pressure: It is saturated vapour pressure of LPG at 65 deg C for LPG cylinders and 55 deg C for bulk vessels.

Authorised Person: - An individual whose job description includes the concerned jobs.

NDT: Nondestructive testing is the process of inspecting, testing, or evaluating materials, components or assemblies without destroying the serviceability of the part or system.

Shall: - Indicates that provision is mandatory.

Should: - Indicates that the provision is recommended as a good engineering practice.

2.0.0 VESSEL DESIGN:

2.1.1 Design Pressure:

Vapour pressure of LPG conforming to IS: 4576 (latest) at a maximum anticipated service temperature of 55 deg. C, to be considered. Providing an allowance of minimum 5% as per code requirements the minimum design pressure shall be 14.5 kg/sq.cm(g). In addition, 3g effect to be taken into account acceleration/deceleration shall be considered while designing of the vessel.

2.1.2 Design Temperature:

The design temperature of the vessel shall be in line with the specification of LPG and as per latest statutory requirement.

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2.1.3 Vessel Design Code:

a) Vessels shall be designed, constructed and tested in accordance with IS 2825; ASME Section VIII Division 1 or Division 2, PD5500, EN 13458, EN 13530, AD:2000 code as amended from time to time, or such other standard or code accepted by the Chief Controller.

b) The design stress shall include an allowance to enable the vessel to withstand shocks normally encountered by movements on road, such as acceleration and deceleration for a minimum of 3g. When the vessel is self-supporting, the vessel design shall provide for carrying the additional stresses normally carried by the chassis frame. Provision shall be made for distributing the localised stresses arising from attachments to the vessel.

c) Mounting of vessels on the chassis or under-frame shall be done in such a manner as to keep the vibrations to the minimum. Saddle supports and other attachments shall also be designed according to the fabrication code.

d) All vessels shall be designed to withstand the most severe combined stresses to which they may be subjected to by the pressure of the gas, the pumping pressures and shock loading caused by transport conditions.

e) Joints: Joints shall be as required by the code with all under cuttings in shell and head material fabricated as specified therein.

All longitudinal shell welds shall be located in upper half of the vessel and shall be staggered when assembling the cylindrical shell from two parts by means of a circumferential joint. The distance between two such staggered joints shall be at least 5 times the thickness of the thicker plate or as specified by code as adopted.

2.1.4 Material Specifications:

Material used in the manufacture of pressure parts of the vessel shall be in accordance with IS 2825; ASME Section VIII Division 1 or Division 2, PD5500, EN 13458, EN 13530, AD:2000 code as amended from time to time, or such other standard or code accepted by the Statutory Authority. A single code shall be adopted for materials, fabrication, inspection and testing.

2.1.5 Vessel Plate Thickness:

The nominal thickness of the plate material used in fabrication shall not be less than the sum of minimum calculated thickness as per the fabrication Code and corrosion allowance (CA). Minimum corrosion allowance, wear and tear allowance of 0.5mm in case of non-toxic, non-flammable and flammable gas vessels shall be added to the minimum calculated thickness arrived as per the fabrication code. In addition, minimum 10 percent thinning allowance in case of formed heads shall also be considered. The nominal plate thickness shall also be not less than the minimum calculated thickness and the under-tolerance as allowed in material specification. The minimum actual thickness of the finished formed head shall be physically verified by the Inspecting Authority to ensure that it is not less than the required thickness, as explained above. This shall be indicated in the final certificate issued.

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2.1.6 Connecting Joints/ Nozzles and Manhole:

Connecting joints / nozzles and manhole shall be constructed in accordance with the applicable design and fabrication code.

2.1.7 Baffle Plates:

Every vessel over 5 cu m water capacity shall be fitted with baffle plates to minimise the surge, the design of which should facilitate complete internal inspection.

Baffle plates shall be provided as follows:

a) Over 230 cm in length shall be provided with baffles, the number of which shall be such that the linear distance between any two adjacent baffles or between any tank head and the baffle nearest it, shall in no case exceed 150 cm.

b) Each baffle shall have adequate strength to sustain without undue stress or any permanent set a horizontal force equal to the weight of so much of the contents of the tank as may come between it and any adjacent baffle or tank head, applied as a uniformly distributed load on the surface of the baffle or tank head. Baffles shall be formed with a curvature of 200 to 300 cm radius.

c) Each baffle shall have at least 2/3rd of the cross-sectional area of the tank. Baffles shall have suitable openings at top and bottom. Openings at bottom should allow access to the other side. Baffles shall be attached to the shell by means of suitably spaced cleats (min. 8 nos.) of minimum size 150 x 150 x 6 mm thick. The weld between baffle to cleat and cleat to the shell shall meet the applicable design code requirements. No vessel supports or baffle or baffle cleat shall be welded directly to the vessel. All such supports shall be attached by means of pad of the same material as the vessel. The pad thickness shall not be less than 6 mm and shall not exceed the thickness of the shell material.

Each pad shall extend at least 4 times its thickness in each direction beyond the weld attaching the support. Each pad shall be formed to an inside radius not greater than the outside radius of the vessel at the place of attachment. Each pad corner shall be rounded to a radius of at least 1/4th width of the pad and not greater than 1/2 the width of the pad. Weep holes and tell-tale holes if used shall be drilled or punched before the pads are attached to the tank. Each pad shall be attached to the tank by filler material having the properties conforming to the similar filler material used for welding of the vessel.

Baffle shall be located away from SRV to facilitate ease of access for fitment / removal and safety of SRV.

2.1.8 Painting:

The external surface of the vessel shall be prepared properly before painting. Vessel external surface shall be painted with two coats of red-oxide primer and two coats of enamel paint of the colour stipulated by statutory authorities to prevent corrosion and shall have a reflecting surface.

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2.1.9 Marking:

**Vessel Identification Plate:**

Each vessel shall have a non-corrosive metal plate permanently affixed by brazing or welding on the rear dished end in a place readily accessible for inspection and maintained legibly. Neither the plate itself nor the means of attachment to the vessel may be subjected to impingement by the tank contents. The plate shall be plainly marked by stamping or embossing or by other means of forming letters to the metal of the plate with the following information:

01. Vessel Manufacturer Name
02. Vessel Manufacturer’s identification mark and Serial No.
03. Chief Controller’s approval number
04. Design code
05. Design Pressure
06. Design Temperature
07. Hydrostatic test pressure
08. First test date and subsequent test dates
09. Water capacity in liters
10. Licensed Product capacity in tonnes and symbol or chemical name.
11. Name of the Inspection Agency with their stamp.
13. Next hydro test date of the vessel shall be painted on the body of the vessel.

3.1.0 Valves and Accessories:

LPG pipes, fittings and other equipment mounted on the vessel shall be suitable for LPG service i.e. corresponding to Vapour Pressure of LPG at 55 deg. C. and shall be capable of withstanding the most severe combined stresses set up by the following:

a) Maximum vapour pressure of the product in service.
b) Superimposed pumping pressure.
c) The shock loading during transport movements.

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3.2.0 Fittings:

Fittings to be provided on the vessel shall be as follows:

3.2.1 Safety Relief Valve:

a) Every vessel shall be provided with at least two pressure relieving devices. Each one sized to suit the full relieving capacity of the vessel. The design and operation of Safety Relief Valves shall conform to the provision of SMPV rules as amended from time to time.

b) The relief valves shall be spring loaded and shall be set to discharge and reach full flow conditions as required by the Design Code.

c) Safety relief valve of the vessel shall be set at different values and at not more than 110% of design pressure of the vessel and each having 100 % relieving capacity adequate for limiting the pressure build up in the vessel not more than 120% of design pressure or maximum working pressure.

d) SRV shall be so installed that it does not project out of the top surface of the vessel. Such relief valves shall be provided in a recessed cup formation with suitable rain caps.

e) The relief valve shall be replaced by a new relief valve every ten years or found defective during periodic yearly inspection, whichever is earlier.

f) Safety Relief valves shall be so arranged that the possibility of tampering is minimised and if the pressure setting or adjustment is external, the safety relief valve shall be provided with suitable means of sealing arrangement.

g) The design and operation of Safety Relief Valves shall conform to the provision of the SMPV Rules as amended from time to time.

h) Safety relief valves shall not have isolation valve between the vapor space and the relief valve.

3.2.2 The safety relief valves shall be installed at the top surface in vapour space as per the design code of the vessel.

3.2.3 Each safety relief valve shall be plainly and permanently marked with:

a) Manufacturer’s name and Serial no.

b) Set Pressure

c) Rate of discharge in cubic meter per minute of the gas at 15 deg. C. and at atmospheric pressure.

d) Date of testing and next due date of testing

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3.3.0 Liquid / Vapour Connections:

3.3.1 1 no. 50 mm size liquid inlet / outlet and 1 no. 40 mm size vapour connection shall be provided at the bottom of the vessel. The vapour line shall extend internally with a clearance of 50 mm from the top of the vessel surface. The pipes shall conform to the ASTM A-106B, schedule 80 standards. Liquid/Vapour piping shall be single piece and the end flanges shall be of ASA/ANSI-300 rating.

Strong arrangement shall be provided to fix the piping rigidly to the bullet/chassis to minimise the effect of vibrations.

Strong and sturdy box type guard shall be provided for protection of valve manifold with minimum 5 mm thick plate with proper operational convenience.

3.4.0 Internal Valve with Excess Flow Check Valve:

Internal valves with EFCV of appropriate ratings having dual function comprising of primary shut off valve and excess flow valve of appropriate rating shall be installed on LPG liquid and vapour line. Internal valve shall have a spring – loaded fusible link in its actuation lever to shut off in case of fire beneath. The internal valve shall have a shear section and be designed such that in the event of accident, the lower section of the valve is sheared off, the valve seat (soft seat–which ensures zero leakage) remains inside the tank and is closed by self-stored energy (spring). Typical figure of Internal excess flow check valve is given in annexure II.

Operational fitness examination of the excess flow valve for compressed gas road tankers shall be done once in a year and the closing flow rate testing shall be done during the periodic hydraulic test. The excess flow valves/internal valves shall be repaired/replaced by a new one if found defective on examination or during operation.

3.5.0 Liquid Level Gauging Device:

3.5.1 The vessel shall be equipped with a liquid level gauging device for ready determination of liquid level in the vessel at any time. Liquid level indicators shall be suitable for operation at the design pressure of the vessel. The design shall be such that the unit encompasses a tough, durable steel shock absorber to prevent transfer of any vibrations sustained in transit.

3.5.2 This liquid level gauging device shall be located on the shell near the midpoint /top upper half of the vessel in a recessed cup formation in such a manner as to prevent protrusion of gauge beyond external surface of the vessel.

3.5.3 To avoid damage to this liquid level gauging device, a suitable hinged cover of minimum 5mm thickness shall be provided.

3.6.0 Liquid Level Gauging Device: Maximum Level Indicator:

In addition to the liquid level gauging device, suitable fixed maximum level indicator shall be provided in a recessed cup in such a manner as to prevent protrusion of gauge beyond external surface of the vessel.

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3.7.0 Pressure Gauge:

3.7.1 1 no. dial type (100 MM) glycerin filled pressure gauge with EFCV shall be provided in a recessed cup formation on the rear dish end in the vapour space. In addition, the pressure gauge if not provided in recessed cup shall be adequately protected with a shroud of U-type 10 mm shield metal plate.

3.7.2 The range of the pressure gauge shall be from zero to 25 kg/sq. cm (min.) gauge.

3.8.0 Temperature Gauge:

Suitable temperature gauge to be provided in the liquid space to measure the temperature of the contents.

3.9.0 Drain:

Suitable drain of maximum 40 mm NPT / NGT plug to be provided on the bottom side of vessel with proper shield.

3.10.0 Manholes:

1 no. manhole of size as per IS 2825 or code followed for design and fabrication of vessel shall be provided on the rear dish end.

3.11.0 Protection of Fittings:

a) All valves, fittings, safety relief devices and other accessories to the vessel shall be protected against such damage as could be caused by collision with other vehicles or objects and due to overturning.

b) The protective devices or housing must be designed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with the lading, using a safety factor of not less than 4 based on the ultimate strength of the material to be used without damage to the fittings protected, and must be made of steel at least 5 mm thick.

4.0.0 VESSEL FILLING CONSIDERATIONS:

4.1.0 Filling Capacity:

The maximum quantity of LPG filled into any tank shall be such that the vessel shall not become liquid full due to the expansion of LPG and shall leave a vapour space equivalent to 5% or as stipulated by statutory authority of its volume with the rise of temperature of its contents to a maximum of 55 deg. C.

4.2.0 To arrive at the filling capacity, the maximum filling densities at 15 deg. C. for LPG (as per IS:4576) of various related densities shall be calculated and effected by loading bases as per IS:6044 (Part II), 2001 (Latest Edition). The RLW of the vehicle shall not exceed the authorised Registered Weight of the vehicle as stipulated by the concerned transport authority or by the chassis manufacturer, whichever is less. The Pay Load filled should not exceed the licensed capacity as permitted by the statutory authority.

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4.3.0 No vessel shall be filled with LPG in excess to its design pressure.

5.0.0 VEHICLES - GENERAL SAFETY CONSIDERATIONS:

5.1.0 General Safety Considerations:

5.1.1 There shall be a clear space of at least 15 cm between the back of the cab and the front of the vessel.

5.1.2 Each tank truck shall be provided with at least one rear robust bumper, designed to protect the vessel and piping in the event of a rear-end collision and minimise the possibility of any part of the colliding vehicle striking the vessel. The design shall be such as to transmit the force of a rear end collision in a horizontal line to the chassis of the vehicle. The bumper shall be designed to withstand the impact of the fully loaded vehicle with a deceleration of 2 “g” using a safety factor of 4 based on the ultimate strength of the bumper material. The bumper shall be situated at least 7.5 cm to the rear of the rear-most part of the vessel.

5.1.3 Extension to chassis, if any shall not be more than 300 mm and the extension piece shall not be welded to the chassis.

5.1.4 The maximum width and height of vessel and its service equipment shall be such that these do not project beyond the overall width and height of the rest of the vehicle. The maximum height of the vehicle shall be in accordance with the Motor Vehicles Act, 1989 as amended from time to time.

Wherever cabin height is less than the height of the vessel and fittings on top of it, a height barrier should be provided all along the width of the cabin in the form of a cage with either 50 mm diameter pipe or 50 * 50 * 3mm angle frame on the top of cabin and within the height regulation of Road Transport Authority.

5.1.5 The maximum weight of the liquefied gas for which the vehicle is designed should not exceed the difference in weight between the unladen weight of the vehicle and the maximum gross weight permitted for that class of vehicle under the applicable transport regulations.

5.1.6 Marking of vehicle: All LPG tank trucks shall be conspicuously marked on the vessel to show the product which is being carried and a suitable HAZCHEM sign to be displayed.

5.1.7 Fire Protection: A person, while in, or attending any vehicle conveying flammable gas, shall not smoke or use matches or lighters.

5.1.8 No fire, artificial light or article capable of causing fire or explosion shall be taken or carried on any vehicle carrying flammable gas.

5.1.9 All the vehicles shall be provided with Rear and Under run protecting device as per IS: 14812 (2005) - latest, IS: 14682 (2004) - latest and as per the CMV Rules, 1989 - latest. One typical drawing is shown in Annexure IV.

5.1.10 Should any damage be caused to the pressure vessels / fittings or other parts of the tank trucks for any reason whatsoever and of any nature whatsoever, the Transporter/s after carrying out necessary repairs shall obtain a fresh fitness certificate from PESO or from any other competent authority nominated by PESO.

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5.2.0 Stability Considerations:

Provided the distance from the center of the vessel to the road surface is less than the distance between the centers of the outer wheels of the rear axle then the tank truck will be reasonably stable. This is also essential in order to ensure maximum stability especially where the tank truck is to operate in areas where there are numerous hurdles and the roads are bad. In accordance with IS: 9618, 1980 (latest) the ratio of H/W shall be kept less than 1 (where ‘H’ is the height of the center of gravity of the vessel from the road level and ‘W’ is the distance between the center of the outer tyres of the rear axle).

Latest braking system of the vehicle (tanker) to be ensured as per The Central Motor Vehicle Rules, 2016 (latest).

5.3.0 Safety Equipment:

5.3.1 The vehicles shall carry the following:

a) A First Aid box.
b) 2 nos. 9/10 Kg DCP (ISI marked) Periodicity of testing to be followed as per OISD Std. 142.
c) Low temperature hand gloves - 01 set.
d) Safety Goggles 02 no.
e) Red flags – 02 nos.
f) Fume mask - 2 nos.
g) Wooden plugs of different sizes
h) Teflon/Wooden mallets – 02 nos.
i) Teflon tape – 03 nos
j) Non sparking tools – spanner and hammer – 01 set
k) Metallic gaskets - 04 nos.
l) M-seal
m) Insulation tape – 02 nos.

n) Flange guard SS (2” & 1.5” pipes) with rubber collar

o) SRV tightening fixture

p) Folding reflective emergency red triangles (for stopping traffic) – Refer 5.6.0(c)

q) Temperature gauge - 01 no.

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r) Pressure gauge - 01 no.
s) Barricading tapes
t) FLP torch - 01 no.

The above equipment should be in good working condition.

5.3.2 An emergency information board shall be displayed on the vehicle mentioning the important contact numbers. Vehicle shall carry TREM card (Transport Emergency Card) in which all important emergency numbers of industry plants attached to the loading location are available.

5.4.0 Mountings:

5.4.1 Vessel shall be securely attached to the chassis.

Mounting of the vessels on the chassis or under frame shall be done in such a manner as to keep the vibrations to the minimum.

U-Bolts used for mounting of the pressure vessel on the chassis shall conform to ASTM 193 B7 and the nuts to A194 Gr.2H. The number and size of bolts should be as per the design requirements for the particular chassis and load thereon.

5.4.2 It is recommended to adopt the design of the mountings / drawings as recommended by the manufacturers of the chassis.

5.4.3 All attachments to the vessel shall be protected against accidental damage which may result from collision, overturning or other operational cause.

5.5.0 Design Safety Requirements - Mechanical:

5.5.1 The engine of the vehicle shall be of Internal Combustion (IC) type.

5.5.2 Where the fuel system is gravity-fed, a quick action cut-off valve shall be fitted to the fuel feed pipe in an easily accessible and clearly marked position.

5.5.3 The engine and exhaust system together with all electrical generators, motors, batteries, switch-gears and fuses shall be efficiently screened from the vessel or the body of the vehicle by a fire-resistant shield or by an enclosure within an approved fire resistant compartment.

Spark arrester shall be welded to the exhaust pipe of the tank / truck. Spark arrester shall be of a type approved by PESO. The approval identification should be available on the spark arrester.

The exhaust shall be located in front of the load and shall have ample clearance from fuel system and combustible materials.

Any alternate spark elimination system duly approved by PESO shall also be acceptable e.g. in case exhaust of diesel engine is based on design having electronic fuel management with

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unit injectors and electronic control unit coupled with turbo charger and intercooler arrangement, no spark arrester to be provided. No leakage in exhaust silencer pipe exists.

This clause will not be applicable for the vehicle models, which have been granted exemption by PESO.

5.5.4 When the equipment referred to in Clauses 5.5.1, 5.5.2 & 5.5.3 are mounted forward of the back of the driving cab, the cab can be considered to act as an acceptable shield, provided the back, the roof and the floor of the cab, are of fire-resisting type construction for the full width of the cab, without any openings in the back or roof, and that the back extends downwards to the top of the chassis. For rear view, in case of trailers, toughened reinforced glass may be provided.

Reflector strip shall be fitted around the vehicle and tank to enhance visibility.

5.5.5 When the equipment referred to in clauses 5.5.1, 5.5.2 & 5.5.3 are mounted to the rear of the cab, it shall be contained wholly within an approved fire-resisting compartment.

5.5.6 In such cases where the fuel used to propel a vehicle gives off a flammable vapour at a temperature less than 65 deg. C, the fuel tank shall not be mounted behind the shield unless the following requirements are complied with namely,

a) The fuel tank is protected from external blows by stout steel guards or by the under frames of the vehicle.

b) The fill pipe of the fuel tank of the vehicle is provided with:

i) An arrangement facilitating breathing of the fuel tank and preventing spillage of fuel in the event of overturning of vehicle and

ii) Suitable locking arrangement.

c) The fuel-feed apparatus placed in front of the fire-resisting shield is used to lift the contents of the fuel tank.

5.5.7 The cabin shall be painted with color scheme as stipulated by the Transport Authority.

5.5.8 The overall height of the vessel shall not exceed the height of the driver cabin including the height barrier if any.

For fixed chassis, a guard railing of 2” dia. pipe should be provided along the entire length of the vessel. The height and width, however, shall not exceed as that stipulated by the Transport Authority.

5.6.0 Design Safety Requirements - Electrical:

The following requirements shall be complied with in connection with the electrical and anti-static properties of the vehicle, namely:

a) The electrical system:

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i) The battery shall be mounted inside the cabin within a metallic cover with openings in an easily accessible position.

ii) A readily accessible two pole cut-off switch of not less than 300 Amps rating.

iii) Electrical wiring shall be heavily insulated and be adequate for maximum current loads to be carried. Electrical wirings shall be provided with suitable over current protection in the form of fuses or automatic circuit-breakers and installed so as to be protected from physical and chemical damage on contact with possible product spill either at location or on road being encased in the metal conduit.

The electrical system shall use two wire systems (other than starter / alternator) instead of earthing negative terminal to the body of the vehicle.

iv) Have all junction boxes sealed.

v) Normal/emergency lighting other than that permitted by the Transport Authority shall not be allowed.

vi) The vessel shall be electrically continuous with the chassis.

b) Earthing boss on the saddle of the vessel shall be provided on both sides. Typical figure is shown in Annexure V.

c) The vehicle should carry minimum six reflector cones having base of 12” dia and height of 2.5 feet. These cones should be used for marking out the area where truck is parked or in the event of an accident segregating it from other portion of the road.

d) Tyres shall be of the "anti-static" type.

6.0.0 PRE-FABRICATION AND INSPECTION REQUIREMENTS DURING FABRICATION:

6.1.1 The inspection shall be in two stages:

a) The first stage inspection shall constitute of complete inspection from design stage to complete fabrication and test as per appropriate code including material identification and the final hydro-test as per Annexure I. However, any additional information required by statutory authorities may be incorporated in the Annexure for issuance of the license.

b) The second stage inspection would be carried out by a competent person recognised by statutory authorities. The competent person shall check the vehicle for overall conformity to the standard and issue the certificate of safety as per the SMPV Rules 2016(latest).

6.1.2 Vessel should be fabricated by the party approved by Statutory Authorities according to design as per the SMPV Rules 2016(latest) and IS: 2825(latest) or equivalent as approved by Statutory Authorities. Fabrication shall progress under stage wise inspection by an
independent Inspecting Agency (approved by statutory authorities). Stage Inspection should include the following:

a) Appraisal of the design and drawing.
b) Appraisal of fabrication procedure.
c) Qualification of welding procedure and performances.
d) Identification of Raw Materials to the specification and size e.g. plates/forging/ coupling studs etc.
e) Counter testing of the materials and matching with original TCs. In other words, Inspection agency shall be involved during manufacturing of the components at component manufacturer’s premises.
f) Inspection of weld set ups in accordance with the fabrication codes.
g) Witnessing of NDT tests i.e. Radiography, Liquid Penetration test, Ultra Sonic Flaw detection.
h) Inspection of formed heads.
i) Witnessing of destructive testing.
j) Witnessing of stress relieving.
k) Final visual inspection and dimensional checks.
l) After satisfying the above, hydro test to be carried out at the required test pressure for min. 30 minutes.
m) Stamping the vessel on a permanently welded plate as mark of certification.
n) Documentation and Certification.

6.2.0 Mounting and Inspection:

6.2.1 Mounting drawing of the vehicle shall be approved by statutory authority. The drawing should clearly specify the make and model of the vehicle along with fabrication drawing of the vessel. It should also specify the load distribution on the various axles, center of gravity and stability ratio in both laden and unladen conditions. The drawing shall have a general assembly drawing indicating all the major dimensions and the positions of the various fittings and all accessories.

6.2.2 The vessel should be securely mounted as per the approved drawing specified in 6.2.1. After mounting all the fittings on the vessel, the vessel shall be leak-tested at 12 kg/cm² pressure with water and subsequently at 6 kg/cm² pneumatically by a recognized competent person. During leakage test with water the chassis shall be adequately supported to avoid possible damage to the under carriage. Pneumatic testing shall be accompanied by soap bubble test.

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6.2.3 After satisfying the test as stated above and ensuring conformity of the vessel and the vehicle in terms of mounting drawing, the competent person shall issue certificate of safety in the specified format as per the SMPV Rules, 2016 (latest).

6.3.0 Purging:

After completion of hydro and pneumatic tests, the bullet shall be purged safely.

Evacuation, degassing or purging of transport vessels used for flammable gases shall be carried out at a gas tanker degassing station or licensed premises equipped with degassing, evacuation and purging facilities duly approved by statutory authorities.

6.4.0 The CMV Rules 2016 (latest): Vehicle used for transportation of liquefied gas shall have Brake system, emission norms, spark arrester and labels as per the CMV Rules 2016, (latest).

7.0.0 PERIODIC TESTING & INSPECTION:

The inspection and testing of service vessels and its accessories shall be as per the following schedule:

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>DETAILS OF CHECKS/ TESTING</th>
<th>PERIODICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vessel</td>
<td>a) Non-destructive test (NDT)</td>
<td>Once in 5 yrs.</td>
</tr>
<tr>
<td></td>
<td>b) Condition of external painting.</td>
<td>Once in 2 yrs.</td>
</tr>
<tr>
<td></td>
<td>c) Hydro test at original test pressure, internal and external detailed inspection.</td>
<td>Once in 5 yrs.</td>
</tr>
<tr>
<td>2. Safety Relief Valve Set pressure</td>
<td>As stipulated by Statutory authorities</td>
<td></td>
</tr>
<tr>
<td>3. Internal Valves</td>
<td>a) Condition of valve working of EFCV</td>
<td>Once in 1 yr.</td>
</tr>
<tr>
<td></td>
<td>b) Checking on</td>
<td>Once in 1 yr.</td>
</tr>
<tr>
<td>5. Pressure Gauges</td>
<td>Accuracy within original range</td>
<td>Once in 1 yr.</td>
</tr>
</tbody>
</table>

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ANNEXURE - I

SAFETY CERTIFICATE UNDER RULE 43 SMPV RULES, 2016 (latest)

CERTIFICATE NO. Date

I, -------- hereby certify that the compressed gas transport vehicle of AAAA having the particulars noted below has been examined by me at -------- and found to meet the requirements of Chapter IV of SMPV(U) Rules, 2016. I also certify that the vessel it’s all fittings after completion of its mounting, as per approved drawing, has been tested by in my presence hydraulically at (pressure) on date ----- followed by pneumatic test at ----- on dt. ------ and found free from any leakage.

1. NO. AND DATE OF APPROVAL BY PESO:
   a) Fabrication Drawing Approval No(s)
   b) CCE’s Approval reference
      xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   a) Mounting Drawing No
   b) CCE, s Approval reference

2. VEHICLE PARTICULARS:
   (i) Registration No.
   (ii) Make, Model no. & Year of Manufacturing
   (iii) Engine No
   (iv) Chassis No
   (v) Unladen weight actual (ULW)
   (vi) Maximum laden weight as certified by Chassis Manufacturer
   (vii) Running gear Details:
      a) Make
      b) Chassis No.
      c) RTA Approval No.
      d) Other Details

3(A). VESSEL PARTICULARS:
   (i) Identification No.

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(ii) Fabricator's Name

(iii) Particular of Inspection Certificate

(iv) Design Code

(v) Design Pressure (kg./cm2)

(vi) Maximum Allowable Working Pressure (kg./cm2)

(vii) Design Temperature

(viii) Water Capacity in liters

(ix) Name of the gas to be transported

(x) Initial hydraulic test on (date)

(xi) At (pressure)

(xii) By (Inspecting agency)

(xiii) Last Hydraulic test done on (date)

(xiv) At (Pressure)

(xv) By (Competent Person)

(xvi) Ultrasonic Thickness measurement (Not applicable for new vessels) Shells Dish Ends
   a) Minimum thickness observed
   b) Nominal plate thickness
   c) Minimum calculated thickness (without corrosion allowance)
   d) Corrosion Allowance

3(B) FITTINGS PARTICULAR;

I) SAFETY RELIEF VALVES No. 1 No. 2 No. 3

a) Identification No.

b) Manufacturing Date

c) Make

d) Size

e) Set pressure, Kg/cm2g:

f) By (Inspection Agency)

g) Discharge flow rate:

h) Are size & flow rate adequate; (if not reasons may be given)

i) Whether safety relief valve is located inside vessel

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j) Tested on (date):
k) Tested at (pressure):
l) Whether housed in weld caps, if not, detail of the protection provided

(II) LEVEL GAUGE:

(a) Magnetic level gauge:

(i) Make

(ii) Serial number and location

(iii) Manufacturing date

(b) Maximum level gauge:

(i) Make

(ii) Serial Number & location

(iii) Depth of gauge

(iv) Manufacturing date

(c) Roto gauge:

(i) Make

(ii) Serial Number & location

(iii) Manufacturing date

(III) PRESSURE GAUGE:

(i) Make:

(ii) Range:

(iii) Date of Calibration:

(iv) Whether excess flow valve provided:

If yes, Particulars thereof like Make, Identification number and Manufacturing date etc.:

(IV) EXCESS FLOW VALVE/INTERNAL VAPE

WITH EXCESS FLOW CHECK VALVES No.1 No.2 No. 3

(i) Make:

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(ii) Identification no.:

(iii) Location and Type:

(iv) Size:

(v) Manufacturing date:

(vi) Closing Flow Rate:

(vii) Differential Pressure at closing flow rate:

(viii) Date of Last Test:

(ix) Whether size, differential pressure at closing flow and Closing Flow rate is adequate for the gas (name of the product) & Service (If 'No' reasons may be given)

(V) DISCHARGE VALVE:

(i) Location and Type:

(ii) Make & size

(iii) Whether discharge pipe provided with closing device:

(VI) DRAIN POINT

(i) Size & Mode of closure:

(VII) TEMPERATURE GAUGE

(i) Make & Range:

4. VEHICLE DESIGN PARTICULARS:

(i) Fire resisting shield: (nature of construction):

(ii) Whether extended up to the top of chassis:

(iii) Gap between driver's cabin and vessel (Min. 15 cms.):

(iv) Fuel tank (Capacity, construction & protection against damage):

(If the capacity has been increased from the original fuel tank capacity, particular thereof):

(v) Whether transfer pump driven by engine of vehicle provided. If yes, whether provision for stopping engine from outside made.

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(vi) Battery and cut-off switch (Nature, capacity & location)

Whether the switch is readily accessible.

(vii) Particulars of wiring

Whether properly fixed and protected

(viii) Earthing points (construction & location):

Whether strong flexible cable for electrical bonding, at least 5m long and with suitable clamp/clip at each end, provided:

(ix) Electrical wiring particulars:

(a) How fixed with chassis & protected against damage:
   Whether all junction boxes are sealed: Yes/No

(b) Whether insulated and fixed with the chassis:

(c) Whether conducted or protected suitably from physical & chemical damage

(d) Whether all junction boxes sealed:

(e) Whether industrial type sockets are provided in case of trailer:

(x) Clearance between end of vessel and end of rear bumper (minimum 7.5 cms)

(xi) Guard railing around vessel Particulars of construction:

Whether Railing is considered adequately strong:

(xii) Fastening of vessel with Chassis Particulars of fastening:

(a) No. of U bolts provided:

(b) Material specification:

(c) Lock Nut provided or not:

(d) Padding particulars:

(e) Whether secured well to the Chassis:

(f) Whether chassis is extended:
   If yes, the length extended:
   Nature of welding:

Condition of chassis and its fittings – whether satisfactory in relation to safety of the vehicle:

(xiii) Bottom pipeline:

   a) Whether pipeline between excess flow valve and discharge valve is a single piece and not pieces welded together:

   b) Whether pipelines and valves adequately secured with chassis (give particulars) & sufficiently away from moving parts of the vehicle:

   c) Mode of protection from pilferage:

(xiv) Manhole: -

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a) Diameter:  
b) Nature of protection cover over manhole thickness and height:  

(xv) Particulars of fire extinguishers provided:  

(xvi) Whether height barrier provided on the top of driver’s Cabin?  

(xvii) Whether the exhaust of the engine has been provided with spark arrester if yes, Make, CCE’s approval No. and Serial No.:  

(xviii) Emergency Kit details along with CCE approval number  
(a). Identification No:  
(b). Make:  
(c). CCE’s Approval reference:  

5. Details of any other equipment mounted on the chassis of the vehicle, (pumps, compressors etc.)  

6. Details like make, serial number(s), size, discharge flow rate and date of replacement of Safety valve. (Safety valve shall be replaced once in ten years-or earlier, if found defective, for mobile Tanker vehicles carrying flammable, toxic and corrosive gases).  

7. Any other Remarks & observation: -  

Please submit thickness profile report of both dish ends and each shell plate of mobile pressure vessel duly endorsed by Competent Person (attached with this certificate).  

Signature: 
Name of Counter Signing Authority/Person 
Ref. No. 
Revalidation Date 
Place: 
Date: 

Signature: 
Name of Competent Person 
Ref. No. 
Revalidation Date 
Place of Test: 
Date: 

Note: This Certificate shall be generated through PESO’s Online System. This Certificate shall be considered valid only when signed by Competent Person and Counter Signing Authority both.
INTERNAL VALVE WITH EXCESS FLOW CHECK VALVE

- Manually operated stem positively connected to valve stem so operator knows if valves is closed.
- Manually operated - spring loaded to automatically return to closed position.
- All springs and controls designed within body of valve for protection of parts and to provide a clean, smooth, easy operative valve.
- Emergency opening of valve provided to allow the valve stem to engage the excess flow check disc so it can be partially lifted manually for emergency evacuation of container product.

The valve can be arranged for automatic closing through operation of feasible elements (fire exposure) and for remote manual closing.
INTERNAL TYPE SAFETY RELIEF VALVE

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ANNEXURE- IV

VALVE BOX AND CRASH GUARD TO PROTECT VALVES / MANIFOLD

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ANNEXURE - V

TYPICAL EARTHING POINTS

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### SCHEDULE OF NOZZLE

<table>
<thead>
<tr>
<th>Service</th>
<th>Quantity</th>
<th>Size</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manhole</td>
<td>1</td>
<td>18&quot;</td>
<td>With cover</td>
</tr>
<tr>
<td>Safety Relief Valve</td>
<td>2</td>
<td>2&quot;</td>
<td>With full relieving capacity</td>
</tr>
<tr>
<td>Liquid inlet/outlet</td>
<td>2</td>
<td>2&quot;</td>
<td>Internal EFCV with valve</td>
</tr>
<tr>
<td>Vapour connection</td>
<td>1</td>
<td>1 1/2&quot;</td>
<td>Internal EFCV with valve</td>
</tr>
<tr>
<td>Drain</td>
<td>1</td>
<td>1&quot;</td>
<td>With plug and shield</td>
</tr>
<tr>
<td>Rotogaugie</td>
<td>1</td>
<td>1&quot;</td>
<td></td>
</tr>
<tr>
<td>Pressure gauge</td>
<td>1</td>
<td>3/ 4&quot;</td>
<td>With EFCV and cover</td>
</tr>
<tr>
<td>Fixed level gauge</td>
<td>1</td>
<td>1/4&quot;</td>
<td></td>
</tr>
</tbody>
</table>
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NOTES

1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
2. ALL FLANGE BOLT HOLES TO STRADDLE C/C CENTRES LINE UNLESS OTHERWISE SPECIFIED.
3. DISH ENDS SHALL BE MADE BY COLD PRESSING.
4. CIRCUMFERENTIAL & LONGITUDINAL WELD SHALL BE CLEAR ALL COUPLING AND REINFORCEMENT PADS.
5. ALL BUTT WELDS ARE FULL PENETRATION WELD ACCESSIBLE FROM OTHER SIDE SHALL BE GOUGED BACK TO SOUND METAL & REWELDED.
6. ALL SHARP CORNERS WILL BE ROUNDED OFF.
7. ALL FITTINGS APPROVED BY CODE, NAPUR.
8. ELECTRODES - AWS E - 7018.
9. IS:226 IS WELDABLE QUALITY.
10. ALL PADS TO BE TESTED FOR TIGHTNESS PNEUMATICALLY TO 2 KG/SQ.CM.(G) WITH SOAP SOLUTION ON ATTACHMENT WELDS.
11. FLANGES TO HAVE SERRATED FINISH.
12. PLATE THICKNESS SHOULD BE +VE TOLERANCE.
13. WELD CAP SHOULD BE NORMALISED AFTER PRESSING.

<table>
<thead>
<tr>
<th>NOZZLE SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SR.NO.</strong></td>
</tr>
<tr>
<td>N1</td>
</tr>
<tr>
<td>N1</td>
</tr>
<tr>
<td>N1</td>
</tr>
<tr>
<td>N7</td>
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<td>N2</td>
</tr>
<tr>
<td>N8</td>
</tr>
<tr>
<td>N6</td>
</tr>
<tr>
<td>N9</td>
</tr>
</tbody>
</table>

**DESIGN DATA**

<table>
<thead>
<tr>
<th>DESIGN CODE</th>
<th>IS:2825-1989, C.L. 1 SMPV, RULES (UF) 1981</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGN TEMPERATURE</td>
<td>AS PER STATUTORY REQUIREMENT</td>
</tr>
<tr>
<td>DESIGN PRESSURE</td>
<td>14.5 KG/CM (G) + 3G. EFFECT = 15.77 KG/CM</td>
</tr>
<tr>
<td>RADIOPHONY</td>
<td>100%</td>
</tr>
<tr>
<td>WELD JOINT EFFICIENCY</td>
<td>1</td>
</tr>
<tr>
<td>P.W.H.T.</td>
<td>STRESS RELIEVED</td>
</tr>
<tr>
<td>CORROSION ALLOWANCE</td>
<td>0.5 MM</td>
</tr>
<tr>
<td>TEST PRESSURE</td>
<td>20.5 KG/CM (G)</td>
</tr>
<tr>
<td>SERVICE</td>
<td>L.P.G.</td>
</tr>
<tr>
<td>WATER CAPACITY</td>
<td>38280 LITRES (APPROX.)</td>
</tr>
<tr>
<td>PAINTING</td>
<td>TWO COAT OF WHITE ENAMEL PAINT</td>
</tr>
<tr>
<td>PAY LOAD</td>
<td>18000 K.G.S.</td>
</tr>
</tbody>
</table>

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LPG TANK TRUCKS: REQUIREMENTS OF SAFETY ON DESIGN/ FABRICATION AND FITTINGS

DETAIL OF MANHOLE - M1

DETAIL - 'W4'

DETAIL - 'D'

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DETAIL OF SUPPORT

HOLE FOR WIRING 20 DIA.
HOLE FOR BRAKE LINE 20 DIA.

DETAIL OF BASE PLATE

5 THK.

DETAIL OF NAME PLATE & BRACKET

12 THK.

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# OISD – STD – 159

**LPG TANK TRUCKS: REQUIREMENTS OF SAFETY ON DESIGN/ FABRICATION AND FITTINGS**

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>QTY.</th>
<th>SIZE (mm)</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>PAD FOR N2</td>
<td>1</td>
<td>150 x 100 x 8 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>39</td>
<td>PAD FOR NR</td>
<td>1</td>
<td>550 DIA. x 12 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>38</td>
<td>WELD CAP FOR NR</td>
<td>1</td>
<td>10&quot; N8 x 12 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>37</td>
<td>HALF CPLG. FOR N8</td>
<td>1</td>
<td>1&quot; NPT x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>36</td>
<td>EARTHING BOSS</td>
<td>1</td>
<td>55 DIA. x 35 LONG</td>
<td>IS-226/IS-2062</td>
</tr>
<tr>
<td>35</td>
<td>BAFFLE PLATE</td>
<td>3</td>
<td>1744 x 2334 x 3 THK.</td>
<td>M.S.</td>
</tr>
<tr>
<td>34</td>
<td>BAFFLE PLATE SUPPORT</td>
<td>36</td>
<td>150 x 100 x 8 THK.</td>
<td>IS-226</td>
</tr>
<tr>
<td>33</td>
<td>BAFFLE PAD PLATE</td>
<td>6</td>
<td>1500 x 100 x 8 THK.</td>
<td>SA-515/516,GR.-70</td>
</tr>
<tr>
<td>32</td>
<td>LADDER SUPPORT PAD</td>
<td>4</td>
<td>100 x 75 x 8 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>31</td>
<td>R.F. PAD N9,N4,N5</td>
<td>1</td>
<td>1100 x 400 x 12 THK.</td>
<td>SA-515/516,GR.-70</td>
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<tr>
<td>30</td>
<td>WELD CAP FOR N4,N5</td>
<td>2</td>
<td>8&quot; N8 x 12 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>29</td>
<td>WELD CAP FOR N9</td>
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<td>6&quot; N8 x 12 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>28</td>
<td>PIPE FOR N2</td>
<td>1</td>
<td>1-1/2&quot;N8 x SCH.80 x 312 LONG</td>
<td>A-106,GR.-8</td>
</tr>
<tr>
<td>27</td>
<td>SUPPORT PLATE N2</td>
<td>1</td>
<td>100 x 230 x 8 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>26</td>
<td>PIPE FOR N3</td>
<td>1</td>
<td>1-1/2&quot;N8 x SCH.80 x 312 LONG</td>
<td>A-106,GR.-8</td>
</tr>
<tr>
<td>25</td>
<td>PIPE END BOSS</td>
<td>1</td>
<td>22 DIA. x 25 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>24</td>
<td>FULL CPLG. N3</td>
<td>1</td>
<td>1/2&quot; BSP x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>23</td>
<td>FULL CPLG. N2</td>
<td>1</td>
<td>1-1/2&quot; NPT x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>22</td>
<td>HALF CPLG. N1,N4,N5,N10</td>
<td>4</td>
<td>2&quot; NPT x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>21</td>
<td>HALF CPLG. N6</td>
<td>1</td>
<td>3/4&quot; NPT x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>20</td>
<td>HALF CPLG. N9</td>
<td>1</td>
<td>1/4&quot; NPT x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>19</td>
<td>HALF CPLG. N7</td>
<td>1</td>
<td>1&quot; NPT x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>18</td>
<td>PLUG FOR N7</td>
<td>1</td>
<td>1&quot; NPT x 6000#</td>
<td>A-105</td>
</tr>
<tr>
<td>17</td>
<td>NUTS FOR MANHOLE</td>
<td>16</td>
<td>1&quot; DIA. UNC.</td>
<td>SA-194,GR.-2H</td>
</tr>
<tr>
<td>16</td>
<td>STUDS FOR MANHOLE</td>
<td>16</td>
<td>1&quot; DIA. x 4&quot; LG. UNC</td>
<td>SA-193,GR.-B7</td>
</tr>
<tr>
<td>15</td>
<td>HANDLE FOR MANHOLE</td>
<td>2</td>
<td>20 DIA. x 330 LG.</td>
<td>IS-226</td>
</tr>
<tr>
<td>14</td>
<td>GASKET FOR MANHOLE</td>
<td>1</td>
<td>520 O.D. x 450 I.D. x 3 THK.</td>
<td>CAP-40</td>
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<tr>
<td>13</td>
<td>MANHOLE COVER</td>
<td>1</td>
<td>610 DIA. x 38 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>12</td>
<td>PAD PLATE FOR MANHOLE</td>
<td>1</td>
<td>610 O.D. x 450 I.D. x 49 THK.</td>
<td>SA-515/516,GR.-70</td>
</tr>
<tr>
<td>11</td>
<td>NAME PLATE</td>
<td>1</td>
<td>210 x 110 x 3 THK.</td>
<td>S.S.-304</td>
</tr>
<tr>
<td>10</td>
<td>NAME PLATE BRACKET</td>
<td>1</td>
<td>290 x 130 x 5 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>9</td>
<td>LIFTING LUG</td>
<td>2</td>
<td>220 x 140 x 20 THK.</td>
<td>IS-226/IS-2062</td>
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<td>8</td>
<td>PAD FOR LIFTING LUG</td>
<td>2</td>
<td>300 x 150 x 12 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>7</td>
<td>RIB PLATE</td>
<td>24</td>
<td>8 THK. x TO SUIT</td>
<td>IS-226/IS-2062</td>
</tr>
<tr>
<td>6</td>
<td>BASE PLATE</td>
<td>2</td>
<td>12 THK. x TO SUIT</td>
<td>IS-226/IS-2062</td>
</tr>
<tr>
<td>5</td>
<td>BEARING PLATE</td>
<td>4</td>
<td>500 x 2580 x 12 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
<tr>
<td>4</td>
<td>BASE PLATE</td>
<td>8</td>
<td>380 x 220 x 12 THK.</td>
<td>IS-226/IS-2062</td>
</tr>
<tr>
<td>3</td>
<td>BEARING PLATE</td>
<td>4</td>
<td>2580 x 250 x 12 THK.</td>
<td>SA-515,GR.-70</td>
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<tr>
<td>2</td>
<td>DISH END</td>
<td>2</td>
<td>2320 I.D. x 8 THK.</td>
<td>SA-515,GR.-70</td>
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<tr>
<td>1</td>
<td>SHELL</td>
<td>1</td>
<td>2320 I.D. x 7500 x 12 THK.</td>
<td>SA-515,GR.-70</td>
</tr>
</tbody>
</table>

**BILL OF MATERIAL**

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