Chapter 2.

Overview of Process

The chapter outlines the process of production of Liquefied Petroleum Gas (LPG) and Propane from the Natural Gas in GAIL (India) Limited. The ways of marketing these products is also touched upon in this section. Material safety data sheet of LPG and Propane regarding their physical and chemical properties are highlighted. This chapter also highlights the LPG tank trucks: requirements of safety for design/fabrication and fittings.

2.1 Process of LPG and Propane Production

Liquefied Petroleum Gas is popularly known as LPG. It is used primarily as domestic fuel in cooking ranges and in commercial and industrial installations as a fuel for furnace. It can also be used as feed stock for petrochemical industry. However, since in India, consumption of LPG is more than what we produce indigenously, we are mostly using it as a fuel. LPG is a mixture of hydrocarbons consisting mainly of Propane (C$_3$H$_8$) and Butane (C$_4$H$_{10}$) in the ratio 50:50 (by weight) with a maximum vapour pressure of 16.87 Kg/cm$^2$g at 65 deg C. It should conform to IS: 4576 specification. LPG today
is the most sought after fuel for the domestic sector and demand has constantly out-stripped supply.

To meet the GAIL's (GAIL India Limited) objective of utilization of the various fractions of gas apart from transportation and marketing of natural gas led to the establishment of LPG plants at Vijaipur, Vaghodia, Usar and Lakwa.

GAIL has commissioned its first LPG plant on 11th Feb. 1991 at Vijaipur. The second plant was also commissioned at Vijaipur exactly one year after i.e. on 11th Feb. 1992. These LPG Recovery Plants are the largest Natural Gas fractionation plants in the country. These plants have a designed capacity to process 15 MMSCMD Natural Gas and to produce 1230 TPD of LPG. Lean Gas after LPG extraction is compressed and fed back into the HVJ pipeline.

**GAIL (India) LIMITED - OVERVIEW**

![Map of GAIL (India) Limited](image)

**Figure 6 – Overview of GAIL (India) Limited**

LPG Recovery Plant at GAIL (India) Limited Vijaipur, with its efficient operation and maintenance practices, have increased production over 1500
Overview of Process

TPD which is equivalent to about one lakh LPG cylinders (approx. weight = 14.2 Kg) per day in the domestic circle.

LPG is filled under pressure, stored and transported to the consumer. When the cylinder valve is opened reduction of pressure takes place and the liquid turns into gas. LPG is in gaseous form at ambient temperature and pressure, and it is almost twice as heavy as air. Hence, it always settles down to floor level in case of leakage. LPG is colorless and odorless. Therefore, a distinctive fuel odor is added before it is filled into cylinder to enable easy detection in case of leakage.

LPG is different from natural gas. Natural gas is predominantly a mixture of methane & ethane with small quantities of Propane & butane. Natural Gas cannot be easily liquefied and marketed to consumers in cylinders like LPG.

LPG is normally available from two sources:-

(i) Petroleum refineries.

(ii) Gas fields by fractionation of natural gas.

Various processes by which LPG can be separated from Natural Gas are:-

- Oil absorption process.
- Turbo expander process.
- External Refrigeration process.
Overview of Process

2.1 Alternate Processes:

2.1.1 Oil Absorption Process:-

In this process, the desired LPG components are recovered from the gas by absorption in oil such as Naphtha. Rich oil containing absorbed components flows through fractionating column whereby light ends, LPG and Natural gas are separated out. Remaining oil is recycled back to the absorber. The residue gas from the absorber and stripper flows into the consumer gas pipeline.

2.1.1.2 Cryogenic Process using Turbo expander:-

This process involves expansion of gas isentropically through turbo expander. The gas gets cooled and the liquid condensed due to cooling is separated and fractionated to recover LPG, Natural Gasoline and Lean Gas. The energy of expander recovered through the Turbo-Expander is either used to generate power or to drive a compressor for the lean gas.

2.1.1.3 Cryogenic Process using External Refrigeration Process:-

The gas is cooled using external refrigeration system. The condensed liquid is separated and fractionated to recover LPG, Natural Gasoline and Lean Gas. The refrigeration system operates in a closed cycle.

2.1.2 Choice of Process:

The Cryogenic process using turbo-expander has been selected on the following basis:

2.1.2.1 Oil absorption process is uneconomical for light gases as in this case. This process essentially involves very large quantity of absorbing oil like
naphtha from which the desirable LPG components have to be separated out. The total thermal duty in the process is also very high. The worldwide trend for recovering LPG from natural gas is towards the cryogenic route.

2.1.2.2 In the cryogenic process utilizing propane refrigeration the butane recovery is limited by the minimum achievable temperature of \(-35\) deg C to \(-37\) deg C. The only way to increase the recovery is to cascade it with another refrigerant like ethane which will make the process uneconomical. In this case where gas is available at high pressure around 54.2 Kg/cm\(^2\)g and part of lean gas is required around 44 Kg/cm\(^2\)g, free pressure drop is available for use, favouring use of turbo expander. Using a turbo expander it is possible to achieve very low temperatures. With a temperature of around \(-50\) deg C it is possible to recover nearly 90% butane.

2.1.3 PROCESS DESCRIPTION

The LPG Recovery Plant consists of the following sections:-

- Gas receiving, drying and regeneration
- Chill down
- Distillation

2.1.3.1 Gas receiving, drying and regeneration:-

Natural Gas is received from HVJ Pipeline at a pressure of around 54.2 Kg/cm\(^2\)g and temperature of around 30 Deg C. The gas flows to a Knock Out (K.O.) Drum where any liquid present in the gas is knocked off. After this the
gas is dried in molecular sieve dryers to remove water below the 1 ppm level. A two bed system is used - one bed for drying the gas and another one for regeneration.

2.1.3.2 Chill down Section:-

The dried gas is cooled to (-) 65 Deg C in two stages. In the first stage, it is cooled to (-) 35 Deg C in chiller by heat exchange with various cold streams in the chill down system and external Propane refrigeration. The condensed liquid is separated out in Separator - I and vapor is expanded through a single stage turbo-expander. The vapor liquid mixture from the turbo-expander is fed to a second stage separator (Sep-II). The Hydrocarbon liquids from the two separators, after heat exchange are fed to the fractionation section to recover LPG, Propane, Pentane and SBPS.

Vapors (Lean Natural Gas) from the second separator are taken through the chiller to recover refrigeration. Then it is compressed to about 31 Kg/cm2g by the expander compressor. The quantity of lean gas required for NFL (National Fertilizer Plant) and branch line of HVJ Pipeline is compressed in a GT driven Lean Gas Compressor to 45 Kg/cm2g and the rest of gas is compressed to 55.2 Kg/cm2g and sent to Vijaipur Compressor station of HVJ pipeline for further transmission.

2.1.3.3 Distillation Section:-

The distillation section consists of LEF, Propane and LPG Column.
2.1.3.3.1 LEF Column:

Liquid from the two separators flows to chiller to supply cold and is then routed to Light End fractionating Column (LEF). This column removes all Methane, Ethane, and most of Carbon Dioxide as overhead vapors. Bottom stream consists of a part of Propane, Butane and Heavier Hydrocarbons. Reflux is generated by condensing a part of overhead vapors. The refrigerant duty is supplied by vapors from the second stage separators and external Propane refrigeration.

2.1.3.3.2 Propane Column:

Liquid from LEF column bottom is fed to Propane Column where Propane is produced as top product.

2.1.3.3.3 LPG Column:

Liquid from Propane column bottom is fed to LPG Column for separation of LPG and Heavier Hydrocarbons. This column separates LPG as top product.

2.1.3.3.4 SBPS Column:

Liquid from LPG Column bottom is fed to SBP Column where Pentane is produced as top product and SBP Solvent 50/120 as bottom product. Residual heavy hydrocarbon from the column is spiked back into HVJ through NGL Booster & Injection Pumps.

Propane Refrigeration system is provided to supply refrigeration required in chiller and 2nd LEF Condenser in Propane recovery case.
2.1.3.4 Safety facilities:-

Gas detectors are placed in order to detect LEL at critical points of the plant and it’s indication comes to CCR. Whenever gas detectors indicate LEL beyond safe limits, the location is checked for any gas leakage. In case of any leak appropriate corrective action is taken.

Like any other gas processing units, LPG Recovery unit of ours also needs certain offsite facilities and utilities systems.

2.1.3.5 The offsite and Utility systems:-

a. Water system (Raw Water, Service Water and Drinking Water)
b. Fire water network for fixed fire protection system.
c. Cooling Water system
d. Compressed Air (Instrument Air and Plant Air) system
e. Inert gas System
f. Product Storage, Handling and Transfer system
g. Steam and Soft Water System
h. Flare and Blow down system
i. Product Loading and Dispatch system
j. Effluent Treatment Plant
k. Chemical Storage and Distribution

a. Raw Water Treatment Plant:-

Raw water is required to meet the cooling water makeup, service water, drinking water & fire water requirement. The raw water system consists of a raw water reservoir, raw water treatment plant, and filtered water reservoir and
Overview of Process

various pumps to provide water to the different requirements. Based on the characteristics of raw water the following lines of treatment are adopted namely pre-chlorination of raw water, treatment with alum to coagulate the suspended impurities, treatment with lime correct the pH, chemical mixing if required, clarification, filtration through a rapid gravity filter bed and stabilization of the filtered water by chlorine for drinking purposes. The water is then supplied through designated pumps as service water, cooling water make up, drinking water and make up for the fire water system.

b. Instrument air:-

It is used for pneumatic instruments and plant air is required for cleaning, blowing and operating pneumatic tools. This system consists of air compressors, twin bed dryers, instrument and plant air receiver.

c. Inert gas:-

It is required in the plant continuously in hot water system to provide inert atmosphere under pressure. Inert Gas also requires during initial startup and after total shutdown for purging the system. It is used intermittently for blanketing methanol tanks. Two inert gas plants each of 150 NM$^{3}$/Hr capacities are installed to cater the above needs. Inert gas is produced by combustion of natural gas and air in an Inert Gas Generator.

d. Product Storage and Handling:-

- 8 numbers LPG Horton Spheres of capacity 2500 M$^3$ each (corresponding to 7 days designed production) have been provided for storage of LPG.
Overview of Process

Diameter of Sphere is 17 m. LPG is stored under pressure and at ambient temperature.

- 3 numbers Propane Horton Spheres have been provided for the storage of Propane.
- 1 Fixed dome type roof cylindrical tank is provided for storage of SBP solvent. SBPS is stored under atmospheric pressure and ambient temperature
- Five numbers Pentane bullets each having capacity of about 100 MT have been provided. Security system has been provided to protect storage tanks from fire. In case of fire on storage tank, the thermal fuses located on various points on each sphere melt at 85°C, thereby depressurizing the instrument air control loop which in turn activates water spray system on storage tank.

e. Low Pressure Steam:-

It is used in Vapour Absorption Refrigeration (VAR) system for Air Conditioning and in Blow down Vaporiser in plant area. It is also used intermittently for furnace startup. The system consists of Boiler which is fuel gas fired. Steam is generated in a boiler of 5 tons/hr and supplied at a pressure and temperature of about 2.5 Kg/cm² and 140°C to various locations. Chemicals are dosed in the boiler feed water and the boiler to maintain the quality and to prevent corrosion. Soft water is used as boiler feed water. Service water is treated in a softener unit regenerable by brine solution.
Overview of Process

f. A common flare system:-

It is provided for both trains for safe disposal of flammable by various pressure relief units by reducing them to less objectionable compounds by combustion. The common facilities consists of knock out drum, molecular seal, water seal drum and flare stack.

g. Liquid effluent:-

It comprises of oily water, effluent from vessel drain, floor washings and storm water. Vessel drains and washings is of very small magnitude. Effluent treatment system consists of collecting water from OWS in a surge pool from where it is pumped to an API separator. Here the free oil will be skimmed off and stored in a storage tank. The effluent will be treated to MINAS standard for allowable concentration of pollutants for discharge. The system is designed to treat sanitary and process wastes, cooling water blow down and contaminated rain water. The treated water is used for horticulture purposes. LPG Recovery Plant is being operated, monitored and controlled efficiently from a central Control Room having computerized distributed control system. The process parameters are thus achieved/ optimized with the state-of-the-art Digital Control Systems. All process and machine parameters are available at a central control room which are continuously monitored thus ensuring product quality conforming to IS specifications and machine safety.

LPG and Propane storage tank farm is provided with sophisticated in-built safety and security systems. LPG and Propane product is evacuated in bulk both by Road tankers and Rail wagons. LPG and Propane Road evacuation
facilities are provided with 8 bays for simultaneous filling, while LPG Rail loading system has provision for simultaneous loading of 80 Tank wagons, with an in-motion weigh bridge arrangement for custody transfer.

**Figure 7 – Screen shot of loading gantries at GAIL (India) Ltd Vijaipur**

GAIL has launched two new value added products in the year 1993-94, viz. Special Boiling Point Solvent (SBP Solvent 50/120) and Pentane mixture. In the following year GAIL introduced Propane, a premier fuel which is projected to substitute LPG in the industrial sector. In order to further augment the availability of LPG in the country to meet the never ending demand of the same, and with the commissioning of the Propane Recovery Plant leading to availability of surplus propane, GAIL took up a new project viz. mixing of propane with imported butane to produce Blended LPG, for the first time in the country, which heralded a revolution by enhancing LPG availability by
Overview of Process

more than 1.2 Lakh MT per annum thereby saving substantial Foreign Exchange.

To keep pace with the HVJ up-gradation, Natural Gas processing of the LPG Plants is increased to around 17.5 MMSCMD (i.e. a capacity utilization of 120%). The LPG Recovery Plant at Vijaipur, with its strength of about 417 employees (including contract employees), has consistently displayed exemplary performance year after year, which have fetched National Safety Awards as well as Excellent Rating in achieving and surpassing the MOU targets for the fifth consecutive year, from the Government of India. In July'96 LPG Recovery Plant received international quality system standard ISO-9001:2000 certificate maintaining highest level of quality in the operation and maintenance of its LPG plants.

In India Loading and unloading operation of the Liquefied Petroleum Gas (LPG) and Propane tanker is done with manual intervention to know the liquid level content inside the tank of the tanker lorry. Loading and unloading operation of Liquefied Petroleum Gas (LPG) and Propane tanker is carried out with intermittent checking of liquid level inside the tank with the help of rotogauge. Rotogauge is a devise fitted in the tanker which is useful in measuring the liquid level inside the tanker in terms of percentage. In the present scenario the rotogauge helps to determine the liquid level inside the tank and liquid level inside the tank is ensured. (maximum allowable liquid level is 95% and Vapour space of 5% is left).
Figure 8 - Hydro carbon tanker with rotogauge

Figure 9 - Rotogauge
Figure 10 – Loading activity of LPG tanker

Figure 11 – Rail Loading Gantry
2.2 Properties of LPG and Propane

2.2.1 Properties of LPG / Material Safety Data sheet of LPG

<table>
<thead>
<tr>
<th>MATERIAL SAFETY DATA SHEET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I - PRODUCT IDENTIFICATION</strong></td>
</tr>
<tr>
<td>TRADE NAME: LIQUEFIED PETROLEUM GAS (LPG)</td>
</tr>
<tr>
<td>CHEMICAL CHARACTERIZATION: Mixture of Butane and Propane</td>
</tr>
<tr>
<td>FORMULA: Mixture of C\textsubscript{3}H\textsubscript{8} &amp; C\textsubscript{4}H\textsubscript{10}.</td>
</tr>
<tr>
<td>UN NO: 1075</td>
</tr>
<tr>
<td>USE (S): Product.</td>
</tr>
</tbody>
</table>

<p>| <strong>II - HAZARD INGREDIENTS</strong> |</p>
<table>
<thead>
<tr>
<th>MATERIAL OR COMPONENT</th>
<th>% AGE</th>
<th>HAZARD DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>50%</td>
<td>Flammable gas</td>
</tr>
<tr>
<td>Butane</td>
<td>50%</td>
<td>Flammable gas</td>
</tr>
<tr>
<td>Propylene</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

| **III - PHYSICAL DATA** |
| BOILING POINT (°C): > -40 | MELTING POINT (°C): N/A |
### SPECIFIC GRAVITY (H2O=1):
0.51 to 0.58 at 50 DegC

### VAPOUR PRESSURE (KPa):
1311.56 mmHg @ -20 DegF

### VAPOUR DENSITY (AIR=1):
1.5

### SOLUBILITY IN H2O:
Slight at 30 Deg C.

### VOLATILES:
N/A

### EVAPORATION RATE:
N/A

### APPERANCE AND ODOUR:
Colorless odorless gas.

### IV- FIRE AND EXPLOSION DATA

<table>
<thead>
<tr>
<th>Flash Point (°F)</th>
<th>-104 Deg C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Ignition Temp (°C)</td>
<td>466 Deg C</td>
</tr>
</tbody>
</table>

### FLAMMABLE LIMITS IN AIR:
Lower: 1.9  Upper: 9.5

### EXTINGUISHING MEDIA:
Dry chemical powder, Carbon dioxide and water spray.

### SPECIAL FIRE FIGHTING PROCEDURE:
Spray water to keep the container cool. It is preferred to stop the flow of gas.

### PROTECTIVE EQUIPMENT FOR FIRE FIGHTERS:
Use breathing apparatus and proximity suit.

### UNUSUAL FIRE AND EXPLOSION HAZARD:
Air vapour mixture highly explosive.

### V- HEALTH HAZARD INFORMATION

### PERMISSIBLE EXPOSURE LEVEL:
Not established permissible exposure limit.
TLV (ACGIH+) TWA: 100 ppm, 1800 mg/M3.
Odour threshold: 5000 ppm to 20000 ppm.
NIOSH PEL TWA: 350 mg/M3.
CL = 1800 mg/M3 (15 minutes)

### ROUTES OF EXPOSURE

<table>
<thead>
<tr>
<th>Inhalation</th>
<th>Asphyxiate/suffocation/difficulty in breathing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin Contact</td>
<td>Irritation</td>
</tr>
<tr>
<td>Skin Absorption</td>
<td>Not Known</td>
</tr>
<tr>
<td>Eye Contact</td>
<td>Redness</td>
</tr>
<tr>
<td>Ingestion</td>
<td>Not known</td>
</tr>
</tbody>
</table>

### EFFECTS OF OVEREXPOSURE

### ACUTE OVER EXPOSURE
Practically no toxicity except that it may asphyxiate, highly dangerous fire and severe explosion hazard when exposed to heat flame (or) oxidizer.

### CHRONIC OVEREXPOSURE
Not known
### EMERGENCY AND FIRST AID PROCEDURES

<table>
<thead>
<tr>
<th>Part</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EYES</strong></td>
<td>Immediately flush with water.</td>
</tr>
<tr>
<td><strong>SKIN</strong></td>
<td>Wash with water and soap for at least 15 minutes. Remove contaminated clothes. Keep warm using blankets.</td>
</tr>
<tr>
<td><strong>INHALATION</strong></td>
<td>Shift victim in a fresh air area. If breathing has been leased give artificial respiration first. Consult physician.</td>
</tr>
<tr>
<td><strong>INGESTION</strong></td>
<td>Do not indulge vomiting. Consult physician without delay.</td>
</tr>
<tr>
<td><strong>NOTES TO PHYSICIAN</strong></td>
<td>Continue to administer oxygen under low pressure. There is no known anti dotes for acute exposure.</td>
</tr>
</tbody>
</table>

### VI- REACTIVITY DATA

- **CONDITIONS CONTRIBUTING TO INSTABILITY:** Stable
- **INCOMPATIBILITY:** With oxidizing materials.
- **HAZARD DECOMPOSITION PRODUCT:** Carbon dioxide, Carbon monoxide
- **CONDITION CONTRIBUTING TO HAZARDOUS POLYMERIZATION:** No

### VII- SPILL OR LEAK PROCEDURES

- **STEPS TO BE TAKEN IF MATERIAL RELEASED OR SPILLED:**
  - Do not enter in the gas area without protective wears.
  - Get the area evacuated.
  - Stop flow of gas if without risk.
  - Spray water to keep the container cool.

- **NEUTRALIZING CHEMICAL:** none.

- **WASTE DISPOSAL METHOD:**
  - Collect the spillage & wash the effected area with plenty of water.
  - Allow gas to burn under control.

### VIII- SPECIAL PROTECTION INFORMATION

- **VENTILATION REQUIREMENTS:** adequate ventilation required.

- **SPECIFIC PROTECTIVE EQUIPMENT**
  - **RESPIRATORY (SPECIFY IN DETAILS):** Respiratory protective equipment required.
  - **EYE & FACE:** Safety goggles.
  - **HAND & ARM:** Hand gloves (PVC synthetic only).
  - **OTHER CLOTHING AND EQUIPMENT:** gum boots, PVC apron.

### IX- SPECIAL PRECAUTIONS

- **PRECAUTIONARY STATE MENTS:**
  - Avoid contact with oxidizers olefin impurities may lead to narcotic effect or it may act as a simple asphyxiate a very dangerous hazard when exposes to heat or flammable. If fire is big, keep surrounding area cool by spraying.

- **OTHER HANDLING AND STORAGE REQUIREMENTS:**
  - Store the container in a cool, dry and well ventilated specified place, away from heat, spark and flame.
## 2.2.2 Properties of Propane / Material Safety Data Sheet of Propane

### MATERIAL SAFETY DATA SHEET

#### I - PRODUCT IDENTIFICATION

**TRADE NAME:** PROPAINE  
**CHEMICAL CHARACTERIZATION:** Dimethyl methane, Propyl hydride.  
**FORMULA:** $\text{C}_3\text{H}_8$  
**UN NO:** 1978  
**HAZCHEM CODE:** 2WE  
**USE:** Product.

#### II - HAZARD INGREDIENTS

<table>
<thead>
<tr>
<th>MATERIAL OR COMPONENT</th>
<th>% AGE</th>
<th>HAZARD DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>100</td>
<td>Flammable gas</td>
</tr>
</tbody>
</table>

#### III - PHYSICAL DATA

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOILING POINT (°C)</td>
<td>-42</td>
</tr>
<tr>
<td>MELTING POINT (°C)</td>
<td>-217</td>
</tr>
<tr>
<td>SPECIFIC GRAVITY (H2O=1)</td>
<td>0.59</td>
</tr>
<tr>
<td>VAPOUR PRESSURE</td>
<td>6840 mmHg @ 20 Deg C.</td>
</tr>
<tr>
<td>VAPOUR DENSITY (AIR= 1)</td>
<td>1.6</td>
</tr>
<tr>
<td>SOLUBILITY IN H2O</td>
<td>65-ml/100ml water at 35 Deg C.</td>
</tr>
<tr>
<td>VOLATILES</td>
<td></td>
</tr>
<tr>
<td>VAPORATION RATE</td>
<td></td>
</tr>
<tr>
<td>APPEARANCE AND ODOR</td>
<td>Colourless, odour less compressed liquid gas.</td>
</tr>
</tbody>
</table>

#### IV- FIRE AND EXPLOSION DATA

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLASH POINT (°C)</td>
<td>-104.4</td>
</tr>
<tr>
<td>AUTO IGNITION TEMP (°C)</td>
<td>450</td>
</tr>
<tr>
<td>FLAMMABLE LIMITS IN AIR</td>
<td>LOWER: 2.1  \</td>
</tr>
<tr>
<td>EXTINGUISHING MEDIA</td>
<td>Stop flow gas foam, Carbon dioxide, Dry chemical powder.</td>
</tr>
<tr>
<td>SPECIAL FIRE FIGHTING PROCEDURE</td>
<td>Stop the flow of gas and keep the containers cool by spraying water if exposed to heat or flame.</td>
</tr>
<tr>
<td>PROTECTIVE EQUIPMENT FOR FIRE FIGHTERS</td>
<td>Proximity suit with BA set</td>
</tr>
<tr>
<td>UNUSUAL FIRE AND EXPLOSION HAZARD</td>
<td>Flash back along vapour trail may occur.</td>
</tr>
</tbody>
</table>

#### V- HEALTH HAZARD INFORMATION

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERMISSIBLE EXPOSURE LEVEL</td>
<td>Not established permissible exposure limit</td>
</tr>
<tr>
<td>ROUTES OF EXPOSURE</td>
<td></td>
</tr>
<tr>
<td>INHALATION</td>
<td>Simple asphyxiant-shortness of breath, headache, drowsiness, unconsciousness.</td>
</tr>
<tr>
<td>SKIN CONTACT</td>
<td>Frostbite, redness, pain, blisters.</td>
</tr>
<tr>
<td>SKIN ABSORPTION</td>
<td>Not known</td>
</tr>
<tr>
<td>EYE CONTACT</td>
<td>Frostbite, redness, pain, and pain-impacted vision.</td>
</tr>
<tr>
<td>INGESTION</td>
<td>Not Known</td>
</tr>
<tr>
<td>EFFECTS OF OVEREXPOSURE</td>
<td></td>
</tr>
<tr>
<td>ACUTE OVER EXPOSURE</td>
<td>Not Known</td>
</tr>
</tbody>
</table>
### Overview of Process

#### Chronically Overexposure
- Not Known

#### Emergency and First Aid Procedures

<table>
<thead>
<tr>
<th>Eyes:</th>
<th>First rinse with plenty of water for several min. Remove contact lenses if easily possible, then take to a doctor.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin:</td>
<td>On frostbite, rinse with plenty of water, do not remove clothes. Refer for medical attention.</td>
</tr>
<tr>
<td>Inhalation:</td>
<td>Fresh air rest artificial respiration if indicated. Refer to medical attention.</td>
</tr>
<tr>
<td>Ingestion:</td>
<td>Do not indulge vomiting. Consult physician without delay.</td>
</tr>
<tr>
<td>Notes to Physician:</td>
<td>Continue to administer oxygen under low pressure. There is no known antidotes for acute exposure.</td>
</tr>
</tbody>
</table>

#### Reactivity Data

<table>
<thead>
<tr>
<th>Conditions Contributing to Instability:</th>
<th>Stable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incompatibility:</td>
<td>Oxidizers.</td>
</tr>
<tr>
<td>Hazard Decomposition Product:</td>
<td>None in particular.</td>
</tr>
<tr>
<td>Condition Contributing to Hazardous Polymerization:</td>
<td>Does not occur.</td>
</tr>
</tbody>
</table>

#### Spill or Leak Procedures

<table>
<thead>
<tr>
<th>Steps to be Taken if Material Released or Spilled:</th>
<th>Shut off leaks if without risk. Warn everybody that air mixture is explosive.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutralizing Chemical:</td>
<td>Not Known</td>
</tr>
<tr>
<td>Waste Disposal Method:</td>
<td>Allow the gas to burn under control.</td>
</tr>
</tbody>
</table>

#### Special Protection Information

<table>
<thead>
<tr>
<th>Ventilation Requirements:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Protective Equipment:</td>
<td></td>
</tr>
<tr>
<td>Respiratory (Specify in Details):</td>
<td>Provide self-contained breathing apparatus.</td>
</tr>
<tr>
<td>Eye &amp; Face:</td>
<td>Safety goggles.</td>
</tr>
<tr>
<td>Hand &amp; Arm:</td>
<td>Provide safety hand gloves</td>
</tr>
<tr>
<td>Other Clothing and Equipment:</td>
<td>Safety shoes.</td>
</tr>
</tbody>
</table>

#### Special Precautions

<table>
<thead>
<tr>
<th>Precautionary Statements:</th>
<th>A simple asphyxiant. Flammable gas may cause flash fire.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Handling and Storage Requirements:</td>
<td>Keep in a cool dry, well-ventilated area, away from heat, flame or oxidizers.</td>
</tr>
</tbody>
</table>
2.3 Construction requirement of LPG and Propane tank trucks

2.3.1 Introduction:

2.3.1.1 In view of the increase in the number of road accidents involving LPG tank trucks, constraints in the country and experience gained over the years a need was felt to standardise design of bulk LPG tank trucks. This standard has been prepared by a Functional Committee comprising of representatives of Oil Industry, Dept. of Explosives (Govt. of India) and Consultants, constituted for standardisation of the design of bullets along with material specifications, fittings, mounting etc for transportation of LPG in bulk by road. This standard has been formulated based on various engineering codes, standards and draft recommendations prepared by Industry Committee formed for this purpose during 1989.

2.3.1.2 Notwithstanding above, all LPG tank trucks should meet the requirements of the Motor Vehicle Acts and Regulations and Static & Mobile Pressure Vessels (Unfired) Rules, 1981 as amended from time to time.

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 having maximum vapour pressure not exceeding 16.87 Kg/Sq. cm. at 65 Deg. C. in bulk by road tank trucks. This standard will be applicable for all new LPG tank trucks.
2.3.2 Vessel design:

2.3.2.1 Design Pressure:

Vapour pressure of LPG conforming to IS:4576 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. In addition, 3g effect to take into account acceleration/deceleration shall be considered while designing of the vessel.

2.3.2.2 Design Temperature:

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

2.3.2.3 Vessel Design Code:

2.3.2.3.1 Vessel shall be designed, fabricated and tested in accordance with requirements of Class I pressure vessels conforming to IS:2825 - 1969 (Latest Edition) BS-5500, ASME SEC. VIII or equivalent codes accepted by Statutory Authority. The vessel shall be designed to withstand shocks normally encountered during transport including those set up by the movement of the contents of the vessel such as acceleration / deceleration of a minimum of 3g to be calculated considering that the vessel is full with LPG at 55 deg. C. Saddle supports and other attachments shall also be designed according to the fabrication code.

2.3.2.3.2 Joints: Joints shall be as required by the code with all undercutting 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.

2.3.3 Material Specifications:

Material used in the manufacture of pressure parts of the vessel shall be in accordance with that specified in IS: 2825 (latest edition), BS-5500, ASME SEC. VIII or equivalent code as adopted. A single code shall be adopted for materials, fabrication, inspection and testing.

2.3.4 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), if necessary and in addition, adequate thinning allowance in case of formed heads. For mobile vessels (for which CA may not be necessary) an allowance of at least 0.5 mm. shall be included in place of CA to safeguard against wear and tear. The nominal plate thickness shall also be not less than the minimum calculated thickness and the under-tolerance as allowed in material specification and in addition the thinning allowance as mentioned above. 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.
2.3.5  **Connecting Joints/Nozzles and Manhole:**

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

2.3.6  **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:

2.3.6.1 Over 230 cms 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 cms.

2.3.6.2 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 cms radius.

2.3.6.3 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 $\frac{1}{4}$ width of the pad and not greater than $\frac{1}{2}$ 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.

2.3.7 Painting:

Vessel external surface shall be sand blasted and painted with two coats of red-oxide primer and two coats of enamel paint of the colour stipulated by statutory authorities.

2.3.8 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 in addition to that as required by local regulations:

1. Vessel Manufacturer
2. Vessel Manufacturer’s Serial No.
3. Design code
4. Radiography
5. PWHT
6. Design Pressure
7. Design Temperature
8. Hydrostatic test pressure
9. First test date and subsequent test dates
10. Water capacity in liters
11. Licensed Product capacity in tonne and symbol or chemical name.
12. Name of the Inspection Agency with their stamp.
13. Certificate number of Inspecting Agency.
14. a) Shell thickness
    b) Dish End Thickness
15. This vessel shall not contain any product having vapour pressure in excess of 120 RVP at 55 deg. C.
16. Next hydrotest date of the vessel shall be painted on the body of the vessel.
2.3.9 **Valves and Accessories:**

LPG pipes, fittings and other equipments 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.

2.3.10 **Fittings:**

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

2.3.10.1 **Safety Relief Valve:**

There shall be minimum two safety relief valves with 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.

SRV shall be so installed that it does not project out of the top surface of the vessel. If necessary, recessed cup formation on vessel shall be made to house the SRV. (Refer OISD Std. 160). The safety relief valves shall be installed at the top surface around the central portion of the vessel.

**Safety relief valves shall have following marking punched:**

a) Manufacturer’s name and Serial no.
b) Set Pressure

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

d) Date of first test

e) Name of the Inspecting Agency with their stamp.

2.3.10.2 Liquid / Vapour Connections:

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.

2.3.10.3 Internal Valve with Excess Flow Check Valve:

Internal valves with EFCV of appropriate ratings shall be installed on LPG liquid and vapour line. ‘Built in’ internal valve shall be remotely operable from drivers cabin/rear end of vehicle manually or pneumatically with a lever through a cable system extending to driver’s cabin and fitted with a thermal fuse link. This valve shall have an in-built internal excess flow check valve. (Refer Annexure B).

2.3.10.4 Liquid Level Gauging Device - Roto Gauge:

a. The vessel shall be equipped with a liquid level gauging device for ready determination of liquid level in the vessel at any time. The liquid level gauging device shall be of the direct level gauge type with zero leakage of product to atmosphere. The design shall be such that the unit
encompasses a tough, durable steel shock absorber to prevent transfer of any vibrations sustained in transit.

b. 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.

c. To avoid damage to this liquid level gauging device, a suitable hinged cover shall be provided.

2.3.10.5 Liquid Level Gauging Device: Maximum Level Indicator:

Suitable fixed level indicator shall be provided.

2.3.10.6 Pressure Gauge:

2.3.10.6.1 One no. dial type (100 MM) glycerine filled pressure gauge with EFCV shall be provided on the rear dished end in the vapour space. This shall be protected by 10 mm thickness U-type shield metal plate.

2.3.10.6.2 The range of the pressure gauge shall be from zero to 21 kg/sq. cm (min.) gauge.

2.3.10.7 Temperature Gauge:

Provision is considered not necessary. However, subject to suitable amendment to SMPV Rules, 1981.

2.3.10.8 Drain:

Suitable drain of maximum 25 mm NPT plug to be provided on the bottom side of vessel with proper shield.
2.3.10.9 Manholes:

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

2.3.10 Protection of Fittings:

a) All valves, fittings, safety relief devices and other accessories to the vessel proper 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 metal at least 5 mm thick.

2.3.11 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. To arrive at the filling capacity, the maximum filling densities at 15 deg. C. for LPG of various related densities shall be calculated and effected by loading bases as per IS:6044 (Part II), 1972 (Latest Edition). The RLW of the vehicle shall not exceed the authorised Registered Weight of the vehicle by the
concerned transport authority or chassis manufacturer, whichever is less. The Pay Load filled should not exceed the licensed capacity as permitted by the Statutory authority.

2.3.12 Vehicles - general safety considerations:

2.3.12.1 General Safety Considerations:

a. 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.

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

c. The maximum width and height of vessel and its service equipments 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 Motor Vehicles Act, 1989 as amended from time to time. Each vessel shall be provided with a height barrier and designed as stipulated in OISD Std. 160.
2.3.12.2 Stability Considerations:

Provided the distance from the center of the vessel to the road surface is less than the distance between the center 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, 1969 (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).

2.3.12.3. Safety Equipments:

The vehicles shall carry the following:

a) A First Aid box.

b) 2 nos. 10 Kg DCP (ISI marked) and 1 no. 2 Kg CO2 fire extinguishers (ISI marked). Periodicity of testing to be followed as per OISD Std. 142.

c) Leather hand gloves and heat resistant hand gloves.

d) Safety Goggles

e) 2 nos. red flags

The above equipment should be in good working condition. In addition, each vehicle must carry non-metallic tools, wooden plugs of appropriate size and sealing compound for any emergency.
An emergency information board should be displayed on the vehicle mentioning the important telephone nos. of contractor, Oil company’s loading base, attached Bottling Plants and easier contact nos. in the event of accident in addition to other details enumerated as above (Ref. OISD Std. 161).

2.3.13 Mountings:

2.3.13.1 Vessel should be securely attached to the chassis.

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

2.3.14 Design Safety Requirements - Mechanical:

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

2.3.14.2 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.

2.3.14.3 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. All vehicles carrying LPG should be equipped with a spark arrester of approved design from approved manufacturer. As per Static and Mobile Pressure Vessel Rules 1981 and Petroleum Rules 1976, the exhaust of all such vehicles is required to be routed on the front side of the vehicle. The exhaust is to be fitted with an approved spark arrestor.
2.3.14.4 When the equipment referred to in the above Clauses are mounted forward of 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.

2.3.14.5 When the equipment referred to in above clauses are mounted to the rear of the cab, it shall be contained wholly within an approved fire-resisting compartment.

2.3.14.6 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 over turning 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.

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

2.3.14.8 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.

ANNEXURE-V

TYPICAL DRAWING OF LPG TANK TRUCK
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 GROOVED BACK TO SOUND METAL & REWELDED.
6. ALL SHARP CORNERS WILL BE ROUNDED OFF.
7. ALL FITTINGS APPROVED BY CODE, NAGPUR.
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>SR.NO.</th>
<th>SERVICE</th>
<th>QTY</th>
<th>SIZE</th>
<th>SCH./THK.</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>MANWAY</td>
<td>1</td>
<td>18&quot; NB</td>
<td>PAD TYPE</td>
<td>WITH COVER</td>
</tr>
<tr>
<td>N4,N5</td>
<td>SAFETY RELIEF VALVE</td>
<td>2</td>
<td>2&quot; NPT</td>
<td>HALF CPL.G.</td>
<td>WITH S.R.V.</td>
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<tr>
<td>N1</td>
<td>LIQUID INLET</td>
<td>1</td>
<td>2&quot; NPT</td>
<td>HALF CPL.G.</td>
<td>WITH E.F.V. + B.V.</td>
</tr>
<tr>
<td>N10</td>
<td>LIQUID OUTLET</td>
<td>1</td>
<td>2&quot; NPT</td>
<td>HALF CPL.G.</td>
<td>WITH E.F.V. + B.V.</td>
</tr>
<tr>
<td>N7</td>
<td>DRAIN</td>
<td>1</td>
<td>1&quot; NPT</td>
<td>HALF CPL.G.</td>
<td>WITH PLUG</td>
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<tr>
<td>N2</td>
<td>VAPOUR CONNECTION</td>
<td>1</td>
<td>1-1/2 NPT</td>
<td>FULL CPL.G.</td>
<td>WITH E.F.V. + B.V.</td>
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<tr>
<td>N8</td>
<td>ROTO GAUGE</td>
<td>1</td>
<td>1&quot; NPT</td>
<td>HALF CPL.G.</td>
<td>W/ M+ ROTOGAUGE</td>
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<tr>
<td>N6</td>
<td>PRESSURE GAUGE</td>
<td>1</td>
<td>3/4&quot; 1/4&quot; NPT</td>
<td>HALF CPL.G.</td>
<td>WITH E.F.V. + P.G.</td>
</tr>
<tr>
<td>N9</td>
<td>FIX LEVEL GAUGE</td>
<td>1</td>
<td>1/4&quot; NPT</td>
<td>HALF CPL.G.</td>
<td>WITH FIX LEVEL GAUGE</td>
</tr>
</tbody>
</table>

DESIGN DATA

<table>
<thead>
<tr>
<th></th>
<th></th>
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</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>RADIOGRAPHY</td>
<td>100%</td>
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<tr>
<td>WELD JOINT EFFICIENCY</td>
<td>STRESS RELIEVED</td>
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<tr>
<td>F.W.H.T.</td>
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<tr>
<td>CORROSION ALLOWANCE</td>
<td>0.5 MM</td>
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<tr>
<td>TEST PRESSURE</td>
<td>20.5 KG/CM (G)</td>
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<tr>
<td>SERVICE</td>
<td>L.P.G.</td>
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<tr>
<td>WATER CAPACITY</td>
<td>3820 LITRES (APPROX.)</td>
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<tr>
<td>PAINTING</td>
<td>TWO COATS OF WHITE ENAMAL PAINT</td>
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<tr>
<td>PAY LOAD</td>
<td>18000 K.G.S.</td>
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