INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**CODE OF PRACTICE FOR INSTALLATION & COMMISSIONING OF PROPANE / LPG PIPELINE**	**IPSS:1-06-048-13**
	NO CORRESPONDING INDIAN STANDARDS EXISTS	

0.0 **FOREWORD**

This inter plant Standard prepared by the Standards Committee on Pipes, Fittings, Valves and Piping Layout, IPSS 1:6 with the active participation of the representatives of all the steel plants and associated organization in the field and was adopted in March, 2013.

0.1 Inter Plant Standards for Steel Industry primarily aim at achieving rationalization and unification of parts and sub-assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment for existing or new installations by individual steel plants.

1.0 **SCOPE**

1.1 This IPSS standard stipulates engineering requirements for installation and commissioning of Propane/LPG pipelines made of carbon steel with operating pressure up to 6 kg/cm^2 & temperature from 30^{0}C - 70^{0}C.

2.0 **LAYOUT DESIGN**

2.1 Propane / LPG pipelines are distributed to various units from its storage tank to various units through network of pipelines. Following statutory aspects and precautions shall be taken into account while designing the layout.

2.1.1. Pipelines shall always follow overhead routed only. In no case, it shall follow underground route.

2.1.2. All overhead pipelines shall be routed maintaining a minimum clearance of 8.0m between bottom of supporting structures and top of road crossing / railway tracks. The line laid over tracks carrying hot materials shall have a minimum clearance of 15m and shall be provided with heat shields of suitable design.

2.1.3. The Main Header shall run minimum 15m away from any building, water reservoirs, pump houses, fuel storage tank, gas holder, etc. Extreme caution shall be exercised in routing pipelines near tunnels and sewers to avoid the possibility of any leakage.

2.1.4. Pipelines shall not be used for supporting any other pipeline or electrical cable trays / racks / individual cables. Electrical cable shall not be routed along with Propane/LPG pipe line. Pipelines shall be electrically grounded.

2.1.5. Pipelines shall be routed away from source of heat viz. burners, open flames, pilot lamps, welding torches, heating elements, boilers, incinerators, burning matters etc.

2.1.6. Pipelines shall be routed away from moving machines, source of vibration, e.g. where heavy equipment movement or handling of heavy materials is expected.

2.1.7. Pipelines shall not be routed in pipe-racks carrying other service pipes which require maintenance using high temperature accessories.

2.1.8. Pipelines shall not be routed along with high operating temperature pipeline along with fuel gas pipelines.

3.0 SELECTION OF PIPE SIZE

3.1 The diameter of a pipeline shall be selected judiciously so that the required pressure is available at consumer points with the maximum flow. It is recommended that the velocities be maintained between 2-4 m/sec in pipeline.

3.2 Maximum DN 50 pipe size shall be considered while designing the supply to individual plant. However, higher diameter may be considered for header, from where multiple pipelines are taken as branches.

4.0 SYSTEM STABILITY & FLEXIBILITY

4.1 All Propane/LPG pipelines shall be anchored at suitable intervals, the pipelines shall be designed to provide sufficient flexibility to prevent development of undesirable stresses at any part / equipment in complete system.

4.2 System design shall have proper supporting arrangement to take care of various movements in pipeline network and system should be stable in all adverse conditions (excessive undue stresses, vibrations, movements etc.). Location of sliding point (SP) and fixed point (FP) shall be clearly identified while designing.

4.3 Flexibility shall be provided through internal configuration of pipelines comprising of bends, loops or offset etc.

4.4 While designing the pipeline, maximum expansion/ contraction due to maximum differential temperature is to be considered.

5.0 EQUIPMENTS & FACILITIES

5.1 VALVES

5.1.1. Valves shall be provided in pipelines for isolation, controlling pressure and flow, venting, draining, releasing pressure etc. Sectionalizing valves on long straight pipe work without branch line are not recommended. Valves shall be suitable for service condition in all respects and located suitably with respect to operation and maintenance.

5.1.2. Various other valves considered in the system are as follows:

i) Stop Valves at following locations:

- At source station & consumer points.
- At branch pipe from main header
- At purging and draining points
- Before pressure gauges

ii) Isolating and by-pass valves for flow-meters, filters etc.

iii) Non return valves on all pipelines requiring unidirectional flow.

iv) Pressure regulating valve together with isolation and relief valves for all pressure reducing installations.

v) Manual drain valves at low points and manual vent valves at all high points of pipe work.

5.2 DRAINING FACILITIES

5.2.1. Pipelines shall have proper draining system to take out condensate from the pipelines. To ensure free condensate flow, pipelines shall have minimum gradient of 1 mm/m run towards the drainage points. Drain points shall be provided at the lowest location and special care shall be taken to restrict inflow of air into the system from outside. Sealing material / compound shall be used at vulnerable joints. Drain pipes shall be designed to drain out complete condensate within 30 minutes.

5.3 PURGING FACILITIES

5.3.1. Each section shall comprise of separate purging system. Inlet for purging shall be located at one end of the section and outlet shall be at the other end. Purging points shall be so selected that there is no dead end which cannot be purged. Purge system shall be protected against backflow of propane / LPG gas into the purging pipelines.

5.3.2. Purging points shall not be near the accumulated condensate. Only one purging bleeder is to be installed in one section and it is never to be combined with the bleeder of any other section. Sampling points at suitable places are to provided with isolating valve for collection of sample required for analyzing the composition of gas during purging/charging/de-commissioning the system.

5.3.3. All purging connection from nitrogen line to Propane/LPG line shall be with flexible hose, which shall be disconnected after completion of purging.

5.3.4. Since Propane/LPG pipeline will be subjected to hydraulic test, it shall be provided with vent at high points with valves having flow upwardly.

5.3.5. Each section shall have separate purging and venting system.

5.4 SAFETY DEVICES

Safety devices shall be installed in pipelines to provide protection from hazardous condition that may result due to exceeding of permitted maximum pressure. Following devices shall be considered in the system to take care of any mishap.

5.4.1. SAFETY RELIEF VALVE

A safety relief valve shall be provided to release the gas when the pressure in the pipeline exceeds by 1.1 times the maximum working pressure. The safety relief valve shall be of reliable design and rating as per system requirement.

5.4.2. FLASH BACK ARRESTORS

5.4.2.1. System shall be protected by flashback arrestors and non-return devices or a combination of both. The flash back arrestors shall be dry / wet type depending upon the application. The flash back arrestor shall be designed in such a way that it does not cause appreciable pressure drop at peak demand.

5.4.2.2. The following location shall be considered for installation of flashback arrestors and its design shall be compatible to pipe size:

i) At the outlet of the source of a Propane/LPG viz. generation plant / discharge manifold rack.

ii) At branch points from main header to shop sub-header.

iii) At the entry to each consuming unit.

5.4.2.3. When a single unit of flashback arrestor is not adequate to handle required flow rate, multiple units of flashback arrestors shall be installed for parallel operation. In such a case, the individual gas inlets, outlets and liquid drain connections must each be interconnected to respective common header.

5.5 SUPPORTS

5.5.1. Various supporting arrangement viz. anchors, saddles, rollers, clamps, U-bolts, studs, hangers, spring supports, sway bracings, vibration dampeners shall be considered.

5.5.2. Design, material and workmanship for structural steel work used for pipe supports shall conform to relevant Indian Standards.

5.5.3. Supports for overhead pipelines within shops maybe taken from shop structures, columns, trusses etc. Wherever suitable shop structures are not available, pipes shall be supported on trestles, towers and/or pipe bridges.

5.5.4. Anchors or fixed points (FP) shall be provided to secure the desired points of piping in fixed positions. They shall permit the line to expand and contract freely in opposite directions away from the anchored point. Selection of FP & SP shall be based on the structural stability of the system.

5.5.5. The maximum unsupported span for pipelines shall be as indicated as below:

Pipe Support Spacing

Pipe size , DN mm	Max. Unsupported Span,mm
i) 15 and below	1500
ii) 20,25 ,32	2000
iii) 40,50	3000

6.0 TECHNICAL SPECIFICATION

6.1 PIPES

Pipes for Propane/LPG service shall be hot finished seamless as per ASTM -A-106 Grade –B. Pipes of other standards which are equivalent or superior to the above may also be used. Pipe thickness of various pipes shall as per following schedules:

Pipe size , DN mm	Pipe Schedule
i) 40 and below	Schedule 80
ii) 50 - 150	Schedule 40
iii) 150 - 300	Schedule 20

6.2 VALVES

Flanged or socket welded valves like gate, globe, diaphragm may be used compatible to Propane/LPG service. However, the design and construction of valves shall be such that the risk of ignition due to friction is minimal. Valves shall be of similar pressure class as that of the pipeline on which the valve is installed.

6.3 FLANGES AND COUPLINGS

6.3.1 Plate flanges fabricated from carbon steel a plate to IS 2002:1992, grade-2A, in accordance with IS 6392:1998 may be used for pipelines.

6.3.2 Forged carbon steel, slip-on or weld neck flanges, shall be used for pipelines.

6.3.3 Screwed and socket couplings are not recommended for use in pipelines.

6.3.4 Blank flanges for pipelines shall be so designed as to withstand the testing pressure.

6.4 FITTINGS

6.4.1. Selection of Tee & reducers shall be as per ANSI / ASME B 16.9 or equivalent and shall be able to withstand the deflagration and denotation conditions respectively.

6.4.2. Tees shall be right angled type. Use of angular tees shall be avoided.

6.5 PIPE BENDS

6.5.1. Use of mitered bends is not allowed for any classes of pipelines.

6.5.2. Pipe bends shall be true to angle and shall have a smooth surface free from spots and corrugations. Inner Diameter(ID) of the bend should match ID of the corresponding pipe.

6.5.3. Smooth bends shall normally have a radius of 5 times the nominal diameter.

6.5.4. Standard bends and elbows shall have dimensions as per relevant IS or equivalent code for the service. Bends and elbows shall have socket/butt welding ends unless otherwise specified.

7.0 PRESSURE TESTING

7.1 GENERAL REQUIREMENTS

7.1.1. Prior to acceptance and initial operation, installed piping shall be pressure tested to ensure the system's strength and to ensure that it is leak proof.

7.1.2. In the event of any repairs or modification made after the pressure test, the affected section shall be re-tested.

7.1.3. A piping system may be tested as a complete unit or in sections. So, accordingly, complete system shall be made into multi sections.

7.1.4. Special components which require special testing may be tested separately and as per separate test procedure.

7.1.5. Wherever possible, pipe joints including welds shall be left uncoated and exposed for examination during test.

7.1.6. Equipment which is not to be included in the test shall either be disconnected from the piping or isolated by blank flanges.

7.1.7. Prior to testing, it has to be ensured that the interior of the piping system is clear of all foreign materials.

7.2 PNEUMATIC PRESSUE TESTING

Testing may be carried out with an inert gas or air. Any pneumatic testing shall include checking at 1.1 times the normal working or minimum 1.7 kgf /cm^2 gauge pressure. The pressure shall be increased gradually in steps with sufficient time to allow the piping to equalize strains during test and also to check for any leakage. Pressure in the section / system must remain constant during holding period. Holding time shall be about 30 minutes.

7.3 HYDRAULIC TESTING

Wherever pneumatic testing is not recommended, a hydraulic testing shall be done with water for each section separately. Testing pressure shall be 1.5 times the working pressure. Holding time shall be about 24hrs without any drop in pressure.

7.4 LEAKAGE TEST

7.4.1. Leakage testing shall be carried out with nitrogen or air at a pressure not less than the maximum working pressure. With some equipment e.g. non-return valves it may also be necessary to test for leakages at a lower pressure.

7.4.2. Test duration shall be sufficiently long for detecting any leaks but not less than half hour (30 minutes). While subjected to test pressure the piping system shall be visually examined for signs of leakage or other defects.

7.4.3. Any leakage or drop in pressure shall be clearly identified. Defects noticed are to be rectified and system is to be re-tested.

7.4.4. Test / re-test shall be performed till pressure remains constant and then only system shall be declared leak-proof and O.K.

7.5 TEST RECORDS

7.5.1. All manufacturers' test certificates for bought out items & equipment used in the system shall be kept as record. Tests performed at site, shall also be kept as record.

7.5.2. Record shall be kept of each section during the testing along with integrated testing.

7.6 MARKING

Propane/LPG pipelines must be clearly marked by with distinctly visible "Propane/LPG Gas" or by color code. The identification markings must be repeated at regular intervals and visible locations to ensure that the pipelines can be clearly identified among other pipelines in that location.

7.7 CHECK POINTS PRIOR TO COMMISSIONING

7.7.1. It is to be ensured that system has been designed as per system requirement. All fabrication & erection has been done compete in all respect.

7.7.2. The source of Propane/LPG is ready to be commissioned or already commissioned.

7.7.3. Site is to be cleared of all erection material

7.7.4. Safety instructions, notices and displays are securely put in visible and appropriate locations at regular intervals.

7.7.5. Fire fighting facilities are ready to face any eventuality.

7.7.6. All drawings manuals, test certificate issued by the manufactures and statutory authorities are available with the personnel deployed for commissioning.

7.7.7. All consumers of Propane/LPG shall be kept inoperative till such time that the commissioning of the pipeline is over and the system is certified as being ready to be put into service.

7.7.8. All sources of heat and fire must be kept away from the system. Possibility of spark from any source shall be completely eliminated.

7.7.9. Location and travel path of moving machinery automobiles shall be identified and restricted in such a way that they do not create hindrance for the commissioning operation and introduce hazardous situation.

7.7.10. Possibility and occurrence of vibration and physical shock to the Propane/LPG pipelines shall be eliminated.

7.7.11. System is electrically earthed / grounded.

7.7.12. After testing, repair, re-testing, the all pipelines & equipment shall be painted as per system specification with proper color code.

7.7.13. It shall be ensured that the safety devices and instruments installed as per specifications. Drain system is to be checked for any source of inflow of air into the system. It is to be checked for any sort of jamming. Devices against entry of air and oxygen (i.e. condensate drainage system etc.) shall be checked for proper operation and it has to be ensured that they are not blocked.

7.7.14. Wet type flashback arrestors shall also be checked, particularly for maintenance of correct water level filters and dry type flash back arrestors shall be examined for proper conditions and has to be ensured that they are not blocked.

7.7.15. The setting of pressure regulators / reducing stations shall be as per specified parameters/duty conditions.

7.7.16. All valves at service points, isolation, vent, drain points and equipment connections etc shall be checked for complete opening and tight shut-off.

7.7.17. Qualified test personnel should be available throughout the purging/commissioning. They should be equipped with necessary testing instruments.

7.7.18. All Propane/LPG pipelines must be made clear and free from rust & dirt. Pipes shall be cleaned internally by blowing compressed air or nitrogen gas through pipes. Velocity of blowing shall not be less than 20 m/sec with pressure of 4 to 7 kg / cm^2 at inlet. All vents, drains, service points including flashback arrestors shall be blown by means of blowing medium.

7.7.19. Wet type flashback arrestors shall be blown after draining the water. After blowing operation is over, the flashback arrestor must be refilled with water upto the correct water level. Dry type flashback arrestors may be cleaned in–situ by blowing compressed air through the same.

7.8 PURGING

7.8.1. Nitrogen gas shall be used as purging medium. It shall either freely available at site or stored quantity equal to 4 times the volume of pipes shall be available with sufficient pressure to conduct purging. Nitrogen shall be available with pressure of about 1kg/cm^2. Nitrogen used for purging shall have at least 97% purity.

7.8.2. If the pipeline is long, then purging is to be done in sections. Each section shall have separate purge points as inlet & outlet. All purging connections shall be connected with suitable hose and hose couplings.

7.8.3. All openings of service points shall remain shutoff by closing the isolation valves. All openings like service points shall remain shutoff during purging.

7.8.4. Purging shall be commenced from the Propane/LPG source. The isolation valve between the source and pipeline shall be closed. The isolation valve located at other end of the same section / pipeline being purged shall remain closed. Nitrogen intake to the section / pipeline shall be started by opening the nitrogen inlet valve provided at the source. During purging, the vent valve located at the other end of the section / pipeline shall remain open.

7.8.5. Purging operation shall be carried out till sample taken is found to be within permissible limit. Once the purging operation is complete, the nitrogen inlet valve at the source and the vent valve at the other end shall be closed.

7.8.6. The section of pipeline which follows the section already purged will be taken up for purging in case of a sectionalized purging operation. If the pipeline is a short one and need not be sectionalized, the consuming shops pipelines shall be taken up for purging.

7.9 CHARGING

7.9.1. Just after purging, the system is ready for charging with Propane/LPG gas. In case of long pipeline or with multi branches, the system shall be charged after converting complete system into various sections.

7.9.2. Charging shall be done from the source side one by one in sequence. It is always to be ensured that nitrogen filled section is always ahead of section already charged with Propane/LPG. Thus complete system shall be charged progressively upto consuming shops.

7.9.3. If main header is connected to multi consumer shops, then charging of pipelines from header to consumer shop shall be taken one by one.

7.9.4. Once the pipeline in the yard is charged with Propane/LPG and there is nitrogen pressurized barrier inside the consuming shop internal pipe work, the charging of Propane/LPG in the shop header may be taken up with one shop connected to the supply pipeline, at a time.