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INTER PLANT STANDARD - STEEL INDUSTRY



CODE OF PRACTICE FOR ACETYLENE GAS PIPELINES

IPSS:1-06-033-97

CORRESPONDING IS DOES NOT EXIST

FOREWORD 0.

- 0.1 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 organizations in the field was adopted in March 1997
- Acetylene gas is distributed to consumers from a source such as a generation plant or cylinder discharge manifold by means of pipelines. In view of the explosive behaviour of acetylene in piping systems, special precautions need to be taken in design, fabrication, erection, testing and commissioning of acetylene gas pipelines.
- This Code of Practice stipulates engineering requirements for safe 0.3 design, construction and commissioning of Acetylene gas pipelines. It is based on the concept of "Working Ranges", which also has been followed by Industrial Gases Committee (IGC), Paris. The Working Ranges have been introduced in this standard in the form of a table (instead of a graph as done by IGC as per Appendix I(page 2))

The concept of "Working Range" includes a combination of parameters such as "deflagration pressure limit", "detonation pressure limit", nature and place of ignition etc.

The "guidelines" given in this Code of Practice are based on published information and observations made by various authorities on the subject of Acetylene gas in pipelines. It is expected that adherence to the quidelines presented in this standard will significantly reduce the safety hazard related to in acetylene transmission through pipeline systems.

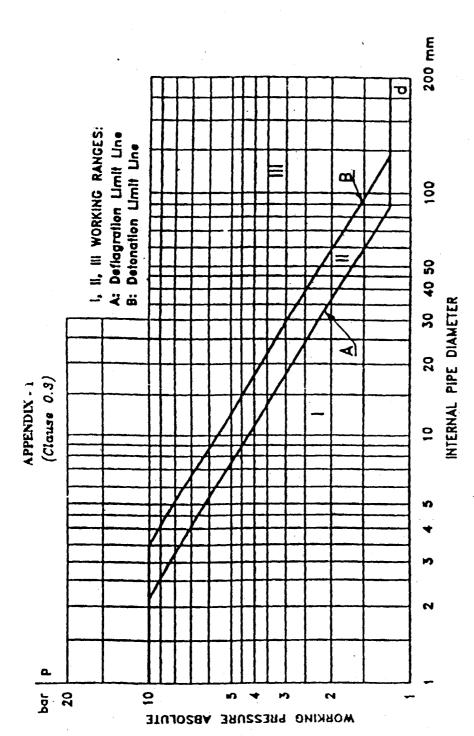
All references to 'IS' or other standard shall be constructed as reference to latest revision of the same.

The definition of some of the terms used are given at Annexure-A 0.4 (page 28)

SCOPE

1.

- This inter plant standard covers the design, fabrication, erection, testing and commissioning of Acetylene gas pipelines having a maximum operating pressure (PW) of 150 Kpa (1.5/kg sq cmg) operating at a temperature upto 60°C. The pipeline covered herein is intended to convey commercially available gaseous acetylene containing small amounts of impurities normally present when produced from Calcium Carbide as per IS 1040 'Calcium carbide, technical' and IS 308 'Dissolved acetylene (gas)' and used for welding, brazing, cutting and allied processes.
- 1.2 This standard does not cover the following:



NOTE:

1. Working Range I : Below line A Acetylene decomposition hazard is slight

Working Range II: On and above line A but below line B On ignition acetylene decomposition in the form of deflagration may occur

Working Range III ; On and above line B On ignition acetylene decomposition will start as a deflagratich in sufficiently long pipelines transition to detonation may occur

- Pipelines conveying mixtures of acetylene gas with diluents.
- Pipelines for interconnecting acetylene compressor with downstream equipment such as driers and acetylene gas cylinder filling manifolds.
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- Cylinder discharge manifolds.
- Acetylene pipelines in a chemical plant where the gas is used as a process feed material.

2. NOMINAL SIZE

- 2.1 Conveying pipe size covered under this standard is upto and including a nominal diameter (DN) 50 maximum.
- 3. CHARACTERISTICS OF ACETYLENE GAS TRANSMISSION AS THROUGH PIPELINES
- 3.1 Acetylene can burn in the presence of air or oxygen from a range of concentration of 2% to 82%. In case of any source of ignition occurring in Acetylene Pipeline, decomposition of Acetylene around and hydrogen may be initiated even in the near absence of air or oxygen.
- 3.2 Ignition energy required to initiate decomposition of Acetylene gas, velocity of propagation of the decomposition through the pipeline and associated pressure rise within the system is closely related to working pressure and size of the pipeline.

Categories of pipelines indicated in clause No.4 specifies the pressure limits (for various pipe diameters) above which, Acetylene Gas decomposition as 'deflagration and detonation' may occur.

4. CATEGORIES OF PIPELINES

4.1 Depending upon the maximum operating pressures, acetylene gas pipelines shall be categorized into Class I, Class II and Class III as per Table-1 (page 4).

5. DESIGN BASIS

- 5.1 Layout
- 5.1.1 Acetylene pipe work shall preferably be routed overhead. However, underground routing may also be permitted, if the requirement so domands with proper safety measures against exβlosion.

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		TABLE	1 (Clay	se 4.1)	
	d.	" · · ·		•	
MAXIMUM	OPERATING	PRESSURE FOR	VARIOUS	CLASSES OF	PIPELINES

Sl.No.	Nominal	Max. operating Pressure Kpa/(Kg/cm ² g)			
	Diameter of pipe (mm)	Class-I	Class-II	Class-III	
1.	ြေး 10	250 (2.5)*	40 to un		
2.	15	200 (2.0)*	250 (2.5)*		
3.	20	150 (1.5)	240 (2.4)*		
4.	25	125 (1.25)	200 (2.0)	Upto 250 (2.5)*	
5.	(32)	80 (0.8)	150 (1.5)	Upto 250 (2.5)*	
6.	40 40	60 (0.6)	130 (1.3)	Upto 250 (2.5)*	
7.	\$ 0	50 (0.5)	100 (1.0)	Upto 250 (2.5)*	

- () = non-preferred size
- * = the use shall be limited to 1.5 kg/cm²g
- Kpa = Kilo pascals, jauge
- NOTE 1: For a pipeline system having different sizes of pipes in it and having same maximum operating pressure, the class for the entire system shall be selected by identifying the pipe section having maximum internal diameter. If flash back arrestors are installed on the pipeline to separate the system into individual sections, each section shall be considered to be a separate pipeline system and designed accordingly.
- NOTE 2: In the case of a pipeline system having different maximum operating pressures, the class of the system shall be selected by the highest operating pressure unless;
 - i) the equipment creating the pressure differential acts by itself to stop the propagation of deflagration and/or detonation from both upstream and downstream sides.
 - ii) a flash back arrestor is installed in between sections operating at different pressures.
- NOTE 3: If the conditions (i) and (ii) indicated in Note.2 above are met either individually or together, separate classes maybe considered (as per rules given above) for the sections upstream and downstream of the equipment.
- 5.1.2 While routing acetylene pipelines the following aspects shall be considered.
- 5.1.2.1 The main acetylene header of class II & III category shall run min 15 meters from any buildings, fire protection facilities like water reservoirs and pump houses and storage tank facilities containing hazardous flammable liquids and fuel gas storage facilities like gas

holder etc. In case of locations where possibility of fire and explosion hazards exist, provision of increased safety distances beyond 15 meters shall be made.

Extreme caution shall be exercised in routing acetylene gas pipelines near tunnels, buildings and sewers to avoid the possibility of leaking acetylene gas in such installations.

- 5.1.2.2 Pipeline route shall be away from location of heat sources like burners, open flames, pilot lamps, welding torches, heating elements, boilers, incinerators, burning or glowing materials/metals, cinders etc.
- 5.1.2.3 Pipeline route shall be away from location and travel path of moving machines, places of occurrences of vibration, e.g. where heavy equipment movement or handling of heavy materials are expected.
- 5.1.2.4 Electrical cable(s) shall not be routed along with acetylene gas pipe-work.
- 5.1.3 Installation of acetylene gas pipelines in pipe-racks carrying other service pipelines which may require maintenance of a type in which either high temperature or heavy equipment is employed, is not allowed. Routing of high operating temperature pipelines, fuel gas or liquid fuel, steam and oxygen pipelines shall also be avoided along with acetylene gas pipelines, as far as possible.

5.1.4 Insulation

- 5.1.4.1 All overhead acetylene gas pipelines shall be protected against excessive external heat and possible formation of liquid acetylene. The pipelines may be insulated to achieve this. In all case of insulation provided on acetylene lines, claddings (vapour barriers) shall be of fire resistant type.
- 5.1.5 All overhead acetylene gas pipelines shall be routed maintaining a minimum clearance of 6.0 meters between bottom of supporting structures and top of road crown/railway tracks. The pipelines laid over tracks carrying hot materials shall have a minimum clearance of 10 meters and shall be provided with heat shields of suitable design.
- 5.1.6 Underground or buried acetylene gas pipelines shall be laid with a minimum earth covering of 1200 mm in areas subject to temporary loads. Acetylene gas pipelines shall not be laid underground wherever permanent load like buildings including its approns, equipment foundation etc are built. In case of underground road crossings, pipe sleeves shall be used and in such case minimum distance for entrance and exit from edge of crossings, depth of fill over pipe sleeves, location of sleeve vent and type of seal for sleeve shall be specified in the design.
- 5.1.7 The bleeder pipes from purging connections and relief valve outlets of acetylene lines shall be routed upward and terminated at a height of atleast 4.0 metres above building roof, top of the highest pipe on a pipe rack/top of any platform whichever is higher.

- 5.1.8 Acetylene pipeline shall not be used for supporting any other pipelines or electrical cable trays/racks/individual cables.
- 5.1.9 Platforms access ladders, hand railings etc shall be provided to facilitate access to instruments and accessories for easy operation and maintenance of valves, instruments and accessories located above 2.0 metres from ground level.
- 5.1.10 All acetylene pipes and flanges shall be electrically bonded and grounded properly. At flanged and bolted connections jumpers or spring washers may be installed for continuity of grounding.
- 5.2 Pipe Sizing
- 5.2.1 The diameter of a pipeline shall be finalized judiciously so that the required pressure is available at consumer, with the maximum flow in a given pipe run. It is recommended that the velocities be maintained between 2 to 4 metres/second for sizing of pipelines.
- 5.2.2 If calculated pipe size becomes more than DN 50 then multiple pipes of DN 50 and smaller diameter may be used to meet the required flow rate.
- 5.4 Expansion & Flexibility
- 5.4.1 All acetylene gas pipelines shall be anchored at suitable intervals. The pipelines shall be designed to provide sufficient flexibility to prevent development of undesirable forces or moments at points of connection to equipment, at anchorages or at guide points due to thermal expansion/contraction.
- 5.4.2 Flexibility shall be provided by changes of direction i.e. by the use of bends, loops or offsets. Wherever no self compensation can be used to cater for the expansion deformation of the pipelines, expansion loops (U-loops) shall be used.

Expansion bellows shall not be used on acetylene pipelines.

- 5.4.3 The provision for expansion and flexibility shall take into consideration the maximum possible temperature differential between the design temperature and the ambient temperature in cold season.
- 5.5 Valves & Measuring Devices
- Valves shall be provided on acetylene gas pipework for isolation of pipe sections and equipment, control of pressure and flow, venting draining, pressure relief etc. Sectionalizing valves on long straight pipework without branch line are not recommended. However if user desires it may be provided as per mutual agreement between purchaser and contractor. They shall be suitable for service conditions in all respects and located suitably considering ease of commissioning, decommissioning, operation and maintenance.

Materials of construction and selection/specification of the valves shall be as per Clause 7 and 8.2 respectively.

- 5.5.2 The valves provided shall include but not limited to the following:
 - i) Stop valves shall be provided as follows:
 - on all pipelines both at sources and consumers
 - in the branch pipes to each consumers both at the point of branching and at entry to each consumer/shop
 - for purging of acetylene pipelines and for draining of test fluid/condensate
 - for 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 valves 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 pipework.
- Drains Provisions should be made to drain the accumulated condensate or testing fluid from acetylene pipelines. To ensure condensate drainage and liquid drainage, pipelines shall be laid with a gradient of about 1 mm per metre run towards the drainage points. Drainage points shall be provided at the lowest points of acetylene gas pipework and special provisions should be made in its designito prevent entry of air into the acetylene line and to prevent freezing of any seal liquid used. The size of the drain pipelines shall be such that the entire pipeline between sectionalizing valves can be drained within the desired time period which in no case shall be more than 30 minutes.
- 5.7 Purging Facilities - It is recommended that provisions be made for purging all section(s) of acetylene conveying pipelines with nitrogen gas. Purge systems shall be protected against backflow of acetylene from acetylene lines into the purging medium pipes. In the design of the acetylene lines there should be no dead-end sections which cannot be positively purged. The purging bleeders of acetylene pipelines shall not be combined with the purging bleeder of any other pipeline. All purge connections shall be so designed that pulling of air into the acetylene system is not possible and shall be so located as to prevent accumulation of condensate. One purging bleeder installed in one section of the acetylene gas pipeline shall not be combined with the bleeder of any other section of the same pipeline. If temporary purging connections are to be provided, the design shall be such that it should prevent accidental connection of any system other than the purge gas. Sampling points shall be provided with proper valving for collection of sample of acetylene gas required for analyzing the composition of gas during purging/charging/de-commissioning of the system.

All purging connections from Nitrogen line to Acetylene line shall with flexible hose, which shall be disconnected on completion of purging.

- 5.7.1 Since acetylene gas pipelines will be subjected to hydraulic test (Ref clause 11.3), it shall be provided with vent points with valves at high points and led upward as per 5.1.7.
- 5.7.2 All such outlet points of venting and purging (5.7) shall be installed in such a way as to have the possibility for purging and venting of all pockets in the acetylene gas pipelines.
- 5.8 Safety Devices
- 5.8.1 Safety devices are installed in acetylene gas pipelines to provide protection from hazardous condition that may result due to exceeding of permitted maximum pressure, the propagation of acetylene decomposition, the entry of air/oxygen or flash back.
- 5.8.2 Flash back arrestors
- 5.8.2.1 All acetylene gas pipeline 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. For prevention of entry of all or oxygen these shall be fitted as near as practicable to any outlet point. The flash back arrestor shall be designed in such a way that it do not cause appreciable pressure drop at peak demand.
- 5.8.2.2 The following locations should be considered for installation of flashback arrestors:
 - a) at the outlet of the source of acetylene gas such as a generation plant or discharge manifold rack.
 - b) at the entrance and exit of gas holders, if installed, within the acetylene gas conveying systems.
 - c) at the exit of each booster, if any installed on the acetylene gas pipeline system.
 - d) at branch point from main header to shop sub-header.
 - e) at the entry to each consuming unit.
- 5.8.2.3 The location of flashback arrestors must be selected depending upon the type, size and 'Class' of pipelines. Flashback arrestors shall be provided for separation of sections which fall into different 'Class' categories (Ref Notes of Table-1).
- 5.8.2.4 In an acetylene gas distribution network of class III category where one or more ring mains are formed by joining one or more points in the pipeline system, each ring main munt be protected by a flashback arrestor unless the pipeline is designed in accordance with 6.3.1 and 6.3.2.

- 5.8.2.5 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. When this is done, the individual gas inlets, outlets and liquid drain connections must each be interconnected to respective common headers.
- 5.8.3 Safety Rollief Valves
- 5.8.3.1 A safety relief valve shall be set so as to open and relieve the gas when the pressure in the pipework being protected by it exceeds 1.1 times the maximum working pressure. The safety relief valve shall be capable of a flow rate equal to or greater than the maximum flow in the pipeline.
- 5.8.3.2 The safety relief valve shall be of reliable design and performance.
- 5.9 Supports for Overhead Pipework
- 5.9.1 All supports required for proper alignment and control of pipework like anchors, saddles, rollers, clamps, U-bolts, guides, hangers, spring supports, sway bracings, vibration dampeners shall be provided as required.

Supports provided shall prevent, under operating conditions, excessive stresses and excessive vibration of supporting element.

- 5.9.2 Design, material and workmanship for structural steel work used for pipe supports shall conform to relevant Indian Standards.
- 5.9.3 The movable supports for the piperines shall be used for the following type:
 - a) Sliding supports: For horizontal displacement of pipelines
 - b) Spring supports or hangers: In places of vertical displacement of pipes
 - c) Hangers: For above ground pipelines.
- 5.9.4 Supports for overhead pipework within shops may be 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.
- 5.9.5 All supporting elements, except for springs shall be designed for the weight of the pipe filled with water and the weight of insulation, if any. Thrust load shall be considered wherever significant. Other loads such as thermal and frictional load, weight of fittings, condensate, internal pressures, wind load etc shall be considered wherever applicable.
- Anchors or restraints 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 and shall be so arranged as to be structurally suitable for the particular location, line and loading conditions under consideration.

- 5.9.7 For insulated pipes, if any, steel protectors for the insulation shall be provided at points where the pipe is supported on rollers, slides or other elements requiring contact outside the insulation.
- 5.9.8 The maximum unsupported span for pipelines shall be as indicated in Table-2.

TABLE 2 - PIPE SUPPORTS SPACING

Pipe Size, DN mm	Max. Unsupported Span, mm
15 and below	1500
20, 25, 32	2000
40, 50	3000

6. DESIGN

6.1 Pipe for Class-I Category - The design thickness for internal pressure only, used for straight pipes shall be not less than that calculated (for "tm" less than "D/6") in accordance with the equation No.(1).

tm =
$$\frac{PW \times D/2}{2 \text{ SE} + 0.4 \text{ PW}}$$
(1)

tm = Wall thickness in mm, minimum

PW = Working pressure, gauge, Kpa

D = Outside diameter of pipe, mm

S = Allowable Stress, KPa where S = Ts/3.0 or El/1.5

E = Weld joint efficiency, E shall be 1 as seamless pipes are recommended

d = Internal diameter, mm

Ts = Specified min tensile stress at room temperature

El = Specified min yield stress at design temperature

6.2 Pipes for Class-II Category - Pipes shall be suitable to withstand decomposition occurring due to deflagration of acetylene gas. The calculated wall thickness shall be not less than that calculated in accordance with equation No.(2).

tm =
$$\frac{\{11 \ (PW+100.0)-100.0\} \times D}{1.818 \times f \times E + \{11 \ (PW+100.0)-100.0\}}$$
(2)

PW - Working pressure, gauge, Kpa

f - Stress of material at the lower yield point, Kpa

E = 1 as seamless pipes are recommended

D = Outside dia of pipe, non

- 6.3 Pipes for Class-III Category
- 6.3.1 Pipes falling in Class III category must be designed to withstand decomposition of acetylene gas occurring as 'detonation'.

Class III category of pipelines are those where initiation and/or development of detonation is possible. To minimize the probability of the onset of detonation, multiple pipelines of smaller diameter or pipeline length less than the predetonation distance may be used. For a general idea of the predetonation distance for acetylene at different pressures, refer Fig 1 (page 29).

The shock wave travelling along an acetylene gas pipeline, as a result of the occurrence of deponation will create conditions of high stress, wherever the same is reflected, like in locations where sharp bends, valves and blanked or dead ends are installed.

- 6.3.2 Class-III category pipes may be designed considering:
 - a) to withstand reflection occurring at any place in the entire pipework
 - b) provision of reinforcement at reflection points with increasedwall thickness and designing the balance straight lengths to withstand undisturbed detonation.
- 6.3.2.1 In the category (a) above where the entire system is designed to withstand detonation and reflection occurring at any point, the thickness calculated shall be not less than that calculated in accordance with equation (3).

tm =
$$\frac{(35 (PW+100.0)-100.0) \times D}{1.818 \times f \times E + (35 (PW+100.0)-100.0)}$$
(3)

- E = 1 as seamless pipes are recommended
- 6.3.2.2 In the category (b) above, the pipework excluding reflection points shall be designed for undisturbed detonation, for which the thickness calculated shall be not less than that calculated in accordance with equation (4).

tm =
$$\frac{(20 (PW+100.0)-100.0) \times D}{1.818xfxE+[20 (PW+100.0)-100.0]}$$
(4)

- E = 1 as seamless pipes are recommended
- 6.3.2.3 At all locations of reflection points as per category (b) above, for example, blanked ends, valves and bends (of radius less than 5 times the internal diameter (d)). Tee joints etc, the increased thickness shall not be lose than twice that of the wall thickness errived at in accordance with equation (4). These reinforcing thickness must be selected for a length of pipe of atleast three times the internal diameter (d).

- 6.3.2.5 Wherever a reflection point is protected by a flashback arrestor which is located within predetonation distances from the reflection point, provision of increased wall thickness is not necessary.
- 6.3.2.6 Smooth pipe bends (excluding mitre bends) having bend radius of 5 times the internal diameter (d) or more may be considered as straight sections, where the fabrication/manufacture of the bend does not make it weak compared to straight pipes.
- **6.3.2.7** It must be ensured that there is no sudden change in the internal dimensions or shape particularly while designing the reinforcements at reflection points.
- **6.3.3** The required thickness of pipe shall be calculated in accordance with equation 5.

t = tm + C(5)

Where:

- t = Required thickness, mm
- The Pressure design thickness as calculated in accordance with any of the equations (1), (2), (3) or (4) above.
- The sum of the mechanical allowances, corrosion and erosion allowances mm. For threaded components, the nominal thread depth, for mechanical allowances, shall apply. Minimum corrosion allowance shall be 0.76 mm.
- **The thickness** of pipe(s) shall be the next available higher thickness (above the calculated thickness) selected from relevant Indian Standard (Ref 8.1 and Appendix-II(page 13).

7. MATERIALS OF CONSTRUCTION

- 7.1 Steel is recommended as the main material of construction for acetylene transmission systems. In a pipeline system, materials for all components like joints, seals, gaskets, diaphragms, hoses etc must be so chosen that they are adequately resistant to the action of commercial grade acetylene, including its impurities as indicated in IS 1040 and 308 and solvents like acetone (if present) etc, under the system operating conditions (i.e. temperature, pressure) and resistant to atmospheric corrosion.
- 7.2 The recommended tensile strength of carbon steels used for the construction of acetylene gas pipelines of Class-II and III mategory shall not be less than 320 MPa and elongation after fracture shall be greater than or equal to 8400 divided by the minimum tensile strength, but not less than 17% in any case. For these categories of pipelines, materials subject to ageing or brittle fractures shall not be considered.

APPENDIX - II

MIN THICKNESS* FOR PIPES OF CLASS-I, II & III

Nom. Dia	Out. Dia	Pressure	Calc. Thk	tm + Allowance	Selected Thk as
ND .	00	PV	tm	T .	per code T1
ALL STATES	and	Кра	ma ·	FM ·	figh
CLASS-1 (IS	1239 medium)				
6 '	10.6	250	0.018	1.636	2.00
10	17.5	250	0.030	1.650	2.35
15	21.8	200	0.030	1.955	2.65
20	27.3	150	0.028	1.953	2.65
25	34.2	125	0.029	2.272	3.25
(32)	42.9	80	0.023	2.265	3.25
40	48.8	60	0.020	2.262	3.25
50	8.06	50	0.021	2.262	, 3.65
CLASS-11 (1S	1239 heavy)				. *
15	21.8	250	0,237	1.026	3.25
20	27.3	240	0.288	1.084	3.25
25	34.2	200	0.317	1.117	4.05
(32)	42.9	150	0.330	1.131	4.05
40	48.8	130	0.345	1.148	4.05
50	60.8	100	0.371	1.178	4.5
CLASS-III (I	s 1978)				•
25	33.4	250	1.245	2.161	4.55
(32)	42.2	250	1.574	2.530	4.85
40	48.3	250	1.801	2.786	5.08
50	60.3	250	2.248	3.29ù	5.54

^{() =} Non-preferred size .

While selecting pipe thickness, preference shall be given to higher class for a particular pipe size. However for pressures exceeding 1.02 $\rm Kg/cm^2g$ pipe thickness should be selected as per highest class applicable. Pipe as per other standard which are equivalent or superior (like ASTM) to above may also be used.

HOTE 1: For class-1 pipes, allowable stress considered for pipes of 1S 1239 (Medium). Mild steel tubes, tubulars and other wrought steel fittings' is 91450 Kpa. "T" includes corrosion allowance of 0.76 mm, tolerance on the wall thickness (-) 12.5% and depth of thread.

NOTE 2: For class-II pipes, minimum yield stress considered for pipes of IS 1239 (Heavy) is 188000 Kpa.

"I" includes corrosion allowance of 0.76 mm and tolerance on the wall thickness (-) 12.5%.

NOTE 3: For class-III pipes, minimum yield stress considered for pipes of IS 1978 'Line pipe' is 172549

Kpa: "I" includes corrosion allowance of 0.76 mm and tolerance on the wall thickness (-) 12.5%.

NOTE 4 : The weld joint efficiency for class-I pipes have been considered as 0.8.

Acetylene pipelines and/or its components may explode when subjected to friction or shock if it contains copper, silver and mercury which forms compounds with acetylene even when present in small quantities under certain operating conditions. Presence of certain other metals results in severe corrosion when they come in contact with impure acetylene. These are aluminium, magnesium and zinc.

In view of the above, copper and copper bearing alloys containing copper more than 70% are not allowed to be used for acetylene service. In case of silver alloys for the purpose of brazing silver content is less than 43% and copper content shall be less than 21% and the gap between two parts to be brazed shall be less than 0.33 mm. Special care must be taken to minimize area of filler metal exposed to acetylene and to remove as far as practical all traces of flux.

Equipment with Glass as a component such as sight glasses, U-tube manometers and similar devices shall be so designed that they are protected against external damage or made to withstand breakage. The glasses used for such applications shall be of toughened class and protected with external cover.

7.3 For the manufacture of fittings, valve bodies or similar components, ferrous metals like wrought iron is also suitable for use in pipeline Class-III category. Spheroidal graphite cast iron and wrought iron are also suitable for use in pipeline Class-II category. Apart from the above ferrous metals, grey and malleable cast iron may also be permitted for use in pipeline Class-I category.

8. SPECIFICATION

8.1 Pipes - Pipes for acetylene service shall be seamless as per the following standards:

Class of	Pipe	Line
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Standard

Class-I		IS	1239	(Medium)
Class-II		IS	1239	(Heavy)
Class-III		15	1978	

Pipes as per other standards which are equivalent or superior to the above may also be used.

Pipes shall be tested as per the same standard to which they are manufactured. Test pressure as stipulated in clause 11.3.4 shall be ensured before commissioning of the pipelines.

8.2 Valves - Flanged or socket welded valves like gate, globe, diaphragm may be used as required for acetylene service. However the design and construction of valves shall be such that the risk of ignition due to friction is minimized. Valves shall be of similar pressure class as that of the pipeline on which the valve is installed. Materials selected for valve construction shall be in line with 7.0.

Test pressure of valve installed in Class-I category pipelines shall be 1.5 times the design pressure for the valve body and 1.1 times the design pressure for the seat.

Test pressure of valves installed in Class-II category pipelines shall be not less than that calculated in accordance with equation 6.

$$Pt = \frac{11 (PW+100)-100}{1.1}$$
 (6)

Where Pt = minimum test pressure of the valve, Kpa, gauge.

Test pressure of valves installed in Class-III category pipelines shall be not less than that calculated in accordance with equation-7.

Pt =
$$\frac{20 \text{ (PW+100)}-100}{1.1}$$



- 8.3.1 Flanges and couplings
- 8.3.1.1 Plate flanges fabricated from carbon steel plates to IS 2002 Grade 2A in accordance with IS 6392 may be used for pipelines of Class-I category. Screwed connections and couplings may be used for Class-I category pipes only wherever required.
- 8.3.1.2 Forged carbon steel slip-on or weld neck flanges shall be used for Class-II and III category pipelines. The flanges used for Class-II and III category pipelines must be of the same pressure Class as that of the pipelines on which they are installed. Screwed and socketed couplings are not recommended for use in pipelines of Class-III category.
- 8.3.1.3 Blank flanges for Class-III category pipelines shall be so designed as to withstand the reflection as outlined in 6.3.2.
- 8.3.2 Fittings For selection and design of fittings the following may be followed.
- 8.3.2.1 For Class-I, Class-II and III category pipelines, tees and reducers shall be Forged Carbon Steel. For Class-II and III category pipelines use and design of fittings shall be in line with 6.2 and 6.3 to withstand the deflagration and denotation conditions respectively.

Bends may be either hot bends or forged bends. Radius of bends shall preferably be 5 times the nominal diameter of pipe but in no case be less than 1.5 times the nominal diameter of the pipe on which they are used.

- 8.3.3.2 Reducers for Class-II and III category pipelines shall have maximum size reduction of two sizes per reducer. For example reducers of size 50x40 and 50x25 may be used but sizes of 50x20 shall not be used.
- 8.3.3.4 Tees shall be right angled type. Use of angular tees shall be avoided.
- 8.3.3.5 Use of mitred bends is not allowed for any classes of pipelines.

- 8.4 Gaskets Compressed asbestos gaskets to IS 2712 Grade W/3 Compressed asbestos fibre jointings' of atleast 1.6 mm thickness is recommended for use in acetylene service.
- 8.5 Nuts & Bolts For Class-I category pipelines nuts and bolts to IS
 1367 may be used. For Class-II and III category pipelines high
 tensile alloy steel bolts/stude and nuts shall be used.
- 8.6 Plashback Arrestors Flanhback arrestor installed on acetylene gas pipeline shall be as per IS 11006.
- 8.7 Pressure Gauges
- 8.7.1 Class-I category pipelines may be fitted with any type of pressure gauges suitable for acetylene gas at the working pressure.
- 8.7.2 Pressure gauges for Class-II and III category pipelines shall comply with one of the following:
- 8.7.2.1 The pressure gauge withstand the pressures resulting from an acetylene decomposition without serious leakage.
- 8.7.2.2 A properly sized vent closed with a rupture disc shall be provided for allowing the escape of gas in a safe direction away from the working area, in case of failure of the pressure gauge. The inlet orifice to the measuring device of all gauges shall be fitted with a device to limit the rate of leakage in the event of rupture or failure (e.g. orifice of a maximum of cross sectional area 0.1 mm²).
- 8.7.2.3 The pressure gauge shall be fitted with a flashback arrestor.
- 8.8 Regulators Regulators used for pipeline in Class-II and III category shall either be protected from decomposition or shall be designed to withstand such decomposition without bursting the body. It must be ensured that the membrane and seal material comply with 7.
- 8.9 Hoses
- 8.9.1 Hoses may be used where rigid pipes are not suitable.
- **8.9.2** The thickness for hoses used in Class-I category shall be suitable to withstand 1.5 times the maximum working pressure.
- 8.9.3 Hoses for pipelines of Class-II category shall be of type having a bursting pressure of not less than 11 times the maximum absolute working pressure.
- 8.9.4 Hoses for pipelines of Class-III category shall be of a type having a bursting pressure of not less than 35 times the maximum absolute working pressure.
- 8.9.5 Special considerations should be given to the design of the end fittings for hoses, particularly to avoid sudden changes in internal diameter. Wherever a change in diamete is required, a gradual taper should be made.

8.9.6 Where hoses are used in an installation it must be ensured that for protection of electrostatic charging the resistance between two end couplings, should not exceed 10 ohms.

9. FABRICATION OF PIPEWORK

- 9.1 All steel pipework shall be of socket/butt-welded construction. Use of socket weld joints are however, preferred. Welds on pipelines shall be located at places where the minimum bending stresses occur as far as practicable. Flanges shall be provided on straight lengths as required for easy erection and maintenance. Flanged joints shall be provided to match the connecting ends of equipment, valves and fittings etc. Where screwed connections are permitted (reference 8.3.1.1), the same may be provided of acceptable standard. Number of flanged and/or screwed joints shall be restricted to a minimum to minimize the possibility of gas leakage.
- 9.2 Joints are recommended to be assembled with the inside of all pipes and fittings smooth, clean and free from burns, blisters, scale, welding slag, sand and dirt etc. The inside edges of pipes and tubings will be reamed after cutting to remove burns. Wherever possible the inside of the weld without backing rings shall be ground smooth. Flange faces shall be free from particles of weld metal.
- 9.3 Soap water solution may be used when cutting threads for acetylene pipework and oil or grease shall not be used.

9.4 Welding

- 9.4.1 All jointing by electric arc and gas welding process shall be as per IS 10234 'Recommendations for general pipeline welding' and IS 1323 'Code of practice for oxy-acetylene welding for structural work in mild steel' respectively or equivalent. However provisions of statutory regulations, if any, and IS 6044 (Part 1 & 2), Fire Protection manual of the Insurance I. ciation of India etc. shall be complied with, wherever applicable.
- 9.4.2 All welding work shall be carried out by qualified welders. All filler materials, edge preparation, post-weld treatment etc shall be as per relevant standards. All welds shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond the root areas. Reinforcements, wherever required shall be applied in such a manner that it will have smooth pipes and welded fittings.
- prior to welding. If tack welds are used, the tacks shall be either fused into the first layer of weld or else chipped out. All welds shall be built up by the application of multiple beads or passes; the thickness of metal deposited in each bead or pass shall not exceed 3 mm. Each bead shall be cleaned and, if not a work hardening material, shall be lightly peened before the next bead is laid. The complete weld and surrounding pipe shall be cleaned of slag and metal splatter on all surfaces and the inside beads shall be ground smooth where practicable.

- 9.4.4 Welded carbon steel piping need not be stress relieved except where specified.
- 9.4.5 Pabrication of Bends by cutting and welding of pipe is not allowed. Branches, reducers etc may be fabricated from pipes, by cutting and welding as above, wherever permitted by this code.
- 9.5 Bending
- 9.5.1 Metallic pipework
- 9.5.2 Pipe bends shall be true to angle and have a smooth surface free of flat spots and corrugations. Actual inside diameter at any portion of the pipe shall not deviate by more than ± 3% from the inside pipe diameter calculated from outside dia and thickness as per pipe specification.
- 9.5.3 Smooth bends shall normally have a radius of 5 times the nominal diameter.
- 9.5.4 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.

10. ERECTION

- 10.1 General
- 10.1.1 Pipes shall be cut to measurement and installed without forcing or springing except where cold springing is explicitly specified in the drawings.
- 10.1.2 Unions wherever permitted by this code, or flanges shall be installed in all piping connections to equipment, valves, instruments, and miscellaneous specials to facilitate dismantling for maintenance. However, number of such unions and/or flanges shall be restricted to a minimum.
- 10.2 Supports for Overhead Pipework
- 10.2.1 Supports of overhead pipework as per clause 5.9 shall be installed. The work shall include installation of such protection as may be needed to prevent mechanical damage to piping. Such installations shall be made in a satisfactory manner.
- 10.3 Buried Pipework
- 10.3.1 General
- 10.3.1.1 All buried pipework shall be laid with earth cover sufficient to avoid damage from pressure of vibration caused by surface traffic. Hinimum earth covering over the pipe shall be 1200 mm from the finished ground level in areas subject to temporary loads. The pipe shall be embedded and cushion of 200 mm shall be maintained before back filling.

- 10.3.1.2 Large stones, rubble etc found during excavation shall be dumped far away to avoid damage to pipework during backfilling. The trench bottom shall be leveled to the required levels keeping in view the pipe slopes required. In steeply sloping trenches, pipe anchors shall be provided.
- 10.3.1.3 All buried steel pipework including accessories shall be externally coated and wrapped to prevent corrosion. The coatings shall be coal tar enamel craft paper. The external coating work shall conform to the latest edition of IS 10221 'Code of practice for coating and wrapping of underground mild steel pipelines' for both material and workmanship. After completion of coating and wrapping, the entire length of the coated pipe shall be tested for defects by "Holiday Detectors" and defective portions are to be rectified.
- 10.3.1.4 For long lengths of underground pipelines through corrosive soil, cathodic protection of the pipeline is recommended. The type and degree of protection shall depend upon the survey of soil resistivity along the proposed pipe route. However, cathodic protection based on the principle of sacrificial anodes (with minimum life of not less than ten (10 years) is preferred for acetylene pipelines.

10.3.2 Pipework Installation

- 10.3.2.1 Precautions shall be taken at all times to prevent damage to the coating and wrapping on the pipe and appurtenances by workmen or trespassers. During laying and at any other time while pipe is exposed, no person shall be permitted to walk on a pipe wearing boots or shoes with mails or other attachments that may injure the coating. Care must be exercised to prevent the dropping of tools, rivets and other materials on, and the dragging of heavy objects over a pipe, and other acts that would mar its coating and wrapping. Pipe handling slings and any block used in handling or storing pipe must be well padded to avoid damage to pipe coating.
- 10.3.2.2 Ends of pipes in the storage yard shall be closed by an approved head or barrier. The heads or barriers shall not be removed until a pipe is about to be laid. Each day, at the close of work and when laying is not in progress, the open ends of a line shall be similarly protected. If it becomes necessary to backfill a trench before making connections to adjacent piping, the open ends shall be closed by suitable timber bulkheads.
- 10.3.2.3 After a pipeline has been laid on skids, it shall be thoroughly cleaned, inspected and any damage to the protective coating satisfactorily repaired while the pipe is suspended above the trench. The pipe shall then be lowered into place upon the subgrade and laid.
- 10.3.2.4 After completion and acceptance of the field test on each major section of an underground pipeline, all testing media shall be removed from the section and all interior surface cleaned. All abrasions and other damages to the coating shall then be repaired.

10.3.3 Road and track crossing

10.3.3.1All underground pipelines crossing rail tracks or roads where the depth of cover from the bottom of the ties or road bed to the top of pipe is between 1200 mm and 1800 mm shall be protected. This protection shall be by reinforced concrete culvert, reinforced concrete casing pipe, or steel casing pipe or sleeve. The annular space between casing pipe and inner pipe at the ends shall be suitably sealed. Details as indicated in 5.1.6 shall be followed.

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- 10.3.3.2A culvert shall be laid true to line and grade with the bottom quadrant contact with the undisturned trench bottom and with tamping. The culvert shall extend beyond the ends of railroad ties or road bed by a distance equal to the depth of bury of the bottom of the pipe. Proper venting of culvert/tunnel/pipe sleeves shall be provided.
- 10.3.4 Suitable anchors of concrete shall be provided at bends and other locations in a pipelines where unbalanced pressures may develop under normal or test pressure and tend to cause movement in the pipelines.
- 10.3.5 Every precaution shall be taken against the floating of the pipe due to water flowing into the trench or from caving, flushing or puddling. In case of such floating, replacement of the pipe shall be made by making good any injury or damage which may result.

10.3.6 Valve chambers

- 10.3.6.1 Valves on an underground pipeline shall be located in a masonry chamber covered with R.C.C. slabs and manhole with cover. The chamber size shall enable free movement during maintenance and/or repair work to the valves. Chambers which because of their design or construction could become, in any way, hazardous to human life shall not be permitted. The valve chamber shall be properly vented to prevent accidental accumulation of acetylene gas.
- 10.3.6.2 The design shall incorporate sufficient escape provisions for personnel in the event of flooding or other emergency. A minimum of two manholes must be provided where, because of its size, maintenance or replacement of valves may required more than one person at a time. Manholes shall be of suitable size and shall be located on the cover slab in opposite locations.
- 10.3.6.3 Hydro insulation of manholes shall be provided for the total height as required.
- 10.4 Structural Platforms & Supports
- 10.4.1 All required operating platforms, valve stands, access ladders, handrails etc shall be erected, after the piping has been installed. Structural steelwork in connection with those items shall conform to the relevant Indian Standards for Structural Steelwork.

11. INSPECTION TEST

11.1 All components used for the construction of the acetylene pipework, (except for site fabricated components like reducers, tees etc), shall have proper manufacturer's test certificates conforming to the requirements of the code.

11.2 Inspection

- 11.2.1 The components of the pipework shall be subjected to visual inspection. The pipeline, after completion of erection, shall be inspected for its conformity with the construction drawings prepared as per the stipulations of the code.
- 11.2.2 All weld joints shall be visually examined either during manufacture, fabrication and erection to ensure conformity with the requirements of this Code of Practice.

11.3 Pressure Tests

11.3.1 General - Prior to acceptance and initial operation, installed piping shall be pressure tested to ensure the system's strength and to ensure that it is leakproof.

In the event any repairs or additions made following the pressure test, the affected piping shall be retested.

A piping system may be tested as a complete unit or in sections. For the connecting piping and other appurtenances for testing, it it not required that the tie-in sections of pipes be pressure tested.

Special components which require special testing may be tested separately and/or as per separate test procedure. Test at pressures stipulated in 6.2 shall be performed for valves before installation in addition to testing after installation in the piping system as stipulated in 11.3

- 11.3.2 Test medium Testing may be carried out with an inert gas or air, provided sufficient precautions are taken to avoid any risks associated with the test. Any pneumatic or gas testing shall include a preliminary check at not more than 170 KPa (1.7 kg/Sq cm) gauge pressure. The pressure shall be increased gradually in steps providing sufficient time to allow the piping to equalize strains during test and also to check for leaks. Freumatic or gas testing is not recommended if the the test pressure exceeds 4000 KPa (40 kgs per sq cm gauge). Wherever pneumatic or gas testing is not recommended, a hydraulic test must be performed.
- 11.3.3 Test preparation Wherever possible, pipe joints including welds shall be left uscoated and exposed for examination during test.

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

If test pressure is to be maintained for a grolonged period of time and the test medium in the system is subject to thermal expansion, precautions shall be taken to avoid development of excessive pressure.

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

- 11.3.4 Hydraulic testing The following test pressures shall be adopted for hydraulic testing of systems/components for acetylene service.
- 11.3.4.1 Class-I 1.5 times the maximum working gauge pressure.
- 11.3.4.2 Class-II 10 times the maximum working gauge pressure, minimum test pressure 2000 KPa, gauge (20 kg/sq cm g).
- 11.3.4.3 Class-III 20 times the maximum working gauge pressure. Minimum test pressure 3000 KPa, gauge (30 kg/sq cm g).

11.3.5 Leakage test

- 11.3.5.1 Leakage testing shall be carried out with gas 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 leakage at a lower pressure.
- 11.3.5.2 Leakage test duration Test duration shall be sufficiently long for detecting any leaks but not less than half hower (30 minutes) for each 14 cubic metres (500 cft) of pipe volume or fraction thereof except that when testing a system having a volume less than 0.3 cubic metres (10 cft), the test duration may be reduced to (10) ten minutes. For piping system having a volume of more than 68 cubic metres (2400 cft), the duration of the test need not exceed twenty four (24) hours.

While subjected to test pressure the piping system shall be visually examined for signs of leakage or other defects. Any reduction in test pressure as indicated by pressure gauges shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.

If leakage or other defects appear, the affected portion of the piping system shall be repaired or replaced and retested.

41.3.6 Test records

- 11.3.6.1All manufacturer's test certificates as stipulated in 11.1 and test records of tests performed as per 8.2 shall be preserved.
- £1.3.6.2 Records shall be made of each piping installation during the testing as per 11.3 and preserved.
- 11.3.6.3 A certification based on 11.3.6.1 and 11.3.6.2 shall be made that the entire piping has been pressure tested as required by this code.

12. IDENTIFICATION

12.1 Acetylene pipelines must be clearly identified by the word "Acetylene gas" or by colour coding. The identification markings must be repeated at regular intervals and visible locations to ensure that the pipeline(s) can be clearly identified and are not confused with adjacent pipelines carrying other substances.

13. COMMISSIONING

13.1 General

- 13.1.1 It has to be ensured before an acetylene piping system is put into commission that it has been designed in line with stipulations of this code and fabricated and erected in line with the construction drawings based on the design and tested in accordance with clause 11.
- 13.1.2 In case the system is taken up for commissioning after a considerable time has elapsed after its erection and testing and there is a possibility that the system has deteriorated, then the system shall be retested as per clause 11 before it is commissioned.
- 13.1.3 Commissioning of acetylene pipeline at night is not recommended.
- 13.2 Prerequisites for Commissioning
- 13.2.1 The source of acetylene gas (Generation plant or discharge manifold) is ready to be commissioned or already commissioned.
- 13.2.2 Various valve operating platforms, platform access, walkings, staircases and cat ladder access etc are cleared of erection debris and all work places are cleared and do not have obstructions lying about.
- 13.2.3 Safety instructions, notices and displays are securely placed in visible and appropriate locations at regular intervals of the pipeline being taken up for commissioning.
- 13.2.4 Adequate numbers of fire fighting personnel, fire fighting equipment and appliances are placed in appropriate locations near the piping systems.
- 13.2.5 All drawings, manuals, test certificates issued by the manufacturer and statutory authorities are available with the personnel deployed for commissioning.
- 13.2.6 The personnel deployed for commissioning must check the conformity of the system taken up for commissioning with all the drawings, documents indicated in 13.2.5, and their satisfaction as regards the conformity is recorded.
- 13.2.7 A survey has to be conducted berone commissioning work is taken up as regards the following.

- 13.2.7.1 All consumers of acetylene shall be kept inoperative till such time that the commissioning of the pipeline is fover and the system is certified as being ready to be put into service.
- 13.2.7.2 All sources of heat and fire must be kept away from the acetylene system. Possibility of sparks from locomotives/sutomotives, chimney/stacks, static electricity, short critical shall be completely eliminated.
- 13.2.7.3 Location and travel path of moving machines, automobiles shall be identified and restricted in such a way that they do not create hindrance for the commissioning operation and introduce hazardous situations.
- 13.2.7.4 Possibility and occurrence of vibration and physical shock to the acetylene pipelines shall be eliminated.

- 13.2.7.5 Electrical continuity and Earthing of the piping system has been provided.
- 13.2.7.6 Unauthorized use of pipeline as electrical conductor or as a support for other items have not been made.
- 13.2.7.7 All electrical installations in the proximity are identified.
- 13.2.8 Inspection of colour coding as per 12.0 has been properly made for the entire systems. Visual inspection shall also be carried out for satisfactory surface condition and painting of the system. Particular attention shall be paid to places where corrosion may be expected to occur.
- 13.2.9 It shall be ensured that the safety devices and instruments installed are of the correct type and specifications and do not show signs of deterioration or malfunction or unauthorized usage. 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. Wet type flashback arrestors shall also be checked, particularly for maintenance of correct water level.
- 13.2.10 Filters and dry type flash back afrestors shall be examined for proper conditions and has to be ensured that they are not blocked.
- 13.2.11 The setting of pressure regulators/reducing stations shall be as per specified parameters/duty conditions.
- 13.2.12 All valves at service points, isolation, vent, drain points and equipment connections etc shall be checked for complete opening and tight shut-off.
- 13.2.13 Qualified test personnel should be available throughout the purging/commissioning operations in addition to necessary testing commissioning. They should be a recommissioning to the instruments in good serking conditions.
- 13.3 Cleaning
- 13.1 All acetylene pipelines must be made clear and free from rust & dirt.

- 13.3.2 Finally acetylene pipelines must also be properly cleaned internally by blowing compressed air or nitrogen gas through pipes. Velocity of blowing shall not be less than 15 to 20 m/sec and pressure at the air/nitrogen inlet shall be 400 Kpag to 700 Kpag (4 to 7 kg per sq cm gauge). All vents, drains, service points including flashback arrestors shall be blown by means of blowing medium.
- 13.3.3 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.
- 13.4 Preparation for Pipeline Purging
- 13.4.1 Nitrogen gas shall be used as purging medium.
- 13.4.2 If the pipeline is long, then commissioning in sections is recommended. Identification of section to be purged along with its isolation valves, purge-in purge-out and nitrogen supply provisions in the vicinity of purge-in points shall be made.
- 13.4.3 All purge-in connections shall be connected with suitable hose and hose couplings with nitrogen supply provisions.
- 13.4.4 Complete isolation of the entire distribution system(s)/pipe(s) to be commissioned from connected system/acetylene gas source/consuming shop/equipment shall be ensured by completely shutting off isolation valves provided for these purposes. In case of sectionalization of pipelines, isolation valve(s) at each end of section(s) shall remain completely shut-off.
- 13.4.5 All openings like service points shall remain shut-off by closing the isolation valves provided for the purpose.
- 13.5 Preamble to Purging & Commissioning

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- 13.5.1 The entire acetylene pipeline system shall be identified in two (2) groups:
 - a) Supply pipeline(s) in the open yard.
 - b) Pipework inside consuming shop(s).
- 13.5.2 The purging commissioning work for the above two (2) groups shall be taken up in the same sequential order. In case of multiple supply pipework, one (1) pipeline shall be taken up for purging/commissioning at a time.

For multiple consuming shops connected to the particular supply pipeline already commissioned, one (1) shop may be taken up for commissioning at a time. Shops other than that taken up for commissioning shall remain completely shut off from the already commissioned pipeline by the isolation valve which is already shut-off as per 13.4.4. Once a particular shop is commissioned, commissioning of agetylene pipeline inside the next shop, connected to the already commissioned supply pipe may be taken up for commissioning.

- 13.5.3 Once all the shops connected to a particular supply pipeline in the header is commissioned, another supply pipeline and connected consumers may be taken up for commissioning.
- 13.5.4 it shall be noted that the sole purpose of the process of purging and successful commissioning of the acetylene gas pipeline(s) is to ensure that no air and/or oxygen comes in contact with acetylene gas and all possible caution should be exercised and care taken in this regard.
- 13.6 Purging & Commissioning
- 13.6.1 Purging of acetylene gas shall be commenced from the acetylene gas source. The isolation valve between the source and pipeline shall closed as per 13.4.4. The isolation valve for the section/pipeline being purged and located at the other end of the same section/pipeline shall also remain closed as per 13.4.5. Nitrogen admission to the section/pipeline shall be started by opening the nitrogen inlet valve connection provided at the source end. Nitrogen gas admission may be done by connecting the mitrogen supply system with flexible hoses. At the same time the vent valve located at the other end of the section/pipeline shall remain open.

in the next step of operation, the purging operation shall be carried out in accordance with 13.7. Once the purging operation for the above section in complete, the nitrogen inlet valve at the source end and the vent valve at the other end shall be closed. The section which has been purged shall remain pressurized with nitrogen gas at a pressure of about 100 Kpa gauge (1 kg/sq cm g).

- 13.6.2 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 conquerny shop(s) connected may be taken up for purging (ref 13.5.2) in accordance with 13.7.
- 13.6.3 For eight of the next section of pipeline, if applicable, nitrogen gas interion as in 13.6.1 and in 13.7 shall be made for the section just after gas pipeline sectionalizing valve which isolates the already purged section and the next section downstream. All the sectionalization valves in this second section shall remain closed. This locates shall be repeated until all sections of the pipeline is purger, and pressurized with nitrogen.
- 13.6.4 Acetylene gas from the source shall now be admitted into the first section/pipeline downstream to it in accordance with 13.9. In case of a short pipeline, instead of pressurizing two (2) section of pipelines with nitrogen as is done for longer pipelines, after the supply pipeline is pressurized with nitrogen, the next consuming shop(s) internal header(s) shall be purged and pressurized with nitrogen. Thus in a particular pipe route there will always be a nitrogen filled section/shop internal pipe ahead of the section already charged with acetylene gas.
- 13.6.5 Admission of acetylene gas in the first section or pipeline indicated in 13.6.4 shall be made in accordance with 13.7.

- 13.6.6 The Complete pipeline in the yard shall thus be charged progressively upto the consuming shops in case of sectionalized pipelines.
- 13.6.7 Once the pipeline in the yard is charged with acetylene gas and there is a nitrogen pressurized barrier inside the consuming shop internal pipework, the charging of acetylene gas in the shop header may be taken up with one (1) shop connected to the supply pipeline, at a time.

For purging operations of yard pipelines and shop internal pipework elaborated in the preceding sections, nitrogen gas of minimum 97.5% purity with a velocity of 15 to 20 metres/second shall be used for purging a section/pipeline. The minimum volume of nitrogen used for purging shall generally be 4 times the volume of pipework/section.

Introduction of nitrogen gas shall be continued till samples taken at selected vent/purge out points show a satisfactory end point. The acetylene pipeline may be considered free from air if the outgoing nitrogen contains not more than 2 to 5% oxygen. Nitrogen supply shall be terminated and all isolation/purge-in/drain/vent or purge out valves for the pipeline/section under consideration may be kept completely shut-off under nitrogen pressure as indicated in 13.6.1.

Once a particular section of the pipeline/shop internal pipework is pressurized by filling with nitrogen and the section ahead (except for a terminal section at consuming end) is also pressurized by nitrogen filling in accordance with the procedure outlined above, admission of acetylene gas shall be commenced. Acetylene gas with is already charged in the earlier section or pipeline (for example, at the start of the entire operation, the source like generation plant or discharge manifold etc), shall be admitted by opening the inlet isolation valve a few turns. The valves for purge-out point and/or discharge points shall be opened. Gas samples shall be collected for measuring acetylene gas concentration. The section or pipeline vent/purge-out points shall be closed as soon as the acetylene concentration of 10% by volume of nitrogen is reached.

It must be ensured that the acetylene gas/acetylene gas - nitrogen mixture coming out of the terminal section inside a consuming shop is diverted away and out of any shop/work place to a safe distance.

It must also be ensured that any section of the acetylene gas pipeline which is not in use, after commissioning, the said section shall be purged with nitrogen and remain pressurized with nitrogen gas till it is put on stream.

References :

- Code of Practice for Acetylene Pipelines based upon working ranges (IGC Document No.9/78/E).
- 2. Acetylene Transmission for Chemical Synthesis, Recommended Minimum Practices for Piping System Compressed Gas Association (CGA), U.S.A. Pamphlet No.G.1.3.
- 3. Standards of M/s M.W. Dastur & Company Ltd, Calcutta.
- 4. Standards for values and piping specification IE 12 published by Union Carbide, U.S.A.

ANNEXURE-A (Ref clause 0.4)

A.1 DEFINITIONS

- A.1.1 Deflagration A flame produced by decomposition or combustion that travels into the unreacted gas at a velocity which is less than that of sound. The rate of propagation of a deflagration flame increases with the density, the temperature and the turbulence of unreacted gas. Since these three parameters tend to increase as a deflagration progresses the rate of propagation is usually not steady but tends to increase continuously and sometimes less to detonation.
- 1:1.2 Detonation A flame prefluced by decomposition or combustion that travels into the unreacted gas a rate above the speed at of sound. Unlike a deflagration where the pressure in front of and behind the flame front rises at the same time, a detonation involves a sharp difference in pressure between the reacted and unreacted gas. The change from the low pressure of the unreacted gas to the high pressure of the reacted gas takes place in a shock wave at the front of the flame.
- A.1.3 Predetonation Distance The distance that deflagration travel in a working range III pipelines (Ref Fig 1) before it develops into a detonation.
- A.1.4 Reflection If in case of detonation the forward moving shock wave hits an obstruction such as the end of a pipe or a closed valve, the pressure increases considerably and the shock wave is reflected. The effect is similar to "Water Hammer".

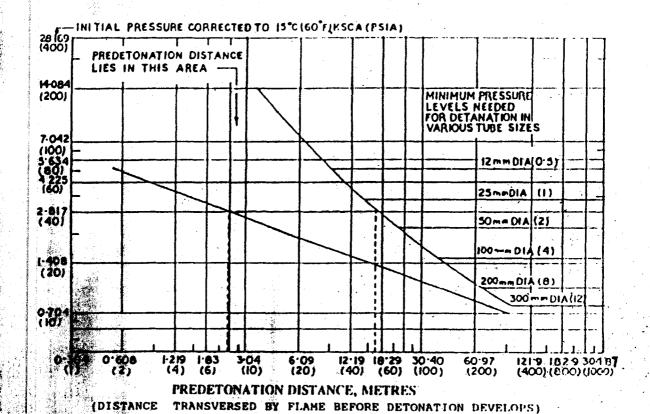


FIGURE - 1 (Ref cl 6.3.1 & annexure A (A.1.3))

FOR EXAMPLE :

For acetylene at pressure of 2.8 kgs/cm² absolute (ksca), the predetonation distance lies in the range of 2.4 m to 16.75 m provided the diameter of the tubes is large enough so that it does not preclude detonation at this pressure. The horizontal lines of the above Figure shows the least pressures required for detonation in tubes of different diameters. It also shows that 2.4 to 16.75 m range for detonation to occur applies to tubes larger than 35.5 mm internal diameter but not smaller.

The above figure applies to detonation that develop in acetylene gas from deflagration and which in turn is initiated from non shown thermal source of initiation.