<table>
<tr><td colspan="3">INTERPLANT STANDARD - STEEL INDUSTRY</td></tr>
<tr><td rowspan="2"></td><td>CODE OF PRACTICE FOR LAYING OF UNDERGROUND PIPELINES FOR WATER SERVICES</td><td>IPSS:1-06-035-17
(First Revision)</td></tr>
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0. FOREWARD

0.1 This interplant standard has been 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 and was adopted in May 1999 and first revision done in July 2017.

1. SCOPE

1.1 This interplant standard covers the guidelines for laying and testing of pipelines to be laid underground in the steel plants for pressurised water services .

This standard also includes handling and jointing of pipes, hydrostatic tests, backfilling and restoration of surface.

2. CLASSIFICATION OF PIPES

Depending upon the service, the following types of pipes shall be used:

i) Cast iron as per IPSS: 1-06-003-95

ii) Ductile iron as per IS: 8329

iii) Steel including GI as per IS: 1239 for pipe size up to DN 150. Pipes of size DN 250 and above shall be as per IS: 3589 or Rourkela Commercial quality.

iv) Polyethylene (high/low density).

V) CMDI Pipes as per I S: 8329-2000, class: k-9

2.1 General Criteria for Selection of Pipes

i) **Cast iron -** Cast iron pipes shall normally be used in sewage lines. They shall also be used for raw water and drinking water.

ii) **Ductile iron -** For conveyance of raw and drinking water from a distant place, ductile iron pipes are preferred over CI pipes. Now-a-days, the use of ductile iron pipe is increasing because of its property to withstand very high internal and external pressure and resistance to corrosion.

iii) **Steel including GI -** MS pipes shall commonly be used in water services because of its ease of jointing at site and fabrication of fittings from the pipe. For conveying of soft and demin water, stainless steel pipes or rubber-lined MS pipes shall mostly be used. Rubber lined MS pipes are normally not laid underground.

GI pipes are quite common for smaller size drinking water mains (DN 150 max.), distribution pipe work and plumbing inside building.

iv) **Polyethylene (high/low density) -** Use of these pipes are recommended for potable water services.

Note: For long distance piping, soil condition shall be surveyed before selecting the pipe material and its type of protection.

3. CLEARING THE SITE

3.1 Preliminary work shall be done before starting of pipe laying including pegging out, clearing and disposal of all shrub, grass, large and small bushes, trees, debris etc along the route.

4. EXCAVATION AND PREPARATION OF TRENCHES FOR LAYING UNDERGROUND PIPELINE –

The trench shall be so dug that the pipe is laid to the required depth at required alignment. When the pipeline is under a roadway, a minimum clear cover of 1.5 m is recommended, but it shall be modified to suit local conditions by taking protective measures. The trench shall be shored, wherever necessary, and kept dry so that the workmen shall work there safely. The discharge of the trench dewatering pumps shall be conveyed either to drainage channels or to natural drains.

4.1 **Trenching -** Trenching includes all excavation which is carried out manually or by machine. Where the sides of the trench provide reasonable side support, the trench width shall be kept to a minimum required for proper densification of pipe zone bedding and backfill material. If the pipe zone bedding and backfill require densification by compaction, the width of the trench for the pipe shall be generally as per clause No. 5.5. Each case shall, however, be judged considering the safety of the trench and the method of laying and jointing the pipe and the need to avoid damage to pipe coating. The trench shall be excavated to the exact gradient specified so that no making of the sub-grade by backfilling is required and the pipe rests on solid and undisturbed ground when laid. The bottom of the trench shall be properly trimmed to permit even bedding of the pipeline. If exact gradient is not achievable then sand bedding shall be provided to achieve required gradient. For pipes larger than 1200 mm diameter the curvature at the bottom of the trench shall match the curvature of the pipe as far as possible, subtending an angle of about 120 deg at the centre of the pipe, as shown in Fig. 1A. Where rock or boulders are encountered, the trench shall be trimmed to a depth of at least 100 mm below the level at which the bottom of the barrel of the pipe shall be laid and filled to a like depth with lean cement concrete or with non-compressible material like sand of adequate depth to give the curved seating, as shown in Fig. 1B and Fig. 1C. In all the cases there shall be a uniform and continuous bearing and support for the pipe at every point between the sockets, flanges or other joints. For socket and spigot jointed pipes a sand bedding is preferred for uniform support at socket joints as well as throughout the pipe length.

In case non-load bearing soil is encountered during laying of underground pipes, special precaution shall be taken to avoid sagging of pipe during erection. In such case, cement concrete bedding can be thought of as first alternative. However, in worst conditions, provision of piles can be considered for supporting of pipes at regular interval.

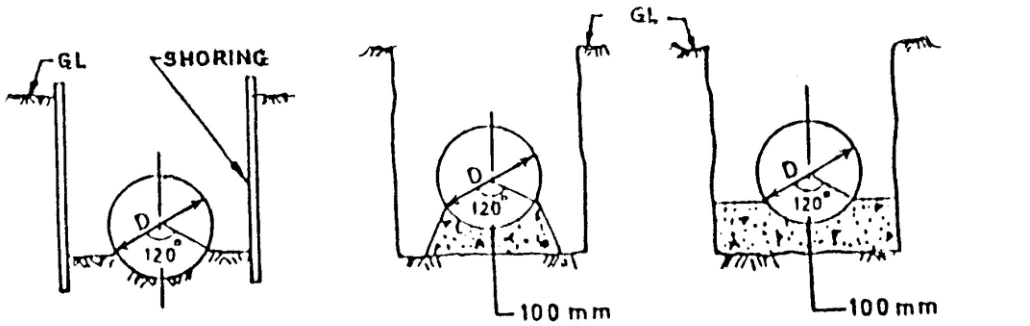


FIG. I TRENCHING FOR PIPES

4.1.1 Braced and sheeted trenches - Open-cut trenches shall be sheeted and braced if required. When close sheeting is required, it shall be so driven as to prevent adjacent soil from entering the trench either below or through such sheeting.

The client shall have the right to order the sheeting to be driven to the full depth of the trench or to such additional depths as may be required for protection of the work. Where the soil in the lower limits of a trench has the necessary stability, the client at his discretion may permit stopping of the driving of sheeting at some designated elevation above the trench bottom. Trench bracings and sheeting provided in the trench shall normally be removed during backfilling. Trench bracing may be removed when the backfilling has reached the respective level and sheeting shall be removed after the backfilling has been completed or has been brought up to such an elevation as to permit safe removal. Sheeting and bracing shall also be removed before filling the trench but only in such a manner as will ensure adequate protection of the completed work.

4.1.2 Provision for joints **-** While jointing pipes in trench, additional excavation of required width and depth shall be provided at such places to permit welding/positioning of sockets and flanges. A minimum of 300 mm additional clearance on all sides of a pipe for a length of about 450 mm is recommended for this purpose.

4.2 Backfilling - For the purpose of backfilling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top:

a) Zone `A': From the bottom of the trench to the level of the centreline of the pipe

b) Zone `B’: From the level of the centreline of the pipe to a level 400 mm above the top of pipe, and

c) Zone `C’: From a level, 400 mm above the top of the pipe to the top of the trench

4.2.1 Backfill material - All backfill materials shall be free from cinders, ashes, slag, refuse, rubbish, organic material, boulders, stone or other material, which in the opinion of the authority is unsuitable. The following materials shall be used depending upon site condition.

*4.2.1.*1Backfill with excavated material - Excavated material shall be used for backfilling in any zone when the backfill material is not specified provided that such material consists of loam, clay, sand, fine gravel or other material which are suitable for backfilling. It should not contain any sharp-edged material that will cause damage to the coating of the pipe.

4.2.1.2 Backfill sand - Sand used for backfill shall be natural sand graded from fine to course.

4.2.1.3 Backfill murram - Murram used for backfill shall be natural murram having durable particles graded from fine to course in a reasonably uniform combination with no stones *larger* than 20 mm in size.

4.2.2 Method of backfilling - Backfilling in Zone `A’ shall be done manually with sand, fine gravel or other approved material placed in layers of 150 mm and compacted by tamping. Backfilling in Zone `B’ shall be done manually or by approved mechanical methods in layers of 150 mm. Backfilling in Zone `C’ shall be done manually or by approved mechanical methods.

5. LAYING OF UNDERGROUND PIPES

5.1 **Pipe Handling** - Delivery of the pipes, specials and appurtenances shall be taken from the stockyard of the authority and transported to the site of laying and stacked along the route on timber skids or on soft material. While unloading, pipes shall not be thrown down from the trucks nor shall be dragged or rolled along hard surfaces. All pipes, fittings, valves shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipe materials and protective coatings and linings. Slings of canvas or equally non-abrasive material of suitable width or special attachment shaped to fit the pipe ends shall be used to lift and lower coated pipes so as to eliminate the risk of damage to the coating. Metallic wire ropes slings for handling of pipes should not be used.

5.2 **Pipe Inspection**

5.2.1 Steel pipes and specials - Steel pipes and specials shall be inspected and defects such as protrusions, grooves, dents, notches etc noticed, if any, shall be rectified. Care should be taken that the resulting wall thickness does not become less than the minimum required. If the wall thickness reduces by more than 10 per cent of the original thickness, the damaged portion shall be cut out as a cylinder and replaced by a good piece of pipe. In case of a dent if the depth of the dent exceeds 2 per cent of the outer diameter of the pipe, same shall be removed. Dents shall be removed by cutting out a cylindrical portion of the pipe and replacing the same with good piece of pipe. Insert patching may be permitted if the diameter of the patch is less than 25 per cent of the nominal diameter of the pipe. Repairs by hammering with or without heating shall not be permitted. Any damage to the internal coating shall also be carefully examined and rectified.

5.2.2 Cast iron and ductile iron pipes and fittings - Cast iron and ductile iron pipes and fittings shall be inspected for defects and shall be rung with a light hammer preferably while suspended to detect cracks. Cracks can also be detected by smearing the outerside of pipe with chalk dust and by pouring a little kerosene on the inside of the pipe at the suspected spots.

5.2.3 Polyethylene pipes and fittings - Polyethylene pipes and fittings shall be inspected and if a damage or kink is noticed, same should be cut out completely.

5.3 Lowering and Assembling of Pipes and Specials - The pipe shall be lowered progressively with the help of shear legs or cranes using wide belts or slings. Extra care shall be taken to preserve the coating while lowering. After the pipe is lowered, it shall be laid in correct line, level and gradient by use of levelling instruments. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in line.

When laying is not in progress, a temporary end closure should be securely fitted to the open end of the pipeline. This shall make the pipe buoyant in the event of the trench being flooded, in which case the pipes should be held down either by partial re-filling of the trench or by temporary strutting.

All underground pipelines shall be preferably laid in slope (minimum slope 1:500) for ease of draining the pipeline. Drain valves shall be provided at the lowest point and the drain line shall be extended up to the nearest drain if hydrostatic level permits. Otherwise drain pit with dewatering sump shall be provided.

5.3.1 Welded pipes - For steel pipes, care shall be taken so that the longitudinal joints of consecutive pipes are staggered by at least 30 deg and shall be placed at the upper third portion of the pipeline. If there are two longitudinal joints they should be on the sides. While assembling, the pipe faces shall be brought close enough to leave a uniform gap not exceeding 2 mm. In case of large diameter pipes, the spiders from inside and tightening rings from outside or other suitable equipment should be used to keep the two faces in shape and position till at least one run of the welding is carried out. The pipe faces shall be tack-welded alternatively at one or more diametrically opposite pairs of points. After completing tack-welding, full welding shall be carried out in suitable runs following a sequence of welding portions of segments diametrically opposite.

For fittings fabricated from pipes, reference should be made to IPSS:1:06:020-95.

5.3.2 Socket and spigot pipes (cast iron and ductile iron) - After placing a length of pipe in the trench, the spigot end shall be centred in the socket and forced inside and aligned to gradient. On level ground, the socket ends shall face the upstream but when the pipeline runs uphill

the socket ends should face the upgrade. Deflection of socket and spigot end pipes in horizontal or vertical plane are permitted within certain limits,

For lead joints : 2.5 deg

Rubber joints

- for nominal bore 80 to 300 mm : 5 deg
- for nominal bore 350 to 400 mm : 4 deg
- for nominal bore 450 to 750 mm : 3 deg

On gradients of 1:15 or steeper, precautions shall be taken to ensure that the spigot of the pipe being laid does not move into or out of the socket of the laid pipe during the jointing operations. As soon as the joint assembly has been completed, the pipe shall be held firmly in position while the trench is backfilled over the barrel of the pipe. The backfill shall be well compacted.

Wherever cutting of pipe is required at site, the same shall be done with special precaution as laid down in IS:3114.

5.4 Pipeline Anchorage

All socket and spigot jointed pipelines require anchorage -

i) at changes of direction and at dead ends to resist the thrust developed by internal pressure, and

ii) when they are laid on steep gradient.

Anchor or thrust blocks shall be designed in accordance with IS:5330. Steeply inclined pipelines shall be secured by transverse anchors spaced as indicated in Table-1.

TABLE - 1

SPACING OF TRANSVERSE ANCHORS FOR STEEPLY INCLINED PIPELINES

Gradient		Spacing (m)
1 in 2 and steeper	..	5.5
Below 1 in 2 to 1 in 4	..	11.0
Below 1 in 4 to 1 in 5	..	16.5
Below 1 in 5 to 1 in 6	..	22.0
Flatter than 1 in 6	..	Not usually required

Typical anchor blocks to resist horizontal thrust, vertical thrust and gradient thrust for buried mains are shown in Fig. 2.

The thrust developed in a pipeline at change of direction or at closed ends can be calculated using the following formulae.

Formulae for thrust calculation:

1. At change of direction Pressure thrust : $p.a.2.\text{Sin}\ \theta/2$

2. At closed valves, blank ends Pressure thrust : p.a.

3. Dynamic thrust due to flow of fluid in a bend is calculated as Dynamic thrust : $2\ \text{Sin}\ \theta/2.\ \rho.\frac{a.\ v2}{g}$

4. Total thrust at a bend due to pressure and change of direction is calculated as Total thrust : $2\text{Sin}\theta/2.(\rho.a+\rho.\frac{a.v2}{g})$

where

p = pressure
a = area on which the pressure
θ = angle of deviation
ρ = density of fluid
v = velocity

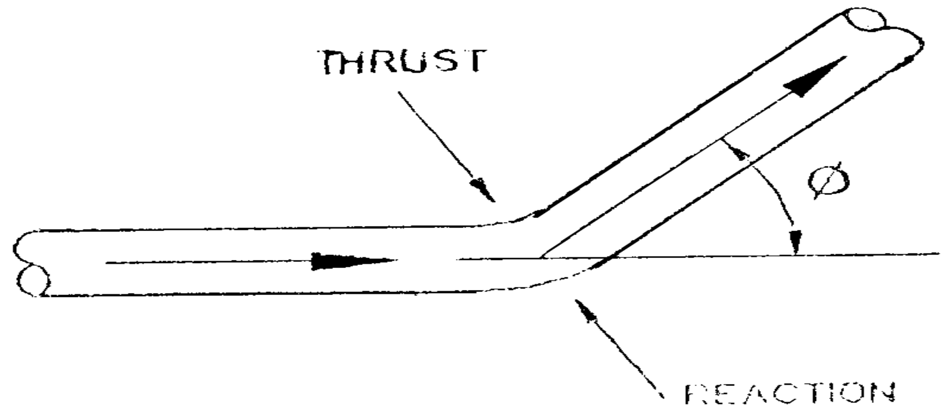


Fig 2

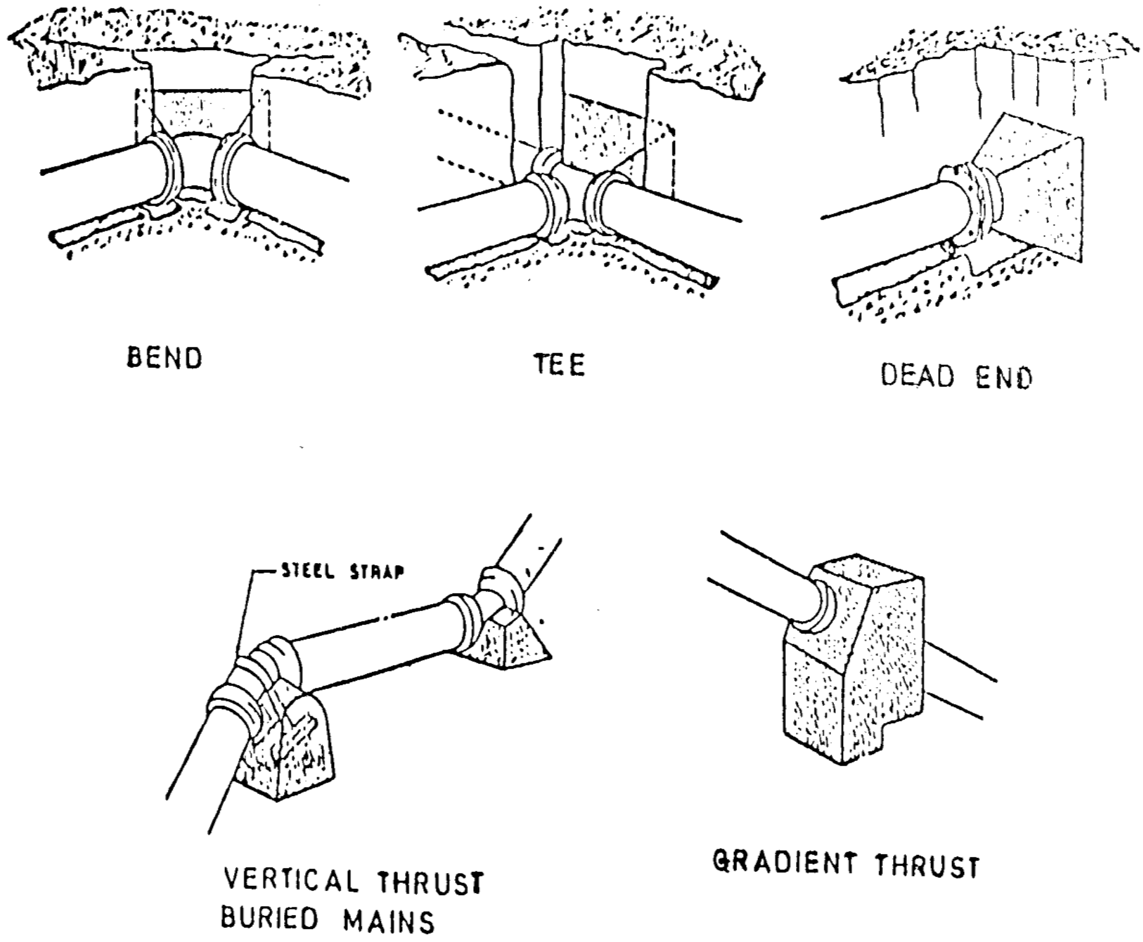


FIG. 2 TYPICAL THRUST BLOCKS

5.5 Pipe Spacing - For underground laying of more than one pipeline side by side, the following clearance shall be maintained between the pipes as well as between the pipe wall and trench wall:

TABLE - 2

SPACING OF PIPES IN TRENCHES

Sl. No.	Nominal dia (mm)	A (mm)	B (mm)
1.	Up to 150	300	200
2.	200 to 500	400	300
3.	600 to 750	500	500
4.	800 and above	Min. 500 and will increase depending upon the pipe dia	

TABLE-2

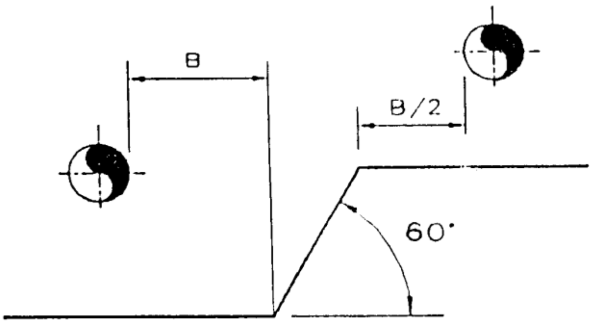


FIG. 3A

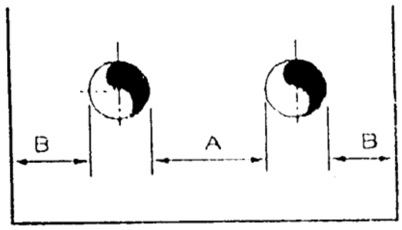


FIG. 3B

Note: Minimum trench width shall be 750 mm

5.6 Avoidance of other Service Pipes

As far as possible, water pipelines shall be laid below existing services and also below gas pipes, cables, cable duct and drains at crossings, but not below sewers, which are usually laid at greater depth. If it is unavoidable, water pipelines below sewer shall be properly protected. A minimum clearance of 150 mm shall be provided between any pipeline. In case of laying water line parallel to sewer line, a minimum clear spacing of 1.5 m shall be maintained, however, for drinking water network, crossing or laying of pipeline close to sewerage line shall be avoided. At least 3 m clearance shall be maintained while laying drinking water and sewerage lines in parallel. For crossing of drinking water and sewerage pipelines, the sewerage line shall be encased.

5.7 Road and Railway Crossing

All underground pipelines crossing rail tracks or roads where the depth of the cover from the bottom of the ties or road bed to the top of the pipe is less than 1500 mm shall be protected. This protection may be either culvert, concrete casing pipe or concrete trench with cover depending upon suitability and the decision of the Purchaser.

In case of casing pipe, the ends shall be sealed. Concrete trenches shall also be sand filled. Concrete pipe sleeves shall be of extra strong reinforced concrete casing pipes of suitable length. The minimum size of a casing pipe shall be as per Table-3 given on the next page.

5.8 Earth Coverage

All buried pipe work shall be laid with earth cover sufficient to avoid damage from pressure of vibration caused by surface traffic. Minimum earth covering over the pipe shall be 1000 mm from the finished ground level in areas subject to temporary loads.

TABLE - 3

CASING PIPE SIZES

Service pipe dia (mm)	Minimum dia of casing pipe	
	For flanged pipelines (mm)	For welded pipelines (mm)
100	300	200
150	400	250
200	500	300
250	600	400
300	600	500
350	600	500
400	700	600
500	800	600
600	900	700

5.9 Protection of Underground Pipelines

5.9.1 Buried steel pipelines are liable to external corrosion and shall be protected by the use of suitable coatings. Protective coating/wrapping shall also be provided for ductile iron pipes when laid in aggressive soils.

Steel pipelines shall be coated with any of the following as per the decision of the Purchaser:

i) Coal tar enamel and fibre glass resin polyester tissue in accordance with IS: 10221.

ii) Corrosion protection tape

iii) Concrete as per IS: 1916.

When the pipe is coated/wrapped before laying, same shall be made continuous after laying.

In case of laying in aggressive soil, ductile iron pipes shall be protected using adhesive tape coating or by polythene sleeving.

All buried steel pipes shall be provided with cathodic protection in addition to wrapping when the soil is very corrosive in nature.

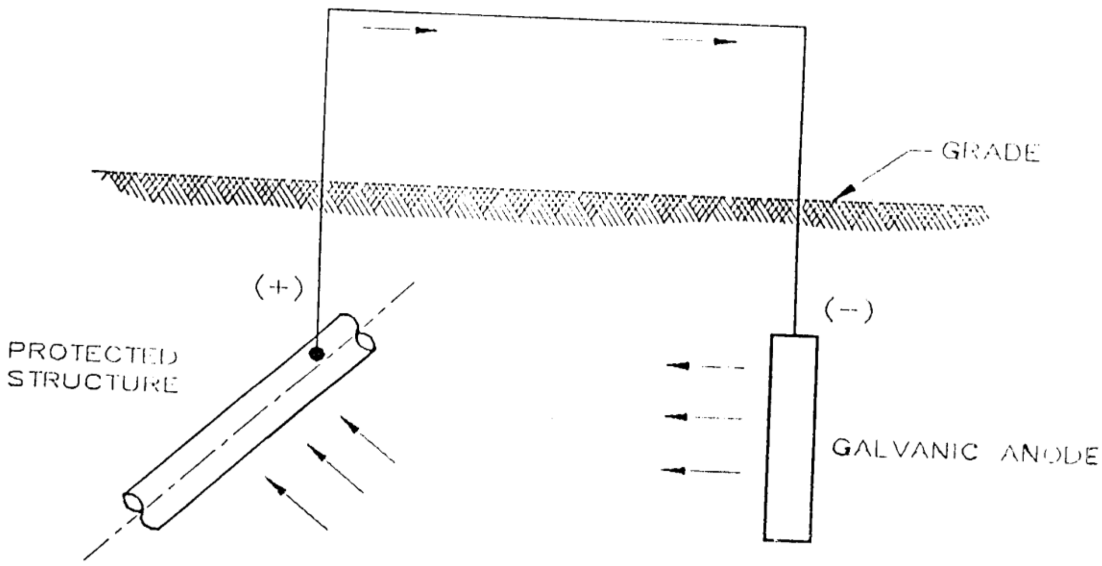
5.9.2 Cathodic protection

Cathodic protection systems reverse the electro chemical corrosive force by creating an external circuit between the pipeline to be protected and an auxiliary anode (sacrificial metal) buried in the ground at a predetermined distance from the pipe. Direct current applied to the circuit is discharged from the anode surface and travels through the surrounding electrolyte to the pipe (cathode) surface.

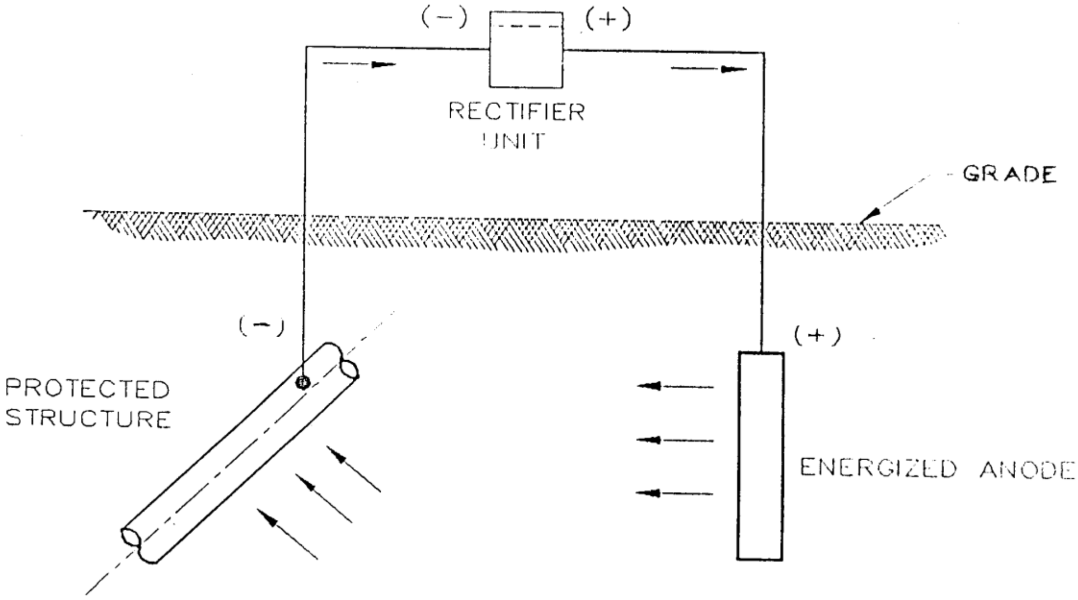
Two (2) methods are available for generating a current of sufficient magnitude to guarantee protection. In the first method, sacrificial anode material such as magnesium or zinc is used to create galvanic cell. The electrical potential generated by the cell causes current to flow from the anode to the pipe, returning to the anode through a simple connecting wire (refer Fig. 4A). This system is generally used where it is desirable to apply small amounts of current at a number of locations, most often on coated pipelines in lightly or moderately corrosive soils.

The second method of current generation is to energies the circuit with an external DC power supply. This technique, commonly referred to as the impressed current method, uses relatively inert anodes (usually graphite or silicon cast iron) connected to the positive terminal of a DC power supply, with the pipe connected to the negative terminal (refer Fig. 4B). Impressed current shall be supplied in several ways. The rectifier can be changed ac into dc, solar systems or fuel cells can produce dc directly and diesel engines can drive dc generator. However, when commercial electricl power is available, it is almost always chosen as it is reasonably efficient trouble-free and cheap. This system is generally used where large amount of current is required at relatively few locations, and in many cases it is more economical than sacrificial anodes.

For cathodic protection, a corrosion survey including chemical-physical analysis of the soil shall be performed along the pipeline.



FIG−4A: CATHODIC PROTECTION−GALVANIC ANODE TYPE



FIG−4B: CATHODIC PROTECTION−RECTIFIER TYPE

5.10 Internal Coating or Lining

Where water to be conveyed is aggressive in nature, the pipeline should be provided with an internal coating or lining of bitumen, coal tar, epoxy resin, basalt. Care shall be taken to ensure that the material used for lining is non-toxic. The lining shall be applied before or after laying. In the former case, it shall be made continuous after laying. Ductile iron pipes shall normally be cement lined to reduce the frictional headloss of the conveying fluid.

5.11 Pipeline Markers

Distinctive markers at a distance of every 40 meters approx. for straight pipes and marker for every change of direction shall be placed at ground level to identify the location of important pipelines and valves and valve pits shall be marked.

5.12 Valves, Instruments and Surge Protection Devices

The spacing of isolation valves along a pipeline depends upon the type of terrain through which the pipeline passes and the operational flexibility required. For long distance pipelines, isolation valves shall be positioned as follows:

i) At the beginning and end of the pipeline

ii) To facilitate hydrostatic testing and repair of sections of the pipeline

iii) On either side of a major crossing.

Valve pits shall be constructed for all isolation valves and pipe drainage facility shall also be provided at such locations in addition to drainage valves at lowest points as far as possible. Air release valves shall be provided at all areas where the pipe has been locally raised.

Dismantling joints or any other suitable device shall be provided at regular interval for long distance pipeline and at valve pits depending upon space availability for pipe diameter DN 300 and above.

Proper surge suppression devices shall be provided in long distance water pipelines to avoid water hammer after carrying out surge analysis.

Pressure indicating and flow recording instruments shall be provided at suitable locations satisfying the norm laid down by the instrument manufacturer.

5.13 Valve Chambers

5.13.1 All valves and instruments provided in underground pipelines shall be placed in RCC valve pits covered with RCC slabs and provided with manhole and cover. The chamber size shall enable free movement during maintenance and or repair work to the valves.

Gate valves for size up to DN 350 shall be placed in valve pits. Gate valves of size DN 400 and above shall normally be gear operated and for these valves, operating room shall be provided having valve operating platform and monorail for maintenance.

All valve pits and valve operating room shall be provided with dewatering sump.

The height of wall pit shall be 300-500 mm from **FGL (Finished ground level)**

6.0 JOINTS AND JOINTING

Type of joint varies with the material of construction of the pipe. However, various types of joints used for different types of pipes are discussed below:

6.1 Jointing of Polyethylene Pipes

The commonly used joints for polyethylene pipe are as follows:

i) Insert type joints

ii) Compression fittings

iii) Fusion welding

iv) Threaded joints

v) Flanged joints and

vi) Telescopic joints.

Insert type joints are commonly used for LDPE pipes wherein a serrated PE or metallic fitting is inserted into the pipe and tightened by a clip. Fusion welding shall commonly be used in HDPE pipes. Screwed joints are common for high pressure pipes and flanged joints are used for jointing LDPE and HDPE pipes of 100 mm and above size to valves etc. Telescopic joints are normally not recommended. For further details of jointing of polyethylene pipes, reference shall be made to IS:7634 (Part-II).

6.2 Jointing of CI/Ductile Iron Pipe

Two types of joints shall be used with CI/ductile iron pipes:

i) Socket and spigot joints

ii) Flanged joints

6.2.1 <u>Socket and spigot joint</u> - CI socket and spigot pipes shall either be lead jointed or flexible jointed type (TITON joint). Flexible joints incorporate gasket of elastomeric materials and the joints shall be simple push-on-type or mechanical joint type where the seal is effected by the compression of a rubber gasket between a sealing on the inside of the socket and the external surface of spigot. Rubber gasket for flexible joints or TITON joints shall conform to IS:12820.

Flexible joints shall normally used in clear water and drinking water services and lead caulking in effluent lines.

6.2.1.1 <u>Lead joints</u> - This type of joint is made by first caulking in spun yarn then filling the remainder of the joint space by running in molten lead and then thoroughly caulking the lead. Lead for caulking purpose shall conform to IS:782. The quantity of lead required for different sizes of pipes shall be as per Table 4 given on the next page.

6.2.2 <u>Flanged joint</u> - Flanged joints shall be made on pipes having a flange at each end of the pipe. The seal is usually effected by means of a flat rubber gasket compressed between two flanges by means of bolts.

Ductile iron pipes shall be either flanged joint or socket and spigot flexible joint type as described above.

TABLE - 4

DETAILS OF LEAD JOINTS

Nominal size of pipe (mm)	Lead/joint (kg)	Depth of lead joint (mm)
80	1.8	45
100	2.2	45
125	2.6	45
150	3.4	50
200	5.0	50
250	6.1	50
300	7.2	55
350	8.4	55
400	9.5	55
450	14.0	55
500	15.0	60
600	19.0	60
700	22.0	60
750	25.0	60
800	31.5	65
900	35.0	65
1000	41.0	65
1100	46.0	65
1200	52.0	70
1500	66.5	75

Note: The quantities of lead given are provisional and a variation of 20 per cent is permissible either way. For details of lead caulking reference should be made to IS: 3114.

6.3 Jointing of Steel Pipes

Commonly used joints for steel pipes are as follows:

i) Welded joint
ii) Flanged joint
iii) Screwed joint

The welding of pipes in the field shall comply with IS:816. Electrodes used for welding shall comply with IS:814.

7.0 TESTING OF PIPELINE

7.1 General - Before commissioning, all pipelines shall be tested for:

i) Mechanical soundness and leakage tightness of pipes and fittings

ii) Leak tightness of joints and

iii) Soundness of any construction work, in particular that of the anchorages.

7.2 Field Testing of Underground Pipes

After the pipe has been laid and all joints completed, the trench may be backfilled leaving 600 mm on each side of the joints exposed till the line has been tested and approved. Bulkheads or plugs of a type which will not damage lining, pipe ends or threads, shall be used in each section to be tested. Before applying the test pressure, all air shall be expelled from the section under test.

7.3 Procedure for Test

Each section of the pipe to be tested shall be slowly filled with clean water and all air shall be expelled from the pipeline through air release valves and various outlets fixed on the pipelines. The specified test pressure shall be applied based on the elevation of the lowest point of the linear section under test and corrected to the elevation of the test gauge, by means of a pump connected to the pipe.

All exposed pipes, fittings, valves and joints shall be carefully examined during the open trench test. Any visible leaks observed in pipe joints should be properly repaired. Any cracked or defective pipes, fittings, valves discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until satisfactory to the Authority.

7.4 Duration of Test

The duration of each pressure test shall not be less than 2 hours. During the test period there shall be no drop in pressure of water.

7.5 Test Pressure

All water pipe work as erected shall be tested at 1.5 times the maximum operating pressure of the pipe work or the pressure to which the pipeline shall be subjected under surge condition.

8.0 COMMISSIONING

8.1 General

The cleaning, flushing and commissioning of the pipe work shall be carried out after completion of hydrostatic tests. Cleaning shall be carried out prior to erection as well as after erection.

8.2 Cleaning

All pipe work shall be thoroughly cleaned of all foreign matters such as scales, dirt, oil, grease etc by wiping and wire brushing before fabrication and erection/assembly.

8.3 Flushing

All pipelines shall be flushed till all dirt, scales and foreign matters are removed immediately prior to commissioning. During flushing equipment such as filters, heat exchanger shall be by-passed to prevent entry of dirt and foreign matters into the same.

8.4 Disinfection of Drinking Water Mains

8.4.1 The mains intended for potable water supplies shall be disinfected before commissioning them for use. Special care should be taken to avoid contamination of pipes, valves, fittings and pipe interiors, both before and during construction.

8.4.2 After pressure testing the pipe main shall be flushed with water of sufficient velocity to remove all dirt and foreign materials. After flushing disinfection shall be done using liquid chlorine, sodium or calcium hypochlorite using the following methods:

8.4.2.1Continuous feed

In this method water having a chlorine concentration of at least 20 to 50 mg/lit is fed to the new main at a constant rate. The water shall remain in the main for a minimum of 24 hours, during which time all valves, hydrants, etc along the main shall be operated to ensure their proper disinfection. Following the 24 hours period no less than 10 mg/l chlorine residual shall remain in the main.

8.4.2.2Slug method

In this method, a continuous flow of water is fed with a constant dose of chlorine but with rates proportioned to give a chlorine concentration of at least 300 mg/l. The chlorine is applied continuously for a period of time to provide a column of chlorinated water that contacts all internal surfaces of the main for a period of at least 3 hours. As the slag passes tees, crosses, etc proper valves shall be operated to ensure their disinfection. This method is used mainly for large diameter drinking water mains.

8.4.3 During disinfection, proper care shall be taken to prevent flow of strong chlorine solution into the supply line. After disinfection, the chlorinated water shall be flushed to waste until the remaining water has residual chlorine equal to that pertaining in the rest of the system.

REFERENCES

a) IS 5822:1994

Code of practice for laying of electrically welded steel pipes for water supply (second revision).

b) IS 12288:1987

Code of practice for use and laying of ductile iron pipes.

c) IS 3114:1994

Code of practice for laying of cast iron pipes (second revision).

d) IS 7634 Part II: 2012

Code of practice for plastic pipework for potable water supplies.

e) IS 10221:2008 Code of practice for coating and wrapping of underground mild steel pipelines

f) Government Manual on Water Supply & Treatment (third Edition)