इंटरनेट मानक

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Jawaharlal Nehru
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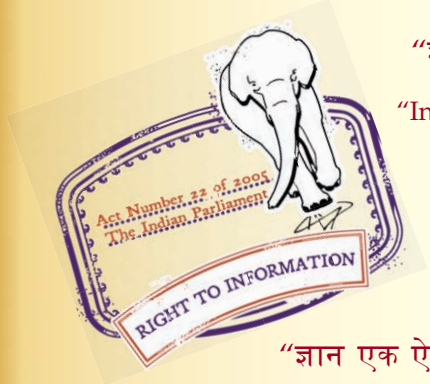
IS 13916 (1994): Code of practice for installation of glass fibre reinforced plastic (GRP) piping system [CED 50: Plastic Piping System]



"ज्ञान से एक नये भारत का निर्माण"
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"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 13916 : 1994
(Reaffirmed 2004)

भारतीय मानक

कांच रेशा प्रबलित प्लास्टिक (जी आर पी) पाइपिंग तंत्र की स्थापना — रीति संहिता

Indian Standard

INSTALLATION OF GLASSFIBRE REINFORCED PLASTIC (GRP) PIPING SYSTEM — CODE OF PRACTICE

UDC 621 : 643·2 [678·0675] : 006·76

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1994

Price Group 5

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastic Pipes and Fittings Sectional Committee had been approved, by the Civil Engineering Division Council.

With the publication of IS 12709 : 1994 'Specification for glass fibre reinforced plastic (GRP) pipes, joints and fittings for use for potable water supply (*first revision*)', the technical committee felt it necessary to prepare a code of practice for the installation of these pipes so as to provide guidelines for the users to follow a uniform and correct method. This code has been prepared with this in view.

The committee responsible for the formulation of this standard is given at Annex A.

Indian Standard

INSTALLATION OF GLASSFIBRE REINFORCED PLASTIC (GRP) PIPING SYSTEM — CODE OF PRACTICE

1 SCOPE

1.1 This standard describes procedure of laying GRP piping system installation and includes requirements for trenching, handling, jointing, compaction of back filling and post installation hydrostatic test.

1.1.1 This code does not cover installation that require special attention, techniques and materials like:

a) Pipe through rigid walls,

b) Subaqueous piping, and

c) Plant or pumping station piping.

NOTES

1 Pipes, fittings and rubber gaskets to be used for installation of piping system as per this code shall conform to the following standards:

a) The GRP pipes, jointing and fittings shall conform to IS 12709 : 1993.

b) The Rubber gasket shall conform to IS 5382 : 1985.

2 Appropriate stiffness class of the GRP pipe (*see* IS 12709 : 1994) shall be selected to withstand the overburden (dead load), live load and vacuum conditions, if any, considering site conditions.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
5382 : 1985	Rubber sealing rings for gas mains, water mains and sewers (*first revision*)
12709 : 1993	Specification for glass-fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply (*first revision*)
2720 (Part 7) : 1980	Methods of test for soils : Part 7 Determination of water content dry density relation using light compaction (*second revision*)

3 TERMINOLOGY

3.0 The terms defined in IS 12709 : 1994 shall apply in addition to those defined in **3.1** to **3.13** (*see* Fig. 1).

3.1 Bedding

Bedding is the sound granular material directly beneath the pipe in the trench bottom. Bedding includes the basic trench foundation '*E*' if required plus especially prepared layer of sand '*F*' on which pipe will rest.

3.2 Coupling Area of Joint

This is the space inside the socket in which the rubber ring gasket operates.

3.3 Groove

This is a seating made by turning to lodge the rubber ring gasket. It possesses the section laid down in the design and is machined at one end of each pipe section or in the coupling as the case may be.

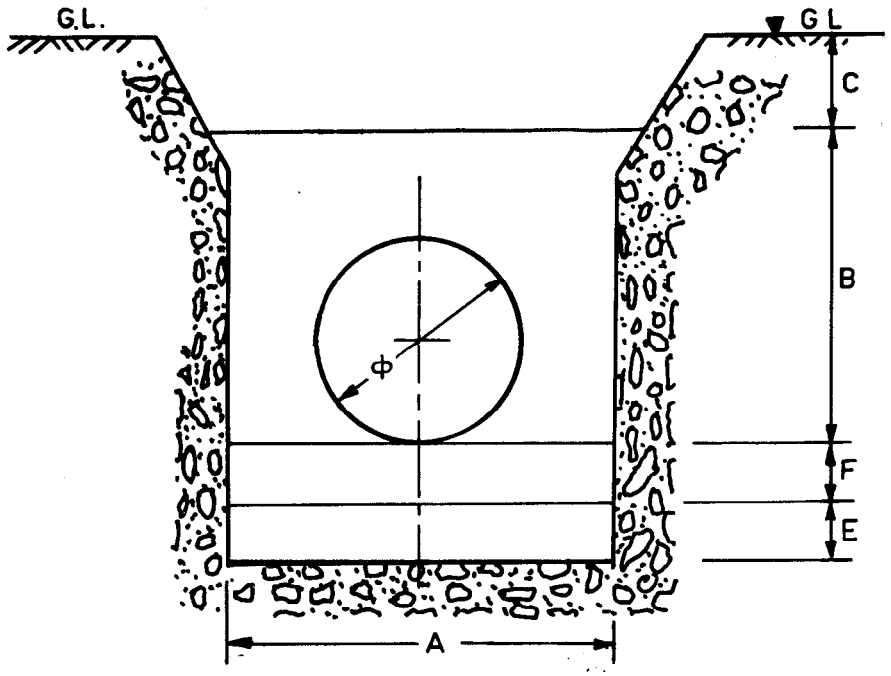


FIG. 1 TRENCH CROSS SECTION SHOWING TERMINOLOGY RELATIONSHIP

3.4 Leading in

This is the initial part of the socket and assists insertion of the rubber ring gasket.

3.5 Pipe Zone (B)

It is the trench cross section area from the bottom of the pipe to a minimum of 300 mm above the top of the pipe and is filled with sound granular soil (*see* **3.12**).

3.6 Primary Backfill

It is the initial compacted backfill within the pipe zone upon which the pipe will depend for side support and will consist of sound granular material.

3.7 Relative Compaction

It means the density of compacted, dry site soil expressed as a percentage of laboratory standards, as determined by the procedure.

3.8 Ring Deflection

It means an out of round condition not exceeding 5% of the diameter of a pipe section as a result of external loads imposed upon it.

3.9 Rubber Ring Gasket or Packing

This is a rubber ring having the section, diameters and hardness specified by the design and forms the hydraulic seal for the pipes.

3.10 Secondary Backfill (C)

It is between the pipe zone and ground level and is filled with properly compacted native soil.

3.11 Socket

In this part of a pipe, the end of the pipe bearing the rubber ring gasket is inserted or it is a coupling with rubberring gaskets as the case may be.

3.12 Sound Granular Soil

It shall be crushed rock with a size range of 5 mm to 25 mm, pea gravel or sand.

3.13 Unstable Ground

It shall mean native soil which are soft, mushy and/unstable to stand vertically when excavated and which can not be expected to provide a firm foundation or side support.

4 HANDLING

4.1 Transportation

All pipe sections and fittings shall be supported on timber saddles spaced at 4 m centres with a maximum overhang of 2 m. Stock height should not generally exceed 2 m. Pipes shall be strapped to the vehicle over the support points using non-metallic pliable straps or ropes only.

4.2 Storing of Pipe and Fittings

4.2.1 Pipes and fittings with diameters of less than 1 m may be stored directly on sandy soil, the ground should be flat and free from sharp projection and stones/rocks bigger than 40 mm in diameter or of other potentially damaging debris.

4.2.2 Pipes with diameters greater than 1 m may be stored on their delivery cradles at a maximum distance of 6 m c/c.

4.2.3 If the surface is not flat or is sloping, then all the pipes shall be checked to prevent rolling.

4.2.4 All rubber rings, gaskets and other items shall be stored in a cool, dry and dark place to avoid damage of any kind.

4.2.5 The containers of lubricants should be kept tightly closed to avoid entry of dirt.

4.3 Unloading, Lifting and Lowering

4.3.0 The following procedures should be followed so as to eliminate potential damage to pipes and fittings and to maintain maximum safety during unloading, lifting and lowering.

4.3.1 All the pipes and fittings shall be lifted with pliable straps, slings or ropes. These may be canvas or polyester belts with a minimum width of 10 cms or nylon ropes with a minimum diameter of 30 mm. Steel cables or ropes shall not be used for lifting and transportation of pipe. Ropes shall not pass through the section of the pipe end to end.

4.3.2 Straight continuous lengths of pipe may be lifted at one point. However, owing to its very smooth surface it is usually safer for the pipe to be lifted at two points.

4.3.3 Pipe assemblies fabricated in multiple sections or special places shall be lifted with two or more lifting points.

4.3.4 Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.

4.3.5 Pipes of different diameters may be nested to reduce the transportation cost and space. Denesting accomplished by starting with smallest size by lifting slightly with an inserted padded beam to suspend and carefully moving it out of the bundle without touching the other pipes.

NOTE – Stacking of different diameter pipes by nesting however, is not permitted, except in their original transport packing.

5 PIPE JOINTING

5.0 General

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Selection of different pipe jointing system depend upon location, site and working condition, pressure and flow of liquids.

5.1 Unrestrained Pipe Joint

These pipe joints are capable of withstanding internal pressure but not longitudinal forces. These joints however can accommodate the linear variation of the pipe due to temperature variation.

5.1.1 *Spigot and Socket Joint with Single Water Tight – Rubber Ring Gasket/Packing*

This type of joint enables a pipeline to be laid speedly

and is suitable for low (up to 3 PN) pressures in burried lines (*see* Fig. 2).

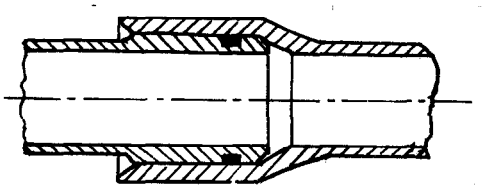


FIG. 2 ILLUSTRATION OF SPIGOT AND SOCKET JOINT WITH SINGLE RUBBER GASKET

5.1.2 *Spigot and Socket Joint with Double Watertight Rubber Ring Gasket/Packing*

This joint is made with double rubber ring and is suitable for high pressure (3 PN and above) (*see* Fig. 3).

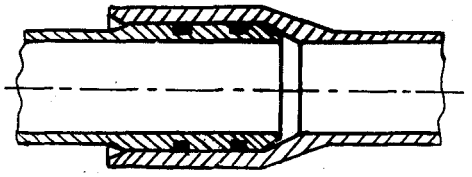


FIG. 3 ILLUSTRATION OF SPIGOT AND SOCKET JOINT WITH DOUBLE RUBBER GASKET

5.1.3 *Double Socket Coupling Joint with Watertight Rubber Ring Gasket/Packing*

This joint is made with double socket type coupling and is suitable both for low and high pressure (*see* Fig. 4).

5.1.3.1 Cleaning, lubrication and installation of rubber ring gasket should be as given in **8.1.7.**

5.1.3.2 The pipe to be connected shall be placed on the bed with the sufficient distance from previously joined pipe to allow lowering of pipe with the coupling into position. Pull the pipe with coupling on to the previously laid pipe by means of jack after clamping the pipe.

5.1.3.3 Care shall be taken in the alignment of the coupling with pipes.

5.2 Restrained Pipe Joint

The restrained type pipe joint is capable of withstanding internal pressure and longitudinal forces. For pipe line consisting of restrained joints only, expansion joints shall be provided in consultation with the manufacturer of pipe fittings.

NOTE – Coefficient of thermal expansion for GRP pipes may be taken as 30×10^{-6} mm/°C.

5.2.1 *Spigot and Socket Joint with Glueing*

This joint is suitable for underground applications under conditions of normal outside loads and low pressures. It is easy to make and enables a high laying speed to be reached. The glueing is to be done by polyester cement or any other adhesive suitable for a hydraulic and mechanical seal (*see* Fig. 5).

5.2.2 *Spigot and Socket Joint with Glue and Overlay*

This type of joint is suitable both for low and high pressure (*see* Fig. 6). Glueing the joint should be done with suitable adhesive and overlay with the same material as used in pipe. The minimum thickness of overlay shall be 1.5 times of the thickness of pipes.

5.2.3 *Butt Joint*

It is used for running pipes and for the connection of straight runs to fittings (reduction, elbows, flanges, etc). The minimum thickness of joint '*t*' shall not be less than

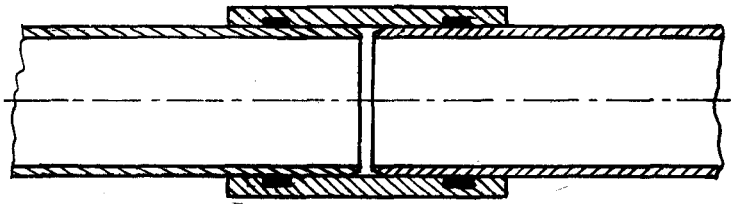


FIG. 4 ILLUSTRATION OF DOUBLE SOCKET COUPLING JOINT

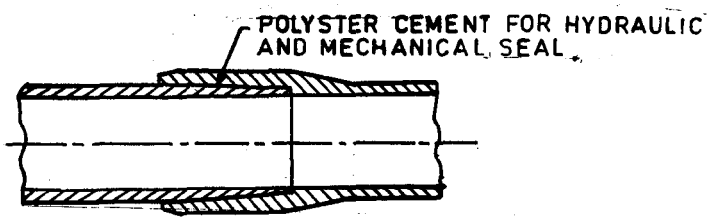


FIG. 5 ILLUSTRATION OF SPIGOT AND SOCKET JOINT WITH GLUEING

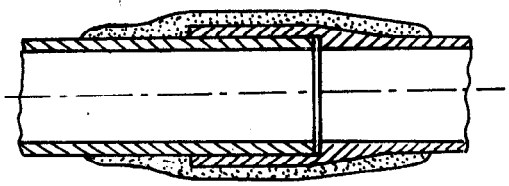


FIG. 6 ILLUSTRATION OF SPIGOT AND SOCKET JOINT WITH GLUE AND OVERLAY

the thickness of pipe. Width of overlay shall not be less than ten times the thickness of the pipe on either side of the joint. The joint is made with hand lay up method (*see* Fig. 7).

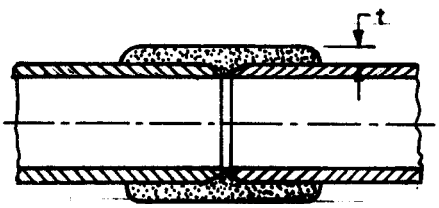


FIG. 7 ILLUSTRATION OF BUTT JOINT

5.2.4 *Flanged Joint*

The flange joint is used for connecting the valves, pumps or any other apparatus or pipes of different materials. The flanged joint is made from the same material as the pipe (*see* Fig. 8).

5.2.5 *Steel Collar on GRP Pipe for Flanged Connection*

A steel loose flange is slipped on to a GRP pipe and then a hand lay up collar is done. The steel collar may now be connected to any flanged connection (*see* Fig. 9).

6 EXCAVATION AND PREPARATION OF TRENCH

6.1 Trench Excavation

6.1.1 *Trench Contour*

The surface at the trench grade should be continuous, smooth and free of big rocks more than 1.5 times the thickness of the pipe if rounded, or more than 1.0 times the thickness of the pipe if they have sharp edges and may cause point loading on the pipe. When ledge rock, hardpan, big rocks, timber or other foreign materials are to be found, it is advisable to pad the trench bottom with sand or compacted fine grained soils at least 15 cm thick so as to provide an adequate foundation.

6.1.2 *Trench Width, A*

The width of the trench at top of the pipe should not be greater than necessary to provide adequate room for joining the pipe in the trench and for compacting the backfill in the zone of the pipe at the side thereof. If necessary, bell holes are permissible at the joints.

6.1.3 *Trench Depth*

Trench depth should be determined by the intended service, properties, size of the pipe and local conditions, such as properties of soil and combination of static and dynamic loading. It should be ensured that the burial depth is sufficient to prevent the conveyed fluids from being affected by frost penetration.

Local, state and other safety regulations/laws should be followed. If required, necessary measures should be taken to support the trench walls with sufficient strength to protect the employees working in the trench.

6.2 Stable Trench Conditions

Stable trench conditions occur with soils where only small displacement is caused by variations in pressure (stresses) or moisture content. Such conditions enable the trench wall to be made vertical from the bed to top of the pipe without the use of shearing or sheet piling (*see* Fig. 10). The slope 'c' at the top edge of the trench on either sides should be provided to avoid caving in of the top soil and to facilitate smooth installation of the pipeline.

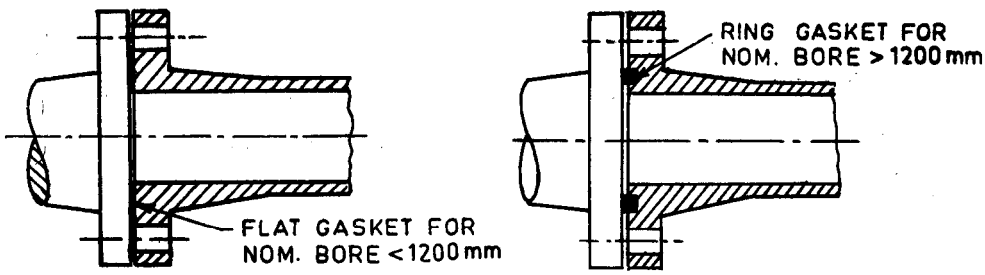


FIG. 8 ILLUSTRATION OF FLANGED JOINT

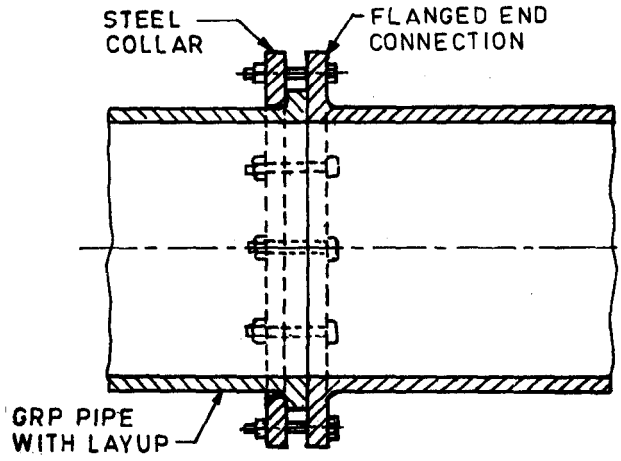
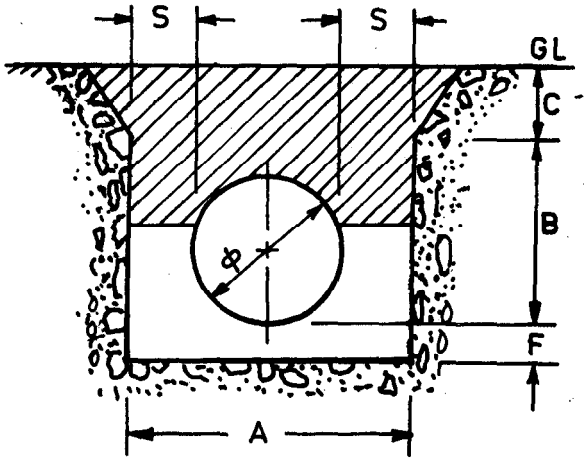


FIG. 9 ILLUSTRATION OF STEEL COLLAR FOR FLANGED CONNECTION



A = Width of the trench.

B = Pipe zone area filled with sound granular soil to a minimum of 300 mm above the top of the pipe.

C = Secondary backfill, having minimum depth as (D-300) mm to avoid floatation and should be encased appropriately in RCC pipe or with RCC slab when impact load/vibration of vehicular traffic or otherwise is anticipated.

S = Should be as per the following values:

Pipe Dia	*S* mm
200 to 500	200
600 to 900	300
1 000 to 1 600	450
Above 1 600	600

F = Bedding (15 cm) minimum.

FIG. 10 INSTALLATION IN STABLE SOILS – METHOD OF TRENCH CONSTRUCTION

6.3 Unstable Trench Conditions

6.3.1 This condition exist when the bottom has soft, loose, or highly expansive soil. Unstable soil conditions occur when soil has less than 1 440 kg/m^2 of cohesion as calculated from an unconfined compression test. Cohesion for different consistency of soil is given in Table 1 for information.

Table 1 Consistency for Cohesive Soils

Consistency	Cohesion in kg/m^2 from Unconfined Compression Test
Very soft	1 220
Soft	1 220-1 440
Medium	1 440-4 880
Stiff	4 880-9 765
Very stiff	9 765-19 530
Hard	19 530

6.3.2 The bottom of the trench and its sides must be stabilized before laying the pipeline. This can be accomplished (*see* Fig. 11 and Fig. 12) by lowering the water table at least 25 cm below the elevation of the invert with well points, shoring or sheet piling the sides or by over excavating the bottom and sides of the trench and replacing them with a mixture of sand and coarse gravel or crushed stone or a combination of the above methods.

6.4 Trench Dewatering

Ideally the water level should be kept below the pipe invert for the installation to proceed normally. In conditions when the water level is high, the usual and most economical method of laying pipes is as follows:

a) Open enough trench to lay one or two lengths of pipe and then backfil;

b) Remove the ground water by starting construction at the outlet and placing the pipe upstream, water will drain through the pipe in this stream;

c) If the pipe has to be laid from the inlet down stream, the water may have to be pumped to the surface of the ground at the top of the trench for disposal; and

d) Do not turn off the dewatering system until sufficient cover depth has been reached to prevent the pipe floatation.

7 BEDDING, BACKFILLING AND COMPACTION

7.1 Bedding

7.1.1 The pipe should be uniformly and continuously supported through its whole length with firm stable bedding material. Pipe bedding material should be sand or gravel as per the requirements on the backfill material (*see* **3.6**).

7.1.2 The bedding should be placed so as to give complete contact between the bottom of the trench and the pipe and should be compacted to provide a minimum compaction corresponding to 90% maximum dry density [*see* IS 2720 (Part 7) : 1980].

7.1.3 If the pipe is supported on grade elevation with use of timber or of tapered wedges, they must be removed and not left in place. They can usually be pulled out after the bedding has been compacted to the specified minimum compaction. The voids from which the timber has been removed must be properly filled and compacted.

7.2 Back Filling

7.2.1 Back filling should be placed in layers not exceeding a depth per layer which can be compacted to a minimum of 85% maximum dry density [*see* IS 2720 (Part 7) : 1980]. Lift should normally not be greater than 30 cm in height and the height differential on each side of the pipe should be limited to this amount so as to prevent lateral movement of the pipe.

7.2.2 Most coarse grained soil are acceptable. This may comprise of gravel or sand. However, silty sand, clayey sand, silty and clayey gravel shall not be used unless proposed to be used in conjunction with gravel or clean sand.

7.2.3 It is very important that the pipe zone backfill material does not wash away or migrate into the native soil. Likewise, potential migration of the native soil into the pipe zone backfill must also be prevented.

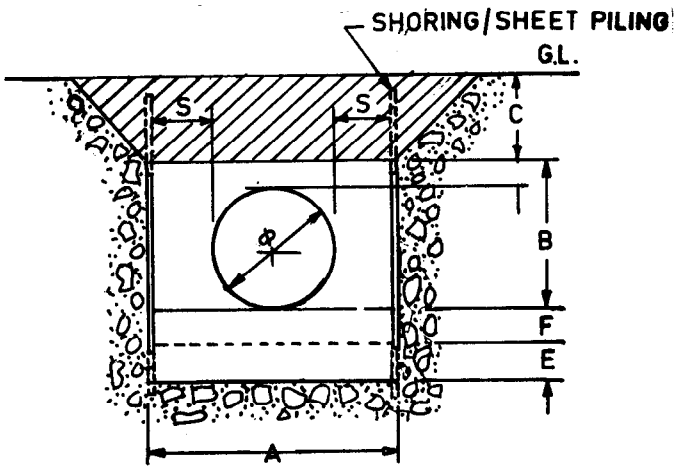
7.2.4 Heavy earth moving equipment used for backfilling should not be brought until the minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or 120 cm in the case of wheeled roaders or roller compactors.

7.3 Compaction

Vibratory methods are preferably for compaction. Compaction within distances of 15 cm to 45 cm from the pipe is usually done with hand tempers.

8 LAYING OF PIPE

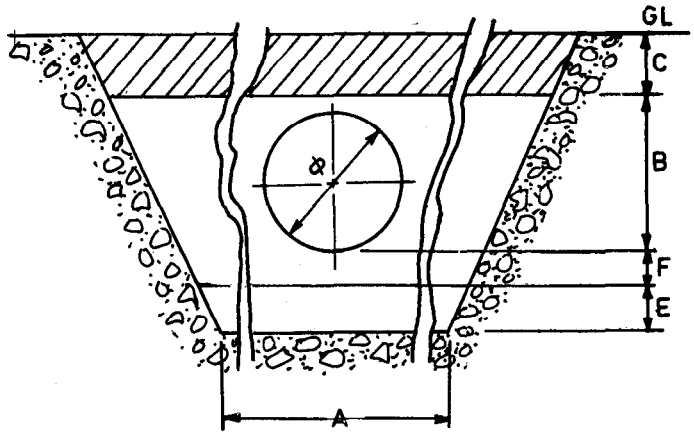
8.1 Laying should take place only after the trench and the surface supporting the pipes have been prepared according to this specification.



E = Foundation (if required), 15 cm minimum

NOTE – *A*, *B*, *C*, *F* and *S* are as explained in Fig. 10.

FIG. 11 METHOD OF TRENCH CONSTRUCTION FOR UNSTABLE SOIL CONDITIONS — ALTERNATIVE 1



NOTE – Notations are as explained in Fig. 11 except S = 1 Diameter (*Min*)

FIG. 12 METHOD OF TRENCH CONSTRUCTION FOR UNSTABLE SOIL CONDITIONS – ALTERNATIVE 2

8.2 For a coupling type of joint, two rubber ring gaskets are first fixed into the groove inside the coupling and then the coupling is to be fixed at the coupling area of the pipe and pipe is to be lowered in the trench.

8.3 Before placing a pipe in the trench, it is necessary to clean any remains of earth, sand or mud from the inside of the socket and from the opposite end bearing the rubber ring gasket/packing. When cleaning has taken place, run a hand around inside the socket to ensure that there are no residues of hardened resin which can be removed readily with a chisel. It is also necessary to check that the groove has an even depth and has not been damaged for instance, during carriage of handling.

8.4 Place the pipe in the trench, taking care to dig a small hollow at each end so that the groove and the socket are well separated from the sand and gravels in the bottom of the trench.

8.5 Anchor the first pipe section laid according to the method described and leave its ends free along a space enough for insertion of the next section and for checking.

Place the next pipe section in the trench and leave enough space for the operator to be free to move and to work between the two pipe sections so as to carry out the cleaning and checking operations (*see* Fig. 13).

8.6 Clean the coupling area of the joint once more with a cloth and also clean the flared portion of the lead-in using suitable lubricant.

8.7 Clean the groove again, take the rubber ring gasket and lubricate it by running it between the hands and checking at the same time, it being in good condition. It should be ensured that every portion of the ring or inside of the socket must not lacks lubricant as it will impair good insertion of the pipe.

8.8 For socket and spigot type of joint, pass the rubber ring under the pipe until it settles into the groove, then pull it forcibly upwards and follow the ring with the hands so that three quarters of it is positioned in the groove, then lift the ring above the upper generating line of the pipe forcibly and then release it so that it falls into the groove thus being freed of any twists.

8.8.1 Run the hands around the pipe to check that the whole of the packing is in its seating and, in the case of large diameter pipes, smear lubricant again above the inserted rubber ring gasket/packing (*see* Fig. 14).

8.8.2 Align and bring together the two pipe sections until rubber ring touches the flared portion of the lead-in.

When this has taken place, examine the position of the ring and above all, ensure that there are no sand or other foreign bodies present.

8.8.3 Fit the socket onto the spigot very slowly, dwelling halfway along the coupling area, and check the position of the packing visually.

8.8.4 Proceed with the joint until the socket is halted by the abutment ledge. The next pipe section should not be fitted until the previous pipe section has been anchored with an overlay of sand.

8.9 Check the rubber ring gasket/packing after the joint has been coupled. This check must always be carried out and is performed with a blade of steel or of another metal having a thickness of 0.4/0.5 mm, a width of 15 mm and any length greater than 200 mm, the blade being inserted into the annular space between the socket and the spigot.

This check should be conducted along all the circumference where the packing is compressed so as to ensure that the rubber ring has a homogeneous depth and is therefore correctly positioned in its seating. If the ring is found to be seated differently at one point than other points or if there is any doubt, disconnect the joint, check the rubber ring and replace it if it shows any permanent signs of faulty seating, check once more the coupling area of the joint, the flared lead-in of the socket and the groove on the spigot. When re-inserting the pipe section, take extra care to align the pipes perfectly. When uncoupling pipe sections, never use chains or steel cables in direct contact with the pipes.

Check once again the position of the ring with the blade.

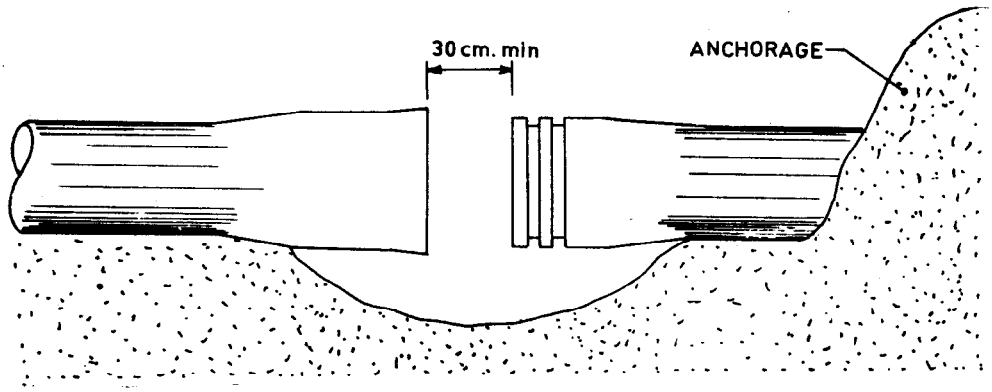


FIG. 13 LAYING OF PIPE

8.10 Misalignment of the Joint

When for reasons of the lay-out of the line the joint has to be misaligned (but such misalignment must remain within the limits provided by the supplier of the pipes), such misalignment at the predetermined angle should be applied only after having inserted the pipe and the joint is thoroughly checked for its watertightness (*see* **9**).

8.11 Lowering of Pipes

Pipes should be lowered in the trench with appropriate mechanical means like chain pulley block, excavators, etc.

8.12 Thrust Block

RCC thrust block should be provided at bends and at places of reduction in cross section to take care of thrust.

9 HYDROSTATIC TESTS

9.1 Completed pipe in joints shall be hydrostatically tested for leakage as given in **9.2** prior to acceptance and service. It shall be done regularly as installation proceeds. Installation should never exceed testing by more than 1 km.

9.2 Leak detection testing shall be carried out at a test pressure corresponding to 1.5 times the pressure class of the pipe/fittings. The test pressure shall be maintained for a period of 24 hours. Each full length pipe section, fittings and joint shall be leak tight.

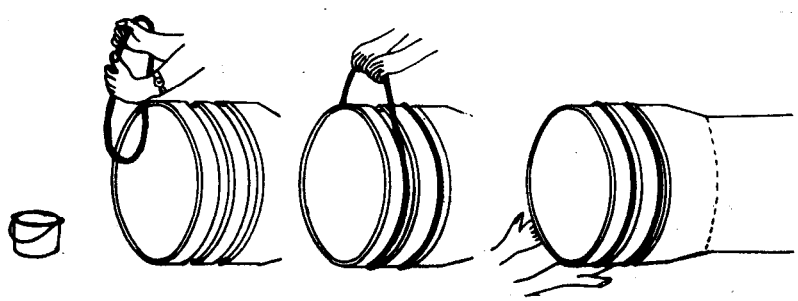


FIG. 14 FIXING OF RUBBER GASKET ON SPIGOT

ANNEX A
(*Foreword*)

COMMITTEE COMPOSITION

Plastic Pipes and Fittings Sectional Committee, CED 50

Chairman	*Representing*
SHRI K. PRABHAKRA RAO	Engineer-in-chief's Branch (Ministry of Defence), New Delhi
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CHIEF ENGINEER (DESIGNS)	Directorate General of Works, Central Public Works Department, New Delhi
SUPERINTENDING ENGINEER (S&S) (*Alternate*)	
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(*Continued on page 10*)

(*Continued from page 9*)

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Panel for GRP Pipes and Fittings, CED 50 : P1

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This Indian Standard has been developed from Doc : No. CED 50 (4736).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at New India Printing Press, Khurja, India