IS 7634-3 (2003): Plastics Pipe Selection, Handling, Storage and Installation for Potable Water Supplies - Code of Practice : Part 3 - Laying and Jointing of UPVC Pipes [CED 50: Plastic Piping System]

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भारतीय मानक

पेय जलपूर्ति के लिए प्लास्टिक के पाइप का चुनाव, प्रहस्तन, भण्डारण और संस्थापन — रीति संहिता

भाग 3 यू पी वी सी पाइपों को बिछाना एवं जोड़ना

(पहला पुनरीक्षण)

Indian Standard

PLASTICS PIPES SELECTION, HANDLING, STORAGE AND INSTALLATION FOR POTABLE WATER SUPPLIES — CODE OF PRACTICE

PART 3 LAYING AND JOINTING OF UPVC PIPES

(First Revision)

ICS 83.140.3;91.140.60

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Plastic Piping System Sectional Committee, CED 50

FOREWORD

This Indian Standard (Part 3) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastic Piping System Sectional Committee had been approved by the Civil Engineering Division Council.

The preparation of a code of practice for plastics pipe work for potable water supplies was taken up to make available comparative properties of different types of plastics pipe. Additionally, it would give guidance for their selection for different situations arising in practical usage and also to recommend sound practices for the installation, jointing and testing of such pipe systems. It was hoped that the code would assist in greater application of plastic pipes. Part 3 of the standard covered laying and jointing of unplasticized polyvinyl chloride (UPVC) pipes.

The other parts published so far in the series are:

Part 1 Choice of materials and general recommendations

Part 2 Laying and jointing polyethylene (PE) pipes

In the formulation of the original standard, due weightage was given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This was met by deriving assistance from BS : CP 312 : Part 2 : 1973 'Code of practice for plastics pipe work for the conveyance of fluids under pressure' issued by the British Standards Institution.

With the advent of globalization and the likelihood of the influx of foreign competition, the committee felt that this standard should be brought even more in line with revised international standards. The need was also felt to give a more comprehensive treatment to the entire area of handling, transportation, storage, installation and very importantly, the testing of pipelines prior to their commissioning. For this purpose, assistance was drawn from the European Standard prEN 1452-6 : 1994 'Plastics piping systems for water supply — Unplasticized poly vinyl chloride (UPVC) Part 6 : Recommended practice for installation as well as other literature'. Further, the sections on heat application method have been altogether deleted from this revision, as it is felt that this is an operation requiring considerable skill by trained personnel and therefore is not recommended for use by normal installation teams in the field.

The composition of the Committee responsible for formulation of this standard is given in Annex A.

Indian Standard

PLASTICS PIPES SELECTION, HANDLING, STORAGE AND INSTALLATION FOR POTABLE WATER SUPPLIES — CODE OF PRACTICE

PART 3 LAYING AND JOINTING OF UPVC PIPES

(First Revision)

1 SCOPE

1.1 This code of practice (Part 3) gives guidance for the proper methods of laying and jointing of unplasticized polyvinyl chloride (UPVC) pipe work for potable water supplies (water mains and services buried in ground and for the conveyance of water above ground for both outside and inside buildings).

1.2 This standard is applicable for cold water supplies upto and including 45°C only. Appropriate de-rating factors apply as per IS 4985 : 2000 'Unplasticized PVC pipes for potable water supplies — Specification (*third revision*).

1.3 This standard does not purport to give guidelines for designing and dimensioning of pipelines.

1.4 Local bye-laws shall be strictly observed whenever used for municipal water distribution.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicted below:

IS No.	*Title*
4985 : 2000	Unplasticized PVC pipes for potable water supplies — Specification (*third revision*)
5382 : 1985	Specification for rubber sealing rings for gas mains, water mains and sewers
14182 : 1994	Solvent cement for use with unplasticized polyvinylchloride plastics pipe and fittings

3 JOINTING TECHNIQUES

3.1 General

Unplasticized PVC pipes are made by a continuous extrusion process and are generally available as rigid (hard), in-factory cut lengths. Pipes are supplied with one of the following four end conditions:

a) Plain end, for jointing by means of separate couplers, including mechanical joints,
b) Integral socket on one end, for solvent cement jointing,
c) Integral socket on one end for jointing with elastomeric sealing rings, and
d) Threaded, for jointing with threaded couplers.

3.1.1 Satisfactory jointing plays an important role in successful performance of these pipes. Commonly used joints are as follows:

a) Solvent welded joints,
b) Integral elastomeric sealing ring joints,
c) Mechanical compression joints,
d) Flanged joints,
e) Screwed or threaded joints, and
f) Union coupled joints.

3.2 Solvent Welded Joints

3.2.1 These are permanent in nature and can withstand axial thrust (end-load bearing). This technique is used with plain ended pipes with couplers, for pipes with integral sockets as well as with injection moulded fittings (*see* Fig. 1).

3.2.2 Pipes and fittings are manufactured to certain tolerances to provide for small variations in the extrusion, moulding and socket processes and are not exact in size.

3.2.3 *Solvent Cement*

Consists essentially of a solution of vinyl chloride polymer or copolymer dissolved in a suitable volatile mixture of organic solvents. The solvent constituents soften the mating surfaces, which diffuse into one another to form a 'cold weld'.

3.2.3.1 *Specification*

Solvent cement shall conform to all the requirements of IS 14182.

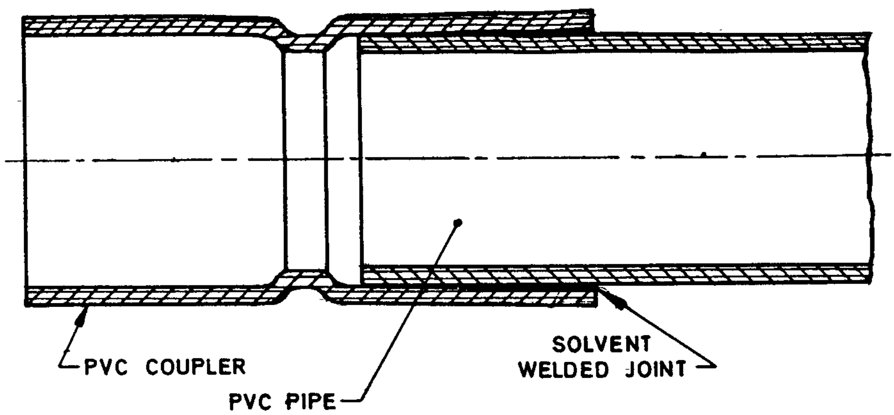


FIG. 1 PVC SOLVENT WELDED JOINT

3.2.3.2 *Selection*

Solvent cement is available in three grades of viscosity as given below to cover a range of pipe sizes from 20 mm to 630 mm. Sufficient solvent cement shall be applied so that a wet-film thickness adequate enough to fill a gap in a pipe joint is formed. Selection is also dependent on the climatic conditions prevalent at the site.

Pipe Size	*Cement Type*	*Minimum Viscosity*		*Minimum Wet Film Thickness*
mm		MPa.s	cp	mm
Upto 50	Regular bodied	90	90	0.15
63 to 160	Medium bodied	500	500	0.3
Above 200	Heavy bodied	1 600	1 600	0.6

Medium bodied and heavy bodied cements may be used for smaller pipe sizes than that shown in the table above. The reverse does not hold good.

3.2.3.3 *Storage*

PVC solvent cement should be stored in a cool place except when actually in use at the site. The cement has a limited shelf life when not stored in hermetically sealed containers. HDPE screw top containers are not considered hermetically sealed. The cement is not suitable for use if it exhibits an appreciable change from the original viscosity, or if a sign of gelation is apparent. Addition of thinners is not recommended for restoring the original viscosity.

3.2.4 *Procedure*

3.2.4.1 *Cutting*

Pipes are supplied with square-cut and de-burred ends. However, if pipes need to be cut to smaller lengths, use a fine-toothed hand saw and a mitre box or a power saw with wood-working blades, with a suitable guide. The cutting must not raise a burr or ridge on the cut end of the pipe. Failure to remove the ridge will result in cement in the fitting or socket being scraped away from the jointing surfaces, leading to a dry joint with probability of joint failure. Remove all burrs and ridges with a de-burring knife, file, or abrasive paper (*see* Fig. 2).

3.2.4.2 *Chamfering*

Provide an approximately 2 mm wide, 15° chamfer on pipe ends. A chamfer prevents the cement film from being wiped off into the interior of the socket during assembly.

3.2.4.3 *Dry fit test*

Before applying cement, insert the pipe end into the socket of the next pipe or fitting to check that interference occurs at about $\frac{1}{3}$ to $\frac{2}{3}$ of the socket depth. When the pipe and the socket are at their extreme tolerances, the pipe can bottom (travel fully into) in the socket. In such a case, it should be a snug fit. A loose or wobbly fit will result in joint failure. Another pipe end or the socket should be selected until these conditions are fulfilled. Mark the insertion depth on the pipe end with a felt tip pen or marker.

3.2.4.4 *Cleaning*

Surfaces to be joined must be free of dust, dirt, oil, moisture and other foreign material. Wipe clean with a dry cloth. If this is not sufficient, use a chemical (such as dichloro-methane, methyl ethyl-ketone or mechanical cleaner). With chemical cleaners, observe safety precautions. Ketones are inflammable.

3.2.4.5 *Application of cement*

PVC solvent cement is quick drying, therefore it shall be applied as quickly and carefully as possible and in consistence with good workmanship. For larger sizes, it is advisable for two workers to work simultaneously on the pipe and socket. The surface temperature of the

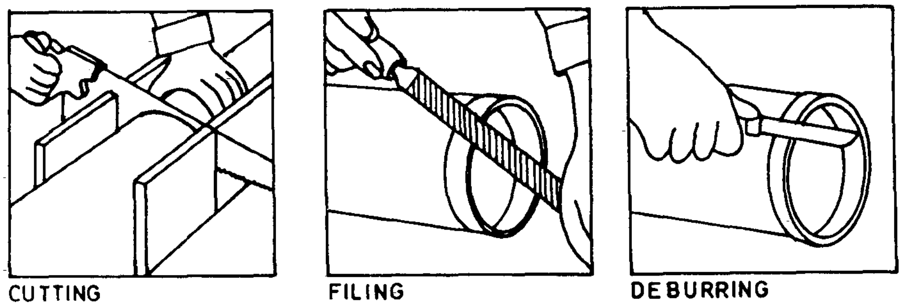


FIG. 2 PIPE CUTTING AT SITE

mating surfaces should be above 0°C but should not exceed 45°C. Water can be used to cool the surfaces, but these should be wiped thoroughly dry before application of cement.

Dip the applicator brush in the solvent cement and apply a liberal coat of cement to the end of the pipe upto the insertion depth.

Apply a uniform thin coat of cement inside the socket, working axially from the inside of the socket to the outside. Do not apply any cement on the shoulders of the socket (socket-to-pipe transition area). Care should be taken not to apply excess cement inside the socket. Excess cement in the socket will be pushed further into the pipe during assembly and cause the pipe to soften and weaken at that point. Hot and dry climates generally require slightly thicker coatings of solvent cement.

In climates with large differences between day and night temperatures, it is advisable to make joints early in the morning or in the evening when it is cooler. Thus, the joints are prevented from being pulled apart if the pipes contract.

3.2.4.6 Within 20 s after the last application of solvent cement, insert the pipe into socket in a single steady and every controlled but forceful action. Press it in fully until it bottoms. No hammer blows should be used. If there is any sign of drying of the cement coat before insertion; the surface should be re-coated, avoiding application of excess cement in the socket. Once the insertion is complete, hold in place for 1 min without shifting the pipe in the socket.

3.2.4.7 For large diameter pipes, two or more workers may be needed for this operation. Mechanical equipment such as levers and winches may be used. Care shall be taken to ensure that force is not transmitted to previously made joints. Until the cement is set, the pipe must be prevented from backing out of the socket.

3.2.4.8 Immediately after assembly, wipe the excess solvent cement from the pipe at the end of the socket. A properly made joint will have a uniform bead around its entire perimeter. Any gaps in this bead may be indicative of an improper joint due to insufficient cement or the use of a lighter-bodied cement than the one recommended.

3.2.4.9 *Setting times*

Joints should not be handled until the requisite setting time has elapsed. Recommended setting times are a function of the ambient temperature at the job site as given below:

Temperature °C	*Recommended setting times, Min* h
15 to 40	1
5 to 15	2
–5 to 5	4
–20 to –5	6

3.2.4.10 *Installation and commissioning*

After the setting time has elapsed, the pipe may be handled carefully for installation. Pressure testing may be carried out only after a curing period of 24 h.

3.3 Integral Elastomeric Sealing Ring Joints

Pipes are cut to length and bell socket in-line, to form a groove for the elastomeric sealing ring, and supplied in nominal lengths. Couplers and bends fabricated out of UPVC pressure pipes are likewise socket.

3.3.1 Elastomeric sealing ring joint consists of an elastomeric sealing element located in the groove in the socket formed integrally with the pipe or fitting. The sealing element (sealing ring) is automatically compressed to form a pressure tight seal when the spigot of the pipe is inserted into the socket.

3.3.2 These joints are non-end load bearing and it is essential to ensure the probability of joint separation due to axial thrust. Joint separation can be prevented in below ground applications by incorporating concrete anchor blocks at appropriate places. In above ground applications, anchor blocks must be provided (*see* **6.4**). Where large diameter pipes operating at high pressures are involved, axial thrusts of several tonnes can be developed.

3.3.3 In order to meet water quality and bio-degradation requirements, elastomeric sealing rings are usually made from synthetic materials like ethylene-propylene-diene (EPDM) copolymer, styrene-butadiene rubber (SBR) or a combination of synthetic and natural rubber. The material should conform to IS 5382.

3.3.4 *Procedure*

3.3.4.1 Pipes are supplied with the spigot end chamfered. However, if pipes have to be shortened for any reason, preparation of the ends will be necessary before assembly.

3.3.4.2 Cutting of pipes, if required, must be done on a jig to ensure that the cut is square to the axis of the pipe. It is recommended that the pipe be marked around the entire circumference prior to cutting. The pipe ends must be chamfered at an angle of 15° with a medium grade file and de-burred. (*see* Fig. 2).

3.3.4.3 Clean the spigot end of the pipe upto the insertion depth (depth of the corresponding socket). Remove all traces of mud, dirt, grease and gravel. Do not use any chemicals or solvents for cleaning. For stubborn areas of dirt, a very fine grade of emery or sand paper can be used lightly. Wipe the pipe with a clean cloth moistened with water and allow to dry completely.

3.3.4.4 Clean the inside of the socket. Remove all traces of mud, dirt, grease and gravel. Do not use any chemicals or solvents for cleaning. For stubborn areas of dirt, a very fine grade of emery or sand paper can be used lightly. Wipe the inside of the groove with a damp cloth and allow to dry completely.

3.3.4.5 Mark the insertion depth on the spigot of the pipe, if not already applied by the manufacturer. The insertion depth is equal to the depth of the socket of the pipe, measured upto the end of the parallel portion of the socket (excluding the shoulder). This distance is marked on the spigot (excluding the chamfer) with an indelible felt-tip marking pen.

3.3.4.6 Insert the elastomeric sealing ring into the groove. Rings to be used are system specific and shall be those supplied by the manufacturer for his own system. Form the ring into a heart shape by pinching a portion of the ring from the inside (*see* Fig. 3). Insert into the socket and release to seat into the groove. Ensure proper seating of the ring in the groove. If the ring is wrongly inserted it will lead to leakage. It may also dislocate completely during assembly. Follow instructions of the manufacturer.

3.3.4.7 Apply lubricant to the outside of the spigot (consult the manufacturer). The lubricant should cover the entire surface of the spigot for at least half the insertion depth, starting from the end of the pipe. The lubricant used should not have any detrimental effect on the pipe, fittings or the elastomeric sealing ring and shall not be toxic, shall not impart any taste or odour to the water or encourage growth of bacteria. Do not use oil-based or solvent-based lubricants.

3.3.4.8 Align the socket and spigot correctly in the horizontal and vertical planes. Ensure that no sand or dirt adheres to the lubricated surfaces of the pipe.

3.3.4.9 Insert the spigot end carefully into the socket. Place a firm wooden block against the other end of the pipe and, using a crow-bar as a lever, push home the spigot upto the insertion depth mark (*see* Fig. 4). For larger sizes of pipe, the use of a jointing jack may be helpful. The jack can also be used to extricate a pipe from a socket.

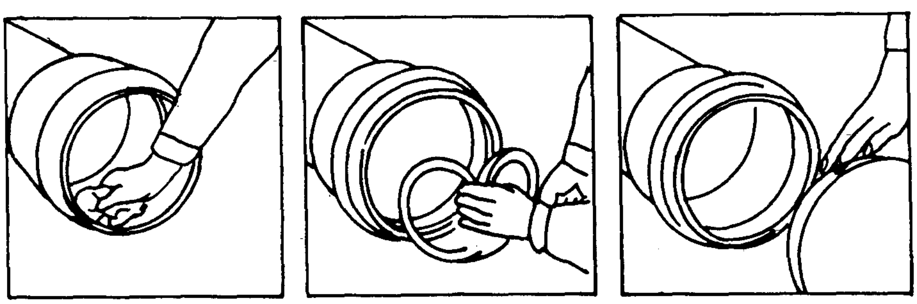


FIG. 3 SEALING RING JOINT ASSEMBLY

3.4 Mechanical Compression Joints

These are commonly separate fittings made from UPVC or metal and can be in the form of a coupler for connecting pipes and fittings of the same material and of the same dimensions, or as an adaptor for connecting components of different materials and/or dimensions. Generally compression fittings consist of four main elements: body, elastomeric sealing rings, backing (compression) rings and bolts. Both pipe ends should be clean and free from damage before assembly is begun. Each element is positioned on the pipe separately, centred over the joint and the sealing rings compressed between the body of the fitting and the pipe by tightening the backing rings. Bolts should not be over tightened and the manufacturer's recommendations followed at all times (*see* Fig. 5).

3.5 Flanged Joints

These are used for jointing of UPVC pipes to other pipes, fittings, valves and vessels made from dissimilar materials, for example metals. The joint is made by compressing a gasket or elastomeric sealing ring between the mating surfaces of the flanges. Detailed flange designs can vary considerably. Figure 6 and Fig. 7 show two types of flanged joints.

3.6 Screwed or Threaded Joints

These are similar to the joints used with metal pipes. If the pipe has to be joined by screw threads, only thick walled pipe should be used and cut with taper threads. Some manufacturers supply pipes with factory cut threads. Threaded pipes shall not be subjected to a pressures exceeding two-thirds of the rating for unthreaded pipes.

3.6.1 To obtain a good thread, it is essential to ensure that:

a) Die holder is fitted with a guide of the correct size. The guide must be properly screwed down so that the two halves of the die are flush with the face of the holder.
b) Die is not blunt.
c) Two halves of the die are adjusted so that they are seated squarely in the holder and are equidistant from the sides of the holder. Observe the gaps on either side.
d) There are no sharp edges on the end of the pipe. Provide a light chamfer with the edge of a sharp knife.
e) Die holder is carefully slid over the pipe and the two halves of the die adjusted with the fingers so that the first threads seat lightly on the pipe. Pipe must be properly centered. Now tighten the adjusting screws ¼ turn with a spanner.
f) Thread is cut slowly and that after every ½ turn, the die is turned back ¼ turn.
g) Entire thread is cut in four equal passes.

Automatic threading machines may also be used. Follow the instructions of the manufacturer.

3.6.2 Short pieces of thick-walled pipe may be threaded at one end and solvent cemented onto normal walled pipe at the other to make the connector pieces to screwed metal fittings. This system may be used for pipes upto 50 mm outside diameter.

3.6.3 No tape or paste shall be used for jointing. The joint shall be made to firm hand tightness using only strap wrenches.

3.6.4 There is no well defined increase in tightness at assembly as there is with metal fittings. These joints can therefore very easily be overstrained.

3.6.5 Injection moulded threaded joints are used for jointing PVC to metal pipes. Injection moulded threads are less notch sensitive than cut threads.

3.6.6 PVC to metal connections with threaded joints should be made with the PVC as the male components of the joint. PVC as the female component may be used only when specific arrangements are made to prevent over tightening or where both the threads are of parallel form and the fluid seal is made by a separate ring or gasket. A typical illustration of this is shown in Fig. 8.

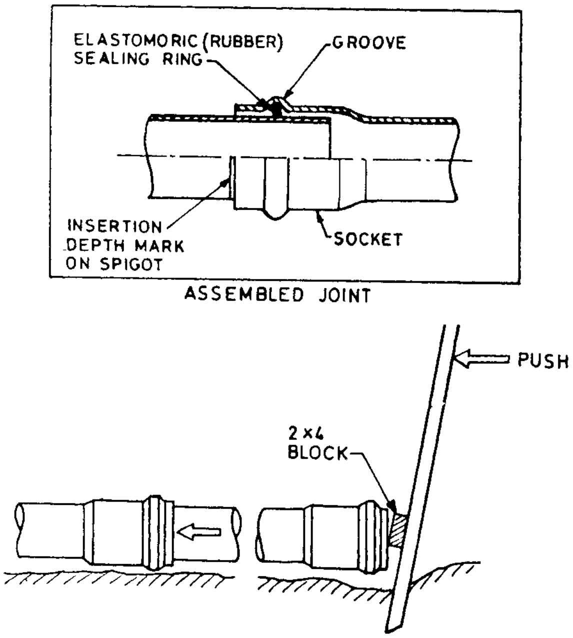


FIG. 4 BAR AND BLOCK ASSEMBLY

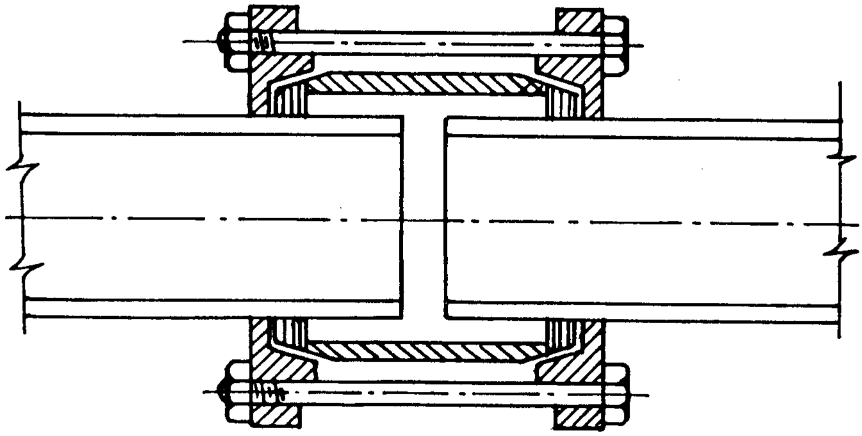


FIG. 5 MECHANICAL COMPRESSION JOINT

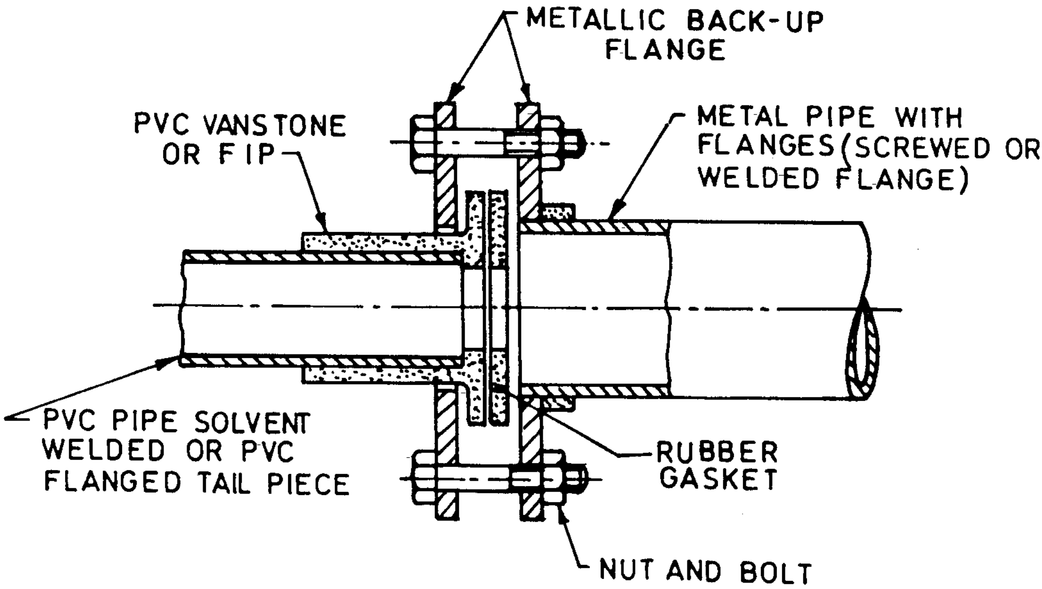


FIG. 6 FLANGED JOINTS WITH PVC

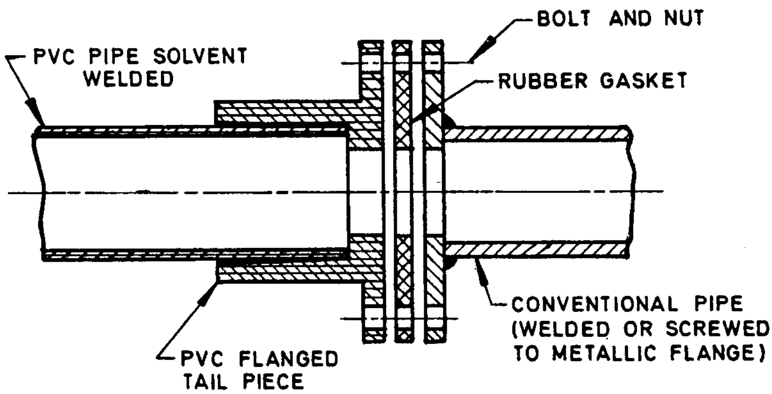


FIG. 7 FLANGE JOINTS (JOINTING PVC PIPES AND OTHER CONVENTIONAL PIPES USING PVC FLANGED TAIL PIECE)

3.6.7 While connecting metallic water taps to the PVC pipes in domestic plumbing, it is recommended to use a metallic coupler to the tap and then connect the same to the PVC pipe using injection moulded threaded joints. The metallic part alone is supported and not the PVC. The unsupported length from the face of the wall should not be more than 100 mm for satisfactory operation and a strong coupling should be provided on the face of the wall at the point of overhang. For any repairs on the tap, the tap should be removed from the metal coupler to avoid working on it *in-situ*. A typical illustration of such a connection is shown in Fig. 9.

3.7 Union Joint

This is a form of flanged joint, but the faces are held together by a screwed connection. A composite metal and PVC socket union is a very satisfactory method of jointing PVC to screwed metallic fittings. A typical illustration of union is shown in Fig. 10.

3.8 Service Connections

3.8.1 Both metal and plastic saddles are available for the off take of service connections from larger bore pipes (50 mm diameter and above). One type of saddle consists of a half round moulded unplasticized PVC section which is solvent cemented to the pipe surface. The outside of the PVC section has a boss on to which the service connection may be screwed. Another type consists of two half round sections of metal or PVC which are bolted together or held around the pipe by wedge grips. A seal is formed between the saddle and the pipe by a rubber O-ring compressed between the

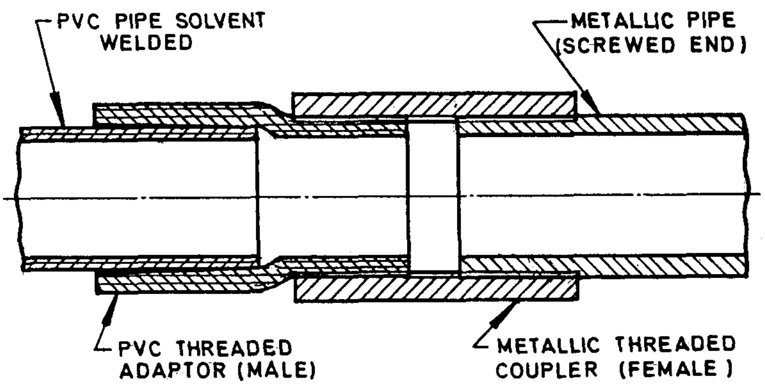


FIG. 8 JOINTING PVC PIPE TO CONVENTIONAL PIPE USING THREADED JOINTS

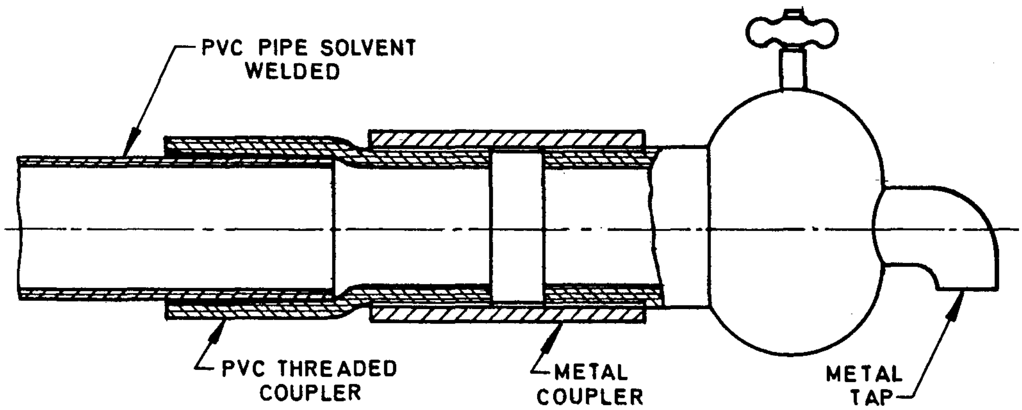
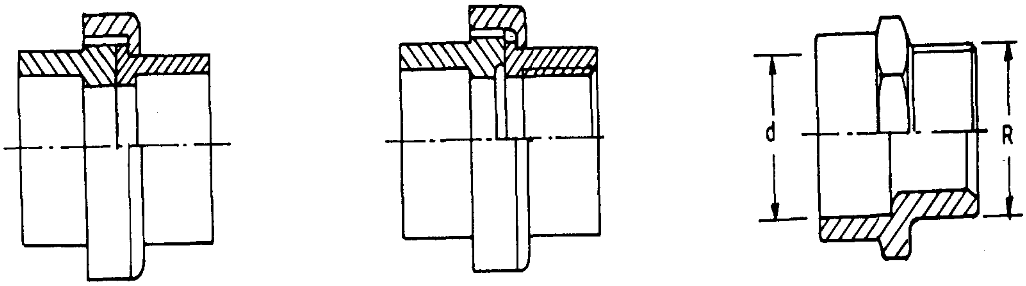


FIG. 9 CONNECTION OF PVC PIPE TO METALLIC WATER TAPS



a) UNION COUPLER b) UNION ADAPTER c) ADAPTER BUSH

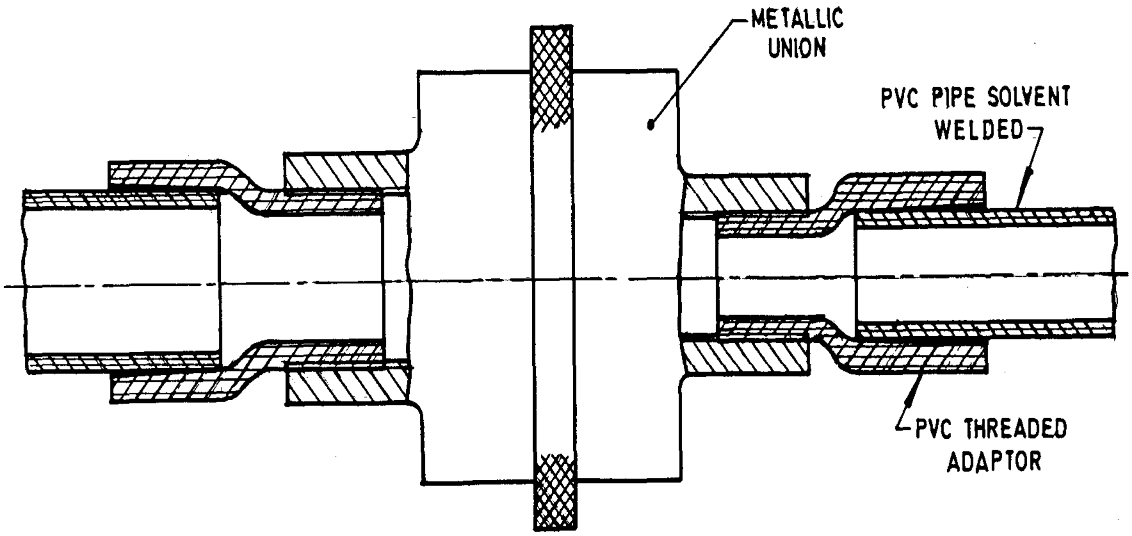


FIG. 10 TYPES OF UNION JOINTS

pipe and the under surface of the section. The service connection is taken from a boss on the upper section.

3.8.2 Conventional equipment for tapping under pressure may be used with these service connections using a special trepanning cutter to pierce the pipe wall. Some ferrules have self contained cutters for this purpose. Ferrules should not be screwed directly into un-reinforced pipes without the introduction of a reinforcing saddle piece. A typical illustration of union is shown in Fig. 11.

4 TRANSPORT, HANDLING AND STORAGE OF PIPES

Because UPVC pipes are durable and light, they are more likely to be mishandled. Care should be taken to ensure that pipes are not damaged during handling, storage and transport.

4.1 Transport

4.1.1 When transporting pipes, flat bed vehicles should be used. The bed should be free from nails and other projections. When practical, pipes should rest uniformly on the vehicle over the whole length (*see* Fig. 12).

4.1.2 The vehicles should have side supports approximately 2 m apart and the pipes should be secured effectively during transport. All posts should be flat with no sharp edges.

4.1.3 When loading spigot and socket pipes, the pipes should be stacked on the vehicle so that the sockets do not take excessive loads.

4.1.4 Where pipes overhang the vehicle, the amount of overhang should not exceed 1m.

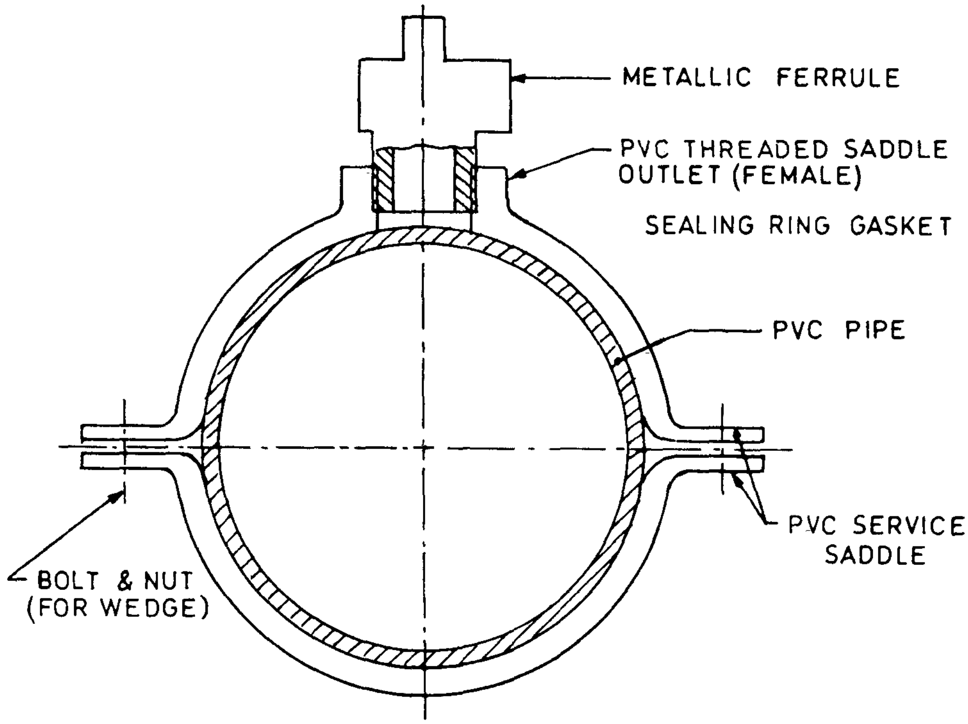


FIG. 11 FERRULE CONNECTION USING SERVICE SADDLE

4.1.5 High stiffness pipes should be placed at the bottom of the load and low stiffness pipes at the top.

4.1.6 Care should be taken to avoid positioning the pipes near to any exhaust systems or any other potential hazards such as diesel oil, paints or solvents.

4.1.7 Pipes should be inspected prior to off-loading.

4.1.8 When pipes are transported in bundles, the bundles should be secured effectively and off-loaded as described in **4.3**.

4.2 Handling

4.2.1 UPVC pipes should be handled keeping in mind that they are made of plastic and are also susceptible to damage if mishandled. They should not be thrown, dropped or dragged. Single pipe of upto 250 mm can be lifted by two men without difficulty (*see* Fig. 13, 14 and 15).

4.2.2 Mechanical lifting equipment used for lifting pipes and pipe bundles should not damage the pipe. Fork-lift forks should be flat and protected. Cranes should have spreader bars. No wire ropes, chains or hooks should be used. Slings should be made of rope or webbing 7 to 10 cm wide (*see* Fig. 16).

4.2.3 If pipes have been telescoped for transporting, the inner pipes should be removed first and stacked separately.

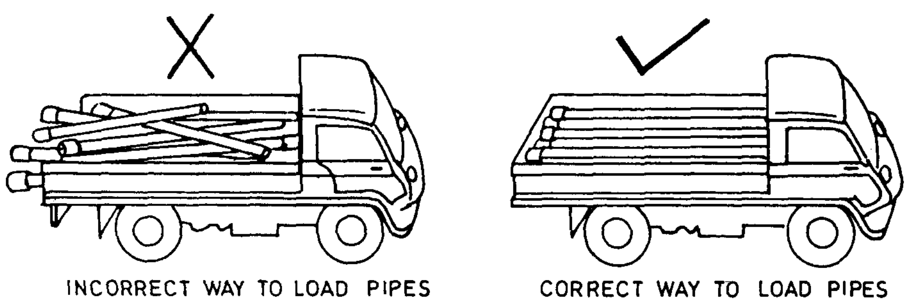


FIG. 12 TRANSPORTATION

4.2.4 Resistance to impact is reduced in cold weather. Extra care needs to be taken at temperatures around 0°C. At temperatures below –15°C, special instructions from the manufacturer should be obtained.

4.3 Storage

4.3.1 Pipes should be stacked on a surface flat and free from sharp objects, stones or projections in order to avoid deformation or damage. Ends of pipes should be protected from abrasion and chipping.

4.3.2 The pipes should be supported evenly over their whole length. The bottom layer of the stack should be supported on wooden battens of uniform size, at least 50 mm wide and placed not more than 2 m apart. The sockets should not bear on the ground (*see* Figs. 17 and 18).

4.3.3 Pipes of different diameters and different pressure classes should preferably be stacked separately.

4.3.4 Factory packed pipes should packed in bundles with timber battens at minimum three places. These should not be unpacked until required for use.

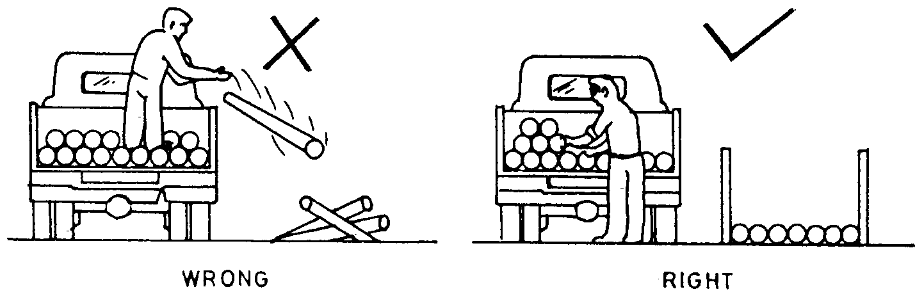


FIG. 13 HANDLING

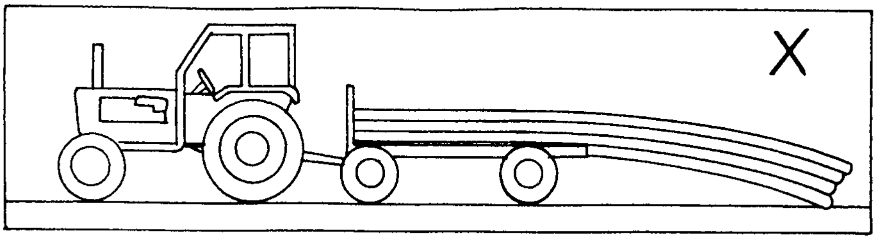


FIG. 14 HANDLING AND TRANSPORTATION

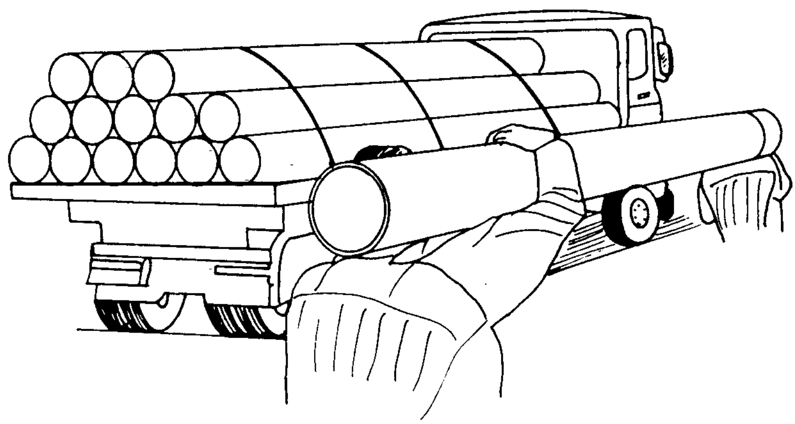


FIG. 15 MANUAL HANDLING

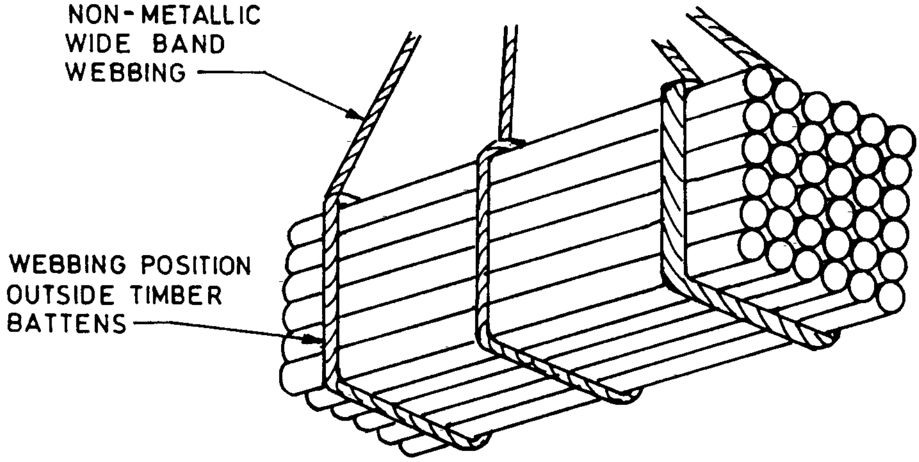


FIG. 16 MECHANICAL LIFTING

4.3.5 Bundles in depots should be stacked no more than three units or 2 m high, whichever is lower, as shown in Fig. 19.

4.3.6 On the site, bundles should be stacked no more than two units or 1 m, whichever is lower.

4.3.7 Timber framed bundles should be stacked timber to timber.

4.3.8 It should be necessary to store pipes loose or if they are received loose, care should be taken to see that each layer of the stack lies alternatively with the sockets on opposite ends of the stack. The sockets of

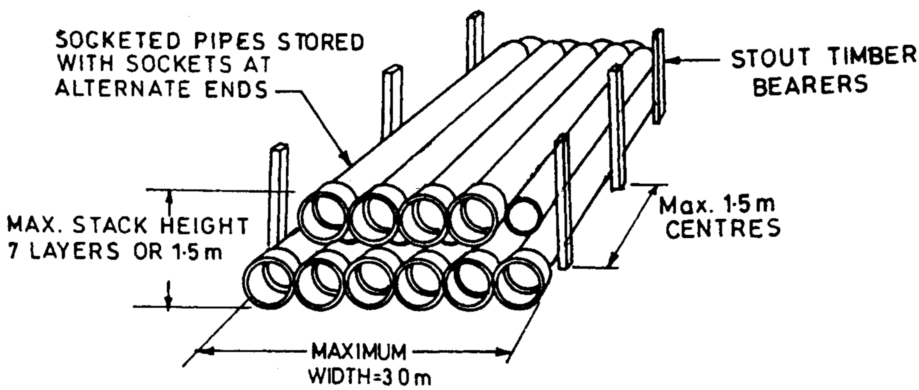


FIG. 17 STACKING IN DEPOT

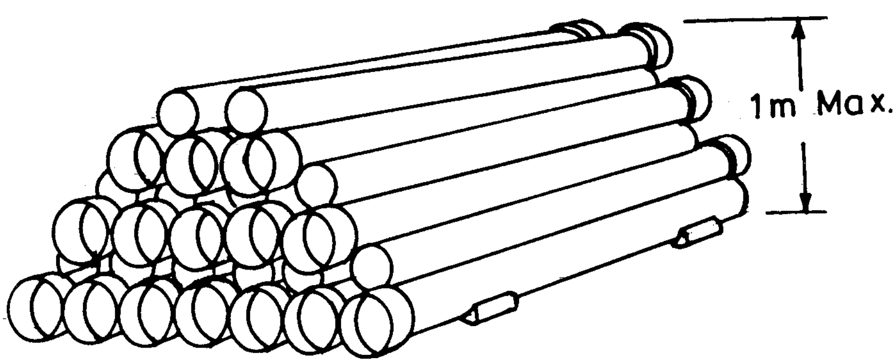


FIG. 18 STACKING AT SITE

each pipe must project sufficiently for the pipes to be supported correctly along the whole length (parallel stacking) [*see* Fig. 20(A)].

4.3.9 The sides of the stack must be supported with timber battens to prevent stack collapse. The side supports should be spaced not more than 3 m apart. The width of the bottom layer should not exceed 3 m.

4.3.10 Alternatively, pipes can also be stacked with adjacent layers lying at right angles to each other (cross stacking), while observing that the sockets lie as stated in **4.3.8** [*see* Fig. 20 (B)].

4.3.11 Stack height should not exceed 1.5 m in depots and stores or 1 m at construction sites (*see* Fig. 17 and 18).

4.3.12 Prolonged exposure of the pipes to sunlight must be avoided. Pipes must be protected from ultra-violet light (sunlight), which would otherwise cause discolouration and can reduce the impact strength of the pipe. However, resistance to internal water pressure is not reduced. Suitable protection by a free-venting cover (canvas tarpaulin or polyethylene sheeting) is

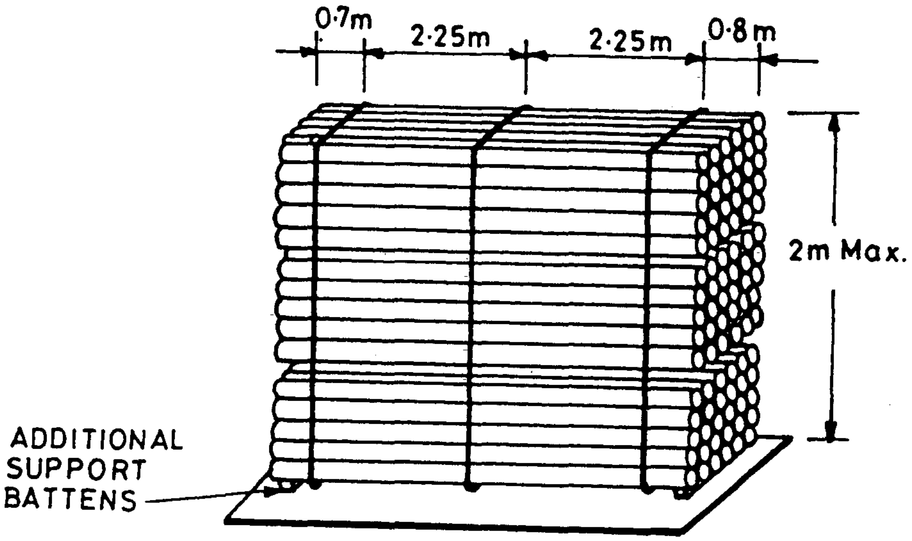
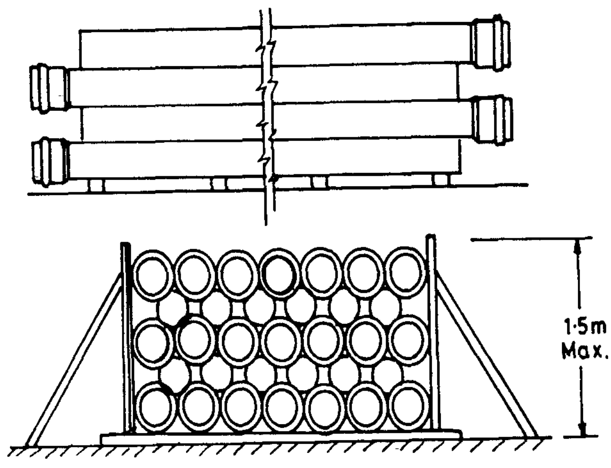
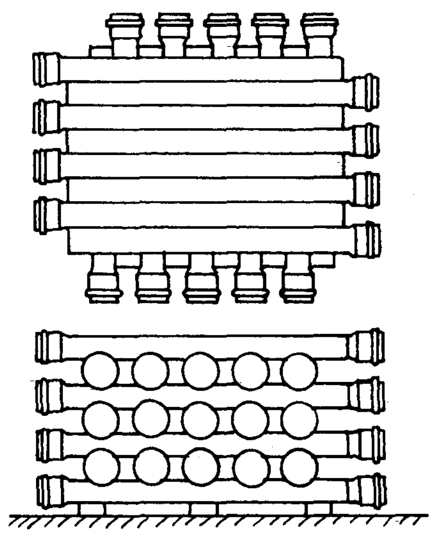


FIG. 19 STACKING OF BUNDLED PIPES



20A Parallel Stacking



20B Cross Stacking

FIG. 20 STACKING OF PIPES

recommended if the total exposed time is likely to exceed 4 weeks (*see* Fig. 21).

4.3.13 Pipes should be stored away from any heat source and should not be in contact with any other potential hazards such as diesel oils, paints or solvents.

4.3.14 If PVC pipes are date coded at the time of manufacture, it is recommended to rotate stocks on a 'first-in-first-out' basis.

5 STORAGE, HANDLING AND TRANSPORTATON OF FITTINGS, VALVES AND ANCILLARIES

5.1 Because UPVC fittings, valves and ancillaries are light and easy to handle, they are more likely to be mistreated than metallic components.

Throughout all stages of storage, handling and transport they should be preserved from damage and contamination and be kept separate from and not temporarily jointed to the pipes until required for installation. When fittings are provided in packaged form, they should be retained in the individual package provided by the supplier, together with all associated rings, gaskets, nuts, bolts and accessories.

5.2 The impact resistance of UPVC fittings, valves and ancillaries is reduced in cold weather and more care needs to be taken when handling these products at temperatures below 0°. If temperatures fall below –15°, special instructions should be obtained from the manufacturer.

5.3 Fittings, valves and auxiliaries should be used in the order of delivery to ensure the correct rotation of stock.

5.4 Sealing rings should be stored in a cool place with temperatures not exceeding 35°, preferably below 25°. The seals should be protected from light, in particular strong sunlight and artificial light with a high ultra-violet content. They should not be stored in a room with any equipment capable of generating ozone, for example mercury vapour lamps, high voltage electrical equipment which may give rise to electrical sparks of silent electrical discharge. The seals should be stored in a relaxed condition free from tension, compression or other deformation. For instance, they should not be suspended from any part of the circumference. The seals should be maintained in a clean condition; they should not be removed from their containers until shortly before use. Shelf-life of sealings rings depends on the material of manufacture. Consult the manufacturer.

While handling, care should be taken that they are not abraded, scratched or nicked and that the sealing lips are not damaged in any way.

6 UNDERGROUND INSTALLATION

6.1 General

The long term performance of UPVC pressure pipelines is directly affected by the quality of workmanship and materials used in installing the product. Competent supervision of all stages is important.

In buried pipelines, the pipe and the soil form an integral structure. When installed properly, UPVC pipe gains strength due to the support of the soil. The soil and pipe wall deflect or compress depending on any one combination of the following three factors:

a) Pipe stiffness,
b) Soil stiffness, and
c) Load on the pipe.

6.2 Trenching

6.2.1 *Location*

Drinking water pipelines should not be located below sewerage pipelines.

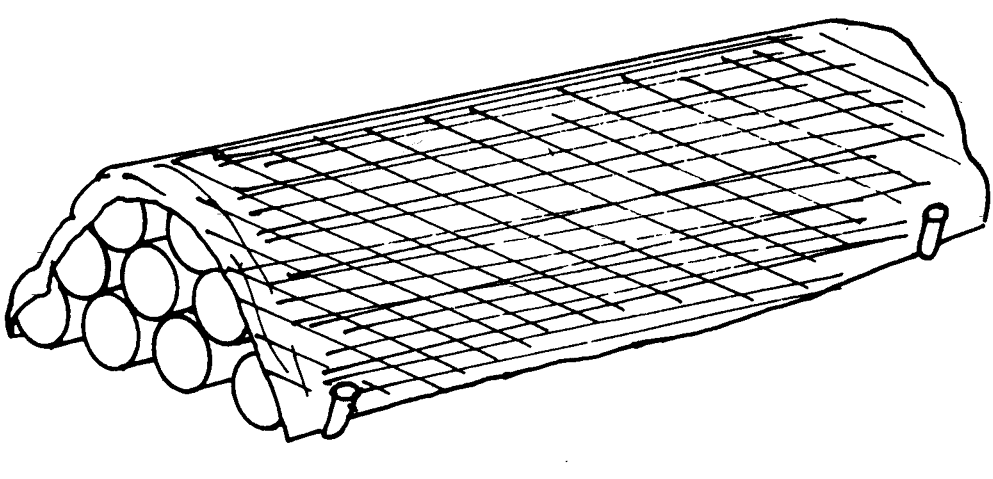


FIG. 21 PROTECTION FROM SUNLIGHT

Where a pipeline runs parallel to other pipelines or cables, the distance between them should not be less than 0.4 m.

At points of congestion, a distance of 0.2 m should be maintained unless steps are taken to prevent direct contact.

6.2.2 *Width*

Trenches should be of adequate width to allow the burial of pipe, while being as narrow as practical. If expansion and contraction are not problems and snaking of pipe is not required, minimum trench widths may be obtained by joining the pipe outside the trench and then lowering the piping into the trench after the testing. A trench width of two or three times the pipe diameter is a good rule of thumb. *See* Tables 1 and 2 for narrow (unsupported) and supported trench widths. Where necessary to prevent cave-ins, trench excavations in unstable soil shall be adequately supported. As backfill is placed and sheeting withdrawn, the void left by the withdrawn sheeting shall be filled and compacted before withdrawing the next increment.

Table 1 Unsupported Narrow Trench Width, Minimum

(*Clause* 6.2.2)

Sl No.	Nominal Pipe Sizes (Diameter in mm)	Trench Width	
		Number of Pipe Diameters (Approximately)	Width mm
i)	63	7.1	450
ii)	75	6.0	450
iii)	90	5.0	450
iv)	110	4.0	450
v)	125	4.0	500
vi)	140	3.9	550
vii)	160	3.5	560
viii)	180	3.2	580
ix)	200	3.0	600
x)	225	2.8	630
xi)	280	2.4	680
xii)	315	2.25	710
xiii)	355	2.1	760
xiv)	400	1.9	760

6.2.3 *Trench Bottom*

The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipeline. There should be no sharp objects that may cause point loading. Any large rocks, hard pan, or stones larger than 20 mm should be removed to permit a minimum bedding thickness of 100-150 mm under the pipe. For pipes of diameters 100 mm or greater, bell holes in the bedding, under each socket joint, shall be provided by removing some of the bedding material, to accommodate the larger diameter of the joint and to permit the joint to be made properly.

Table 2 Supported Trench Width, Minimum

(*Clause* 6.2.2)

Sl No.	Nominal Pipe Sizes (Diameter in mm)	Trench Width	
		Number of Pipe Diameters (Approximately)	Width mm
i)	63	14.2	900
ii)	75	12.0	900
iii)	90	10.0	900
iv)	110	8.2	900
v)	125	7.2	900
vi)	140	6.4	900
vii)	160	5.6	900
viii)	180	5.0	900
ix)	200	4.5	900
x)	225	4.2	940
xi)	280	3.5	990
xii)	315	3.1	1 040
xiii)	355	3.1	1 090
xiv)	400	2.85	1 140

6.2.4 *Excavated Material*

Excavated material should be deposited at a sufficient distance away from the trench to prevent damage to the pipeline through falling stones or debris.

6.2.5 *Soil*

The type of soil and the amount of compaction of the pipe embedment directly affect the performance of the pipeline. With proper embedment soil and compaction, greater burial depths are possible and higher external pressure capability and less pipe deflection will occur.

6.2.6 *Minimum Cover*

The following guidelines should be followed:

a) If frost is anticipated, locate the pipeline below the frost line.
b) A minimum cover of 0.9 m when truck traffic is expected.
c) A minimum cover of 1.8 m when heavy truck or locomotive traffic (dynamic loads) is expected. Usually pipe below 2.0 m of cover are not affected significantly by dynamic loads. If the application prevents deep burial of the pipe and heavy traffic passing over the pipe is expected, it would be advisable to use steel or reinforced concrete casing to prevent damage to the pipe.
d) For high static and/or surcharge loads, it is important to use pipes of an appropriate stiffness in order to ensure the initial deformation of the pipe is maintained within a limit of 5 percent, maximum

6.2.7 Bedding and backfill material may be available by selection from 'as dug' excavated material. Such soils as free draining coarse sand, gravel and soils of a friable nature, that is soils which crumble easily, are considered suitable.

'As dug' material must be free from boulders, sharp stones, flints, lumps of clay or chalk. Contaminated soil and any organic material should be discarded. Where excavated material is not suitable, suitable imported material must be used.

Prepare the bedding by laying on soft soil and alternatively compacting and watering sparingly until an effective thickness of 100 to 150 mm is achieved.

6.2.8 At the end of each working period, the pipeline should be temporarily capped to prevent the ingress of surface water, sand, dirt, debris and vermin.

6.3 Laying

Lay the pipes in the trench after ensuring that bell holes have been provided for at the appropriate places in the bedding (pipes of diameter 110 mm or less, with no live load application, do not require bell holes in the trench bottom). These have to be refilled carefully after testing of the pipeline and prior to complete backfilling of the trench. Though not essential, the pipes should be laid with the spigots entered into the sockets in the same direction as the intended flow of water.

6.4 Anchoring

6.4.1 To sustain thrust caused by internal pressure, concrete anchor blocks should be provided at all changes of direction, tees, blank ends, large reductions in diameter and valves. The purpose of the anchor block is to transfer the total thrust to the trench sides. It is therefore important to take account of the load-bearing capacity of the surrounding ground (*see* Fig. 22).

6.4.2 Recommended mixture for concrete is one part cement, two parts washed sand and two parts gravel.

6.4.3 Where concrete would be in direct contact with the pipe or fittings, these should be wrapped with a compressible material, for example rubber sheet or foamed polyethylene sheet, to accommodate creep and prevent the occurrence of high local stress concentrations. The compressible material should not contain substances which could attack the pipe, for example plasticizers.

6.4.4 Typical thrusts generated are given in Table 3. Thrust forces on reducers need only be considered where the reduction in diameter is large (315 to 90 mm). In such cases, the thrust is the product of test pressure and annulus area:

$$F = 2p.\pi.\frac{D_i^2 - D_e^2}{4}$$

where

F = thrust force;

p = test pressure;

D_i = inside diameter of the larger pipe; and

D_e = outer diameter of the smaller pipe.

6.5 Backfilling

6.5.1 The first sidefill or haunching layer should be placed by hand and compacted in layers under the lower quadrants of the pipe upto the spring level (half the vertical diameter) of the pipe. Compaction can be done by careful trampling with the feet or with tamping tools.

6.5.2 Care should be taken to leave adequate area around the joint free of backfill to allow for inspection during testing of the pipeline.

6.5.3 Successive layers of backfill of 75 mm thickness may then be placed over and compacted to a height above the crown of not less than 150 mm. Light vibrating machinery may be used, but not directly above the pipe.

6.5.4 If imported granular, free-flowing material is used, this should be able to flow around the pipe and can easily be raked into position to form a complete, self-compacting surround. With carefully controlled pouring, the whole surround upto 150 mm above the crown may be placed in one pass.

6.5.5 Where side sheeting trench support has been used, this should be partially withdrawn during the placing of the side fill and surround, so that no voids are left between the pipe and the trench walls.

6.5.6 On completion of the surround to the pipe, suitable excavated material may be then replaced as backfill in 250 mm compacted layers upto the top of the trench. No heavy compaction equipment may be employed until there is at least 300 mm of fill above the crown of the pipe.

6.5.7 Metal marker tape can be laid into the final backfill to enable electronic location of the pipeline, if required.

7 ABOVE GROUND INSTALLATION

7.1 Since solvent cemented joints will sustain axial thrust caused by internal pressure (*see* **3.2**), it is strongly recommended that UPVC pipes and fittings systems installed above ground or in service ducts constructed below ground are jointed by the solvent cement method. In certain circumstances the manufacturer's advice should be considered. Other

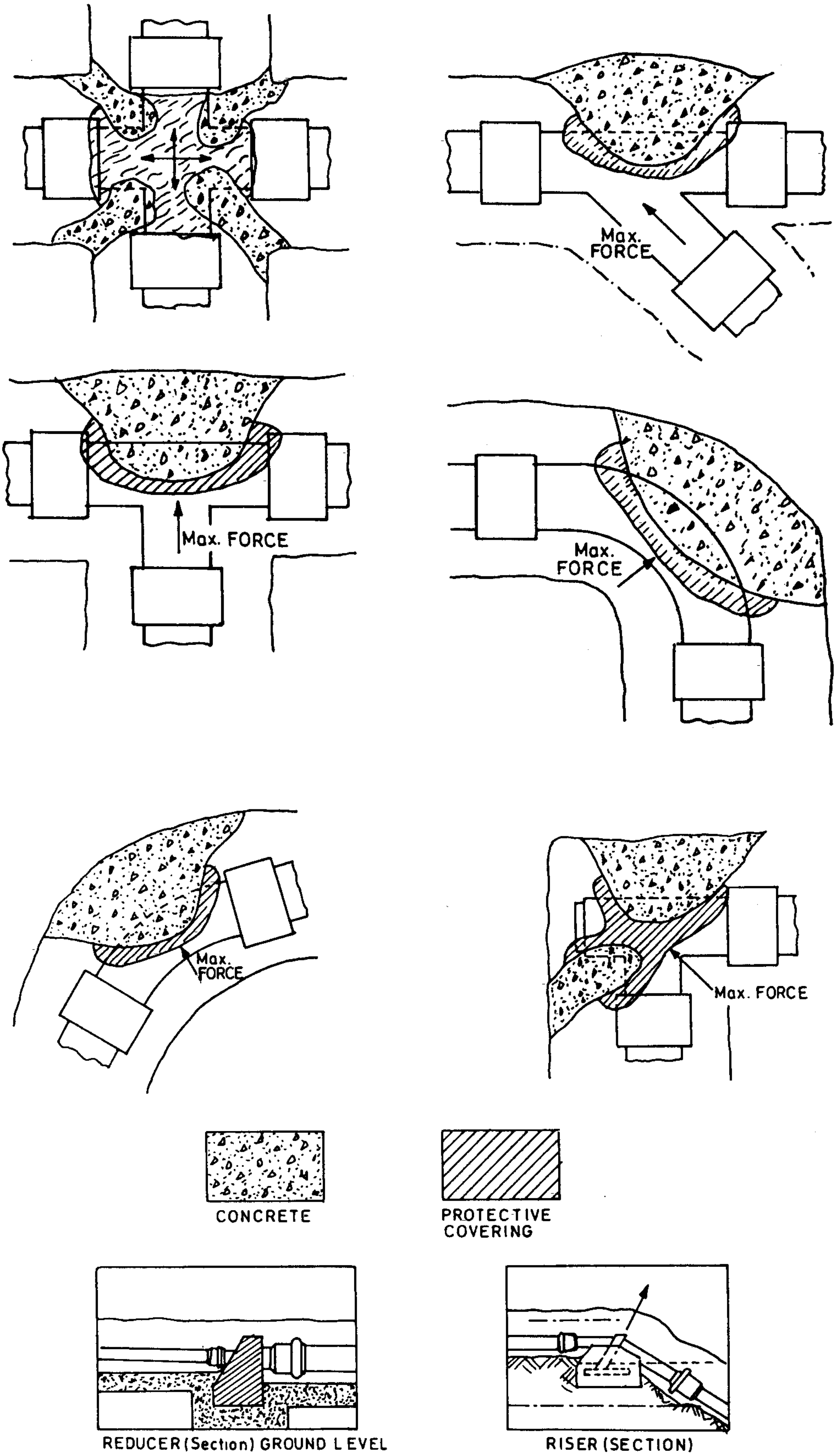


FIG. 22 VARIOUS TYPES OF POURED CONCRETE ANCHORING

Table 3 Thrust Forces for Blank Ends and Bends

(*Clause* 6.4.4)

Sl No.	Nominal Diameter d_n mm	Thrust on Blank End (kN/bar)[1)]	Radial Thrust on Bends kN/bar of Various Angles (kN/bar)[1)]			
			90°	45°	22. 5°	11.25°
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	63	0.31	0.44	0.24	0.12	0.06
ii)	75	0.44	0.62	0.3	0.17	0.09
iii)	90	0.64	0.90	0.49	0.25	0.12
iv)	110	0.95	1.34	0.73	0.37	0.19
v)	125	1.23	1.74	0.94	0.48	0.24
vi)	140	1.54	2.18	1.18	0.68	0.30
vii)	160	2.01	2.84	1.54	0.78	0.39
viii)	180	2.54	3.60	1.95	0.99	0.50
ix)	200	3.14	4.44	2.40	1.23	0.62
x)	225	3.98	5.62	3.04	1.55	0.78
xi)	250	4.91	6.94	3.76	1.92	0.96
xii)	280	6.16	8.71	4.71	2.40	1.12
xiii)	315	7.79	11.02	5.96	3.04	1.53
xiv)	355	9.90	14.00	7.58	3.86	1.94
xv)	400	12.57	17.77	9.62	4.90	2.46
xvi)	450	15.90	22.49	12.71	6.21	3.12
xvii)	500	19.63	27.77	15.03	7.66	3.85
xviii)	560	24.63	34.83	18.85	9.61	4.83
xix)	630	31.17	44.08	23.86	12.16	6.11

[1)] The values in the table are per bar of internal pressure.

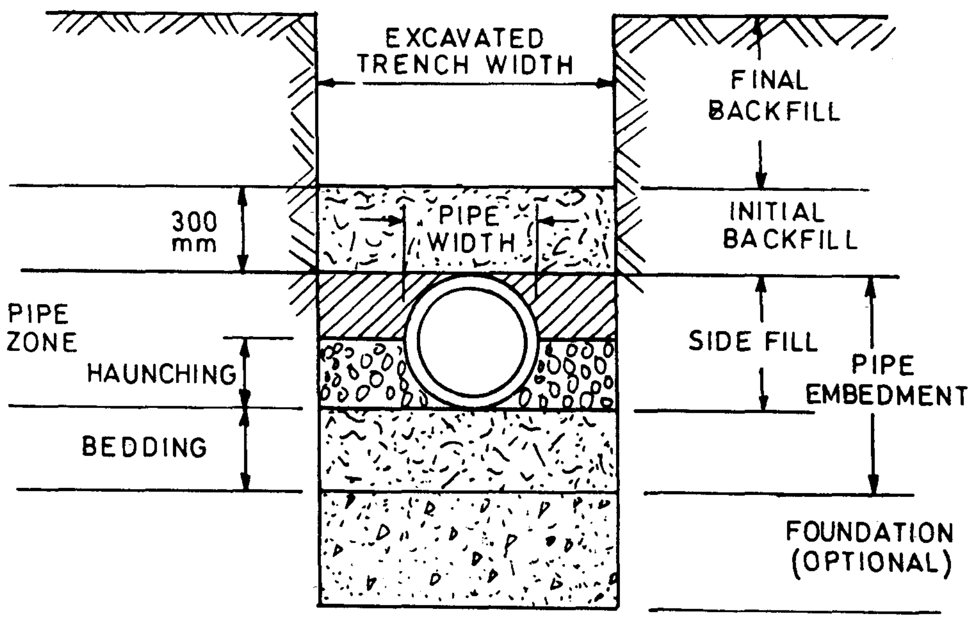


FIG. 23 TERMINOLOGY OF TRENCH CROSS-SECTIONS

forms of end-load bearing joints are also acceptable for inclusion in above ground installations.

7.2 UPVC pipes may fracture if fluids contained within the pipes are allowed to freeze. Sections which are likely to freeze should be isolated and drained, or insulation provided to prevent damage.

7.3 The coefficient of linear expansion of UPVC is approximately 60×10^{-6} m/m/°C or 0.06 mm/m/°C. The following equation is used for calculating the dimensional variation:

$$\Delta L = 0.06\, L \times \Delta T$$

where

ΔL = variation in length, in mm,

L = initial length, in m, and

ΔT = change in temperature of the pipe wall, in °C.

Example: For a temperature variation of 20°C, a UPVC pipe 10 m long will have a variation in length of 0.06 × 10 × 20 = 12 mm

Where ambient temperatures are reasonably constant, the change in pipe wall temperature can be taken as being equal to the change in fluid temperature. Where this is not the case, the pipe manufacturer's advice should be obtained.

For length variations with temperature, *see* Fig. 24 and Fig. 25.

7.4 Pipes should be installed in such a way as to ensure that the minimum amount of stress is induced in the system from movement caused by expansion/contraction or any other forces.

Examples of correct and incorrect installation are shown in Fig. 26.

7.5 UPVC pipes should not be restrained in the hoop direction by straps or clamps made from unyielding material. The use of a compressible material such as rubber of foamed polyethylene between clamp and pipe is recommended.

Pipes should be free to move in the longitudinal direction unless otherwise fixed for expansion/contraction control.

Recommended distances for horizontal or vertical support centres are given in Table 4.

7.6 UPVC pipes should be installed at sufficient distances from sources of heat to prevent damage due to radiant heat.

7.7 All control devices (such as valves) should be correctly supported so that the pipe is not subjected to any operational torsion strain. In addition, the support provided should be sufficiently robust to prevent bending and direct stresses being induced by the weight of the device.

7.8 UPVC pipes and fittings installed above ground should be protected from direct sunlight.

8 INSTALLATION IN DUCTS

Where possible, pipes with end-load bearing joints should be used for installation inside inaccessible ducts. In addition, rings should be fitted to the pipe to provide optimum support and to facilitate the withdrawal of the pipe in the event of rupture (*see* Fig. 27 for typical detail). For large diameter pipes, or where the duct is large compared to the pipe but not large enough to be accessible, other methods of securing the pipe may be necessary (*see* Fig. 28). The opening between the pipes and the ducting system should be sealed at the ends.

Table 4 Minimum Supports for Unplasticised PVC Pipes

(*Clause* 7.5)

All dimentions in millimetres.

Sl No.	Outside Diameter of Pipe d_e	Distance Between Supporting Centres for Water at Temperatures Horizontal Pipes						Vertical Pipes 20 °C to 45 °C
		20 °C	25 °C	30 °C	35 °C	40 °C	45 °C	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	16	750	670	600	500	400	—	800
ii)	20	850	770	700	600	500	—	900
iii)	25	900	820	750	650	550	500	1 000
iv)	32	1 000	920	850	750	650	570	1 200
v)	40	1 100	1 050	1 000	900	800	700	1 400
vi)	50	1 250	1 200	1 150	1 050	950	800	1 600
vii)	63	1 400	1 350	1 300	1 200	1 100	970	1 800
viii)	75	1 500	1 450	1 400	1 300	1 200	1 070	2 000
ix)	90	1 650	1 600	1 550	1 450	1 350	1 200	2 200
x)	110	1 850	1 800	1 750	1 650	1 550	1 370	2 400
xi)	140	2 150	2 100	2 050	1 950	1 850	1 720	2 500
xii)	160	2 250	2 200	2 150	2 070	2 000	1 850	2 500
xiii)	225	2 500	2 450	2 400	2 320	2 250	2 120	2 500
xiv)	250	2 575	2 500	2 450	2 400	2 300	2 200	2 500

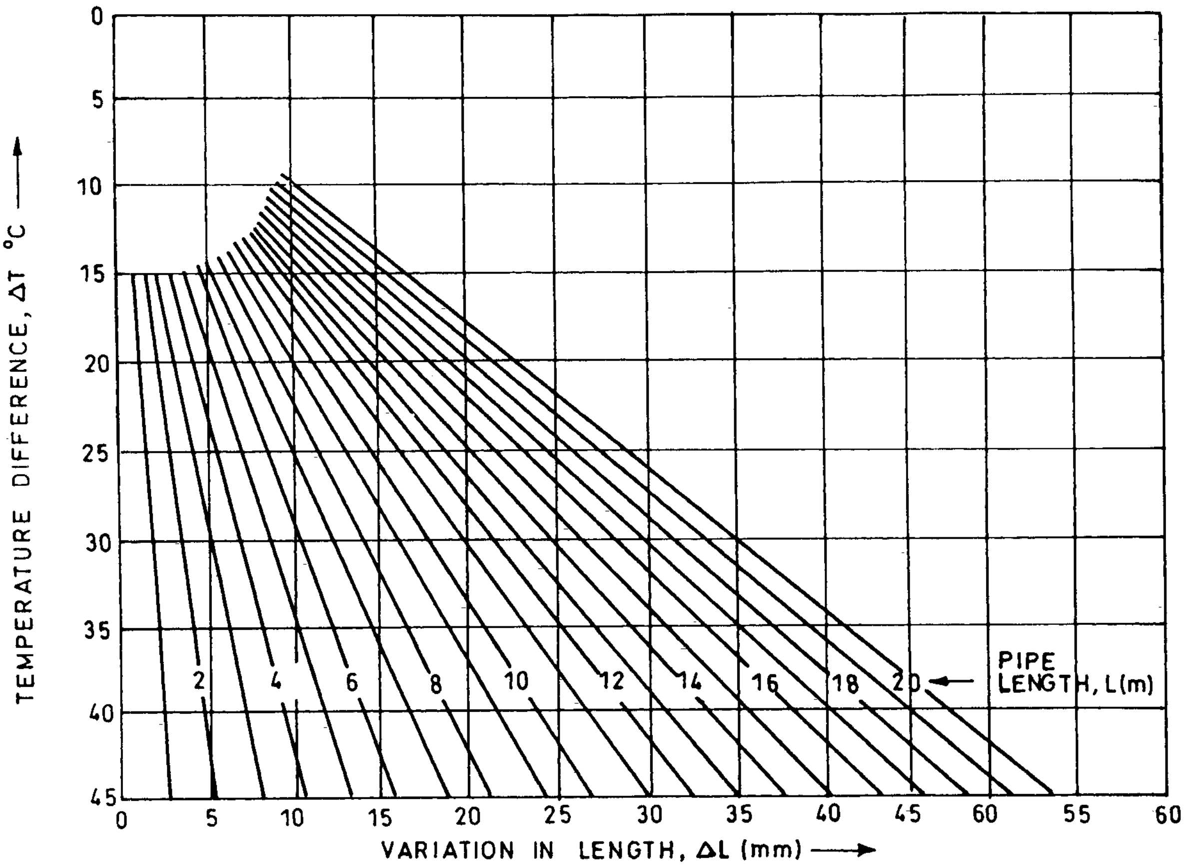


FIG. 24 THERMAL EXPANSION/CONTRACTION OF PVC PIPE

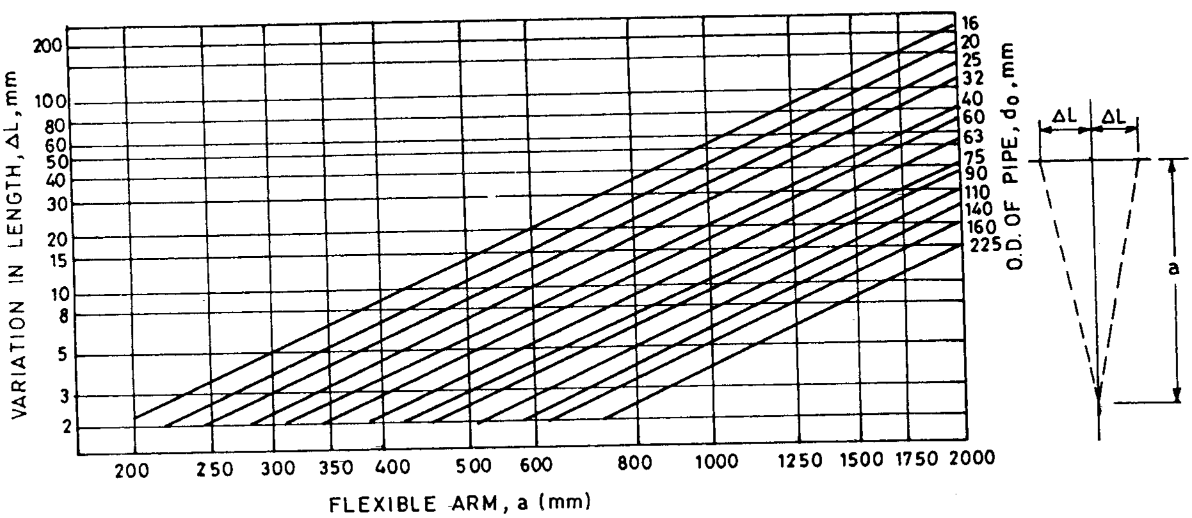


FIG. 25 MINIMUM FREE LENGTHS, a, OF FLEXIBLE ARM

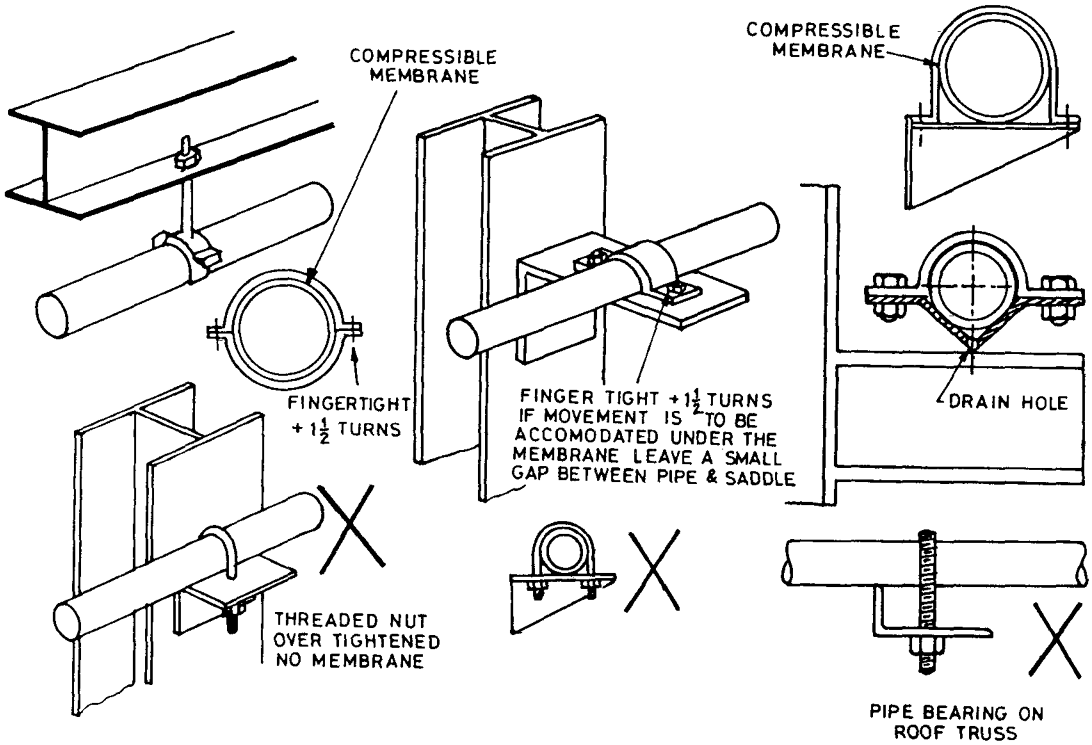


FIG. 26 CORRECT AND INCORRECT INSTALLATION

8.1 Installation of pipes in accessible ducts should be as described for above ground installation under **7**.

9 TESTING

WARNING : Pressure tests should never be carried out using compressed air or gasses.

9.1 Preparation

9.1.1 Pipe systems should be hydraulically tested in lengths appropriate to the diameters and site conditions. Pipelines longer than 800 m may require testing in sections. Preferably, the length selected for test is between 300 m and 500 m.

9.1.2 Preferably, the test should be carried out between blank flanges (*see* Fig. 29). Testing against closed valves is not recommended, unless there is no alternative.

9.1.3 Do not support the end pieces of the test section against the already laid pipes of the proceeding section.

9.1.4 Testing should not take place until any concrete used for anchoring has fully cured (normally 72 h) and attained its required strength. Solvent cemented joints must be allowed to harden for a minimum of 24 h before being subjected to test conditions.

9.1.5 It is important to provide sufficient backfill over the main barrel of the pipe, to prevent displacement and to maintain stable temperature conditions. Leave joints free for inspection.

9.1.6 The test position should be located at the lowest point of the pipeline profile to encourage expulsion of air as the pipe is being filled with water. Adequate air release mechanisms should be located at all high points along the line.

9.1.7 Test-ends should be designed to enable the measured filling and subsequent emptying of the pipeline. Air bleed should also be incorporated at each end.

9.1.8 Pressurizing equipment should be adequately sized. Check all seals and non-return valves prior to the test. Pressure gauges should have an accuracy of ± 0.2 bar. Automatic pressure recording equipment is recommended.

9.1.9 Before filling the pipeline, all line valves and air venting systems should be checked open. All air must be removed from the system.

9.1.10 Fill the system slowly. Water velocity must not exceed 0.6 m/s. Potable water pipelines should be tested with potable water only. After charging, close all air valves and check proper action of automatic valves.

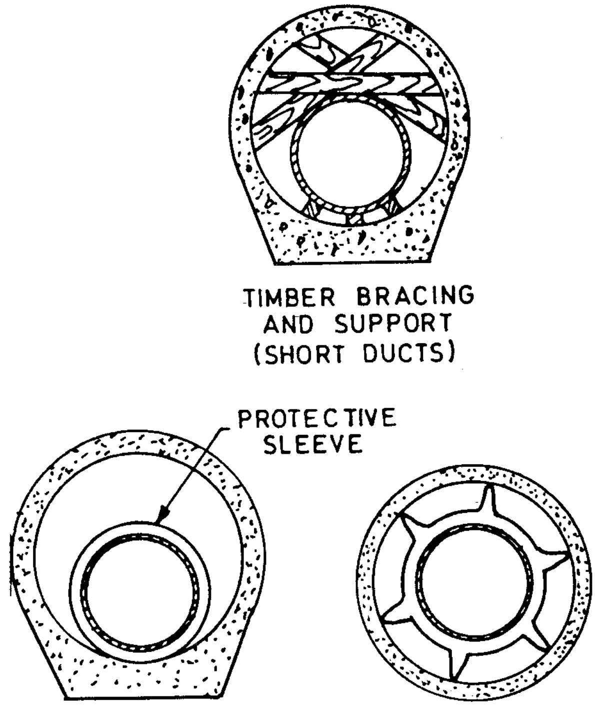


FIG. 27 TYPICAL DETAILS OF PIPES INSTALLED IN SMALL DUCTS

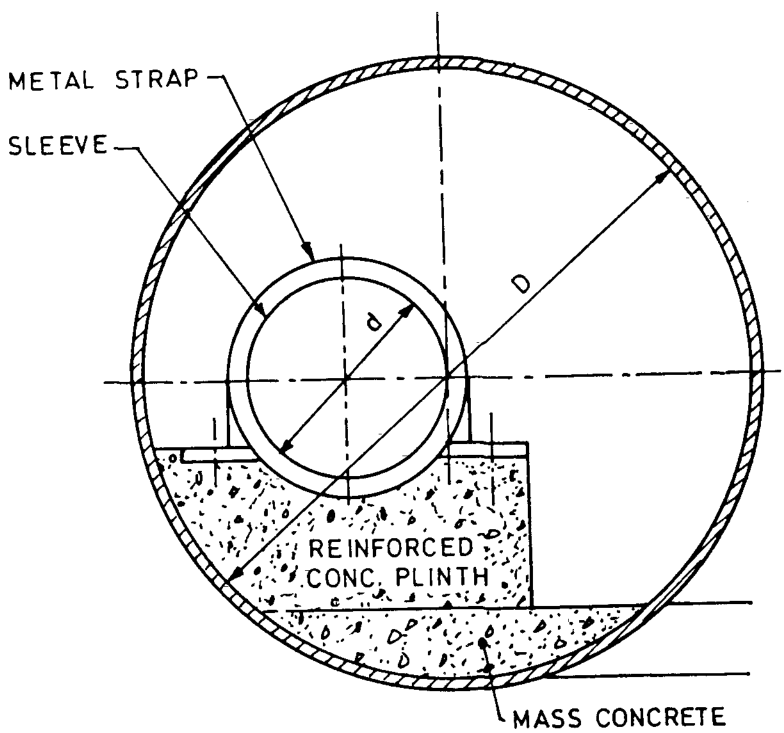
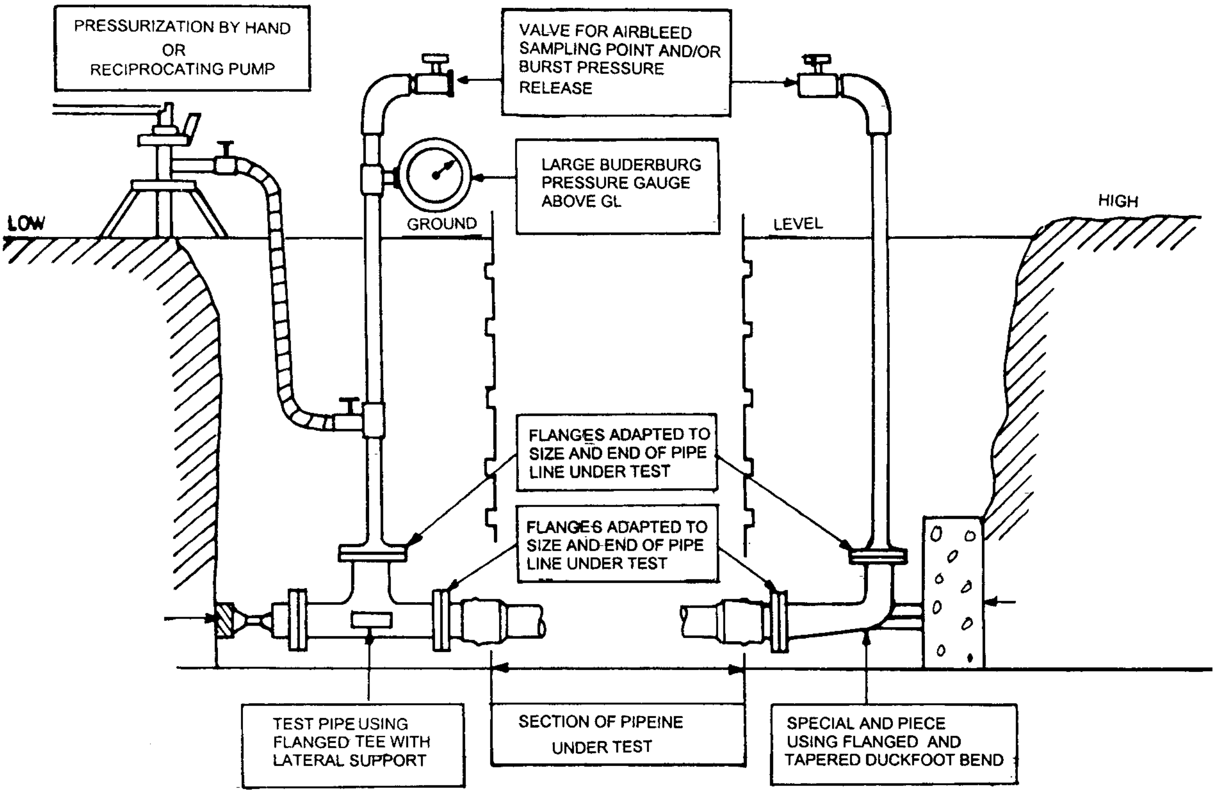
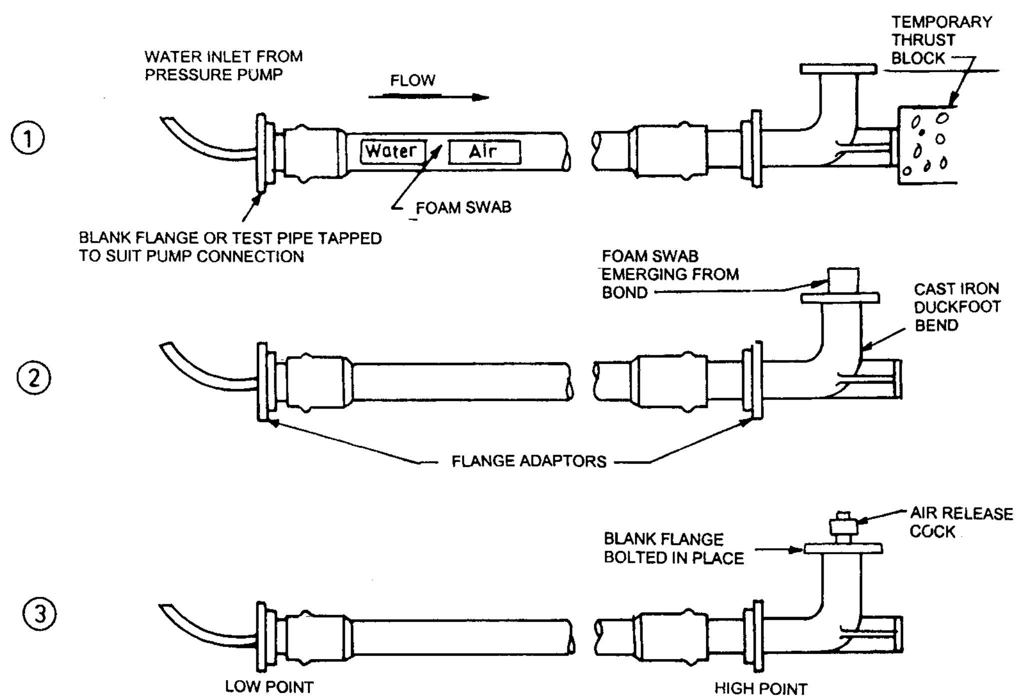


FIG. 28 TYPICAL DETAILS OF PIPES INTALLED IN LARGE DUCTS



29A Typical Layout Details for Test Ends



29B Filling Behind a Form Swab

FIG. 29 PRESSURE TESTING OF INSTALLED PIPELINE

9.1.11 During filling, a number of movements will be seen in the pipeline. Allow the pipeline to stabilize under a nominal pressure for a minimum of 2 h.

9.2 Test Pressures[1)]

9.2.1 The test should conform to the following conditions:

a) be carried out at ambient temperature;
b) be applied for at least 1 h, but not more than 24 h; and
c) not exceed 1.5 times the maximum rated pressure of the lowest rated component.

9.3 Applying the Test

9.3.1 Allow the system to stabilize for 2 h after filling. Apply pressure steadily. Observe pressure gauges throughout and record the rates of pressure increase recorded.

9.3.2 The pressure should be increased till the specified pressure is reached at the lowest part of the section. Maintain test pressure at this level, by additional pumping if necessary, for a period of 1 h.

9.3.3 Close all valves and disconnect the pressurizing unit. No further water should be allowed to enter the system for a further period of 1 h.

9.3.4 During the test period, carry out a visual examination of all joints and exposed connections.

9.4 Interpretation of the Results

9.4.1 There should be no leakage in any part of the section.

9.4.2 If there has been a decrease in pressure during this period other than due to leakage, the original pressure is re-established by injecting a measured quantity of water into the section.

9.4.3 The test is considered to be satisfactory if:

a) there is no decrease in pressure (a slight rise in pressure is also, possible due to changes in ambient temperatures),
b) the measured quantity of water required to reinstate the pressure to the original test pressure is less than the 'permissible maximum' Q,

where

Q = 4.5 litres per 1.6 km per 25 mm of nominal bore per 30 m head of test pressure per 24 h.

[1)] The recommended selection of test pressure is either: the nominal pressure PN of the piping system (lowest PN of any component), or 1.5 times the actual operating pressure, whichever is greater.

The volume of water added is an allowance made to compensate for the natural expansion/movement of the pipe and flexible joints under pressure and for the inevitable entrapment of small amounts of air within the test length. In bubble form, this air compresses and may pass in and out of solution at test pressures.

9.4.4 On completion of any test, the residual pressure should be released slowly and in a carefully controlled manner.

WARNING : The rapid decompression of any entrained air may cause surge conditions which are potentially dangerous both to the pipeline and to personnel.

9.4.5 All defects revealed in the test should be rectified and the procedure repeated until a satisfactory result is obtained.

10 CORROSION PROTECTION

10.1 UPVC pipes are resistant to all normal soil conditions and require no corrosion protection.

10.2 UPVC pipe has a high resistance to chemicals and withstands attack by concentrated mineral acids (except nitric acid above 50 percent concentration), alkalis, oils aromatic free petrol and alcohols. However, UPVC pipes are sensitive to aromatic, or chlorinated hydrocarbons, nitro compounds, esters, ketones and strong oxidizing agents such as dry chlorine gas.

10.3 Where adjacent metallic parts are protected, no hot-or cold-applied coatings, or varnishes which contain solvents, should come in contact with UPVC.

10.4 Soil above and around the trench containing the pipeline should be protected from pollution through spilled aromatic hydrocarbons, paint, solvents, etc.

10.5 Anti-corrosion tape or similar protective materials applied to metal connecting pieces should be of a type which does not damage the UPVC pipes or fittings if they come into contact with the pipeline.

11 PRESSURE SURGE (WATER HAMMER)

In operating conditions where surge pressures will occur, suitable precautions should be taken. In such circumstances, a surge analysis should be undertaken to establish the magnitude and frequency of surge pressure transients.

Pressures greatly in excess of normal sustained operating pressures can be generated when fluid velocities change rapidly. The magnitude of pressure surge largely depends on the rate of change of velocity and the modulus of the pipe material.

Common causes of pressure surges are:

a) opening and closing of valves,
b) starting and stopping of pumps,
c) changes in turbine speeds,
d) changes in reservoir elevation,
e) liquid column separation, and
f) entrapped air.

12 REPAIRING DAMAGED PIPE

For the replacement of damaged underground PVC pipe with a new pipe length, PVC double-socket couplings are available from the manufacturer. The replacement can be done with a length of pipe with a spigot at each end and two double-socket repair couplings, also called slip-couplings (*see* Fig. 30), or a length of socket pipe plus one double-socket repair coupling. In exposing the damaged area, enough of the line should be excavated so that the pipe can be flexed both to aid in handling the damaged area and to insert the replacement material.

12.1 Installing a Replacement Section with a Double-Socket Repair Coupling (Slip-Coupling) on Each End

12.1.1 Cut out the damaged area. Ensure that cuts are square to the axis of the pipe. This area should include all the damaged area as well as include enough gap on each side so that the replacement length with double-socket couplings on each end can be accommodated (*see* Fig. 30 and Fig. 31).

12.1.2 Chamfer the ends of the pipeline and put reference marks on the ends.

12.1.3 Determine the necessary length of the replacement pipe by measuring the gap dimension, multiplying it by 2, and subtracting the result from the length of the cut out section, as shown in Fig. 31(A). Cut the replacement pipe to the proper length and chamfer the ends.

12.1.4 Mount both the couplings on the ends so that they are in a position as shown in Fig. 31(B).

12.1.5 Insert the replacement assembly in the line and slide the couplings into the proper position so that each coupling is centred over the gap [*see* Fig. 31(C)].

12.2 Installing a Replacement Section with a Length of Socket Pipe and One Coupling

12.2.1 Carry out the necessary cutting and chamfering of the damaged area as per **12.1.2**.

12.2.2 Mount the coupling on the cut and chamfered end of the replacement length.

12.2.3 Complete the integral socket joint first by pushing the socket end onto the cut spigot end.

12.2.4 Slide the double-socket coupling onto the cut end of the line and centre it over the gap.

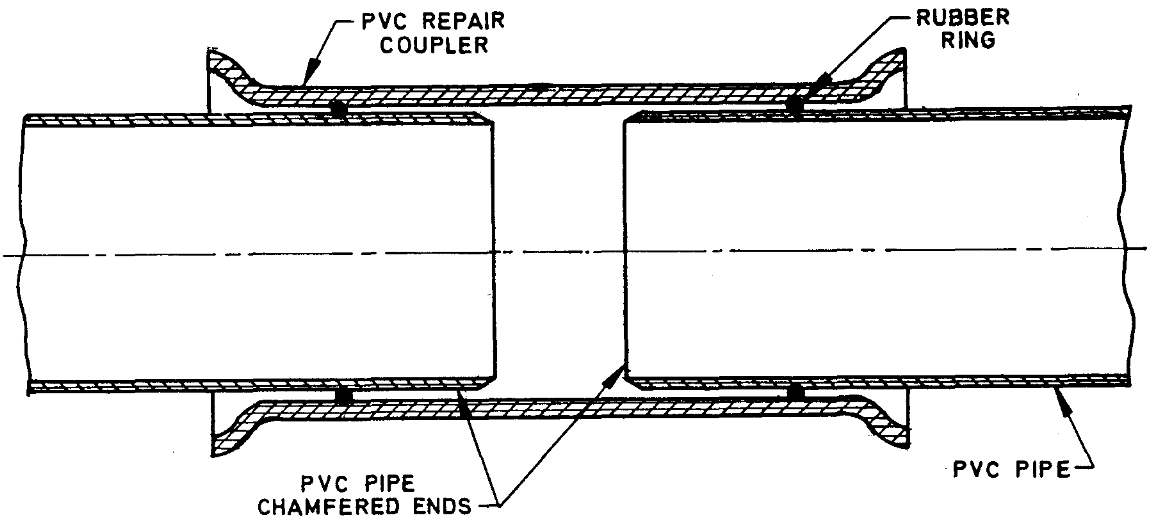
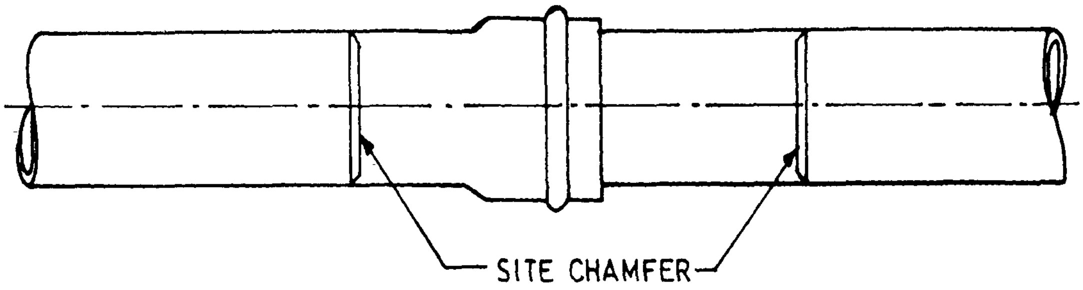
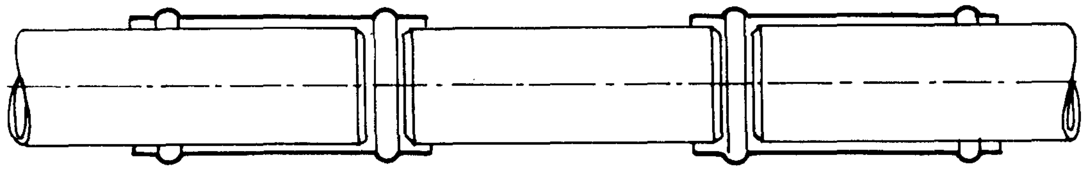


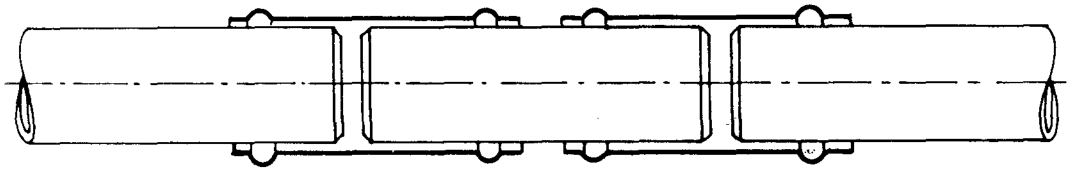
FIG. 30 PVC DOUBLE-SOCKET REPAIR OR SLIP-COUPLER (SCHEMATIC)



31A Faulty Joint Cut Out and Pipe Ends Chamfered



31B Slip-Couplers Positioned with Make up Pipes in Position



31C Slip-Couplers Moved into Position and Make up Piece

FIG. 31 REPAIRS USING DOUBLE-SOCKET REPAIR COUPLERS

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Plastic Piping System Sectional Committee, CED 50

Organization	*Representative(s)*
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(*Continued from page* 26)

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(*Continued on page* 28)

(*Continued from page* 27)

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