SUB HEAD : 18.0

WATER SUPPLY

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18.0 WATER SUPPLY

18.1 TERMINOLOGY

Air Gap: The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or fitting supplying water to a tank or other device and the flood level rim of the receptacle in a water supply system.

Air Valve: A valve that releases air from a pipe line automatically without loss of water, or introduces air into a pipe line automatically if the internal pressure becomes less than that of the atmosphere.

Available Head: The head of water available at the point of consideration due to main's pressure or overhead tank or any other source of pressure.

Back Flow: The flow of water into the distributing pipes of water system from any source or sources other than its intended source.

Back Siphonage: The flowing back of used, contaminated or polluted water from a plumbing fitting or vessel into a water supply system due to a lowering of pressure in such system.

Ball Cock (Fig. 18.1): A faucet opened or closed by the fall or rise of a ball floating on the surface of water.

Branch (Fig. 18.2): (i) A special form of cast iron pipe used for making connections to water mains. The various types are called T, Y, T-Y, double Y, and V branches, according to their respective shapes.

(ii) Any part of a piping system other than a main.

Capacity: The storage capacity of storage or flushing cistern or a tank when filled up to the water line.

Non Return Valve (Fig. 18.4): A device provided with a disc hinged on one edge so that it opens in the direction of normal flow and closes with reversal of flow.

Collar: A pipe fitting in the form of a sleeve for jointing the spigot ends of two pipes in the same alignment.

Coupling: A pipe fitting with inside threads only, used for connecting two pieces of pipe.

Cross (Fig. 18.2): A pipe fitting used for connecting four pipes at right angles.

Elbow (Fig. 18.2): A pipe fitting for providing a sharp change of direction in a pipe line.

Ferrule (Fig. 18.2): A pipe fitting for connecting a service pipe to a water main.

Fitting: Anything fitted or fixed in connection with the supply, measurement, control, distribution, utilization or disposal of water.

Fire Hydrant (Fig. 18.5): A device connected to a water main and provided with necessary valve and outlets, to which a fire hose may be attached for discharging water at a high rate for the purpose of extinguishing fires, washing down streets, or flushing out the water main.

Flange (Fig. 18.2): A projecting flat rim on the end of a valve, pipe etc.

Flanged Pipe (Fig. 18.2): A pipe provided with flanges so that the ends can be joined together by means of bolts.

Float Valve: A valve in which the closure to an opening such as a plug or gate is actuated by a float to control the flow into a tank.

Sluice Valve (Gate Valve) (Fig. 18.4) : A valve in which the flow of water is cut off by means of a circular disc., fitting against machine-smoothed faces, at right angles to the direction of flow. The disc is raised or lowered by means of a threaded stem connected to the handle of the valve; the opening in the valve is usually as large as the full bore of the pipe.

Nipple (Fig. 18.2): A tubular pipe fitting usually threaded on both ends and less than 300 mm long used for connecting pipes or fittings.

Offset: A combination of elbows or bends which brings one section of the pipe out of line but into a line parallel with the other section in a piping system.

Reflux Valve (Fig. 18.4): A non return valve used in a pipe line at a rising gradient to prevent water that is ascending the gradient from flowing back in the event of a burst lower down.

Socket (Fig. 18.2): The female part of the spigot and socket joint.

Spigot (Fig. 18.2): The male part of a spigot and socket joint.

Stop Cock (Fig. 18.3): A control valve fixed at the end of a communication pipe which controls the supply from the water main.

Storage Tank: A tank or a cistern for storage of water which is connected to the water main by means of a supply pipe.

Service or Supply Pipe: Pipe through which supply is drawn from water mains.

Union (Fig. 18.2): A pipe fitting used for joining the ends of two pipes neither of which can be turned.

Valve: A device used for controlling the flow of water in a pipe line.

18.2 GENERAL REQUIREMENTS

18.2.1 Any damage caused to the building, or to electric, sanitary water supply or other installations etc. therein either due to negligence on the part of the contractor, or due to actual requirements of the work, shall be made good and the building or the installations shall be restored to its original condition by the contractor. Nothing extra shall be paid for it, except where otherwise specified.

18.2.2 All water supply installation work shall be carried out through licensed plumbers.

18.2.3 It is most important to ensure that wholesome water supply provided for drinking and culinary purposes, is in no way liable to contamination from any less satisfactory water. There shall, therefore, be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for conveying or containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose. The provision of reflux or non-return valves or closed and sealed valves shall not be construed a permissible substitute for complete absence of cross-connection.

18.2.4 Where a supply of wholesome water is required as an alternative or standby to supply of less satisfactory water or is required to be mixed with the latter, it shall be delivered only into a cistern, and by a pipe or fitting discharging into the air gap at a height above the top edge of the cistern equal to twice its nominal bore, and in no case less than 15 cm.

18.2.5 No piping shall be laid or fixed so as to pass into, through or adjoining any sewer, scour outlet or drain or any manhole connected therewith nor through any ash pit or manure-pit or any material of such nature that can cause undue deterioration of the pipe.

18.2.6 Where the laying of any pipe through fouled soil or previous material is unavoidable, the piping shall be properly protected from contact with such soil or material by being carried through an exterior cast iron tube or by some other suitable means. Any piping or fitting laid or fixed which does not comply with the above requirements, shall be removed and re-laid in conformity with the above requirements.

18.2.7 The design of the pipe work shall be such that there is no possibility of backflow towards the source of supply from any cistern or appliance whether by siphonage or otherwise, and reflux or non-return valves shall not be relied upon to prevent such back flow.

18.2.8 All pipe work shall be so designed, laid or fixed, and maintained so that it remains completely watertight, thereby avoiding wastage of water, damage to property and the risk of contamination of the water conveyed.

18.2.9 In designing and planning the layout of the pipe work, due attention shall be given to the maximum rate of discharge, required economy in labour and materials, protection against damage and corrosion, protection from frost, if required, and to avoidance of airlocks, noise transmission and unsightly arrangement.

18.2.10 To reduce frictional losses, piping shall be as smooth as possible inside. Methods of jointing shall be such as to avoid internal roughness and projection at the joints, whether of the jointing materials or otherwise.

18.2.11 Change in diameter and in direction shall preferably be gradual rather than abrupt to avoid undue loss of head. No bend or curve in piping shall be made so as to materially reduce or alter the cross-section.

18.2.12 Underground piping shall be laid at such a depth that it is unlikely to be damaged by frost or traffic loads and vibrations. It shall not be laid in ground liable to subsidence, but where such ground cannot be avoided; special precautions shall be taken to avoid damage to the piping. Where piping has to be laid across recently disturbed ground, the ground shall be thoroughly consolidated so as to provide a continuous and even support.

18.2.13 Where the service pipe is of diameter less than 50 mm the stop valves shall be of the screw-down type and shall have loose washer plates to act as non-return valves. Other stop valves in the service line may be of the gate type.

18.2.14 In flats and tenements supplied by a common service pipe a stop valve shall be fixed to control the each branch separately. In large buildings a sufficient number of stop valves shall be fixed on branch pipes, and to control groups of ball valves and draw off taps, so as to minimize interruption of the supply during repairs, all such stop valves shall be fixed in accessible positions and properly protected from being tampered with, they may be of the gate type to minimize loss of head by friction.

18.2.15 Water for drinking or for culinary purposes as far as possible shall be on branch pipes connected directly to the service pipe.

18.2.16 Pumps shall not be allowed on the service pipe as they cause a drop of pressure on the suction side thereby affecting the supply to the adjoining properties. In cases where pumping is required, a properly protected storage tank of adequate capacity shall be provided to feed the pump.

18.2.17 Service pipes shall be so designed and constructed as to avoid air-locks, so that all piping and fittings above ground can be completely emptied of water to facilitate repairs. There shall be draining taps or draw-off taps (not underground) at the lowest points, from which the piping shall rise continuously to draw-off taps, ball valves, cisterns, or vents (where provided at the high points).

18.2.18 Service pipes shall be designed so as to reduce the production and transmission of noise as much as possible. Appliances which create noise shall be installed as far distant as possible from the living rooms of the house. High velocity of water in piping and fittings shall be avoided.Piping shall be confined, as far as possible, to rooms where appliances are fixed, it shall have easy bends, and where quietness is particularly desired, holder bats or clamps shall be insulated from the piping by suitable pads.

18.2.19 The rising pipe to the storage cistern, if any, or to any feed cistern shall be taken as directly as possible to the cistern and shall be fixed away from windows or ventilators.

18.2.20 All pipe work shall be planned so that the piping is accessible for inspection, replacement and repair. To avoid its being unsightly, it is usually possible to arrange it in or adjacent to cupboards, recesses, etc. provided there is sufficient space to work on the piping with the usual tools. Piping shall not be buried in walls or solid floors. Where unavoidable, piping may be buried for short distances provided that adequate protection is given against damage and that no joints are buried. If piping is laid in ducts or chases, these shall be roomy enough to facilitate repairs and shall be so constructed as to prevent the entry of vermin. To facilitate removal of pipe casing, floor boards covering piping shall be fixed with screws or bolts.

18.2.21 When it is necessary for a pipe to pass through a wall or floor, a sleeve shall be fixed therein for insertion of the pipe and to allow freedom for expansion, contraction and other movement. Piping laid in wood floors shall, where possible, be parallel with the joists.

18.2.22 Where storage tanks are provided to meet overall requirements of water connection of service pipe with any distributing pipe shall not be permitted except one direct connection for culinary or drinking requirements.

18.2.23 No service pipe shall be connected to any water closet or urinal. All such supplies shall be from flushing cisterns which shall have supply from storage tank.

18.2.24 No service or supply pipe shall be connected directly to any hot-water system or to any apparatus used for heating other than through a feed cistern thereof.

18.3 MATERIALS

18.3.0 The standard size of brass or gun metal fittings shall be designated by the nominal bore of the pipe outlet to which the fittings are attached. A sample of each kind of fittings shall be got approved from the Engineer-in-Charge and all supplies made according to the approved samples.

All cast iron fittings shall be sound and free from laps, blow holes and pitting. Both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging, stopping or patching of the casting shall not be permissible. The bodies, bonnets, spindles and other parts shall be truly machined so that when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished. The area of the water way of the fittings shall not be less than area of the nominal bore, chromium plating wherever specified shall be of 0.3 micron. The chromium shall never be deposited on brass unless a heavy coating of nickel is interposed. In the case of iron a thick coat of copper shall first be applied, then one of nickel and finally the chromium. In finish and appearance the plated articles when inspected shall be free from plating defects such as blisters, pits roughness and unplated areas and shall not be stained or discoloured. Before fitting is plated, the washer plate shall be removed from the fittings, the gland packing shall be protected from the plating solution.

18.3.1 Ball Valve (Brass)

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703 (Fig. 18.1). The ball valve shall be of following two classes:—

(a) ***High Pressure:*** High pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.

(b) ***Low Pressure:*** Low Pressure float valves are indicated by the abbreviation 'LP' and are designed for use on mains having a pressure up to. 0.175 MPa.

The ball valves shall be of following nominal sizes 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm. The nominal size shall correspond with the nominal bore of the inlet shanks. Polyethylene floats shall conform to IS 9762.

18.3.2 Bib Taps and Stop Valve

Brass (Fig. 18.3): A bib tap is a draw off tap with a horizontal inlet and free outlet and a stop valve is a valve with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clock wise direction.

The bib tap and stop valve shall be polished bright. The minimum finished weights of bib tap and stop valve shall be as specified in Table 18.1.

TABLE 18.1
Minimum Finished Mass of Bib Taps and Stop Valves

Size	*Minimum Finished Mass*			
	Bib Taps	*Stop Valves*		
		Internally Threaded	*Externally Threaded*	*Mixed End*
(1)	*(2)*	*(3)*	*(4)*	*(5)*
mm	*kg*	*kg*	*kg*	*kg*
8	0.250	0.220	0.250	0.235
10	0.300	0.300	0.350	0.325
15	0.400	0.330	0.400	0.365
20	0.750	0.675	0.750	0.710
25	1.250	1.180	1.300	1.250
32	--	1.680	1.800	1.750
40	--	2.090	2.250	2.170
50	--	3.700	3.850	3.750

In case these are required to be nickel plated, the plating shall be of the first quality with a good thick deposit of silvery whiteness capable of taking high polish which will not easily tarnish or scale.

18.3.3 Ferrules (Fig. 18.2)

The ferrules for connection with C.I. main shall generally conform to IS 2692. It shall be of non ferrous materials with a C.I. bell mouth cover and shall be of nominal bore as specified. The ferrule shall be fitted with a screw and plug or valve capable of completely shutting off the water supply to the communication pipe, if and when required.

18.3.4 Fire Hydrants (Fig. 18.5)

The hydrant shall conform to IS 909 and shall consist of the following components:

(a)	Body	(d)	Gland	(g)	Valve
(b)	Bonnet	(e)	Spindle Cap	(h)	Screwed Outlet
(c)	Spindle	(f)	Spindle Nut	(i)	Outlet and Chain

The body, bonnet, gland, outlet cap and spindle cap and shall be of good quality cast iron grade FG 200 of IS 210. Outlet, seat for valve, valve, spindle nut, check nut shall be made of copper alloy as per IS 909.

18.3.5 Gate Valve - Gun Metal (Fig. 18.5)

These shall be of the gun metal fitted with wheel and shall be of gate valve type opening full way and of the size as specified. These shall generally conform to IS 778.

18.3.6 Pig Lead

Pig lead shall be of uniform quality, clean and free from foreign materials. It shall be of uniform softness and capable of being easily caulked or driven. It shall conform to IS 782 for caulking lead in all respects.

18.3.7 Lead Wool

Lead wool shall conform to IS 782 in all respects. Lead wool shall consist of fine strands or plated ribbons of lead. The cross-section of the individual strands shall be flat. The dimensions in the sectional plane shall not be less than 0.13 mm and not more than 0.90 mm and the rope shall be supplied in minimum lengths of two metres and the maximum length in any one package shall be such that the package does not weigh more than 50 Kg.

18.3.8 Non-Return Valve (Gun Metal) (Fig. 18.4)

A non-return valve permits water to flow in one direction only and is provided on the ascending part of the main to check return flow. The non-return valve shall be of Gun metal and shall be of horizontal or vertical flow type as specified.

The valve shall be of quality approved by the Engineer-in-Charge and shall generally conform to IS 778.

18.3.9 Pipes and Specials

Pipes and specials may be of any of the following types as specified:

(a) Cast iron centrifugally cast (spun) – IS 1536

(b) Galvanised steel – IS 1239 & IS 4736

(c) PE-AL-PE Pipes – IS 15450

(d) PP-R Pipes – IS 15801

(e) CPVC pipes – IS 15778

In choosing the material for piping and fittings, account shall be taken of the character of the water to be conveyed through it, the nature of the ground in which the pipes are to be laid and the relative economics.

18.3.10 Pipes- Centrifugally Cast (Spun) Iron Pipes

18.3.10.1 The spun iron pipes shall conform to IS 1536. The spun iron pipes shall be of cast iron cast centrifugally and vary in diameters from 80 mm to 750 mm. These shall be of class LA, class A and class B, as specified. Pipes shall be tested hydrostatically at the pressure specified in table 18.2 & 18.3. Tolerances on specified dimensions shall be as prescribed in Appendix A.

18.3.10.2 ***Specials:*** The specials shall conform to IS 1538. The hydraulic test pressure of each class shall be as detailed in Table 18.4. Tolerances on specified dimensions shall be as prescribed in Appendix B of sub head- 18.

TABLE 18.2

Hydrostatic Test pressure for centrifugally cast socket & spigot pipes in MPa		
Hydrostatic Test pressure for works in MPa		
Class	*Up to DN 600*	*DN 700 & above*
LA	3.5	1.5
A	3.5	2.0
B	3.5	2.5

TABLE 18.3

Hydrostatic Test pressure for centrifugally cast pipes with screwed on flanges in MPa		
Class	*Up to DN 600*	*DN 700 & above*
B	2.5	1.6

TABLE 18.4

Hydrostatic Test pressure for fittings in MPa (N/mm^2) (metre head)		
Nominal - Diameter	*Fitting without branches or with branches not greater than half the principle diameter.*	*Fitting with branches greater than half the principal Diameter.*
Up to and including 300 mm	2.5 (25)	2.5 (25)
Over 300 mm and up to and including 600 mm	2.0 (20)	2.0 (20)
Over 600 mm and up to and including 1500 mm	1.5 (15)	1.0 (10)

18.3.11 Pipes-Galvanised Iron

18.3.11.1 The pipes (tubes) shall be galvanised mild steel hot finished seamless (HFS) or welded (ERW) HRIW or HFW screwed and socketed conforming to the requirements of IS 1239 Part-I for medium grade. They shall be of the diameter (nominal bore) specified in the description of the item, the sockets shall be designated by the respective nominal bores of the pipes for which they are intended.

18.3.11.2 ***Galvanising shall conform to IS 4736 :*** The zinc coating shall be uniform adherent, reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare batches, black spots, pimples, lumping runs, rust stains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

18.3.11.3 The dimensions and weights of pipes and sockets and tolerances shall be as prescribed in Appendix 'C'.

18.3.11.4 All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

18.3.11.5 All tubes shall withstand a test pressure of 50 Kg/sq.cm without showing defects of any kind.

18.3.11.6 ***Fittings :*** The fittings shall be of mild steel tubular or wrought steel fittings conforming to IS 1239 (Part-2) or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

18.3.12 Shower Rose Brass

The shower rose shall be of chromium plated brass of specified diameter. It shall have uniform perforations. The inlet size shall be 15 mm or 20 mm as required.

18.3.13 Sluice Valves-Brass/Gun Metal (Fig. 18.4)

The sluice valves are used in a pipe line for controlling or stopping flow of water. These shall be of specified size and class and shall be of inside non-raising screw type up to 300 mm size and raising or non-raising screw type above 300 mm with either double flange or double socket ends and cap or hand wheel. These shall in all respects comply with the Indian Standard Specification IS 780 for valves up to and including 300 mm size and for valves above 300 mm size. Class I sluice valves are used for maximum working pressure of 10 Kg/sq.cm (100 metre head) and class II sluice valve for 15 Kg/sq.cm (150 metre head).

The body, domes covers, wedge gate and stuffing box shall be of good quality cast iron, the spindle of bronze, and the nut and valve seats of leaded tin bronze. The bodies, spindles and other parts shall be truly machined with surface smoothly finished. The area of the water way of the fittings shall be not less than the area equal to the nominal bore of the pipe.

The valve shall be marked with an arrow to show the direction of turn for closing of the valve.

18.3.14 Surface Box (Fig. 18.6 & 18.7)

This shall be of cast iron, well made and free from casting and other defects. All sharp edges shall be removed and finished smooth. The shape and dimensions for surface boxes for stop cocks, sluice valves, fire hydrants, water meters etc. shall be as specified in Fig. 18.3 & 18.4.

The C.I. surface boxes shall be coated with a black bituminous composition except in case of fire hydrants where the cover of the surface box shall be painted with two coats of rust resisting bright luminous yellow paint for clear visibility during night.

18.3.15 Water Meter (Domestic Type) (Fig. 18.4)

18.3.15.1 Water meters shall be selected according to flow to be measured and not necessarily to suit a certain size of main. The following points shall govern the selection of meters:

(a) The maximum flow shall not exceed the nominal capacity of the meter.
(b) The continuous flow shall be not greater than the continuous running capacity rating.
(c) The minimum flow to be measured shall be within minimum starting flows.

18.3.15.2 Inferential water meter has the same accuracy as the semi-positive type at higher flows; it passes unfiltered water better than a semi-positive meter and is lower in cost.

18.3.15.3 Special care is necessary in selecting the most suitable meter where large rates of flow may exist for short periods. The normal working flow shall be well within the continuous running capacity specified in IS 779, as high rates of flow over short period may cause excessive wear if the meter chosen is too small for the duty.

18.3.15.4 Owing to the fine clearances in the working parts of meters, they are not suitable for measuring water containing sand or similar foreign matter, and in such cases a filter or dirt box of adequate effective area shall be fitted on the upstream side of the meter. See Fig. 18.4. It shall be noted that the normal strainer fitted inside a meter is not a filter and does not prevent the entry of small particles, such as sand.

18.3.15.5 Water meters and their parts, especially parts coming in continuous contact with water shall be made of materials resistant to corrosion and shall be non-toxic and non-training. Use of dissimilar metals in contact under water shall be avoided as for possible in order to minimise electrolytic corrosion.

18.3.15.6 ***Body :*** The body of water meter shall be made either from Type A or Type B materials as specified below:—

Type A : The body of water meters shall be made from bronze, brass or any other corrosion resistant material e.g. Grey iron castings, blackheart malleable iron, pherodial graphite iron casting.

Type B: The body of the water meters shall be made form suitable plastics.

Note: Plastics shall have following qualities:

(i) It shall not affect the potability of water.

(ii) Elongation, 15 per cent, Min. on a specimen of length 150 mm (for procedure of determination of elongation).

(iii) Water absorption on immersion for 24 hours should not exceed 0.6 per cent by weight (for procedure of determination of water absorption).

(iv) It shall be capable of withstanding temperature up to 55°C without undergoing deformation or softening and becoming unsatisfactorily in performance.

18.3.15.7 ***Registration Box:*** Registration box of water meters of Type A shall be made from bronze, brass, aluminium alloy or suitable plastics. Registration box of water meters of Type B shall be made from suitable plastics or aluminium alloys. The registration box of dry dial water meters shall be provided with one or two escape holes for minimising the accumulation of condensed water.

18.3.15.8 ***Cap:*** Cap of water meters of Type A shall be made from brass, bronze, aluminium alloy or suitable plastics. The cap of water meters of Type B shall be made of plastics or aluminium alloy. Where the cap and registration box are integral, the materials for cap may be the same as used for registration box. The cap shall be so designed and fixed to the registration box as to avoid entry of water and dirt. The transparent window which covers the dial shall be inserted from the inside into the cap. The protective lid shall be secured by a robust hinge or other suitable method of robust construction.

18.3.15.9 ***Locking Arrangement:*** Provision shall also be made to lock the lid. The provision shall be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks, the hole provided for padlocks shall be of a diameter not less than 4 mm.

18.3.15.10 ***Wiper:*** Where so required for dry-type water meters the transparent window covering the dial shall be provided with a wiper on the inner side for wiping off condensed water.

18.3.15.11 ***Connecting Arrangements:*** The meter casing shall be fitted in the pipe line by means of two conical or cylindrical nipples or tail pieces with connecting nuts which shall be provided with each meter. The nipples of water meters of Type A shall be made of the same materials as specified for body.

Nipples of water meters of Type B shall be made of the same materials as specified for the body where they are integral with the body of the water meters; where they are separate, they shall be made of malleable iron, galvanized steel or suitable plastics. The nuts shall be of the same material as used for nipples. The internal diameter of the nipple where it connects the pipe line shall be equal to that corresponding to the nominal size of the meter. The threads on the connection shall conform to IS 779. The minimum length of the threads shall be as given in Table 18.5.

18.3.15.12 ***Strainers:*** Water meters shall be provided with strainers. Strainers shall be of a material which is not susceptible to electrolytic corrosion. They shall be of plastics or other corrosion-resistant materials for both Type A and Type B meters. They shall be rigid, easy to remove and clean, and shall be fitted on the inlet side of the water meter. It shall be possible to remove and clean the strainer in such a way as not to permit disturbing the registration box or tampering with it. The strainer shall have a total area of holes not less than twice the area of the nominal inlet bore of the pipe to which the meter is connected however, in the case of meters provided with internal strainer involving opening of the registration box for cleaning, an additional external strainer shall be fitted on the inlet side satisfying the above requirements.

Overall dimension of water meters shall be as specified in Table 18.6.

TABLE 18.5
Minimum Length of Thread on Connections

Nominal size of meter	*Minimum length of thread*
15	12
20	14
25	16
40	20
50	25

(All dimensions in millimeters)

Screws & studs shall be of brass or other corrosion resistant material.

TABLE 18.6
Overall Dimensions of Water Meters

Nominal size of Meter	*Overall length including nipples*	*Overall width. (Max.)*	*Overall height (Max.)*
1	*2*	*3*	*4*
15	250	100	180
20	290	130	240
25	380	170	260
40	430	210	300
50	470	270	300

All dimensions are in mm.

Tolerance on the overall length shall be ± 5 mm. for meter with nipples and +0,-2 mm for meters without nipples.

18.3.15.13 ***Capacity on Short Period Rating or Nominal Capacity:*** The nominal capacity of the water meters shall be as specified in Table 18.7. The meters shall be capable of giving minimum discharges as stated in the table without the head loss exceeding 10 m within the meters.

18.3.16 Yarn (Spun)

Spun yarn shall be of clean hemp and of good quality. It shall be soaked in hot coal tar or bitumen and cooled before use.

18.4 LAYING AND JOINTING OF PIPES AND FITTINGS

18.4.1 Unloading

18.4.1.1 The pipes shall be unloaded where they are required.

18.4.1.2 ***Unloading (except where mechanical handling facilities are available) :*** Pipes weighing up to 60 kg shall be handled by two persons by hand passing. Heavier pipes shall be unloaded from the lorry or wagon by holding them in loops, formed with ropes and sliding over planks set not steeper than 45 degree. The planks shall be sufficiently rigid and two ropes shall always be used to roll the pipes down the planks. The ropes should be tied on the side opposite the unloading. Only one pipe shall be unloaded at a time.

TABLE 18.7
Nominal Capacity of Water Meters

Discharge per hour		
Nominal size of meter (mm)	*Semi positive Type (liters)*	*Inferential Type (liters)*
15	2000	2500
20	3400	3500
25	5500	5500
40	10000	16000
50	15000	23000

18.4.1.3 Under no circumstances shall the pipes be thrown down from the carriers or be dragged or rolled along hard surfaces.

18.4.1.4 The pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded.

18.4.2 Storing

18.4.2.1 The pipes and specials shall be handled with sufficient care to avoid damage to them. These shall be lined up on one side of the alignment of the trench, socket facing upgrade when line runs uphill and upstream when line runs on level ground.

18.4.2.2 Each stack shall contain pipes of same class and size, consignment or batch number and particulars of suppliers, wherever possible, shall be marked on the stack.

18.4.2.3 Storage shall be done on firm, level and clean ground. Wedges shall be provided at the bottom layer to keep the stack stable.

18.4.3 Cutting

18.4.3.1 Cutting of pipes may be necessary when pipes are to be laid in lengths shorter than the lengths supplied, such as while replacing accessories like tees, bends, etc. at fixed position in the pipe lines.

18.4.3.2 A line shall be marked around the pipe with a chalk piece at the point where it is to be cut. The line shall be so marked that the cut is truly at right angle to the longitudinal axis of the pipe. The pipe shall be rigidly held on two parallel rafters nailed to cross beams, taking care that the portion to be cut does not overhang and the cut mark is between the two rafters. The pipe shall be neatly cut at the chalk mark with carpenter's saw or hacksaw having a long blade, by slowly rotating the pipe around its longitudinal axis so as to have the uncut portion on top for cutting. Cutting of the pipe at the overhang should, as far as possible, be avoided, as an overhanging and is liable to tear off due to its weight before the cutting is complete.

18.4.4 Trenches

18.4.4.1 The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.

18.4.4.2 Cover shall be measured from top of pipe to the surface of the ground.

18.4.4.3 The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layers.

18.4.4.4 If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe. Where excavation requires blasting operation, it shall be ensured that no pipes have been stacked in the vicinity and completed pipe line in the vicinity has already been covered before starting of blasting operations; this is necessary to prevent damage to the exposed pipes in the vicinity by falling stones as a result of blasting.

18.4.4.5 After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

18.4.4.6 Roots of trees within a distance of about 0.5 metre from the side of the pipe line shall be removed or killed.

18.4.4.7 The excavated materials shall not be placed within 1 metre or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling they may be re-laid and compacted in the same order to the satisfaction of the Engineer-in-Charge.

18.4.4.8 The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after dewatering the trenches.

18.4.4.9 Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water mains cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the Engineer-in-Charge.

18.4.5 Laying

18.4.5.1 The pipes shall be lowered into the trench by means of suitable pulley blocks, sheer legs chains ropes etc. In no case the pipes shall be rolled and dropped into the trench. One end of each rope may be tied to a wooden or steel peg driven into the ground and the other end held by men which when slowly released will lower the pipe into the trench. After lowering, the pipes shall be arranged so that the spigot of one pipe is carefully centered into the socket of the next pipe, and pushed to the full distance that it can go. The pipe line shall be laid to the levels required. Specials shall also be laid in their proper position as stated above.

18.4.5.2 Where so directed, the pipes and specials may be laid on masonry or concrete pillars. The pipe laid on the level ground, shall be laid with socket facing the direction of flow of water.

18.4.5.3 The pipes shall rest continuously on the bottom of the trench. The pipes shall not rest on lumps of earth or on the joints. Four metre long wooden templates may be used to check the level of the bed. Clearance of approximately 100 mm in depth and width equal to length of the collar plus 30mm on both sides shall be provided at the joint which shall be refilled from sides after the joint is made.

18.4.5.4 In unstable soils, such as soft soils and dry lumpy soils it shall be checked whether the soils can support the pipe lines and if required suitable special foundation shall be provided.

18.4.5.5 Some clayey soils (for example black cotton soil) are drastically affected by extremes of saturation and dryness. In changing from saturated to a dry condition, these soils are subjected to extraordinary shrinkage which is usually seen in the form of wide and deep cracks in the earth surface and may result in damages to under ground structures, including pipe materials. The clay forms a tight gripping bond with the pipe, subjecting it to excessive stresses as the clay shrinks. It is recommended that in such cases an envelope of a minimum 100 mm of tamped sand shall be made around the pipe line to avoid any bonding.

18.4.5.6 In places where rock is encountered, cushion of fine earth or sand shall be provided for a depth of 150 mm by excavating extra depth of the trench, if necessary, and the pipes laid over the cushion. Where the gradient of the bed slopes is more than 30 degree it may be necessary to anchor a few pipes against sliding downwards (Fig. 18.8).

18.4.6 Thrust Blocks (Fig. 18.8)

18.4.6.0 Thrust blocks are required to transfer the resulting hydraulic thrust from the fitting of pipe on to a larger load bearing soil section.

18.4.6.1 Thrust blocks shall be installed wherever there is a change in the direction/size of the pipe line or the pressure line diagram, or when the pipe line ends at a dead end. If necessary, thrust blocks may be constructed at valves also.

18.4.6.2 Thrust blocks shall be constructed taking into account the pipe size, water pressure, type of fitting, gravity component when laid on slopes and the type of soil. The location of thrust blocks for various types' fittings is given in Fig. 18.8.

18.4.6.3 When a fitting is used to make a vertical bend, it shall be anchored to a concrete thrust block designed to have enough weight to resist the upward and outward thrust. Similarly at joints, deflected in vertical plane, it shall be ensured that the weight of the pipe, the water in the pipe and the weight of the soil over the pipe provide resistance to upward movement. If it is not enough, ballast or concrete shall be placed around the pipe in sufficient weight to counteract the thrust.

18.4.6.4 When the line is under pressure there is an outward thrust at each coupling. Good soil, properly tamped is usually sufficient to hold pipe from side movement. However, if soft soil conditions are encountered, it may be necessary to provide side thrust blocks of other means of anchoring. In such cases only pipe on each side of the deflected coupling shall be anchored without restricting the coupling.

18.4.6.5 Pipes on slopes need be anchored only when there is a possibility of the back fill around the pipe sloping down the hill and carrying the pipe with it. Generally for slopes up to 30 degree good well drained soil carefully tamped in layers of 100 mm under and over the pipe, right up to the top of trench will not require anchoring.

18.4.6.6 For steeper slopes, one out of every three pipes shall be held by straps fastened to vertical supports anchored in concrete.

18.4.7 Back Filling and Tamping

18.4.7.1 Back filling shall follow pipe installation as closely as possible to protect pipe from falling boulders, eliminating possibility of lifting of the pipe due to flooding of open trench and shifting pipe out of line by caved in soil.

18.4.7.2 The soil under the pipe and coupling shall be solidly tamped to provide firm and continuous support for the pipe line. Tamping shall be done either by tamping bars or by using water to consolidate the back fill materials.

18.4.7.3 The initial back fill material used shall be free of large stones and dry lumps. In stony areas the material for initial back fill can be shaved from the sides of the trenches. In bogs and marshes, the excavated material is usually little more than vegetable matter and this should not be used for bedding purposes. In such cases, gravel or crushed stone shall be hauled in.

18.4.7.4 The initial back fill shall be placed evenly in a layer of about 100 mm thick. This shall be properly consolidated and this shall be continued till there is a cushion of at least 300 mm of cover over the pipe.

18.4.7.5 If it is desired to observe the joint or coupling during the testing of mains they shall be left exposed. Sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing.

18.4.7.6 Balance of the back fill need not be so carefully selected as the initial material. However, care shall be taken to avoid back filling with large stones which might damage the pipe when spaded into the trench.

18.4.7.7 Pipes in trenches on a slope shall have extra attention to make certain that the newly placed back fill will not become a blind drain in effect because until back fill becomes completely consolidated there is a tendency for ground or surface water to move along this looser soil resulting in a loss of support to the pipe. In such cases, the back fill shall be tamped with extra care and the tamping continued in 100 mm layers right up to the ground level.

18.4.8 Hydrostatic Tests (Fig. 18.9)

18.4.8.1 After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests:

(a) Pressure test at a pressure of at least double the maximum working pressure-pipe and joints shall be absolutely water tight under the test.

(b) Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for duration of two hours.

18.4.8.2 ***Hydrostatic Tests:*** The portions of the line shall be tested by subjecting to pressure test as the laying progresses before the entire line is completed. In this way any error of workmanship will be found immediately and can be corrected at a minimum cost. Usually the length of the section to be tested shall not exceed 500 m.

18.4.8.3 Where any section of a main is provided with concrete thrust blocks or anchorages, the pressure test shall not be made until at least five days have elapsed after the concrete is cast. If rapid hardening cement has been used in these blocks or anchorages, test shall not be made until at least two days have elapsed.

18.4.8.4 Prior to testing, enough back fill as described in 18.4.7 shall be placed over the pipe line to resist upward thrust. All thrust blocks forming part of the finished line shall have been sufficiently cured and no temporary bracing shall be used.

18.4.8.5 The open end of the section shall be sealed temporarily with an end cap having an outlet which can serve as an air relief vent or for filling the line, as may be required. The blind face of the end cap shall be properly braced during testing by screw jacks and wooden planks or steel plate as shown in Fig. 18.6.

18.4.8.6 The section of the line to be tested shall be filled with water manually or by a low pressure pump. Air shall be vented from all high spots in the pipe line before making the pressure strength test because entrapped air gets compressed and causes difficulty in raising the required pressure for the pressure strength test.

18.4.8.7 The test pressure shall be gradually raised at the rate of approximately one Kg./sq. cm./min. The duration of the test period if not specified shall be sufficient to make a careful check on the pipe line section.

18.5 LAYING AND JOINTING OF CAST IRON PIPES AND FITTINGS (EXTERNAL WORK)

18.5.0 Specifications described in 18.4 shall apply, as far as applicable.

TABLE 18.8
Test Pressure for Pipes

Class of pipe	*Maximum field test pressure kgf./sq.cm*
5	3.75
10	7.50
15	11.25
20	15.00
25	18.75

18.5.1 Trenches

18.5.1.1 The gradient is to be set out by means of boning rods and the required depth to be excavated at any point of the trench shall be regarded as directed by the Engineer-in-Charge. The depth of the trench shall not be less than 1 metre measured from the top of the pipe to the surface of the ground under roads and not less than 0.75 metre elsewhere.

18.5.1.2 The width of the trench shall be the nominal diameter of the pipe plus 40 cm but it shall not be less than 55 cm in case of all kinds of soils excluding rock and not less than 1 metre in case of rock.

18.5.2 Laying

Any deviation either in plan or elevation less than 11.25 degrees shall be effected by laying the straight pipes around a flat curve of such radius that minimum thickness of lead at the face of the socket shall not be reduced below 6 mm or the opening between spigot and socket increased beyond 12 mm at any joint. A deviation of about 2.25 degree can be effected at each joint in this way. At the end of each day's work the last pipe laid shall have its open ends securely closed with a wooden plug to prevent entry of water, soil, rats and any other foreign matter into the pipe.

18.5.3 Lead Caulked Joints with Pig Lead

18.5.3.1 This type of lead caulking is generally done in providing joints in gas water and sewer lines wherever it is practicable to use cast lead caulking, but not in case of wet conditions.

18.5.3.2 The approximate depth and weights of pig lead for various diameters of C.I. pipes and specials shall be as given in Table 18.9.

TABLE 18.9
Lead for Different Sizes of Pipes

Nominal size of pipe mm.	*Lead per joint Kg.*	*Depth of lead joint mm*
(1)	*(2)*	*(3)*
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

Note: 1. The quantity of lead given in the table is on average basis and a variation of 10 per cent is permissible.
2. Before pipes are jointed on large scale, three or four sample joints shall be made and the average consumption of lead per joint shall be got approved by the Engineer-in-Charge.

Only required quantity of spun yarn shall be put so as to give the specified depth of lead in the joint.

18.5.4 Lead Caulked Joint with Lead Wool Yarn

18.5.4.1 This type of lead caulking is generally done when it is inconvenient or dangerous to use molten lead for joints, for example in cases such as inverted joints or in wet trenches or in exceptional cases. In such cases the joints shall be made with lead wool or yarn. Caulking with lead wool or yarn shall however be not carried out without the prior permission of Engineer-in-Charge.

18.5.4.2 The approximate weights and depths of lead wool or lead yarn required for each joint of various dia. of C.I. pipes and specials shall be as given in Table 18.10. Just sufficient quantity of spun yarn shall be put so as to give specified depth of lead wool.

18.5.4.3 ***Jointing:*** The spun yarn shall first be inserted and caulked into the socket as described under jointing with pig lead. Lead wool or yarn shall then be introduced in the joint in strings not less than 6 mm thick and the caulking shall be repeated with each turn of lead wool or yarn. The whole of the lead wool or yarn shall be compressed into a dense mass. The joint shall then be finally finished flush with face of the socket.

18.5.5 Flanged joints

18.5.5.1 Cast iron pipes may be jointed by means of flanges cast on. The jointing material used between flanges of pipes shall be compressed fiber board or rubber of thickness between 1.5 mm to 3 mm. The fiber board shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight per m^2 shall be not less than 112 gm/mm thickness.

TABLE 18.10

Diameter of pipe (mm)	*Weight of lead wool or lead yarn (kg)*	*Depth of lead wool or lead yarn (mm)*
80	0.80	19
100	0.90	19
125	1.25	20
150	1.60	23
200	2.05	23
250	2.95	25
300	3.50	25
350	4.65	29
400	5.70	31
450	6.70	32
500	8.30	33
600	10.00	35
700	11.80	36
750	13.60	38
800	15.40	40
900	16.80	40

Note: An allowance of five per cent variation in the specified weights and depths is permissible.

18.5.5.2 Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively. The practice of fully tightening the bolts one after another shall not be allowed.

18.5.5.3 Several proprietary flexible joints are available for jointing cast iron pipes and these may be used with the specific approval of the authority, however, they shall be used strictly in accordance with the manufacturer's instructions.

18.5.5.4 For joints in small diameter cast iron piping, copper-alloy screwed unions or ferrules shall be used, and for large dia. The joints shall be made by flanged connecting pieces.

18.5.6 Hydrostatic

The procedure for testing for leakage under pressure shall be as described in Appendix D of Chapter 18 which is to be read in addition to 18.4.8. The joints of pipes and specials have to be repaired till the leakage in the portion under test is within the specified limit indicated in Appendix-D.

18.5.7 Measurements

18.5.7.1 The net length of pipes as laid or fixed, shall be measured in the running metres correct to a cm. specials shall be excluded and enumerated and paid for separately. The portion of the pipe within the collar at the joints shall not be included in the length of pipe work.

18.5.7.2 Excavation, refilling, shoring and timbering in trenches masonry or concrete pillars and thrust blocks, wherever required, shall be measured and paid for separately, under relevant items of work.

18.5.7.3 Lead caulked joints shall be measured and paid for separately.

18.5.8 Rate

The rate shall include the cost of materials and labour involved in all the operations described above except for the items measured/enumerated separately under Para 18.4.7.1, 18.4.7.2, 18.4.7.3 which shall be paid for separately.

18.6 LAYING AND JOINTING OF G.I. PIPES (EXTERNAL WORK)

18.6.0 The specifications described in 18.4 shall apply, as far as applicable.

18.6.1 Trenches

The galvanised iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be as in Table 18.11.

TABLE 18.11

Dia of pipe (mm)	*Width of trench (cm)*	*Depth of trench (cm)*
15 to 50	30	60
65 to 100	45	75

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earth work in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

18.6.2 Cutting and Threading

Where the pipes have to be out or rethreaded, the ends shall be carefully filed out so that no obstruction to bore is offered. The end of the pipes shall then be carefully threaded conforming to the requirements of IS 554 with pipe dies and taps in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of pipes and fitting shall be protected from damage until they are fitted.

18.6.3 Jointing

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over. **Teflon Tape** should be used on threads instead of **'Dhaaga/ Safeda'**. The end shall then be screwed in the socket, Tee etc. with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

18.6.4 Thrust Blocks (Fig. 18.8)

In case of bigger diameter pipes where the pressure is very high, thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) of adequate size and shape shall be provided on all bends to transmit the hydraulic thrust to the ground, spreading it over a sufficient areas, depending upon the type of soil met with.

18.6.5 Painting

The pipes shall be painted with two coats of anticorrosive bitumastic paint of approved quality.

18.6.6 Testing of Joints

The pipes and fittings after they are laid and jointed shall be tested to hydraulic pressure of 6 Kg/sq. cm (60 meter). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should

have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found leaking shall be replaced and joints found leaking shall be redone, without extra payment.

18.6.7 Trench Filling

The pipes shall be laid on a layer of 7.5 cm sand and filled up to 15 cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth as described in 20.3.7. The surplus earth shall be disposed off as directed.

18.6.8 Measurements

The lengths shall be measured in running metre correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gun metal taps (cocks), valves, unions, lead connection pipes and shower rose. All pipes and fittings shall be classified according to their diameters, method of jointing and fixing substance quality and finish. In case of fittings of an equal bore the pipe shall be described as including all cuttings and wastage. In case of fittings of unequal bore the largest bore shall be measured.

Note: G.I. unions shall be paid for separately in external work as well as in internal work.

Digging and refilling of trenches shall either be measured separately as specified in the appropriate clauses of excavation and earth work or clubbed with main item.

18.6.9 Rate

The rate shall include the cost of labour and materials involved in all the operations described above. The rate shall not include excavation in trenches, painting of pipes and sand filling all round the pipes, unless otherwise specified.

18.7 LAYING AND JOINTING G.I. PIPES (INTERNAL WORK)

18.7.0 For internal work the galvanised iron pipes and fittings shall run on the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall. When it is found necessary to conceal the pipes, chasing may be adopted or pipes fixed in the ducts or recess etc., provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage and where so required joints are not buried. Where directed by the Engineer-in-Charge, a M.S. tube sleeve shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion and contraction and other movements. In case the pipe is embedded in walls or floors it should be painted with anticorrosive bitumastic paints of approved quality. The pipe shall not come in contact with lime mortar or lime concrete as the pipe is affected by time. Under the floors the pipes shall be laid in layer of sand filling as done under concrete floors.

All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern holder bat clamps of required shape and size so as to fit tightly on the pipes when tightened with screwed bolts, these clamps shall be embedded in brick work in cement mortar 1:3 (1 cement: 3 coarse sand), and shall be spaced at regular intervals in straight lengths as shown in Table 18.12.

The clamps shall be fixed at shorter lengths near the fittings as directed by the Engineer-in-Charge.

For G.I. pipes 15 mm diameter, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the

holes shall be carefully made of the smallest size as directed by the Engineer-in-Charge. After fixing the pipes the holes shall be made good with cement mortar 1:3 (1 cement: 3 coarse sand) and properly finished to match the adjacent surface.

TABLE 18.12

Dia. of Pipe (mm)	*Horizontal length m*	*Vertical length m*
15	2	2.5
20	2.5	3
25	2.5	3
32	2.5	3
40	3	3.5
50	3	3.5
65	3.5	5
80	3.5	5

Unions will be provided to facilitate connections additions and alterations as well as for maintenance and for change of pipes. The locations where unions are to be provided will be decided with prior written approval of the Engineer-in-Charge.

18.7.1 Measurements

The lengths shall be measured in running metre correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees elbows, reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gun metal taps (cocks), valves, unions, lead connection pipes and shower rose. All pipes and fittings shall be classified according to their diameters, method of jointing and fixing substance, quality and finish. In case of fittings of an equal bore the pipe shall be described as including all cuttings and waste. In case of fittings of unequal bore, the largest bore shall be measured. Pipes laid in trenches (or without supports) and pipes fixed to walls, ceilings, etc. with supports shall be measured separately.

18.7.2 Rate

The rate shall include the cost of labour and material involved in all the operations described above. The rate shall include the cost of cutting holes in walls and floors and making good the same. This shall not however, include concealed pipe work in which case cutting of chase and making good shall be paid separately. It shall not include painting of pipes and providing sleeves, unless specified otherwise. It will also not include union which shall be paid for separately.

18.8 POLYPROPYLENE RANDOM CO-POLYMER (PP-R) PIPES

18.8.1 The PP-R is a bonded, multilayer pipe consisting of different layers of the pipe:-

(a) The inner-most layer of the pipe to be Anti – bacterial to prevent bacteria growth inside pipe surface.

(b) The middle layer to be of plain PP-R which is neither in contact with Water and nor under direct effect of the atmospheric conditions.

(c) The outer-most layer to be of U.V. stabilized PP-R to prevent the pipe surface from sunlight under exposed atmospheric conditions.

The pipes should in general be conforming to the requirements of IS 15801 except that specified with in nomenclature of the item. The pipes should have smooth inner surface with non-contracting diameters. The pipes shall be cleanly finished, free from cracks and other defects. The pipes shall be clean and well cut along ends after taking into consideration the desired length, using the pipe scissors. The Polypropylene used for manufacturing the pipe shall conform to the requirements of IS 10951 and IS 10910. The specified base density shall be between 900

kg/m^3 and 910 kg/m^3 when determined at 27°C. The resin should be mixed with sufficient quantity of colour master batches. The colour master batch should be uniform throughout the pipe surface. The standard dimension ratio (SDR) i.e. ratio of the nominal outer diameter of a pipe to its nominal wall thickness should be 7.4/11 as given in the item.

18.8.2 Fittings

Plain fittings, Chrome plated brass threaded fittings and Valves shall be as per nomenclature of item or as directed by engineer- in- charge.

(a) The plain fittings shall be Polypropylene Random Copolymer and comply with all the requirements of the pipes. The plain fittings shall comprise of Socket, Elbow, Tee, Cross, Reducer socket, Reduction Tee, End Cap, Crossover, Omega, Threaded Plug and wall clamps in available sizes.

(b) The Chrome Plated Brass threaded fittings shall be Chrome Plated Brass threaded piece molded inside Polypropylene random copolymer fitting. The maternal shall comply with all the requirements of the pipes. The Chrome plated Brass threaded fittings shall comprise of Socket, Elbow and Tee (Male & Female) in available sizes. These are the fittings for C.P. connections and for continuations from existing Galvanized Irion Pipes and fittings.

(c) The valves shall be Polypropylene Random Copolymer Valves. The valves comprise of Gate Valve, Ball Valve, Concealed stop valve and Chrome Coated Valve in available sizes.

The Valves sizes availability in Polypropylene Random Copolymer is as follows:-

(i) Gate Valve - 20 mm to 63 mm
(ii) Ball Valve - 20 mm, 25 mm, 32 mm, 40 mm, 50 mm & 63 mm
(iii) Concealed Stop valve - 20 mm & 25 mm
(iv) Chrome Coated Valve - 20 mm & 25 mm

However, the other Brass/Bronze Valves can be connected to Polypropylene Random pipes using C.P. Brass threaded fittings of desired sizes.

18.8.3 Laying and Jointing of Pipes and Fittings

The specifications described in 18.4 shall apply as far as possible. The pipes and fittings shall run in wall chase as specified. Pipes shall run only in vertical or horizontal alignment as far as possible. The installation of pipes is similar to that of the metal pipes with the only difference in the jointing procedure. The jointing of the PP-R pipes and fittings are done by fusion welding by means of a welding machine. The marking on pipe shall carry the following information:-

c) Manufacturer's name/ trade mark
d) PPR pipe
e) SDR-
f) Out side diameter and minimum wall thickness
g) Lot No. / Batch No. containing date of manufacturing. And machine number.

18.8.4 The out side diameter of pipes, tolerance in the same and ovality of pipe shall be as given in Table 18.13 below.

TABLE 18.13
Outside Diameter, Tolerance and Ovality of Pipes

Sl. No.	*Nominal Size*	*Outside Diameter*	*Tolerance (Only positive tolerance)*	*Ovality*
	DN	*mm*	*mm*	*mm*
(1)	*(2)*	*(3)*	*(4)*	*(5)*
(i)	16	16.0	0.3	1.2

(1)	(2)	(3)	(4)	(5)
(ii)	20	20.0	0.3	1.2
(iii)	25	25.0	0.3	1.2
(iv)	32	32.0	0.3	1.3
(v)	40	40.0	0.4	1.4
(vi)	50	50.0	0.5	1.4
(vii)	63	63.0	0.6	1.6
(viii)	75	75.0	0.7	1.6
(ix)	90	90.0	0.9	1.8
(x)	110	110.0	0.9	2.2

1. The values specified for tolerance on outside diameter have been calculated as 0.009DN, rounded off to the next higher 0.1 mm subject to minimum of 0.3 mm. No negative tolerances are allowed.
2. The basis for the values specified for ovality is:
   (a) For nominal outside diameters ≤ 75 mm, the tolerance equals (0.008 DN+1.0) mm, rounded to the next higher 0.1 mm, with a minimum value of 1.2 mm.
   (b) For nominal outside diameters ≥ 75 mm and ≤ 250 mm, the tolerance equals 0.20 DN, rounded to the next higher 0.1 mm.
   (c) For nominal outside diameter > 250 mm, the tolerance equals 0.35 DN, rounded to the next higher 0.1 mm.

18.8.5 Wall Thickness

The minimum and maximum wall thickness of pipes shall be as given in Table 18.14 below:-

TABLE 18.14

Sl. No.	Nominal Size	SDR 11		SDR 7.4	
	DN	Min	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
(i)	16	-	-	2.20	2.70
(ii)	20	1.90	2.30	2.80	3.30
(iii)	25	2.30	2.80	3.50	4.10
(iv)	32	2.90	3.40	4.40	5.10
(v)	40	3.70	4.30	5.50	6.30
(vi)	50	4.60	5.30	6.90	7.80
(vii)	63	5.80	6.60	8.60	9.70
(viii)	75	6.80	7.70	10.30	11.60
(ix)	90	8.20	9.30	12.30	13.80
(x)	110	10.00	11.20	15.10	16.90

Note: The wall thickness tolerances have been calculated on the following basis:
(a) Limit deviation=0.1e + 0.2 mm rounded up to the nearest 0.1 mm.

(b) A local increase in wall thickness of up to +0.2e is permissible for e up to 10 mm and up to 0.15e for e greater than 10 mm. The mean of the measurement shall, however, still lie within the given limit deviations.

The quality of each installation system ultimately depends on the tightness, stability and lifetime of its connections. The pipe of the desired length is cut using the pipe scissors. The proper heating piece is taken and mounted on the welding machine. The welding device is switched on - Control lamp and switch lamp will lit. When ready, control lamp gets off, which means that welding temperature of 260 Degrees ±10 Degrees Celsius has been reached. The pipe end and the fitting to be welded are heated on the welding machine. Before heating the fitting and the pipe, the dirty welding tools, pipe and fitting are cleaned with a cloth. When heated up (with heating time as per the Table shown below), the pipe

and the fitting is removed from the welding machine and the two pieces connected together by applying a little pressure without twisting. The joint is allowed to cool down for a few seconds. The welding process is that safe because the properly heated part of Polypropylene create a homogeneous connection.

Guidelines for Welding PP-R Pipes and Fittings (DVS Guideline 2207, Part II)

Outer diameter of pipe(mm)	*Heating Time (Seconds)*	*Cooling Period (Minutes)*
16	5	2
20	5	2
25	7	2
32	8	4
40	12	4
50	18	4
63	24	6
75	30	8
90	30	8

The same procedure shall be adapted for exposed as well as concealed fittings. The Crossovers may be used wherever the overlapping of the PP-R pipes is required. The fixing shall be done by means of Wall Support Clamps keeping the pies about 1.5 cm clear of the wall where to be laid on the surface. Where it is specified to conceal the pipes, chasing may be adopted. For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. Pipe sleeves shall be fixed at a place the pipe is passing, through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. Fixed supports prevent any movement of the pipe by fixing it at some points. Fittings are used in creating the fixed points. Fixed supports must not but installed at bending parts and the direction changes must be done in the pipe itself. In between the fixed supports some arrangements must be done to compensate any potential elongation or shrinkage in the pipe length. For exposed straight pipes having length more than 5 meters, to compensate the expansion an expansion piece must be used.

18.8.6 Piping Installation Support

Piping shall be properly supported by means of wall support clamps as specified and as required, keeping in view the proper designing for expansion and contraction. Risers shall be supported at each floor with clamps.Due to high coefficient of thermal expansion the heat losses though the pipes is highly reduced. Therefore, for internal Bathroom hot geyser water distribution lines, the insulation is often not required.

18.8.7 Installation of Water Meter and Valves

PP-R lines shall be cut to the required lengths at the position where the meter and Valves are required to be fixed. Suitable C.P. Brass threaded fittings shall be attached to the pipes. The meter and Valves shall be fixed in a position by means of connecting pipes, jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed. And the meter shall be installed exactly horizontally or vertically in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken to not to disturb the factory seal of the meter. Wherever the meter shall be fixed to a newly fitted pipeline, the pipeline shall have to be completely washed before fitting the meter.

18.8.8 Testing

All water supply system shall be tested to Hydrostatic pressure test. Maximum operating pressure at varying degree of temperature is given in Table 18.15:-

TABLE 18.15

Sl. No.	*Temperature*	*SDR 11*	*SDR 7.4*
		Pressure MPa	*Pressure MPa*
(i)	10	1.91	3.02
(ii)	20	1.63	2.58
(iii)	30	1.37	2.17
(iv)	40	1.15	1.84
(v)	50	0.98	1.55
(vi)	60	0.82	1.28
(vii)	70	0.62	0.98
(viii)	80	0.39	0.62
(ix)	95	0.27	0.4

The pressure test is performed in 3 steps being preliminary test, main test and final test. For the preliminary test a pressure which is 1.5 times higher than the possible working pressure is applied and this is repeated two times in 30 minutes with intervals of 10 minutes. After a test period of 30 minutes, the test pressure must not be dropped more than 0.6 bar and no leak must occur. Main test follows the preliminary test. Test time is two hours, in doing so the test pressure taken from the preliminary test must not have fallen more than 0.2 bar. After completion of these tests, the final test comes which has to be done under a test pressure of 10 bars and 5 bar in the interval of 15 minutes. Between the respective test courses, pressure has to be removed.

All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner.

System may be tested in sections and such sections shall be entirely checked on completion of connection to the overhead tanks or pumping system or mains. In case of improper circulation, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and refinishing of floors and walls as required.

After commissioning of the water supply system, contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which are not working efficiently shall be replaced by new ones.

18.8.9 Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work, which shall include PP-R pipe and fittings including plain fittings and Chrome Plated Brass Threaded fittings. Deductions for the length of valves shall be made. The cost includes cutting chases in the masonry wall and making good the same, trenching, refilling and testing of joints. The cost of gate valves/ wheel valves/union shall be paid for separately.

18.9 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES

18.9.1 CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS 15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides. The polymer from which the pipe compounds are to be manufactured shall have chlorine content not less than 66.5%.

The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. The pipes shall not have any detrimental effect on the composition of the water flowing though it.

Diameter and wall thickness of CPVC pipes are as per given in Table 18.16 below.

TABLE 18.16

Sl. No.	Nominal Size	Nominal Outside Diameter	Mean Outside Diameter		Outside Diameter at any point		Wall thickness					
							Class 1, SDR 11			Class 3, SDR 17		
			Min	Max	Min	Max	Avg. Max	Min	Max	Avg. Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(i)	15	15.9	15.8	16.0	15.8	16.0	2.2	1.7	2.2	-	-	-
(ii)	20	22.2	22.1	22.3	22.0	22.4	2.5	2.0	2.5	-	-	-
(iii)	25	28.6	28.5	28.7	28.4	28.8	3.1	2.6	3.1	-	-	-
(iv)	32	34.9	34.8	35.0	34.7	35.1	3.7	3.2	3.7	-	-	-
(v)	40	41.3	41.2	41.4	41.1	41.5	4.3	3.8	4.3	-	-	-
(vi)	50	54.0	53.9	54.1	53.7	54.3	5.5	4.9	5.5	-	-	-
(vii)	65	73.0	72.8	73.2	72.2	73.8	-	-	-	4.8	4.3	4.8
(viii)	80	88.9	88.7	89.1	88.1	89.7	-	-	-	5.9	5.2	5.9
(ix)	100	114.3	114.1	114.5	113.5	115.1	-	-	-	7.5	6.7	7.5
(x)	150	168.3	168.0	168.6	166.5	170.1	-	-	-	11.1	9.9	11.1

Notes

1. For CPVC pipes SDR is calculated by dividing the average outer diameter of the pipe in mm by the minimum wall thickness in mm. If the wall thickness calculated by this formula is less than 1.52 mm, it shall be increased to 1.52 mm. The SDR values shall be rounded to the nearest 0.5.

18.9.2 Dimensions of Pipes

The outside diameter, outside diameter at any point and wall thickness shall be as given in Table 18.16.

18.9.2.1 ***Diameter :*** The outside diameter and outside diameter at any point as given in Table 18.16 shall be measured according to the method given in IS 12235 (part 1).

18.9.2.2 *Diameter at any point :* The difference between the measured maximum outside diameter and measured minimum outside diameter in the same cross-section of pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

(a) 0.5 mm, and

(b) 0.012 d_n rounded off to the next higher 0.1 mm.

18.9.2.3 *Wall Thickness :* The wall thickness of the pipes shall be as given in Table 18.16. Wall thickness shall be measured by any of the three methods given in IS 12235 (part 1). To check the conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

Tolerance on Wall Thickness

(a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness (e_{Min}) and the wall thickness at any point (e), (e - e_{Min}) shall be positive in the form of +y, where y=0.1 e_{Min}+0.2 mm.

(b) For pipes of minimum wall thickness greater than 6mm, the permissible variation of wall thickness shall again be positive in the form of +y, where y would be applied in two parts.

(c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and absolute maximum measured values. The tolerance applied to this average wall thickness from these measurements shall be within the range 0.1 e_{Min}+0.2 mm (see Table 18.16).

(d) The maximum wall thickness at any point shall be within the range $0.15e_{Min}$ (see Table 18.16).

(e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

18.9.2.4 ***Effective Length (Le) :*** If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 3, 5 or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

18.9.3 Pipe Ends

The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

18.9.4 Physical and Chemical Characteristics

18.9.4.1 ***Visual Appearance :*** The colour of the pipes shall be off-white. Slight variations in the appearance of the colour are permitted.

The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

18.9.4.2 ***Opacity :*** The wall of the plain pipe shall not transmit more than 0.1 per cent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).

18.9.4.3 ***Effect on Water :*** The pipes shall not have any determinate effect on the composition of the water flowing through them, when tested as per 10.3 of IS 4985.

18.9.4.4 ***Reversion Test :*** When tested by the method prescribed in IS 12235 (Part 5/ Sec 1 and Sec 2), a length of pipe 200 ±20 mm long shall not alter in length by more than 5 per cent.

18.9.4.5 ***Vicat Softening Temperature :*** When tested by the method prescribed in IS 12235 (part 2), the Vicat softening temperature of the specimen shall not be less than 110°C.

18.9.4.6 ***Density :*** When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1450kg/m^3 and 1650kg/m^3.

18.9.5 Mechanical Properties

18.9.5.1 ***Hydrostatic Characteristics :*** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (part 8/Sec 1), the pipe shall not fail during the prescribed test duration. The temperatures, duration and hydrostatic (hoop) stress for the test shall conform to the requirements given in Table 18.17. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

TABLE 18.17
Requirements of Pipes for Internal Hydrostatic Pressure Test
(Clause 18.9.5.1)

Sl. No.	*Test*	*Test Temperature Min*	*Test Period*	*Hydrostatic (Hoop) Stress*
		°C	*h*	*MPa*
(1)	*(2)*	*(3)*	*(4)*	*(5)*
(i)	Acceptance	20	1	43.0
(ii)	Type	95	165	5.6
(iii)	Type	95	1000	4.6
(iv)	Type	95	8760	3.6 (Test for thermal stability)

18.9.5.2 ***Thermal Stability by Hydrostatic Pressure Testing :*** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec 1) and as per requirement given in Table 18.17, Sl. No. (iv), the pipe shall not burst or leak during the prescribed test duration.

18.9.5.3 ***Resistance to External Blow at 0°C :*** When tested by the method prescribed in IS 4985, with classified striker mass and drop height as given in Table 18.18, the pipe shall have a true impact rate of not more than 10 per cent.

TABLE 18.18
Classified Striker Mass and Drop Height Conditions for the Falling Weight Impact Test
(Clause 18.9.5.3)

Sl. No.	*Nominal Pipe Size*	*Mass of Falling Weight*	*Falling Height*
	mm	*Kg*	*mm*
(1)	*(2)*	*(3)*	*(4)*
(i)	15	0.5±0.5%	300±10
(ii)	20	0.5±0.5%	400±10
(iii)	25	0.5±0.5%	500±10
(iv)	32	0.5±0.5%	600±10
(v)	40	0.5±0.5%	800±10
(vi)	50	0.5±0.5%	1000± 10
(vii)	65	0.8±0.5%	1000±10
(viii)	80	0.8±0.5%	1200±10
(ix)	100	1.0±0.5%	1600±10
(x)	150	1.6±0.5%	2000±10

18.9.5.4 ***Flattening Test :*** When tested by the method prescribed in IS 12235 (part 19), pipe shall show no signs of cracking, splitting and breaking.

18.9.5.5 ***Tensile Strength :*** When tested by the method prescribed in IS 12235 (Part 19), the tensile strength at yield shall not be less than 50 MPa at 27 ± 2°C.

18.9.6 Sampling and Criteria for Conformity

The sampling procedure and criteria for conformity shall be as given in Annexure F.

18.9.7. Marking

18.9.7.1 Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m. The marking shall show the following:

(a) Manufacturer's name or trade-mark
(b) Outside diameter,
(c) Class of pipe and pressure rating, and
(d) Bath or lot number

18.9.7.2 ***BIS Certification Marking :*** Each pipe may also be marked with the Standard Mark.

18.9.8 Fittings

The fittings shall be as follows:

(a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm.
(b) Brass threaded fittings.
(c) Valve from size 15 mm to 160 mm
(d) *Brass Threaded Fittings:* All types of one end brass threaded male/female adaptors in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions. All fittings shall carry the following information:
    (1) Manufacturer's name/trade mark.
    (2) Size of fitting

18.9.9 Piping Installation Support and Spacing

18.9.9.1 ***Concealed Piping:*** Pipes can be concealed in chases. The pipes and fitting are to be pressure tested prior to concealing the chases. To maintain alignment of CP fittings while joining, all alignment of fittings and pipe shall be done correctly. DO NOT USE NAILS FOR HOLDING OF PIPES IN THE CHASES.

18.9.9.2 ***External Installations:*** For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes. Pipes sleeves shall be fixed at a place the pipe is passing through a wall or floor so as to allow freedom for expansion and contraction. Clamping of the pipe is done to support it while allowing the freedom for movement.

All pipes exposed to sunlight shall be painted with a water based acrylic paint emulsion to enhance UV protection. Pipes in trenching shall be laid in accordance to the Good Plumbing practices followed for Metal piping.

Recommended Support Spacing (Distance between Pipe Clamps Horizontal Support)

Pipe Size	*Horizontal Support (In meters)*			
	Temperature			
	23°C	*38°C*	*60°C*	*82°C*
16 mm (1/2")	1.22	1.22	1.07	0.92
20 mm (3/4")	1.53	1.37	1.22	0.92
25 mm (1/0")	1.68	1.3	1.37	0.92
32 mm (1 1/4")	1.83	1.68	1.53	1.22
40 mm (1 1/2")	1.98	1.83	1.68	1.22
50 mm (2")	2.29	2.14	1.98	1.22

18.9.9.3 ***Expansion LOOP:*** CPVC systems, like all piping materials, expand and contract with changes in temperatures. CPVC pipes shall expand 7.5 cm per 30 m length for a 40^0C temperature change.

Expansion does not vary with Pipe size. Thermal expansion can be generally be accommodated at changes in direction. On a long straight run, an offset or loop based on the following chart is required.

Nominal Pipe Size	*Length of Run (Meter), Loop length in cms.*				
	6 metre	*12 metre*	*18 metre*	*24 metre*	*30 metre*
15 mm	43	56	69	79	86
20 mm	48	66	81	91	104
25 mm	53	74	91	104	117
32 mm	58	81	102	117	130
40 mm	63	89	109	127	142
50 mm	71	102	124	145	63

18.9.10 Testing

All water supply systems shall be tested to hydrostatic pressure test. The pressure tests are similar to the test pressure used for other plastic/metal pipes. System may be tested in sections and such section shall be entirely checked on completion of connection to the overhead tank or pumping system or mains.

18.9.11 Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work, which shall include CPVC pipe and fittings including plain and Brass threaded fittings and jointing solvent cement.

18.10 PE-AL-PE PIPES

18.10.1 The PE-AL-PE pipes are bonded, multilayer pipes consisting of metal aluminium and polyethylene i.e. metallic pipe bonded with adhesive both internally and externally by polyethylene coating. The layers of PE-AL-PE pipes are:-

(i) The interior layer of polyethylene
(ii) The adhesive layer
(iii) Aluminium tube
(iv) The adhesive layer
(v) The external layer of polyethylene

Polyethylene composite pressure pipes have welded aluminium tube reinforcement between inner and outer polyethylene layers, inner and outer polyethylene layer being bonded to aluminium tube by melt adhesive and are manufactured as per IS 15450

The specially manufactured compression joints fittings should be used for PE-AL-PE pipes which are available in 3 types i.e. brass, composite and composite external sealing. Either of these fittings should be used. The external sealing fittings should be used only for cold water applications.

18.10.2 (i) Polyethylene compounds shall conform to IS 7328 as follows:
- (a) PEEWA 45 T006 for black pipes and
- (b) PEELA 45 T006 for coloured pipes.

(ii) Aluminium shall have following properties:
- (a) Minimum elongation: 20%
- (b) Ultimate tensile strength: 100 MPa.

The aluminium strip shall have nominal thickness as specified in Table 18.19 (i). Tolerances on all thickness for all sizes shall be (+) 0.02 mm.

TABLE 18.19 (i)
Aluminium Thickness and Tolerances for PE-AL-PE Pipe

S. No.	*Nominal Pipe Size (mm)*	*Nominal Aluminium Thickness (mm)*
(i)	1216	0.20
(ii)	1620	0.25
(iii)	2025	0.25
(iv)	2532	0.30
(v)	3240	0.30
(vi)	4050	0.30

(iii) Dimensions of pipes shall be as given in Table 18.19 (ii).

TABLE 18.19 (ii)

S. No.	*Nominal pipe size (mm)*	*Nominal outside diameter (OD) mm*	*Total wall thickness*		*Outer PE layer thickness Minimum (mm)*
			Minimum (mm)	*Maximum (mm)*	
(i)	1216	16	1.75	2.00	0.40
(ii)	1620	20	2.00	2.25	0.40
(iii)	2025	25	2.45	2.70	0.40
(iv)	2532	32	2.80	3.20	0.40
(v)	3240	40	3.40	3.80	0.40
(vi)	4050	50	4.00	4.40	0.40

(iv) The PE-AL-PE composite pipe shall be pressure rated for maximum water pressures of 1.38 MPa at 23°C and 1.10 MPa at 60°C.

18.10.3 Jointing

While jointing PE-AL-PE pipes, following steps are required to be taken to ensure a leak proof and strong pipe joint:-

(a) Cut the pipe square by cutter to the required and proper length.
(b) Select the fitting to be used and dismantle its nuts and split rings.
(c) Place the nut and split ring over the pipe. Ensure that 'O' rings are in proper position of insert.
(d) Prepare the end of pipe to be jointed for roundness and chamfer by using beveling tool. Push the pipe over the insert and inside the support groove fully.
(e) Push the split ring and nut towards connector till split ring touches the support groove.
(f) Tighten the nut over connector with spanner.

If the joints are required to be dismantled for any reason, the 'O' ring and split ring should be inspected before reassembling the joint for any damage. If any ring is found damaged, the same should be replaced. All other components can be reused. The joint sealing with fittings is done by silicone rubber ring. No thread sealing is involved. Tightening of the nuts is required only for compressing the spilt ring over the pipe, hence excessive tightening of the nuts is to be avoided. In case threading is required for fixing valves and fixtures, then select the fittings already having male or female thread as per the requirement.

18.10.4 Fixing in Portion of PE-AL-PE Pipes

For installation of PE-AL-PE pipes and fittings, following steps are required to be taken to ensure easy and faster installation:-

18.10.4.1 Measure the exact length of pipe required from fitting to fitting.

18.10.4.2 Cut pipe to required length by using PE-AL-PE pipe cutter to ensure clean and square cut. If the cut is not proper then the joint will not be proper/leak proof.

18.10.4.3 Use external bending spring for straightening of the PE-Al-PE pipes which are available in coils. If there are any bends in between then insert the external bending spring over the pipe and bend it to required angle. Move the spring after bending to next bending location. After putting the pipe in position completely, remove the spring. If the ends of pipes are required to be bent then the external bending spring may not support the pipe fully. In such cases, use internal bending spring. Use of bending springs facilitates bending of pipe to desired radius without causing any deformation to the pipe.

18.10.4.4 While connecting the fitting to the end of the pipe, follow the jointing procedure.

The PE-AL-PE pipe can be bent easily to the required shape. The bending shall be done in such a way that the bending radius is not less than 5 times the outer diameter of the pipe. As the pipe stays in shape, elbows are generally not required. Due to the unique jointing system, unions are not at all required. Bending of PE-AL-PE pipe in 'L' shape is not recommended. Use elbow in case it is absolutely necessary.

18.10.4.5 PE-AL-PE pipe can be installed in both internal and external work. For concealed work the walls can be recessed by hand or mechanical router for speed. Where PE-AL-PE pipe are installed on the surface, the maximum clipping center should be kept as Table 18.20.

Table 18.20

Pipe size	*Horizontal (mm)*	*Vertical (mm)*
1216	800	1000
1620	800	1000
2025	1000	1200
2532/3250	1200	1500

The pipes installed on surface must have two additional clamps at fittings other than as specified above.

18.10.4.6 It is necessary to provide clip/hook at the threaded fittings.

18.10.4.7 Only Teflon Tape should be used on threads instead of 'Dhaaga/ Safeda'. While for fittings, specially designed rubber "Seal" should be used.

18.10.5 For pressure testing the pipeline system, specially designed test plugs are to be used in female thread elbows instead of ordinary GI nipples with MS plugs before covering the pipes in chases.

18.10.6 Diameter of pipes should be increased from 16 mm OD to 20 mm OD when the user points exceed three. The head recommended for flush valve in gravity flow system is minimum 10 meters for 3240 mm size pipe. For optimum calculations and further design IS 15450 and "manufacturer's plumbing design guidelines" should be referred.

18.10.7 Storing Precautions

18.10.7.1 PE-AL-PE pipe should be stacked carefully so as to prevent them from falling or causing damage with any external sharp edged material. PE-AL-PE pipe is a tough material but needs greater protection from accidental damages when installed in comparison to metallic pipes.

18.10.7.2 Where PE-AL-PE pipe is to be connected to heavy items such as pumps or valves it is likely to impose undue strain in the pipes, hence the pump or valve should be supported directly using the support bracket.

18.10.7.3 The PE-AL-PE pipe are malleable, hence these should be protected from any heavy load/impact and drilling etc. Where these pipes are provided under the ground, adequate cover as per IS 15450 should be provided.

18.10.8 The maximum allowable parameters for various components of PE-AL-PE piping system are given in Table 18.21.

TABLE 18.21

Fluid	*Service temperature deg 'C'*	*Maximum allowable service pressure in bar*			
		PE-AL-PE pipe	*Fitting Internal Sealing*	*Fitting Internal Sealing*	*Fitting end Seal*
			Brass	*Composite*	*Composite*
Water	Ambient	15	13	10	10
	65	10	10	10	-
	80	10	10	4	-

Before the pipes are covered or put to use, these should be tested for any leakage as per the following table:-

The requirement of hydraulic test pressure are given in the following table at 20°C & 60°C temperature respectively using water.

TABLE 18.22

Description	*Pressure in MPa*	
Nominal Pipe Size	*1 Hour Test (20°C)*	*10 Hour Test (60°C)*
1216	3.0	2.50
1620	2.70	2.50
2025	2.60	2.50
2532	2.30	2.10
3240	2.20	2.00

18.11 MAKING CONNECTION OF G.I. DISTRIBUTION BRANCH WITH G.I. MAIN

18.11.1 Preliminary Work

A pit of suitable dimensions shall be dug at the point where the connection is to be made with the main and earth removed up to 15 cm below the main. The flow of water in the water main shall also be disconnected by closing the sluice or wheel valves on the mains.

18.11.2 Making Connection

For cutting and jointing 18.6.2 and 18.6.3 shall apply. The G.I. main shall first be cut. Water if any collected in the pit shall be bailed out and, ends of the G.I. pipes threaded. The connection of distribution pipe shall then be made after fixing G.I. tee of the required size to the G.I. main and fittings such as Jam nut, G.I. socket connecting piece etc.

18.11.3 Testing of Joints

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra payment.

The pipes & fittings after they are laid shall be tested to hydraulic pressure of 6 kg./sq.cm. (60 m). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock of water hammer. The draw of laps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

18.11.4 Finishing

The portion of the pipe in the pit shall be painted with bitumastic paint and encased with sand 15 cm all-round. The pit shall be filled with earth in level with the original ground surface watered, rammed and the area dressed.

18.11.5 Measurements

The work of making connections shall be enumerated.

18.11.6 Rate

The rate shall include the cost of labour and materials involved in all the operations described above.

18.12 FIXING BRASS AND GUN METAL WATER FITTINGS

18.12.0 The fitting shall be fully examined and cleared of all foreign matter before being fixed. The fitting shall be fitted in the pipe line in a workman like manner. The joints between fittings and pipes shall be leak-proof when tested to a pressure of 17.5 kg/sq.cm. The defective fittings and joints shall be replaced or redone.

18.12.1 Measurements

Fittings shall be enumerated.

18.12.2 Rate

The rate shall include cost of all the material and labour involved in all the operation described above.

18.13 FIXING FERRULES

18.13.1 For fixing ferrule the empty main shall be drilled and tapped at 45 degree to the vertical and the ferrule screwed in. The ferrule must be so fitted that no portion of the shank shall be left projecting within the main into which it is fitted.

18.13.2 Measurements

Ferrule shall be enumerated.

18.13.3 Rate

The rate shall include the cost of all materials and labour involved in fixing the ferrule.

18.14 INSTALLATION OF FIRE HYDRANT

18.14.1 The hydrant shall be fully examined and cleared of all foreign matter before being fixed. The fixing shall be done on the water main which shall be of minimum 80 mm dia. The flanged end of the hydrant shall be fixed to the flanged outlet of a tee in the water main by means of bolts, nuts and 3 mm rubber insertion or chemically treated compressed fiber board 1.5 mm minimum thickness and of weight not less than 0.183 gm. per sq.cm. This can also be fixed by means of flanged tail piece which may be connected to the water main by C.I. specials.

18.14.2 Measurements

Fire hydrant shall be enumerated.

18.14.3 Rate

The rate shall include the cost of materials and labour involved in all the operations described above against relevant item of work.

18.15 INSTALLATION OF SLUICE VALVE

18.15.1 The valve shall be fully examined and cleared of all foreign matter before being fixed. The fixing of the valve shall be done by means of bolts, nuts and 3 mm rubber insertions or chemically treated compressed fiber board 1.5 mm minimum thickness and of weight not less than 0.183 gm./sq.cm. with the flanges of spigot and the socketed tail pieces drilled to the same specification in case of S&S pipes and with flanges in case of flanged pipes. The tail pieces shall conform to IS 1938. These shall be jointed to the pipe line by means of lead caulked joints.

18.15.2 Measurements

Sluice valve shall be enumerated.

18.15.3 Rate

The rate shall include the cost of material and labour involved in all the operations described above.

18.16 INSTALLATION OF WATER METER AND STOP VALVE (FIG. 18.3 and 18.4)

18.16.0 The G.I. line shall be cut to the required length at the position where the meter and stop cock are required to be fixed. The ends at the pipe shall then be threaded. The meter and stop cock shall be fixed in position by means of connecting pipes, G.I. jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the nipples of the meter shall be removed and the meter installed exactly horizontal or vertical in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken that the factory seal of the meter is not disturbed. Wherever the meter shall be fixed to a newly fitted pipe line, the pipe line shall have to be completely washed before fitting the meter. For this purpose a piece of pipe equal to the length of the meter shall be fitted in the proposed position of the meter in the new pipe line. The water shall be allowed to flow completely to wash the pipe line and then the meter installed as described above by replacing the connecting piece.

18.16.1 Testing of Joints

Testing of joints shall be done as described in 18.6.6.

18.16.2 Measurements

The work of fixing meters and stop cocks shall be counted in numbers separately according to the diameters.

18.16.3 Rate

The rate shall include the cost of labour and materials involved in all the operations described above excluding the cost of stop cock and water meter.

18.17 FIXING SURFACE BOX (FIG. 18.6)

18.17.1 The C.I. surface box shall be fixed on the top of masonry chamber in plain or reinforced cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) as the case may be.

18.17.2 Measurements

Masonry chambers shall be enumerated under the relevant items.

18.17.3 Rate

The rate shall include the cost of materials and labour involved in all the operations described above, except the excavation in saturated soil, soft or decomposed and hard rock if met with. The difference of cost, between ordinary soil and saturated soil or soft or decomposed or hard rock as the case may be, shall be paid for separately.

18.18 POLYETHYLENE WATER STORAGE TANKS

18.18.1 Material

Polyethylene used for manufacture of tanks and manhole lids may be high density (HDPE), low density (LDPE) or linear low density (LLDPE) and shall conform to IS 10146. Polyethylene shall be compounded with carbon black so as to make the tank resistant to ultra violet rays from the sun. The percentage of carbon black content in polyethylene shall be 2.5 ± 0.5 percent and it shall be uniformly distributed. The materials used for the manufacture of tank, manhole lid and fittings shall be such that they neither contaminate the water nor impart any taste, colour, odour or toxity to water.

18.18.2 Manufacture and Finish

The tanks shall be manufactured by rotational moulding process. Each tank and the manhole lid shall be single piece having arrangement for fixing and locking the manhole lid with the tanks. Excess material at the mould parting line and near the top rim shall be neatly cut and finished. The internal and external surface of the tanks shall be smooth, clean and free from hidden internal defects like air bubbles, pit and metallic or other foreign material inclusion. Capacity of the tank, minimum weight of the empty tank (without manhole lid) and the manufacture brand name shall be embossed on the top surface of the tank near manhole.

18.18.3 Shape, Size and Capacity

The tank shall be cylindrical vertical with closed top having a manhole. Diameter and height of the tank of various capacities shall be as per manufacturer's specifications and a clearance of ± 3 percent shall be permitted on these dimensions. Capacity of the tank or up to the bottom of the inlet location whichever is less. Capacity of the tank shall be specified. Extra capacity if any shall be ignored.

18.18.4 Weight and Wall Thickness

Minimum weight of the empty tank (exclusive of manhole lid fittings) and the minimum wall thickness of top, bottom and sides shall be specified in Table 18.23. Wall thickness shall be checked beyond 150 mm of the edge where the direction the plane of tank surface changes.

18.18.5 Installation and Fittings

The flat base of the tank shall be fully supported over its whole bottom area on a durable rigid flat and level platform sufficiently strong to stand without deflection the weight of the tank when fully filled with water. Depending upon the capacity and location tanks may be suitably anchored as per the directions of the Engineer-in-Charge. For inlet, outlet and other connections fully threaded GI, HDPE or PVC connections with hexagonal check nuts and washers on either side of the tank wall shall be provided. Holes for threaded connections shall be drilled and not punched. Pipes entering of leaving the tank shall be provided with unions and suitably supported on a firm base to avoid damage to the tank walls.

18.18.6 Manhole Lid

The lid shall rest evenly and fit over the rim of the manhole so as to prevent the ingress of any foreign matter into the tank. The lid shall be provided with suitable arrangement for locking it with the tank.

18.18.7 The tank and its components shall conform to the local bye-laws for preventions of mosquito menace.

18.18.8 Measurements

Dimensions shall be measured to the nearest cm. and weight of the empty tank shall be recorded to the nearest 100g. Capacity of the tank as defined in 18.18.3 shall be calculated to the nearest litre.

TABLE 18.23

S. No.	*Capacity litres*	*Minimum Wall Thickness mm*	*Minimum Weight of Empty Tank kg*
1	*2*	*3*	*4*
1.	200	4.4	7.8
2.	300	4.4	9.0
3.	400	5.5	15.0
4.	500	6.0	18.0
5.	700	6.6	23.5
6.	1000	7.0	33.0
7.	1250	7.0	40.0
8.	1500	7.0	47.0
9.	1700	7.0	54.0
10.	2000	8.2	64.0
11.	2500	8.2	81.0
12.	3000	8.8	96.0
13.	4000	10.4	138.0
14.	5000	10.7	191.0
15.	6000	10.7	209.0
16.	7500	10.7	250.0
17.	10000	11.5	363.0
18.	15000	11.5	550.0
19.	20000	13.2	814.0

18.18.9 Rates

The rate shall include the cost of the tank, manhole lid, carriage and delivery at the place specified. Hoisting, installation, fittings, platform and anchoring shall be payable separately.

18.19 TUBE WELLS WITH HAND PUMPS

18.19.1 Casing Pipe

The casing pipe shall be of M.S. or W.I. of 100 mm dia. and strong enough to stand hammering and vibrations to which it is subjects.

18.19.2 Filter and Brass Strainer

The filter shall consist of a G.I. pipe of the required diameter with 15 mm diameter holes covered with brass strainer both inside and outside. It shall have a driving point riveted or welded to it.

18.19.3 Hand Pump

This shall be of approved quality. It shall be complete with necessary bolt and nuts for joining to the masonry or concrete base.

18. 20 CUTTING HOLES IN WALL UPTO 30 × 30 CM

18.20.0 Square holes of size as specified or as directed by the Engineer-in-Charge shall be cut in the masonry. Any damage to the adjoining portion or to any other item shall be made good as directed by the Engineer-in-Charge. All dismantled material shall be removed from the site.

18.20.1 Masonry Work

Brick work etc. shall be made good by using the same class of brick, tile or stone masonry as was cut during the execution of work. The mortar to be used shall be cement mortar 1:4 (1 cement: 4 fine sand) or as directed by the Engineer-in-Charge.

18.20.2 Finishing

Cement mortar in 1:4 mix (1 cement: 4 sand) shall be used for plastering or pointing, as may be required. Sand shall be fine or coarse, as used in the original work. The surface shall be finished with two or more coats of white wash, colour wash, distemper or painting as required but where the surface is not to be white washed, colour washed, distempered or painted; it shall be finished smooth with a floating coat of neat cement or as required to match with the surrounding surfaces.

18.20.3 Measurements

The holes shall be enumerated.

18.20.4 Rate

The rate shall include the cost of labour and materials required for all the operations described above.

18.21 CUTTING HOLES IN R.C.C. FLOORS (UPTO 15 × 15 CM)

18.21.0 Square holes of size as specified shall be cut in R.C.C. floor and roofs for passing drain pipe etc. Any damage to the adjoining portion or to any other item shall be made good as directed by the Engineer-in-Charge. All the dismantled material shall be removed from the site.

18.21.1 Cement Concrete

After insertion of drain pipe etc. the hole shall be repaired with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and the surface finished to match with the existing surface. The top and bottom shall be finished properly to make the joint leak proof. The specifications for cement concrete work and finishing etc. shall be the same as detailed under relevant sub-heads.

18.21.2 Measurements

Holes shall be enumerated.

18.21.3 Rate

The rate shall include the cost of labour and material required for all the operations described above except the pipe which shall be paid for separately.

18.22 CUTTING CHASES IN MASONRY WALLS

18.22.1 Making Chases

Chases are made in the walls for housing G.I. Pipes etc.

I. Cutting of chases in one brick thick and above load bearing walls :

(i) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided.

(ii) The depths of vertical chases and horizontal chases shall not exceed one third and one sixth of the thickness of the masonry respectively.

(iii) When narrow stretches of masonry (or short lengths of walls) such as between doors and windows, cannot be avoided, they should not be pierced with openings for soil pipes or

waste pipes or timber joints, etc. Where there is a possibility of load concentration, such narrow lengths of walls shall be checked for stresses and high strength bricks mortar or concrete walls provided, if required.

(iv) Horizontal chases when unavoidable should be located in the upper or lower one third of height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one metre in length. Where unavoidable, stresses in the affected area should be checked and kept within the permissible limits.

(v) Vertical chases should not be closer than 2 m in any stretch of a wall. These shall be kept away from bearings of beams and lintels. If unavoidable, stresses in the affected area should be checked and kept within permissible limits.

(vi) Masonry directly above a recess, if under than 30 cm (Horizontal dimension) should be supported on lintel. Holes in masonry may be provided up to 30 cm width x 30 cm height without any lintel. In the case of circular holes in masonry, no lintel should be provided up to 40 cm in diameter.

II. Cutting of chases in half brick load bearing walls

No chase shall be permitted in a half brick load bearing wall and as such no recessed conduits and concealed pipes shall be provided in half brick thick load bearing walls.

III. Cutting of chases in half brick non-loading bearing walls

In case of non load bearing half brick walls services should be planned with the help of vertical chases. Horizontal chases should be provided only when unavoidable.

IV. Cutting of chases in stone masonry walls

The provision (i) to (vi) under Sl. No. I are equally applicable to stone masonry walls also.

Note:

1. No inclined chase shall be permitted in brick masonry or stone masonry walls. In case inclined chases are unavoidable these shall be cut with written approval of the Engineer-in-Charge, and shall be repaired properly to his satisfaction. However, in half brick masonry wall, no inclined chase will be permitted.

2. Chases shall be made by chiseling out the masonry to proper line & depth. Any damage to the adjoining portion or to any other item shall be made good, as decided by the Engineer-in-Charge, for which no extra payment shall be made. All dismantled material shall be removed from site.

18.22.2 Filling Chases

After G.I. Pipes etc. are fixed in chases, the chases shall be filled with cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) or cement mortar 1:4 (1 cement: 4 coarse sand) as may be specified or otherwise directed by the Engineer-in-Charge and made flush with the masonry surface. The concrete surface shall be roughened with wire brushes to provide a key for plastering.

18.22.3 Measurements

Chases shall be measured in running meter correct to a cm.

18.22.4 Rates

The rate shall include the cost of labour the materials involved in all the operations described above excluding the cost of providing pipes etc. which shall be paid separately.

APPENDIX A

TOLERANCES FOR CAST IRON (CENTRIFUGALLY CAST) PIPES

(Clause 18.3.10)

Dimensions	*Nominal diameter (DN)*	*Tolerances in mm*
(a) External diameter of barrel (DE)	All diameters.	± 1/2f = ± (4.5 + 0.0015 DN)
(b) Internal diameter of socket (DI)	All diameters.	± 1/3f = ± (3 ± 0.001 DN)
(c) Depth of socket (P)	(1) Up to and including 600 mm	± 5
	(2) Over 600 mm and up to and including 1000 mm	± 10

Note : (1) f is the caulking space of the joint in millimeters and is equal to 9 + 0.003 DN.
(2) The jointing tolerances applicable to rubber joints (mechanical or push in joints) shall be as specified by their manufacturer and shall be within the tolerances specified above.

Tolerance on Thickness

Dimensions	*Tolerance in mm*
(a) Wall thickness	– (1 + 0.05 e)
(b) Flange thickness	± (2 + 0.05 b)

Where e = is the thickness of the wall in millimeters and
b = is the thickness of the flange in millimeters.

Tolerance on Length

Type of Casting	*Tolerance in mm*
(a) Socket and spigot, and plain ended pipes	± 25
(b) Flanged pipes	± 10

APPENDIX B

TOLERANCES FOR SPECIALS OF CAST IRON PIPES

(Clause 18.3.10.2)

Tolerances in Diameter

Dimension	*Nature of joint*	*Nominal diameter (DN)*	*Tolerance in mm*
External diameter of spigot (DE) f or ± (4.5 + 0.0015 DN)	Lead joints	All diameters	±1/2
Internal diameter of socket (DI) f or ± (3 + 0.001 DN)	Lead joints	All diameters	±1/3
Depth of socket (P)	Lead joints	Up to and including 600 mm	± 5
		Over 600 mm up to and including 1000 mm.	± 10
		Over 1000 mm up to and including 1500 mm.	± 15

Tolerances on Thickness

Dimension	*Tolerance in mm*
Wall thickness Flange thickness	– (2 + 0.05 e) ± (3 + 0.05 b)

Where e = the standard thickness of the wall in millimeters, and
b = the standard thickness of the flange in millimeters.

Tolerance on Lengths

Type of fitting	*Nominal diameter*	*Tolerance in mm*
Socket fittings and flange spigot pieces	Up to and including 450 mm	± 20
	Over 450 mm	± 20 – 30
Flanged fittings	All diameters	± 10

APPENDIX C

PARTICULARS OF MEDIUM GRADE G.I. PIPES

(Clause 18.3.11.3)

Nominal bore	*Dimension of pipes*			*Weight of pipe*	
	Outside diameter		*Thickness*	*Plain end*	*Screwed end socket*
(mm)	*Max. (mm)*	*Min. (mm)*	*(mm)*	*Kg/m*	*Kg/m*
6	10.6	9.8	2.0	0.404	0.407
8	14.0	13.2	2.3	0.641	0.645
10	17.5	16.7	2.3	0.839	0.845
15	21.8	21.0	2.6	1.21	1.22
20	27.3	26.5	2.6	1.56	1.57
25	34.2	33.3	3.2	2.41	2.43
32	42.9	42.0	3.2	3.10	3.13
40	48.8	47.9	3.2	3.56	3.60
50	60.8	59.7	3.6	5.03	5.10
65	76.6	75.3	3.6	6.42	6.54
80	89.5	88.0	4.0	8.36	8.53
100	115.0	113.1	4.5	12.2	12.50
125	140.8	138.5	4.8	15.90	16.40
150	166.5	163.9	4.8	18.90	19.50

Tolerance in Thickness and Weight

A) **Thickness**

1. Butt welded medium tubes — + not limited
– 10 per cent

2. Seamless tubes — + not limited
– 12.5 per cent

B) **Weight**

1. Single tube (light series) — + 10 percent
- 8 per cent

2. Single tube (medium and heavy series) — ± 10 per cent

3. For quantities per load of 10 tonnes, min (light series) — ± 5 per cent
– 8 per cent

4. For quantities per load of 10 tonnes, min (medium and heavy series) — ± 7.5 per cent

APPENDIX D

PROCEDURE FOR PRESSURE TEST

(Clause 18.5.6)

1. Each valved section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants and blow-offs. If these are not available at high places, necessary tapping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.

2. If the trench has been partially back-filled the specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer-in-Charge. The duration of the test shall not be less than 5 minutes.

3. Examination under Pressure: All exposed pipes, fittings, valves, hydrants and joints should be carefully examined during the open-trench test. When the joints are made with lead, all such joints showing visible leaks shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the authority. Any cracked or defective pipes, fittings, valves or hydrants 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 Engineer-in-Charge.

4. If the trench has been back-filled to the top, the section shall be first subjected to water pressure normal to the area and the exposed parts shall be carefully examined. If any defects are found, they shall be repaired and the pressure test repeated until no defects are found. The duration of the final pressure tests shall be at least one hour.

Procedure for Leakage Test

5. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No pipe installation shall be accepted until the leakage is less than the number of cm^3/h determined by the formula:

$$ql = \frac{ND\sqrt{P}}{3.3}$$

Where ql = the allowable leakage in cm^3/h.
N = number of joints in the length of the pipe line.
D = diameter in mm, and
P = the average test pressure during the leakage testing kg/cm^2.

6. Variation from Permissible Leakage: Should any test of pipe laid in position discloses leakage greater than that specified in Para 5 the defective joints shall be repaired until the leakage is within the specified allowance.

APPENDIX E

GUIDELINES FOR STORAGE AND INSTALLATION OF CPVC PIPES

E-1 STORAGE

CPVC pipes of all sizes are packed in polyethylene packing rolls and both the ends of the packed roll are sealed with air bubble film cap in order to provide protection during handling and transportation. After packing, the whole bunch of pipes is tightened with polypropylene/ HDPE strapping. Each role is then marked with size/type of the pipe, lot number and quantity. The packed pipe rolls are stored in their respective racks in properly covered storage area. Apart from providing protection during handling and transportation, the packing rolls also protect the pipe from ultra violet rays.

E-2 INSTALLATION GUIDELINES

E-2.1 Visually inspect pipe ends before making the joint. Use of a chamfering tool will help identify and crakes, as it will catch on to any crack.

E-2.2 Pipe may be cut quickly and efficiently by several methods. Wheel type plastic tubing cutters are preferred. Ratchet type cutter or fine tooth saw are another options. However, when using the ratchet cutter be certain to score the exterior wall by rotating the cutter blade in circular motion around the pipe. Do this before applying significant downward pressure to finalize the cut. This step leads to a square cut. In addition, make sure ratchet cutter blades are sharp. Cutting tubing as squarely as possible provides optimal bonding area within a joint.

E-2.3 Burrs and filings can prevent proper contact between the tube and fittings during the assembly, and should be removed from the outside and inside of the tube. A chamfering tool is preferred, but a pocket knife or file is also suitable for this purpose.

E-2.4 Use only CPVC cement jointing. Use CPVC cement, which is fully recommended by the manufacturer.

E-2.5 When using adhesive solution/solvent cement be certain of proper ventilation.

E-2.6 When making a join, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged waterways. Do not allow excess cement to puddle in the fitting and pipe assembly. This could result in a weakening of the pipe wall and possible pipe failure when the system is pressurized.

E-2.7 Rotate pipe one-quarter to one-half turn while inserting it into the fitting socket and remove the excess adhesive solution/solvent cement from the joint with clean rag.

E-2.8 When making a transition connection to metal threads, use a special transition fitting or CPVC male threaded adapter whenever possible. Do not over-torque plastic threaded connections. Hand tight plus one-half turn should be adequate.

E-2.9 Hang or strap CPVC systems loosely to allow for thermal expansion. Do not use metal straps with sharp edges that might damage the tubing.

E-2.10 CPVC stub outs for lavatories, closets and sinks are appropriate. However, on areas where there is a likelihood that movement or impact abuse will occur, metal pipe nipples may be amore appropriate stub-out material. Showerheads, tub spouts and outside still cocks are examples.

E-2.11 When connected to a gas water heater, CPVC tubing should not be located within 50 cm of the flue. For water heaters lacking reliable temperature control, this distance may be increased up to 1 m a metal nipple or flexible appliance connector should be utilized. This measure eliminates the potential for damage to plastic piping that might result from excessive radiant heat from the flue.

APPENDIX F

SAMPLING AND CRITERIA FOR CONFORMITY OF CPVC PIPES

(Clause 18.9.6)

F-1 ACCEPTANCE TESTS

F-1.1 Acceptance test are carried out on samples selected from a lot for the purpose of acceptance of the lot.

F-1.2 Lot

All CPVC pipes in a single consignment of the same class, same size and manufactured under essentially similar conditions shall constitute a lot.

F-1.3 For ascertaining conformity of the lot to the requirements of the specification, samples shall be tested from each lot separately.

F-1.4 Visual and Dimensional Requirements

F-1.4.1 The number of test samples to be taken from a lot shall depend on the size of the lot and the outside diameter of the pipe, and shall be in accordance with Table F-1.

TABLE F-1
Scale of Sampling of Visual Appearance and Dimensional Requirements
(Clause F-1.4.1 and F-1.4.3)

Sl. No.	*Number of pipes in the lot*	*Sample number*	*Sample size*	*Cumulative sample size*	*Acceptance number*	*Rejection number*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
(i)	Up to 1000	First	13	13	0	2
		Second	13	26	1	2
(ii)	1001 to 3000	First	20	20	0	2
		Second	20	40	1	2
(iii)	3001 to 10000	First	32	32	0	3
		Second	32	64	3	4
(iv)	10001 & above	First	50	50	1	4
		Second	50	100	4	5

F-1.4.2 These pipes shall be selected at random from the lot and in order to ensure the randomness of selection, a random number table shall be used. For guidance and use of random number tables, IS-4905 may be referred to. In the absence of a random number table, the following procedure may be adopted:

Starting from any pipe in the lot, count them as 1, 2, 3, etc, up to r and so on, where r is the integral part of N/n, N being the number of pipes in the lot, and n the number of pipes in the sample. Every rth pipe so counted shall be withdrawn so as to constitute the requires sample size.

F-1.4.3 The number of pipes given for the first sample in col. 4 of Table F-1, shall be taken from the lot and examined for visual and dimensional requirements given in Table 18.16 and 18.9.4.1. A pipe failing to satisfy any of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements, if the number of defectives found in the firm sample is less than or equal to the corresponding acceptance number given in col. 6 of Table F-1. The lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col. 7 of Table F-1. If, however, the number of defectives found in the first sample lies between the corresponding acceptance and rejection numbers given in

cols. 6 and 7, a second sample of the size given in col. 4 shall be taken and examined for the requirements. The lot shall be considered to have satisfied these requirements. The lot shall be considered to have satisfied these requirements if the cumulative sample is less than or equal to the corresponding acceptance number given in col. 6, otherwise not.

F-*1.5 Reversion Test*

F-1.5.1 The lot, having satisfied visual and dimensional requirements, shall be tested for reversion as given in 18.9.4.4.

F-1.5.2 For this purpose, the number of pipes given for the first sample in col. 4 of Table F-2 shall be taken from the lot. The sample pipe failing the reversion test shall be considered as defective. The lot shall be deemed to have met the requirements given in this specification for the reversion test, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col. 6. This lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col. 7 if, however, the number of defectives in the first sample lies between the corresponding acceptance and rejection numbers given in col. 6 and col. 7, a second sample of size given in col. 4 shall be taken and examined for the requirements. The lot shall be considered to have satisfied the requirements, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in col. 6, otherwise not.

TABLE F-2
Scale of Sampling for Reversion, Vicat Softening Temperature and Density Test
(Clause F-1.5.2, F-1.6.2 and F-1.7.2)

Sl. No.	*Number of pipes in the lot*	*Sample number*	*Sample size*	*Cumulative sample size*	*Acceptance number*	*Rejection number*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
(i)	Up to 1000	First	5	5	0	2
		Second	5	10	1	2
(ii)	1001 to 3000	First	8	8	0	2
		Second	8	16	1	2
(iii)	3001 to 10000	First	13	13	0	2
		Second	13	26	1	2
(iv)	10001 & above	First	20	20	0	3
		Second	20	40	3	4

F-1.6 Vicat Softening Test

F-1.6.1 The lot, having satisfied visual and dimensional requirements shall be tested for Vicat softening temperature as given in 18.9.4.5.

F-1.6.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for reversion under F-1.5.2 using Table F-2.

F-1.7 Density

F-1.7.1 The lot, having satisfied the visual and dimensional requirements, shall be tested for density as given in 18.9.4.6.

F-1.7.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for reversion under F-1.5.2 using Table F-2.

F-1.8 Resistance to External Blow at 0°C

F-1.8.1 The lot, having been found satisfactory according to F-1.4, F-1.5, F-1.6 and F-1.7 shall be tested for resistance to external blow at 0°C as given in 18.9.5.3.

F-1.8.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be as specified in Table 18.18 and Table F-3.

TABLE F-3
Scale of Sampling for Resistance to External Blow at 0°C

Sl. No.	*Number of pipes in the lot*	*Sample number*	*Sample size*	*Cumulative sample size*	*Acceptance number*	*Rejection number*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
(i)	Up to 3000	First Second	3 3	3 6	0 1	2 2
(ii)	3001 to 10000	First Second	3 5	5 10	0 1	2 2
(iii)	10000 & above	First Second	8 8	8 10	0 1	2 2

F-1.9 Internal Hydrostatic Pressure Test (Acceptance Test)

F-1.9.1 The lot having been found satisfactory according to F-1.4, F-1.5, F-1.6, F-1.7 and F-1.8 shall be subjected to the requirements of the acceptance test for internal hydrostatic pressure as given in 18.9.5.1 and Table 18.17 Sl. No. (i). The number of pipes to be taken from the lot shall depend on the size of the lot and shall be according to Table F-4.

TABLE F-4
Scale of Sampling for Internal Hydrostatic Test
(Clause F-1.9.1 and F-1.9.3)

Sl. No.	*Number of pipes in the lot*	*Sample size*	*Acceptance number*
(1)	*(2)*	*(3)*	*(4)*
(i)	Up to 3000	2	0
(ii)	3001 to 10000	3	0
(iii)	10000 & above	5	0

F-1.9.2 The pipes shall be taken at random from the lot. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

F-1.9.3 Number of Tests and Criteria for Conformity

The number of test samples shall be as given in Table F-4. The lot shall be considered to have satisfied the requirements for this test, if the number of test samples failing in this requirement is equal to the corresponding acceptance number given in column 4 of Table F-4.

F-2 TYPE TESTS

F-2.1 Type tests are intended to prove the suitability and performance of a new composition or a new size of pipe. Such tests, therefore, need to be applied only when a change is made in polymer composition or when a new size of pipe is to be introduced. Type test for compliance with 18.9.4.2, 18.9.4.3, 18.9.5.1 (Type test only) and 18.9.5.4 shall be carried out.

F-2.1.1 ***Verification of Malfunction Temperature T_{mal}***

For this test, the manufacturer to the testing authority one assembly, selected preferably from a regular production lot.

F-2.1.2 *Opacity*

For this test, the manufacturer or the supplier shall furnish to the testing authority one sample of the pipe of the thinnest wall section, selected preferably from a regular production lot.

F-2.1.2.1 The sample so selected shall be tested for compliance with requirements for opacity as given in 18.9.4.2.

F-2.1.2.2 If the sample passes the requirements of the opacity test, the type of the pipe under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

F-2.1.2.3 In case the sample fails in the test, the testing authority, at its discretion, may call for a fresh sample and subject the same to the opacity test. If the sample passes the repeat test, the type of pipe under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and re-submit the product for type approval.

F-2.1.2.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for a fresh sample for opacity test for the purpose of type approval.

F-2.1.3 ***Test for Effect on Water***

For this type test, the manufacturer or the supplier shall furnish to the testing authority three samples of the smallest size of pipe taken from each machine (selected preferably from a regular production lot).

F-2.1.3.1 Three samples so selected shall be tested for compliance with the requirements for effect on water as given in 18.9.4.3.

F-2.1.3.2 If all three samples pass the requirements for effect on water, the type test of the pipe under consideration shall be considered to be eligible for approval, which hall be normally valid for a period of one year.

F-2.1.3.3 In case any of the samples fails in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number, and subject them to the test for effect on water. If, in the repeat test, no single failure occurs, the type of pipe under consideration shall be considered eligible for type approval. If any of the samples fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.1.3.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for effect on water test for the purpose of type approval.

F-2.1.4 ***Internal Hydrostatic Pressure Test (Type Test) and thermal Stability***

For this type test, the manufacturer or the supplier shall furnish to the testing authority, three samples of pipes of different diameters and different classes (selected preferably from a regular production lot).

F-2.1.4.1 Three samples so selected shall be tested for compliance with the requirements of type test given in Table 18.9.4.3.

F-2.1.4.2 If all the three samples pass the requirements of the quality test, the type of pipe under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

F-2.1.4.3 In case any of the samples fail in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number and subject them to the type test. If, in the repeat test, no single failure occurs, the type of pipe shall be considered for type approval. If any of the samples fails in the repeat tests, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.1.4.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for type test for the purpose of type approval.

F-2.1.5 ***Tensile Strength Test (Type Test)***

For this type test, the manufacturer or the supplier shall furnish to the testing authority, five samples of pipe of different diameters and different class (selected preferably from a regular production lot).

F-2.1.5.1 Five samples so selected shall be tested for compliance with the requirements of type test given in 18.9.5.4.

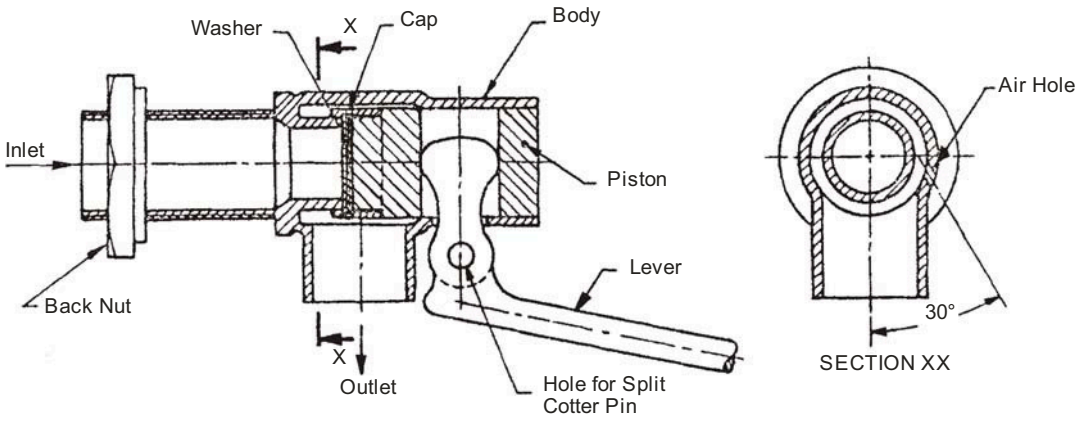
F-2.1.5.2 If all the five samples pass the requirement of the quality test, the type test of pipe under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

F-2.1.5.3 In case any of the samples fails in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original numbers and subject them to the type test. If, in the repeat test no single failure occurs, the type of pipe shall be considered for type approval. If any of the samples fail in the repeat tests, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.1.5.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for type test for the purpose of type approval.

BALL VALVE (ASSEMBLY)

Sub Head : Water Supply
Clause : 18.3.1

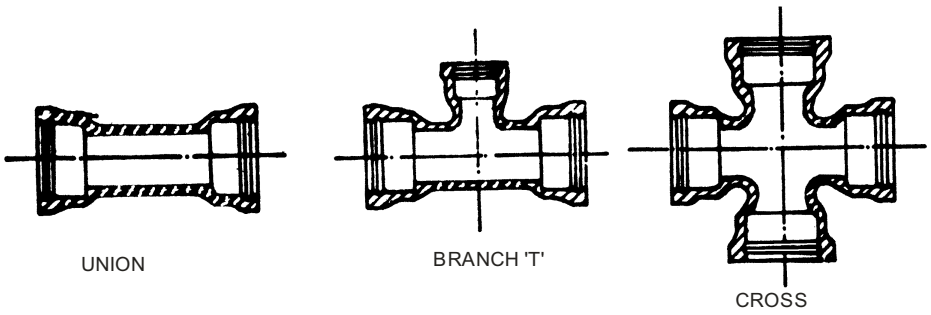


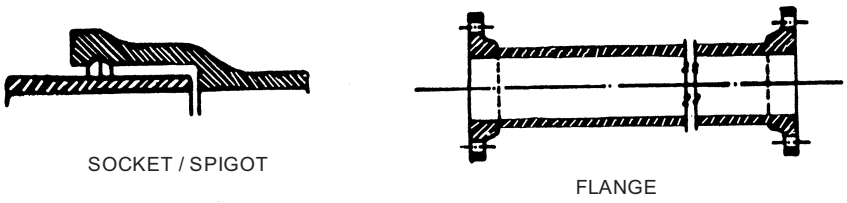
Note : The shapes of the component parts are only illustrative but the dimensions and minimum requirements, where specified, are binding.

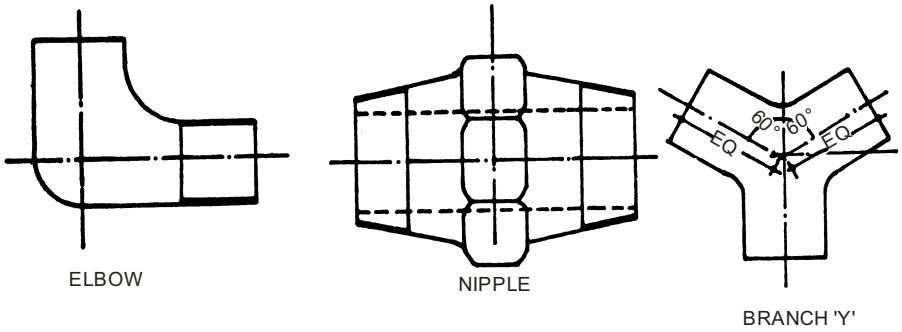
Fig. 18.1 : Ball Valve (Assembly)

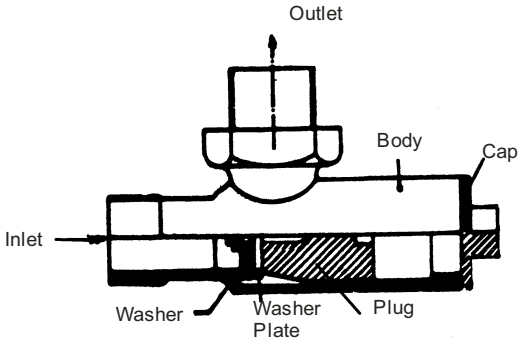
FITTINGS & SPECIALS

Sub Head : Water Supply
Clause : 18.3.9









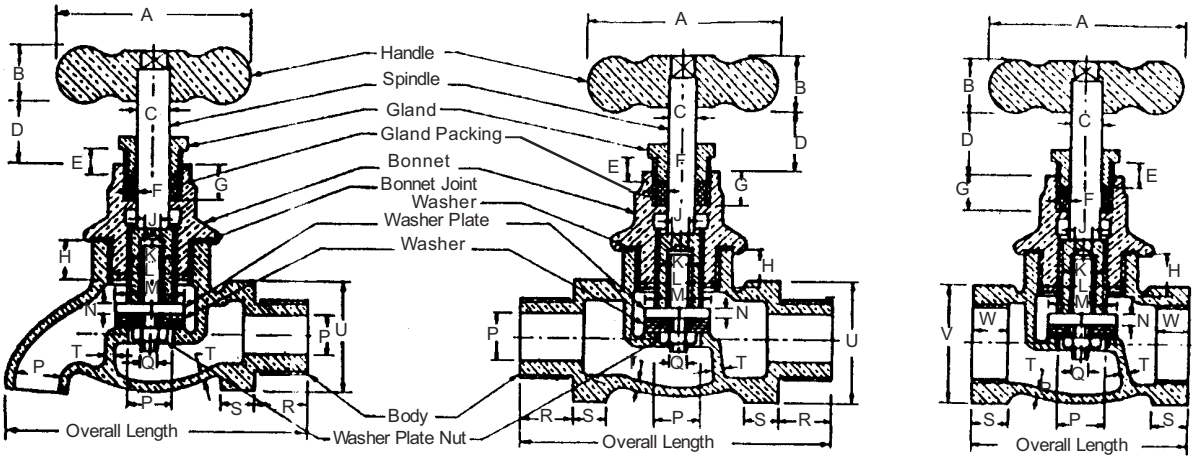
FERRULE
(Clause 18.3.3)

Drawing not to Scale

Fig. 18.2 : Fittings & Specials

BIP TAP & STOP VALVE

Sub Head : Water Supply
Clause : 18.3.2



BIB TAP

EXTERNALLY THREADED STOP VALVE

INTERNALLY THREADED STOP VALVE

All dimensions in millimetres

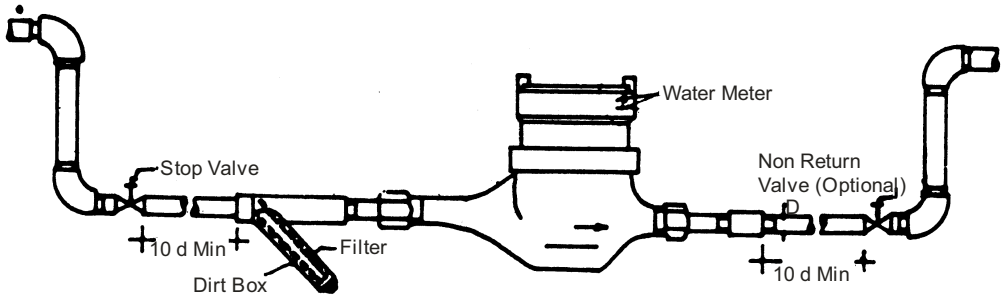
Dimensions → / *Nominal Sizes ↓*	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*	*M*	*N*	*P* + 0.0 −0.5	*Q*	*R*	*S*	*T*	*U*	*V*	*W*	*Lift of Washer Plate (with Washer in Position, Min.)*
	Min.	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*	*Min.*
8	47.8	13.3	7.8	16.5	6.3	2.0	7.9	7.0	3.8	10.0	M 20x 1.5	14.3	2.8	6.5	2.4	11.0	4.7	1.6	15.2	19.5	7	3.5
10	54.0	14.0	9.4	18.7	7.5	2.0	9.5	9.5	4.7	11.5	M 20 x 1.5	15.9	3.2	9.0	3.2	11.4	7.9	2.0	20.8	23.3	7	4
15	54.0	14.0	9.4	19.0	7.5	2.0	9.5	11.0	5.6	11.5	M 24 x 1.5	19.0	3.2	13.0	4.1	15.0	9.5	2.0	25.6	28.3	9	4.5
20	60.4	15.7	10.9	20.1	8.9	2.5	11.1	12.5	6.4	13.5	M 30 x 1.5	25.4	4.0	18.0	4.9	16.3	10.3	2.0	30.5	33.0	10.5	6
25	66.8	18.0	12.5	23.0	10.1	2.5	12.7	13.0	7.1	17.0	M 39 x 1.5	33.3	4.0	23.0	4.9	19.1	11.0	2.8	37.6	42.4	11.5	7
32	74.6	20.5	14.1	30.9	11.4	2.5	14.3	16.0	7.8	19.0	M 48 x 1.5	40.1	4.3	30	5.9	21.4	12.7	3.2	47.2	52.1	13.5	9.5
40	82.5	22.0	15.7	33.3	12.7	2.5	15.9	17.5	8.6	20.5	M 56 x 1.5	47.7	5.5	36	6.6	21.4	14.3	3.2	56.4	58.5	13.5	11
50	95.0	25.3	17.3	35.9	14.0	2.5	17.4	17.5	12.5	26.0	M 72 x 1.5	63.5	6.3	46	8.3	25.1	15.9	4.0	70.1	71.5	16.5	14.5

Note 1: Length of thread R includes cut back under hexagon, if any.
Note 2: The values of K are for core diameter.
Note 3 : The diameter of U and V are for face to face.
Note 4: The dimension F is packing space.

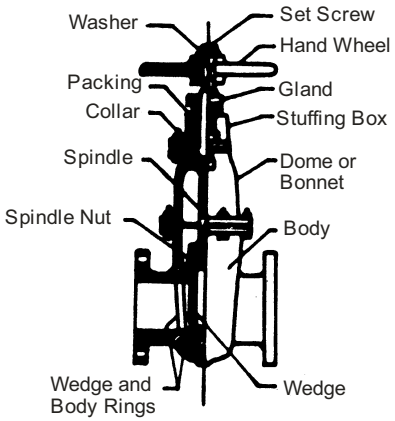
Fig. 18.3 : Bib Tap & Stop Valve

COCKS VALVES & METER

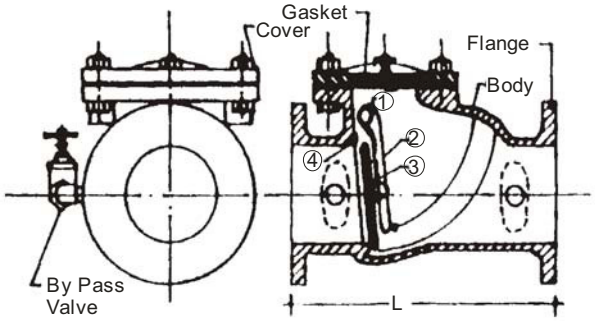
Sub Head : Water Supply
Clause : 18.3.15



WATER METER ASSEMBLY



SLUICE VALVE
(Clause 18.3.13)



NON-RETURN VALVE
(Clause 18.3.8)

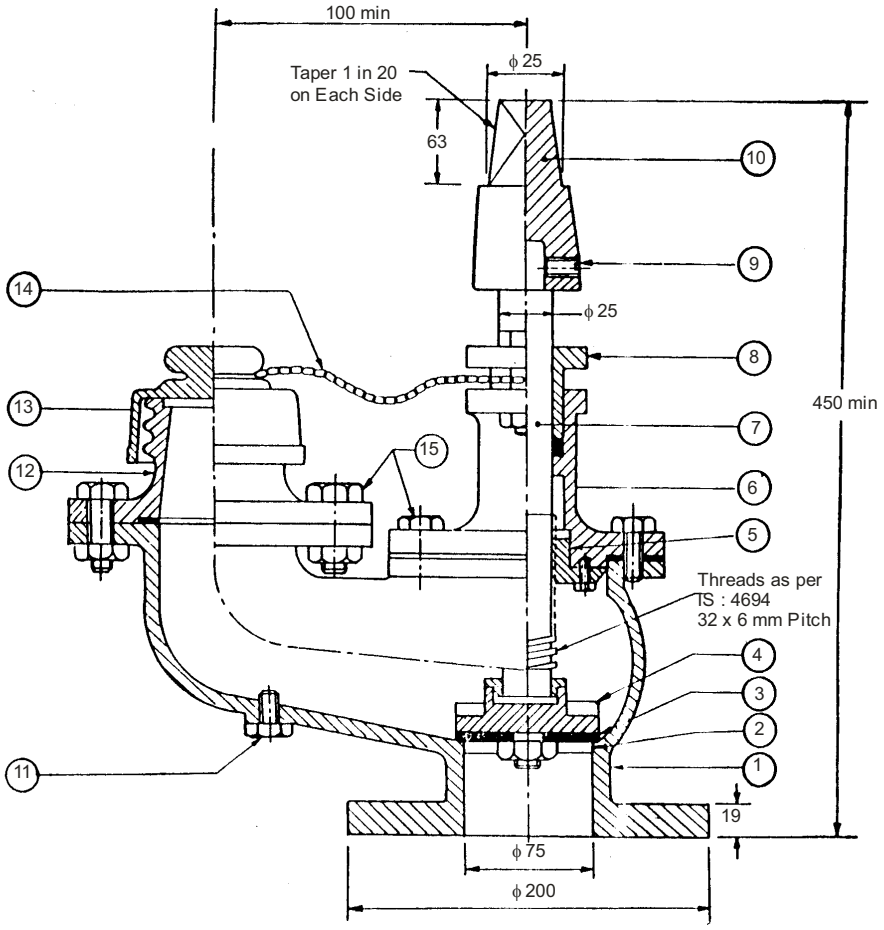
① Hinge Pin
② Hinge
③ Door
④ Body Ring

Drawing not to Scale
All Dimensions are in MM

Fig. 18.4 : Cocks Valves & Meter

UNDERGROUND FIRE HYDRANT, SLUICE-VALVE GATE

Sub Head : Water Supply
Clause : 18.3.4



No.	Description	Mat.	Mat. Specification
1	Body	C.I.	IS 210-1972 FG-200
2	Valve Seat	G.M.	IS 318-1981 LTB-2
3	Washer	Rubber	IS 937-1981
4	Valve	G.M.	IS 318-1981 LTB-2
5	Spindle Nut	G.M.	IS 318-1981 LBT-2
6	Bonnet	C.I.	IS 210-1978 FG-200
7	Spindle	Brass	IS 319-1989
8	Gland	C.I.	IS 210-1978 FG-200
9	Grush Screw (12 mm)	M.S.	IS 6094-1981
10	Spindle Cap	C.I.	IS 210-1978 FG-200
11	Drain Bolt	M.S.	-
12	Outlet	G.M.	IS 318-1981 LTB-2
13	Cap	C.I.	IS 210-1978 FG-200
14	Chain	Gal. MS	-
15	Nut and Bolt	M.S.	-

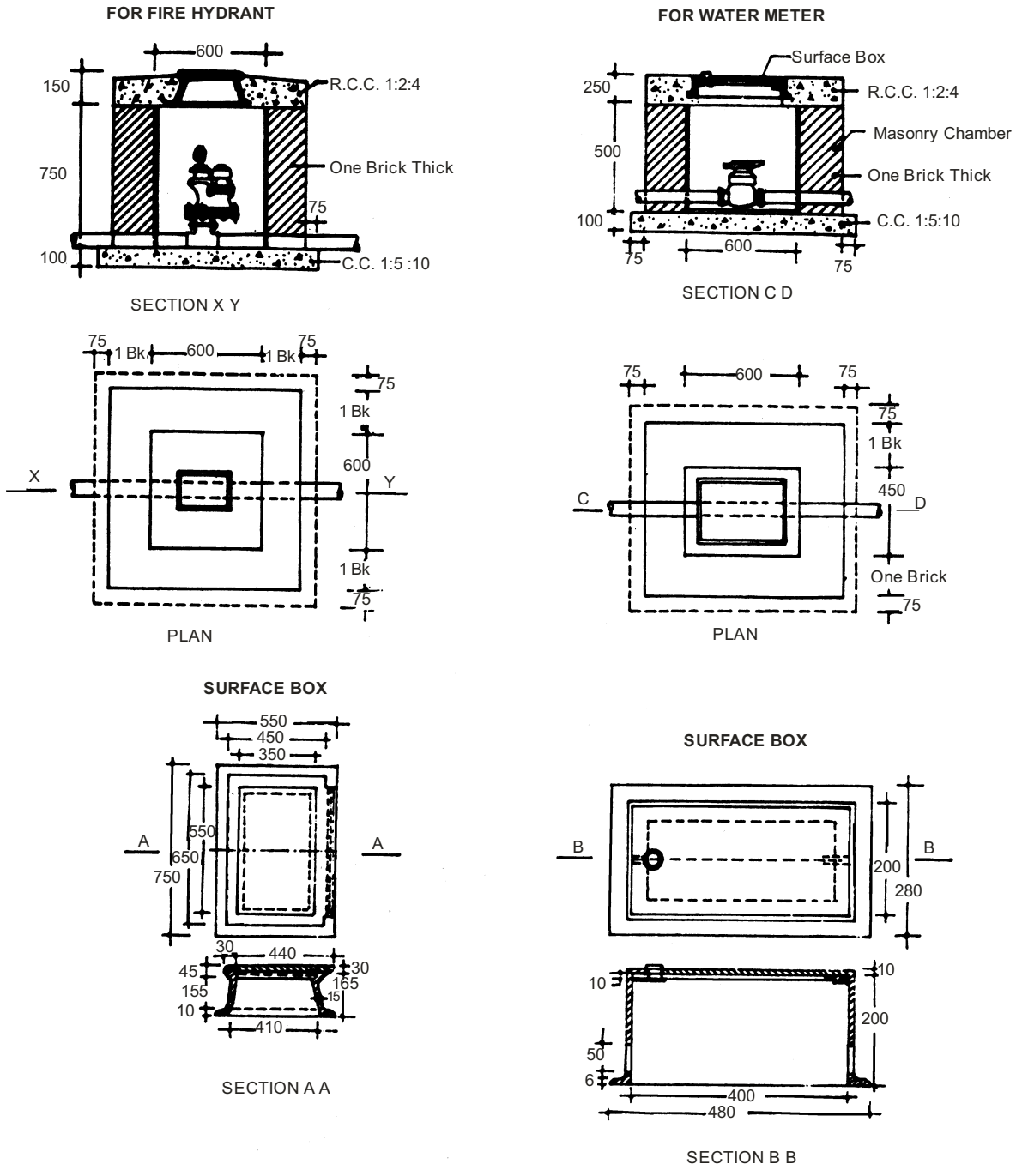
TOLERANCES AS PER IS 2102-1962

All Dimensions are in MM

Fig. 18.5 : Underground Fire Hydrant, Sluice-Valve Gate

MASONRY CHAMBERS & SURFACE BOXES

Sub Head : Water Supply
Clause : 18.3.14

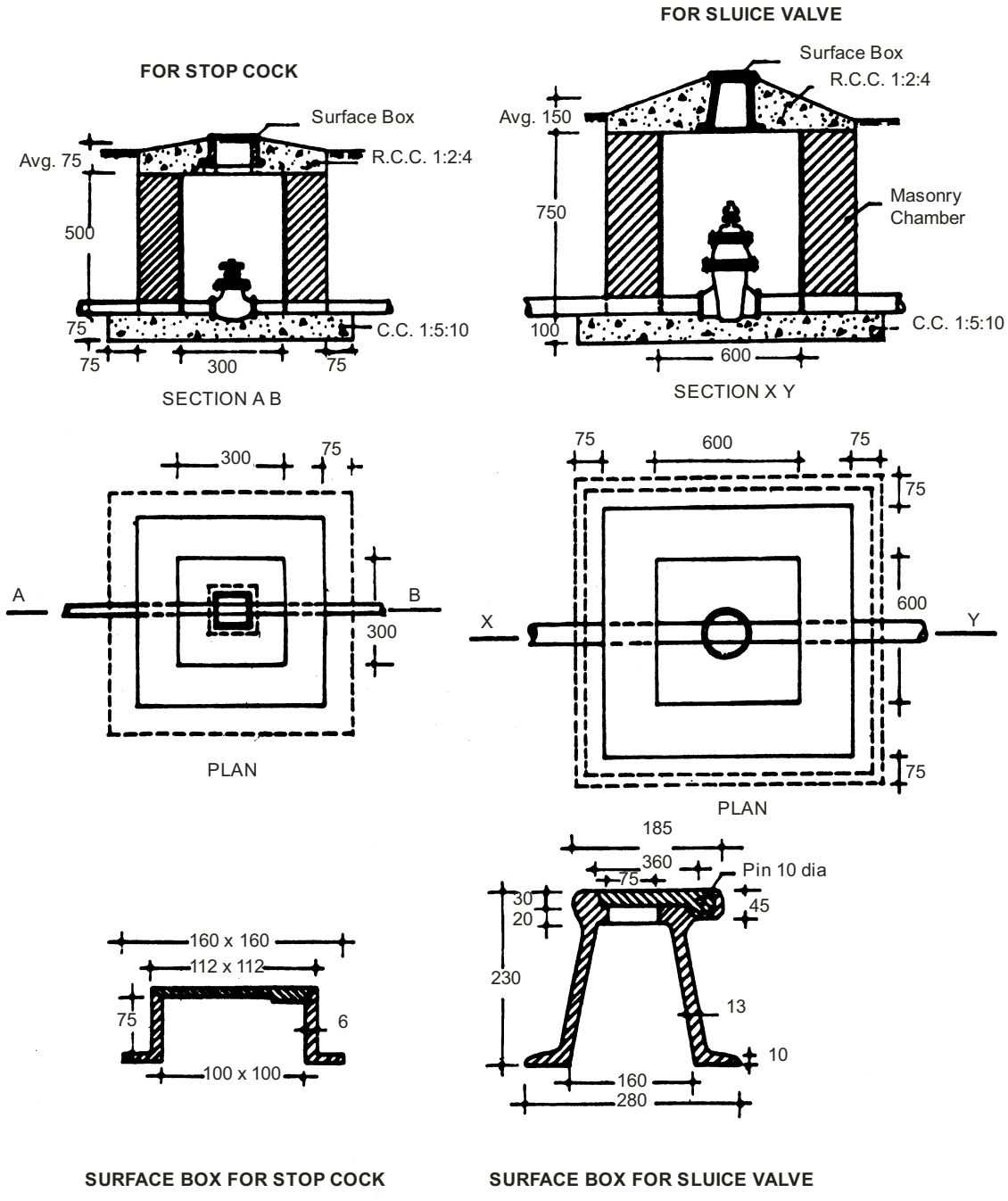


Drawing not to Scale
All Dimensions are in MM

Fig. 18.6 : Masonry Chambers & Surface Boxes

MASONRY CHAMBERS & SURFACE BOXES (Contd.)

Sub Head : Water Supply
Clause : 18.3.14

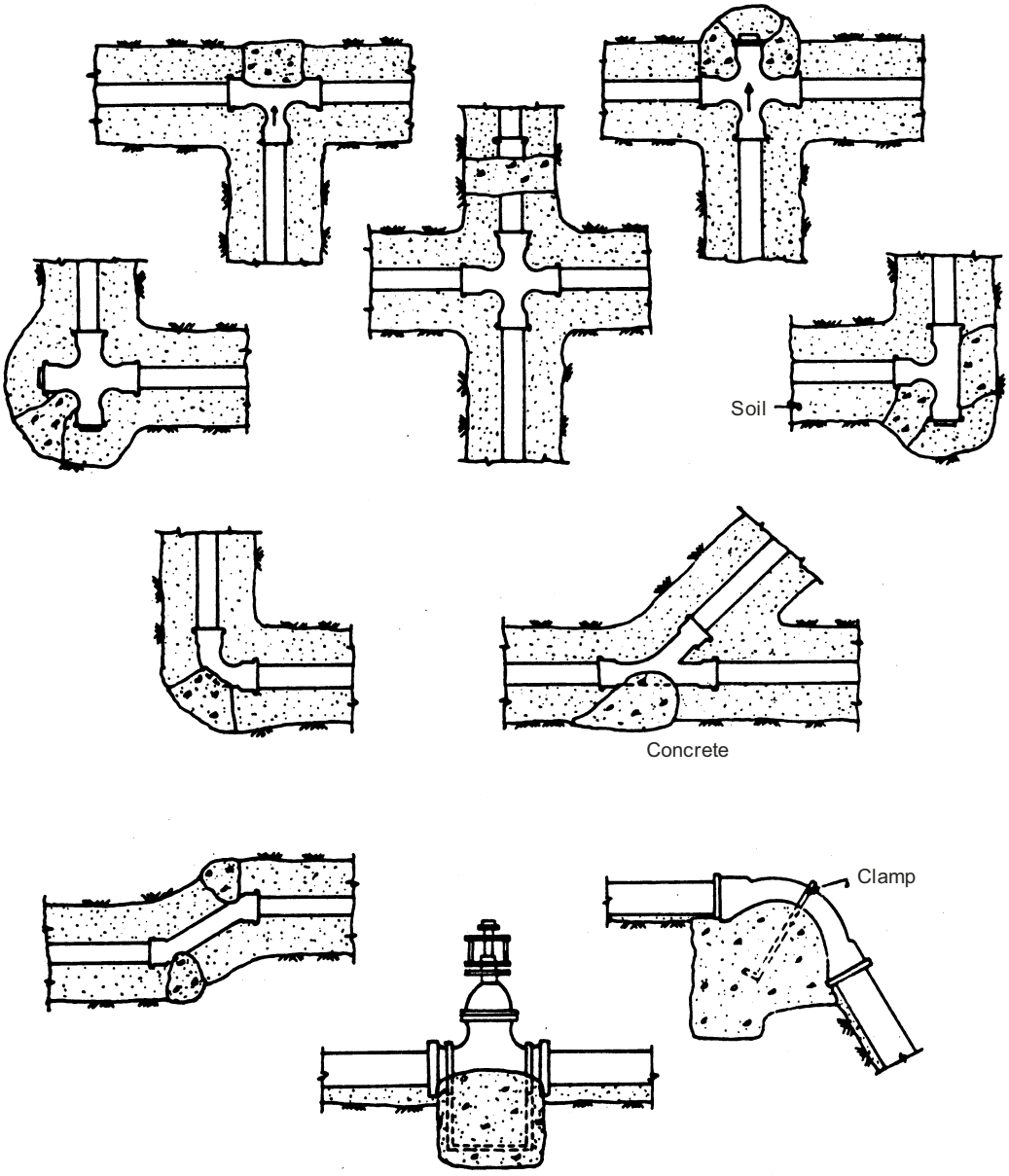


Drawing not to Scale
All Dimensions are in MM

Fig. 18.7 : Masonry Chambers & Surface Boxes (Contd.)

THRUST BLOCKS

Sub Head : Water Supply
Clause : 18.4.6

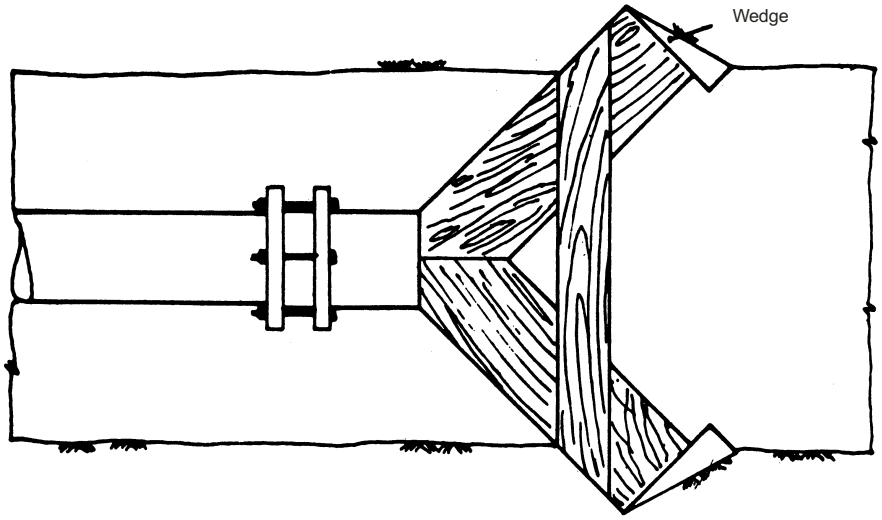


Drawing Not to Scale

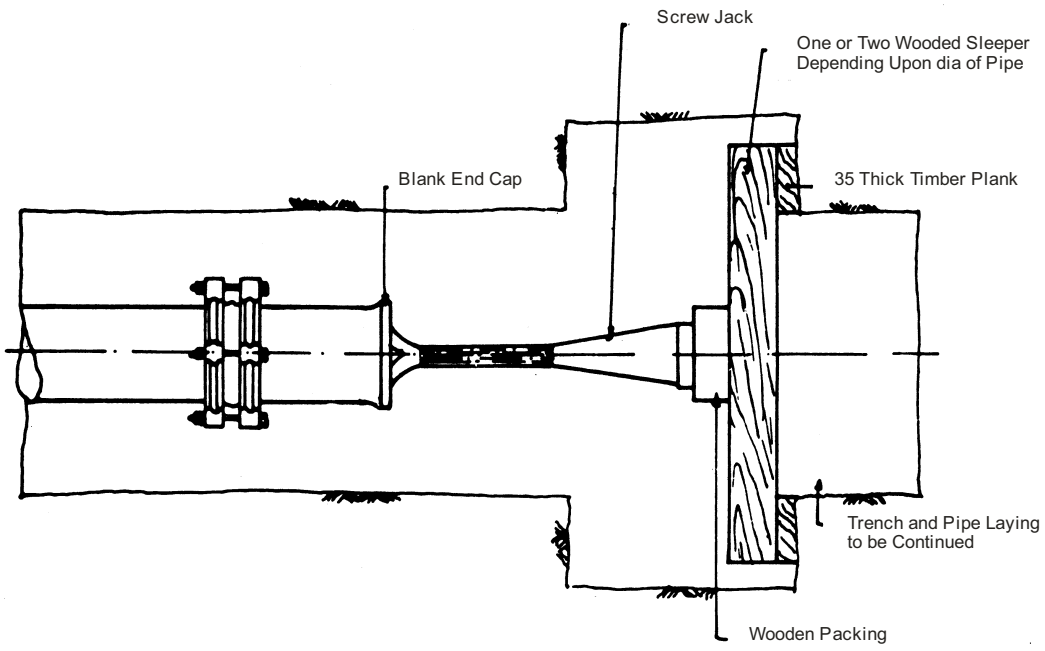
Fig. 18.8 : Thrust Blocks

HYDROSTATIC TESTS
(END CLOSURE FOR PIPES)

Sub Head : Water Supply
Clause : 18.4.8



FOR PIPES UPTO 125 NOMINAL DIA



FOR PIPES OF NOMINAL DIA OVER 125

Drawing Not to Scale
All Dimensions are in mm

Fig. 18.9 : Hydrostatic Test (End Closure for Pipes)