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CODE OF PRACTICE FOR WATER SUPPLY IN BUILDINGS

(Second Revision)

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(*Continued on page* 42)

Indian Standard

CODE OF PRACTICE FOR WATER SUPPLY IN BUILDINGS

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 30 November 1983, after the draft finalized by the Water Supply and Sanitation Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard, first published in 1963 and subsequently revised in 1972, made an attempt to provide the minimum standards for the design, layout and workmanship governing water supply in buildings and helped in bringing about desired uniformity in the bye-laws and regulations framed by different water supply authorities in the country. The need for following the regulations are imperative as they are intended for the prevention of waste, misuse, undue consumption and contamination of drinking water, the conservation of which has become an urgent necessity in view of its increasing demand.

0.2.1 The salient changes made in the revision are for estimating the demand load for water supply system, for which the minimum water supply requirements for residential purposes has been changed to 200 liters per head per day and the discharge curve are now based on Hazen and William formula.

0.2.2 A separate Indian Standard laying down guidelines for registration of plumbers is under preparation.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This code deals with water supply in buildings, and covers general requirements and regulations for water supply, plumbing connected to public water supply, licensing of plumbers, design of water supply systems, principles of conveyance and distribution of water within the premises, storage, water fittings and appliances, and inspection and maintenance.

1.2 Many administrative authorities controlling water supply have their own set of bye-laws, rules and regulations for supply of water to suit local conditions. These should be strictly conformed to before operations are commenced for laying of pipelines or plumbing systems which are to be connected to public water supply.

1.3 This code does not cover aspects of water supply for fire fighting purposes.

2. TERMINOLOGY

2.0 For the purpose of this code, the following definitions shall apply.

2.1 Addition to a Building — Addition to the cubic contents or to the floor area of a building.

2.2 Air Gap — The distance between the lowest point of a water inlet or feed pipe to an appliance and the spill-over level (or the overflowing level) of the appliance.

2.3 Anchors — *See* **2.53.**

2.4 Appliance — A receptacle or apparatus in which water is heated, treated or measured, or in which it is utilized before passing to waste.

2.5 Approved — Accepted or acceptable under an applicable specification stated or cited in this code or accepted as suitable for the proposed use under the bye-laws or regulations of the Authority.

2.6 Area of a Floor or Floor Area of a Building — The area of a horizontal section taken at the plinth or floor level of any storey of a building inclusive of all projecting and overhanging parts of the external walls and of such portions of the partition walls as belong to the building.

2.7 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.

2.8 Authority Having Jurisdiction — The authority which has been created by a statute and which for the purpose of administering the code may authorise a committee or an official to act on its behalf; hereinafter called the ' Authority '

2.9 Backflow — The flow of water or other liquids, mixtures or substances into the distributing pipes of a potable supply of water system from any source or sources other than its intended source (*see* **2.11**).

2.10 Backflow Prevention Device — Any approved measure or fitting or combination of fittings specifically designed to prevent backflow or backsiphonage in a water service.

2.11 Back Siphonage — The flowing back of used contaminated or polluted water from a plumbing fixture or vessel into a water supply pipe due to a reduced pressure in such pipe (*see* **2.9**).

2.12 Branch — Any part of the piping system other than a main.

2.13 Building — Any permanent or temporary structure built for the support, shelter or enclosure for persons, animals, chattels or property of any kind, and includes a house, outhouse, stable, shed, hut and every other such structure, whether of masonry, bricks, wood, mud, metal or any other material but does not include a watchman's booth, a *mandap* or other similar kinds of temporary structures erected on ceremonial occasions.

2.14 Capacity — The volume of a storage cistern measured up to the maximum water line.

2.15 Code — The word, where used, alone shall mean these regulations, subsequent amendments thereto, or any emergency rule or regulation which the Authority may lawfully adopt.

2.16 Combined Area of the Floors — Sum total of the area of two or more number of floors.

2.17 Communication Pipe — That part of a service pipe which vests in the water undertakers. It starts at the water main and terminates at a point which differs according to the circumstances of the case.

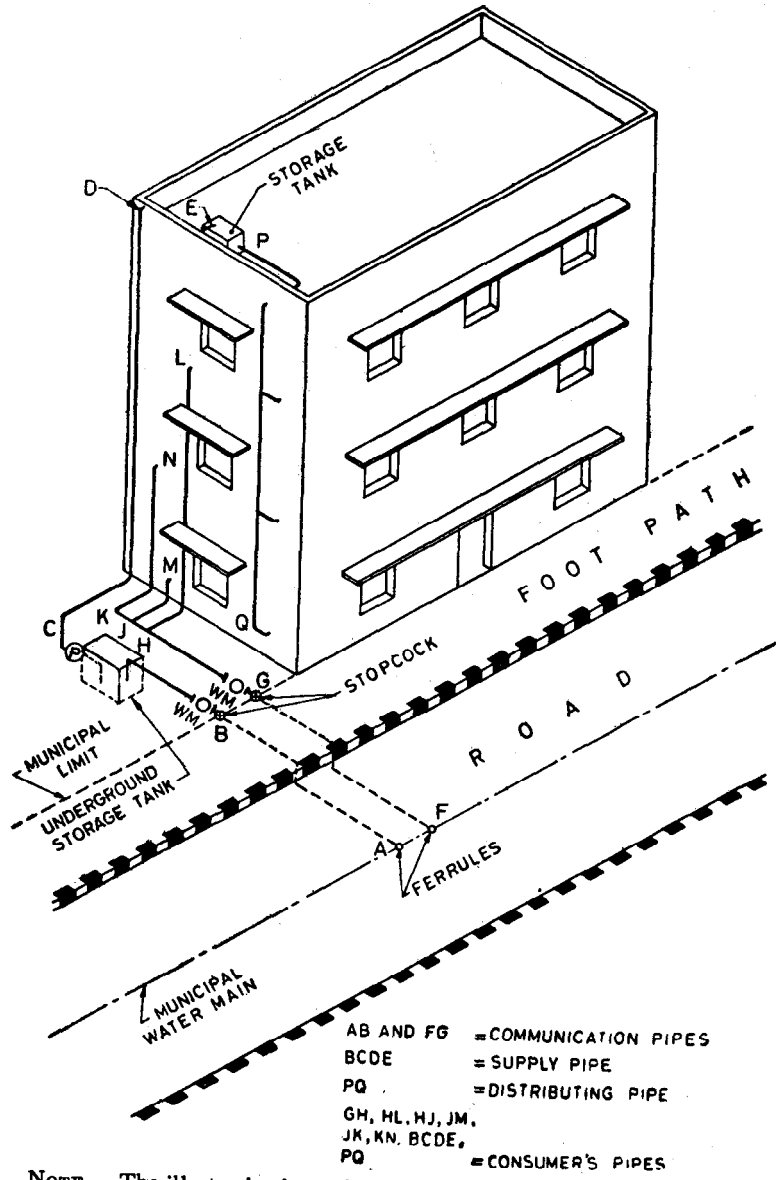
2.18 Consent — Consent obtained or given in writing.

2.19 Consumer — Any person who uses or is supplied water or on whose application such water is supplied by the Authority.

2.20 Consumer's Pipe — The portion of service pipe used for supply of water and which is not the property of the Authority (*see* Fig. 1).

2.21 Cross Connection — A connection between two normally independent pipelines which permits flow from either pipeline into the other.

2.22 Diameter — Unless specifically stated, the nominal (internal) diameter of the pipe.



NOTE — The illustration is not intended to indicate recommended positions of underground storage tank (where provided), pipes, etc, and this will depend on local situations.

FIG. 1 TYPICAL SKETCH FOR IDENTIFICATION OF DIFFERENT TYPES OF WATER SUPPLY PIPES

2.23 Direct Tap — A tap which is connected to a supply pipe and subject to pressure from the water main.

2.24 Domestic Purposes — All purposes incidental to the occupation of a dwelling.

2.25 Downtake Tap — A tap connected to a system of piping not subject to water pressure from the water main.

2.26 Dwelling — A building used or constructed or adapted for use wholly or principally for human habitation. It may include garages, other outhouses appurtenant thereto.

2.27 Effective Opening — The minimum cross-sectional area at the point of water supply, measured or expressed in terms of (a) diameter of a circle, (b) if the opening is not circular, the diameter of a circle of equivalent cross-sectional area.

2.28 Existing Work — A plumbing system or any part thereof which has been installed prior to the date on which the code comes into effect and is made applicable by the Authority.

2.29 Factory — A place to which the provisions of the *Indian Factories Act* of 1948 and amendments thereto from time to time apply.

2.30 Feed Cistern — A storage vessel used for supplying cold water to a hot water apparatus, cylinder or tanks.

2.31 Fitting — Coupling, flange, branch, bend tees, elbows, unions, waste with plug, P or S trap with vent, stop ferrule, stop valve, bib tap, pillar tap, globe tap, ball valve, cistern storage tank, baths water-closets, boiler gyser, pumping set, with motor and accessories, meter, hydrant valve and any other article used in connection with water supply and santitation.

2.32 Float Operated Valve — Ball valves or ball taps and equilibrium by valves operated by means of a float.

2.33 Flushing Cistern — A cistern provided with a device for rapidly discharging the contained water and used in connection with a sanitary appliance for the purpose of cleansing the appliance and carrying away its contents into a drain.

NOTE — The nominal size of a cistern is the quantity of water discharged per flush.

2.34 General Washing Place — A washing place provided with necessary sanitary arrangement and common to more than one tenement.

2.35 Horizontal Pipe — Any pipe or fitting which makes an angle of more than 45° with the vertical.

2.36 **Insanitary** — Contrary to sanitary principles or injurious to health.

2.37 **Licensed Plumber** — A person licensed under the provisions of this code.

2.38 **Offset** — A pipe fitting used to connect two pipes whose axis are parallel but not in line.

2.39 **Period of Supply** — The period of the day or night during which water supply is made available to the consumer.

2.40 **Pipe Work** — Any installation of piping with its fitting.

2.41 **Plinth** — The portion of a structure between the surface of the surrounding ground and surface of the floor, immediately above the ground.

2.42 **Plumbing** — (a) The pipes, fixtures and other apparatus inside a building for bringing in the water supply and removing the liquid and water borne wastes; (b) The installation of the foregoing pipes, fixtures and other apparatus.

2.43 **Plumbing System** — The plumbing system shall include the water supply and distribution pipes; plumbing fittings and traps; soil, waste, vent pipes and anti-siphonage pipes; building drains and building sewers including their respective connections, devices and appurtenances within the property lines of the premises, and water-treating or water-using equipment.

2.44 **Potable Water** — Water which is satisfactory for drinking, culinary and domestic purposes and meets the requirements of the Authority.

2.45 **Premises** — Premises shall include passages, buildings and lands of any tenure, whether open or enclosed, whether built on or not, and whether public or private in respect of which a water rate or charge is payable to the Authority or for which an application is made for supply of water.

2.46 **Public Building** — A building used or intended to be used either ordinarily or occasionally as a church, chapal, temple, mosque or any place of public worship, *DHARAMSHALA*, college, school, theatre, cinema, public concert room, public hall, public bath, hospital, hotel, restaurent, lecture room or any other place of public assembly.

2.47 **Residual Head** — The head available at any particular point in the distribution system.

2.48 **Service Pipe** — Pipe that runs between the distribution main in the street and the riser in the case of a multistoreyed building or the water in the case of an individual house and is subjected to water pressure from such main.

2.49 Stopcock — A cock fitting in a pipeline for controlling the flow of water.

2.50 Stop Tap — Stop tap includes stop cock, stop valve or any other devices for stopping the flow of water in a line or system of pipe at will.

2.51 Storage Cistern — A cistern for storing water.

2.52 Supply Pipe — So much of any service pipe as is not a communication pipe.

2.53 Supports — Supports, hangers and anchors or devices for supporting and securing pipe and fittings to walls, ceilings, floors or structural members.

2.54 Tenement — A room(s) in the occupation of or meant for the occupation of one tenant.

2.55 Vertical Pipe — Any pipe which is installed in a vertical position or which makes an angle of not more than 45° with the vertical.

2.56 Warning Pipe — An overflow pipe so fixed that its outlet, whether inside or outside a building, is in a conspicuous position where the discharge of any water therefrom can be readily seen.

2.57 Washout Valve — A device located at the bottom of the tank for the purpose of draining a tank for cleaning, maintenance, etc.

2.58 Water Line — A line marked inside a cistern to indicate the highest water level at which the supply valve should be adjusted to shut off.

2.59 Water Main (Street Main) — A pipe laid by the water undertakers for the purpose of giving a general supply of water as distinct from a supply to individual consumers and includes any apparatus used in connection with such a pipe.

2.60 Water Outlet — A water outlet, as used in connection with the water distributing system, is the discharge opening for the water (a) to a fitting, (b) to atmospheric pressure (except into an open tank which is part of the water supply), and (c) to any water-operated device or equipment requiring water to operate.

2.61 Water Supply System — Water supply system of a building or premises consists of the water service pipe, the water-distribution pipes, and the necessary connecting pipes, fittings, control valves, and all appurtenances in or adjacent to the building or premises.

2.62 Waterworks — Waterworks for public water supply include a lake, river, spring, well, pump with or without motor and accessories, reservoir, cistern, tank, duct whether covered or open, sluice, water main, pipe

culvert, engine and any machinery, land, building or a thing used for storage, treatment and supply of water.

3. LICENSING PLUMBERS

3.1 For grant of license to plumbers, 'Indian Standard Guidelines for Registration of Plumbers (*under preparation*)' may be followed.

4. APPLICATION FOR OBTAINING SUPPLY FROM WATER-WORKS

4.1 Application Forms — Every consumer requiring a new supply of water or any extension or alteration to the existing supply, shall apply in writing in the prescribed form given in Appendix A to the Authority.

4.2 Bulk Supply — In the case of large housing colonies or where new services are so situated that it will be necessary for the Authority to lay new mains or extend an existing main, full information about the proposed housing scheme shall be furnished as early as possible to the Authority. The Authority shall also be given information regarding the phased requirements of water supply with full justifications. Such information shall include site plans showing the layout of roads, footpaths, buildings and boundaries, and indicating thereon the finished line and level of the roads or footpaths and water supply lines and appurtenances.

4.3 Completion Certificate — On completion of the plumbing work for the water supply system, the licensed plumber shall give a completion certificate in the prescribed form (*see* Appendix B) to the Authority for getting the water connection from the mains.

5. DESIGN OF DISTRIBUTION SYSTEMS

5.1 General — Proper design of the water distributing systems in a building is necessary in order that the various fittings may function properly, and there is an adequate supply to meet the needs of the occupants of the building, both with regard to their domestic as well as flushing (of sanitary appliances) requirements.

NOTE — In general, a daily per capita water consumption of at least 200 litres may be used for most of the large towns and cities in India as design figure to meet domestic and flushing needs. However, for lower income group (LIG) and economically weaker section of the society the value of water supply may be reduced to 135 litres per capita per day.

5.1.1 There shall be at least a residual head of 0·018 N/mm^2 at the consumer tap.

NOTE — The residual head shall be taken at the highest/farthest outlet in the building.

5.2 Estimate of Demand Load — The demand load for water supply system in a building is not exactly determinable. The number of sanitary fittings varies not only for different classes of buildings but also in the same class of buildings depending upon the habits of the people. The minimum flow that will be satisfactory for any part of the premises will greatly depend upon the consumer, his standard of living, his professional needs, the size of the family and other ancilliary requirements, such as gardening.

5.2.1 The water supply requirements for residences and for buildings other than residences have been specified in IS : 1172-1983*. Whereas in the case of buildings other than residences, the number of persons normally required to occupy the same is usually known; in the case of residences, the number of persons occupying the premises varies largely from place to place. In many large cities, there is over-crowding in residential buildings. The requirements stipulated in this code are based upon an average family of 5 and a consumption of 1 000 litres per one dwelling unit. Thus if a building contains ten dwelling units, the requirement of water has been taken as 10 000 litres per day.

5.3 Rate of Flow — One of the important items that needs to be determined before the sizes of pipes and fittings for any part of the water piping system may be decided upon, is the rate of flow in the service pipe which, in turn depends upon the number of hours for which the supply is available at sufficiently high pressure. If the number of hours for which the supply is available is less, there will be large number of fittings in use simultaneously and the rate of flow will be correspondingly large.

5.3.1 The data required for determining the size of the communication and service pipe are (a) the maximum rate of discharge required, (b) the length of the pipe, (c) the head loss by friction in that length, and (d) the roughness of the interior surface of the pipe. In determining the head loss by friction, allowance shall be made for the elevation of the intake works in relation to the available pressure in the water main and of the losses in fittings, such as bends, stop-taps, meters [*see* IS : 2951 (Part 2)-1965†]and any obstructions to the flow of water. As the pipeline tends to accumulate internal incrustation in course of time, normally an average value for discharge co-efficient ' C ' is assumed.

5.4 Discharge Computation

5.4.1 Several formulae, diagrams and tables of calculated values are available for the measurement of flow through pipes. However, almost all studies based on the Reynolds number of flow, pipe roughness and flow

*Code of basic requirements for water supply, drainage and sanitation (*third revision*).

†Recommendation for estimation of flow of liquids in closed conduits : Part 2 Head loss in valves and fittings.

pattern (like turbulent, transient, laminar) yields accurate and mutually consistent results over a very large range of the flow compared to emperical formulae which have limitations regarding their range of applicability. Although non-dimensional parameters are used, these rational formulae based on Raynolds number need information on viscosity and the calculations are more involved. To obviate the involved calculations, a universal pipe friction diagram as prescribed in IS : 2951 (Part 1)-1965* and IS : 2951 (Part 2)-1965† may be followed.

5.4.2 Temperature of water and consequently its viscosity at a place is an extremely variable factor, depending upon season and time. Further, commercially available standard sizes of pipes are only to be used against the size arrived at by actual design. Therefore, several emperical formulae are used, even though they give less accurate results. The Hazen and William formula and the charts based on the same may be used without any risk of inaccuracy in view of the fact that the pipes normally to be used for water supply are of smaller sizes. Nomogram of Hazen and William's equation has been provided in Appendix C.

6. MATERIALS, FITTINGS AND APPLIANCES

6.1 Standards for Materials, Fittings and Appliances — All materials used in the construction of any of the works or any of the appliances described in this code shall conform to the relevant Indian Standards where available in so far as these standards are applicable. Where no such standards exist, the materials shall be of the quality and workmanship acceptable to the Authority, and shall be open to inspection at the manufacturer's works before despatch.

6.2 Materials for Pipes — Pipes may be of any of the following materials:

a) Cast iron, vertically cast or centrifugally (spun) cast (*see* IS : 1536-1976‡ and IS : 1537-1976§;

b) Steel (lined or coated with bitumen or bituminous composition and out-coated with cement concrete or mortar, where necessary) (*see* IS : 1916-1963‖ and IS : 3589-1966¶);

c) Reinforced concrete (*see* IS : 458-1971**);

*Recommendation for estimation of flow of liquids in closed conduits: Part 1 Head loss in straight pipes due to frictional resistance.

†Recommendation for estimation of flow of liquids in closed conduits: Part 2 Head loss in valves and fittings.

‡Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage (*second revision*).

§Specification for vertically cast iron pressure pipes water, for gas and sewage (*first revision*).

‖Specification for steel cylinder reinforced concrete pipes.

¶Specification for electrically welded steel pipes for water, gas and sewage (200 to 2000 mm nominal diameter).

**Specification for concrete pipes (with and without reinforcement) (*second revision*).

d) Prestressed concrete (*see* IS : 784-1978*);

e) Mild steel tubes or tubulars (galvanized) [*see* IS : 1239 (Part 1)-1979†];

f) Copper (*see* IS : 1545-1982‡);

g) Brass (*see* IS : 407-1981§);

h) Wrought iron;

j) Asbestos cement (*see* IS : 1626-1960‖ and IS : 1592-1980¶);

k) Lead [*see* IS : 404 (Part 1)-1977**];

m) Polyethylene (*see* IS : 3076-1968††) and (IS : 4984-1978‡‡); and

n) Unplasticized PVC pipes (*see* IS : 4985-1981§§).

6.2.1 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 piping is to be laid and the relative cost as compared with its useful life. The material shall be resistant to corrosion, both inside and outside or shall be suitably protected against corrosion.

6.2.2 Lead piping shall not be used to convey domestic water supply as most of the waters in India are plumbo solvent and are liable to cause lead poisoning. Lead piping may, however, be used for flushing and overflow pipes. It is liable to corrosion on contact with fresh cement mortar or concrete and shall be protected by wrapping with a protective material which will also permit movement due to expansion and contraction.

6.2.3 Copper piping may be used particularly in hot water installations provided water is not capable of dissolving an undue amount of copper.

6.2.4 Asbestos cement pipes may be used; however, adequate safeguards should be taken while laying backfilling (*see* IS : 6530-1972 ‖‖).

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*Specification for prestressed concrete pipes (including fittings) (*first revision*).

†Specification for mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fourth revision*).

‡Specification for solid-drawn copper alloy tubes for condensers and heat exchangers (*second revision*).

§Specification for brass tubes for general purposes (*third revision*).

‖Specification for asbestos cement building pipes, gutters and fittings (spigot and socket types).

¶Specification for asbestos cement pressure pipes (*second revision*).

**Specification for lead pipes: Part 1 For other than chemical purposes (*second revision*).

††Specification for low density polyethylene pipes for potable water supplies (*first revision*).

‡‡Specification for high density polyethylene pipes for potable water supplies, sewage and industrial effluents (*second revision*).

§§Specification for unplasticized PVC pipes for potable water supplies (*first revision*).

‖‖Code of practice for laying of asbestos cement pressure pipes.

6.2.5 Mild steel tubes used in plumbing system shall be of medium class conforming to IS : 1239 (Part 1)-1979*.

6.2.6 Polythene pipes and PVC pipes should not be laid on hot surfaces or in too close a proximity of hot water pipes. Care should also be taken to avoid locations where they are likely to be exposed to atmospheres charged with coal gas [*see* IS : 7634 (Part 2)-1975† and IS : 7634 (Part 3)-1975†].

7. CONVEYANCE AND DISTRIBUTION OF WATER WITHIN THE PREMISES

7.1 Basic Principles — Some of the details of plumbing which are considered necessary for properly designed, acceptably installed and adequately maintained plumbing systems are given in **7.2** to **7.12**. Though the details of construction may vary, the basic sanitary and safety principles are the same, and they merit serious study. Furthermore, in the event of any unforeseen situation not covered by specific provisions in this code, the principles enumerated may serve as useful guides.

7.2 Wholesome water supply provided for drinking and culinary purposes shall not be 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 containing impure water or water liable to contamination or of uncertain quality or water which has been used for any purpose. The provision of reflux or non-return valves or closed and sealed stop valves shall not be construed as a permissible substitute for complete absence of cross-connection.

7.3 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. Reflux or non-return valves shall not be relied upon to prevent such backflow.

7.4 Where a supply of wholesome water is required as an alternative or stand-by to a 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 of 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 150 mm. It is necessary to maintain a definite air gap in all appliances or taps used in water-closets.

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*Specification for mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fourth revision*).

†Code of practice for plastics pipe work for potable water supplies:
Part 2 Laying and jointing polyethylene (PE) pipes.
Part 3 Laying and jointing of unplasticized PVC pipes.

7.5 All pipe work shall be so designed, laid or fixed, and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage to property and the risk of contamination of the water conveyed.

7.6 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 would be likely to cause undue deterioration of the pipe, except as permitted in **7.7**.

7.6.1 Where lines have to be laid in close proximity to electric cables or in corrosive soils, adequate precautions should be taken to avoid electrical accidents and corrosion.

7.7 Where the laying of any pipe through corrosive soil or pervious 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 as approved by the Authority. Any existing piping or fitting laid or fixed, which does not comply with the above requirements, shall be removed immediately by the consumer and relaid by him in conformity with the above requirements and to the satisfaction of the Authority.

7.8 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.

7.9 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.

7.10 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 which is likely to materially diminish or alter the cross-section.

7.11 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.

7.12 No boiler for generating steam or closed boilers of any description or any machinery shall be supplied direct from a service or supply pipe. Every such boiler or machinery shall be supplied from a feed cistern.

8. GENERAL REQUIREMENTS FOR PIPE WORK

8.1 General — The following general principles shall apply in the layout and planning of the pipe work.

8.1.1 Any pipe going underground should have adequate cover.

8.1.2 Every communication pipe shall have inserted in it, in an accessible position, a stop cock of the prescribed kind, having an area of waterway at least equal to the internal sectional area of the communication pipe. It should be fixed with a cover or guard box so as to be accessible to the Authority.

8.1.3 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 (*see* IS : 781-1977*). Other stop valves in the service line may be of the gate type (*see* IS : 778-1980†).

8.1.4 In flats and tenements supplied by a common service pipe, a stop tap shall be fixed to control the branch to each separately occupied part. 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.

8.1.5 Water for drinking or for culinary purposes shall not, as far as possible, pass through any cistern, and, therefore, direct taps supplying water for these purposes shall be on branch pipes connected directly to the service pipe.

8.1.6 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.

8.1.7 Service pipes thall 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.

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*Specification for cast copper alloy screw-down bib taps and stop valves for water services (*second revision*).

†Specification for copper alloy gate, globe and check valves for water works purposes (*third revision*).

8.1.8 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 and shall be housed in sound-proof cabins. The planning of the building shall allow for such arrangements. 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.

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

8.1.10 Piping shall be so located that it is not unduly exposed to accidental damage, and shall be fixed in such positions as to facilitate cleaning and avoid accumulations of dirt.

8.1.11 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, there shall be enough space 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.

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

8.1.13 In buildings where it is desirable to have some means of identifying the use of the various pipes, they shall be painted in accordance with Appendix D (*see also* IS : 2379-1963*).

8.2 Prohibited Connections — A service pipe shall not be connected into any distribution pipe; such connection may permit the backflow of water from a cistern into the service pipe, in certain circumstances, with consequent danger of contamination and depletion of storage capacity. It might also result in pipes and fittings being subjected to a pressure higher than that for which they are designed, and in flooding from overflowing cisterns.

*Colour code for the identification of pipelines.

8.2.1 No pipe for conveyance or in connection with water supplied by the Authority shall communicate with any other receptacle used or capable of being used for the conveyance other than water supplied by the Authority.

8.2.2 Where storage tanks are provided no person shall connect or be permitted to connect any service pipe with any distributing pipe.

8.2.3 No service pipe shall be connected to any water-closet or urinal. All such supplies shall be from flushing cisterns which shall be supplied from storage tank (*see* **12.3**).

8.2.4 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. This shall also apply to every gas producer, gas engine, compressor, oil engine, cooling jacket or other apparatus in or by which water supplied by the Authority may be heated.

9. LAYING OF MAINS AND PIPES ON SITE

9.1 Excavation and Refilling — The bottoms of the trench excavations shall be carefully prepared so that the barrels of the pipes, when laid, are well bedded for their whole length on a firm surface and are true to line and gradient. The width of the excavation shall be sufficient to allow the pipes to be properly laid and jointed, joints holes being made where necessary.

9.1.1 In the refilling of the trenches, the pipes shall be surrounded with fine selected material, well rammed so as to resist subsequent movement of the pipes. No stones shall be in contact with the pipes, and when the excavation is in rock, the bottom shall be cut deep enough to permit the pipes to be bedded on a layer of fine selected material, or (especially where there is a steep gradient) on a layer of concrete.

9.2 Preparing Pipes for Laying Underground — The pipes shall be carefully cleared of all foreign matter before being laid. They shall be thoroughly brushed out internally with a well-fitting hard brush, and after laying the open end shall be temporarily plugged to prevent ingress of water, soil, etc, precaution shall be taken to prevent floatation of the plugged pipes, should the trench become flooded.

9.2.1 Any coating, sheathing or wrapping of the pipes shall be examined for damage and repaired, where necessary, and shall also be made continuous over the joints.

9.2.2 Concrete Pipes and Cast Iron Pipes — Pipes should be laid in accordance with the requirements given in IS : 783-1959* and IS : 3114-1965†, respectively.

*Code of practice for laying of concrete pipes.
†Code of practice for laying of cast iron pipes.

9.3 Laying Underground Mains — Where the trench is on a slope, pipe laying shall proceed in an 'uphill' direction to facilitate joint making.

9.3.1 Except in the case of small pipes under low pressure, thrust blocks of concrete shall be formed at all bends to transmit the hydraulic thrust on to undisturbed ground and to spread it over a sufficient area. Where the hydraulic thrust is in an upward direction, anchor-blocks of sufficient weight shall be provided to which the pipes shall be secured with steel straps. The displacing forces in the mains due to end and radial thrust on bends are given in Appendix E.

9.4 Surface Boxes — Iron surface boxes shall be provided to give access to valves (*see* IS : 3950-1979*) and hydrants, and shall be supported on concrete or brickwork which shall not be allowed to rest on the pipes and transmit traffic loads to them, allowance being made for settlement. Vertical iron guard pipes may be provided to enclose the spindles of sluice valves. It is not generally necessary entirely to enclose the valves and hydrants in brick or concrete chambers, but if the latter are provided they shall be of sufficient dimensions to permit repairs being carried out to the fittings.

9.4.1 If the surface box, mounted on a guard pipe, is fixed over the underground stop valve merely to give access for operating the latter, the limited space provided by this arrangement will not permit the repacking of the stop valves gland or other repairs to be carried out with excavation. The guard pipe may be supported on bricks, and should not rest on the supply pipe.

9.5 Meters — If the service pipe is to be metered, the meter may be provided and fixed by the Authority. Private meter of approved type may be permitted to be used subject to such conditions as the Authority may prescribe. Meters of domestic type shall conform to the requirements of IS : 779-1978†. Meters of bulk type shall conform to the requirements of IS : 2373-1981‡. The meter shall be installed in accordance with IS : 2401-1973§. The meter shall be fitted beyond the stopcock with unions to facilitate the necessary periodic changing of the meter. If fitted in an exposed position outside the building, the meter shall be housed in water meter boxes conforming to IS : 2104-1981‖.

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*Specification for surface boxes for sluice valves (*first revision*).
†Specification for water meters (domestic type) (*fifth revision*).
‡Specification for water meters (bulk type) (*third revision*).
§Code of practice for selection, installation and maintenance of domestic water meters (*first revision*).
‖Specification for water meter boxes (domestic type) (*first revision*).

9.6 Laying Service Pipes — Service pipes of less than 50 mm bore may be connected to mains by means of right-angled screw-down ferrule of non-ferrous metal conforming to IS : 2692-1978*, but the ferrule itself shall not be more than 25 mm bore. Ferrule of 20 mm bore and above shall not be used in mains of less than 100 mm bore. The main is drilled and tapped and the ferrule screwed in. In case of large-sized trunk mains, this may be done by a tapping under pressure machine, which will obviate any interference with the use of the main.

9.6.1 Service pipes of 50 mm bore and upward shall be connected to special T-branches which have to be inserted into the line of the main. Special branch pipes shall also be used for service pipes of less than 50 mm bore where the bore of the main is not greater than thrice that of the service pipe.

9.6.2 In the process of installing or repairing any part of a plumbing installation, the finished floors, walls, ceilings, tile-work or any other part of the building or premises, which shall be changed or replaced, shall be left in a safe structural condition in accordance with the requirements of the relevant codes and any building bye-laws approved by the Authority. All exterior openings provided for the passage of pipe shall be properly sealed.

9.6.3 Precautions against contamination of the mains shall be taken when making a connection, and where any risk exists, the main shall be subsequently disinfected (*see* **13.1** and **13.2**). The underground water service pipe and the building sewer or drain shall be kept at a sufficient distance apart to the satisfaction of the Authority so as to prevent contamination of water. Water service pipes or any underground water pipes shall not be run or laid in the same trench as the building sewer or drainage pipe. Where this is unavoidable, the following conditions shall be fulfilled :

a) The bottom of the water service pipe, at all points, shall be at least 30 cm above the top of the sewer line at its highest point.

b) The water service pipe shall be placed on a solid shelf excavated at one side of the common trench.

c) The number of joints in the service pipe shall be kept to a minimum.

d) The materials and joints of sewer and water service pipe shall be installed in such a manner and shall possess the necessary strength and durability so as to prevent the escape of solids, liquids, and gases therefrom due to temperature changes, settlement, vibrations and superimposed loads.

*Specification for ferrules for water services (*first revision*).

9.6.4 The service pipe shall pass into or beneath the building at a depth below the external ground level of not less than 0·75 m (provided the foundation is deeper than 0·75 m) and at its point of entry through the structure should be accommodated in a sleeve which should have previously been solidly built in. The space between the pipe and the sleeve shall be filled with bituminous or other suitable material for a minimum length of 15 cm at both ends.

9.6.5 Care shall be taken to ensure that before the pipeline is charged all piping and fittings are clean internally, and free from particles of sand or soil, metal fittings, chips, etc, which besides causing obstructions may lead to failure by corrosion.

9.7 Securing and Supporting of Pipes — Lead piping of not more than 25 mm bore, in vertical runs, may be secured direct to brick walls (other than external walls) by iron pipe clamps driven into the wall joints, or may be secured to wooden battens or other wood work by iron or brass clips with ears for screw fixing, the clamps or clips or holder bats being at not more than 90 cm intervals. Damage to the piping by the clamps shall be prevented by the insertion of small lead pads.

9.7.1 Copper piping shall be secured by copper or copper-alloy clips direct to wood work, or by similar bracket-clips built-in to walls or screwed to plugs.

9.7.2 Wrought iron and steel piping shall be secured in a manner similar to that used for copper piping, except that the clips shall be of iron or steel.

9.7.3 Plastic pipes should be secured and suppored in accordance with the recommendations given in IS : 7634 (Part 2)-1975* and IS : 7634 (Part 3)-1975*.

9.8 Pipes Laid Through Ducts, Chases, Notches or Holes — Ducts or chases in walls for piping shall be provided during the building of the walls. If they are cut in existing walls, they shall be finished sufficiently smooth and large enough for fixing the piping. In the case of lead pipes, the joints may be wiped outside the duct, and the pipes eased back into the duct after jointing.

9.8.1 Wherever possible back-boards shall be provided in chases for fixing the piping; otherwise lead piping shall be protected from contact with lime or cement by building paper or felt. Where covers are provided to chases, they shall be fixed with screws for easy removal.

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*Code of practice for plastics pipe work for potable water supplies;
Part 2 Laying and jointing polyethylene (PE) pipes.
Part 3 Laying and jointing of unplasticized PVC pipes.

9.8.2 Piping laid in notches or holes shall not be subjected to external pressure, and shall be free to expand and contract without noise due to friction on the wood.

9.9 Lagging for Pipes — Where lagged piping outside buildings is attached to walls, it shall be entirely covered alround with waterproof insulating material and shall not be in direct contact with the wall. Where it passes through a wall, whether into a building or not, the lagging shall be continued along the pipe throughout the thickness of the wall, and where it emerges from the ground, the lagging shall be continued into the ground until the depth of 0·75 m is reached.

9.9.1 Lagged piping connected to cisterns, enclosed by insulating casing shall pass at right angles through the casing and be lagged independently of the casing if the piping is sandwiched between the cistern and the casing, it will, probably, not be sufficiently insulated.

9.9.2 The minimum thickness of insulating material for lagging hot-water piping inside buildings shall be 12 mm in the case of glass in fibre form, compressed felt, and felted slag or mineral wool and 20 mm in the case of asbestos, 85 percent magnesia, compressed backed cork and granulated cork (raw or baked).

9.9.3 All lagging exposed to moist conditions shall be waterproof or covered with a waterproof wrapping.

9.10 Spacing of Fixings for Internal Piping — Fixing on internal pipes shall be spaced at regular intervals as given in Appendix F.

10. JOINTING OF PIPES

10.1 Cast Iron Pipes — The spigot and socket joints of cast iron pipes are usually caulked with lead. The common form of joint is made by first caulking in spun yarn, then filling the space left in the joint by running in molten lead, taking care that no dross enters the joint, and then thoroughly caulking the lead. The spun yarn shall be clean and sterile and the lead shall conform to IS : 782-1978*. The lead need not extend into the joint further than the back of the groove formed in the socket.

10.1.1 The spun yarn is used to centre the spigot in the socket, to prevent the flow of molten lead into the bore of the pipe, to reduce the amount of lead required to complete the joint and to make the joint watertight. Spun yarn may become infected with bacteria, which may contaminate the water and, therefore, shall be effectively sterilized before use by being exposed to the vapours of 40 percent formaldehyde in an air-tight chamber for not less than 3 hours. Alternatively, proprietary brands

*Specification for caulking lead (*third revision*).

of sterilized spun yarn may be used. Threaded lead or lead wire or strip may be used instead of spun yarn, thus producing a solid lead joint. Lead covered yarn may also be used which does not have the disadvantages of plain yarn. Cold lead may be caulked into the joint space first followed by spun yarn, and the joint then completed with cold or molten lead.

10.1.1.1 Rubber ring joints may also be suitable wherever there is a provision for them in the spigot made by the manufacturer.

10.1.2 Caulking may be done with pneumatic tools or with a hand hammer weighing not less than 2 kg. When working with lead wool, it is very important to use caulking tools of appropriate thickness to fill the joint space, and to thoroughly consolidate the material from the back to the front of the socket. Lead run joints shall be preferably finished 3 mm behind the socket face.

NOTE — Attention is also drawn to IS : 3114-1965* for jointing of cast iron pipes, quantity of lead and spun iron for different sizes of pipes, etc.

10.1.3 Cast iron pipes may also be jointed by means of flanges of cast iron and steel pipes with flanges welded-on.

10.1.4 Flanged joints shall be made with jointing rings of good quality, smooth, hard, compressed fibre board (not less than 1·5 mm thick) and of such width as to fit inside the circle of bolts. The rings shall be smeared thinly with graphite paste. Alternatively, the jointing rings may be of rubber or rubber insertion or gutta-percha, or may be corrugated non-corrosive alloy together with a suitable jointing paste. The nuts shall be carefully tightened, in opposite pairs, until the joint ring is only just sufficiently compressed between the flanges to ensure watertightness of the joint under the desired water pressure.

10.1.5 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.

10.1.6 For joints in small diameter wrought iron or steel piping and cast iron piping, copper-alloy screwed unions or ferrules shall be used and for large diameters, the joints shall be made by flanged connecting pieces.

10.2 Welded Steel Pipes — Plain-ended steel piping may be jointed by welding except where the piping is provided with a lining which would be damaged by heat (*see* IS : 5822-1970†).

10.3 Wrought Iron and Steel Screwed Pipes — Screwed wrought iron or steel piping is jointed with screwed and socketed joints, using screwing

*Code of practice for laying of cast iron pipes.
†Code of practice for laying of welded steel pipes for water supply.

fittings of wrought iron, steel or malleable cast iron. Care shall be taken to remove any burr from the ends of pipes after screwing. A jointing compound, which may be one of the many proprietary makes, may be used according to the maker's instructions together with a grummet of a few strands of fine yarn, but compounds containing red lead shall not be used because of the danger of contamination of the water. Any threads exposed after jointing shall be painted, or in the case of underground piping, thickly coated with bituminous or other suitable composition to prevent corrosion.

10.3.1 Screwed wrought iron or steel piping may also be jointed with screwed flanges of wrought iron, steel or cast iron.

10.4 Asbestos Cement Pipes — Asbestos cement pipes are jointed with flexible joints supplied by the pipe makers.

10.5 Copper Pipes — Screwed copper piping shall be jointed with screwed copper-alloy fittings. The screw threads of the pipe shall be cleaned out and the joint made by screwing the fittings on after first treating the threads with raw linseed oil or other suitable jointing compound. Alternatively, the screw threads of the pipe and the fittings may be tinned, and the joint heated to the melting point of the solder when being screwed.

10.5.1 Plain copper piping shall be jointed with compression (manipulative or non-manipulative) or with capillary joints, in each case using copper-alloy fittings, or by welding. Only manipulative compression joints, that is, joints in which the pipe ends are flanged, belled or swaged, are suitable for use with fully annealed copper piping.

10.5.2 In the case of the capillary joint, the pipe end and the interior of the socket of the fitting shall be cleaned with steel wool, fluxed, and fitted together, and the joint then heated to just above the melting point of the solder, which is either provided in the fitting or is touched into the joint with a solder stick, and which then flows by capillarity to fill the joint space. If the pipe is of fully annealed copper, its ends shall be made truly round before jointing.

10.5.3 It is important that the correct size of fittings is used to suit the nominal size of the pipe.

10.5.4 Copper piping may be autogenous welded or bronze welded, the latter giving the stronger joint. The piping may be jointed directly or by the use of weldable copper or copper alloy fittings. The welding may be done by an oxy-acetylene blow pipe, using filler rod of copper or bronze and a suitable flux. Bronze rod shall be genuine bronze which is not likely to fall by dezincification. Copper piping may be welded to cast brass fittings by this method. Copper to be welded shall be ' deoxidized copper ' and

not ' tough pitch copper '. Welding shall be done by skilled craftsman only.

10.5.5 Copper piping of small diameter shall be jointed to cast iron, wrought iron, or steel piping by the use of copper-alloy screwed unions or ferrules. For screwed copper piping of diameter, larger than about 40 mm, a flanged joint shall be used, the copper pipe shall have a copper alloy flange screwed, brazed or welded on, and this shall be jointed to the iron or steel flange by alloy bolts or nuts.

10.6 Lead Pipes — Lead and lead alloy piping shall be jointed with wiped solder joints or by other suitable methods.

10.6.1 Lead and lead alloy piping shall be jointed to cast iron, wrought iron, steel or copper piping by the use of copper alloy screwed unions or ferrules.

10.7 Concrete Pipes — Concrete pipes shall be jointed in accordance with the recommendations given in IS : 783-1959*.

10.8 Polyethylene and Unplasticized PVC Pipes — These pipes shall be jointed in accordance with the recommendations given in IS : 7634 (Part 2)-1975† and IS : 7634 (Part 3)-1975†, respectively.

11. STORAGE OF WATER

11.1 Purposes for Providing Storage — In a building, provision is required to be made for storage of water for one or more of the following reasons :

a) To provide against interruptions of the supply caused by repairs to mains, etc;

b) To reduce the maximum rate of demand on the mains;

c) To tide over periods of intermittent supply; and

d) To maintain a storage for the fire fighting requirement of the building.

11.2 Materials for Construction of Storage Tanks — They shall be constructed of iron, wrought iron or mild steel plates or sheets and shall be made watertight without the use of putty. The materials used shall be of sufficient strength and thickness. Reinforced cement concrete tank or tanks made of any other suitable building material may be allowed as storage tanks.

11.2.1 Tanks made of galvanized steel sheets may be of welded, riveted or pressed construction. The pressed-steel tanks are normally 120 cm

*Code of practice for laying of concrete pipes.

†Code of practice for plastics pipe work for potable water supplies:
Part 2 Laying and jointing polyethylene (PE) pipes.
Part 3 Laying and jointing of unplasticized PVC pipes.

square, the thickness of sheet varying according to the depth of the tank. Tanks with external flanges are most convenient except where space is limited or where it is required to erect them direct on to a flat roof or floor. Where special sizes of tanks are necessary, these are provided for by the use of the special making-up plates allowing considerable variation in size. If of iron or steel, the metal shall be galvanized or coated internally with bituminous composition or other suitable material of a kind which does not impart a taste or odour to the water, especially if this has been chlorinated, and externally with a good quality anti-corrosive weather-resisting paint. Lead lined tanks shall not be used. Rectangular pressed steel tanks shall conform to the requirements given in IS : 804-1967*.

11.3 Storage Tanks and Ball Valves — Every storage tank shall be of the prescribed kind and shall at all times be made and at all times be maintained watertight and shall be properly covered with a closed fitting dust, light and mosquito-proof lid fitted with a lock and key and shall be provided with a sound and suitable ball valve conforming to IS : 1703-1977† securely fixed to the tank and set in such a position that the body of the ball valve cannot become submerged when the cistern is full up to the water line. Every valve shall be so adjusted as to limit the level of the water in the cistern to 25 mm below the lip of the warning or overflow pipe. A stop valve conforming to IS : 781-1977‡ shall be provided as near the tank as practicable on every outlet pipe from a storage tank, excepting on the warning pipe.

11.4 Warning Pipes of Storage Tanks — Every tank shall be provided with an efficient mosquito-proof warning pipe. The outlet of the warning pipe shall be in such a position outside the building as will allow the discharge of water from such warning pipe being readily seen. The position of the warning pipe shall not be changed except with the permission of the Authority. The outlet of the warning pipe shall be not less than 60 cm above any drain, sink or gully over which the same may be fixed. No overflow pipe shall be allowed to be connected directly to any drain or sewer, nor shall it discharge on to any street. All warning pipe unions shall be not less than 20 mm in bore so fixed that the bottom of the pipe will be 25 mm above the top water level. In every storage vessel, the water line shall be set below the overflowing level of the warning pipe, or of the overflow pipe if there is no warning pipe, at a distance of not less than 25 mm or of not less than the internal diameter of the pipe, whichever is greater.

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*Specification for ractangular pressed steel tanks (*first revision*).

†Specification for ball valves (horizontal plunger type) including floats for water supply purposes (*second revision*).

‡Specification for cast copper alloy screw-down bib taps and stop valves for water services (*second revision*).

11.5 Provision of Stop Valves — Storage tanks shall be provided with a stop valve or stop tap at every outlet other than overflow pipes, so that there shall be no necessity to empty the vessel to enable repairs to be carried out to the downtake pipes, fittings, etc. Such valves or taps shall preferably be full-way gate valves so as not to impose any undue obstruction of the flow of the water. A stop valves shall be provided on the inlet connection also to facilitate stopping of flow temporarily in the event of improper functioning of ball valve or for cleaning of storage tank.

11.6 Position of Storage of Tanks — Every storage tank used or fixed in connection with the water supplied by the Authority shall be easily accessible and placed in such position as to admit of thorough inspection and cleaning, and if placed within the house or building, it shall have a clear space of not less than 60 cm between the top of the cistern and ceiling, rafter or roof. If the capacity of tank is bigger than 500 litres, a greater clear space shall be provided.

11.6.1 In cases where overhead storage tanks are supported on roof slab of the building, careful inspection and calculation shall be carried out to ascertain whether the structure of the building is of sufficient strength to take the increased load. The tanks shall be preferably supported on bearers so as to distribute the load. The weight of the tank, and its contents of water shall be calculated and taken into account in the design of bearers and supports. Where bearers are used as supports, the height shall not be less than 200 mm clear space.

11.7 Grouping of Storage Tanks — If the storage required is more than 5 000 l, it is advantageous to arrange it in a series of tanks or in compartments so inter-connected that each can be isolated for cleaning and inspection without interfering with the supply of water. This can conveniently be done by the use of a header pipe to which each tank/compartment is connected and from which the distributing pipes branch off, each branch into and out of the header pipe being provided with a stop valve. Each tank/compartment shall have its own float-operated valve and overflow pipe, and a draining valve to facilitate cleaning out. It is often convenient, even in small installations, to provide two tanks coupled together in this way. In large storage tanks, the outlet shall be at the end opposite the inlet, to avoid stagnation of the water. In high rise buildings, storage tanks may be placed in different tiers to ensure more equitable pressure distribution of water.

11.8 Proivision of Outlets — The outlet pipe shall be fixed 50 to 75 mm above the bottom of the tank and provided preferably with copper gauge strainers. The wash-out or draining pipe shall be made flush at the bottom of the tank at its lowest point. The floor of the tank shall be erected so as to give a slight fall to the wash-out pipe for cleaning purposes.

11.9 Underground Storage Tanks — When buried or underground storage tanks are used for the storage and reception of water for domestic purposes, the following requirements shall be complied with:

a) The tank shall project at least 30 cm above the highest flood level. Where this is not possible the manhole cover shall be raised 30 cm above the highest flood level of the locality or ground level whichever is higher.

b) The design of the tank shall be such as to provide for the draining of the tank when necessary and water shall not be allowed to collect round about the tank.

c) The tank shall be perfectly watertight.

d) The inner surface of the tank shall be rendered smooth as far as possible.

e) The top of the tank shall be so levelled as to prevent accumulation of water thereon.

f) The tank shall have a complete cement concrete cover leaving a manhole opening provided with a properly fitting mosquito-proof hinged cast iron cover fitted with a leakproof cast iron frame. Where tank is of a large size, adequate number of manholes shall be provided.

g) No gap shall be allowed to remain round the suction pipe and arrangement shall be provided for proper discharge of spill water from the electric pump by connecting the pump cabin to the water drain, or by providing a small hole which will enable the water to flow out.

h) The overflow pipes or vent shafts, if provided, shall have a wiregauge cover of 1·5 mm mesh properly screwed tightly to the opening.

11.10 Jointing of Pipes to Storage Tanks — For jointing steel pipe to a storage tank, the end of the pipe shall be threaded, passed through a hole in the tank and secured by backnuts both inside and outside. The pipe end shall be flush with the face of the inside backnut to obviate corrosion of the pipe threads. For joining copper pipe to steel or copper tank a connector of non-ferrous metal shall be used having a shoulder to bear on the outside of the tank and secured by a backnut inside.

11.11 Storage Capacities — The quantity of water to be stored shall be calculated taking into account the following factors:

a) Hours of supply at sufficiently high pressure to fill up the overhead storage tanks;

b) Frequency of replenishment of overhead tanks, during the 24 hours;

c) Rate and regularity of supply; and

d) Consequences of exhausting storage particularly in case of public buildings like hospitals.

If the water supply is intermittent and the hours of supply are irregular, it is desirable to have a minimum storage of half-a-day's supply for overhead tanks.

11.11.1 The particulars of water supply requirements of residential buildings and of buildings other than residences are given under **3.1** and **3.2** of IS : 1172-1983*. It has been stipulated that, where there is full-flushing system a minimum of 200 litres per head per day shall be assured out of which about 45 litres per head per day may be taken as flushing requirements and the remaining 155 litres for other domestic purposes.

11.11.2 When a single supply is provided it is not necessary for health reasons to have separate storage for flushing and sanitary purposes. In such cases when only one storage tank has been provided, tapping of water may be done at two different levels so that a part of the water will be exclusively available for flushing purposes.

11.12 Pumping of Water

11.12.1 In case of multi-storey buildings where the height of the fitting or storage tank is such as will not permit of their being fed with the available pressures in the water main, pumping is necessary. The house service pumps are usually of the centrifugal type driven by electric motors, where electric power is available.

11.12.2 In cases where pumping is necessary, storage tank shall be provided either at the ground level or partially buried underground, in which case it shall conform to the requirements given under **11.9** for underground storage tanks. The storage tank should have a minimum capacity of 50 percent of the overhead storage tank. The advantage of the storage tank is that it can be fed continuously during low pressure hours and, therefore, the pump can be worked at any time of the day and the overhead storage may be replenished continuously. The pump also works at a steady head and there is no chance of overloading.

12. WATER FITTINGS AND APPLIANCES

12.1 Bath, Lavatory and Mixing Taps — Bath, lavatory and mixing taps shall generally comply with the requirements specified for bib taps in

*Code of basic requirements for water supply, drainage and sanitation (*third revision*).

IS : 781-1977*. Combination taps, mixing valves (*see* IS : 1701-1960†) or blenders, for mixing hot and cold water and discharging the mixture through a single outlet shall be fed with both hot water and cold water under pressure only from cisterns at the same level or from the same cistern; the *cold water should not be supplied directly from a service pipe as otherwise, there is danger of scalding* if the pressure in the service pipe unexpectedly fails. To ensure satisfactory results from such fittings, it is also desirable that the feed pipe does not also feed other fittings.

12.2 Position Where Self-closing Taps are Permissible — Self-closing taps and other special fittings of makes approved by the Authority may be permitted to be used on direct pipes and distributing pipes from tanks. Self-closing taps shall be of non-concussion type and shall comply with IS : 1711-1970‡.

12.3 Water-Closet Flushing Cistern — All water closets and urinals shall be supplied with water from proper flushing cistern or from other equally efficient and suitable waste preventing apparatus. Flushing cisterns having 10 litres discharge capacity and discharging at an average rate of 5 l/s are considered suitable for wash-down water closets and squatting pans IS : 2556 (Part 2)-1981§ and IS : 2556 (Part 3)-1981‖.

12.4 Water-Closet Flush Valves — No person shall fix, fit or use upon any premises any flush valves, or similar apparatus through which water supplied by the Authority is intended to pass unless previous permission of the Authority is obtained. Such flush valves or flushing apparatus shall be of the self-closing type and shall be allowed on water-closets only. The design of the flushing valve or flushing apparatus of similar type shall be such that no single flush shall exceed 15 l. All flush valves shall be fitted with regulating stop cock or valve in addition to the regulating screw on the top of the valve which shall be sealed by an authorized officer. Every flush valve shall be provided with a suitable and approved type of stop cock on the upstream side of the flush valve.

12.5 Urinal Flushing Cistern — Every urinal flushing cistern, in which water supplied by the Authority is used, shall have an efficient waste preventing apparatus so constructed as to prevent discharge of more than 5 litres of water to each stall, basin or compartment at each flush (*see* IS : 2326-1970¶).

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*Specification for cast copper alloy screw-down bib taps and stop valves for water services (*second revision*).

†Specification for mixing valves for ablutionary and domestic purposes.

‡Specification for self closing taps (*first revision*).

§Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down water-closets (*third revision*).

‖Specification for vitreous sanitary appliances (vitreous china): Part 3 Specific requirements of squatting pans (*third revision*).

¶Specification for automatic flushing cisterns for urinals (*first revision*).

12.6 Use of Automatic Flushing Cisterns — Flushing apparatus capable of discharging automatically (*see* IS : 2326-1970*) may be allowed to be fitted on water-closets.

12.7 Use of Ball Valves — Ball valves shall be of one of the classes, namely high pressure or low pressure and shall conform to the requirements specified in IS : 1703-1977†.

12.8 Silencing Pipes of Ball Valves — A silencing pipe may be fitted to a ball valve when permitted by the Authority and in such cases anti-siphonage holes shall be provided in the pipe or in the body of valves and these holes shall be above the overflow level.

13. CLEANING AND DISINFECTION OF THE SUPPLY SYSTEM

13.1 All water mains, communication pipes, service and distribution pipes used for water for domestic purposes should be thoroughly and efficiently disinfected before being taken into use and also after every major repair The method of disinfection shall be subject to the approval of the Authority. They shall also be periodically cleaned at intervals, depending upon the quality of water and the treatment it receives before use. It is, however, desirable that the communication pipes and the storage cisterns are thoroughly cleaned at least once every year in order to remove any suspended impurities that may have settled in the pipes or the tanks.

13.2 Disinfection of Storage Tanks and Downtake Distribution Pipes — Storage tanks and downtake distribution pipes shall be disinfected as follows:

The storage tanks and pipes shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while the tanks are being filled, to ensure thorough mixing. Sufficient chemical shall be used to give the water a dose of 50 parts of chlorine to one million parts of water. If ordinary bleaching powder is used, the proportion will be 150 g of powder to 1 000 ℓ of water. The powder shall be mixed with water to a creamy consistency before being added to the water in the storage tank. If a proprietary brand of chemical is used, the proportions shall be as specified by the makers. When the storage tank is full, the supply shall be stopped and all the taps on the distributing pipes opened successively, working progressively away from the storage tank. Each tap shall be closed when the water discharge begins to smell of chlorine. The storage tank shall then be topped up with water from the supply pipe and with more disinfecting chemical in the recommended

*Specification for automatic flushing cisterns for unrinals (*first revision*).

†Specification for ball valves (horizontal plunger type) including floats for water supply purposes (*second revision*).

proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purposes.

14. INSPECTION AND TESTING

14.1 Testing of Mains Before Commencing Work — All pipes, fittings and appliances shall be inspected, before delivery at the site to see whether they bear, where appropriate, the certification mark of the Indian Standards Institution or the mark of the testing station of the Authority. All pipes and fittings shall be inspected and tested by the manufacturers at their factory and shall comply with the requirements of this Code. They shall be tested hydraulically under a pressure equal to twice the maximum permissible working pressure or under such greater pressure as may be specified. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective item shall be clearly marked as rejected and forthwith removed from the site.

14.2 Testing of Mains After Laying — After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25-mm inlet with a stopcock allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 0·5 N/mm^2 or the maximum working pressure plus 50 percent, whichever is the greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of large diameter, by a power-driven test pump, provided that the pump is not left unattended. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The test pump having been stopped, the test pressure shall maintain itself without measureable loss for at least half an hour. The mains shall be tested in sections as the work of laying proceeds; it is an advantage to have the joints exposed for inspection during the testing. The open end of the main may be temporarily closed for testing under moderate pressure by fitting a watertight expanding plug of which several types are available. The end of the main and the plug shall be secured by struts or otherwise, to resist the end thrust of the water pressure in the mains.

14.2.1 If the section of the main tested terminates with a sluice valve, the wedge of the valve shall not be used to retain the water. Instead the valve shall be temporarily fitted with a blank flange, or in the case of a socketed valve, with a plug, and the wedge placed in the open position while testing. End support shall be given as in **14.2.**

14.3 Testing of Service Pipes and Fittings — When the service line is complete, it shall be slowly and carefully charged with water, allowing all

air to escape and avoiding all shock or water hammer. The service shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipe shall be absolutely watertight. All piping, fittings and appliances shall be checked over for satisfactory support, and protection from damage, corrosion and frost. Because of the possibility of damage in transit, cisterns shall be re-tested for water tightness on arrival on the site, before fixing.

15. MAINTENANCE

15.1 Storage tanks shall be regularly inspected and shall be cleaned out if necessary. Tanks showing signs of corrosion shall be emptied, thoroughly wire-brushed to remove loose material (but not scrapped), cleaned and coated with anti-corrosive paint of inert composition not liable to impart taste or odour or otherwise contaminate the water. Before cleaning the cistern, the outlet shall be plugged to prevent debris entering the pipe. The tank shall be examined for corrosion and water tightness after cleaning.

15.2 Record drawings showing pipe layout and valve positions shall be kept up to date and inspection undertaken to ensure that any maintenance work has not introduced cross-connections or any other undesirable feature.

15.3 Any temporary attachment fixed to a tap or outlet shall never be left in such a position that back-siphonage of polluted water into the supply system may occur.

15.4 All valves shall be periodically operated to maintain free movement of the working parts.

15.5 All taps and ball valves shall be inspected for water tightness; glands shall be made good; washers shall be replaced and machanism of spring operated taps and ball valves shall be repaired where required.

15.6 All overflow pipes shall be examined and kept free from obstructions.

APPENDIX A

(*Clause* 4.1)

APPLICATION FORM FOR TEMPORARY/PERMANENT SUPPLY OF WATER/FOR ADDITIONS AND/OR ALTERATIONS TO THE SUPPLY OF WATER

I/we.....hereby make application to the* .....for the temporary/permanent supply of water/for the following additions and/or alterations to the water supply requirements and water fittings at the premises, ... Ward No. .....Street No. .....Road/Street known as..... .....for the purpose described below and agree to pay such charges as the Authority may from time to time be entitled to make and to conform to all their bye-laws and regulations .....licenced plumber, has been instructed by me/us to carry out the plumbing work.

Description of the premises.....

Address.....

Purpose for which water is required.....

.....

The connection/connections taken by me/us for temporary use shall not be used by me/us for permanent supply unless such a permission is granted to me/us in writing by the Authority.

I/we hereby undertake to give the*..... due notice of any additions or alterations to the above mentioned supply which I/we may desire to make.

My/our requirements of water supply are as under:

a) I/we request that one connection be granted for the whole of the premises.

*Insert here the name of the Authority.

b) I/we request that separate connections may be granted for each floor and I/we undertake to pay the cost of the separate connections.

c) My/our probable requirements for trade purposes are..... litres per day, and for domestic purposes are..... litres per day.

d) Our existing supply is.....litres per day.
Our additional requirements of supply is..... litres per day.

e) The details as regards proposed additions and alterations in fittings are as follows :

.....

.....

Signature of the licensed plumber

Name and address of the licensed plumber.....

.....

Date.....

Signature(s) of the applicant(s)

Name and address of the applicant(s).....

.....

Date.....

NOTE 1 — Please strike out whichever is not applicable.

NOTE 2 — The application should be signed by the owner of the premises or his constituted attorney and shall be countersigned by the licensed plumber.

APPENDIX B

(*Clause* 4.3)

FORM FOR LICENSED PLUMBER'S COMPLETION CERTIFICATE

Certified that I/we have completed the plumbing work of water connection No.....for the premises as detailed below. This may be inspected and connection given:

Ward No.	Road/Street
Locality	
Block No.	House No.
Existing water connection No. (if any)	
Owned by	
Owner's address	
Applicant's name	Son of
Address	
Situation	
Size of main on	street
Where main is situated	
Size of service pipe	
Size of ferrule	
No. of taps	No. of closets
No. of other fittings and appliances	
Road cutting and repairing fee	
Paid (Receipt enclosed)	

Dated.....

Signature of licensed plumber.....

Name and address of the licensed plumber .....

.....

The Authorities report :

Certified that the communication and distribution pipes and all water fittings have been laid, applied and executed in accordance with the provisions of bye-laws and satisfactory arrangements have been made for drainaing off waste water.

Connection will be made on.....

Date..... The Authority

APPENDIX C

(*Clause* 5.4.2)

NOMOGRAM OF HAZEN AND WILLIAMS EQUATION

(*See* Fig. 2)

C-1. Examples of the nomogram are given below:

Example 1

Find the total friction loss in 25 mm ϕ G.I. pipe discharging 0·25 l/s in total length of 300 m.

Procedure

$Q = 0{\cdot}25$ l/s

Pipe $\phi = 25$ mm

Frictional loss from nomogram = 30 m/1 000 m

Total friction loss in 300 m length = $\frac{30 \times 300}{1\,000} = 9$ m

Example 2

Find suitable diameter pipe to carry 15 l/s from service line to overhead tank.

Total length of service main = 200 m.

Residual pressure available at the take off point on supply line is 15 m.

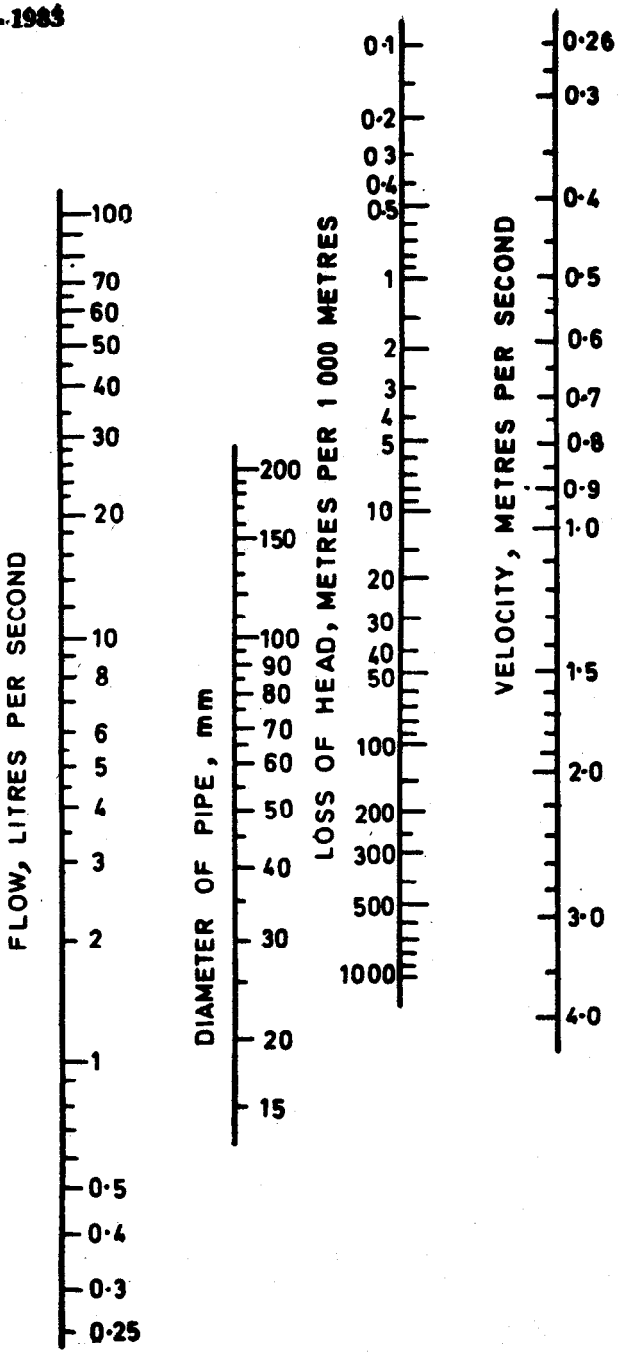

FIG. 2 NOMOGRAM OF HAZEN & WILLIAMS EQUATION (C = 100)

Procedure

Available head = 15 m

Deduct residual head = 2 m

Deduct 10 percent for losses in bends and specials = 1·3 m

Friction head available for loss in pipe of 200 m = 15−2−1·3
= 11·7 m

Friction head available for loss in pipe of 1 000 m

$$= \frac{11 \cdot 7 \times 1\,000}{200} = 58 \cdot 5 \text{ m/1 000 m}$$

From the nomogram for a discharge of 15 l/s and friction loss of 58·5 m/1 000 m dia of nearest commerical size of pipe is 100 mm dia.

APPENDIX D

(*Clause* 8.1.13)

IDENTIFICATION OF PIPES, CONDUITS AND DUCTS IN A BUILDING

D-1. IDENTIFICATION BY COLOUR

D-1.1 To indicate the class of its contents, each pipe shall be marked with the appropriate primary identification colour as per details given below:

Contents	*Identification Colour*
Water	Sea green
Steam	Silver grey
Air	Sky blue
Drainage and other wastes	Black
Gases	Canary yellow
Oils	Light brown
Acids and alkalis	Dark violet
Fire installations	Fire red

D-1.2 The colour marking shall be applied to the entire length of pipe or as a band of colour near valves, junctions, walls, etc. The minimum width of colour band shall be 25 mm.

D-1.3 Where, in the usual course of manufacture or to satisfy the requirements of any other Indian Standards, the pipes are painted to a required colour, the identification colour shall be applied after the pipe is fixed in position. The final colour marking shall not be conflicting with the provision given in **D-1.1**.

D-1.4 Charts showing the colours for primary identification should be displayed at those points where they are likely to be needed for reference.

APPENDIX E

(*Clause* 9.3.1)

END THRUST AND RADIAL THRUST ON BENDS IN MAINS

(Calculated for a pressure of 1·0 N/mm^2)

Diameter of Main	*End Thrust*	*Radial Thrust on Bends of the Following Angles*			
		90°	45°	22½°	11¼°
mm	t	t	t	t	t
50	0·196	0·278	0·150	0·077	0·036
80	0·503	0·711	0·385	0·196	0·091
100	0·785	1·111	0·601	0·306	0·142
150	1·767	2·499	1·353	0·690	0·321
225	3·976	5·623	3·043	1·551	0·721
300	7·067	9·994	5·409	2·757	1·282

NOTE — For pressures other than 1·0 N/mm^2, multiply by the pressure and divide by 10.

APPENDIX F

(*Clause* 9.10)

SPACING OF FIXING FOR INTERNAL PIPING

Kind of Piping	*Size of Pipe*	*Internal for Horizontal Runs*	*Internal for Vertical Runs*
	mm	m	m
Lead	All sizes	2	3
Copper, light gauge	15	1	2
	20	2	2·5
	25	2	2·5
	32	2·5	3
	40	2·5	3
	50	2·5	3
	65	3	3·5
	80	3	3·5
	100	3	3·5
Copper, heavy gauge; wrought iron and mild steel	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
	100	4	5
Cast iron	50	2	2
	80	2·5	2·5
	100	2·5	2·5

(*Continued from page* 2)

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