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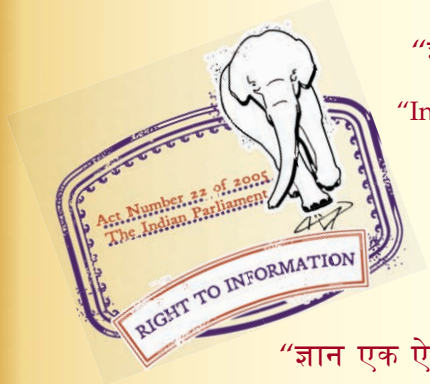
IS 7558 (1974): Code of practice for domestic hot water installations [CED 24: Public Health Engineering.]



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Indian Standard

CODE OF PRACTICE FOR DOMESTIC HOT WATER INSTALLATIONS

(Second Reprint JANUARY 1997)

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Indian Standard

CODE OF PRACTICE FOR DOMESTIC HOT WATER INSTALLATIONS

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CODE OF PRACTICE FOR DOMESTIC HOT WATER INSTALLATIONS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 4 November 1974, after the draft finalized by the Water Supply and Sanitation Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Hot water supply systems are being increasingly installed in buildings especially in the colder regions of the country, hotels and other places and this code is intended to give necessary guidance for installation, inspection, etc.

0.3 This code is a necessary adjunct to the following:

IS : 302-1967 General and safety requirements for light electrical appliances (*third revision*)
IS : 368-1963 Electric immersion water heaters (*revised*)
IS : 732-1963 Code of practice for electrical wiring installations (system voltage not exceeding 650 volts) (*revised*)
IS : 1172-1971 Code of practice for basic requirements for water supply, drainage and sanitation (*first revision*)
IS : 2065-1972 Code of practice for water supply in buildings (*first revision*)
IS : 2082-1965 Storage type automatic electric water heaters (*revised*)
IS : 3017-1965 Thermostats for use with electric water heaters
IS : 4648-1968 Guide for electrical layout in residential buildings

0.4 Good workmanship is an essential requirement for compliance with this code.

0.5 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from BSCP 342-1950 'Centralized domestic hot water supply' issued by the British Standards Institution.

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1. SCOPE

1.1 This code covers general requirements, design considerations, installation practice, inspection and maintenance of individual domestic hot water supply installations.

1.2 Many administrative authorities controlling water supply have their own set of bye-laws, rules and regulations for the supply of water to suit local conditions. These shall be strictly adhered to in design and installation for laying of pipe lines or hot water systems which are connected to public water supply.

1.3 Rules regarding electric connections to electric water heaters laid down by local authorities shall be strictly followed.

2. TERMINOLOGY

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

2.1 Administrative Authority — An individual, an official, a board, a department or any agency established and authorised by Union or State Government or any statutory body created by law who undertakes to administer and enforce the provisions of this code as adopted or amended.

2.2 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.

2.3 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.

2.4 Available Head — The head of water available at the point of consideration due to mains pressures or over head tank or any other source of pressure.

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

2.6 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* **2.8**).

2.7 Backflow Preventer — A device or means to prevent backflow into the potable water system.

2.8 Back Siphonage — The flowing back or used, contaminated or polluted water from a plumbing fittings or vessel into a water supply system due to a lowering of pressure in such system (*see* **2.6**).

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

2.10 Building — Any permanent or temporary structure built for the support, shelter or enclosure of persons, animals, or property of any kind, and includes house, outhouse, stable, shed, hut and every other such structure, whether of masonry, brick, 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.

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

2.12 Cross Connection — Any physical connection or arrangement between the separate piping systems, one of which contains potable water and the other contains water of unknown or questionable safety, whereby water may flow from one system to the other, the direction of flow depending on the pressure differential between the two systems (*see* **2.6** and **2.8**).

2.13 Capacity — The capacity of a storage tank when filled up to the water line.

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

2.15 Communication Pipe — The part of the service pipe extending from the water main up to and including the stopcock, which is under the control of the Authority.

2.16 Consent — Consent obtained or given in writing.

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

2.18 Diameter — Unless specifically stated, the nominal (internal) diameter as designated commercially.

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

2.20 Downtake Tap — A tap taken off from a storage tank situated at a higher elevation in the building.

3. EXCHANGE OF INFORMATION

3.1 Full co-ordination at the planning stage between the architect, the owner, the civil engineer, contractor, electrical engineer and electrical contractor is essential. The necessary space should be provided for water heater at a suitable point in relation to the kitchen sink, bathroom and other draw-off points and for planned pipe runs.

3.2 The architect shall plan the location of all pipe runs, overhead storage tanks and location of shut off valves in order to have easy operation and maintenance.

3.3 The architect shall co-ordinate with structural engineer and inform him of additional loads and support arrangements for overhead storage cisterns.

In case of wall hung hot water heaters, structural stability and fixing arrangement on the wall in question shall be checked by the structural engineer.

3.4 While designing the installations or selecting the hot water equipment, the scale-forming and corrosive properties, if any, of the available water supply, shall be taken into consideration.

3.5 Where justified by the size of the installation, plans for record purposes shall be provided on completion of the installation work. These shall be in a permanent form suitable for convenient reference.

3.6 The contractor employed for the execution of the work shall be a plumber licenced by the competent authority.

4. DESIGN CONSIDERATION

4.1 General — In electric water heating practice for domestic purposes, the accepted method is to use storage heaters in which water is steadily heated up to a predetermined temperature and stored until required for use. The heating by electricity of a large quantity of water, such as required for a hot bath, within the time normally taken to run the water into the bath, requires a heater of too high a rating to be practicable in normal domestic premises.

4.1.1 Various types of electric water heating appliances are available, and it is recommended that a choice of the most suitable for given circumstances should be made in consultation with the electricity supply authority.

4.1.2 The efficiency realized in an electric water heating system depends upon the measures taken to minimize heat losses which occur from the storage vessel and from the distributing pipework and associated accessories, if any.

4.2 Storage Temperature

4.2.1 The design of hot water supply system and its appliance shall be based upon the following temperatures:

Scalding	65°C
Sink	60°C
Hot bath	43°C as run, for use at 41°C
Warm bath	37°C
Tepid bath	29·5°C

4.2.2 In order to minimize the danger of scalding, precipitation of scale from hard water, to reduce standing losses, risk of steam formation and the possibility of damage to porcelain or other fittings and the surface finishes, a storage temperature of 60°C is recommended. If storage capacity is limited, a higher temperature up to 65°C may be adopted when soft water is used.

4.3 Hot Water Storage Capacity — The size of the storage vessel is governed by the maximum short time demand of the domestic premises. Depending on local conditions this shall be 50-75 litres at 60°C in a dwelling with a bath tub and 25 litres at 60°C for a shower or a tap (for bucket supply). The capacity of the storage vessel shall not be less than 20 percent in excess of the required maximum short time demand. In larger houses where a single hot water heater is supplying to more than one bathroom or kitchen or both, the maximum short time demand shall be estimated and capacity decided accordingly. Small electric or gas storage heaters of 15-25 litres capacity may be used to supply one or two points of draw off depending on type of use of hot water. Volume of hot water required for a bath when hot and cold waters are mixed is given in Table 1.

TABLE 1 VOLUME OF HOT WATER REQUIRED FOR A BATH WHEN HOT AND COLD WATERS ARE MIXED

i) Storage temperature, °C	75	70	65	60	55	50
ii) Percentage of hot water required	51	55	60	66	73	82·5
iii) Quantity of hot water in litres required for a 115 litre bath	59	63	69	76	84	95

4.4 Rate of Flow — With storage type installation, the recommended minimum rates of flow for different types of fixtures are given in Table 2.

TABLE 2 RATE OF HOT WATER FLOW

Sl No.	Fixtures	Rate of Flow l/min
(1)	(2)	(3)
i)	Bath tub	22·5
ii)	Kitchen sink	18
iii)	Wash basin	7
iv)	Shower (spray type)	7

4.5 Design of Storage Vessel

4.5.1 In efficient storage water heaters, the hot water floats on the relatively cold water. This enables the hot water to be drawn off even though a substantial quantity of cold feed water may have recently entered into the vessel.

4.5.2 Hot water storage tanks shall be oblong or cylindrical in shape and should be installed with the long side vertical in order to assist effective stratification or layering of hot on cold water. The ratio of height to width or diameter should not be less than 2 : 1. An inlet baffle should preferably be fitted near the cold inflow pipe, in order to spread the incoming cold water.

4.6 Materials for Storage Vessel and Pipes

4.6.1 The knowledge and experience of local water undertaking will afford valuable guidance in the selection of materials suitably resistant to the chemical action of the water of the particular locality.

4.6.2 Materials resistant to the chemical action of water supplied shall be used in construction of vessel and pipes. Some of the metals used in hot water appurtenances are unsuitable for use with certain water supplies. In general, tinned copper and certain other materials, such as monel are suitable for most waters.

4.6.3 The suitability of galvanized mild steel for storage tanks depends on the *p*H value of the water and the extent of its temporary hardness. If the *p*H value is 7·2 or less, it is inadvisable to use galvanized mild steel. For values of *p*H of 7·3 and above the galvanized mild steel may be used provided the corresponding temporary hardness is not lower than those given in Table 3.

TABLE 3 USE OF GALVANIZED METAL IN RELATION TO *p*H VALUE AND TEMPORARY HARDNESS OF WATER

*p*H Value	Minimum Temporary Hardness Required mg/l
7·2 or under	(*see* Note)
7·3	>210
7·4	⩾150
7·5	140
7·6	110
7·7	90
7·8	80
7·9 to 8·5	70

NOTE — Use of galvanized metal for *p*H 7·2 or under is not advisable.

4.6.4 When water supplied is known to have appreciable salt content, galvanized iron vessels and pipes shall not be used.

4.6.5 To minimize corrosion due to electrolytic action, each installation shall, as far as practicable, be restricted to one type of metal only, such as all copper or all galvanized mild steel but in order to avoid risk of damage due to expansion of galvanized iron or galvanized mild steel pipes, short sections of lead or copper pipe, bend or set may be used for connection to baths and basins. However, it is advisable to avoid use of lead pipes in making connection to wash basins.

4.6.6 Under no circumstances shall ungalvanized (black) mild steel pipes and fittings, such as sockets, bushes, etc, be used in any part of a hot water installation including the cold feed pipe and the vent pipe.

4.7 Location of Storage Vessel — The loss of heat increases in proportion to the length of pipe between the storage vessel and the hot water tap since each time water is drawn the pipe is filled with hot water which then cools. The greatest aggregate losses of this kind occur from the pipe runs feeding the hot water tap most frequently used, such as the kitchen tap in small dwellings. The storage vessel shall, therefore, be so placed that the pipe-runs to the most frequently used outlets, are as short as possible.

4.8 Immersion Heater Installation

4.8.1 If a domestic storage vessel is to be adopted to electric heating by the provision of an immersion heater and thermostat, the following recommendations shall be observed:

a) *Location of immersion heaters* — The immersion heater should be mounted with its axis horizontal, except in the case of the circulation which is normally mounted with its axis approximately vertical.

b) In a tank with a flat bottom a space of not less than 75 mm, below the immersion heater and 50 mm below the cold feed connection shall be provided to allow for accumulation of sludge and scale and where it will not affect the working of the immersion heater.

c) In cylindrical storage vessel with inwardly dished bottoms, the inlet pipe shall be arranged so that the incoming cold water is not deflected directly into the hot water zone. The lowest point of the immersion heater shall be 25 mm, above the centre line of the cold feed inlet, which in turn is usually 100 mm above the cylinder rim.

d) *Location of thermostat* — Where the thermostat does not form an integral part of the immersion heater, it shall be mounted with its axis horizontal, at least 50 mm away from and not lower than the immersion heater.

e) *Dual heater installations* — If desired, the principle of the dual heater may be adopted. In this case one heater and its thermostat should be installed at a low level as indicated in (b) and (c). The second heater and its thermostat shall be similarly disposed in the upper half of the cylinder at a level depending on the reserve of hot water desired for ordinary domestic use. The bottom heater shall be under separate switch control.

f) *Clearance around storage vessel* — Adequate clearance shall be provided between the tank and the cup board, door or walls to allow the convenient insertion and adjustment of the immersion heater and thermostat and to give space for thermal insulation.

4.8.2 *Rating of Immersion Heaters* — The rating of an immersion heater shall be determined according to the following factors:

a) Proposed hot water storage capacity (the maximum with cold water as indicated in **4.3** shall be taken into account),

b) Rate of utilization (draw off frequency),

c) Permissible recovery period, and

d) Inlet water temperature.

4.8.2.1 When operating continuously under thermostatic control a 2 kW heater is adequate for small dwellings requiring 90 litres of hot water storage. The decision regarding rating and capacity should be taken in consultation with the electricity supply authority.

4.9 Thermal Insulation

4.9.1 To ensure efficiency and economy in operation, the hot water storage vessel and pipes should be adequately insulated wherever necessary to minimize the heat loss.

4.9.2 The whole external surface of the storage vessel including the cover to the handhole should be provided with a covering equivalent at least to 75 mm thickness of thermal insulating material having a conductivity not exceeding 0·043 K Cal/m²/h/°C/mm.

5. TYPES OF HOT WATER HEATERS

5.1 Electric Storage Heaters — A storage water heater consists of a thermally insulated vessel, one or more electric heating elements, thermostats and pipe connections and is assembled by the manufacturer ready for installation on site. The rated input of heater in kW for storage heaters of various rated capacity (in litres) shall be as follows as recommended in IS : 2082-1965* :

Rated capacity in litres	6	15	25	35	50	70	100	140	200
Recommended input in kW	1·0	1·0	1·0	1·5	2·0	2·0	3·0	4·0	5·0

NOTE — For dual hot water heaters, the rated input includes the ratings of both the elements.

5.1.1 *Types of Electric Storage Heaters*

5.1.1.1 *Non-pressure or open outlet type* — The shape of such storage heater is normally cylindrical or rectangular. This type is controlled by a stop valve situated on the inlet pipe of heater. It may subject to the requirements of local water supply undertakings, be fed directly from the water mains or alternatively from a cistern. A non-return valve shall be fitted in the inlet pipe (*see* Fig. 1).

5.1.1.2 *Pressure type* — Water heaters of this type shall not be connected direct to the water mains but to the cistern placed at an appropriate height. This type is generally cylindrical in shape.

5.1.1.3 *Cistern type* — This type is normally cylindrical or rectangular in shape. It incorporates a feed tank with ball valve arranged for direct connection to the water main. Connection for overflow pipe is also provided for which any special requirement of the local water supply undertaking shall be observed.

*Specification for storage type automatic electric water heaters (*revised*).

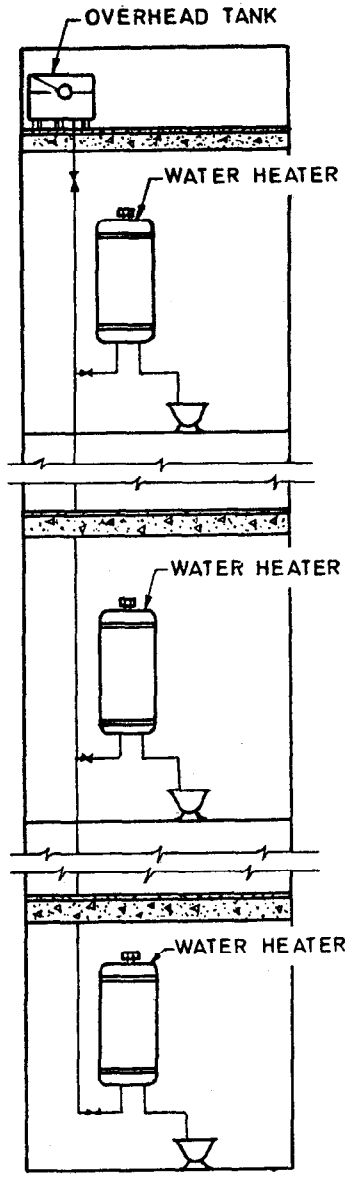

FIG. 1 NON-PRESSURE TYPE INSTALLATION

5.1.1.4 *Dual heater type* — This is a displacement water heater having two heating units one towards the top container and the other near the bottom, the unit being independently controlled. The shape is generally cylindrical.

5.1.2 The 90 litres unit is designed primarily for installation under the draining board adjacent to the kitchen sink, the kitchen sink tap being the most frequently used hot water outlet in a dwelling. It is usually also coupled to the bathrooms hot water taps.

5.1.2.1 The unit is provided with two heaters, each controlled by a thermostat one heater placed near the top of the tank, is of low rating (usually 0·5 kW) to provide sufficient hot water for ordinary domestic use, the main heater, of higher rating (usually 2·5 kW) is placed near the bottom of the tank and can be manually switched on before a bath is required. The complete unit, as manufactured comprises a thermally insulated cylinder, electric heating elements and the thermostats and pipe connections.

5.1.3 Larger units may be designed to be coupled to and to operate in conjunction with a fuel-fired domestic water heater, as shown in Fig. 2.

5.2 Gas Water Heaters

5.2.1 Gas water heaters shall be of two types, namely, 'instantaneous' and 'storage'.

5.2.2 The instantaneous type may be multi-point supplying to more than one outlet or single-point supplying to one outlet only.

5.2.3 The multi-point instantaneous heater may be connected to all hot water taps. When a tap is turned on, the flow of water opens the gas valve and the gas is ignited by the pilot flames. The cold water flowing through the appliance is heated immediately and the flow of hot water will continue as long as it is required. When the tap is turned off the gas is extinguished except for the pilot jet. The quantity and temperature of water delivered per minute depends on the rate of flow of gas and its thermal properties and the rate of flow of water.

5.2.4 A single point instantaneous heater is controlled by a water tap on the inlet and the hot water outlet shall have an unobstructed discharge into the bath, basin, sink, etc.

5.2.5 Instantaneous heaters are particularly suitable when the demand for hot water is intermittent, and as auxiliaries to a solid fuel system to give partial (single flow) or complete (multi-point) service either in conjunction with, or in place of the solid fuel system. They are also useful for supplying distant taps which would require too long a draw-off pipe from the solid fuel system.

5.2.6 The storage type are of two kinds, namely: (a) the self-contained unit which comprises heater and cylinder or tank in one appliance and operates independently or in conjunction with a solid fuel boiler, and (b) the

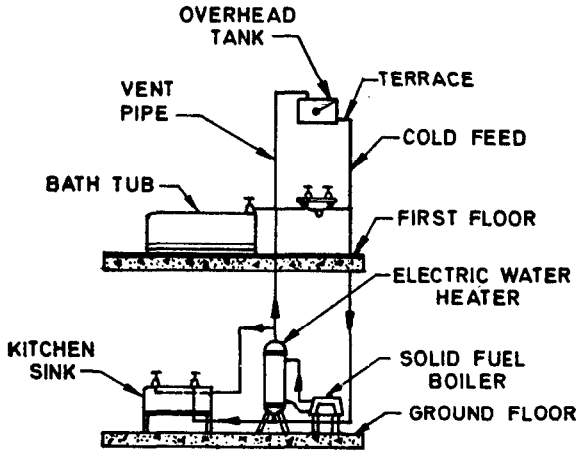

FIG. 2 ELECTRIC WATER HEATER WORKING IN CONJUNCTION WITH FUEL-FIRED BOILER

circulator which has a separate cylinder or tank and operates in conjunction with a solid fuel boiler. Both the above types are capable of supplying hot water at a uniform temperature and with a good rate of flow at more than one tap simultaneously up to the capacity of the cylinder or tank. There is also a single point storage heater of 10 to 25 litres capacity which is fitted over sink or basin and does not require a draw off or expansion pipe.

5.2.7 With storage type appliances, water is heated and flows into the cylinder or tank until all the water is raised to a temperature between 60 to 65°C whereupon the gas rate is automatically reduced by a thermostat to that required to maintain the water at that temperature. When hot water is drawn from the cylinder or the tank the thermostat valve opens and the full gas rate is resorted until the incoming cold water has been heated.

5.2.8 Self-contained heaters are designed to give stratification of the stored water, the advantage of which are the ability to withdraw hot water shortly after lighting the heating unit and the avoidance of mixing between stored hot water and incoming cold water when a small quantity of hot water is withdrawn.

5.2.9 Self-contained storage heaters can be used as alternatives to solid fuel system with retention of full rate of flow at all hot taps, especially where the storage of existing system is inadequate. Circulators can be used for the same purposes when the existing storage is satisfactory. Sink storage heaters can be used as auxiliaries to a storage system to supply sink or basin when the full storage is not in use or to avoid too long a draw off pipe from the existing system or as independent heaters to supply hot water to isolated sinks.

5.2.10 Heaters of either type should have an automatic water operated gas valve, interlocking the gas and water tap.

5.2.11 Some instantaneous and storage gas water heaters require to be fitted with a flue. A flue connection is not normally required to a gas water heater for the sink which is intended for intermittent use. When usage is likely to be prolonged or where heaters are fitted in small rooms with inadequate ventilations, it is necessary to fit a flue discharging to the outer air and to increase the fresh air inlet to the room. When a water heater is to be totally enclosed, provision shall be made for the entry of an ample supply of fresh air to the enclosure and for the effective discharge of the products of combustion outside the building by ensuring that the area of the inlet is not less than the area of the flue socket of the heater.

6. COLD WATER SUPPLY TO HEATERS

6.1 A storage water heater (pressure type) shall be fed from a cold storage tank and under no circumstances connected directly from the water main, excepting the type which incorporates a feed tank with ball valves and overflow pipe arrangement (cistern type heaters) or non-pressure type heaters.

6.2 Storage Cisterns

6.2.1 The storage capacity of a cold water tank shall be at least twice the capacity of the hot water heater. The capacity of the storage tank may however be one and half times when the number of heaters connected to one common tank exceeds ten.

6.2.2 The cold water storage tank for supply to hot water heaters shall be a separate tank, if practicable. In case of a common tank which also supplies cold water to the fixtures, this cold water supply connection shall be so arranged that the 50 percent of the net capacity worked out as in **6.2.1** shall be available for supply to the hot water heaters.

6.2.3 In case of multistoreyed buildings where a common overhead tank over the stair/lift well is generally installed, it is advisable to have one or more local tanks for supply to the hot water heaters. This arrangement shall help in reducing the length of the vent pipes (*see* Fig. 3).

6.2.4 In tall multistoreyed buildings where the static pressure increases with the height, the total static pressure on the hot water heaters on the lowest floor shall not exceed the rated working pressure of the hot water heater installed. Should the height of the building so require, additional tanks shall be provided on the intermediate floors to restrict the static head to permissible limits (*see* Fig. 4).

6.2.5 As an alternate to arrangements stated in **6.2.3** and **6.2.4**, an individual storage tank in each flat may be provided for supply to hot water heaters (*see* Fig. 5).

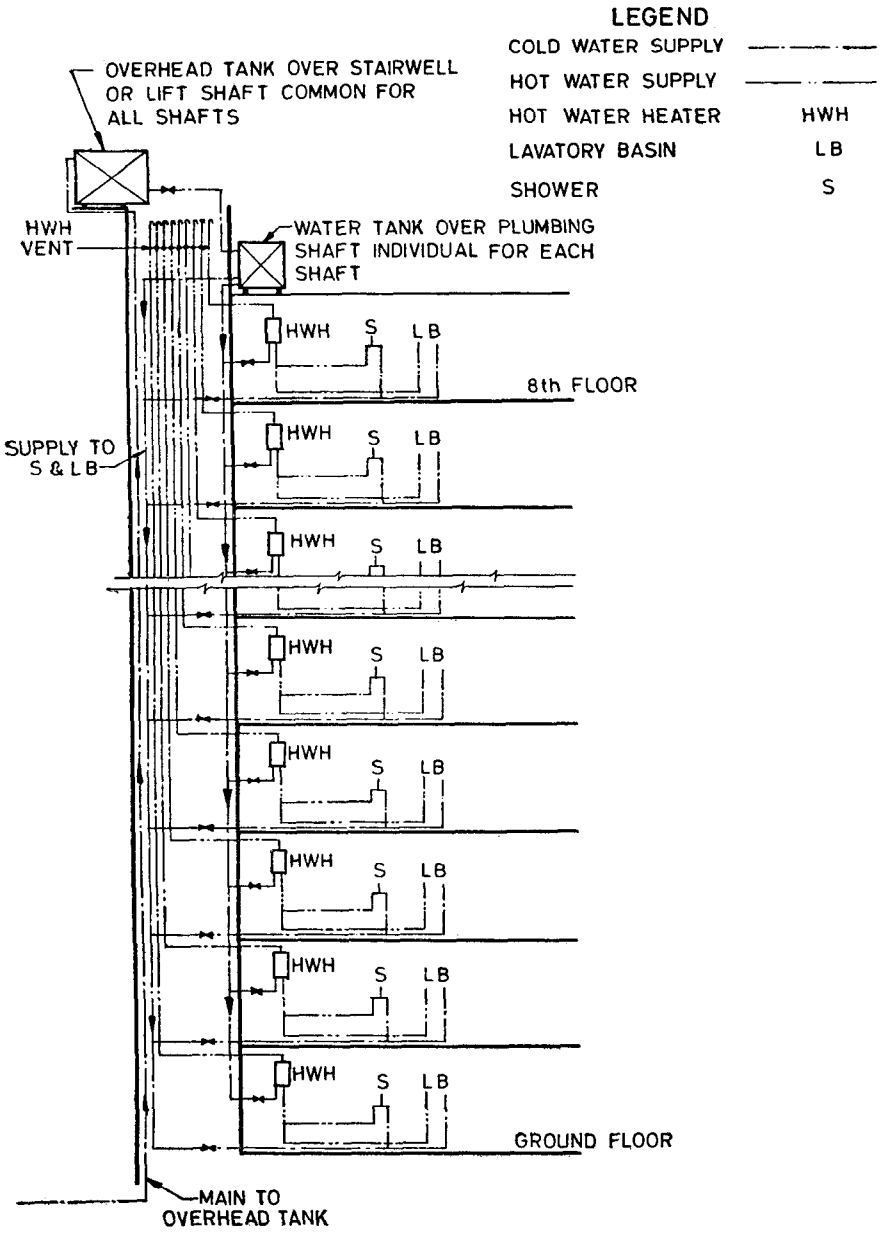

FIG. 3 INSTALLATION FOR 8-STOREYED BUILDING

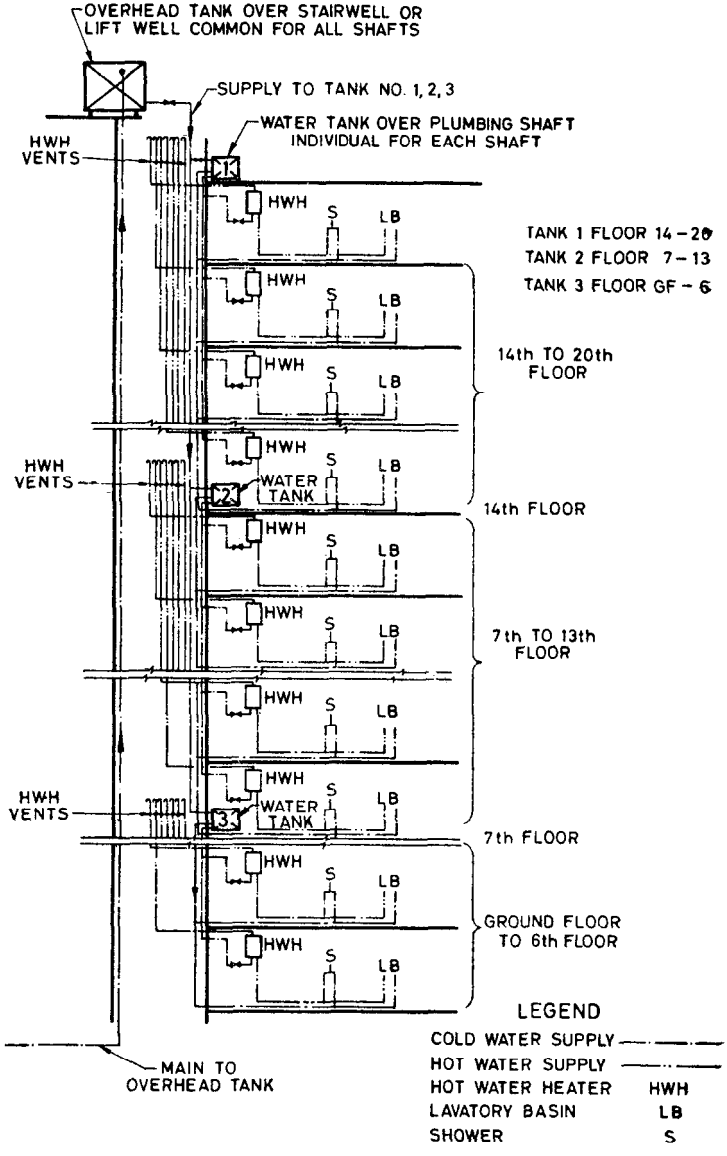

FIG. 4 INSTALLATION FOR 20-STOREYED BUILDING

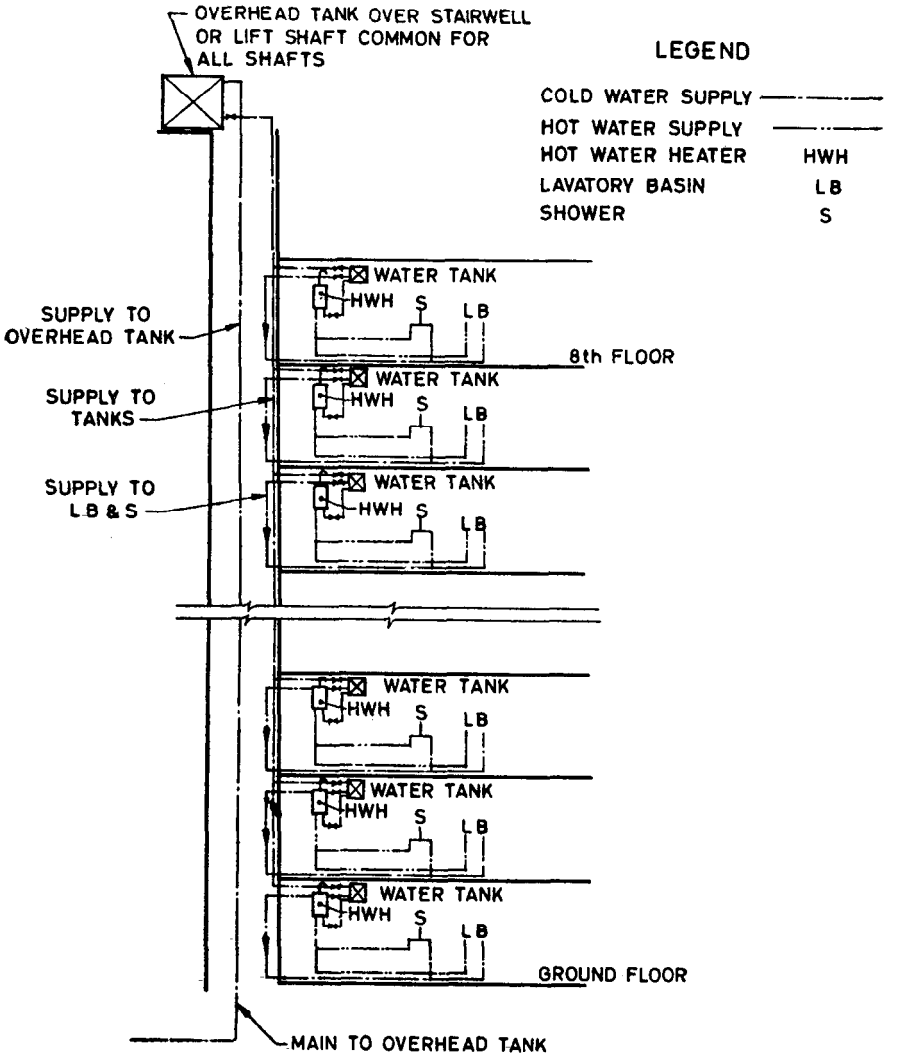

FIG. 5 INSTALLATION FOR 8-STOREYED BUILDING WITH INDIVIDUAL WATER TANKS

6.3 Cold Water Feed

6.3.1 The cold water feed pipe connecting cold water tank with the hot water heater shall not be less than 20 mm bore and it shall leave the cold water tank at a point not less than 5 cm above the bottom of the tank and shall connect into the hot water heater near its bottom. The cold feed pipe shall not deliver cold water to any other connection but into the hot water cylinders only.

6.3.2 In case of multistoreyed buildings, a common cold feed pipe may be installed but each hot water heater shall be provided with a check valve (horizontal type check valve shall be preferred over vertical type for easy maintenance).

6.3.3 Care shall be taken in installing the piping to prevent air locks in the piping and negative pressure in the hot water heater. Cold feed pipe shall not be cross connected with any other source of supply and pressure (*see* Fig. 3).

7. HOT WATER PIPING

7.1 Expansion Pipe or Vent Pipe

7.1.1 Each pressure type hot water heater or cylinder shall be provided with a vent pipe of not less than 20 mm bore. The vent pipe shall rise above the water line of the cold water tank by at least 15 cm plus 1 cm for every 30 cm height of the water line above the bottom of the heater. The vent shall discharge at a level higher than cold water tank and preferably in the cold water tank supplying the hot water heaters. Care shall be taken to ensure that any accidental discharge from the vent does not hurt or scald any passer-by or persons in the vicinity.

7.1.2 The vent pipe shall be connected to the highest point of the heater vessel and it shall not project downwards inside it as otherwise air may be trapped inside, resulting in surging and consequent noises.

7.1.3 At no point, after leaving the vessel shall the vent pipe dip below level of the connection.

7.1.4 A vent pipe may, however, be used for supply of hot water to any point between the cold water tank and the hot water heaters.

7.1.5 Vent pipe shall not be provided with any valve or check valves.

7.2 Hot Water Heaters

7.2.1 The common hot water delivery pipe shall leave the hot water heater near its top and shall be of not less than 20 mm bore generally, and not less than 25 mm, if there are hot water taps in the same storey as that on which the hot water heater is situated.

7.2.2 Hot water taps shall be of types causing minimum friction or alternatively oversized tap may be provided such as 20 mm tap on a 15 mm pipe.

7.2.3 The hot water distributing system shall be so designed that the hot water runs quickly at the draw-off taps when opened to avoid the running to waste of an undue amount of water which has cooled while standing in the pipes when the taps are closed. With this end in view a secondary circulation system with flow and return pipes from the hot water tank shall be used where justified. Whether such a system is used or not, the length of pipe to a hot water draw off taps measured along the pipe from the tap to the hot water tank or the secondary circulation pipe shall not exceed the lengths given in Table 4.

TABLE 4 MAXIMUM PERMISSIBLE LENGTHS OF HOT WATER DRAW-OFF PIPES

Sl No.	Largest Internal Diameter of Pipe	Length m
(1)	(2)	(3)
i)	Not exceeding 20 mm	12
ii)	Exceeding 20 mm but not exceeding 25 mm	7·5
iii)	Exceeding 25 mm	3·0

NOTE — In the case of a composite pipe of different diameters, the largest diameter is to be taken.

7.2.4 Wherever mixing of hot and cold water is done by a mixing fitting, that is, hot and cold stopcocks delivering to a common outlet of mixed water (that is, showers, basin or bath supply fittings), the pressure in the cold and hot water system shall be equal. This can be achieved by connecting the cold supply from an overhead tank at the same static height as the overhead tank supplying cold water to the hot water heaters. In case this is not possible, hot and cold water should be supplied to the fixtures by separate supply taps.

8. INSPECTION AND TESTING

8.1 Testing of Mains Before Commencing the Work — All pipes, fittings, and appliances shall be inspected, before delivery at site to see whether they bear, where appropriate, the certification mark of Indian Standards Institution or the mark of the testing station of administrative authorities. All pipes and fittings shall be inspected and tested by the manufacturers' at their factory and shall comply with the requirements of the relevant Indian Standard. These shall be tested hydraulically under 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 items shall be clearly marked or rejected and forthwith removed from the site.

8.2 Testing of the System After Installation—After the hot water system including the hot water heaters has been installed, it shall be carefully charged with water, so that all air is expelled from the system. The entire system shall then be hydraulically tested to a pressure of 5 kg/cm^2 or twice the working pressure whichever is greater for a period of at least half an hour after a steady state is reached. The entire installation shall then be inspected visually for leakages, and sweating. All such defects, if found, shall be rectified by removing and remarking the particular section. Caulking of threads, hammering and welding of leaking joints shall not be allowed.

8.3 Hot Water Testing — After the system has been proved water-tight, the hot water heaters shall be commissioned by connecting the same to the electrical supply. The system shall then be observed for leakage in pipes due to expansion or overheating. The temperature of water at outlets shall be recorded. The thermostats of the appliances shall be checked and adjusted to temperatures specified in **4.2.1.**

8.4 Electrical Connection — The provisions of the relevant code of practice for electrical connection of domestic appliances (*see* IS : 302-1967*) shall be observed. The metal work of the water heating appliances and installation other than current carrying parts shall be bonded and earthed in conformity with the above code. It should be noted that screwing of an immersion heater into a tank or cylinder cannot be relied to effect a low resistance earth connection, a satisfactory separate earthing of heater should be effected.

9. MAINTENANCE

9.1 The system shall be regularly inspected for leakages and corrosion.

9.2 The entire system shall be periodically flushed. Overhead cold water tanks shall be cleaned and painted (where required). Corroded pipes and appliances shall be removed and replaced.

9.3 The electrical installation shall be checked for earth continuity and any defects or deficiencies corrected.

9.4 All valves normally left open or closed shall be tested by opening and closing to check the proper functioning. Valves incrustated with rust or scales shall be cleaned or replaced as warranted.

*General and safety requirements for light electrical appliances (*third revision*).

9.5 All taps, ball valves shall be inspected for water tightness. Glands shall be made good, washers shall be replaced and mechanism of spring operated taps and ball valves shall be repaired where required.

9.6 All overflow pipes shall be kept free from obstruction.

9.7 Record drawings showing piping 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. Any addition or alterations to the systems shall be duly recorded from time to time.

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