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भारतीय मानक
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IS 13039 : 2014
(Reaffirmed 2019)

बाहरी हाईड्रेन्ट सिस्टम — प्रावधान तथा रख-रखाव — रीति संहिता

(पहला पुनरीक्षण)

External Hydrant Systems — Provision and Maintenance — Code of Practice

(First Revision)

ICS 13.220

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BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली-110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Fire Fighting Sectional Committee, CED 22

FOREWORD

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

One of the methods for extinguishing fire in towns, cities and industrial buildings is by providing external hydrant systems. Fire hydrant systems consist of suitable capacity reservoirs, arrangements to impart pressure to the water, means to convey the water to various locations and suitable water outlets at the required locations. In order that such system could function efficiently, it is necessary to give guidance for the provision, installation, inspection and maintenance of this system.

Table 23 of SP 7 : 2005 'National Building Code of India', governs requirements for various types of individual buildings and small scale industries only. For other industries, requirements are to be worked out based on relevant Indian standards namely 'IS 9668 Code of Practice for provision and maintenance of water supplies and fire fighting, IS 13039 Code of Practice for external hydrant systems provision and maintenance and IS 3844 Code of Practice for installation and maintenance of internal fire hydrants and hose reels on premises' in consultation with local fire authorities.

IS 9668 covers provisions and maintenance of water supplies for extinguishing fires in towns, cities and industrial buildings and IS 13039 covers provision and maintenance of external hydrant systems.

Purpose of this revision of IS 13039 is to delete water supply requirements for industries from IS 9668 and bring out an up-to-date comprehensive standard, for external hydrant systems in medium and large scale industries (other than petroleum refining and petrochemical plants which are governed by OISD standards), which would include water supply requirements also. IS 9668 would now cover provisions for water supplies for towns and cities only.

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 'Rules for rounding off numerical values *revised'*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Indian Standard

EXTERNAL HYDRANT SYSTEMS — PROVISION AND MAINTENANCE — CODE OF PRACTICE

(First Revision)

1 SCOPE

This standard covers provision of installation Inspection and maintenance of hydrant systems in medium and large scale industrial risks (other than petroleum refining and petrochemical plants which are governed by OISD standards).

2 REFERENCES

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

3 CLASSIFICATIONS OF OCCUPANCIES

Water supply, pumping capacity and other features of the hydrant system depend not only on the size of the risk but also on its fire growth and spread potentialities. For the purpose of hydrant systems design the risks are to be categorized under the classes as given in Annex B.

4 HYDRANTS/FIXED MONITORS

4.1 Before commissioning, the hydrant system shall be flushed thoroughly.

Fire hydrants shall be of stand post type conforming to IS 908.

If site conditions demand, they can also be of underground type conforming to IS 909, however only where the hydrants are properly enclosed in a surface box of cast iron or masonry, 750 mm square and 80 mm above ground level, the top of the hydrant outlet being not more than 80 mm below the top of the box. Such surface boxes shall be protected by hinged cast iron covers as specified in IS 3950.

4.2 Water shall be available immediately to all hydrants/fixed monitors at all times, with all cut-off valves being kept open.

4.3 Connections for any purpose other than fire fighting are not permitted from the hydrant/fixed monitor/stand post or from any portion of the hydrant service. Hose reels can however be tapped from hydrant stand posts.

4.4 All hydrant outlets shall be situated 1 m above ground level.

4.5 The stand posts shall be 80 mm in diameter for single headed hydrants, 100 mm for double-headed hydrants and monitors of 63 mm or 75 mm size and 150 mm for monitor of 100 mm size.

It is recommended that stand posts be painted ‘fire red’ (shade No. 536 as per IS 5).

4.6 Only oblique hydrants conforming to IS 5290 with outlets angled towards ground shall be used. The hydrant couplings shall be of the instantaneous spring-lock (female) type of 63 mm diameter and valves shall be of the screw down type.

Suitable pressure reducing devices may be provided for hydrants where the pressure exceeds 7 kg/cm^2.

4.7 Double-headed hydrants shall consist of two separate landing valves.

4.8 Hydrants shall be easily accessible, storage of any kind on or around the hydrant being prohibited.

Where hydrants are situated in remote locations, they shall be approachable by means of paved pathways**.**

4.9 Hydrants located in situations where they are likely to be damaged by vehicular traffic shall be protected by guard rails on all sides.

4.10 Hydrants shall be located bearing in mind the attendant fire hazards, at the different sections of the premises to be protected and so as to give most effective service. They shall be so distributed as to provide protection for the buildings on all sides and need not necessarily be equidistant from each other (*see* **4.11**).

4.11 Advantage shall be taken of convenient door and/or window openings to place hydrants so that only a minimum length of hose is required to reach the openings through which fire may be attacked.

In case of continuous blank walls, suitable provision shall be made on the walls near hydrant posts for easy access inside the premises.

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4.12 At least one hydrant post shall be provided for every 60 m of external wall measurement in case of light hazard occupancy, for every 45 m in case of ordinary hazard occupancy and every 30 m of external wall measurement or perimeter of building/unit battery limit in case of high hazard occupancy.

Measurements shall be calculated on the total length of walls of all buildings/perimeter of all battery limits to be protected except in the case of opposite buildings (other than those of high hazard category) within 22.5 m of each other, where the measurement of the shorter opposing wall may be omitted.

Notwithstanding the above, hydrants protecting utilities and miscellaneous buildings in high hazard risks may be spaced at 45 m.

4.13 Where any part of a building is normally used for storage purpose or where hazardous processes are carried out, there shall be two single or one double headed hydrant within 15 m of the building, the layout being such that two jets of water can be played simultaneously on the highest point of the roof.

4.14 All hydrants and monitors should be serially numbered.

4.15 For light and moderate hazard risks, hydrant heads shall be positioned at distances not less than 2 m from the face of the building or edge of the storage plot to be protected. Such buildings shall not be deemed to be protected by a hydrant unless such hydrant is within 15 m of the building.

4.16 In case of buildings/plants occupied for high hazard process or storage areas, the hydrants shall be located at a minimum distance of 15 m from the periphery of storage tank or hazardous equipment under protection.

In the case of buildings, this distance shall be not less than 5 m and more than 15 m from the face of building.

Hydrants/Monitors shall be located along road side for easy accessibility as far as possible.

4.17 In case where, owing to the size or layout of the building, or building being divided by internal walls, if any point within the building is at a distance of more than 45 m from an external fire hydrant, an internal hydrant system shall be provided so that no portion of the floor is more than 45 m from an external hydrant or 30 m from an internal hydrant.

Distance of 45 m indicated above shall be increased to 60 m for light hazard occupancies and reduced to 30 m for high hazard occupancies.

In case of large open areas like switchyards, where it is not feasible to lay internal hydrants, alternate hydrants may be replaced by monitors of suitable size.

4.18 High hazard industrial occupancies, hazardous buildings and basements exceeding 200 m^2 in area shall be protected by automatic sprinklers or such other appropriate systems

4.19 Fire Escape/Fire Access Staircases

4.19.1 In case of storied buildings, satisfactory access shall be provided to all parts of each floor by means of incombustible internal or external staircases.

4.19.2 All buildings having area more than 500 m^2 on each floor shall have a minimum of two staircases.

At least one of them shall be on external wall of the building and shall open directly to the exterior, interior open space or to an open space of safety

4.19.3 Exact numbers, width, location, etc, of such staircases and ramps for basements shall depend on travel distance requirements given under **4.5.1**, **4.5.2** and **4.5.3** and Table 22 of National Building Code of India depending on type of occupancy.

4.19.4 Internal staircases shall conform to **4.9**, external staircases shall conform to **4.11** and ramps shall conform to **4.14** of National Building Code of India.

4.19.5 All staircases (protected escape routes) shall be pressurized as per **4.10** of National Building Code of India**.**

4.19.6 Internal fire hydrants and hose reels shall be provided on internal/external fire escape staircases as per provisions given under **5.8, 5.10, 5.13, 5.14, 5.15** and **6** of IS 3844.

4.19.7 A hydrant shall be provided on every floor landing which shall be not less than 1.25 m.

4.19.8 Exits to the access staircases shall always be kept open during working hours. During non-working hours, the exits may be locked from the staircase side only.

Locks of all exits shall have one master key, which shall be available either at the main gate, or any other prominent and easily accessible location known to the fire fighting personnel. Alternatively, the key shall be kept in a glass-fronted box or in the hose box on the staircase landing.

4.19.9 Adequate smoke venting facilities shall be provided for safe use of exits.

4.20 Monitors

4.20.1 Monitors conforming to IS 8442 shall be located at strategic locations for protection of cluster of columns, heaters, gassifiers, etc, and where it may not be possible to approach the higher levels.

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The requirement of monitors shall be established based on hazard involved and layout considerations. Monitors shall be located to direct water on the object as well as to provide water shield to firemen approaching a fire. The monitors should not be installed less than 15 m from hazardous equipment. Also, the location of water monitors shall not exceed 45 m from the hazard to be protected. Variable flow monitors may be installed at critical locations.

4.20.2 A minimum of 2 monitors shall be provided for the protection of each such area. Water monitors for protection of heaters shall be installed so that the heater can be isolated from the remainder of the plant in an emergency.

4.20.3 Tank wagon and tank lorry loading/unloading bays and gantry area should be provided with alternate fire hydrants and water cum foam monitors having multipurpose combination nozzles for jet spray and fog arrangement located at spacing of 30 m on either sides of the gantry.

4.20.4 Monitors should be painted with luminous colour for ease of identification during emergency.

4.21 Storage of material in the open shall be protected as under:

Material	*Protection*
Non-hazardous storage	One single hydrant for every 60 m of storage periphery located beyond 2 m but within 15 m of storage area
Coal or Coke	One single hydrant for every 45 m of storage periphery located beyond 2 m but within 15 m of storage area
Other storages	One double hydrant for every 45 m of the storage periphery located beyond 2 m, but within 22.5 m of storage area

NOTES

1 In the case of open storage areas of bamboo, bagasse, grass/hay and timber, at least 50 percent of hydrant shall be replaced by fixed monitors having nozzle bore of 38 mm diameter, if the individual stack height is more than 6 m and total storage exceeds 5 000 tonne.

2 Where hydrant/monitors located along one longer side of a storage area are more than 90 m from those along the other longer side, monitors having jets of longer reach may be accepted.

4.22 Protection for Storage Tanks/Vessels

4.22.1 In case tanks are located more than 22.5 m from the dyke walls, one double hydrant shall be replaced by a 38 mm monitor (Every alternate monitor should be a foam monitor and a minimum of one such foam monitor should be provided).

4.22.2 Additional requirement for water spray protection for storage tanks/vessels.

4.22.2.1 Class A petroleum storage in above ground tanks shall have fixed water spray system, whether floating roof or fixed roof.

4.22.2.2 Adequate provision shall be made to promptly and effectively dispose of all liquids from the fire areas during operation of fire protection systems in such areas.

4.22.3 Fixed/semi-fixed foam system shall be provided for the following tanks:

'Floating roof tanks storing Class 'A' petroleum products.'

5 PUMPS

5.1 General

5.1.1 Pumps conforming to IS 12469 shall be exclusively used for fire fighting purposes and shall be either,

a) electric motor driven centrifugal pumps; or
b) compression ignition engine driven centrifugal pumps; or
c) vertical turbine submersible pumps.

5.1.2 Pumps shall be direct-coupled, except in the case of engine-driven vertical turbine pumps wherein gear drives shall be permitted. Belt-driven pumps shall not be accepted.

5.1.3 Parts of pumps like impeller, shaft sleeve, wearing ring, etc, shall be of non-corrosive metal, preferably of brass or bronze or stainless steel. Where seawater is used or where the quality of water necessitates the use of special metals/alloys, the use of such metals or alloys shall be insisted.

5.1.4 The capacity of the pump(s) would depend on whether or not tapping(s) for water spray and/or foam protection for tanks/spheres/bullets/plants/other facilities is (are) taken from the hydrant service.

In case there is no tapping from the hydrant service, the capacity of the pump shall be as per hereunder. However, where the water demand for water sprays and/or foam protection as per **5.1.4.2**, **5.1.4.3**, **5.1.4.4**, **5.1.4.5** and **5.1.4.6** is more than that required for the hydrant system, the pumping capacity shall be based on the higher water demand.

5.1.4.1 The capacity of pumps for hydrant service shall be determined by the class of occupancy and size of installation as per Tables 1, 2 and 3.

5.1.4.2 Where transformers are protected by high velocity water spray system tapped from hydrant

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system, water requirements of the spray system shall be determined as per rules for water spray system under IS 15325. Water requirement of the spray system worked out as above shall then be loaded by 1 750 litre/min for supplementary hose stream protection.

5.1.4.3 Where plants and other facilities are protected by sprinkler system tapped from the pressurized hydrant service, water requirement of the sprinkler system shall be determined as per the rules for sprinkler system under IS 15105. If the total water requirement for sprinkler system exceeds the requirement of the hydrant service as per Tables 1, 2 and 3 the pumping capacity shall be equivalent to the former.

5.1.4.4 Where spheres/bullets are protected by a medium velocity water spray system tapped from pressurized hydrant service, water requirements of the spray system shall be determined as mentioned under IS 15325. Water application may be reduced to 5 litre/min where the bullets/Spheres coated with approved passive materials providing fire resistance of at least 2 h.

The water requirement of the spray system worked out as above shall then be loaded for supplementary hose stream protection as under:

Water capacity of Bullets/ Spheres m^3	*Supplementary hose stream protection* litre/min
Up to and including 50 m^3	1 750
Above 50 m^3 and up to 150 m^3	2 250
Above 150 m^3	4 500

If the total water requirement for spray protection and hose steam protection for spheres/bullets worked out as above exceeds the requirements of the hydrant service as per Tables 1, 2 and 3 the pumping capacity shall be equivalent to the former.

NOTE — For design criteria of medium velocity water spray system reference shall be made to IS 15325.

Table 1 Pump Capacity — Light Hazard Risk
(*Clause* 5.1.4.1)

Nature of Risk	**Number of Hydrants**	**Pump Capacity** litre/min (m^3/h)
(1)	(2)	(3)
Light hazard	Not exceeding 20	1 620 (96)
	Exceeding 20 but not exceeding 55	2 280 (137)
	Exceeding 55 but not exceeding 100	2 850 (171)
	Exceeding 100[1)]	2 850 (171) plus 2 850 (171) for every additional 125 hydrants or part thereof.

[1)] The total pumping capacity need not be greater than 11 400 litre/min (683 m^3/h) irrespective of the number of hydrant points.

NOTE — Delivery pressure at pump discharge at rated capacity shall be hydraulically designed.

Table 2 Pump Capacity — Ordinary Hazard Risk
(*Clause* 5.1.4.1)

Nature of Risk	**Number of Hydrants**	**Pump Capacity** litre/min (m^3/h)
(1)	(2)	(3)
Ordinary hazard	Not exceeding 20	2 280 (137)
	Exceeding 20 but not exceeding 55	2 850 (171)
	Exceeding 55 but not exceeding 100	4 550 (273)
	Exceeding 100[1)]	4 550 (273) plus 4 550 (273) for every additional 125 hydrants or part thereof.

[1)] Total pumping capacity need not be greater than 18 200 litre/min (1 092 m^3/h) irrespective of the number of hydrant points.

NOTES

1 Where situation warrants, higher capacity pumps not exceeding 410 m^3/h may be accepted.

2 In case of new systems where the number of hydrants is expected to be between 100 and 150; and where further extension of the system beyond 150 hydrants is not anticipated, a single pump of 410 m^3/h capacity may be permitted.

3 Likewise in case of old installations where the system is extended beyond 100 hydrants but not exceeding 150 hydrants; and where further extension beyond 150 hydrants is not anticipated, an additional pump of 171 m^3/h may be permitted.

4 In order to achieve the minimum pressure at higher elevation, booster pump(s) with a capacity of 137 m^3/h, having requisite rated head may be acceptable. The booster pump shall be regarded as a pressure-compensating device only.

5 A higher capacity booster pump may be stipulated where considered necessary. Booster pump shall be located at ground level only.

6 Electrically driven booster pump(s) shall in addition to the normal supply be connected to the emergency power supply also and satisfy all requirements applicable to main pumps.

7 Delivery pressure at pump discharge at rated capacity shall be hydraulically designed.

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Table 3 Pump Capacity — High Hazard Risks (other than those Governed by OISD Standards)
(*Clause* 5.1.4.1)

Sl No.	Nature of Risk litre/min (m^3/h)	Number of Hydrants	Pump Capacity
(1)	(2)	(3)	(4)
i)	Sub Category (A)	Not exceeding 20	2 850 (171)
		Exceeding 20 but not exceeding 55	4 550 (273)
		Exceeding 55 but not exceeding 100	6 825 (410)
		Exceeding 100	6 825 (410) plus 6 825 (410) for every additional 125 hydrants or part thereof.
ii)	Sub Category (B)	Not exceeding 20	Two of 2 850 (171)
		Exceeding 20 but not exceeding 55	Two of 4 550 (273)
		Exceeding 55 but not exceeding 100	Two of 6 825 (410)
		Exceeding 100	Two of 6 825 (410) plus one of 6 825 (410) for every additional 200 hydrants or part thereof.

NOTES

1 In calculating the number of hydrants in the system, a double headed hydrant shall be counted as two, a fixed monitor of 63 mm size having nozzle bore of 32 mm shall be counted as three, a fixed monitor of 75 mm size having nozzle bore of 38 mm shall be counted as four and a fixed monitor of 100 mm size having nozzle bore of 45 mm as six hydrant points.

In case of risks, where double headed hydrants are used throughout the system (Except light/ordinary hazard areas protected by separate ring mains), a double headed hydrant may be regarded as a single hydrant only

2 In case of high hazard (Sub-category B) risks where the aggregate pumping capacity required in terms of the above Table or of **5.1.4.2**, **5.1.4.3**, **5.1.4.4**, **5.1.4.5** and **5.1.4.6** hereunder exceeds 1 640 m^3/h, larger capacity pumps are acceptable provided the capacity of the largest pump does not exceed 25 percent of the aggregate installed pumping capacity.

3 Delivery pressure at pump discharge at rated capacity shall be hydraulically designed.

5.1.4.5 Where the plants and other facilities are protected by medium velocity water spray systems, tapped from hydrant service, water requirement of the spray system shall be determined as per rules for water spray systems under IS 15325. Water requirements of the spray systems worked out as above shall then be loaded by requirements for supplementary hose stream protection which shall be limited to capacity of individual hydrant pump required had there been no spray protection with a maximum of 4 500 litre/min.

If the total water requirement for spray protection and hose stream protection worked out as above exceeds the requirements of the hydrant service as per Tables 1, 2 and 3, the pumping capacity shall be equivalent to the former.

5.1.4.6 Where storage tanks containing flammable liquids are protected by a medium velocity water spray system tapped from the hydrant service, the water requirements of the spray system shall be calculated as per IS 15325. The water requirement of the spray system worked out as above shall then be loaded for supplementary hose stream protection as under:

Sl No.	*Where the Largest Tank in a Dyke has a Diameter*	*Water Requirement* litre/min
i)	Up to 10 m	1 150
ii)	More than 10 m and up to 20 m	2 250
iii)	Over 20 m	3 400

If the total water requirement for spray protection and hose stream protection for storage tanks worked out as above exceeds the requirements of the hydrant service as per Tables 1, 2 and 3, the pumping capacity shall be equivalent to the former.

5.1.5 Pumps shall be capable of furnishing not less than 150 percent of rated capacity at a head not less than 65 percent of the rated head.

The shut-off head shall not exceed 120 percent of rated head in the case of horizontal pumps and 140 percent in the case of vertical turbine type pumps.

5.1.6 Each pump shall be provided with a name-plate giving, the delivery head, capacity and the number of rev/min.

5.1.7 In case of electrically driven pumps it is necessary that a compression ignition engine driven pump of similar capacity be installed as a standby. Where the hydrant service consists of two or more pumps, number of standby pumps shall be equal to half the number of main pumps.

5.1.8 The diameter of the suction pipe shall be such that the rate of flow of water through it does not exceed 120 litre/min.

5.1.9 Fire pumps shall be provided with positive suction and automatic starting devices capable of sequential starting of the pumps. The pumps shall be connected to audible alarm such as hooter or a siren

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located in a prominent place outside the pump house. Where there is a central fire station in the premises, additional alarm point shall also be provided in the fire station.

The pumping arrangement shall incorporate jockey pumps to take care of system losses. Also, Installation of jockey pumps helps to prevent hydraulic surges. The capacity of the jockey pumps shall neither be more than 5 percent of the installed pumping capacity nor less than 3 percent thereof (with a minimum of 10.8 m^3/h) unless the aggregate installed pumping capacity is in excess of 820 m^3/h, in which case the capacity of the jockey pump (s) shall be not less than 25 m^3/h plus 1 percent of the installed pumping capacity in excess of 820 m^3/h.

5.1.10 Each pump shall be provided with a non-return valve and a sluice valve on the delivery side, the sluice valve being installed on the upstream side of the non-return valve. A pressure gauge shall also be provided between the pump and the non-return valve. The size of the non-return valve and cut off (sluice) valve shall not be less than the size of the initial delivery pipe and, in no case, less than the delivery outlet of the pump. No butterfly valves shall be installed inside the pump room.

5.1.11 When the premises are also protected by sprinkler installation having elevated tank(s) as one of the main sources of water supply, and where the arrangement for filling the tank(s) is taken from the hydrant service, the connection shall be taken directly from the pump to the top of the tank (through a stop valve) and not through the hydrant mains.

5.1.12 In no case shall the pump from be sited within a building occupied for any other purpose.

Pumps shall not be installed in open. The pump rooms shall normally have brick/concrete walls and non-combustible roof, with adequate lighting, ventilation and drainage arrangements.

The pump room shall be so located as to be both easily accessible and where any falling masonry and the like from other buildings occasioned by fire or otherwise, cannot damage the pump room.

For high hazard (Sub-category B) occupancies, in addition to the above provisions, the pump room shall be located 30 m clear of all equipment where flammable fluids having flash point below 65°C are handled and/or stored and 15 m clear of pipes/pipe racks (carrying fluids other than water).

In case of light and ordinary hazard risks, pump rooms shall be located 6 m away from all surrounding buildings and overhead structures. Where this is not feasible the sides of the pump room falling within 6 m of the surrounding buildings shall be masonry walls of 355 mm thickness with door and window openings if any therein, protected by 2 h fire resisting doors and 6 mm thick wired glasses in steel framework respectively and the roof of the pump room shall be of reinforced cement concrete (RCC).

Likewise, when the pump room is attached to a building, a fire separating wall of 4 h fire resistance shall be constructed between the pump room and the attached building with wall openings therein protected by 2 h fire resisting doors on either sides. The roof of the pump room shall be of RCC construction at least 100 mm thick and access to the pump room shall be from the outside.

5.2 ELECTRICALLY DRIVEN PUMPS

5.2.1 The sub-station(s) and/or D.G. house(s)-supplying power to the fire pump(s) shall be of incombustible construction and shall be located at least 6 m away from all surrounding buildings.

Where this is not feasible, all door and window openings of the surrounding buildings within 6 m of the sub-station(s) and/or D.G. house(s) shall be protected by single fireproof doors and 6 mm thick wired glasses in steel framework respectively. Likewise, roof eaves, if any, of the surrounding buildings falling within 6 m of the sub-station(s) and/or D.G. house(s) shall be cut off and wall raised as a parapet.

The above provisions shall also apply when the sub-station(s) and D.G. house(s) are within 6 m of each other.

Where the sub-station(s) and/or D.G. house(s) are attached to buildings, fire resisting wall of 4 h fire resistance with door openings therein protected by 2 h fire resisting doors on either sides shall be constructed to segregate the sub-station(s) and/or D.G. house(s) from the attached buildings and where the attached building is storied, the roof of the sub-station(s) and/or D.G. house(s) shall be of R.C.C. construction of at least 100 mm thickness.

Transformer cubicles inside these sub-stations shall be separated from H.T. and L.T. cubicles and from each other by blank walls of bricks/stone/concrete blocks of 355 mm thickness or of R.C.C of 200 mm with door openings, if any therein, protected by 2 h fire resisting doors.

The sub-station(s) and D.G. house(s) shall also be separated from each other as above.

Transformers installed outdoors, which are supplying power to fire pump(s), shall be located at least 6 m away from all surrounding buildings (including sub-station(s) and/or D.G. house(s).

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Where this is not feasible all door and window openings of the building(s) within 6 m of the transformer shall be protected by 2 h fire resisting doors and 6 mm thick wired glasses in steel framework respectively. Likewise, roof eaves of the building(s) falling within 6 m of the transformer shall be cut and wall raised as a parapet.

Baffle walls of bricks/stone/concrete blocks of 355 mm thickness or of R.C.C. of 200 mm thickness shall be constructed between two transformers and these walls shall be extended horizontally 600 mm beyond the extremities of the transformers and vertically 600 mm above the highest point of the transformers.

NOTE — Where oil capacity of the individual transformer is larger than 5 000 litres separating walls must be provided in between the transformers and a clear distance as per the following table shall be maintained between the transformers and the substation:

Oil Capacity of Individual Transformer litre	*Clear Separating Distance* m
5 000 to 10 000	8.0
Above 10 000 up to 20 000	10.0
Above 20 000 up to 30 000	12.5
Over 30 000	15

Notwithstanding above, For high hazard (sub-category B) occupancies, sub-station(s) supplying power to the fire pump(s) shall, in addition to complying with the above provisions, be located 30 m clear of all equipment where flammable fluids having flash point below 65°C are handled and/or stored

5.2.2 Electric supply feeder(s) to sub-station(s) supplying power to fire pump shall, consist of armoured cables buried underground which shall not pass under any building or permanent structures.

If the feeders are laid inside an underground cable duct/ gallery, they shall be placed in a corner of the duct/ gallery and shall be isolated from other cables in the duct/gallery by means of fire bricks/sand packing/other suitable passive protection of at least 30 min fire rating.

Under extenuating circumstances, where it is not feasible to lay the feeders underground, overhead feeders may be laid provided they do not fall within a horizontal distance of,

a) 15 m of any process buildings/plant or tanks containing flammable liquids; or
b) 6 m of any other building or tanks containing non-flammable liquids or of storage in open.

5.2.3 in case of high hazard (sub-category B) occupancies, all sub-stations (except main receiving station in the route of the electrical supply to the fire pump(s) which receive power by overhead feeders shall be provided with two sets of feeders which, apart from conforming with the above distance provisions, shall be run along two different routes in such a way that failure of more than one route due to a single mishap would be a remote possibility.

5.2.4 A direct feeder without any tapping shall be laid from the sub-station to the pump house. The feeder shall consist of an armoured cable buried underground and shall not pass under any building or permanent structure.

The cable run inside the substation from the breaker up to its point of burial or entry into cable duct/gallery shall be provided with suitable passive protection of at least 30 min fire rating.

If the feeder is laid inside an underground cable duct/ gallery, it shall be placed in a corner of the duct/gallery and shall be isolated from other cables in the duct/ gallery by means of fire bricks/sand packing/other suitable passive protection of at least 30 min fire rating.

Under extenuating circumstances, overhead feeders may be laid provided they do not fall within a horizontal distance of,

a) 15 m of any process buildings/plant or tanks containing flammable liquids; or
b) 6 m of any other building or tanks containing non-flammable liquids or of storage in open.

NOTE — In case of High Hazard 'B' occupancies, if the feeder to the fire pump(s) is not buried underground, two sets of feeder shall be provided which shall,

a) conform to the above distance provisions;
b) be run along two different routes in such a way that failure of more than one route due to a single mishap would be a remote possibility.

5.2.5 Sufficient spare power shall always be available to drive pumping set(s) at all times throughout the year.

5.2.6 The electric supply to the pumping set(s) shall be entirely independent of all other equipment in the premises that is even when the power throughout the entire premises is switched off, the supply to the pump shall continue to be available un-interrupted. This can be achieved by taking the connection for the pump(s) from the incoming side of the main L.T. breaker. However, in cases where two or more transformers and/ or sources of supply are connected to a common bus bar the connection may be taken through the bus bars.

5.2.7 The fire pump circuit shall be protected at the origin by an automatic circuit breaker so set as to permit the motor to be overloaded during an emergency to the maximum limit permissible by the manufacturers. Further, the under voltage release/no volt coil of that circuit breaker shall be removed.

Where cable lengths are long enough to warrant back-up protection, such a protection may be provided.

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5.2.8 It is recommended that telltale lamps, which would continuously glow when power is available to the fire pump(s) circuit, be provided and fixed in a prominent position, both in the substation and in the pump room.

5.2.9 Where there is more than one source of power for the operation of pumping set(s) every electrical circuit shall be so designed as to ensure that when necessary, the set(s) will continue to operate without the manual operation of an emergency switch.

5.2.10 The pumping set(s) shall be securely mounted on a robust bedplate, if of the horizontal type, and shall be free from vibration at all variations of load.

5.2.11 The motor shall be of continuous rating type and its rating shall be at least equivalent to the horsepower required to drive the pump at 150 percent of its rated discharge (*see* **7.4.1.5**).

5.2.12 The motor shall be of totally enclosed type or drip proof type, the latter having their air inlets and outlets protected with meshed wire panels to exclude rodents, reptiles and insects.

5.2.13 The motor windings shall be vacuum impregnated with heat and moisture resisting varnish (preferably glass fibre insulated) to withstand tropical conditions.

5.2.14 Motors wound for high tension supplies shall have a suitable fixed warming resistance to maintain the motor windings in a dry condition at all times. The resistance shall be connected to the lighting or other equivalent circuit.

Heating apparatus shall also be provided, for medium tension motors where they are located below ground level, in order to maintain the motor windings in a dry condition. Adequate drainage arrangements shall also be provided in the pump house in such cases.

5.2.15 Wiring in the pump room shall be in accordance with IS 1646. The incoming cable to the fire pump room shall terminate in an isolating switch fuse unit incorporating HRC fuses and provided with a distribution system, where necessary.

5.2.16 It is preferable to have direct on line starters for the fire pump motors. However, star delta starters are also acceptable. Any other arrangement would require prior approval of authority having jurisdiction.

5.2.17 The starting switchgear for the fire pumps shall incorporate an ammeter with a clear indication of the motor full load current. Remote controlled starting arrangements are also acceptable.

5.2.18 Cables for motors and switchgear shall be armoured type.

5.2.19 It is recommended that equipment throughout be painted fire red and suitably marked for identification.

5.2.20 Necessary spare parts including a set of fuses shall be kept in readiness in a glass-fronted box in the pump house.

5.3 Compression Ignition Engine Driven Pumps

5.3.1 *Pump Room*

In sub-zero conditions, the pump room shall be artificially heated to maintain the temperature of the room above 10°C.

Adequate ventilation shall be provided for the air required for aspiration and to limit the temperature rise in the room to 10°C above the ambient temperature when the engine is on full load.

5.3.2 *Engine*

5.3.2.1 The engine shall be,

a) able to accept full load within 15 s from the receipt of the signal to start;
b) naturally aspirated, supercharged or turbo-charged and either air or water-cooled. In the case of charge air cooling by means of a belt-driven fan or of a belt driven auxiliary water pump there shall be multiple belts such that should half the belts break, the remaining belts would be capable of driving the fan or pump;
c) Capable of operating continuously on full load at the site elevation for a period of 6 h;
d) Provided with an adjustable governor to control the engine speed within 10 percent of its rated speed under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load; and
e) Provided with an in-built tachometer to indicate r.p.m. of the engine.

5.3.2.2 Engines, after correction for altitude and ambient temperature, shall have bare engine horsepower rating equivalent to the higher of the following two values:

a) 20 percent in excess of the maximum brake horsepower required to drive the pump at its duty point; and
b) The brake horsepower required for driving the pump at 150 percent of its rated discharge.

5.3.3 The coupling between the engine and the pump shall allow each unit to be removed without disturbing the other.

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5.3.4 *Air Filtration*

The air intake shall be fitted with a filter of adequate size to prevent foreign matter entering the engine.

5.3.5 *Exhaust System*

The exhaust shall be fitted with a suitable silencer and the total backpressure shall not exceed the engine maker's recommendation. When the exhaust system rises above the engine, means shall be provided to prevent any condensate flowing into the engine.

5.3.6 *Engine Shut-Down Mechanism*

This shall be manually operated and return automatically to the starting position after use.

5.3.7 *Fuel System*

5.3.7.1 *Fuel*

There shall be kept on hand at all times sufficient fuel to run the engine on full load for 6 h, in addition to that in the engine fuel tank.

5.3.7.2 *Fuel tank*

5.3.7.2.1 The fuel tank shall be of welded steel, constructed to relevant Indian or Foreign Standard for mild steel drums. The tank shall be mounted above the engine fuel pump to give gravity feed unless otherwise recommended by the manufacturer. The tank shall be fitted with an indicator showing the level of the fuel in the tank.

5.3.7.2.2 The capacity of the tank shall be sufficient to allow the engine to run on full load for:

Class of Hazard	*Capacity* h
Light hazard	2
Ordinary hazard	4
High hazard (A)	6
High hazard (B)	8

NOTE — where there is more than one compression ignition engine driven pump set there shall be a separate fuel tank and fuel feed pipe for each engine.

5.3.7.3 *Fuel feed pipes*

Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position. Pipe joints shall not be soldered and plastic tubing shall not be used.

5.3.7.4 *Auxiliary equipment*

The following shall be provided:

a) A sludge and sediment trap;
b) A fuel level gauge;
c) An inspection and cleaning hole;
d) A filter between the fuel tank and fuel pump mounted in an accessible position for cleaning; and
e) Means to enable the entire fuel system to be bled of air (Air relief cocks are not allowed; screwed plugs are permitted).

5.3.8 *Starting Mechanism*

Provision shall be made for two separate methods of engine starting namely:

a) Automatic starting by means of a battery powered electric starter motor. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression.
b) Manual starting

NOTE — The starter motor used for automatic starting may also be used for manual starting provided there are separate batteries for manual starting.

5.3.9 *Battery Charging*

The means of charging the batteries shall be by a 2-rate trickle charger with manual selection of boost charge and the batteries shall be charged in position. Where separate batteries are provided for automatic and manual starting, the charging equipment shall be capable of trickle charging both the batteries simultaneously. Equipment shall be provided to enable the state of charge of the batteries to be determined.

5.3.10 *Engine Exercizing*

The test shall be for a period of at least 5 min each day. Where closed circuit cooling systems are used, the water level in the primary system shall be checked and if necessary, water shall be added during the course of procedure.

5.3.11 *Tools*

A standard kit of tools shall be provided with the engine and kept on hand at all times.

5.3.12 *Spare Parts*

The following spare parts shall be supplied with the engine and kept on hand:

a) Two sets of fuel filters, elements and seals;
b) Two sets of lubricating oil filters, elements and seals;
c) Two sets of belts (where used);
d) One complete set of engine-joints, gaskets and hoses;
e) Two injector nozzles;
f) One complete set of piston rings for each cylinder; and

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g) One inlet valve and one exhaust valve.

6 WATER SUPPLIES

6.1 Water for the hydrant services shall be stored in an easily accessible surface/underground lined reservoir or above ground tanks of steel concrete or masonry. The effective capacity of the reservoir above the low water level (defined hereunder), or above the top of the pump casing in case it is higher than the low water level for the various classes of occupancies and size of hydrant installations shall be as indicated in the Table 4.

The low water level is a point at least three times the diameter of the suction pipe above the draw-off point.

6.2 Large natural reservoirs with water capacity exceeding 10 times the aggregate water requirements of all fire pumps there from may be left un-lined.

6.3 The fore bay supplying water to the thermal power station fed by canals from perennial water sources like rivers, rivulets, dams, etc, may be accepted as firewater reservoirs provided the availability of 2 h pumping capacity is ensured. The cooling water pond(s) may also be accepted as firewater reservoirs provided the availability of 2 h pumping capacity is ensured.

Cooling water basins shall not be acceptable as equivalent to cooling water ponds.

6.4 Reservoirs of and over 225 000 litre capacity shall be in two interconnected equal compartments to facilitates cleaning and repairs.

6.5 Fire pump(s) tapping shall be taken from both the compartments and shall be connected through sluice valves to a common suction header. The pumps, in turn, shall draw their suction from the common header through sluice valves. In case of dual purpose reservoirs catering to fire water and general water requirements, the tapping for the general water pumps shall be taken at a higher level such that the capacity of the reservoir between the low water level as defined heretofore (or the top of the fire pump casing in case it is higher than the low water level) and the general water tapping is at least equivalent to the requirements indicated in Table 4.

7 MAINS

7.1 The hydrants mains shall normally be laid underground or in masonry culverts with removable covers of incombustible construction according to the provisions given in IS 5822 and shall be of any one of the following types:

a) Cast iron double flanged pipes conforming to the following standards:

Type of Pipes	*Class of Pipes*	*Ref to, Indian Standard*
Horizontally cast iron pipes	B	IS 7181
Vertically cast iron pipes	A	IS 1537
Centrifugally Cast (Spun) Iron Pipes	A	IS 1536
Centrifugally cast (Spun) ductile iron pipes	A	IS 8329

NOTE — In case of vertically cast pipes, where the nominal diameter of the pipes exceeds 300 mm or where the pump delivery pressure exceeds 7 kg/cm^2, Class B pipes would be necessary.

b) Centrifugally cast (Spun) iron class A pipes with tyton joints — (Rubber gasketed).

c) Wrought or mild steel pipes (un-galvanized) of Medium grade conforming to IS 1239 (Part 1 and Part 2) or IS 3589 having welded joints and coated and wrapped as per IS 10221. Galvanized pipes with flanged joints and fittings can also be used. MS pipes may be allowed for extension of existing systems which are laid with CI pipes

Holiday testing for wrapping and coating is essential. Holiday testing may preferably be carried by flexible and detachable ring probe,

Table 4 Size of Hydrant Installations
(*Clauses* 6.1 *and* 6.5)

Sl No. (1)	Nature of Risk (2)	Capacity of Static Storage Exclusively Reserved for Hydrant Service (3)
i)	Light hazard	Not less than 1 h aggregate pumping capacity with a minimum of 135 000 litre
ii)	Ordinary hazard	Not less than 2 h aggregate pumping capacity.
iii)	High hazard (A)	Not less than 3 h aggregate pumping capacity
iv)	High hazard (B)	Not less than 4 h aggregate pumping capacity

NOTE — The capacity of the reservoir for ordinary and high hazard class occupancies may be reduced by the quantum of inflow of 1 h in case of ordinary hazard, 90 min in case of high hazard (A) and 2 h in case of high hazard (B) occupancies, from a reliable sources (other than town's main), but in no case shall the reservoir capacity be less than 70 percent of that mentioned above.

In case of light hazard class occupancies the minimum capacity of the reservoir shall be increased to 225 000 litre, if the highest floor of the building is more than 15 m above the surrounding ground level.

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which will enable the entire 360°of the surface of the pipe to be scanned.

At least 10 percent of all the welded joints shall be radio graphically tested and half of the joints radio graphed shall be the 'field joints'.

d) CPVC pipes conforming to IS 16088, un-plasticized PVC Class 4 pipes conforming to IS 4985 and HDPE pipes conforming to IS 4984 are permitted for use in light hazard occupancies for underground mains only. Depth at which such pipes shall be laid shall conform to relevant standards

7.2 Underground mains shall be laid such that the top of the pipe is not less than 1 m below the ground level and masonry or equivalent supports shall be provided at regular intervals which shall be suitable for soil conditions. In case of poor soil conditions, it may be necessary to provide continuous masonry or equivalent supports.

7.3 Mains above ground shall be medium grade wrought or mild steel (galvanized or un-galvanised) conforming to IS 1239 (Part 1 and Part 2) or IS 3589 with welded, threaded or flanged joints, adequately supported at regular intervals on masonry or RCC stools or pedestals and not on pipe racks. The mains shall be supported at regular intervals not exceeding 6 m. It should be supported at every 3 m for pipes less than 150 mm diameter.

Such pipes shall be run at least 6 m away from the face of the buildings and open storage areas in case of light and ordinary hazard occupancies and 15 m in case of high hazard occupancies

In case of practical difficulties in maintaining the stipulated distance from the face of the building, for example between boiler house and T. G. building and between transformer and T. G. building in thermal power plants, the same may be permitted to be laid overhead provided the mains installed in such areas form part of sub-ring only.

7.4 Except for internal mains, mains shall not be laid under buildings. Where, however, circumstances necessitate laying of mains under buildings, the portion of mains falling under the buildings shall be laid in masonry trenches with removable covers and cut-off valves shall be provided at points of entry and exit.

As far as possible, mains shall not be laid under large open storages, railroads and roads carrying heavy traffic.

7.5 The mains shall not traverse ground that is not under the control of the owner of the installation nor under a public roadway.

7.6 The system shall be capable of withstanding for 2 h a pressure equivalent to 150 percent of the maximum working pressure. While hydro-testing. Inclusion of cut-off valves in the mains to be tested can be avoided.

7.7 All boltholes in flanges shall be drilled. The drilling of each flange shall be in accordance with the relevant Indian Standards.

7.8 Flanges shall be faced and have jointing of rubber insertion or asbestos compound.

7.9 Fittings installed underground shall be of cast iron 'heavy' grade conforming to IS 1538 whereas those installed above ground shall normally be of medium grade wrought steel or mild steel conforming to IS 1239 (Part 2) or malleable iron fittings conforming to IS 1879.

7.10 Mild steel stand post may be accepted even in cases where underground mains are of cast iron.

7.11 It is recommended to provide semi-circular RCC pipes fore cast iron pipes at road crossings.

7.12 Mains shall be laid in rings (except as specified in **7.13**) and the size of the initial pipe shall not, in any case, be less than the internal diameter of the delivery outlet of the pump.

Flushing connections with isolation valves should be provided at suitable locations in the firewater ring main.

7.13 In the case of riser mains in storied buildings and in locations where it is not feasible to lay a ring main, a terminal main may be provided, but in no case shall the number of hydrants on such terminal mains exceed 5. A terminal main of 80 mm diameter shall not feed more than one hydrant that having a diameter of 100 mm shall not feed more than two hydrants that having a diameter of 125 mm shall not feed more than three hydrants and a main of 150 mm shall not feed more than five hydrants. Where number of hydrants on a riser exceeds 5, 200 mm terminals can be used subject to satisfactory pressure being available at the topmost point.

7.14 The hydrant system shall be hydraulically so designed that when half of the aggregate pumping capacity is being discharged at the farthest/ hydraulically most remote point and the other half in the most vulnerable area enroute, a minimum running pressure of 5.25 kg/cm^2 is available at the former point and the rate of flow of water does not exceed 5 m/s anywhere in the system (flow through one hydrant can be taken as 600 litre/min for this purpose).

In case the hydraulically most remote point is the area fed by other systems tapped from hydrant system, the entire aggregate pumping capacity shall be considered as being discharged at this point at a minimum running

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pressure of 5.25 kg/cm^2 and the hydrant system shall be so designed that the rate of flow of water does not exceed 5 m/s anywhere in the system.

7.15 Isolation Valves

7.15.1 Isolation valves shall be provided in the network to enable isolation of any section of the network without affecting the flow in the rest. These valves are distributed according to the general layout of the installation. The isolation valves shall be normally located near the loop junctions. Additional valves shall be provided in the segments where the length of the segment exceeds 300 m.

7.15.2 Cut-off valves shall conform to IS 780/ IS 14846, Class 2.

7.15.3 In case of system having working pressure in excess of 7 kg/cm^2 PN-1.6 rating would be necessary for valves conforming to IS 780 and Class 3 for those conforming to IS 14846. Cast steel valves of class 150 are, however, acceptable irrespective of the working pressure of the system.

7.15.4 Other types of valves like rising spindle valves may also be used.

7.15.5 Butterfly valves can be accepted subject to the condition that the valves of diameter exceeding 150 mm shall necessary be of gear operated.

7.16 All cut-off valves shall be of the right-hand type and enclosed in properly constructed surface boxes, at least 1 m^2 in area so as to allow for broken joints being easily remade. The top of the surface box shall be 80 mm above ground level, except where it is located on a road. Valve wheels shall have an arrowhead engraved or cast thereon showing direction for turning open and close.

It is recommended that the position of the surface box be indicated by an iron plate painted fire red with distinct lettering. Such plates shall also show the open and close direction as cast or indicated on the valves and the serial number of the sluice valve.

7.17 In case of installations in earthquake prone zones, flexible couplings shall be used for jointing purposes.

8 HOSE PIPES

8.1 In the case of yard hydrants, hose pipes and nozzles shall be installed either in central hose stations which shall be of the type which enables the condition and quantity of hose, nozzles, etc. to be checked over at a glance and ensures that other useful equipment is ready at hand in the event of a fire or near each hydrant in glass fronted hose boxes of suitable design. In case of hydrants on upper floors or internal hydrants, hosepipes and nozzles shall necessarily be installed near each hydrant in glass fronted hose boxes of suitable design.

NOTE — Locations and number of hose stations will depend upon several factors such as fire loads, accessibility and positions of watch posts. Such locations shall be finalised in consultation with authority having jurisdiction.

8.2 Requirements of Hose Pipes

8.2.1 If hose is kept in central hose stations, for each of the first ten hydrants in the compound of the premises (a double headed hydrant counting as two except where they are provided as a standard practice throughout the system), two lengths of hose 15 m each and an additional 15 m length for each hydrant in excess of ten, shall be provided.

In case of system having more than 55 hydrant outlets, the total number of hose lengths required may be limited to 55 plus 20 percent of the number of hydrant outlets in excess of 55.

Where a fire engine is maintained on the premises manned by a whole time fire brigade, the number of hose pipes required (including those on the engine) would be 55 plus 10 percent of the number of outlets in excess of 55.

8.2.2 If hose is kept in hose boxes alongside hydrants, each box shall contain two lengths of 15 m each.

8.3 All hoses shall be of 63 mm diameter of either of the following types:

a) Unlined flax canvas complying with IS 4927;
b) Rubber lined woven-jacketed as per IS 636; and
c) Controlled percolation type complying with IS 8423.

8.4 All couplings shall be of the instantaneous spring-lock type and the nozzles shall be of not less than 16 mm in diameter, or more than 25 mm in diameter except in case of high hazard occupancies where the maximum nozzle diameter may be 32 mm.

All couplings, branch pipes and nozzles shall otherwise comply with IS 903.

8.5 Hose shall be attached to the coupling in such a way that each half of the coupling shall have two 5 mm diameter holes drilled in the tail. The hose shall be first fixed to the tail of the coupling with copper rivets then served or bound with 1.5 mm galvanized mild steel or copper wire for a length of 50 mm which shall extend to the outer ends of the grooving on the coupling tail. Over the galvanized mild steel or copper wire a leather or equally protective band shall be bound with four strands of 1.12 mm galvanized mild steel or copper wire at each end of the band. The protective band shall be carried beyond the tail of the coupling to prevent leaking. Copper wire, if used, shall be softened before being used. Couplings

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attached to the hose otherwise than by copper rivets shall not be accepted.

8.6 Spare hose to the extent of 10 percent of the above requirements, with a minimum quantity of 30 m shall always be kept readily available. Such spare hose shall be in 15 m lengths, readily attached to couplings.

8.7 It is recommended that a system of marking and numbering hose be arranged so that the various lengths are easily recognisable.

8.8 In central hose stations and hose boxes a tin containing a set of spare rubber rings packed in french chalk shall be kept.

8.9 Central hose stations and hose boxes shall be so arranged that hose is not exposed to the sunrays.

8.10 All central hose stations or hose boxes, when provided with locks shall have one master key which shall be available either at the main gate or any other prominent and easily accessible location known to the fire fighting personnel.

9 REQUIREMENTS OF NOZZLES

9.1 The number of nozzles to be provided shall be equivalent to half the number of hose pipes installed on the premises.

9.2 In locations where a jet of water directed from a normal type nozzle is likely to cause more harm than good or where a gentle spray of water is essential for the extinguishment of a fire, a fog type or a spray type of nozzle complying with IS 2871 shall be used.

9.3 Spare nozzles to the extent of 10 percent of the above requirements, with a minimum of two, shall always be kept readily available.

10 FOAM COMPOUND

10.1 Foam used should be compatible with hazard involved. Foam systems shall conform to IS 12835.

10.2 Stock of Foam Compound

10.2.1 Quantity of foam compound to be stored shall be equal to 100 percent of requirement of largest fixed roof or floating roof tank, plus that required for one portable foam monitor of 4 500 litre/min foam solution capacity and two hose streams of foam each with a capacity of 1 140 litre/min of foam solution.

10.2.2 Foam compound should be tested periodically for ensuring its quality and the deteriorated quantity replaced.

11 FIRE FIGHTING PERSONNEL

11.1 A squad consisting of watch and ward personnel, fire pump men and departmental supervisors and/or operatives trained in the operation of the fire service shall be maintained on the premises round the clock. The number of personnel constituting the squad shall necessarily depend upon the size of the risk, but in no case shall less than eight trained persons be available at any time during the day or night.

Minimum number of trained persons required may be further reduced to six in case of automatic pressurised hydrant systems.

11.2 Squad leaders shall be trained by government recognized institution and their usefulness would be considerably enhanced, if they reside on the premises.

11.3 Squad personnel shall be provided with clothing and equipment including helmets confirming to IS 2745 or IS 2925, belts and boots preferably fire fighter's boots.

11.4 A muster roll showing the duties allocated to each member of the brigade shall be prepared and copies supplied to each squad leader as well as pasted in convenient places throughout the premises, so as to be quickly available for reference in case of emergency.

11.5 Practice drills shall take place weekly and wet drills shall be carried out at intervals of not more than a fort-night

11.6 During wet drills, hydrants (including those of upper floors), hose pipes and nozzles, shall be taken into use in rotation, so that the efficacy of these appliances would be automatically checked and any defects observed, set right.

11.7 A register signed by fire marshal and works manager shall be kept showing Information such as names and designations of the persons attending the drill, type of drill dry or wet, serial number of hydrants operated, duration of operation of pumps, defects observed, if any is useful.

11.8 The services of the pump man could be profitably utilized for the maintenance of all fire fighting appliances including hand appliances. He shall also be thoroughly conversant with the locations of all appliances, particularly of hydrant cut-off valves so that in an eventuality he can be of assistance to the factory's fire brigade or the town's fire brigade.

11.9 Keys of all doors in the factory premises shall always be available at the main gate.

11.10 It is recommended that fire pump room(s) and the main gate(s) of all factory premises be connected to all manufacturing sections through the internal telephone system.

Telephones interlinked to this system may also be put up in proper cubicles at convenient locations near

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godown ranges and other strategic points. This would affect saving of valuable time in an emergency to alert the fire fighting personnel and the pump man.

11.11 Pump repeater panel should be provided in guard house.

12 MAINTENANCE

12.1 Pumps

12.1.1 *General*

12.1.1.1 A trained pump man shall be available on all shifts and at all hours of the day and night to operate the pumps as and when required.

12.1.1.2 Pump sets shall be run for at least 5 min every day.

12.1.1.3 All pump glands shall be maintained in efficient working condition and the packing renewed as required to maintain efficiency.

12.1.1.4 Suction and delivery valves shall be examined once every six months, particularly where sand or other objectionable matter is liable to be drawn through the pump suction.

12.1.1.5 All working parts shall be kept clean and lightly oiled. Any necessary repairs shall be put in hand and carried out immediately.

12.1.2 *Electrically Driven Pumps*

12.1.2.1 The bearing grease cup shall be checked once every week and refilled with fresh grease, if necessary.

12.1.2.2 Starter contacts shall be cleaned once every week.

12.1.2.3 Insulation resistance of pump motor circuit shall be examined once every six months and record of results shall be maintained.

12.2 Mains

12.2.1 Hydrant mains shall be tested once a fortnight with a pump delivering at its maximum pressure. A running test with two or more hose lines each 30 m long operating shall be carried out.

12.2.2 All cut-off valves shall be operated and oiled, if necessary, once a month.

12.2.3 Cut-off valves shall be thoroughly overhauled annually to remove sludge and other foreign matter collected in the valve seating.

12.3 Hydrants

12.3.1 All hydrants shall be examined systematically once a week to ensure that valves and spring catches are maintained in good condition.

12.3.2 Spare washers shall be kept for hydrant valve seats.

12.4 Hose Pipes and Nozzles

12.4.1 All hose boxes/hose stations shall be inspected externally once every week to ensure that the equipment installed therein is intact. Further, the hose boxes/hose stations shall be cleaned internally and externally once a month.

12.4.2 When the hose gets worn out at the tail end of the coupling(s), it is permissible to cut the end(s) of the hose. However should the lengths of the hose after cutting(s) fall below 90 percent of its original, the hose shall be discarded.

12.4.3 A hose register shall be kept showing Information such as date purchased, date brought into use, date cut (if reduced in length), is useful.

12.4.4 Any hose becoming inefficient through use, neglect or from any other cause, shall be discarded.

12.4.5 Fire protection hose shall not be used for purposes other than fire protection and drill.

13 MEASURES TO BE TAKEN WHERE THE INSTALLATION IS FOR ANY REASON TEMPORARILY INOPERATIVE

13.1 If any component of the hydrant system is to be replaced for any reason whatsoever, the entire system shall not be rendered inoperative but the particular section shall only be isolated by closing the necessary cut-off valves. If, however, it is not possible to complete the replacement before nightfall, the cut-off valves shall not be left closed overnight. Instead, blank flanges shall be provided at the point where the component has been removed so that the entire system, other than the component, which has been removed, would remain operative through the night.

13.2 Only one compartment of the reservoir shall be emptied out at a time of cleaning or repair work.

13.3 If the pump is expected to be inoperative for more than 72 h, every effort shall be made to connect the service water supply to the hydrant system for the duration the pump is inoperative.

13.4 If the hydrant service is to be extended, the extended portion shall be first laid and, thereafter, the connection between the existing system and the extension shall be carried out expeditiously, so that the entire system is not left inoperative overnight.

14 ACCEPTANCE TEST

Fire flow tests are conducted on water distribution systems to determine the rate of flow available at

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various locations for fire-fighting purposes. A certain residual pressure in the mains is specified at which the rate of flow should be available. Following definitions shall apply for acceptance test:

a) *Rated capacity* — The flow available from a hydrant at the designated residual pressure (rated pressure) either measured or calculated.
b) *Residual pressure* — The pressure that exists in the distribution system, measured at the residual hydrant at the time the flow readings are taken at the flow hydrants.
c) *Static pressure* — The pressure that exists at a given point under normal distribution system conditions measured at the residual hydrant with no hydrants flowing.

14.1 Flow Testing

For the purpose of uniform marking of fire hydrants, the ratings should be based on a residual pressure of 1.4 bar for all hydrants having a static pressure in excess of 2.8 bar. The procedure consists of discharging water at a measured rate of flow from the system at a given location and observing the corresponding pressure drop in the mains.

14.2 Test Layout

After the location where the test is to be run has been determined, a group of test hydrants in the vicinity is selected. One hydrant, designated the residual hydrant, is chosen to be the hydrant where the normal static pressure shall be observed with the other hydrants in the group closed, and where the residual pressure shall be observed with the other hydrants flowing.

This hydrant is chosen so it will be located between the hydrant to be flowed and the large mains that constitute the immediate sources of water supply in the area. The number of hydrants to be used in any test depends upon the strength of the distribution system in the vicinity of the test location. Sufficient discharge should be achieved to flow the total demand necessary for fire-fighting purposes.

The equipment necessary for field work consists of the following:

a) A single 14 bar bourdon pressure gauge with 0.068 9 bar graduations;
b) A number of pitot tubes;
c) Hydrant wrenches;
d) 3.5 or 4.0 bar bourdon pressure gauges with 0.068 9 bar graduations, and scales with 1.6 mm graduations (One pitot tube, 3.5 or 4.0 bar gauge, a hydrant wrench, a scale for each hydrant to be flowed); and
e) A special hydrant cap tapped with a hole into which a short length of 6.35 mm brass pipe is fitted; this pipe is provided with a T connection for the 14 bar gauge and a cock at the end for relieving air pressure.

14.3 Test Procedure

In a typical test, the 14 bar gauge is attached to one of the 64 mm outlets of the residual hydrant using the special cap. The cock on the gauge piping is opened, and the hydrant valve is opened full. As soon as the air is exhausted from the barrel, the cock is closed. A reading (static pressure) is taken when the needle comes to rest.

At a given signal, each of the other hydrants is opened in succession, with discharge taking place directly from the open hydrant butts. Hydrants should be opened one at a time. With all hydrants flowing, water should be allowed to flow for a sufficient time to clear all debris and foreign substances from the stream(s). At that time, a signal is given to the people at the hydrants to read the pitot pressure of the streams simultaneously while the residual pressure is being read. After the readings have been taken, hydrants should be shut down slowly, one at a time, to prevent undue surges in the system.

14.4 Pitot Readings

When measuring the pitot pressure of a stream of practically uniform velocity, the orifice in the pitot tube is held downstream approximately one-half the diameter of the hydrant outlet or nozzle opening, and in the centre of the stream. The centre line of the orifice should be at right angles to the plane of the face of the hydrant outlet. The air chamber on the pitot tube should be kept elevated. The valve for the flowing outlet should be wide open to give a more streamlined flow and a more accurate pitot reading.

14.5 Determination of Discharge

At the hydrants used for flow during the test, the discharges from the open butts are determined from measurements of the diameter of the outlets flowed, the pitot pressure (velocity head) of the streams as indicated by the pitot gauge readings, and the coefficient of the outlet being flowed If flow tubes (stream straighteners) are being utilized, a coefficient of 0.95 is suggested unless the coefficient of the tube is known.

The formula used to compute the discharge, Q, in US gpm from these measurements is as follows:

$$Q = cd^2\sqrt{p}$$

where

c = coefficient of discharge (*see* Fig. 1);

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d = diameter of the outlet in inches; and

p = pitot pressure (velocity head), in psi.

14.6 Determination of Discharge Without a Pitot

If a pitot tube is not available for use to measure the hydrant discharge, a 3.5 or 4.0 bar gauge tapped into a hydrant cap can be used. The hydrant cap with gauge attached is placed on one outlet, and the flow is allowed to take place through the other outlet at the same elevation.

14.7 Calculation Results

The discharge in US gpm for each outlet flowed is obtained by the formulae given below:

$$Q = 29.84 cd^2 \sqrt{p}$$

If more than one outlet is used, the discharges from all are added to obtain the total discharge.

The formula that is generally used to compute the discharge at the specified residual pressure or for any desired pressure drop is

$$Q_R = Q_F \frac{H_R^{0.54}}{H_F^{0.54}}$$

where

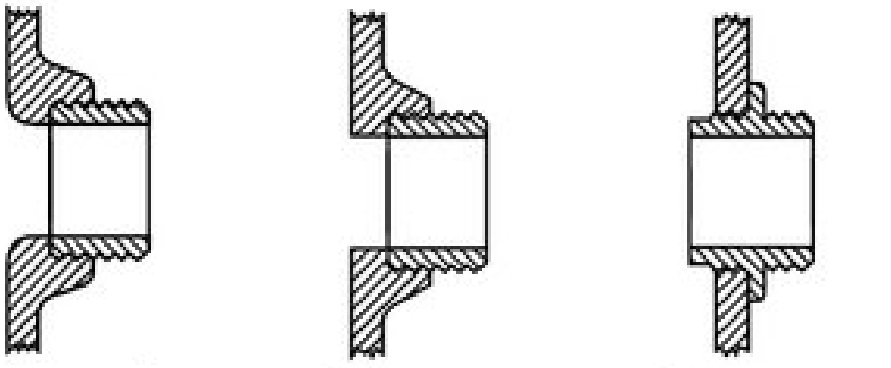
Q_R = flow predicted at desired residual pressure;

Q_F = total flow measured during test;

H_R = pressure drop to desired residual pressure; and

H_F = pressure drop measured during test.

Results are usually carried to the nearest 380 litre/min for discharges of 3 800 litre/min or more, and to the nearest 190 litre/min for smaller discharges, which is as close as can be justified by the degree of accuracy of the field observations. The data secured during the testing of hydrants for uniform marking can be valuable for other purposes. The form show in Annex C may be used to record information that is taken and the results of the flow test should be indicated on a hydraulic graph.



Outlet smooth and nounded (coef. 0.90) | Outlet square and sharp (coef. 0.80) | Outlet square and into borrell (coef. 0.70)

FIG. 1 VALUES OF COEFFICIENT OF DISCHARGE

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ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
5 : 2007	Colours for ready mixed paints and enamels (*fifth revision*)
636 : 1988	Specification for non-percolating flexible fire fighting delivery hose (*third revision*)
780 : 1984	Sluice valves for water works purposes (50 to 300 mm size)
903 : 1993	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner (*fourth revision*)
908 : 1975	Specification for fire hydrant stand post type (*second revision*)
909 : 1992	Specification for underground fire hydrant sluice valve type (*third revision*)
1239	Specification for steel tubes, tubular and other wrought steel fittings :
(Part 1) : 2004	Steel tubes (*sixth revision*)
(Part 2) : 2011	Steel pipe fittings (*fifth revision*)
1536 : 2001	Specification for centrifugally cast (spun) iron pressure pipes for water gas and sewage (*fourth revision*)
1537 : 1976	Specification for vertically cast iron pressure pipes for water, gas and sewage (*first revision*)
1538 : 1993	Specification for cast iron fittings for pressure pipes for water, gas and sewage (*third revision*)
1641 : 2013	Code of practice for fire safety of buildings(general): general principles of fire grading and classification (*second revision*)
1646 : 1997	Code of practice for fire safety of buildings (general): Electrical installations
1879 : 2010	Malleable cast iron pipe fittings _ Specification
2745 : 1983	Specification for Non-metal helmet for firemen and civil defence personnel (*second revision*)
2871 : 2012	Specification for branch pipe, universal for fire fighting purposes (*second revision*)
2925 : 1984	Specification for Industrial Safety Helmets
3844 : 1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises (*first revision*)
3589 : 2001	Specification for steel pipes for water and sewage (168.3 to 2 540mm outside diameter) (*third revision*)
3950 : 1979	Specification for surface boxes for sluice valves (*first revision*)
4927 : 1992	Specification for unlined flax canvas hose for fire fighting (*first revision*)
4989 (Part 4) : 2003	Specification for multipurpose aqueous film forming foam liquid concentrate for extinguishing hydrocarbon and polar solvent fires.
4984 : 1995	Specification for high density polyethylene pipes for potable water supplies (*fourth revision*)
4985 : 2000	Specification for unplasticized PVC pipes for potable water supplies (*third revision*)
5290 : 1993	Specification for landing valves (*third revision*)
5822 : 1994	Code of practice for laying of electrically welded steel pipes for water supply (*second revision*)
7181 : 1986	Specification for horizontally cast iron double flanged pipes for water, gas and sewage (*first revision*)
8329 : 2000	Specification for centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage (*third revision*)
8423 : 1994	Specification for controlled percolating hose for fire fighting (*first revision*)
8442 : 2008	Stand post type water and foam monitor for fire fighting — Specification
10221 : 2008	Code of practice for coating and wrapping of underground mild steel pipelines (*first revision*)
12469 : 1988	Specification for pumps for fire fighting system
12835	Code of practice for design and installation of fixed fire extinguishing system
(Part 1) : 1989	Low expansion foam
14846 : 2000	Specification for sluice valves for water works purposes (50 to 1 200 mm size)
15105 : 2002	Design and Installation of Fixed Automatic Sprinkler Fire Extinguishing Systems — Code of Practice

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IS No.	*Title*	*IS No.*	*Title*
15325 : 2003	Code of practice for design and installation of fixed automatic high and medium velocity water spray system	16088 : 2012	Specification for chlorinated polyvinyl chloride (CPVC) pipes for automatic sprinkler fire extinguishing system
		SP 7 : 2005	National Building Code of India

ANNEX B

(*Clause* 3)

BROAD CLASSIFICATION OF INDUSTRIAL AND NON-INDUSTRIAL OCCUPANCIES INTO DIFFERENT DEGREE OF HAZARD

Light Hazard Occupancies	Moderate Hazard Occupancies	High Hazard Occupancies
Abrasive Manufacturing Premises	Airport and other Transportation Terminal Buildings	**SUB-CATEGORY (A)**
Aerated Water Factories	Aluminium Factories	Aircraft Hangers
Agarbatti Manufacturing	Atta and Cereal Grinding	Aluminium/Magnesium Powder Plants
Areca nut slicing and/or Betel nut Factories	Bakeries and Biscuit Factories	Bituminised Paper and/or Hessian Cloth/ Tar Felt Manufacturing
Analytical and/or Quality Control Laboratories	Beedi Factories	Cotton Waste Factories
Asbestos Steam Packing and Lagging Manufacturing	Bobbin Factories	Celluloid Goods Manufacturing
Battery Charging/Battery Service Stations	Bookbinders, Envelopes and Paper bag Manufacturing	Chemical Manufacturing using raw materials having flash points below 23 C
Battery Manufacturing	Cable manufacturing	Cigarette Filter Manufacturing
Breweries	Camphor Boiling	Cinema Films and T.V. Production Studios
Brick Works	Candle Works	Coal and/or Coke and/or Charcoal Ball and Briquettes Manufacturing
Canning Factories	Carbon Paper/ Typewriter Ribbon Manufacturing	Collieries
Cardamom Factories	Cardboard Box Manufacturing	Cotton Seed Cleaning or De-linting Factories
Cement Factories and/or Asbestos or Concrete Products Manufacturing	Carpenters, Wood wool and Furniture Manufacturing	Distilleries
Ceramic Factories and Crockery and Stoneware Pipe Manufacturing	Carpet and Durries Factories Cashewnut Factories	Duplicating / Stencil Paper Manufacturing Fire-works Manufacturing.
Clay Works	Chemical Manufacturing using raw materials having flash points above 23 C	Foam Plastics Manufacturing and/or Converting Plants
Clock and Watch Manufacturing	Cigar and Cigarette Factories	Godowns and Warehouses (storing combustible/flammable goods).
Coffee Curing Roasting and grinding Premises	Coir Factories	Grass, Hay, Fodder and Bhoosa (chaff) Pressing Factories
Condensed Milk Factories, Milk Pasteurising Plant and Dairies	Coir Carpets, Rugs, Tobacco, Hides and Skin Presses	Industrial Gas Manufacturing (other than Inert/ halogenated hydrocarbon gases)
Confectionery Manufacturing	Cold storage premises	Jute mills and jute presses
Educational and Research Institutes	Cork products manufacturing	Linoleum Factories

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ANNEX B — (*Continued*)

Light Hazard Occupancies	Moderate Hazard Occupancies	High Hazard Occupancies
Electric Generating Houses (Hydro electric)	Dry Cleaning, Dyeing and Laundries	LPG Bottling Plants (Mini)l)
Electric Lamps (Incandescent and Fluorescent) and TV Picture Tube Manufacturing	Electric substations/ Distribution stations	Man Made Fibres (Acrylic fibres/yarn mfg)
Electro Plating Works	Electric Generating stations (other than Underground power houses)	Match Factories
Engineering Workshops	Enamelware Factories	Mattress and Pillow Making
Fruits and Vegetables Dehydrating and Drying Factories	Filter and Wax paper Manufacturing	Metal or Tin Printers (where more than 50 percent of floor area is occupied as Engineering Workshop; this may be taken as Ordinary Hazard Risk)
Fruit Products and Condiment Factories	Flour Mills	Oil Mills
Glass & Glass Fibre Manufacturing	Garages	Oil Extraction Plants
Godowns and Warehouses Storing non-combustible Goods only	Garment Makers	Oil Terminals/Depots handling flammable liquids having flash point of 23°C and below. Paints & Varnish Factories
Green houses	Ghee Factories (other than vegetable)	Paper and cardboard mills having raw material yards
Gold Thread /Gilding Factories	Godowns and Warehouses (other than those under light and High Hzard A categories) Grain and/or Seeds Disintegrating and/or Crushing Factories	Piers, Wharfs and Jetties — handling extra hazardous materials
Gum and/or Glue and Gelatine Manufacturing	Grease Manufacturing	Printing Ink Manufacturing.
Ice, Ice Candy and Ice-cream Manufacturing	Hosiery, Lace, Embroidery and Thread Factories	Rosin Lamp black and Turpentine Factories
Ink (excluding Printing Ink) Factories	Incandescent Gas Mantle Manufacturing	Saw Mills
Mica Products Manufacturing	Industrial Gas Mfg. (Inert/ halogenated hydrocarbon gases)	Sponge Iron Steel Plants (Gas Based)
Multiple block apartment buildings	Man-made Yarn/Fibre Manufacturing (other than Acrylic fibres/yarn mfg)	Surgical Cotton Manufacturing
Multiple block business buildings	Manure and Fertiliser Works. (Blending, Mixing and granulating)	Tarpaulin and Canvas Proofing Factories
Multiple block star hotel buildings	Mineral Oil Blending and Processing	Turpentine and Rosin Distilleries
Places of worship	Museums	Tyre Retreading and Resoling Factories
Pottery Works	Oil and Leather Cloth Factories.	**SUB-CATEGORY (B)**
Poultry Farms	Oil Terminals/Depots other than those categorised under High hazard A	Ammonia and Urea Synthesis Plants
Salt Crushing Factories and Refineries	Open storage of flammable liquids in drums, cans etc	CNG Compressing and Bottling Plants
Stables	Oxygen Plants	Coal based methane plants
Sugar Candy Manufacturing	Paper and Cardboard Mills. without Raw Material Yards	Explosive Factories

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ANNEX B — (*Concluded*)

Light Hazard Occupancies	Moderate Hazard Occupancies	High Hazard Occupancies
Sugar Factories and Refineries	Piers, Wharves jetties and Dockyards other than those categorized under High hazard A	NOTE — In case of complexes having separate plants having varying degrees of hazard, authority having jurisdiction shall be consulted to decide on level of protection to be provided
Tanneries/Leather Goods Manufacturers	Plastic Goods Manufacturing	
Umbrella Assembling Factories	Plywood /Wood Veneering Factories	
Vermicelli Factories	Printing Press Premises	
Water Treatment/ Filtration Plants and Water Pump Houses	Pulverising and Crushing Mills	
Zinc/Copper Factories	Rice Mills	
	Rope Works	
	Rubber Goods Manufacturing	
	Rubber Tyres and Tubes Manufacturing	
	Shellac Factories	
	Silk Filatures	
	Soaps and Glycerine Factories.	
	Spray painting	
	Starch Factories	
	Tea Factories	
	Textile Mills	
	Tobacco (Chewing) and Pan-Masala Making	
	Tobacco Grinding and Crushing	
	Tobacco Redrying Factories	
	Woollen Mills	

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ANNEX C

(*Clause* 14.7)

HYDRANT FLOW TEST REPORT

Location _____ Date _____

Test made by _____ Time _____

Representative of _____

Witness _____

State purpose of test _____

_____

Consumption rate during test _____

If pumps affect test, indicate pumps operating _____

A_1 A_2 A_3 A_4

Flow hydrants: _____

Size nozzle _____

Pilot reading _____

Dishcharge coefficient _____ Total GPM

GPM _____

Static B _____ psi Residual B _____ psi

Projected results @20 psi Residual _____ gpm; or @ _____ psi Residual _____ gpm

Remarks _____

_____

_____

_____

_____

Location map: Show line sizes and distance to next cross-connected line. Show valves and hydrant branch size. Indicate north. Show flowing hydrants — Label $A_1, A_2, A_3 A_4$. Show location of static and residual — Lable B.

Indicate B Hydrant _____ Sprinkler _____ Other (identify) _____

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices:			*Telephones*
Central	:	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	2323 7617 2323 3841
Eastern	:	1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	:	SCO 335-336, Sector 34-A, CHANDIGARH 160022	260 3843 260 9285
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