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KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	<b>ENGINEERING STANDARD FOR          FIRE WATER DISTRIBUTION          AND STORAGE FACILITIES</b>  <b>(PROJECT STANDARDS AND SPECIFICATIONS)</b>	

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## SCOPE

This Project Standard and Specification specifies minimum requirements for water supply for fire-fighting purposes. It is important that all authorities concerned should work together to provide and maintain these minimum water supplies and discussions with municipality fire stations would include not only the water available from the hydrants but also help to assure the continuous and adequate flow of water for fire-fighting.

The following items are also included in this Standard:

- basic for a fire-fighting water system;
- fire-water pumping facilities;
- water tanks for fire protection;
- fire hose reel (water) for fixed installation; and,
- water spray fixed system.

## REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. API (American Petroleum Institute)
  - API 2001(7th edition) "Fire Protection in Refineries Seventh Edition"
2. NFC (NFPA) (National Fire Codes)
  - NFC Section 1231 "Water Supply"
  - NFC Section 15 "Water Spray System"
  - NFC Section 22 "Water Tanks"
  - NFC Section 24 "Mains Water Supplies"
  - NFPA-20 "Standard for the Installation Pumps for Fire Protection"
  - NFPA-15 "Standard for Water Spray Fixed systems for Fire Protection"
3. BSI (British Standards Institution)
  - BS 5306 Part 1 "System Design Water Supply"

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## DEFINITIONS AND TERMINOLOGY

**Coupling** - A device for connecting lengths of hose so as to secure continuity from the source of a water supply to the delivery point.

**Fire Hydrant (Underground Fire Hydrant)** - An assembly contained in a pit or box below ground level and comprising a valve and outlet connection from a water supply main.

**Fire Hydrant Pillar** - A fire hydrant whose outlet connection is fitted to a vertical component projecting above ground level.

**Foam Inlet** - Fixed equipment consisting of an inlet connection, fixed piping and a discharge assembly, enabling firemen to introduce foam into an enclosed compartment.

**Hose Reel** - Fire-fighting equipment, consisting of a length of tubing fitted with a shut-off nozzle and attached to a reel, with a permanent connection to a pressurized water supply.

**Hydrant Outlet** - The component of fire hydrant to which the standpipe is connected.

**Landing Valve** - An assembly comprising a valve and outlet connection from a wet or dry riser.

**Rising Main, Dry (Dry Riser)** - A vertical pipe installed in a building for fire fighting purposes, fitted with inlet connections at fire brigade access level and landing valves at specified point, which is normally dry but is capable of being charged with water usually by pumping from fire service appliances.

**Rising Main, Wet (Wet Riser)** - A vertical pipe installed in a building for fire fighting purposes and permanently charged with water from a pressurized supply, and fitted with landing valves at specified points.

**Shut-off Nozzle** - A device which is coupled to the outlet end of hose reel tubing and by means of which the jet of water or spray is controlled.

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## UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

## GENERAL

1. Water is the most commonly used agent for controlling and fighting a fire, by cooling adjacent equipment and for controlling and/or extinguishing the fire either by itself or combined as a foam. It can also provide protection for firefighters and other personnel in the event of fire. Water shall therefore be readily available at all the appropriate locations, at the proper pressure and in the required quantity.
2. Fire water should not be used for any other purpose.
3. Unless otherwise specified or agreed, the Company requirements which are given for major installations such as refineries, petrochemical works, crude oil production areas where large facilities are provided, and for major storage areas shall be applied.
4. In determining the quantity of fire water, i.e. "required fire water rate", protection of the following areas shall also be considered:
  - a. General process;
  - b. storage (low pressure), including pumpstations, manifolds and in line blenders, etc.;
  - c. pressure storage (LPG, etc.);
  - d. refrigerated storage (LNG etc.);
  - e. jetties;
  - f. loading.
  - g. buildings
  - h. ware houses
5. Basically, the requirements consist of an independent fire grid main or ring main fed by permanently installed fire pumps taking suction from a suitable large capacity source of water such as storage tank, cooling tower basin, river, sea, etc. The actual source will depend on local conditions and is to be agreed with the Company.  
The water will be used for direct application to fires and for the cooling of equipment. It will also be used for the production of foam.

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## **WATER SUPPLIES**

### 1. Nature of Supply

The choice of water supplies shall be made in cooperation with the relevant authorities.

### 2. Public Water Systems

(Applicable also to private supply systems.)

### 3. One or more connections from a reliable public water system of proper pressure and adequate capacity furnishes a satisfactory supply. A high static water pressure shall not, however, be the criterion by which the efficiency of the supply is determined.

If this cannot be done, the post indicator valves shall be placed where they will be readily accessible in case of fire and not liable to injury. Where post indicator valves cannot readily be used, as in a city block, underground valves shall conform to these provisions and their locations and direction of turning to open shall be clearly marked.

### 4. Adequacy of water supply shall be determined by flow tests or other reliable means. Where flow tests are made, the flow in (L/min.) together with the static and residual pressures shall be indicated on the plan.

### 5. Public mains shall be of ample size, in no case smaller than 15 cm (6 in).

### 6. No pressure regulating valve shall be used in water supply except by special permission of the authority concerned. Where meters are used they shall be of an approved type.

### 7. Where connections are made from public waterworks systems, it may be necessary to guard against possible contamination of the public supply. The requirements of the public health authority shall be determined and followed.

### 8. Connections larger than 50.8 mm to public water systems shall be controlled by post indicator valves of a standard type and located not less than 12.2 m from the buildings and units protected.

## **BASES FOR A FIRE-FIGHTING WATER SYSTEM**

### 1. A ring main system shall be laid around processing areas or parts thereof, utility areas, loading and filling facilities, tank farms and buildings whilst one single line shall be provided for jetties and a fire-fighting training ground, complete with block valves and hydrants.

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2. The water supply shall be obtained from at least two centrifugal pumps of which one is electric motor-driven and one driven by a fully independent power source e.g. a diesel engine, the latter serving as a spare pump.
3. The water quantities required are based on the following considerations:
  - a. There will be only one major fire at a time.
  - b. As a Recommendation in processing units the minimum water quantity is 200 dm<sup>3</sup>/s or air foam making and exposure protection. It is assumed that approximately 30% of this quantity is blown away and evaporates; the balance of this quantity, which is 140 dm<sup>3</sup>/s per processing unit, shall be drained via a drainage system\*.

\* The quantity of fire water required for a particular installation should be assessed in relation to fire incidents which could occur on that particular site, taking into account the fire hazard, the size, duties, and location of towers, vessels, etc. The fire water quantity for installations having a high potential fire hazard should normally be not less than 820 m<sup>3</sup>/h and no greater than 1360 m<sup>3</sup>/h.
  - c. For storage areas the quantity needed for making air foam for extinguishing the largest cone roof tank on fire and for exposure protection of adjacent tanks.
  - d. For pressure storage areas the quantity needed for exposure protection of spheres by means of sprinklers.
  - e. For jetties the quantity needed for fighting fires on jetty decks and ship manifolds with air foam as well as for exposure protection in these areas.
  - f. The policy for a single major fire or more to occur simultaneously shall be decided upon by the authorities concerned.

Note:

The above specification is based on one major fire only.

4. For new installations the quantities required for items (a) to (f) mentioned above shall be compared, and the largest figure shall be adhered to for the design of the fire-fighting system.

The system pressure shall be such that at the most remote location a pressure of 10 bar can be maintained during a water take-off required at that location.

5. Fire-fighting water lines shall be provided with permanent hydrants.

Hydrants with 4 outlets shall be located around processing units, loading facilities, storage facilities for flammable liquids, and on jetty heads and berths.

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Hydrants with two outlets shall be located around other areas, including jetty approaches.

6. Fire hose reels shall be located in each process unit, normally 31-47 m apart at certain strategic points.
7. The minimum fire water rate for various types of process units is given in Appendix A.
8. The water will be applied by means of hose and branch pipes using jet, spray or fog nozzles, or by fixed or portable monitors preferably with interchangeable nozzles for water or foam jets.
9. Fire-Water Ring Main System-General
  - a. Fire-water ring mains of the required capacity shall be laid to surround all processing units, storage facilities for flammable liquids, loading facilities for road vehicles and rail cars, bottle filling plants, warehouses, workshops, utilities, training centers, laboratories and offices. Normally, these units will also be bounded by service roads. Large areas shall be sub-divided into smaller sections, each enclosed by fire-water mains equipped with hydrants and block valves.  
A single fire water pipeline is only acceptable for a fire-fighting training ground. Fire-water to jetties shall be supplied by a single pipeline provided that it is interconnected with a separate pipeline for water spray systems. The fire-water pipelines from the fire pumps to the jetty shall be provided with isolating valves, for closing in the event of serious damage to the jetty. These valves shall close without causing high surge pressures.
  - b. The fire-water mains shall be provided with full bore valved flushing connections so that all sections and dead ends can be properly flushed out. The flushing connections shall be sized for a fluid velocity in the relevant piping of not less than 80% of the velocity under normal design conditions but for not less than 2 m/s.
  - c. Fire-water mains shall normally be laid underground in order to provide a safe and secure system, and which will give in addition, protection against freezing for areas where the ambient temperature can drop below 0°C. When in exceptional circumstances, fire-water mains are installed above ground they shall be laid alongside roads and not in pipe tracks where they could be at risk from spill fires.
  - d. The basic requirements consist of an independent fire grid main or ring main fed by permanently installed fire pumps. The size of ring main and fire pumps shall be such as to provide a quantity of water sufficient for the largest single risk identified within the overall installation.



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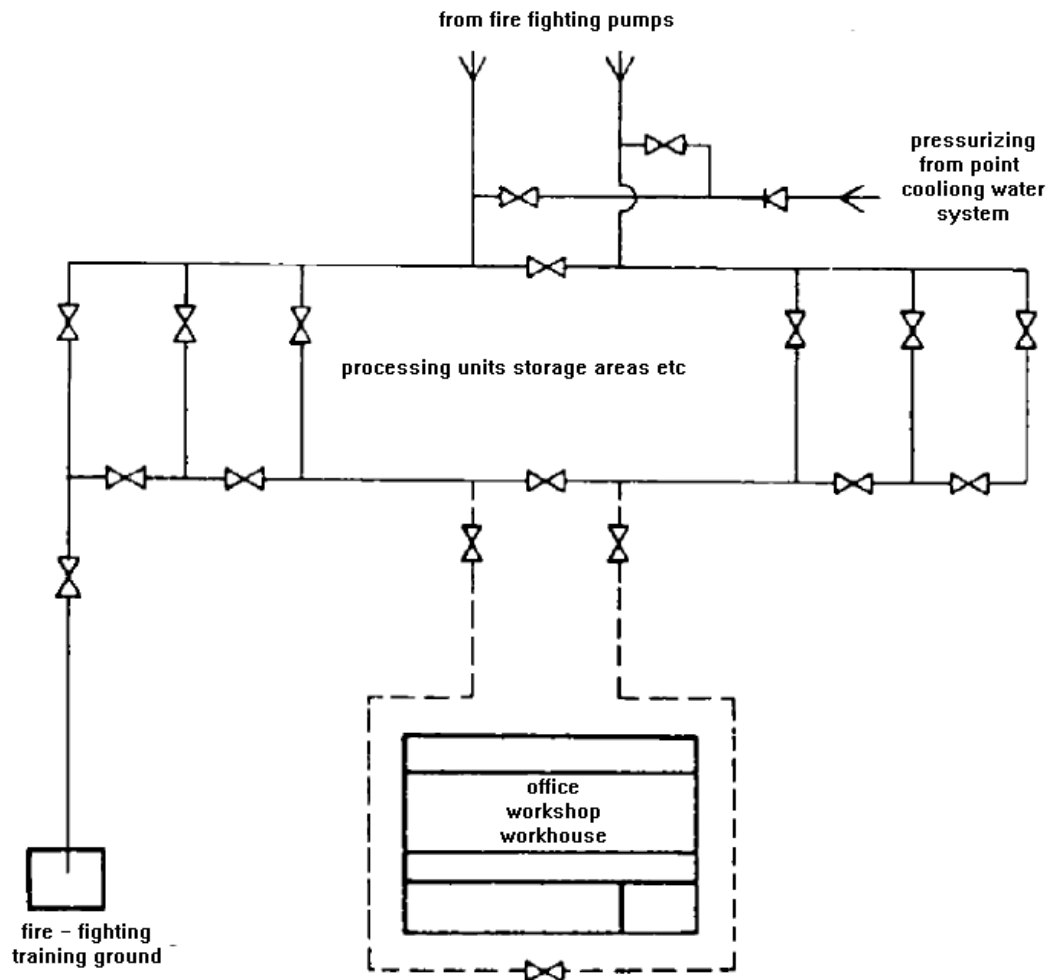
Suction will be from a suitable large capacity source of water such as storage tank, cooling tower basin, river, sea, etc. The actual source will depend on local conditions and is to be investigated. Pump suction lines shall be positioned in a safe and protected location and incorporate permanent, but easily cleanable strainers or screening equipment for the protection of fire pumps.

Advantage should be taken where available in obtaining additional emergency water supplies through a mutual aid scheme or by re-cycling but mandatory national or local authority requirements may modify these to a considerable extent.

#### 10. Fire-Water Ring Main/Network Design

- a. The fire-water mains network pipe sizes shall be calculated and based on design rates at a pressure of 10 bar gage at the takeoff points of each appropriate section, and a check calculation shall be made to prove that pressure drop is acceptable with a blocked section of piping in the network. The maximum allowable flow/velocity in the system should be 3.5 m/s.  
Fire-water rates shall, however, be realistic quantities since they determine the size of fire water pumps, the fire-water ring main system and the drainage systems which have to cope with the discharged fire water. If the drainage system is too small or becomes blocked, major hazards such as burning hydrocarbons floating in flooded areas may occur to escalate the fire. Facilities for cleaning shall therefore be provided. For large areas such as pump floors, and in pipe tracks, fire stops shall be provided to minimize the spillage area. It is assumed that 30% of fire water evaporates or is blown away while extinguishing a fire. This figure shall be taken into account for the design of drainage systems.
- b. Under non-fire conditions, the system shall be kept full of water and at a pressure of 2 to 3 bar gage by means of a jockey pump, by a connection to the cooling water supply system, or by static head from a water storage tank. If a jockey pump is used, it shall be 'spared' and both pumps shall have a capacity of 15 m<sup>3</sup>/h to compensate for leakages.
- c. The fire-water ring main systems shall be equipped with hydrants. A typical arrangement of a fire-water distribution system is shown in Fig. 1
- d. A single water line connected to the ring main system shall run along the jetty approach to the jetty deck. This line shall be fitted with a block valve located at a distance of about 50 m from the jetty deck.
- e. For small chemical plants, depots, and minor production and treatment areas, etc., for which precise commensurate with the size of risk involved, requirements shall be as specified or agreed with N.I.O.C. Authorities.

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**Fig. 1 - Typical Sketch of Fire-Fighting Water Distribution System**

## **FIRE-WATER PUMPING FACILITIES**

### **General**

1. Fire-water shall be provided by at least two identical pumps, each pump shall be able to supply the maximum required capacity for a fire water ring main system. Fire water pumps shall be of the submerged vertical type when taking suction from open water, and of the horizontal type when suction is taken from a storage tank.
2. The fire-water pumps shall be installed in a location which is considered to be safe from the effects of fire and clouds of combustible vapor, and from