

# FIRE SERVICE EXAMINATION BOARD

## STUDY NOTE

EXAMINATION

SUB-OFFICERS EXAMINATION

PAPER

OPERATIONS

SUBJECT

SCIENCE AND FIREFIGHTING

ITEM

HYDRANTS AND WATER SUPPLIES

STUDY NOTE No.

2104

### ***INTRODUCTION TO THE STUDY NOTE***

***This study note has been prepared as the basis of study in connection with the qualifying examinations for promotion.***

***Candidates will be expected to demonstrate knowledge of the information contained in the study note and understand how it should be applied:***

***The 'References' made at the end of the Study Note are included for information only and candidates will not be expected to study these as part of the bibliography.***

## WATER SUPPLIES AND HYDRANTS

### 1. Introduction

This study note outlines the legislation in respect of water supplies for firefighting, the water authorities' methods of water distribution and hydrants, which give brigades the means to access these supplies.

### 2. Legislation concerning Water Supplies

The principal legislation relating to the supply of water in the UK is:

- (a) The Water Industry Act 1991;
- (b) Water Act 1989; and
- (c) Water (Scotland) Act 1980.

Under this legislation Water Undertakers have a duty to provide a supply of water for 'domestic purposes' and an obligation to provide a supply of water for commercial or industrial purposes if it does not affect the domestic supply of existing customers.

### 3. The Fire Services Act 1947

Sections 13, 14, 15 and 16 of the Fire Services Act 1947 contain provisions for the supply of water for firefighting.

#### 3.1 Provision of Water for Firefighting

Section 13 of the Fire Services Act specifies the fire authorities' responsibility for securing adequate supplies of water and ensuring that it is available for firefighting. This is generally satisfied in the United Kingdom by most of this water being taken from hydrants on water undertakers' mains, (normally NOT trunk mains) though water from private mains, eg on factory premises, is also used, subject to agreement.

The primary function of these mains is to provide water for domestic purposes and this provision may not be adequate for fire fighting in a particular area.

*There is, at the present time, no legislation, which requires water undertakers to provide minimum flow rates for firefighting purposes.*

Under Section 14 (1) and (2) of the Act, the fire authority may enter into an agreement with statutory water undertakers for the purpose of implementing Section 13 on such terms as to payment or otherwise as may be specified in the agreement.

No water undertakers shall unreasonably refuse to enter into any such agreement proposed by a fire authority.

### 3.2 Improving Supplies of Water for Firefighting

Mains supplies can be improved by increasing the size of the mains but if a fire authority requests this, then that fire authority will have to pay.

Financial considerations will often limit the sort of improvement that is reasonable for a fire authority to ask for, so it may be necessary to negotiate a compromise with the water undertaker between firefighting requirements and what the undertaker would provide for domestic purposes.

### 3.3 Hydrant Marker Plates

Section 14 (3) of the Act states that undertakers are responsible, at the expense of the fire authority, for the clear indication, by a notice or distinguishing mark which may be placed on a wall or fence adjoining a street or public place, of the situation of every fire hydrant provided by them.

### 3.4 Surveying Water Supplies

To augment mains supplies, brigades should survey all sources of water, including open water, near enough to be of use for fire risks in their area. This has become even more important in recent years as water authorities have lowered operating pressures, particularly at night.

### 3.5 Agreement with other Providers

A fire authority is empowered under Section 15 (1) of the Act to make agreements to secure the use, in case of fire, of water under the control of any person *other than water undertakers* to improve the access to any such water and to lay and maintain pipes and carry out other works in connection with the use of such water in case of fire.

Section 15 (2), however, indicates that the fire authority may be liable to pay reasonable compensation for this use.

### 3.6 Work affecting Supply

Section 16 of the Act provides that if a person is proposing to carry out works for the supply of water to any part of the area of a fire authority, that person is required to give not less than six weeks notice in writing to the fire authority prior to the commencement of the works.

In the case of works affecting any fire hydrant the authority or person executing the work is normally required to give the fire authority written notice at least seven days before the work has begun.

In an emergency, where it would be impracticable for notice to be given in the time stipulated, notice is to be given as early as may be.

### 3.7 Senior Fire Officer

Section 30 of the Act establishes that, at any fire, the senior fire officer present has sole charge and control of all operations for the extinction of the fire, including the use of any water supply, and that the water undertaker, on being requested by this officer to provide a greater supply and pressure of water for firefighting, shall take all necessary steps to comply with the request even if this results in the interruption of supplies to normal consumers. Failure, without reasonable excuse, on the part of the undertaker to comply is an offence.

NB. Section 147 of the Water Industry Act 1991 stipulates that no charge may be made by any water undertaker in respect of:

- (a) Water taken for the purpose of the extinguishing of fires or taken by a fire authority for any other emergency purposes;
- (b) Water taken for the purpose of testing apparatus installed or equipment used for extinguishing fires or for the purpose of training persons for fire-fighting; or
- (c) The availability of water for any purpose mentioned in paragraph (a) or (b) above.

However, Section 23 of the Water (Scotland) Act 1980 states only that: "the undertakers shall allow any person to take, without payment, water for extinguishing fires from any pipe on which a hydrant is fixed."

## 4. Distribution of Water Supplies

Water undertakers obtain their water from three main sources:

- (a) River intakes;
- (b) Impounding reservoirs. These contain water collected from high ground, streams and general rainfall; and
- (c) Underground sources eg wells, boreholes and springs.

About one-third of the total supply is drawn from each source but in each case the water is fed into main storage reservoirs, purified and then passed into the distribution system.

This system conveys water to the consumer and, in general, consists of mains and pipes laid under public roads. There is no standard pattern for an authority's distribution network but it will often consist of:

- (a) A network of trunk and distribution mains:

- (b) Service reservoirs; and
- (c) Booster pumps, which supplies water to a number of zones, sometimes referred to as District Metered Areas (DMAs), in each of which the pressure is maintained at a high enough value to satisfy normal consumer demand.

The design of the public network, including diameters of pipes etc, is based on factors such as:

- (a) Maximum requirements at peak demand;
- (b) Minimum pressure requirements;
- (c) Ageing factors;
- (d) Estimated future demands.

#### **4.1 Trunk and Distribution Mains**

The DMAs are supplied by a system of trunk mains of up to 1.2m in diameter and distribution mains.

Service mains, which supply the consumers within a DMA, are smaller and usually of 75, 100 or 150mm diameter.

Distribution mains may sometimes supply large consumers, whose demands may be too great for the service mains.

In rural areas even the distribution mains may not exceed 150mm and could be only 75mm.

#### **4.2 Service Reservoirs**

Service reservoirs serve the dual purpose of balancing the distribution system and providing a reserve of water against the possibility of an interruption in supply due to a breakdown or excessive demand. These often include large overhead tanks and water towers.

Because of the possibility of contamination, water should never be taken directly from service reservoirs though it may be acceptable to the water undertaker for it to be taken from adjoining washouts.

#### **4.3 Booster Pumps**

Booster pumps are used to:

- (a) Increase pressure in trunk mains for transfer of supplies over long distances;
- (b) Provide opportunities to reconfigure areas to balance pressures;

- (c) Provide support to areas, particularly at times of peak demand, when gravity flows would be insufficient to maintain supplies;
- (d) Provide supplies to areas that lie close to, or above, the level that water is physically able to flow under gravity alone.

## 5. Planning

As a general principle there should be operational cooperation between fire services and water undertakers to provide and secure water for firefighting.

Water undertakers' expertise is central to the process of assessing and predicting the extent to which the distribution system can provide water for firefighting purposes. Such provision is therefore a joint process balancing what might be required with what may be available and then agreeing any actions necessary to fill the gap – if one exists.

Particular attention should be paid to those potential incidents that carry the greatest risk and might demand substantial water resources for firefighting.

Careful pre-planning, both to determine the likely water requirement and to identify available sources, is essential.

## 6. Water Quality

A particular concern is that of the possible effect of Fire Service operations on water quality.

A Drinking Water Inspectorate has been established with the responsibility for monitoring water quality and instigates prosecutions in such events as the supply of discoloured water, which is considered 'unwholesome'.

Any firefighting or testing of apparatus has the potential to affect the chemical or microbiological quality of the water. The causes include disturbing sediment in the main by changes in the rate of flow or flow reversal, and negative pressures in the main, which could suck in, contaminated water from the surrounding soil.

## 7. Industrial Risks

There may be isolated patches of high risk in a predominantly low-risk area. In these cases fire authorities usually advise the owners to install some form of adequate water supply for firefighting, eg reservoirs, underground tanks.

In many industrial premises large quantities of water will be required for processes carried on in the plant. In these circumstances fire authorities should have discussions with the owners and agree on the amounts they can take for firefighting. However, under Section 58 of the Water Industry Act 1991, developers, at their own expense, may require water undertakers to install and maintain hydrants specifically for firefighting purposes.

Whatever the situation in these cases, it should be made quite clear to the owners that the fire authority cannot be expected to meet the expense of providing water supplies for special premises out of all proportion to the remainder of the risk in the area.

The fire authority should advise such premises to install equipment in accordance with the appropriate British Standard.

## 8. Pressure and Flow in Mains

It should be noted that, because of the variation in the demands from customers, flow and pressure in the mains will vary according to the time of day, day of the week and the time of year so that the quantity of water available for firefighting may also vary. The standing pressure at a hydrant, ie the pressure in the main when water is being taken only for normal domestic purposes, is not in itself an accurate guide to how much water will be available in an emergency situation. When firefighting water is being drawn the flowrate, and hence the loss of pressure due to friction, may, particularly if the main is of small diameter, be considerably greater than normal with the result that the pressure in the main will fall.

The reduction in pressure depends on:

- (a) The diameter of the main;
- (b) The condition of the main internally (which affects its diameter and roughness);
- (c) The length of the main;
- (d) The amount of water being drawn from the main.

### 8.1 Small Diameter Mains

For a small diameter main the internal pressure may reduce to not much more than atmospheric, even when only one hydrant is opened, so that attempts to obtain more water by opening neighbouring hydrants would be futile, even at a relatively modest flow rate of 1000 L/min, it is quite possible that most of the available pressure in the main is used to overcome friction in the main itself.

### 8.2 Large Diameter Mains

On the other hand, provided there is no constriction in it, a large main of 200mm or more will probably be able to supply several pumps before the pressure falls substantially. Consequently the location of these larger mains, especially those upstream of pressure reducing valves, and the hydrants on them is an important aspect of pre-planning.

Once the standing pressure is used to overcome friction in the main no further increase in flow will be possible no matter how many hydrants are opened.

### 8.3 Frictional Loss

Tuberculation and corrosion in mains will reduce their effective diameter and cause internal roughness which, together with the bends and fittings such as meters, will increase frictional loss. This is one of the main reasons why hydrants fitted on two different mains of the same diameter in the same pressure zone can give very different rates of flow.

A knowledge of the capacity of every main is an important aspect of planning efficient fire protection of an area, consequently it may be necessary to conduct flow tests from hydrants, particularly those on long mains of small diameter.

## 9. Hydrants - Statutory Requirements

Section 57 of the Water Industry Act 1991 requires the water undertakers to allow water to be taken from their mains, by any person, for firefighting purposes, and at the fire authority's expense, to provide hydrants where the fire authority require them and maintain such hydrants in good working order.

Section 58 of the same Act requires water undertakers, at the request and expense of the owner or occupier of a factory or place of business, to fix fire hydrants for the purpose of firefighting only.

For Scotland similar provisions are made in the Water(Scotland) Act 1980.

### 9.1 Other Users

Although, with the exception of specially requested hydrants, the cost of installing, maintaining and renewing them is borne by the fire authority, the water undertaker is entitled to allow other individuals or concerns to use fire hydrants, and occasionally damage is caused in this way.

Under Section 14(3)(b) of the Fire Services Act 1947, when damage is caused to a hydrant as the result of any use made of it with the consent of the water undertaker when not used for firefighting or other purposes of a fire brigade, the fire authority shall not be liable for the cost of repairing or replacing the hydrant incurred as a result of the damage.

Section 14(5) of the same Act makes it an offence to use a fire hydrant without proper authority, or to damage or obstruct a hydrant otherwise than in consequence of using the hydrant with the consent of the water undertaker.

### 9.2 Siting and Fixing of Hydrants

When water mains are installed or changed, the plans submitted to the fire authority will show the intended route and size of the mains.

The fire authority should:

- (a) Identify likely fire risks;

- (b) Estimate the water requirements; and then
- (c) Specify the number and position of hydrants required

The water undertakers should be able to state the approximate flow of water from each proposed hydrant under most conditions. The fire authority will then be able to decide whether the flow from the hydrants near the fire risk is sufficient to cover the risk adequately and, if not, to plan for additional supplies.

#### **References**

The Fire Service Manual, Volume 1 Technology, Equipment & Media, Hydraulics, Pumps and Water Supplies.