

LESSON ONE

FIREFIGHTER II

Water Supplies

DOMAIN: COGNITIVE / PSYCHOMOTOR

LEVEL OF LEARNING: KNOWLEDGE / APPLICATION

MATERIALS

Water distribution map or water point map for the local jurisdiction; dry and wet barrel hydrant cutaway, if available; pitot tube and gauge; hydrant, hose wrenches, and testing equipment; one set of 2" thru 1½" stack tips; IFSTA Essentials 5th edition or Jones and Bartlett Fundamentals of Fire Fighter Skills 2nd Edition or Delmar Firefighter's Handbook 3rd Edition; overhead projector or laptop computer and multimedia projector; projection screen.

NFPA 1001 JPRs, 2008 edition

6.5.3 Prepare a pre-incident survey

Junior Member Statement:

Junior Member training activities should be supervised by qualified instructors to assure that the cognitive and psychomotor skills are completed in a safe and non-evasive manner. While it is critical that instructors be constantly aware of the capabilities of all students both mentally and physically to complete certain tasks safely and successfully, the instructor should take every opportunity to discuss with departmental leaders and students the maturity and job awareness each participant has for the hazards associated with fire and rescue training.

TERMINAL OBJECTIVE

The Firefighter II candidate shall accurately describe in writing all of the basic components of the local water distribution system and the means to determine the condition of the components.

ENABLING OBJECTIVES

1. The Firefighter II candidate shall correctly describe in writing the available water sources and how the water is distributed within their jurisdiction.
2. The Firefighter II candidate, when given a fire hydrant, shall correctly describe its type and operating characteristics.
3. The Firefighter II candidate shall correctly list in writing six conditions that result in reduced hydrant effectiveness.
4. The Firefighter II candidate, when given the necessary equipment and available hydrants of the local jurisdictions, shall correctly describe and determine the water pressures that exist within a water distribution system.
5. The Firefighter II candidate shall correctly describe in writing the type of valves utilized within the jurisdiction.
6. The Firefighter II candidate shall correctly describe in writing two causes for increased friction loss within the water distribution system.
7. The Firefighter II candidate, when given any location within their jurisdiction, shall correctly identify the recommended size of water main.

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MOTIVATION

The complexity of a modern water system warrants a great deal of careful study. Water must be controlled from its source to its eventual discharge from a nozzle. The knowledge of the necessary equipment and systems required to accomplish this task is critical. Careful attention to the details of the water distribution system by the firefighter will produce highly efficient use of that water distribution system at the most crucial phase of fireground operations.

PRESENTATION

ENABLING OBJECTIVE #1

The Firefighter II candidate shall correctly describe in writing the available water sources and how the water is distributed within their jurisdiction.

1. Discuss the various types of water sources found within the jurisdiction.
 - a) River supply.
 - b) Lake supply.
 - c) Impounded water supply.
 - d) Ground water supply.

2. Discuss, in detail three basic methods for water movement within the jurisdiction.
 - a) Direct pumping system.
 - b) Gravity system.
 - c) Combination System.

3. Briefly discuss the four fundamental components of the water system utilized by the jurisdiction.
 - a) Source.
 - b) Treatment plant.
 - c) Means of movement.

- d) Distribution/Storage system.
4. List and describe, in detail, the major piping components of a water distribution system (e.g. distributors, primary feeders, and secondary feeders).
- a) For residential areas, the recommended water hydrant supply is at least six inches in diameter.
 - b) Dead-end water mains violate the principle of the grid system.
 - c) Businesses and industrial districts the recommended main size is eight inches, with cross-connecting mains every 600 feet.
 - d) Twelve-inch mains may be used on principle streets and in long mains not cross-connected at frequent intervals.

Reference:

Delmar Handbook 3rd edition, pages 235-238

J&B Fundamentals 2nd edition, pages 444-452

IFSTA Essentials 5th edition, pages 594-597, 599-600

NOTE: A Fire department may utilize a water distribution system and a mobile water supply system. The probability of this occurrence becomes more likely with the growing number of annexations of rural communities. If this situation does exist, the instructor may have to demonstrate the interaction of the two systems.

APPLICATION

Have each Firefighter II candidate correctly outline, in writing, the water distribution system starting from the source of primary supply up to the hydrant outlet. Have the firefighters use actual names and locations as their identifying factors. Once completed, randomly select six or eight firefighters to present their outline to the group.

PRESENTATION

ENABLING OBJECTIVE #2

The Firefighter II candidate, when given a fire hydrant, shall correctly describe its type and operating characteristics.

1. Discuss briefly the design and mechanical assembly of the wet-barrel hydrant. Point out the fact in North Carolina, freezing winter temperatures usually negate their use.
2. Discuss, in detail, the design characteristics of the type of dry-barrel hydrant utilized by this jurisdiction.
3. Explain each of the mechanical components within the hydrant assembly.
4. List the steps for properly operating the dry-barrel hydrant. Emphasize the need for slow and cautious operation.
5. Discuss the local jurisdiction's policies for color-coding hydrants.

Reference:

Delmar Handbook 3rd edition, pages 238-241
J&B Fundamentals 2nd edition, pages 452-456
IFSTA Essentials 5th edition, pages 605-607

APPLICATION

Have each individual Firefighter II candidate correctly label a diagram of the wet and dry barrel hydrants. Below each diagram have the Firefighter II candidate correctly list the steps for the proper operation of the hydrant.

PRESENTATION

ENABLING OBJECTIVE #3

The Firefighter II candidate shall correctly list in writing six conditions that result in reduced hydrant effectiveness.

1. Discuss the importance of having a readily accessible and useable hydrant at a fireground location.
2. Discuss the need for regular maintenance and inspection on all hydrants within the jurisdiction and the responsible agencies.
3. List the hazards that make a hydrant susceptible to damage.

4. Describe the major conditions that result in the reduced effectiveness of a fire hydrant.
 - a) Sedimentation.
 - b) Deposits.
5. Discuss the jurisdiction's procedure for having a hydrant repaired.

Reference:

Delmar Handbook 3rd edition, page 248

J&B Fundamentals 2nd edition, pages 455-458

IFSTA Essentials 5th edition, pages 605-610

APPLICATION

Divide the class into groups of two to six. Allow each group to design a hydrant inspection and maintenance record sheet. Have each group present their record sheet to the class. Have the other groups observe, and as each group completes its presentation, allow constructive feedback from the class.

PRESENTATION

ENABLING OBJECTIVE #4

The Firefighter II candidate, when given the necessary equipment and available hydrants of the local jurisdictions, shall correctly describe and determine the water pressures that exist within a water distribution system.

1. Describe the step-by-step procedure for reading and recording water flow pressure from a hydrant. Note the use of a solid stream nozzle tip to improve low velocity discharge. Discuss the need for flow pressures to fall within an acceptable range, not too high and not too low.
 - a) Formula for computing hydrant flow:
$$\text{GPM} = 29.83 \times c \times d^2 \times \sqrt{P}$$
$$\text{L/min} = 0.0667766 \times c \times d^2 \times \sqrt{P}$$

Note: "d" is the diameter of the hydrant or nozzle orifice in inches. "P" is the pressure in psi (kPa) as read on the

gauge of the pitot at the orifice. "c" is the coefficient of discharge.

- b) Coefficient will vary with the type of hydrant outlet or nozzle used. When using a hydrant, feel the inside contour of the orifice to determine which one of the three types will be used. The three types of hydrant discharges and their discharge coefficients are 0.70, 0.80, and 0.90.
2. Discuss the different types of pressure found within a water distribution system and define these pressures.
 - a) Static pressure.
 - b) Normal operating pressure.
 - c) Residual pressure.
 - d) Flow pressure.
 3. Demonstrate the correct procedure for positioning the pitot tube and gauge in the discharge stream.

Reference:

Delmar Handbook 3rd edition, pages 247-248

J&B Fundamentals 2nd edition, pages 457-459

IFSTA Essentials 5th edition, pages 604-605

APPLICATION

Divide the class into groups of four or five and have the groups read and record pressures on at least three hydrants with fairly stable, known pressures. At the end of the exercise have each group report their pressure readings and determine which group is most accurate.

PRESENTATION

ENABLING OBJECTIVE #5

The Firefighter II candidate shall correctly describe in writing the type of valves utilized within the jurisdiction.

1. Discuss the various types and designs of valves utilized within the water distribution system. Emphasize the two general categories of Indicating and Nonindicating valves.

2. Discuss the need for different valves, as the application of a valve is specific to its task. Explain why valves are required on a water distribution system.

Note: Valve spacing in high value districts should be no more than 500 feet.

3. List any hazards associated with the use of improper procedures in opening and closing a valve. Include hazards to personnel and hazards to the water distribution system.

Reference:

Delmar Handbook 3rd edition, pages 241-242

J&B Fundamentals 2nd edition, pages 954-955

IFSTA Essentials 5th edition, pages 600-601

APPLICATION

Divide the class into groups of two or three. Give each group an assigned number that corresponds with a particular type of valve (i.e., Group One - O.S.& Y.; Group Two - BUTTERFLY; Group Three - NONINDICATING GATE VALVE). Each group will then cite at least two locations where the valve would be used and list the proper operating procedure for that particular type of valve. Have a spokesperson from each group present the group's reasoning to the class.

PRESENTATION

ENABLING OBJECTIVE #6

The Firefighter II candidate shall correctly describe in writing two causes for increased friction loss within the water distribution system.

1. Discuss the general reasons for friction loss in water pipes. Note that pipe of different compositions will have different friction loss coefficients.
2. Discuss the need for regular flow testing of the water mains to determine if a reduced flow exists.
3. Briefly define tuberculation, encrustation and sedimentation. Describe how these processes can

cause an increase in friction loss within the water distribution system.

4. Discuss, in detail, how a partially closed or fully closed valve on a water main can cause an increase in friction loss.
5. Describe how an obstruction, such as a rock or board, can affect friction loss and the ways in which obstructions get into water mains.

Reference:

Delmar Handbook 3rd edition, pages 245-246, 248

IFSTA Essentials 5th edition, pages 599, 603-604, 609-610

APPLICATION

Divide the class into groups of two or three. Have each group read and record the flow pressure from a deluge gun equipped with a solid stream 2" tip. The single 2½" hose coming from a hydrant supplying the deluge gun will have a standard 2½" gate valve located at one end of the hose. By partially closing the gate valve each time a reading is taken, each group will experience a reduced flow pressure reading such as the type that would occur on a water main with a partially closed valve.

PRESENTATION

ENABLING OBJECTIVE #7

The Firefighter II candidate, when given any location within his/her jurisdiction, shall correctly identify the recommended size of water main.

1. Discuss the correct size and design of water distribution system piping in relation to the type of district or locality the water main will supply.
2. Describe the possible impact of undersized water mains and why water mains may eventually become undersized for a given locality.
3. List the methods by which a water main's pressure can be increased or boosted.
 - a) Booster pumping stations.

b) Elevated storage tanks.

Reference:

Delmar Handbook 3rd edition, pages 236-238

J&B Fundamentals 2nd edition, pages 449-452

IFSTA Essentials 5th edition, page 600

APPLICATION

Prior to class, select several locations from the local jurisdiction where water mains do exist. Have the firefighters determine the correct size of the water main for each location. Upon completion of the exercise present the class with a water main map that details the size of the mains in the selected locations. Compare the results.

SUMMARY

List and review the available sources of water and the means by which the local jurisdiction distributes water.

Review the type and operating characteristics of the hydrants common to the local jurisdiction.

Reiterate the six major conditions that can cause a hydrant to become ineffective as a water source for the fire department.

Review the procedure for determining the pressure on a given water main utilizing a pitot tube and gauge.

Review the types of water main control valves common to the local jurisdiction and highlight the reasons for using a particular type.

Reiterate the major causes of friction loss that affect a water distribution system.

Summarize the concept of determining water main size as it relates to a given locale within the jurisdiction.