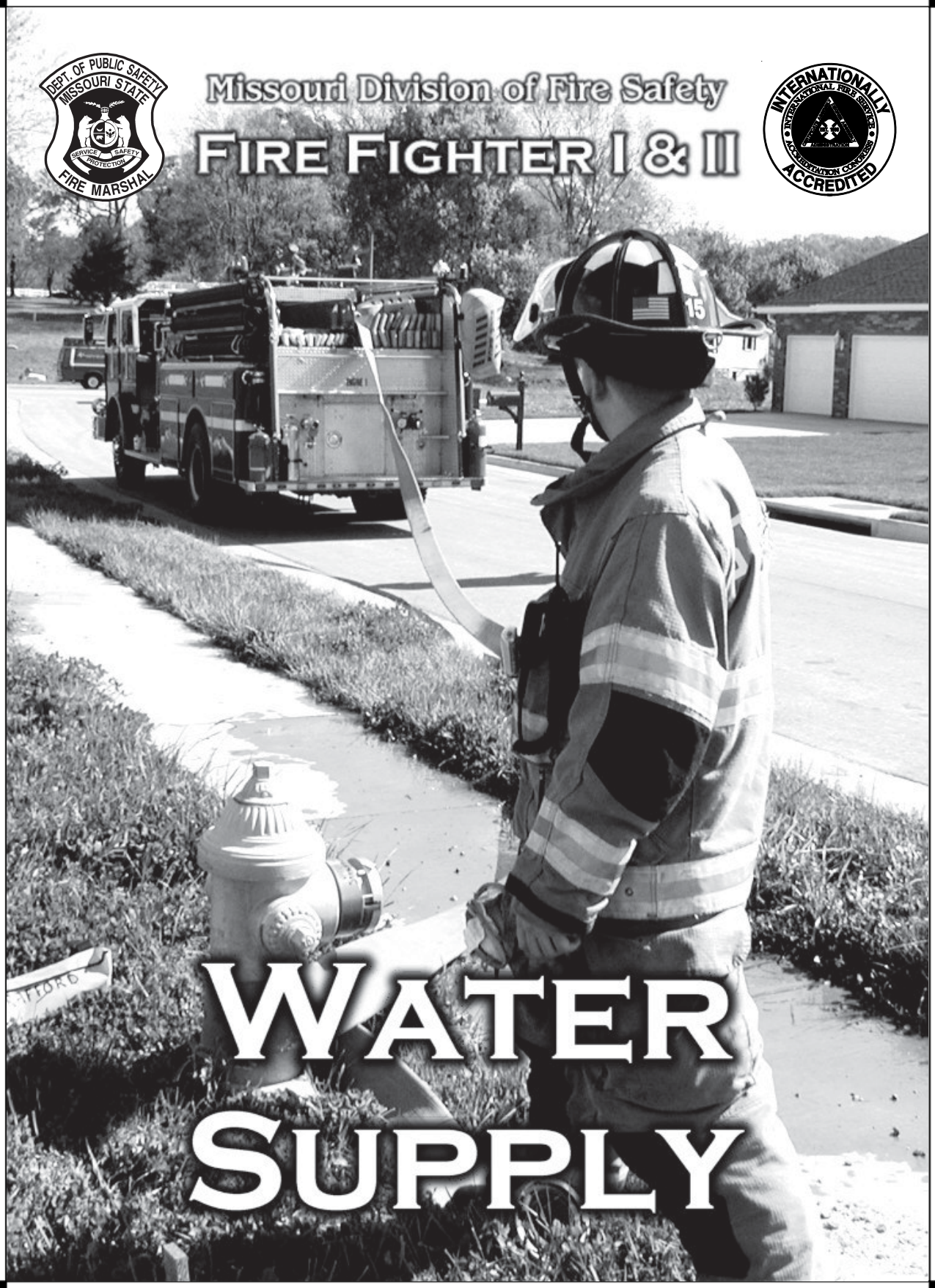
Missouri Division of Fire Safety

Fire Fighter I & II



Water Supply

UNIT OBJECTIVES

Upon completion of this unit of study, the student should be able to:

1. Identify the parts of a water distribution system.
2. Identify the causes of increased resistance or friction loss in water mains.
3. Identify the types of water main valves.
4. Define the terms static pressure, normal operating pressure, residual pressure, and flow pressure.
5. Identify the differences between dry-barrel and wet-barrel hydrants.
6. Describe the conditions which reduce hydrant effectiveness.
7. Describe and demonstrate connecting a supply hose to a hydrant and operating the hydrant.
8. Identify the apparatus and equipment necessary for a water shuttle and how to set up a portable water tank and assemble equipment to transfer water between portable tanks.
9. Demonstrate the assembly and connection of drafting equipment required for drafting from a static water supply.

NFPA STANDARDS

Successful completion of the information in this section is necessary to fulfill the requirements of the following sections of NFPA 1001-2008:

Fire Fighter I Standard

5.3.15* Connect a fire department pumper to a water supply as a member of a team, given supply or intake hose, hose tools, and a fire hydrant or static water source, so that connections are tight and water flow is unobstructed.
(A) Requisite Knowledge. Loading and off-loading procedures for mobile water supply apparatus; fire hydrant operation; and suitable static water supply sources, procedures, and protocol for connecting to various water sources.
(B) Requisite Skills. The ability to hand lay a supply hose, connect and place hard suction hose for drafting operations, deploy portable water tanks as well as the equipment necessary to transfer water between and draft from them, make hydrant-to-pumper hose connections for forward and reverse lays, connect supply hose to a hydrant, and fully open and close the hydrant.

Fire Fighter II Standard

6.5.3* Prepare a preincident survey, given forms, necessary tools, and an assignment, so that all required occupancy information is recorded, items of concern are noted, and accurate sketches or diagrams are prepared.
(A) Requisite Knowledge. The sources of water supply for fire protection; the fundamentals of fire suppression and detection systems; common symbols used in diagramming construction features, utilities, hazards, and fire protection systems; departmental requirements for a preincident survey and form completion; and the importance of accurate diagrams.
(B) Requisite Skills. The ability to identify the components of fire suppression and detection systems; sketch the site, buildings, and special features; detect hazards and special considerations to include in the preincident sketch; and complete all related departmental forms.

NOTES	STUDENT GUIDE
	I. Water Supply A. Water has always been the primary extinguishing agent for fire fighting for its: 1. 2. Economy 3. Effectiveness 4. B. Fire fighters must have a knowledge of water supply systems and how to use these systems to supply water for fire fighting efforts **II. Water Distribution Systems** *(Essentials p. 594)* A. Public and private water supply systems typically serve large areas with numerous individual properties 1. May be a city-operated utility, a public water supply district, or a private water company 2. Several municipal water systems in Missouri have been sold to private corporations B. Sources of water supply 1. Surface water a. Rivers b. Lakes c. Reservoirs

NOTES	STUDENT GUIDE
	2. Ground water a. Water wells b. Water-producing springs C. Means of moving water 1. Direct pumping system a. Uses pumps to take water from the primary source to the treatment process and into the distribution system b. Most direct pumping systems are found in agricultural and industrial settings c. d. Backup generators and duplicate pumps may be needed for reliability 2. Gravity system a. Uses a primary water source at a higher elevation than the distribution system b. Gravity pressure is adequate only when the primary water source is more than 100 feet higher than the highest point in the water system 3. Combination systems a. b. Water is pumped from the treatment facilities to elevated storage tanks

NOTES	STUDENT GUIDE
	c. Gravity flow is supplied by elevated tanks for storage and pressure (1) When consumption is high, the tanks supply extra water and pressure (2) Elevated reservoirs can ensure the water supply when other parts of the system may be inoperable D. Processing or treatment facilities 1. Provide treatment to remove contaminants and add chlorine to kill bacteria 2. May add fluoride or oxygen 3. The fire department's concern with treatment facilities is that a maintenance problem, power loss, or fire may reduce the volume and pressure of available water supplies 4. E. Distribution systems 1. The amount and pressure of water that a distribution system can deliver depends on: a. The capacity of its pipe network b. The capacity of elevation of its storage tanks 2. As water flows through piping, its movement causes friction which reduces pressure a.

NOTES	STUDENT GUIDE
	b. Friction loss reduces the volume and pressure available from fire hydrants c. Less pressure will be lost when fire hydrants are supplied from two or more directions (1) Dead-end hydrant: receives water from only one direction (2) When a hydrant receives water from two or more directions, it has a circulating feed or looped line 3. Grid system: a distributing system that has circulating feed from several mains a. Primary feeders: b. Secondary feeders: intermediate-sized pipes within the loops of primary feeders that aid the concentration of flow c. Distributors: d. Two or more primary feeders should run from the water source to high-risk and industrial areas 4. Recommended size of supply mains from the American Water Works Association a. Residential hydrant supply mains: 6-inches b. Business and industrial districts: 8-inches with cross-connecting mains every 600 feet

NOTES	STUDENT GUIDE
	c. 12-inch mains should be on principal streets and in long mains 5. Water main valves a. Valves should be within the grid system so small districts can be shut off without affecting the entire system (1) The water department must be able to open valves when increased flow is needed during an emergency (2) In the event of a main break, the valves may have to be closed to isolate areas b. Indicating valves: visually show if valve is open or closed (1) Post indicator valve: (2) Outside screw and yoke (OS&Y) valve (a) (b) The stem is extended when the valve is open and invisible when the valve is closed c. Non-indicating valves (1) Usually buried or in manholes (2)

NOTES	STUDENT GUIDE
	d. Gate valves (1) May be indicating or non-indicating (2) Usually the non-rising stem type (3) The control valve is operated by a handle or screw mechanism which rises or lowers a plate into or out of the waterway e. Butterfly valves (1) May be indicating or non-indicating (2) The control valve is operated by a handle mechanism which rotates a valve disk to open or shut the valve f. 6. Water mains a. Underground water mains may be constructed of: (1) Cast or ductile iron (2) Asbestos cement (3) Steel (4) Polyvinyl chloride plastic (PVC) (5) Concrete b. A water main must be the proper type for the soil conditions and pressures needed

NOTES	STUDENT GUIDE
	(1) Some soil types may corrode some materials (2) Extra protection may be needed to prevent breaks in certain soil types c. The interior surface of the pipe creates resistance (friction loss) to water flow d. Encrustations and sediments in a pipe cause increased friction loss F. Pressures within water supply system 1. Pressure is the velocity of water through pipe or hose of a certain size 2. Static pressure a. b. Normal pressure within a system before a hydrant is opened c. True static pressure is rarely found in a water system 3. Normal operating pressure: 4. Residual pressure: 5. Flow pressure:

NOTES	STUDENT GUIDE
	III. Fire Hydrants *(Essentials p. 605)* A. Hydrant construction 1. Barrels, bonnets, and foot pieces are constructed from cast iron 2. Internal working parts are usually made of bronze 3. Valve facings may be rubber, leather, or composite materials B. Hydrant operations 1. As a safety precaution, tighten hydrant outlet caps that will not be used 2. Turn the outlet cap nut counterclockwise and remove the outlet cap 3. If time permits, flush the hydrant before connecting hoses 4. Turn operating nut in direction of arrow (usually counterclockwise) 5. Open and close hydrant slowly and fully a. Opening too fast may cause the hose attached to flail violently or burst b. C. Dry-barrel hydrants 1.

NOTES	STUDENT GUIDE
	2. The valve holding back the water is located underground, below the anticipated frost line for the area 3. Water in the barrel of dry-barrel hydrant drains through a small drain hole at the bottom of the hydrant after closing 4. If the hydrant is not completely opened or closed, the drain hole will be partially open and cause soil erosion around the hydrant base 5. To test the ability for a hydrant to drain: a. After flowing water, close the hydrant and cap all discharges except one b. Place a hand over the open discharge c. A slight vacuum should be felt on the hand as the barrel drains 6. If water is bubbling up out of the ground at a dry-hydrant's base when the hydrant is fully open, a broken component in the hydrant barrel is allowing water to get past the drain opening D. Wet-barrel hydrants 1. 2. Always filled with water to a compression valve at each outlet 3. Also referred to a "frost-free" or "California" hydrants

NOTES	STUDENT GUIDE
	E. Hydrant color coding from NFPA 291, *Recommended Practice for Testing and Marking Hydrants* 1. Light blue: 1,500 gpm or more 2. Green: 1,000 to 1499 gpm 3. Orange: 500 to 999 gpm 4. Red: less than 500 gpm 5. Local color-coding of hydrants differ depending on the jurisdiction F . Hydrant locations 1. Different jurisdictions have different requirements for hydrant spacing and locations depending on: a. Types of construction b. Types of occupancies c. Building densities d. Water main size e. Required fire flow for area occupancies 2. G. Hydrant effectiveness may be affected by different factors 1.

NOTES	STUDENT GUIDE
	2. Discharge outlets may face the wrong direction to allow hose attachment 3. 4. Corrosion may prevent the proper operation or impede the flow of water 5. Lack of clearance between outlet caps and the ground 6. Outlet caps missing or stuck in place with paint 7. Stem nut that cannot be turned or turns freely with no result 8. Obstructions (bottles, cans, rocks) inside hydrant outlets H. Testing hydrants 1. In some jurisdictions, hydrants are tested by a water department instead of the fire department a. Where fire departments do hydrant testing, fire fighters usually assist with the testing b. If the water system is privately-owned, the fire department should coordinate hydrant testing with the system owner 2. Pitot tube and gauge are used to test the flow pressure of a hydrant 3. Use of the pitot tube and gauge a. Pitot tube is held so that blade slices into water stream

NOTES	STUDENT GUIDE
	b. Open the petcock to make sure the air chamber is drained, close petcock c. Edge blade in stream with opening centered in stream d. e. Tube should be parallel to the opening with the air chamber slightly above the center of the stream f. If the gauge is fluctuating, take the value between the highest and lowest readings 4. Fixed-mount pitot tubes are available to reduce the possibility of human error **IV. Alternative Water Supplies** *(Essentials p. 610)* A. Alternative water supplies may have to be used even in areas with adequate water systems 1. The water system may fail due to broken mains or power outages 2. Fires may occur in areas some distance from hydrants, such as fields or along limited-access highways 3. Departments may have to draw water from sources such as lakes, ponds, rivers, swimming pools, and water tenders

NOTES	STUDENT GUIDE
	B. Drafting from a static source 1. 2. Hard suction intake hose is used primarily to draft water because it is designed to withstand the partial vacuum created when drafting without collapsing 3. Drafting operations are affected by debris, sediment, and rocks which can clog strainers, damage pumps, and clog nozzles a. Hard suction hoses must have strainers in place when drafting from a natural source b. Strainers can be supported by a ladder or floating strainer used to prevent hose from drawing in sediment c. A strainer should have at least 24-inches of water above and below it d. Floating strainers can draft from water as shallow as 24-inches deep 4. In some areas dry hydrants are installed at static water sources to supply water for fire fighting a. Usually constructed of steel or PVC pipe with strainers at the water source and large connections to connect to a pumper b. In order to establish a water supply from a dry hydrant, hard suction must be used and a drafting operations set up

NOTES	STUDENT GUIDE
	5. Drafting operations a. Suitable water source must be located for adequate water supply and to allow positioning of pumper nearby b. Pumper is positioned near water source c. Check hard suction coupling for dirt, debris, and worn gaskets d. The hard suction hose is attached to intake on pumper e. Strainer or floating strainer is attached to hard suction f. All connections must be air tight to allow for adequate draft g. If a floating strainer is not used, a ladder should be positioned in the water for the strainer to rest on h. Strainer is placed in water i. Pumper pulls a draft by priming the pump until positive pressure is indicated j. If unable to achieve draft, tighten connections with rubber mallet k.

NOTES	STUDENT GUIDE
	C. Rural operations usually consist of water shuttle operations 1. Water is hauled from a supply by water tenders (tankers) to portable tanks where it can be drawn to the attack pumper 2. Water shuttles are recommended for distances greater than one-half mile or greater than the amount of supply line carried 3. Enough water tenders must be available to maintain the needed fire flow 4. a. Water supply officers should be at both the fill site and dump site b. Personnel should be assigned to traffic control, fill site connections, and dumping c. If possible, tanker drivers should stay in their vehicles during the operations 5. Water shuttle operation components a. Water source - fill site b. Transport system: tankers/tenders c. Dump site - d. Portable tanks (1) Range from 1,000 gallons and up

NOTES	STUDENT GUIDE
	(2) May be collapsible or folding with a metal frame holding a synthetic or canvas duck liner (3) May be a self-supporting synthetic tank with a floating collar that rises as the tank is filled (4) Before opening a portable tank, a heavy tarp should be spread on the ground to protect the tank liner from damage (5) If possible, portable tanks should be positioned: (a) As level as possible to allow for maximum capacity (b) To allow for easy access for tankers from multiple directions (c) So as not to obstruct scene access for other apparatus (d) With the drain towards the lower side (6) (7) If multiple tanks are used, a jet-siphon can be used to transfer water between tanks (a) The jet-siphon may be incorporated into a low-level strainer and attached to hard suction hose, which is placed between the tanks (b) The jet-siphon draws the water through the hard suction hose

NOTES	STUDENT GUIDE
	e. Water tenders/tankers (1) NFPA 1901, *Standard for Automotive Fire Apparatus*, requires that water tenders on ground level be capable of dumping or filling rates of at least 1,000 gpm (2) Pumping water from a tanker should only by done by trained and qualified apparatus operators (3) Water tender unloading methods: (a) Gravity dumping through large (10- to 12-inch) dump valves (b) Jet dumps that increase the flow rate (c) Apparatus-mounted pumps that off-load the water (d) Combinations of these methods (4) Water tenders must be capable of being quickly refilled during emergency operations by using: (a) The best fill site or hydrant available (b) Large hoselines (c) Multiple hoselines (d) If necessary, a pumper with adequate flow

NOTES	STUDENT GUIDE
	D. Relay pumping operations 1. Multiple pumpers can be used in a series to relay water to the scene if the water source is close enough 2. The water supply must be capable of maintaining the required volume for the incident's duration 3. The number of pumpers needed will depend on: a. The volume of water needed b. The distance from the water source to the scene c. The amount of hose available d. Pumper capacities 4. 5. A relay pumping operation must be established quickly to be worthwhile **V. Water Supply Summary** A. For as long as there have been fire fighters, water has been the primary tool used to control fires B. Fire fighters must understand how water systems function to provide them with the water needed in an emergency C. More importantly, fire personnel must be proficient at getting the water from the supply source to the fire apparatus and then on the fire