

**DRIVER/OPERATOR - PUMPER
NFPA 1002**

The following lesson plans for Apparatus Driver/Operator - Pumper are based on NFPA 1002, Standard for Fire Department Vehicle Driver/Operator Professional, 1993 Edition. These lesson plans contain the same material that is covered in the Career Development Course for Driver/Operator Pumper. The material in these lesson plans follows natural learning simple to complex sequencing practices. Therefore, mastery of the material in the beginning is required before advancing to the latter lesson plans. The sequence of material in these detailed lesson plans is different from the Career Development Course and NFPA 1002 sequence, which were designed to serve other purposes.

It is recommended that you become familiar with NFPA 1002, Standard for Fire Department Vehicle Driver/Operator Professional Qualifications prior to using these lesson plans. The following list identifies all Lesson Plans and the related NFPA 1002 Job Performance Requirements. Note that if some of the numbers appear more than once; this is because several of the Job Performance Requirements or their prerequisites have to be broken in parts and taught at different times. Finally, if only the Job Performance Requirement number is identified, then all the prerequisite knowledge and skills are covered in that lesson.

Lesson Plan 1

2-2.1
2-2.1

Lesson Plan 2

2-3.1 2-3.3.2
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2-3.1.2 2-3.5
2-3.2.1 2-3.6
2-3.2.2 2-3.6.1
2.3.3 2-3.8
2-3.3.1

Lesson Plan 3

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3-1.3
3-1.4
3-1.5

Lesson Plan 4

3-2.1
3-2.1.1

Lesson Plan 5

3-3.1
3-3.1.1

Lesson Plan 6

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DOD FIRE SERVICE CERTIFICATION SYSTEM

LESSON PLAN 1

Personnel Classification: Apparatus/Driver Operator - Pumper

Subject: Preventive Maintenance

NFPA 1002 Objectives

2-2.1

2-2.2

Training Materials/Equipment:

Pumper vehicle, service records used by the agency, including fire apparatus history card

References:

IFSTA, Fire Department Pumping Apparatus, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Fire Stream Practices, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Water Supplies for Fire Protection, 4th Edition, 1988, Fire Protection Publications, Oklahoma State University.

NFPA 1002: Fire Vehicle Operator Professional Qualifications, 1993 National Fire Protection Association, Quincy, Massachusetts

NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs, 1992 National Fire Protection Association, Quincy, Massachusetts

Additional Information:

IFSTA Firefighter Videotape Series - Fire Pump Operation and Maintenance, Fire Protection Publications, Oklahoma State University

Instructor Tasks

- Review lesson outline to ensure understanding of contents and procedures.
- Review references for lesson.
- Use additional references and your knowledge to enrich lesson outline.
- Select and prepare any additional audio-visual aids that may assist in the presentation of the lesson.
- Ensure that all equipment needed, including any audio-visual equipment, is available.
- Review lesson at end of session to ensure student understanding.
- Ensure that the topics and objectives of the lesson have been adequately covered.

INTRODUCTION AND OBJECTIVES

- I. Greet class
- II. State purpose of the lesson
- III. Establish relation to previous and following lessons
- IV. Review NFPA 1002 objectives for this lesson
- V. Review any additional materials for this lesson

PRESENTATION

LESSON OUTLINE

INSTRUCTOR NOTES

2-2.1. Preventive Maintenance

- A. Routine Tests, Inspections, and Servicing Functions
 1. Approach to an apparatus check

The majority of the information presented here is by automotive system: battery, coolant system, electrical system, etc. However, as Pumper Driver/Operators become more familiar with vehicle, it may be easier and quicker to approach the vehicle location by location: inside the cab, around the body, under the hood, etc.
- B. Battery check procedure
 1. Corrosion
 - a. Check for corrosion around terminals and other areas surrounding the battery
 - b. Wipe these clean to ensure maximum contact between battery and wires
 2. Cell electrolyte level
 - a. Check the water level of the battery and fill, if needed
 - b. The fill point should at least cover plates
 - c. Be sure water is between minimum and maximum fill levels
 3. Specific gravity
 - a. It is the density of the water which tells the driver/operator how charged the battery is
 - b. To check; draw water from battery into a hydrometer

LESSON OUTLINE

INSTRUCTOR NOTES

- c. Read the measurement on the hydrometer which indicates whether the battery is charged enough to operate
- d. This must be done cell by cell
- 4. Test for voltage
 - a. Touch the voltmeter to the two terminals of the battery; be sure that the polarity is correct: red on red (positive) and black on black (negative)
 - b. Be sure voltmeter is set to the appropriate scale
- 5. Charging the battery
 - a. Charge the battery if the hydrometer indicates the battery is low
 - b. Identify polarity of battery to be charged (positive or negative ground)
 - c. Attach red charger cable to positive battery post
 - d. Attach black charger cable to negative battery post
 - e. Connect battery charger to a reliable power source (away from gasoline and other flammable vapors)
 - f. Set desired battery charging voltage and charging rate (if so equipped); switches on battery chargers should be in the OFF position when not in use
 - g. Use caution because hydrogen gas is produced during charging
 - h. Reverse procedure to disconnect the battery charger

LESSON OUTLINE

INSTRUCTOR NOTES

- C. Brake system
 - 1. Air brakes
 - a. Pressure test by tapping the brake pedal
 - b. Check low air warning system
 - c. Check air chuck on rear of apparatus
 - 2. Emergency brakes
 - a. Check emergency brakes (hand brakes) for hold
- D. Coolant system
 - 1. The coolant system protects both engine and pump
 - 2. For safety, be sure coolant is checked when the engine is entirely cool
 - 3. Procedure
 - a. Check the coolant color and level in the radiator and add fluid (if applicable)
 - b. Inspect the hoses for cracks or leaks
 - c. Flush the coolant system and add rust inhibitor (if applicable)
 - d. Check the radiator fan for loose or cracked blades
 - e. Check temperature gage reading with engine running
- E. Electrical system
 - 1. There are numerous electrical connections in an apparatus; damage from moisture or corrosion can render an electrical connection inoperative
 - 2. Lights
 - a. Operate headlight dimmer switch
 - b. Operate clearance, stop, and back up lights
 - c. Operate all compartment lights and switches
 - d. Operate warning lights and switches
 - e. Operate the floodlights and switches
 - 3. All motor-driven equipment should be started and run once a week
 - a. Operate rotating lights
 - b. Operate hose reel rewind

LESSON OUTLINE

INSTRUCTOR NOTES

- c. Operate apparatus controls
 - d. Operate header and defroster fan
 - e. Operate heater and/or air conditioner (if applicable)
 - f. Operate public address system and radio
 - g. Operate horn
 - h. Check audible and usual warning devices
- F. Fuel system
- 1. A full tank of fuel; ensures maximum running time
 - 2. Procedure
 - a. Check fuel level, add fuel if needed
 - b. Check fuel pumps and filters periodically
 - c. Check fuel tank cap vent for blockage, clear if necessary
 - d. Drain moisture from fuel/water separator
- G. Hydraulic fluids
- 1. Be certain the fluid added is compatible with the fluid already in the reservoir; type of fluid needed is often printed on reservoir or check appropriate Technical Order
 - 2. Procedure
 - a. Wipe off lid of reservoir before opening to prevent contamination from water or other contaminants
 - b. Amount to be filled is also found in the appropriate Technical Order
 - c. Check master cylinder reservoir
 - d. Check power steering fluid reservoir (if applicable)
- H. Lubrication/oil levels
- 1. General
 - a. Prime objective of good maintenance
 - b. Proper lubrication saves maintenance and repair dollars; reduces out-of-service time

LESSON OUTLINE

INSTRUCTOR NOTES

- c. Oil gives protection against corrosion, foaming, sludging, and carbon accumulation
 - d. To protect oil from contamination, prevent any unnecessary engine starts
 - 2. Procedure
 - a. Check technical order for correct viscosity of the oil
 - b. Check engine oil level
 - c. Check exterior of engine for leaks
 - d. Check transmission oil level
 - e. Check exterior of transmission for leaks
 - f. Check all oil lines for leaks, corrosion or damage
 - g. Check differential oil levels
 - h. Check oil pressure with engine running
- I. Tires
 - 1. Check tires for cuts, breaks, proper inflation, and uneven wear
 - 2. Check valve stems for corrosion or damage
 - 3. Inflate tires to proper level as noted on tire
 - 4. Check lugs for tightness and rims for damage
- J. Steering system
 - 1. Check steering gear for excessive motion and periodically lubricate steering gear
 - 2. Check seals on steering gear
 - 3. Check fluid reservoir, add fluid if needed
 - 4. Check all lines and hoses for damage
- K. Belts
 - 1. Check to make sure belts are present
 - 2. Check belts for wear
 - 3. Check for proper tension

LESSON OUTLINE

INSTRUCTOR NOTES

- L. Tools, appliances, and equipment
 - 1. General
 - a. Tools, appliances, and equipment refer to those items carried on the fire apparatus but not permanently attached to or a part of the apparatus
 - b. Most removable equipment is common to all fire equipment and should be checked daily
 - 2. Procedure
 - a. Remove and (if applicable) clean any equipment attached to the apparatus
 - b. Check portable extinguishers by weighing or checking pressure gauge
 - c. Check hose loads for correct finishes
 - d. Inventory all nozzles and appliances
 - e. Check air pressure in self-contained breathing apparatus and spare bottles
 - f. Examine regulators and face pieces
 - g. Operate hand lights
 - h. Operate power tools
 - i. Operate hand tools
 - j. Check ground ladders
 - k. Check that the first-aid kit is complete
 - l. Check all tool mountings
 - m. Check fluid levels of all power tools/equipment
- M. Agent tank level
 - 1. Check the water level by shining a flashlight onto water surface
 - 2. Fill the agent tank to capacity
 - a. This should be done daily
 - b. At no time should tank be less than full
 - 3. Check the inside surface for corrosion and cleanliness
 - 4. Check the accuracy of agent level gauges compared to actual agent levels in the tank
 - a. If there is a difference between the two, alert appropriate maintenance facility immediately

LESSON OUTLINE

INSTRUCTOR NOTES

- N. Cab and Body
 - 1. Check operation and condition of compartment doors
 - 2. Check weather seals around cab and compartment doors
 - 3. Check windshield washer solvent, add if needed
 - 4. Operate windshield wipers and washers
 - 5. Check mirror adjustment
 - 6. Inspect all glass for breaks or discoloration
 - 7. Check operation of seat adjusting mechanisms
 - 8. Check condition and operation of seat belts
- O. Other components to check while inside cab
 - 1. Check mirrors for cracks and cleanliness
 - 2. Check map case is complete with grid maps and other applicable maps
 - 3. Check seats for tears and adjustability
- P. Water and Foam Piping
 - 1. Check underside of apparatus for leaks
 - 2. Check drain valves
 - 3. Check oil level for priming pump
- Q. Other components to check on the body of the apparatus
 - 1. General
 - a. Fire apparatus must be kept clean.
 - b. A clean apparatus engine permits proper inspection and ensures efficient operation as needed
 - 2. Procedure
 - a. Check the body for cleanliness and wash away any visible dirt
 - b. Check for oil, moisture, dirt, and grime
 - c. Check body panels for rust, dents, or exposed areas needing touch-up paint
 - d. Check weather seals around cab and compartment doors for looseness, damage, and deterioration

LESSON OUTLINE

INSTRUCTOR NOTES

- 2-2.2 Document routine tests, inspections, and service functions
 - A. Fire apparatus record
 - 1. Maintain as required
 - B. Fire apparatus data and history
 - 1. Maintain as required
 - C. Gasoline, oil and mileage record
 - 1. Maintain as required
 - D. Apparatus inspection report
 - 1. Complete as required
 - a. Daily
 - b. Weekly
 - c. Periodic
 - E. Fire equipment record
 - 1. Complete as required
 - a. Daily
 - b. Weekly
 - c. Periodic

REVIEW

- I. Discuss key lesson points.
- II. Ask questions on the material covered.
- III. Review material that may be unclear.
- IV. Administer test or quiz.
- V. Critique test or quiz.

SUMMARY

- I. Summarize what has been covered.
- II. Relate what has been covered to the next lesson.

DOD FIRE SERVICE CERTIFICATION SYSTEM

LESSON PLAN 2

Personnel Classification: Apparatus Driver/Operator - Pumper

Subject: Driving Operating

NFPA 1002 Objectives

2-3.1	2-3.3.2
2-3.1.1	2-3.4
2-3.1.2	2-3.5
2-3.2.1	2-3.6
2-3.2.2	2-3.6.1
2-3.3	2-3.8
2-3.3.1	

Training Materials/Equipment:

Fully equipped and operational ARFF vehicle, chalkboard, hydrometer, voltmeter, traffic cones, 50 foot tape measure

References:

IFSTA, Fire Department Pumping Apparatus, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Fire Stream Practices, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Water Supplies for Fire Protection, 4th Edition, 1988, Fire Protection Publications, Oklahoma State University.

NFPA 1002: Fire Vehicle Operator Professional Qualifications, 1993 National Fire Protection Association, Quincy, Massachusetts

NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs, 1992 National Fire Protection Association, Quincy, Massachusetts

Additional Information:

IFSTA Firefighter Videotape Series - Fire Pump Operation and Maintenance, Fire Protection Publications, Oklahoma State University

Additional Information:

Applicable Technical Manuals

IFSTA Pumping Apparatus Series Videotapes, Fire Protection Publications, Oklahoma State University

Instructor Tasks

- Review lesson outline to ensure understanding of contents and procedures.
- Review references for lesson.
- Use additional references and your knowledge to enrich lesson outline.
- Select and prepare any additional audio-visual aids that may assist in the presentation of the lesson.
- Ensure that all equipment needed, including any audio-visual equipment, is available.
- Review lesson at end of session to ensure student understanding.
- Ensure that the topics and objectives of the lesson have been adequately covered

INTRODUCTION AND OBJECTIVES

- I. Greet class
- II. State purpose of the lesson
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- V. Review any additional materials for this lesson

PRESENTATION

LESSON OUTLINE

INSTRUCTOR NOTES

- 2-3.1 Operate fire department vehicle
 - A. Operate a fire department vehicle over a predetermined route
 1. Predetermined route
 - a. Incorporate
 - 1) Maneuvers
 - 2) Features
 2. Vehicle must be operated in compliance with
 - a. Federal laws
 - b. State laws
 - c. Local laws
 - d. Department rules and regulations
 - e. Requirements of NFPA 1500
 3. Predetermined route must include
 - a. 4 left and 4 right turns
 - 1) Approach point of turn
 - 2) Activate turn signal
 - 3) Insure path is clear of traffic or obstructions
 - 4) Check rearview mirrors
 - 5) Slow vehicle
 - 6) Apply brakes, if necessary
 - 7) Make smooth turn to new path of travel

LESSON OUTLINE

INSTRUCTOR NOTES

- b. Straight section of urban business street
 - 1) Drive at posted speed limit or drive based on conditions
 - 3) Stay in correct lane
 - 4) Move eyes to check
 - a) ahead
 - b) side streets and roads
 - c) other traffic
 - d) rear view mirrors
 - e) observe all traffic laws
- c. 2 lane rural road
 - 1) Drive at posted speed limit or drive based on conditions
 - 2) Stay in correct lane
 - 3) Move eyes to check
 - a) ahead
 - b) side streets and roads
 - c) other traffic
 - d) rear view mirrors
 - 4) Observe all traffic laws
- d. Intersections
 - 1) Going through
 - a) Approach with vehicle under control
 - b) Observe cross streets/roads
 - c) Slow apparatus
 - d) Be prepared for controlled stop
 - e) Yield to traffic on the right
 - f) Proceed through intersection when safe to do so

LESSON OUTLINE

INSTRUCTOR NOTES

- 2) 2 intersections where stop is required
 - a) Approach with vehicle under control
 - b) Observe cross streets/roads
 - c) Slow apparatus
 - d) Bring apparatus to smooth stop
 - e) Yield to traffic that has right of way
 - f) Proceed through intersection when safe to do so
- e. Railroad crossing
 - 1) Approach crossing with vehicle under control
 - 2) Bring apparatus to complete stop
 - 3) Look in both directions
 - 4) Cross tracks when safe to do so
- f. Curve -right or left
 - 1) Approach curve at safe speed with apparatus under control
 - 2) Slow apparatus, if necessary
 - 3) Stay in proper lane
 - 4) Maintain control of apparatus through curve
 - 5) Accelerate out of curve
- g. Section of limited access highway
 - 1) Conventional ramp entrance
 - a) Approach ramp at safe speed
 - b) Activate turn signal
 - c) Maintain safe ramp speed
 - d) Check side and rearview mirror prior to merge
 - e) Adjust speed to merge safely with traffic in acceleration lane

LESSON OUTLINE

INSTRUCTOR NOTES

- 2) Conventional ramp exit
 - a) Activate turn signal
 - b) Check side and rearview mirror
 - c) Steer into deceleration lane
 - d) Slow apparatus
 - e) Maintain control on exit ramp
- 3) Long stretch to allow lane changes
 - a) Activate turn signal
 - b) Check rearview mirror to make sure lane is clear
 - c) Gradually change lanes when safe to do so
- h. Downgrade that requires down shifting and braking
 - 1) Maintain safe speed on approach to downgrade
 - 2) Apply brakes to slow apparatus, if necessary
 - 3) Shift to next lower gear, if applicable
 - 4) Use grade retarder, if available
 - 5) Observe engine tachometer to prevent engine overspeeding
 - 6) Use brakes and shift to lower gear, if necessary
 - 7) Maintain control of apparatus
- i. Upgrade that requires shifting to maintain speed
 - 1) Maintain safe speed on approach to upgrade
 - 2) Accelerate when starting up hill
 - 3) Shift to next lower gear when speed slows, or engine rpms fall
 - 4) Change gears to maintain proper rpm
 - 5) Remain in proper lane

engine

LESSON OUTLINE

INSTRUCTOR NOTES

- j. Underpass or low clearance or bridge
 - 1) Approach underpass or bridge slowly
 - 2) Insure that clearance is adequate for apparatus
 - 3) Stop apparatus and check height, if not sure
 - 4) Spotter should be used

C. NFPA 1500, *Standard on Fire Department Occupational Safety*

and Health Program, Section 4-2

(Review NFPA 1500, Section 4-2)

4-2.2

4-2.3

4-2.4

4-2.5

4-2.6

4-2.7

4-2.8

4-2.9

4-2.10

LESSON OUTLINE

INSTRUCTOR NOTES

2-3.1.1 Prerequisite Knowledge

- A. Effect on vehicle control
 - 1. Braking reaction time
 - a. Speed directly affects time required to stop
 - b. Driver should know stopping distances for specific apparatus
 - 1) Total stopping distance: Sum of driver/operator reaction distance and vehicle braking distance
 - 2) Reaction distance: distance traveled while driver transfers foot from accelerator to brake pedal after perceiving need to stop
 - 3) Braking distance: distance vehicle travels from time brakes are applied until it comes to a complete stop
 - 2. Load (weight) factors
 - a. Loads must be considered by all drivers
 - b. Laws of physics
 - 1) When vehicle undergoes change in velocity of direction - transfer takes place relative to change
 - c. Position of load has effect on vehicle
 - 1) The lower the load the easier to control on turns
 - 2) The higher the load the greater the potential for skidding or rollover
 - 3) Avoid high speed turns
 - 4) Steer smoothly to avoid abrupt changes
 - 5) Be extremely careful on slopes and hills

LESSON OUTLINE

INSTRUCTOR NOTES

3. General steering reactions
 - A. Be alert to situations in order to prevent rapid steering movements and loss of control
 - B. Adjust speed for condition to maintain control while maneuvering the vehicle
 - C. Keep both hands on the wheel at all times, except when shifting or using other controls
 - D. Hands should be positioned at ten and two o'clock
4. Speed
 - A. Adjust speed to compensate for conditions
 - 1) Weather
 - 2) Darkness
 - 3) Traffic
 - 4) Area
5. Centrifugal force
 - A. Force which acts or impels an object out from a center of rotation.
 - B. Related factors
 - 1) Speed of travel
 - 2) Radius of curve
 - 3) Road and tire conditions
 - 4) Grade
 - 5) Superelevation (banked, flat, crowned)
- B. Applicable laws and regulations
 1. Identify all applicable laws related to the operation of emergency vehicles
 - a. Local
 - b. State
 - c. Federal
 2. Identify all applicable rules and regulations of the department

LESSON OUTLINE

INSTRUCTOR NOTES

3. General
 - a. Emergency vehicle operators are subject to all traffic regulations unless a specific exemption is made. The exemption(s) would apply to emergency conditions only.
 - b. Legal decisions have held that driver/operators who do not obey state, local, or department regulations can be subject to criminal and civil prosecution if the apparatus is involved in an accident.
 - c. If the driver/operator is negligent and is involved in an accident, both the driver/operator and the department may be held responsible
 - d. Follow all laws regarding direction of travel, direction of turns, and parking unless under emergency conditions
 - e. Regardless of conditions - stop for school buses with flashing lights
 - f. Obey all traffic laws and signals when returning to quarters and non emergency travel.

2-3.1.2 Prerequisite Skills

- A. Safe vehicle operation
 1. Emergency and non-emergency defensive driving
 - a. Defensive driver
 - 1) Makes allowances for
 - a) Own deficiencies
 - b) Lack of skill and knowledge of others
 - 2) Recognizes there is no control over
 - a) Unpredictable actions of others
 - b) Weather
 - 3) Concedes right-of-way
 - 4) Makes concessions to avoid collisions
 - 5) Looks ahead and watches situations develop

LESSON OUTLINE

INSTRUCTOR NOTES

- b. Defensive driving factors
 - 1) Proper attitude
 - a) Remain calm and drive in a safe manner
 - b) Reckless driving is never acceptable
 - c) Aggressive attitudes are a menace to other vehicles, pedestrians, and other fire fighters on the apparatus
 - 2) Anticipation of other drivers actions
 - a) Other drivers may panic at sound of siren
 - b) Some ignore warning signals
 - c) Never assume other driver will react in a rational manner
 - d) Always expect the unexpected
 - 3) Focus fixation
 - a) Tendency to steer towards a spot where attention is focused
 - b) Don't focus on distractions
 - 4) Visual lead time
 - a) Aim high in steering - get the the big picture
 - b) Allows driver/operator to become more aware of conditions that may require slowing or stopping
- 2. Safe driving during adverse weather
 - a. Slippery road surfaces
 - 1) Increase stopping distances 3-15 times more than normal
 - 2) Try brakes in area free of traffic
 - 3) If apparatus skids - release brakes immediately

LESSON OUTLINE

INSTRUCTOR NOTES

- 4) Adjust speed to road and weather conditions so that apparatus can be stopped and maneuvered safely
 - b. Vehicle skids
 - 1) Caused by:
 - a) Driving too fast
 - b) Failing to appreciate weight shifts
 - c) Failing to anticipate obstacles
 - 2) If apparatus goes into skid
 - a) Release brakes immediately
 - b) Steer in the direction of skid
 - c. Snow and ice
 - 1) Snow tires and chains will
 - a) reduce stopping distance
 - b) Increase grip for starting
 - c) Increase hill climbing ability
 - 2) Still necessary to maintain lower speeds even with chains
 - 3) Pump brakes gently on snow and ice stopping distance
 - d. Fog
 - 1) Visibility is at its worst in fog
 - 2) Drive slowly using low beams
 - 3) Avoid sudden stops by tapping on brake pedal
 - 4) Never assume a clear road except for distance that you can actually see
- B. Operate passenger restraining devices
1. Fasten seat belts
 2. Make sure that all personnel are seated and belted before moving apparatus

LESSON OUTLINE

INSTRUCTOR NOTES

2-3.2 Use automotive gauges and controls

- A. Monitor gauges while operating the pumper
- B. All applicable controls will be used during the performance of the driving and operations functions required by this standard

2-3.2.1 Prerequisite Knowledge

- A. Identification and operation of automotive gauges and proper operation limits
 - 1. Gauges are required to ensure proper operation of engine and components and to warn of malfunctions when gauges do not show normal operating ranges
 - 2. Necessary when under way and when operating on the fire ground
 - 3. Some gauges are duplicated
 - a. Dashboard
 - b. Pump panel
 - 4. Speedometer
 - a. Shows vehicle speed
 - 5. Odometer
 - a. Shows miles traveled
 - 6. Tachometer
 - a. Measures engine RPM (revolutions per minute)
 - b. Provides the driver/operator with information on how to operate the vehicle efficiently without harming the engine
 - c. Provides the driver/operator with information on engine operation when pumping
 - d. Provides an indication of safe operating limits of the engine
 - 1) Consult technical manuals for proper operating range

LESSON OUTLINE

INSTRUCTOR NOTES

7. Oil pressure gauge
 - a. Measures oil pressure
 - b. Indicates that oil is being supplied to the engine at the proper pressure
 - c. Normal operating pressures are specified in operations and maintenance manuals
 - d. Significant deviations from normal pressures is an indication of a problem
 - e. Consult technical manuals for proper operating range
8. Ammeter
 - a. Measures and shows the amount of current drawn from the battery to operate electrical equipment, or the amount of current being supplied to the battery for charging
 - b. Consult technical manuals for proper operating range
9. Voltmeter
 - a. Indicates battery conditions - low or high
 - b. Provides a relative indications of battery condition by showing the amount of drop in voltage that is measured when some of the more demanding electrical accessories are used.
 - c. Indicates the top voltage available when the battery is fully charged
 - d. Consult technical manuals for proper operating range
10. Air pressure gauge
 - a. Indicates air pressure available to operate air brakes
 - b. Consult technical manuals for proper operating range

LESSON OUTLINE

INSTRUCTOR NOTES

11. Water temperature gauge
 - a. Indicates temperature of engine coolant
 - b. Provides an indication of when the engine is overheating
 - c. Consult technical manuals for proper operating range
12. Fuel gauge
 - a. Indicates the level of fuel in the tank
13. Transmission oil temperature, if applicable
 - a. Shows temperate of transmission oil
 - b. Consult technical manuals for proper operating range

2-3.2.2 Prerequisite Skills

- A. Operate vehicle controls
 1. Set parking brake
 2. Place transmission gear selector in neutral
 3. Turn master switch on
 4. Turn on ignition switch
 5. Engage starter switch
 6. After start-up observe engine gauges and warning lights for proper readings
 - 1) Run engine at 800 to 1,000 rpm to obtain proper operating temperatures and gauge readings
 7. Turn on all necessary lights, communications equipment, and warning equipment
 8. Select proper gear range
 9. Move vehicle forward
 10. Come to a complete stop
 11. Shift into reverse
 12. Come to a complete stop
 13. Place transmission selector in neutral
 14. Apply parking brake

LESSON OUTLINE

INSTRUCTOR NOTES

15. Allow engine to idle for at least 2 minutes before shut down
 - a. Immediate shutdown results in engine temperature increase
 - b. May result in damage to heads, exhaust manifolds, and turbocharger
 - c. Engine temperature should stabilize before shutdown
16. Reduce engine speed to low idle
17. Shut of all lights and other equipment
18. Turn ignition switch off
19. Place electrical master switch in the off position

2-3.3 Back a fire department vehicle from a roadway

- A. Into a restricted space on right and left side
 1. Measures driver/operators ability to drive past a space and to back the apparatus into the space without having to stop and pull forward
 2. Spotter must be used
 3. Restricted space 12 ft in width (Unless vehicle is exceptionally wide, variance must requested.)
 4. Exercise requires a 90 degree right and left hand turns from roadway
 5. Vehicle must be parked
 - a. Without having to stop and pull forward
 - b. Without striking obstructions
 6. Steps
 - a. Driver/operator should drive forward and pass the dock on the left
 - b. Stop the apparatus
 - c. Back the apparatus into the dock
 - d. Repeat the steps by driving forward with the dock on the right

LESSON OUTLINE

INSTRUCTOR NOTES

2-3.3.1 Prerequisite Knowledge

- A. Vehicle dimensions (see technical manual for specific vehicle)
 - 1. Length - inches
 - 2. Width - inches
 - 3. Wheel base - inches
 - 4. Overall height - inches
- B. Turning characteristics (see technical manual for specific vehicle)
 - 1. Turning circle - feet

2-3.3.2 Prerequisite Skills

- A. Use mirrors for backing
 - 1. Make sure all mirrors are adjusted properly
 - 2. Sit straight with both hands on the steering wheel
 - 3. Move head from side to side to check mirrors
 - 4. Make sure that you can see the spotter
 - 5. Back apparatus following the directions of the spotter
 - 6. If you cannot see the spotter - stop
 - 7. Check each mirror from time to time while backing, but always look for the spotter.

2-3.4 Maneuver a fire department vehicle around obstructions

- A. Measures ability to steer apparatus in close limits without stopping
- B. Spotter must be used
- C. On a roadway around obstructions
- D. Move in forward and reverse
- E. Maneuver through obstructions without
 - 1. Stopping to change direction of travel
 - 2. Striking obstructions
- F. Steps
 - 1. Drive apparatus forward in a straight line with the markers on the left
 - 2. Stop the apparatus just beyond the last marker

LESSON OUTLINE

INSTRUCTOR NOTES

3. Back the apparatus between the markers by passing to the left of marker number 1, to the right of marker number 2 and the left of marker number 3
 4. After clearing marker number 3 stop the apparatus
 5. Drive forward between the markers leaving marker number three on the left, marker number 2 on the right and marker 3 on the left
- 2-3.5 Turn a fire department vehicle 180 degrees within a confined space
- A. Measures driver/operators ability to turn apparatus around in a confined space
 - B. Spotter must be used
 - C. Vehicle must be stopped and backed up to complete turn
 - D. Continuous U-turn is not allowed
 - E. Vehicle must be turned 180 degrees without striking obstructions within an area measuring
 - F. Steps
 1. Move apparatus through 12 ft opening in one of the 50 ft legs (Unless vehicle is exceptionally wide, variance must requested.)
 2. Turn the apparatus 180 degrees and return through the same opening
 3. No limitation on the number of times the vehicle may be maneuvered
- 2-3.6 Maneuver fire department vehicle in areas with restricted horizontal and vertical clearances
- A. Measures driver/operators ability to steer apparatus in a straight line, judge distances from wheel to object, and stop on a finish line.
 - B. Operator accurately judges ability of vehicle to pass through openings
 - C. Operator accurately judges ability of vehicle so that no obstructions are struck
 - D. Steps
 1. Drive forward and reverse through the prop without striking anything

LESSON OUTLINE

INSTRUCTOR NOTES

- 2-3.8 Operate systems and equipment
 - A. Operate in accordance with
 - 1. Manufacturers instructions and specifications
 - 2. Department policies and procedures
 - 3. Technical order
 - B. Systems
 - 1. Set relief valve
 - a. Pump in operation
 - b. All lines flowing at desired flow rate
 - c. Set relief valve at desired relief pressure
 - d. Check to make sure discharge pressure is maintained
 - 2. Set pressure governor
 - a. Set governor for desired discharge pressure
 - b. Check to make sure discharge pressure is maintained
 - C. Equipment
 - 1. Operate each piece of equipment that is carried on the vehicle
- 2-3.6.1 Prerequisite Skills
 - A. Judging vehicle clearances
 - 1. Skill development
 - a. Practice judging distances while driving and maneuvering at slow speeds.
 - b. Stop periodically get out of vehicle and look at actual distances
 - c. Perform maneuvers that will develop skill at judging distance to the:
 - 1) Front
 - 2) Back
 - 3) Height
 - 4) Width/sides
 - d. Use spotter

REVIEW

- I. Discuss key lesson points.
- II. Ask questions on the material covered.
- III. Review material that may be unclear.
- IV. Administer test or quiz.
- V. Critique test or quiz.

SUMMARY

- I. Summarize what has been covered.
- II. Relate what has been covered to the next lesson.

DOD FIRE SERVICE CERTIFICATION SYSTEM

LESSON PLAN 3

Personnel Classification: Apparatus/Driver Operator - Pumper

Subject: Pumper - General

NFPA 1002 Objectives

3-1.2

3-1.3

3-1.4

3-1.5

Training Materials/Equipment:

Fully equipped and operational pumper.

References:

IFSTA, Fire Department Pumping Apparatus, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Fire Stream Practices, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Water Supplies for Fire Protection, 4th Edition, 1988, Fire Protection Publications, Oklahoma State University.

NFPA 1002: Fire Vehicle Operator Professional Qualifications, 1993 National Fire Protection Association, Quincy, Massachusetts

NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs, 1992 National Fire Protection Association, Quincy, Massachusetts

Additional Information:

IFSTA Firefighter Videotape Series - Fire Pump Operation and Maintenance, Fire Protection Publications, Oklahoma State University

- Review lesson outline to ensure understanding of contents and procedures.
- Review references for lesson.
- Use additional references and your knowledge to enrich lesson outline.
- Ensure that all equipment needed, including any audio-visual equipment, is available.
- Review lesson at end of session to ensure student understanding.
- Ensure that the topics and objectives of the lesson have been adequately covered

INTRODUCTION AND OBJECTIVES

- I. Greet class
- II. State purpose of the lesson
- III. Establish relation to previous and following lessons
- IV. Review NFPA 1002 objectives for this lesson
- V. Review any additional materials for this lesson

PRESENTATION

LESSON OUTLINE

INSTRUCTOR NOTES

- | | |
|--|--|
| <p>3-1.2 Perform routine tests, inspections and service functions
<u>See Lesson Plan 1, 2-2.1</u></p> <p>3-1.3 Practical driving exercises
<u>See Lesson Plan 2, 2-3.3 through 2-3.6</u></p> <p>3-1.4 Position a fire department pumper</p> <p>A. At a fire hydrant</p> <ol style="list-style-type: none">1. Hard suction hose<ol style="list-style-type: none">a. Consider length of hard suction hoseb. Hose may be connected either to hydrant or pumper firstc. Position pumper to make final connection3. Soft suction hose<ol style="list-style-type: none">a. Consider length of soft suction hoseb. Hose may be connected either to hydrant or pumper firstc. Position pumper to make final connectiond. Hose must not have kinks or sharp bends <p>B. At a static water supply source</p> <ol style="list-style-type: none">1. Consider lift and horizontal distance to water source2. Consider stability of ground to support pumper<ol style="list-style-type: none">a. Initiallyb. During a long period of pumping3. Connect hard suction to intake <p>3-1.5 Operate a fire department pumper over a predetermined route
Covered in Lesson Plan 2</p> | |
|--|--|

REVIEW

- I. Discuss key lesson points.
- II. Ask questions on the material covered.
- III. Review material that may be unclear.
- IV. Administer test or quiz.
- V. Critique test or quiz.

SUMMARY

- I. Summarize what has been covered.
- II. Relate what has been covered to the next lesson.

DOD FIRE SERVICE CERTIFICATION SYSTEM

LESSON PLAN 4

Personnel Classification: Apparatus/Driver Operator - Pumper

Subject: Water Supply

NFPA 1002 Objectives

3-2.1
3-2.1.1

Training Materials/Equipment:

Classroom, chalkboard, references, etc.

References:

IFSTA, Fire Department Pumping Apparatus, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Fire Stream Practices, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Water Supplies for Fire Protection, 4th Edition, 1988, Fire Protection Publications, Oklahoma State University.

NFPA 1002: Fire Vehicle Operator Professional Qualifications, 1993 National Fire Protection Association, Quincy, Massachusetts

NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs, 1992 National Fire Protection Association, Quincy, Massachusetts

NFPA 291: Recommended Practice for Fire Flow Testing and Marking of Hydrants, 1995 National Fire Protection Association, Quincy, Massachusetts

Additional Information:

IFSTA Firefighter Videotape Series - Fire Pump Operation and Maintenance, Fire Protection Publications, Oklahoma State University

IFSTA Firefighter Videotape Series - Developing Fire Flow/Hydraulics, Fire Protection Publications, Oklahoma State University.

Instructor Tasks

- Review lesson outline to ensure understanding of contents and procedures.
- Review references for lesson.
- Use additional references and your knowledge to enrich lesson outline.
- Select and prepare any additional audio-visual aids that may assist in the presentation of the lesson.
- Ensure that all equipment needed, including any audio-visual equipment, is available.
- Review lesson at end of session to ensure student understanding.
- Ensure that the topics and objectives of the lesson have been adequately covered

INTRODUCTION AND OBJECTIVES

- I. Greet class
- II. State purpose of the lesson
- III. Establish relation to previous and following lessons
- IV. Review NFPA 1002 objectives for this lesson
- V. Review any additional materials for this lesson

PRESENTATION

LESSON OUTLINE

INSTRUCTOR NOTES

3-2.1 Estimate fire flow based on the following:

- A. Location
 1. Building, structure, vehicle, vessel (tank, container, etc.)
 - a. Amount of fire
 - b. Size (building, vessel)
 - c. Construction
 - d. Contents
 2. Exposures
 3. Rule of thumb formula for estimating initial fire flow
 - a. $\text{Length} \times \text{Width of Building} / 3 = \text{gpm}$
 - b. Example
 - 1) $60 \text{ ft} \times 30 \text{ ft} = 1800 / 3 = 600 \text{ gpm}$
- B. Alternative sources of water
 1. Fire hydrants
 2. Static sources
 3. Tankers

LESSON OUTLINE

INSTRUCTOR NOTES

3-2.1.1 Prerequisite Knowledge

- A. Components of a water distribution system
 - 1. Source of water
 - a. Wells
 - b. Rivers/streams
 - c. Lakes/dams
 - d. Ground - wells
 - 2. Storage
 - a. Elevated storage tanks
 - b. Standpipe storage tanks
 - c. Reservoirs
 - 3. Pumps
 - a. Required to maintain pressure and move water
 - 4. Distribution system
 - a. Primary feeders
 - 1) Large pipes
 - 2) Carry large quantities of water
 - b. Secondary feeders
 - 1) Network of intermediate size pipe
 - 2) Reinforces grid by forming loops that interlock primary feeders
 - c. Distributors
 - 1) Small internal grid arrangement
 - 2) Serve consumers
 - 3) Supply fire hydrants
- B. Types of supply systems
 - 1. Gravity system
 - a. Water source located at higher elevation
 - b. Elevation provides pressure to move water through the system
 - 2. Direct pumping system
 - a. Requires a series of pumps to provide pressure and move water through the system

LESSON OUTLINE

INSTRUCTOR NOTES

3. Combination
 - a. Gravity and pumps are used to supply the system
- B. Problems related to small diameter and dead-end mains
 1. Small diameter pipe
 - a. 4 inch and smaller pipe do not have the capacity to supply fire flows of 500, 750 and 1,000 gpm
 - b. 6 inch has limited capacity for short distances
 - c. 8 inch preferred to supply fire hydrants
 2. Dead end mains
 - a. Long lengths of small diameter pipe cannot supply adequate fire flows to hydrants
 - b. Maximum length of dead end supply to hydrants at 1,000 gpm
 - 1) 4 inch 50 feet
 - 2) 6 inch 380
 - 3) 8 inch 1,550
- C. Low pressure
 1. May result in inadequate supply
 2. Some systems may supply large quantities at low pressures
 3. Most reliable way to know is to conduct flow tests to determine available water at various locations
- D. Private water supply systems
 1. May or may not be reliable
 2. May have limited capacity
 3. May have limited duration
 4. Hose threads may not be compatible
 5. Determine strengths and weaknesses through pre fire planning

LESSON OUTLINE

INSTRUCTOR NOTES

- E. Hydrant coding systems
 - 1. Some systems may be coded using NFPA 291, Standard on Fire Flow Testing and Marking of Hydrants
 - 2. Color Coding system
 - a. 1,500 gpm or greater light blue
 - b. 1,000 gpm to 1,499 gpm green
 - c. 500 gpm to 999 gpm orange
 - d. less than 500 gpm red
 - e. Caps and bonnets should be painted
 - f. Periodic flow tests be conducted so that coding is accurate - no specific times for testing
 - g. Caution should be used with coding system
 - 1) During peak demand periods quantity may be less than indicated
- F. Reliability of static water sources
 - 1. May or may not be water due to season or demand
 - 2. Water level may vary by season or demand
 - 3. May not be accessible when level is low
 - 4. If primary source, check frequently

REVIEW

- I. Discuss key lesson points.
- II. Ask questions on the material covered.
- III. Review material that may be unclear.
- IV. Administer test or quiz.
- V. Critique test or quiz.

SUMMARY

- I. Summarize what has been covered.
- II. Relate what has been covered to the next lesson.

DOD FIRE SERVICE CERTIFICATION SYSTEM

LESSON PLAN 5

Personnel Classification: Apparatus/Driver Operator - Pumper

Subject: Sprinklers and Standpipes

NFPA 1002 Objectives

3-3.1
3-3.1.1

Training Materials/Equipment:

Fully equipped fire department pumper and training facility equipped with sprinkler or standpipe system

References:

IFSTA, Fire Department Pumping Apparatus, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Fire Stream Practices, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Water Supplies for Fire Protection, 4th Edition, 1988, Fire Protection Publications, Oklahoma State University.

NFPA 1002: Fire Vehicle Operator Professional Qualifications, 1993 National Fire Protection Association, Quincy, Massachusetts

NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs, 1992 National Fire Protection Association, Quincy, Massachusetts

Additional Information:

IFSTA Firefighter Videotape Series - Fire Pump Operation and Maintenance, Fire Protection Publications, Oklahoma State University

- Review lesson outline to ensure understanding of contents and procedures.
- Review references for lesson.
- Use additional references and your knowledge to enrich lesson outline.
- Ensure that all equipment needed, including any audio-visual equipment, is available.
- Review lesson at end of session to ensure student understanding.
- Ensure that the topics and objectives of the lesson have been adequately covered

INTRODUCTION AND OBJECTIVES

- I. Greet class
- II. State purpose of the lesson
- III. Establish relation to previous and following lessons
- IV. Review NFPA 1002 objectives for this lesson
- V. Review any additional materials for this lesson

PRESENTATION

LESSON OUTLINE

INSTRUCTOR NOTES

- | | |
|--|--|
| <p>3-3.1 Supply water to sprinkler or standpipe systems</p> <p>A. Sprinkler system</p> <ol style="list-style-type: none">1. Points to remember<ol style="list-style-type: none">a. Pumper should be able to supply the necessary volume and pressure to the systemb. Select a good water supply sourcec. Sprinkler control valve must be open for operation to be effective2. Steps<ol style="list-style-type: none">a. Locate fire department connection for the sprinkler systemb. Locate a water supply sourcec. Position pumper for best advantage of:<ol style="list-style-type: none">1) Water source2) Fire department connectiond. Connect supply line from water source to pumper<ol style="list-style-type: none">1) Select size based on anticipate volume required2) Larger is bettere. Charge the supply linef. Connect one or two 2-1/2 inch hose lines to fire department connectiong. Charge the hose lines to the fire department connectionh. Increase discharge pressure to 150 psi | |
|--|--|

LESSON OUTLINE

INSTRUCTOR NOTES

- i. Monitor and adjust discharge pressure when conditions change.
 - j. Shut down only when directed by Command.
- B. Standpipe system
- 1. Points to remember
 - a. Pumper should be able to supply the necessary volume and pressure to the system
 - b. Select a good water supply source
 - c. System may be wet or dry
 - d. Dry system will have to be filled when first connected
 - 2. Steps
 - a. Locate fire department connection for the standpipe system
 - b. Locate a water supply source
 - c. Position pumper to best advantage
 - 1) Water source
 - 2) Near fire department connection
 - d. Connect supply line from water source to pumper
 - 1) Select size based on anticipate volume required
 - 2) Larger is better
 - e. Charge the supply line
 - f. Connect one or two 2-1/2 inch hose lines to fire department connection
 - g. Charge the hose lines to the fire department connection
 - h. Increase discharge pressure to 150 psi
 - i. Adjust discharge pressure based on the following:
 - 1) Height of fire floor
 - a) Add 5 psi for each floor
 - b) Elevation loss is .5 psi per foot
 - c) Average height of floor = 10 ft

LESSON OUTLINE

INSTRUCTOR NOTES

- 2) Friction loss in standpipe system
 - a) Add 25 psi
- 3) Friction loss for standpipe hose line, based on size and length
- 4) Communication with crew on fire floor
- I. Monitor and adjust discharge pressure when conditions change.
- j. Shut down only when directed by Command

3-3.1.1 Prerequisite Knowledge

- A. Pump discharge pressure
 - 1. Sprinkler systems
 - a. Calculate engine discharge pressure to provide 150 psi at the sprinkler connection
 - 2. Standpipe systems
 - a. Calculate engine discharge pressure based on the following:
 - 1) Height of fire floor
 - a) Add 5 psi per floor
 - 2) Number and size of hose lines used on fire floor
 - a) Calculate friction loss based on diameter, length and desired nozzle pressure
 - 3) Friction loss in standpipe system
 - a) Use 25 psi for standpipe system
 - 4) Total all friction loss figures to determine pump pressure
- B. Hose layouts
 - 1. Will vary with each type of occupancy and system
 - 2. Small sprinkler and standpipe systems have only one hose connection
 - 3. Large systems may have more than one hose connection

LESSON OUTLINE

INSTRUCTOR NOTES

4. May be forward or reverse lay depending upon:
 - 1) Location of sprinkler or standpipe connection
 - a) Some connections are located on building
 - b) Some connections are located a distance from the protected building
 - 2) Location of water source
5. Layout should be made based on:
 - 1) Anticipated volume (gpm) required
 - 2) Pre fire plan estimates
- C. Location of fire department connection
- D. Operating principles of sprinkler systems as defined in:
 1. NFPA 13, Standard for the Installation of Sprinkler Systems
 2. NFPA 13D, Standard for the Installation of Sprinkler Systems in One and Two Family Dwellings and Mobile Homes
 3. NFPA 13R, Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height
- E. Fire department operations in sprinklered occupancies as defined in:
 1. NFPA 13E, Recommendations for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems.
- F. Operating principles of standpipe systems as defined in:
 1. NFPA 14, Standard for the Installation of Standpipes and Hose Systems

REVIEW

- I. Discuss key lesson points.
- II. Ask questions on the material covered.
- III. Review material that may be unclear.
- IV. Administer test or quiz.
- V. Critique test or quiz.

SUMMARY

- I. Summarize what has been covered.
- II. Relate what has been covered to the next lesson.

DOD FIRE SERVICE CERTIFICATION SYSTEM

LESSON PLAN 6

Personnel Classification: Apparatus/Driver Operator - Pumper

Subject: Operations

NFPA 1002 Objectives

- 3-4.1
- 3-4.1.1
- 3-4.1.2
- 3-4.2
- 3-4.3
- 3-4.4

Training Materials/Equipment:

Fully equipped pumper, pressurized water source, static water source, foam concentrate, foam eductors and nozzle, chalkboard, or overhead projector

References:

IFSTA, Fire Department Pumping Apparatus, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Fire Stream Practices, 7th Edition, 1989, Fire Protection Publications, Oklahoma State University.

IFSTA, Water Supplies for Fire Protection, 4th Edition, 1988, Fire Protection Publications, Oklahoma State University.

NFPA 1002: Fire Vehicle Operator Professional Qualifications, 1993 National Fire Protection Association, Quincy, Massachusetts

NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs, 1992 National Fire Protection Association, Quincy, Massachusetts

Additional Information:

IFSTA Firefighter Videotape Series - Fire Pump Operation and Maintenance, Fire Protection Publications, Oklahoma State University

Instructor Tasks

- Review lesson outline to ensure understanding of contents and procedures.
- Review references for lesson.
- Use additional references and your knowledge to enrich lesson outline.
- Select and prepare any additional audio-visual aids that may assist in the presentation of the lesson.
- Ensure that all equipment needed, including any audio-visual equipment, is available.
- Review lesson at end of session to ensure student understanding.
- Ensure that the topics and objectives of the lesson have been adequately covered

INTRODUCTION AND OBJECTIVES

- I. Greet class
- II. State purpose of the lesson
- III. Establish relation to previous and following lessons
- IV. Review NFPA 1002 objectives for this lesson
- V. Review additional objectives for this lesson

PRESENTATION

LESSON OUTLINE

INSTRUCTOR NOTES

- 3-4.1 Produce effective hand or master streams from
- A. Produce an effective fire stream using the following sources
 1. Internal tank
 2. Pressurized source
 3. Static source
 - B. For each of the items listed above the:
 1. Pump must be safely engaged
 2. The vehicle safety devices are set
 3. Pressure control devices are set
 4. Produce effective hand stream
 - a. Rated flow of nozzle is achieved
 5. Produce effective master streams
 - a. Rated flow of nozzle is achieved

LESSON OUTLINE

INSTRUCTOR NOTES

3-4.1.1 Prerequisite Knowledge

Formulas used to Solve Fire Department Pumper Hydraulic Problems

A.0 Common letters and abbreviations used as symbols that are used in fire service hydraulics

1. EL elevation loss
2. r radius
3. A area
4. d diameter
5. p a constant (3.1416)
6. g gravity
7. $\sqrt{\quad}$ square root
8. h height
9. L length
10. AL appliance loss
11. FL friction loss
12. V volume
13. P flow pressure
14. gpm gallons per minute
15. psia pounds-per-square-inch absolute
16. psig pounds-per-square-inch gauge
17. s distance
18. t time
19. PDP pump discharge pressure
20. NP nozzle pressure

LESSON OUTLINE

INSTRUCTOR NOTES

- B.0 List of equations
1. Area of a circle
 - a. $A = \pi r^2$
 - 2.0 Capacity of a large cylindrical tank
 - a. Gallons = $d^2 6L$
 - 1) Where:
d = diameter in ft.
6 is a constant
L = length in ft.
 - b.0 $V = \pi r^2 L$
 - 1) A longer but accurate method for finding cubic feet in the tank
 - 2) Where:
p = 3.1416
r = radius
L = length
 - 3.00 Gallons per minute from an orifice
 - a. $gpm = 29.7 d^2 \sqrt{P}$
 - 1) Where:
d = orifice diameter
P = psi (pitot tube and gauge reading)
29.7 = a constant
 - 4.00 Water flow
 - a. $Q = gpm/100$
 - 5.0 Friction loss in hose
 - a. $FL = CQ^2 L$
 - b. FL = friction loss in psi
 - c. C = friction loss coefficient (Table 4.3 IFSTA, Fire Streams, 7th Edition)
 - d. Q = Flow rate in hundreds of gpm
 - 1) Q = gallons per minute/100
 - e. Length of hose in hundreds of feet
 - 1) L = length of layout/100

LESSON OUTLINE**INSTRUCTOR NOTES**

- 6.0 Nozzle reaction
- a. $NR = 0.0505Q\sqrt{NP}$
- 1) NR = nozzle reaction
 Q = flow (GPM)
 NP = nozzle pressure; (psi at base of nozzle)
 0.0505 is a constant
8. Friction loss coefficients for single hose lines*
- a. For use with the formula $FL = CQ^2L$
- b.
- | Size/Type of hose | Coefficient |
|-------------------|-------------|
| 1-1/2 inch | 24 |
| 1-3/4 inch | 15.5 |
| 2 inch | 8 |
| 2-1/2 inch | 2 |
| 3 inch | 0.8 |
| 4 inch | 0.2 |
| 5 inch | 0.08 |
| 6 inch | 0.05 |
- *Table 4.3 IFSTA, Fire Streams, 7th Edition
- 9.0 Required pump discharge pressure
- a. $PDP = NP + FL$
- 2) PDP = pump discharge
 NP = nozzle pressure
 FL = friction loss
- 10.00 PDP with back pressure and pressure "gain"
- a. $PDP = NP + FL + 0.5(h)$
- 1) h = ft. above or below the pump
 0.05 is a constant

LESSON OUTLINE

INSTRUCTOR NOTES

C. Hydraulic calculations for friction loss

Find the nozzle or pump discharge pressures

1. Given

- b. Length of hose = 400 ft.
- c. Size of hose = 2-1/2 in.
- d. Size of nozzle = 2-1/2 in.
- e. Type of nozzle = variable gallonage fog nozzle
- f. Gpm = 250
- g. Nozzle pressure = 100 psi

7.0 Solution

a. Friction loss formula

- 1) $FL = CQ^2L$
- 2) $FL = 2 \times 2.5^2 \times 1$
- 3) $FL = 2 \times 6.25 \times 1$
- 4) $FL = 12.5$ psi
- 5) $FL = 12.5$ psi / 100 feet

b.0 Formula for quantity based on the gpm flowing through the nozzle

- 1) Quantity $Q = \frac{\text{gpm}}{100}$
- 2) $Q = \frac{250}{100}$
- 3) $Q = 2.5$

c.0 Multiply the friction loss (FL) per 100 feet by the length of hose (HL) per 100 ft. to find total friction loss for the hose

- 1) Total Friction Loss = $FL \times HL$
- 2) Total Friction Loss = 12.5×4
- 3) Total Friction Loss = 50 psi

d.0 Pump discharge pressure equals friction loss plus nozzle pressure

- 1) $PDP = FL + NP$
- 2) $PDP = 50 + 100$
- 3) $PDP = 150$

LESSON OUTLINE

INSTRUCTOR NOTES

D.000 Find water flow in gallons per minute

1. Given

- a. Diameter of the orifice (d): 1-1/4 inch
- b. Nozzle pressure p): 49 psi
- c. Formula: $\text{gpm} = 29.7d^2\sqrt{P}$

2.0 Solution

- a. $\text{Gpm} = 29.7d^2\sqrt{P}$
- b. $\text{Gpm} = 29.7 \times 1.25^2 \sqrt{49}$
- c. $\text{Gpm} = 29.7 \times 1.56 \times \sqrt{49}$
- d. $\text{Gpm} = 46.40 \times 7$
- e. $\text{Gpm} = 324.8$

LESSON OUTLINE

INSTRUCTOR NOTES

E.00 Find friction loss in the supply and attack lines

1. Given

- a. Length and size of lines = 300 ft. of 2-1/2 in. supply line wyeed into three 200 ft. of 1-1/2 in. lines
- b. Gpm flow = 100 gpm from each nozzle
- c. Friction loss FL) in wye = 10 psi
- d. Constant for 1-1/2 in. conversion = 13.5
- e. Formulas needed

1) $Q = \frac{\text{gpm}}{100}$

2) $FL = CQ^2L$

2.00 Solution

a. First find FL in the 1-1/2 inch line

1) $Q = \frac{\text{gpm}}{100}$

2) $Q = \frac{100}{100}$

3) $Q = 1$

4) $FL = CQ^2L$

5) $FL = 24 \times 1 \times 2$

6) $FL = 48 \text{ psi} / 200 \text{ feet}$

LESSON OUTLINE**INSTRUCTOR NOTES**

b.0 Second, find the FL for the 2-1/2 inch line

1) $Q = \frac{\text{gpm}}{100}$

2) $Q = \frac{300}{100}$

3) Line 1 = 100 gpm
Line 2 = 100 gpm
Line 3 = 100 gpm
Total flow = 300 gpm

4) $Q = 3$

3) $FL = CQ^2L$

4) $FL = 2 \times 3^2 \times 3$

5) $FL = 2 \times 9 \times 3$

6) $FL = 54 \text{ psi} / 300 \text{ feet}$

c.0 Total friction loss (TFL)

1) 48 psi - 1-1/2 inch

2) 54 psi - 2-1/2 inch

3) 102 psi total friction loss (FL)

d. Friction loss (FL) in wye = 10 psi if the flow is over 350 gpm

F.000 Find friction loss in siamesed lines

1. Given

a. Size and length of hose: two 2-1/2 in. lines each 1,000 ft., into one 2-1/2 in. 100 ft. long

b. Gpm flow: 250

c. Nozzle type = variable gallonage fog nozzle

d. Formulas

1) $Q = \frac{\text{gpm}}{100}$

2) $FL = CQ^2L$

LESSON OUTLINE**INSTRUCTOR NOTES**

2.00 Solution

a. First, calculate the friction loss for the single line

1) $Q = \frac{\text{gpm}}{100}$

2) $Q = \frac{250}{100}$

3) $Q = 2.5$

4) $FL = CQ^2L$

5) $FL = 2 \times 2.5^2 \times 1$

6) $FL = 2 \times 6.25 \times 1$

7) $FL = 12.5 \text{ psi} / 100 \text{ feet}$

b. Calculate the friction loss of the two 2 - 1/2 lines

1) $FL = CQ^2L$

2) $FL = 0.5 \times 2.5^2 \times 10$

3) $FL = 0.5 \times 6.25 \times 10$

4) $FL = 31.25$

c. Friction loss coefficients for multiple hose lines*

For use with the formula $FL = CQ^2L$

Number/Size of hose	Coefficient
Two 2-1/2	0.5
Three 2-1/2	0.22
Two 3 inch	0.2

*Table 4.5 IFSTA, Fire Streams, 7th Edition

d.0 Total friction loss (TFL)

1) 12.5 psi - 2-1/2 inch hose line

2) 31.25 psi - both 2-1/2 inch hose lines

3) 43.75 psi total friction loss (TFL)

G.000 Find friction loss in wyed lines

1. Given

a. Size and length of hose: 200 ft. of 2-1/2 in. lines
wyed into two 200 ft. 1-3/4 in. lines

b. Gpm flow: 100 gpm at each nozzle

c. Nozzle type: constant flow fog nozzle

d. Conversion factor for 1-3/4 in. = 5.95

LESSON OUTLINE

INSTRUCTOR NOTES

e. Formulas

1) $Q = \frac{\text{gpm}}{100}$

2) $L = \frac{\text{hose length}}{100}$

3) $FL = CQ^2L$

2.00 Solution

a. First find FL for 1-3/4 in. lines

1) $Q = \frac{\text{gpm}}{100}$

2) $Q = \frac{100}{100}$

3) $Q = 1$

4) $FL = CQ^2L$

5) $FL = 15.5 \times 1^2 \times 2$

6) $FL = 31 \text{ psi} / 200 \text{ feet}$

b.0 Second, find FL for the 2-1/2 line

1) $Q = \frac{\text{gpm}}{100}$

2) $Q = \frac{200}{100}$

3) $Q = 2$

4) $FL = CQ^2L$

5) $FL = 2 \times 2^2 \times 2$

6) $FL = 2 \times 4 \times 2$

7) $FL = 16 \text{ psi} / 200 \text{ feet}$

c.0 Total friction loss (TFL)

1) 31 psi - 1-3/4 inch hose line

2) 16 psi - 2-1/2 inch hose line

3) 47 psi total friction loss (TFL)

LESSON OUTLINE**INSTRUCTOR NOTES**

H.000 Find friction loss for standpipe line

1. Given

- a. 4 inch standpipe
- b. Gpm flow: 125 gpm
- c. Size of hose 1-3/4 inch
- b. Length of hose: 200 ft. each line
- c. Type of nozzle: Variable gallonage fog nozzle
- d. 4th floor
- e. Formulas

1) $Q = \frac{\text{gpm}}{100}$

2) $FL = CQ^2L$

2.00 Solution

a. First, find friction loss

1) $Q = \frac{\text{gpm}}{100}$

2) $Q = \frac{125}{100}$

3) $Q = 1.2$

4) $FL = CQ^2L$

5) $FL = 0.324 \times 1.2^2 \times 0.4$

6) $FL = 0.324 \times 1.44 \times 0.4$

7) $FL = 0.22 \text{ psi / standpipe}$

b. Elevation loss

1) Elevation pressure = 5 psi x # of floors

2) Elevation pressure = 5 psi x 4 floors

3) Elevation pressure = 20 psi

c. Friction loss in hose

1) $Q = \frac{\text{gpm}}{100}$

2) $Q = \frac{125}{100}$

3) $Q = 1.25$

4) $FL = CQ^2L$

5) $FL = 15.5 \times 1.25^2 \times 2$

6) $FL = 15.5 \times 1.6 \times 2$

7) $FL = 49.6$

LESSON OUTLINE**INSTRUCTOR NOTES**

- d.0 Total friction loss (TFL)
 - 1) 0.22 psi - standpipe
 - 2) 20 psi - elevation
 - 3) 48.4 psi - 1-3/4 inch line
 - 3) 68.6 psi total friction loss (TFL)

I. Find estimated remaining available volume from hydrant while pumping

1. Given

- a. Static intake pressure: 50 psi
- b. Psi drop when one line is open: 5 psi
- c. Gpm of one line: 250 gpm
- d. Estimates needed
 - 1) The amount of water that is still available after one line is supplied is based on the following percentages:
 - 0-10% - 3 times the amount of water being delivered
 - 11-15% - 2 times the amount of water

2.00 Solution

- a. Divide the static pressure by the psi drop when the line is open
- b. This will calculate percentage of drop
 - 1) Percent drop = static pressure ÷ psi drop when one line is open
 - 2) Percent drop = $50 \div 5$
 - 3) Percent drop = 10%
 - 4) A 10% drop shows that 3 times the amount of water used is still available
 - 5) $250 \text{ gpm} \times 3 = 750 \text{ gpm}$ still available

LESSON OUTLINE**INSTRUCTOR NOTES**

- J. Mental Calculation of Correct Pump Discharge Pressure, GPM, Friction Loss, and Nozzle Pressure

Often at a fire scene there is no time to develop the equations needed to supply hoselines correctly; quick reference approximations

Size of hose in.)	Rule-of-thumb gpm)
1-1/2	100
1-3/4	200
2-1/2	250
3	500
4	1,000
5	1,500

Nozzle	Optimum nozzle pressure (psi)
Fog - handline	100
Fog - master stream	100
Solid stream - handline	50
Solid stream - master stream	80

Device	Friction loss (psi)
Ladder pipes	10
Deck guns	10
Wye	10
Siamese	10

2-1/2 in. handline flows gpm)	Friction loss (psi)
200	10
250	15
300	20

LESSON OUTLINE

INSTRUCTOR NOTES

- 0 K. Calculation of Nozzle Reaction of Hand and Master Streams
1. One of the basic laws of physics, Newton's third law, states that for every action there is an equal and opposite reaction
 2. Water flowing out of nozzle will cause a backward reaction
 3. Since the reaction force is dependent upon amount of water flowing through hose, it will therefore depend on the size of the nozzle used and the nozzle pressure
 4. Formulas
 - a. For straight-tipped solid stream nozzles
 - 1) $NR = 1.5d^2NP$
 - 2) NR = nozzle reaction in lb.
d = nozzle diameter in.
NP = nozzle pressure in psi at the nozzle
 - b.0 For fog pattern nozzles
 - 1) Not based on standard formula because nozzle diameter does not flow a concentrated core of water
 - 2) The formula is calculated as follows
 $NR = 0.0505Q^2NP$
 - 3) Where
 - a) NR = nozzle reaction in lb.;
 - Q = flow in gallons per minute;
 - NP = nozzle pressure in psi, at the base of the nozzle

LESSON OUTLINE

INSTRUCTOR NOTES

- L. Computing Maximum Lift of a Fire Department Pumper
1. Drafting water is the process of using water from a static source, such as a pond, lake, or basin
 2. Since water source is static, pump operator's job is force water into the pump to be used on the fire ground
 3. Process
 - a. For each 1 in. of mercury vacuum created,

water will be pushed into the non-collapsible

hose (or hard sleeve) a distance of 1.13 ft.
 - b. Lift measured from surface of static source to

centerline of pump, at sea level, will allow water
to be pushed to a height of
 - 1) $14.7 \text{ psi} \times 2.304 \text{ ft./lb.} = 33.86$
 - 2) $29.7 \text{ in. of mercury} \times 1.13 \text{ ft./lb.} = 33.81$
 - c.0 The perfect vacuum necessary for the
theoretical lift of 33.9 ft. is almost impossible to

achieve, even in a laboratory.
 - d. Additional loss in optimum lift is accounted for

due to friction in the suction hose
 - e. Head loss, water temperature, atmospheric

pressure at the site location and condition of the
pump all contribute to lessening the theoretical

height that a pumper may raise water.
 - f. Limits practical lifts to
 - 1) 28 ft. for an excellent rating
 - 2) 25 ft. for a good rating
 - 3) Pumpers should not be tested at a lift

- greater than 10 ft.
- 4) A primer on a fire department pumper must be capable of raising water 10 ft. into a dry pump through 20 ft. of appropriate size hose in not more than 30 seconds
- 5) For effective operation, lift should be no higher than 10 ft.

LESSON OUTLINE

INSTRUCTOR NOTES

- g.0 Most pumpers in service lift somewhat less than these figures because
 - 1) Atmospheric pressure is higher on clear, fair days and lower on cloudy or stormy days
- h.0 The pressure change will influence the maximum lift
 - 1) Altitude changes atmospheric pressure by dropping approximately 1 in. of mercury (1/2 psi) for every 1,000 ft. of altitude above sea level

LESSON OUTLINE

INSTRUCTOR NOTES

3-4.1.2 Prerequisite Skills

- A. Methods of power transfer
 - 1. Mechanical linkage
 - a. This is not very common as a main method but is usually included as part of the pump's emergency back-up
 - b. It is operated from the pump itself
 - c. Manual override should be practiced frequently
 - 2. Electrical or hydraulic
 - a. Common methods of power transfer
 - b. Procedure (before leaving the cab)
 - 1) Disengage clutch
 - 2) Place the road transmission in neutral
 - 3) Place the clutch in proper gear
 - 3. The normal arrangement is for power transfer case to be controlled from inside cab of the apparatus.
 - a. If road transmission is not placed in correct gear, pump will not turn at needed rpm to operate effectively
 - b. Check that transmission is in correct gear; observe speedometer reading after pump is engaged
 - b. With the pump engaged, speedometer reading will be between 10 to 15 mph, depending on the apparatus
 - 4. Locks
 - a. To prevent a manual transmission from slipping out of gear, or an automatic

transmission gear
during pumping
provided on
shift lever to hold it in proper
pumping

selector from moving
operations, lock is
transmission or
gear for

LESSON OUTLINE

INSTRUCTOR NOTES

B. Priming Systems

1. Because centrifugal pumps have slippage; cannot prime themselves
2. A source of vacuum or negative pressure needed to draft
3. Positive displacement pumps
 - a. Largely used as priming pumps; not as main source of pressure
 - b. Work on the principle that when pressure is applied to a confined liquid, same outward pressure is equally transmitted within the liquid in all directions
 - c. There are two basic types of positive displacement pumps
 - 1) Piston pumps
 - a) All piston pumps contain a piston that moves back and forth inside a cylinder
 - b) As the piston is driven forward, air within the cylinder is compressed; creates a higher pressure inside pump than the atmospheric pressure in discharge manifold
 - c) This pressure causes the discharge valve to open and air to escape through discharge lines
 - d) This action continues until piston completes its travel on forward stroke and stops

LESSON OUTLINE

INSTRUCTOR NOTES

- e) At the point that pressures equalize; discharge valve closes
 - f) As the piston begins the return stroke, area in cylinder behind piston increases; pressure decreases, creates partial vacuum.
 - g) At this time, the intake valve opens, allows air from suction hose to enter pump
 - h) Atmospheric pressure forces water to rise within hose until piston completes its travel; intake valve closes
 - i) More air is discharged until all the air has been removed; water enters
 - j) The pump is now considered to be primed
- 2) Rotary gear pump
- a) Consists of two gears that rotate in a tightly meshed pattern inside a watertight case
 - b) Gears are constructed so they contact each other; in close proximity to the case
 - c) With this arrangement, watertight and airtight pockets are formed by the gears within case as they turn from intake to outlet
 - d) Total amount of water that can be pumped depends on size of pockets

LESSON OUTLINE

INSTRUCTOR NOTES

- 3) Rotary vane pump
 - a) The rotor is mounted off-center inside housing
 - b) The vanes are free to move within slot where they are mounted
 - c) As the rotor turns, vanes are forced against housing by centrifugal force; rotor usually has an rpm of 1,000 to 1,500
 - d) When surface of vane that is in contact with the casing becomes worn, centrifugal force causes it to extend further; automatically maintains a tight fit
 - e) This self-adjusting feature makes rotary vane pump much more efficient at pumping air than a standard rotary gear pump
 - f) As rotor turns, air is trapped between rotor and casing in the pockets formed by adjacent vanes
 - g) As vanes turn, pocket becomes smaller; compresses air and causes pressure to build up
 - h) Pocket becomes even smaller as vanes progress toward discharge opening

LESSON OUTLINE

INSTRUCTOR NOTES

- i) Pressure reaches its maximum level, forcing trapped air out of pump
- j) Water forced into pump by atmospheric pressure until pump fills with water
- k) At this point, pump is primed

C Drafting Operations

1. Draft procedure

- a. Select proper water source capable of drafting operation
- b. Maneuver apparatus to draft site
- c. Stop before reaching water source to connect hard suction hose and strainer to pumper
- d. Attach strainer to hard suction hose
- e. Attach hard suction hose to intake
- f. Move to final draft position
- g.. Minimize lift distances
- h. Surround strainer with at least 24 in. of water on all sides
- i. Properly place pump in gear
- j. Prime pump
- k. Systems check
 - 1) Check couplings on hard suction hose for airtight seal
 - 2) Check that all drains are closed
 - 3) Check that intake relief valve outlet is capped
 - 4) Check that circulator valve or booster cooling valve is completely applicable)

turned off (if

LESSON OUTLINE

INSTRUCTOR NOTES

- D Pressure relief systems
1. Automatic pressure control
 - a. The volume of water moving through pump may change suddenly when a nozzle is shut down rapidly or when setting is changed on a variable gallonage nozzle
 - b. The fire fighter on the nozzle cannot tolerate any sudden changes in pressure.
 - c. During the critical stages of the attack, a sudden change in pressure can be disastrous
 - d. A shutdown of one line can mean surge on others so that some type of automatic pressure regulation is essential to ensure safety of personnel operating hoselines; directs excess pressure to intake side of pump
 2. Relief valve
 - a. The main action is to relieve excess pressure within the pump discharge
 - b. An adjustable spring-loaded pilot valve actuates the relief valve to bypass water from discharge to intake chamber of pump
 - c. Rerouting permits pump to continue in operation when pressure rises above the working pressure
 - d. When the discharge pressure rises higher than allowed by the pilot valve setting, the spring in the pilot valve moves; permits water to dump back into pump intake

LESSON OUTLINE

INSTRUCTOR NOTES

3. Pressure governor
 - a. For centrifugal pumps only
 - b. It is pressure actuated to adjust engine throttle
 - c. The main feature of a pressure governor is that it regulates power output of engine to match set pump discharge requirements
 - d. When the pressure in the discharge chambers of the pump exceeds pressure necessary to maintain safe fire streams, engine speed is reduced; speed of impellers dependent on engine speed
- E. Pump Gauges
 1. Vacuum gauge
 - a. The gauge is usually calibrated from 0 to 600 psi positive pressure; 0 to 30 in. of vacuum on the negative side
 - b. This gauge provides an indication of vacuum present at intake of pump during priming or when pump is operating from draft
 - c. It also provides an indication of residual pressure when pump is operating from a hydrant or is receiving water through a supply line from another pump
 2. Pressure gauge
 - a. A pressure gauge is calibrated to measure 600 psi unless pumper is equipped to supply high-pressure fog streams, in which case the gauge may be calibrated up to 1,000 psi
 - b. The pressure gauge registers the pump discharge pressure

LESSON OUTLINE

INSTRUCTOR NOTES

- c. On a centrifugal pump, may also be a compound gauge; both intake and discharge of centrifugal pump will register negative pressure during priming
 - d. Pressure gauges can be connected to individual discharge lines
 - e. An individual line gauge is the only way to be certain that the pump has been adjusted properly
 - 3. Flowmeter
 - a. Flow meters virtually eliminate possibility of operator error; provide an accurate reading of water flow in gallons per minute
 - b. The number displayed on the flowmeter requires no further calculation; reflects how much water is moving through discharge valve
 - c. NFPA 1901 allows flow meters to be used instead of pressure gauges on all 2-1/2 in. or larger outlets
- F. Transfer Valve
 - 1. Found on two stage pumps
 - 2. May be manual or power operated
 - 3. Function is to change pump from series to parallel or from parallel to series operation
 - 3. Two positions
 - a. Series
 - b. Pressure
 - 3. When pump is use at more than one half of rated capacity, parallel operation should be used
 - a. Example: When a 1,000 gpm pump is pumping more than 500 gpm - parallel operation should be used

LESSON OUTLINE

INSTRUCTOR NOTES

- G. Auxiliary Cooling Systems
1. The primary function of auxiliary coolers is to control the temperature of cooling water in the apparatus engine during pumping operations
 2. Two types: marine and immersion
 - a. Marine
 - 1) Inserted in one of the hoses used in engine cooling system; engine coolant must travel through it as it circulates through system
 - 2) Coolant from radiator passes through tubes in cooler; colder water from fire pump comes in contact with metal tubes
 - 3) Colder water conducts heat away from tubes; reduces temperature of coolant flowing through them
 - 4) A valve on the pump panel is used to control the amount of water being supplied to auxiliary cooler
 - b. Immersion
 - 1) Mounted with radiator coolant passing through body of the cooler
 - 2) Water from fire pump passes through tubing mounted inside the cooler; immersed in coolant
 - 3) As cooler water from fire pump passes through tubing, heat from coolant is absorbed by tubing and dissipated in water from pump
 - 4) Valve on pump panel used to control degree of cooling desired

LESSON OUTLINE

INSTRUCTOR NOTES

- H Nozzles
1. Solid stream
 - a. Flow is constant and determined by tip size
 - b. Only control is shutoff
 - 1) Flow can be varied somewhat by partially closing shutoff; creates extreme turbulence and destroys stream
 - 2) For normal fire fighting operations, should be operated fully open
 - c. Pressures
 - 1) Handlines - 50 psi at tip (standard)
 - 2) Master streams - 80 to 100 psi at tip
 - d. This type of nozzle is rarely used for interior operations; may be used to great advantage in exterior, defensive operations
 - e. Solid-stream nozzles produce little or no spray
 - f. Internal blades called vanes designed into nozzle to create a straighter stream

LESSON OUTLINE

INSTRUCTOR NOTES

2. Basic types of fog nozzles
 - a. Most common type is peripheral jet
 - 1) Adjustable pattern, usually from straight stream to about 120°
 - 2) Of more importance to the driver/operator, most, except for very old models, are constant flow; they deliver same gpm in all patterns
 - 3) Adjustable flows are very common
 - a) 1-1/2 in. flows commonly vary from 30-120 gpm
 - b) 2-1/2 in. flows commonly vary from 120-250 gpm
 - c) 2-1/2 in. turbojet operated in flush position flows about 325-350 gpm
 - d) Stream is not good, but if heavy, blitz-type stream is needed, this may be used.
 - 4) Department has standard operating procedures specifying
 - a) normal gpm setting for all adjustable-flow nozzles
 - b) Settings are not changed without notifying driver/operator
 - 5) If 1-1/2 in. are normally set on 95 gpm, can be changed to either 60 or 120 without much effect on tip pressure
 - 6) The most standard and desired pressure is 100 psi
 - b. For fixed-flow nozzles, driver/operator should know rated flow

LESSON OUTLINE

INSTRUCTOR NOTES

3. Flows
 - a. The critical factor regarding flows is that driver/operator must be familiar with nozzles in use by department
 - b. Where adjustable flow nozzles are used, must be a standard operating procedure regarding flow settings and changes of flow settings
4. Automatic nozzles
 - a. Automatic nozzles require different way of thinking, both for driver/operator and nozzle person
 - b. Features
 - 1) Slide shutoff valve enables nozzle person to vary flow without destroying stream characteristics
 - 2) Other automatic nozzles use a ball-type shutoff; produce very poor streams when partially shut off
 - 3) These may be so poor that nozzle operators will refuse to control flow from nozzle; ask driver/operator to control it from pump

LESSON OUTLINE

INSTRUCTOR NOTES

- 3-4.2 Pump a supply line in a relay pumping operation
- A. Source pumper
 1. Connect to water supply
 2. Connect supply line to relay pumper
 3. Start flow of water when signaled by relay pumper
 4. When relay is established - increase pressure and maintain desired intake pressure to relay pumper
 - B. Relay pumper
 1. Connect hose line from source pumper
 2. Connect discharge lines to other pumper or appliance
 3. Signal source pumper to start flow
 4. Pump out of gear
 5. Open discharge valve
 6. When water flows out of discharge - engage pump
 7. Close discharge valve
 8. Open valves to charge attack lines
 9. Adjust throttle for proper pump pressure
 - 10.
 - C. Flow and pressure based on
 1. Size of hose line
 2. Length of hose line
 - D. Shut down in reverse order
 1. Relay pumper shuts down first

LESSON OUTLINE

INSTRUCTOR NOTES

3-4.3 Produce a foam fire stream

- A. Objective is to produce properly proportioned foam

- B. Steps for using an external eductor
 - 1. Assemble necessary equipment
 - a. Foam concentrate
 - b. Foam eductor
 - 1) Eductor and nozzle must have same gpm rating
 - c. Foam nozzle
 - d. Hose
 - 2. Connect equipment
 - a. Connect eductor to pump discharge
 - b. Connect hose line to eductor
 - c. Connect nozzle to hose line
 - 1) Length of hose line should not exceed manufacturers recommendations
 - d. Open foam concentrate and insert pickup tube
 - e. Place pump in gear and open discharge valve
 - f. Increase pump pressure to that required for the eductor

- C. Steps for using a pump proportioner with foam tank (if equipped)
 - 1. Two kinds of systems
 - a. Around the pump proportioner
 - 1) With pump in gear
 - a) Open bypass valve
 - b) Set metering valve for percent foam concentration
 - c) Attach hose line or lines
 - b. Balanced pressure proportioner
 - 1) With pump in gear
 - a) Activate foam concentrate pump
 - b) Set metering valve for percent foam concentrate

c) Attach hose line or lines |

LESSON OUTLINE
INSTRUCTOR NOTES

- 3-4.4 Change water supply source while pumping an attack line
- A. Objective is to maintain flow to attack line while changing from apparatus water tank to external water source
 - B. Steps
 1. Connect pumper to external water source
 2. Deploy attack line
 3. Place pump in gear
 4. Pump attack line using tank water
 5. Adjust pump for proper discharge pressure and flow
 6. Open suction valve to take water from external source
 7. Close tank valve
 8. Pump attack line using external water source

REVIEW

- I. Discuss key lesson points.
- II. Ask questions on the material covered.
- III. Review material that may be unclear.
- IV. Administer test or quiz.
- V. Critique test or quiz.

SUMMARY

- I. Summarize what has been covered.
- II. Relate what has been covered to the next lesson.