College Lakeland
Emergency Training Centre

FFTS-S601 Basic Pumping Operations

NFPA 1002 (2009)

LAST REVISED: February 15, 2012

FFTS-S601 Basic Pumping Operations

NOTE

Material in this student-guide is supplementary information only.

This document is designed to assist the student through each learning objective by providing the textbook readings, supplementary information to the textbook and by offering practice questions to prepare for the test.

No exam questions will be asked from this student-guide. The final test is based on Chapters 1 – 12 of the textbook.

Lakeland College Emergency Training Centre
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FFTS-S601 Basic Pumping Operations

Rationale

All fire apparatus require preventative, routine maintenance to ensure they are kept in peak operating condition. All firefighters – both operators and drivers – are responsible for the basic, routine maintenance required on apparatus and equipment to keep them serviced and maintained in safe operating condition. They are also responsible for the safe operation of the fire apparatus. Whether on route to an emergency or during non-emergency situations, you will encounter road hazards, weather conditions and common situations that require familiarity with local traffic laws, vehicle maneuverability and your ability to operate the apparatus safely. It is vital that each operator is confident in his ability to operate the apparatus in any given situation - including adverse circumstances. Contrary to popular belief, an emergency scene is not where you are commonly most at risk. Surprisingly, you are most at risk riding to or from an emergency. According to NFPA statistics for 1998, 19% of on-duty fatalities occurred while firefighters were responding or returning to an incident.

Water is a fundamental tool in firefighting, regardless if where it is used. Public, private and static water systems supply water to both urban and rural areas. It is crucial that firefighters have a good working knowledge of water supply to the pumper and attack apparatus.

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Learning Outcome

When you have completed this course, you will be able to perform and document routine tests, inspections and servicing functions on the systems and components, such as the battery, braking system, fuel, hydraulic fluids, oil, tires, steering system, belts, tools, appliances and equipment, given a fire department vehicle , its manufacturer's specifications and the appropriate maintenance and inspection forms, so that the operational status of the vehicle is verified and reported.

When you have completed this course, you will also be able to perform routine tests and inspections and servicing functions on water tanks, pumping systems and foam systems, given a fire department pumper and its manufacturer's specifications; and produce effective hand or master streams, given an internal tank, pressurized source, static source and transfer from internal tank to external source, so that the pump is safely engaged, all control and safety devices set, the rated flow achieved and maintained and the apparatus monitored for potential problems. Successful completion of this course will ensure you have the skills to supply water to a sprinkler system or standpipe system by connecting a fire department pumper to a water supply as member of a team, given a supply or intake hose, hose tools, and a fire hydrant or static water source, so that connections are tight and water flow is unobstructed

Sound training develops safe drivers. When you have completed this course, you will be able to operate a fire department vehicle, given a vehicle and a predetermined route on a public way that incorporates a variety of manoeuvres and features that the driver/operator is expected to encounter during normal operations, so that the vehicle is safely operated in compliance with all applicable provincial and local laws, department rules and regulations and standards.

Finally, when you have successfully completed this course you will be able to respond safely on apparatus to an emergency.

Required Textbook

IFSTA. Goodson, C. & Brakhage, C. (Eds.). (2006), *Pumping apparatus driver/operator handbook.* 2nd. Ed., Stillwater,OK: Fire Protection Publications.

Learning Objectives

1. Describe how to perform routine tests and service functions on the department's fire apparatus. NFPA 1002 (2009) 4.2.1

2. Explain how to document the routine tests, inspections and servicing functions. NFPA 1002 (2009) 4.2.2

3. Describe how to operate a fire department vehicle on a pre-determined route on a public way. NFPA 1002 (2009) 4.3.1

4. Describe how to back a vehicle from a roadway into restricted spaces. NFPA 1002 (2009) 4.3.2

5. Explain how to maneuver a vehicle around obstructions while moving forward and in reverse. NFPA 1002 (2009) 4.3.3

6. Describe how to turn a fire department vehicle 180 degrees within a confined space. NFPA 1002 (2009) 4.3.4

7. Explain how to maneuver a fire department vehicle in areas with restricted horizontal and vertical clearances. NFPA 1002 (2009) 4.3.5

8. Explain how to operate a vehicle using defensive driving techniques under emergency conditions. NFPA 1002 (2009) 4.3.6

9. Describe how to operate all fixed systems and equipment on the vehicle not previously covered. NFPA 1002 (2009) 4.3.7

10. Describe how to perform the routine tests, inspections and servicing functions for water tank and other extinguishing agent levels, pumping systems, and foam systems. NFPA 1002 (2009) 5.1.1

11. Explain how to produce effective hand or master streams supplied from an internal tank, a pressurized source, a static source, and transfer from internal tank to external source. NFPA 1002 (2009) 5.2.1

12. Explain how to supply water to fire sprinkler and standpipe systems so that water is supplied at correct volume and pressure. NFPA 1002 (2009) 5.2.4

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Practical Skills Requiring Demonstration

1. Perform routine tests, inspections and servicing functions required to assure the operational status of fire department apparatus. NFPA 1002 (2009) 4.2.1

    a. Use hand tools. NFPA 1002 (2009) 4.2.1, 5.1.1

    b. Recognize system problems. NFPA 1002 (2009) 4.2.1, 5.1.1

    c. Correct any deficiencies noted according to policies and procedures. NFPA 1002 (2009) 4.2.1, 5.1.1

2. Demonstrate competence in performing tasks that should be done daily, weekly and monthly for fire apparatus maintenance. NFPA 1002 (2009) 4.2.1, 5.1.1

3. Complete the appropriate departmental documentation completely and accurately. NFPA 1002 (2009) 4.2.2

4. Safely operate a Fire Department vehicle in compliance with all applicable state and local laws, departmental rules and regulations, and the requirements of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, Section 4-2. NFPA 1002 (2009) 4.3.1

    a. Operate passenger restraint devices. NFPA 1002 (2009) 4.3.1, 4.3.6

    b. Maintain safe following distances. NFPA 1002 (2009) 4.3.1, 4.3.6

    c. Retain control of the apparatus while accelerating, decelerating and turning. NFPA 1002 (2009) 4.3.1, 4.3.6

    d. Maintain reasonable speeds for the road, weather and traffic conditions. NFPA 1002 (2009) 4.3.1, 4.3.6

    e. Operate safely during non-emergency conditions and under adverse environmental or driving surface conditions. NFPA 1002 (2009) 4.3.1, 4.3.6

    f. Demonstrate ability to use and understand automotive gauges and controls. NFPA 1002 (2009) 4.3.1, 4.3.6

5. Demonstrate the ability to back a vehicle from a roadway into restricted spaces on both the right and left sides of the vehicle requiring 90-degree right-hand and left-hand turns from the roadway, so that the vehicle is parked within the restricted areas without having to stop and pull forwards and without striking obstructions. NFPA 1002 (2009) 4.3.2

    a. Use mirrors, judge vehicle clearance and operate vehicle safely. NFPA 1002 (2009) 4.3.2, 4.3.3, 4.3.4, 4.3.5

6. Demonstrate the ability to manoeuvre a vehicle around obstructions on a roadway while moving forward and in reverse so that the vehicle is manoeuvred through the obstructions without stopping to change the direction of travel and without striking obstructions. NFPA 1002 (2009) 4.3.3

7. Demonstrate the ability to turn a fire department vehicle 180 degrees within a confined space. NFPA 1002 (2009) 4.3.4

8. Demonstrate the ability to manoeuvre a fire department vehicle in areas with restricted horizontal and vertical clearances. NFPA 1002 (2009) 4.3.5

9. Operate a vehicle using defensive driving techniques under emergency conditions. NFPA 1002 (2009) 4.3.6

10. Demonstrate the ability to produce effective hand or master streams so that the pump is safely engaged, all pressure control and vehicle safety devices are set, the rated flow of the nozzle is achieved and maintained, and the apparatus is continuously monitored for potential problems. NFPA 1002 (2009) 5.2.1

    a. Position a fire department pumper to operate at a fire hydrant and at a static water source. NFPA 1002 (2009) 5.2.1

    b. Perform power transfer from vehicle engine to pump and draft water. NFPA 1002 (2009) 5.2.1

    c. Operate pumper pressure control systems. NFPA 1002 (2009) 5.2.1

    d. Operate the volume/pressure transfer valve on multi-stage pumps. NFPA 1002 (2009) 5.2.1

    e. Operate auxiliary cooling systems. NFPA 1002 (2009) 5.2.1

    f. Make the transition between internal and external water sources. NFPA 1002 (2009) 5.2.1

    g. Assemble hose lines, nozzles, valves and appliances. NFPA 1002 (2009) 5.2.1

11. Supply water to fire sprinkler and standpipe systems. NFPA 1002 (2009) 5.2.4

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Objective One

Describe how to perform routine tests and service functions on the department's fire apparatus. NFPA 1002 (2009) 4.2.1

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 1. The Driver/Operator
7-9	Skills and Physical Abilities Needed by the Driver/Operator
9-10	Selection of the Driver/Operator

Page Number	Chapter 2 Types of Apparatus Equipped with a Fire Pump
13-15	Fire Department Pumpers
15-16	Initial Attack Fire Apparatus
16-18	Mobile Water Supply Apparatus
18-19	Wildland Apparatus
20-21	Pumping Apparatus Typing
21	Aircraft Fire Apparatus
22	Fire Boat Apparatus
22-23	Aerial Apparatus Equipped with Fire Pumps
23	Ladder Tenders
23-24	Rescue Apparatus Equipped with Fire Pumps
24	Trailer-Mounted Fire Pumps

Page Number	Chapter 3 introduction to Apparatus Inspection and Maintenance
31-33	A Systematic Maintenance Program
33-35	Cleanliness
35-50	Apparatus Inspection Procedures
51	Charging Batteries
51-54	General Fire Suppression Equipment Maintenance

Exercise One

1. In apparatus where the battery is housed in a special compartment, what must the operator do to prevent build-up of heat and explosive fumes?

2. List the six steps involved in charging a battery.

3. In addition to the service brakes, which are limited to emergency stops and final stops, fire apparatus usually employ a secondary means of decelerating. List three commonly used means to decelerate.

4. During the daily maintenance on braking systems, operators must pressure test the brake pedal. What differs in the process between air brakes and hydraulic brakes?

5. What is the best way to test the lighting and electric motor components of electrical systems?

6. In addition to manufacturer's recommendations for the type of oil used, what four factors must each fire department take into consideration before selecting the oil to be used in its apparatus?

7. Tires should be inspected daily for two potential problems. What are they?

8. What can operators do to minimize problems with the steering system of fire apparatus?

True/False

9. Batteries produce carbon dioxide while being charged.

10. Almost all air brake systems have minor leaks that are nearly impossible to stop.

11. Over extended periods, high coolant temperatures can lead to poor engine lubrication, low power levels and smoke, deposits on valves and high fuel consumption.

12. Regardless of the type or brand of oil used, the best way to monitor the condition of hydraulic oil is to have samples undergo electrochemical analysis at a laboratory.

13. The only way to ensure a fire pump works is to operate it.

14. As a firefighter, you should be aware of when shop maintenance is required and when the work is done so as to maintain the records and to ensure the work is completed on schedule.

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Exercise One Answers

1. Where a battery compartment is provided, the operator must make sure the battery is adequately ventilated to prevent build-up of heat and explosive fumes.

2. The six steps involved in charging a battery are:
   a. Identify the positive and negative grounds of the battery.

   b. Fasten the red cable to the positive terminal.

   c. Fasten the black cable to the negative post.

   d. Attach the charger to a reliable power source.

   e. Set the desired battery charging voltage and charging rate (where equipped).

   f. Reverse the process to remove the charging cables

3. In addition to the service brakes, fire apparatus usually employ a secondary means of decelerating, such as gearing down, engine brakes or retarding devices.

4. In both cases, the foot pedal is depressed to pressure test the brakes. The difference lies in the fact that the vehicle must be in motion to test hydraulic brakes whereas air brakes are tested while the vehicle rests.

5. The best way is to physically turn the separate components on and off.

6. Conditions such as corrosion protection, foaming, sludging and carbon accumulation of the oil must also play a part in each department's decision about the type of oil to be used.

7. Tires should be inspected for proper inflation and signs of wear.

8. Operators should check the drive shaft and universal joints of the steering system.

True/False

9. False

10. True

11. False

12. False

13. True

14. True

Objective Two

Explain how to document the routine tests, inspections and servicing functions.
NFPA 1002 (2009) 4.2.2

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 3 Introduction to Apparatus Inspection and Maintenance
31-33	A Systematic Maintenance Program
33-35	Cleanliness
35-50	Apparatus Inspection Procedures
51	Charging Batteries

Page Number	Appendix B Sample Vehicle Inspection Forms
513	Daily Vehicle Pre-Trip Inspection Report
514	Daily Apparatus/Equipment Inspection
515-516	Apparatus Defect Report
517-519	Apparatus Inspection
520-524	Emergency Vehicle Reports from VFIS
525-532	Apparatus and Equipment Checklists from Virginia Beach FD.

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Exercise Two

1. Who is responsible for completing maintenance forms?

2. What are the keys to an effective record-keeping system?

3. List five purposes/advantages to an effective record-keeping system

Exercise Two Answers

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1. The operator who completes the maintenance work is responsible for completing the appropriate forms.

2. An effective system should be simple and should work for the fire personnel who use it.

3. Advantages to an effective record-keeping system include the ability to:

   a. Inventory equipment.

   b. Outline in-service maintenance.

   c. Provide a means by which to pinpoint mechanical problems.

   d. Trail problem areas.

   e. Track the efficiency of fire apparatus and equipment.

   f. Contribute to management information.

   g. Voice opinions about the efficiency of equipment.

   h. Save a lot of time when you don't have to continually start the same job at the beginning.

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Objective Three

Describe how to operate a fire department vehicle on a pre-determined route on a public way. NFPA 1002 (2009) 4.3.1

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 4 Operating Emergency Vehicles
59-63	Collision Statistics and Causes
63-64	Driving Regulations
64-72	Starting and Driving the Vehicle
72-87	Safe Driving Techniques
87-89	Traffic Control Devices

Excerpts from the Traffic Safety Act, 2007.

1.(1) In this Act

(m) "emergency vehicle" means

i. a vehicle operated by a police service as defined in the *Police Act;*
ii. a firefighting or other type of vehicle operated by the fire protection service of a municipality,
iii. an ambulance operated by a person or organization providing ambulance services,
iv. a vehicle operated as a gas disconnection unit of a public utility,
v. a vehicle designated by regulation as an emergency response unit;

113 (1) The Lieutenant Governor in Council may make regulations (a) governing the driving and operation of (i) emergency vehicles; (b) governing the use of vehicles in relation to (ii) emergency vehicle personnel who are carrying out functions, duties or work on or in relation to a highway or vehicles or persons located on or using a highway.

116 The Minister may make regulations (h) governing any manner respecting the equipping of vehicles with and the use of flashing lights; (i) designating vehicles as emergency response units and governing any matter respecting the use and operation of those vehicles;

ALBERTA REGULATION 304/2002

Traffic Safety Act

USE OF HIGHWAY AND RULES OF THE ROAD REGULATION

Part 2, Division 2.
Use of siren
62 A siren on an emergency vehicle shall be operated only when the vehicle is being used in response to an emergency, an emergency call or an alarm.

Operating and parking emergency vehicle
63(1) Where, considering the circumstances, it is reasonable and safe to do so, a person driving an emergency vehicle may while the vehicle's siren is operating do one or more of the following:

(a) drive the vehicle in excess of the speed limit;

(b) proceed past a traffic control signal indicating stop or a stop sign without stopping;

(c) contravene any provision that is prescribed by the Act, this or other regulations or a municipal bylaw governing the use of the highways.

(2) An emergency vehicle, while its siren is operating, has the right of way over all other vehicles.

(3) Notwithstanding subsection (2), when sirens are operating on emergency vehicles, the persons driving the emergency vehicles, where practicable, should drive the vehicles in such a manner so that the vehicles, with respect to each other, are operated in the following order:

(a) firstly, a vehicle operated by a fire protection service;

(b) secondly, an ambulance;

(c) thirdly, a vehicle operated by a police service;

(d) fourthly, a vehicle operated as a gas disconnection unit of a public utility;

(e) fifthly, a vehicle designated by regulation as an emergency response unit.

(4) Where, considering the circumstances, it is reasonable and safe, an emergency vehicle may, while its flashing lights are operating, be parked contrary to any provision that is prescribed by the Act, this or other regulations or a municipal bylaw governing the parking of motor vehicles.

(5) Where a peace officer is not present, the person driving and the other personnel of an emergency vehicle, if the circumstances so require, have the powers of a peace officer under the Act and this Regulation with respect to traffic control and direction to the extent necessary to enable them to efficiently perform their duties.

Railroad Crossings

Railway crossings, too, require special attention. It is important for the operator of the apparatus to hear/see whether or not a train is approaching. Suffice it to say that the train's braking time is much greater than that of the fire apparatus and that it is much larger than you are.

When you come to a railroad crossing, slow to a speed that will allow you to stop safely if the need arises. You MUST slow at all crossings UNLESS it is controlled by a control signal or a flagman that indicates you may proceed. As you approach an uncontrolled railway crossing, slow, look both ways and listen. If you hear or see the train, do not try to cross. Proceed when the path is clear. Traditionally a lot of railway crossings are quite bumpy and could cause extensive undercarriage damage. Also, the passengers might be flung around and equipment may be lost if the bump is severe enough. When going across the rails do not apply brakes for this will also cause severe shock to the front-end components.

Bridges

Negotiate *accessible* bridges as you would roads. Respect the same guidelines on one-way bridges as you would on one-way roads. However, you must realize that many bridges will not be accessible to fire apparatus.

Take the time, before emergencies, to determine what routes are unavailable to you. Pre-planning is crucial when bridges exist within your fire department's jurisdiction. The height, weight and even width restrictions of bridges can, at times, limit your access to that specific route. Make sure, before you enter, that there will be sufficient clearance and support for the apparatus. If in doubt, find another route. Remember, in cold weather the surface of bridges freeze first, well before the roads freeze.

All commercial vehicles, including fire apparatus, are limited in height and weight by the Traffic Safety Act. Typically, no vehicle is permitted to drive on Alberta highways if the gross vehicle mass (GVM) is greater than allowed by the Act.

In general, commercial vehicles must be LESS than:

- 2.6 metres (8.5 feet) in width
- 4.15 metres (13.6 feet) in height
- 12.5 metres (41 feet) in length
- 23 metres (75.4 feet) in length, for a truck and towed trailer combination
- 22,600 kg GVM for tandems, depending on the size of tire used on the steering (front) axle (17,000 kg rear axle, 5,600 kg front axle)
- 14,700 kg GVM on 2-axle units (9,100 kg rear axle, 5,600 kg front axle)

Most fire apparatus *exceed* the legal limitations placed on commercial vehicles. Each manufacturer will have established guidelines for the weight limitations for the apparatus that are affixed to the vehicle on a label and are outlined in the operator's handbook.

Fire apparatus are given leeway from the official rules because of their use in firefighting operations.

Because most fire apparatus bend the rules in height and weight restrictions, the operator MUST follow the rules established that govern height and weight restricted routes. Once again, exceptions are quite often made to the rules in order to allow access to otherwise unreachable areas. However, these exceptions are established by the municipal government in conjunction with the fire department and include pre-planned routes that *must* be followed to avoid needless accidents. The added weight/height of the fire apparatus makes the vehicle even more prone to incidents on routes with posted limitations than other vehicles. The weight of water is 1 Litre=1 Kilogram and some trucks have up to a 4000 Litre tank which equates to 4 metric tonnes of extra weight. When parking on a soft shoulder of the road be aware that this part of the road is not designed for that kind of weight.

Pre-planned routes and limitations are necessary because most of our cities were built before modern technology and without planning for the size of fire apparatus. In Edmonton, for example, any vehicle that exceeds 4.8 metres (16 feet) in height will run into trouble with:

- trolley lines
- bridges
- overpasses
- pedways
- construction sites

Widths may also come into play with narrow roads, bridges and tunnels. Gross vehicle mass (weight) limits the vehicle's access to some roads and to bridges. Know your apparatus and respect posted limitations for height and weight; they are designed to keep you from getting wedged in bridges and stuck in trolley lines.

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Identification and Operation of automotive Gauges

NFPA 1901 (2009), *Standard for Automotive Fire Apparatus,* section 14.3.6.1 stipulates that each apparatus must have specific instrumentation and controls installed in the vehicle where the operator can see and use them efficiently. This equipment includes:

- Speedometer
- Tachometer
- Odometer
- Oil pressure gauge
- Coolant temperature gauge
- Voltmeter
- Hazard indicator light
- Air pressure gauge (if applicable)
- Automotive transmission temperature indicator or gauge (if applicable)
- Turn signal controls and indicator lights
- Headlight controls
- Fuel level gauge
- Master ignition switch
- Heater/defroster controls
- Warning signals controls
- Master electrical load switch
- "Battery on" indicator light
- Windshield wiper and washer controls
- PTO-engaged indicator
- Height of vehicle information
- Pump controls, if applicable

The majority of the instrumentation works in the same way as that of a regular passenger vehicle.

Gauges ensure the operator knows the engine is functioning within the proper range and warn when the engine is not performing properly, both when the apparatus is travelling and during fire suppression operations. As operator of the apparatus, you must know where each of the gauges is located, what the recommended parameters are and what each gauge measures. For your convenience, many of the gauges are duplicated on the pump panel so that you have easy access to the readings during pumping operations.

Speedometer
The speedometer not only shows your speed of travel but also indicates that the fire pump is operating properly. Some speedometers even register when the pump is operating.

Familiarity with normal speedometer readings while the pump runs and the engine idles allows the operator to ensure everything is set properly before he leaves the cab. It will also provide a means to track pump problems if the problem originates with the drive shaft.

Tachometer
The tach displays the engine speed in revolutions per minute (rpm). This information allows the operator to shift and to drive the apparatus efficiently but it can also provide information about the pump.

When the fire department conducts the initial acceptance tests on the pump, the rpm required to pump at rated capacity is established and recorded. Over time, as the pump wears down, the amount of rpm needed to pump the rated capacity will increase. Any unusual increase (or decrease) in the rpm will indicate a problem in the system.

Oil Pressure Gauge
This gauge reading shows when an adequate supply of oil is being distributed to the engine's most crucial components. It is a measure of oil pressure – not oil quantity. However, low levels of oil in the crankcase will cause the oil pressure to drop and the gauge to flutter.

The operator's manual will outline the normal range for each apparatus but climate wear and individual quirks will cause slight variations between engines. Take the time to learn what is normal for your apparatus. Any variation from the norm, except higher than normal pressures at start-up (when the oil is cold), is usually a sign of trouble.

Oil Temperature
Consult your manual for the normal range in oil temperature and memorize it. If the engine exceeds this range during normal driving, investigate. Slow down, pull over and check oil levels or inspect for damage because you have a problem.

Coolant Temperature Gauge
The engine coolant temperatures displayed on this gauge are very important. If too cool, the engine is not operating efficiently and if too hot, there is mechanical damage to the engine parts. Know the normal range for your vehicle.

You can drive from the fire station and in city traffic at low temperatures but this will cause wear of piston rings, higher oil consumption and shorter engine life. Over long periods of time, low temperatures will cause poor oil lubrication, poor combustion, increased valve deposits and higher fuel consumption.

A sudden increase in temperature is a sign of trouble that will only be compounded by driving the vehicle. Shut off the engine as quickly as possible and investigate the problem.

Fuel Gauge
As with any vehicle, this gauge shows you how much fuel is left in your tank. Always ensure a full tank before you receive the call to an emergency. There is no way of determining, in advance, how much fuel will be required at a fire scene. Your best bet is to keep the tank full and to monitor the gauges mounted both on the pump panel and in the cab of the apparatus. An average is about 2 hours' worth of fuel on the truck.

Ammeter
This instrument shows the amount of current the battery draws to operate the electrical equipment or the amount of current the battery is taking to maintain its charge. The reading includes only the amount of current flowing into or out of the battery; it does not include any current supplied from a generator or alternator. When running, the electrical system should contain enough power to supply the required current **and** to retain enough reserve to start the engine. Make sure you know what that amount of power should be for your particular apparatus.

Voltmeter
The voltmeter provides an indication of the battery condition and shows the top voltage available when the battery is fully charged. When the more demanding electrical accessories are in use, the voltmeter shows any drop in voltage that may occur. This is an optional instrument that may or may not be installed in your apparatus.

Air Pressure Gauge
Apparatus equipped with air brakes will have an air pressure gauge that indicates whether there is enough pressure in the system to run the brakes. You must familiarize yourself with the normal ranges for your apparatus.

Exercise Three

1. How are **bulkheads** different than **baffles**?

2. List five ways to maximize your lead-time.

3. List the four factors that influence braking distance.

4. What four things determine braking reaction time?

5. When you double the weight of the apparatus, you ____ the required braking distance.

6. What two things should you do if you find yourself in a skid?

7. How do you lessen the effect of roll during corners?

8. During normal driving, your hands should always be positioned at ____o'clock and ____ o'clock on the steering wheel.

9. Describe the steps and changes in hand position recommended to steer through a left-hand corner.

10. The key to keeping ____ force in check is a smooth, controlled steering action.

11. List five ways to lessen the effects of liquid surge.

12. When making a ____ turn, keep the front of the apparatus toward the centre of the road to keep your back end from climbing the curb. Conversely, when you make a ____ turn, point your front end toward the outside of the corner.

13. List four ways to lessen the effects of weight transfer.

True/False

14. The officer riding the apparatus is responsible for the safety of the firefighters riding on it.

15. An apparatus that carries a heavy load requires no extra time and distance to reach a full stop.

16. When you double your speed, the time required to stop doubles.

17. Efficiency and consistency far outweigh speed on an emergency run.

18. Fire apparatus are exempt from laws that require all drivers to stop for school buses with flashing lights.

19. The operator of fire apparatus must follow the same basic rules as everyone else who drives a vehicle on public roads.

20. Exceptions to the general rules of driving are made to operators driving fire apparatus at any time.

21. If you are involved in an accident with the fire apparatus, you can be subject to criminal and civil prosecution.

22. When responding to an emergency, the operator may exceed posted speed limits, as long as property and life are not endangered.

23. The operator may not disregard regulations that refer to direction of travel, direction of turns and parking.

24. You must slow down to compensate for conditions such as wet roads, darkness and bad weather.

25. What is a skid?

26. List five factors that can cause a skid.

27. If the road appears to gather more light, you are coming to a ____ and if the road appears split, you are probably approaching a ____.

28. Night driving, inclement weather and any other situation where your visibility is less than ____ metres can create difficulties for apparatus operators.

29. List five precautions you can take to help ensure you and the apparatus arrive safely at the fire scene during poor weather conditions.

30. What gear should the transmission be in when you turn over the engine?

31. List the steps involved in starting an apparatus with a manual transmission.

32. If you become stuck on an incline, what should you do?

33. Use ____ brakes for emergency stops and final stops.

True/False

34. Avoidance of a skid requires that you decelerate to avoid the potential problem.

35. When travelling through smoke, keep your headlights on high beam.

36. It is better to turn off the engine than to idle for long periods of time.

37. Turn the apparatus off as soon as you return to the fire hall.

38. Fire apparatus are most like to be in an accident at a ____.

39. When responding to an emergency call, you should always expect the unexpected from other drivers on the road. List four items you should pay special attention to during your response.

40. Approach and cross the intersection at reduced speeds of ____.

41. Proceed, without hesitation, through intersections only when ____.

42. What should you do upon approach to an uncontrolled railroad crossing?

43. Many bridges are not ____ to fire apparatus.

True/False

44. Operators can rely completely upon their warning devices to warn people of the approach of the apparatus.

45. Which Act governs vehicles that travel provincial roads?

46. Under this Act, vehicles are limited in ____ and ____.

47. Most fire apparatus ____ the legal limitations placed on commercial vehicles by the Act.

48. Where can you find information from the manufacturer about the gross vehicle carrying capacity of the apparatus?

49. Why is it so important that operators respect the rules in respect to height and weight restricted routes?

50. Who determines any exceptions to posted weight and height-restricted routes?

51. List four problems areas that a vehicle exceeding 16 feet in height will encounter in city areas.

52. The ____ of the apparatus may also come into play with narrow roads, bridges and tunnels.

53. If you, as operator, were to ignore the height restrictions of a bridge, what might the possible ramifications include?

54. Where must the instrumentation and controls required while driving be installed?

55. What are automotive gauges used for?

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56. When are automotive gauges used?

57. The ____ not only shows your speed of travel but also indicates that the fire pump is operating properly.

58. As the pump wears down, the amount of rpm needed to pump the rated capacity will
    a. increase

    b. decrease

    c. stay the same

59. The ____ gauge reading shows when an adequate supply of oil is being distributed to the engine's most crucial components.

60. The engine coolant temperatures are very important. If too ____, the engine is not operating efficiently and if too ____, there is mechanical damage to the engine parts.

61. What does the voltmeter measure?

True/False

62. NFPA 1801 governs what instrumentation is installed in automotive apparatus.

63. Higher than normal oil pressure readings at start-up (when the oil is cold) are usually a sign of trouble.

64. A sudden increase in coolant temperature is a sign of trouble.

65. The voltmeter shows the amount of current the battery draws to operate the electrical equipment or the amount of current the battery is taking to maintain its charge.

66. The ammeter reading includes current supplied from a generator or alternator.

Exercise Three Answers

1. Bulkheads divide tanks into several smaller tanks. Baffles are bulkheads with holes that allow the liquid to flow through.

2. To maximize your lead time,
   a. Aim far ahead in your steering to find the safest path of travel.

   b. View the big picture – stay back and see as much as possible.

   c. Keep your eyes moving – scan, don't stare.

   d. Allow yourself an "out" in the event the unexpected happens.

   e. Do your best to ensure others on the road see and hear you.

3. Braking distance depends on:
   a. Brake condition.

   b. Traction.

   c. Gross Vehicle Mass (weight).

   d. Speed.

4. Braking reaction time depends on:
   a. Perception time

   b. Reaction time

   c. Lag time

   d. Braking time

5. When you double the weight of the apparatus, you double the required braking distance.

6. The thing to remember at the time of a skid or loss of control is to stay off the brakes and steer the vehicle out of the skid.

7. Roll can be greatly reduced by steering smoothly and by avoiding jerky motions on the steering wheel.

8. During normal driving, your hands should always be positioned at three o'clock and nine o'clock on the steering wheel.

9. As you approach a left-hand turn, place your left hand at 12 o'clock. As you start to turn, pull the steering wheel toward you with your left hand and, at the same time, slide your right hand to six o'clock. As your left-hand approaches six o'clock, control the wheel with your right hand and move your left hand back to the 12 o'clock position. Continue this pattern until you have completed your turn.

10. The key to keeping centrifugal force in check is a smooth, controlled steering action.

11. In order to lessen the effects of liquid surge, you must:
    a. Drive smoothly.
    b. Use controlled braking.
    c. Avoid quick or jerky steering.
    d. Slow down before curves, then accelerate slightly though the curve.
    e. Plan your braking distance.
    f. Don't over-steer, over-accelerate or over-brake.

12. When making a right turn, keep the front of the apparatus toward the centre of the road to keep your back end from climbing the curb. Conversely, when you make a left turn, point your front end toward the outside of the corner.

13. Lessen weight transfer by avoiding:
    a. excessive speed in turns
    b. abrupt steering action
    c. slopes too steep for the apparatus
    d. over-steering

True/False

14. False

15. False

16. False

17. True

18. False

19. True

20. False

21. True

22. True

23. False

24. True

25. A skid is a loss of control that occurs when the tires lose traction with the road surface.

26. A skid can be the result of:
    a. Driving too fast for road or weather conditions.

    b. Turning too sharply or too quickly.

    c. Failure to properly appreciate weight shifts.

    d. Braking too hard.

    e. Accelerating too quickly.

    f. Failure to anticipate obstacles on the road.

    g. Inadequate tire treads.

    h. Incorrect tire air pressure.

27. If the road appears to gather more light, you are coming to a rise and if the road appears split, there is probably a bump in the road.

28. Night driving, inclement weather and any other situation where your visibility is less than 150 metres can create difficulties for apparatus operators.

29. Take the following precautions to arrive safely:
    a. Adjust your speed to road and weather conditions.

    b. Use chains and/or snow tires to increase traction.

    c. Do not rely completely upon your chains and snow tires for traction.

    d. Use your windshield wipers.

    e. Increase the distance between you and other vehicles.

    f. Pump your brakes to avoid locking the wheels.

g. Keep the apparatus properly maintained.

30. The transmission should be in neutral when you turn over the engine.

31. Starting a manual transmission apparatus:
    a. Put transmission in neutral.
    b. Disengage clutch.
    c. Start engine.
    d. Shift into appropriate gear.
    e. Release emergency brake.
    f. Engage clutch and accelerate.
    g. Release clutch slowly and smoothly.
    h. Keep in low gear until rpms are high enough to shift.

32. If Stuck:
    a. Keep rpm constant and low.
    b. Keep front wheels straight.
    c. Engage and disengage clutch slowly.
    d. Avoid spinning your wheels.
    e. Call for help.

33. Use service brakes for emergency stops and final stops.

True/False

34. False

35. False

36. True

37. False

38. Fire apparatus are most like to be in an accident at an intersection.

39. Expect the unexpected and remain alert to:
    a. approaching traffic at the crest of hills

    b. traffic entering from secondary roads and driveways

    c. slow-moving vehicles

    d. other emergency response vehicles

40. Approach and cross the intersection at reduced speeds – 24-32 km/h (15-20 mph).

41. Proceed, without hesitation, through intersections only when the light is green or you can account for the safety of all lanes.

42. As you approach an uncontrolled railway crossing, slow, look both ways and listen to ensure the path is clear for you to proceed.

43. Many bridges are not accessible to fire apparatus.

True/False

44. False

45. The Traffic Safety Act governs vehicles that travel Alberta's roads.

46. Under the Traffic Safety Act, vehicles are limited in weight and height.

47. Most fire apparatus exceed the legal limitations placed on commercial vehicles.

48. This information can be found affixed to the vehicle on a label and are also outlined in the operator's handbook.

49. The operator MUST follow the rules established that govern height and weight restricted routes because most fire apparatus bend the rules in height and weight restrictions. The added weight/height of the fire apparatus makes the vehicle even more prone to incidents on routes with posted limitations than other vehicles.

50. These exceptions are established by the municipal government in conjunction with the fire department and must be followed to avoid needless accidents.

51. Any vehicle that exceeds 4.8 metres (16 feet) in height will run into trouble with:
    a. trolley lines
    b. bridges
    c. overpasses
    d. pedways
    e. construction sites

52. The width of the apparatus may also come into play with narrow roads, bridges and tunnels.

53. If you were to ignore height restrictions, you could:
    a. wedge the apparatus into the bridge opening
    b. cause public humiliation for the fire department
    c. damage the vehicle and the bridge
    d. snarl traffic up for hours

54. The instrumentation and controls must be installed in the vehicle where the operator can see and use them efficiently.

55. Automotive gauges ensure the operator knows that the engine is functioning within the proper range and warn when the engine is not performing properly.

56. Automotive gauges are used both when the apparatus is in motion and during fire suppression operations.

57. The speedometer not only shows your speed of travel but also indicates that the fire pump is operating properly.

58. As the pump wears down, the amount of rpm needed to pump the rated capacity will a) increase.

59. The oil pressure gauge reading shows when an adequate supply of oil is being distributed to the engine's most crucial components.

60. The engine coolant temperatures are very important. If too cool, the engine is not operating efficiently and if too hot, there is mechanical damage to the engine parts.

61. The voltmeter provides an indication of the battery condition and shows the top voltage available when the battery is fully charged.

True/False

62. False

63. False

64. True

65. False

66. False

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Objective Four

Describe how to back a vehicle from a roadway into restricted spaces.
NFPA 1002 (2009) 4.3.2

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 4 Operating Emergency Vehicles
90-91	Practical Driving exercises – Alley Dock

Objective Five

Explain how to maneuver a vehicle around obstructions while moving forward and in reverse. NFPA 1002 (2009) 4.3.3

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 4 Operating Emergency Vehicles
90-91	Practical Driving exercises – Serpentine Course

Exercise Five

1. List the seven things that the carrying capacity of the apparatus chassis must be able to support collectively.

2. How and where must certification of carrying capacity be indicated?

3. How is it that fire apparatus are excluded from many of the limitations placed on the operation limits of commercial vehicles?

4. Each fire apparatus has operation limitations unique to its ____ and ____ that you must respect.

True/False

5. The size and weight of many apparatus exceeds the size and weight restrictions established for commercial vehicles.

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Exercise Five Answers

1. The carrying capacity of the apparatus chassis must be adequate to carry the weight of the:
   a. apparatus
   b. fully loaded water tanks
   c. loaded miscellaneous tank
   d. hose loads
   e. personnel
   f. ladders
   g. Other equipment
2. Certification of these capacities must appear on a label attached to the vehicle.
3. Fire apparatus are excluded, in most cases, by municipal legislation or special permit.
4. Each fire apparatus has operation limitations unique to its use and size that you must respect.

True/False

5. **True**

Objective Six

Describe how to turn a fire department vehicle 180 degrees within a confined space.
NFP 1002 (2009) 4.3.4

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 4 Operating Emergency Vehicles
91-92	Practical Driving exercises – Confined Space Turnaround

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Exercise Six

1. List the two purposes of fire apparatus.

2. A combination of ____ and ____ is used to support the forces exerted on the truck's aerial device and/or other equipment and to serve as a base of support for it.

3. Today's apparatus weigh 20 to 35 tonnes or more. They must be built with dimensions wide and ____ enough to support that ____.

4. List the six steps required to take a corner smoothly.

5. Why will your apparatus roll more on a corner than a passenger vehicle?

6. If you are steering a pumper that has only half a tank of water through a tight corner, when should you accelerate to lessen the effects of roll and water surge as much as possible?

7. When you must reverse the apparatus, where should your spotters be positioned?

8. List four things that can negatively affect the safe operation of the apparatus.

9. List 10 safe driving practices.

True/False

10. Corners with more than 140 degrees of arc will cause the body of the apparatus to roll.

11. It is safer and often faster to drive around the block and try to position the vehicle again than it is to reverse.

Exercise Six Answers

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1. Fire apparatus serve two purposes: transport of equipment and personnel from the fire department to a location where it is needed and performance of a function once at the fire scene.

2. A combination of mass (weight) and design (size) is used to support the forces exerted on the truck's aerial device and/or other equipment and to serve as a base of support for it.

3. Today's trucks weigh 20 to 35 tonnes or more. They must be built with dimensions wide and long enough to support that weight.

4. To take the corner smoothly,
   a. Reduce your speed.

   b. Trail off your braking.

   c. Steer into the corner.

   d. Aim about two-thirds of the way through the corner.

   e. Accelerate.

   f. Steer out of the corner.

5. An apparatus will tend to roll more on corners than your average passenger vehicle because of its height and weight.

6. Minimize the roll by starting your acceleration after the apparatus has settled on its springs and you are on a straight stretch.

7. Your spotters should station themselves on either side of the rear of the apparatus in positions where they can clearly see the path the apparatus is taking.

8. Traffic regulations, road conditions, weather conditions and the other vehicles on the road can each influence the safe operation of the apparatus.

9. Safe driving practices include:
   a. Focus on safe arrival rather than speed.
   b. Anticipate.
   c. Slow down through intersections.
   d. Drive defensively.
   e. Expect the unexpected.
   f. Realize that people may not see or hear your approach.
   g. Remain alert to road and traffic conditions.
   h. Pre-plan your braking distances.
   i. Do not clash gears.
   j. Keep your foot off the clutch; it is not a footrest.
   k. Use low gears to leave a stop.
   l. Maintain control of the apparatus.
   m. Take nothing for granted.
   n. Keep engine speeds below 15 km/h (10 mph) when you leave the station.
   o. Do not idle the engine unnecessarily.
   p. Maintain your apparatus.

True/False

10. False

11. True

Objective Seven

Explain how to maneuver a fire department vehicle in areas with restricted horizontal and vertical clearances. NFPA 1002 (2009) 4.3.5

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 4 Operating Emergency Vehicles
91-92	Practical Driving exercises – Diminishing Clearance

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Objective Eight

Describe how to operate a vehicle using defensive driving techniques under emergency conditions. NFPA 1002 (2009) 4.3.6

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 4 Operating Emergency Vehicles
76-82	Defensive Driving Techniques
92-93	Road Tests
93	Summary

Objective Nine

Explain how to operate all fixed systems and equipment on the vehicle not previously covered. NFPA 1002 (2009) 4.3.7

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 2 Types of Fire Apparatus Equipped with a Fire Pump
24-25	Apparatus-Mounted Special Systems-Electric Power Generation Equipment
25-27	Scene Lighting and Power Distribution Equipment
27-28	Hydraulic Rescue Tool Systems

Tools, Appliances and Equipment

The nozzles, Wye, Siamese and hardware used with the fire hose, as well as the portable tools and equipment used in conjunction with the fire apparatus, require special attention. Each piece of equipment requires regular preventative maintenance to function reliably. For the most part, the maintenance program involves common sense; make sure your equipment is clean, accessible and operable.

Daily

- Lift and check the gauges on fire extinguishers to check for damage or loss of pressure.
- Ensure hose loads are ready for quick deployment.
- Inventory all nozzles and appliances.
- Operate all valves.
- Ensure SCBAs and spare bottles have adequate air pressure.
- Make sure protective breathing equipment operates properly.
- Examine regulators.
- Verify hand lights and flashlights work.
- Ensure axes, shovels, pulaskis, and McLeod Tools are sharp.
- Ensure water backpacks are functioning properly.

Weekly

- Remove and clean all equipment.
- Start and run all portable engine, motor-driven equipment, fans, chain saws, rotary blade saws, etc.

Periodically

- Remove, check and reload hose, changing the bends.
- Service test hose annually.
- Remove and hand clean ladders.
- Lubricate motor-, gear- and hand-operated appliances, as per manufacturer's recommendations.
- Flush the pump and water tank twice a year.

The pump requires a bit of special attention. Pump overhaul is expensive and time-consuming. Excessive wear and damage that might make overhaul necessary can be avoided or delayed by following a routine, preventative maintenance program. The only way to ensure a fire pump works is to operate it. It is not, however, necessary to run the pump at full capacity. We will run through a few generic guidelines for routine maintenance. Refer to the manufacturer's recommendations for specific instructions.

- Ensure the pumps are mounted securely.
- Open and clean all pump drains, weekly or after each use.
- Inspect and clean all suction intake strainers, weekly or after each use.
- Check the pump gearbox and priming pump reservoir for proper oil levels and traces of water, weekly or after each use.
- Reset governor or relief valve, weekly or after each use.
- Trigger the changeover valve while pumping from the booster tank, weekly.
- Inspect packing glands for extreme leakage. Replace packing or gaskets as required.
- Operate all valves (including relief valve), weekly.
- Check all gauges to ensure they work.

- Operate the pump primer with all pump valves closed, semi-annually.
- Remove discharge caps and check vacuum leakage through valves, semi-annually.
- Recalibrate the flowmeter, according to manufacturer's instructions.

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Objective Ten

Describe how to perform the routine tests, inspections and servicing functions for water tank and other extinguishing agent levels, pumping systems, and foam systems.
NFPA 1002 (2009) 5.1.1

Learning Material

The water tanks, pumping systems, foam systems and the components that feed them are critical to fire suppression operations. A delay or break in water delivery is a very serious problem that must be avoided, wherever possible. When a problem does arise, it must be remedied quickly and efficiently.

The best way to avoid problems is through routine tests, inspections and servicing. However, it is inevitable that some malfunctions will take place, despite regular inspection and maintenance. In this scenario, even the most experienced of pump operators will not always be able to diagnose symptoms to cure the problem. The key is a thorough understanding of your equipment and its maintenance requirements, combined with a systematic approach to diagnosis.

Tanks

Always keep water tanks full to help prevent corrosion within the tank. Flush the tank and pump regularly to reduce the likelihood of stagnation and rust within. Many newer tanks are made of plastic and will not have a problem with rusting or corrosion. The frequency of flushing depends on local conditions; as a minimum, flush the system with clean water at least twice a year, more often in areas where excessive deposits build up. Ideally, flush the water pump weekly and the water tank monthly.

When and if rust particles appear in the water, empty the tank, rinse it out and refill to full capacity with clean, fresh water.

Each tank comes equipped with a minimum of one clean-out sump that has a removable pipe plug, measuring at least 76 mm (3 inch) in diameter. Take the time to check the condition of the sump's parts during flushing operations.

At the same time, glance at the tank's level indicator to ensure that it is properly recording the level or amount of water in the tank(s). A malfunctioning indicator could cause major problems, especially when the reading is not backed up with a physical verification of water levels. Always physically check tank level.

In summary,

- Keep tanks full.
- Do not overfill tanks.
- Flush the tank(s) and pump(s) regularly.
- Empty and refill the tank if rust appears in the water.
- Check condition of sump and parts.
- Verify tank indicators are operating properly.
- Keep fill and vent openings clean.
- Ensure all connections to the tank are capable of recommended filling/water transfer rates.

Pump Systems

Only a fire pump that is properly operated and maintained can be depended upon to work in an emergency situation. Seeing as how the bulk of its use is in emergencies, it is crucial that the fire pump undergo a maintenance, inspection and testing program that includes accurate written records.

The overhaul of a fire pump is costly and time-consuming. Regular maintenance, and proper use, can do a great deal to extend the life of the pump.

Maintenance

After each use:

- Open and flush out pump drains.
- Clean suction inlet strainers.
- Check oil levels.
- Reset governor or relief valves.
- Close drain valves.
- Flush systems that have pumped salt, foam or corrosive water.
- Refill the booster tank.
- Clear air from the pump.

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Your role in the regular maintenance of the fire pump should also include a weekly test where water is discharged through the system.

Semi-annually:

- Test the tightness of packing and gaskets by operating the priming system. DO NOT tighten the pump packing unless you have been properly trained.
- Check vacuum leakage through valves.
- Check operation of the changeover or transfer valve.
- Test the pressure control device.
- Change the oil in the pump drive gearbox.

Fire pumps should be tested annually to ensure the pump, driver, suction and power supply each operate efficiently and to make any adjustments that may be required to return the unit to peak efficiency.

The pump's power source should also be checked. Where the drive is an electric motor, check the motor's current supply as well as its auxiliary equipment. If the pump is driven by a diesel engine, ensure there is enough fuel to run for eight hours. Ensure all batteries are fully charged.

In addition, test-operate the starting equipment and carefully check its functioning. With a diesel engine, replenish or renew the crankcase oil, as required. Give the oil filter and air cleaner the necessary attention. Check the automatic battery charging equipment and verify the specific gravity of the battery electrolyte at least once a month.

The cooling and lubrication of a centrifugal fire pump is so dependent upon water that the pump must never run unless the pump casing is full of water. Pay close attention to the bearings and stuffing boxes during the first few minutes of operation to ensure they do not heat up and require no adjustment. Read the suction inlet and discharge outlet pressure gauges occasionally to make sure that the inlets are not obstructed.

It goes without saying that accurate records should be kept of all findings and that repairs should be made, where required.

Some Good Pumping Principles are:

- Use clean water only.
- Flush hydrants before filling the water tanks.
- Keep the suction strainer away from the bottom or sides of the static water source when drafting (450 mm from the surface, 600 mm from the bottom of the water source).
- Keep pump bearings and bushings properly lubricated.
- Do not run the pump without water.
- Change lubricants regularly.

Foam Systems

All foam equipment must be flushed with water and allowed to dry, after each use, to avoid problems at the fire scene. One of the most common causes of foam proportioning mishaps is a failure to flush venturi-type equipment after use. However, simply flowing water through the eductor will not clean the proportioner; you must operate the pickup tube to ensure water is run through the pickup apparatus for a minimum of one minute.

The basic rule for cleaning both portable and built-in systems is to operate the system, as normal, for a minimum of one minute BUT set the pickup tube in water rather than foam concentrate.

Maintenance

- Flush after each use.
- Check the condition of supply lines.
- Ensure there is no water backflow into the foam proportioning system or foam concentrate tank.
- Keep the filtration system clean to prevent debris from entering the system.
- Make sure all indicators, flow meters and pressure indicating devices are operational.
- Remember to physically check the foam level and not depend on the gauges during checks.

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Exercise Ten

1. List a minimum of four jobs that should be completed after each use of the fire pump.

2. Why must a centrifugal pump never be run unless it is full of water?

3. In addition to maintenance on the pump itself, what other components of the pump system should receive regular maintenance and inspection?

4. How often should the pump undergo intensive testing?

5. Why should water tanks be kept full?

6. Flush the tank and pump regularly to reduce the likelihood of ____ and of ____ within.

7. How often should you, ideally, flush the water tank(s)?

8. What is one of the most common causes of foam proportioning failure?

True/False

9. Flowing water through the eductor will clean the proportioner.

Exercise Ten Answers

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1. After each use, it is important that you open and flush out pump drains, clean suction inlet strainers, check oil levels, reset governor or relief valves, close drain valves, flush systems that have pumped either salt or corrosive water, refill booster tank, and clear air from the pump.

2. Centrifugal pumps should never be run without water because the cooling and lubrication of the pump are very dependent upon the water. Running the centrifugal pump without water can overheat the pump and cause serious damage.

3. The other components include the power source, fuel levels, batteries, crankcase oil, air cleaner, oil filter, bearings, stuffing boxes, suction inlet, discharge outlet and gauges.

4. The pump should undergo intensively testing annually.

5. Water tanks should be kept full to prevent corrosion within the tank and to be ready for use at the fire scene.

6. Flush the tank and pump regularly to reduce the likelihood of stagnation and rust within.

7. Ideally, flush the water tank monthly.

8. One of the most common causes of foam proportioning failure is a failure to flush venturi-type equipment after use.

True/False

9. False

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Objective Eleven

Explain how to produce effective hand or master streams supplied from an internal tank, a pressurized source, a static source, and transfer from internal tank to external source. NFPA 1002 (2009) 5.2.1

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 5 Positioning Apparatus
99-107	Positioning Fire Attack Pumpers
107-115	Positioning Water Supply Pumpers
115-119	Positioning Wildland Fire Apparatus
119-124	Positioning Support Apparatus
124-131	Special Positioning Situations

Page Number	Chapter 6 What is Water and Where Does it Come From
135-139	Characteristics of Water
139-140	Advantages and Disadvantages of Water
140-146	Water Pressure and Velocity
147-151	Friction Loss
151-160	Principles of Municipal Water Supply Systems
160-161	Private Water Supply Systems

Page Number	Chapter 7 Fire Hose Nozzles and Flow Rates
165-171	Fire Hose Nozzles
171-177	Selecting Nozzles
178-179	Nozzle Pressure and Reaction

Exercise Eleven

1. What is the total pressure loss due to friction loss in 150 m of 65 mm hose when 1200 L/min is flowing?

2. What would be the water flow from a 27 mm tip at 400 kPa?

3. If 1400 L/min is flowing, what will be the friction loss per 30 metres of 50 mm hose?

4. What is the friction loss in 120 metres of 65 mm hose when there is 1100 L/min flowing?

5. List three ways to create pressure for a water supply.

6. What are the two main parts of a centrifugal pump?

7. Explain the basic operating principle of positive displacement and centrifugal pumps.

8. Name two different types of positive displacement pumps.

9. List three common uses of the positive displacement pump.

10. Why is the centrifugal pump considered to be a non-positive displacement pump rather than a positive displacement pump?

11. Is a centrifugal pump self-priming? Yes or no? Why?

12. When putting the pump into gear, how do stationary operations differ from pump and roll operations?

13. How are midship mounted pumps powered?

14. List the seven steps required to put a midship mounted pump into gear.

15. If operating a multi-stage pump, when would you set the transfer valve to the PARALLEL (VOLUME) position?

16. Under what circumstances might you open the pump-to-tank line (tank fill valve) partially?

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True/False

17. Power take-off apparatus are equipped with a clutch between the pump and engine motor and the operator must leave the cab to engage the pump.

18. Midship mounted pumps incorporate shifting levers to get the power to the pump.

19. The ____ hydrant receives water from only one direction.

20. Pumpers, regardless of style and size, are limited as a supply source by what?

21. Hydrants that are colour-coded with ____ caps have a rated capacity of between 3,785 – 5,675 L/min.

22. List two situations where an urban fire department must consider static sources for fire suppression.

23. List five static sources of water.

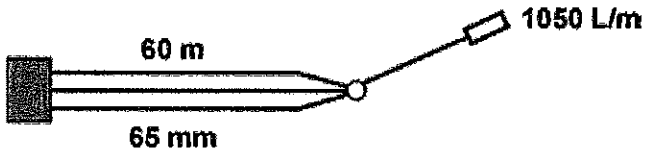
24. What two potential problems do small diameter mains, dead-end hydrants, low pressure supply systems, private water supply systems and static sources all have in common?

True/False

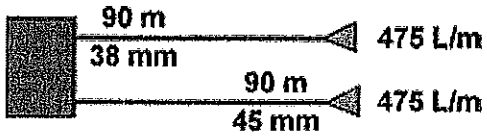
25. The water supply and pressure in a hydrant is unlimited.

26. What is the pump discharge pressure needed to supply 90 metres of 38 mm hose flowing 475 L/min to a fog nozzle?

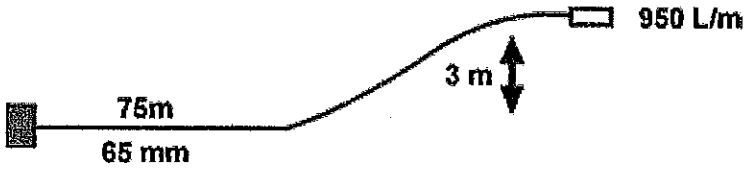
27. You have three 65 mm lines, each 60m long, equipped with a smooth bore master stream that is flowing 1050 L/min. How much pump discharge pressure is required to supply the lines?



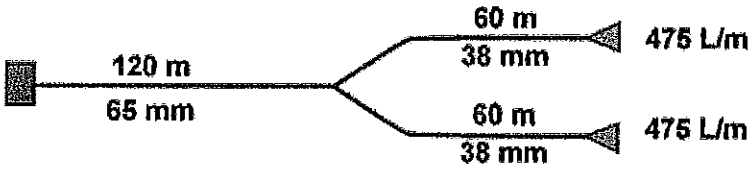
28. You have one 45 mm hose line 90 m long and one 38 mm hose line 90 m long being supplied by one pumper. Each line has a 475 L/min fog nozzle. What is the pump discharge pressure needed to supply each of the lines?



29. As the pump operator, you need to supply water to a smooth bore hand line flowing 950 L/m through 75 m of 65mm hose line. The line goes up a hill 3 metres. What is the pump discharge pressure (PDP)?



30. As the pump operator, you need to supply water to two fog nozzles flowing 475 L/m each through a sisco line with 120 metres of 65 mm line attached via a gated wye to 60 metres of 38 mm line on each side of the wye. What is the pump discharge pressure (PDP)?



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Exercise Eleven Answers

1. FL = CQ^2L
   $= 3.17 \times \left(\frac{1200}{100}\right)^2 \times \frac{150}{100}$
   $= 3.17 \times 144 \times 1.5$
   = 685 kPa

2. L/min = $.0667766 \times d^2 \times \sqrt{NP}$
   $= .0667766 \times 27^2 \times \sqrt{400}$
   $= .0667766 \times 729 \times 20$
   = 973.6

3. FL = CQ^2L
   $= 12.7 \times \left(\frac{1400}{100}\right)^2 \times \frac{30}{100}$
   $= 12.7 \times 14^2 \times 0.3$
   = 745 kPa

4. FL = CQ^2L
   $= 3.17 \times \left(\frac{1100}{100}\right)^2 \times \frac{120}{100}$
   $= 3.17 \times 11^2 \times 1.2$
   = 460 kPa

5. Pressure is created naturally, chemically and mechanically.

6. The two main parts are the impeller and case.

7. Positive displacement pump – A positive action takes place, forcing all of the water and air out of the pump body each time one cycle of the operation is completed.
   a. Centrifugal pump – Centrifugal forces creates the water velocity needed to attain the required pump discharge pressure.

8. They are the piston pump and gear pump.

9. Positive displacement pumps are used in small capacity, high-pressure fire fighting applications, as priming pumps during drafting operations and as booster pumps.

10. It is not restricted to pumping a specific amount of water with each revolution of the pump.

11. No. The centrifugal pump is incapable of pumping air; it relies on the water's velocity to move it through the system.

12. When putting the pump into gear during stationary operations, the operator must engage the brakes and later put the engine transmission into "neutral" rather than a "drive" gear.

13. Midship mounted pumps - For the pump to operate, both the pump and transmission must be in gear because the pump is driven by the engine's power – transferred from the wheels to the pump.

14. To put the pump into gear,
    a. Stop apparatus.

    b. Set brakes.

    c. Set engine to idle.

    d. Put truck transmission into "neutral".

    e. Use pump shift lever to transfer power from wheels to pump.

    f. Put truck transmission into "pumping gear" and lock.

    g. Engage clutch (standard) or depress accelerator (automatic).

15. Set the transfer valve to the PARALLEL (VOLUME) position if pump may have to use more than 50% of its capacity. This way, you won't have to shut down the pumping operation to switch the valve when and if other water sources are incorporated.

16. Open the pump-to-tank line (tank fill valve) partially, IF attack lines are not ready.

True/False

17. False

18. False

19. The hydrant that receives water from one direction is referred to as a dead-end hydrant.

20. Pumpers are limited as a supply source by the capacity of their tanks.

21. Hydrants that are colour-coded with green caps have a rated capacity of between 3,785 – 5,675 L/min.

22. Urban fire departments must consider static sources in the event of system failure or insufficient water supply.

23. Static sources include: oceans, lakes, ponds, rivers, swimming pools, farm stock tanks and storage tanks.

24. They can be lacking in quantity and force of water flow.

True/False

25. False

26. The PDP required is 1472 kPa. NP = 700 kPa

$$FL = CQ^2L$$

$$FL = 38 \times \left(\frac{475}{100}\right)^2 \times \frac{90}{100}$$

$$FL = 38 \times 4.75^2 \times 0.9$$

$$FL = 772 \text{ kPa}$$

$$H = 0$$

$$PDP = NP + FL \pm H$$

$$PDP = 700 + 772 \pm 0 = 1472 \text{ kPa}$$

27. The PDP required is 573kPa. NP = 550 kPa

Option 1	Option 2
$FL = CQ^2L$ $FL = [CQ^2L] \div 9$ $FL = \left[3.17 \times \left(\frac{1050}{100}\right)^2 \times \frac{60}{100}\right] \div 9$ $FL = [3.17 \times 10.5^2 \times 0.6] \div 9$ $FL = 23$	$FL = CQ^2L$ $FL = 0.347 \times \left(\frac{1050}{100}\right)^2 \times \frac{60}{100}$ $FL = 0.347 \times 10.5^2 \times 0.6$ $FL = 23$ The different "C" value of 0.347 comes from the siamesed line chart.
Option 3 $FL = cQ^2L$ $FL = 0.317 \times \left(\frac{350}{100}\right)^2 \times 0.6 =$ $FL = 0.317 \times (3.5)^2 \times 0.6$ FL = 23 kPa The 350 comes from taking the total flow and dividing by the number of lines to determine the work of each line.	

Remember that you square the supply lines. 3^2=9 or C=0.347

$$H = 0$$

$$PDP = NP + FL \pm H$$

$$PDP = 550 + 23 \pm 0 = 573 \text{ kPa}$$

28. The PDP needed is 500 kPa for the 45 mm hose and 1472 kPa for the 38 mm hose.

NP = 700 kPa

45mm hose

$$FL = CQ^2L$$

$$FL = 24.6 \times \left(\frac{475}{100}\right)^2 \times \frac{90}{100}$$

$$FL = 24.6 \times 4.75^2 \times 0.9$$

$$FL = 500 \text{ kPa}$$

$$PDP = NP + FL \pm H$$

$$PDP = 700 + 500 \pm 0 = 1200 \text{ kPa}$$

38mm hose

$$FL = CQ^2L$$

$$FL = 38\left(\frac{475}{100}\right)^2 \times \frac{90}{100}$$

$$FL = 38 \times 4.75^2 \times 0.9$$

FL = 772 kPa

$$PDP = NP + FL \pm H$$

$$PDP = 700 + 772 \pm 0 = 1472 \text{ kPa}$$

29.

$$FL = CQ^2L$$

$$FL = 3.17 \times \left(\frac{950}{100}\right)^2 \times \frac{75}{100}$$

$$FL = 3.17 \times (9.5)^2 \times 0.75$$

$$FL = 215$$

$$PDP = NP + FL \pm H$$

$$PDP = 350 + 215 + 30 = 595 \text{ kPa}$$

30. The PDP is 1,557 kPa

38 mm line

$$FL = CQ^2L$$

$$FL = 38\left(\frac{475}{100}\right)^2 \times \frac{60}{100}$$

$$FL = 38 \times (4.75)^2 \times 0.6$$

$$FL = 514$$

65 mm line

$$FL = CQ^2L$$

$$FL = 3.17 \times \left(\frac{950}{100}\right)^2 \times 1.2$$

$$FL = 3.17 \times (9.5)^2 \times 1.2$$

$$FL = 343$$

$$PDP = NP + FL \pm H$$

$$PDP = 700 + 514 + 343 \pm 0 = 1{,}557 \text{ kPa}$$

Objective Twelve

Explain how to supply water to fire sprinkler and standpipe systems so that water is supplied at correct volume and pressure. NFPA 1002 (2009) 5.2.4

Learning Material

Read, IFSTA, *Pumping apparatus driver/operator handbook.*

Page Number	Chapter 9 Fireground Hydraulic Calculations
253-254	Standpipe operations

Page Number	Chapter 11 Operating Fire Pumps
347-351	Sprinkler and Standpipe Support

Exercise Twelve

1. All structures that contain automatic sprinkler systems should be recognizable by the ____ affixed to the building's exterior wall.

2. When should you add additional lines to supply an active sprinkler system?

3. Provide the sprinkler system with between ____ and ____ of pump discharge pressure.

4. Where are standpipe connections usually found?

5. Some standpipe systems serve as ____ throughout the building.

6. The minimum supply requirement for Class ____ standpipe systems is 400 L/min for 30 minutes – with 450 kPa at the top outlet with 400 L/min flowing.

7. To calculate and ensure an effective fire stream from the standpipe system to all floors in the structure, you must provide ____ loss for the standpipe system.

True/False

8. The water supply for sprinkler systems is intended to furnish water to only a portion of the sprinkler heads.

9. Preplanning is critical to structural fires that involve standpipe or sprinkler systems.

College Lakeland
Emergency Training Centre

Exercise Twelve Answers

1. All structures that contain automatic sprinkler systems should be recognizable by the water motor gong affixed to the building's exterior wall.

2. Add additional lines if:
   a. The fire appears too large for system capacity.

   b. The sprinklers do not produce full discharge patterns.

3. Provide the sprinkler system with between 1050 kPa and 1400 kPa of pump discharge pressure.

4. The standpipe connections are usually found in stairwells, just outside stairwells, in hose cabinets, in extinguisher cabinets or outside the building.

5. Some standpipe systems serve as fire hose outlets throughout the building.

6. The minimum supply requirement for Class II systems is 400 L/min for 30 minutes – with 450 kPa at the top outlet with 400 L/min flowing.

7. To calculate and ensure an effective fire stream from the standpipe system to all floors in the structure, you must provide 175 kPa loss for the standpipe system.

True/False

8. True

9. True