

BASIC PUMPING STANDARD OPERATING GUIDELINE

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I. Scope

This standard establishes a guideline for pumping a fire apparatus.

II. Definitions

1. **Appliance** – A device, other than a hand held nozzle, where the direction of water flow is interrupted or changed.
2. **Bleeder Valve** - Valve on a gate that allows air from an incoming supply line to be bled off before allowing the water into the pump.
3. **Compound or Vacuum Gauge** – A gauge capable of measuring positive or negative pressures. This is the gauge that measures the intake pressure on a pump.
4. **Cavitation** – A condition that is created by water vapor bubbles (air) in the pump.
5. **Centrifugal Pump** – A non-positive displacement pump where water is introduced at the center of a revolving impeller, and moved outward. Can not pump air.
6. **Discharge** - Valve used to move water from the pump to the hose line.
7. **Discharge Gauge** - Shows the operator the pressure at each of the discharge valves being used.
8. **Drain** - Valve used to drain water from piping and pumps.
9. **Engine Pressure** - The actual pressure at the pump panel.
10. **Friction Loss** - The part of the total pressure lost due to turbulence of water moving against the interior surfaces of pipes, hose, and appliances.
11. **G.P.M.** – Gallons per minute.
12. **Gutter Line** – A hand line used to flow water so the pump does not over-heat.
13. **Intake** - Valve used to allow water to enter the pump.
14. **Master Gauge** - Shows the highest pressure being pumped.
15. **Master Stream** - Any fire stream that is flowing over 350 gpm.
16. **Nozzle Pressure** – Pressure at which water is being discharged from the nozzle.
17. **Pressure** – A measure of the energy contained in water and is stated in pounds per square inch (psi).
18. **Primer** – A small positive displacement pump that allows for the air to be displaced from the pump and suction hose. This allows the pump to receive water from a static water source.
19. **Pressure Governor**-Pressure control device that controls engine speed. Designed to eliminate a hazardous condition resulting from excessive pressures.

- 20. Pressure Relief Valve-** Automatic device designed to release excess pressure from a pump while multiple lines are flowing.
- 21. Pump Shift Override-** Allows the operator to bypass the electric pump shift and still engage the pump manually.
- 22. Residual Pressure** - Pressure left over in a water system after water is flowing.
- 23. RPM Gauge** - Revolutions per minute of the motor.
- 24. Static Pressure** - Water pressure available in a system prior to water flowing.
- 25. Tank to Pump Valve** –Valve that allows water from the tank into the pump.
- 26. Tank Fill Valve** – Valve that allows the operator to fill the booster tank from water coming in to the pump. Can also be used to recirculate water, to cool the pump.
- 27. Water Hammer** – The concussion effect of a moving stream of water, when its flow is suddenly stopped.
- 28. Water Temperature Gauge** - Allows the operator to monitor the water temperature of the motor.

III. Standards and Measurements

One gallon of fresh water weighs 8.33 pounds (use 8.3 in formulas.)

Atmospheric pressure at sea level is 14.7 pounds..

50 foot section of 1 3/4 inch hose contains 6.24 gallons.

50 foot section of 2 1/2 inch hose contains 12.75 gallons.

50 foot section of 3 inch hose contains 18.3 gallons.

100 foot section of 5 inch hose contains 102 gallons. (Approx. 950 lbs.)

100 foot section of 5 inch hose uncharged weighs approx. 103 lbs.

IV. Placing Pump in Gear

A. Automatic Transmission

1. Bring apparatus to full stop. Come to idle speed.
2. Shift transmission to neutral. Set the parking brake.
3. Operate pump shift device.
4. Shift road transmission into proper gear. This is usually drive.
5. Check the indicator lights to see if pump is in gear, check speedometer, and listen as pump goes in gear.
6. Depress accelerator to ensure shift is complete.

V. Operating From the Booster Tank and Pressurized Water Source

1. Set Wheel chocks.
2. Check "OK to pump light".
3. Open tank to pump valve.
4. Set throttle to 100 to 1200 rpm's
5. Engage primer (If needed)
 - a. Approximately 30 seconds for 1250 gpm pumps or less
 - b. Approximately 45 seconds for 1500 + gpm pumps
 - c. Add 15 seconds for front or rear intakes
 - d. Engage primer until steady stream of water is flowing from the primer discharge hose.
 - e. Look for pressure reading on master gauge and vacuum on the compound gauge.
6. Be sure hose is clear of hose bed and hose crew is ready for water.
7. Slowly open appropriate discharge.
8. Increase the throttle control to desired pressure.
9. Set pressure control devices.
10. Connect supply line to intake valve.
11. Open bleeder (if available) to purge air and leave open until steady stream of water flows from the opening.

The following procedures need to be done together to stop from losing pressure on the lines being supplied

12. Open intake valve slowly. Close tank to pump valve slowly (This needs to be done simultaneously when possible)
13. Adjust throttle to maintain desired pressure.
14. Open "tank fill" valve to refill tank.

** Partially open tank fill valve to recirculate water when no water is flowing, or use a gutter line

** Check all gauge readings

VI. Shutting Down Procedures

1. Reduce throttle control to idle.
2. Close discharge valves.
3. Make sure tank is full of water.
4. Close intake valves.
5. Place transmission in neutral.
6. Wait for engine speedometer to go to zero.
7. Operate pump shift device.

VII. Friction Loss

Formula Method:

$$FL = CQ^2 L$$

FL= Friction loss in psi

C= Coefficient – from a predetermined chart

Q= Quantity – GPM divided by 100

L= Length – length of hose divided by 100

Pump Discharge Pressure= Nozzle Pressure+ Friction Loss

Coefficients:

1 ¾"- 15.5

2 ½"- 2

3"- .8

5"- .08

Nozzle Pressures:

All standard Fog: 100 psi

Smooth bore (handline): 50 psi

Smooth bore (masterstream): 80 psi

Standard Tip Sizes:

<u>Tip Size</u>	<u>GPM</u>
7/8	160
15/16"	185
1"	200
1 1/8"	250
1 ¼" (handline)	325
1 ¼" (master stream)	400
1 3/8"	500
1 ½"	600
1 ¾"	800
2 "	1000

Appliances: Rules of thumb to remember are:

- 10 psi FL. for hose appliances, such as wyes and Siamese.
- Insignificant for flows < 350gpm.

Elevation:

- add 5 psi of friction loss per story
- add or subtract .5 lbs. of friction loss per foot of elevation

VIII. Drafting Procedures

1. Select Draft Site
 - a. Optimum usage is within 10 ft vertical lift
 - b. Need minimum 18" of water on all sides of the strainer
 - c. Keep strainer off the bottom to avoid picking up debris (Use ladder if needed)
2. Position pumper as near as possible to the water source.
 - a. Set parking brake
3. Attach suction hose to pump.
 - a. Suction hose should be even to or lower than the intake
 - b. Ensure that all connections are tight
 - c. Ensure all drains and valves on the intake side of the pump are closed
 - d. Use the front or opposite side intake if possible (front intake piping reduces capacity)
4. Ensure you have a means for water circulation
5. Place pump in gear in accordance with transmission instructions:
6. Primer Operation
 - a. Set throttle to 1000 to 1200 rpm's
 - b. Engage primer
 1. Approximately 30 seconds for 1250 gpm pumps or less
 2. Approximately 45 seconds for 1500 + gpm pumps
 3. Add 15 seconds for front or rear intakes
 - c. Engage primer until steady stream of water is flowing from the primer discharge hose.
 - d. Look for pressure reading on master gauge and vacuum on the compound gauge.
7. Open circulation valve.
8. Open discharge valves slowly while increasing rpm's to maintain or increase pressure.
9. If pump fails to prime, check for the following:
 - a. Air leaks
 - b. Debris on strainer
 - c. Oil level low in priming tank
 - d. Defective priming valve
 - e. Drafting lift to high
 - f. Not enough water above strainer- may cause whirl pooling
 - g. Hard sleeve higher than intake
 - h. Primer not activated long enough
10. Maintenance after drafting:
 - a. Refill primer oil (if applicable)
 - b. Back flush pump with clean water

IX. Pump and Tank Capacities

Engine 71 -	1500 GPM	1000 Gallons	35 Foam
Tanker 72 -	1250 GPM	2500 Gallons	
Engine 74 -	1250 GPM	1250 Gallons	40 Foam
Brush 75 -	300 GPM	300 Gallons	10 Foam

X. Foam procedure for E-71

1. Place pump in gear by following procedure in section IV
2. Open tank to pump valve
3. Prime pump
4. Press the RED button on the foam flow display
5. Press the menu button (white/gray button) and select %
6. Select the proper foam percentage using the up arrow
7. The bar light will indicate that you are ready to flow foam
8. Open the discharge to flow foam (any 1 $\frac{3}{4}$ pre-connect)

After using foam

9. Press the RED button on the foam flow display
10. Open the foam flush for 3-5 minutes
11. Close foam flush
12. Close discharge

XI. Foam procedure for E-74

1. Place pump in gear by following procedure in section IV
2. Open tank to pump valve
3. Prime pump
4. Select percentage of foam to be used (turn the dial)
5. Open inductor valve
6. Throttle up to 200 psi
7. Open foam valve
8. Open discharge valve to foam line
9. Place foam attachment on nozzle

After using foam

10. Close foam valve
11. Throttle down to 100 psi
12. Open foam flush
13. Flow water for 3-5 minutes
14. Throttle down to idle
15. Close foam flush
16. Close inductor valve
17. Set percentage dial to off
18. Close valve to foam line

XII. Steps for Back flushing Pumps

1. Shut off the apparatus.
2. Open all discharges and intakes
3. Remove all intake screens.
4. Place a supply line in the upper most discharge.
5. Charge the supply line.
6. Let water flow from all intakes for at least 5 minutes.
7. Shut off supply line.
8. Replace screens in intakes.
9. Close all discharges.
10. Refill booster tank.

XIII. Guidelines for Draining Pumps

1. When the temperature is predicted to be below 25°F for an extended period of time (Daytime Highs).
2. Anytime the temperature is predicted to be or drops below 15°F.
3. When a piece of apparatus is going to be outside for an extended period of time with the temperature below freezing (32°F), with or without the engine running.
4. Anytime at the discretion of an Officer.

XIV. Steps for Draining Pumps

1. Shut tank- to- pump valve.
2. Open master drain.
3. Remove all caps and pre-connected hose lines (intake & discharge).
4. Open all individual discharge and intake valves.
5. Open all individual drains.
6. Open all inline drains (intake and discharge).
7. Wait till water has stopped flowing (maybe as long as 10-15 minutes).
8. Close all valves.
9. Cap all discharges, intakes, and reconnect all hose lines.
10. Close all drains.
11. Make notification to the department members that pumps have been drained.
12. When the pump is recharged with water make sure that the tank is topped off. (The average pump holds 50-75 gallons of water, depending on piping)

XV. Operating from a Hydrant

1. Flush the hydrant before hooking up lines
2. Obtain static pressure reading after hydrant is charged
3. Residual pressure should be noted each time a hose line is charged.

XVI. Dump Tank Transfer

When 2 or more dump tanks are set up, the easiest way to pump out of all of them is to do a dump tank transfer. By doing this you will not have to move the hard sleeve from one tank to the others. First place one end of a hard sleeve in the dump tank you want to run water from into the tank you are pumping from. Then you will need to run an 1 1/2" or 1 3/4" hose from the engine to the end of the hard sleeve in the tank you are wanting to pull water from. Charge the hose to 50 psi. This should cause water to flow into the tank you are pumping from.