



RUSSELLVILLE FIRE DEPARTMENT
POLICY MANUAL

Policy Number:
Section:
Original Date:
Revised Date:

PURPOSE

To assist pump operators in developing proper fire streams by providing a standard for the pumping of hose lines.

Officers and pump operators should assure adequate pressure is provided to hose lines to create a proper stream of water.

POLICY

This guideline does not attempt to address all procedures and formulas for calculating proper pump pressures. It does give the pump operator a “rule of thumb” guide to achieve adequate hose stream performance. Officers and pump operators should be guided by fire ground conditions, stream performance, and water supply when necessary to calculate pump pressures other than in this guideline.

Pump in Volume when:

- Pumping into more than one 3” line or one 5” line
- Pumping into a master stream device.
- Pumping into another engine (relaying).
- Pumping into a sprinkler or standpipe siamese

Proper Pump Pressures:

- Booster Lines - Pump at 200 psi
- Preconnect 1 ¾ “Lines; 100’ pump at 135 psi, 150’ pump at 150 psi, 200’ pump at 170 psi. Calculations are based on flowing 150 gpm
- Preconnect 2 ½ “200’ pump at 125 psi. Based on 250 gpm.

Note: These preconnect pressures are derived from hydraulic calculations and can be altered as needed to affect performance by the officer in charge.

- Master Stream - Smooth bore pump at 80 psi (in volume)
Fog nozzle pump at 100 psi (in volume)
- Aerial Ladder Waterways – Pump at 150 psi (in volume) initially, additional pressure may be necessary depending on elevation of the ladder to achieve desired gpm flows at the pedestal readout.
- Relay Pumper - Pump at 50 psi (in volume) unless changed by officer at the fire. Main objective is to keep 50 psi intake pressure at the attack engine.
- Ground Monitor - Smooth bore pump at 80 psi (in volume)
Fog nozzle pump at 100 psi (in volume) plus on both layouts add approximately 5 psi per 100’ of hose between pump and the monitor.
- Parallel Lines - Calculate only one line, do not exceed 200 psi
- Sprinkler Siamese - Pump at 150 psi (in volume)
- Standpipes - Pump at 165 psi plus 5 psi per story above the first floor (in volume).

Approved



Calculating Pump Pressures

Flow from a nozzle is relative to the pressure provided at the nozzle. In simpler terms, nozzles are designed to flow specific amounts of water at a specific pressure. Greater pressure will provide a greater amount of water. However, if the pressure is much above recommended pressure the stream produced will become poor or the attack line may become unmanageable. Nozzle pressure below those recommended will produce fire streams with less flow and reach.

All nozzles that produce a broken stream are considered fog nozzles. This includes revolving distributor nozzles and large fog stream nozzles used on master streams.

To calculate the pressure needed at the pump other factors must be taken into consideration. The hose and hose appliances create turbulence in the water flowing through the line. This turbulence causes a loss in pressure called friction loss. Additional pressure is required to push water up an elevation. Additional pressure is added at the pump to compensate for these factors.

Recommended Nozzle Pressures

ALL FOG NOZZLES	100 PSI
SMOOTH BORE MASTER STREAMS	80 PSI
SMOOTH BORE HAND LINES	50 PSI
FOAM EDUCTORS	200 PSI (at the Eductor)

Friction Loss in Appliances

MASTER STREAM APPLIANCES	25 PSI
STANDPIPE SYSTEMS	25 PSI

Hydraulic engineering calculations are very precise, however for fireground operations we need not be exact. A variance of 5 to 10 psi will be only slightly noticeable at the nozzle. Rounding of numbers is acceptable and expected in fireground calculations

To calculate the pressure needed at the pump, called PUMP DISCHARGE PRESSURE, use the following formula:

$$PDP = NP + TPL$$

PDP = Pump discharge pressure

NP = Nozzle pressure (from the list above)

TPL = Total pressure loss in psi (appliance, standpipe systems, friction, and elevation losses)

Approved

Fire Chief



Friction loss is calculated using the following formulas:

For 1 ¾" in hose **FL = 15.5Q²L**

For 2 ½" in hose **FL = 2Q²L**

For 3" in hose **FL = 0.8Q²L**

For 5" in hose **FL = .08Q²L**

Q = flow rate in hundreds of gallons (flow divided by 100)

L = Length of hose in hundreds of feet (feet of hose divided by 100)

Pump Pressures for Sprinkler and Standpipe Systems

When supplying sprinkler systems a pump pressure 150 psi is adequate for most fires. This takes into consideration 100 ft. of dual 3 in. line. If longer layouts are needed to connect to the sprinkler connection add 5 psi per 100 ft. of hose.

When supplying standpipe or combination standpipe/sprinkler systems, pump pressure is as follows:
Note: calculations based on flowing 150 gpm

PDP = NP + TPL

NP = FOG NOZZLE PRESSURE = 100 psi

TPL = FRICTION LOSS = 150 ft. 1 ¾" in HOSE = 50 psi

STANDPIPE SYSTEM = 25 psi

100 ft. 3" HOSE = 5 psi

ELEVATION = +5 psi PER STORY ABOVE FIRST FLOOR

PUMP DISCHARGE PRESSURE = 100 + 80 = 180 psi + ELEVATION

Note; if more than 100 ft. of attack line is used add 15 psi per 50 ft. of 1 ¾" hose.

Relay Pumping

Under most conditions a 5" line from the hydrant will provide adequate flows for firefighting. However, when large flows are required, as when master streams are utilized, elevation, or when the layout is longer than 800 ft. provided on the engine company, it is necessary to pump in relay.

To relay pump supply pumper(s) should set in at intervals not to exceed 800 ft. of 5" hose. Initially pump pressures of 50 psi should be utilized and adjusted to maintain 50 psi at the attack pumper. This should provide approximately 1000 gpm.

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