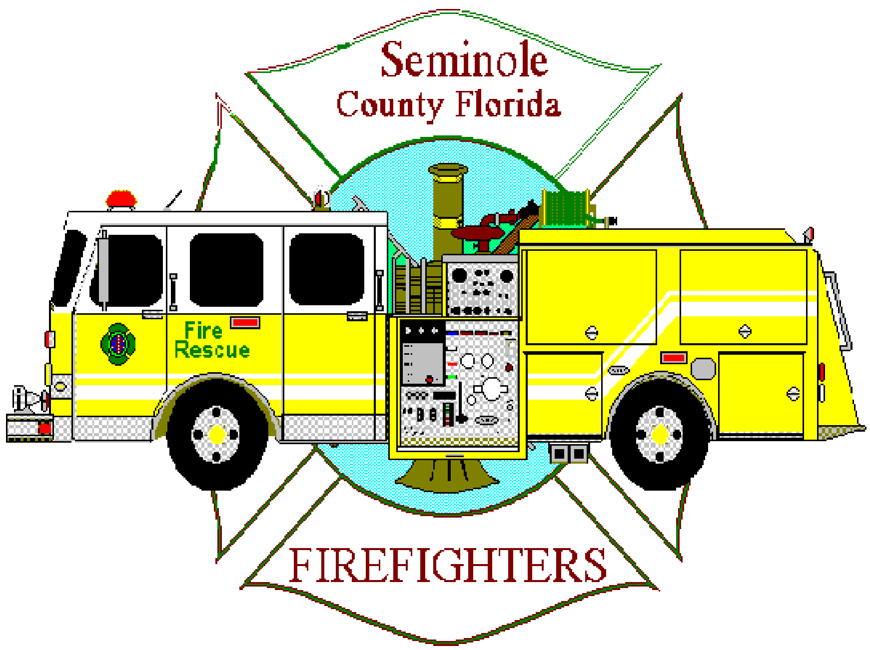
Pumping Large Diameter Hose



PRODUCED BY

SEMINOLE COUNTY EMS/FIRE/RESCUE
TRAINING BUREAU

The objective of this information is to provide some insight into solving water supply problems. Student objectives include:

- Understanding water supply problems
- Advantages of large diameter hose over multiple smaller lines
- Managing water supply
- Calculating friction in the field

Knowing the Rules

Rules apply to most everything in life. Our society is bases on rules, some can be bent, some even broken but, when we violate rules of nature we are setting ourselves up for failure.

Some of the rules to follow

- Know the rules of the road you must be able to get the people and equipment to the incident
- Know the capabilities of your crew
- Know the capabilities of your equipment
  - Performance Standards for apparatus
  - Hose testing
  - Pump testing
- Understand the principles of Hydraulics (movement of fluids at rest and under pressure)
- Understand the principles of Friction Loss

Determining fire flow and matching water delivery is much the same as managing your money.

- You can't spend what you don't have, as there is NO water credit.
- When your income exceeds your outgo, your upkeep becomes your downfall
- If you can get it to the pump you can deliver the water

As a pump operator, you should understand how to calculate engine pump discharge pressures. The standard equation use to calculate this pressure is EP=NP+FL(+/-) ELEV.

EP or engine pressure, sometimes referred to as pump discharge pressure, is the pressure required at the apparatus to deliver the desired fire stream. Centrifugal pumps are widely used in fire fighting due to their ability to take advantage of incoming pressure. This is most evident when a 1,000 GPM pumper is connected to a hydrant that can deliver 1250 GPM. The pumper can deliver more than its rated capacity up to its critical velocity.

- Critical velocity is that point where so much turbulence is created that it makes it impossible to move any more water. You have reached the limits of you equipment.

NP or nozzle pressure, is the pressure at the nozzle tip. Many nozzle tips run standard pressures. It is generally considered that fog nozzles operate at 100# of pressure, no matter if it is on a small booster line or a master stream. Even the AUTOMATIC type fog nozzles for years operated at 100#. Today some manufactures are producing low pressure nozzles where flows remain high but operating pressures are reduced.

Solid stream handlines are generally operated at 50#. Pressures over 65# makes these hoselines difficult to manage and can be dangerous to the handlers.

Solid master streams generally operate at 80#. These devices flow large volumes of water, 300 GPM and greater, and are supplied by two or more hoselines.

FL or friction loss is calculated based upon hose diameter and GPM discharge. The latest information from IFSTA; Producing Fire Streams, uses a simple way to calculate this loss.

FL = C Q2 L

FL = friction loss per 100` of hose
C = coefficient of friction, based upon diameter of hose
Q = quantity, which is the GPM divided by 100
L = lengths of hose, which is the number of 100` lengths divided by 100

FRICTION LOSS COEFFICIENTS - SINGLE LINE
For common hose diameters of supply hose

HOSE DIAMETER	FRICTION COEFFICIENT
2½`` hose	2
3`` hose w/2½`` couplings	.8
4`` hose	.2
5`` hose	.08

Street Rule Hydraulics

The principles of hydraulics and calculation require math skill. Mathematics is an exact science, however fire stream hydraulics in the field is not that accurate. There are a number of ways to solve the EP equation. We know nozzles pressures, can determine elevation losses or gains, and can determine our desired GPM discharge. Many agencies use flow charts to help the pump operator determine the Engine Pressure.

Subtract ten method will give you a quick factor of friction in 2½`` hose. Simply subtract 10 from the first two digits of the GPM and that will give you an approximation of friction per 100 ft of hose. Example: 200 GPM in 2½`` 20-10 = 10, so 10# of friction per 100 ft of hose. This method is most accurate within the GPM ranges of 180 to 300 GMP's.

Five finger hydraulics is a system of counting on your fingers to determine friction loss in a 2½`` hose . To use this system some simple math is necessary, along with a basic understanding of how it works. In the equation CQ2L, the value of Q = the GPM divided by 100. In the five finger system the finger tips represent the Q value in hundreds of gallons and the valleys represent the half hundreds.

Five Finger Hydraulics for 2 1/2" Hose Per 100'

The base numbers are coefficients used as multipliers to determine friction loss per 100 ft of 2½``hose. To complete the process remember to add the lengths of hose. This will give you total friction loss for you calculation. This information is put in the engine pressure equation

TO determine friction loss in 3``,4`` and 5`` hose, you can use the five finger system. Replace the finger base numbers with the same number as the finger tip. This will modify your system to reflect Q2. Example 3`` hose flowing 300 GPM, tip of 3 (which is the Q value) times the base number of 3 equals 9. That is the friction loss in 100 ft of 3`` hose flowing 300 GPM.

Friction loss in large diameter hoses is just one step further than the 3`` system.

To determine friction loss in 4`` hose calculate fingertip times finger base as in the 3`` system and then divide your answer by 5. Example 4`` hose flowing 500 GPM, tip of 5 times the base of 5, divided by 5 equals 5# per 100 ft. For higher flows simply count on both hands, i.e. 800 GPM, 8 times 8 equals 64 divided by 5 equals approximately

To determine friction loss in 5`` hose calculate fingertip times finger base as in the 3`` system and then divide your answer by 12. Example 5`` hose flowing 1000 GPM, tip of 10 times the base of 10, divided by 12 equals 8# per 100 ft. For higher flows simply count on both hands.