

RFI411.org — Subject: Large Diameter Hose Demo: 2-1/2" vs 4"

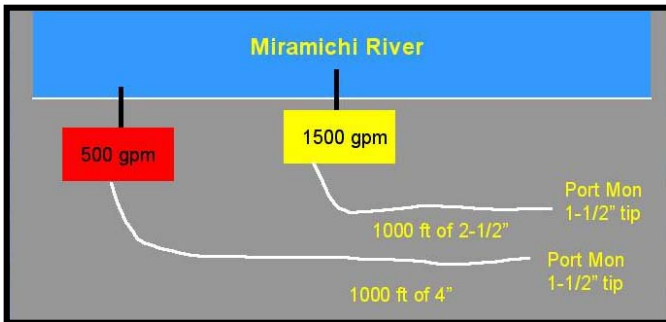
Miramichi, New Brunswick, Canada — LDH Demo
How a 500-gpm Pumper Can Out-pump a 1500-gpm Pumper



Objective

As a part of a Rural Water Supply course, they wanted to demonstrate the value of 4" hose over 2-1/2" hose in rural water supply operations.

Since seeing is believing, I had them set a demo using the Miramichi River as the water source. I told them to find a 500-gpm pumper and the largest pumper they could get— a 1500-gpm pump.



The Set-Up

Two identical portable monitors with 1-1/2" smoothbore nozzles were set up. One was supplied by 1000 ft of 2-1/2" hose, and one was supplied by 1000 ft of 4" hose.

A tanker with a 500 gpm pump supplied the 4" hose, while the 1500-gpm pump supplied the 2-1/2" hose.



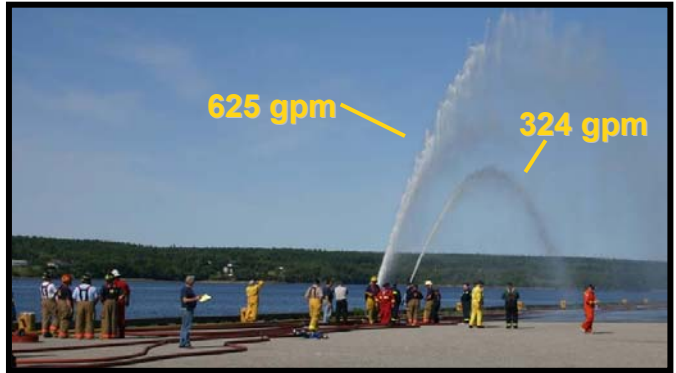
500-gpm Pump & 4" Hose

The 500-gpm pump drafting through 20 ft of 4" suction hose and discharging through 1000 ft of 4" hose.

LDH Non-believers in Become Believers



1500-gpm pump drafted through 20 ft of 6" suction hose and discharged through 1000 ft of 2-1/2" hose.



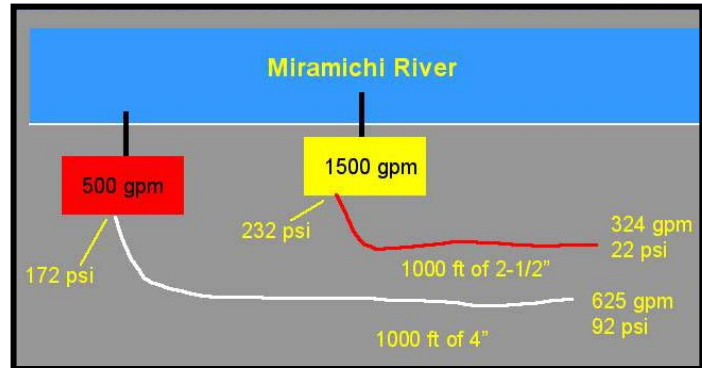
Seeing is Believing. The 4" hose allows the 500-gpm pump to deliver 625 gpm a distance of 1000 ft, while the 2-1/2" hose limits the 1500-gpm pump to delivering only 324.

The 500-gpm Pump:

- discharged 625 gpm @ 172 psi at the pump
- delivered 625 gpm @ 92 psi at the 1-1/2" tip
- delivered 125% of capacity 1000 ft

The 1500-gpm Pump:

- discharged 324 gpm @ 232 psi at the pump
- delivered 324 gpm @ 22 psi at the 1-1/2" tip
- delivered 22% of capacity 1000 ft



Why the Difference?

The 2-1/2" (small diameter) hose forced the 1500-gpm pump to expend much of its energy in over-coming the high friction loss (210 psi) in the hose.

The 4" hose allowed the 500-gpm pump to expend most of its energy pushing 625 gpm (5,200 lb/min) 1000 ft with only 80 psi friction loss.

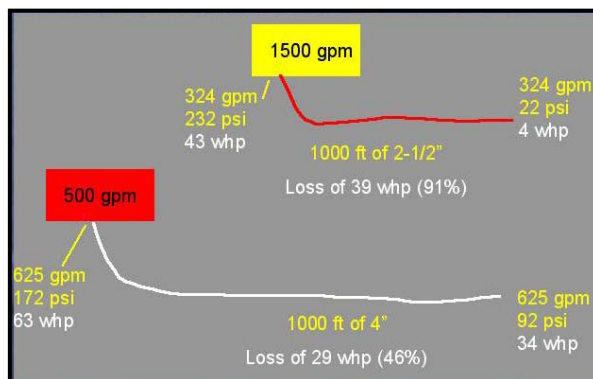
It's All About Water Horsepower

Water Horsepower (whp)

A pump does work in 2 ways. It delivers gpm, which is really a measured of the weight a pump can move. Since 1 gal of water weighs 8.3 lb, a 1000 gpm pump can move 8,300 lb per minute. The pump also creates psi, the force required to lift water vertically — .5 psi is required to lift water a distance of 1 ft. Fire apparatus pumps are designed to deliver a rated capacity in gpm at a rated discharge pressure of 150 psi.

$$\text{whp} = \frac{\text{gpm} \times \text{psi}}{1714}$$

The output (work) of a pump can be measured in terms of whp. The formula for whp is as shown above. The whp of the 500 gpm pump used in our test = $(500 \text{ gpm} \times 150 \text{ psi}) \div 1714 = 43.8 \text{ whp}$. The whp of the 1500 gpm pump used = $(1500 \text{ gpm} \times 150 \text{ psi}) \div 1714 = 131.2 \text{ whp}$.



To get a true appreciation of the benefit of using 4" hose in this test, we need to look at the test results in terms of whp, as shown above:

The 1500-gpm Pump & 2-1/2" Hose:

- Designed to deliver 1500 gpm @ 150 psi (131 whp)
- Discharged 324 gpm @ 232 psi or 43 whp (33% of the rated whp) at the pump
- Delivered 324 gpm @ 22 psi or 4 whp at the 1-1/2" tip
- Expended 91% (39 whp) of the whp at the pump moving 324 gpm through 1000 ft of 2-1/2" hose

The 500-gpm Pump & 4" Hose:

- Designed to deliver 500 gpm @ 150 psi (44 whp)
- Discharged 625 gpm @ 172 psi or 63 whp (131% of the rated whp) at the pump
- Delivered 625 gpm @ 92 psi or 34 whp at the 1-1/2" tip
- Expended only 46% (29 whp) of the whp at the pump moving 625 gpm through 1000 ft of 4" hose

The 500-gpm pump & 4" hose delivered 193% of the gpm, 418% of the psi, and 850% of the whp the 1500-gpm pump & 2-1/2" hose delivered.