DRILL OF THE MONTH

DRILL TOPIC: FIRE GROUND HYDRAULICS REVIEW

TIME REQUIRED: 2-3 HOURS

MATERIALS: Dry Erase Board, Flip Chart, Handouts

REFERENCES: Pumping Apparatus Driver Operator Handbook, 3rd Edition,

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PREPARATION:

MOTIVATION: Pump Operators need to be able to develop the proper Pump Discharge Pressure on the fire ground to supply the various size attack lines as well as move water through various size supply lines going to the fire scene. A good PO should have a basic understanding of fire ground hydraulics and be able to use some rule of thumb calculations to achieve the desired pump pressure for certain scenarios..

OBJECTIVE (SPO): The student will demonstrate a basic understanding of Fire Ground Hydraulics and be able to develop the proper Pump Discharge Pressure for the various fire scene situations.

OVERVIEW:

Fire Ground Hydraulics
* Types of Pressure
* Friction Loss
* Calculating Available Water Flow from a Hydrant
* Calculating Friction Loss for various size Hose Layouts
* Fire Ground Rules of Thumb

SPO The student will be able to demonstrate a basic understanding of fire ground Hydraulics and be able to develop the proper Pump Discharge Pressure for the various fire scene scenarios.

EO 1-1 Explain the various types pressure.

EO 1-2 Explain the standard nozzle pressures required to produce a good fire stream.

EO 1-3 Explain how to calculate available water from a hydrant.

EO 1-4 Demonstrate how to calculate required Pump Discharge Pressures for various fire ground scenarios using simple mathematical formulas and rules of thumb.

I Hydraulics Terminology Review

A. Engine / Pump Discharge Pressure - pressure developed by the fire pump measured in PSI.

B. Static Pressure - pressure at the fire hydrant with no water flowing

C. Residual Pressure - pressure remaining at the hydrant with water flowing.

D. Nozzle Pressure - pressure at the nozzle with water flowing.

E. Intake Pressure - pressure at the intake side of the pump from a supply line from a hydrant or another pumper.

F. Pressure Loss due to Elevation - due to the weight of water pressure is lost as it is Pumped to a higher floor of a building or up hill.

G. Flow - amount of water moving through a hose line pipe measured in G.P.M.

H. Friction Loss - amount of pressure lost in a hose line, appliance or pipe due to friction created by water moving through it.

II. Standard Nozzle Pressure

A. Solid Stream Nozzles, Hand Held	50 psi.
B. Solid Stream, Master Stream	80 psi
C. All Fog Stream Nozzles	100 psi

III. Calculating Available Flow from a Hydrant

A. Obtain Static Pressure Reading on Pump Intake Gauge when turning on hydrant before flowing any water.

B. Watch for drop in intake pressure after flowing water to fire ground.

C. Calculate percentage drop in Static pressure

$$\frac{\text{Static Pressure - Residual Pressure}}{\text{Static Pressure}} \qquad \frac{60 - 54}{60} = \frac{6}{60} = 10\% \text{ Drop}$$

D. Amount of Water Flow Remaining

0 - 10%	- 3 more lines
11 - 15%	- 2 more lines
16 - 15%	- 1 more line
25 +%	- No more Lines

IV. Calculating Friction Loss

A. Friction Loss in 3" Hose = $\frac{\text{G.P.M.}}{100} = \frac{400}{100} = 4\ (\text{x } 4) = 16$ psi FL / 100' hose

Friction Loss in 2 ½" Hose $\frac{\text{G.P.M.}}{100} = \frac{200}{100} = 2\ (\text{x}2) \text{ x } 2 = 8$ psi FL/ 100' hose

Friction Loss in 4" Hose $\frac{\text{G.P.M.}}{100} = \frac{500}{100} = 5\ (\text{x}5) = \frac{25}{5} = 5$ psi FL/100' Hose

Friction Loss in 5" Hose $\frac{\text{G.P.M.}}{100} = \frac{600}{100} = 6\ (\text{x}6) = \frac{36}{15} = 2.5$ psi FL /100 Hose

V. Calculating Pump Discharge Pressure, Attack Lines

Need to know G.P.M. Flow in order to figure Friction Loss
Use Max G.P.M. flow for size of attack line.
1 ½" = 100 G.P.M.
1 3/4" = 150 G.P.M.
2 ½" = 250 G.P.M.

PDP = Nozzle Pressure + Friction Loss + Appliances in hose line + or - Elevation

PDP = NP + FL + App +/- EL

VI. Calculating Pump Discharge Pressure, Supply Lines

Need to Know Total Fire Ground Flow to determine FL in supply lines

PDP = Intake Pressure + Friction Loss + Appliances + or - Elevation

PDP = 50 psi IP + FL +/- EL

VII. Rules of Thumb to Remember for.Fire Ground Calculations

A. Maximum Flow for Supply Lines

1. 2 ½" Hose = 250 G.P.M.
2. 3" Hose = 400 G.P.M.
3. 4" Hose = 1000 G.P.M.
4. 5" Hose = 1500 G.P.M.

B. Pressure Loss due to Elevation

5 psi for every 10' or Floor of a building, minus 1st Floor

C. Intake Pressure for Relay Operations

Always try to give next pumper 50psi IP.
It should never drop below 20 psi

D. When flowing Dual Supply lines, same size & length

Split G.P.M. Flow in half and calculate FL on 1 hose line.

When flowing Dual Hose lines, Same size & different lengths

Split G.P.M. Flow in half and calculate FL on 1 hose line but average hose lengths.

When flowing dual hose lines (Different sizes & same length) Split G.P.M. flow According to these percentages:

3" & 2 ½" 60% / 40%
4" & 3 " 70% / 30%

E. Friction Loss for Appliances in Hose line:

Add 10 psi FL for hose line appliances when flowing 350 gpm or higher
Add 25 psi FL for ALL Master Stream appliances for all gpm flows

VIII. Practical Scenarios for students to figure Pump Discharge Pressures using Fire Ground Hydraulics

Make up simple problems for calculating desired PDP for various size attack & supply lines scenarios. Use dry erase board or have problems pre-printed on handouts for students to solve.

REVIEW:

Fire Ground Hydraulics

* Types of Pressure
* Friction Loss
* Calculating Available Water from Hydrant
* Calculating Friction Loss for various hose layouts
* Fire Ground Rules of Thumb to Remember

REMOTIVATION: Pump Operators must be able to develop the proper Pump Discharge Pressure to supply various size fire attack lines as well various size hose lines supplying the fire ground. Remembering these basic rules of thumb will make your job easier during both simple and complex emergency operations.