Relay Pumping Operations

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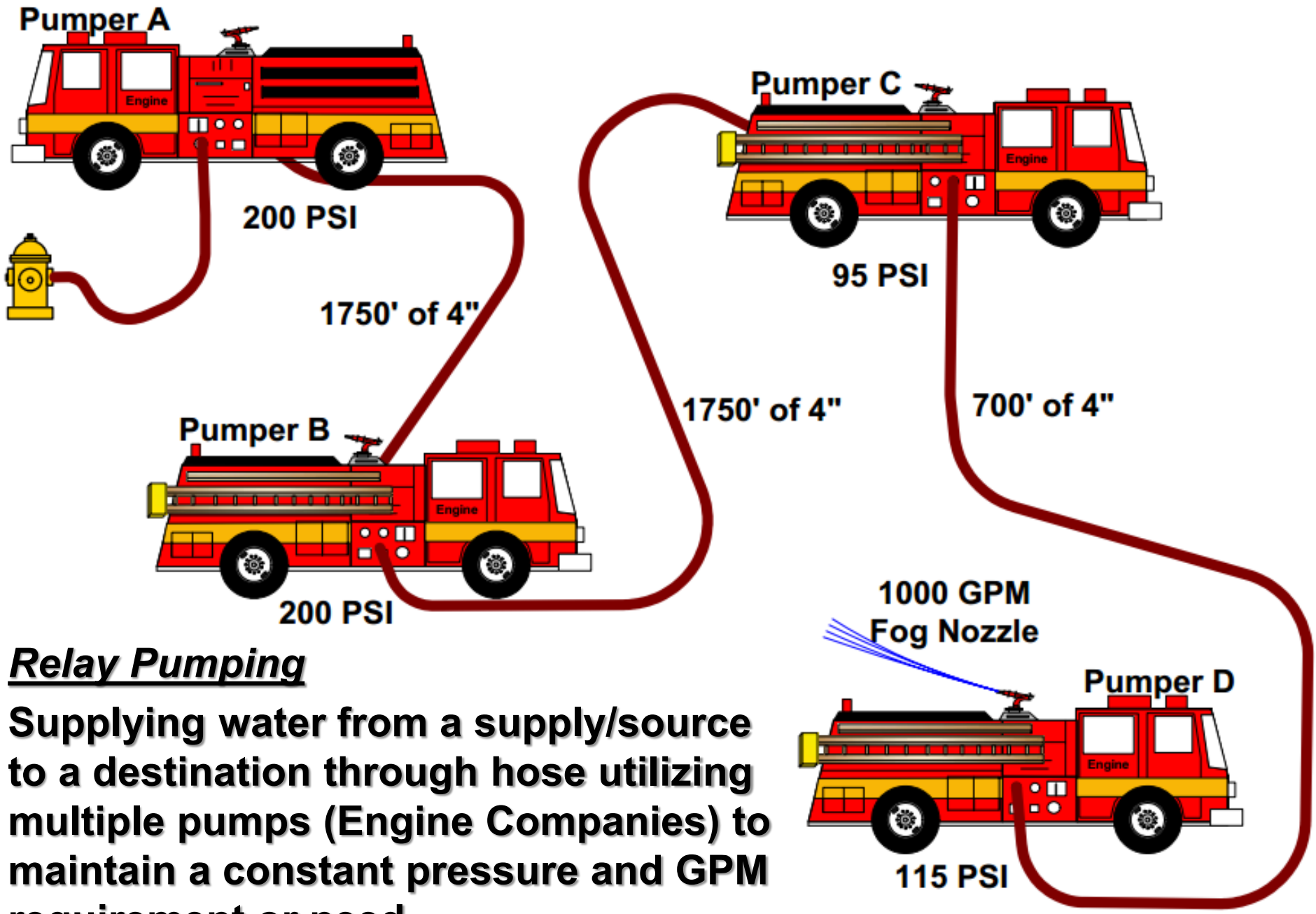
OBJECTIVES

- Identify potential water sources
- Demonstrate acquiring water from various water sources
- Demonstrate proper relay pumping hydraulic calculations
- Demonstrate proper relay pumping techniques



Relay Pumping

Supplying water from a supply/source to a destination through hose utilizing multiple pumps (Engine Companies) to maintain a constant pressure and GPM requirement or need.

Water Supply/Source Possibilities

Hydrants

Portable Tanks/Pumpkins

Tanks

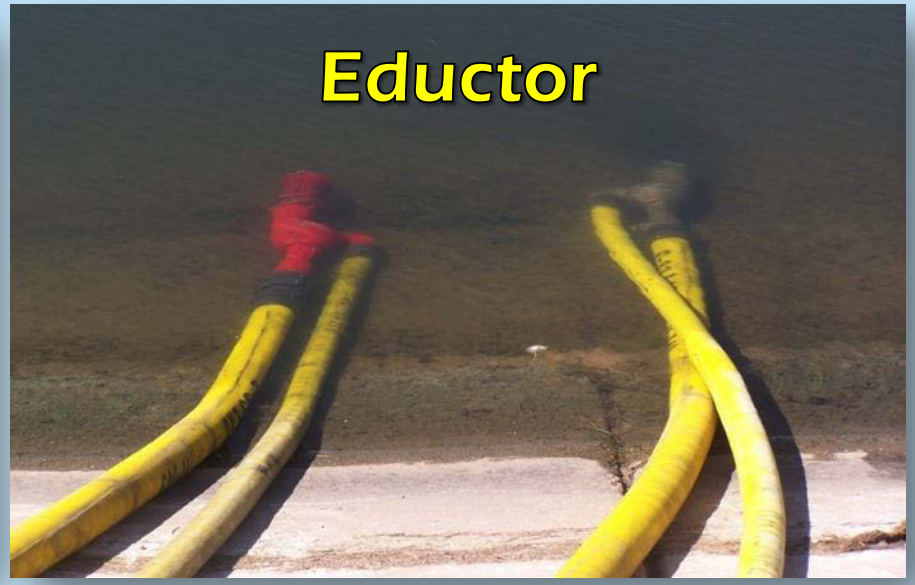
Pools

Lakes

Rivers

Ocean

Water Supply/Source Acquisition



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Relay Pumping Hydraulics

To effectively pump and supply water through a relay pumping operation, five basic pieces of information are needed:

- ✓ **How much water is required at the destination or how much water is being utilized at the destination? (GPM Flow)**
- ✓ **What size hose is being utilized to move the water from the supply/source to the destination? (Hose factor)**
- ✓ **How far away is the destination from the supply/source? (How much hose, length)**
- ✓ **Is there any change in elevation from the supply/source to the destination? (Elevation = +/- ½ psi per foot)**
- ✓ **Required incoming pressure (Intake Pressure) at the destination? (LACoFD utilizes a standard of 25 psi Intake Pressure)**
  - ✓ For basic hydraulics, 25 psi can be thought of as the “nozzle pressure”.

Relay Pumping Hydraulics

Other information that is good to know:

- **What is the maximum pump rating of your pump and/or each pump in the relay operation?**
  - ❖ ***This will determine the amount of water that can be delivered.***
    - **The pump with the greatest rated capacity should be placed at the supply/source.**
    - **The pump with the smallest rated capacity should be placed at the destination.**
- **What is the maximum distance that each pump can provide the required GPM through the hose?**
  - ❖ ***Overall distance can be increased by:***
    - **Increasing the size of hose**
    - **Adding hose lines**
    - **Adding pumps (Engine Companies)**

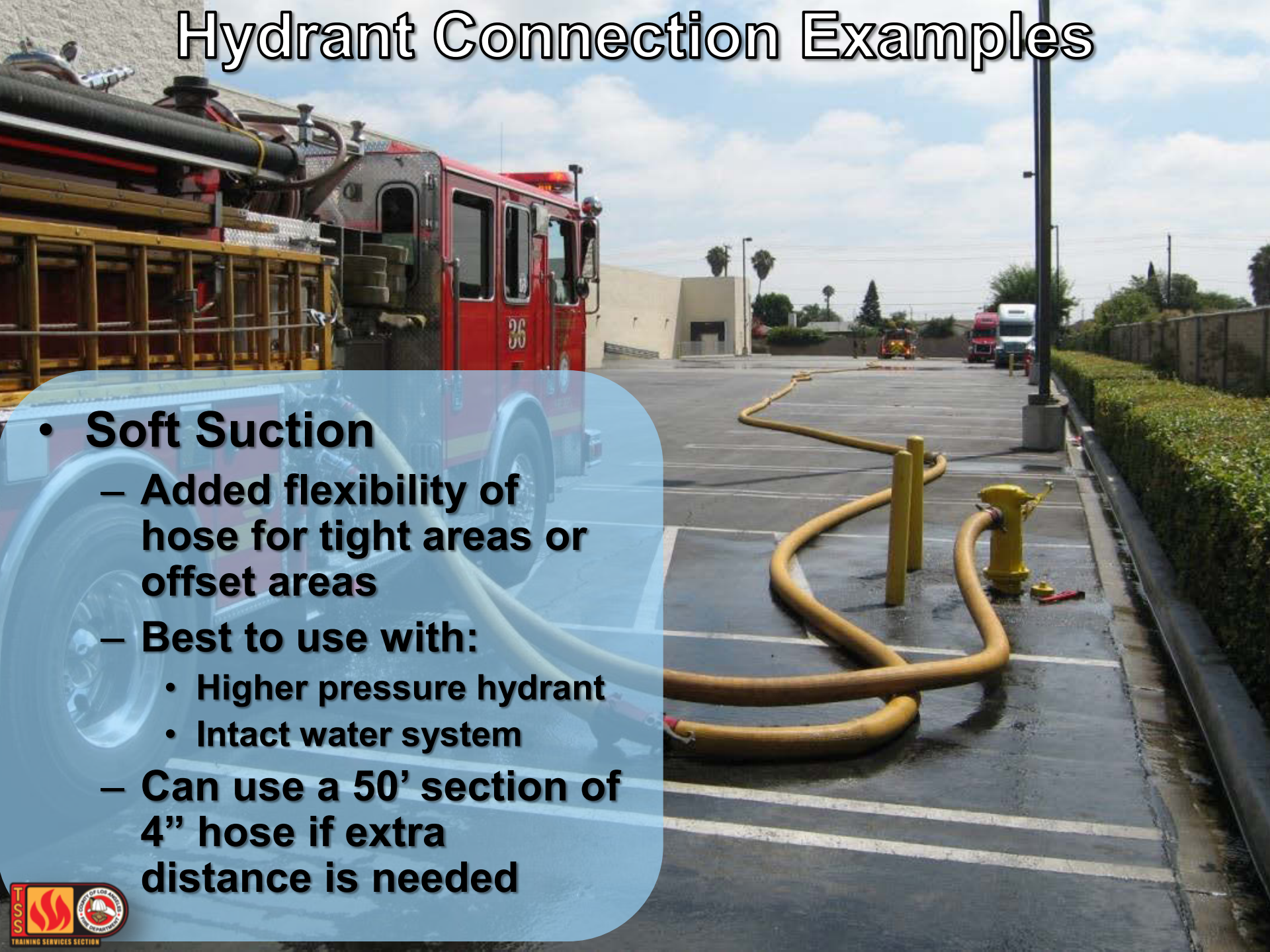
LACoFD Engine Main Pump Capacity Ratings

- 1989 Kovach (Manual) = 1000 GPM
- 1990/91 Pierce (Manual) = 1000 GPM
- 1993 KME (Manual & Jake Brake) = 1000 GPM
- 1995 KME (Manual & Telma) = 1000 GPM
- 1998 KME (Automatic) = 1000 GPM
- 2006/07 KME (Automatic) = 1500 GPM
- 2010 KME (Automatic) = 1500 GPM
- 2013 KME (Automatic) = 1500 GPM

Hydrant Connection Examples

- **Hard Suction**
  - **Maximizes water supply**
  - **Best to use with:**
    - **Low pressure hydrant**
    - **Compromised water system**
      - **Can "draft" water from a damaged system that has residual water in pipes**

Hydrant Connection Examples



- **Soft Suction**
  - Added flexibility of hose for tight areas or offset areas
  - Best to use with:
    - Higher pressure hydrant
    - Intact water system
  - Can use a 50’ section of 4” hose if extra distance is needed

Hydrant Connection Examples

- **Soft Suction x 2**
  - **Can add extra supply line (2 ½” or 4”) for more water**

Hydrant Connection Examples

Note gated wye on hydrant for additional supply

Supplying From Source Engine

Pump through Hydra-Assist

When pumping large diameter hose, connect hose to right side discharge for safety

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Supplying From Source Engine

Direct Pumping

When pumping large diameter hose, connect hose to right side discharge for safety

Supplying Next Engine

Middle Engine

When pumping large diameter hose, connect hose to right side discharge for safety

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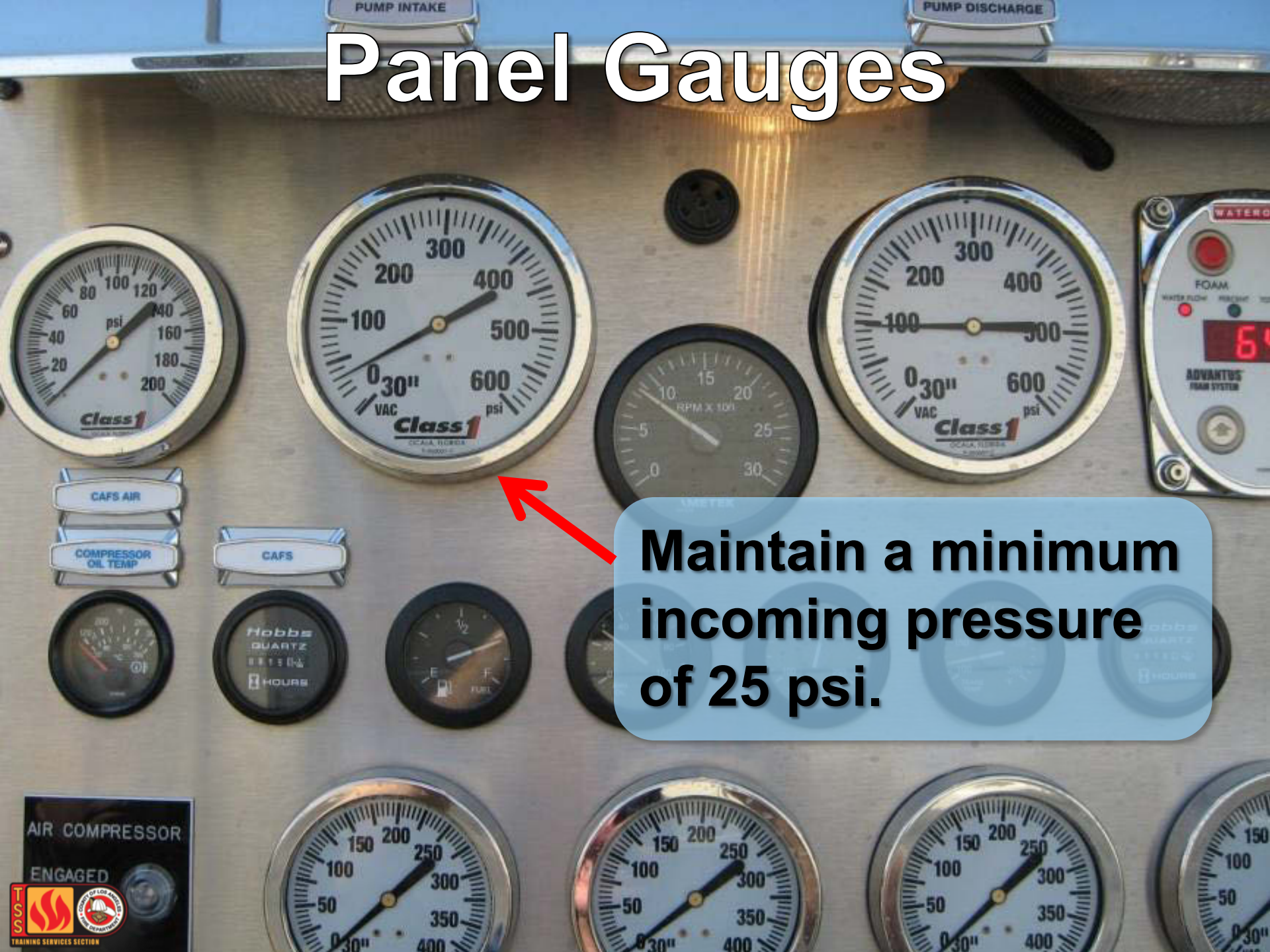
Destination Engine

- **Destination Engine**
  - **Fire Fighting Engine**

Panel Gauges



Maintain a minimum incoming pressure of 25 psi.

Other Supply Possibilities

Supplies hydrant pressure to second engine.
First engine will draw off the amount of water needed. The remaining water supply will pass through the pump to the second engine.

- **Tandem Pumping**
  - Connecting two engines to one hydrant.
    - Connect through the keystones

Both engines are flowing 1000 GPM

Other Supply Possibilities

Tandem Pumping

- Used when hydrant pressure supply is desired to second pump, and first engine is pumping high outgoing pressure.
- Engines should be close together, 100 feet or less hose length.
- Can be used with a damaged hydrant system, limited hydrants, and excellent hydrant system.

Other Creative Water Supplies

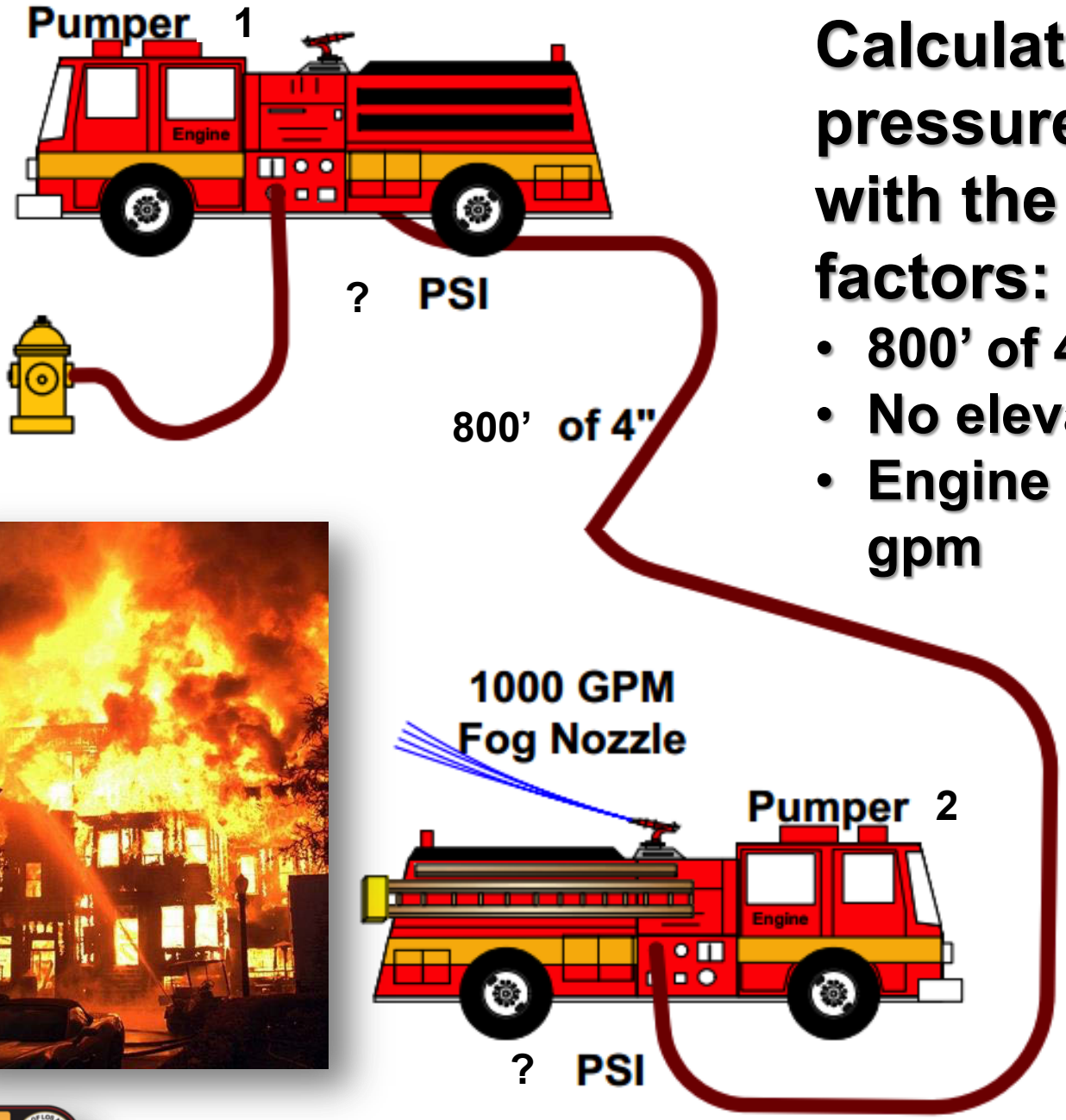
- "Draft Pit" made from ladders and salvage cover
- Trash dumpster (line with salvage cover) to use water eductor
- Dig a hole and line with a salvage cover
- Water run off, drainage channel dammed up

Relay Pumping Hydraulics

- **Maximum working pressure**
  - **LACoFD recommended maximum safe pumping pressure is 200 psi**

- **Therefore, with a required incoming pressure of 25 psi at the destination, each pump (Engine Company) within the relay operation has a working pressure of 175 psi**
  - **NOTE – Each engine/pump within the relay operation is considered a destination for the previous engine/pump, and a supply/source for the next engine/pump in line.**

Sample Hydraulic Problems for Relay Pumping



Calculate the engine pressure for Engine 1 with the following factors:

- 800' of 4" hose
- No elevation gain or loss
- Engine 2 flowing 1000 gpm

Remember, we only need to know how much water Engine 2 is flowing….NOT how, why, where, or what Engine 2 outgoing pressure is.

Relay Pumping Hydraulics

- Engine 2 GPM = 1000
- Relay Hose size = 4” (Factor = .2)
  - Conversion: 1000 x .2 = 200 GPM which equals 10 psi per 100’ of hose
- Relay Distance = 800’
  - Friction loss for distance: 10 x 8 = 80 psi
- Elevation between supply/source and destination - Flat ground = 0 psi
- Intake Pressure = 25 psi

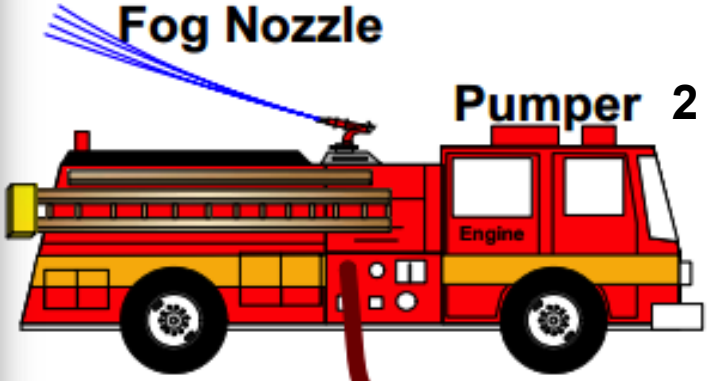
- Therefore the math is simple

  80 + 25 = 105 psi for Engine 1

105 PSI

800’ of 4"

1000 GPM
Fog Nozzle



25 PSI
(Incoming)

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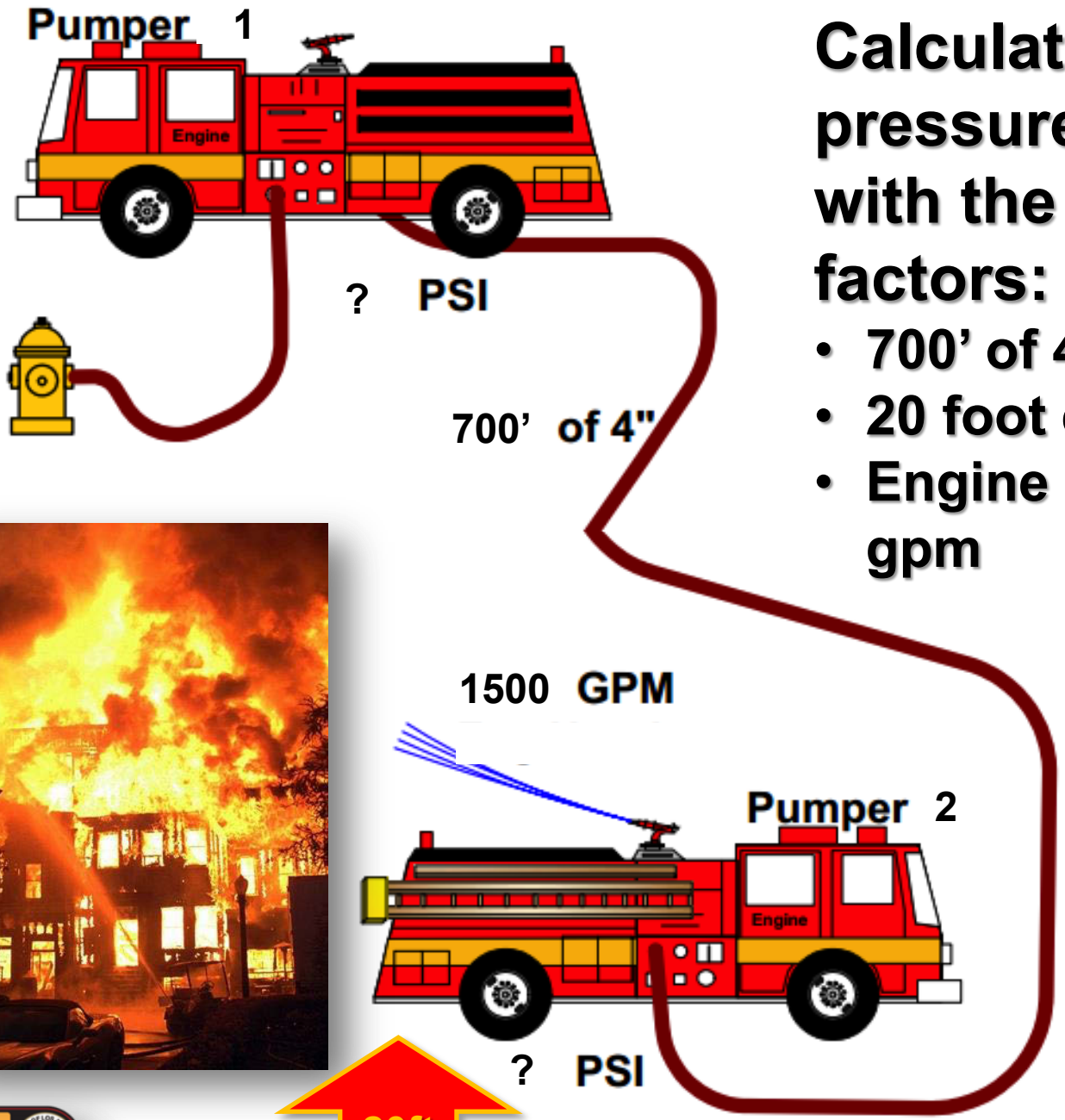


Calculate the engine pressure for Engine 1 with the following factors:

- 700' of 4" hose
- 20 foot elevation gain
- Engine 2 flowing 1500 gpm

Remember, we only need to know how much water Engine 2 is flowing….NOT how, why, where, or what Engine 2 outgoing pressure is.

Relay Pumping Hydraulics

- Engine 2 - GPM = 1500
- Relay Hose size = 4” (Factor = .2)
  - Conversion: 1500 x .2 = 300 GPM which equals 21 psi per 100’ of hose
- Relay Distance = 700’
  - Friction loss for distance: 21 x 7 = 147 psi
- Elevation between supply/source and destination – 20 feet above:
  - ½ psi x 20 = 10 psi
- Intake Pressure = 25 psi

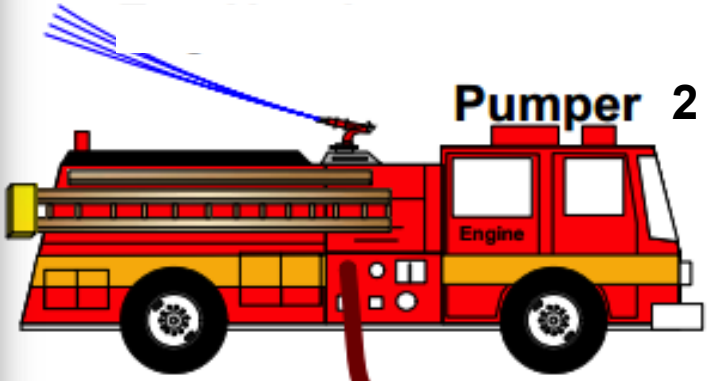
- Therefore the math is simple

  147 + 10 + 25 = 182 psi for Engine 1

182 PSI

700’ of 4"

1500 GPM



25 PSI
(Incoming)

Extra Practice

Go to the white board, draw these out and come up with a solution.

Relay Pumping Hydraulics

- Calculate Engine Pressure (EP) for third engine/pump (Engine 3) in line of a five engine/pump relay operation using 4” hose to supply water to Engine 4 which is supplying 1200 GPM to Engine 5. Engine 4 is 900 feet away and 30 feet above Engine 3.
  - Remember, we only need to know how much water Engine 4 is flowing….NOT how, why, where, or what Engine 4 outgoing pressure is. We also don’t need to know any of the specifics of the Engine 5 operation.

Relay Pumping Hydraulics

- Engine 4 - GPM = 1200
- Relay Hose size = 4” (Factor = .2)
  - Conversion: 1200 x .2 = 240 GPM which equals 14 psi per 100’ of hose
- Relay Distance = 900’
  - Friction loss for distance: 14 x 9 = 126 psi
- Elevation between supply/source and destination – 30 feet above:
  - ½ psi x 30 = 15 psi
- Intake Pressure = 25 psi

- Therefore the math is simple

  126 + 15 + 25 = 166 psi for Engine 3

Relay Pumping Hydraulics

- Calculate Engine Pressure (EP) for the supply/source engine/pump (Engine 1) supplying water to Engine 2 flowing 750 GPM, 600 feet away, using two 2 ½ ” hose lines, 50 feet below Engine 1.
  - Remember, we only need to know how much water Engine 2 is flowing….NOT how, why, where, or what Engine 2 outgoing pressure is.

Relay Pumping Hydraulics

- Engine 2 - GPM = 750 Divided by 2 hose lines = 375
- Relay Hose size = 2 ½ ” (Factor = 1)
  - Conversion: 375 x 1 = 375 GPM which equals 32 psi per 100’ of hose
- Relay Distance = 600’
  - Friction loss for distance: 32 x 6 = 192 psi
- Elevation between supply/source and destination – 50 feet below:
  - ½ psi x -50 = -25 psi
- Intake Pressure = 25 psi

- Therefore the math is simple

  192 + 25 - 25 = 192 psi for Engine 1

Relay Pumping Hydraulics

- Calculate Engine Pressure (EP) for the supply/source engine/pump (Engine 1) supplying water to Engine 2 flowing three 2 ½" hose lines with 1 ¼" smooth bore nozzles tips, 800 feet away, using a 4" hose lines, 25 feet above Engine 1.
  - Remember, we only need to know how much water Engine 2 is flowing….NOT how, why, where, or what Engine 2 outgoing pressure is.

Relay Pumping Hydraulics

- Engine 2 - GPM = 975 (325 x 3)
- Relay Hose size = 4” (Factor = .2)
  - Conversion: 975 x .2 = 195 GPM which equals 9 ½ psi per 100’ of hose
- Relay Distance = 800’
  - Friction loss for distance: 9 ½ x 8 = 76 psi
- Elevation between supply/source and destination 25 feet above:
  - ½ psi x 25 = 12 ½ psi
- Intake Pressure = 25 psi

- Therefore the math is simple

  76 + 12 ½ + 25 = 113 ½ psi for Engine 1

Relay Pumping Practice

- **Practice Drills**
  - –Pump through a Hydra-Assist
  - –Draft and water eductor from a self made “Draft Pit”, be creative
  - –Tandem pump

Relay Pumping Practice

- **Practice Drills**
  - **Discover maximum relay length and GPM**
    - **Engine 1, lay from hydrant 600 feet or more**
    - **Flow 600 GPM to 1500 GPM, can you do it?**
      - **See how much you can pump, vary the GPM flow**
    - **Engine 2, pump Engine 1 at various GPM needs**
      - **Pump through Hydra-Assist**
      - **Pump direct line**
    - **Engine 2, add a supply line, how much does it help?**
      - **2 ½" and 4"**


Now take what you've learned & apply it!
HANDS ON TRAINING
Get out there and get some HANDS ON TRAINING!
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TRAINING SERVICES SECTION

Director of Training
Battalion Chief Patrick Errett

LACoFD Training Services Section
(323) 881-2436