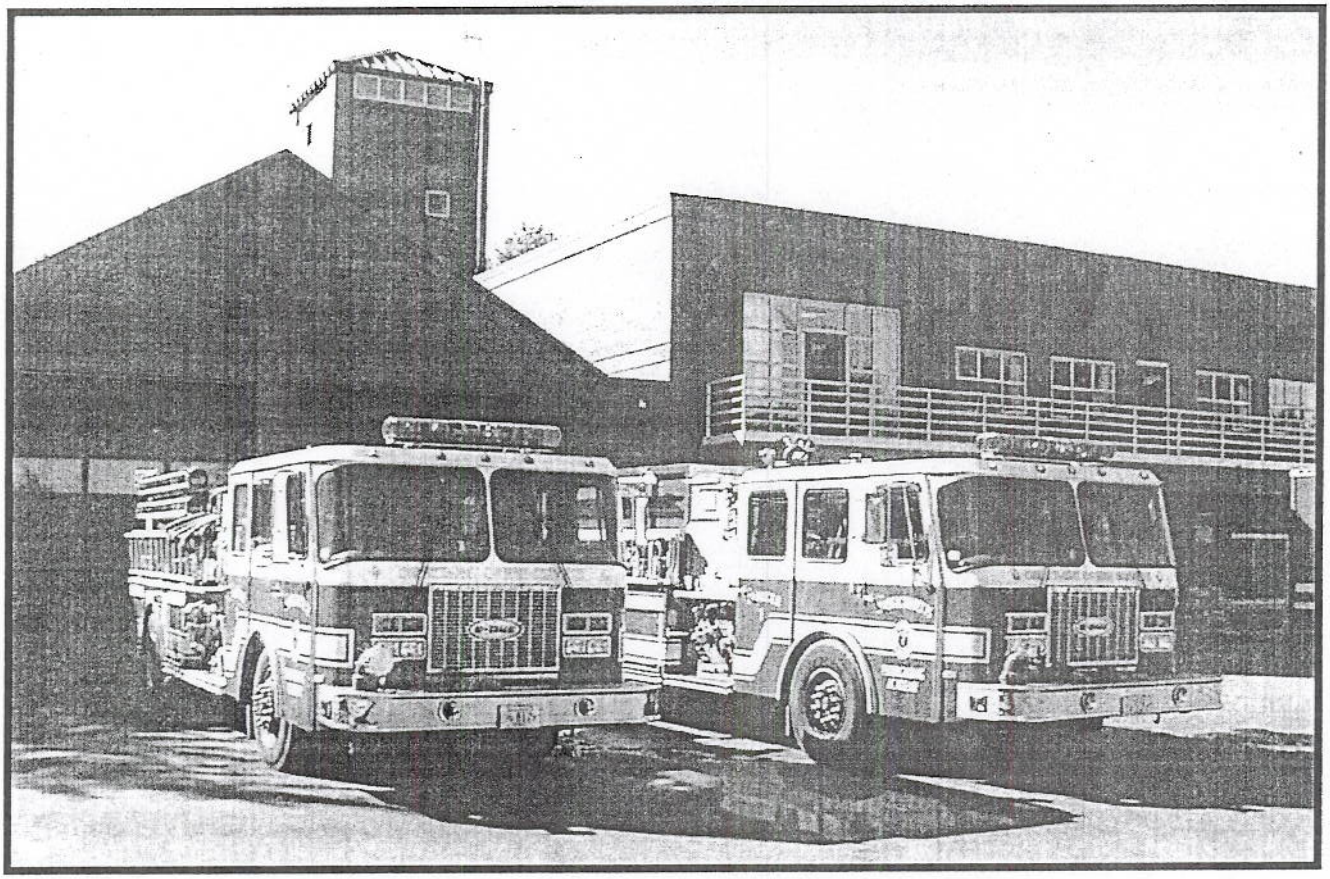
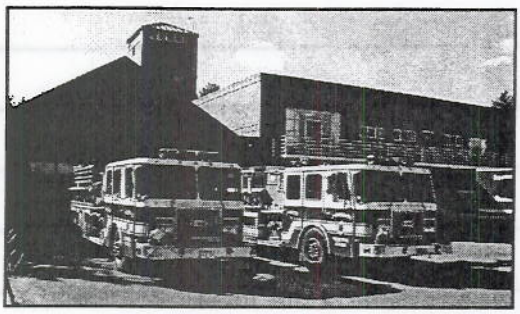
Rural Water Supply



Student Notes

Department of Fire Services
Massachusetts Firefighting Academy

Firefighter Skills Training Group
PO Box 1025 - State Road
Stow, MA 01775
978-567-3200



Rural Water Supply

Objective:

The student shall have an understanding of the methods, components and equipment common to rural water supply

2

- **The student shall understand the considerations that are unique to the rural water supply setting**
- **The student shall understand the methods, components and equipment that are common to rural water supply operations**
- **The student shall demonstrate the methods and procedures for setting up and using the following evolutions:**
  - **Drafting**
  - **Relay Pumping**
  - **Tanker Shuttle**
  - **Folding Tanks**
  - **Portable Pumps**

3

Inspection, Maintenance and Testing

4

This section will give the student an understanding of daily, weekly and annual testing and inspection of apparatus

5

Daily Inspection

Engine Oil Level	Fuel Level
Radiator Coolant	Water Tank Level
Batteries	Tires
All Lights	Air System Pressure
Horn and Siren	Equipment
Warning Lights	SCBA / Handlights

6

Weekly Inspection

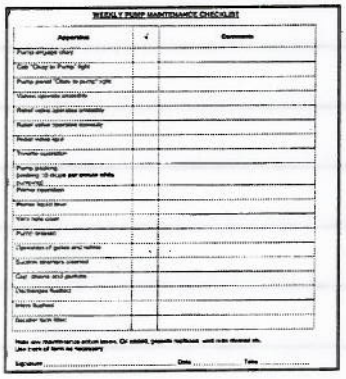
Transmission Oil Level	Check for Loose Nuts, Pins etc.
Power Steering Fluid	Start and Run Motor Driven Equipment
Hydraulic Brake System	Check Operation of Pump
Air Brake System	Equipment on Apparatus
Check All Engine Belts	Ladders
Battery Terminals / Cables	Tools
Operate Valves in Cooling System	SCBA
Check Drains and Hose Connections	Salvage Equipment
Radiator Fluids	Motor Oil (cold)

7

Vacuum Test / Dry Pump Test

- All intakes capped
- All discharges closed and uncapped
- Drain water from pump
- Develop minimum of 22 of Hg with primer
- Vacuum should not drop more than 10 inches of Hg in 5 minutes
- Connect hard suction
- Repeat test

8



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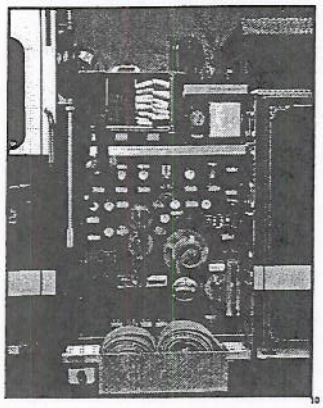
Pump Theory



10

Functions of a Fire Dept. Pumper

- Provides water for firefighting
- Controls water
- Source of water to supply pumpers at the proper pressure

11

Provides Water for Firefighting

- Handlines
- Master stream appliances
- Supplement sprinkler system
- Supplement standpipe system
- Relay pumping to other apparatus

12

Controls Water

- Friction loss
- Back pressure
- Forward pressure
- Excessive line pressure when other lines shut down
- Increase pressure

13

Water Sources

- Tank Supply
- Pressure Source
- Hydrants
- Dry Hydrants
- Static Sources
- Cisterns

14

Rotary Vane

- Used as a priming device
- In a cycle, the rotor turns, and the vanes advance outward
- Space between the rotor and housing is filled with water
- Vanes then force air out the discharge

15

Centrifugal Pump

- Spinning action creates outward force
- An impeller is used
  - Water enters the eye and is thrown outward

16

Single Stage Pump

- Has one impeller
  - Total flow and pressure depend on engine speed
- May have a single or double eye in the impeller
- Greatest efficiency is at or near capacity
- More common and simpler to operate, purchase and maintain

17

Two Stage Pump

- Also known as series/parallel or pressure/volume
- Has two impellers on a single shaft
- Two modes of operation

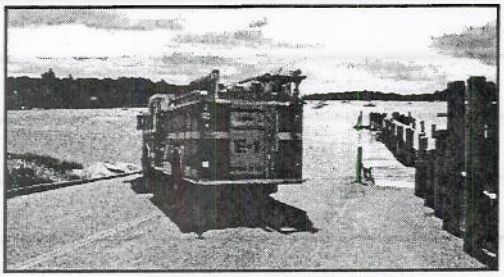
18

Series/Parallel

- Water flows through each impeller in series/pressure
- Pressure is increased by each impeller
- Results in higher pressure and lower volume
- Pressure setting is used for flows up to 50% to 70% of pump capacity

19

Large capacity pumps have a large pump cavity and are better suited for drafting operations



Parallel or Volume

- Both impellers are working, but not in series
- Water passes through either impeller, but not both
- Results in greater volume and lower pressure
- Used for flows greater than 50% to 70% of pump capacity

21

Class Ratings

- Have a capacity of 750 to 2500 gpm
- Tested to pump:
  - 100% of capacity @ 150 psi net capacity
  - 70% of capacity @ 200 psi net capacity
  - 50% of capacity @ 250 psi net capacity
- Must be capable of pumping at capacity up to 2000 feet of elevation

22

Powering Pumps

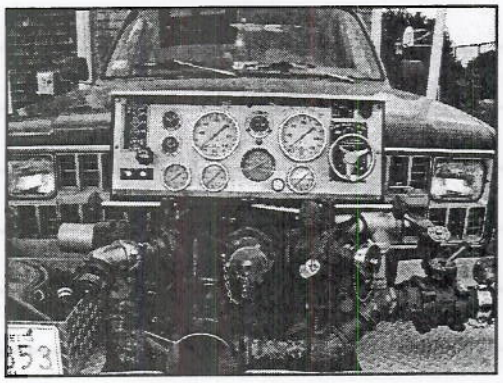
- Front Mounts
- Power Take Off
- Midship
- Rear Mount
- Separate Engine

23

Front Mount

- Pump is driven through a reduction gear with a clutch on the front of the motor
- Pump is independent of transmission – pump and roll capability
- Location of pump makes it susceptible to freezing and collision damage
- Pump is engaged by a clutch lever most often found at the pump itself

24

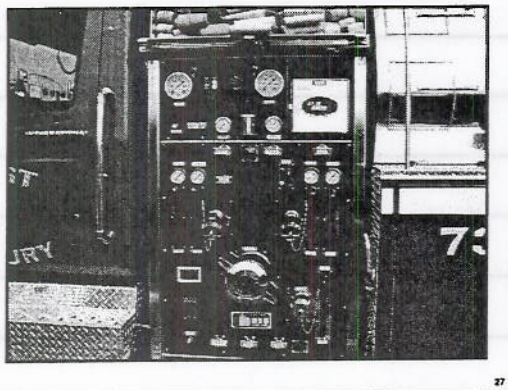


25

Power Take Off (PTO)

- PTO pumps are smaller (250 – 1500 gpm)
- Driven by gears within the transmission case (shaft)
- Pump is engaged by a PTO control
- Apparatus is normally stopped, but may be moved in a lower gear

26

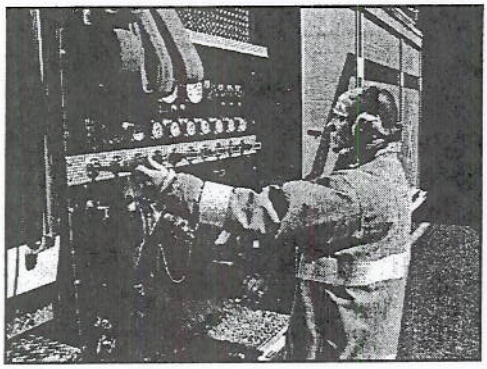


27

Midship

- Split-drive, shaft driven through a transfer case from the road transmission
- Transfer case allows selection of road or pump capability
  - Usually no pump and roll capability
- Allows for full power from engine to the pump
- Pump is engaged by shifting the transfer case lever from road to pump

28

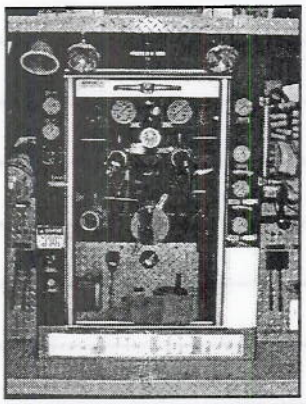


29

Rear Mount

- Split-drive, shaft driven through a transfer case from the road transmission
- Transfer case allows selection of road or pump capability
  - Usually no pump and roll capability
- Allows for full power from engine to the pump
- Pump is engaged by shifting the transfer case lever from road to pump

30

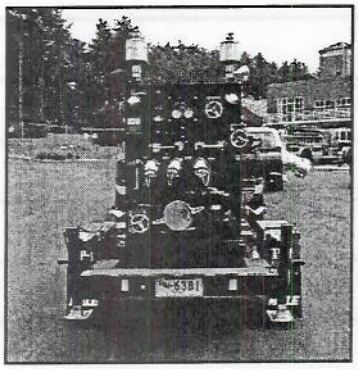


31

Separate Engine

- Power is independent of the apparatus
- Examples:
  - Skid-mounted
  - Trailer mounted
  - Built into the apparatus
  - Crash truck

32



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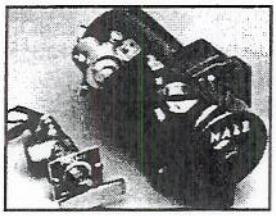
Priming Devices

- Rotary Vane
- Exhaust Ejector



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The Need for a Priming Device

- Absolute negative pressure is impossible to achieve
- Open waterway found in centrifugal pumps
- Remove air from the pump cavity and suction hose creating a higher outside pressure that pushes water up into the pump

35

Types of Priming Devices

- Positive Displacement Rotary Vane
- These will expel air with or without a lubricant
  - Dry used on the newer pumps
  - Oil may be used to reduce wear and priming time
  - Oil is no longer recommended
  - Environmentally friendly anti-freeze

36

Pressure Relief Devices

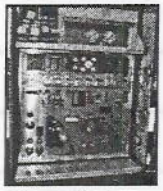
- Pumps must be equipped with a device to control pressure
- The devices operate in a range of 90 – 300 psi
- When activated, the pressure rise shall not exceed 30 psi

37

Types of Relief Devices

- Relief valve
- Governor
- Gated incoming relief valve
- Automatic pressure relief devices installed on the pump
- Built into the pump suction tube MIV (Hale)

38



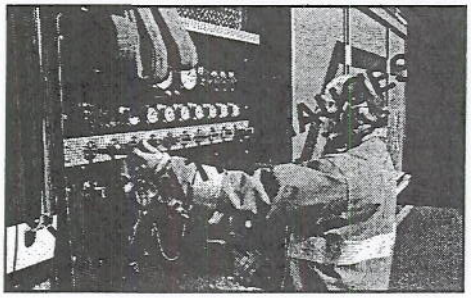
Pump Panel Components

Large Suction Intake	Governor	Throttle
Auxiliary Intake	Tank Gauge	Transfer Valve
Discharges	Tank Suction	Drains
Compound Gauge	Tank Fill	Rating Tag
Pressure Gauge	Primer Control	Test Plugs
Line Gauge	Relief Valve	Radio Equipment
Pump Power Indicator Lights		Engine/Transmission Lights

39

Engine / Pump Cooling System

Protects the engine from overheating



40

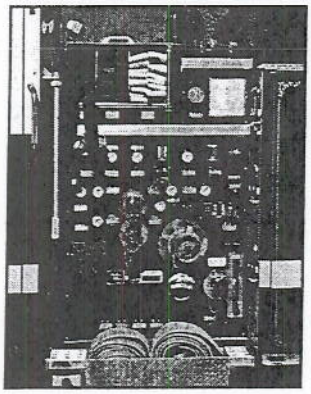
Methods to Cool the Engine

Open Hood	Thermostat
Radiator	Cooling Coil
Fan	Radiator Fill
Auxiliary Cooler	Pump Cooler Valve
Water Pump	Tank Fill Valve

41

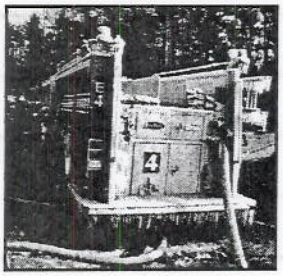
Where are the controls for these cooling lines?

- Auxiliary cooler
- Cooling coil
- Radiator fill
- Pump cooler



Cold Weather Operations

- Protect from Freezing:
  - Pumps
  - Hoses / Gauges
  - Controls
  - Pump Operator
  - Caps



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Speed of freezing depends on:

- Temperature of area where apparatus is stored vs. outside temperature
- Volume of water discharged
- Surface area exposed
- Duration of exposure
- Wind chill affects personnel only

44

Freezing Prevention
Apparatus

- Do not shut down lines completely
- Moving water does not freeze as quickly
- Drain booster lines, monitors etc.
- Valves should be closed when no hoselines are connected
- Check antifreeze levels
- Circulate water
- All pumps leak – watch for icing

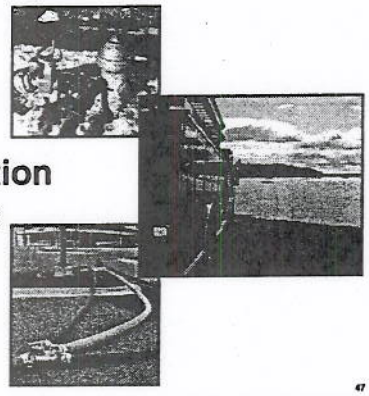
45

Freezing Prevention
Pump Operator

- Take time to dress properly prior to leaving the station
- Dress in multiple layers
- Move around – standing still slows the body down
- Drink warm fluids
- Use the pull-out platform step

46

Water Distribution Systems



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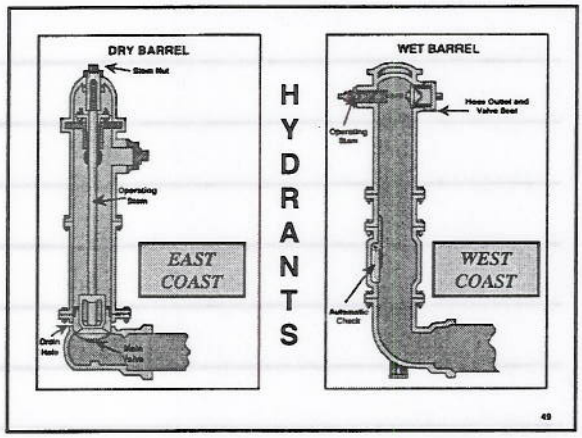
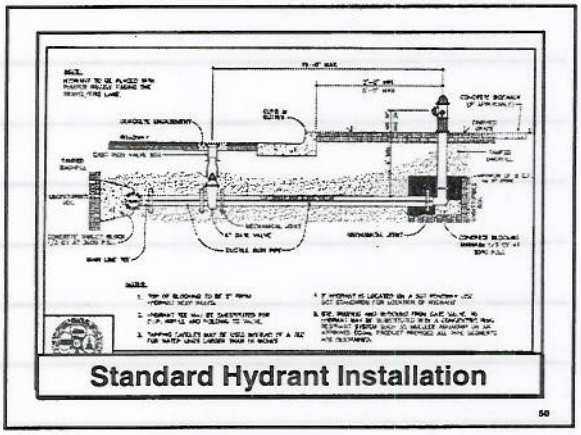
Water Distribution Systems

- Components
  - Supply Sources
    - Reservoirs, tanks, in-ground cisterns
  - Treatment Facility
    - Softens water, fluoride, cleans, removes bacteria and minerals
  - Delivery System
    - Gravity
    - Pump
    - Combination
    - Above Ground Storage Tanks

48





Proper opening of the hydrant requires 18 – 22 turns of the operating nut

NFPA Hydrant Color Code

Caps and Bonnet Color Code	
500 - 999 GPM	Orange
1000 + GPM	Light Blue

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Markings

- Weather
- Time of Day
- Ease of Locating
  - Flags
  - Pole Markings
- Carrying Capacity Varies
  - Diameter
  - Pressure
  - Friction Loss
  - Age of Water System

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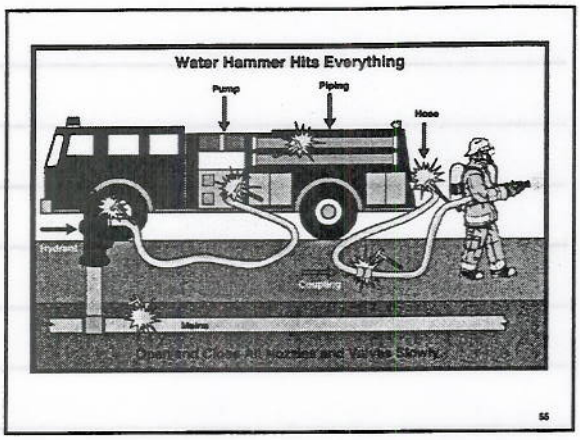
Water Flow Problems

- Water Hammer
- Nozzle Reaction
- Cavitation
- Dead End Mains
- Incrustation
- Sedimentation

54



Cavitation of a Pump

("the pump running away from the water")

- Water is discharged from the pump faster than it is coming in
- Air cavities are created in the pump and move from the point of highest vacuum into the pressurized section and collapse
- High velocity causes severe shock to the pump – usually resulting in damage

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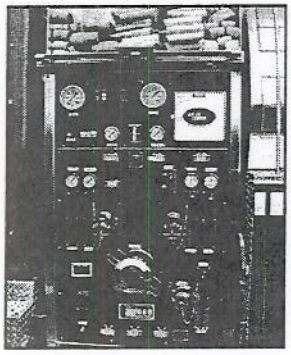
Water Supply Officer

57

Hydraulics



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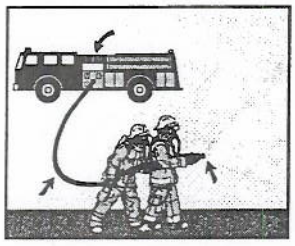
Friction Loss is part of the total pressure that is lost while forcing water through pipes, fittings, fire hose, nozzles and adapters



Friction Loss is lost energy!

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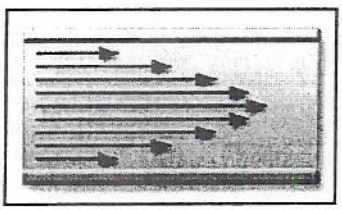
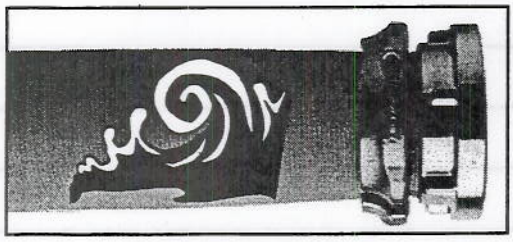
Quality of Flow



LAMINAR FLOW
Water is moving in a straight line

60



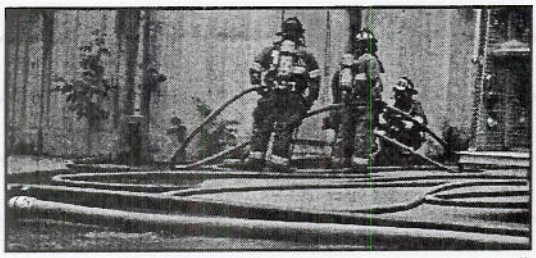
TURBULENT FLOW

Water is moving in a swirling motion

61

Hose

- Quality and Age
  - Rougher: more resistance
- Diameter
  - Larger hose: less friction loss for the same gpm



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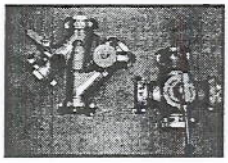
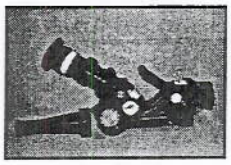
Efficient Carrying Capacity of Hose

1-1/2"	100 gpm
1-3/4"	150 gpm
2"	200 gpm
2-1/2"	300 gpm
3"	500 gpm
4"	1000 gpm
5"	2000 gpm

63



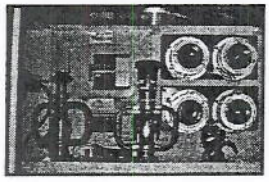


Appliances

- Varies with type and amount of flow
- Rule of Thumb: add
  - 10 psi for master streams and ladder pipes
  - 5 psi for wyes, siameses etc
  - 25 psi for standpipes

GPM's Delivered

- Varies with type of nozzle
- Combination (fog)
  - Varies with nozzle pressure
- Solid Stream
  - Varies with tip size



TIP SIZE	
1-1/4" = 400 gpm	¾" = 100 gpm
1-3/8" = 500 gpm	7/8" = 150 gpm
1-1/2" = 600 gpm	15/16" = 175 gpm
1-3/4" = 800 gpm	1" = 200 gpm
2" = 1000 gpm	1-1/8" = 250 gpm
	1-1/4" = 300 gpm

Types of Pressure

- Static Pressure
- Residual Pressure
- Negative Pressure
- Normal Operating Pressure
- Line Pressure
- Discharge Pressure
- Nozzle Pressure
- Net Pump Pressure
- Flow Pressure
- Forward Pressure
- Back Pressure

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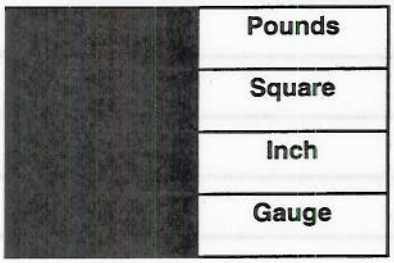

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Static Pressure:

stored energy that is available to move water through pipes, hoses and appliances.

- Shown on compound gauge with no water flowing
- Static pressure remains the same at any point in the closed system if elevation is the same
  - No matter what size hose or piping

69

Residual Pressure:

kinetic energy that is available perform work. Water pressure that was not used to overcome back pressure due to elevation or friction loss.

- Incoming pressure shown on compound gauge with water flowing
- Residual pressure is different at various points in the system due to friction loss and elevation

70

Negative Pressure:

any pressure created in the fire pump or hard suction hose which is less than atmospheric.

- Atmospheric pressure is 14.7 psi at sea level

71

Normal Operating Pressure:

pressure through water distribution system during normal consumption demands.

- Fluctuates during day and night
- And also according to time of year

72

Line Pressure:

pressure needed to provide proper nozzle pressure with a given layout.

73

Discharge Pressure:

in situations requiring multiple lines, the pump develops pressure for the highest line (greatest pressure).

- **Gate back for all others to get the proper line pressure**

74

Nozzle Pressure:

the pressure required at the nozzle to develop a proper fire stream from a nozzle.

- **Nozzle pressure and the tip size determine flow capability**
- **Standard nozzle pressure**
  - **Combination: 100 – 75 – 50**
  - **Solid Handline: 50**
  - **Solid Master Stream: 80**

75

Net Pump Pressure:

combined total pressure (psi) developed by the fire pump.

- **Net pump pressure = PSIG pressure + PSIG vacuum (inches of Hg.)**

76

Flow Pressure:

forward velocity pressure at a discharge opening measured with a Pitot Gauge

77

Forward Pressure:

pressure gained by water flowing, when the nozzle is lower than the pump.

Figured at 0.5 psi per foot.

- **5 psi per floor below ground level**

78

Back Pressure:

pressure that is must be overcome when the nozzle is above the pump.

Figured at 0.5 psi per foot

- **5 psi per floor above ground level**

79

Nozzle Reaction is equal to half the flow

80

Actual Flow and Reaction Force

	60		95		100		125		150		200		250	
100	60	30	95	48	100	51	125	63	150	76	200	101	250	126
75	52	23	82	36	87	38	108	47	130	57	173	76	217	95
50	42	15	67	24	71	25	88	32	106	38	141	51	177	63

Akron Brass

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Actual Flow and Reaction Force

Solid Bore Discharge Table
GPM

	3/8"	1/2"	5/8"	3/4"	7/8"	15/16"	1"
PSI							
50	29.5	53	82.3	118	161	182	210
60	32.3	58	90	129	176	199	230
70	35	62.1	97.1	140	190	215	249
80	37.3	66.4	104	149	203	230	266

Akron Brass

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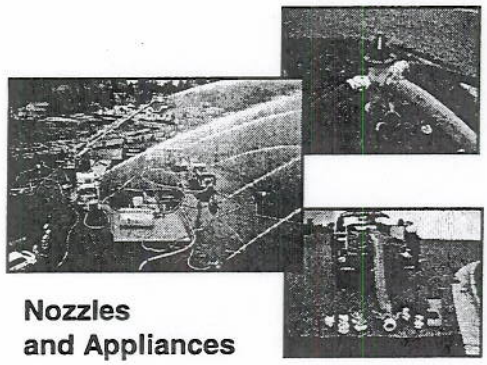

Nozzles and Appliances

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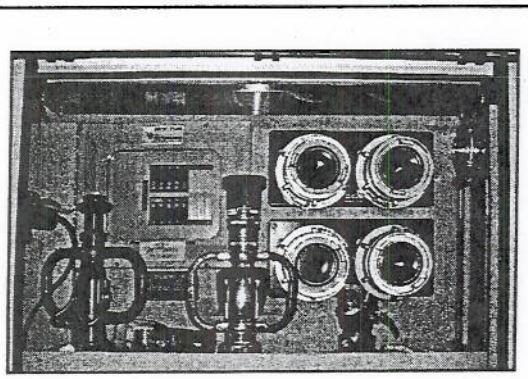

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Solid Stream

- Fixed orifice, smooth bore nozzle which produces an unbroken stream
- Produces a stream that is compact and has little shower or spray
- Has good reach
- Made to operate in a range of 40 – 60 psi with 50 psi being the accepted standard

85

Solid Stream

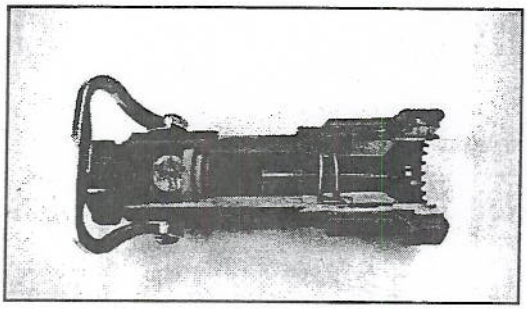
- Advantages
  - Greater reach
  - Greater penetration
  - Less likely to disturb normal thermal layering of heat and gases during interior attack
- Disadvantages
  - Set stream pattern
  - May not be used for foam application
  - Less heat absorption per gallon delivered
  - Must be fully opened to get full gpm/psi delivered

86

Combination Nozzle

- Produces a fog stream of fine water droplets
- Can be adjusted to different patterns
- The fog pattern is good for heat absorption
- Made to operate in a range of 50 – 100 psi
- Fixed gallonage
- Adjustable gallonage
- Automatic

87



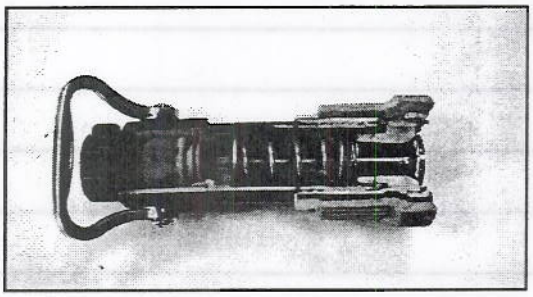
Combination Nozzle

Combination Nozzle

- Advantages
  - Discharge pattern may be adjusted
  - Gallonage may be adjusted
- Disadvantages
  - Does not have the reach or penetration power of solid streams
  - Fog stream is more susceptible to wind current
  - When improperly used during interior attack, can cause the spread of fire, create heat inversion and cause steam burns
  - Need to operate fully open to get full gpm/psi

Automatic Nozzles

- Combination nozzle with a sensing device that maintains a constant 100 psi
- May use slide valve or ball valve
- Automatic adjustable gallonage
- Requires minimum contact with pump operator
- Able to control nozzle reaction at the nozzle
- Handlines: 1-1/2" – 3" hose
  - 50 – 350 gpm (full range)
  - 60 – 200 gpm (mid range)



Automatic Nozzle

91

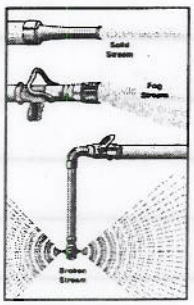
Automatic Nozzle

- Advantages
  - Nozzle operator has flow control
  - Consistent hard-hitting streams
  - Maintains optimum nozzle pressure at all times
  - Will adjust to the flow available
    - If flow is increased, the gpm's will automatically increase pressure
  - Will maintain maximum reach for available flow

92

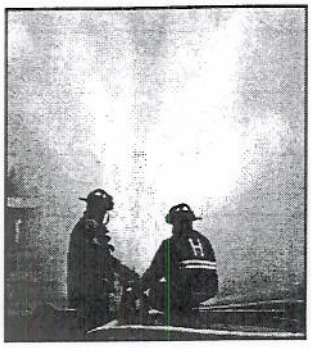
Broken Stream Nozzle

- Produces coarsely divided drops of water
- Good heat absorption
- Examples:
  - Piercing Nozzle
  - Water Curtain Nozzle
  - Bresnan Nozzle
  - Cellar Nozzle
  - Chimney Nozzle
  - Navy / Rockwood Nozzle



93

Master Stream Appliances



94

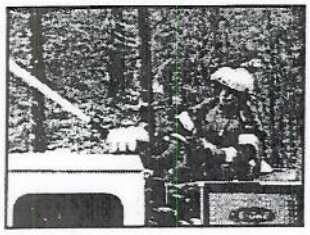
Master Stream Appliances

- Master streams are discharged from appliances using tips larger than 1-1/4"
- May be either solid stream or fog
- Solid tip master streams should be operated in a range of 60 – 80 psi
- Combination tip master streams are operated at 50 –100 psi
- Friction loss in master stream appliances starts at 10 psi
- The age of the appliance may require more psi with high flows at the tip

95

Master Stream Appliances

- Ladder Pipe
- Monitor
- Deck Gun
- Portable Unit



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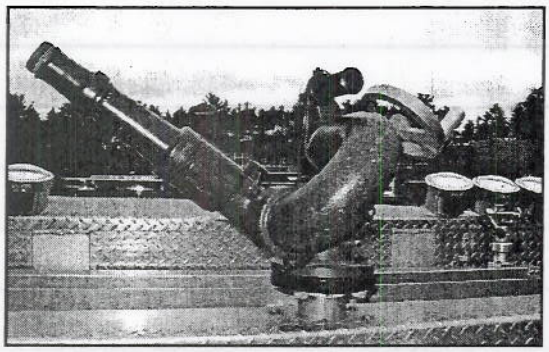
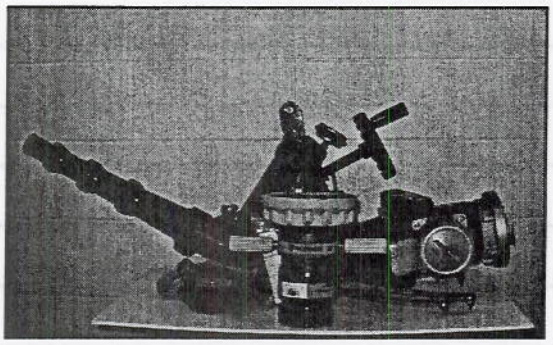


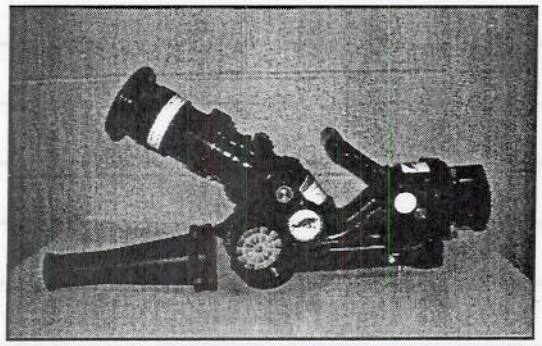
Monitor

97



Deck Gun

96



Portable Gun

95

Ladder Pipe

100

Pressures for Ladder Pipe Operations

- Nozzle Pressure
  - 80 or 100 psi
- Friction Loss in Gun and Siamese
  - 15 psi
- Friction Loss in 3" Hose
  - Based on size of tip or model of combination nozzle
- Friction Loss due to Elevation
- Friction Loss in Supply Line

101

See manufacturer's recommendations regarding limitations

Check manufacturer's specifications regarding the tip weight capacity of the aerial

102

NFPA 1901
Section 20.G.2

- Ladder pipe with tip sizes 1-1/4" (400 gpm), 1-3/8" (500 gpm) and 1-1/2" (600 gpm) can be attached to the aerial
- Sufficient lengths of 3" or larger attack hose complying with Standard 1961 to reach between the installed ladder pipe and the ground with at least 10' of hose available on the ground with the ladder at full extension
- One hose strap for each ladder section
- Halyards to control the ladder pipe from ground level

103

Ladder Pipe Operation Safety

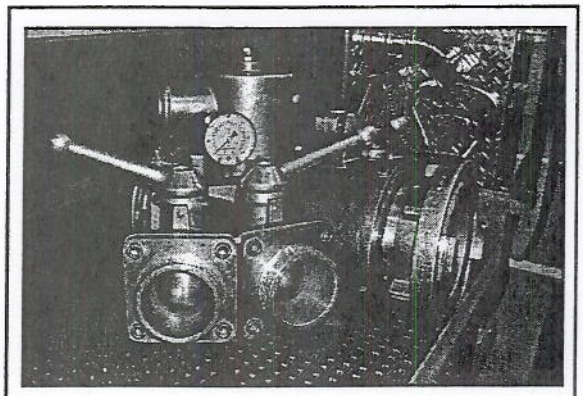
- 80 – 80 – 80 Rule
- Make sure ladder pipe and handle are securely locked
- No firefighters on the ladder
- Water on and off slowly to prevent water hammer
- Do not use guy wires to avoid twisting
- Never attempt t move the vehicle with the ladder pipe operating
- Watch ground around outriggers
- Check hydraulic system for overheating

104

Ball Distributor Valve

- Used with Large Diameter Hose
- Also called portable hydrant or manifold
- Principle is same as a wye appliance
- Generally have a 4" or 5" inlet with 2 or more 2-1/2" outlets
- May also be an outlet that is same size as the inlet

105

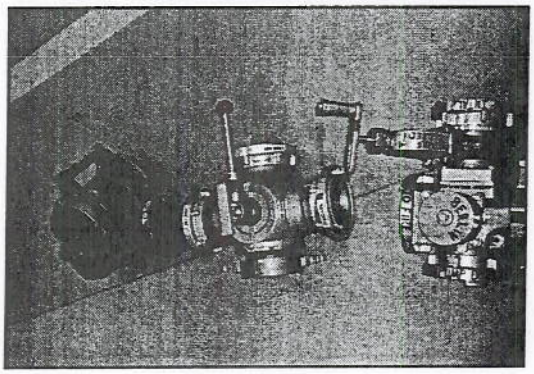


106

Hydrant Assist Valve

- Makes pumping the LDH line accessible and does not require the shutdown of the hydrant in order to set the pump
- With these valves there is no stoppage of water flow

107

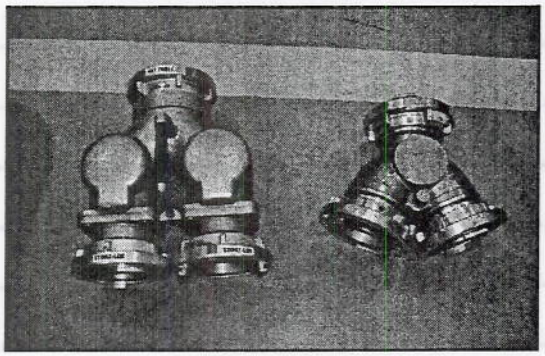


108

Wyes and Siamese Valves

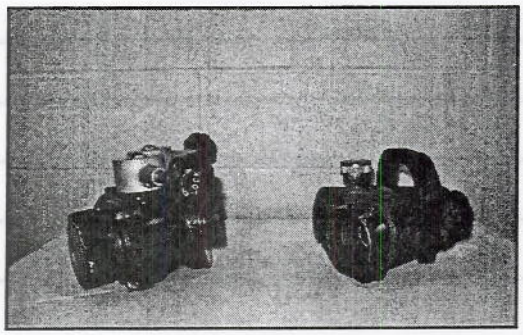
- Wye
  - Divides one or more lines
  - Has one female and two or more male connections
  - Used to divide a larger line into smaller lines
- Siamese
  - Combines two or more lines into one line
  - Has one male and two or more female connections
  - Used to combine several smaller lines into one larger one to supply a ladder pipe or ground gun

109



LDH Siamese

110



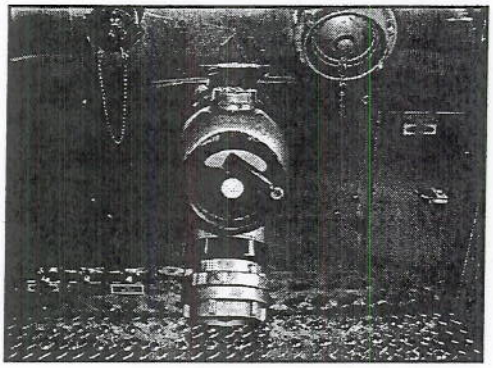
2-1/2" Siamese

111

Gated Incoming Relief Valves

- Designed to release all air coming into the pump from LDH
  - Must be opened manually
- Should be left open when the pumper is put back in service
- Newer type are self-closing
  - Paddle wheel closes the bleeder valve
- Female end comes in 4", 4-1/2", 5" or 6"
- Storz side comes in 4", 5" or 6"
- Older type pressure relief is on the pump side, not the hose side

112



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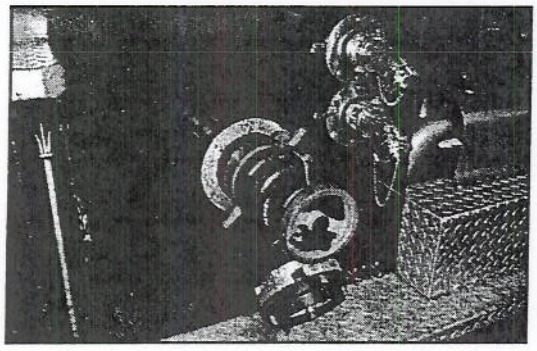

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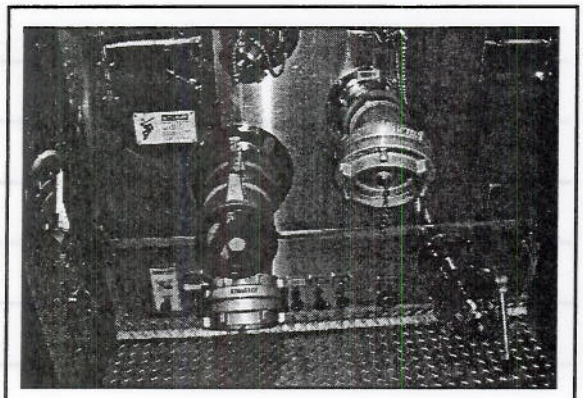
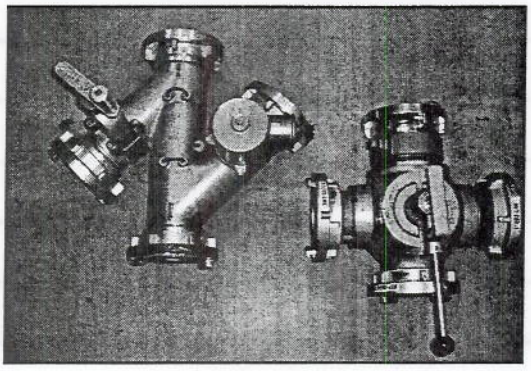


115

Relay Valves

- Z-Valve
- LDH inlet and outlet with 1 gated LDH valve and 1 clapper valve
- Used to increase the pressure in a long LDH relay
- Adapter to convert a Harrington hydrant assist valve into a relay valve

116



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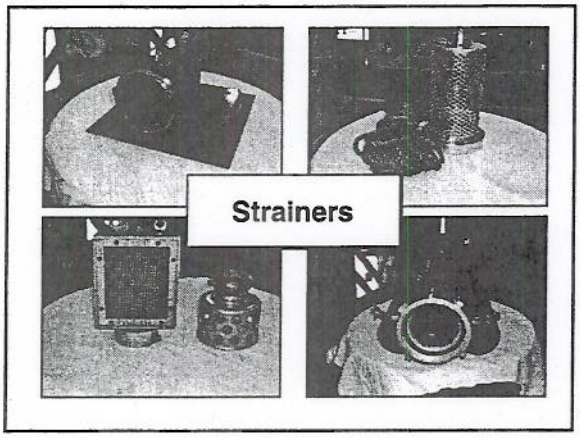
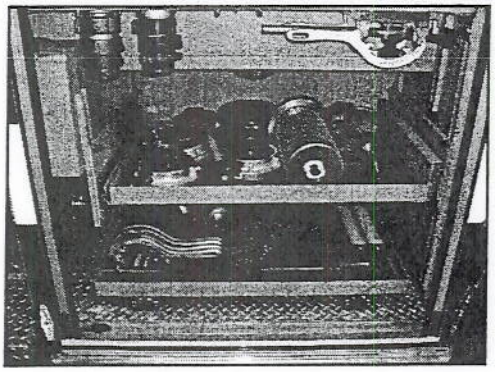


Adapters

NPT / NST 1-1/2"	2-1/2" Double Male
2-1/2" NST / Storz	2-1/2" Double Female
4" x 5" Storz	5" Double Female
6" Female x Storz	6" Double Female
2-1/2" Female x 1-1/2" Male	5" Female x 2-1/2" NST
2-1/2" NST to 3" NST	6" Female x 2-1/2" NST
1-1/2" Double Male	Cam Lock Male / Male NST
1-1/2" Double Female	Cam Lock Female / Female NST

119



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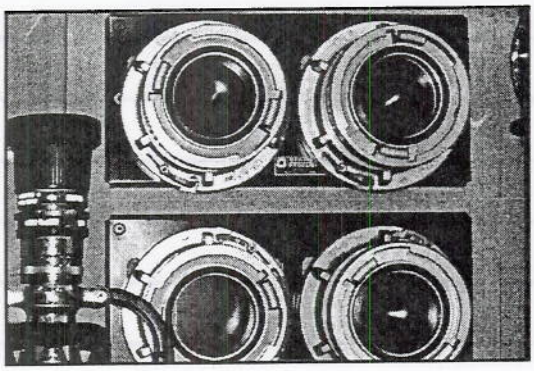
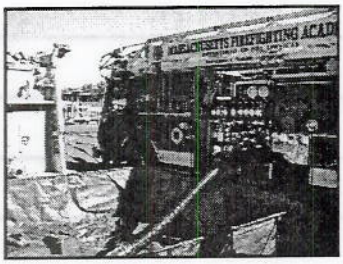


121

Drafting



122

Static Water Sources

- May be limited in total volume
- Limited by pump capacity and lift
- Class A Ratings
  - 100% @ 150 psi
  - 70% @ 200 psi
  - 50% @ 250 psi
    - Test performed at draft with no more than 10' lift
    - Test performed with 20' of hard suction

123

Limitations in Hard Suction

Flow capability 1000 gpm pumper
20' – 30' suction hose @ 150 psi net

4'	1160 gpm	1345 gpm
10'	1000 gpm	1170 gpm
16'	790 gpm	960 gpm
22'	485 gpm	590 gpm

124

Atmospheric Pressure

- Maximum Theoretical Lift
  - 14.7 psi
  - 2.3 ft / psi
  - 33.9 ft
- Maximum Actual Lift
  - 25 ft

125

Effect of Altitude

1000'	1.22'
2000'	2.38'
3000'	3.50'
4000'	4.75'

126

Priming Requirements

- Must raise water 10' through 20' of hard suction in not more than 30 seconds
  - 45 seconds for pumps 1500 gpm or larger
- Must develop 22 inches of mercury up to an elevation of 1000' above sea level
- Pump must hold vacuum for at least 10 minutes with a loss of not more than 10 inches of Hg

127

Types of Priming Devices

- Rotary (Positive Displacement)
- Engine Manifold – Gas Motors
- Exhaust Ejector – Portable Pumps

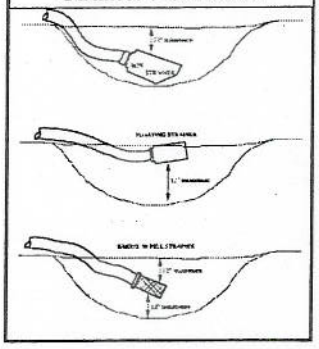
128

Drafting Procedure

- Spot the truck
- Connect the hard suction
  - 12" off the bottom and from the surface
- Close all drains and discharges
- Prime until a steady discharge or constant pressure reading
- If no prime, check drains, discharges and suction hose
- When primed, increase throttle and open discharges slowly

129

Strainer Placement



130

System Check
When Pump Will Not Draft

- Primer Operation
- All Suction Connections
  - Suction
  - Unused Inlets
  - Auxiliary Inlets
  - Tank Suction Valve
- All Discharge Connections
  - 2-1/2" Discharges
  - 1-1/2" Discharges
  - Booster
  - Tank Fill
  - Drains

131

Rural Water Supply is used in:

- Out of hydrant areas
  - Rural / city areas where there are no domestic supplies
  - Highways
- Water main failure
- Water mains insufficient for required flow

132

Rural water supply must be planned for:

- Target hazards
- Time of year
- Time of day
- Weather conditions
- Fill station access
- Placement of apparatus for continuous flow of shuttle vehicles

133

Shuttle Components

- Fire Scene (Dumpsite)
- Water Supply (Fill Station)
- Transportation

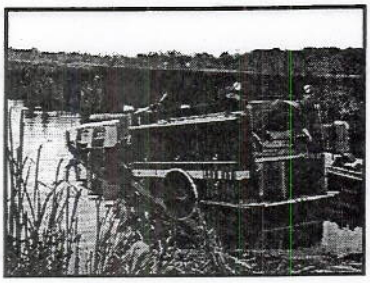
134

Dumping vs. Pumping

Pumping is the least effective method to off-load water due to:

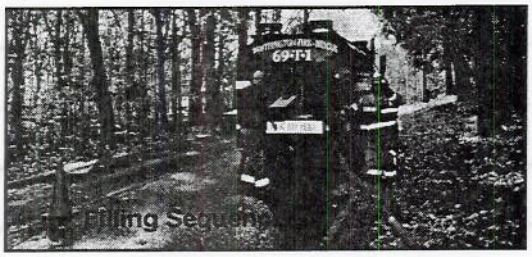
- Piping of pump determines flow
- Friction loss in hose
- Time to set up pump
- Manpower

135



Way NOT to Fill a Tanker

128



Filling Sequence

- Fill crew attaches line to tanker and holds valve on tanker open
- Signal pump operator to fill
- Pump operator throttles up for maximum fill
- When tank is full, pump shuts down first, then tank valve is closed and the line is disconnected
- Fill crew signals for tanker to leave

Apparatus at Draft

- If the pump that is going to the draft site stops at the fire to drop its tanks, it should leave a quarter of a tank on board for priming
- Position apparatus for drafting
- Remember to leave room for traffic flow
- Utilize dry hydrants if known and accessible
- Utilize floating strainers to minimize the whirlpool effect in shallow water

141

Tankers / Tenders:

- Have large discharge valves (6" – 12")
- Discharge rates of 800 – 1500 gpm
- Average fill time for tanker is 3 minutes
- Most tankers use big lines to fill
- Pressure / vacuum tankers – fill and empty by themselves

136

Water Hammer

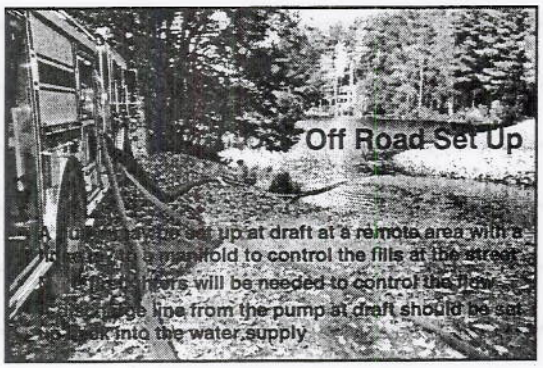
- Open and close all valves **S-L-O-W-L-Y**
- Fill crew holds intake valve at tanker in the open position and holds it open during filling operations. This valve is not shut down until after the supply pump has shut down
- One pump fills one tanker at a time.
- Multiple stations can be set up

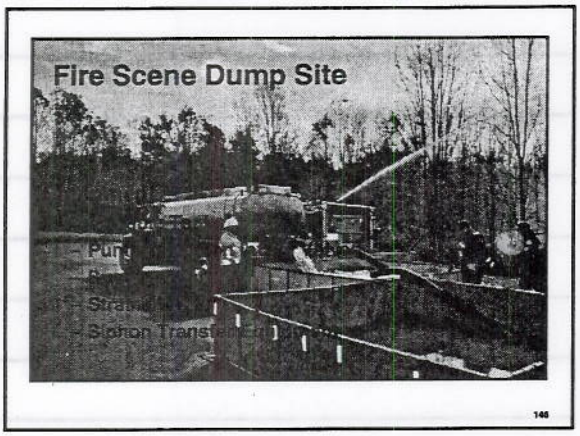
137

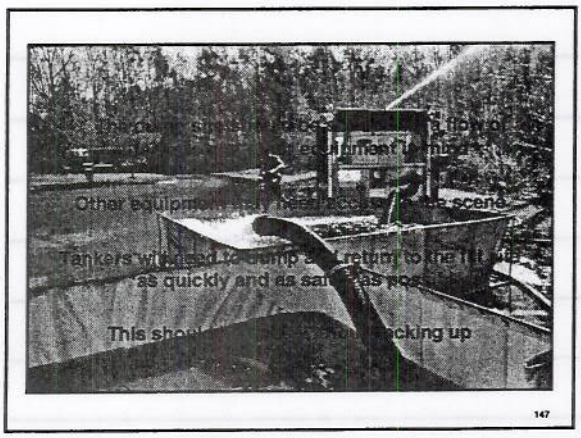
Ways to Fill a Tanker

- Drafting
- Hydrant Direct
- Apparatus at a Hydrant
- Vacuum Tanker

138


Off Road Set Up
set up at draft at a remote area with a
manifold to control the fills at the street
ers will be needed to control the flow
e line from the pump at draft should be set
into the water supply
145


Fire Scene Dump Site
148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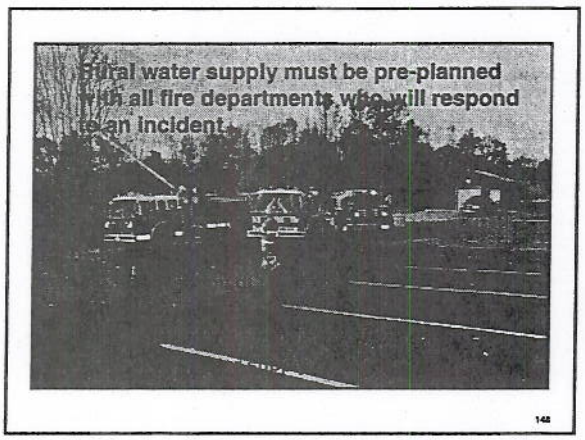

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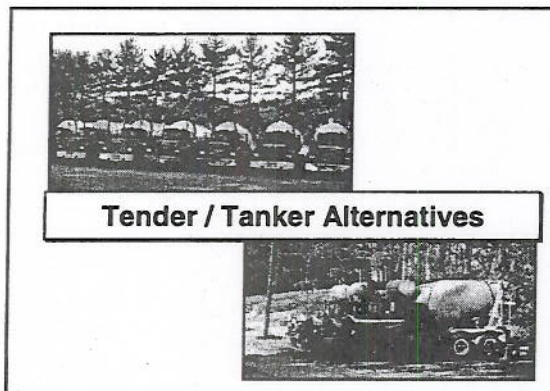

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For more information, contact:

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