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TYPE 1 ENGINE OPERATIONS (1.1)

Developed by Engineers
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- NFPA 1002 Standard on Fire Apparatus Driver/Operator Professional Qualifications
- IFSTA Driver/Operator Handbook, 2nd Edition

TASK SKILL DESCRIPTION AND DETAIL

This training chapter is intended to create consistency for operations of Type 1 Fire Engines. It is NOT intended to replace education, training and experience of engineering and hydraulic principals related to Type 1 pumping operations.

This Training Chapter is broken into 5 sections related to Type 1 Engine Operations:

Section A: 1st Due Pump Operations (*Getting the initial handline into service*)
Section B: Pump Boss & D-Deck Operations
Section C: Hydrant Operations (Establishing Water Supply)
Section D: Drafting Operations (Establishing Water Supply)
Section E: Troubleshooting Procedures

Section A: 1st Due Pump Operations (Getting the initial line into service).

Placing the apparatus fire pump into service and charging the initial fire attack hoseline is critical to the overall fire scene and an essential priority for the 1st Due Engineer. The hoseline selected for deployment and fire attack will be situation dependent on the location, size, water supply and exposures of the fire incident. This section is not meant to be all inclusive for every LFRA's Type 1 Apparatus pump. It is however designed to be a guide for personnel to be able to use as a reference for initial pump operations for fire attack on LFRA's Type I Engines.

Once the apparatus arrives on scene and a location is determined for apparatus placement, the below sequence should be followed to place the apparatus pump into service for initial fire attack.

Placing the Apparatus Fire Pump into Operation:

Automatic Pump Shift:

- Place the apparatus in neutral.
- Set the apparatus parking air brake.
- While your foot is on the apparatus brake, place the pump into gear by operating the pump shift control and switching it down to the "Pump" position.

- Place the apparatus into Drive by pushing the “D” on the push button transmission selector.
- At this point if the pump has engaged, you should be able to hear a change in the engine, the speedometer should increase to 10-15 mph and the “Okay to Pump” & “Pump Engaged” lights should be illuminated next to the pump shift, indicating the pump is operational. You may now exit the cab.
- After exiting the cab, go to the pump panel. Pull the “Tank to Pump” valve all the way open.

- Open your “Pump Cooler” and “Heat Exchanger” (If applicable) valves to help keep the pump cool or warm.

- Place your wheel chocks on the rear DO side tire.

- The apparatus pump should now be ready to supply a handline with water.

Manual Pump Shift:

- Place the apparatus in neutral.
- Set the apparatus parking air brake.
- While your foot is on the apparatus brake, operate the pump shift control and switch it down to the “Neutral” position.
- Exit the cab; find the manual pump shift lever on the pump panel (usually near the bottom).

- Pull the manual pump shift lever.

- Enter the cab; place your foot on the brake and place the pump all of the way into gear by operating the pump shift control and switching it down to the “Pump” position.

- Place the apparatus into Drive by pushing the “D” on the push button transmission selector.
- At this point if the pump has engaged, you should be able to hear a change in the engine, the speedometer should increase to 10-15 mph and the “Okay to Pump” & “Pump Engaged” lights should be illuminated next to the pump shift, indicating the pump is operational. You may now exit the cab.
- After exiting the cab, go to the pump panel. Pull the “Tank to Pump” valve all the way open.
- Open your “Pump Cooler” and “Heat Exchanger” (If applicable) valves to help keep the pump cool.
- Place your wheel chocks on the rear DO side tire.
- The apparatus pump should now be ready to supply a handline with water.

Charging the initial handline for Fire Attack:

- Once the firefighter has selected the initial handline for fire attack, assist in clearing the hosebed and flaking out the hoseline.
- Go back to the pump panel and be prepared to open the valve to the hoseline that has been selected.
- Before opening the desired valve, turn on the Foam Pro System (if equipped). Engaging the system will allow foam to flow to the end of the line upon charging the line for fire attack.

- Await the signal (visual or radio) that the firefighter is ready for water.
- Once the signal is received, open the valve to the selected handline all of the way but slowly to reduce the potential of water hammer or the firefighter losing the handline.

- Select the required pressure for the line by first utilizing the pump chart and then throttling up the Pump Boss or D-Deck to the required operating pressure. (Refer to Pump Boss & D-Deck Operations section). At this point the line will be bled by the firefighter and it may take a few seconds to stabilize the pressure of the handline.

- The hoseline should now be operational for fire attack.

***Disengaging the Fire Pump and Returning the Apparatus to Service:**

- Once the Incident is over, first throttle down the Pump Boss/D-Deck to idle.
- Slowly close the hoseline valves that are open to help prevent water hammer.
- Open the bleeder valves associated with the handlines that were in operation to bleed the lines.
- Close the "Tank to Pump" valve.
- Close the "Heater Exchanger" and "Pump Cooler" valves.
- Enter the cab and place your foot on the brake.
- Place the apparatus into Neutral by pushing the "N" on the push button transmission selector.
- Take the pump out of gear by operating the pump shift control and switching it up to the "Neutral" position first, wait 5 seconds and then switch the pump shift control all the way up to the "Road" position. Doing this slowly, helps insure that the drive axle is appropriately engaged.
- Both the "Ok to Pump" and "Pump Engaged" lights should now be turned off on the pump shift control, indicating the apparatus is now ready to drive.
- Remove the wheel chocks and stow before moving the apparatus.
- The apparatus is now ready to drive.
  Filling the onboard water tank is discussed under the Hydrant Operations Section but must be completed before the apparatus is officially put back into service.

Section B: Pump Boss & D-Deck Operations
Pressure Governors

Pressure governors regulate engine pressure by adjusting engine rpm to compensate for attack lines being opened or shut. With modern electronically controlled engines, the pressure governor throttles the engine to speed up or down to maintain the pressure set by the operator. This prevents an excessive amount of pressure being transferred to another line. As pump operators it is important to understand how to operate and troubleshoot pressure governors.

- Pressure governors must be set while pumping the desired pressure.
- Must be set at highest pressure necessary (gate back other lines)
- Pressure governors provide cavitation protection.
- If the pressure governor senses an increase in rpm without a corresponding increase in pressure, the engine will return to idle after 3-5 seconds.
- Engine RPM's will fluctuate as lines are opened or closed.

Pump Boss

The Pump Boss pressure governor combines full engine status displays including check and stop engine indicators, RPM, oil pressure, temperature, and battery voltage while providing control in both pressure and RPM modes of operation.

Controls

Control Knob

The control knob is used to adjust pressure and RPM settings. The governor senses how fast and in what direction the control knob is rotated and sends a signal to the Electronic Control Module to increase or decrease the engine RPM proportionally.

- Rotate the control knob clockwise to increase engine RPM
- Rotate the control knob counterclockwise to decrease engine RPM
- Press the red idle button to immediately return the engine to idle.

If the control knob is rotated quickly; the engine RPM changes quickly.
If the Control knob is rotated slowly; the engine RPM changes slowly.

Pressure Mode Operation

In the pressure mode of operation the governor maintains a constant discharge pressure within system capabilities. It adjusts the engine RPM automatically to compensate for variations in pressure.

- Press “Pressure” button to select pressure mode, by doing so the pressure light will turn on.
- Press the preset button or turn control knob to desired pressure setting.
- When pumping operation is complete rotate control knob counterclockwise or press idle button.

RPM Mode Operation

In the RPM mode of operation the governor maintains a constant engine RPM. The pump discharge pressure can vary but, as a safety feature, the governor limits the increase in pressure to 30 PSI over the last established PSI value. As the discharge pressure approaches this limit, the

governor lowers the RPM to prevent a high surge in pressure. The RPM LED light blinks as the governor sets a lower RPM which becomes the new operating RPM setting.

- Press “RPM” button to select RPM mode, the RPM light will illuminate.
- Press the preset button or turn control knob to desired engine RPM.
- When pumping operation is complete rotate control knob counterclockwise or press idle button.

Switching Between Operating Modes

- There is no variation in discharge pressure or RPM’s when changing between pressure or RPM modes.
- When the engine is at idle; changing between modes will happen immediately.
- When switching from pressure to RPM during pumping operations, the RPM button needs to be pressed and held for 3 seconds before it will switch. This is to prevent any accidental change-overs during pumping operations. (This is the same as switching from RPM to pressure.)

Detroit Diesel Fire Commander

Controls

- The **MODE** switch selects the desired operating mode of the governor.
- The **INC** switch is used to gradually increase the speed of the engine.
- The **DEC** switch is used to gradually decrease the speed of the engine.
- The **IDLE** switch is used to instantly bring the engine to idle rpm.
- The **PRESET** switch is used to instantly bring the engine to a pre-programmed rpm in the RPM mode, or to a preprogrammed pump pressure in the PRESSURE mode.
- The **MENU** switch is to be used only by qualified service personnel when installing the governor.
- When illuminated, the **RPM** LED indicates that the RPM mode is active.
- When illuminated, the **PRESSURE** LED indicates that the PRESSURE mode is active.
- When illuminated, the **PUMP ENGAGED** LED indicates that the road-to-pump shift has been completed.
- When illuminated, the **OKAY TO PLMP** LED indicates that the road transmission has been placed in pump gear and the pump is in operation.
- When illuminated, the **THROTTLE READY** LED indicates that the throttle control interlock is active.
- **ENGLISH/METRIC LED** selects the units of measure indicated in the INFORMATION CENTER and ENGINE DATA displays. This selection is programmed by the technician installing the EFC. Engine RPM, Battery Voltage, Engine Oil Pressure, and Engine Coolant Temperature are displayed digitally in the ENGINE DATA portion of the EFC control panel.
- Messages are displayed in this **INFORMATION CENTER DIGITAL DISPLAY WINDOW** regarding the operating status of the EFC as well as displaying any problems with the apparatus such as low voltage, low oil pressure, overheated engine, etc. In addition, when a problem occurs with the mechanical or electrical systems of the apparatus which require immediate attention, the EFC will sound a loud audible warning to alert the pump operator.

Section C: Hydrant Operations

Properly securing an uninterrupted water supply with the attack Type 1 Engine is essential to help support all fire ground operations. Having a water supply allows Engine companies to actively engage the fire for extended periods of time if necessary and provide the correct GPM to fully extinguish and control a fire incident. Engineers must be proficient in the basic skill of securing a water supply from a pressurized water source such as a fire hydrant in order to facilitate an efficient incident operation.

Connecting the Apparatus to a Hydrant after laying into the Incident: (Refer to Municipal Water Supply Training Manual Chapter for connecting LDH to a Hydrant, Forward Lays, Reverse Lays and Relays).

- Once the Apparatus has laid into the Incident scene with a dry supply line from the hydrant, place the apparatus correctly for fire attack.
- Place the Apparatus fire pump in gear.
- After exiting the cab, go to the pump panel. Pull the “Tank to Pump” valve all the way open.
- Open your “Pump Cooler” and “Heat Exchanger” (If applicable) valves to help keep the pump cool.
- Chock the wheels.
- Break the LDH at the nearest coupling that will allow for connection to the Apparatus LDH Intake.
- Connect the LDH to the Master Intake on the Officer’s side of the apparatus if possible, this is for safety in the event the LDH burst off of the pressurized source.
- Open the Master intake bleeder valve to bleed the air from the line once the LDH is charged.

- Communicate with the Firefighter at the hydrant to charge the LDH.
- Once the LDH is charged and the air is bled from the line and water is flowing through the bleeder valve, close the Master intake bleeder valve.

- Open the Master intake valve slowly or if an electronic valve is present, push the button selector once to open the valve fully (ensure the valve has fully opened).

- As the Master Intake is being opened, ensure that there is not an incoming pressure surge of 30 psi or greater on any lines that are being flowed at the time of hydrant change-over by watching the pressure gauge on the monitored line and gating back that valve if needed.

- Once the change-over is complete, close the “Tank to Pump” valve, note your residual intake pressure and then crack open your “Tank Fill” valve to refill the on-board tank if water has been flowing from the apparatus.

- Notify the IC or Fire Attack Group Sup (if established) and inform them that water supply is established.

- Once the on-board apparatus tank is filled, close your “Tank Fill” valve.

- Continue to monitor the apparatus pump and water supply for any changes and adjust accordingly.

Obtaining your own water supply as an Engineer via connecting to a hydrant: (Within 100’ of apparatus)

- Place the apparatus correctly for fire attack.
- Place the Apparatus fire pump in gear.
- After exiting the cab, go to the pump panel. Pull the “Tank to Pump” valve all the way open.
- Open your “Pump Cooler” and “Heat Exchanger” (If applicable) valves to help keep the pump cool.
- Chock the wheels.
- Charge the initial attack lines and set the appropriate pressures.
- If the decision has been made to get a water supply as the Engineer (**Within 100’ of apparatus**), take the needed amount of LDH to the Hydrant.

- Make the connection to the hydrant.

- Connect the LDH to the Master Intake (if not already pre-connected) on the Officers side if possible.

- Open the Master intake bleeder valve to bleed the air from the line once the LDH is charged.

- Charge the LDH from the hydrant.

- Once the LDH is charged and the air is bled from the line and water is flowing through the bleeder valve, close the Master intake bleeder valve.

- Open the Master intake valve slowly (if an electronic valve is present, push the button selector once to open the valve completely, *a green light should illuminate*) to help prevent water hammer and pressure surges into the apparatus pump.

- As the Master Intake is being opened, ensure that there is not an incoming pressure surge of 30 psi or greater on any lines that are being flowed by watching the pressure gauge on the monitored line and gating back that valve if necessary.

- Once the change-over is complete, close the “Tank to Pump” valve, note your residual intake pressure and then crack open your “Tank Fill” valve to refill the on-board tank if water has been flowing from the apparatus.

- Notify the IC or Fire Attack Group Sup (if established) and inform them that water supply is established.
- Once the on-board apparatus tank is filled, close your “Tank Fill” valve.

- Continue to monitor the apparatus pump and water supply for any changes and adjust accordingly.

Section D: Drafting Operations

When selecting a drafting site, setting up the site, and connecting to the pump refer to the Rural Water Supply training manual page V:\Fire\Training\LFR Training Materials\LFR Training Manual\Training Manual Finalized Documents\Engine Company Operations\Water Supply Operations - Rural.docx

Put the pump into operation

- If the pump is a 2 stage pump switch it to *VOLUME* (Figure 1)
- Make sure all drains and valves are closed before priming the pump
- Set engine RPM's between 1000 and 1200 RPM
- Once the pump is operational and everything is hooked up properly, open the intake valve and prime the pump using the primer (Figure 2)
- Typically the priming process takes between 10 and 15 seconds.
    - If priming is unsuccessful or it takes more than 30 seconds check for air leaks.
        - Drains valves, bypass or cooling valves, and couplings are common areas for air leaks.
        - Check for insufficient priming fluid in the reservoir.
        - Engine speed may be too low.
        - Lift is too high.
        - A high point in the intake hose is creating an air pocket.

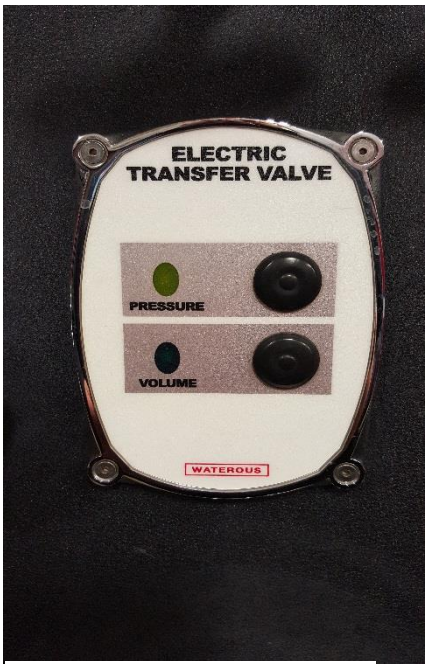

Figure 1

- After successfully getting a prime
    - You will hear a change in the sound of the primer
    - You will see the negative pressure reading on the intake pressure gauge
- Increase the RPM's so that the pressure output is between 50 and 100psi
- Slowly open discharge valves to ensure that no air enters the pump and causes it to loose prime, if the output pressure drops below 50 psi pause and wait for it to equalize before continuing or increase the RPM's to compensate for the drop.

- If hose lines are not ready to be charged a booster line can be opened to discharge back into the water source.
- It's important to keep water flowing through the pump to ensure the pump doesn't overheat and that the prime isn't lost.
- If the priming device fails, it is possible to obtain a prime using the tank water flowing through a hose line to create a venturi in the pump and draw the static water into the pump.

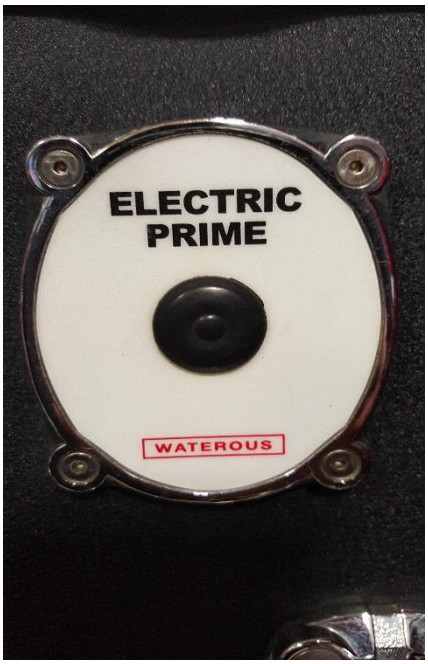

Figure 2

Operating the pump from a draft

- Demands careful monitoring of the gauges associated with the engine as well as the pump.
- Ensuring the engine is not overheating
- Pressures are staying consistent (fluctuating pressures can be a result of air
- Continuously monitor the strainer and intake hoses
- Ensure they are not drawing air into the pump because the water is creating a whirlpool.
- If you notice a gradual increase in the vacuum with no changes in flow; there may be a blockage developing in the strainer.
- Utilize the booster line to spray at the strainer and keep debris away.

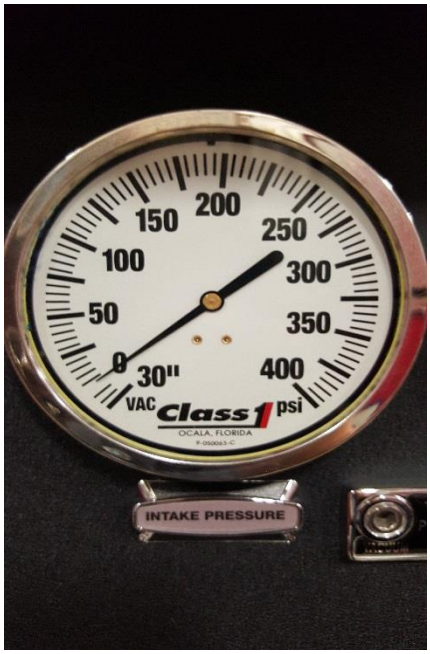

Figure 3

Shutting down the operation

- Slowly decrease RPM's to an idle
- Close discharge and intake valves
- Take the pump out of gear
- Unhook all intake and discharge hoses
- Drain pump and flush with copious amounts of fresh clean water
- Operate primer with fresh clean water

Section E: Troubleshooting Procedures

Pump Troubleshooting

- **Pump won't engage**
  - Check the Transmission range (ensure that its transferred to drive)
  - Low Air Pressure or Voltage (Check gauges)
  - Park Brake not Engaged
  - Transmission did not shift (try Drive – Reverse – Drive, to help shifting into pump)
  - Manually engage the pump

- **Low pressure output**
  - Make sure the transmission went into 4th gear
  - Poor water supply
  - Defective gauge (verify the output pressure with another gauge)
  - Check the Pressure/Volume position (make sure it's in one or the other, not in-between)
  - Pull the Primer to ensure air has evacuated the pump.

- **Engine won't throttle up with electric governor**
  - Ensure "OK to Pump" light is on
  - If in "pressure" mode switch to RPM (if there's a problem with the pressure sensor "pressure" mode will not function)
  - Check water supply (if governor senses cavitation, it will limit throttle)
  - If pressure isn't above 100psi at 1000rpm, the governor assumes there is insufficient water and returns to idle
  - Pull the Primer to ensure air has evacuated the pump.

TASK SKILL INSTRUCTIONAL REQUIREMENTS AND IMPLEMENTATION

- Minimum of gloves and helmets when instructing and participating in training.

REFERENCE INFORMATION

- IFSTA Pumping Apparatus Driver/Operator Handbook 2nd Edition