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Introduction

The intent of this manual is to provide a foundation from which all Driver Operators should work and reference. This condensed and comprehensive guide addresses many subjects associated with fire service hydraulics and pumping apparatus. Additional resources can be found in the following publications:

• IFSTA Pumping Apparatus, Driver/Operator Handbook
• NFPA 1002, Standard for Fire Apparatus Driver/Operator Professional Qualifications
• NFPA 1901, Standard for Automotive Fire Apparatus
• NFPA 1906, Standard for Wildland Fire Apparatus
• NFPA 1911, Standard for Service Tests of Fire Pumps on Fire Apparatus
• NFPA 24, Private Fire Service Mains and their Appurtenances (Hydrants)
• NFPA 1142, Dry Hydrants

One of the best qualities a Driver Operator (DO) can possess is common sense. Being able to think fast and calculate accurately, knowing the abilities and limitations of your apparatus, knowing how to troubleshoot your equipment, and being able to improvise are all desirable traits of a DO. Remember when something won’t start, flow, pump, or isn’t there your crew will be coming to you for help. It is essential that you as the DO, know what is carried on the apparatus, how it works, and how to troubleshoot any problems. Making the right decisions will keep you from having to justify your actions.
Driver Operator Manual

Chapter 1

Apparatus Positioning & EVOC
Section 1

Introduction

Each year approximately 22% of all firefighter injuries and deaths are caused by vehicle collisions while responding to or returning from emergency calls. Some of the reasons for these accidents include: excessive speed, unfamiliarity with the apparatus and lack of a driver training program.

The first goal of the DO is to get the apparatus and crew to the scene in an expedient, safe and efficient manner. Every DO must be familiar with the State and Departmental laws/polices governing the operation of emergency vehicles. Additionally, the concepts of defensive driving, including: evasive tactics, anticipating other driver’s actions, braking and reaction times, and weight transfer must be understood.

Gross Vehicle Weights
The vehicle weights for apparatus on the Menomonee Falls Fire Department fully loaded with equipment and crew are:

<table>
<thead>
<tr>
<th>Unit #</th>
<th>Fleet #</th>
<th>Color Code</th>
<th>Year Make/Model</th>
<th>GVWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2761</td>
<td>420</td>
<td>White</td>
<td>2006 Pierce Saber Engine</td>
<td>40,000lbs</td>
</tr>
<tr>
<td>2762</td>
<td>1127</td>
<td>Orange</td>
<td>2020 Pierce Enforcer Engine</td>
<td>50,000lbs</td>
</tr>
<tr>
<td>2763</td>
<td>1111</td>
<td>Purple</td>
<td>1995 HME Engine</td>
<td>43,000lbs</td>
</tr>
<tr>
<td>2764</td>
<td>421</td>
<td>Burgundy</td>
<td>2016 Pierce Arrow XT Engine</td>
<td>50,000lbs</td>
</tr>
<tr>
<td>2765</td>
<td>427</td>
<td>Black</td>
<td>2002 Pierce Saber Engine</td>
<td>40,000lbs</td>
</tr>
<tr>
<td>277?</td>
<td>1132</td>
<td>Red</td>
<td>2020 Pierce Arrow XT Platform</td>
<td>82,000lbs</td>
</tr>
<tr>
<td>2791</td>
<td>428</td>
<td>Silver</td>
<td>2004 US Tanker Tender</td>
<td>66,000lbs</td>
</tr>
</tbody>
</table>

Keep in mind when driving these vehicles that they are extremely heavy and do not handle or stop as fast as the privately owned vehicle you drive.

Apparatus Positioning on or Near Roadways
The following recommendations regarding positioning of apparatus on or near roadways should be followed per SOG S1002.02. Placement can be affected by weather, time of day, scene lighting, traffic speed and volume, hills, curves and other obstructions. If police have not yet arrived, first control oncoming vehicular traffic before addressing the emergency. Remember that smoke generated by fires can dramatically decrease visibility.
General Roadway Incident Safety Rules:

• Limit your on-scene exposure time to what is required to complete the assignment.
• Never trust traffic! Be aware of your surroundings! Never turn your back on traffic.
• Use apparatus, directional warning bar, emergency and scene lighting, safety cones, flares and law enforcement personnel to gain control of the traffic.

Transition area: An area where traffic is moved from the normal lanes of traffic.

• Speeds less than 40 mph – 100 ft.
• Speeds greater than 40 mph – 200 ft.

Buffer area: An area that provides a recovery area for errant vehicles and protects emergency responders.

• Speeds less than 40 mph – 50 ft.
• Speeds greater than 40 mph – 100 ft.

Incident area – An area containing the incident and emergency workers.

Termination area – Area where traffic is allowed to return to its normal lanes.

• Deploy floodlights to light the work area while not blinding other drivers.
• Personnel working around traffic shall wear department approved traffic safety vests. For added visibility and safety, don traffic vest over your bunker coat.
• Whenever possible, appoint a safety officer to be responsible for the safety of the work zone and the emergency responders.

General Driving and Operating Safety Guidelines:

When two or more emergency vehicles are traveling “Emergency” together in the same direction, maintain a separation distance of at least 300 feet.

• Do Not pass another emergency vehicle that is responding “Emergency” with you.
• Avoid passing on the right if at all possible.
• Keep doors and compartments closed when not in use. Practice “good housekeeping” when operating on scene.

**Fireground Positioning**

This section addresses the positioning of pumping apparatus for fire attack and water supply. Because the topic of positioning specialty apparatus (Quints, Tenders) can be complex, it will not be covered in this section, but is addressed in a separate class. Positioning of engines for relay operations or water shuttle operations is covered in “Water Sources”, Chapter 2 of this manual.

There is no one rule that applies to positioning of apparatus on the fireground. Rescue situations, water availability, apparatus exposure, method of attack, weather, terrain, positioning requirements of other apparatus, department SOG’s and tactical judgment are all deciding factors.

**General Fireground Positioning Guidelines:**

• Rescue is always the first priority on a fire scene. First arriving units must evaluate conditions and leave room for the quint if necessary. Position apparatus so tools, equipment or ladders can be quickly deployed to complete a rescue.
• Water supply may dictate positioning. The engine should be able to connect to a hydrant and pump attack lines while operating in a safe and effective manner.
• Method of fire attack can govern placement. Operating in the offensive mode will warrant keeping the engine close to the building to ensure the nozzle reaches the fire and tools and equipment are readily available to firefighters. A defensive operation may require the engine to be placed a greater distance from the building.
  • Collapse zone is 1½ times the height of the building.
• Wind direction is a consideration. When possible position the engine upwind on the windward side of the incident.
• Terrain can have a significant effect. Given the choice, always choose a paved surface over an unpaved surface.
• Relocation potential must be considered. Conditions may change for the worse and your apparatus may need to be moved.
• Apparatus that are not being used should be kept in the staging area out of the way so as to not interfere with fireground operations.
  • Position the apparatus so that its use is maximized.
• First due units set the stage for the remainder of the incident. Good initial placement will contribute to the successful outcome of the incident.
  • Generally, on residential alarms, the front of the building belongs to the Quint.
• Maintain access on the roadway for hose lines and later arriving vehicles.
• Stay clear of power lines that may fall and contact apparatus. Power lines should be given adequate clearance.
• Park at least 25’ from the rear of any apparatus to allow enough room to remove the ground ladders and equipment from the rear compartments.

In the event the DO experiences any mechanical problem while pumping the apparatus that requires the apparatus to be shut down, the DO shall immediately advise the IC of the situation.

**Backing of Apparatus**
Most accidents involving apparatus occur while backing. Whenever possible, drivers should avoid backing by planning their travel routes in advance. Because of the potential to cause damage, injuries and even death, we need to ensure that it is safe prior to backing an apparatus. Therefore, the following guidelines shall be followed in addition to those specified in Standard Operating Guideline S1006.01 regarding the backing of apparatus. Prior to the actual backing of any apparatus, there shall be at least one person deployed at the rear of the apparatus to assist the driver with the backup operation. The default place for this person to station themselves shall be to the rear of the apparatus being backed up, on the left (driver’s) side and in such a position that the backup person is not in the path of the apparatus (see diagram).
Both the driver and the backup person shall have eye-to-eye contact with each other via the left outside mirror of the apparatus. To ensure the driver can communicate with the backup person, the driver’s side window should be opened. If a portable radio is present, it shall also be used by the backup person in order that he/she will have a verbal communications link with the driver of the vehicle being backed. In EVERY backup situation, visual contact between the driver and the backup person shall be maintained. IF AT ANY TIME THE DRIVER LOSES VISUAL CONTACT WITH THE Backup PERSON the DRIVER SHALL STOP IMMEDIATELY. The apparatus will remain stopped until such a time that visual contact is restored.

When backing up an apparatus at night, the spotter should use a flashlight in a manner that allows the driver to see the spotter. Avoid shining the flashlight in the driver's eyes or mirror. When a backup person is not available, the driver shall perform a 360 degree walk around of the vehicle to be moved and visually check for any obstacles at or above ground level that the vehicle to be moved may hit. Such obstacles shall include, but are not limited to, people, animals, vehicles, furnishings, buildings, rocks, holes, ditches, trees, utilities and overhead obstructions, etc.

When backing any apparatus equipped with a back-up camera, do **not** use the camera, maintain eye contact with your back-up person and follow their directions. The camera should only be used in conjunction with the vehicle’s mirrors when a back-up person is not available.
Introduction

A DO needs to be able to obtain water from a variety of sources that may be available on or around the fireground. An adequate water supply is one of the most vital steps in ensuring a successful fireground operation. To deliver water for fireground operations, the DO has several options:

• Tank Supply
• Hydrant
• Static Water Source
• Dry Hydrant
• Relay Operation
• Water Shuttle
• Nurse Tender Operation
• Direct Pumping

Tank Supply

The amount of water available on an apparatus must be considered when making tactical decisions. Tank water on the fireground can quickly be depleted depending on the gpm being discharged. Apparatus on the Menomonee Falls Fire Department have the following water tank capacities:

• Engines 2761, 2763, and 2765 - 750 gallons, 2764 – 1000 gallons
• Quint - 300 gallons
• Brush Trucks - 300 gallons
• Tenders - 3,500 gallons

When operating solely from tank water, the DO needs to accurately calculate how much time is available to firefighting crews and notify them when the tank level is at 50% full and again at 25% full.

• Field tests have shown that an engine operating solely from its water tank can supply a typical 1¾” pre-connect continuously flowing 150 gpm for approximately 5 minutes. It is strongly suggested not to operate more than two pre-connects (100 gpm ea.) or one 2½” blitz line (200 gpm) unless connected to a secure water source.
• The truck operating from its water tank can provide a typical 1¾” pre-connect flowing 150 gpm water for a minimum of 2 minutes. It is strongly suggested not to operate this apparatus without being connected to a secure water source.
• It is strongly recommended not to operate a master stream unless connected to a secure water source.
• The FDC should not be supplied until a connection to a secure water source has been made.

Radio Designation

As a DO operating on scene, your radio designation is “Driver Engine – 2761”, and your officer would be “E-2761”, and firefighter would be “Firefighter Engine - 2761”.

Emergency Evacuation (SOG S1006.04)
When the IC announces an emergency evacuation, units on scene will blast their air horns intermittently 1 to 10 seconds blowing, followed by 1 to 10 seconds of silence for 50 seconds (this is consistent with the MFFD SOG for evacuation).

**Relay Pumping**

In some situations the water source is remote to the fire scene and in order to supply water to the fire, a relay operation must be established. Relay pumping involves pumping water through fire hose to at least one other engine. The engine receiving the water can either pump it to attack lines or pump it to another engine in the relay.

Any apparatus equipped with a fire pump can participate in the relay. The engine located at the water source is called the “source” engine, and the engine located on the scene is called the “attack” engine. Engines placed between the source and attack engines are referred to as “relay” engines. It is always best to position the largest capacity engine at the water source. When relaying water, laying dual 3” supply lines is preferred as this will reduce friction loss and will supply twice the volume of a single 3” line. When laying supply line(s) from the hydrant the maximum distance should not exceed 300’, otherwise a relay should be established by placing an engine at the hydrant. Whenever possible, a water supply officer should be appointed and a separate TAC channel for water supply should be established. Keep in mind you do not have to be an “officer” to be appointed as a water supply officer. Relaying water is an involved process and requires communication and coordination between all engines joining in the relay and the water supply officer. Of all the apparatus in the relay, only the water supply officer should communicate with the IC.

Prior to establishing a relay, consideration must be given to the volume of water needed on the scene and the distance from the water source to the scene. When operating in a relay, each engine must maintain at least 20 psi intake pressure. Pump discharge pressure (PDP) is equal to the sum of the friction loss in the 3” supply lines plus 20 psi residual pressures for the engine you are supplying. Once all apparatus are in place and hose connections are made, the relay can begin. All apparatus should have their intake bleeder valves open. The source engine begins by obtaining water and relaying to the next engine in line that is either a relay engine or an attack engine. When shutting down the relay operation, start by shutting down the attack engine first and working backward toward the water source.

**Water Shuttles**

A water shuttle operation is another means used to supply water to the fire scene. Water shuttles involve a process in which tenders or engines deliver their load of water to a portable dump tank at the scene, travel to a fill site, reload with water and return to the scene to dump again. Shuttles are generally used when relay pumping is not practical. When given a choice to relay pump or shuttle water, relay pumping proves to be a more dependable choice. As in all operations involving water supply, a water supply officer and a separate TAC channel should be provided. Recall, only the water supply officer communicates with the IC.
An effective water shuttle operation requires the use of two pumpers and at least two tenders or additional engines to shuttle water. In setting up a water shuttle, locate one engine at the fill site and one at the dump site. The best fill and dump sites are those located so the drivers of tenders can drive in a straight line without backing up or maneuvering.

**Fill Site Operations**

A fill site can be either a static water source or a hydrant. The purpose of the fill site operation is to reload the tenders or engines as expeditiously as possible. As the apparatus arrives at the fill site, they are directed by a spotter. The spotter will direct the apparatus into position so the tank can be filled from at least one 3” hose coming from the “fill” engine. A firefighter is assigned the task of a “make and break” person. His/her job is to fill the tank of the tender or engine as quickly as possible using one or more 3” lines from the fill engine. The driver of the tender or engine being filled should remain in the cab while the tank is filling. Once the tank is full, the hose lines are disconnected by the “make and break” person and the tender or engine pulls away and travels to the dump site and the process is repeated.

**Dump Site Operations**

The dump site consists of one or more portable tanks located at or near the emergency scene. As apparatus arrive at the dump site as directed by a spotter, they will be directed to dump their load into the portable tank. Tenders can empty their load in 3-4 minutes. Like at the fill site, the drivers of the tenders should remain inside the vehicle. An engine also located at the dump site drafts the water from the portable tank and relays it, either to an attack engine, or pumps it to its own attack lines. Portable tank(s) and the dump site engine should be positioned so easy access and egress is maintained for apparatus dumping into the portable water tank. Incidents that require flow rates in excess of 300 gpm are best served by multiple portable tanks. It is recommended that the dump site engine flow a booster line back into the portable tank to ensure the prime is not lost when discharge lines are shut down.

**Dump Site Operational Methods**

The following are three primary methods that can be used to operate a dump site:

- Nurse Tender Operations
- Direct Pumping Operations
• Portable Water Tank Operations

**Nurse Tender Operations**

This method involves a tender that parks immediately adjacent to the attack pumper. The attack pumper is supplied by a discharge line from the tender. The primary advantage of this method is that in many cases the nurse tender is so large that the fire is controlled before there is a need to refill the tank.

**Direct Pumping**

This type of operation is a method of relay pumping that involves two engines and/or tenders supplying an attack engine. As shown in the illustration, the attack engine lays a supply line going in on arrival. The next arriving engine and/or tender arriving shall connect a Siamese to the end of the supply line. The Siamese and attack engine are now being fed from that apparatus. Meanwhile, the second due engine arrives and connects to the open port on the Siamese and pumps in at half the pressure of the first engine.

As the first due engine runs out of water, the pressure will drop and the second due engine will take over and increase to the desired pump pressure. The empty engine disconnects and leaves to refill with water while another engine arrives in its place. This process can be repeated until the operation is discontinued.
Driver Operator Manual

Chapter 3

Fireground Hydraulics
Introduction

In addition to driving the fire apparatus to and from the emergency scene the DO is also responsible for operating its fire pump and possessing a thorough knowledge of all the tools and equipment carried onboard.

To produce effective fire streams, an extensive knowledge of hydraulics is essential. This chapter will help provide you with a system for developing effective fire streams and an understanding of fire stream management. An adequate supply of water delivered properly is essential for successful extinguishment. Any delay, or inadequate supply of water, will greatly jeopardize fireground operations.

Abbreviations

The following are common abbreviations that are used in hydraulics and throughout this manual:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Appliance Loss</td>
</tr>
<tr>
<td>EL</td>
<td>Elevation Loss/Gain</td>
</tr>
<tr>
<td>FL</td>
<td>Friction Loss</td>
</tr>
<tr>
<td>gpm</td>
<td>Gallons per Minute</td>
</tr>
<tr>
<td>NR</td>
<td>Nozzle Reaction</td>
</tr>
<tr>
<td>PDP</td>
<td>Pump Discharge Pressure</td>
</tr>
<tr>
<td>LDH</td>
<td>Large Diameter Hose</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>Diameter</td>
</tr>
<tr>
<td>FDC</td>
<td>Fire Department Connection</td>
</tr>
<tr>
<td>TPL</td>
<td>Total Pressure Loss</td>
</tr>
<tr>
<td>NP</td>
<td>Nozzle Pressure</td>
</tr>
<tr>
<td>psi</td>
<td>Pounds per Square Inch</td>
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<tr>
<td>Q</td>
<td>gpm/100’</td>
</tr>
<tr>
<td>L</td>
<td>Length/100’</td>
</tr>
</tbody>
</table>

Definitions of Terms

Driver Operators must understand the following definitions as they relate to fire service hydraulics:

• Appliance: Term applied to any wye, Siamese, deluge monitor, reducer, adaptor, fitting or other piece of hardware used in conjunction with fire hose for the purpose of delivering water.

• Back Pressure: Also known as “Head”. Pressure generated by the weight of a column of water above the pump. This is figured at .434 psi per foot of elevation.

• Discharge: The quantity of water issuing from an opening expressed in gallons per minute (gpm).
  - Drafting: The process of raising water from a static source to supply an engine.

• Elevation Pressure: Pressure that is gained or lost due to elevation (.434 psi rounded up to .5 psi per foot).

• Engine: Also known as a “Pumper”. The most basic type of fire apparatus consisting of a fire pump, water tank, and fire hose.

• Fire Department Connection: Device to which a pumper connects into to boost or supplement the water flow in a sprinkler or standpipe system.

• Flow Pressure: Pressure created by the rate of flow or velocity of water coming from a discharge opening (measured using a pitot gauge).
  - Force: A measurement of weight that is expressed in pounds.

• Friction Loss: Loss of pressure created by the turbulence of water moving against the interior walls of fire hose or appliances.
  - Master Stream: A large caliber hose stream capable of flowing 350 gpm or more.
• Normal Operating Pressure: Pressure on a water system during regular domestic consumption.
  • Nozzle Pressure: Pressure at which water is discharged from a nozzle.
• Nozzle Reaction: Force directed at a person or device holding a nozzle by the velocity of water being discharged, measured in pounds.
• Pitot Gauge: Instrument that is inserted into a stream of water to measure the velocity pressure of a stream.
  • Pressure: Force per unit area, measured in pounds per square inch (psi).
• Residual Pressure: That part of the total available pressure not used to overcome friction loss or gravity while forcing water through fire hose and appliances. It is the pressure remaining when water is flowing.
  • Siamese: Hose appliance that combines two or more lines into one.
• Static Pressure: Stored potential energy available to force water through fire hose and appliances. Static means at rest or without motion.
• Velocity: Speed at which water travels through fire hose, measured in feet per second (FPS).
• Water Hammer: Force created by the rapid deceleration of water, generally resulting from closing a nozzle or valve too quickly.
  • Wye: Hose appliance with one inlet and two or more outlets that are usually gated.

5 Types of Pressure

  Static Pressure: Water at rest or not moving.
  Flow Pressure: The velocity of water coming from a discharge opening.
  Residual Pressure: Pressure remaining when water is flowing.
  Elevation Pressure: Pressure gain or loss due to elevation.
  Atmospheric Pressure: Pressure exerted by the air surrounding us.

Friction Loss
Friction loss is pressure used to overcome resistance while forcing water through fire hose, pipes, and appliances. To calculate the friction loss, it is necessary to know the following:
  • The volume or quantity of water flowing (expressed in gpm)
  • The size of the hose
  • The length of the lay
Friction loss is independent of pressure when the gpm remains constant in the same size hose. In other words, if 200 gpm is flowing through a 2½” hoseline at 50 psi, the friction loss will remain the same if the pressure is increased to 100psi.
Smaller hose creates more friction than larger hose when flowing the same amount of water. This is because in smaller hose, more of the water comes in contact with the sides of the hose, thus creating more friction.

If the length of the hose lay is doubled, then the friction loss will double (when gpm remains constant). For example, 100’ of 1¾” flowing 100 gpm has 12 psi friction loss, therefore 200’ of 1¾” flowing the same gpm will have 24 psi friction loss.
Other factors that affect friction loss in hose lines are:
- Rough linings inside fire hose
- Sharp bends or kinks
- Improper or protruding gaskets
- Appliances
- Partially closed valves

There are many ways to estimate the friction loss in fire hose. Methods like the old hand, new hand, drop 10, and the condensed “Q” are just a few that you may have learned. Conceivably, the most accurate method to determine friction loss is to conduct your own tests. By doing this you will know, with almost exact certainty, the volume of water flowing at specific pressures. Additionally, this enables us to have consistency in friction loss calculations department wide.

**Calculating Friction Loss in 3” Hose**

An easy way of calculating friction loss is to look at the table below. Take the 1st digit of the flow (gpm) and multiply it by the 1st digit of the next number immediately below it. The result is friction loss per 100’ of 3” hose. For example, if the flow is 200 gpm, take 2 and multiple it by 2 (the 1st digit of the next number down the column). The answer is 4, which is the friction loss in 100 feet of 3” hose. Let’s try a flow of 350 gpm, 3 x 4 equals 12, which is the friction loss in 100 feet of 3” hose. This method is known as Q^2 or condensed Q.

<table>
<thead>
<tr>
<th>GPM</th>
<th>Friction Loss in 100’</th>
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</thead>
<tbody>
<tr>
<td>100</td>
<td>1 psi</td>
</tr>
<tr>
<td>150</td>
<td>2 psi</td>
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<td>200</td>
<td>4 psi</td>
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<tr>
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<td>25 psi</td>
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<tr>
<td>550</td>
<td>30 psi</td>
</tr>
<tr>
<td>600</td>
<td>36 psi</td>
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**Rounding**

When calculating hydraulic problems, the numbers we work with are in multiples of 50. On occasion you will derive an answer that is not a multiple of 50. When this occurs, round to the closest multiple of 50. Example: You derive an answer of 333 gpm. Round it to the closest multiple of 50 which would be 350 gpm. Round down when you derive a number that is exactly in between, for instance 425 gpm would be rounded down to 400 gpm.
Appliance Loss
Friction loss in small appliances (double males, double females, reducers, wyes, and Siamese) is negligible, and therefore, will not be calculated. The appliance loss for the deck gun on Pierce Saber/Arrow XT engines is minimal, and therefore is not calculated.

Elevation Gain or Loss
When hose lines are laid to an elevation that is higher or lower than the pump an additional factor known as “Elevation Pressure” (EP) must be considered. In the beginning of this chapter we learned that a column of water 1’ high exerts a downward pressure of .434 psi at its base. Therefore, the same column of water at a height of 10’ will exert a downward pressure of 4.34 psi. For fireground operations round 4.34 psi up to 5 psi (that is a ½ psi for each foot of elevation above or below the pump). When calculating elevation pressure in multi-story buildings, figure +/- 5 psi for each floor, not including the first floor. A story is estimated to be 10 feet high.

Q: Firefighters are operating on top of a hill where the nozzle is 40’ above the pump. What is the elevation gain/loss (EL)?

A: EL = .5 psi x 40’ = 20 psi
Tip Sizes and GPM

<table>
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<th>Handline Tip Size</th>
<th>Nozzle Pressure</th>
<th>Approximate GPM</th>
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<tbody>
<tr>
<td>15/16”</td>
<td>50 psi</td>
<td>185</td>
</tr>
<tr>
<td>1”</td>
<td>50 psi</td>
<td>210</td>
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<tr>
<td>1”</td>
<td>50 psi</td>
<td>210</td>
</tr>
<tr>
<td>1 1/8”</td>
<td>50 psi</td>
<td>265</td>
</tr>
<tr>
<td>1 1/4”</td>
<td>50 psi</td>
<td>328</td>
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Master Stream

<table>
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<tr>
<th>Tip Size</th>
<th>Nozzle Pressure</th>
<th>Approximate GPM</th>
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</thead>
<tbody>
<tr>
<td>1 3/8”</td>
<td>80 psi</td>
<td>500</td>
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<td>1 1/2”</td>
<td>80 psi</td>
<td>600</td>
</tr>
<tr>
<td>1 3/4”</td>
<td>80 psi</td>
<td>813</td>
</tr>
<tr>
<td>2”</td>
<td>80 psi</td>
<td>1062</td>
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Standard Nozzle Pressure

<table>
<thead>
<tr>
<th>Nozzle Pressure</th>
<th>Nozzle</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 psi</td>
<td>Smooth Bore Handline</td>
</tr>
<tr>
<td>50 psi</td>
<td>Combination Nozzle</td>
</tr>
<tr>
<td>80 psi</td>
<td>Smooth Bore Master Stream</td>
</tr>
<tr>
<td>*100 psi</td>
<td>Fog Nozzle</td>
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</tbody>
</table>

*Note: Many years ago, it was safe to say all fog nozzles operated at 100 psi nozzle pressure. Newer lower pressure fog nozzles are now becoming popular in the fire service and have different operating pressures. Check the information listed on the nozzle for the proper operating pressure.

Total Pressure Loss

“Total Pressure Loss” (TPL) is the sum of friction loss, appliance loss, and elevation loss/gain expressed in psi.

TPL = FL + AL +/- EL

Pump Discharge Pressure (PDP)

“Pump Discharge Pressure” (aka pump or engine pressure) is the sum of the following:

- Nozzle Pressure (NP)
- Friction Loss (FL)
- Appliance Loss (AL)
- Elevation Loss/Gain (EL)

PDP = NP + TPL

Nozzle Reaction

Nozzle reaction is the ultimate decider of effective fire flows for handlines. If the nozzle reaction is too great then the nozzle operator will either gate down to control the hoseline or will lose control of it and suffer the corresponding consequences. By definition, nozzle reaction is the force of the water being discharged that is directed to a person or device holding the nozzle. Nozzle reaction can be calculated for fog and smooth bore nozzles.
**Fog Nozzle:** NR = \(0.0505 \times \text{gpm} \times \sqrt{\text{NP}}\)

Q: Determine the nozzle reaction from on a 1¾” hose line with a fog nozzle flowing 150 gpm?

A: 
\[
0.0505 \times 150 \times 10 \\
0.0505 \times 1500 \\
\text{NR} = 75.75 \text{ pounds}
\]

**Smooth Bore Nozzle:** NR = \(1.57 \times d^2 \times \text{NP}\)

Q: Determine the nozzle reaction on a 2½” hoseline flowing with a 1” tip?

A: 
\[
1.57 \times (1)^2 \times 50 \\
1.57 \times 50 \\
\text{NR} = 78.5 \text{ pounds}
\]

**Nozzle Reaction for Handlines**

Studies have concluded that:
1 firefighter can handle about 60 pounds of nozzle reaction
2 firefighters can handle about 70 pounds of nozzle reaction
3 firefighters can handle about 90 pounds of nozzle reaction

<table>
<thead>
<tr>
<th>100psi Fog Nozzle</th>
<th>Smooth Bore 2 ½”</th>
<th>Combination Nozzle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GPM</strong></td>
<td><strong>Reaction in pounds</strong></td>
<td><strong>GPM</strong></td>
</tr>
<tr>
<td>100</td>
<td>51</td>
<td>1” tip</td>
</tr>
<tr>
<td>150</td>
<td>76</td>
<td>1 ⅛” tip</td>
</tr>
<tr>
<td>200</td>
<td>101</td>
<td>1 ¼” tip</td>
</tr>
<tr>
<td>250</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>152</td>
<td>Fog 150</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15/16’ Tip</td>
</tr>
</tbody>
</table>

**Reach of Fire Streams**

An angle of 25 to 30 degrees works best to achieve maximum horizontal reach. At 50 psi nozzle pressure using a 1” tip on a handline, water travels approximately 115 feet. At 80 psi nozzle pressure using a 1¾” tip mounted on the apparatus, the distance that the water travels is approximately 220 feet (approximately 200 feet when mounted on the ground).
Standpipe & Sprinkler Systems
Properly installed and maintained fire sprinkler and standpipe systems have proven to be a dependable first line of defense against fires. 96% of fires in sprinkled buildings are held in check or extinguished by sprinklers. On acceptance, these systems are generally hydrostatically tested to 200 psi. This is why we should never exceed this pressure when supplying the FDC. When supplying these systems, always connect with at least two 3” hose lines. The fire department pumper, when connected to the FDC, serves as a back-up only to assist the domestic water supply when the building is equipped with an operational fire pump. Where there is no fire pump installed, the fire department pumper serves to increase the pressure to the fire protection system(s).

Remember to verify that the control valves are “open” and the fire pump is operating (if equipped). Standpipe systems are the main source of water supply for fighting fires in high-rise or large buildings. Water is delivered to the fire area via standpipes. There are 3 classes of standpipe systems:

- Class I: 2½” outlets for fire department use.
- Class II: 1½” outlets for occupant use.
- Class III: A 2½” outlet with a 1½” reducer attached.

Note: A “combined” system is different from a “combination” system. Combination refers to a system with both Class I and Class II outlets, whereas a combined system is an integrated standpipe/sprinkler system.

Many fire protection systems in Menomonee Falls Fire Department are “combined” systems. When supplying a combined system, the pump operator’s priority should be able to supply and maintain 150 psi to the sprinkler system. If a hose line(s) is simultaneously in use, the pump operator should pump to the highest pressure, either the hose layout or the sprinkler system (not to exceed 200 psi).

  Firefighters may need to gate down their supply to avoid excessive nozzle reaction.

For sprinkler operations, build the PDP to 150 psi and maintain it. Once connected to a sprinkler system, be certain to keep the pump cool by means of re-circulating water by cracking the tank fill, opening a booster line, or other appropriate means. As a rule of thumb, a 1250 gpm pumper can supply approximately 60 sprinkler heads.

  If you are supplying a standpipe system, PDP can be calculated by the sum of the following:
  • Nozzle pressure
  • Friction loss in the attack hose
  • Appliance loss
• Elevation loss (5 psi per floor)
• Friction loss in the standpipe system (25 psi)
• Friction loss in the hose supplying the FDC

Alternative methods of supplying a system are to:
• Use a double male/double female when the FDC swivel does not turn.
• Consider using the Quint as an elevated standpipe.
• Consider using interior hose cabinets or outlets when the FDC is not accessible.

_PDP may exceed 200 psi as long as the pressure at the FDC is 200 psi or less._

**Calculating Available Water**

The ability of the DO to calculate the available water from a hydrant is an essential element of the overall role of the driver. Regardless of the size of the fire, DOs should know the amount of water available from a particular hydrant when pumping during an incident. When an engine is connected to a hydrant and not discharging water, the reading on the intake gauge is called static pressure. Once the pump begins flowing water, the reading on the intake gauge is called residual pressure. The difference between the two readings is called _"pressure drop"_.

**1st Digit Method**

• Once connected to the hydrant, record the static pressure.
• Multiply the 1st digit of the static reading by 1, 2, and 3.
• Open the line and flow the desired amount of water and record the residual pressure.
• Subtract the difference between the static and residual pressures.

If the pressure drop does not exceed 1 times the first digit, a **minimum** of 3 additional lines flowing the same gpm can be added.

If the pressure drop does not exceed 2 times the first digit, 2 additional lines flowing the same gpm can be added.

If the pressure drop does not exceed 3 times the first digit, 1 additional line flowing the same gpm can be added.

If the pressure drop exceeds 3 times the first digit, no additional lines flowing the same gpm can be added (although it may be possible that a line flowing fewer gpm may be added as long as the residual pressure remains above 20psi).

Q: An engine connects to a hydrant with a static pressure of 84 psi. The DO opens a line flowing 250 gpm and notes the residual pressure drops to 73 psi. How many additional set-ups can be added?

A: Static Reading was 84. Take the 1st digit, which is 8. Multiply 8 by 1, 2, and 3 respectively:

8 x 1 = 8
8 x 2 = 16
8 x 3 = 24

Now, subtract the residual from the static pressure. 84 - 73 = 11.

11 is the pressure drop, and falls between 8 and 16. Therefore, 2 additional setups flowing the same gpm can be added. This hydrant will provide an additional 500 gpm or a total flow of 750 gpm.
**Estimating the Static Pressure**
We often connect to a hydrant after we are flowing water from our tank. When the hydrant is opened, the pressure reading on the intake gauge is residual pressure. The following method is used to estimate the static pressure.

- Note the residual pressure after the first line is in operation.
- Open another discharge flowing the same gpm as the first line.
- Note the difference in residual pressures on the intake gauge.
- Divide this difference by 2.
- Adding this number to the original residual pressure gives you your estimated static pressure.

Q: A pre-connected line flowing 150 gpm is in operation off of tank water. The hydrant is then opened and the intake gauge reads 66 psi (residual pressure). A nozzle flowing the same gpm is opened. The residual pressure is now 58 psi. What is the estimated static pressure?

A: The difference between the two pressures is 66 - 58 = 8 psi. Divide 8 by 2 = 4. Add 4 to the original residual pressure, 66 + 4, and the estimated static pressure is 70 psi. You can now calculate the available flow from the hydrant by using 70 psi as the static pressure and 4 as the pressure drop.

**Calculating Available Water from a Draft**
When operating from a static source such as a canal, lake or other abundant source, the DO needs to know how many gpm the pump can provide for firefighting operations. This topic is discussed further in Chapter 4 of this manual.

**Maximum Efficient Flow in Fire Hose**
The maximum efficient flow also referred to as critical velocity is the maximum amount of water that can be put through a fire hose before the fire stream breaks up and becomes ineffective. The table below lists hose sizes with the associated flows. Keep in mind that these flows are conservative in that more water can be supplied if needed but this table should be used as a guideline.

<table>
<thead>
<tr>
<th>Hose Size</th>
<th>Critical Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½”</td>
<td>125 gpm</td>
</tr>
<tr>
<td>1 ¾”</td>
<td>200 gpm</td>
</tr>
<tr>
<td>2 ½”</td>
<td>300 gpm</td>
</tr>
<tr>
<td>3”</td>
<td>500 gpm</td>
</tr>
<tr>
<td>5”</td>
<td>1200 gpm</td>
</tr>
</tbody>
</table>

**Relay Pumping**
By using the following table the DO can determine the maximum distance that a certain flow may be pumped. Built into these figures is the consideration that a 20 psi residual pressure is available at the next pumper in the relay.

**Elevated Master Streams**
One of the uses of a quint is to provide an elevated stream for fire attack and exposure protection. Elevated streams can be effectively directed into or onto the upper portions of tall buildings, which are
beyond the reach of ground mounted devices. These ground or apparatus mounted devices are usually only effective to about the third floor. Heavy streams from aerial devices can also be very effective in controlling volume fires on the lower or ground floors. When setting up aerial devices, consideration must be given to wind direction and exposure protection. The DO should anticipate the need for elevated master streams during escalating fires. Consideration should be given to initial truck placement for rescue, ventilation, etc., and the potential need to relocate for water tower operations. If possible, spot the apparatus for current tactical assignments, and future needs. If building collapse becomes a possibility, the quint and personnel should be placed outside the potential collapse zone. The collapse zone area is not less than one and one half times the building height. Whenever possible, Quinths should be provided with their own supply engine(s) not more than 100 feet from the vehicle. At least two 3” supply lines should be used to supply the quint.

**Fire Flow**
As we have already discussed, the DO is required to obtain and deliver adequate water to the fire. A quick, easy to use formula can be used to estimate the amount of water (fire flow in gpm) needed for a structural fire attack:

\[
\text{Length} \times \text{Width} \times \% \text{ of Area Involved in Fire} = \text{gpm} \\
\frac{3}{1}
\]

Using this formula will give you the needed water flow in gallons per minute to darken the fire in 10 - 30 seconds when applied properly. It can also be adjusted for exposures if necessary by adding 25% for each exposure. Here are some examples:

Example: 15’ x 20’ room, fully (100%) involved, no exposures

\[
15' \times 20' \times 1 \times \frac{3}{1} = 300 \text{ sq. ft.}
\]

= 100 gpm

Example:
If the room in Example 1 is only half involved:

\[
15' \times 20' \times .5 \times \frac{3}{1} = 300 \times .5 = 150 \text{ SF}
\]

= 50 gpm

Example:
A two-car garage that is 24’ x 24’ that is a third involved with 1 exposure:

\[
24' \times 24' \times .3 \times \frac{3}{1} = 58 \text{ GPM}
\]

Add 15 GPM (25% of the flow rate) for the exposure (58 x .25) = 73 gpm total.
Introduction
Another option for obtaining water from other than municipal water systems are static water sources such as lakes, canals, oceans, portable water tanks and swimming pools. It is important that the DO properly assess and evaluate the proposed drafting site for usability and reliability. When choosing a drafting site look for a body of water that is large enough to supply the engine at its rated capacity and be of adequate size to supply water to the fireground operation. Be aware of water runoff and the possibility of soil erosion around the apparatus. Good drafting sites in your battalion should be identified during Quick Access Survey (QAS) activities, area familiarization and use of the Hydrant Information System software.

Drafting is a process of raising water from a static source to the fire pump. The distance between the top of the water and the center of the pump is known as lift.

During the process of drafting, air is removed from the intake hose and fire pump by a device known as a primer. “Priming the pump” means creating a pressure differential between the inside of the pump, the hard suction hose and the atmosphere creating a vacuum. Because a negative pressure is created inside the hose, water is forced to rise inside the intake hose and into the pump.

Theoretical Lift vs. Maximum Lift
Theoretically, at sea level a fire pump can lift water 33.8 feet (14.7 psi x 2.304 ft/psi). For a variety of reasons a perfect vacuum is impossible to obtain with a fire pump. The maximum height to which water can actually be drafted is approximately 25 feet as opposed to the theoretical lift of 33.8 feet.

Preparing For Drafting Operations
Park the apparatus near the drafting site. Inspect the water source to ensure it is adequate. Once a location to draft has been established connect the strainer to the hard suction hose and connect the hard suction hose to the engine. When all connections are made tight with a rubber mallet the apparatus can slowly and safely be brought into position at water’s edge and the hard suction hose can be placed into the water (be certain that all couplings have gaskets). Be sure the hose is supported by personnel and not dragged as the apparatus is moved. To ensure safety, persons supporting the hose should stand on the opposite side of the hose to which the apparatus is moving. The wheels shall be chocked when the apparatus is in position. If you can safely connect the hard suction hoses at water’s edge, then initially place the apparatus at water’s edge and chock the wheels. Once the apparatus is in position engage the pump. Make sure that all valves, bleeders and drains are closed and all unused openings are capped snugly. If drafting from the driver side, on some models, the DO must open the master intake valve.
(MIV) before starting the priming process. On some Pierce engines it is possible to obtain a draft with the MIV closed and then transition from tank water to draft without any interruption of flow.

If your apparatus is equipped with a governor, select the “RPM” mode on the governor. Increase engine speed to approximately 1000 - 1200 rpm and activate the primer control. Watch the intake and pressure gauges; the intake gauge will drop below zero and the discharge pressure will increase as the pump is primed. You will also hear a difference in the sound of the primer pump as water enters the pump. This process of priming the fire pump should take less than 30 seconds for 1250 gpm pump or less, and less than 45 seconds for 1500 gpm pumps. If the pump does not prime, begin the troubleshooting process. Once a draft is established, slowly open the discharge valve and increase the throttle to maintain a minimum discharge pressure of 50 psi. If you are operating with a governor, change from “RPM” mode to “pressure” mode. Continue to open the discharge valve all the way and build the discharge pressure to the appropriate level. Set the pressure control device once the desired pressure has been achieved.

**Calculating Available Water from a Draft**

When operating from a static source such as a canal, a lake or another abundant source the DO needs to know how many gpm the pump can provide for firefighting operations. We know that fire pumps receive their rating based on pumping from a draft at 10’ of lift. As an example, a 1500 gpm pumper can supply 1500 gpm at 10’ of lift. At 20’ of lift the same pump is going to have to work much harder to raise the water the additional 10’. This will result in the pump discharging only 955 gpm. Furthermore a 1500 pump operating from a 4’ lift can discharge 1735 gpm.

<table>
<thead>
<tr>
<th>Lift in Feet</th>
<th>Gallons per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1735</td>
</tr>
<tr>
<td>6</td>
<td>1660</td>
</tr>
<tr>
<td>8</td>
<td>1575</td>
</tr>
<tr>
<td>10</td>
<td>1500</td>
</tr>
<tr>
<td>12</td>
<td>1410</td>
</tr>
<tr>
<td>14</td>
<td>1325</td>
</tr>
<tr>
<td>16</td>
<td>1225</td>
</tr>
<tr>
<td>18</td>
<td>1085</td>
</tr>
<tr>
<td>20</td>
<td>955</td>
</tr>
<tr>
<td>22</td>
<td>800</td>
</tr>
<tr>
<td>24</td>
<td>590</td>
</tr>
</tbody>
</table>
Drafting Tips
It is important to monitor pumping operations closely at all times. Record the initial vacuum reading once the draft is established. An increase in vacuum with a decrease in gpm may indicate a clogged strainer. Manually clean debris away from the strainer, or direct a stream from a booster hose at the strainer. Problems that develop are usually a result of air leaks or air admission to the pump. These problems may be caused by an air leak on the pump intake, whirlpool above the strainer or defective pump packing. Beware when drafting that it is possible to draw water from your tank if your tank-to-pump valve does not work properly or isn’t closed completely. The DO should check the water tank to make sure the water level isn’t going down. If the water tank goes empty you will lose the draft. Cracking open the tank fill valve will assure that you maintain a full tank. However, this is a troubleshooting tactic. Keeping the tank fill cracked open should not be common practice. A booster hose can be tied, with the nozzle open, to a solid object and the water directed back into the source. This will ensure the vacuum is not lost if the main hose lines being supplied are shut down. If a whirlpool occurs around strainer, air will be introduced into the pump resulting in inadequate water intake. Use the booster hose and direct the stream at the whirlpool – this will break the whirlpool effect and allow the strainer to operate effectively.

Improper positioning of the hard suction hose can lead to the formation of an air pocket inside the hose. This may occur when the hose is placed over an object (when going over a railing) resulting in a “hump” in the hose.

Shut Down Procedure
When the drafting operation has been completed, decrease engine speed to idle, take the pump out of gear and drain the pump. Back flush the pump with clean water and fill the water tank with hydrant water if needed. Confirm that the pump is primed before returning to service.

Cavitation
When a centrifugal pump is attempting to discharge more water than it is receiving, a vacuum is created near the eye of the impeller. This may happen while pumping from draft or from a hydrant. The real problem in either case is a discharge in excess of the intake that, in turn, causes a vacuum to occur.

Whether taking water from a hydrant or drafting, the most reliable indication that a pump is approaching cavitation is when an increase in engine rpm does not cause an increase in PDP. If the pump is approaching cavitation and more pressure is needed but no more water is available, discharge gates may have to be gated down. This will allow pressure to increase but will result in a reduction of flow to hose lines. At no time should a pump be operated under cavitation producing conditions for long periods. DOs that are knowledgeable about the causes and effects of cavitation can avoid them and save substantial amounts of money, and unnecessary shop time, for equipment that is needed on the fireground.

Although this chapter’s focus is on drafting, cavitation can also occur while operating from a dynamic water source when the intake pressure approaches 0 psi. It is important for the DO to remember to maintain at least 20 psi intake pressure when operating from a hydrant or in a relay.
**Troubleshooting**

Unable to Prime the Fire Pump:
- Be sure all drains, bleeders, discharges and unused intakes are fully closed.
- Drain the water from the fire pump.
- A high point in the suction hose creating an air pocket.
- Check that the couplings are tight and gaskets are present.
- The lift is too high.
- Check that the hard suction hose is not separating from the coupling.
- Strainer is not fully submerged.
Driver Operator Manual

Chapter 5

Foam Operation
Foam can be a valuable tool for extinguishing Class A (ordinary combustibles) and Class B (flammable liquids) fires. Knowledge of how foam prevents or extinguishes fire, application methods and delivery systems used by PBCFR is necessary to mitigate these incidents.

**Terms**

Foam Concentrate – The foam product as it is carried in 5 gallon buckets or on board the apparatus in the foam cell.

Foam Solution – The result of foam concentrate mixed with water at the desired proportion.

Finished Foam – Foam solution mixed with air and applied to the burning fuel.

Wetting Agent – An additive to water that reduces the surface tension of plain water, which allows it to penetrate surfaces where water might normally run off, to reach deep-seated fires. This helps reduce the amount of water needed to extinguish the fire and also provides a quicker knockdown.

**Type of Foam**

Menomonee Falls Fire Department utilizes 1 type of foam:

- Class A+B combination foam at 1%, 3%, and 6%

FIREBULL – FIREBULL F3 Fluorine Free Foam is a seamless transition from AFFF products for fire departments. FIREBULL eliminates all of the long-established issues of Class B foams: it will not clog, gum, or corrode foam systems or equipment. FIREBULL offers the simplicity of using one product to
extinguish multiple classifications of fire, allowing fire departments and brigades to increase their stocking supply by using just one product that serves two purposes. Unlimited Shelf Life.

**Class A capabilities**- Wood, Grass, Coal, Tires, Hay, Cotton, Cardboard, Initial
- Knockdown: 0.25%
- Wetting Agent: 0.25%-1.0%
- Cars, Trucks, Heavy Equipment: 0.50% up to 1.0%

**Class B capabilities**- Non-Polar Solvents: Gasoline, Gasoline w/10% Ethanol, Jet A, JP4/5/8, Crude Oil, Diesel, Etc.
- 3% using 0.16gpm/ft2 for 10-20 minutes
Foam System (Husky 3)
The foam proportioning system is an on demand, automatic proportioning, single point, direct injection system suitable for all types of Class A & Class B foam concentrates, including the high viscosity (6000 cps), alcohol resistant Class B foams. The operation of the system is based on direct measurement of water flow, and remains consistent within the specified flows and pressures. The system automatically balances and proportions foam solution at rates from 0.1% to 9.9% regardless of variations in water pressure and flow, up to the maximum rated capacity of the foam concentrate pump. The design of the system allows operation from draft, hydrant, or relay operation. This provides a versatile system to meet the demands at a fire scene.

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<tr>
<th>Concentration Percentage</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>6%</td>
<td>200</td>
</tr>
<tr>
<td>3%</td>
<td>400</td>
</tr>
<tr>
<td>1%</td>
<td>1200</td>
</tr>
<tr>
<td>0.5%</td>
<td>2400</td>
</tr>
<tr>
<td>0.3%</td>
<td>4000</td>
</tr>
</tbody>
</table>

Husky 3 Steps for Operation

- Engage water pump transmission.
- Recirculate water.
- Turn the system ON.

  **NOTE:** The default foam valve will open automatically (typically Class A, @ 0.3-.5%).

- Begin flowing water, foam pump will activate.
- Use the ARROW UP / ARROW DOWN buttons to change percentage (*if needed*).
- When beginning the mop up phase, turn the system OFF; use the foam in the hose for mop up.

  **NOTE:** The only flush needed is to run the hose until it is mostly free of bubbles. The foam pump is designed to be flooded with foam.
Foam System (Husky 3)

The foam proportioning system is an on demand, automatic proportioning, single point, direct injection system suitable for all types of Class A & Class B foam concentrates, including the high viscosity (6000 cps), alcohol resistant Class B foams. The operation of the system is based on direct measurement of water flow, and remains consistent within the specified flows and pressures. The system automatically balances and proportions foam solution at rates from 0.1% to 9.9% regardless of variations in water pressure and flow, up to the maximum rated capacity of the foam concentrate pump. The design of the system allows operation from draft, hydrant, or relay operation. This provides a versatile system to meet the demands at a fire scene.

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<td>2400</td>
</tr>
<tr>
<td>0.3%</td>
<td>4000</td>
</tr>
</tbody>
</table>

Husky 3 Steps for Operation

- Engage water pump transmission.
- Recirculate water.
- Turn the system ON.

**NOTE:** The green LED will illuminate and stay lit constant.

- Begin flowing water out of one of the foam/water discharges, foam pump will activate (flashing green LED when foam pump is injecting).
- Use the INC % or DEC % buttons to change percentage (*if needed*).
- When beginning the mop up phase, turn the system OFF; use the foam that is left in the hose and plumbing for mop up.

**NOTE:** The only flush needed is to run the hose until it is mostly free of bubbles. The foam pump is designed to be flooded with foam.
Nozzle

Elkhart Brass SM-20

The Select-O-Matic series of hand line nozzles are the most efficient and effective fire suppression tools available to the fire service today. The automatic mechanism in each of these nozzles assures you of a superior firefighting stream throughout the flow range. The constant flow feature assures you of the same gallonage throughout the fog and straight stream patterns. This helps make Select-O-Matics ideal for use with foam eductors and the application of AFFF and Class A Foam. A built-in flush feature allows passage of debris from the nozzle without shutting down.

Operations

Select-O-Matic nozzles are designed to maintain sufficient pressure to give an effective firefighting stream as long as the flow is within the nozzle’s flow range. The flow ranges of the Select-O-Matics are as follows:

- SM-30F series, 75-325 gpm
- SM-20F series, 60-200 gpm

Foam Expansion Tube

When greater expansion rates of foam solution are needed, a foam aeration tube can be quickly attached to many of Elkhart Brass combination fog nozzles. All tubes are Elk-OLite® cast finish with a nylon cord wrap.
In-Line Eductor
Apparatus also are equipped with portable foam eductors. These eductors have a rating of 95 gpm and require an inlet pressure of 200 psi for proper operation. It is important to know that the nozzle and eductor must have the same gpm rating; otherwise the eductor will not work. Automatic nozzles will work with foam eductors. Foam eductors work on the venturi principle. When 200 psi is supplied to the inlet of the eductor, a large amount of that inlet pressure is lost in creating the vacuum necessary to pull foam concentrate from the bucket into the water. The pressure at the exit of the eductor is called back pressure. If the back pressure is more than 65% - 70% of the inlet pressure, then the eductor stops producing a vacuum, and foam cannot be made. The actual back pressure at the eductor is the combination of nozzle pressure plus friction loss in the hose and elevation loss.

Now, let’s breakdown the components so you can easily understand what’s happening:
Flow rating of eductor 95 gpm
Inlet pressure to eductor 200 psi
**Maximum back pressure on eductor** (70% of 200 psi) **140 psi**
Nozzle pressure (automatic nozzle) 100 psi
FL in 300’ of 1¾” hose (flow 95 gpm, \([10.8 \times (.95)2 \times 3]\)) 29 psi
Elevation loss 0 psi
**Actual Back Pressure Total 129 psi**

The above layout will work since the actual back pressure of 129 psi is less than the maximum allowable back pressure of 140 psi. Foam will be made.

Setting up the Eductor
1. When using an automatic nozzle with a foam eductor, the nozzle must be fully open to prevent excessive back pressure which will prevent foam pick-up. When selectable gallonage nozzles are used, the nozzle flow must be matched to the flow of the eductor (95 GPM).
2. Set the metering dial to the desired percentage.
3. Place the pick-up tube in the foam bucket making sure the tube inlet is not restricted.
4. The nozzle should be completely open.
5. Charge the line so the eductor inlet pressure is 200 psi.
6. Do not use more than 300 feet of 1¾” hose between the eductor and the nozzle.
**Eductor Maintenance**

The eductor should always be cleaned of any foam concentrate after each use. Clean water should be flushed through the pick-up tube and the metering head rotated to each different percentage pick-up. The metering head should also be removed to ensure that the check ball is free to move.

When the pumping operation is completed and before apparatus is placed back into service, the water tank, discharges and fire pump need to be completely flushed of all foam solution until clear water flows from all discharges.

*Do not mix different types or brands of foam.*
**Introduction**
This chapter provides the DO with the basic operational maintenance and checkout information regarding fire apparatus utilized by MFFD. This chapter is not intended to be the sole source of information pertaining to these vehicles. More detailed information is available from the manufacturer’s maintenance and operations manuals available at the Good Hope Garage.

**Engine Oil**

![Engine Oil Image]

The oil level on the dipstick should be between the upper “Full” and lower “Add” marks. Add motor oil only when the oil level is below the lower mark on the dipstick.

**Transmission Fluid**

![Transmission Fluid Image]

To accurately check the transmission fluid it must reach its normal operating temperature of 160° to 200° F. Operate the transmission in a Drive “D” gear until the fluid reaches its normal temperature. On a level surface and with the transmission in neutral, wipe the dipstick clean and check the fluid level. A safe operating level is any level within the “Hot” / “Run” (upper) band on the dipstick. If the fluid is not within this range, add as needed.

**Adding Fluids to Apparatus**

Under no circumstances should any member of the fire department at any type of oil, transmission fluid, brake fluid or antifreeze to any vehicle. We need to follow the same procedure for adding fluids as we do for the repairs of the vehicles. Fluids will only be added by the mechanics at the garage.

**Brake System**

MFFD utilizes a dual air system on its fire apparatus. This consists of a primary air system (brakes), and a secondary air system (accessories). Air for operating the brakes, as well as other components, is provided by an engine driven air compressor. Revving the engine will change the speed of this compressor therefore; you can rev the engine in an attempt to rapidly build air pressure. When the air pressure falls below 60 psi, a buzzer will sound and a “Low Air Pressure” light will display on the dashboard and the rear brakes will begin to apply until sufficient air pressure is established.
**Antilock Brake System (ABS)**
Fleet 421 and all of the ambulances are equipped with an ABS that works to control wheel speed during emergency stops. During emergency stops, **do not** pump the brake pedal. Press and hold the pedal to the floor and hold it until the vehicle comes to a stop. The system also includes a dash mounted ABS warning light which will indicate any problem with the system. Notify the Central Shop immediately if the ABS warning light comes on and stays on.

**Door Open/Flashing Lights**
All apparatus are equipped with a flashing red light that indicates when a compartment or cab door is open. On newer apparatus, these warning devices will also indicate when the deck gun or telescoping lights are left in the up position. Amazingly, there are still drivers that don’t pay attention to these devices. If you get a door open warning, immediately stop the vehicle and perform a 360-degree walk-around of the apparatus to find and correct the cause for the alarm. If all doors are closed and secure, email BC Rokenbrodt and Lt. Biedenbender and write it up in “Firehouse”.

**Miscellaneous**
Inspect the engine for fuel, oil or air leaks. The floor beneath the apparatus should also be checked for fluid leaks during the daily vehicle checkout. Check the cab interior for loose items. According to NFPA 1901, all equipment in the cab must be securely mounted or enclosed in a compartment. Do not place helmets, clipboards, portable radios, etc. on the dashboard. These loose objects have become lodged between the steering wheel and dashboard locking the steering wheel!

Check the operation of all cab devices, lighting, warning devices and communication equipment.

Check the operation of all warning lights, running lights, exterior lighting and the back-up alarm.

**Tire Pressures**
As part of weekly maintenance we are required to check the tire pressure in the tires on our vehicles. Each of the vehicles have tire pressures labeled above the wheel well. If for some reason the tire pressures are not listed on the wheel wells you should than refer to the manufacturer’s specifications located inside the driver’s door.

- Check all of the tires on the vehicle with a tire pressure gauge
- The rear dual tires check the single port on the CrossFire system
• If the tire need air, contact your BC and advise them that a vehicle needs air in the tire, you will need to fill them at the Good Hope garage. The mechanics at the garage will not fill the tires on the vehicle but we can use the air hose since it will fill the tires safer and faster.

• Some of our engines have sand in them for the balancing of the tires.

For the vehicles with the CrossFire Tire Pressure Monitoring systems the following description applies. You can also find the same information on the driver’s counsel of the vehicles containing the Crossfire system. (Our Crossfire System is 120psi)
Driver Operator Manual

Chapter 7

Vehicle Layouts
**Vehicle Layouts**

This section is intended to give the DO the ability to study and have forward knowledge of the layouts of our apparatus here at the Menomonee Falls Fire Department. This does not take the place of the practical exercise but is intended to be used as a reference for the DO only to study from.

**Fleet 421**

Battery Switch, ignition switch, start switch

Pump Shift, Transmission selection panel

---

Green – Large Diameter Discharge
Orange – No 2 Passenger side Discharge
Purple – Front Bumper Discharge
Silver – 2 ½” Crosslay
White – No 2 Crosslay

Pink – Deluge Discharge
Yellow – No 1 Crosslay
Brown – Driverside Rear Discharge
Blue – No 3 Driverside Discharge
Red – No 1 Driverside Discharge
Fleet 427 / 420

- Yellow – 1 ¾” Crosslay (SB)
- White – 1 ¾” Crosslay (Fog)
- Gray – 2 ½” Crosslay
- Green – L/D Discharge
- Red – 2 ½” D/S Discharge
- Blue – 2 ½” D/S Discharge
- Pink – Deluge Discharge
- Brown – D/S Rear Discharge
- Orange – P/S Discharge
Fleet 426

Orange – 1 ¾” Smooth Bore       Red – 1 ¾” Fog
Blue – 2 ½” P/S Discharge       Black – Large Dia. Discharge
White – 2 ½” D/S Discharge      Green – 2 ½” P/S Discharge
Yellow – 2 ½” D/S Discharge
- Blue circle: Red arrow indicates the position of use.
- Yellow circle: Indicates the ignition switch.
- Red circle: Indicates the start button.
Fleet 1111 (Franny) cont.

#1 Brown – OS 2 ½” Discharge
#2 Orange – Front Bumper
#3 Red – DS 2 ½” discharge
#4 Yellow – OS (Fog) Crosslay
#5 Gray – DS (Smoothbore) Crosslay

#6 Orange – DS 2 ½” Discharge
#7 Blue – DS rear LD discharge
#8 Gray – Deck Gun
#9 Green – OS 2 ½” Discharge
Checkoff Sheets
Date__________________  Candidate Name______________________________  FD Number____________________

**Driver Operator Skill – Final Pumper Checkoff**

**Task:** Safely and properly drive the Engine to a designated location and setup the engine for pumping operations.

**Performance Outcome:** The candidate shall be able to properly drive and then park the engine, set chocks and properly engage the pump. Properly operate the aerial platform to obtain all of the objectives listed in the Aerial Operations section.

**Conditions:** Turnouts, Helmet, Gloves

<table>
<thead>
<tr>
<th>Task Steps</th>
<th>First Test</th>
<th>Retest</th>
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<tbody>
<tr>
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<td>Pass</td>
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<tr>
<td><strong>Vehicle Operations</strong></td>
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<tr>
<td>1. Battery / Ignition</td>
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<td>2. Starting Procedures</td>
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<tr>
<td>2. Headlight switch</td>
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<td>3. Wiper controls</td>
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<td>4. Warning Lights</td>
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<tr>
<td>5. High Idle</td>
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<tr>
<td>6. Sirens / Air Horn / Siren Brake</td>
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<td>7. Gauges / Info Display</td>
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<tr>
<td>8. Vehicle Height Indicator</td>
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<tr>
<td>9. Jake Brake Operations</td>
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<tr>
<td><strong>Driving Course</strong></td>
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<td></td>
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<tr>
<td>1. Tight Right Turn</td>
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<tr>
<td>2. Tight Left Turn</td>
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<tr>
<td>3. Maintain Lane</td>
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<tr>
<td>4. Drive on HWY 41/45 with two lane changes</td>
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<tr>
<td><strong>Pump Operations</strong></td>
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<tr>
<td>1. Completed Pumper—Operational Check Skill Sheet</td>
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<tr>
<td>2. Completed Pumper—Pumping from a Water Tank Skill Sheet</td>
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<td>2. Completed Pumper—Pumping from Hydrant</td>
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<td>3. Completed Pumper—Drafting Skill Sheet</td>
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<td>4. Completed Pumper—Foam Skill Sheet</td>
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<tr>
<td>5. Completed Pumper—Sprinkler System Skill Sheet</td>
<td></td>
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<tr>
<td>6. Completed Pumper—Aerial Waterway Skill Sheet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Confidently Engages Fire Pump on Apparatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Confidently flows multiple lines</td>
<td></td>
<td></td>
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<tr>
<td>9. Confidently makes hydrant hook up</td>
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<tr>
<td><strong>Overall Skill Sheet Performance Outcome</strong></td>
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Allotted Time: 30 minutes with driving
Actual Time: __________________

Evaluator Comments____________________________________________________________________
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Retest Approved by
____________________________________________________________________________________

Evaluator Signature   FD #   Candidate Signature   Date

Retest Evaluator Signature   FD#   Candidate Signature   Date
**Driver Operator Skill – Pumping Operational Check**

**Task:** Complete a vehicle Operational Check on Engine & Truck

**Performance Outcome:** The candidate shall be able to properly complete all of the tasks on the attached Operational Check Sheet

**Conditions:** Given PPE (Helmet, gloves)

<table>
<thead>
<tr>
<th>NO.</th>
<th>Task Steps</th>
<th>First Test</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Pass</td>
<td>Fail</td>
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<tr>
<td>1.</td>
<td>Safely &amp; properly perform all Engine elements of the attached Operational Check (include winter pumping operations)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>Safely &amp; properly perform all Aerial elements of the attached Operational Check</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Overall Skill Sheet Performance Outcome**

☐ ☐ ☐ ☐

Allotted Time: 20 minutes  
Actual Time: __________________

Evaluator Comments

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Retest Approved by __________________________

Evaluator Signature  ____________  FD #  ____________  Candidate Signature  ____________  Date  ____________

Retest Evaluator Signature  ____________  FD#  ____________  Candidate Signature  ____________  Date  ____________
**Driver Operator Skill – Pumping from Water Tank**

**Task:** Safely operate fire engine pump from tank water

**Performance Outcome:** The candidate shall be able to properly put apparatus into pump, flow effective streams out of multiple discharges, monitor water tank level, set pressure governor, and correctly shut down pumping operations.

**Conditions:** Given PPE (boots, pants, gloves, helmet), additional FF needed for hose lines

<table>
<thead>
<tr>
<th>NO.</th>
<th>Task Steps</th>
<th>First Test</th>
<th>Retest</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Pass</td>
<td>Fail</td>
</tr>
<tr>
<td><strong>Pumping</strong></td>
<td></td>
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</tr>
<tr>
<td>1.</td>
<td>Safely park and set vehicle in proper position (chocks)</td>
<td></td>
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<tr>
<td>2.</td>
<td>Transfer vehicle from Road to Pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Engage pump, select mode, Open TTP, Open TF, increase RPMs, &amp; circulate water</td>
<td></td>
<td></td>
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<tr>
<td>4.</td>
<td>Select proper discharges and proper pressures</td>
<td></td>
<td></td>
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<tr>
<td>5.</td>
<td>Check pressure control device &amp; monitor water tank level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Operate Auxiliary Cooling system, Review communications with FFS &amp; Command (hand &amp; radio)</td>
<td></td>
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<tr>
<td>7.</td>
<td>Shut pump down, emergency stop button, and properly place vehicle back into road position</td>
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</tbody>
</table>

**Overall Skill Sheet Performance Outcome**

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<thead>
<tr>
<th></th>
<th></th>
<th>Pass</th>
<th>Fail</th>
<th>Pass</th>
<th>Fail</th>
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Allotted Time: 30 minutes

Actual Time: ____________________

Evaluator Comments____________________________________________________________________
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Retest Approved by ____________________________

Evaluator Signature _______________   FD # ___________   Candidate Signature _______________   Date _______________

Retest Evaluator Signature _______________   FD # ___________   Candidate Signature _______________   Date _______________
Date__________________  
Candidate Name______________________________  
FD Number____________________

**Driver Operator Skill – Pumping from Hydrant**

**Task:** Safely and properly operate a fire pump with a pressurized water source.

**Performance Outcome:** The candidate shall be able to properly park the apparatus with wheel chocks, engage the fire pump, flow an effective stream through a hose line from the booster tank, set the pressure governor, make the proper connections to a hydrant, transfer from the booster tank to the pressurized water source, and properly shut down all pumping operations.

**Conditions:** Given PPE (boots, pants, gloves, helmet)

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<tr>
<th>NO.</th>
<th>Task Steps</th>
<th>First Test</th>
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<tr>
<td></td>
<td></td>
<td>Pass</td>
<td>Fail</td>
</tr>
<tr>
<td>1.</td>
<td>Safely and properly park the apparatus for pumping operations</td>
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<tr>
<td></td>
<td>with wheel chocks. Engage the fire pump and circulate water.</td>
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<tr>
<td>2.</td>
<td>Set pressure relief device and pump cooler. Flow an effective</td>
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<tr>
<td></td>
<td>water stream from a discharge.</td>
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<tr>
<td>3.</td>
<td>Safely and properly “wrap” a hydrant and place the hydrant bag behind</td>
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<tr>
<td></td>
<td>the hydrant bag behind the hydrant. Perform the proper hydrant connections.</td>
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<tr>
<td>4.</td>
<td>Disconnect the 5” hose from the hose bed and properly attach to an intake.</td>
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<tr>
<td>5.</td>
<td>Open the hydrant and bleed air from the supply line.</td>
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<tr>
<td>6.</td>
<td>Transfer the water supply from booster tank to hydrant. Acknowledge</td>
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<tr>
<td></td>
<td>Intake &amp; Discharge gauges and pressure relief system.</td>
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<td>7.</td>
<td>Top off booster tank. Transfer supply back to booster tank and</td>
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<tr>
<td></td>
<td>shut down hydrant. Properly end pumping operations and return the vehicle</td>
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<tr>
<td></td>
<td>and all equipment back to service.</td>
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**Overall Skill Sheet Performance Outcome**

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<tr>
<th>Pass</th>
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Allotted Time: 30 minutes  
Actual Time: ______________

Evaluator Comments___________________________________________
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___________________________________________________________________________________________

Retest Approved by ____________________________________________

Evaluator Signature  
FD #

Candidate Signature  
Date

Retest Evaluator Signature  
FD#

Candidate Signature  
Date
**Driver Operator Skill – Drafting**

**Task:** Safely and properly draft water from a static water source.

**Performance Outcome:** The candidate shall be able to properly place apparatus into pump, attach suction hose to apparatus with a low level strainer, pull a prime and flow water through a discharge, close TTP and operate from draft. Set up second suction hose between 2 tanks and flow through jet siphon to keep initial water tank full. Fill vehicle’s water tank.

**Conditions:** Given PPE (boots, pants, gloves, helmet) 2 portable tanks, 2 hard suction hoses, jet siphon

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<th>NO.</th>
<th>Task Steps</th>
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<tr>
<td></td>
<td></td>
<td>Pass</td>
<td>Fail</td>
</tr>
<tr>
<td>1.</td>
<td>Safely and properly park apparatus. Transfer mode from road to pump and select RPM (Pierce). Circulate water or flow a discharge.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>Attach suction hose with low level strainer and place into portable tank filled with water.</td>
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<tr>
<td>3.</td>
<td>Prime the hose and pump. Make the transfer to from vehicle tank to portable tank.</td>
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<tr>
<td>4.</td>
<td>Set up suction hose with jet siphon between two portable tanks and run the 1 ¾” hose line.</td>
<td>☐</td>
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<tr>
<td>5.</td>
<td>Fill the initial tank and top off vehicle tank.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>Discuss possible priming problems: loose connections, soccer ball, etc…</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>7.</td>
<td>Shut down operation, return all equipment back to service.</td>
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**Overall Skill Sheet Performance Outcome**

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**Evaluator Comments**

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Retest Approved by ________________________________  ________________________________  ______________

Evaluator Signature  FD #  Candidate Signature  Date

Evaluator Signature  FD #  Candidate Signature  Date

Retest Evaluator Signature  FD#  Candidate Signature  Date
Date______________

Candidate Name__________________________________  FD Number____________________

**Driver Operator Skill – Foam**

**Task:** Safely and properly perform Class A & B foam operations and return all equipment back to service.

**Performance Outcome:** The candidate shall be able to properly proportion and flow Class A foam from a Husky System, draft Class B foam with a pick up tube and an educator, flush the system, hoses, and nozzles.

**Conditions:** Given PPE (boots, pants, gloves, helmet), Class A & B foam systems, buckets, and nozzles

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<th>NO.</th>
<th>Task Steps</th>
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<td>Pass</td>
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<tr>
<td><strong>Pumping</strong></td>
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<tr>
<td>1.</td>
<td>Park engine, wheel chocks, place into pump, check water &amp; foam gauges, turn Husky System ON, select proper discharge, nozzle &amp; pressure. Flow Class A foam and adjust proportion percentages (less than 5 gallons of foam).</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>2.</td>
<td>Refill Class A foam tank to full and flush system and hoses</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>Transfer to drafting Class B foam from a 5 gal bucket with pick up tube. Switch to in-line educator and draft Class B foam.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>Flush system, educator, hoses &amp; nozzle with clean water</td>
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<td>☐</td>
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<tr>
<td>5.</td>
<td>Refill water tank and return pump to road position.</td>
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<tr>
<td>6.</td>
<td>Put all necessary equipment away.</td>
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<tr>
<td>7.</td>
<td>Discuss Class A vs. Class B foam applications</td>
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**Overall Skill Sheet Performance Outcome** | ☐ | ☐ | ☐ | ☐ |

Allotted Time: 30 minutes

Actual Time: __________________

Evaluator Comments____________________________________________________________________
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Retest Approved by ___________________________________________________________________
_________________________________       _______________________________    _______________
Evaluator Signature

FD #

Candidate Signature

Date

_________________________________      ________________________________   _______________
Retest Evaluator Signature

FD#

Candidate Signature

Date
Date________________________
Candidate Name______________________________ FD Number______________________________

**Driver Operator Skill – Sprinkler System (FDC)**

**Task:** Safely and properly supply a sprinkler system with water from a pressurized water source

**Performance Outcome:** The candidate shall be able to properly connect to a hydrant, operate pump from a pressurized water source, attach proper hose lines to a building’s FDC and flow at the proper rate. Break down operation and return pump, hydrant, and all equipment back to service.

**Conditions:** Given PPE (boots, pants, gloves, helmet) hydrant, hydrant bag, hoses, appliance

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<th>Fail</th>
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<tr>
<td></td>
<td><strong>Pumping</strong></td>
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<tr>
<td>1.</td>
<td>Properly grab a hydrant, and safely park vehicle in the most advantageous position for supplying the sprinkler system with water. Chock tires.</td>
<td>☐</td>
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<tr>
<td>2.</td>
<td>Engage pump and establish pressurized water source.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>3.</td>
<td>Attach proper hoses from vehicle to building with proper hoses and appliances. Either 3” or 5” hoses will be used. (FDC size is a variable, 2.5”, 2.5” x 2.5”, 4”, or 5”)</td>
<td>☐</td>
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<td>4.</td>
<td>Flow water at 150psi (pump rated capacity) and discuss when to flow at higher pressures (elevation, current sprinkler system effectiveness)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>5.</td>
<td>Shut pumping operation down, and break down hose connections.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>6.</td>
<td>Refill water tank if needed and shut down hydrant. Place pump into road position.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>7.</td>
<td>Return all equipment back to service</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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**Overall Skill Sheet Performance Outcome**

☐ ☐ ☐ ☐

Allotted Time: 30 minutes Actual Time: _________________

Evaluator Comments__________________________________________________________

____________________________________  ________________________________  _______________
Evaluator Signature                   FD #                             Candidate Signature          Date

Retest Approved by _____________________________

____________________________________  ________________________________  _______________
Evaluator Signature                   FD #                             Candidate Signature          Date

Retest Evaluator Signature            FD# #                             Candidate Signature          Date
Date________________________
Candidate Name_________________________ FD Number____________________

**Driver Operator Skill – Pumping Aerial Waterway**

**Task:** Safely and properly flow water through the aerial waterway and understand its limitations

**Performance Outcome:** The candidate shall be able to properly park the aerial truck, set chocks and establish a pressurized water source. Properly place the ground plates and jacks and set the safety pins. Place the aerial ladder into a blitz attack position and flow proper water flow. Re-position to a defensive position and flow the proper water flow.

**Conditions:** Given PPE (boots, pants, gloves, helmet) Supply hose

<table>
<thead>
<tr>
<th>NO.</th>
<th>Task Steps</th>
<th>First Test</th>
<th>Retest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Pumping</strong></td>
<td>Pass</td>
<td>Fail</td>
</tr>
<tr>
<td>1.</td>
<td>Safely and properly park aerial apparatus. Chock tires. Establish a pressurized water source and circulate water.</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>2.</td>
<td>Place ground plates and jacks, then secure the pins. Verify proper aerial pressure to turn table.</td>
<td>□</td>
<td>□</td>
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<tr>
<td>5.</td>
<td>Close valve and drain waterway. Top off water pump and shut down the pump. Shut down hydrant.</td>
<td>□</td>
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<tr>
<td>6.</td>
<td>After aerial is drained, bed ladder. Pull jack pins, stow jacks and put jack plates away.</td>
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<tr>
<td>7.</td>
<td>Discuss pumping the waterway from an Engine’s pump</td>
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</table>

**Overall Skill Sheet Performance Outcome**

Allotted Time: 30 minutes

Evaluator Comments____________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

Retest Approved by __________________________________________________________________

Evaluator Signature ____________________________ FD # ____________________________ Candidate Signature ____________________________ Date ____________________________

Retest Evaluator Signature ____________________________ FD # ____________________________ Candidate Signature ____________________________ Date ____________________________
**Driver Operator Skill – Aerial Driver Checkoff**

**Task:** Safely and properly drive the Aerial Platform to a designated location and setup the truck for aerial operations.

**Performance Outcome:** The candidate shall be able to properly park the aerial truck, set chocks and engage the aerial platform. Properly place the ground plates and jacks. Properly operate the aerial platform to obtain all of the objectives listed below.

**Conditions:** Given PPE (boots, pants, gloves, helmet) Supply hose

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<td></td>
<td></td>
<td>Pass</td>
<td>Fail</td>
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</table>

**Vehicle Operations**

1. Battery / Ignition
2. Starting Procedures
3. Headlight switch
4. Wiper controls
5. Warning Lights
6. High Idle
7. Sirens / Air Horn / Siren Brake
8. Gauges / Info Display
9. Vehicle Height Indicator
10. Jake Brake Operations

<table>
<thead>
<tr>
<th>Driving Course</th>
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<tbody>
<tr>
<td>NO.</td>
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</tbody>
</table>
1. Tight Right Turn
2. Tight Left Turn
3. Maintain Lane
4. Drive on HWY 41/45 with two lane changes

**Aerial Operations**

1. Aerial Master, Aerial PTO, Front brake lock switches
2. Wheel Chocks
3. Ground Pads, Outrigger deployment
4. Aerial Operations
   a) Spot Pitched Roof
   b) Spot Commercial Roof
   c) Spot Window
   d) Lower near ground
5. Nozzle Controls
6. Discussion on Parapet Operations
7. Emergency / Auxiliary Operations
8. Video display for FLIR camera

<table>
<thead>
<tr>
<th>Overall Skill Sheet Performance Outcome</th>
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<td>NO.</td>
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Allotted Time: ____________________ minutes

Actual Time: ____________________

Evaluator Comments: ____________________
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<tbody>
<tr>
<td>Retest Evaluator Signature</td>
<td>FD#</td>
<td>Candidate Signature</td>
<td>Date</td>
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