Rural Firefighting

Study Guide

Establish and Deliver Water Supplies Using Light Pumps

RFLP-1

Fire & Rescue Services ITO

NATIONAL TRAINING

Status of this Document

This document is issued by the National Rural Fire Authority.

What This Means
It is written to comply with:

- other National Training material
- National Rural Fire Authority best practice
- Forest and Rural Fires Act 1977
- Fire Service Act 1975
- Health and Safety and other relevant legislation
- New Zealand Qualifications Authority requirements
- Fire and Rescue Services Industry Training Organisation (FRSITO) requirements.

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Recommendations for changes to this material should be sent to National Rural Fire Authority.

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Study Guide Introduction

Overview

Welcome to Establish and Deliver Water Supplies using Light Pumps. This course is made up of this study guide, a workbook and practical training session including assessment. During the course you will learn about:

1. Pumps and Equipment.
2. Water Supplies.
3. Pump Operation.
4. Pump Operation in the Field.
5. Recommissioning.

Read through this study guide and complete the workbook before your practical training date. This will ensure that you are familiar with the subject and can highlight any questions for the training session.

Course Objectives

After studying this material, you should be able to demonstrate knowledge of:

- pumping principles
- preparing a pump site
- setting up a light portable pump
- operating a light portable pump
- recommissioning a light portable pump after use
- reinstating a pump site.

This course provides evidence towards the achievement of unit standard 3270 Establish and deliver water supplies for fire fighting, and unit standard 21417 Operate light portable pumps in a vegetation fire environment.

Theory

There are five theory sections in this course. Once you have completed all five sections complete the workbook and make notes of any questions you want to ask during the practical training.

Assessment and Evidence

Because each participant's practical experience differs, you will need to check with an approved assessor and discuss the requirements for you to achieve the unit standard. This could include attestation of previous practical experience and/or practical assessment.

A properly maintained work record will support your portfolio of evidence for use as evidence for assessment against unit standards. You'll need to maintain a record of relevant work experience, together with an evaluation of tasks completed at an incident by the relevant supervisor.

Practical Training and Assessment

There is a practical component to this course and this comprises of a practical session and a practical assessment. This needs to be completed with an approved assessor for this course. This training is made up of three parts:

1. The instructor demonstrates the use of the waterway equipment and the trainees practise using each item.
2. Trainees work in a crew to set up and use waterway equipment and practise these skills.
3. Trainees complete the supervised assessment.

Section 1: Pumps and Equipment

Pump Types

Relevance to Equipment

This study guide and the associated assessment refer only to light portable pumps; the other types of pumps are described for information and comparison only.

Pump Classification

The National Rural Fire Authority pump types are listed below, along with their abbreviations and examples of the pumps that meet each classification.

Type	Abbreviation	Capacity	Examples
High Pressure / Low Volume	HP/LV	100 l/min at 1800 kPa (light portable pump)	Wajax Wick 375
Low Pressure / Medium Volume	LP/MV	300 l/min at 300 kPa	Firemaster HP50, HP80 Waterous Floto STD
Medium Pressure / Medium Volume	MP/MV	500 l/min at 500 kPa	Firemaster 10, 18 Waterous PB18 2515
High Pressure / Medium Volume	HP/MV	900 l/min at 700 kPa	Firemaster 15, 20 Waterous E603

Light Portable Pumps

Light portable pumps are also defined as:

- being started and primed by hand
- having no instrumentation, eg pressure gauges
- having output that is controlled by waterway equipment installed on the output side of the pump, e.g. a controlled dividing breeching.

Wajax

The Wajax is the most common light portable pump used for vegetation firefighting. It is the pump referred to throughout this study guide unless otherwise stated.

There are four models of engine used to power Wajax pumps:

1. Wick 375 with a solo engine.
2. MK III Wajax with a Rotax engine.
3. MK IV Wajax with a Rotary engine.
4. MK V Wajax with a Robin engine.

The other important features of the Wajax pump are:

- four-stage centrifugal pump*
- inlet = 50 mm male Camlock
- outlet = 41 mm (forestry) male threaded screw.

A multi-stage pump produces high pressures by passing water through each stage one after the other, each stage increasing the pressure.

Figure 1.1 – Wajax pumps – left to right: MK V Robin engine; MK III Wick engine

Figure 1.2 – Cutaway Wajax pump showing the arrangement of the impellers and distributors

Pump Equipment

Pump Set

A High Pressure / Low Volume Pump Set may be made up of the following:

- 1 Wajax (or equivalent) pump
- 1 suction hose and foot valve
- 1 spare spark plug and spark plug spanner
- 4 packs of delivery hose
- 3 short delivery hoses (2 and 8 m of 41 mm hose)
- 1 pair of earmuffs (Class 4)
- two 41 mm controlled dividing breechings
- two 41 mm nozzles
- 1 shovel
- 1 fuel can (minimum 10 litres, appropriately colour coded)
- 1 hydroblender or Class A foam proportioner and foam concentrate.

As you work through the rest of this study guide, most of these items will be discussed. Others may be more fully explained in other material.

Pump Accessories

Accessories that may be required in addition to the High Pressure / Low Volume Pump Set include:

- torch and hand-held radios
- priming pump
- direct pumping relay adaptor
- foam nozzle
- hose strangler
- hose ramps (41 mm hose)
- bypass hose / tank filler adaptor
- self-supporting portable dam
- Class A foam inductor
- pump / hydroblender carrying frame.

As you work through the rest of this study guide, most of these items will be discussed. Others may be more fully explained in other material.

Fuel

Most light portable pumps use two-stroke engines because they are lighter than a four-stroke engine of equivalent power.

Two-stroke engines require lubricating oil to be mixed with their fuel.

Fuel containers and fuel tanks on pumps should be colour coded to avoid using the wrong fuel in a pump; using fuel without lubricating oil in a two-stroke engine will cause damage. Containers, tanks and swing tags are coloured blue (see figure 1.3).

Figure 1.3 – Fuel type identification tag

Suction Hose

Suction hose is constructed differently to delivery hose because it needs to resist collapsing when the pump creates negative pressure within the hose. Common types of suction hose have spiral wire reinforcing or ribs to maintain their shape and provide the necessary strength.

Wajax suction hose is fitted with a 50 mm female Camlock coupling at one end and a 50 mm BSP thread at the other to accept a combined strainer and foot valve.

Strainer and Foot Valve

The combined strainer and foot valve is designed to do several jobs:

- it prevents debris larger than the pump can handle being drawn into the pumps
- the foot valve is a one-way valve that allows water to enter the hose but prevents it from draining. The foot valve prevents the pump from losing prime if the suction hose is lifted out of the water
- by ‘pumping’ the suction hose backwards and forwards with the strainer/foot valve submerged, the hose can be filled as a way of priming the pump.

Basket strainers woven like a wicker basket are used when additional filtering is required.

Summary

Use this summary checklist to check you understand the main points of this module.

Light portable pumps

- started and primed by hand
- have no instrumentation
- have output controlled by waterway equipment.

Wajax features

- four-stage centrifugal pump*
- inlet = 50 mm male Camlock
- outlet = 41 mm (forestry) male threaded screw.

Fuel

- usually two-stroke.

Section 2: Water Supplies

Types of Water Supplies

Types of Water Supplies

Firefighting water supplies come in three basic groups:

- static water supply
- pressurised water supply
- mobile water supply.

Static Water Supply

Static water supplies can include:

- lakes
- rivers and streams
- ponds
- dams
- the sea
- swimming pools
- wells.

Pressurised Water Supplies

Pressurised water supplies are those in which water is distributed under pressure from gravity (head) or pumps, eg:

- urban water mains (reticulated supply)
- private water schemes, eg gravity fed from a tank.

Mobile Water Supplies

Mobile supplies are those by which water is transported to the fire ground from a distant source, eg:

- tankers
- fire appliances
- helicopters.

Figure 2.1 – Rural Fire Force Tanker

Limited Water Supplies

Limited water supplies often include:

- tanks
- wells
- portable dams
- natural and manmade dams
- swimming pools.

A limited supply must be used sparingly. If the supply is insufficient, water may need to be brought to the fire ground, or dry firefighting techniques may need to be used.

Portable Dams

Portable dams can be purpose-built or improvised, and they can be used for a number of purposes:

- to hold a water supply delivered by tanker
- as part of an open relay
- as large 'Dipping Dams' for filling helicopter buckets
- for the mixing of additives with firefighting water.

Figure 2.2 – Portable dam

You will be required to set up a portable dam as part of your assessment.

Unlimited Water Supplies

An unlimited water supply has either a volume or a flow that is far in excess of your requirements, eg:

- the sea
- rivers
- lakes.

Suitability of Water Supply

Pre-planning

Pre-planning identifies suitable water supplies in advance of an incident. This reduces the time and effort required to locate and establish a water supply when required.

Figure 2.3 – Signage for a pre-identified water supply

Hidden Water Supplies

Water supplies are not always apparent. They can be:

- hidden from view behind or under vegetation
- too low a flow to be useful.

Hidden water supplies can be assessed and recorded as part of pre-planning.

Access

Access to a water supply can limit its usefulness to you. Potential solutions can include:

- cutting an access track through vegetation
- clearing and/or flattening out a space for a portable pump.

Safety Note

If the route to access a water supply is difficult, identify an escape route for personnel working at the supply.

Assessment of Water Supply

Not all water sources are suitable for firefighting use. You need to be able to assess a supply and decide upon its suitability for firefighting.

Location

When assessing a water source for firefighting purposes, consider the following:

- is it adjacent to the fire area?
- will the location be threatened by the fire or smoke?
- are there adequate communications at this point?
- is there a safe escape route?
- has a safety zone been identified?
- have LACES (the pink card) been considered?

Access

When assessing the accessibility of a water source for firefighting purposes, consider the following:

- what type of pump will be used (portable, trailer or vehicle mounted)?
- how close to the water can the pump be located?
- is there firm ground on which to place the pump or park the appliance?
- can the pump be safely carried or driven to the pump site?
- is the site tidal or does the water level rise and fall (eg hydro-power rivers or irrigation canals) during the day?
- what are the requirements of the pump/s being used?

Quality

When assessing the quality of water available for firefighting purposes, consider the following:

- fresh water is better than stagnant water
- clear water is better than muddy water
- is it weedy or does it have floating debris?
- hard ground is better than soft ground
- when the pond level is lowered, will you be left with only mud?
- sea water is corrosive and hard on equipment.

Quantity

When assessing the quantity of water available for firefighting purposes, consider the following:

- how much is there? How much will you need?
- is it a limited or unlimited supply?
- is there an in-flow of water to top up the supply?

Depth and Flow

Suction hose in shallow water will tend to create a vortex (whirlpool) that allows air to be drawn into the pump. Air in the water entering the pump can:

- reduce performance
- cause the pump to lose its prime.

Loose Material

Mud, silt, vegetable matter, stones and rubbish in the water supply can block the strainer on the suction hose, reducing the volume the pump can deliver.

There are ready-made suction trays and any number of improvisations that can minimise this problem.

Note: Place the suction hose in water with a depth of at least three times the diameter of the strainer to prevent a vortex forming.

Figure 2.4 – Basket strainer

Figure 2.5 – A hose pack used to minimise clogging of a suction strainer

Figure 2.6 – A purpose-built suction tray (left) and improvised tray using a shovel

Estimation of Volume

Rectangular Container

To calculate the capacity of a rectangular container, eg a rectangular swimming pool or tank:

Capacity (in *litres*) = length (m) × breadth (m) × depth (m) × 1000

If the container has an uneven depth, the average depth in the calculation is used:

Capacity (in *litres*) = length (m) × breadth (m) × average depth (m) × 1000

For example:

A pond is approximately 5 metres by 10 metres and varies from 1 to 3 metres deep.

Capacity (in *litres*) = 5 (length) × 10 (breadth) × 2 (average depth) × 1000
= 100,000 litres

Your estimations will have to take into account the practicalities of how much water you can actually use. The section on improving water supplies deals with some of the possible limitations on supply and ways to counter them.

Usage Rate

The usage rate is the volume of water that is used in a given period of time. By estimating the usage rate, you can estimate:

- how long a limited supply will last
- whether you can supply water fast enough to satisfy demand.

To estimate the usage rate, you need to know:

- how many pumps will be used
- the approximate output capacities of each pump.

To find the usage rate of one or more pumps, add the output capacities of all the pumps using the same supply.

For example:

1 × medium volume pump @ (900 litres per minute) 54,000 litres per hour and

2 × Wajax pumps @ (150 litres per minute) 9000 litres per hour.

54,000 + 9000 + 9000 = 72,000 litres per hour

Duration Estimation

To estimate how long you will be able to supply water from a fixed supply, divide the capacity of the supply by the usage rate, eg:

$$\frac{\textbf{50,000 litres}}{\textbf{900 litres per hour}} = \textbf{approximately 55 minutes}$$

You will be able to supply water for nearly 1 hour.

Water supply	**Volume**	**Pump**	**Pump output**	**Duration of supply (approx)**
Large pond	50,000 lt	Aqualite	900 lt/min	55 mins
Large pond	50,000 lt	2 × Wajax	300 lt/min	2 hrs 45 mins
Portable dam	2,000 lt	Wajax	150 lt/min	13 mins
Fire appliance	3,600 lt	Wajax	150 lt/min	24 mins
Fire appliance	3,600 lt	Darley or other PTO pump	1320 lt/min	3 mins

Figure 2.7 – Examples of duration of various supply and pump combinations

Improving Water Supply

Boosting the Capacity of a Supply

Not all water supplies are adequate for the task. Where the capacity of the water supply is marginal, consider other ways to increase the volume or flow of water to the fire ground.

Hydrant Supplies

If working from a pressurised supply, such as reticulated water mains:

- use multiple hydrants
- use hydrants on separate water mains
- ask the local council or controlling authority to boost the pressure in the main.

Pumped Supplies

If relying on pumps to deliver water to the fire ground, the supply can be improved by:

- using multiple pumps
- using larger-capacity pumps
- relay pumping.

Mobile Supply

When relying on tankers, the rate of supply can be improved by:

- increasing the number of vehicles in the shuttle, eg when utilising Fire Service appliances that may only have 1300–1500 litres onboard
- using larger tankers to get more from each trip, eg dedicated Rural Fire Force tankers, local authority water carriers or even milk tankers.

Hose Supply

The volume of water supplied to the fire ground can be increased by:

- using larger-diameter hose
- using twin hoses.

Assuming the pump can deliver a great enough volume, the approximate relationships are as follows:

- 41 mm hose will deliver about 2.5 times as much water as does 25 mm hose
- 70 mm hose will deliver nearly three times as much water as does 41 mm hose.

Capturing the Flow

Where there is sufficient volume but the water is just too shallow, digging a hole or damming the flow to create a pool can make the water deep enough.

Figure 2.8 – Dam created to increase depth

Creating dams and digging holes to divert flow or create a pool can also allow you to utilise more of the volume in a flowing source.

Summary

Now, use this summary checklist to check you understand the main points of this module.

Water supply

There are many possible sources of water that may be available to you at an incident.

Types of water supplies

- static
- pressurised
- mobile.

Limited water supplies

Limited supplies will require you to manage water usage, improve the supply or change tactics.

Hidden water supplies

- hidden from view
- too low a flow to be useful.

Assessment of water supplies

- location
- access
- quality
- quantity
- depth and flow.

Improving water supplies

- boost the capacity of the supply in hydrants, pumps, mobile and hose supplies.
- capture flow by digging a hole or dam to create a pool.

Section 3: Pump Operation

Pump Operation and Hydraulic Principles

Jet Reaction

Jet reaction is the force generated by the moving jet of water exiting a nozzle. As a pump operator, you need to be aware that a nozzle and hose that isn't under control will whip around at high speed and can cause serious injuries and damage if it strikes people or objects.

While operating a pump, you need to be ready to react to an out-of-control hose by shutting off the water.

Sudden variations in pressure at the nozzle can also unbalance the firefighter holding it if the jet reaction takes them by surprise. Opening valves too quickly is the most common way of rapidly altering the jet reaction.

Pressure

Pump operators control the flow and pressure of water being supplied to firefighters at the nozzle.

As the water travels through the hose on its way to the nozzle, there is a loss of energy due to:

- the height of the branch/nozzle above the pump
- friction in the hose.

Pump operators need to provide the correct pressure at the pump to overcome both these losses so the pressure delivered at the nozzle(s) is sufficient.

Head

Head (or back pressure) is the pressure generated by the weight of water above the pump.

Friction Loss

Friction loss is the loss of pressure between the pump and the end of a hose line when pumping water.

Overcoming Friction Loss

Friction loss can be reduced in several ways, depending on the equipment available:

- use lined (non-percolating) hose for water delivery over long distances
- use larger-diameter hose – doubling the diameter will reduce friction losses by a factor of four (for the same flow)
- twin hose lines – using two hoses will allow you to deliver the same flow with a quarter of the friction loss or deliver twice the flow for the same friction loss
- use relay pumping.

Nozzle Pressure

Nozzle pressure is the pressure remaining at the end of the hose after head and friction losses.

A typical forestry branch requires a minimum pressure of 350 kPa for effective operation.

Cavitation

Cavitation occurs when bubbles form inside the pump; it is caused by trying to pump more water than is available. Cavitation can be recognised by a rattling sound and can damage the pump.

The immediate solution is to reduce the throttle setting on the pump to match the available water supply.

Crackling Jet

A crackling jet is an early indication that air is drawn into the pump along with the water. Check the suction hose to ensure:

- the strainer is far enough below the water surface to prevent a vortex forming
- the connections are tight and free from debris and the seals are in place.

As more air enters the pump, it may lose its prime.

Blast Back

Directing a jet into soft ground can result in debris being blasted back at the firefighter. During mop-up, it may be necessary to reduce the pump pressure to minimise this effect.

Water Hammer

If the flow of water through a hose is stopped suddenly, e.g. by slamming shut a valve, the sudden jump in pressure can burst hoses and damage other equipment. Always open and close valves slowly.

Gravity

When the nozzle is below the pump, the head pressure created increases the nozzle pressure. You may need to decrease the engine speed to maintain a suitable nozzle pressure.

For mopping up, gravity alone may provide sufficient nozzle pressure.

Refuelling

Before Refuelling

Stopping the pump to refuel needs to be carefully managed to minimise the disruption to the firefighters you are supplying with water. To make the refuelling stoppage as short as possible, do the following:

1. Ensure you have enough fuel of the correct type. (Make sure by checking that the fuel can or its label and the fuel tank have the same colour code.)
2. Notify the nozzle operator.
3. Ensure everyone relying on the hose lines you control has backed off to safe positions.
4. Close down the hose line supply.
5. Stop the engine.

During Refuelling

1. Avoid spilling fuel by using a funnel and pour slowly.
2. In calm conditions, wait for a minute after refuelling to allow fuel fumes to clear.
3. Check the state of the soap capsules in the hydroblender or foam supply.

Note: The new pumps have remote fuels tanks and different rules would apply, i.e. you change tanks without shutting down with relative safety. You can refuel a tank as it would be approximately a metre from the engine.

Safety Note

Care must be taken while refuelling.

Priming

Priming a Wajax Pump

'Prime' refers to having the suction hose and pump case full of water. If they are not, the pump will not move water.

Light portable pumps are primed by hand via a number of different methods.

Note: The pump will not pump air and revving the engine will not prime the pump.

Using Suction Hose Fitted with a Foot Valve

1. Open any waterway equipment on the discharge side of the pump, e.g. controlled dividing breeching (this allows air to exit the pump as water enters it).
2. Hold the suction hose, close foot valve and move it backwards and forwards vigorously while submerged.
3. Priming is complete when water exits the pump via the outlet.
4. Start the engine.

Tip: Avoid driving the foot valve into the bottom of the water supply. This can force loose material into the valve, resulting in a blocked valve or damage to other equipment.

Hand Priming Pump

1. Attach the priming pump to the outlet of the pump.
2. Pump the priming pump until water comes out of it.
3. Remove the priming pump.
4. Start the engine.

Figure 3.1 – Wajax priming pump

Using a Container

1. Remove the filler cap on the top of the pump..
2. Fill the pump and suction hose through the filler cap, using any suitable container. Continue pouring water into the filler cap until it overflows.
3. Replace the filler cap.
4. Start the engine.

Note: Never run a Wajax pump without the pump being primed. Running a Wajax while dry will damage the seal and bearing around the pump shaft.

Starting the engine

Starting a Waxjax Pump (Cold Start)

1. Check that all necessary equipment is connected, e.g. controlled dividing breeching, bypass hose.
2. Prime pump.
3. Open the air vent on the fuel tank.
4. Turn fuel on.
5. Close the choke.
6. Set the throttle to 1/3.
7. Turn the ignition (cut-out switch) to on.
8. Grip the starter handle firmly and pull until you feel resistance. Let the handle retract and then pull the handle vigorously. Keep pulling until the motor fires.
9. When the motor fires, slowly open the choke.

Tips for Starting

The first part of step 8 ensures the piston is at the top of the compression stroke when you pull the starter. This avoids the jerking and ‘rebounding’ that sometimes occurs.

Avoid pulling the starting cord to its full extension, as this can damage the mechanism.

Starting a Waxjax Pump (Hot Start)

As per cold start but **DO NOT** use choke.

Engine Troubleshooting

Troubleshooting Tips

If the engine fails to start or is not running properly, check the following:

1. Ignition switch, set to ON.
2. Fuel tap, turned to ON.
3. Fuel tank vent, set to OPEN.
4. Fuel level, tank full.
5. Choke, closed for cold starting or flooding, open for hot starting.
6. Air intake, clean and unobstructed.
7. Spark plug, is it clean?
8. Is the engine flooded?

Engine Flooded

Repeated attempts to start an engine can cause excess fuel to 'flood' the engine. Different engines have different procedures for dealing with flooding.

This is the procedure for a Wajax pump:

1. Remove the air filter.
2. Turn off the fuel.
3. Open the throttle fully.
4. Attempt to start engine – when engine starts, turn fuel on and replace the air filter.
5. Choke, closed for cold starting or flooding, open for hot starting.

Summary

Now, use this summary checklist to check you understand the main points of this module.

Pump operation

- starting a Wajax pump
- do not use choke when engine is warm.

Refuelling

- stop the pump before refuelling
- use correct colour-coded fuel.

Priming

- a pump will not pump air
- suction hose fitted to the foot valve
- hand priming pump
- using a container.

Section 4: Pump Operation in the Field

Locating a Light Portable Pump

Choosing a Location

A few extra minutes spent choosing the best location and improving your water supply will result in the best possible water supply, and less chance of having to relocate in the middle of an incident.

Dropping of the Water Level

You need to consider the effect of removing water from a supply. As the water's edge retreats, you will have to relocate the pump. You may end up trying to pump while knee deep in the mud that has been exposed as the water retreated.

Pumping from the sea, an estuary or a creek may also mean the water's edge moves away from you as the tide goes out, and then floods your pump location as it rises again.

Solid Ground

Setting up your pump on solid bare ground provides several advantages:

- safe footing
- no risk of exhaust setting fire to vegetation
- the pump stays level.

If the only available area is on soft ground or is covered in vegetation, you may need to clear and level a space on which to place the pump. A shovel is included as part of a light portable pump kit for clearing and levelling ground.

Level Ground

An engine will tolerate running on a gentle slope. However, if the slope is too steep, it can result in oil or petrol not flowing around the engine properly.

Cut a level platform into sloping ground, if necessary.

Securing the Pump

Physically securing the pump, usually by tying it to something, is sometimes necessary to prevent it from moving.

Distance and Height from Water

Locating your pump too far from the water, or too high above it, will require you to carry and use more suction hose.

The greater the height between the water and the pump, the less water the pump will be able to move, because energy is wasted in lifting the water up to the pump. The practical limit for most light pumps is about 2 metres; at this height, the output of the pump will be about 2/3 of the rated output.

Safety Note

An ideal location for pumping may not be a safe location. Be wary of placing yourself at risk by positioning a pump close to fast-flowing water or deep water, at the edge of a high bank or where mud and obstacles could cause you to trip and fall.

Clear Space around the Pump

The exhaust from a pump or a hot engine can ignite vegetation. The shovel in a light portable pump kit can also be used to clear an area around the pump to prevent a highly embarrassing situation in which you start your own fire.

Wetting the vegetation around the pump, and keeping it wet, is also an option.

Time and Resources to Set Up the Pump

If water is required quickly, you may need to choose a less-than-ideal location in order to get set up quickly.

A lack of resources or personnel may also restrict your choices.

Try to develop a back-up plan to use if you have to relocate to improve the position or water supply, or if you get time and resources to do the same.

Exhaust Fumes

Engine exhaust contains toxic and asphyxiating gases. Even when working in the open, you can be exposed to harmful levels of exhaust if the air is still.

Most of the harmful components of exhaust are heavier than air and will accumulate in low spots and enclosed areas. Even pumping in the bottom of a small gully could expose you to harmful levels of exhaust.

Hearing Protection

Always wear a minimum of grade four ear protection when operating a light pump.

In order to hear any requests or instructions given over the radio, stand away from the pump.

Operator Safety – General

Remember to apply LACES (the pink card), even when you are operating a pump.

Figure 4.1 – A clear, level pump position and a pump operator wearing personal protection equipment (PPE).

Using Waterway Equipment

Controlled Dividing Breeching

The two most common uses for a controlled dividing breeching are to:

- provide a bypass hose
- control the flow to two separate hose lines.

'Water on!' Through a Controlled Dividing Breeching

These instructions for delivering water are designed to minimise sudden changes in flow and pressure that can cause problems for firefighters and damage equipment.

1. Open the hose side of the dividing breeching (slowly).
2. Close the bypass side of the dividing breeching (slowly).
3. Increase the engine speed to deliver the required pressure.

'Water off!' Through a Controlled Dividing Breeching

These instructions for delivering water are designed to minimise water hammer, which can damage equipment:

1. Open the bypass side of the dividing breeching (slowly).
2. Reduce engine speed to 1/3 or less.
3. Close the hose line side of the dividing breeching (slowly). This will hold water in the hose line (especially when pumping uphill).

Hand Signals

When portable radios are not available, clear, commonly understood hand signals are less likely to be misunderstood than shouted instructions or improvised signals.

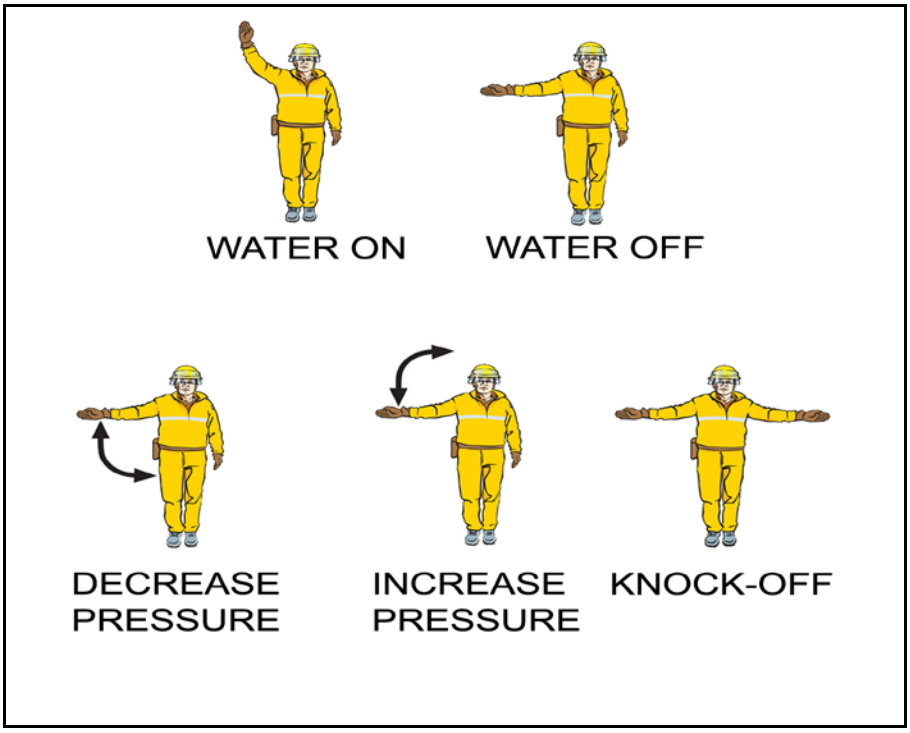

Figure 4.2 – Hand signals for hose lines

Runners (Messengers)

When hand signals and portable radios cannot be used, messages can be sent by runner:

- a verbal message relying on the memory of the runner is sufficient for brief messages.
- a written message will be necessary for messages that are too long or complex to be reliably held in memory, eg messages between Crew Leader and Incident Controller.

Controlled Dividing Breeching

A controlled dividing breeching is used to split a delivery into two parts that can be independently controlled, or to bypass or release pressure when pumping uphill.

Use of Short Delivery Hoses

Rather than connecting the controlled dividing breeching directly to the pump outlet, you can run a short hose between the pump and the breeching. Separating the pump and the breeching provides several advantages:

- the pump operator is removed from the noise of the pump.
- radio interference from the pump engine is reduced.

Figure 4.3 – Controlled dividing breeching connected via a short length of hose

Figure 4.4 – Controlled dividing breeching connected on the pump outlet

Bypass Hose

If a pump is left running without water flowing through it, cavitation may occur as the water heats up. Allowing a small amount of water to pass through the pump will keep it cool. A bypass hose can also help to minimise water wastage by returning water to a static supply, e.g. a portable dam.

Note: Attach a tank fill adaptor to the end of the bypass hose to stop it snaking while under pressure.

Figure 4.5 – Bypass hose in operation in cleared area

Waterway Couplings

A variety of waterway equipment and adaptors exist to suit the different pumps, hose and water supplies available.

The standard hose and waterway couplings are:

- 41 mm (rural) threaded
- 70 mm (fire service) instantaneous.

Figure 4.6 – 41mm and 70 .mm hose

Suction Hose Couplings

The standard suction hose couplings are:

- 50 and 75 mm Camlock (rural, water tanks, wells)
- 75 and 100 mm round thread (Fire Service standard couplings).

Figure 4.7 50 and 75 mm camlock suction hose

Figure 4.8 – 75 and 100 mm standard hose couplings

Delivery Hose Adaptors

Delivery hose adaptors allow the mixing and matching of equipment on the fire ground, eg the feeding of forestry hose from Fire Service equipment.

Common adaptors include:

- 70 mm male instantaneous to 41 mm (single or twin outlet) male forestry
- 41 mm female to 50 mm female Camlock (Wajax pump relay adapter).

Figure 4.9 –Male Fire Service instantaneous to 41 mm male forestry adaptor

Relay Pumping

Reasons for Relay Pumping

If the distance or height over which water must be delivered is too great, a relay pumping system will be required.

Distance between Pumps

The rule of thumb for how many lengths of hose you can have between two pumps in a relay using 41 mm hose and Wajax pumps is:

flat ground = 12 lengths

steep terrain = 6 lengths

If steep terrain limits your choices for pump sites, place the pump lower in the system rather than higher.

Relay Types

A pump can be introduced into a relay system either by:

- using a relay adaptor, known as a closed relay or pressure-fed system
- using a portable dam/s, known as an open relay or static system.

Closed Relay Pumping

Connecting the delivery hose from one pump directly to the inlet of the next pump using a relay adaptor is called a closed circuit system.

Each pump in the relay boosts the pressure, making up for the losses from friction and pumping uphill, to ensure there is adequate pressure at the nozzle.

Figure 4.10 – Wajax in a closed relay being fed via a relay adaptor

Open Relay Pumping

Delivering water from the first pump into a portable dam and taking water from the dam via the suction hose from the next pump is called an open system.

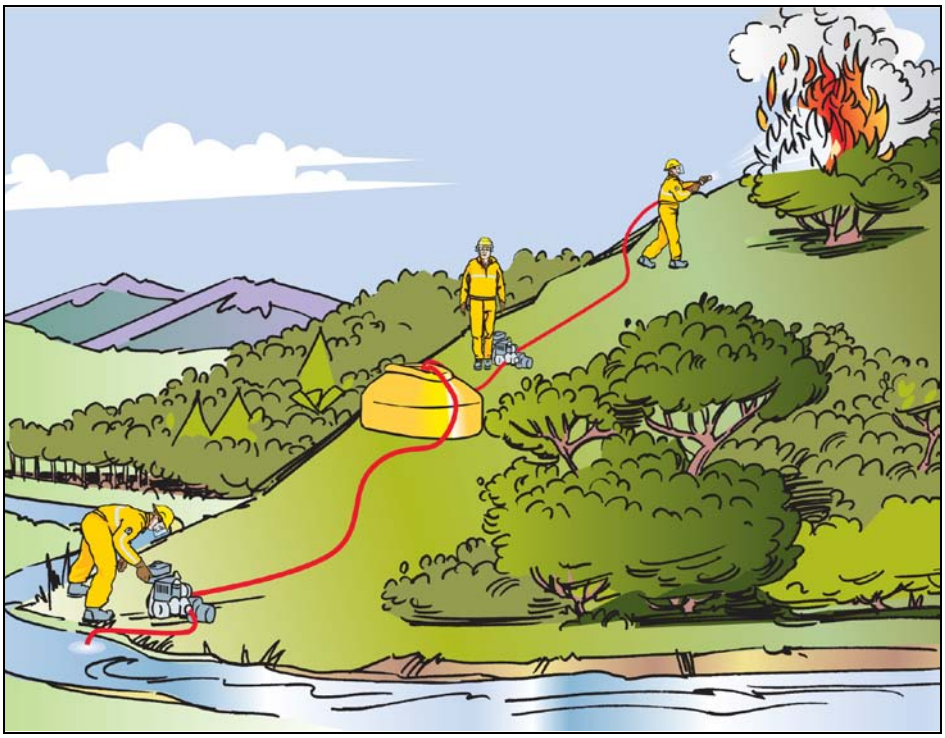

Figure 4.11 – Open relay

Figure 4.12 – Portable dam used as part of an open relay

Relay Adaptor

These instructions are designed to get a relay adaptor connected quickly and with minimal disruption to the pumping operation:

1. Call for water off from the base pump.
2. Disconnect the hose line at the appropriate point.
3. Place relay pump in position.
4. Connect the relay adaptor to the pump inlet.
5. Connect delivery hose from the last pump in the system to relay adaptor.
6. Connect the hose line to the dividing breeching on the outlet side of the relay pump.
7. Call for water on from the base pump at full speed.
8. Start the relay pump when water arrives.

To adjust the engine speed of your pump to suit the pressure of water coming into the inlet, feel and observe the hose:

- if the hose is hard, increase engine speed.
- if the hose collapses, reduce engine speed.
- at the correct engine speed, the hose will be just firm.

If the inlet hose is still collapsed at low engine speeds, check the water supply from the pumps below you in the system.

Portable Dam

These instructions are designed to get a portable dam established and connected quickly, and with minimal disruption to the pumping operation:

1. Set up a portable dam in an appropriate position and next to a set of hose couplings.
2. Disconnect the hose line.
3. Start filling the dam.
4. Place the pump in position and set it up with a suction hose as for an open water supply.
5. Wait until there is enough water in the dam to establish prime and maintain the required flow.
6. Start and run the pump.
7. Monitor the level of water in the dam and prevent it running dry.
8. Maintain communication with the base pump operator to control the water coming into the dam.

Relay Pumping Tips

A relay pumping system is put in place when a single pump cannot supply sufficient water at sufficient pressure to the firefighters who require it. To maximise the performance of a relay:

- always use lined hose (non-percolating) for water delivery over long distances, as lined hose produces less friction loss and provides more water
- only use percolating hose at the fire site proper where there is a risk of embers burning holes on the hose
- if using a mixture of hose to run the required distance, always use the largest diameter hose at the beginning of the system, using progressively smaller hose as it approaches the fire ground
- use the highest performance pump available at the water supply and use progressively smaller pumps as the hose line progresses
- if using a hydroblender, always move it to the last pump in a relay. This will avoid cavitations in the pumps from capsules emulsifying
- Class A foam proportioner may remain at the first pump as solution, in a relay, on contact with air, at the nozzle.

Water Additives

Advantages

Because water isn't always available in sufficient quantities, additives can allow you to make better use of the supplies you do have.

Water Additives

Additives change the properties of water to make it more effective in suppressing and extinguishing fires.

Water's high surface tension prevents it from penetrating into organic fuels, especially deep duff layers. If the ground is extremely dry, plain water may not soak in and may just run off.

Suppressants

Fire suppressants are designed to increase the effectiveness of water in extinguishing fire by:

- soap via capsules in a hydroblender
- Class A foam.

Fire suppressants are applied directly to the burning fuels.

Hydroblender and Soap Capsules

A hydroblender is a canister holding solid soap capsules, included into a delivery hose line. The soap capsules dissolve to provide the wetting action.

Figure 4.13 – Hydroblender connected into delivery hose

Class A Foam Solution

Class A foam solution enhances the fire-extinguishing properties of plain water for use on woody fuels.

Plain water has limitations in cooling and penetrating woody fuels, because of its high surface tension. Water's high surface tension causes water to form into droplets that tend to roll off the vegetation, limiting the cooling effect.

A solution of Class A foam concentrate in water has a lower surface tension than plain water. This means:

- each drop of water will spread out across the vegetation surface
- the increased surface area contact increases the cooling rate through more rapid heat absorption.

Foam Proportioners/ Inductors

A variety of foam-making equipment is available. As a pump operator, you are most likely to be in charge of managing a foam proportioner or inductor close to the pump.

A foam proportioner inducts foam concentrate into firefighting water.

Refer to ‘Use water and additives study guide for information on the use of Class A foam.

Figure 4.14 – Foam inductor
(between suction and pump)

Retardants

Fire retardants are chemical additives applied to unburnt fuel ahead of the fire to retard ignition.

Fault Finding

Problem Solving in the Field

There are many reasons that a pump may perform poorly or fail during operations. This section identifies common problems and solutions.

Problem	Fault	Possible solutions
Failure to prime, or prime lost	Pump not primed correctly	Repeat priming to ensure the suction hose and pump case are full to overflowing
	Air leaking into suction	Check that couplings are tight and undamaged
		Check rubber washers in couplings to ensure they are in place and undamaged
	Air entering via vortex	Increase the depth of the suction strainer – dig a hole or dam flow if necessary
		Place flat object, eg the blade of a shovel, over the suction strainer
Poor pump output	Blocked suction strainer or foot valve	Clean debris off strainer
		Add a basket strainer to limit debris build-up
		Place suction tray or blade of shovel under strainer
	Water level dropping, increasing loss to suction lift	Reduce height of suction lift by moving pump closer to water level
		Increase flow into a portable dam to maintain water level
Cavitation	Pump running faster than available water available can support	Reduce throttle setting, and consider ways to improve the supply

Summary

Now, use this summary checklist to check you understand the main points of this module.

Locating a light portable pump

- location
- water levels
- solid level ground
- secure the pump
- exhaust fumes
- hearing protection.

Waterway equipment

Controlled dividing breeching used to:

- provide a bypass hose
- control flow.

Communications:

- hand signals
- runners.

Couplings

- 41 mm threaded
- 70 mm instantaneous.

Relay pumping

Used if the height or distance water is to be delivered is too great for a single pump:

- open
- closed.

Water additives

Make better use of available water.

Section 5: Recommissioning

Retrieving and Recommissioning Equipment

Retrieving Equipment

If different agencies have provided equipment, you need to sort and return it to the correct fire force and/or fire agency. It's easy to overlook some items of equipment and leave them behind.

Endeavour to retrieve equipment without causing damage to it or to the environment:

- don't drag equipment along the ground, as this may cause damage.
- if you having been using foam, soap capsules or retardants, don't flush the equipment into a waterway.
- take care when using vehicles to pick up equipment.

Recommissioning

Recommission equipment on site before leaving or at the fire station, whichever is the most appropriate at the time.

All equipment must be recommissioned before storing it. This is part of the role you have. Don't leave this task to someone else.

Recommissioning equipment includes checking and servicing to ensure that:

- all items are accounted for (use the check list/s)
- all items are in full working order (damaged items have been tagged and replaced)
- pumps have been flushed with clean fresh water and refuelled
- used hose is replaced as required (some hose types will require drying and repacking at a later time, while others can be rolled and re-stowed immediately after use)
- all equipment is re-stowed on vehicles as it usually is (or as close to as possible) on the assumption that it will be required again at short notice.

Even if it is not your equipment, if you have used it, then you are responsible for recommissioning it.

Labelling of Hoses and Pumps

You're more likely to have your equipment returned to you (and sooner) if you make sure it is clearly identified.

Restoring the Site

Limiting your Impact

Before vacating the scene, ensure you leave it as close as possible to the state that you found it. The only exception is that the water level may be lower.

In an urgent situation, it's easy to just get stuck in and cut down vegetation, dig holes and make tracks to obtain access to a water supply.

You may need to:

- work with the landowner
- cleanup damage to waterways and water points.

Sometimes damage may not be repairable.

You will avoid issues by being proactive and taking some basic precautions.

Proactive Restoration

Proactive restoration requires consideration of factors that will affect your decisions about setting up water supplies, eg:

- think about the situation with respect to the fire and the time available to carry out the task
- are you establishing a water supply for initial attack? Or a back-up water supply? Or the preparation of an alternative water supply for later in the day or tomorrow? How much time do you have? More time will allow you to take actions to reduce your impact on the site.
- what is required from the water supply? What site options are there?
- will the preferred water supply site be on private or public land?
- what environmental impacts are likely if you disturb the area?
- are there any restrictions on using water additives (suppressants and/or retardants) from this site?

Restoration

Restoration can involve any or all of the following:

- notifying the landowner of the activities
- removing everything that was brought in
- cleaning up as required
- reinstating the area to its previous state
- advising the fire authority should refilling of the reservoir be required.

Recommissioning the Pump

Check that the Pump Kit is Complete

With the aim of maintaining your equipment in a ready state:

- check the contents of the pump kit against the inventory
- check for damage to any part of the pump kit.

Check that the Pump is in Working Condition

More than just checking the contents of the pump kit, the pump must also be proven to be in working order:

- perform a general visual check of the pump, looking for defects
- check the motor controls to see that they function correctly
- check the pump strainer and fittings
- check the suction hose couplings to ensure that they operate correctly and that the seals are in place and in good condition
- test run the pump
- at the end of the test running of two-stroke engines, turn the fuel tap off to run the carburettor out of fuel.

Clean and Refuel

Cleaning the pump will prevent damage:

- if the pump has been used in brackish or contaminated water, flush the pump by pumping clean water through it
- drain the pump
- clean the top of the fuel tank and spare fuel container
- wipe down the pump.

Store Correctly Ready for Use

Once the pump and kit is tested and cleaned, it must be stored in a secure manner so that it can be transported and unloaded safely and effectively the next time it is needed. To do this:

- store securely if kept on a vehicle
- for a long period of storage, use a fuel additive.

If a pump is stored for more than six months, the fuel will have to be replaced before use. The use of a fuel stabilizer is recommended.

Documentation

As pump operator you are responsible for your resource and may be asked to record equipment use details.

Documentation may include:

- appliance check sheet (small incidents)
- at large incidents – the Resource Check In/Out forms
- Daily Time Record (DTR)
- signing-in equipment taken to the fire ground
- signing out of equipment before leaving the fire ground
- signing off the equipment as being recommissioned and returned to the fire station/depot
- completing running sheets as required
- a recording system for tracking resources e.g. T-cards.

Accurate and clearly completed paperwork means:

- fuel used and other costs will be reimbursed
- broken equipment will be identified and repaired
- hours of use and down time of equipment will be recorded so that necessary maintenance can be carried out – ensuring safe and workable equipment is available for the next fire
- equipment you lent out comes back to you.

Summary

Now, use this summary checklist to check you understand the main points of this module.

Recommissioning

Recommissioning equipment ensures it remains in a serviceable and ready state.

Restoration

Restoration of the site used during operations is an important part of your role. Failure to make reasonable attempts to restore a site may generate ill feeling with landowners.

Restoration involves returning the site, as far as possible, to its original condition.

Glossary

Charged line	A line of hose filled with water under pressure and ready to use.
Class A foam	A chemical concentrate added to water that combines foaming and wetting agents specifically formulated for extinguishing vegetation fires. The foam is biodegradable and non-toxic and is used from 0.1% to 1.0% concentrate.
Closed circuit relay	A relay pumping system in which the hose line from one pump is directly connected to the inlet of the next pump in the relay via a suitable adaptor.
Equipment	Fire suppression equipment, which may include hose pumps, fire engines, hand tools, etc.
Fire suppressant	An additive designed to reduce the surface tension of water, thus increasing water's efficiency as a fire-extinguishing agent. Suppressants are applied directly to the burning fuels.
Friction loss	The loss of energy from water between the lining of hose and the water flowing inside, observed as a drop in pressure from one end of a hose line to the other.
Head	The pressure created by a difference in height between the pump and the point the water is being taken from or delivered to.
Open circuit relay	A relay pumping system in which the hose line from one pump discharges into a portable dam or other container from which the next pump in the relay draws water.
Static water supply	A supply of water in a reservoir or pond, of limited capacity.
Vortex	The 'whirlpool' effect created in shallow water by the movement of water into the suction hose. A vortex allows air to enter the suction hose, resulting in poor pump performance, loss of prime or damage to the pump.
Water point	Any natural or constructed supply of water that is readily available for fire control operations.
Wetting agent	An additive that reduces the surface tension of water or other liquid causing it to spread and penetrate more effectively *(see fire suppressant)*