Rural Firefighting

Study Guide

Load Water and Additives for Aerial Operations

RFLWAO-1

EMQUAL
EMERGENCY MANAGEMENT QUALIFICATIONS

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
- Emergency Management Qualifications (EMQUAL) requirements.

The document, its content and specified processes are not to be altered, except through National Rural Fire Authority training processes.

Recommendations for Change

National Rural Fire Authority welcomes feedback on all its products and processes to ensure currency and continuous improvement.

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

Document title: **Load Water and Additives for Aerial Operations**

Published: November 2011

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Contents

Acknowledgements i

Study Guide Introduction 1

Section 1: Command Structure 3

Section 2: Fireground Requirements 5

Section 3: Flight Requirements 9

Section 4: Safety and Communication 13

Section 5: Requirements for Personal Fitness/Operation Safety 15

Section 6: Site Selection 17

Site selection for helicopters and fixed wing aircraft 18

Section 7: Site Layout 21

Reviewing the Site 22

Section 8: Loading Procedures Overview 23

Section 9: Helicopter (Monsoon) Buckets 25

Section 10: Helicopter Bucket Loading Procedures 27

Adjusting Skirts on Buckets 29

Drop Patterns 30

Section 11: Fixed Wing Aircraft 31

Loading Procedures 33

Section 12: Additives 36

Retardants 37

Acknowledgements

The National Rural Fire Authority (NRFA), New Zealand Fire Service (NZFS) and the Emergency Management Qualifications (EMQUAL) acknowledge the help of the many subject matter experts in preparing this course.

Study Guide Introduction

Overview

This study guide covers material on Load Water and Additives for Aerial Operation, supporting unit standard 3288 version 4. The course is made up of theory and practical training.

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

Two booklets 'Aircraft safety Fire management-working with the aviation sector' and 'Air Operations Information and Checklists' (orange book) are useful to have as reference.

Course Objectives

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

- safe practices when loading aircraft with water and additives
- working as part of a crew to set up a site for aircraft loading and filling operations
- filling helicopter buckets or fixed wing hoppers with water and additives to safe load levels

Assessment

The assessment consists of two parts:

1. A theory assessment.
2. A practical assessment where participants work in a crew to set up a site for aircraft loading and filling operations.

Section 1: Command Structure

Introduction

Effective firefighting requires:

- clear command structure
- clear role responsibilities
- thorough understanding of your responsibilities and reporting lines.

What is the command structure

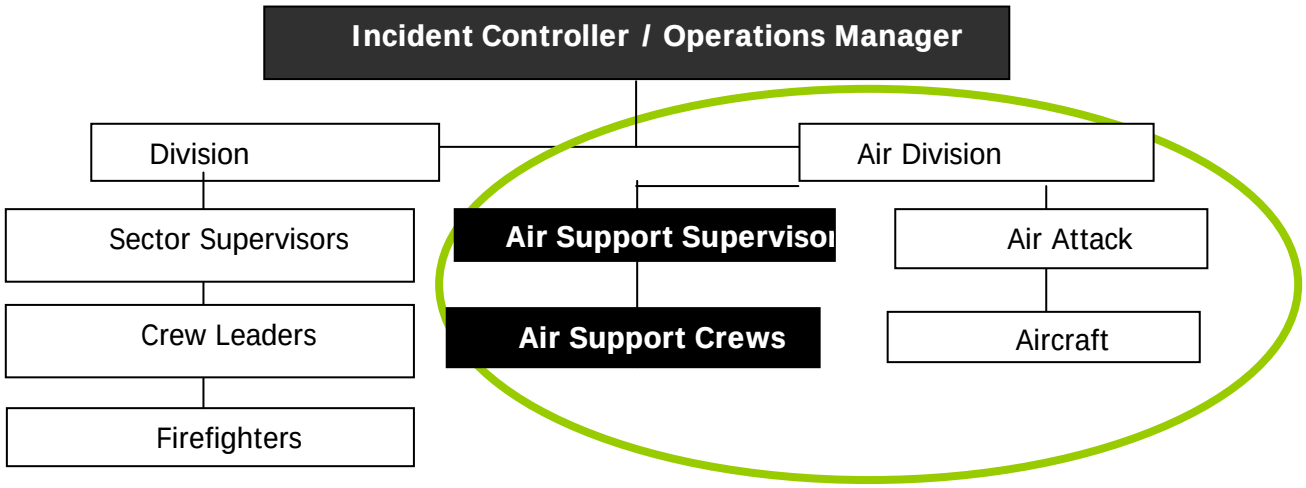
In the Rural Fire Management Handbook the structure for Incident Management is explained. This includes when aircraft are deployed for firefighting, the Incident Controller (IC) will consider the need to establish an **Aircraft Unit,** that:

- may be under the management of the Air Support Supervisor (for ground operations) and Air Attack Supervisor (for aerial operations) or
- may be under the direction of the Operations Manager or IC, depending on the size of the incident.

Note

This provides a safe and effective organisational and command structure.

The diagram below illustrates the command structure for a moderate scale fire (20-100 ha) - an Aircraft Unit under the joint supervision of the *Air Support Supervisor* and *Air Attack Supervisor* both reporting to the *IC/Operations Manager*. You are part of the Air Support Crew.



Responsibilities and Tasks

Your Responsibilities and Tasks	Pilot/Aircraft Crew Responsibilities
Own PPE and aircraft safety	Own PPE and aircraft safety
Understand site selection and implement requirements	The safe weight load/lifting capacity of the aircraft
Load equipment/cargo, with the required supervision	Load equipment/cargo and personnel
Site layout and set up filling/loading equipment. Ensure that the landing area remains secure.	Attach the bucket and long line/sling loads
Operate portable pumps and hose attachment	Check equipment secure/safe
Fill bucket/hopper with water and load additives/hopper	Monitor filling
Know where to position and how to use clear signal communications with pilot and other crew/crew leader/aircraft crew	Acknowledge communication
Hazard identification and mitigation of safety procedures	Hazard identification and mitigation of safety procedures

Note

As the fire suppression work progresses, new and different water/additive filling points may have to be found and used. These may or may not require ground crew. (e.g. if deep ponds or water holes in rivers are useful, safe and nearby). The key aspect with applying water to a fire by aircraft is to operate safe, short and effective cycle times and place the water in the most effective and appropriate location on the fire.

As a crew member undertaking an aircraft support role (loading aircraft with water and additives) you will be under the control and supervision of a crew leader or at a larger incident an Airbase Manager. You need to understand how as a team member to provide for a safe, and efficient Air Base operation.

Section 2: Fireground Requirements

Personal Safety

All personnel have a responsibility for personal safety.

Personal Protective Equipment (PPE)

Ensure you have the correct PPE:

- leather or other safety boots with woollen socks
- fire resistant coveralls
- woollen or plain cotton underclothes (no nylon)
- eye goggles (not safety or sun glasses)
- ear protectors
- leather gloves – protective
- dust mask (respiratory protection) if mixing powder and retardant
- safety helmet with chin strap (needed on all aircraft operations).

For extended periods of operation, consider providing full wet weather clothing to be worn over the above PPE to offset the hazards of hypothermia and chemical absorption e.g. raincoats, over-trousers, gumboots etc.

Protection of water supplies

When working with additives (i.e. foam or retardant), fireground safety includes the protection of water supplies.

When any additive mixer is set up and the portable pump is set to draw water from an open water supply, position the unit and tank so that:

- in the event of a spillage, additives do not flow into the water supply
- if you can't find a suitable site, protect the water supply by constructing a drain, bund or dam around the base
- in the event of any spillage, take additional steps to stop the flow of additives into the water supply, e.g. cover the spillage with earth.

Workplaces

At an aircraft loading area different activities must be separated to avoid one activity compromising another.

It is best to have a separate refuelling area from loading water and additives area from passenger transport etc.

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Defined working zone	Each geographically separate activity is a defined working zone. Having the distinction is more important with larger jobs, e.g. when more aircraft involved or when working in a confined area. Each activity should have a clearly marked out area. This could be a spray painted 'H' on dry grass for loading water and additives – 'H' or a 'R' for refuelling etc.
Safe work area	A safe work area is a work area where persons are not exposed to any hazards. This is achieved by identifying, isolating, eliminating and minimising hazards. A risk assessment must be conducted and should be documented. This needs to include strategic locations of suitable fire extinguishers and first aid kits.
Efficient work area	An efficient work area is a work area where people work with little wasted effort or lost time.
Note	At larger airbases, your *Air Support Supervisor* should provide a suitable map defining these working zones.
Equipment and consumables	At the loading area, keep only equipment and consumable resources necessary for the job: • dispose of all other items well back from the loading and landing areas away from rotor or propeller wash • equipment such as pumps, dams, mixing equipment and hose needs to be readily available to enable safe and effective loading • spare items not immediately required and empty containers should be removed away from flight paths and rotor wash to a secure site. This prevents them getting into propellers, rotors, breaking Perspex or damaging aircraft bodies • for larger or ongoing work, a storage area may be provided that allows for daily resource use and avoids a large stockpile in the open that is close to the airstrip/helipad • remove and dispose of rubbish safely.

Vehicle parking

Park only essential vehicles at loading areas. This includes:

- fuel tankers (however, for added safety a separate parking area for tankers away from the flight deck area is advisable)
- utilities towing trailer tankers
- fire trucks used in pumping
- command vehicles essential to that site's operation
- command vehicles and caravans used at the airbase or loading area should be parked away from noisy pumps, aircraft and flight-paths.

Figure 2.1 – Helicopters and fuel tank position

All other vehicles, including those of important visitors, television crews and general transport vans, should park well away from the loading areas and entrance/exit paths for their own safety.

A designated site map distributed at the check in point will help to inform you.

Mixing additives

There are environmental safety requirements when additives are used:

- review the manufacturer's guidelines on the material safety data sheets for safe handling of retardant and foam concentrates
- avoid skin contact with additive concentrates
- ensure crew have access to eye and hand wash facilities.

Note

Personal risk is minimised if you wear the correct clothing, drink water frequently, maintain your energy levels, work at a steady pace and look after each other.

Only essential personnel should be working on the air side of any designated aircraft landing area.

Section 3: Flight Requirements

Lift, payloads and strop length

Weight is a vital factor for flight safety. The helicopter may be taking off at maximum power and lift. When filling a helicopter bucket, it's important you understand both load location and lift balance and how your actions affect aircraft safety.

Weight of helicopter

The helicopter weight is made up of:

- aircraft
- fuel
- passengers
- on board cargo
- bucket including water capacity or other underslung equipment.

Figure 3.1 – Fire crew loading onto helicopter

Changes in the quantity of water lifted per load will vary with:

- aircraft type
- time of day
- weather conditions (air temperature increase, wind direction and strength increase or decrease
- site conditions, location (density altitude - higher altitude sites result in less lift = less load carrying capacity).

Lift capacity (hottest time of day)

The unfortunate net effect is that when a fire is burning at its best, aircraft lift capacity (water and additives) will be at its least.

Maximum performance

If helicopter's maximum loading is for example 500 L, then it's better to take 450 L to get better aircraft performance.

This gives 10% under load that will aid with the climbing and manoeuvrability of the helicopter.

Note: Most pilots will lift 90% of capacity anyway to give them 10% power capacity for emergencies.

Payloads

The payload carried (water + bucket + additives) must be close to 90% of the aircraft's maximum possible lifting capacity. If it isn't the aircraft is under-utilised.

Strop length

The strop length from the helicopter cargo hook to the helicopter bucket is important. If the helicopter is dropping water while close to the ground directly onto the fire, its rotor wash may cause isolated flare ups if the strop length is too short. Longer strops result in less rotor wash fanning a fire, but makes getting the bucket on target more difficult for the pilot due to its swinging pendulum effect. This is dependent on the pilot's skill and time of day.

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Pump efficiencies

The table below shows approximately how long it will take to fill each bucket with different types of pump in seconds.

Pump flow rate at free flow	Bucket volume (Litres)			
	450 L	900 L	1500 L	5000 L
Medium Pressure/Medium Volume 800 L/min e.g. Millenium, Waterous	30 sec	1 min	2 mins	6 mins
High Pressure/High Volume 1400 L/min e.g. Angus	20 sec	40 sec	60 sec	3.5 mins

Hint: use large volume pumps, hose and goose necks for fast bucket fills (i.e. maximum flow at least pressure).

Section 4: Safety and Communication

What the pilot may communicate

The pilot:

- will advise when to stop filling the bucket/hopper
- may request to decrease or increase water amount in bucket/hopper
- will advise if there is an issue/problem with the aircraft or bucket
- will advise when there is a need to refuel the aircraft or load additives etc.

The pilot will advise the crew leader or at a larger incident the Airbase Manager, who will advise filling crew. It is not very often a pilot will speak directly to a filling crew.

What you may communicate with your crew

Communicate with crew:

- safety concerns
- water ON/OFF
- variation to additive requirements.

(Refer to the Aircraft Safety booklet for more details)

How best to communicate

Radio

This may be limited to line of sight and suffer interference from nearby aircraft/pump engines. Conversations with pilots must be kept to a minimum, no unauthorised use of aviation radio.

Hand signals

For example ‘Water on!’, ‘Water off!’.

The other party must know what the signal means and be close enough to see it. Maintain eye contact with the pilot during the loading operation. (Refer to the Aircraft Safety booklet for details)

Know the signals you will use.

Why communicate

Your ability to communicate is important because:

- if any part of the water supply chain fails, the operation stops
- if the aircraft is overloaded, it won't take off or it will be dangerous at take off
- if the aircraft is not loaded to capacity, it is not used efficiently
- the aircraft may require fuel
- the pilot may require to take short breaks or have other things to report
- the type and amount of additive and water may vary
- the site may need to be moved, dampened down (dust abatement)
- the people loading the water may have to get pump operators to pump more or less water as aircraft arrive and depart, and refuel/unblock/clean intakes on pump
- ground crews may notice something (that the pilot cannot see) on the aircraft or the helicopter bucket that may require attention, e.g. bird strike, damaged bucket seals, damaged strop, loose shackle etc.

Figure 4.1 – Crew waiting for helicopter to land

Section 5: Requirements for Personal Fitness/Operation Safety

Loading aircraft

Loading aircraft requires a reasonable level of fitness. Loading personnel should expect to refill aircraft as quickly as possible and have a quick turnaround.

Upper body strength is required to lift charged hose lines into buckets or tanks as well as 20 kg retardant/suppressant containers.
Ideally, staff should be rotated through work stations and not worked so hard as to become excessively tired.

Safety throughout the operation is the responsibility of everyone at the site.

The crew leader or at a larger incident the Airbase Manager should identify, eliminate, isolate and minimise site hazards, and make hazards known to others working in or entering the site.

The site should also be monitored for new hazards and these treated accordingly. Crew members should also report hazards to their crew leader.

This approach complies with the Health and Safety in Employment Act 1992.

Section 6: Site Selection

Site selection may be carried out initially by the Incident Controller after a briefing by the Air Support Supervisor, or on the requirements of the Incident Action Plan. Site selection should only be carried out by qualified and experienced people. The success of the air operation depends on the site selection, and if incorrect, the pilot will not land at the selected site. Once selected, the site needs to be authorised by suitably qualified and experienced personnel.

Your site must comply with the requirements as listed below.

Factors in site selection

Factors to consider in site selection:

- no aerial hazards (e.g. poles, wires, trees, pylons, masts)
- adequate clean water supply
- large staging and working areas clear of buildings
- good flight path for approach, filling, landing and departure
- level, firm and good run-off (for excess water) surface for loading operations
- adequate depth of water supply if dip filling (river flow not too strong)
- close to the fire (if possible)
- upwind of the fire
- road access for fuel/logistical supplies
- safety for pump operator and site personnel
- safety for aircraft (wind, wires, entrapment)
- foreign objects can be removed
- no wandering stock or nearby water fowl or other birds
- wind indicators present
- a slightly raised area for the landing site
- adequate take off length when fully laden
- security set up to stop non operational people entering area
- not too wet or muddy.

Figure 6.1 – Site selection

Site selection for helicopters and fixed wing aircraft

Both helicopters and fixed wing aircraft require flight paths in and out of a landing site. The key difference is length. Both require safe sites as detailed previously.

Note: A helicopter stops then lands, a fixed wing lands then stops.

Rural fire authorities may have established predetermined landing areas and have these noted by GPS coordinates and inspected annually. Experienced and trained personnel may also establish temporary landing areas but the final say for use rests with the pilot.

Figure 6.2 – Fixed wing aircraft dumping water

The following table describes several important differences that may render some sites unsuitable or unworkable.

Site Aspect	Fixed Wing	Helicopter
Airstrip orientation	Critical in strong winds. Unimportant in calm conditions. Difficult in cross winds.	Wider tolerance of airstrip direction in various wind conditions
Airstrip surface	Uneven runway surfaces and grass/debris pose hazards. Mud and corrugations less tolerated. (Grass is not a hazard by itself. Grass strip is preferred landing surface for agricultural aircraft then gravel or sealed.)	Less need for extensive flat and close grazed areas. Mud undesirable but limited amounts workable. Some corrugation OK.
Airstrip length	Critical for both takeoff and landing. (0.6 – 1 km) Heavier payload, longer airstrip.	Less critical.
Airstrip altitude	More versatile than helicopters at higher altitudes. Payloads reduced.	Better suited to lower altitudes < 5000 ft. Very limited > 9000 ft. Payload reduced.
Turning circle	Space required to do “U” turns at loading area or other places. Mud can be created.	Little extra space required.

Note

Fixed wing aircraft and helicopters working from the same airstrip are not a good combination. Keep them separated and in different airspace.

Both helicopters and fixed wing aircraft have a place in firebombing.

Fixed wing aircraft are more demanding of site conditions than helicopters. Strong cross winds, uneven runways, intermittently wet runways and runway length are all critical success factors for fixed wing aircraft operation. If any of the fixed wing site aspects are dangerous or unsuitable, the most sensible thing to do is to stand the aircraft down, modify the site or find a more suitable site.

Any decision is made in consultation with the pilots. They are the experts and will advise when they can no longer operate safely.

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Section 7: Site Layout

Establish

Once your site has been selected, consider the following points about site layout:

- water supply point
- pump location – firm, level (so will not vibrate into water body), clear of any flammable material
- fitting hose to pump to mixing tank (retardant) or dam.

Note

Some water supplies have insufficient flow rate to meet a pump's output, and a storage dam may be required.

Consider using a tank or damming to form a deeper hole in the creek (being mindful of environmental issues).

Choose a high volume pump to make sure that the hopper/bucket is filled as quickly as possible.

Use a portable dam or tanker to provide a reservoir if the stream flow rate is less than the required pumping rate.

Avoid

Excessive wetting of the landing area (mud).

Spilling foam/retardant mixes into creeks or ponds.

Site layout briefing

Where working with one or multiple aircraft, the Helibase Manager will provide the briefing.

Caution

After the site is selected, hazards may change. You need to be aware of new hazards that may occur with a previously safe site. For example, people entering the area (public, management), wandering stock, sun angle, smoke hazard entering the site etc.

Figure 7.1 – Crew briefing

Safe firefighting requires you to constantly take in information and reassess requirements.

Reviewing the Site

If the fire grows	Review the location of the loading site – you may need to increase or move the site; or set up an additional site.
Multiple aircraft start backing up	Locate alternative sites, larger pumps, more people, tanker supplies. Fill intermediate storage tanks while the aircraft are away.

Section 8: Loading Procedures Overview

Helicopter and Fixed Wing

Active vegetation fire suppression often requires loading water and additives for effective aerial operations.

The objectives are to:

- run a safe effective and efficient operation at all times
- fill the aircraft as quickly as possible
- ensure quick cycle times (load and drop water).

The ‘Aircraft safety Fire management-working with the aviation sector’ booklet has information on loading for both water and additives, baggage and cargo.

Figure 8.1 – Helicopter bucket with extended strop

Section 9: Helicopter (Monsoon) Buckets

Helicopters buckets are commonly used as part of vegetation fire fighting in NZ. Buckets can be filled by dipping if suitable dipping sites are available. The alternative is to pump fill, provided there is appropriate water supplies and pump equipment.

Dipping may be the safest option and the fastest cycle time. If this is the case, use dipping.

The idea is to get a short cycle time.

Cycle Time

Cycle time is the time from filling the aircraft or bucket, flying off, dropping load, returning and refilling (and then repeating the cycle).

To achieve a fast cycle time the following is required:

- a suitable filling site close to the fire (preferred distance less than 2 km upwind)
- water supplies that meet volume and quality requirements, e.g. large lake or river
- pumping capacity that enables a quick fill directly, or via a temporary dam or pond e.g. HPHV pumps
- sufficient personnel to operate pumps and load resources efficiently and safely.

Dipping

Dipping is a good option:

- dipping is generally the safest option
- loading by dipping is faster when suitable dipping sites are available.
- dipping helicopter buckets in a deep pond pool, in the river or a reasonably calm sea will give quicker loading than pump filling with a fire pump, especially with a large bucket.
- if dipping sites are unavailable or unsuitable, temporary or portable dams with pump and hose operations can be used
- some helicopter operators will not dip from running water. Check with pilots if they are happy/permitted to dip fill from a fast moving stream.

Figure 9.1 – Helicopter filling from portable dam and river

Section 10: Helicopter Bucket Loading Procedures

To load helicopters:

- wear appropriate PPE
- stay well clear of the helicopter's tail section and other hazardous areas, remain on slightly lower ground or crouched
- as aircraft approaches, keep your back to the wind facing the helicopter, ensure that you know where the bucket is at all times
- provide a target for the pilot to land the bucket
- keep away and to the side of the aircrafts flight path.

Figure 10.1 – Helicopter bucket filling

Step	Action
1	As aircraft arrive, one person holds the upper rim of the bucket to keep it from rolling over due to rotor wash or uneven ground.
2	At the same time, the other person/s places the gooseneck outlet/s into the bucket and opens the valves if fitted, and signals “water on”.
3	If adding foam concentrate manually, do so at the very last moment otherwise excess foaming is created.
4	Watch the pilot for a signal to you to stop filling. Keep eye contact.
5	When the bucket is filled to the pilot’s satisfaction: • signal “water off” to the pump operator • turn the hose valve off • remove gooseneck • Step away to the side of flight path (safe area into pilots view).
Note	Any unnecessary personnel movements (particularly quick) distract pilots. Do not leave filling position until job finished. During filling, the pump operator should run the pump at maximum flow minimum pressure rate, and then at idle in between fillings. When working with helicopters with belly tanks, the aircraft must land for filling. Care must be exercised when approaching them. Read ‘Aircraft safety Fire management - working with the aviation sector’ booklet and do as it instructs. Be aware that the pilot’s location varies from machine to machine i.e. either left or right or more inboard so their view of the filling operation will vary. Ground crews will need to adjust if dealing with these variables.
Caution	**Under no circumstances are the persons on the aircraft loading hose valve, to leave their position until the loading operation is complete and the hose removed from the helicopter bucket.**

Adjusting Skirts on Buckets

These instructions apply to buckets which have adjustable skirts. (Cloud Burst and Bambi type buckets do not have skirts and cannot be adjusted).

Adjusting skirts

Water can be used more efficiently by raising or lowering the skirt to suit the types of fuel.

Raised skirt

A raised skirt discharges the water in a very wide pattern This is useful for grass fires and light surface fuels.

Midway skirt

The midway skirt does not allow a column of water to be produced so this does not give as good penetration through heavy undergrowth

Lowered skirt

A **lowered skirt** is best for dense forest canopies or very heavy fuels, logging slash and/or spot fires such as burning spars as:

- water discharges in a column
- even with a lower skirt, helicopter bucket contents may not penetrate mature forest crowns to ground levels – but they will penetrate scrub if the helicopter is low enough.

This is useful for dense vegetation, forest canopies, and deep seated hot spots.

How is the skirt adjusted

Adjust the skirt by shortening/lengthening up to three chains using dog lead swivels that hook into different sections of the chain.

Who decides

The crew leader in charge at the helipad in consultation with the pilot, will issue instructions to raise or lower the skirt.

Drop Patterns

The drop pattern from an aircraft will depend on:

- fuel type
- altitude
- air speed
- topography.

Depending on the type of fuel the drop pattern may have to vary.

For fine fuel e.g. grass, a wide pattern at high speed is suitable to penetrate through. For scrub type fuels or forest fires a slower air speed is required to allow greater penetration of the water/foam mix.

Drop patterns may change during course of the fire. Feedback from ground crews is important and any suggested changes to the drop pattern must be made through the Air Support Supervisor in consultation with the pilots.

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Section 11: Fixed Wing Aircraft

When filling a fixed wing aircraft, you need to be aware of different safety zones then when working with helicopters and buckets.

- You can be much closer to propellers / exhaust outlets.
- On sloping ground the aircraft could move unexpectedly.
- Fixed wing aircraft require turning areas at the fill location.
- All activities involving fixed wing aircraft are done in an authorised access area only (no public access).

Please refer to ‘Aircraft safety Fire management- working with the aviation sector’ booklet. Read it, learn it, and implement it.

Figure 11.1 – Extra caution required when filling connection forward of wing

Connect the hose to the aircraft filling points in accordance with the pilots instructions.

The filling points on the aircraft could be either:

- a belly tank attached beneath the aircraft, or
- an internal tank within the fuselage.

Both of these tanks will have an inlet on the side of the aircraft. It is safer to have the hopper fill connection at the rear of the wing rather than in front of it.

Some aircraft may not require a gooseneck and a hose fitting may be able to be attached directly to the aircraft and locked in place. This system minimises spillage. Some aircraft may have a *control valve* fitted to the inlet to the tank – you'll need to open this valve as well as the one on the gooseneck or outlet.

Note

The key is to get fast cycle times for the aircraft without compromising safety.

If a gooseneck is required for top filling, extra care is needed to not damage aircraft skin and results in prop wash back over the aircraft.

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Loading Procedures

To load fixed wing firebombing aircraft:

- wear appropriate PPE
- make sure pre-arranged hand signals between the pilot and the pump delivery are clear
- aircraft must manoeuvre to the aircraft loading hose – do not chase the aircraft
- stay well clear of the aircraft's turning and wait for the pilot to put the aircraft's nose-wheel(s) on the predetermined or agreed marks
- wait for the aircraft to stop moving
- wait for the pilot's approval before approaching or loading the aircraft
- do not leave your position until filling is completed
- hoses can be damaged if dragged towards the aircraft for filling. Use skates to support the hoseline if possible
- make sure that trained and authorised persons are positioned at the delivery pump and the aircraft loading hose valve and in view of each other at all times when loading.

Note

Under no circumstances are the persons on the aircraft loading hose valve or supply pump to leave their position until the loading operation is complete and the hose removed from the aircraft.

Caution

Other things to watch out for:

- approach the aircraft from its side/rear with a uncharged and shut off hose
- never position yourself near known hazardous parts of the aircraft – e.g. rotating propellers or wing
- never move under the body or wing of the aircraft
- do not connect aircraft loading hoses and commence loading unless the pilot has given approval and specified the amount to be loaded.

Hopper filling

The inlet is usually below the hopper.

To begin loading, follow the steps below:

Step	Action
1	Make sure the camlock arms on the aircraft loading valve are locked.
2	Fit the charged hose to the tank or inlet fitting (camlock, instantaneous coupling etc).
3	Open the valve (fully) on the side of the aircraft first.
4	Open the aircraft loading hose valve (fully for maximum flow rate).
	Signal “water on” to the pump operator.

Watch the pilot’s signals for shutting off water supply (decrease pump pressure). Shut off valves as required.

Check to make sure the bomb door is securely closed before beginning the loading operation.

Belly tank filling

The inlet is usually above the height of the tank and a flap at the inlet will prevent backflow.
Goosenecks may be required to load water/additives. Once the filling is complete, the goosenecks valve is closed and the gooseneck is withdrawn.

Some hints

When filling, avoid kinks in hoses – this improves flow rate.

Only turn the valves on when the goose neck is in the tank filling.

Withdraw the gooseneck only once the water supply is shut off.

Walk promptly to/from the aircraft but don’t run.

To finish loading, follow the steps below:

Step	Action
1	Signal “water off” to the pump operator.
2	Close the aircraft loading hose valve first.
3	Close the valve on the side of the aircraft.
4	Do not “just shut off the pump”.
5	Walk promptly away with charged hose to pumps or safe area.
6	Make sure that hose line is clear of the aircrafts wheel track
7	Check to make sure that no serious leaks are evident from the bomb door before permitting the aircraft to move off.
8	As the aircraft taxis off, crouch down and protect yourself from propeller blown surface grit.

General procedures – hopper and belly tanks.

- Check to make sure the hose is removed from the aircraft and no serious leaks are evident from the bomb door before permitting the aircraft to move off.
- As the aircraft taxis off, keep your back to the aircraft and/or watch for unsecured items - remedy as appropriate.

Watch outs

Foreign objects/debris (FOD) are being blown about.

Propeller wash as loose items such as empty foam containers and retardant bags can blow about landing areas.

Watch where you walk as foam concentrate and mixed retardant can be slippery.

Make sure that operations people are wearing safety equipment.

Make sure that unauthorized persons do not “chat” with pilots and loading personnel during operations.

Make sure that water and fuel levels are adequate for the delivery pumps.

Make sure that camera operators or journalists entering loading area are authorized and supervised.

Section 12: Additives

Class A Foam

How foam works:

- foam solution when added to water reduces the surface tension on water
- foam is created when the water and foam load is dropping from a aircraft forcing air into the solution, this aerates the water/foam solution creating the foam
- adding foam reduces surface tension in the water and the water spreads out over the surface.

Figure 12.1 – Water on leaf without foam (top) with foam (bottom)

Important facts

The cleaner the water, the better the foam that is produced.

Foam makes the wetting and cooling power of water go further.

Use clean, non-salty water if you want to make good foam.

Dirty water (with clay particles or fine organic material in it) requires more foam concentrate to produce foam.

Foam is corrosive to some metals so when recommissioning equipment make sure that everything is flushed with clean fresh water.

Extreme caution has to be taken using foam near helicopters. Any spillage **has to be reported to the pilot immediately**.

Manual or injection systems

Foam solution/concentrate may be added manually to an aircraft or bucket/hopper **or** may be injected by an onboard induction system

If added manually, add foam last. This avoids the tendency to create froth from the outlet or get foam in your eyes – and allows you to fill a tank to full capacity

Retardants

How retardants work

Fire retardants are mixtures of chemicals (basically fertilisers) and additives that hold the mix in suspension. When added to water and applied to unburnt vegetation, they inhibit the combustion process when they evaporate. Some fire retardants also release a nitrogen gas on heating which is not combustible.

Fire retardants are more effective when they are applied to a ridge top or a gully bottom than at a steep mid-slope.

Types of fire retardants

Some retardant concentrates are powders (e.g. phoscheck) and others are a liquid (e.g. Fire-Trol). Each type of retardant has its own handing requirements. Phoscheck and Fire-Trol are trade names; both can come in powder form or liquid.

All retardants have a dye added so that the pilot can see where he/she dropped their last load.

Note

Be careful:

- avoid skin contact with any fire retardant concentrate
- wash retardant off promptly if it comes into contact with your skin or clothes
- dyes and contents may stain clothing indefinitely
- don’t inhale the retardant dust
- keep retardant dust and liquids out of your eyes - wear goggles.

Type of fire retardant	Examples of product	Handling characteristics	Handling measures
Granulated powder	Phos-Chek: D75-R, D75-F, P100-F, 259-F, G75-F.	Can blow into eyes. Beware of dust, rotor wash and prop wash near the mixing site.	Premix in a holding dam before placing in helicopter (monsoon) bucket. Wear eye and skin protection.
Liquid suspension	Fire Trol 934. Fire-TroI936. Fire Trel 931-R Phos-Chek LC-95-W Phos-Check LC-95A-R & L.	Long term storage of container will form a hardened precipitate at the bottom of the pail and this may require mixing before use.	Agitate mix within pail to keep suspended. Wear eye and skin protection.

Mixing all fire retardants near a fire site

This is best done in large batches in portable dams or tanks as it is very messy pouring retardants into open helicopter buckets under rotor wash! Preplanning and equipment are required.

There are various means of mixing fire retardant and some are more effective than others:

- portable dam with high volume pumps
- specialised mixing equipment.

The ratios will be set in accordance with the result of the drops on the fire ground and in discussion with the ground crews, AAS and pilots.

The change in ratio will alter the amount of retardant carried (weight) and this can affect the performance of the aircraft.

Environmental matter

Keep retardants away from waterways. Much of the contents of fire retardants have the same properties as fertilisers and will enrich water as with untreated sewerage.

Figure 12.2- Additive containers

Figure 12.3 – Pre-mixing retardants

Viscosity

Viscosity is the measure of how thick a liquid is. Viscosity of fire retardants determines the drop and fuel coating characteristics.

For example

Honey has a **high** viscosity.

Water has **lower** viscosity.

Changes in viscosity:

- a very viscous mixture of retardant tends to fall in large drops, not effectively coating the vegetation
- a very low viscosity coats the fuel but tends to run off the vegetation
- to coat the vegetation effectively it is important that the viscosity is within prescribed limits
- the mix ratio determines the viscosity. It there is a heavier viscosity mix, the AAS and pilot may need to alter the speed and height of the drop patterns to ensure effective coverage on the fire ground
- always advise pilot prior to loading a different mix of retardant.