Rural Firefighting

Study Guide

Dry Firefighting Techniques – Use of Hand Tools

RFUHT-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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Contents

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Study Guide Introduction

Overview

Welcome to Dry Fire Fighting Techniques – Use of Hand Tools. This course is made up of this study guide, a practical training session, a theory assessment and a practical assessment. During the course you will learn about:

1. Dry Firefighting Fundamentals
2. Tools for Firefighting
3. Fire Line Construction.

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

Course Objectives

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

- suppress a fire using dry firefighting techniques.
- describe and demonstrate how to use firefighting hand tools.
- construct a fire line and carry out mop-up tasks.

This course provides evidence towards the achievement of unit standard 3286 Control vegetation fires using dry fire fighting techniques.

Practical Training

The practical training session is made up of three parts:

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

Theory

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

Assessment and Evidence

Because each trainee'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 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 Theory and Practical Assessment

A practical training session is made up of three parts:

1. The instructor demonstrates the use of the wet firefighting equipment and the trainees practise using each item.

2. Trainees work in a crew to set up and use wet firefighting equipment and practising using these skills.

3. Trainees complete the supervised assessment.

At the practical training, you will be asked to:

- watch the instructor demonstrate use of hand tools
- use the tools yourself.

There is also a theory assessment that supports the practical assessment. This is usually completed at the same time as the practical assessment after the practical training session. This will be given to you by the assessor for the course. You will need to have an approved assessor assess you against the practical and theory assessment to be awarded this unit standard.

Section 1: Dry Firefighting Fundamentals

Introduction

To control and successfully fight vegetation fires, we must know:

- why a fire burns
- what makes it spread

Fire Triangle

The aim of fire suppression is to stop combustion (i.e. extinguish the fire) by eliminating one of the three critical components – heat, fuel, oxygen:

- oxygen is required for burning.
- heat energy causes flammable materials to emit vapours that mix with oxygen and burn.
- fuel such as grass or trees can be ignited.

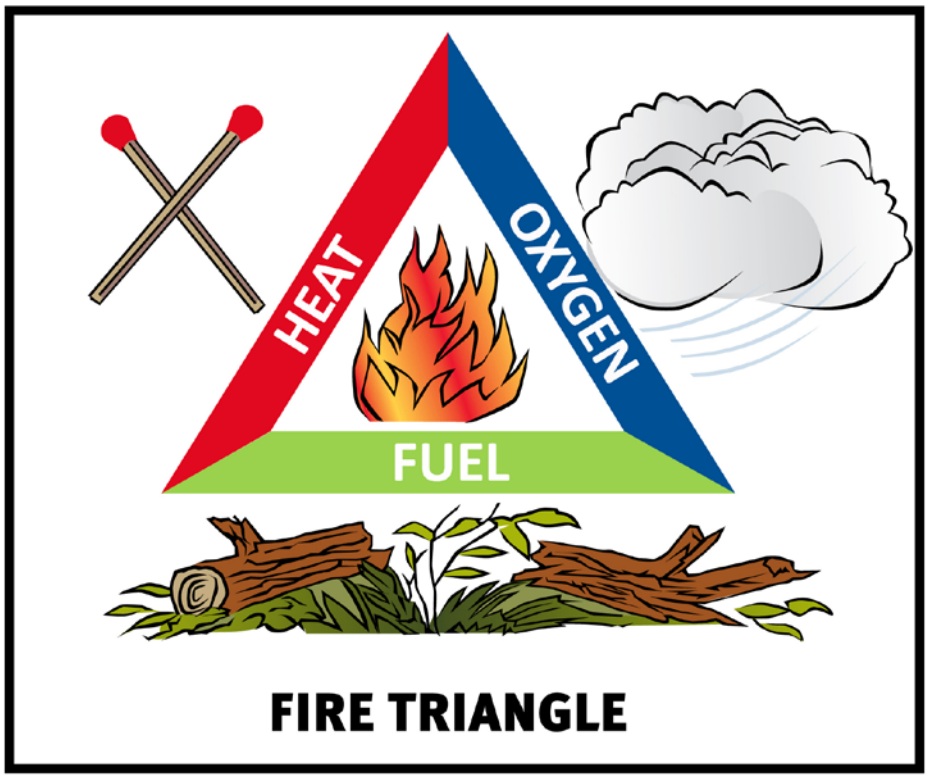


Figure 1.1 – Fire Triangle

Fire Behaviour

Fire development

The three major factors that influence fire development and vegetation fire behaviour are topography, fuel and weather.

Fire spread

Fire spreads as the burning fuel preheats the unburnt material to the ignition point and it starts burning. Wind speed, direction and slope accelerate the effects of this preheating process.

Fire intensity

Fire intensity refers to the amount of heat released by the burning fuel.

Fire intensity is influenced by the amount of available fuel plus rate of spread of the fire.

This intensity makes controlling or containing a free-burning vegetation fire difficult.

Flame length

Flame length is directly related to fire intensity. The longer the flames, the greater the intensity.

Suppression effort

Getting a good grasp of the fire intensity will help you accurately determine required suppression efforts.

Remember, fire intensity may limit fire suppression efforts.

Flame Lengths and Fire Intensity

The following chart shows estimated flame height in relation to fire intensity and Fire Danger Class Interpretation.

Fire Danger Class Interpretations		
Fire Danger Class	**Description of Probable Fire Potential and Implications for Fire Suppression**	**Nominal Max Flame Height**
EXTREME	This situation is explosive. The only effective and safe control action warranted until the fire run expires is at the back and along the flanks.	**3.6 metres**
VERY HIGH	Any attempt to attack the fire's head should be limited to the use of helicopters with buckets, or of fixed-wing aircraft.	**2.6 to 3.5 metres**
HIGH	Water under pressure (from ground tankers or fire pumps with hose lays) and bulldozers are required for effective action at the fire's head.	**1.4 to 2.5 metres**
MODERATE	Direct manual attack around the entire fire perimeter by firefighters with only hand tools and backpack pumps is possible.	**Up to 1.3 metres**
LOW	Resulting fires generally do not spread much beyond their point of origin. If they do, they are easy to control.	**No visible flame**

Safety Note

Do not use the above notes as a guide for firefighter safety. Fires can be potentially dangerous or life threatening at any level of fire danger.

Fire Extinguishing Methods

Three extinguishing methods

There are three methods of extinguishing a fire. Each breaks the fire triangle. You can use one or a combination of these three methods:

1. Cut off the oxygen supply to SMOTHER the fire.
2. Reduce the temperature to COOL the fire.
3. Remove the fuel from the path of the fire to STARVE the fire.

Smothering

This can be the quickest and most efficient form of attack when dealing with small fires. Cutting off the oxygen supply of a large fire in the open is usually impractical.

To smother the fire:

- shovel soil onto a fire – in most cases, this will help to put the flames out, but embers will continue to burn slowly; and/or
- lay a blanket of firefighting foam over burning fuels.

Cooling

The most common way of using cooling to fight fires is by applying water.

Using water:

- removes heat as the water turns to steam
- cools the fuel to a temperature below its ignition temperature.

Applying water to the flames may not stop the entire process, as the fuel may continue to give off flammable vapours.

Starving

Removing the fuel is an effective way of stopping a fire. This fuel removal, rather than the use of water, is termed ‘dry firefighting’.

Examples include:

- using hand tools to remove the fuel to create a fire line
- using machinery, eg bulldozers, to create a wider fire line or to clear a large area.

Figure 1.2 – Fire Extinguishing Methods

Fire Suppression

Fire suppression rules

The three basic rules in fire suppression are:

1. Fast initial attack
   - Provide for safety first.
   - Be organised.
   - Move to the fire as quickly as possible.
   - Stop the fire from spreading.
2. Decisive actions
   - Deploy adequate resources.
   - Work hard and quickly to bring the fire under control.
3. Prompt and complete mop-up
   - When the fire is contained, begin the mop-up immediately.
   - Mop up thoroughly.

Stages of extinguishing a vegetation fire

The four stages of extinguishing a vegetation fire are:

1. Knockdown	A concentrated initial suppression on the fire perimeter so that fire intensity is reduced and fire spread can be slowed or stopped.
2. Containment	After the fire intensity is reduced, the suppression resources contain the fire within the perimeter.
3. Control	Once contained, widen the blacked-out perimeter using hand tools and hose lines to prevent any break-out of fire.
4. Mop-up/extinguish	Completely extinguish the burning area by mop-up and patrol until there is no possibility of re-ignition. This may include digging out, cutting down or cutting open smouldering fuels.

Methods of Attack

Strategy

The strategy selected for use at a fire whether in grassland, forest or at any other incident will depend on threats to the safety of firefighters as a first priority, as well as other factors such as rate of spread, fire intensity, fuel and resources.

The strategy decided will affect the tactics used to attack the fire. The Incident Controller may choose to use either a direct or indirect attack.

Direct attack

What is a direct attack?

A direct attack is when the initial effort is directed at containing the spread of fire by extinguishing the burning edge or perimeter.

Direct attack on a fire

The direct attack is the preferred method in New Zealand as it ensures that the main dangers of a fire are ahead of and moving away from firefighters.

1. Approach the fire from the base, starting suppression effort along the perimeter at the base of the fire, which has the lowest spread rate and heat output.
2. Then, work along the flanks of the fire towards the head, which has the fastest-moving and hottest part.
3. Remain one foot in the black, just inside the burnt area, as progress is made along the flanks.

This method, also known as chasing the fire head, is a pincer movement along the flanks, aiming to close the two flanks together and cut off the head of the fire.

Your fire attack must be fast and effective. Speed of suppression is vital, as it must exceed the rate of fire spread for the fire to be contained.

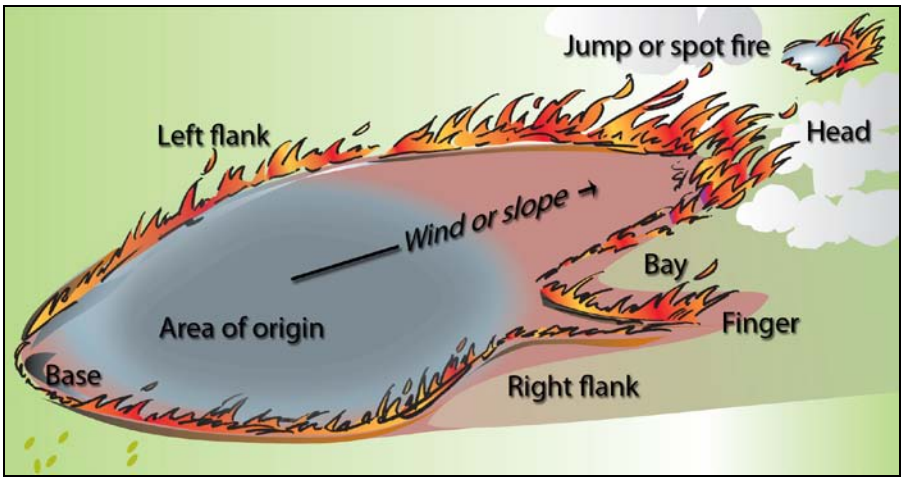


Figure 1.3 – Parts of the fire

Safety Note

'One foot in the black'

By staying just inside the burnt area while moving along the flanks, firefighters can avoid many dangers and have a safer area to retreat to should fire behaviour become dangerous.

Direct attack ensures:

- that the main dangers of a fire are ahead of, and moving away from, the firefighters
- firefighters do not get ahead of the unburnt fuels.

Dropping water from an aircraft reduces the fire intensity and assists fire crews working on the fire line.

Indirect attack

What is an indirect attack?

An indirect attack is when:

- the fire is showing extreme fire behaviour and is dangerous to approach
- the fire is inaccessible.

Indirect attack:

- uses favourable terrain, such as natural barriers and/or constructed firebreaks well away from the fire perimeter
- contains the fire by burning out the fuels between the fire barriers and the fire.

The Incident Controller must authorise burning out.

A Crew Leader controls the actual burning out.

Safety Note

Only do burning under direction and supervision.

First priority: Protecting life, including safety of firefighters.

Second priority: Protecting property or vegetation.

Aircraft operating alone are not effective firefighting tools.

Aircraft are used to drop water to knock down the surface flame so that ground crews can work at the fire edge.

If an aircraft arrives during firefighting and starts dropping water, firefighters must continue their task and not rely on the aircraft to take over.

The aircraft supports the work of the firefighters.

Relying on aircraft alone may result in failure to extinguish the fire.

Figure 1.4 –Aerial support

Fireground Safety

Spot fires

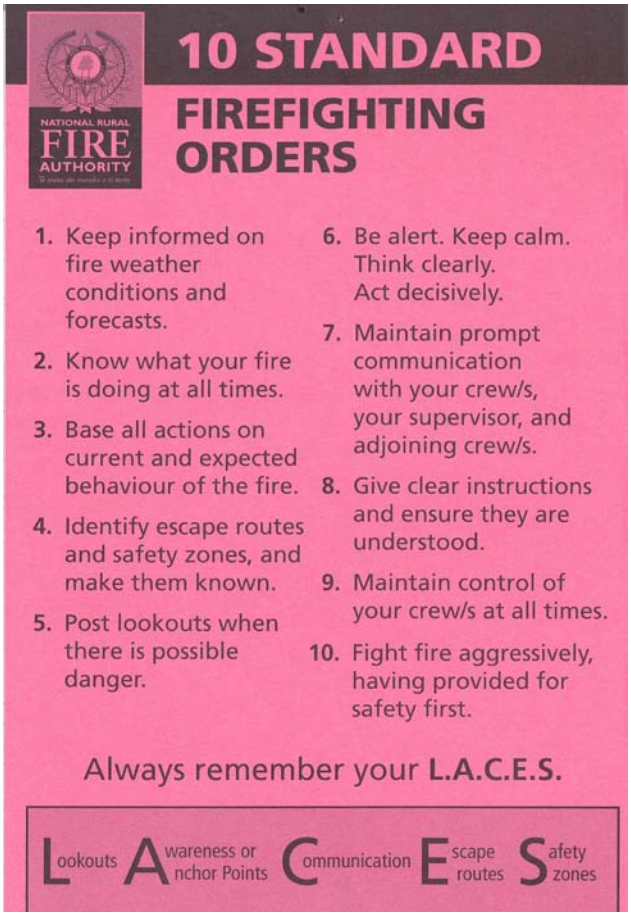
Additional fire(s) may start outside of the area of the main fire.
They may be ignited either by airborne ember transport or by fire creeping underground.

Dangers of containing/suppressing spot fires include:

- working in unburnt vegetation
- moving away from your escape route
- multiple spot fires linking with the main fire in severe conditions
- working in isolation from the crew
- spot fire(s) developing rapidly to become too intense to contain with hand tools.

LACES

Carry this pocket card and refer to it.



Personal safety

Ensure that clothing protection is worn. You should wear:

- helmet with neck protection flap (chin strap), visor or goggles
- fire resistant overalls
- leather lace up boots
- leather gloves
- woollen socks and cotton undergarments

Safety in the fireground

Ensure that you have identified escape routes:

- burnt out area
- back along entry path
- along road/firebreak away from the fire.

Think about your position in respect to the fire. Do not go:

- uphill or downwind away from fire
- through flames unless clear ground can be seen beyond and flames are less than knee height
- into thick unburnt fuel.

Scene Preservation

Area of origin

Generally, the area of origin (where the fire started) will be somewhere between the base and the centre of the burnt area. Protect everything that could relate to the cause of the fire. Do not disturb the area with hose line routes, hand tools or access routes.

Section 2: Firefighting Tools

Introduction

As a firefighter, you will use a variety of hand tools. Some tools are better than others at certain tasks.

Over time, you will learn which tools are best for each task. To help you get started, here is a list of basic hand tools and their uses.

Hand Tools

Shovel

Figure 2.1 – Shovel

Common techniques are described below.

Note: Methods of using the shovel and other hand tools will be demonstrated during the practical session.

Beating

Use the back of the shovel blade with short, patting strokes to beat out a small flame, e.g. a grass fire.

Cutting

Shovels are also used for trimming and delimbing light branches, using the side of the cutting edge. The shovel needs to be sharpened along both sides, not just the point section of the blade.

Digging

Dig into burning materials to:

- expose the material and spread it out to allow it to cool
- mix the material with soil to cool and smother.

Generally speaking, it is not encouraged to bury burning materials unless there is a short-term need to stop embers being picked up by a strong wind.

Throwing.

1. Casting: the overhead throw

   This throw casts soil on an overhead target or one that cannot be approached closely, using loosely compacted soil to extinguish a fire at a distance or at the top of a small tree. The soil must be chopped finely in order to be effective.

2. Fanning: the side-on throw

   This method is most effective to knock down flame in ground fuels. Again, the soil must be chopped finely in order to be effective.

Other uses

The shovel can also be used to protect your face from radiant heat.

Fire Rake

Figure 2.2 – Fire Rake

A fire rake has a serrated cutting edge to remove surface fuels to create a fire line (narrow fire break).

To safely and efficiently use a fire rake:

- Extend the rake horizontally away from the body.
- Strike downwards to dig into the surface litter.
- Hold down with both arms.
- Drag fuel towards you.

McLeod Tool

Figure 2.3 – McLeod Tool

Used for scraping and cutting into ground fuels. The double-sided head allows you to cut small roots (blade side) and rake surface litter (pronged side).

To safely and efficiently use a McLeod tool, follow the guidelines for fire rakes.

Pulaski

Figure 2.4 – Pulaski

A Pulaski is a double-headed tool with:

- an axe for cutting branches
- a grubber for digging into and cutting root systems.

Mattock

Figure 2.5 – Mattock

Another double-headed tool for:

- cutting large root systems
- digging into (grubbing) hard ground that the fire rake or McLeod tool are too light for.

Axe

Figure 2.6 – Axe

Used for felling small trees and removing small branches.

Slasher

Figure 2.7 – Slasher

Used for cutting scrub and small branches, and clearing light scrub from a fire line.

Beater

Figure 2.8 – Beater

Use a beater for beating out fire involving light fuels.

Use in short, low beats to conserve energy.

Follow-up with a shovel or McLeod tool may be required to create a fire break along the edge of the fire.

Safety Note

When working with hand tools:

- work at least 3 metres apart
- keep at least 3 metres apart when carrying hand tools to the job
- stand hand tools up when not in use.

Knapsack Pumps

Knapsack pumps

Knapsack pumps are hand pumps with a rigid or soft backpack container holding up to 20 litres of water. An adjustable nozzle allows the operator to choose between a spray and a jet.

Always add a wetting agent like a Class A foam concentrate to the water.

Since knapsack pumps have a limited capacity, they can only be used sparingly.

Knapsacks are used to:

- extinguish small fires in light materials
- mop up and patrol.

Figure 2.9 – Knapsack Pumps: REGA Pack (left) and Scotty (right)

Use on small surface fires

Apply water as a fine spray with a sweeping motion.

Use on hot spots and smouldering fuel

Apply water as a jet.

Burners/Flamethrowers

Burning tools are available in various types and models. They are used for prescribed burning operations and burning out unburned fuels within the fire or burn perimeter.

Lighting vegetation to control a fire is only permitted if directed by the Incident Controller and controlled by a Crew Leader.

Using burners introduces new hazards. It must only be done with close supervision and control of the crew.

Drip torch

A drip torch is a hand-held container with a short tube and wand. It uses diesel fuel or diesel/kerosene mix fuel.

Figure 2.10 – Drip Torch

Gas wand

A gas wand is a hand-held LPG burner.

Figure 2.11 – Gas Wand

For further information on prescribed burning. and burning equipment go to ‘Carrying out (unit standard 3298)and leading burn (unit standard 3294) operations NRFA training package.

Using and Safe Handling of Hand Tools

Protecting the user and the tools

As is the case in most other jobs, safe working practices protect both the user and the tools by ensuring they are controlled at all times.

Preparation

Having the correct tools at hand and in working condition makes for an effective response:

- Use the right tool for the job.
- Ensure handles fit tightly and are free of splinters.
- Use a file with a handle to keep cutting edges sharp.
- Cover cutting edges when not in use.

Blunt tools are dangerous and ineffective. Extra effort is required to dig and cut with a blunt tool, increasing fatigue. Blunt tools are more likely to glance off their target, increasing the likelihood of the operator hitting themselves or someone close by.

During travel

Safe habits for carrying and travelling with tools:

- Pass tools handle first.
- Keep 3 metres apart when carrying tools to the task.
- Carry tools at their balance point, at waist height alongside the body, with the blade forward and the cutting edge facing away from the body.
- Secure tools when transporting.

In use

General rules for using tools:

- Work at least 3 metres apart to minimise the chances of striking another person.
- Use tools only for their intended purpose. Using the wrong tool makes for harder work and increases the risk of accidents.
- Find firm footing to reduce stress on your body and maintain control over the tool.

Cutting

When using tools for cutting:

- ensure you have enough room to swing the tool
- remove overhanging limbs that might interfere when swinging the tool
- find a comfortable and stable stance
- have a firm grip and footing
- be especially careful on hillsides
- keep checking the position of other crew members during felling operations
- stand two tree lengths away from felling operations.

When tools are not in use, stand the tool upright.

Maintenance

After use

Cover cutting edges when not in use.

Do not leave tools where someone can step on them.

Check that the tool is in good working order before returning it to storage.

Sharpening hand tools

Sharp cutting and digging tools require less effort to use and are less likely to deflect off their target.

When sharpening the cutting edges of hand tools:

- file strokes should move away from the sharp edge
- hold the tool firmly.

The angle ground into the edge of a cutting tool is called the bevel. The bevel reduces the thickness of the blade to a point where a cutting edge can be formed by sharpening.

Not all tools have the same blade bevel, so it’s important to follow the original bevel. If, for example, the bevel on an axe blade is made too shallow, the edge will bend or chip in use.

The shape of the cutting edge is also important. Always work evenly over the entire length of the edge to retain the shape of the edge.

Using power tools for sharpening

Using power tools to sharpen tools can ruin them because:

- too much heat can alter the temper of the blade, making it soft or brittle
- it is easy to remove too much metal with power tools, leading to extra work to restore the edge
- it can be difficult, especially with hand-held tools, to maintain the original shape and bevel.

Discolouration of the metal indicates that it has been heated too much.

Cooling the blade with water frequently during sharpening can help avoid over-heating.

Shovel sharpening

To sharpen a shovel:

- file along the blade of the shovel from each side to the centre
- move the file in one continuous motion for a consistent edge
- use a 45 degree angle
- use up to 20 strokes per side for a good edge
- use a bar clamp or vice to hold the shovel firmly to the bench.

Figure 2.12 – Shovel Sharpening

Power Tools for Firefighting

Power tools can speed up the process of creating fire lines and access routes; however, they can neither do the entire job nor be as easily transported and deployed.

Power tools are only mentioned here in order to give a more complete description of dry firefighting techniques.

Safety Note

Power tools must only be operated by trained and competent operators.

Brush Cutter

Use brush cutters for cutting light fuels in preparation for constructing a fire line. You can clear a two metre wide line of vegetation much faster with a brush cutter than with hand tools. However, a crew must still follow along with hand tools to dig the appropriate width of bare dirt line.

Figure 2.13 – Brush Cutter

Chainsaw

A chainsaw is used to fell scrub and small trees, to cut through ground debris in preparation for fire line construction and to open access for a hose line.

To ensure safety around chainsaws, stand at least two tree lengths from a chainsaw being used during felling operations.

Safe operating principles include wearing protective clothing and recognising the hazards inherent in using the correct ancillary equipment (wedges, etc).

Section 3: Fire Line Construction

Introduction

Firefighters working as ground crews are the most efficient and effective resource to combat low- to moderate-intensity fires.

Advantages

Advantages of ground crews include their ability to:

- react to changing fire and weather conditions
- apply diverse control techniques
- provide feedback on progress and problems.

Limitations

The limitations of firefighters include become tired and fatigued and therefore there is a need for supervision and support, eg food and water.

A fire line may be constructed in situations where firefighting water is difficult to access.

The objective of constructing a fire line is to create a continuous strip of ground clear of all combustible material. The fire line creates a barrier that fire cannot cross, or that can at least be defended by extinguishing the spot fires created by the fire crossing the line.

A fire line may also include natural barriers such as rivers, roads, barren ground and previously constructed firebreaks.

In situations where water for firefighting is not available to secure the fire perimeter, the firefighter's job is to construct the fire line. The firefighter digs below the surface of the ground to the mineral layer of soil. This procedure clears fuels (e.g. downed wood, dry branches, twigs, leaves and needles, and duff including roots) and prevents the fire from spreading.

Fire lines are only effective against ground fires.

Attributes of a fire line

A fire line relies on creating a continuous break in combustible material. This requires:

- clearing vegetation at the surface
- digging down to the mineral layer of earth
- removing additional aerial fuel
- scattering material scraped up into the burnt area.

The depth of the fire line depends on fuel and soil type, plus the size of the fire. A fire line is usually 30–60 cm wide. The depth of the line is always to the mineral layer of the soil.

Digging down to the mineral layer of the earth is necessary because underground fuel can survive the initial ground fire and provide a path for the fire to cross the control line.

Control lines are both natural fire barriers, such as rivers and barren areas, and constructed fire barriers, like roads, railway lines and cleared firebreaks. These can help contain the fire.

Factors affecting the construction of a fire line

The effectiveness and efficiency of construction of a fire line depend on several factors and the way a crew reacts to them.

Knowing the terrain	Determining the conditions ahead of the fire is necessary to avoid wasted effort. You must be confident of completing a fire line.
Following the path of least resistance	Time is critical and the work takes a lot of energy from the crews. Choosing the easiest appropriate path will make the most of a crew's energy.
Using existing fire breaks	Using and connecting existing fire breaks, such as roads, creeks and areas of sparse fuel, reduces the amount of work required to create a fire line.
Avoiding heavy fuels	Creating a line through heavy fuels requires extra work due to the nature of the vegetation and required dimensions of an effective fire line.
Cutting across fire edge bays	Where there are bays of unburnt fuel in a fire edge, a short, straight line can be cut to join the tips of fire figures.
Avoiding the steepest part of slopes	Avoiding steep slopes avoids the need for extensive trenching.

Rate of work

Many factors affect the rate at which a fire line can be constructed:

- individual firefighter performance (fitness and technique)
- teamwork
- duration of task
- availability of the correct tools
- working environment, including heat stress and weather
- fire environment, including fuels and topography.

Crew leaders need to take these factors into account when tasking their crews, and tasks need to be realistic.

Associated techniques

There are occasions and circumstances that require variation on the standard fire line and other efforts to contain fire spread.

Scratch lines

Scratch lines are a quickly constructed alternative to a fire line for the containment of low-intensity fires in light surface fuel.

A scratch line is formed by raking and scraping away loose surface fuel in a narrow strip.

Clearing aerial fuels

If aerial fuels may ignite and carry fire across the line, clear the lower branches of trees on both sides of the line.

The ability of a crowning fire to spread through aerial fuels is unlikely to be overcome by a fire line.

Trenching

Trenches have different purposes depending on the terrain:

- A trench on flat ground is dug to ensure a continuous break is formed in fuel below the surface.
- On steep slopes, trenches are dug to prevent burning fuel rolling down the slope and carrying fire with it.

Flat ground

On flat ground, to prevent fire spread through sub-surface fuel, a trenching would usually include:

- a trench 30 cm wide
- scattering mineral soil on both sides of the trench to increase effectiveness.

In deep duff, machinery may be needed to create a suitable trench in reasonable time.

Slopes

Trenching involves chopping and digging into a slope to form a trough and enhancing the barrier by piling the soil dug up along the downhill side of the trench.

The steeper a slope is the deeper and wider any trench will need to be.

There are other actions that can help prevent material from moving downhill, including:

- turning logs to lie up and down the slope
- digging small and loose material into the ground
- cutting down overhanging material.

Constructing a Fire Line

Constructing a fire line

Ideally, a fire line is constructed starting at the base of the fire, moving along the flanks and finally cutting across the head of the fire to complete the containment.

Suppression techniques

The ‘progressive method’, also known as the ‘one lick method’ and the ‘step up method’ are the best way to build and maintain a fire line with hand tools.

Progressive method (One-lick)

This is where each individual firefighter only does part of the required job, then moves forward in a slow walking pace with each firefighter behind removing vegetation as they go. This means that no one firefighter completes any one section; however, after several firefighters have passed over the same area the section is progressively reduced. The progressive method can be used in thick scrub, open or in forest litter, or grass country.

There are six tasks in the progressive method. In tasks three to six, firefighters work as a close team.

Task	Action
One	Cut the vegetation at ground level, using chainsaws and brush cutters if required.
Two	Move cut vegetation away from the fire edge.
Three	Scrape away surface fuels.
Four	Cut into duff layer.
Five	Remove duff fuels.
Six	Expose to mineral earth.

To increase the width of the fire line in grass fuels, an option is to dig and roll the turf to the side away from the fire on the protected side.

Step-up

This is where firefighters complete individual sections of the trail. The firefighters are spread out and each firefighter clears a short section of the trail down to mineral earth. Once one firefighter completes a reasonable section, step up is called and all firefighters move on to the next unprepared section.

Tips for fire line construction

Use these tips when constructing a fire line:

- Deal first with those areas from where the fire is likely to escape.
- Keep the fire line as short as possible.
- Avoid sharp turns in the fire line.
- Use existing barriers and fire breaks wherever possible.
- Construct a fire line through open areas wherever possible to avoid battling through heavy, dense fuels.
- Pay attention to shifts in wind direction.
- Encircle areas containing several spot fires to avoid constructing a line around each fire.
- Consider blocking constructing lines to cut the fire off from any hazardous fuels such as slash heaps or wind-falls.
- Fire lines can be constructed in sections, with multiple crews working on different sections.

Spars

Fire lines should be cut far enough from spars so that a spar that falls, and associated debris, will remain inside the line.

Felling a spar is an option, but is not always possible. If a spar is left standing, all the fuel should be removed from around it.

Use of machinery in support

If machinery is being used in constructing fire lines, ground crews may be required to follow up behind and clean up the line.

Ground crews as patrols will be required to follow up the machinery.

Mop-up and Patrol

Mop-up is the task of extinguishing a fire after it is contained.

When a fire is contained, continue the aggressive approach used in the initial attack phase in the mop-up phase in order to maintain control. This means vigorous and thorough mop-up action, followed by active patrols.

The fire is not out until the mop-up is finished.

Sloppy mop-up and inadequate patrol can waste all the hard work and expense of containment.

Prompt and complete mop-up is just as important as a fast initial attack.

Mop-up tactics

For small fires:

- extinguish all smouldering fuels
- work on problem areas first.

For large fires:

- extinguish the perimeter first, giving priority to problem areas
- then work inwards, concentrating on hot spots that could send sparks out of the fire area if the wind increases.

Figure 3.1 – Mopping up

Mop-up methods

- If the fire has burnt into the sub-surface fuels, establish a fire line around the fire perimeter.
- Extinguish the perimeter first, giving priority to problem areas.
- Extinguish all smouldering materials with water (if possible) and soil, working inwards from the fire line.
- Fuels that are not completely burned should be allowed to burn themselves out or should be burned out.
- Burnt fuels can also be turned over out of their beds of hot embers, or scattered.
- Remove or protect hazardous fuels just outside the fire area.
- Closely check places where spot fires can start.
- Clear rotten logs, stumps, singed scrub and undergrowth and low-hanging branches from both sides of the line.
- Make sure that no roots cross under the fire line.
- Deal with burning spars that could spread wind-blown hot embers.
- Use experienced fellers to fell spars or trees. Keep other personnel at least two tree lengths away.
- To extinguish burning materials, dig it out.
- To help cool down burning materials, use a shovel to turn it over and expose it to air.
- Chop or scrape embers from logs and extinguish these with water, if possible.

Safety Note

Check doubtful hot spots for warmth with the back of a hand (cold-trailing). Take extra care to avoid burning the hands when cold-trailing. Areas showing smoke or steam indicate that heat is present.

Dry mop-up

When water is not available, firefighters have to rely on dry mop-up methods. Dry mop-up can also be used in preference to relaying water.

Dry mop-up is:

- chopping up or digging out burning embers and spreading them out so they will burn up quickly
- spreading and mixing embers with mineral soil to cool them down.

Methods may include a combination of:

- constructing a fire line around the fire perimeter
- throwing dirt with a shovel to extinguish flame
- checking the fire line for hidden roots that could carry the fire under the fire line
- turning material over and scraping embers off
- chopping up burning material and spreading it out to burn out quickly
- mixing embers with mineral soil to cool them
- positioning material on slopes, or digging it in, so it will not roll downhill
- cutting down high smouldering material
- moving smouldering material from the fire edge into the burnt area
- scattering or removing concentrations of unburnt fuel near the fire area
- checking for fire underneath or in stumps
- scraping or chopping out all fire in logs.
- Bury burning material as an immediate way of stopping embers being blown into an unburnt area. These materials must be uncovered and extinguished later.

Cold-trailing

To help detect a hot spot underground, use the back of the hand to feel for heat. Even deep-seated hot spots can warm the surface of the ground.

Infrared equipment

Check with your Incident Controller to see if there is thermovision scanner (heat-seeking) equipment available. This equipment can be in the form of a torch-sized (buzzer) device or a heat-seeking camera. These units require trained operators to be used effectively.

Burning Spars

Problems

Burning spars have numerous problems:

- Fire in a spar (standing dead tree or standing portion from which at least the leaves and smaller branches have fallen) may not be detected.
- Windblown embers may spread into an unburnt area.
- Spar may weaken and fall.

Solutions

Here are some solutions:

- Identify spars that could cause problems.
- Assess potential dangers.
- If spar appears to be unstable, mark off the area and keep away at least twice the distance of the height of the spar.
- If spar seems stable, apply water from a distance, taking care not to spread embers and start a new fire.

Safety Note

Always check your LACES:

L ookouts

A wareness of anchor points

C ommunication

E scape routes

S afety zones

Safety Note

Spar felling is hazardous, and should only be done by skilled personnel.

Spars or live trees with burnt-out root systems can fall at any time without warning or sound.

Patrol

The last action on a fire is to patrol the burnt and surrounding area, checking for any sign of rekindling fire.

Start patrolling immediately after the fire is contained.

Depending on the conditions, patrols may be required for a long period (minimum of 48 hours during dry periods) to ensure that any rekindling is detected and dealt with quickly.

This may also be necessary several weeks later, especially during high winds.

Patrolling duties may include:

- using the senses to find burning embers – look, listen, smell and touch
- cold-trailing or using the back of the hand to feel for heat in the ground
- keeping moving – a hot spot could be rekindling new fuels at any time
- staying within calling distance of other crew members in case assistance is needed
- using hand tools to dig for hot spots
- using water to cool sub-surface hot spots.

Patrols should also:

- check for smouldering spots inside and outside the fire area
- be continually moving around the area, looking for hotspots that could rekindle new fuels.

Use a thermovision scanner operated by trained personnel to help locate hot spots and to detect deep-seated hot spots not apparent at the surface.

Declaring a fire out

The fire is considered to be out when all heat sources (hot spots) have been extinguished and there is no likelihood of the fire rekindling.

The way to be sure of this is cold-trailing the entire area on a small fire or the secured strip next to the fire edge on a large fire.

When the secured strip is safe, mop-up operations can begin on the interior of the burnt area.

Only the Incident Controller can declare the fire is out.