



# Working safely at vegetation fires

## Study Guide

# Status of this document

This document, its content and specified processes are not to be altered except through Fire and Emergency New Zealand Training processes.

## **Recommendations for change:**

Fire and Emergency New Zealand encourages and welcomes feedback on all its products and processes to ensure currency and continuous improvement.

Recommendations for changes to this material should be sent to Fire and Emergency New Zealand. Please use the Feedback/Suggestions form on the Portal.

**Document title:** Working Safely at Vegetation Fires

**Published:** September 2015 **Amended:** July 2016; May 2017; March 2019; September 2019; November 2020

## **Disclaimer**

This content contains Fire and Emergency New Zealand training material which has been developed to guide and support firefighters working for Fire and Emergency New Zealand and partner agencies only.

Fire and Emergency New Zealand makes no representation as to the appropriateness, effectiveness or safety of this material for anyone other than authorised Fire and Emergency New Zealand or partner agency personnel. Fire and Emergency New Zealand will not be responsible or liable for any outcome caused by unauthorised reliance on this material.

© Fire and Emergency New Zealand – Training

If you wish to copy or reproduce any of the material in this document, please contact:

Fire and Emergency New Zealand  
National Training  
PO Box 2133  
Wellington  
Ph:(04) 4963600

# Contents

Status of this document	b
<b>Contents</b>	<b>1</b>
<b>Introduction</b>	<b>2</b>
<b>Section 1: How Fires Burn</b>	<b>3</b>
What makes a fire burn?	3
How do vegetation fires spread?	4
Where do fires burn?	5
How can we tell how hot a fire is?	6
What are the parts of a fire called?	<b>8</b>
Summary	10
Self check	11
<b>Section 2: Factors that influence the behaviour of fires</b>	<b>12</b>
What topographical factors affect fire behaviour?	12
How does fuel factors affect fire behaviour?	14
How can weather affect fire behaviour?	16
Summary	18
Self check	19
<b>Section 3: Extinguishing Fires</b>	<b>20</b>
Chain of command at a rural fire	20
What is a safety briefing?	21
What Personal Protective Equipment (PPE) should you wear?	21
How can you suppress a vegetation fire?	22
Type of attack	23
What are the different methods of communicating at a fire?	25
Summary	27
Self check	28
<b>Section 4: Hazards and survival</b>	<b>29</b>
Fire behaviour hazards	29
How should you deal with fire behaviour hazards?	29
Operational hazards – tools and equipment	30
Safety planning	35
Summary	38
Self check	40
<b>Section 5: Protecting yourself and others</b>	<b>41</b>
How does exposure to radiant heat affect you?	41
How does exposure to smoke and dust affect you?	42
How does metabolic heat affect you?	43
How does fatigue affect you?	43
How can burns affect you?	44
How does sunburn and windburn affect you?	44
How does lack of food affect you?	45
How does dehydration affect you?	45
Noise	46
Heat illness	46
Summary	50
Self check	52

# Introduction

This study guide provides the information you need to keep yourself and others safe at a vegetation fire.

It also covers the knowledge you will need for achievement of unit standard 3285 *Demonstrate knowledge of protection of personal safety at vegetation fires*, level 3, credit 3.

## Pre-course requirements

You need to read this study guide before attending the one-day training course. The **self-check questions** at the end of each section are to help you reinforce and retain what you've read. You can refer back to the relevant part of the section to see if your answers are correct. Your pink LACES card will also help you complete the self checks. You will not be asked to submit your answers for marking.

It's also important you complete the **pre-course task** before attending the course. You should receive this task at the same time as the study guide. You must hand in the completed task to the course trainer during the course, as this will provide supporting evidence for assessment purposes.

It is recommended you finish reading the study guide before starting the pre-course task. You may refer back to the study guide if you need to fill any gaps or check your answers. This will help prepare you for the on-course assessment.

## Assessment

You will complete a theory assessment at the end of the training course. You must complete this without reference to the study materials or course handouts.

## Finding your way around the study guide

It's important that you begin by knowing the characteristics of vegetation fires, how they burn, and why. So in sections one and two we talk about what vegetation fires are, and the factors that affect the way they burn. This will prepare you for sections three and four, where we talk about how you can put these fires out safely, and about avoiding hazards. Finally, in section five we discuss how you can protect yourself and others from the fire.

There are a number of words that may be unfamiliar to you. These are explained in word check boxes throughout the study guide.

There are also safety notes. Please read these carefully.

At the end of each section, read the summary. Then complete the self check page for that section. If there's anything you don't understand, ask your local trainer or when you attend the course ask the trainers on the course.



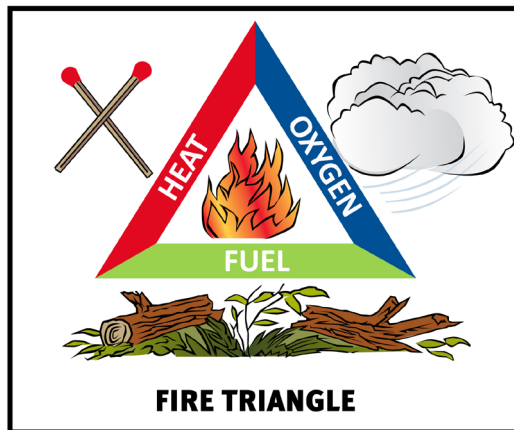
### SAFETY NOTE

This is an example safety note.

# Section 1: How Fires Burn

## What makes a fire burn?

Fire is created by fuel, oxygen, and heat. If you take away one of these, you can't make a fire. These three parts of a fire make up what is called the "fire triangle."



Oxygen is a gas in the air. Heat works with oxygen to create a flame. But they both need something to burn. Fuel is anything that will burn. It can be solid (e.g. wood) liquid (e.g. petrol) or gas.

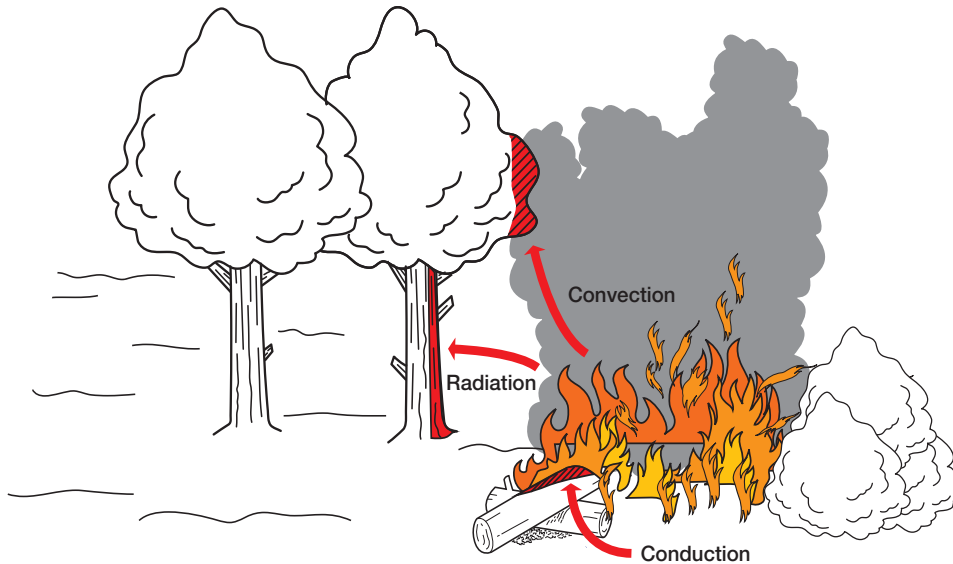
### Stages of combustion (burning)

There are three different but overlapping stages of combustion.

<p><b>Preheating</b></p> <p>Unburnt fuels are heated and flammable gasses are released</p>	<p><b>Gaseous</b></p> <p>The escaping gasses are ignited and produce heat and light</p>	<p><b>Charcoal</b></p> <p>The fuel no longer gives off enough gas to support flame and the fuel smoulders</p>

## How do vegetation fires spread?

Heat can be transferred from burning vegetation to unburnt vegetation. The four different ways this can happen are radiation, conduction, convection and ember transport.



### Radiation

Radiation is rays of heat coming in a straight line from something very hot like a fire or the Sun. The rays from burning vegetation travel in all directions to heat the unburnt vegetation near it, before the flames get to it.

### Conduction

Different substances conduct (carry) heat at different rates. Metals (eg steel gates) are more effective conductors of heat than wood (eg fence). Wood is a poor conductor of heat.

### Convection

As the fire gets hotter, the air is heated to an even greater temperature than the fire and rises up.

A convection column of air can carry ash, embers and small pieces of burning fuel.

### Ember Transport

Ember transport is when embers are carried by wind, by the convection column, or by rolling downhill.

**Fire can spread faster by a combination of these methods.**



#### SAFETY NOTE

Watch out for spot fires occurring.

## Where do fires burn?

There are three main layers of fire.

Subsurface fires happen under the surface of the ground. Surface fires happen on the ground and above. Crown fires happen in higher vegetation layers.

### Subsurface (Ground fire)

A ground fire burns in the organic materials under the surface in the soil layer (peat, humus, roots). It can also burn in buried materials (such as in landfills).

- Ground fires smoulder with no flame and little smoke
- They can burn unnoticed, and may later ignite surface fires

### Surface fire

A surface fire burns fuels at, and above, ground level. Surface fires are the most common type of fire.

They burn fuels lying on or near the ground (e.g. grass and scrub).

They can be fast travelling in strong winds and on steep slopes and able to burn all fuels in their path.

### Crown fire

A crown fire burns in the tops of trees. It usually needs a surface fire to keep it going.

Crown fires can spread rapidly in strong winds and on steep upward slopes.

An intense surface fire may follow behind a crown fire. Ember transport from crown fires can cause new surface fires.



#### SAFETY NOTE

Subsurface fires can create underground cavities which can collapse.



#### SAFETY NOTE





Your first responsibility is the safety and welfare of yourself and others, so you have to watch out for hazards!

## How can we tell how hot a fire is?

Dry fuel will produce very intense heat.

We can tell the heat of the fire by the length of the flame and the colour of the smoke. The longer the flame, the hotter the fire.

In the following table, the colour of smoke tells us something about the dryness of the fuel and fire intensity.

				
Smoke colour	Dense white	Grey	Black	Copper-bronze
Fuel moisture	Very moist fuel	Moist fuel	Dry fuel	Very dry fuel
Fire heat	Low	Moderate to high	High to very high	Extreme



### SAFETY NOTE

Caution when fire size is unknown.

### Flame Length

**Less than 0.3 metres.** Low Danger. Fire does not spread much and is easy to control.



**Between 0.3 metres and 1 metres.** Moderate Danger. Direct manual attack is possible.





**Between 1 metre to 2.5 metres**

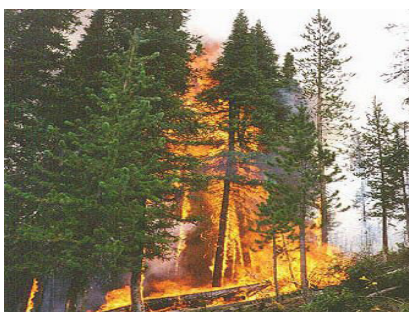
High Danger. Water under pressure and heavy machinery for effective firefighting.

**Between 2.5 metres and 3.5 metres**

Very High Danger. The head should only be attacked with aircraft.

**Over 3.5 metres**

Extreme Danger. The only safe action is at the back and along the flanks.

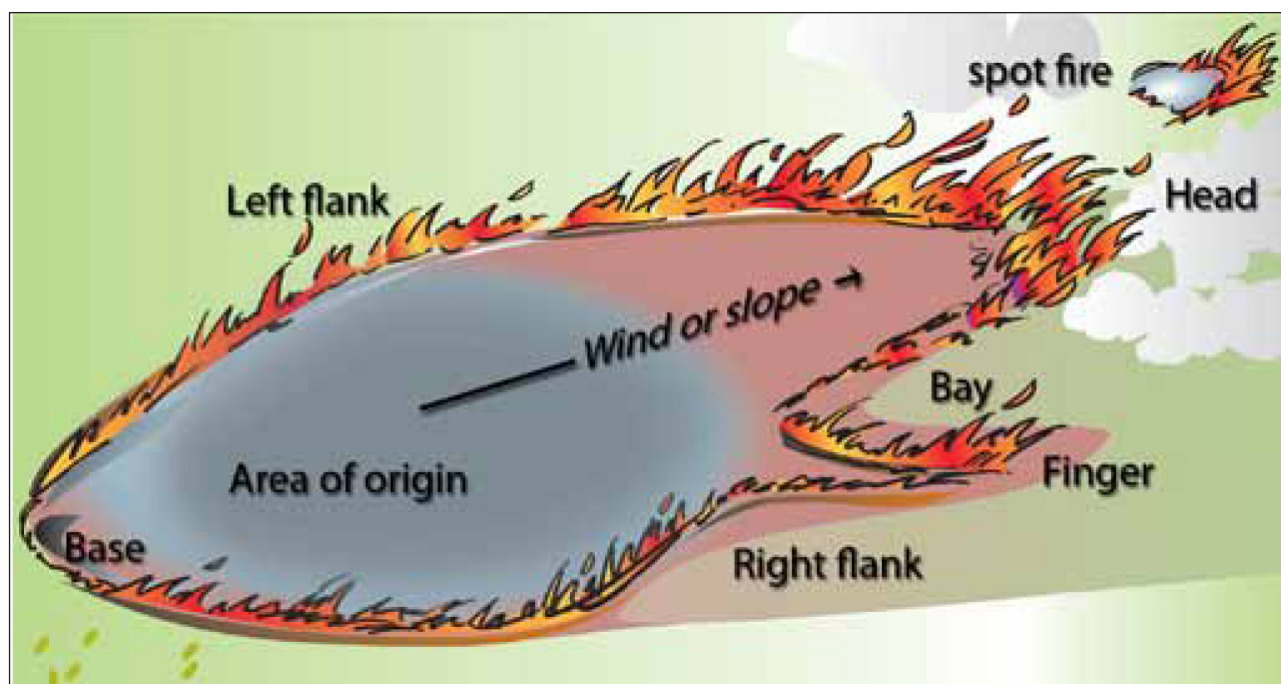
**SAFETY NOTE**

Do not attempt a frontal attack.

## What are the parts of a fire called?

### Word Check

Area of origin	Where the fire starts
Base	Where the fire is the least intense
Bays	Indents between forward moving 'fingers' of the fire
Embers & Firebrands	Loose particles of burning fuel in the air
Flanks	The left and right outside edges of the fire
Head	The front of the fire
Islands	Areas of unburnt fuels within the fire
Perimeter	The whole outer edge, or boundary of the fire
Spot fires	New fires ignited by embers from the main fire



The fire usually starts somewhere between the base to the centre area. The least intense part of the fire is the outer edges, this has the lowest flames and slowest rate of spread where possible. Try not to work in the area of origin. This area should be protected where possible to help find the cause of the fire.



### SAFETY NOTE

The burnt out area is usually the safest place to be at a wildfire.

The head of the fire is at the opposite end. It is the part of a fire where the rate of spread, flame length and intensity are greatest, usually when burning downwind or upslope. The position of the head of the fire depends on wind direction, fuel and topography. It is dangerous to work in this area.

The flanks are the sides of the fire. The fire intensity is lower at the flanks. Fingers are narrow slivers of the advancing vegetation fire that extend beyond the head or flanks. There will sometimes be 'islands' of unburnt fuels inside the fire perimeter.

Spot fires are new fires ignited ahead of, or away from, the main fire. They are started by embers, or by a burning object called a firebrand.

## What helps a fire to spread?

Three things influence the spread of a vegetation fire – topography (the shape and features of the land), weather and fuel (usually vegetation).

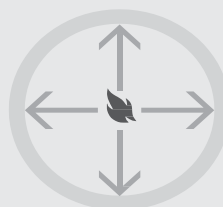
**Topography** Fire can move quickly up slopes.

**Weather** Wind speed and direction influence fire spread.

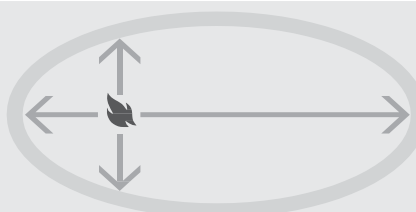
**Fuel** The dryness, size and amount of a fuel can effect how the fire spreads. Fires will spread quickly with dry fuels.

The speed of the wind, the direction of the wind, and the slope of the ground has a major effect on how fast the fire spreads. In the diagrams below the wind is blowing left to right.

**Spread pattern 1 (on a calm day and flat ground).** This is when the fire starts on flat ground, with an even fuel distribution, and on a calm day. The edge of the fire (perimeter) will move out evenly from the ignition point, in a circular pattern. Fire spread is slow under these conditions.



**Spread pattern 2 (on a windy day or slight slope).** The fire will travel in the same direction as the wind or up slope.



**Spread pattern 3 (by strong wind on a steep slope).** Wind and slope both increase the heating of nearby vegetation. The fire takes on an elliptical (egg) shape with the pointed end moving the fastest. It is pushed forward and up or down the slope by its steepness and the wind.



### SAFETY NOTE

A flank fire can become a head fire with a change in wind direction.



### SAFETY NOTE

Fires run uphill much faster on steep slopes.

## Summary

The fire triangle shows the three things necessary for a fire to ignite and continue to burn:

### Oxygen + Heat + Fuel = Fire

Heat is transferred by:

**Radiation** Heat energy that travels in a straight path outward in all directions from its source (like the rays of the sun)

**Conduction** The transfer of heat through solid objects from an area of higher temperature to an area of lower temperature

**Convection** The transfer of heat through air. As hot air rises, it carries heat with it, gradually losing this heat to the surrounding air

**Ember transport** Hot embers are transported by wind, convection column or rolling downhill of a fire.

The shape of a vegetation fire is determined by wind, topography and fuel.

There are three types of vegetation fire:

A **crown fire** burns in the tops of trees ahead of and above an intense surface fire

A **surface fire** burns in surface vegetation such as grass, scrub and forest litter

A **sub surface** fire burns the organic material in the soil layer, as in a peat fire.

The parts of a vegetation fire are:

- Fire perimeter
- Area of origin
- Head
- Flanks (left/right)
- Fingers
- Base
- Spot fires
- Unburnt pockets or islands

## Self check

	True √	False X
Taking away fuel stops the fire	<input type="checkbox"/>	<input type="checkbox"/>
2. Only radiation and convection transfer heat	<input type="checkbox"/>	<input type="checkbox"/>
3. Radiant heat needs a substance to travel through	<input type="checkbox"/>	<input type="checkbox"/>
4. Convection is when heat moves upward	<input type="checkbox"/>	<input type="checkbox"/>
5. A crown fire burns at the top of trees	<input type="checkbox"/>	<input type="checkbox"/>
6. Spotting is when hot embers start new fires	<input type="checkbox"/>	<input type="checkbox"/>
7. The intensity of the fire is greatest at its flanks	<input type="checkbox"/>	<input type="checkbox"/>
8. The area of origin is where the fire started	<input type="checkbox"/>	<input type="checkbox"/>
9. Wind has little influence on fire behaviour	<input type="checkbox"/>	<input type="checkbox"/>
10. Most fires are sub surface (ground) fires	<input type="checkbox"/>	<input type="checkbox"/>



### NOTE

Review your knowledge on the information in this Study Guide prior to fire season.

11. What is your first responsibility in a fire?

---

12. Fires respond quickly to shifts in \_\_\_\_\_

13. The colour of smoke will tell you about the \_\_\_\_\_ of fuel and the \_\_\_\_\_ of the fire.

14. Draw the spread pattern you would find on a windy day or on a slight slope:

# Section 2: Factors that influence the behaviour of fires

## The Fire Environment

The fire environment consists of three major components:

- Topography
- Fuel
- Weather

You need to be able to predict how the fire is going to burn. As the fire spreads, the land, vegetation and weather may change.

### Work check

Fire Behaviour	The way that fuel ignites, flame develops and fire spreads
Fire Ground	The area where the fire is burning, or may spread to, or anywhere firefighters are working
Fireline	The outer edge of the fire, where fire fighters are suppressing it.
Terrain	The land surface (e.g. ridges, valleys and gullies)

## What topographical factors affect fire behaviour?

The slope and height (elevation) of the land, the way it is facing (aspect), and its valleys and gullies (terrain) all affect the way the fire behaves.

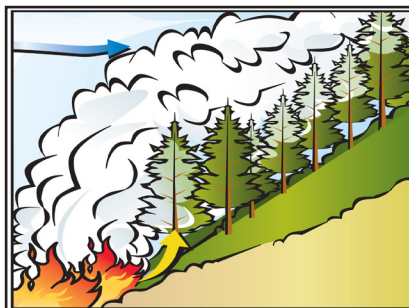
### Slope

The slope will affect the speed of a fire. A fire burning upslope preheats the unburnt fuels quicker than a fire on level ground. The opposite is true for a fire travelling downslope.

The fire doubles its speed as it moves for every 10 degrees up a slope. For example:

A fire spreading at 500 m (metres) per hour, will speed up to 1000 m per hour up a 10° slope.

The rate of fire spread will be slower downslope.



Slope, elevation and aspect can all affect wind strength, amount of rainfall and air temperature, which in turn affect the dryness of vegetation.



### SAFETY NOTE

Fire can spread up a slope or downwind faster than you can move.



### SAFETY NOTE

Avoid being uphill or downwind of a fire.

## Word Check

Aspect	The direction that a slope faces (north, east, south or west)
Barriers	Areas of land with no vegetation cover
Elevation	The height of the land
Prevailing wind	The overall direction the wind is blowing from.

## Elevation

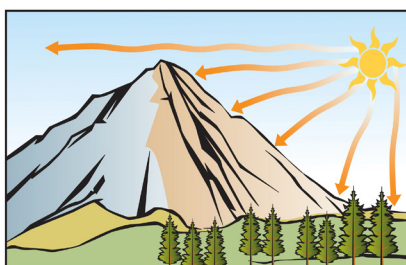
Generally temperature decreases with elevation and relative humidity increases.

Wind strength can increase as airflow is forced over or around hills. Rainfall will be greater on the side of a hill or mountain range that faces the wind.

## Aspect

North/West facing slopes are usually sunny and dry. The sun shines on this side.

Northern / western slopes tend to have lighter, more flammable vegetation, while southern / eastern slopes have damper fuels.



South/East facing slopes are wetter.

## Terrain

The terrain is made up of valleys, gullies, slopes, ridges and flat areas. These can all affect the direction and rate of fire spread, and fire behaviour. Like water, wind flows along the lowest and easiest path following the shape of the land.

Local winds can be shaped by ridges and valleys, and flow in a different direction than the prevailing wind. This could potentially make the fire less predictable.



Narrow, shallow gullies can “funnel” the wind creating a fast moving path. This is sometimes called the “chimney effect”. It can cause high intensity fires and spot fires.

## Chimney Effects

On steep terrain, the slope effect can combine with the wind, funnelling into any depression, resulting in strong up-draughts.



### SAFETY NOTE

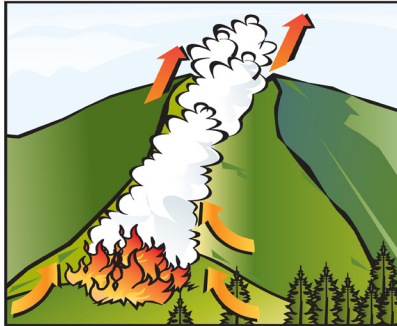
Make sure you or someone else knows the area.



### SAFETY NOTE

Normally familiar country can become foreign in the dark or in smoky conditions.

The funnel effect directs the movement of fire into a narrow rising path eg. a saddle or steep gully.



The fire's rate of spread (ROS) and intensity increase rapidly, like a chimney in a fireplace. Even comparatively shallow gullies running up a slope can create a chimney effect.

Barriers to fire spread include landslides or barren areas, roads and railways, firebreaks, rivers, lakes and fire resistant vegetation.

## How does fuel factors affect fire behaviour?

**SAFETY NOTE**

Spot fires starting away from the main fire may develop into other fires.

### WORD CHECK

Fire intensity	How hot a fire will burn
Flammable	Something flammable is easily set on fire
Relative humidity (RH)	The moisture in the air

### Crown fuels

Crown fuels are the tops of the trees. They are more affected by wind. Crown fires may be hotter and faster than surface fires.

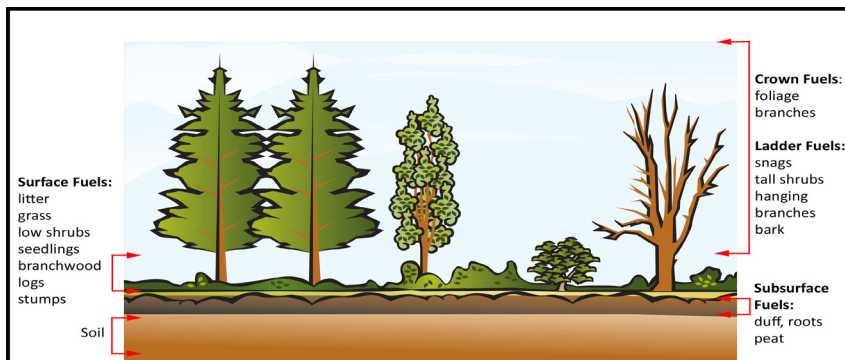
Ladder fuels are the fuels that link crown fuels and surface fuels. They may include dead fuels hung up in lower branches of scrub or unpruned trees, tall shrubs, small size trees, bark flakes, draped needles, tree lichens.

### Surface fuels

Surface fuels are at the surface of the ground. Examples are litter, low and medium sized shrubs, seedlings, grasses, fallen dead matter.

### Subsurface (Ground) fuels

Subsurface fuels are the partially rotted materials under the surface of





the ground (duff, roots, peat, buried wood etc). These fuels can burn from centimetres deep to a metre or more.

### Fuel quantity

The greater the amount of fuel to burn, the larger the fire and the greater the fire intensity.

The more available fuel there is to burn, the larger and hotter the fire.

## Fuel features

### Fine fuels

Examples are cured grass, fallen leaves, needles, small twigs, ferns, tussock and forest floor litter. They lose moisture easily and dry out quickly. Dry, fine fuels ignite easily. They carry a fire rapidly and can preheat surrounding fuels.



### Medium fuels

They require more time to dry out and are too large to be ignited until after the leading edge of the fire front passes. They are small enough to be completely burned. Examples are scrub, branches, young trees, manuka, gorse and coastal vegetation. They need a mixture of fine fuels to ignite them. They can spread the fire rapidly, and will produce hot fires.



### Heavy/ Coarse fuels

These are large, dense, woody or deep organic materials. Examples are logging slash, stumps, wind-felled trees, mature trees and native forest. They are usually difficult to ignite. Once on fire, heavy fuels can take some time to burn. Once well involved in a fire, they will produce high intensity fires.



### Chemical Composition

Some fuels are very flammable because of oils, waxes and resin. Examples are gorse and monoao. Manuka is a dense wood containing oils and resins that burn easily and produce large amounts of heat.

Other fuels may look the same but are resistant to burning, such as broom. Willow is softer wood containing a large amount of moisture that makes it difficult to burn.

### Fuel moisture

Fine fuels (small diameter)	These fuels lose moisture quickly and dry out easily and daily in warm dry conditions. Frost also dries out fine fuels quickly, as it draws out moisture and cures. This is called frost curing.
Medium fuels (greater diameter)	These take longer to be dry enough to burn than fine fuels. Drying out might take a week.
Heavy fuels	The fire has to evaporate the moisture before the fuel can burn. It will take a long drought to dry out these fuels.



### SAFETY NOTE

Fuels will burn to a greater extent during drier periods.

## How can weather affect fire behaviour?

“Weather” includes air temperature, relative humidity, wind speed and direction, and rainfall. It can change often during a fire.

### Air temperature

Fuels in direct sunlight will dry out and ignite more easily than shaded fuels. High air temperatures dry out and preheat fuels.

### Relative Humidity (RH)

Moisture in the air can dampen dry fuels. Wet fuels lose moisture to dry air (sunny days). Green vegetation does not lose or gain moisture as quickly as dead fuels.

When relative humidity is low, fuels ignite and burn easily. Fires could be hotter.

### Wind speed

Wind helps dry out fuels. It directly affects the rate of fire spread and fire direction.

Whirlwinds are formed when there is a difference in temperature between the burnt and unburnt area.

### Rainfall

Fuels absorb moisture in continuous rain or high relative humidity.

In short periods of heavy rain, water tends to run off and not be absorbed by fuels.



### SAFETY NOTE

Dry air (low RH) results in more active fire behaviour.



### SAFETY NOTE

A sudden increase in wind speed will rapidly increase fire intensity,

### Change between day and night

Fire normally burns quickly during mid afternoon when relative humidity (RH) is low and the temperature is higher. It usually burns more slowly during the night. Fast burning at night can happen with low relative humidity (RH) and strong wind speeds.

### Fire intensity

Topography, fuel and weather greatly affect the intensity of the fire. A fire that is burning a great amount of fuel quickly, will be much hotter than a fire burning a small amount of fuel more slowly. Knowing about potential fire intensity is important because it will tell you if you have enough resources to safely suppress the fire.

### Combined effects

A fire will react to the environment it is burning in.

When all the factors of topography, fuel and weather are known it becomes possible to predict the behaviour of a fire.



#### SAFETY NOTE

A fire in steep terrain will increase fire intensity behaviour.



#### SAFETY NOTE

Use caution when you are working in areas where you do not know the local weather.

## Summary

The three main factors affecting fire behaviour are topography, fuel and weather. These make up the fire environment.

Topographical factors that affect fire behaviour:

- slope affects speed, direction and intensity of a fire
- aspect influences fuel dryness
- shape of terrain influences speed and direction of fire spread
- elevation influences fuel dryness
- barriers to fire spread can assist with containment of a fire

Fuel factors that affect fire behaviour. The main fuels are:

- Subsurface fuels are the partially rotted material under the ground surface
- Surface fuels are at the surface of the ground
- Crown fuels are the tops of the trees

Fuel features include:

- the size of the fuel
- the quantity of the fuel
- what the chemical composition of the fuel is
- how much moisture is in the fuel

Weather variations affect fire behaviour:

- air temperature affects fuel dryness and fuel preheating
- Relative Humidity (RH) affects the fuel moisture content
- wind affects rate and fire direction. It can change quickly
- rainfall affects fuel moisture content

Air temperature, humidity and wind, change between night and day



### SAFETY NOTE

Knowing about potential fire behaviour and intensity is important because it will tell you if it is safe to extinguish the fire.

## Self check

	True ✓	False X
1. Fuel, weather and topography influence fire behaviour	<input type="checkbox"/>	<input type="checkbox"/>
2. Coarse fuels ignite more readily than fine fuels	<input type="checkbox"/>	<input type="checkbox"/>
3. The moisture content of fuel affects fire behaviour	<input type="checkbox"/>	<input type="checkbox"/>
4. Fine fuels ignite easily and burn quickly.	<input type="checkbox"/>	<input type="checkbox"/>
5. Fires usually travel faster down than up a slope	<input type="checkbox"/>	<input type="checkbox"/>
6. Temperature increases with elevation	<input type="checkbox"/>	<input type="checkbox"/>
7. On steeper slopes, the heat can be more intense	<input type="checkbox"/>	<input type="checkbox"/>
8. Heavy fuels are the easiest to ignite	<input type="checkbox"/>	<input type="checkbox"/>
9. High air temperatures dry out and pre-heat fuels	<input type="checkbox"/>	<input type="checkbox"/>
10. Wind shifts change fire behaviour more than other factors	<input type="checkbox"/>	<input type="checkbox"/>



### NOTE

Review your knowledge on the information in this Study Guide prior to fire season.

11. What are some barriers to fire spread? \_\_\_\_\_

\_\_\_\_\_

12. The slope will affect the \_\_\_\_\_ of the fire.

13. Materials under the surface of the ground are called \_\_\_\_\_ fuels.

14. Some fuels with resins, waxes and oils in them, are more

\_\_\_\_\_

# Section 3: Extinguishing Fires

Extinguishing a fire safely needs:

- Situational awareness (hazards and risk)
- Safety attitude
- Good leadership
- Command structure
- Good communications
- Correct PPE
- LACES (pink card)

## Chain of command at a rural fire

The Incident Controller has the highest level of responsibility at a fire. At a fire, you will report to your Crew Leader who may also act as the Incident Controller.

### Incident Controller

The Incident Controller assesses the risks and makes decisions about the strategy. This strategy must be communicated to all. Incident Controller provides an overall briefing.

- What are the safety issues?
- What are the known hazards?
- What is the rate of spread?
- What kinds of fuel are there?
- What is the fire intensity?
- What resources do we have/need?

### Crew Leader

The crew leader firstly ensures safety of the crew and then makes sure that tasks get done.

He/she gives safety briefings to the crew.

### Firefighters

Firefighters carry out tasks given by the crew leader. They look out for the safety and welfare of themselves and others.

As a firefighter, you must report to your crew Leader if there is a problem on the fire ground.

Each person must clearly understand:

- who they are responsible to/for
- what they are responsible for
- that no one should be given a task beyond his/her ability.

## What is a safety briefing?

Safety and welfare are the primary responsibilities of everyone at a fire. Crews must be provided with a safety briefing before going onto the fireground. Safety briefings include:

- fire suppression objectives
- methods of communication
- escape routes / safety zones / anchor points
- the tasks that will be allocated to the crew
- Safety Officer identified
- reminder of safe work practices
- known hazards and risk assessment (refer LACES).

## What Personal Protective Equipment (PPE) should you wear?

All crew members need to have good clothing and equipment for their personal protection. You should not attend a fire unless you are safely clothed. Personal protective equipment, (PPE), must protect you from:

- physical injury – scratches, abrasions and direct burns
- exposure to radiant heat
- a build up of metabolic heat (see section 5 for definition)

Clothing for firefighting must meet Fire and Emergency approved standards:

- safety helmet with neck-protecting cloth
- helmet visor or goggles
- approved fire resistant overalls meeting Fire and Emergency standards
- fire rated safety boots with woollen socks
- leather gloves with wrist protection.



It is recommended you wear woollen or plain cotton underclothes. Other fabrics, such as nylon, can melt at high temperatures and cause serious injury.



### SAFETY NOTE

Wear PPE carefully at the fireground and make sure that others are also wearing correct PPE.



### SAFETY NOTE

Certain operations may require additional PPE.

### Other safety items

Earmuffs for when you are near pumps, power equipment, heavy machinery and aircraft.

Goggles and dust masks (P2 charcoal filter rating) in ashy and dusty conditions when undertaking mop up.

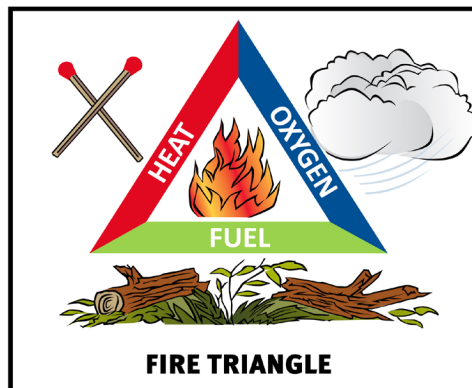
You may need extra warm clothing (e.g. woollen coat, balaclava and gloves) when working in cooler areas (e.g. high country or overnight). Take a drink bottle.

A kit bag might be useful for carrying PPE.

Wear a small back pack with extra clothing and high energy food, if you are likely to be working in remote areas for some time.

## How can you suppress a vegetation fire?

1. Cutting off the oxygen supply will smother the fire. Use foam or soil.
2. Reducing the temperature will cool the fire. Use water at the base of the flames.
3. Removing the fuel from the path of the fire will starve it. Use hand tools or machinery to create a firebreak (Sometimes called "dry firefighting").



### Three basic rules of fire suppression

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.



#### SAFETY NOTE

Think about safety during all four stages. Watch out for each other and the fire.



## There are four stages to extinguishing a fire

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.

## Type of attack

Depending on the type of fire, you can attack it directly or indirectly. First step is to size up the fire and then select a method of attack. The method is either direct or indirect attack.

### Direct attack

A direct attack is used mainly on low intensity wildfires that can be easily and safely reached by firefighters.

Firefighters work from an anchor point on the base edge of the fire and this edge then becomes the fire line.

For further information on direct attack see resources for:

Control vegetation fires using dry fire fighting techniques US 3286, and Suppress vegetation fires with water and with water with additives US 3287.



### SAFETY NOTE

Only experienced Incident Controllers should authorise indirect attacks.

**Indirect attack**

An indirect method is to use a natural fire barrier, or to construct a fire line some distance from the fire's existing perimeter.

**Anchor point**

Always start with an anchor point. This may be a fire break, road, river, or the base of the burnt area. This safe area is then continually extended along the flanks of the fire. It will provide an escape route back to the anchor point at all times.

In case the fire does something you didn't expect, your crew should have an alternative escape route planned.

**Safety zone**

You also need somewhere else to go to, in case it is too dangerous to just go back to the anchor point. A burnt out area could provide an alternative but beware of potential for reburn.

## What are the different methods of communicating at a fire?

Make sure that you understand instructions. Ask again if you don't. If you give an instruction, make sure it is clear.

There are four main ways of communicating at a fire: face to face, radio telephone, hand signals and runners.

### General communication guidelines

What to do:

1. Plan what to say.
2. Speak clearly.
3. Identify receiver and caller.
4. Repeat a message if in doubt.
5. Record important messages.
6. Keep to the point.

### Radio telephone

Sending a message	Examples
Calling	Pump this is Nozzle Operator
Receiving	Nozzle Operator this is Pump
Message	Water off
Acknowledge	Water off

Stand at least 5 metres away from a running engine (pump) when you use a portable radio telephone, so that you can hear.

### Emergency message

To clear the radio channel and gain the attention of other radio users in an emergency, call: "EMERGENCY – EMERGENCY – EMERGENCY"

When you get a reply you must give your name and location and describe the emergency. Stay in contact, as you may have to give more information. Do not give any injured person's name.

If anyone else is on the radio at the same time, they must:

- leave the channel free for you to send the emergency message
- leave the channel free while you wait for a reply.



#### SAFETY NOTE

Always make sure that you have communication with the rest of the crew.



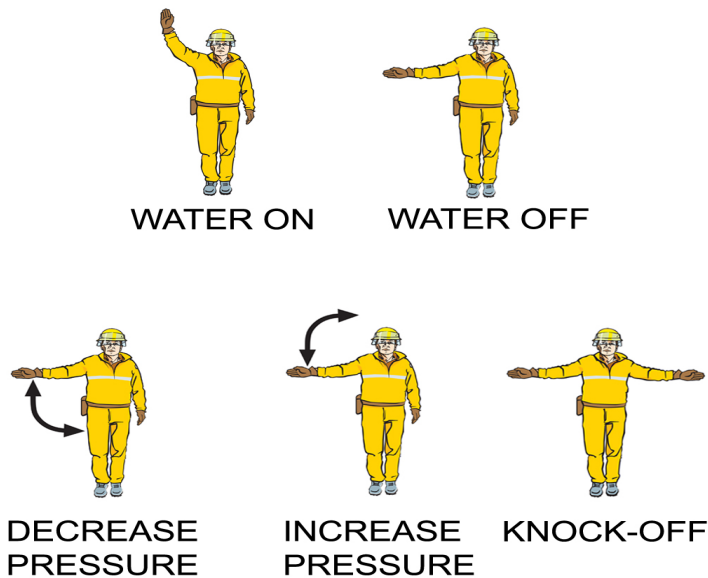
#### SAFETY NOTE

Crew members can easily lose contact with each other.

Any listeners must also wait in case they are asked for assistance.

## Hand signals for hose lines

When radio telephones are not available, use clear hand signals. They are more likely to be understood than shouted instructions. An example would be when communicating with the pump operator.



### SAFETY NOTE

Make sure instructions are always clear and are understood.

### When sending a signal

Face the person you are sending the hand signal to. Make the signal clear. Hold the signal until you receive a reply.

### When receiving a signal

Face the sender and repeat the signal to show you have understood it.

### Runner

When hand signals and radio telephone cannot be used, send messages by runner.

A verbal message is enough for brief messages. Messages with a lot of information will need to be written down e.g. messages between the Crew Leader and the Incident Controller.

Keep contact with crew and Crew Leader.



### SAFETY NOTE

Do not work alone.

## Summary

Chain of command	The chain of command tells you who you should report to. If there is a problem on the fire ground, you should report first to your Crew Leader.
Safety Briefings	You must be given a safety briefing before starting work on the fire.
Personal Protective Equipment (PPE)	You must wear an approved safety helmet, coveralls, gloves and safety boots.
Communications	You need to know how to communicate clearly face to face, using a radio telephone, with hand signals and with runners.
Fire suppression	<p>The stages of fire suppression are: knockdown; containment; control; mop up.</p> <p>To put out a fire you need be safe and organised. You also need to be able to make decisions quickly and to work hard.</p> <p>The fire must be mopped up thoroughly, so that it doesn't re-ignite.</p> <p>To extinguish the fire you can either:</p> <ul style="list-style-type: none"> <li>• Cut off the oxygen supply to smother the fire</li> <li>• Reduce the temperature of the fuel to cool the fire</li> <li>• Remove the fuel from the path of the fire to starve the fire (dry firefighting)</li> </ul> <p>Or combine all three methods.</p>



### SAFETY NOTE

Account for all people in your crew at all times.

## Self check

	True ✓	False X
1. Report problems at the fire to your Crew Leader	<input type="checkbox"/>	<input type="checkbox"/>
2. Only experienced crew members attend safety briefings	<input type="checkbox"/>	<input type="checkbox"/>
3. If you can't do a task, tell someone	<input type="checkbox"/>	<input type="checkbox"/>
4. PPE stands for personal protective equipment	<input type="checkbox"/>	<input type="checkbox"/>
5. PPE protects you from injury and exposure to heat	<input type="checkbox"/>	<input type="checkbox"/>
6. You can smother, cool or starve a fire	<input type="checkbox"/>	<input type="checkbox"/>
7. You can cool the fire with soil	<input type="checkbox"/>	<input type="checkbox"/>
8. Mopping up only involves finding and extinguishing burning fuel above ground	<input type="checkbox"/>	<input type="checkbox"/>
9. Direct attacks work best with low intensity fires	<input type="checkbox"/>	<input type="checkbox"/>
10. Using a natural barrier is an indirect method of attack	<input type="checkbox"/>	<input type="checkbox"/>



### NOTE

Review your knowledge on the information in this Study Guide prior to fire season.

11. Name three PPE items you should wear \_\_\_\_\_

12. You can communicate face to face, by radio telephone, hand signals and \_\_\_\_\_

13. You should k\_\_\_\_d \_\_\_\_\_ a fire, c \_\_\_\_\_ it, control it, and, finally, m\_\_p up.

# Section 4: Hazards and survival

## Word check

Black area	Burnt fuel area
Branch	Nozzle
Spar	Dead tree

## Fire behaviour hazards

### Topographic hazards

- Being uphill of a fire
- Obstacles, loose ground and slips
- Rough country
- Unfamiliar area



### SAFETY NOTE

Take care working in rugged terrain.

### Fuel hazards

- Unburnt vegetation
- Fire spreading across fine fuels more quickly than you can escape
- A spar can become unstable and break and fall. Stay two tree lengths away
- Spot fires



### SAFETY NOTE

Do not work in unburnt fuels when fighting a fire.  
Keep one foot in the black.

### Weather hazards

- Change of wind speed or direction
- Being downwind (in front) of a fire
- Weather hotter and drier after midday.



### SAFETY NOTE

Caution when day getting hotter or fire behaviour is changing.

Be aware of the combined effects of topography, fuel and weather.

## How should you deal with fire behaviour hazards?

### Spot fires

- Spot fires are a sign of extreme fire behaviour
- Convection currents can cause spot fires
- Post a lookout to detect spot fires early



### Flare-ups

Wind gusts can suddenly increase fire intensity

and flame length, especially in light fuels. Burning overhead fuels during wind gusts can cause burning material to drop.

A fire may burn the surface fuels but leave the overhead fuels unburnt.

An increase in wind and temperature may lift a surface fire into the unburnt overhead fuels.



#### SAFETY NOTE

Flare-ups can occur during mop-up stages when crews relax their guard.

## Operational hazards – tools and equipment

### Work Check

Concentrates	A foam or retardant in its strongest form
Foams	Makes water more effective
Retardants	Used as a chemical fire break

### Hand tools

Sharp tools will increase effectiveness. Sharp tools are dangerous. Check that handles are not loose and that they have no splinters. Carry tools at waist height with the working edge facing forward.



You should walk up the line in single file to avoid injury to others.

Stay at least three metres apart when using hand tools.

Stay two tree lengths away from a chainsaw operator during felling operations. (base on the height of the two tallest trees in the area)

Make sure that you are properly trained in using portable equipment such as chainsaws, portable pumps, scrub-bars, and generators.



#### SAFETY NOTE

You must be properly trained before using motorised tools.

### Hose Lines

If you are a nozzle operator, you may get to the fire edge before water is available at the nozzle. This might put you at risk.

Keep away from flames until you have water.

Retreat from the flames if the water goes off without warning.

Powerful jets of water can throw a nozzle operator off balance on slippery or steep ground. A jet of water may splash water and ash into your eyes.



## Suppressants

Foam, soap capsules and retardants are referred to as suppressants.

### *Foams*

Foams are a basically a detergent that makes water more effective.

**Wash any splashes of concentrate off with water.** Some people may have skin that is sensitive to foam.

Watch your footing! Foam and retardants will make hard ground and logs very slippery.

### *Soap Capsules*

Inserted into a hydoblender the treated water saturates dry vegetation more effectively. The hydroblender is also an excellent tool for deep seated fires in such material as hay, baled material or paper.

Some people may have skin that is sensitive to the soap capsules. Watch your footing! Soap capsules may make hard ground and logs very slippery.

### *Retardants*

Liquid fire retardant is sprayed onto vegetation to form a chemical fire break. Try not to let your skin come in contact with retardant concentrate. Use rubber gloves, goggles, and wet weather gear when mixing. If you are mixing powdered concentrate wear a dust mask and goggles.

Most retardants contain a vegetable dye that will leave stains on your skin and clothing. Wash splashes off with water. Some people may have skin that is sensitive to some retardants. **If you develop a skin irritation see a doctor.**

## Machinery hazards

Watch out and keep a safe distance (minimum 2 tree lengths) between yourself and a working machine. Don't work downhill of machinery. Maintain eye contact with the machine operator.

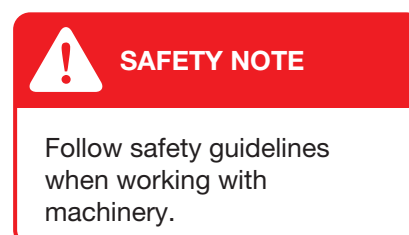
It is difficult for a machine operator to see people on the ground through vegetation, dust and/or smoke.

Watch out for falling trees or previously felled trees, which may be shifted around by heavy earth moving machinery.

Constructing fire lines with heavy machinery is specialised work. Heavy machinery can be used to:

- open up roads or make new access roads
- make fire lines

When crew leaders follow a machine to mop-up, they need to consider the safety of the machine operator as well as that of their crews.



Heavy machinery used in fires includes:

- Tractors (bulldozers)
- Skidders
- Graders
- Excavators.

If the crew and machine are cut off from the escape route, move into the burnt over area.

If that is not possible, move the machine to an area of least fuels. Clear an area to soil, then push a mound of soil towards the fire – the crew should take cover behind the mound or machine.

### Aircraft hazards


Helicopters are used in fire fighting to:

- transport fire fighters and equipment
- survey the fire scene
- carry and drop off water or water with foam.

The main use of helicopters at fire is that they can drop water to knock down surface flame so that ground crews can get in to extinguish the fire.

- Working around helicopters is potentially dangerous.
- Rotor blades, the tail rotor and engine exhaust are all hazardous.
- Helicopters are unstable while hovering.




SAFETY NOTE

Be careful with tools when boarding aircraft, Follow crew instructions.

Firefighters transported by helicopter will need further training, see Study Guide for *Work Safely with Aircraft*.

You must not approach a helicopter unless you are guided by the pilot or ground crew.

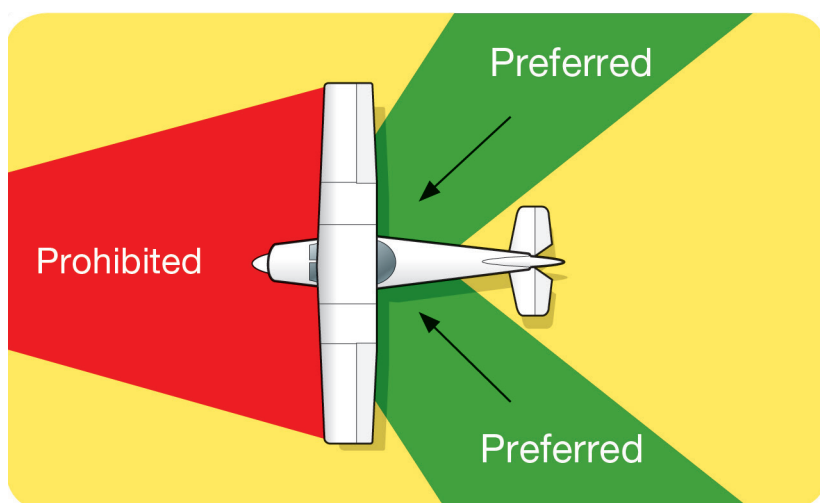


#### SAFETY NOTE

On a signal from the pilot approach the helicopter in a crouched position on the preferred track.

#### Fixed wing aircraft

Some agricultural aircraft have been modified to be used for water dropping. They can release water through the tree canopies. Below are the safe approach zones for a fixed wing aircraft.



#### SAFETY NOTE

On a signal from the pilot approach the aircraft on the preferred track.

Stay clear of firebombing drop zones. If caught in a firebombing drop zone:

- place your hand tools well clear of you
- protect your head with your hard hat or arms
- lie face down with your head facing the coming aircraft
- watch your footing
- watch out for falling branches and debris

### Tree hazards

Some of the common signs which warn you about a potentially dangerous situation include:

- trees have been burning for an extended period of time
- high risk tree species (rot, and shallow root i.e. willow)
- numerous downed trees
- dead and broken tops and limbs overhead
- accumulation of downed limbs
- absence of needles, bark or limbs
- leaning or hung up trees.



#### SAFETY NOTE

Look up when working amongst trees. Watch for falling debris.

Flagging tape should be used to mark all identified physical hazards. This may include holes in ground to overhead hazards. For example taping off an area at least two tree lengths from any tree that is considered likely to fall or drop branches, to prevent entry into this area.

Check with your manager to ensure that you are aware of procedures and when flagging tape(s) is to be used.

### Powerline hazards

- Treat power lines as live at all times.
- Avoid work under power lines.
- Fallen power lines can still be live.
- Heavy smoke or water can conduct electricity.
- When you are applying water to a fire, remember that overhead power lines can be hidden by trees or darkness.
- Know your local hazards – these may include mine shafts, thermal ground, underground collapse, burnt tree stumps, burnt fence posts.



#### SAFETY NOTE

Treat power lines as live at all times.

## Safety planning

All decisions you make before fighting a fire will depend on:

- LACES - always remember your LACES and be familiar with them
- having an escape route
- planning an escape route

### LACES (The 'Pink Card')

Lookouts – Anchor points/Awareness– Communication – Escape routes –Safety zones

Fire and Emergency will have issued you with the (pink) LACES card. On one side it shows you the most common dangerous situations you should watch out for. On the other side it lists the 10 standard fire fighting orders. Read and remember the points. They may save your life.



### Survival in the open

Survival in the open is not easy. If you are suddenly threatened by fire:

- stay calm
- assess your options
- act quickly.

In a panic a safe refuge will be easily overlooked.

Don't worry about leaving equipment behind. Lives are more important. Make sure all members of the crew know that the crew is pulling out and move out together – appoint a "tail end Charlie."

Walk at a steady pace and keep watching for further dangers.

Count and name everybody when you are at the anchor point / safety zone.



#### SAFETY NOTE

Always have an escape plan.



#### SAFETY NOTE

Always look out for potential dangerous situations.



#### SAFETY NOTE

Avoid walking through hot ashes.

If the fire has blocked the escape route you and the crew may need to:

- dig in and wait for the danger to pass over
- choose an area with little or no vegetation
- shelter behind a rock outcrop, in a ditch, behind a fallen tree, or on bare ground
- if you have enough time, use hand tools to clear an area of vegetation
- dig shallow trenches surrounded by cleared ground
- lie face down and shield your body as much as possible from the heat
- if you have water, cover the surrounding vegetation on full spray.

Air temperature, heat and smoke 1–2 metres above the ground will be at least 4 times worse than that at the dig in. The chances of survival will be halved by standing up and exposing your body to the above ground conditions.

Stay where you are until conditions ease.

Staying put may seem the wrong choice. You are safer to stay put.

Follow the instructions of your crew leader.

### Survival in vehicles

DO NOT drive a vehicle through heavy smoke. Flying embers may enter parked vehicles through open windows. Dust and smoke can affect your ability to see ahead. If you can't see through it, you could crash or drive off the road into a greater danger.

In most circumstances, the vehicle bodywork will protect you from flames and radiant heat. So if your escape is cut off by the fire, stay in the vehicle and:

- park on the side of the road opposite the fire or in the middle of a clear area
- close all doors, windows and vents to prevent smoke getting in
- switch on hazard warning lights/head lights
- keep below window level and stay covered to protect yourself from the heat that will be transmitted through the glass.



#### SAFETY NOTE

Do not run through flames unless you can clearly see the ground beyond.



#### SAFETY NOTE

Do not run uphill or down wind away from the fire.

Do not run into unburnt vegetation

Do not burn an area to make a safe refuge

If the conditions are safe to drive:

- use only experienced drivers
- drive carefully
- use headlights at all times
- park where fire spread will not threaten the vehicle
- park facing the way out
- shut windows
- park to the side of road so other vehicles can pass
- leave keys in ignition.

Under a vehicle burn-over situation the conditions in the cab may be as bad as outside. Stay in the cab for longer than is comfortable, to make sure that the conditions outside have improved.

Even in high intensity fires the chances of survival are greater in a vehicle than out in the open.

Modern vehicles are fitted out with synthetic materials that may melt or emit toxic fumes when very hot.

### **Survival in buildings**

A building that can be closed up – a house or fully enclosed shed

– offers the best shelter from radiant heat in a vegetation fire.

Even though the building may eventually burn down, it will provide protection for you while the main intensity of the fire passes. If you have time, make the building as safe as possible:

- close all windows, doors and openings to prevent embers blowing in
- have ready any garden hoses, buckets, wet towels for gap filling
- check the water supply
- take in a hose and fittings if you know that the fitting attached to the end of the hose can be coupled to an internal tap
- if the building should catch fire and the main fire has passed, wrap yourself in a woollen blanket and leave.

Stay outside for as long as possible extinguishing any small outbreaks of fire. When no longer able to stay outside, go into the building and watch for signs of fire starting inside. Look out for roof spaces.

Take shelter on the side of the building away from windows and the approaching fire. Keep low. When the fire passes check for fires on the building.

## Summary

### Topography, fuel and weather hazards

Avoid being uphill of a fire.

Watch out for obstacles that can block an escape route.

Keep the main fire in sight or be in communication with someone who can see it.

Get a map – insist on a thorough briefing – seek local advice

Establish an escape route and maintain a lookout.

It may be better to take an alternative route – or cut a hand line through.

Get advice on local weather influences from local people Watch out for possible flare ups and check escape route Wind shifts change fire behaviour more than any other cause.

Withdrawing crews and reassessment of actions may be a safer option.

### General

Sacrifice property rather than risk lives.

Making a stand in front of a head fire is an extremely dangerous situation and should never be attempted.

Spot fires may create an entrapment situation.

Avoid working near a fire in unburnt fuels Don't work in isolation.

Keep in contact with crew members and crew leader Get clarification when instructions are unclear.

Make sure people know when you are taking a rest break.

Take regular breaks, food and water to avoid fatigue and heat illness

Rotate jobs

Obey road laws – use headlights – proceed cautiously.

Treat Power lines as live at all times.

Stay at least THREE metres apart when using hand tools.

Stay two tree lengths away from a chainsaw operator during felling operations.

Commence firefighting at an anchor point and progress along the flanks.



Wash splashes of foam concentrate or retardants off immediately with water. Get medical help if your skin feels irritated.

Nozzle/branch operators should keep away from flames until they have water on.

Nozzle/branch operators should retreat from the flames if the water goes off without warning.

Keep a safe distance (minimum 2 tree lengths) between the crew and a working machine.

Watch out when working near heavy machines. Do not work downslope of them.

If you are caught in a fire, take shelter in a cleared area, vehicle or building until it passes.

**Always remember your LACES (pink card).**

**Also refer to Dangerous situations to watch out for.**

**SAFETY NOTE**

Safety is always your first consideration.

## Self check

	True ✓	False X
1. Start fighting a fire from the base	<input type="checkbox"/>	<input type="checkbox"/>
2. Treat power lines as live at all times	<input type="checkbox"/>	<input type="checkbox"/>
3. Stay 3 meters apart when using hand tools	<input type="checkbox"/>	<input type="checkbox"/>
4. Use your vehicle to get through heavy smoke	<input type="checkbox"/>	<input type="checkbox"/>
5. Open all windows if you are sheltering in a building	<input type="checkbox"/>	<input type="checkbox"/>
6. If you have to dig in, find an area with little or no vegetation	<input type="checkbox"/>	<input type="checkbox"/>
7. Spot fires indicate safe conditions for firefighters	<input type="checkbox"/>	<input type="checkbox"/>



### NOTE

Review your knowledge on the information in this Study Guide prior to fire season.

8. Describe a hazardous situation

---



---

9. How far away should crews stay from machinery or tree felling?

---

10. What should you do when a flank fire turns into a head fire?

---



---

11. What does L.A.C.E.S. stand for?

---



---

# Section 5: Protecting yourself and others

When fighting fires you are at risk from heat, smoke and stress. You are ultimately responsible for your personal safety.

You are also responsible for the safety and health of others on the fireground. Keep an eye on your team members.

You can reduce risk to your and others' safety if you look after your equipment and use it safely.

But you also have to look after yourself, to make sure that you are in the best possible condition for fighting a fire. If you:

- are physically fit for the task
- are properly trained
- have an understanding of fire behaviour
- have a positive attitude
- follow the safety precautions you will be less likely to be caught in a dangerous situation.

If you have a medical condition or disability, you may become a liability to yourself and others.

## Word check

Radiant heat	Straight line heat from the fire
Hydration	When your body gets enough water
Dehydration	When your body doesn't get the water it needs

## How does exposure to radiant heat affect you?

Radiant heat is emitted from anything that is hot. Radiant heat will in time heat the air, but people will absorb heat far more quickly. Radiant heat will affect people anywhere there is direct sunlight, or where a person is close to a fire. As flame length increases, so does radiant heat.

Even during normal firefighting activities, exposure to radiant heat can be hazardous.



### SAFETY NOTE

Tell your Crew Leader if you have any medical condition that could affect your performance. Tell your crew leader if you are taking medication.



### SAFETY NOTE

Advise your crew leader if you are feeling unwell.

Personal protective equipment (PPE) is designed to offer you some protection against radiant heat. However, exposure to radiant heat can:

- burn you. if your PPE does not provide sufficient protection
- overheat you. which can cause dehydration and heat illness (see section below).

Personal protective equipment (PPE) is designed to offer you some protection against radiant heat.

### **What can you do?**

You should only attack the fire using hand tools when flame lengths are chest height (1 metre) or less.

You should only attack using hose lines when flame lengths are head height (2 metres) or less.

In cases of sudden flare-ups, you need to move further away from the flame to a more comfortable distance. In an emergency you can use water spray to shield the crew from radiant heat while retreating to a safer distance.

It is important not to cover the sides of your face. Exposing the cheeks to radiant heat is an excellent indicator that the situation is becoming too hot. On feeling the increased level of heat retreat to a safer distance.

As radiant heat only travels in straight lines from its source, try to get behind a solid object – it will shield you from the radiant heat. Keep as low as possible, lie face down and cover up all exposed skin until the flare-up subsides.

## **How does exposure to smoke and dust affect you?**

Smoke and dust will irritate your eyes and lungs at fires. As well as restricting visibility, heavy smoke contains carbon monoxide (CO) – a poisonous gas, and may contain toxic gases from other burning material (e.g. rubbish, tyres, chemicals)

Prolonged exposure to heavy smoke can be hazardous to your health. It can:

- reduce your performance on the fireground
- bring on fatigue more quickly
- bring on illness
- alter your perception and judgment.

In severe cases, exposure may result in breathing difficulties, injury or death.

**What can you do?**

Avoid working in smoke unnecessarily, especially for long periods.

Use approved Personal Protective Equipment (PPE) (e.g masks and gloves) when required, especially during mop up.

Be aware that fresh air pockets may be found near the ground. In situations where there is heavy smoke, move to a safer area.

Caution – use of respiratory (dust mask) protection in heavy smoke can be hazardous. Thick smoke will also contain a range of poisonous gases that a dust mask will not protect you from. This is a dangerous situation if caught in a wind shift retreat immediately to a safer area.

**How does metabolic heat affect you?**

Metabolic heat (body heat), is when:

- you are working your muscles hard
- you are absorbing heat from the environment
- the air temperature is high
- you are wearing clothing that has limited ventilation.

**What can you do?**

Wear PPE that allows metabolic heat to escape.

**How does fatigue affect you?**

You get over tired (fatigued) simply because of how stressful and demanding the job is.

If you are exposed to radiant heat and smoke for a long time, it will be stressful, and that is likely to lead to fatigue.

**What can you do?**

Take regular rest breaks, with food and drinks of water. This will give you time to cool off, to replace lost body fluids, and to replace energy.

Rest breaks should be suited to the least fit person in the crew.

They should be taken in a safe area such as a constructed fire line or natural firebreak, where the fire can be seen. If possible taken in the shade and where there is a breeze.

Use the rest break to loosen clothing. This will help you to cool down. Eat small amounts of protein foods, for energy.

**SAFETY NOTE**

Advise crew leader when you are getting tired.

## How can burns affect you?

Burns vary in depth, size and severity. All burns must be reported. They may damage the underlying tissues as well as the skin.

Burns can result from direct contact with the flame (conduction), or from exposure to radiant heat. The immediate dangers are when the burn continues burning the skin and tissues, and shock.

### What can you do?

Firstly, you must wear approved Personal Protective Equipment (PPE).

If you are burned, cool the burn immediately with water for at least 10 minutes and get medical help.

If you are badly burned, another member of the crew will have to cool the burned area immediately and watch out for signs of shock and get medical help.

## How does sunburn and windburn affect you?

Prolonged exposure to sun and wind can lead to burns. You can easily be burnt even when the sky is overcast.

### What can you do?

When you are working outdoors during the day, cover bare skin with sunscreen. Repeat every 2 hours. Make sure that it is water-resistant, and has a sun protection factor (SPF) of at least 30+.



#### SAFETY NOTE

Make sure your crew carries a First Aid kit.

## How does lack of food affect you?

Carbohydrates such as bread, pasta and potatoes help maintain energy.

You need carbohydrates and protein for energy and strength to fight prolonged fires.

### What can you do?

Make sure you have plenty of carbohydrate rich meals and protein rich snacks. Eat regularly.

For a short term top up of energy reserves – use protein or snack bars.

## How does dehydration affect you?

The body's cooling system involves perspiring (sweating). You will get dehydrated if you lose a lot of fluid through sweating, and don't drink water. Muscle cramps are an early sign of dehydration.

Some people dehydrate quickly, and others more slowly – each person has a different ability to regulate heat.

You may begin to suffer the effects of dehydration before you realise it. Even before you get thirsty.

### What can you do?

Drink to prevent thirst – always drink more water than you need.

On the fireground you need to replace fluids frequently.

There's a time lag between the onset of dehydration and feeling the need for water.

You may need up to **150–200 ml every 15 minutes** (depending on your metabolism).

When you are perspiring – this as an indication that your body needs appropriate fluids.

If you are using hand tools you may need to increase this to **300 ml every 15 minutes**.



### SAFETY NOTE

Monitor urine colour. If not clear, drink more water.

**Avoid**

- Milky or fat-containing drinks
- Alcohol
- Chilled and electrolyte drinks

-they can quickly quench your thirst, but may not have enough fluid for re-hydration

-they can cause stomach cramps

Dilute energy drinks 4:1 to ensure adequate re-hydration.

Always carry fresh water and snack bars. Never drink water from vehicle tanks or knapsacks – it may be contaminated.

**Noise**

When working in a noisy environment you must wear the Level 5 grade of earmuffs e.g. around helicopters and pumps.

**Heat illness**

Word check

Evaporation	When something turns from liquid to vapour in the air (e.g. sweat)
Hypothermia	Having a dangerously low body temperature
Respiration	Breathing

Heat illness can either be mild or severe. Heat illness is caused by prolonged exposure to a hot environment. It is caused by heat and dehydration.

It can affect not only your physical welfare, but also your judgment and ability to do the job.

Watch for signs of heat illness in yourself and other crew members. Cool yourself or the affected person immediately.

**Mild heat illness**

A person suffering from mild heat illness will have these warning signs:

Headache	Tiredness
Sweating	Dizziness
Weakness	Nausea

**SAFETY NOTE**

100 ml to 200 ml water every 15 minutes and increase to 300 ml if using hand tools.



If heat illness is recognised early enough and the right action is taken, the person will recover quickly.

If you get mild heat illness and don't treat it, your performance as a firefighter will be lowered.

Your body controls its temperature by blood circulation and sweating.

Your heart rate increases and pumps the blood near to your skin (your face may become flushed) and your body sweats. The sweat evaporates, drawing heat from your body – evaporation requires heat – so your body is cooled.

Mild heat illness will affect some people more than others, as we all have a different ability to manage it. If you are physically fit you will probably cope better with mild heat illness.

You need to watch for warning signs of mild heat illness. Loosen clothing, cool with water, fan the person to increase evaporation cooling.

If you miss the warning signs, you may move in to a state of severe heat illness

### Severe heat illness

This is when your regulatory system can no longer cope with the over-heating body. Your brain has become affected and stops telling the body to cool down.


Symptoms are:

- rapid and strong pulse (increased heart rate)
- shallow breathing
- hot, dry skin (dehydration – no sweating)
- loss of coordination
- unusual behaviour
- collapse and/or seizures.


If someone has these symptoms, you must cool the body immediately. Move the patient to a cooler place. Remove as much clothing as possible. Aggressively cool the patient with water, and try to create a current of air to increase the cooling effect.

Be prepared for cardiac arrest in severe cases (CPR and AED).

Recovery should be rapid with cooling and rehydration. If the patient is not recovering within 10 minutes, or they continue to deteriorate or become unresponsive, you should call an ambulance immediately.


**SAFETY NOTE**

Watch for heat illness in yourself and others.


**SAFETY NOTE**

Urgent medical attention is essential.

## Hypothermia

Hypothermia occurs when your body temperature falls below 35° Celsius. Normal body temperature is about 37°. This drop in body temperature is usually caused by exposure to cold, when you are not wearing the type of clothing needed to prevent loss of body heat. This can happen:

- at night
- in cold wind
- at high altitudes
- working under helicopters filling monsoon buckets
- being wet through in a cool environment.

The effects of hypothermia will be different for different people. Mild symptoms are shivering, cold or numb hands and feet. You can lose consciousness when:

Shivering slows or stops	You become irrational and clumsy
Your skin is cold to touch	Your speech is slurred
Your pulse and breathing slow down	

### Treatment for hypothermia:

If you are helping someone else:

- remove the person to a warm dry shelter out of the wind
- provide warm/dry clothes
- keep a watch on the condition of person
- get medical help.

### First Aid Awareness

First aid is treating an injury or sudden illness using what you have available, until qualified medical aid is able to take over. First aid treatment is given to:

- preserve life
- prevent the condition worsening
- promote recovery.

You will need first aid skills and training, to the level of a current certificate from a recognised first aid authority (e.g. St. John's). Your responsibilities as a first aider are to:

- assess the situation
- identify the cause of the suffering
- give immediate first aid treatment
- arrange for further medical attention if necessary.

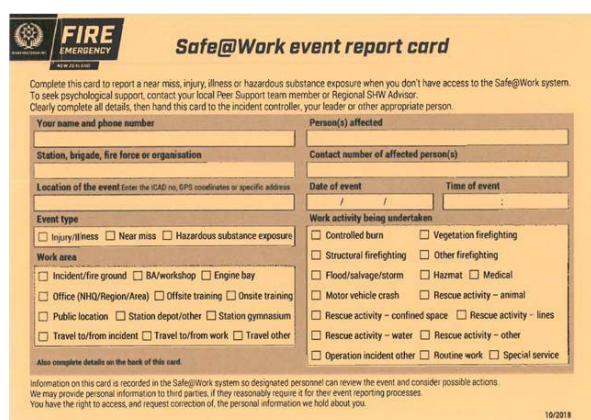
Get medical help for all injuries at fires. Remove unwell firefighters from the fireground.

Inform your crew leader if firefighters are injured or become ill at fires.

### Safe@work system

Anyone suffering injuries, or having accidents, must report these through the Safe@work system, or by completing a “Salmon Card”. Safe@work is accessed via Fire and Emergency Portal (<https://portal.fireandemergency.nz/tools-and-applications/safework/>). Injuries at work should also be reported to supervisors.

Where Safe@work is not available (no computer, no cellphone with app), people with injuries should use the Salmon Card approach which is available as single cards, or in triplicated booklets.



**FIRE EMERGENCY** **Safe@Work event report card**

Complete this card to report a near miss, injury, illness or hazardous substance exposure when you don't have access to the Safe@Work system. To seek psychological support, contact your local Peer Support team member or Regional SHW Advisor. Clearly complete all details, then hand this card to the incident controller, your leader or other appropriate person.

**Your name and phone number** \_\_\_\_\_

**Station, brigade, fire force or organisation** \_\_\_\_\_

**Location of the event** Enter the ICAD no, GPS coordinates or specific address \_\_\_\_\_

**Event type**  
 Injury/illness  Near miss  Hazardous substance exposure

**Work area**  
 Incident/fire ground  BA/workshop  Engine bay  
 Office (NHU/Region/Area)  Offsite training  Onsite training  
 Public location  Station depot/other  Station gymnasium  
 Travel to/from incident  Travel to/from work  Travel other

**Person(s) affected** \_\_\_\_\_

**Contact number of affected person(s)** \_\_\_\_\_

**Date of event** / / **Time of event** : :

**Work activity being undertaken**  
 Controlled burn  Vegetation firefighting  
 Structural firefighting  Other firefighting  
 Flood/salvage/storm  Hazmat  Medical  
 Motor vehicle crash  Rescue activity - animal  
 Rescue activity - confined space  Rescue activity - lines  
 Rescue activity - water  Rescue activity - other  
 Operation incident other  Routine work  Special service

Also complete details on the back of this card.

Information on this card is recorded in the Safe@Work system so designated personnel can review the event and consider possible actions. We may provide personal information to third parties, if they reasonably require it for their event reporting processes. You have the right to access, and request correction of, the personal information we hold about you.

10/2018

# Summary

## Hazards

Most accidents can be avoided – take protective measures.

Crew members must be physically capable and properly trained for the job.

People overcome by fire will be under a lot of stress – they may act irrationally and expose themselves to excessive heat.

Heavy smoke / dust may cause you breathing difficulties, injury or death. Move away.

A build up of body heat can lead to heat stress.

## Take preventative action

Take regular breaks, food and compulsory drinks of water are vital to maintain crew health.

Wear approved PPE.

Immediately cool all burns with water for a minimum of 10 minutes and get medical attention.

Where appropriate apply sunscreen liberally to any exposed skin every 2 hours.

For a short term top up of energy reserves, use protein or snack bars. Always keep a lookout for the unexpected hazard while in the fire area.

Take regular rest breaks as an important part of fire attack strategies. Wear earmuffs when you are in a noisy environment.

## Heat illness and dehydration

Drink water. Dilute energy drinks 4:1 to help re-hydration. Watch for signs of heat illness and treat early on the fireground. Cool a person affected by heat stress immediately.

## Warning

DO NOT run through flames unless you can clearly see the ground beyond.

DO NOT run uphill or down wind away from the fire. DO NOT run into unburnt vegetation.

Modern vehicles are fitted with synthetic materials (e.g. nylon) that may melt and / or give out toxic fumes in the heat.

Make sure you have an escape route at all times, and make sure everyone knows what it is.

Get treatment for:

Burns	• Heat illness
Bleeding	• Hypothermia
Foreign bodies in the eye	• Smoke inhalation
Fractures	• Soft tissue injuries
Heat exhaustion	

Read and remember your:

1. LACES:

- Lookouts
- Anchor points/Awareness
- Communication
- Escape routes
- Safety zones.

2. 21 Dangerous situations to watch out for.

## Self check

	True √	False X
1. Fatigue affects your performance	<input type="checkbox"/>	<input type="checkbox"/>
2. If you are fit you are less likely to get overheated from working hard	<input type="checkbox"/>	<input type="checkbox"/>
3. Solid objects can shield you from radiant heat	<input type="checkbox"/>	<input type="checkbox"/>
4. Avoid pockets of air near the ground	<input type="checkbox"/>	<input type="checkbox"/>
5. An anchor point is the best place to start a fire line	<input type="checkbox"/>	<input type="checkbox"/>
6. Nausea is a sign of heat illness	<input type="checkbox"/>	<input type="checkbox"/>
7. Shallow breathing is a sign of heat exhaustion	<input type="checkbox"/>	<input type="checkbox"/>
8. Do not cool someone suffering from heat stroke		



### NOTE

Review your knowledge on the information in this Study Guide prior to fire season.

9. If a fire turns on you, which way do you go to get out?

---

10. If caught by a fire does the crew split up or stay together?

---

11. If trapped, where should you try to find shelter?

---

12. What do you do if you get sprayed with retardant?

---

13. How does smoke and dust affect you?

---









