



Government
of South Australia



**SOUTH AUSTRALIAN
FARMERS FEDERATION**

South Australian Country Fire Service and South Australian Farmers Federation

JOINT FIRE AWARENESS INFORMATION FOR OPERATING FARM FIRE UNITS

June 2010

ENDORSEMENT

These guidelines have been developed in a cooperative partnership between the South Australian Farmers Federation (SAFF) and South Australian Country Fire Service (CFS), in an effort to foster safety for the farming community when they are involved fire fighting activities.

A Bi-annual program of review has been established where the guidelines will be reviewed and updated as required after each summer to capture areas where they can be improved.

The Farm Fire Unit Working Party reviewed this document in April 2010 and it is intend to be reviewed again in April 2012.

SAFF and CFS recognise that the management of fire is a community responsibility and through these guidelines demonstrate their commitment to supporting the community during times of fires.

These guidelines are hereby endorsed.



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FIRE AWARENESS

This section has been included with the guidelines to help you better understand the nature and behaviour of bushfire, together with suppression activities and bushfire hazards.

You may also wish to consider the benefits of joining your local fire brigade to increase your firefighting skills and knowledge even further. Not only will you raise your skill levels and knowledge, you will also be providing a valuable service to your community. To find out more about being a CFS volunteer, contact your local fire brigade.

1. Types of Bushfire

Each type of fire creates its own peculiar hazards, which will require constant monitoring to ensure safe work practices are observed and carried out at all times.

Bushfires can generally be described in terms of the fuel in which they are burning, grass, scrub or forest plantation.

The following pages explain some of the characteristics of different types of fire, and defines important parts of a bushfire's perimeter.

Ground fire

This type of fire burns the organic material in the soil layer, as happens in a peat fire, and often also burns surface litter and small vegetation.

Characteristics

- Occurs in only a few parts of Australia.
- Smolders with no flame and little smoke.

These fires can burn unnoticed and may later ignite surface fires. You need to take care to avoid stepping into undetected hot spots in the ground.

Surface fire

This type of fire travels just above ground surface in vegetation such as grass, low scrub and forest litter.

It presents a significant hazard to firefighters because conditions can change rapidly due to strengthening winds or wind changes, rapidly increasing fire intensity and rate of spread.

Characteristics

- By far the most common type of fire.
- Burns in fuels lying on the ground.
- Consumes litter and low vegetation, such as grass and scrub.
- Does not extend into the crowns of trees.

Crown fire

This is a fire, which burns in the crowns (tops) of trees ahead of, and above, an intense surface fire in the undergrowth and presents a significant hazard to firefighters. Radiant heat and direct flame contact resulting from the surface fire will ignite treetops. Strong winds carry the fire along the upper storey vegetation.

Characteristics

- It is a fast-traveling fire that is extremely destructive and often consumes all in its path.
- An intense surface fire follows crown fires shortly afterwards.
- Short or long distance spotting often accompanies crown fires. For example, spotting up to 25kms have been recorded.
- Falling material from a crown fire can start further surface fires below. Crown fires are exposed to higher wind speeds in the upper air and because of this can move faster than surface fires.

Parts of a bushfire

The shape of a bushfire is defined by its perimeter, which is the outside edge of the burnt area. Within this there may be burning areas, smouldering areas and blackened areas, as well as pockets of unburnt fuel. There will also be a point of origin that may or may not be identifiable without detailed investigation.

As illustrated in Figure 1, parts of a bushfire include:

- The head;
- The flanks or sides;
- Fingers;
- The rear or heel (sometimes referred to as the back);
- Spot fires ahead of the main fire;
- Unburnt pocket or island; and
- Point of origin.



Figure 1 – parts of a wildfire

The head of the fire

The head of a fire is where the fire is making its greatest progress (usually downwind or upslope) measured by its forward rate of spread. The head is also called the fire front. Flames are tallest and intensity of the fire is greatest at this point. The head of the fire is influenced by wind direction, fuel factors and topography, and will change accordingly.

Flanks or sides of a fire

Both sides of the fire between the head and the rear are called the flanks. They are roughly parallel to the main direction of spread. The intensity of the fire at the flanks is less than at the head. Often they are described by their geographic location (for example, the eastern or western flank of a fire) or by their orientation as viewed from the point of origin or rear of the fire (for example, the left or right flank of a fire).

Fingers

These are long and narrow slivers of the advancing fire, which may extend beyond the head or flanks, and are caused by varying wind direction or variations in fuel or topography.

Rear or heel

This is the section of the perimeter opposite to, and usually upwind or down slope from, the head of a fire. It is the least intense part of the fire's perimeter, with the lowest flames and slowest rate of spread. It may be described as the back of the fire.

Point of origin

This is the area where the fire started. The likely point of origin should, if possible, be left undisturbed for fire investigation.

2. Factors that Affect Bushfire Behaviour

There are three main factors that influence fire behaviour. Fire behaviour and fire spread can alter dramatically depending on changes in:

- Fuel;
- Weather; and
- Topography.

An understanding of how these factors influence fire behaviour is crucial in predicting fire spread and therefore, planning and conducting fire suppression activities.

Fuel

Fuel is one of the most important factors that will influence the way fire behaves and travels.

Variations in fuel will also influence the risk to firefighter safety and firefighting suppression activities.

Fuel varies in its:

- Type;
- Size;
- Quantity;
- Arrangement; and
- Moisture content.

Type

Common types of fuel involved in a bushfire include:

- Grass;
- Forest litter lying on the ground;
- Small shrubs and scrub;
- Trees and bark;
- Decomposing humus and duff (fine ground litter);
- Slash (material remaining after logging); and
- Plantation prunings.

Given the right conditions, most of these fuels will readily ignite and burn at differing speeds and degrees of intensity.

For example, a grass fire is likely to spread more rapidly than a fire in a tall, dense forest but the forest fire would generally burn more intensely than the grass fire due to greater quantities of fuel.

Size

Fuel is normally classified as fine or coarse (heavy) in relation to size.

Fine fuels, less than 6 mm in diameter (i.e. thinner than a pencil) such as leaves, twigs, grasses and some tree barks, burn readily and cause spotting as the burning embers are carried through the air.

Eucalypt fuels, in particular stiff ribbon type bark, are well known for causing long distance spotting, whereas stringy bark causes much of the short distance spotting.

Coarse or heavy fuels, greater than 6 mm in diameter (i.e. thicker than a pencil) such as sticks, branches and logs tend to ignite less readily, burn more slowly and burn for much longer periods.

Quantity

The more fuel there is – the greater the fire intensity.

Arrangement

The size of the fuel particles and the way pieces of fuel are arranged in relation to one another will affect how they burn.

Fuels that are tightly packed together or compacted, such as peat, heavy leaf litter or hay bales, smolder slowly because of the lack of oxygen. Grass hay, closely grouped and standing, will burn quickly and fiercely.

Well separated pieces of fuel, such as sparse forest, are harder to ignite than more closely grouped collections of the same material. This is because radiant heat diminishes the further it travels and does not allow the pre-heating of fuel.

A continuous ladder of fine fuel from the ground surface to the crown of the vegetation encourages the development of crown fires.

Moisture content

Fire behaviour is affected by how damp fuels are i.e. their moisture content (or dryness). The moisture content will vary depending on factors such as weather conditions, vegetation type and moisture content of the soil and whether the fuel is dead or living vegetation.

All dead fuels take up or give off moisture according to the:

- Daily temperature and relative humidity cycles – fine dead fuels change their moisture content rapidly in response to these cycles, while heavy dead fuels change slowly and rarely reach extremes of wetness or dryness;
- Time since last rainfall and the amount of rain received over several days, the effects of recent rainfall will disappear, this happens more rapidly in fine fuels than in heavy fuels; and
- Dryness of the soil – dry soil will dry out fuels in contact with it, and wet soils will moisten such fuels.

The moisture content of fuels affects:

- Ease of ignition;
- Probability of spotting;
- Rate of combustion;
- Rate of fire spread; and
- Amount of heat radiated from the flames.

Measuring fuel moisture content

Weather conditions, temperature, relative humidity and the current seasonal dryness must all be considered when determining fuel moisture content. Several techniques can be used to measure moisture content, including visual assessments of grass and crops, and the use of specialised fuel moisture meters.

Note: the “crackle” sound as you walk through fine fuels is a good indication of the fuel moisture content; the sharper the crackle, the drier the fuel.

Weather

Weather is a major factor that impacts on the spread of fire. The four key elements of weather are:

- Air temperature;
- Relative humidity;
- Wind (speed and direction); and
- Atmospheric stability.

Air temperature

The sun warms solid objects such as fuels and the surface of the land. This has the effect of raising the temperature of the fuels and the surrounding air. An increase in temperature, and the resulting decrease in relative humidity, will reduce the fuel moisture content and therefore, increase the ease of ignition.

Relative humidity

There is always a certain amount of water vapour in the air. Relative humidity (RH) is a measure of the water vapour content of the air, expressed as a percentage of it's maximum water vapour holding capacity at the same temperature.

A high RH figure indicates a high level of water vapour in the air; a low RH indicates a low level of water vapour in the air.

On humid days (days of high RH), fine dead fuels will absorb moisture from the air (adsorption) and will therefore, burn more slowly or may not burn at all.

On days of low humidity (low RH), the dry air will actually draw moisture out of fuels (desorption), they will become drier and therefore, ignite more easily, burn faster and more fiercely.

In a bushfire situation, fire intensity increases as the temperature rises and relative humidity falls during the day, and reduces as humidity increases and temperature drops at night.

Wind

Wind is the most critical aspect affecting the shape, forward rate of spread and fire behaviour. Changes in wind direction and increased strength present serious hazards to firefighters.

A wind change can rapidly cause relatively quiet flanks to become active fire fronts, always keep fuel between you and the fire to a minimum.

Wind speed

Wind speed, or strength, is a major cause of rapid changes in fire behaviour. It will affect the intensity of a fire, the speed at which it travels and its shape. As illustrated in Figure 2, the stronger the wind, the longer and narrower the fire will be.

Wind supplies oxygen for the burning process; removes ash, smoke and moisture from fuels in the area; and slants the flames, hot air and gases over the unburnt fuel

ahead of the fire, therefore, pre-heating the fuels and allowing the fire to spread faster. The wind may also lift burning materials, such as bark and other embers, and carry them ahead of the main fire starting spot fires. The stronger the wind, measured at 10 m above ground level in the open for forecasts, the faster a fire will spread.

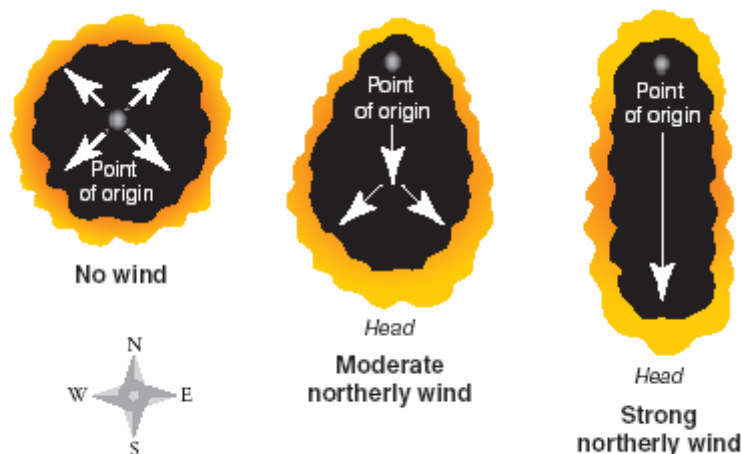


Figure 2 – effects of wind strength on fire shape

Wind direction

It is critical firefighters receive information regarding any potential changes in wind direction. This information is not only required for planning the attack on a fire, but also to ensure the safety of firefighters in the event of the fire changing direction.

Changes in wind direction can cause shifts in the fire front. These shifts are dangerous if they occur suddenly and unexpectedly, and can cause long and relatively quiet fire flanks to suddenly become active fire fronts.

Wind direction refers to the direction the wind is coming from i.e. a “north wind” means a wind originating from the north and travelling in a southerly direction.

For example (see Figure 3):

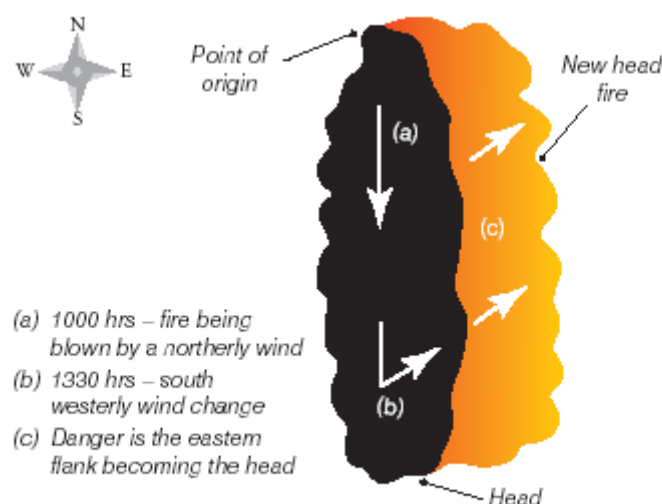


Figure 3 – result of change in wind direction

At 1000 hrs a fire is being blown by a fairly strong northerly wind (a). The fire has an elongated shape with a narrow head. The fire intensity being higher at the head of the fire, the flanks being much cooler as the fire spreads slowly outwards west and east.

By 1330 hrs the fire has advanced to point (b), when a south-westerly wind change occurs.

The wind change causes the cooler eastern flank to suddenly become the new head of the fire (c). The fire, which was burning on a narrow head, is now burning on a wide front. The new head fire will move away at its maximum intensity and rate of spread.

This change in direction will substantially increase the difficulty of fire suppression activities, but more importantly, presents an immediate threat to any firefighters working on what was the eastern flank.

Always be watchful of wind changes and if unpredictable changes occur in your area, warn the people around you and inform a member of CFS.

Atmospheric stability

Atmospheric stability refers to the vertical (upward) movement of air masses that occur when hot air rises and is replaced by cooler air.

This results in an inversion layer forming i.e. a reversal of the normal variation of air temperature with altitude (normally the higher you go the colder it is).

Vertical air movement can affect local wind patterns and can also determine cloud development and therefore, the possibility of thunderstorm development.

In stable atmospheric conditions, fire behaviour will generally be predictable.

Visual indicators of stable conditions are:

- Presence of stratus type clouds (clouds in layers);
- Smoke columns drift apart after limited rise;
- Vertical movement of air is limited;
- Fog layers may be present; and
- Winds are generally light and predictable.

In unstable atmospheric conditions, fire behaviour can be unpredictable.

Visual indicators of unstable conditions are:

- Presence of cumulus (cotton wool) type clouds showing noticeable vertical growth;
- Smoke columns can rise to great heights;
- Winds are gusty and unpredictable;
- Potential for thunderstorms and therefore, lightning strikes; and
- Dust whirls ("willy willies") may occur.

Topography

The third major factor that impacts on the spread of fire is topography. Topography is the surface features of a particular area or region such as mountains, rivers, populated areas, roads, railways and vegetation. The topography of an area will affect the direction and speed at which a fire will travel. The effects can be quite complex as the topography will also effect the local wind speed and direction.

The three main concerns that arise in relation to topography are:

- Slope;
- Aspect; and
- The interaction between terrain and wind.

Slope

Slope will affect the speed, or rate of spread, of a fire. If a fire is traveling upslope as opposed to on level ground, there will be a shorter distance for radiant heat to travel from the flames to unburnt fuel. Therefore, fuels upslope of a fire will be preheated to their ignition temperature quicker than they would be on level ground. The opposite is true for a fire traveling down slope.

The following rules of thumb will help you calculate the affect slope will have on the speed of a fire.

- For every 10° of upslope, double the rate of spread.

For example (see Figure 4): a fire is traveling at 2.5 km per hour on level ground towards a 20° upslope; it reaches the foot of the hill and continues to burn in the same direction; as it moves up the slope, the rate of spread will increase to 10 km per hour (approximately).

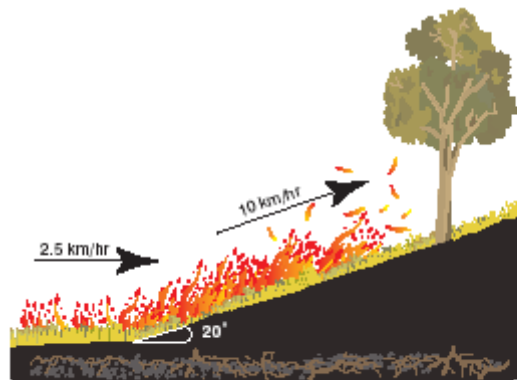


Figure 4 – the effect of upslope

- For every 10° of down slope, halve the rate of spread.

For example (see Figure 5): a fire is traveling at 10 km per hour on level ground towards a 20° down slope; it reaches the edge of the level ground and continues to burn in the same direction down hill; as it moves down the slope, the rate of spread will decrease to 2.5 km per hour (approximately).

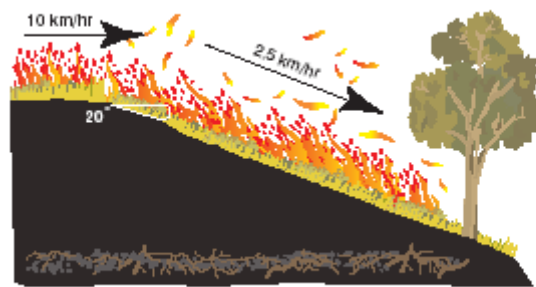


Figure 5 – the effect of downslope

Aspect

Aspect is the direction that a feature or slope faces. This influences the amount of solar radiation that it receives and, as a result, northerly and westerly aspects (which receive more sun) will be warmer and drier than southerly and easterly aspects.

This in turn influences the nature of the vegetation growing on different aspects e.g. northern and western aspects generally have drier and more flammable vegetation than southern and eastern aspects, where vegetation tends to be lush and less flammable.

As a result, fires on northern and western aspects will generally burn more fiercely than fires on southern and eastern aspects.

Terrain and wind

The way the wind interacts with terrain can be quite complex. Exposed faces of hills and ridges may have increased wind speeds, while their leeward side, less exposed or sheltered areas may be almost calm.

Under some circumstances, the leeward side may have dangerous turbulent winds blowing in the reverse direction of the prevailing wind. Spot fires can be drawn back upslope against the prevailing wind.

In mountainous country, winds tend to flow up or down valleys, irrespective of the general wind direction outside these areas. In fact, any change in terrain may have an effect on the wind.

Coastal sea breezes are often experienced in the late afternoon in coastal areas and may affect fire behaviour, depending on local terrain.

Under clear skies, local winds can actually be generated by the terrain, upslope during the day and down slope during the night.

Winds generated by any of these conditions will create complex fire behaviour that has the potential to threaten fire-fighter safety.

3. General Health Hazards

It is vitally important that you are aware of, and know how to avoid, illnesses and problems that may result from vigorous firefighting activity and exposure to smoke, dust and heat.

If you have a medical condition (e.g. asthma, diabetes, heart disease or epilepsy) that may be aggravated by the type of work undertaken on the fireground, you should seek medical advice to ensure you are able to carry out such work.

The following pages will cover:

- Sunburn;
- Smoke and dust hazards;
- Fatigue;
- Dehydration;
- Heat related illness;
- Heat cramps;
- Heat stress;
- Heat exhaustion; and
- Heat stroke.

Sunburn

Prolonged exposure to the sun can lead to sunburn. Although not life threatening, sunburn can impact your effectiveness e.g. you may not be able to wear a knapsack if you have badly sunburnt shoulders.

Be aware that you can easily be sunburnt even when the sky is overcast. When working outdoors during the day you should make sure that you apply a water resistant sunscreen with a sun protection factor (SPF) of at least 30+ to all areas of exposed skin.

You should apply sunscreen liberally to any exposed skin every two hours. As you are likely to be perspiring freely while working on the fireground, you should try, where possible, to apply it more often. Make sure that your face, neck, ears, arms and the backs of your hands are covered.

If wearing complete protective clothing, sunburn should not be a problem. You are more likely to be sunburnt when mopping up or during a break when you have removed your helmet, gloves and outer clothing.

Signs and symptoms

- Redness of the skin;
- Tenderness in the affected area; and
- Blistering, sometimes involving more than one layer of skin.

Treatment actions

- Apply cool, moist compresses to the burnt area;
- rest in a cool place; and
- drink cool water and an electrolyte replacement drink.

Smoke and Dust Hazards

Smoke and dust are ever present irritants to your eyes and lungs at fires. Prolonged exposure to heavy smoke can be hazardous to firefighters.

In addition to restricting visibility, heavy smoke contains carbon monoxide (CO), which is a poisonous gas.

Inhalation of smoke and dust can:

- Reduce your performance on the fireground;
- Bring on fatigue more quickly;
- Bring on illness, alter perception and judgment; and
- Severe inhalation may result in death due to carbon monoxide poisoning.

Minimise the effects of smoke by:

- avoiding unnecessary exposure; and
- using approved PPE (e.g. P2 particulate filters, smoke masks and goggles) where provided if necessary, use handkerchiefs or other close weaved cloth to cover your mouth and nose.

Note: in situations where there is heavy smoke, be aware that fresh air pockets may be found near the ground.

Fatigue

The conditions and work you undertake at an incident can be physically stressful and demanding. Fatigue is a key factor affecting your performance at an incident.

Exposure to radiant heat and smoke for a lengthy period of time may increase your level of physical stress and the likelihood of fatigue.

If you are suffering any form of illness on the fireline you should seek medical attention or advice as soon as possible.

Even the fittest person will tire easily without enough rest, sleep and appropriate and sufficient food and fluids (e.g. water alternated with sports drinks).

If you are tired, you are more likely to make mistakes, which can cause accidents, injury and put others at risk. It is important to take full advantage of rest breaks.

Note: you should not drive vehicles or operate equipment if you are fatigued.

Signs and symptoms

- Tiredness and lack of energy;
- Slowness to react and taking longer than usual to complete tasks;
- Impaired judgment and inability to make decisions;
- Inability to concentrate and lapses in attention; and
- Erratic performance.

Treatment actions

To minimise the possibility of becoming fatigued at an incident, you should:

- Take regular breaks to rest and allow your body to recover;
- Pace yourself;
- Drink water regularly; and (min 1 x litre per hour when firefighting)
- Where possible, avoid working in excessive dust, smoke and heat.

During your breaks, you must:

- Rest out of the sun;
- Cool off (unbutton clothing and remove helmet when away from the fireline if safe to do so);
- Drink water, alternated with an electrolyte replacement drink;
- Regularly eat snacks;
- Avoid strenuous physical recreation; and
- Get ample sleep.

It's possible to force tired muscles to keep on working, but your brain cannot function adequately without sleep. Maintain a high level of fitness. If you are physically fit, you are less likely to experience fatigue in the short term. This, however, does not mean that you can avoid taking adequate breaks and rest. It simply means that you cope better with the physical stress, and recover more quickly than a less fit person.

Dehydration

The body's cooling system involves perspiring. Dehydration will occur if fluids and electrolytes lost through perspiration are not replaced. The importance of this when working on the fireground is clear. On days of total fire ban and extreme fire danger, you should increase your hydration in case you get called out.

Water and an electrolyte replacement drink should be consumed regularly. You should always drink more than you need in order to prevent dehydration. Failure to do this leads to the body overheating and the onset of heat illness.

Your thirst is not a true indication of how much water your body needs. There is a time lag between the onset of dehydration and feeling the need for water. You may, in fact, begin to suffer the effects of dehydration before you realise it.

You know when you are perspiring, use this as an indication that your body needs appropriate fluids.

On the fireground you need to replace fluids frequently. Drink at least 150–200 ml every 10–15 minutes. Water should be alternated with an electrolyte replacement drink (if in doubt drink a litre per hour). If using hand tools you may need to increase this to two litres per hour.

Note: fluid and electrolyte replenishment is vital for your health and safety, especially so for less fit people.

In the past, emphasis has been placed on drinking beverages such as cordial, tea or coffee and soft drinks as more desirable options to water when working on the fireground. Medical research now indicates that this is not the best option as the sugar content reduces the rate at which water is absorbed into the bloodstream and caffeine can increase the rate of body fluid loss (i.e. increased urination).

Therefore, during firefighting, plain water alternated with an electrolyte drink is best. Cool water is naturally preferable, if it is available. However, never chill your drinks as this can quickly quench your thirst without providing you with adequate fluid, cause stomach cramps and fool your body into thinking its cooler than it actually is.

However, during rest periods, it is a good idea to drink water and sweetened beverages such as weak cordial or tea as they can assist in restoring energy.

Milky or fat containing drinks should be avoided. Alcoholic drinks must not be consumed as they increase dehydration and impair your ability to safely carry out tasks.

Water suitable for drinking may not be available in the area in which you are operating. You should carry containers of fresh water, particularly when assisting out of your area.

Note: never drink water from vehicle tanks or knap-sacks as it may be contaminated.

Heat-related Illness

In addition to the health hazards we have just discussed, firefighters also face the risk of heat related illness such as (in order of severity from lowest to highest):

- Heat cramps:
- Heat stress;
- Heat exhaustion; and
- Heat stroke.

The risk for firefighters is increased due to the nature of the work and the conditions it is performed under i.e. hot, humid and dusty conditions, often within the range of radiant heat and while wearing personal protective clothing and equipment.

Note: illnesses caused by exposure to extreme temperatures are progressive and can quickly become life threatening if not treated immediately.

The human body is built to withstand changes in temperature and has an inbuilt “thermostat” that controls the body’s natural heating and cooling systems.

The body cools itself by directing additional blood flow to the skin, which is cooled through the evaporation of perspiration.

Under normal circumstances, its mechanisms for regulating body temperature works well. However, when the capacity of this automatic cooling system is overwhelmed, your body starts to overheat and you become susceptible to heat related illnesses.

The body's natural cooling system may fail if:

- The environment is too hot;
- Perspiration cannot evaporate freely;
- You are ill or unfit;
- Your body's thermostat malfunctions due to disease, drugs or alcohol;
- You fail to maintain adequate fluid intake; and
- You over exert yourself, particularly in conditions of high humidity.

To minimise the risk, you should:

- Take regular rest breaks, preferably in the shade away from the work environment or heat source;
- Loosen clothing to allow more air circulation and better evaporation of perspiration; and
- Maintain adequate and appropriate fluid intake.

Due to their nature, a person may not know they are becoming affected by a heat related illness, you need to look out for each other. You need to be able to recognise the symptoms and know the treatments not only for your own wellbeing, but also for your colleagues on the fireground.

If the heat related illness is not too severe and is recognised and treated early, it may be possible to continue working at a reduced rate, if the symptoms are not recognised or are ignored, the severity will escalate and may end in death.

Heat cramps

These are common muscular cramps that may occur in the heat, during or after exercise, especially when an unfit person has worked hard and perspired a lot.

The onset of heat cramps is caused by failure to maintain adequate intake of fluid and appropriate rest and cool down periods.

Signs and symptoms

- Muscular pain and spasms in the affected area;
- Feeling of tightness in the affected muscles; and
- Inability to relax contracted muscles.

Treatment actions

- Tell the people you are working with;
- take a rest break;
- slowly drink an electrolyte replacement drink or, if unavailable, plain water;
- consume some food from your ration pack;
- gently stretch the muscles; and
- massage the affected area or muscles gently.

Note: although stretching and gentle massage of affected muscles may assist in relieving muscle cramps, this is secondary to fluid replacement and cooling down.

Heat stress

You are suffering heat stress when your body's cooling systems (perspiration and circulation) are being stressed but are not yet overwhelmed by the heat load. As discussed earlier, the body cools itself by perspiring and directing additional blood flow to the skin so that this blood can be cooled as the perspiration evaporates.

As exercise produces heat internally, it is possible to become heat stressed even in relatively cool conditions if clothing and equipment impair heat loss. A hot and humid atmosphere will make the situation worse.

Radiant heat and extremes of air temperatures above normal body temperature (37°C) can add an external heat load to the heat generated internally, further contributing to heat stress.

As heat stress continues to affect the body, internal body temperature will rise and physical performance will drop.

If the heat stress is too great or if the body's cooling system becomes impaired by dehydration or exhaustion, continuing heat stress can lead to either heat exhaustion or heat stroke.

Signs and symptoms

- Feeling very hot;
- Flushed, red skin; and
- Vigorous perspiration, loss of energy and possibly a headache.

Note: in very hot conditions, especially if windy, perspiration may evaporate so fast that the skin seems dry even though significant perspiration and fluid loss is occurring.

Treatment actions

- Tell the people you are working with;
- Take a rest break;
- Loosen clothing to allow more air circulation and better evaporation of perspiration;
- Take regular sips of water and occasional sips of a diluted electrolyte replacement drink.
- If you believe a colleague is becoming affected by heat stress, assist them to do the above.

If heat stress is not too severe and is recognised early, it may be possible to continue working at a reduced rate, with regular rest breaks to cool off. If the symptoms are not recognised or are ignored, serious heat illness may develop.

Heat exhaustion

As its name implies, this condition develops as a result of becoming exhausted from working in the heat. If the body is heat stressed for too long without adequate fluid intake, dehydration develops. This upsets the body's chemistry, leading to weakness as well as reducing its capacity to continue perspiring.

Even if fluid intake is adequate, exhaustion will eventually set in if physical exercise continues beyond a person's normal endurance limits. Heat exhaustion is a combination of physical exhaustion, dehydration and upset body chemistry. If severe, it can lead to collapse and a form of shock.

Firefighters suffering from heat exhaustion are sometimes unaware of their condition and keep trying to work, even to the point of collapse. It is important that firefighters keep an eye on each other. If anyone is slowing down, not looking well or speaking or acting oddly, you should presume that person has heat exhaustion and take appropriate action as described on the following page.

Signs and symptoms

- Feeling faint, light-headed and dizzy;
- Cool, Moist, Pale and Clammy Skin – progressing to red, dry skin;
- Loss of appetite;
- Headaches;
- Irritability and vagueness; and
- Muscular cramps and spasms.
- Vomiting;
- Confusion, drowsiness and weak pulse; and
- Rapid weak pulse;

Treatment actions

As stated previously, it is likely that a person suffering from heat exhaustion may not realise it. You need to look out for each other and if you suspect a colleague is being affected by heat exhaustion:

- Move the casualty away from the work environment or heat source;
- Lay the casualty in the best available shade legs slightly raised
- Remove or loosen clothing; and
- If the casualty is conscious, give frequent sips of water;
- Seek medical attention;
- Do not give salt tablets;
- Sponge or spray water on the casualty only if they are hot.

If a casualty is unconscious, position the person on his or her side, ensure the airway is open, clear the airway and attend to breathing and circulation. Seek medical assistance as quickly as possible.

It can take many hours to recover from even mild heat exhaustion. It is best for the casualty to have had at least one nights sleep before working again, even if initial recovery is fairly rapid. More severe heat exhaustion will require medical treatment with intravenous fluids and admission to hospital. If a casualty continues to work on after heat exhaustion develops, one of two things are likely to follow.

Either the heat exhaustion will become sufficiently severe for the casualty to collapse or the body will seriously overheat, leading to heat stroke.

Heat stroke

Heat stroke is the least common and most severe heat related illness. It occurs when the body's cooling systems are overwhelmed and the body's temperature rises to dangerous levels at which time the body starts to "cook" internally. In cases of severe heat stroke, this is irreversible and death will rapidly follow.

Note: this process can occur quite rapidly, it is essential that the casualty be externally cooled as quickly as possible and urgent medical attention is received if life is to be saved.

Signs and symptoms

- High body temperature (often 40°C or more);
- Red, hot and possibly dry skin;
- Weakness or collapse;
- Reduced conscious state or unconsciousness;
- Full, bounding pulse;

- Rapid pulse and breathing rates; and
- Seizures (fits).

Seizures may occur in cases of severe heat stroke as the brain becomes severely affected by raised temperature. The vigorous muscle contractions involved in seizures rapidly raise body temperature even further. If seizures occur, the person will die unless immediate cooling is achieved.

Treatment actions

This is a medical emergency; immediate, effective cooling is essential.

- Remove the casualty from the work environment and heat source;
- Cool the body quickly
- Give clear cool fluids if the casualty is fully conscious
- Fan or expose the casualty to a breeze;
- Treat for Shock and
- Call an ambulance and get on-site medical assistance while waiting for the ambulance.

If the casualty is unconscious, position the casualty on his or her side and ensure the airway remains open.

Note: it cannot be overstressed, if heat stroke is suspected, urgent medical attention is essential.

4. Bushfire Suppression Activities

Teamwork

Successful firefighting relies on individuals working together as part of a team.

As a member of a team, you must stay in contact with your colleagues at all times, either by sight or radio.

You must make sure that:

- You understand your task and how it fits in with the work of other firefighters around you;
- The person in charge of you knows where you are and what you are doing;
- You know where other firefighters are and what they are doing;
- You stay in regular contact with others; and
- You know the escape plans and, in the event that you have to leave the area quickly, you can be contacted.

Never let anyone work alone, don't allow people around you to "get out of sight", look after your mates and work together.

Frequent communication is important, make regular reports so that you give and receive important information about the fire and your safety, keep an eye on the people around you.

Anchor Points

While working in bushfire situations it is important to work from an anchor point.

An anchor point is an advantageous location from which a fire line can be constructed. It is used to minimise the possibility of being out-flanked by a fire while the line is being constructed.

Possible anchor points include:

- Site of a recent bushfire (i.e. little or no vegetation);
- Bare ground;
- Blacked out fire edge; and
- Non-flammable area such as a lake or river.

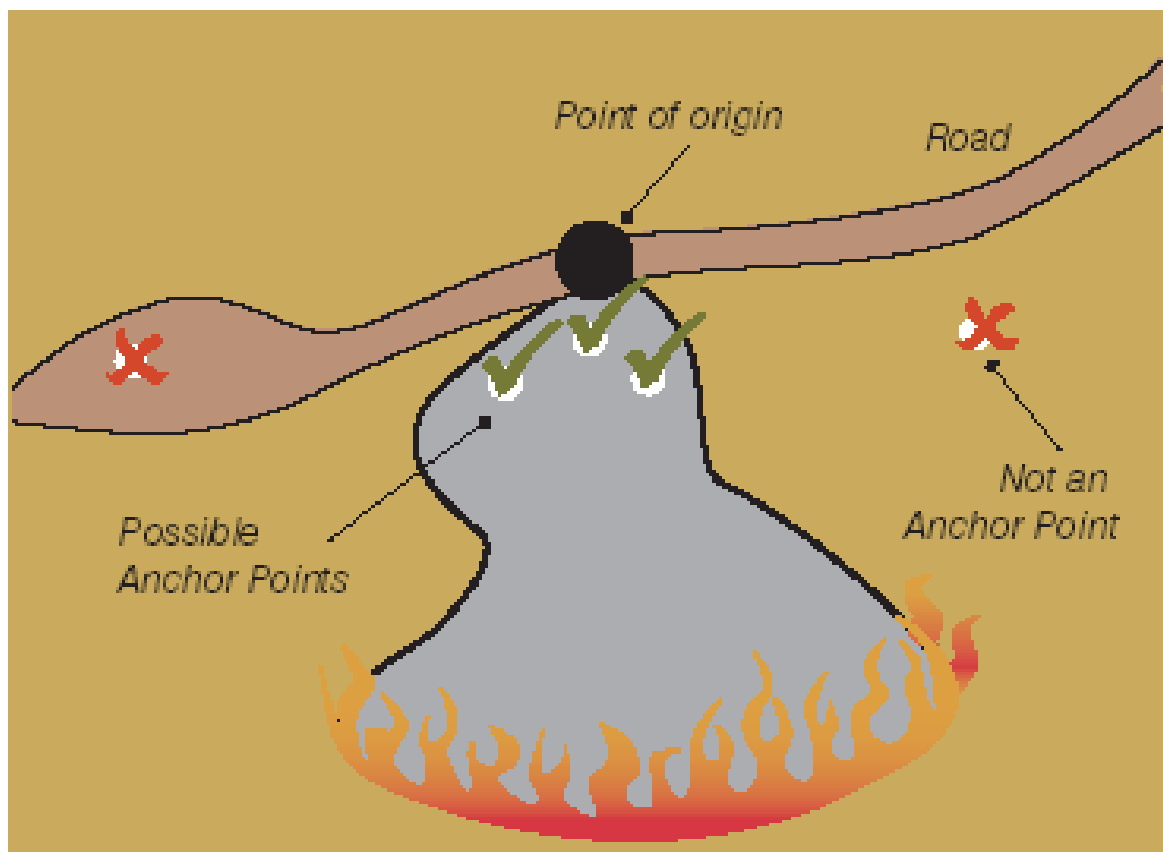


Figure 6 – anchor points

WATCHOUT

WATCHOUT is an acronym used to remind firefighters of potential dangers to their safety and to give advice on safe work practices.

Understanding the meaning of the acronym will help you perform a more comprehensive risk assessment.

WWeather dominates fire behaviour, so keep informed.

Actions must be based on current and expected fire behaviour.

Try out at least two safe escape routes.

Communicate with your supervisor, your crew and adjoining crews.

Hazards beware of variations in fuels and steep slopes.

Observe changes in wind speed and direction, temperature, humidity and cloud.

Understand your instructions, make sure that you are understood.

Think clearly, be alert and act decisively before your situation becomes critical.

Managing the Fire

The safety and success of fire suppression hinges on the command, control and communications systems that are set up to control the incident.

Incident management structure

The Australasian Inter-Service Incident Management System (AIIMS) brings together and manages people, procedures, facilities, equipment and communications in a common organisational structure. This structure expands and contracts in accordance with requirements to manage the incident.

This provides a clear path of delegation of responsibilities and helps to ensure that the health and safety of all personnel is better able to be monitored by the appropriate allocation of activities.

AIIMS functional roles include the following:

- Incident Controller – responsible for the overall management of the incident.
- Planning Section – responsible for the collation of incident resources, current information and predictions of any future development of the incident, and preparing the incident action plan.
- Operations Section – responsible for management and supervision of combating forces (this is the function within which a bushfire firefighter operates).
- Logistics Section – responsible for the provision of facilities, services, materials and finance.

Communications

Communications are vital to the successful outcome of bushfire suppression or any other incident.

A communications plan is developed to provide communications for the whole of the incident, as determined by its size and complexity.

Strategies and Tactics

One of the principles of AIIMS is management by objectives using strategies, tactics and tasks:

- Objective – a statement of what is to be achieved;
- Strategy – a statement of how the objective is to be achieved (e.g. direct attack, indirect attack, parallel attack or a combination);
- Tactic – the tasking of allocated personnel and resources; and
- Task – the job given to any firefighting force or unit (i.e. who is to do the job).

Fire intensity

Fire intensity is a function of the amount of fuel burnt, the energy value of the fuel and the rate of spread of the fire. In general terms the indicators of intensity may be flame length depending on how far they are leaning over and flame height. It is useful to know the indicators of intensity as the intensity of the fire may dictate the method of attack used.

- Low intensity fires have a flame height of less than 1.5 m (less than 500 kw/m).
- Moderate intensity fires have a flame height of 1.5–7 m (500–3000 kw/m).
- High intensity fires have a flame height of 7–14 m (greater than 3000 kw/m).
- Very high intensity fires have a flame height greater than 14 m (greater than 7000 kw/m).

The flames from an intense surface fire may progressively consume elevated shrub and bark fuels, and may eventually reach and ignite the crowns of trees.

Methods of attack

The Incident Controller will ensure that a risk assessment is conducted in order to determine and approve an appropriate strategy. The strategy selected for use at a fire whether in grassland, forest or at any other incident will depend on this risk assessment, taking into account the safety of firefighters as a first priority. The strategy will identify the method to be used to attack the fire:

- Direct attack;
- Parallel attack; or
- Indirect attack.

Direct attack (low intensity fires)

A direct attack is used mainly on low intensity bushfires that can be easily and safely reached by firefighters. Firefighters work from an anchor point directly on the edge of the fire and this edge then becomes the established control line.

In grass fire situations, water is commonly used to extinguish the burning edge of the fire in which case a mineral earth control line may not be required. Firefighters may also use foam and fire retardants to extinguish the fire.

In forest fire situations, a mineral earth control line may be constructed using hand tools or mechanical equipment such as bulldozers, along the fire's perimeter.

Care must be taken not to drag burning material across the control line into unburnt fuels and to work as close to the fire edge as possible. Water, Class foam or retardants may not effectively extinguish a forest fire but will assist in establishing a temporary control line.

To perform a direct attack you can use:

- Water contained in knapsacks, tankers, aircraft or in hose lines from a static water source e.g. a hose lay;
- Bulldozers and other earth moving equipment; and
- Hand tools such as rakehoes, slashers, axes and chainsaws.

The terms *head attack* and *flank attack* are used in bushfire suppression to describe two variations of direct attack techniques for suppressing a bushfire. You should be aware of how these two methods of attack differ.

A head attack (Figure 7) involves directly knocking down the head of the fire and then working towards the point of origin.

The anchor point is the blacked out fire edge at the head of the fire.

This type of attack is used only for low intensity bushfires and in moderate weather conditions where you can get close enough to attack the burning edge and can be sure that there will be no unexpected flare ups or spotting activity.

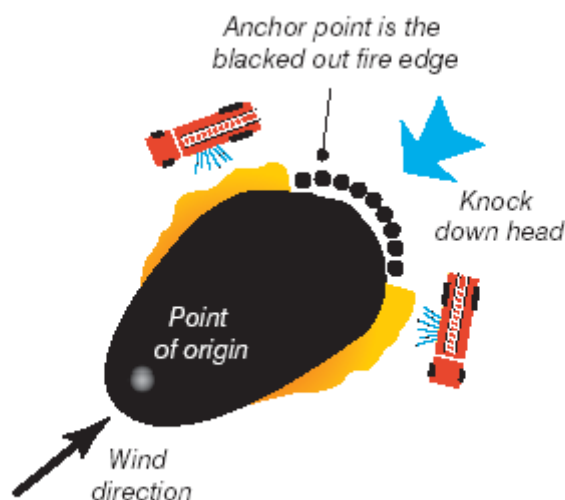


Figure 7 – head attack

A flank attack (Figure 8) involves approaching the fire on the flanks and working directly on them.

One version of a flank attack is to work from the rear using the blacked out edge as an anchor point to work progressively towards the head of the fire in an attempt to “pinch” it out.

This technique is used when it is impractical or unsafe to establish an anchor point at the head of a fire front, for example, high intensity grass fire.

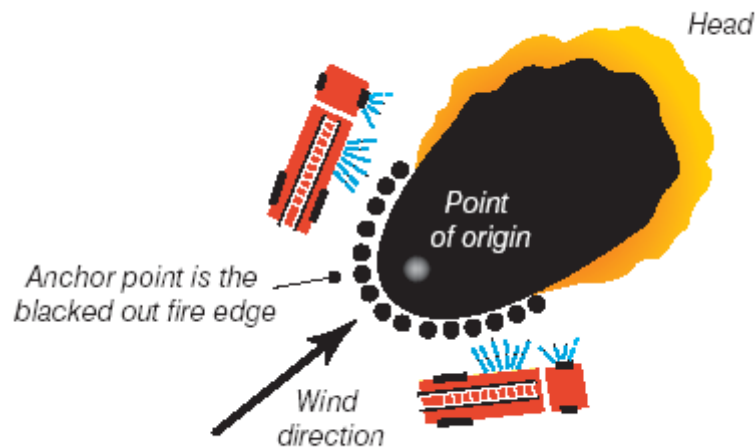


Figure 8 – flank attack

Advantages

- Provides maximum safety for firefighters e.g. the ability to move into the black if required;
- Generally, the least area is burnt of all methods;
- Fuel is removed from the immediate path of the fire, allowing the earliest possible control; and
- Parts of the fire edge that have self extinguished may be quickly incorporated into the control line.

Disadvantages

- Firefighters working at the fire's edge can be exposed to heat and smoke;
- Fences and natural barriers may present obstacles; and
- An irregular control line may be produced which can be difficult to patrol.

Parallel attack (low and moderate intensity fires)

The parallel method of attack commonly involves the construction of a control line parallel to the fire, or just a short distance away from the fire's edge (Figure 9 opposite).

You should be able to see the fire edge to observe changes in fire behaviour.

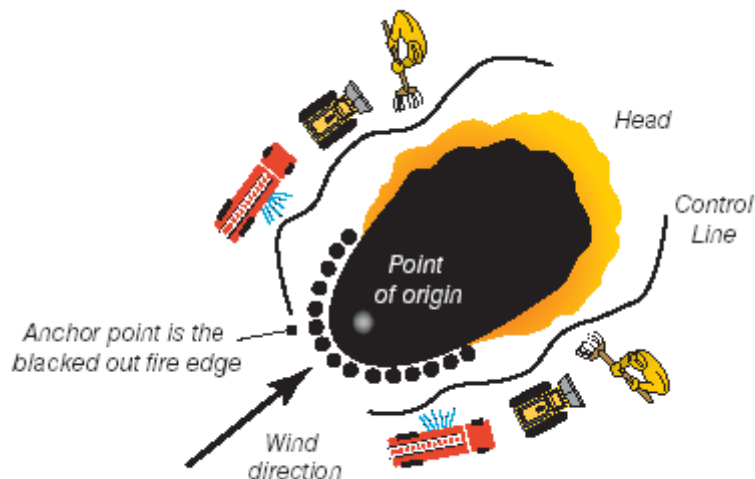


Figure 9 – attack parallel to fire edge

The distance from the fire edge will depend on:

- The intensity of the fire edge and spotting;
- The type of fuel;
- Weather conditions;
- Topography; and
- Equipment used.

In general, control lines are constructed as close as possible to the flanks of the fire. Irregularities in the fire's perimeter can be bypassed using this technique.

You can use a range of equipment to construct control lines e.g. hand-tools, ploughs, graders, bulldozers and chain saws.

The fuel between the main fire and the control line may be burnt out by other firefighters under close supervision. This generally occurs from the point of origin using the blacked out edge as an anchor point as the work on the control line proceeds.

Control line construction must stay ahead of any burning out activities. If this is not possible, you must patrol the control line to ensure that it is not crossed when the main fire reaches it.

Note: when using this technique, you must always remember that the fire is constantly changing due to factors such as fuel and topography. The distance that you can work from the fire edge is dependant on fire intensity, the further away you work from the fire edge, the greater the personal risk if the fire changes direction or intensity increases.

When using the parallel method, you must:

- Commence control line construction from an anchor point;
- Monitor the progress of the fire and note any weather changes; and
- Ensure you have two escape routes.

Advantages

- Control line may be shorter and straighter than in direct attack; and
- Crews may be less exposed to heat and smoke.

Disadvantages

- There will be an increased risk of the fire escaping; and
- The total fire area will be greater than that in a direct attack.

Indirect attack (high/very high intensity and inaccessible bushfires)

The indirect method requires the use of either a natural fire barrier, or the construction of a control line some distance from the fire's existing perimeter, or a combination of both.

The fuel between the control line and the main fire is backburned when conditions are safe to do so. By backburning some distance from the bushfire's existing perimeter, the fire is robbed of fuel.

This technique is generally used when access is not available to the fire edge, the fire is too intense or is spotting, or for environmental reasons. The fire is allowed to burn to predetermined control lines.

Backburning is potentially hazardous and needs experience, knowledge and skill to ensure a successful outcome. This activity is only to be carried out when identified as part of the overall control objective strategy in the Incident Action Plan and following authorisation by the Incident Controller. You will only carry out this task under direction and supervision.

Advantages

- Generally the only means to control fires with long distance spotting;
- Controls more intense bushfire;
- Reduces the exposure of firefighters to bushfire hazards;
- Allows more time for planning and assembling resources appropriate to the incident;
- Allows the location of a control line to be chosen with greater regard to crew safety and environmental considerations;
- Allows more time for the construction of a control line; and
- Control line may be shorter and straighter than in a direct attack.

Disadvantages

- Requires considerable resources and planning;
- The total fire area will be greater than that in either of the previous methods;
- Greater area to be controlled and patrolled, therefore an increased risk of the fire breaking through the control lines;
- The fuel between the fire and the control line may have to be backburned or burnt out – the two fires joining may result in intense fire activity at the junction zone (where the fires meet) and an increased chance of spotting;
- The backburn may fail or escape, creating the difficulty of controlling the main fire and the backburn.

Asset and property protection

Many bushfires occur close to, or enter, urban-rural interface areas and may pose a serious threat to life, livestock and/or property. Isolated rural properties may also be placed under threat from an approaching bushfire.

The Incident Controller will take account of this when planning fire suppression strategies and tactics.

One option to minimise losses may be to apply tactics specifically for property and asset protection. For example, using pumpers or tankers to protect homes and other property using local, static or reticulated water supplies.

Local pre-plans may have already been developed to determine the safe, effective and efficient use of resources for asset protection.

Mineral earth control line.

As you can see from the previous section, a control line is an important part of fire suppression activities.

One form of control line is a man-made or natural fuel-free path. It prevents the spread of fire. When constructing control lines, the term mineral earth (or bare earth) is sometimes used.

This term refers to ground where all vegetation cover has been removed and only rocks and soil are exposed.

The mineral earth should be exposed for the length and width of the control line.

The control line may vary in width and length, depending on the incident.

A control line can be constructed by using:

- Hand tools (e.g. axes, slashers, rakehoes and chain-saws) to remove unburnt surface fuels from the fire; and
- Machinery, such as bulldozers, graders, bobcats and farm tractors fitted with a plough or a blade.

Constructing a control line using hand tools

Constructing a control line using hand tools requires a team effort. It is necessary to work in a planned manner if the team is to work safely, effectively and efficiently.

Rakehoes and axes have sharp edges, failure to observe safe handling and work procedures can result in severe injury.

Key points to remember

- Make the most of natural fire breaks such as:
 - exposed rock shelves;
 - open ground; and
 - creek beds.
- Keep the control line as straight as possible to provide firefighters with a clear view and enable them to move along the control line easily.
- Keep the length of the control line to a minimum.
- Corners should be widened, as fires are more intense in this area and can often spot over at these points.
- Avoid heavy concentrations of fuel as the fire's intensity will increase close to the control line.
- Cut saplings and small trees at ground level to minimise the potential for the sharp stumps to cause accidents.
- Keep the control lines clear of dead trees or stumps.
- Rake and scrape unburnt surface fuels away from the fire.
- Remove rough bark and ladder fuels from trees adjacent to the control line as these can cause spotting across the control line or rake around these, if it is not possible to avoid them.
- Be sure that the fuel is removed down to the mineral earth.
- Patrol the perimeter
- As soon as a control line is established, patrol it regularly to ensure there is no risk of the fire rekindling.
- Create a mineral earth control line around stumps, trees and fence posts to avoid breakaways.

- Use the rake end of your rakehoe to rake away any remaining fuel, such as leaf litter, from the burnt area, being careful to not take any hot embers into the unburnt fuel, then use the sharp edge to scrape or chip down to the bare earth.
- Look into the burnt area to identify elevated, surface or ground fuel hot spots, and look out for fresh outbreaks in the unburnt areas caused by new or previous spotting activity.

Blacking out

Blacking out or mopping up operations involve making sure that a contained fire does not reignite or spread.

Poor blacking out may also increase the risk to your crew or other crews working around you if the fire rekindles.

Thorough blacking out involves locating, breaking open, or exposing and extinguishing any smouldering fuel above or below ground. This is done manually with hand tools, by wetting the fuel, or both. In a grass fire situation, wetting the fuel may be sufficient.

Note: The importance of thorough blacking out cannot be over emphasised. Many fires considered contained have rekindled or started fresh outbreaks due to poor or insufficient blacking out being undertaken.

The first stage of blacking out should concentrate on making the fire perimeter safe. Most successful blacking out is carried out on foot to allow close inspection of potential hot spots. When they are found you must deal with them and be sure they are completely extinguished.

You should:

- Extinguish elevated burning/smouldering fuels first;
- Extinguish any smouldering and hot materials;
- Place any smouldering fuel found outside the control line into the burnt out area;
- Break up fuel concentrations to release the heat; and
- Turn smouldering logs into a position where they will not roll into an unburnt area.

When the edge is controlled, any patches of unburnt fuel can be burnt out or contained within the control line. A strip inside the perimeter must then be blacked out to extinguish all burning or smoldering material. Commencing at the edge and blacking out for 20–30 m is the most common practice.

As with other firefighting activities, consider your hose line as your lifeline. Whether moving up or adding an additional hose length to prevent hose damage, be sure to wet down ahead of your hose to create a cool damp area free of hot embers and threat from naked flame.

Factors to consider when blacking out

Depth of blacking out

The depth of blacking out will depend on a number of factors:

- The size of the bushfire – it may be possible to mop-up the entire area of small or spot fires, in large fires the depth of blacking out will depend on fuel, weather and topography;
- Nature of the fuels – heavy, smouldering fuels like stumps and logs, or tall burning hollow trees showering sparks across the control line from inside the mopped up perimeter increase the risk of reignition, therefore, depth of blacking out needs to take account of this; and
- Terrain or topography – control lines on slopes with burnt ground above unburnt ground pose a risk of smouldering material tumbling down hill into unburnt fuel across the control line, mopping up must be extended further upslope to reduce this risk.

Weather conditions

The likelihood of severe weather approaching may make a greater depth or area of blacking out and additional patrols necessary, particularly on the eastern flank, as a wind change from the west/south-west would blow towards this direction carrying embers on to unburnt fuel.

Different fuels

- Logs and stumps:
- You may have to roll a log over to extinguish the underside. To avoid it rolling down hill or into an unburnt area, use a rock or earth mound as a chock or dig a trench to roll the log into;
- You may have to split a log open to extinguish any burning material inside. If you have insufficient water, use your rakehoe to create a suitable bare earth break around it; and
- When blacking out stumps, firstly cool down the stump and surrounding area. You may need to use a shovel to access hot root holes or an axe to open the stump up.
- Trees:
- Be sure to black out all smouldering bark and elevated fuels to prevent it blowing into unburnt fuel;

- Burning stag trees near the fire edge should be extinguished to stop showering sparks and embers igniting adjacent unburnt fuels. If this is not possible, post a patrol crew twice the tree height clear of the stag and up slope, or have a competent person fell the tree. Then split it open and extinguish it.

Note: the use of chainsaws to assist fire-fighting operations must only be carried out by trained, competent and endorsed people.

- When blacking out in grassland or bush, take care not to spread burning embers back into the unburnt area.
- Animal manure needs to be broken apart and thoroughly wet down.
- Be sure to black out fence posts, as they are a valuable asset.
- Safety
- Falling trees and limbs can kill. These can continue to fall for many days after the main fire has passed. Look up and maintain a close watch while working under canopies. Report any dangers.
- You need to exercise extreme care when applying water to hot beds of burning fuel, as instantaneous production of steam may cause a violent reaction, throwing dust, smoke and steam back into your face.
- Watch out for rolling logs and material burning underground in stump holes.
- Stay at least two tree heights clear and upslope of any burning stag trees.
- Watch out for insects, reptiles and vermin that may have been disturbed as a result of the fire.

5. Taking Refuge

Taking refuge is the last resort. Your highest priority is to avoid being placed in a life threatening situation. You should ensure that you take all necessary actions to avoid life-threatening situations where you may need to take refuge while on foot, in a vehicle or on a tanker. Your chance of survival is significantly reduced if entrapped in a grass fire, and extremely low if entrapped in a forest fire. You need to know the actions to take to improve your chances of survival if for reasons outside your control you find yourself in a critical situation. Remember, you must wear appropriate protective clothing, worn and fitted correctly, at all times on the fire-ground.

The following pages will cover:

- Taking refuge from radiant heat;
- Taking refuge on foot;
- Taking refuge in a structure; and
- Taking refuge in a vehicle.

Taking refuge from radiant heat

Even during normal firefighting activities, radiant heat is a potential killer. You are in real trouble if radiant heat enters your body faster than you can maintain your core body temperature by sweating.

Personal protective clothing and equipment is designed to offer some protection against radiant heat. If you are too close to the fire, your core body temperature will still rise. To overcome this you need to move further away from the heat source (i.e. the flame) to a more comfortable distance. Four times the flame height is the accepted com-fortable distance. As flame height increases so does radiant heat. In cases of sudden flare ups, you may collapse and die within minutes, if you do not find shelter.

As radiant heat only travels in straight lines from its source, taking refuge behind a solid object will shield you from the radiant heat. Keep as low as possible, lay face down and cover up all exposed skin until the flare up subsides.

Objects that may shield you from radiated heat include:

- Heavy machinery (e.g. a bulldozer);
- A large log;
- A stone wall;
- A structure;
- An earth mound;
- A large rock; and
- A tree.

It is worth reiterating that your priority should be to avoid being placed in a life-threatening situation. The following actions should be considered as a last resort when entrapped in a bushfire.

Taking refuge when on foot in a bushfire

If you are on foot and are not in the vicinity of a vehicle or structure, you should consider the following actions:

- Remain calm and do not panic, do not run blindly from the fire as exhaustion makes you prone to heat related illnesses and collapse;
- If you are in grave and imminent danger, to gain immediate radio attention send a “Mayday” message;
- Look after fellow firefighters;
- As fires travel faster uphill, try to cut across a slope out of the path of the head of the fire, do not try to outrun the fire uphill unless you are certain a safe refuge is close by;
- Try to reach bare or unburnt ground towards the back of the fire;
- Do not run through flames unless you are able to see the ground on the other side and they are low enough for you to safely cross (breaks may occur where there is less fuel);
- As a last resort, clear a survival area by removing fuel and sheltering behind a solid object if possible (such as listed opposite) or lay in a depression, stump hole or in a drain face down; and
- Lay face down, ensuring all exposed skin is covered (completely cover yourself with a woolen blanket if available).

Taking refuge in a structure threatened by bushfire

In a bushfire situation, a house or structure of a similar size can provide you with adequate shelter from sparks, embers, radiant heat and flames.

Such a building might eventually burn, but it can protect you until the main fire danger passes.

It is important to remain outside the building for as long as possible. In the early stages of the fire, there may be a shower of sparks and embers blown towards the building. By remaining outside for as long as possible you can:

- Extinguish any small outbreaks;
- Wet down the immediate area;
- Remove or protect any fuels that may be adjacent to the building (e.g. gas cylinders, firewood and awnings); and
- If time permits, fill gutters with water (block down pipes).

When you are forced to take refuge indoors:

- If you are in grave and imminent danger, to gain immediate radio attention send a “Mayday”
- 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 (e.g. the washing machine tap in the laundry if applicable);
- Shut all windows and doors (be aware that sparks and embers can also enter buildings through ventilation covers, sub-floor spaces and under doors and eaves);
- Soak towels and rags with water, in case you need to extinguish small fires and fill available containers, buckets and baths (if applicable);
- Watch for and extinguish any outbreaks of fire, especially in the roof, ceiling, windowsills and verandas or timber decks (the heat will dry out timber surfaces making them more likely to ignite from ember attack); and
- If the building should catch fire and the main fire has passed, wrap yourself in a woollen blanket and leave.

Finally, when the fire front passes (it will generally pass quickly, depending on the fuel available) it should be safe enough to move outside and quickly extinguish any outbreaks and wet down any smouldering materials. This will help to prevent the house or building burning down; you should remain alert to any possible outbreaks.

Taking refuge in a vehicle threatened by bushfire

Vehicles provide an increased level of protection from flames and radiant heat compared to being caught on foot in the open.

Emergency personal protection procedure: – cabin of any vehicle:

- If you are in grave and imminent danger, to gain immediate radio attention send a “Mayday”;
- Give continuous blasts on the horn as a warning signal;
- Ensure others are aware of the nature of the impending danger;
- Park your vehicle in an area of least combustible fuel, preferably on burnt or bare ground, in a quarry pit, wet gully or cutting and away from surrounding or overhanging trees or other vegetation;

- Ensure the off-side (driver's side) of the vehicle is facing away from the fire to reduce the main impact of radiant heat to you and provide further protection for the pump area (if applicable);
- Wind up all windows, close vents, turn on headlights and hazard lights, and leave/start engine running;
- Ensure all personal protective clothing is worn and properly adjusted, and all areas of exposed skin are covered;
- Get down as low as possible in the well of the cabin and cover yourself fully with a woollen blanket, keeping below the bottom of the windscreen;
- When the fire front has passed, extinguish any fires on or around the vehicle that may be a threat to your safety; and
- Advise someone from the emergency services at the fire when the danger has passed.

6. Bushfire Hazards

"Safety First" Safety must be given priority over all other fire suppression considerations and activities.

When working at an incident, you must avoid putting yourself at risk unnecessarily. By following safe work practices you can minimise the risk of injury.

General hazards

There are a range of potential hazards that can arise from the use or misuse of vehicles and machinery during bushfire suppression operations. At night, these hazards pose an even greater risk.

When working around **any** machinery such as a chainsaws, bulldozers, graders, farm machinery or aircraft you must ensure the operator is aware of your location at all times, day or night.

If you need to approach an operator, do so only when you have made eye contact and signalled your need to communicate. Only approach when you receive the signal it is safe to do so, remain in the line of sight of the operator at all times.

At night you should carry a torch or remain in a well lit area. In all cases you must follow the operators instructions.

Working near power lines

Electrical hazards may be encountered at bushfires or other incidents. These hazards may be caused by:

- High winds bringing down power lines;
- Falling trees or branches bringing down power lines;

- Burnt power poles falling and bringing down power lines; or
- Motor vehicle impact bringing down power lines.

You must **always** consider downed electrical wires as **live** until informed otherwise by a power company representative.

A downed live power line will result in electricity being on the ground surface for several metres around the area where the wire is making contact. If it is in contact with an object such as a fence or a vehicle, the whole object should be considered as live.

You should also be aware that overhead high voltage power or transmission lines can short circuit to ground through smoke **without** making direct ground contact.

Precautions

- Do not approach within 8 m of an area where there are downed wires, power lines or towers that are covered in smoke (this distance will increase if the ground is wet or water is present);
- Notify the power supply company to cut power and follow their advice regarding safe work practices;
- Cordon off the area with tape, rope or by other suitable means;
- Do not work directly under high voltage or transmission lines where smoke is present;
- Do not park your vehicle near loose dangling electrical wires;
- Avoid applying a direct stream of water onto electrical equipment or making contact between electrical equipment and wet hose lines as water conducts electricity;
- Take special care at night, use a torch or your vehicle's lights to locate the ends of fallen wires; and
- Ensure people working in the area are warned of the danger.

Vehicles

Vehicles at, or traveling to or from a fire, are a potential hazard to emergency personnel and other road users.

When working on or around vehicles at an incident:

- Know the dimensions of your vehicle;
- Always wear a seat belt where fitted;

- Ensure any items of equipment carried in the vehicle are stowed away, locker doors are closed and secured, and exterior equipment on the vehicle is secured;
- Do not ride on the back of a vehicle unless it is designed for this purpose;
- When working on the rear of a vehicle, be aware that there is a potential for slipping, falling or being thrown, especially if the vehicle is moving over a rough or steep terrain;
- Park properly, a vehicle that is not properly parked (due to haste or panic) can be a hazard as it may move without warning;
- Park safely, both the vehicle and crew are at risk of injury from falling branches or building components if the vehicle is parked too close to unstable trees or buildings;
- Mount and dismount the vehicle using the steps and rails provided to the crew area and cabin to avoid injury – **do not jump from any vehicle**;
- Be cautious when stepping onto uneven or broken ground;
- Whenever possible get someone to guide you when reversing;
- Do not stand behind a vehicle, if the vehicle is reversing, the driver may not see you and you could be injured; and
- Always be alert for hazards created by other vehicles such as vehicles being driven carelessly in conditions of poor visibility, and if alighting on the driver's side of the vehicle, be cautious of passing traffic.

Heavy machinery

Machinery, such as bulldozers, graders, farm machinery, tractors, ploughs and bobcats create their own unique set of hazards. Personnel working near any machinery, in a vehicle or on foot, risk being crushed if the machine operator is not aware of them.

All machine operators have restricted fields of vision to the front and rear due to the engine and roll over protection systems. Dust, smoke and darkness may further impede the operators view.

Approaching heavy machinery

Do not approach machinery until you have established eye contact and received acknowledgement from the operator. Operators will have extreme difficulty hearing over the noise of the machine.

Only approach when directed by the operator. Heavy machinery can slew or turn quickly and without warning. You should never attempt to hitch a ride as the moving tracks, or wheels, can be hazardous.

Dust and poor visibility

Vehicles and earth moving equipment create intense dust. This is a hazard to personnel and traffic due to reduced visibility and the possibility of inhaling dust particles.

If dust is present, or visibility poor:

- Try to work into the wind;
- Make an exclusion zone around the machine;
- Close off road or track; and
- Turn on vehicle or machinery lights.

Trees and rocks

Bushfires are often associated with strong winds which can break away or dislodge previously broken branches that have been supported by other branches (widow makers).

Falling or rolling trees, logs, rocks and branches can cause serious injury or even death. It is possible for living or dead trees to catch fire, fall to the ground, or drop branches with little or no warning. Burning stags (dead trees) are particularly dangerous. Rocks, trees or logs that are dislodged by heavy machinery working on slopes have the potential to roll downhill.

A tree or rock pushed by a machine may dislodge other trees or rocks. This combination creates a domino effect and creates the risk of a severe impact injury at some distance from the machine. **Therefore, always stay more than two tree lengths from heavy machinery and never work downslope.**

Also be aware that trees that are being pushed by a machine may suddenly snap and spring back in the opposite direction, in a whiplash effect.

To reduce the likelihood of injury:

- Always wear your safety helmet;
- Do not park vehicles near or under burning trees or branches; and
- Keep a look out for hazards created by trees, branches and rocks.

Chainsaws

Chainsaws are used at bushfires to cut open burning logs, cut trees and branches that have fallen on roads and to cut firebreaks. They are a useful, but a potentially dangerous tool.

If you have not been trained and endorsed to use a chainsaw, do **not** operate one. A qualified chainsaw operator should always wear the correct protective clothing:

- Helmet;
- Face shield/eye protection;
- Ear protection;
- Gloves;
- Chainsaw trousers (or chaps);
- High visibility clothing; and
- Safety boots (steel cap).

7. Safe Work Practices Around Aircraft

Aircraft are used for a number of activities in fire operations including the following.

- Fire command and control;
- Detecting fires;
- Applying water or aerial retardants (firebombing);
- Aerial ignition of unburnt areas within the fire perimeter;
- Transporting crews and equipment;
- Observing and mapping fires; and
- Fire bomber coordination.

Safety precautions

There are general safety principles that apply when working around aircraft:

- Always follow the directions given by the pilot, flight crew or aircraft coordinator;
- Wear correct eye, ear and head protection, do not wear loose headgear such as baseball caps;
- Stand clear of landing and take off areas and do not smoke within 30 metres of an aircraft or refueling equipment;
- Be aware of propellers, and rotors, particularly when engines are idling during warm up and brief stops. Never lean on them as this may cause the engine to turn over and cause injury;
- Do not handle moving parts such as flaps, aials, and airspeed sensing tubes as these can be easily damaged; and
- Assist with loading and unloading only under the supervision of the pilot.

Working around helicopters

Observe the following procedures when working around helicopters:

- Stay in the pilot's field of view at all times;
- Stay away from spinning main and tail rotors;
- Stand outside the main rotor disc area and await pilot's signal before approaching the helicopter in a crouched position;
- Do not approach the helicopter unless the rotors have stopped or are spinning at operating speed, a slowing rotor can tilt downwards, in windy weather reducing head height;
- Be aware of ground irregularities on uneven, sloping terrain. Approach and leave the helicopter from the lowest down slope side and within the pilot's view;
- Carry long objects, stretchers, and hand tools horizontally; and
- If the helicopter is creating dust, cover your eyes and crouch down with your back to the helicopter until the dust clears.

Firebombing

Firebombing is the term used to describe the dropping of water, foam or retardants in bushfire suppression activities. Helicopters or fixed wing, agricultural type aircraft can carry out firebombing.

To assist in warning ground personnel of incoming drops, some firebombing aircraft are equipped with sirens and will, if fitted, activate the siren prior to and during the release of any load.

Note: not all firebombing aircraft are siren equipped.

If caught in a firebombing zone:

- Move away from the fireline;
- Do not run or panic;
- Watch out for dead or suspended branches;
- Place hand tools well clear of you;
- Hold your helmet on or protect your head with your arms;
- Watch your footing; and
- Wash with cold water if hit with foam or retardant.