

Unit EF1:**Training : Ensure that your actions in the Vegetation Fire Workplace Reduce Risks to Yourself and Others.****Introduction:**

These training materials support the EuroFire Level 2 competency standard **EF1 Ensure that your actions in the vegetation fire workplace reduce the risks to yourself and others**

This document is for people who assist in the management of vegetation fires. It is for situations where: the fire management operation is simple, the level of risk, complexity and fire behaviour is low and the operator is under direct supervision.

All national and local laws relating to fire management techniques must be followed. In addition local landowners may need to be consulted or give their approval before operations takes place.

The training for this unit may be delivered through a combination of formal training, mentoring and coaching. Self-learning should be restricted to knowledge and understanding of the material and not practical application, which must only be carried out under direct supervision.

The nominal/notional/guided learning hours for this module is 20 - 30 hours.

EuroFire is a pilot project. The training material will be evaluated as part of an on-going process. A feedback form is included on the website www.euro-fire.eu

The target audience for this material are the people who work in fire services, farming, forestry, game management, conservation, range land and recreation management who have a role assisting with the management of vegetation fires, either on a full or part-time basis.

Relationship with EuroFire competency standards and risk management

Reference to the EuroFire competency standards should be made to understand the full range of expected learning outcomes. The sections of the standards are: unit title, element title(s), about this unit, key words and phrases, what you must be able to do, this element covers, and what you must know and understand.

The support materials for all the EuroFire competency standards are designed to support a flexible approach to training delivery. They can be adapted or modified to suit a particular target audience. The learning material for this unit should be used with the support materials for other units to ensure all learning outcomes in the standards are covered.

There are various European Union Safety Directives which have been enacted as specific Health and Safety legislation in each country in the EU. This legislation is designed to improve workplace safety and health and reduce work related accidents and diseases. All necessary safety legislation, risk management policies and procedures, for your location, agency or organisation must be followed.

Complimentary (co-requisite) learning:

EF2 - Apply techniques and tactics to control vegetation fires

Subsequent learning:

EF 3 - Communicate within a team and with supervisors at vegetation fires
(to be developed)

EF 4 - Apply hand tools to control vegetation fires

EF 5 - Control vegetation fires using pumped water (to be developed)

EF 6 - Apply Vegetation Ignition Techniques

Learning objectives:

- Assess hazards and risks in a vegetation fire workplace
- Follow organisational fire procedures
- Operate safely on the fireground
- Support others operating on the fireground
- React appropriately and in accordance with organisational, legislative and environmental requirements, to a fire incident.

Keywords and phrases:

Control Line, Direct Attack, Dynamic Risk Assessment, Fire Behaviour, Fire Hazard, Fire Intensity, Fire Risk, Fire Support Office, Fire Shed, Fire Type, Fire Weather, Flame Length, Flank, Flanking Attack, Fuels, Hazard, Head, Heel, Hotspot, Indirect Attack, LACES, Origin, Rate Of Spread, Risk, Topography, Wildfire

Application:

- Basic risk management

A wildfire or prescribed fire environment has many potential hazards, some of which may cause an accident to occur. The aim of risk management is to avoid accidents and minimise the harm that might occur. Risk management is not just an activity for leaders and managers but involves everyone. Everyone is responsible for safety and communication on safety issues should be a two-way process between personnel and supervisors.

Sometimes the terms hazard and risk are confused. The definition of a hazard is anything that may cause harm and the risk is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be.

A good way to create safe working practices is for an organisation to follow the 5 steps to risk assessment. Individuals may be involved in all these steps.

- | | |
|--------|--|
| Step 1 | Identify the hazards |
| Step 2 | Decide who might be harmed and how |
| Step 3 | Evaluate the risks and decide on precautions |
| Step 4 | Record your findings and implement them |
| Step 5 | Review your assessment and update if necessary |

Individuals involved in prescribed burning or fire suppression operations often work in the open for long periods of time. During such operations risk management should be a continuous and dynamic process. Risk assessment and control need to become ingrained into working practices so that they become safe. The concept of dynamic risk assessment helps this process.

Dynamic Risk Assessment:

The continuous process of actively identifying hazards, assessing risks and taking action to eliminate or reduce the risk; all in the rapidly changing circumstances of an incident.

The approach whether written down or carried out mentally should be the same. For each hazard be clear about who might be harmed because it will help you identify the best way of managing the risk.

For each hazard ask yourself:

- Can I get rid of the hazard altogether?
- If not, how can I control the risks so that harm is unlikely?

When controlling risks, apply the principles below, if possible in the following order:

- Try a less risky option
- Prevent access to the hazard
- Organise your work to reduce exposure to the hazard
- Use personal protective equipment
- Use welfare facilities provided

The risks include hazards that are part of the workplace environment as well as those that are specifically fire related, for example vehicle accidents are a significant hazard.

Accidents occur as a result of an unsafe condition or an unsafe act. Often it is the unsafe act, the human factor, which is the cause of an accident.

A fireground environment holds many potential hazards so the first question to be asked is “why am I here at all?” or “what is my purpose here?” For people carrying out prescribed burning operations following a plan this may be to create a firebreak or improve a habitat. For firefighters tackling a wildfire the normal purpose is to protect something, usually in the following order:

- Human life, firstly of the firefighter
- Communities
- Property
- Natural resources

We all rely on our senses of sight, hearing, touch and smell to identify threats. However in the fire environment there are factors that can mislead or confuse our senses, such as noise, smoke and carbon monoxide. There is a need to develop and use safe working practices to control hazards and risks that are not obvious as well as the ones that are obvious.

Also if people operate in extreme conditions for long periods of time they start to think hazards as normal and just accept them. However they are working in unsafe conditions where any unsafe act is very dangerous. A disciplined approach, following instructions, job procedures and safe working practices is essential in these circumstances. Safety is everyone’s responsibility.

Over the years, in various countries, firefighters have lost their lives tackling wildfires. These fatalities have been due to a range of factors from aircraft accidents to the behaviour of the fire itself. Fatal and near-fatal fires have four major common denominators, in that they occur:

- On relatively small fires or deceptively quiet areas of large fires.
- In relatively light fuels, such as grass and shrubs.
- When there is an unexpected shift in wind direction or in wind speed.
- When fire responds to topographic conditions and runs uphill.

Common factors that have lead to these unfortunate situations have been identified and systems of safe working to control these types of hazards and risks have been developed. Particular attention should be paid to the memory aids such as: LACES, Watchout, Fireorders and the 18 Watch Out Situations.

These are described Appendix A.

Safety responsibility in teams

The responsibility for safety is held by individuals, supervisors, managers and organisational procedures. The first responsibility is for individuals to look after the safety and health of themselves, co-workers, the team and the people around them. The use of the “buddy system” where personnel work in pairs, checking each other’s safety and general condition is especially useful.

Individual’s relationship with their supervisor and the team is extremely important. Individuals need to:

- Make sure that the supervisor knows where they are at all times
- Stay in contact with their supervisor
- Know their task(s) and the task(s) of their team
- Know where other team members are and what they are doing
- Know their emergency escape plans to leave the area

After the individual the immediate supervisor is the next person responsible for safety. It is important to develop a relationship with him or her that allows the open discussion of safety issues. At times individual firefighters may see hazards or risks before anyone else and they need to be able to communicate information on safety issues without undermining their supervisor role.

Some organisations have dedicated safety managers both on and off the fireground but the primary responsibility for safety will rest with either the Fire Boss on a prescribed fire or the Incident Commander at a wildfire.

To tackle fires safely depends on individuals working together as a team. Continuous communication is essential. Everyone should always be in contact either verbally, by sight or on a radio with someone else. The paired worker “buddy system” should be used so that individuals are always in contact with a colleague. There is a tendency when working in the open of people gradually becoming separated, don’t allow this to happen.

A safety briefing must be given to everyone attending fires. Personnel should make sure they have extracted the following general safety points before they go to the fireline. If anyone is unsure about any safety issue, ask questions at the briefing.

- Understand the communications and command system
- Understand and follow instructions
- Check that assigned task(s) are within your own and your teams capabilities
- Know the hazards, especially fire behaviour and the terrain
- Know your escape routes and safety zones
- Know where your anchor point is located

1. Risk management: hazard identification and control measures

Situational Awareness

Often accidents are the result of human error. Individuals need to be continually aware of the situation around them. It's too easy to lose this situational awareness by focussing too much on the task. Constantly check for hazards, do simple checks like “look up, look down and look around” the area.

Natural environment

For many people the first change to take account of for prescribed burning and wildfire suppression work is that these activities take place in open country, in farmland, forests, or rangeland. It's only when fires reach the interface with villages and towns that buildings and infrastructure become involved.

So the first issue is to be able to operate safely in rural areas.

Hazard	Control Measures
Changes in the weather	<ul style="list-style-type: none">• Develop knowledge of the effect of time of day, season and topography on local weather conditions• Get advice on local weather influences from local people
Poor work location due to change in wind speed or direction	<ul style="list-style-type: none">• Watch out for flare ups• Check escape routes
Weather getting hotter and drier through the day creating high fire intensities	<ul style="list-style-type: none">• Different tools, techniques and strategies may be required• Withdrawal of teams and reassessment may be a safer option
Slips, trips and falls	<ul style="list-style-type: none">• Wear heat resistant boots with ankle support and a good tread.• Walk carefully over difficult terrain
Dense vegetation, losing sight of the fire and difficult to escape	<ul style="list-style-type: none">• Maintain a lookout• Find alternative route or cut a path through it.• Make sure you have escape routes that are easy to use
Unburned fuel between you and the fire	<ul style="list-style-type: none">• Maintain a lookout• Establish an escape route
Rugged / difficult terrain	<ul style="list-style-type: none">• Avoid difficult areas if possible and use a different approach to the fire• Avoid uphill escape routes• Scout escape routes to avoid obstacles
Venomous snake & insect bites	<ul style="list-style-type: none">• Wear Personal Protective Equipment, be watchful and avoid• If bitten apply pressure bandage, immobilise and seek medical attention immediately

Falling branches and trees, especially dead trees or fire affected trees	<ul style="list-style-type: none"> • Have a lookout • Avoid • If unstable keep 2 tree lengths away
Being lost or disoriented: <ul style="list-style-type: none"> • Unfamiliar area • Heavy smoke • Darkness 	<ul style="list-style-type: none"> • Before leaving get a map and briefing on your area from local people • If lost, remain where you are, if it is safe to do so. • Seek contact with local people or other firefighters to establish your location • Use map and compass to orientate the map and relate land marks to the map • Seek urgent assistance if threatened by the fire.
Water borne pathogen (e.g. bacteria)	<ul style="list-style-type: none"> • Drink safe / clean drinking water • Treat water
Poor hygiene	<ul style="list-style-type: none"> • Maintain good personal hygiene, especially before eating or drinking • Establish appropriate welfare facilities at feeding stations and campsites

Fire environment & fire behaviour

As described in training module **EF2 Apply Techniques and Tactics to Control Vegetation Fire** the fire environment is a combination of the fire triangle (heat, oxygen and fuel) with weather, topography and fuel. The most important influences on fire behaviour as it crosses a landscape are: wind, slope, fuels and aspect. A vegetation fire is constantly reacting and changing, because of these underlying influences, especially if two or more of these factors are working together. If two or more factors are re-inforcing each other they are said to be ***in alignment***.

When approaching a fire first assess fire behaviour.

- Look at what fuels are burning and the flame lengths on the different parts of the fire (head, flanks & heel).
- Work out what is driving the fire at those points. Are the factors that support fire behaviour (wind, slope, fuels & aspect) in alignment or not?
- Will the fire move to places where those factors will be more/less in alignment?

This information should allow an individual to predict local fire behaviour.

Also assess the fire for safety purposes. Work out which parts of the fire are hazardous and should be avoided.

Illustration 1 below shows the key area to avoid, being at the head of the fire. Unless the flames are small don't put yourself in front of a fire. Even if they are small think twice as this is where the fire behaviour can change very quickly. The safest areas to work are usually on the flanks and heel of a fire where the flames are lower.

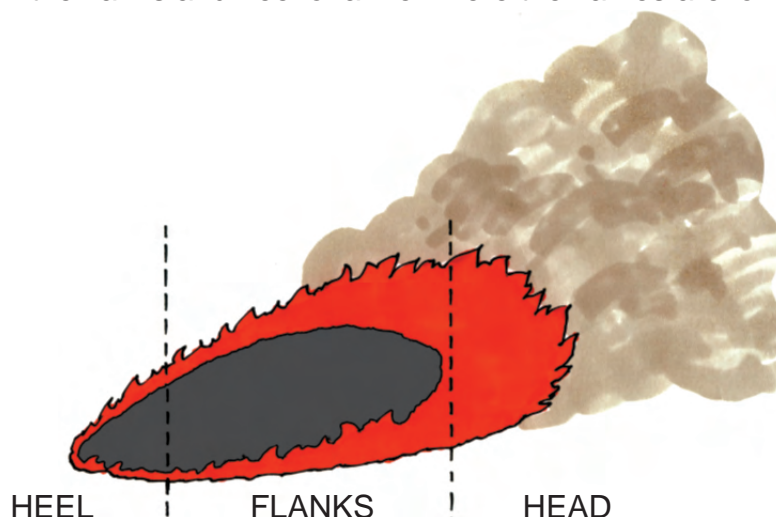


Illustration 1.1. Typical fire shape with associated hazards.

Heel	Flanks	Head
Low flames	Moderate flames	Large flames
Slow rate of spread	Moderate rate of spread	Fast rate of spread
Little smoke	Little smoke	Lots of smoke
		Very hot air

The key question is whether the behaviour of the fire is going to get more intense with bigger flames or less intense with smaller flames. This implies first, a need to constantly be aware of what the fire is doing, either directly or by communication with a lookout and second to have an understanding of what the fire is likely to do now, or in the next 5 or 10 minutes, hours and days. Anticipation of changes in fire behaviour due to changes in the alignment of wind, slope, fuel and aspect is extremely important. Fire behaviour can change very quickly and your thinking should always be ahead of the situation.

Some key questions:

- Where and when will fire behaviour change?
- Will the situation become worse or better?
- How long will your location be safe?
- When should you move?

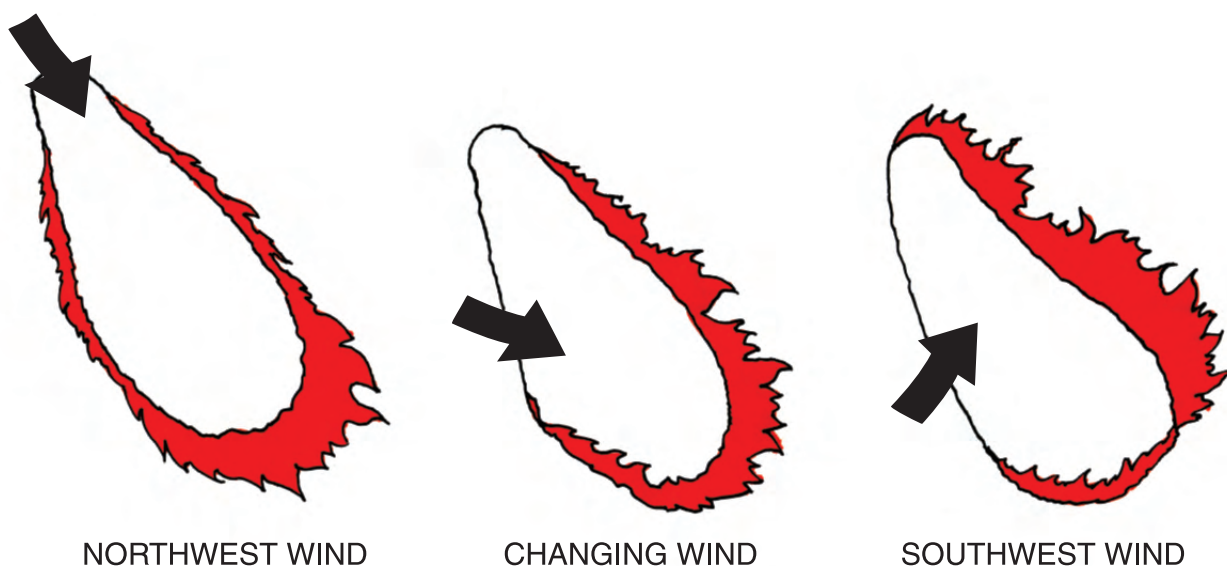


Illustration EF2.1.9 Effect of wind change on a fire

This change, where a relatively quiet flank of a fire rapidly becomes the head of the fire can occur for a variety of reasons, or a combination of reasons:

- A shift in the wind direction, the most common reason for a change in fire behaviour, for example as it curls round a hill,
- Where a fire reaches the bottom of a steep slope,
- The fire moves into an area with a lot of fine fuels,
- The fire moves out of the shadows on a cold, north facing slope onto a hot, south facing aspect

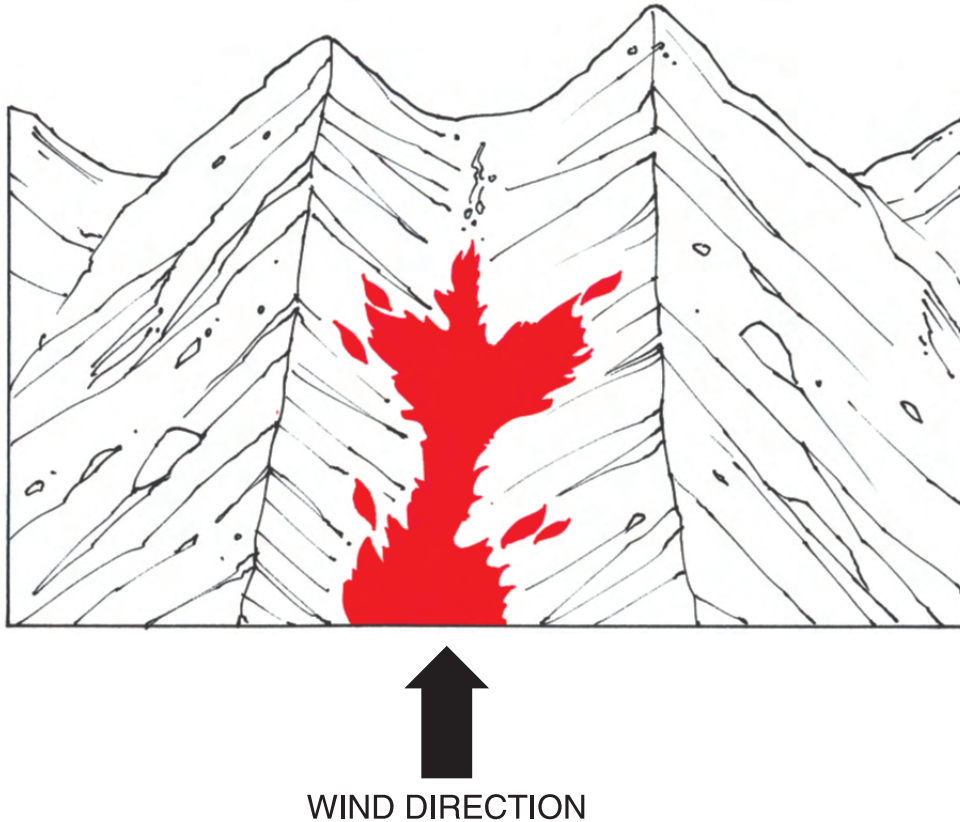


Illustration EF2.3. The chimney effect

In narrow steep valleys heat convection, slope and wind can combine to produce extreme fire behaviour, often known as the chimney effect, with very fast rates of spread and significant spot fire activity. Firefighters can become trapped between the fast developing fire and the slopes, unable to access safe areas fast enough.

When carrying out the assessment of the fire environment there are a number of natural indicators of dangerous conditions. These should be assessed continuously as part of a “**look up, look down and look around**” process.

Table 1. Look up, look down and look around fire behaviour indicators.

Fire Environment Factors	Indicators
Fuel Characteristics (Assess)	Continuous fine fuels Heavy loading of dead and down Ladder fuels Tight crown spacing (<6m) (<20 ft.) High dead to live ratio
Fuel Moisture (Feel and Measure)	Low Relative Humidity (<25%) Low 10 hr Fuel Moisture Content (<6%) Drought conditions Seasonal drying
Fuel Temperature (Feel and Measure)	High temps (>30°C) (>85°F) High % of fuels with direct sun Aspect changing & fuel temp. increasing

Terrain (Scout)	Steep slopes (>50%) Narrow valleys Saddles
Wind (Observe)	Surface winds above 15 kph (10mph) High, fast-moving clouds Sudden calm Battling or shifting winds
Stability (Observe)	Good visibility Gusty winds and dust whirls Cumulus clouds Smoke rises straight up
Fire Behaviour (Watch)	Leaning smoke column Sheared smoke column Well-developed smoke column Changing smoke column Trees torching Smouldering fires picking up Small fire-whirls beginning Frequent spot fires

The type of hazards and control measures for fire behaviour can be seen in Table 2 below.

Table 2. Fire behaviour hazards and control measures.

Fire behaviour hazards	Control measures
Radiant heat	<ul style="list-style-type: none"> • Move away, radiant heat effect drops rapidly with distance • Use physical barriers if necessary (logs, walls, ditches) these block radiant heat • Use appropriate Personal protective equipment (see also metabolic heat load)
Entrapment / burn-over	<ul style="list-style-type: none"> • Maintain awareness of fire behaviour and spread at all times • Avoid dangerous situations by complying with LACES, Watchout, and Fireorders guidelines and the 18 Watchout situations
Exposure to excessive radiant heat	<ul style="list-style-type: none"> • Avoid high fire intensities, most likely at the head of the fire • Shield yourself from the heat source • On foot: <ul style="list-style-type: none"> ○ Evacuate to a safe area using scouted escape routes ○ Look after your buddy ○ Use the “black” if flames are low e.g. areas of less fuel ○ Use Personal Protective Equipment, clear a survival area, find a ditch, wall, log, that you can use for protection ○ Lie down as low as possible

	<ul style="list-style-type: none"> • In a vehicle: <ul style="list-style-type: none"> ○ Park in open away from fuels and approaching fire ○ Remove any fuel containers ○ Clear area of elevated fuels ○ Leave engine and lights on, prepare protection hose lines ○ Close windows, doors and vents ○ Advise supervisor / Head Quarters of actions and location ○ Wait outside vehicle for as long as possible ○ When too hot enter vehicle from side away from fire ○ Remain in vehicle for as long as possible
Smoke and carbon monoxide	<ul style="list-style-type: none"> • Avoid working in smoke unnecessarily, especially for long periods • Where there is heavy smoke – relocate • Use approved Personal protective equipment e.g. goggles and filters when supplied • Make sure you rest in smoke free areas to clear carbon monoxide from your body.
	<ul style="list-style-type: none"> • Being physically fit • Put on lights on machinery and use hand held lights to carry out tasks safely
<p>Extreme fire behaviour:</p> <ul style="list-style-type: none"> • Flare ups • Increasing numbers of spot fires • Rapid fire runs 	<ul style="list-style-type: none"> • Briefings on weather, topography and fuels • Avoiding 18 “Watchout Situations” • Early detection by a lookout • Maintaining awareness of the situation • Maintaining communications with buddy, team and supervisor(s) • Evacuate using scouted escape routes • Use appropriate safety zones
Burns to hands, feet and ankles, particularly in mop-up	<ul style="list-style-type: none"> • Leather gloves • Feel for heat with the back of the hand • Appropriate footwear as issued • Avoid contact with burned out stumps, hot coals, embers
<p>Being outflanked by the fire</p> <ul style="list-style-type: none"> • Round the end of the fireline • Re-ignition • Spotting 	<ul style="list-style-type: none"> • Make sure you start from a secure anchor point • Make sure that your fireline is dug down to mineral soil so that smouldering or creeping fire cannot cross it. • Maintain a lookout to watch for re-ignition upwind of your position • Maintain a lookout to watch for fires crossing the fireline. Lookouts should look outside the perimeter for spot fires.

Equipment and vehicle hazards.

The fire is not the only threat. Situational awareness needs to cover other hazards as well. This includes hazards stemming from equipment and vehicles used as part of the overall management of the fire.

Use of powered equipment and vehicles usually requires specialist skills. Each organisation and country will have its own methods of ensuring the relevant people have these skills with a combination of training and certification. Each piece of equipment will also need to be assessed for appropriate Personal protective equipment. For example a tractor or bulldozer operator may require hearing protection, in addition to other items.

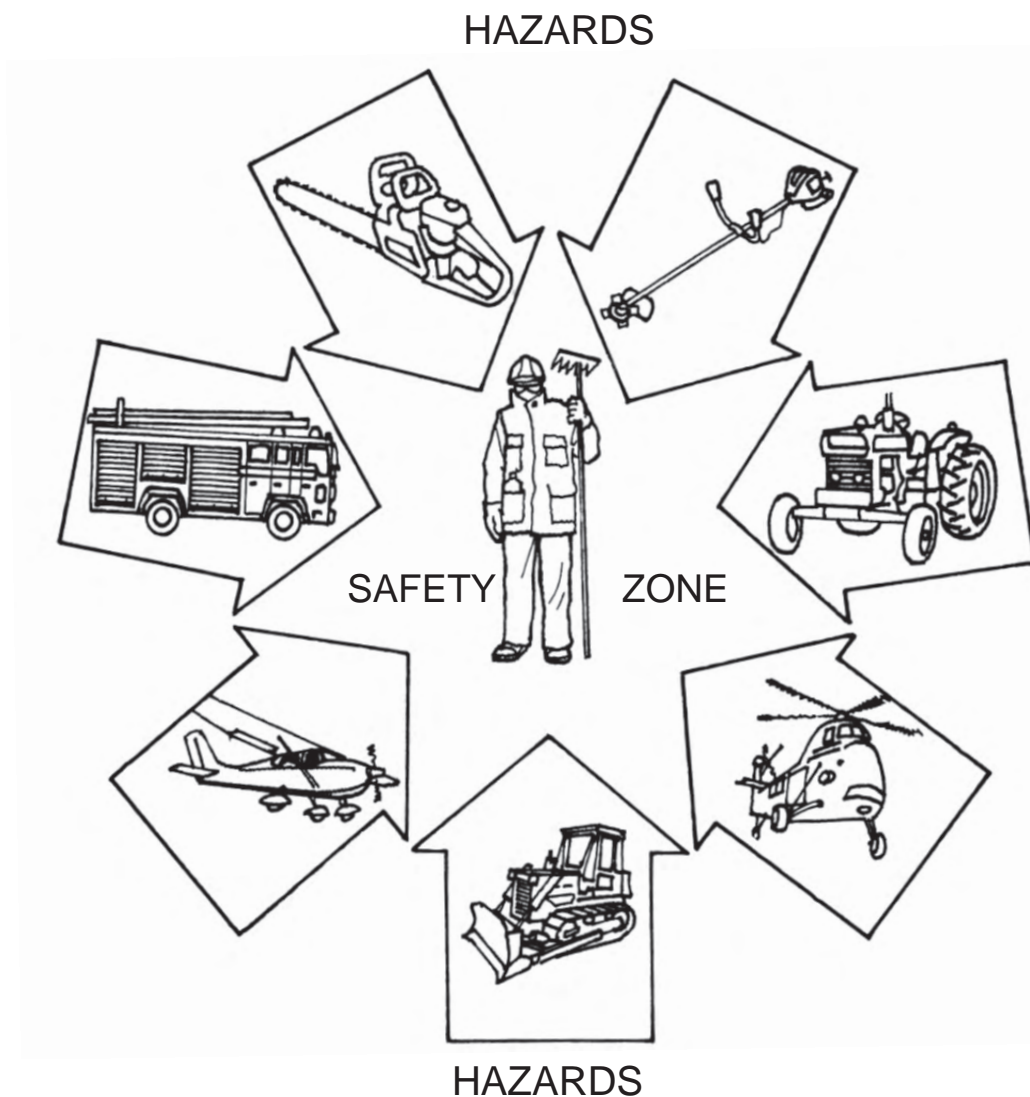
For individuals who are not given specific training avoiding a hazard is a key control measure to minimise risk. The typical danger zones for different types of equipment can be seen in Table 3 below.

Table 3. Equipment and vehicle hazards and control measures.

Equipment / vehicle hazards	Control measures
Hand tools	<ul style="list-style-type: none"> • Keep tools cutting edges sharp & handles smooth • Keep 3 metres apart • When walking hold tools parallel to the ground at waist height with the sharp edge facing forwards
Brushcutter	<ul style="list-style-type: none"> • Keep 3 metres away • Specific Personal Protective Equipment and training required for operators
Chainsaw	<ul style="list-style-type: none"> • Stay at least 2 tree lengths away from a chainsaw in operation • Specific Personal Protective Equipment and training required for operators
Foam concentrate & fire retardents	<ul style="list-style-type: none"> • Avoid splashing in eyes or contact with skin • Wear Personal Protective Equipment (goggles & gloves) • Wash out immediately if contact is made
Hose lines	<ul style="list-style-type: none"> • Avoid flames until water is on • Avoid excessive pressure build up (jet reaction) that can push an operator off balance
Vehicles	<ul style="list-style-type: none"> • Drive defensively not aggressively • Use headlights • Park away from the fire with the vehicle positioned and ready to leave the area
Tractor with implements	<ul style="list-style-type: none"> • Avoid working parts, which may extend beyond the tractor • Avoid area behind cutters where debris goes
Bulldozer	<ul style="list-style-type: none"> • Keep a safe distance away (minimum 2 tree lengths)

	<ul style="list-style-type: none"> • Maintain a lookout when heavy machinery is working in the area • Only approach with the drivers approval • Don't work downhill of machinery
Helicopter, especially rotor blades and aircraft	<ul style="list-style-type: none"> • Follow pilots instructions at all times • Specific safety training required • Keep away from landing and take-off areas
Water drops	<ul style="list-style-type: none"> • Step a short distance away from target area • If caught in target area lie face down towards helicopter/aircraft and hold hand tools on ground away from the body
Dust	<ul style="list-style-type: none"> • Avoid excessive dust
	<ul style="list-style-type: none"> • Use goggles, masks or cloths to protect eyes and airways
Noise	<ul style="list-style-type: none"> • Avoid areas with excessive noise • Use hearing protection provided

The range of equipment and vehicles that may present a hazard to you can be seen in Illustration 1.2 below:



Operational hazards

Situational awareness needs to be maintained during operations. Situations that may be safe one moment can become unsafe the next moment due to a change in fire behaviour or a change in the location of the teams on the ground.

Specific additional control measures may need to be built in to working practices to avoid the human factor in creating accidents.

Table 4: Operational hazards and control measures

Operational Hazards	Control Measures
Metabolic heat load (body heat from hard work)	<ul style="list-style-type: none"> • Use appropriate Personal Protective Equipment e.g. cotton with fire retardant and not heavy turn-out kit • Supervised rests • Rotate tasks and share heavy loads • Drink plenty of water • Good level of physical fitness
Dehydration	<ul style="list-style-type: none"> • Drink lots of safe / clean drinking water (at least 1 litre per hour)
Heat illness caused by combination of: <ul style="list-style-type: none"> • High body temperature from hard work • High air temperature • Radiant heat 	<ul style="list-style-type: none"> • Pre-hydrate before starting work • Pace and share work, take rests • Use appropriate Personal Protective Equipment • Reduce exposure to radiant heat • Loose clothing • Drink water at frequent intervals
Located above a fire on a hill <ul style="list-style-type: none"> • Smoke, heat, rapid rate of fire spread, spot fires 	<ul style="list-style-type: none"> • Avoid locations uphill of a fire • Apply LACES
Located below a fire on a hill <ul style="list-style-type: none"> • Rocks, burning logs rolling downhill creating spot fires below you 	<ul style="list-style-type: none"> • Keep a lookout for fires below and materials rolling downhill • Build properly trenched fireline to catch rolling material
Poor communications: <ul style="list-style-type: none"> • Tasks / instructions not understood • Lines of communication busy / lost • Information not passed on to all people 	<ul style="list-style-type: none"> • Communicate with buddy, team & supervisors. • Make sure you understand tasks, query and clarify • Make sure you understand the communications plan: channels/frequencies • Maintain radios and make sure sufficient batteries • Don't work in isolation
Human factors: <ul style="list-style-type: none"> • Medical conditions • Capabilities • Stress 	<ul style="list-style-type: none"> • Inform supervisors of any medical or physical condition that will affect your performance • Physical fitness • Training and preparation

	<ul style="list-style-type: none"> • Inform supervisor / obtain assistance from buddy/team for any task beyond your capabilities
Fatigue from strenuous work for extended periods in smoky, stressful environment: <ul style="list-style-type: none"> • Short term • Long term 	<ul style="list-style-type: none"> • Pace yourself (conserve energy) • Rotate and share tasks within team • Supervised rest, maintain awareness and lookouts • Regular breaks, water and food • Sufficient sleep • Avoid driving
Injuries from lifting heavy loads	<ul style="list-style-type: none"> • Manual handling training • Physical fitness • Share tasks with team

2. Risk management: risk evaluation and implementation of control measures

Earlier the 5 steps to risk assessment were described.

- Step 1 Identify the hazards
- Step 2 Decide who might be harmed and how
- Step 3 Evaluate the risks and decide on precautions
- Step 4 Record your findings and implement them
- Step 5 Review your assessment and update if necessary.

Once the first 2 steps have been done there are various processes for establishing the level of risk. It is important that organisational procedures are followed as some organisations have sophisticated risk evaluation procedures. However an example of a simple risk evaluation process is given below:

For each hazard:

1. Identify how likely it is to occur: Low, Medium or High
2. Establish how serious its effects could be: Low, Medium or High

Then combine the likelihood and the seriousness as either a Low, Medium or High risk. Some examples are given below.

- A high likelihood and a high seriousness will create a high risk that should receive immediate attention.
- A low likelihood with a medium seriousness could be a medium risk.
- A low likelihood with a low seriousness could be a low risk.

This process gives an immediate prioritisation of the risks that need to be addressed.

The precautions or control measures can then be applied and the risk re-evaluated. If the risk is now acceptable the task can go ahead. If not then the task should not be carried out until a safer way of approaching the task can be identified.

Another way of describing this process, which in a dynamic risk assessment process may also be appropriate is:

- Step 1 Gather information
- Step 2 Risk assessment
- Step 3 Risk control
- Step 4 Decision point
- Step 5 Evaluate

The actual process used should be decided by the organisation that at the time has jurisdiction. It should also relate to the laws that are applicable in the work location.

Tools, tactics and fire behaviour

Flame length can be used as a useful proxy for fire intensity. This means that one of the ways of reducing risks is to have an understanding of the appropriate tools and tactics to use with different flame lengths. See Table 5 below:

Table 5. Tools, tactics and fire behaviour

Flame Lengths (m)	Significance
0 – 0.5	Fires generally self extinguish
0.5 - 1.5	Fire intensity low Hand tools can be used in direct attack to control the fire
1.5 - 2.5	Fire too intense for direct attack with hand tools Pumped water or bulldozers may be needed Flanking / parallel attack recommended
2.5 - 3.5	Fire too intense for direct attack from control line Helicopters & fixed wing aircraft drops may be needed Flanking / parallel attack depending on local flame length
3.5 - 8	Very intense fire Backburning and backfiring may knockdown the head fire Flanking / parallel and indirect attack recommended depending on local flame length.
8m+	Extreme fire behaviour Defensive strategies recommended

The safety issue is to recognise the significance of different flame lengths and apply the appropriate tools and tactics. The hazards that are being reduced through this approach include entrapment and exposure to radiant heat. Radiant travels in straight lines and drops significantly with distance so it is often safer to work further away from the fire and the bigger the flames the further away people need to be.

Personal Protective Equipment (PPE)

Across the European Union it is a legal requirement on employers to provide suitable personal protective equipment for the risks that present hazards to workers. All team members need to be adequately equipped with personal protective equipment. No one should attend a fire unless they are suitably and safely clad.

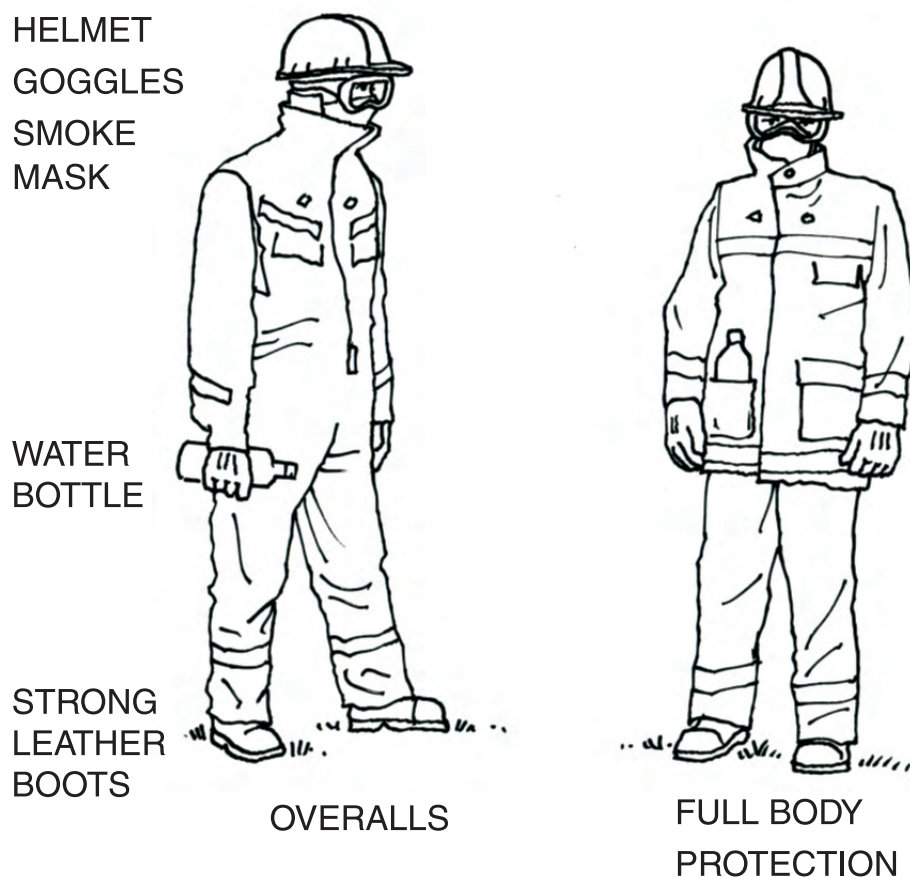


Illustration 2.1. Personal protective equipment

Personal protective equipment must protect from:

- Physical injury - scratches, abrasions and direct burns
- Exposure to radiant heat
- Build up of metabolic heat

This requires a balance of the type of protection, for example, a full fire resistant suit gives very good protection from direct heat and burns, but could very quickly cause heat stress by not allowing body heat to escape. Additional Personal Protective Equipment for ear/eye protection should be provided as needed.

At the other extreme, shorts and a singlet minimise the build up of body heat but the wearer risks burns and abrasions.

Recommended Clothing

Clothing for firefighting should include:

- Safety helmet and neck-protecting cloth (also protects from radiant heat)
- Long sleeve thick shirt and long trousers of thick fabric, or fire resistant overalls
- Leather or other suitable boots with woollen socks
- Woollen or plain cotton underclothes
- Trousers legs, and shirt or overall cuffs and necks should be left open. This allows air to circulate and sweat to evaporate reducing the risk of a dangerous build up of body heat

Fabrics

Wool, fire-resistant cotton or specific fire-resistant material, are the best for firefighter clothing.

Most synthetic fabrics do not allow body heat to escape and may ignite or melt when exposed to heat.

The thickness of material is the main factor in reducing the amount of radiated heat transmitted to the body. Layers of clothing and the air pockets between the layers can create a similar barrier.

Loosely woven fabrics (e.g. wool) provide good insulation from radiant heat and allow body heat ventilation.

Tightly woven fabric (e.g. denim) is a poor insulator from radiant heat and a poor ventilator of body heat, though it has good resistance to wear and tear.

Additional items should be considered:

- Hearing protection is needed when working in a noisy environment (e.g. in the vicinity of pumps, power equipment, heavy machinery and aircraft)
- Dust goggles and dust masks reduce discomfort when firefighters are in smoky, ash and dusty conditions particularly during mop up operations
- Gloves may be needed when working with handtools and/or when mopping up

Note: The face and backs of the hands are important heat sensors.

- Firefighters should retreat immediately when the temperature is too hot for the face or the backs of the hands
- Covering these parts can take that important sensor away from the firefighter
- Additional warm clothing (e.g. woollen bunker coat, balaclavas and gloves) may be necessary when working in cooler environments (e.g. high country or overnight)
- Bottles of treated water should be considered especially where firefighters are working in remote areas to avoid biological pathogens

- A small back pack with extra clothing and high energy food should be considered for crews in remote areas who may be there for some considerable time
- A kit bag may be required for your personal protective equipment

Clothing that is not recommended includes:

- Nylon or non fire resistant synthetic clothing
- Shorts and short sleeve shirts
- Plain cotton overalls without an underlayer of clothing
- Tight fitting garments that soak up sweat and prevent it from evaporating from the skin
- Clothing that restricts normal movement
- Clothing that increases metabolic heat

Balancing the protection

A balance between the level of protective items worn and the level of exposure enables the firefighter to operate safely and effectively.

In situations where there are excessive levels of radiant heat, withdraw to a safer distance.

Increasing the level of protective clothing is likely to lead to metabolic overheating and place the person at greater risk.

- Increasing the distance away from the flame reduces the effects of radiant heat
- Job rotation and regular cooling breaks reduce the build up of metabolic heat
- Potential hazards at a wildfire are different from those of structural firefighting, only use appropriate Personal Protective Equipment

Fitness

The risks from various hazards are reduced by personnel having an appropriate level of physical fitness. The level of fitness that will be required will be determined by the employing organisation. However as constructing fireline with hand tools is hard physical work, and as operations are often conducted in rough hilly terrain generally a high level of fitness is required.

The level of physical fitness also affects individual's ability to cope with other fire related hazards, including smoke, carbon monoxide, stress, and heat illnesses. A person that is in good physical condition is also less likely to suffer fatigue and injuries from lifting loads.

The ability to escape from a rapidly approaching fire to a safety zone is also related to fitness.

Entrapment / burn-over survival actions

When all attempts to avoid entrapment or burn-over situations have failed and when an escape to a safety zone is not possible there are some emergency survival techniques. **These techniques should only be used as a last resort.**

Radiant heat in entrapment and burn-over situations is the greatest threat. Radiant heat travels in straight lines. The fire intensity that you are exposed to is less close to the ground. Pockets of fresh air can also be found close to the ground.

The action to take is therefore to seek shelter as low as possible, behind a solid barrier, where there is no fuel. Airways and exposed skin should also be protected as much as possible. Locations such as a ditch or behind the trunk of a large fallen tree, or in water of reasonable depth, may be suitable. Once in a survival location it is necessary to stay there until the fire has moved away completely, to minimise exposure to heat.

Emergency survival actions where individuals are directly threatened by a fire when on foot or in a vehicle are shown below:

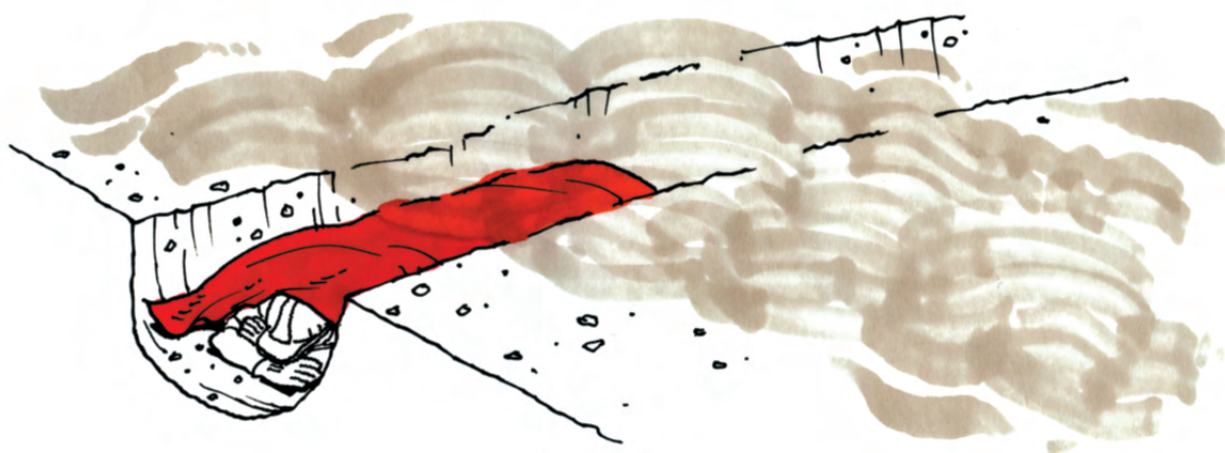


Illustration 2.2. Personal safety on foot - emergency situation



Illustration 2.3. Personal safety in a vehicle - emergency situation

3. First Aid Awareness

European Union legislation puts a duty on employers to make an assessment of the first aid needs of their employees and to make efficient provision of first aid.

First aid is the application of accepted principles of treatment to an injury or sudden illness using the facilities and materials available. It is the approved method of treating an injured or sick person until qualified medical aid is able to render further assessment and treatment.

First aid treatment is given to a casualty to:

- Preserve life
- Prevent the condition worsening
- Promote recovery

Accidents and illness requiring first aid can occur during rural fire fighting. First aid skills and training, to the level of a current certificate from a recognised first aid authority are essential.

In managing a casualty, the responsibilities are to:

- Assess the situation
- Identify the cause of the suffering
- Give immediate first aid treatment
- Arrange for further medical attention if necessary

The particular aspects of first aid that are likely to be needed during rural fire fighting are:

- Scene assessment
- Patient assessment
- Resuscitation

And treatment for...

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

Medical attention should be sought for all injuries at fires

- Unwell firefighters must be removed from the fireground
- Fire management must be informed of all injuries or situations where firefighters become ill at fires
- Names of the injured must not be given over the radio

Many of the medical conditions above are covered in normal first aid training. Some examples of the more specialist needs of people involved in fire management are given below. These conditions are often due to the combination of hot air

temperatures, exposure to radiant heat and especially the internal body heat generated from working hard.

Heat Illness

Heat illness has three stages - heat stress, heat exhaustion and heat stroke. These are the most common conditions to affect firefighters. They affect not only their physical welfare, but also their judgment and competence on the job

- Watch for signs of heat stress and treat early on the fireground.
- Cooling a person affected by heat is a priority

Heat Stress (1st stage)

Heat stress undetected or untreated will quickly lower the performance of a firefighter.

The body controls its temperature by blood circulation and sweating. The heart rate increases and pumps the blood near to the skin (the face may become flushed) and the body sweats. The sweat evaporates drawing heat from the body - evaporation requires heat - so the body is cooled.

People differ in their response to the same heat stress because each person has a different ability to regulate heat.

Firefighters who are physically fit generally have a greater tolerance to heat stress.

Firefighters need to watch for the warning signs of heat stress.

Heat stress is recognised by:

- Flushed face
- Tiredness
- Sweating
- Dizziness
- Weakness
- Nausea

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

- If heat stress is not recognised, the firefighter will move into a state of heat exhaustion
- Loosen clothing, cool with water, fan person to increase evaporation cooling

Heat Exhaustion (2nd stage)

If heat stress is not remedied and hard work continues, the condition can deteriorate into heat exhaustion.

When the brain recognises that the body is overheating it slows down body functions and the symptoms change.

The patient will now have:

- Weak pulse (blood pressure is lowered)
- Clammy skin (sweating)
- Shallow breathing (breathing rate increases)
- Pale face (result of lowered blood pressure)
- Slow reactions

This person is unwell and must be removed from the fireground to rest and recover, and get medical attention. Loosen clothing, cool with water, fan person to increase evaporation cooling

Heat Stroke (3rd stage)

If heat exhaustion is not recognised and treated the person will go into a state of heat stroke.

The regulatory system can no longer cope with the over-heating body, the brain has become affected and ceases to instruct the body to cool down.

The body's regulatory system has failed and the following symptoms result:

- Rapid and strong pulse (increased heart rate)
- Hot, dry skin (dehydration - no sweating)
- High temperature (body heat not controlled)
- Flushed face (increased circulation and temperature)
- Headaches and dizziness
- The person is likely to be irritable, confused, disinterested and may lose consciousness

URGENT MEDICAL ATTENTION IS ESSENTIAL

- This person is hot, dry and in a serious state
- Initial treatment is to loosen clothing, cool with water, fan person to increase evaporation cooling
- URGENT medical assistance is required
- Evacuation should not be attempted before medical treatment has been started because the body must be cooled immediately

Burns

Burns vary in depth, size and severity and may damage the underlying tissues as well as the skin.

Burns can result from direct contact with a heat source or from exposure to radiant heat. The immediate dangers after a burn injury are continuation of burning within the skin and tissues, and shock.

The burnt area must be cooled immediately and the patient monitored for the effects of shock.

- Firefighters must wear approved Personal protective equipment (PPE)
- All burns require immediate cooling with water for a minimum of 10 minutes and seek medical attention

Dehydration

The body's cooling system involves perspiring.

People differ in their response to the same hydration because each person has a different ability to regulate heat.

Firefighters who are physically fit generally have a greater tolerance to heat stress.

Dehydration will occur if fluids lost through perspiration are not replaced regularly. The importance of this when working on the fireground is clear.

- Consume water regularly - always drink more water than you need in order to prevent dehydration - failure to do this leads to the body overheating and the onset of heat illness
- On days of extreme fire danger, increase your hydration in case you get called out
- Drink to **prevent** thirst

Your thirst is not a true indication of how much water your body needs - there's a time lag between the onset of dehydration and feeling the need for water.

- You may 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**.

- You may require up to 150-200 ml every 15 minutes (individual metabolism varies)
- If using hand tools you may need to increase this to 300 ml every 15 minutes
- Re-hydrate with water

Appendix A. Safety procedures

Another key safety response to potentially dangerous situations is to embed the LACES process in working practices. LACES stands for:

Lookouts placed where they can see the fireline, the fire and the teams that are working. They should be experienced and able to keep the team constantly up-to-date on the progress of the fire and its potential to change, as well as recognise and anticipate dangerous fire situations.

Awareness of what is happening with the fire and other activities, must be maintained at all times. Be aware of changes in the weather, where the fire is in relation to different slopes, aspects and fuels. Be aware of the danger zones around machinery and equipment. Be aware of the condition of your buddy and team mates.

Communications by word of mouth, hand signals, radios, between team members, supervisors and incident commanders are all important. Have a back-up plan should radios fail or are out of range and check the radio frequencies to be used. It can be very noisy on the fireline. The distance between personnel may need to be reduced to maintain good communications among the team, especially in difficult situations.

Escape routes Have 2 routes planned and scouted out before commencing operations. Time how long the evacuation will take at a walking pace. Evaluate rate of spread and make sure there is enough time to walk to the safety zone. Work out the trigger point for leaving the fireline and going to the safety zone. Give alarm early not late. The escape routes should avoid going uphill. Everyone on the fireline must know the plan and what is expected of them. Everyone must know what the trigger to evacuate is. Mark routes for access during the day and night.

Safety zones identified, assessed and prepared as necessary. Area should be big enough that you can survive without a fire shelter. You can use previously burned ground and work keeping “one foot on the black”. Use natural features: lee slopes, rocky areas, places with low fuel loads, lakes and ponds, recently felled and cleared areas in forests, roads and helicopter landing sites. Clear these sites of vegetation as much as possible bearing in mind the location of the fire and the speed that the fire is moving towards the location.

Take account of fire behaviour when working out the acceptable size and location of the safety zone. On flat ground with no wind the minimum distance between each person and the fire is four times flame height. This distance should be maintained all around the safety zone. Larger safety zones are required if the location is upslope or upwind of the fire or if it is in an area with heavy fuel loads. Avoid locations in steep narrow valleys, or ones that need an uphill escape route.

In an emergency, while on the escape route, all non-essential equipment should be discarded. Essential equipment to keep includes your hand-tool, some water, radio and fire shelter if provided. Keep as low as possible and protect airways and exposed skin.

The appropriate size of safety zone varies with flame length of the fire to allow people sufficient distance for the radiant heat to dissipate. If the convection column of a fire is pointed at an area, because of wind or slope influences, then the separation distances are greater. See Table 5 below showing minimum distances in the absence of wind and slope influences.

Table 5: Flame length and safety zone sizes

Flame Length (metres)	Separation Distance (metres)
3	12
5	20
10	40
15	60
20	80
30	120
60	240

Some other examples of standard safety procedures are given below:

“Watchout - Australian”

W	Weather dominates fire behaviour so keep informed
A	All actions should be based on current and expected fire behaviour
T	Try out at least 2 safe escape routes
C	Communications maintained with your crew, boss and adjoining crews
H	Hazards to watch out for are heavy fine fuels and steep slopes
O	Observe changes in wind speed and direction, humidity, cloud
U	Understand your instructions and make sure you are understood
T	Think clearly, be alert and act decisively before your situation becomes critical

“10 Standard Fireorders - USA”

F	Fight fire aggressively but provide for safety first
I	Initiate all actions based on current and expected fire behaviour
R	Recognise current weather conditions and obtain forecasts
E	Ensure instructions are given and understood
O	Obtain current information on fire status
R	Remain in communication with crew members, your supervisor and adjoining forces
D	Determine safety zones and escape routes
E	Establish lookouts in potentially hazardous situations
R	Remain in control at all times
S	Stay calm, think clearly and act decisively

From analysis of situations some 18 common issues relating to the development of hazards have been identified:

18 Situations that you should “Watchout” for (USA)

1. You are on a fire that has not been scouted or sized up (assessed)
2. You are in country you have not seen in daylight
3. Safety zones and escape routes have not been identified
4. You are unfamiliar with the local weather and other factors that may influence fire behaviour
5. You are uninformed regarding strategy, tactics and hazards
6. You are not clear on your instructions and assignment
7. You have no communications with your crew members, your supervisor or adjoining forces
8. You are constructing fireline without a safe anchor point
9. You are building fireline downhill and there is fire below you
10. You are attempting frontal attack on the fire
11. There is unburned fuel between you and the fire
12. You cannot see the main fire and you are not in contact with anyone who can
13. You are on a hillside where rolling material can ignite fuel below you
14. You notice the weather is getting hotter and drier
15. You feel an increase in the wind or a change in direction
16. You are getting frequent spot fires across the fireline
17. You notice that the terrain and fuels will make escape to a safety zone difficult
18. You notice firefighters are sleeping on the fireline

Each of these watch-out situations needs you to implement appropriate control measures.

References:

Australasian Fire Authorities Council Limited. (2005). Respond to wildfire. East Melbourne Victoria: AFAC Limited.

Health and Safety Executive. (2006). Five steps to risk assessment. United Kingdom.

National Rural Fire Authority. (2005). Demonstrate knowledge of personal safety at vegetation fires. Wellington, New Zealand.

Teie, W.C. (2005). Firefighter's handbook on wildland firefighting (Strategy, Tactics, and Safety). Rescue, California, United States of America: Deer Valley Press.

Teie W.C. (1997), Fire officers handbook on wildland firefighting, Rescue, California, United States of America: Deer Valley Press

Disclaimer

Every effort has been made to ensure that the information above (“**Information**”) is accurate and is based on what The Global Fire Monitoring Center, The International Association of Fire and Rescue Services and Rural Development Initiatives Ltd (together the “**EuroFire Partners**”) believed to be current good practice as at the date it was prepared. It is not intended to be exhaustive in its content and is open to revision.

The Information is provided for general information purposes only and does not constitute Information which should be relied upon for a specific purpose. The Information is designed to be used in conjunction with any member groups’ own rules, regulations or recommendations and the advice of any relevant professional bodies. It is the responsibility of the individual or group reading this Information to ensure that any risks relevant to a particular activity are fully considered.

The EuroFire Partners and their respective employees or agents, exclude liability (to the maximum extent permissible by law) for any errors, omissions or misleading statements contained in the Information and for any loss, damage or inconvenience suffered by any person acting or refraining from acting as a result of relying on this Information.

[The Information is protected by copyright and intellectual property laws and unless expressly stated or otherwise agreed in writing, you may use and copy the Information only for personal, non-commercial use, subject to appropriate acknowledgement.]

The provision of the Information and your use of the same shall be governed by and construed in accordance with the laws of Scotland and all users of the Information irrevocably submit to the jurisdiction of the Scottish courts as regards any claims or other actions connected with the Information or the use thereof.

