

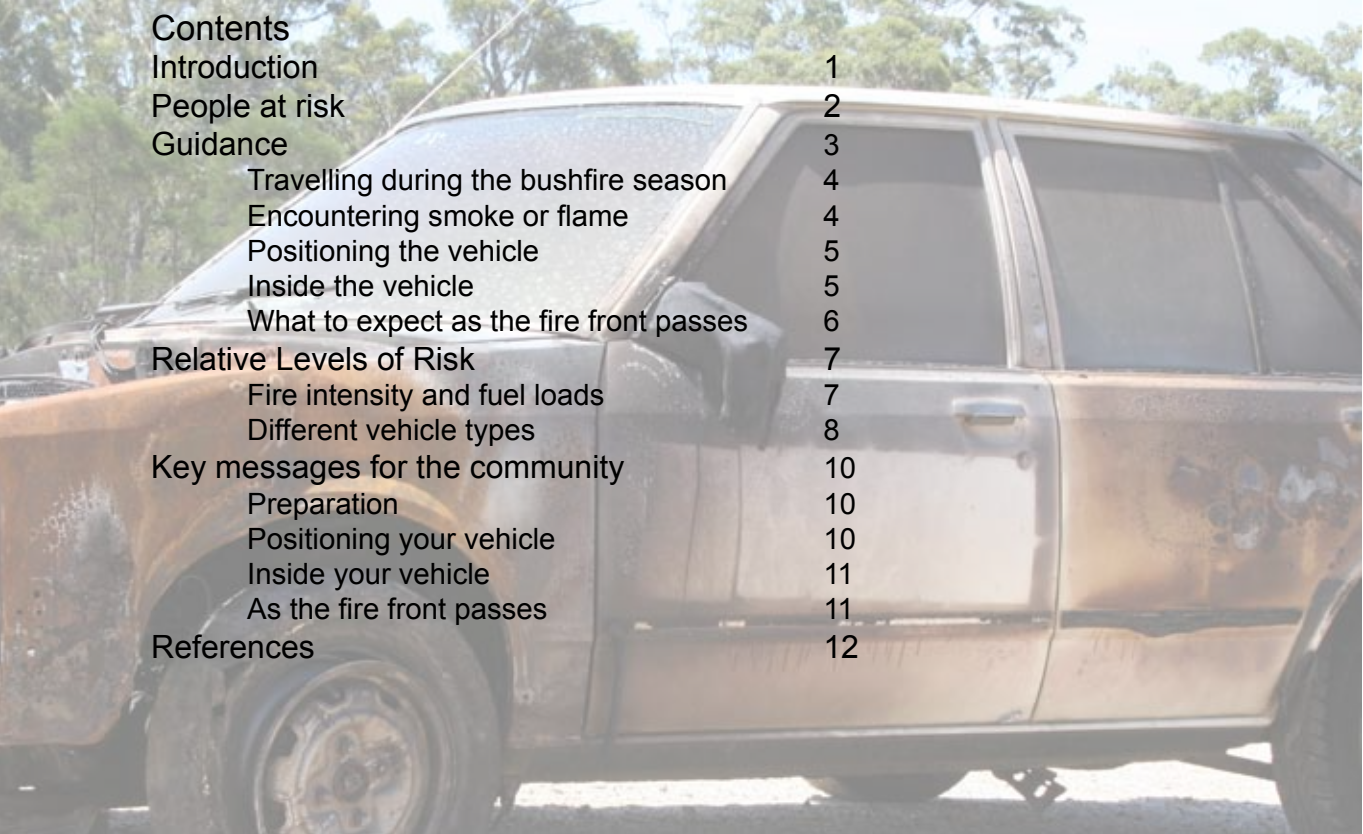
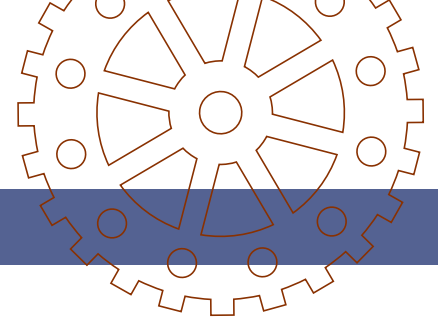


AFAC

# GUIDELINES FOR PEOPLE IN VEHICLES DURING BUSHFIRES

JANUARY 2008





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# Introduction

Current research and scientific testing into vehicle survivability in bushfires has shown that sheltering inside a vehicle is a high risk strategy and it is highly unlikely that a person will survive in such circumstances. It is with extreme caution that people should be advised to take refuge in their vehicle in a bushfire. Whilst sheltering inside a vehicle offers a slightly higher chance of survival than being caught in the open, existing stay or go strategies are much safer options to follow and it is essential that all people exposed to bushfire risk realise this.

It has been widely established that staying with in a well prepared home or evacuating or relocating well in advance of the fire threat are the best survival options during a bushfire. History has shown that many of the fatalities which have occurred have done so when people have been caught on the road, either on foot or in vehicles. The Tasmanian Bushfire (1967), Lara Bushfire (1969), Ash Wednesday (1983) and most recently the Eyre Peninsula Fire in January 2005 have all illustrated this. Eight of the nine fatalities on the Eyre Peninsula were found in or near their vehicles. Last minute evacuation can potentially be a deadly option and this message needs to be reinforced as part of ongoing community education. There are however some people who are more likely to be out and about during a bushfire who may be confronted with the dilemma of what they should do under those circumstances.

## People at risk

There will inevitably be residents who have not heeded the advice to have a bushfire plan in place and decide to evacuate at the last minute or who have made a plan but change their mind when confronted with the situation and decide to flee. In addition, there may be people unfamiliar with the area, such as tourists and visitors, who inadvertently expose themselves to danger. Further, there are those who may be more at risk of being caught on the road during a bushfire due to the nature of their work.

Research and investigations into fatalities in grass and wildfires have shown that many occur when people have been caught on the road in their vehicles (e.g. Krusel & Petris, 1992). People have either fled their vehicle on foot, or tried to drive through the thick smoke and flames which has resulted in accidents and vehicles getting stuck and the occupants entrapped. However it is also true that many of those who have survived being caught out on the road during a bushfire have sheltered inside their vehicle until the

fire front passed and it was safe to get out. The Lara bushfire illustrated this point well. When motorists on the Melbourne-Geelong Freeway were confronted with a fast moving grassfire seventeen people abandoned their vehicles and died while at least six people sheltered in their cars and survived.

Current research and scientific testing into vehicle survivability has shown that sheltering inside a vehicle is a high risk strategy. There are many factors that can make survival very difficult in certain situations. Not least of these is the increased use of plastic in vehicle manufacture, which appears to reduce the level of protection afforded by newer model vehicles. It is worth noting that much of the advice currently provided to the general public is based on the experiences and tests on older style passenger vehicles generally 10-20 years old (Sargeant et al., 2007) or fire fighter vehicle burnover tests.

# Guidance

Recognising that there are groups who may find themselves in a vehicle during a bushfire there are a number of key safety messages that need to be disseminated to the public. These messages were derived from a refinement of the best existing advice, research and ongoing CSIRO work into technical aspects of vehicle survivability. It is intended that the ongoing research will help to validate or amend these key messages as their results become available.

These key messages attempt to dispel any misconceptions that the public may have about the safety or otherwise of sheltering in a vehicle. For example, fears of fuel tanks exploding which prompt vehicle abandonment are not well founded in reality, despite what may be reported in the media. There are however, sizeable risks involved in sheltering in a vehicle during a bushfire that mean survival is by no means guaranteed, especially in moderate to high-intensity bushfires. As such the public need to understand the inherent dangers of being out on the road in a bushfire.

The requirements for utility companies and their contractors are different from that of the general public. Accompanied by the fire service and under their instruction they are often the second people on the scene of a bushfire to reconnect communications and carry out other essential work. As such there is a greater risk of them being caught by a fire while responding to an incident and therefore the employees need additional skills and training for such eventualities. This document focuses on information for the general public.

There are a multiplicity of factors and scenarios that impact on the chances of survival in a vehicle during a bushfire. These include the size of the fuel load, topography, type of fire (low intensity grass fire through to high intensity forest fire), the type of vehicle, its exterior and interior design and the amount of time there is to prepare. The following general advice may help to minimise the level of risk.

## Travelling during the bushfire season

People should avoid journeys in areas where bushfires are burning. People need to know who the local emergency services broadcaster is and keep up-to-date with the information being provided about a fire's progress and any related road closures.

People should reconsider journeys into areas where the fire danger is high to extreme. They should pay attention to fire danger warnings, postponing journeys or finding alternative safe routes if necessary.

During the bushfire season carrying a supply of water on journeys and keeping woollen blankets in the vehicle (at least one for each passenger) is recommended. These items ought to be readily accessible so that they can be utilised immediately if the need arises. Dressing in suitable non-synthetic clothing and shoes is also advisable.

## Encountering smoke or flame

If smoke is in the distance, or can be smelt in the air it is best to u-turn and drive away from the danger.

If confronted with smoke or flames while on the road a driver should stop as soon as it is safe to do so and immediately turn on the vehicle's headlights and hazard warning lights.

if drivers continue to drive through smoke or flames the likelihood of having an accident or running off the road is high. Taking a few moments to assess the situation and make a rational decision about the safest course of action can make all the difference.

There may be occasions however, where the fire front is getting too close and in this situation it is better to look for the safest place to park the vehicle.

## Positioning the vehicle

Scientific testing has demonstrated that a vehicle should not be parked over dry fine fuels, the low level flame contact from these fuels can quickly cause conditions inside the vehicle cabin to become untenable. It is essential to park away from high ground fuel loads, overhanging branches and dense vegetation. Ideally, a non-combustible surface such as gravel or a dirt track in a clearing offers the best location. Care should be taken not to leave the vehicle on the roadway as it increases the risk of collisions with other vehicles.

Use could also be made of local features such as natural or man-made barriers. For example, parking behind a solid brick object or a natural feature (e.g. a rocky outcrop) will shield the vehicle from the radiant heat. If there are other vehicles nearby it is best not to park too close to them in case one vehicle does become engulfed by flames. This additional flame contact and radiant heat exposure could hasten the demise of nearby vehicles.

In general a vehicle orientated towards the oncoming fire front will remain tenable at higher heat radiation levels. Positioning the vehicle towards the oncoming fire front offers a couple of possible advantages. Firstly, if the fuel tank vents then the vapours will be blown away from the vehicle. Secondly, it reduces the amount of window surface exposed to the oncoming fire, thus reducing heat soak into the car and the possibility of glass breaking as the windscreen is tougher than the side windows.

## Inside the vehicle

Once a satisfactory location has been found it is necessary to prepare for the approaching fire front.

Windows and doors should be tightly shut. Whilst entry of smoke into the vehicle is inevitable, the rate at which it occurs is reduced by ensuring all windows and doors are secured. Furthermore, it helps to prevent embers entering the vehicle and setting alight to the interior of the vehicle which could force people to leave the vehicle before it is safe to do so.

The car vents should be closed and the air-conditioning switched off. Vents are another avenue for smoke ingress into the vehicle and therefore need to be shut. Some existing advice recommends leaving air-conditioning in the recirculate mode to keep the interior of the car as cool as possible. However, as radiant heat passes through it will be recirculated inside the vehicle. This negates the beneficial effect of lower temperatures at ground level where occupants need to shelter and higher temperatures towards the roof. Therefore, it is best to switch air-conditioning off.

Drivers should turn their engine off. In all probability a vehicle will not be in a suitable state to drive away after the fire front has passed and there would be other dangers associated with doing so even if it was. For

example, trees blocking roads, other parked cars and emergency services vehicles responding to the incident. Therefore, arguments for leaving the engine running such as to prevent the engine from becoming “oxygen starved” are largely invalid in the context of the general public. Of course, the situation for fire trucks, where this observation has been made during testing, is different. In addition, leaving the engine running in order to be able to move the vehicle to avoid flaring vegetation could pose additional risks to the occupants. These include increased radiant heat exposure and a higher risk of an accident in the poor visibility.

Passengers need to get down as low as possible below the window level. It is essential to minimise exposure to intense levels of radiant heat. People need to remain below the window level and as low as possible while covering their bodies with a woollen blanket to put a shield between themselves and the radiant heat. Using a woollen blanket to shelter under also reduces exposure to toxic gases (Sargeant et al., 2007). Extra care needs to be taken if there are multiple occupants in the vehicle which may make it harder to shelter safely. There may be additional protection from the radiant heat by using any spare woollen blankets to cover the windows on the side facing the oncoming fire front. However, the benefit of this could be negated by the effect of re-radiation on the window making the window more likely to break. Likewise, further investigation of the re-radiation effect of silver heat shields and the toxicity of fumes given off by them is required before the true benefits or dangers can be determined.

Water should be drunk if possible to avoid dehydration. The high temperatures people would be exposed to in a vehicle during a bushfire make them susceptible to dehydration. Therefore keeping fluid intake up is very important.

## What to expect as the fire front passes

Conditions in the vehicle will be uncomfortable as the fire front nears. The heat level will rise and the strong winds may rock the vehicle violently. The time it takes for the fire front to pass varies depending on the intensity of the fire and the amount of fuel surrounding the vehicle. It might be considerably longer in the case of a high intensity forest fire.

During this time entry of smoke into the vehicle will occur, plus interior components may begin to give off fumes due to the intense heat. The windows may break either from the heat or from flying debris. It is also possible that the tyres and parts of the bodywork may catch alight.

The fuel tank is very unlikely to explode in the time needed to shelter in the vehicle although it may vent (particularly LPG tanks). As the vehicle fills with smoke and fumes people may need to breath through a moistened cloth to avoid excessive inhalation. However, it is essential to stay inside the vehicle until the temperature has subsided outside.

When the heat level has dropped it is time to leave the vehicle. Whilst remaining low in the vehicle, cautiously raise a hand to determine whether the heat level has dropped sufficiently. As an indicator, anything hotter than the heat sensed when skin is badly sunburned is too hot. When the heat is at a bearable level and people leave the vehicle, it is important to be aware that door handles and internal parts will be extremely hot. Once outside people need to stay covered up in the woollen blankets and make their way to a safe place to await assistance, an already burnt piece of land in a clearing is the best option.

# Relative levels of risk

In relative terms, a well prepared property offers a far higher degree of shelter from radiant heat and other dangers than being in a vehicle during a bushfire. However, anyone who does find themselves on the road during a bushfire stands a better chance of survival sheltering inside their vehicle than fleeing on foot.

Driving through thick smoke or flame is extremely risky due to the likelihood of having an accident. Therefore, stopping the vehicle in a clearing and following the guidance in this document is a safer course of action than fleeing on foot.

Remember, sheltering in a car has inherent risks and there are a wide range of permutations that may inhibit chances of survival.

## Fire intensity and fuel loads

Levels of radiant heat have been found to become unbearable and force people to leave their vehicles in medium and high intensity forest fires. There is a far higher chance of successfully sheltering in a vehicle during a grass fire or low intensity forest fire where flame heights are relatively small (Cheney & Budd, 1984: 4). Provided the vehicle is not surrounded by large fuel loads.

High fuel loads will result in more intense radiant heat levels that persist for a longer period of time and fuel the combustion of the vehicle (Cheney & Sullivan, 1997: 87). The net result can be that people cannot safely leave the vehicle for a considerable period of time after the fire front has passed. This prolongs their exposure to radiant heat, high levels of smoke inhalation and toxic gases from synthetic materials in the vehicle.

The fire is also more likely to take a hold of the vehicle, with tyres and door seals igniting first, and the persistence of the flame contact leading to destruction of the vehicle. Fire fighting vehicles do not provide survivable conditions in all high intensity bushfire burnover situations (Nichols et al., 2005). Therefore automobiles, that do not have any of the added safety features of

fire fighting vehicles, are even less likely to provide shelter in high intensity fires.

Topography can have a large influence on the survivability of a vehicle. Stopping on a steep slope or in a gully adds to the risks and may not be avoidable in some areas (Rogers, 1985: 19). As such, there are scenarios where the topography and volume of fuel may make survival virtually impossible (Cheney & Budd, 1984: 4), even if the guidance provided by this document is followed. The small likelihood of finding an adequate clearing to situate a vehicle in a densely forested area can also make survival very difficult. Based on risk assessment, people residing in such areas must understand that this is the reality of their situation and a suitable bushfire plan needs to be developed. Visitors, tourists and rural workers should avoid these areas during bushfires.

## Different vehicle types

Vehicle manufacturers increasingly substitute plastic for steel on the bodywork of cars. Plastic bumpers, grills, wing mirrors and other exterior components are likely to ignite more easily than the steel parts used on older model vehicles. The flammability of synthetic materials used inside the vehicle may also limit the time a person can shelter inside the vehicle (Sargeant et al., 2007). In addition, the use of synthetic materials such as polyurethanes in automotive manufacture brings an increased risk of exposure to toxic fumes inside the vehicle which may render it uninhabitable before it is safe to leave (Mangan, 1997: 21). There may also be longer-term health implications, for example the exposure to carcinogens.

Other materials that are replacing steel in the manufacture of vehicles include aluminium, fibreglass and composite materials. All three provide less protection from the intense radiant heat and flame contact than older steel chassis vehicles. These materials are often used in high performance cars and may well contribute to their destruction by fire. Two further categories of vehicles that do not provide adequate protection in a fire are soft top vehicles and motorcycles.

A further trend in some newer models of car is the increased size of windows. The danger this presents is that a larger surface area of

glass in the vehicle increases the radiant heat exposure to the passengers (Paix, 1999: 1). It also makes it harder to shelter safely when there are multiple occupants in the vehicle or the vehicle is heavily loaded with luggage as may be the case with tourists or people evacuating late. Trailers, horse floats and so on may also make it more difficult to locate the vehicle in the most suitable place.

To conclude, the relative level of risk depends on a whole range of factors which are often impossible to mitigate. Therefore, whilst a vehicle can provide adequate shelter in certain conditions, particularly low intensity bushfire, and is preferable to being caught outside, there can be no guarantee of survival given the range and complexity of the scenarios and circumstances that can eventuate.



# Key messages for the community

There are a whole range of factors that may impact on survival chances, the following guidelines may help to minimise the level of risk.

## Preparation

Being out on the road during a bushfire is extremely dangerous – last minute evacuations are a deadly option.

A well thought out bushfire plan is vital for all residents in bushfire prone areas. Plan to remain with your home and defend it, or relocate to a safe area well before the fire is expected to arrive. Your local fire agency has information on developing a bushfire plan.

Travel in the country during the bushfire season needs to be done with extreme caution and vigilance.

Always carry woollen blankets and a supply of water in the vehicle. Dress in suitable non-synthetic clothing and shoes.

Know the local bushfire information system and tune in accordingly when travelling. Your local fire agency has information about emergency service broadcasters

If you see a bushfire in the distance, carefully pull over to the side of the road to assess the situation. If it is safe to do so turn around and drive to safety.

If you have been trapped by the fire find a suitable place to situate the car and shelter from the intense radiant heat

## Positioning your vehicle

Find a clearing away from dense bush and high ground fuel loads.

Where possible, minimise exposure to radiant heat by parking behind a natural barrier such as a rocky outcrop.

Position the vehicle facing towards the oncoming fire front.

Park the vehicle off the roadway to avoid collisions in poor visibility.

Don't park too close to other vehicles.

## **Inside your vehicle**

Stay inside your vehicle – it offers the best level of protection from the radiant heat as the fire front passes.

Turn headlights and hazard warning lights on to make the vehicle as visible as possible.

Tightly close all windows and doors.

Shut all the air vents and turn the air conditioning off.

Turn the engine off.

Get down below the window level and shelter under woollen blankets.

Drink water to minimise the risks of dehydration.

## **As the fire front passes**

Stay in the vehicle until the fire front has passed and the temperature has dropped outside.

Fuel tanks are very unlikely to explode.

As the fire front approaches, the intensity of the heat will increase along with the amount of smoke and embers.

Smoke gradually gets inside the vehicle and fumes will be released from the interior of the car. Stay as close to the floor as possible to minimise inhalation and cover mouth with a moist cloth.

Tyres and external plastic body parts may catch alight. In more extreme cases the vehicle interior may catch on fire.

Once the fire front has passed and the temperature has dropped cautiously exit the vehicle. (Be careful - internal parts will be extremely hot.)

Move to a safe area such as a strip of land that has already burnt.

Stay covered in woollen blankets, continue to drink water and await assistance.

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