Health Standard for firefighters

March 2016

Fire & Rescue New South Wales

Foreword

The development of this Fire & Rescue NSW (FRNSW) *Health Standard for firefighters* (Health Standard) represents a significant step forward in ensuring the health, safety and wellbeing of all firefighters.

In line with requirements under Clause 4 of the *Crown Employees (NSW Fire Brigades Firefighting Staff Death and Disability Award) 2015*, the Fire Brigade Employees' Union and FRNSW must implement an agreed and compulsory health and fitness program. In meeting the requirements under the award, part of the process has been the need to develop a health standard for firefighters that forms the basis to which health assessments can be measured against.

The Health Standard adopts a risk management approach and reflects contemporary evidence based medical knowledge. It has been developed as a result of extensive research and input from a wide range of industry and medical stakeholders.

The Health Standard keeps pace with advances in medical knowledge and understanding of the impact of certain health conditions and firefighting. Contemporary antidiscrimination and privacy principles now legislated in New South Wales have also been taken into account.

FRNSW acknowledges the significant assistance and advice provided by external consultants Dr Bruce Hocking and Ms Fiona Landgren, who are experts in the design and development of medical standards. Acknowledgment is also given to RailCorp for their sharing of knowledge on their management systems and implementation processes around their medical standard and other experts who generously provided their time and expertise. Lastly, thanks need to be given to all members within the project team who provided valuable input in all stages in the development of the Health Standard.

Greg Mullins AFSM

Commissioner, Fire & Rescue NSW

Contents

Tables

Figures

PART 1: INTRODUCTION

1 Purpose of the *Health Standard for firefighters*

Fire & Rescue New South Wales (FRNSW) is committed to enhancing community safety by minimising the effects of hazards and emergency incidents on the people, environment and economy of New South Wales. FRNSW's response profile requires its firefighters to respond to emergency incidents encompassing structural and wildfire suppression, rescues, hazardous materials incidents, storms and tempests, and counter-terrorism activities across the state. FRNSW also runs prevention and preparedness programs to prevent these emergencies and reduce their effects on the community.

FRNSW has a duty under the *Fire Brigades Act 1989* to ensure systems are in place to protect the safety of the public. This includes a responsibility to ensure the health and fitness of firefighters so that they may conduct their physically and psychologically demanding duties safely and effectively. FRNSW also has a duty of care under the *Work Health and Safety Act 2011* to ensure the health and safety of its firefighters as far as reasonably practicable. The management of firefighters in relation to their health and fitness for duty is also governed by obligations under discrimination, workers' compensation and injury management legislation. Where possible, to meet antidiscrimination requirements, FRNSW will accommodate the limitations on the firefighter's capabilities because of health issues through strategies such as job modifications, alternative duties or redeployment.

Firefighters also have a duty of care for their own safety and that of others under work health and safety legislation. They should be aware of the importance of their health and fitness to the overall obligations of FRNSW.

By clearly outlining the health requirements for firefighters, FRNSW seeks to meet its obligations in terms of duty of care, antidiscrimination and equal employee opportunity. It also seeks to ensure consistency and transparency in the assessment of health conditions in a firefighting context. The document also provides firefighters with a clear statement of the health requirements for their job.

With this in mind, this *Health Standard for firefighters* (Health Standard) has been developed to:

- define the level of health required to perform the inherent requirements and demands of firefighting
- describe how the health of firefighters is assessed and reported in relation to these requirements.

The document includes:

- Part 1 – Introduction

  This part describes the purpose and scope of the Health Standard. It also details the steps taken during its development and validation. An overview of the health assessments conducted in relation to the Health Standard is also provided.

- Part 2 – Inherent requirements of firefighters

  This part describes, in detail, the inherent requirements of firefighter tasks and the related health attributes, which in turn provide a basis for the medical criteria outlined in Part 4.

- Part 3 – Medical fitness for duty certifications

  This part outlines how clinical findings are interpreted against the Health Standard to provide a medical fitness certification for a firefighter.

- Part 4 – Medical criteria

  This part includes the criteria for medical fitness for duty for firefighters, arranged alphabetically in sections, addressing the most relevant medical conditions for firefighters.

2 Development of the Health Standard and evidence base

Medical literature and doctrine relating to firefighter and other emergency services personnel have been sourced to inform development of the Health Standard. Where evidence is lacking, expert opinion from members of specialist medical colleges and other health professional organisations provides the basis of this Health Standard.

Key inputs into the development of this Health Standard from a medical view point have included:

- the medical standards for licensing of commercial vehicle drivers contained in *Assessing fitness to drive* (Austroads)
- the standards for medical fitness for duty of rail safety workers contained in the *National health assessment standard for rail safety workers* (National Transport Commission).

Both of these documents have most recently undergone review in 2012.

The Health Standard will be reviewed periodically every 5 years to ensure it keeps pace with medical evidence and the Fire & Rescue NSW operating environment. The standard will also be reviewed if amendment is made to interfacing medical standards (e.g. *Assessing fitness to drive*).

3 Scope and application of the Health Standard

This Health Standard has been developed on the inherent requirements of permanent and retained firefighters, up to the position of Station Commander.

As this standard is based on the inherent requirements of firefighting performed by firefighters up to and including the rank of Station Commander, its application will be modified when assessing firefighters at or above the rank of Inspector, such that only inherent requirements relevant to these roles will be considered.

The Health Standard focuses on medical fitness to perform the inherent requirements of firefighter duties. It does not cover other work, health and safety matters, such as screening for diseases of occupation, nor does it cover aspects such as fatigue or critical incident management, although the interfaces with these are recognised (refer to Section 4). The Health Standard also interfaces with health, fitness and wellbeing programs (refer to Section 4).

The Health Standard is used as a basis for all health assessments conducted to assess medical fitness for duty of applicants for firefighting roles or incumbent firefighters, ensuring consistent assessment across the career of a firefighter.

3.1 Pre-employment health assessments

Firefighters require health assessments at recruitment to determine their initial medical fitness to perform the full range of inherent job requirements. All applicants also undergo a Physical Aptitude Test to determine their ability to meet the physical fitness demands of firefighting.

3.2 Periodic assessments

The mandatory period health and fitness checks conducted for firefighters are similar to those conducted at recruitment, and aim to detect conditions that may impact on a firefighter's ability to safely and effectively perform the inherent requirements of firefighting.

Firefighters will be assessed according to a defined schedule for periodic health assessments. Where indicated by this standard, a more frequent and targeted monitoring protocol for specific medical conditions may be established. This specific monitoring protocol occurs in addition to the routine periodic assessment schedule.

The periodic health and fitness checks also support firefighters in addressing chronic disease risk to assist them with maintaining their medical fitness for duty.

3.3 Triggered health assessments

Assessment of fitness for duty against the standard may be conducted in response to incidents or concerns regarding a firefighter's health and their ability to perform the inherent requirements of their job. These assessments are likely to address a particular health issue (e.g. psychiatric, musculoskeletal) and include scheduled assessments for conditional medical fitness for duty (fit with specified requirements or restrictions). They also include health assessments initiated by supervisors as a result of concerns regarding prolonged or recurrent sick leave, or a firefighter's return to work following illness or injury. Firefighters may request a triggered health assessment through Fire &

Rescue NSW's (FRNSW's) Health & Safety Branch if they are concerned about their ability to safely perform their work due to health reasons.

4 Policy and program interfaces

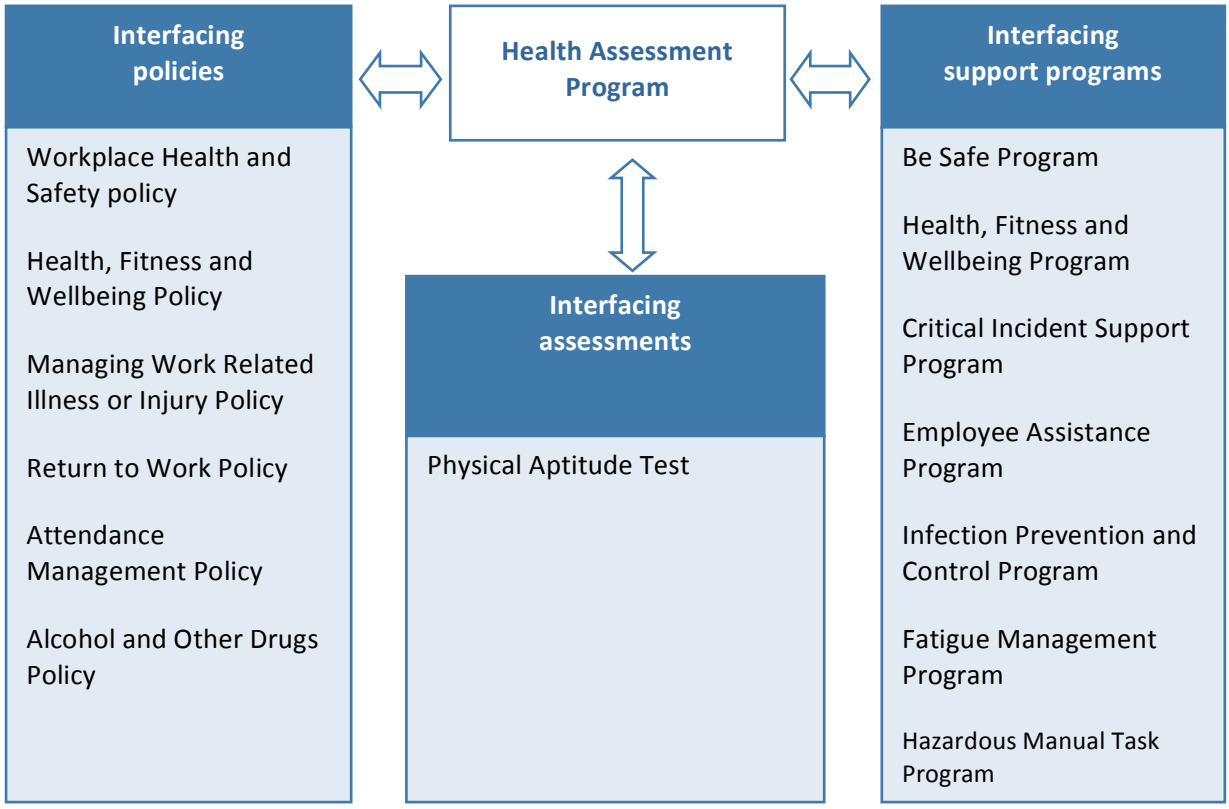
In developing the Health Standard, FRNSW recognises health assessments are one aspect of an integrated safety management system (SMS), which supports the health and safety of its employees and the public. Key aspects of the SMS include appropriate training, maintenance of a safe working environment and implementation of safe working practices, which are continuously monitored and improved (Figure 1).

In addition, health assessments integrate with, and are supported by, a range of other health-related policies and programs as shown in Figure 2.

Medical practitioners assessing firefighters against this Health Standard should be aware of relevant interfacing policies and programs so they may offer relevant and appropriate advice to firefighters. Some of these are described briefly in Sections 4.1–4.8. The medical criteria chapters in Part 4 make reference to these policies and programs as appropriate.

Figure 1 The context of health management within the Fire & Rescue NSW safety management system

Figure 2 Interfacing safety management system policies and programs



4.1 Alcohol and Other Drugs Policy

The FRNSW Alcohol and Other Drugs Policy includes random and targeted testing across the organisation. It also has in place procedures to ensure access to relevant support for firefighters where required.

4.2 Critical Incident Support Program

The FRNSW Critical Incident Support Program supports firefighters who are exposed to trauma, fatalities and major incidents. Periodic health assessments provide a further opportunity to assess general psychological wellbeing (refer to Section 16, Psychiatric disorders).

4.3 Employee Assistance Program

The FRNSW Employee Assistance Program offers free, confidential counselling and support to employees and immediate family members. There is potential for the health professional who performs the health assessment to recommend the program to firefighters, as appropriate (refer to Section 16, Psychiatric disorders).

4.4 Fatigue Management Program

The FRNSW Fatigue Management Program aims to minimise the effect of fatigue on firefighter vigilance. The program takes into account effective ways of managing fatigue in firefighters, given

the nature of shift work, or – in the case of retained firefighters – the fact that their employment with FRNSW is secondary. Periodic health assessments may detect excessive daytime sleepiness or sleep disorders, and they should be managed in accordance with this Health Standard (refer to Section 19, Sleep disorders).

4.5 Health, Fitness and Wellbeing Program

FRNSW has a range of health promotion programs for firefighters under the Health, Fitness and Wellbeing Program. Health promotion activities include those targeted to mitigate cardiovascular risk factors, mental health, general health and fitness. The health assessments do not have a specific role in relation to health promotion, but do provide an opportunity to identify chronic disease risks and alert the firefighter to appropriate support programs.

4.6 Physical Aptitude Test

All firefighter applicants undergo a pre-employment Physical Aptitude Test, which assesses cardiovascular fitness, musculoskeletal strength, endurance and power. This assessment is based on the most critical tasks performed in firefighting, and those most physically demanding and frequently performed.

4.7 Infection Prevention and Control Program

The Infection Prevention and Control Program educates firefighters on preventing the transmission of disease through occupational and environmental exposures. Understanding the modes of transmission of infectious organisms, and knowing how and when to apply the basic principles of infection prevention and control, are critical to the maintenance of optimal firefighter health. The program includes presentations to firefighter recruits, online education packages, station-based education sessions and postexposure counselling and education.

4.8 Hazardous Manual Tasks Program

The Hazardous Manual Task Program provides firefighters with training on the prevention of musculoskeletal injury throughout their career. All training is conducted in accordance with the FRNSW hazardous manual task guidelines, and integrates with the broader range of physical assessment and conditioning support services available to firefighters. This includes functional movement screening.

5 Role and responsibilities of assessing medical practitioners

Medical practitioners should conduct health assessments in line with the processes outlined in this Health Standard. They should have appropriate knowledge and understanding of the firefighting environment, the associated risks and the Health Standard, including:

- familiarity with the tasks involved in firefighting work
- knowledge of and ability to perform the firefighter health assessment
- understanding of the requirements and certification options for medical fitness for duty
- knowledge of the administrative requirements, including form completion and record keeping
- understanding of ethical and legal obligations, and the ability to conduct health assessments accordingly, including appropriate communication with the firefighter and Fire & Rescue NSW
- understanding of ethical issues in relationships with the treating doctor or general practitioner.

Referral for, and management of, ongoing treatment of medical conditions should continue to be the responsibility of the firefighter's general practitioner or treating specialist.

PART 2 – DETERMINING THE HEALTH REQUIREMENTS FOR FIREFIGHTING

This part of the Health Standard sets out inherent requirements of firefighting based on a review of tasks across Fire & Rescue NSW, undertaken in 2010. It also identifies the health attributes (such as senses, musculoskeletal and cardiovascular capacities) needed to fulfill these inherent requirements. This, in turn, provides the basis for applying the medical criteria, which are set out in Part 4 of this Health Standard.

Summary of firefighters' main tasks and health requirements

Driving. The fire appliances are medium rigid class (or above) vehicles. They are driven in emergency mode at high speed while exercising exemptions to normal road rules provided to drivers of emergency vehicles. Driving is performed on a rotating roster basis by the crew member other than the Station Officer. The commercial vehicle medical standard applies for the licences required to drive these vehicles. This class of licence requires good health regarding the health attributes necessary for safe driving (vision and hearing, cognition and psychological health, an absence of conditions likely to cause acute incapacity or impairment).

Structural firefighting work includes rapidly entering buildings and climbing stairs, rescuing victims, hauling hoses, extinguishing fires, and salvage, ventilation and overhaul activities. Rescued victims may be unconscious, burnt, deceased or distressed. Work is conducted in hot and densely smoky conditions. Firefighters must wear an ensemble of personal protective clothing and must use self-contained breathing apparatus (SCBAs). Protective clothing limits the ability for sweat to evaporate and therefore restricts the body's cooling mechanism. Short rest breaks generally occur every 25 minutes if working at high intensities, when the air cylinders of the SCBA need to be replaced. The work requires great cardiopulmonary and musculoskeletal fitness, alertness, good vision and hearing, and psychological resilience.

Wildfire firefighting differs from structural firefighting in that the fire front is rapidly moving through bush or grasslands. The ambient environment is extremely hot. The work requires extensive walking and carrying of hoses and other equipment across difficult terrain, and vigorous use of hand tools. However, the work is similar to structural firefighting in that it requires great cardiopulmonary and musculoskeletal fitness, alertness, good vision and hearing, and psychological resilience. The P2 negative-pressure particle mask that wildfire firefighters wear places an additional load on the respiratory system and does not protect against fire gases, including carbon monoxide.

Hazmat work involves the containment and clean-up of dangerous goods and other hazardous materials. The work may require the firefighter to wear a fully encapsulated hazmat suit, which is resistant to external fluids and gases, but limits the ability for sweat to evaporate. A SCBA is also worn. The work involves rapidly assessing a scene, rescuing victims, identifying the presence of toxic chemicals, performing containment as needed and decontamination. Work may be conducted in variable environmental conditions. The work places considerable cardiac and musculoskeletal demands on the firefighter, and requires alertness, and good vision and hearing.

Rescue work involves rescuing victims who are trapped in cars or on cliff faces, involved in industrial accidents, and so on. The work varies greatly with the situation. It involves applying first aid to the victim and using a wide range of equipment for freeing and transporting the victim – often in awkward situations and on difficult terrain. The work is conducted in variable environmental conditions. Victims may be unconscious, injured, deceased or distressed. The work requires great cardiopulmonary and musculoskeletal fitness, good vision and hearing, and psychological resilience.

6 Risk management approach

Firefighting is safety-critical work. There are considerable potential consequences for life and property if firefighting is not conducted efficiently. Although there are a range of administrative and engineering techniques to assist firefighting, the firefighter remains central and crucial to firefighting operations.

The requirements for firefighter health assessments are determined by a risk management approach, which aims to:

- identify the main tasks of firefighting, and what the impact would be on the firefighter in the event of acute incapacity or impairment
- assess the consequences of acute incapacity or impairment
- establish appropriate controls for the risks associated with acute incapacity or impairment, including the role of health assessments.

This approach ensures that the level and frequency of health assessments conducted is congruent with the risk associated with the tasks performed by firefighters.

It is acknowledged that health assessments are but one of a number of approaches to managing risk. Thus, a mix of engineering, administrative and health assessment measures is likely to be required. In determining the health assessment requirements, it is important to take into account the operational and engineering environment, since overall risk management significantly determines the human attributes that are required for safety. As these environments change, it may be necessary to change the health requirements.

This interaction between technology and human capabilities has implications not only for the setting and application of medical criteria, but also for meeting diverse legal requirements. Medical criteria cannot be simply set at the highest level for safety's sake. They must be set and applied carefully to match the risks associated with the tasks to be consistent with antidiscrimination laws. This requires careful and thorough assessment of the risks to, and as a consequence of, health as part of the assessment process.

Figure 3 shows the key tasks, work demands and health attributes associated with firefighting, and provides a framework for understanding and applying a risk management approach to health assessments. It shows the key aspects of the firefighting job, namely:

- driving of vehicles, including driving in emergency mode
- firefighting (structural and bush firefighting)
- hazmat
- rescue.

For each of these tasks:

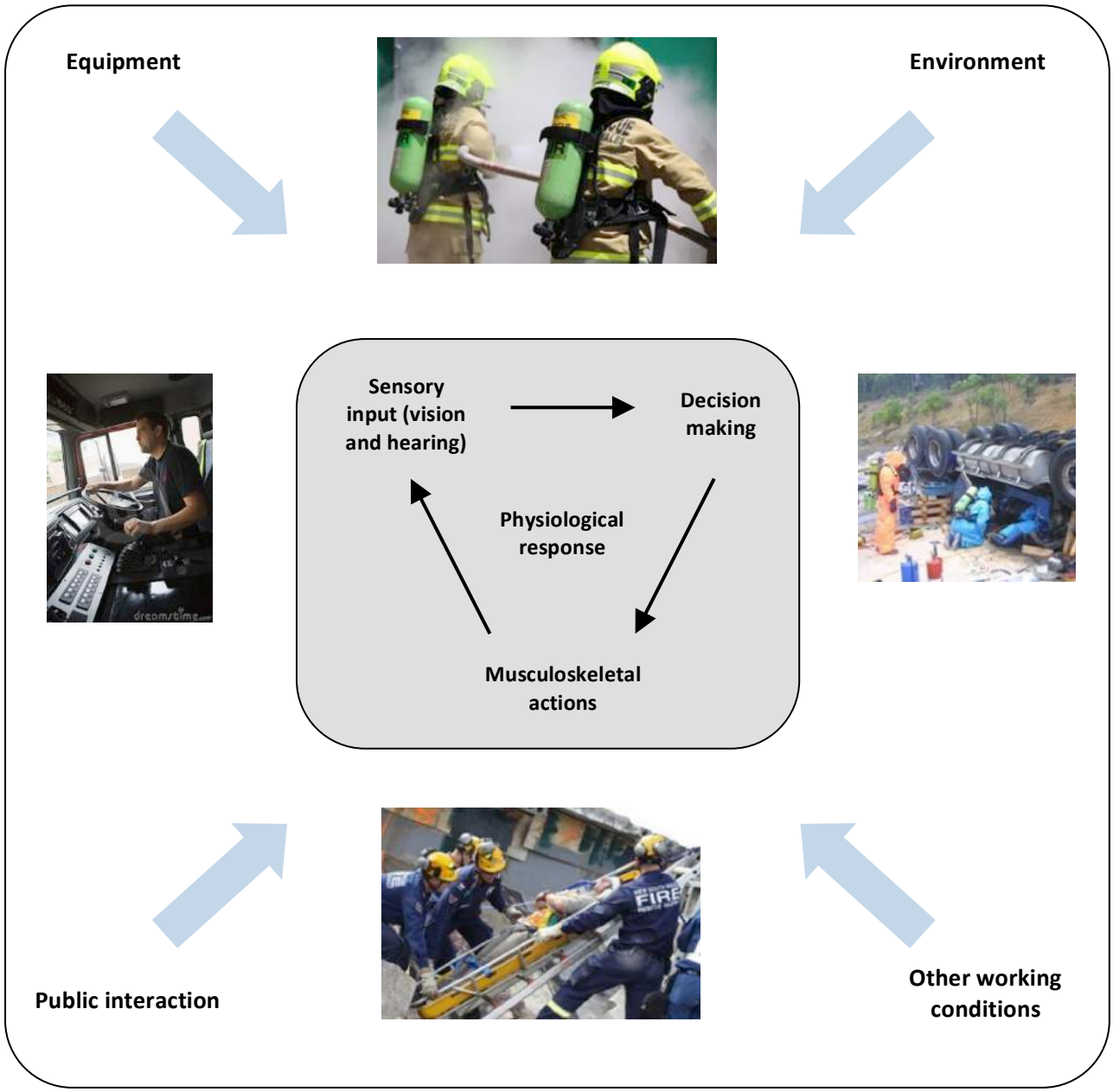
a. information is gained about the environment through the senses (mainly vision and hearing)

b. information is then processed by the brain (cognition or 'situational awareness')

c. decisions are made that are then put into effect by the musculoskeletal system; the cycle rapidly repeats and is multichannelled.

These processes take place within a diverse and challenging operational environment, which places considerable physiological demands on the firefighter.

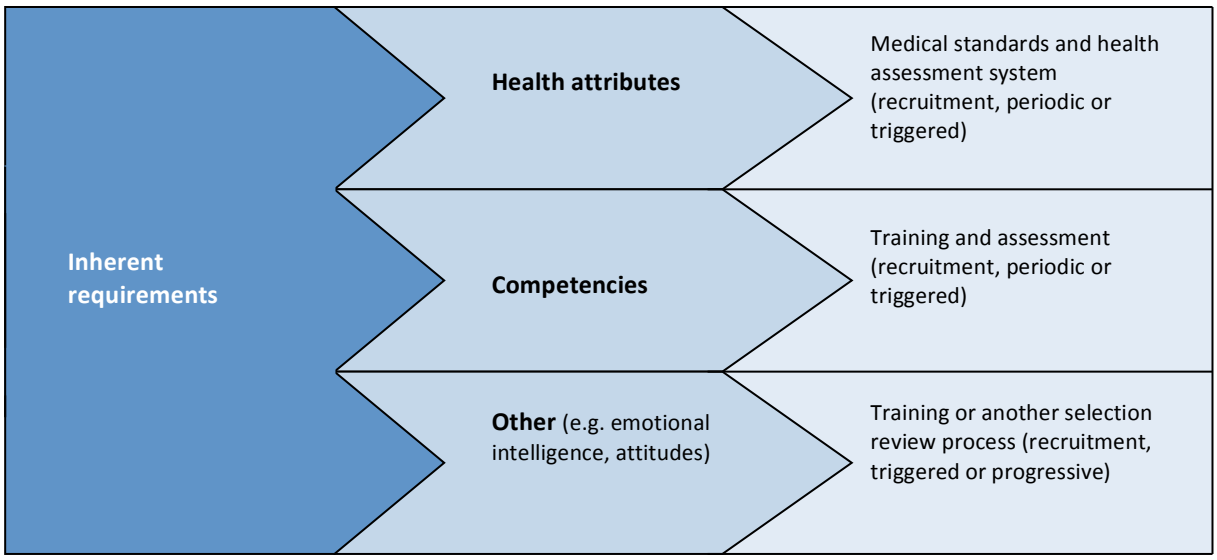
Figure 3 The tasks and work demands of firefighting



Determination of the specific inherent requirements of a firefighter's job is fundamental to a risk-based approach to health management. The term 'inherent requirement' has been variously defined.[1,2] Most simply, the inherent requirements of a job may be described as the essential activities of the job – *the core duties that must be carried out to fulfil the purpose of the position*. This definition encompasses the broad requirements of the job, not just those related to health (refer to Figure 4).

An understanding of the inherent requirements also helps to identify those attributes that cannot be readily assessed through a medical examination (e.g. cognitive capacities) and for which other assessment tools may be required.

Figure 4 Inherent requirements as a basis for health standards



[1] NSW Department of Premier and Cabinet. *Employment health assessment: policy and guidelines*, April 2000 (http://www.dpc.nsw.gov.au/public_employment/policy_directory/policy_statement?metadata=8646).

[2] Australasian Human Rights and Equal Opportunities Commission (https://www.humanrights.gov.au/our-work/disability-rights).

7 Inherent requirements of firefighting

This section outlines the inherent requirements involved in the major tasks of firefighting i.e. driving the appliance, firefighting, hazmat and rescue.

The tasks associated with hearing and visual requirements are complex and are discussed separately to the main tasks (refer to Section 9). There is some duplication in this information to enable a complete understanding of the tasks dependent on the senses.

Note all firefighters are trained to be multi-skilled although some may specialise later. Operational staff, up to and including the ranks of leading Station Officer and Captain, are expected to be multiskilled and their duties are the focus of the requirements described below.

7.1 Driving

All members of the crew – apart from the Station Officer – drive the fire appliances on a rotating roster basis.

All drivers must hold a heavy vehicle (medium rigid or above) licence. Firefighters need to be able to drive different appliances that have different dimensions, weights and handling characteristics (refer to Figure 5).

Under New South Wales law, fire appliances are exempt from normal driving rules while responding to an incident under lights and siren. Drivers must be able to rapidly detect other factors such as vehicles, pedestrians and warning sounds, including when in emergency mode. The driver must be able to hear and respond to auditory cues from other traffic, bells at level crossings and so on while other radio and voice communication is ongoing in the cabin of the appliance. They must also be able to hear warning alarms such as low air pressure in the braking system.

Firefighters also need to be able to access directions to the fire ground via GPS and maps, and to communicate using radio (closed loop communication).

A detailed analysis of the driving tasks requiring vision and hearing is included in Section 9.

Figure 5 Examples of fire appliances

Urban pumping appliance: 15 tonnes (Gross Vehicle Mass)

Aerial pumper: 20 tonnes (Gross Vehicle Mass)

Ladder platform: 26 tonnes (Gross Vehicle Mass)

7.2 Structural firefighting

Structural firefighting is responding to, for example, a house, a factory or an office block fire. Typically, four firefighters turn out in response to an alarm, including one Station Commander. Each firefighter has a designated role. The Station Commander is responsible for commanding the crew and, in some cases, will take command of the entire incident. One firefighter is responsible for driving and operating the pump, and the other two will be allocated tasks depending on the specific incident. Most permanently staffed appliances have self-contained breathing apparatus (SCBA) mounted on the rear seats, allowing the two firefighters in the rear of the cab to don it before exiting the appliance, either before leaving the station or on arrival at the incident. This leads to increased weight when stepping down from the appliance, sometimes onto uncertain ground in poor visibility because of smoke and perhaps night time. The total weight of protective equipment worn during structural firefighting is approximately 21 kg.

On arrival at the incident, firefighters' activities are summarised in the acronym RECEOSV:

- Rescue
- Exposures
- Containment
- Extinguish
- Overhaul
- Salvage
- Ventilation.

The requirements of these activities are described in Sections 7.2.1–7.2.8.

7.2.1 Rescue

The first priority is saving and protecting people's lives (including a firefighter's own life). Upon arrival, information will be gathered about the possible location and number of causalities. Using this information, firefighters that are wearing structural firefighting ensemble (see Section 7.2.8) and SCBA (see Section 7.2.8), and pulling a 'charged' (full of water) line of hose will enter the building. This may require moving long distances carrying heavy equipment, climbing ladders or forcing entry through locked doors (Figure 6). Conditions inside the building are generally extremely hot and smoky.

Figure 6 Forcing entry through a locked door

Entry may require the use of petrol-powered saws or bolt cutters that require a lot of force.

Search and rescue operations procedures are designed to reduce the possibility of disorientation. The search must be systematically performed by the search and rescue crew (firefighters are paired for this task) to ensure that all areas are covered and that nobody is missed. Rescue of an unconscious person is by dragging the victim. One firefighter will hold the casualty under the arms and around the chest and walk backwards while in a semi-squatting position. The other firefighter guides them back to the exit point. It is common for the ground to be covered in debris, and it is reasonable to expect that a victim may weigh 100 kg or more. There is an especially high degree of team interdependence during this stage of firefighting.

Rescuing victims may involve using a fire rescue ladders, which are 10.5 m long, 49 kg and awkward to manoeuvre into place. Firefighters must work as a two-person team (refer to Figure 7). Raising the ladder requires a high degree of upper body strength and shoulder joint stability.

Figure 7 Raising a fire rescue ladder

To raise a fire rescue ladder, firefighters must work as a two-person team.

On arrival at the fire, the first 15 or more minutes involve particularly intense activity without a break. Lighting may be poor due to smoke and/or night time, and the terrain may be uneven and/or slippery, which puts stress on the limbs when moving and quickly assessing a site.

A major consideration is the possibility of a firefighter collapsing, leaving one firefighter on their own. This firefighter would then need to focus on rescue of the other firefighter – for example, they may need to drag the collapsed firefighter to safety on their own, while navigating through the hazardous environment.

7.2.2 Exposures

During this stage of operation, the objective is to confine the fire to the building/compartment of origin. Exposures may be internal (i.e. adjacent home units), external (i.e. adjacent buildings) or the environment. Protection must be achieved rapidly if property damage is to be limited and to ensure that further lives are not placed at risk. This stage will involve obtaining adequate water supplies from hydrants in the street. This operation alone will require a standpipe, a hydrant bar, and a one-into-two breeching to be collected from the appliance and carried to the hydrant. This is commonly 60 m, but is sometimes much further. Once this equipment is attached to the street hydrant, the hose is collected from the appliance and laid out between the hydrant and the appliance, and connected to the pump (Figure 8). Water is then turned on, which supplies the pump with more water. In some situations, this will need to be repeated if sufficient water cannot be obtained from the first hydrant.

Hose is laid out from the outlets of the pump to reach the areas threatened by fire. A suitable method of controlling and directing the water is attached to the hose. A 70-mm-diameter hose, when full of water, weighs about 4 kg/m, and 10s of meters of inflexible hose may need to be quickly manoeuvred into position. For handheld hose lines, a branch is attached. For large volumes of water, a monitor (non-handheld) is used, which is a piece of equipment that firefighters set up and leave, thereby reducing the chance of firefighter injury from building collapse or explosion (Figure 9).

Figure 8 Supplying water to the pumper

Supplying water to the pumper requires endurance and strength to carry the equipment to the hydrant to lay hose.

Figure 9 A firefighting monitor

Monitors are used to deliver large quantities of water while avoiding the need to manually hold and direct the hose.

7.2.3 Containment

During this stage, the expansion of the fire is stopped. This is generally achieved by appropriately applying water or foam, and by reinforcing the number and placement of hose lines (Figure 10). During this stage, similar physical demands are placed on the firefighters as in the exposure stage. Internal work will also expose firefighters to longer periods in high-temperature, low-visibility working conditions, although these may also be found in some close external locations. Often, smaller, easier-to-handle hose lines that are used initially for search and rescue are replaced by larger, heavier hoses that require more strength to operate and control because of the very high water pressure (Figure 11).

Figure 10 Controlling the charged lines of a hose

Controlling charged lines of hose is a physically demanding task, often requiring at least two firefighters per hose line.

Figure 11 Large-diameter hoses

Large-diameter hoses contain significant quantities of water. The weight of the hose (up to 4 kg/m) means that a lot of strength is required if the hose needs to be repositioned.

7.2.4 Extinguish the fire

During this stage, additional resources (firefighter and firefighting equipment) are deployed to overwhelm the fire. Sustained strength and endurance is required to maintain the attack (Figure 12).

Figure 12 Firefighters holding a hose for a long period

A firefighter's stamina is challenged during the extinguishment phase, which requires holding a hose for long periods.

7.2.5 Overhaul

During the overhaul stage, all pockets of fire are totally extinguished and hot fire gases are released from the building. This stage requires methodical work on uneven surfaces while often carrying

heavy equipment (Figure 13). A wide variety of hand tools – such as axes, power saws and shovels – are used, which require strength and coordination to operate them safely. Additionally, the firefighter may be required to work at height from a ladder or another type of elevated platform.

Figure 13 Working on uneven surfaces

It is common for firefighters to work on uneven surfaces that are littered with fire debris. The firefighter needs to maintain control of firefighting tools such as hoses.

7.2.6 Salvage

Salvage involves protecting household possessions, or business stock and equipment from the adverse effects of water, heat and smoke. This requires lifting and moving heavy items, covering items with protective sheeting, and removing debris and water.

7.2.7 Ventilation

Ventilation involves removing smoke and fire gases from a structure. It may require using tools to create openings and exhaust points at varying heights through building walls or roofs. For mechanical ventilation, a positive pressure fan will need to be carried some distance to be set up in the correct location to force clean air into the structure. The fans – which weigh up to 35 kg – are a multiple-person lift, and may need to be carried up stairs or across varying terrain and debris.

7.2.8 Other considerations, including exposures and protective equipment

Poor visibility

Firefighters may have to work in the dark and/or in conditions of poor visibility (Figure 14), which may be due to many causes including smoke, night time or internal building darkness, visual

interference from personal protective equipment, glare from portable lighting, emergency vehicle flashing lights or condensation on the outside of a breathing apparatus mask. Refer to Section 9 for a detailed discussion of visual requirements of firefighter tasks.

Figure 14 Structural firefighting in poor visibility conditions

Note that these photographs were taken during the day.

Heat stress

The temperature of fires varies greatly, from ambient temperatures up to 1000 ^{o}C. It is common for firefighters to work in environments of several hundred degrees. However, the firefighter should not be directly exposed to such temperatures if the fire is correctly assessed and controlled, and if protective equipment is worn. Although heat exposure is important, the main source of heat stress to the firefighter arises from his or her own metabolism because of the strenuous activities in fighting structural fires. The structural firefighting ensemble restricts air flow across the skin surface (and also increases the work load because of the ensembles weight), therefore impeding the removal of body heat through sweating. Eventually, when the air between the skin's surface and the structural firefighting ensemble becomes saturated with sweat, the sweating mechanism will be impaired significantly. Core body temperature in firefighters has been demonstrated to rise to 39 ^{o}C or more. High sweat rates are commonly observed in firefighters undertaking structural firefighting.

Figure 15 Exposure to radiant heat during structural firefighting

Exposure to radiant heat and the accumulation of metabolic heat underneath protective equipment contribute to heat stress during structural firefighting.

Smoke

Smoke is composed of particulate matter (a mixture of solid particles and liquid droplets), and CO_2, CO and numerous other gaseous chemicals. The chemicals include volatile organic compounds, such as formaldehyde and other aldehydes, which can be highly irritating to the upper and lower respiratory tract. In addition, there may be toxic chemicals such as hydrogen cyanide and polycyclic aromatic hydrocarbons. The oxygen levels are lower than normal, because fire consumes oxygen.

Figure 16 Structural fire smoke

Structural firefighting ensemble

The structural firefighting ensemble comprises overpants, a coat and a flash hood. This configuration is designed to protect the firefighter from the heat of the fire. A structural firefighting helmet with visor, and structural firefighting boots and gloves are also worn. The structural firefighting ensemble is protective, but it increases the work load because of its weight (up to 12 kg) and it limits the evaporation of sweat. When combined with a SCBA, the additional weight is about 22 kg (Figure 17).

Figure 17 Structural firefighting ensemble

PPE = personal protective equipment; SCBA = self-contained breathing apparatus

Self-contained breathing apparatus

The SCBA is a key piece of protective equipment. It is a positive-pressure system that imposes minimal load on breathing. It provides clean air, and protects against smoke, gases and heat. A SCBA is generally donned before exiting the appliance. It consists of an air cylinder and a back plate, pneumatics and face mask, and weighs 11–17 kg depending upon the SCBA type and configuration. The air supply lasts for approximately 30 minutes when performing simple tasks; however, it may be used more rapidly dependent on the work environment, firefighter work rate, experience level and fitness. When most of the air in the cylinder is consumed, the firefighter must leave the contaminated atmosphere and replace the cylinder. They may then return to the fire. In an ideal situation, the duration of this demanding work is minimised by good management of the incident (Figure 18).

Figure 18 Firefighter wearing a structural firefighting ensemble and a self-contained breathing apparatus

The combined additional weight of the personal protective equipment (PPE) is about 22 kg, which increases the work load. Additionally, evaporative sweating is significantly reduced while wearing the PPE.

Shift work

The default roster for most permanent firefighters is the '10/14 roster'. This consists of two, 10-hour day shifts (0800–1800) followed by two, 14-hour night shifts (1800–0800), with 96 hours off before the shift cycle repeats. However, the majority of permanent firefighters work a modified '24-hour roster', consisting of a 24-hour day and night shift, 24 hours off, another 24-hour shift, followed by 120 hours off.

Other rosters worked are 'back-to-back' rosters, which is four, 12-hour days (0600–1800) and 108 hours off; and 'special roster', where firefighters work Monday to Friday during normal business hours. Sometimes, there are no firefighting activities in a shift, or there are relatively short ones (of a few hours), which enables refreshment. In the event of a major fire spanning the whole shift, firefighters are recycled and rehabilitated to control fatigue levels. The total time at an incident can vary greatly.

Retained firefighters are on-call (unrostered), and hours worked are often in addition to those worked in primary employment.

7.3 Wildfires

Fighting a wildfire differs from a structural fire in several ways. Wildfires are a rapidly moving fire front that has to be pursued first in an appliance, and then often on foot. Firefighters must lay out heavy hoses and carry other equipment over long distances across difficult terrain, in poor visibility due to smoke. Progressing hoses through bush or grassland requires firefighters to drag hoses charged with water, often against friction from elements such as trees and rocks. This requires significant cardiovascular fitness and musculoskeletal strength. If the wind changes, the whole process needs to be reversed and then repeated at another site. Wildfires may be fought using wet or dry methods.

Dry methods involve creating fire breaks by back-burning and creating control lines using hand tools (e.g. McLeod tools) and earth-moving equipment. Using hand tools requires significant cardiovascular and musculoskeletal fitness.

Wet methods use hoses or knapsacks (a knapsack can weigh up to 16 kg). These methods may involve identifying a source of water (e.g. dam, swimming pool) and carrying a petrol-powered pump to the location so that firefighting can commence. This is often over difficult and unfamiliar terrain (Figure 19).

After the fire has abated, there is extensive work seeking out remaining pockets of fire and hotspots (called 'blacking out'), which is especially dangerous because of the high risk of falling trees and branches.

Figure 19 Wildfire fighting using wet methods

Firefighter pulling and controlling a hose.

Figure 20 Poor visibility conditions of wildfire fighting

7.3.1 Refuge

In an emergency, refuge from the fire must be sought quickly, either within the natural environment or in the appliance fitted with special protection devices. Seeking refuge quickly may require high-level cardiopulmonary and musculoskeletal fitness.

7.3.2 Heat stress

Wildfires typically occur on very hot days with high winds and low relative humidity, so there is little respite available. This heat load is additional to the heat of the fire itself, plus the vigorous activities in fighting the fire as previously described.

7.3.3 Wildfire personal protective equipment

The personal protective equipment (PPE) in wildfire fighting differs from that used for structural firefighting. It is lighter, consisting of the duty wear outlined above, a multipurpose coat, a P2-particle mask and goggles, a multipurpose helmet, and boots (see Figure 21). The P2-particle mask imposes an extra load on the respiratory system, in contrast to a SCBA. The P2 mask protects the firefighter from particulates, but not from gases such as carbon monoxide. At times of severe wildfire activity, the lighter wildfire PPE (level 2) may be replaced with a SFE (level 1) and SCBA.

Figure 21 Personal protective equipment for wildfire firefighting

Personal protective equipment for wildfire fighting showing a multipurpose coat, a P2-particle mask, goggles, a helmet and boots.

7.3.4 Shift work

Unlike structural fires, wildfires may burn for days, so the work may be prolonged.

7.4 Hazmat

A hazardous materials (hazmat) situation is one that involves substances on the list of hazardous substances or dangerous goods, but may include other environmental threats, such as a milk tanker spilling its load into a watercourse.

The hazmat guidelines set out several steps for managing these incidents, using the initialism 'SISIACMR'.

- **S**afe approach. The incident is assessed at a distance, upwind and upgrade. If needed, people may be rescued by being dragged from the scene and decontaminated.
- **I**ncident command. The site is declared as hazmat and a command point established.
- **S**cene security. The incident scene is divided into three concentric zones: the contaminated centre (hot zone), then an inner ring (warm zone) where firefighters operate and pass through decontamination to the outer ring (cold zone), where other services, such as ambulance, operate.
- **I**dentify hazmats. Two firefighters may don SCBA and fully encapsulated (FE) hazmat suits to enter the site and identify the hazardous materials (see Figure 22). This may involve walking up flights of stairs in poor visibility. They work as an interdependent pair. The FE suits are impervious to fluids and gases. The performance of hazmat-related tasks while wearing FE suits results in a significant rise in core body temperature because of significantly impaired sweat evaporation – the firefighter becomes heated from his or her own exertions and the inability to evaporate sweat. FRNSW guidelines recommend a maximum duration of 20 minutes per wear. The firefighters then leave the hot zone and enter the decontamination procedure. Once this has occurred, they will enter the rehabilitation area. If necessary, they may then return to the hot zone. The visual requirements associated with this task are outlined in Section 9.1.2.
- **A**ssess potential harm and minimise environmental contamination. The toxicity and the quantity of hazmat substances are assessed and a plan made for their containment.
- **C**all-in resources. Additional resources such as truckloads of sand or sweeping machines may be called in.
- **M**onitor information.
- **R**ender safe and decontaminate. This may require the firefighter to work in an FE suit – for example, for handling drums of toxic material – or they may change into lighter 'chemical spillage suits' for less-toxic materials. Rendering the material safe may require loading it into drums with hand tools, such as shovels.

Figure 22 Firefighters wearing chemical spillage suits and self-contained breathing apparatus

Firefighters at a site of a toxic (pesticide) spill. They are rescuing the driver and containing the toxin. The work is intense and in direct sunshine for many hours. The chemical spillage suits prevent sweat evaporation.

7.5 Rescue

Fire & Rescue NSW (FRNSW) is the lead agency for rescue in several settings. These include motor vehicle accidents, industrial accidents, cliff face rescues, and urban search and rescue.

Incident sites are attended wearing duty wear, which comprise a long-sleeved shirt, cargo trousers and safety boots.

7.5.1 Motor vehicle accidents

These are the most common rescue incidents and are attended to free victims trapped in their cars. When firefighters arrive at the scene, they conduct a triage to identify saveable persons. First aid – such as cardiopulmonary resuscitation, oxygen administration or placing a neck brace – is applied as appropriate. The situation may be distressing, and may include cries of pain, lacerations, blood and vomit. Hazards such sharp metal and glass, oil and petrol spills, and highway traffic are also identified.

Trapped victims are rescued using a range of heavy equipment. These include hydraulic spreaders, shears and rams, which weigh up to 19 kg (Figure 23).Figure The equipment may need to be carried considerable distances across uneven terrain and on steep slopes. At the site it may need to be held in awkward positions – for example, above the head if the vehicle is lying on its side. Where possible, two people operate the equipment. The work is carried on under a time pressure until the victim is freed and then cared for by paramedics. The work is demanding, and requires considerable musculoskeletal and cardiovascular fitness as well as psychological resilience.

Work is conducted in all weather conditions, with wet weather increasing the likelihood of motor vehicle accidents.

Figure 23 Firefighters using equipment to rescue trapped driver

The firefighters are using a 19 kg tool, held at shoulder height with awkward foot-holds, to cut the car door frame to rescue a driver.

7.5.2 Rescue from heights

These rescues are most often performed to rescue a person trapped on a cliff face or the outside of a building (Figure 24). An anchor and belay point is established at the top of the cliff or building, and one rescuer on double ropes is lowered to the victim. If needed, the victim is placed in a stretcher. The victim and rescuer are then pulled to the top of the cliff by the hauling party. The work requires considerable musculoskeletal and cardiovascular performance, dexterity with ropes, alertness and decision making. The rescuer may also need to render first aid. The rescue may be conducted in extreme weather conditions.

Figure 24 Firefighters performing a heights rescue

7.5.3 Urban search and rescue

Urban search and rescue is conducted when a building has collapsed and there is concern for victims trapped in the rubble or underneath the structure. Officers are trained to crawl, not walk, using

three points of contact across the rubble to avoid falling. They may need to carry a heavy concrete cutting saw to cut through reinforced concrete to free victims. They may be required to crawl through narrow confined spaces to reach victims. The work is demanding and requires musculoskeletal, cardiovascular and psychological fitness, and the ability to tolerate confined spaces (Figure 25).

Figure 25 Rescue team handling a stretcher across unstable rocky terrain

7.6 Natural disasters

Natural disasters work, such as assisting after a storm, has similar requirements to rescue work (Figure 26).

Figure 26 Firefighters working on storm-damaged roofs

The physical requirements of natural disasters work are similar to rescue at heights work.

8 Firefighting tasks requiring vision and hearing

Numerous aspects of the firefighter task require vision and hearing; thus, these requirements are described separately to support understanding and application of the medical criteria contained in this Health Standard.

8.1 Vision

The main considerations regarding vision are visual acuity, visual fields and colour vision. The concern with colour vision is for red–green discrimination, because 8% of men have some degree of red-green colour-recognition deficiency. When assessing colour vision, an important consideration is the co-existence of redundancy of information, so safe working is not solely dependent on accurate colour detection.

8.1.1 Firefighting tasks and inherent requirements relevant to vision

Preparatory

At the station, routine duties include maintaining and repairing equipment, such as breathing apparatus, and hydraulic and electronic equipment. Some of the components are small, and it is important to safety that it is all assembled correctly. Sometimes, the task may require working while wearing gloves that reduce dexterity.

Driving the appliance, including under emergency conditions

The visual tasks associated with driving the appliance to the incident include accessing directions to the incident, and driving the appliance safely. Members of the crew rotate through these jobs.

Accessing directions to the incident requires reading a GPS, maps, street names and building numbers.

As with any commercial vehicle, drivers of the fire appliance must be able to rapidly detect other vehicles, pedestrians and warning signs. In addition, driving may be in emergency mode when speed limits and other road rules may be legally exceeded and traffic lights slowly driven through when red. Normal cues such as the flow of traffic cannot be relied upon. Other drivers may react erratically or unpredictably to the presence of the fire appliance, requiring anticipation and quick reaction by the driver.

Peripheral vision is required for common driving tasks such as merging, changing lanes, and detecting pedestrians and vehicles to the side of the line of vision. Approaching intersections requires the rapid detection of information from multiple directions, particularly when in emergency mode.

Colour vision is not essential to safe driving because of the redundancy of traffic lights (i.e. the position of the red and green lights).

Incident – structural

Firefighters work at night and in conditions of poor visibility, which may be from many causes, including smoke (Figure 27), night time or internal building darkness, visual interference from PPE, glare from portable lighting, emergency vehicle flashing lights or condensation on the outside of the SCBA mask.

Figure 27 Structural firefighting – poor visibility conditions

Note that this photograph was taken during the day.

Visual acuity

On arrival at the fire ground and entry to a structure, visual acuity is necessary for many tasks, including:

- reading fire safety signs and chemical placards (Figure 28), and dangerous goods manifests (Figure 29)
- identifying a gas cylinder from a distance, as the need to get closer to identify such an object could endanger the firefighter (Figure 30)
- identifying casualties in conditions of poor visibility
- identifying visual hazard cues, such as open stairways or voids, uneven surfaces and stairs, and exit signs
- reading channel selectors on handheld radios and equipment with LCDs
- reading the SCBA pressure gauge (Figure 31)
- interpreting thermal-imaging camera displays.

Figure 28 Fire safety signs and chemical placards

Chemical drums showing safety placards, which must be quickly identified.

Figure 29 Dangerous goods manifests

Recognising dangerous goods symbols and text is important.

Figure 30 Liquid petroleum gas cylinder

Liquid petroleum gas cylinder showing a safety placard, which must be quickly identified.

Figure 31 Self-contained breathing apparatus pressure gauge

Self-contained breathing apparatus cylinder pressure gauge (hand held). An alarm sounds when the pressure is low.

Visual fields

Peripheral vision is necessary when arriving at structural fires, where work may be undertaken on roads and there is a need to detect traffic movements.

When entering a structure, peripheral vision is advantageous for detecting hazards and casualties; however, in reality, vision may be impaired by the poor visibility conditions.

Colour vision

Various tasks in structural firefighting require colour recognition. However, the need for red-green colour differentiation may be lessened by redundancy of information in the signal – for example, including a positional or word cue. In structural firefighting, colour vision may be required for:

- interpreting smoke and flame colour
- using colour-coded control panels on appliances
- recognising coloured helmets (designated to personnel with different roles)
- using coloured hydraulic lines
- interpreting fire control panels and medical equipment (such as Guedel airways)
- recognising gas cylinder colours
- recognising industrial pipes.

Wildfire

Wildfire fighting involves several visual tasks often in situations of poor visibility (refer to Figure 32). Duties are often undertaken at the bush–urban interface, so there will be some task overlap with structural fires.

Figure 32 Poor visibility conditions of wildfire fighting

Visual acuity

Visual acuity is required for many wildfire firefighting tasks, including:

- identifying casualties in adverse conditions
- identifying other crew members in adverse conditions
- recognising visual hazard cues, such as uneven surfaces
- reading safety signs, chemical placards and so on
- identifying a gas cylinder from a distance
- finding one's way back to the fire appliance in adverse conditions, particularly during emergency recall.

Visual fields

Peripheral vision is impeded by the goggles that are worn for wildfire firefighting.

Colour vision

The ability to detect a red fire truck against a green bush background had previously been deemed a safety critical task for firefighters. Risk assessment concluded that this is not a major problem in reality. The lines of the vehicle, the use of striped panels, the use of writing on the vehicle, the possible movement of the vehicle, and the use of flashing lights and sirens, as well as the general context, all provide redundancy and aid in locating such a vehicle.

Hazmat

A number of activities rely on vision during hazmat operations.

Visual acuity

Visual acuity is required for several hazmat tasks, including:

- identifying and reading dangerous goods placards and other signage – for example, on an overturned tanker (refer to Figure 33). In hazmat situations, it is safest for the firefighter to identify the hazards from as far away as possible. For some substances, this distance is 200 m or more, which requires using binoculars.
- identifying gas cylinders
- identifying casualties

- reading Material Safety Data Sheets, manifests, emergency response plans, computer screens, chemical labels, pH papers and so on
- reading LCD and LED displays on equipment such as gas monitors and radiation dose meters (refer to Figure 34).

Figure 33 Dangerous goods signage on a tanker

Dangerous goods signage on can be seen on the overturned tanker (red diamond near the number plate).

Figure 34 Reading displays on a gas monitor

Colour vision

Colour vision is relevant for several hazmat tasks:

- reading pH papers
- reading chemical warfare detector papers
- recognising industrial pipe colours
- recognising colour-coded industrial pipelines
- identifying industrial gas cylinders.

However, other cues are often available – for example, labelling.

Rescue

A number of rescue tasks rely on vision. Rescue duties are undertaken at all times of day, and during all weather and other adverse conditions that impact on visibility.

Visual acuity

Acuity is required for:

- locating casualties from motor vehicle accidents who may have been thrown from a vehicle
- identifying casualties in a debris field during urban search and rescue operations
- assessing injuries to victims, sometimes in conditions of poor visibility, to determine the most appropriate rescue methodology
- identifying hazards such as sharp metal and glass
- connecting lines to hydraulic tools
- operating other specialised equipment, changing blades in reciprocating saws (includes identifying the required blade and attaching it correctly)
- reading engravings on safety equipment to assist with knots and cordage during rope rescue

Visual fields

Peripheral vision may be impeded by safety glasses or goggles worn for rescue duties.

Colour vision

Rescue operations use a lot of equipment that is coloured, including cordage, rope, strapping, tubing and lifters. Much of the colour involved is discretionary, in that it is the colour that was ordered at the time. Some colours relate to the particular strain rating of equipment, such as lifting straps. Judicious choice of coloured equipment can avoid confusions here.

8.1.2 The required vision attributes

To be able to perform the inherent requirements of driving the appliance, fire suppression, rescue and hazmat duties, the following visual attributes are required:

- Good **visual acuity** is crucial to driving safely. Good acuity is also essential to firefighting, especially under conditions of poor visibility, so that a firefighter may be operationally effective. Good acuity is crucial for tasks such as identifying casualties and identifying hazards to other firefighters when moving through the incident.

- **Peripheral vision** is crucial to driving safely; however, it is of limited importance in many firefighting situations because the PPE often limits the fields of vision and there are generally poor visibility conditions.
- A risk assessment undertaken by Dr John Parkes in 2009[3] showed that **colour vision** is not essential to safe driving. This is because the position of red and green traffic lights makes the actual colours redundant. With the exception of marine tasks, which are subject to maritime colour vision requirements, all colour vision tasks were risk assessed and none deemed safety critical. Risk mitigation in relation to these task includes:
    - crew members working together and not in isolation
    - assessing overall fire behaviour
    - using positional cues
    - using monitors instead of detection papers
    - using written labels or symbols in addition to colours on cylinders
    - judicious purchasing of certain equipment.

Operational duties are undertaken often under emergency and adverse conditions, where the ability to detect visual information quickly relies on good eyesight, specifically, acuity and fields. Colour vision is not important if there is redundancy of information. Abnormal vision may impact on reaction time, mobility and casualty recognition. Failure to adequately see and respond to imminently hazardous situations jeopardises the safety of the firefighter and others dependent on the firefighter for their safety.

8.2 Hearing

The firefighting tasks that require communication and hearing are described first, to identify the inherent requirements relevant to hearing. Then the necessary hearing health attributes needed to meet these requirements are discussed.

8.2.1 Firefighting tasks and inherent requirements relevant to hearing

Call out

Firefighters must firstly respond to an alarm tone and voice through the station public address system. Retained firefighters must respond to a pager, mobile phone or home telephone.

Firefighters then assemble in the watch room to be briefed on the type of incident and discussions – for example, about the preferred route to the incident.

[3] Parkes J. *Risk assessment of safety critical and other duties performed by NSWFB personnel requiring colour vision*, 2009.

Travelling in the appliance

The hearing tasks associated with travelling in the appliance can be divided into communicating with FireCOM and driving the appliance safely.

Communicating with FireCOM

In the appliance, a radio message will be sent by the Officer in Charge or the driver, using the vehicle-mounted radio, informing the command centre that the appliance is responding. Messages sent will be read back, requiring the ability to verify that the information repeated back is correct. The vehicle-mounted radio is of high wattage. It has a handheld microphone and the sound is volume adjustable (refer to Figure 35). The volume adjustment affects the volume throughout the cabin, which means if it is set too low or too high, it will affect crew members.

Figure 35 Vehicle-mounted radio and microphone

Sirens are activated en route. Usually, the windows will be closed to exclude external noise. However, on occasion, where the air-conditioning is inadequate, windows may be opened during travel – for example, in extreme heat or in wet weather (when the windows fog up).

Additional radio communication that occurs en route includes briefings between the Officer in Charge and the crew about the activities to be undertaken.

Driving the appliance safely.

As with any commercial vehicle, drivers of the fire appliance must be able to rapidly detect other elements, such as vehicles, pedestrians and warning sounds. In addition, driving may be in emergency mode when speed limits and other road rules may be legally exceeded and traffic lights slowly driven through when red. The driver must be able to hear and respond to auditory cues from other traffic, bells at level crossings and so on while other radio communication is ongoing in the cabin of the appliance. The driver of the appliance must also be able to hear warning alarms, such as low air pressure in the braking system.

Incident – structure fires

On arrival at the incident, extensive verbal communication occurs in noisy situations. Appliances, traffic, machinery, diesel fire pumps (used to boost sprinkler and hydrant systems) all generate noise. Additional noise may include emergency warning systems in buildings and peak noise events such as explosions.

Additionally, PPE is donned: a SCBA mask covers the mouth, and a helmet and flash hood cover the ears (refer to Figure 36). From this point, communication between crew members is somewhat inhibited by the helmet and flash hood covering the ears, and close proximity to the noise of the

SCBA demand valve (because of inhalation and exhalation). The SCBA speech diaphragm results in decreased voice projection and muffled speech.

Figure 36 Personal protective equipment and communication

The flash hood sits over the ears under the helmet.

The self-contained breathing apparatus mask sits over the mouth, resulting in decreased voice projection and muffled speech.

Communication without the use of handheld transceivers across distances of up to 5 metres is not uncommon (refer to Figure 37) between team members and between teams at the incident (including inside structures).

Figure 37 Communication without radio transceivers

Once inside a structure, firefighters always work in pairs. Communication occurs between partners to ensure safety. For example, one firefighter may describe identified dangers, such as weakened floors and changes in direction, to their partner.

The bulk of communication between the two firefighters is direct speech. Handheld radio communication is not used between partners. Because of poor visibility from the smoke, few hand and tactile signals are used (Figure 38). Communication may also be required with other crews. Fire and the combustion process can contribute to background noise.

Figure 38 Poor visibility conditions and communication

Firefighters entering structural fire wearing full personal protective equipment. Note the position of each firefighter in relation to each other for poor visibility conditions, resulting in increased reliance on verbal communication and less on visual communication such as signs.

Firefighters need to hear various crucial sounds and noises, including:

- calls from casualties, which they need to localise accurately so they can then rescue the person
- important background noise – for example, fire development cues that may indicate imminent structural collapse such as creaking, falling masonry and beams (refer to Figure 39)
- the sound of gas release valves on heated gas cylinders is important, because pitch increases with increasing pressure and can indicate imminent explosion
- blasts of a horn from the distant fire appliance, which is used as a signal for evacuation
- the low pressure warning whistle a SCBA air supply emits when it reaches a critical level. The whistle generates a 2000–4000 Hz tone at a level of 90 dB. The whistle forms part of the valve arrangement that connects to the bottom of the SCBA cylinder
- a distress signal unit (DSU), which is worn by each firefighter (refer to Figure 40). Stages of pre-alarm are activated if the wearer stops moving for a period of time; this sound is initially soft and intermittent, then it increases in volume. A full alarm is sounded if the wearer fails to move on hearing the pre-alarm. The full alarm generates a 2000–3000 Hz tone at 90 dB (at 3 m). Hearing the DSU alarm by the partner is crucial for firefighter safety. The DSU also has flashing LEDs, which are only visible from limited angles to the firefighter and easily obscured by clothing or other objects. The DSU may also be voluntarily activated to assist additional crews coming in to locate firefighters inside.

Figure 39 Structural collapse of building

Auditory cues are important during internal firefighting for hearing sounds associated with imminent structural collapse.

Figure 40 Distress signal units

A distress signal unit is important to help locate a collapsed firefighter.

A distress signal unit with lights activated in full alarm.

Handheld transceivers are also used to communicate messages – such as the conditions of the incident, the actions being undertaken and the requirement for additional resources – from the firefighter to the incident commander. The handheld transceiver sits over the left or right lower chest in a coat pocket. The transmitting device forms part of the unit that sits in the pocket (refer to Figure 41).

Structural firefighting helmets include an internal speaker and microphone that allow the handheld transceiver to be plugged in, directing communications to one ear inside the helmet (refer to Figure 41).

Figure 41 Handheld transceiver, and structural helmet speaker and microphone

Handheld transceiver in pocket

Helmet radio communication

Communication from the incident commander is received through the handheld transceiver, including updated instructions and other requests. Incident-wide communication may also be received. Handheld transceiver volume levels must be moderated to reduce acoustic feedback between the two transceivers held by the partnered firefighters. High levels of background noise, combined with the SCBA, helmet and hood, can make it difficult to hear incoming messages.

Outside the structure, the pump operator works in close proximity to the noise of the running engine and pump of the appliance. They must be able to hear incoming radio communication from other firefighters on the incident ground, including command personnel and those inside the structure, to activate the correct controls. Duties are undertaken in significant additional background noise from the pumps, and multiple pumps may be present at incidents. The operator must also be able to hear other audible cues such as hissing from a ruptured gas main or noises associated with a collapsing structure. Duties include monitoring two radios – the incident ground radio channel and the command centre radio channel. Both sit on the pump control panel. Although the control panel includes a compound gauge to indicate water pressure, this cannot be monitored the whole time, and the operator needs to be able to hear changes in pitch that indicate changes to water pressure or supply.

Figure 42 Operating the pump against the engine background noise

Wildfire

Firefighters also work in teams of at least two people in wildfires. There may be several other crews in close proximity. Verbal communication with each other and with incident command are important, as is detecting crucial sounds and noises.

The PPE includes helmet and a neck protector, which cover the ears. There is less reliance on SCBA for wildfire firefighting. Mostly, P2-particle masks are worn – which, to some degree, inhibit speech. Communication occurs in high background noise – for example, higher than normal winds are generated by wildfires, the sound of burning bush (comparisons have been made to the sound of a jet engine) and petrol-powered pumps. Important background noise includes the sound of falling trees and venting cylinders.

Handheld radio communication occurs in background noise during wildfire firefighting (refer to Figure 43). Firefighters must also be able to hear and localise victims' calls for assistance in background noise.

Figure 43 Handheld radio communication during wildfire fighting

During mopping-up operations, chainsaws contribute to background noise. Important background noise includes the warning noise of cracking and falling trees and branches.

Hazmat

The impervious FE hazmat suit affects communication by inhibiting speech and hearing (refer to Figure 44). Helmets and flash hoods are not normally worn underneath the suit. The firefighter's speech echoes off of the large visor, which affects communication. Firefighter pairs in FE suits use mainly direct speech and the handheld transceiver to communicate with each other and with the incident commander.

Figure 44 Fully encapsulated suit

Fully encapsulated suit limits hearing and distorts speech.

Splash suits surround the face, sitting over the ears, creating noise likened to a rustling plastic bag.

Rescue

Rescue operations may vary widely. The most common rescue scenarios are motor vehicle accidents. A designated crew member is responsible for fire protection and therefore wears a SCBA; however, other crew members are able to communicate by direct speech without the constraints of the SCBA mask. Powered equipment, the fire appliance engine and other ambient noises (e.g. traffic) all contribute to background noise.

Specialised rescue operations, such as cliff face rescue, may use additional communication tools such as whistles. Background noise may include the crashing of the sea and howling wind. Urban search and rescue operators may be required to hear the fine tapping of a casualty caught below rubble.

9 Health attributes

The necessary health attributes for the effective undertaking of firefighting flow from a consideration of the inherent requirements. The assessment of health for firefighting also requires consideration of disease states, either latent or known, that can impact on capacity or that can lead to acute incapacity.

As with all commercial vehicle drivers, drivers of the fire appliance must be able to rapidly detect other vehicles, pedestrians and warning signs. However, this requirement is particularly important when firefighters are driving in emergency mode at high speed while exercising exemptions to normal road rules provided to drivers of emergency vehicles. Normal cues such as the flow of traffic cannot be relied upon.

Structural firefighting work requires very high levels of musculoskeletal and cardiopulmonary fitness, heat tolerance, alertness and decision-making ability. There are also considerable psychological demands due to exposure to potentially traumatic incidents.

Work is conducted as a team. In particular, when firefighters go into a structure, they go as a pair and are closely dependent on each other. Should one become incapacitated, both that firefighter and the partner are in imminent danger.

Wildfire fighting places similar high demands on the firefighter to structural firefighting work. It requires very high levels of musculoskeletal and cardiopulmonary fitness, heat tolerance and situational awareness.

Hazmat work places considerable demands on the cardiopulmonary and musculoskeletal systems, and requires working in a FE or splash suit while wearing a breathing apparatus, which can lead to heat stress.

Health attributes for firefighting can be described under four main categories – although there is some overlap between them:

- **Senses**: These attributes include vision, balance, and hearing and speech. Problems with vision or hearing rarely cause acute incapacity, apart from Meniere's disease and other causes of vertigo. However, significant impairment of vision or hearing may impact on the ability to effectively and safely perform firefighting duties.
- **Psychological**: These attributes include attentiveness, cognition and psychological resilience, which may be impaired by psychiatric disorders. An acute anxiety state or psychosis may cause significant impairment or acute incapacity. Some psychological conditions may result in impaired or slow reactions, or inappropriate actions.
- **General health**: This attribute refers to conditions that can impact on capacity and/or conditions that may cause acute incapacity or impairment. They include:
    - cardiovascular disorders such as coronary heart disease or arrhythmias
    - respiratory disease such as asthma
    - neurological disorders such as epilepsy and stroke
    - diabetes causing hypoglycaemia
    - heat-related illness – the ability to regulate heat is a particular issue for the cardiovascular system (refer to Section 9.3.1).

- **Musculoskeletal:** These attributes refer to locomotor capacities of the limbs and back, coordination of movement, endurance and agility, and so on. An injury such as a dislocation may cause acute incapacity.

These attributes are discussed in more detail in the following sections.

9.1 Senses

9.1.1 Hearing

To be able to perform the inherent requirements of fire suppression, rescue and hazmat duties, the following hearing attributes are required:

- Firefighters must be able to hear speech from direct verbal communication as well as from radio communications while wearing PPE, which attenuates sound against a noisy background.
- Firefighters must have adequate hearing to be able to hear and localise auditory cues crucial for safety – a victim crying for help, a DSU alarm, or to hear noises associated with imminent collapse or an appliance siren signalling urgent evacuation.
- Conditions will often include significant background noise and SCBA noise. Failure to hear sounds of low intensity, or to distinguish a voice or speech from background noise can lead to failure to respond to imminently hazardous situations. This jeopardises the safety of the firefighter or others who are dependent on the firefighter.
- Firefighters must also be able to hear vehicle, traffic and other road sounds when driving the appliance particularly in emergency mode.

9.1.2 Vision

Firefighting duties are often undertaken under emergency and adverse conditions, where the ability to detect visual information quickly relies on good eyesight – specifically, acuity and field. However, colour vision is not critical if there is redundancy of information. Abnormal vision may impact on reaction time, mobility and casualty recognition. Failure to adequately see and respond to imminently hazardous situations jeopardises the safety of the firefighter and others dependent on the firefighter for their safety.

The following visual attributes are required to be able to perform the inherent requirements of driving the appliance, fire suppression, and rescue and hazmat duties:

- Good visual acuity is crucial to driving safely. Good acuity is also essential to firefighting, especially under conditions of poor visibility, so that a firefighter may be operationally effective. Good acuity is crucial for tasks such as identifying casualties and hazards to other firefighters when moving through the incident.
- Peripheral vision is crucial to driving safely. However, it is of limited importance in many firefighting situations because the PPE limits the fields of vision and there are generally poor visibility conditions anyway. Peripheral vision is necessary when a firefighter arrives at an incident where work may be undertaken on roads and there is a need to detect traffic movements.
- Colour vision. A risk assessment undertaken by Dr John Parkes in 2009 concluded that while some tasks undertaken by firefighters require colour recognition, none were deemed safety critical. The exception to this is marine tasks, which are subject to maritime colour vision requirements.

9.2 Psychological health

Firefighting places heavy demands on various psychological attributes. Psychological conditions can impact on attentiveness, cognition and decision making, and the capacity to manage exposure to distressing events such as motor vehicle accidents, burnt and injured victims, and suicides. Conditions that can impact on psychological resilience, or impair judgement, behaviour, cognition and so on must therefore be assessed. Some psychological states may even result in acute incapacity (e.g. acute anxiety with panic attacks). Cognitive impairment may also occur due to misuse of drugs or alcohol, and some medications.

9.3 General health

9.3.1 Cardiovascular system

Good cardiovascular health is required. This is not merely the absence of cardiovascular conditions that can result in acute incapacity, but also good cardiovascular function, which is essential for coping with extreme workloads and maintaining core body temperature. Therefore, the risk of coronary heart disease and other conditions such as valvular heart disease and arrhythmias need to be assessed.

An efficient cardiovascular system is central to the maintenance of body heat regulation, to avoid impairment or acute incapacity from heat-related illnesses, or a cardiovascular event.

Six of 10 deaths of FRNSW firefighters on duty since 1989 have been cardiac related. Kales et al. studied the risk of fatal heart attacks in American firefighters in relation to their various duties.[4] Out of 449 deaths from 1994 to 2004, they found that fire suppression duties carried the highest risk of cardiac arrest, which was 10–100 times higher than for non-emergency duties. Acute incapacity on the incident ground can be hazardous not only for the firefighter concerned, but for the others in the crew who may be dependent on them, or need to rescue them. Kales et al. also found there was an increased risk of heart attack in the alarm response phase, which may be hazardous if the person was driving the appliance. In association with this research, the National Institute for Occupational Safety and Health (United States) recommends screening of firefighters for cardiac risk factors.[5]

9.3.2 Respiratory system

The extreme workloads of firefighting place high demands on the respiratory system; hence, good respiratory function is required. This includes the ability to wear a P2 negative-pressure particle mask, which imposes an extra load on respiration. Good respiratory function is essential for rapid exchange of O_2 and CO_2. Even normal respiratory function may be threatened by irritants in the firefighting environment, which can cause coughing, bronchospasm and pulmonary oedema. Therefore, conditions such as asthma and chronic obstructive pulmonary disease need to be assessed in addition to overall respiratory function.

9.3.3 Neurological disorders

Neurological disorders such as seizures, epilepsy and stroke can cause acute incapacity. Certain neurological conditions can also result impairments of, for example, cognition, coordination,

---

[4] Kales et al. *NEJM* 2007, 356:1207–15

[5] National Institute for Occupational Safety and Health Alert. *Preventing firefighter fatalities due to heart attacks and other sudden cardiovascular events*, 2007.

attention, judgement, sensation, balance or body temperature regulation. Therefore, any neurological conditions that can impact on these functions or result in acute incapacity must be assessed.

9.3.4 Diabetes

As diabetes is a risk for cardiovascular disease, and good cardiovascular health is required for firefighting, diabetes screening and assessment is important. Diabetes treatment associated with risk of hypoglycaemia is also assessed, as the absence of conditions resulting in impairment or acute incapacity is required for safe firefighting. Diabetes assessment is also relevant due to complications such as retinopathy (can result in visual impairment) and peripheral neuropathy (may affect balance), which can also impact on the effective and safe undertaking of firefighting duties.

9.3.5 Renal disease, fluid balance and acid–base metabolism

The extremes of the operational firefighting environment may cause considerable stress on fluid balance and hydration. Good renal function is required for acid–base balance. In addition, good renal function is required to withstand challenges to hydration, as underlying impaired renal function combined with dehydration may result in further renal injury.

9.3.6 Sleep disorders

Firefighting, including driving the appliance in emergency mode, requires accurate perception of a situation and rapid decision making. Disorders such as obstructive sleep apnoea may result in loss of concentration, and therefore affect the safety of firefighters tasked with driving due to fatigue and impairment of concentration.

9.4 Musculoskeletal

Firefighting places very high demands on the musculoskeletal system regarding strength, stability, dexterity, endurance and coordination; hence, the requirement for good musculoskeletal capacity. Joint instability may cause acute incapacity.

9.5 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2012.

Budd et al. *Int J Wildland Fire* 1997, 7:133–44.

National Fire Protection Association. *NFPA1582: Standard on comprehensive occupational medical program for fire departments*, Avon, MA, 2007.

NIOSH Alert. *Preventing firefighter fatalities due to heart attacks and other sudden cardiovascular events*, 2007.

Office of the Deputy Prime Minister. *Medical and occupational evidence for recruitment and retention in the fire and rescue service*, London, 2004.

Parkes J. *Risk assessment of safety critical and other duties performed by NSWFB personnel requiring colour vision,* 2009.

Rajaratnam SM, Barger LK, Lockley SW, Shea SA, et al. Sleep disorders, health, and safety in police officers. *JAMA* 2011, Dec 21;306(23):2567–78.

Shibasaki et al. *J Appl Physiol* 2006, 100:1692–701.

PART 3: MEDICAL FITNESS CERTIFICATIONS

Assessments undertaken against this Health Standard will result in applicants' or firefighters' medical fitness for firefighting being certified in accordance with one of the following standard classifications.

Fit to Perform Firefighting Duties Without Any Requirements or Restrictions

This indicates the applicant or firefighter meets all criteria in the Health Standard and is medically fit for the full range of firefighting duties without any requirements or restrictions.

For conciseness, this category will be referred to as Fit to Perform Firefighting Duties Unconditional within Part 4 of this standard.

Fit to Perform Firefighting Duties With Specified Requirements or Restrictions

This indicates that the applicant or firefighter meets all criteria in the Health Standard, provided that recommended requirements or restrictions are implemented, which may include and be certified as:

- Fit Subject to Review: more frequent medical review than that required under standard assessment schedules
- Fit Subject to Job Modification: suitable modifications to the job – for example, modification of physical equipment
- Fit Conditional on Wearing of Appropriate Aids (e.g. corrective lenses).

Temporarily Unfit to Perform Firefighting Duties, but fit to perform alternative duties, either with or without specified requirements or restrictions

This indicates that the firefighter does not meet the criteria for Fit to Perform Firefighting Duties Without Any Requirements or Restrictions. Their health situation is such that they may pose a risk to safety and therefore should not perform full firefighting duties at present. They must undergo prompt assessment to determine their ongoing status and be definitively classified. Temporarily Unfit to Perform Firefighting Duties may also be applied in situations where a clear diagnosis has not been made – for example, in the case of an undifferentiated illness that has resulted in blackouts. The firefighter may be assessed as Fit to Perform Firefighting Duties With Specified Requirements or Restrictions.

For conciseness, this category will be referred to as Temporarily Unfit to Perform Firefighting Duties within Part 4 of this standard.

Temporarily Unfit to Perform Any FRNSW Duties

This indicates that the firefighter does not have the capacity to safely perform any meaningful duties available within FRNSW at present; however, they require additional assessment to determine their long-term medical fitness for firefighting.

Permanently Unfit to Perform Firefighting Duties

This indicates that the firefighter does not meet the criteria for Fit to Perform Firefighting Duties Without Any Requirements or Restrictions or Fit to Perform Firefighting Duties With Specified Requirements or Restrictions (or any other conditional category). Their condition is deemed permanent (defined as unlikely to improve to the level required for firefighting duties in the foreseeable future) and they will not be able to perform firefighting duties in the foreseeable future. Fire & Rescue NSW policies such as redeployment may be considered.

PART 4: MEDICAL CRITERIA FOR FIREFIGHTER HEALTH ASSESSMENTS

This part outlines the medical criteria to be applied when assessing a firefighter's fitness for firefighting duties. It also includes guidelines for assessment and management or various health conditions with respect to firefighting work.

For the purposes of this standard, firefighting is used to collectively define all of the inherent tasks detailed in Part 2 of this document.

This part is presented in a series of chapters addressing the main health conditions that are likely to affect fitness to perform firefighting duties, including:

- blackouts
- cardiovascular conditions
- diabetes
- hearing
- musculoskeletal conditions
- neurological conditions, including dementia, seizures and epilepsy, vestibular disorders and other neurological conditions
- psychological conditions
- respiratory conditions
- sleep disorders
- substance misuse
- vision and eye disorders.

Each section provides general information about the condition and its effects on medical fitness for duty, and then provides advice about the medical assessment of the condition. The tables set out the criteria to be met for medical fitness for duty; however, they are not exhaustive. The criteria usually emphasise function in relation to the job, rather than being based on diagnosis or impairment.

When assessing a firefighter, the assessing medical practitioner should be mindful of the general principles and demands of firefighting work (refer to Sections 7–9), and the implications for safety and effective delivery of service. These principles should be the touchstone for difficult cases or conditions not adequately covered in this Health Standard.

This Health Standard does not presume to deal with the myriad conditions that may affect health on a short-term basis. Such conditions may include post–major surgery, severe migraine, fractures to limbs or acute infections.

Clinical judgement is usually required on a case-by-case basis, although the text in each section gives some advice on the clinical issues to be considered.

10 Blackouts

10.1 Relevance to firefighting duties

Unpredictable, spontaneous loss of consciousness is incompatible with performing firefighting duties, including driving an appliance in emergency mode and working in dangerous environments. Loss of consciousness in these circumstances is likely to jeopardise the safety of the individual firefighter, their crew and members of the public.

10.2 General assessment and management guidelines

Blackouts may arise from various conditions including:

- hypotension because of inappropriate vasodilation (e.g. vasovagal faints, autonomic nervous system disorder)
- other cardiovascular disorders (e.g. arrhythmias, flow obstruction, or other unusual conditions such as subclavian steal)
- neurogenic disorders (e.g. epilepsy)
- metabolic disorders (e.g. hypoglycaemia)
- psychiatric disorders (e.g. hyperventilation, psychosomatic states)
- drug intoxication
- sleep disorders.

For the purpose of this Health Standard, a syncopal event is defined as a loss of consciousness arising from a cardiovascular cause (refer to Section 11, Cardiovascular disorders).

Blackouts, whether they occur on or off duty, should be managed as per Figure 45. Determination of the cause of blackouts may be difficult and require extensive investigations (cardiac, neurological) and specialist referral.

Some conditions causing blackouts are temporary (e.g. acute infection or during venepuncture) and should not impact on fitness for duty if found to be triggered by a well-defined provoking factor that can be avoided at work. The cause should be confirmed by the firefighter's treating doctor since vasovagal syncope can also result from conditions that are not so benign.

In the event of an unexplained blackout, the firefighter should be classified 'Temporarily unfit to perform firefighting duties' until the cause is ascertained and treated.

Despite extensive investigation, it is not always possible to determine whether the mechanism of a blackout is syncope, seizure, hypoglycaemia, a sleep disorder or another condition. For blackouts of unknown cause – as some of these cases will, in fact, be seizures – a standard similar to that for seizures is applied (refer to Table 1).

Where a firm diagnosis has been made, the criteria appropriate to the condition should be referred to elsewhere in the Health Standard. For blackouts not covered elsewhere in the Health Standard, refer to Table 1.

Figure 45 Management of blackouts and firefighting

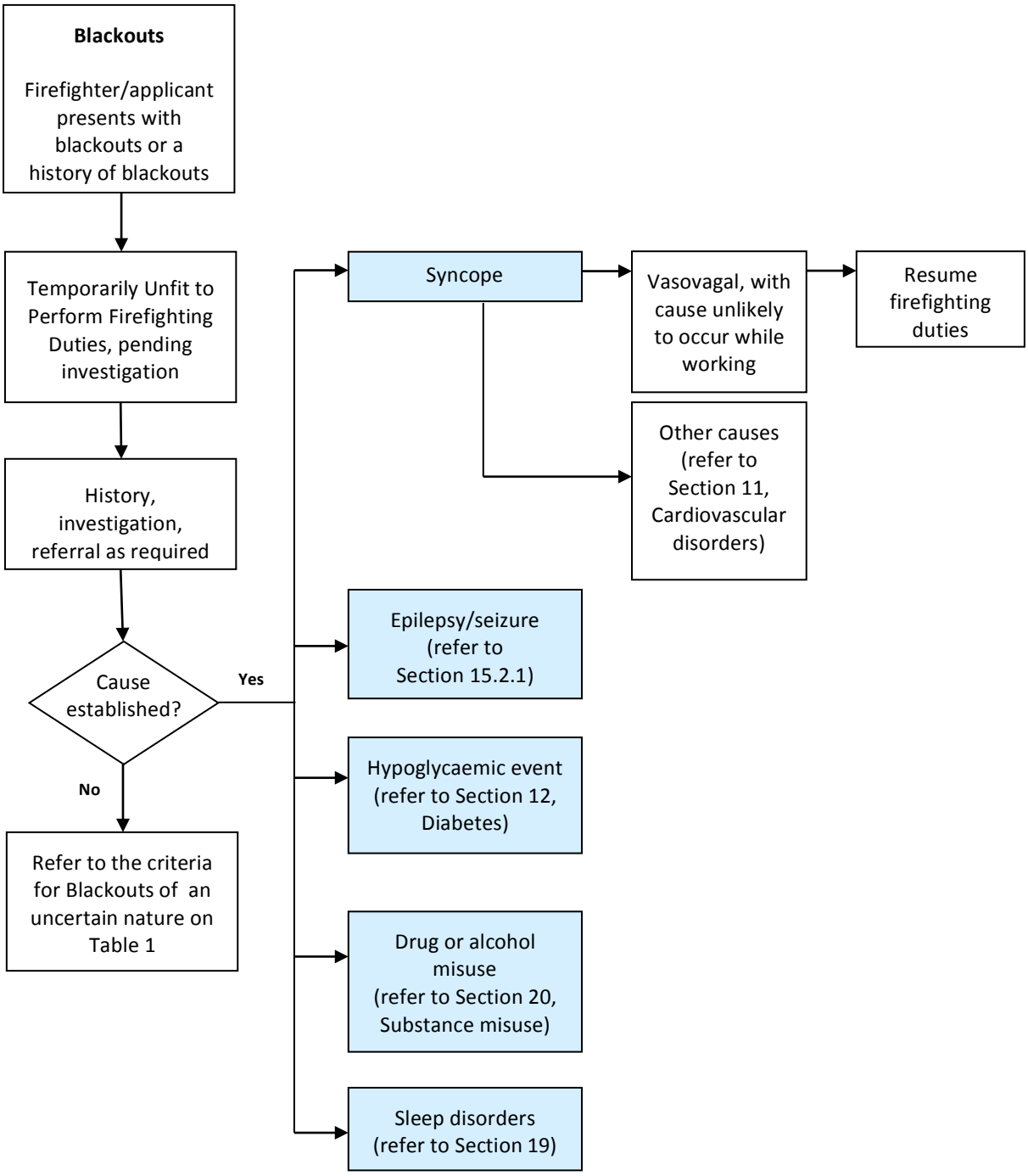


Table 1 Medical standards for operational firefighters – blackouts of uncertain nature

Condition	Criteria
Blackouts (an episode(s) of impaired consciousness) of uncertain nature	A firefighter is not Fit to Perform Firefighting Duties if they have experienced blackouts that cannot be diagnosed as syncope, seizure or another condition. If there has been a **single blackout** or more than one blackout in a 24-hour period, Fit to Perform Firefighting Duties Subject to Review may be determined by the FRNSW Occupational Physician, taking into account information provided by the appropriate specialist as to whether the following criterion is met: • there have been no further blackouts for at least **five years**. If there have been **two or more blackouts** separated by at least 24 hours, Fit to Perform Firefighting Duties Subject to Review may be determined by the FRNSW Occupational Physician, taking into account information provided by the appropriate specialist as to whether the following criterion is met: • there have been no further blackouts for at least **10 years**.
Exceptional cases	Where a firefighter with one or more blackouts of undetermined mechanism does not meet the standard for Fit to Perform Firefighting Duties, Fit to Perform Firefighting Duties Subject to Review may be determined by the FRNSW Occupational Physician taking into account information provided by assessing specialists, investigations undertaken and blackout-free period. Where the firefighter holds a licence subject to the medical standards for commercial vehicles (e.g. medium rigid, heavy rigid), the driver licensing authority assessment will also be taken into account.

10.3 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2012.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

11 Cardiovascular disorders

11.1 Relevance to firefighting duties

The cardiovascular demands of operational firefighting duties are extreme, resulting in significant cardiovascular and thermal strain. Acute incapacitation of a firefighter during firefighting duties, including operation of the appliance, can severely jeopardise the safety of the firefighter, their crew (who may have to rescue them) and members of the public.

Active firefighting can be one of the most strenuous activities undertaken by people.

Analysis of the inherent requirements of Fire and Rescue NSW (FRNSW) firefighting duties closely match those of American firefighters as outlined in National Fire Protection Association's *NFPA1582: Standard on comprehensive occupational medical program for fire departments*. Therefore, consideration of United States (US) data and experience are highly relevant and are discussed here.

The leading causes of on-duty deaths in firefighters are acute cardiovascular events. In the US, acute cardiovascular events accounted for 45% of all on-duty deaths occurring between 1995 and 2004. These rates are significantly higher than for other occupational groups, such as police and emergency medical services, with rates of 22% and 11%, respectively. Also, for every fatal cardiovascular event on duty, it is estimated that there are 17 nonfatal on-duty events in the US.

Acute cardiovascular events include acute myocardial infarction, fatal arrhythmia and other events such as stroke.

In the five years to 2012, sudden cardiac death continued to account for 42% of on-duty deaths in the US. The NFPA reported that, in 2012, in spite of the reduction in numbers of on-duty deaths (from all causes), sudden cardiac death was still the number one cause of on-duty firefighter deaths, and usually accounted for the highest share of deaths in any given year. In 2012, of the 74% of cardiac death victims for whom autopsy or medical records were available, 40% were reported to have had a history of cardiac problems, such as previous heart attacks or revascularisation procedures (e.g. stent or coronary artery bypass grafting). More than 50% of FRNSW deaths on duty in the past 20 years have been caused by cardiac events.

Studies confirm that the conditions of firefighting can precipitate acute cardiovascular events in susceptible individuals; these events are not just c-incidentally occurring while the firefighter is on duty. Although active fire suppression represents only 1–5% of on-duty time, fire suppression accounts for the majority of on-duty cardiovascular deaths:

- active fire suppression duties (more than 30%)
- alarm return (17%)
- alarm response (13%)
- physical training (12%).

Also, these deaths do not follow the normal circadian pattern of the general population – 66–77% occur between midday and midnight as do most emergency operations, whereas in the general population, the peak incidence of myocardial infarction is 0600–1100.

Acute incapacitation of a firefighter jeopardises the safety of the firefighter, their crew and members of the public.

11.1.1 Factors specific to firefighting

There are several factors specific to firefighting that act either individually or collectively to increase the risk of a heart attack:

- **Sympathetic activation.** Heart rates rise dramatically following initial alarm, and reach near maximal or maximal predicted values during simulated or actual fire emergencies. Firefighters go from complete rest to full activity in minutes. Irregular episodes of strenuous activity in normally sedentary individuals are well-known precipitants of acute coronary events, as are periods of high emotional stress.
- **Strenuous activity.** Structural and bushfire firefighting, hazmat, and search and rescue all entail a high physical workload. Many duties are undertaken with the additional load of personal protective equipment of up to 21 kg, significantly adding to cardiovascular and thermal strain.
- **Oxygen update capacity.** Studies estimate that the average required oxygen uptake capacity, as measured by oxygen consumption required for the safe performance of firefighting duties, is 9.7–12.8 metabolic equivalents (METS) (VO_2 of 33.9–45 ml/kg/min). $V0_2$ max declines with age, so the stated range represents the following levels of fitness for each age group:
    - **30s:** a good level for men and good to excellent level for females
    - **40s:** good to excellent level for men and excellent to superior for females
    - **>50:** excellent to superior level for men and superior for females
- **Body heat.** The work of firefighting produces large amounts of metabolic heat. Additional sources of thermal strain include radiant heat from fires, ambient temperature and humidity. Core body temperature can rise to 39 °C. Normal heat dissipation mechanisms are severely limited by the firefighting ensemble and chemical suits. Heat-related illness is therefore a risk and adds to cardiovascular strain, with predisposing factors including obesity, low levels of fitness, dehydration, lack of acclimatisation, sleep deprivation, concurrent illness, medications that impair thermoregulation (e.g. stimulants and anticholinergics) and medications that increase fluid loss (e.g. diuretics).
- **Dehydration.** Heat stress and dehydration are closely related and add to cardiovascular strain. Dehydration results in decreased plasma volume (and hence stroke volume), with further impairment of thermoregulation and haemoconcentration. Haemoconcentration causes changes in blood electrolytes and increases blood viscosity. Prothrombotic tendencies are therefore potentially acutely increased.
- **Sweating.** The firefighting ensemble and chemical suits result in profuse sweating – as much as 2 litres or more per hour during strenuous firefighting activity. Plasma volume has been reported to decrease by 15% after 18 minutes of strenuous firefighting drills.[6] Because of activities undertaken when not on duty – including sports, activities at home and other employment (secondary for permanent firefighters, primary for retained firefighters) –firefighters may be relatively dehydrated before undertaking active operational duties.
- **Carbon monoxide exposure.** Carbon monoxide is present in virtually all fire environments. Inhalation results in disruption to the blood's transport and intracellular use of oxygen. The resultant hypoxia leads to decreased oxygen supply to the myocardium. Unstable angina may be

---

[6] Smith DL, Liebig JP, Steward NM, Fehling PC. *Sudden cardiac events in the fire service: understanding the cause and mitigating the risk,* Skidmore College, Health and Exercise Sciences, First Responder Health and Safety Laboratory, 2010.

precipitated in those with previously stable disease. The risk of myocardial infarction is more acutely increased for those with underlying critical coronary artery atherosclerosis.

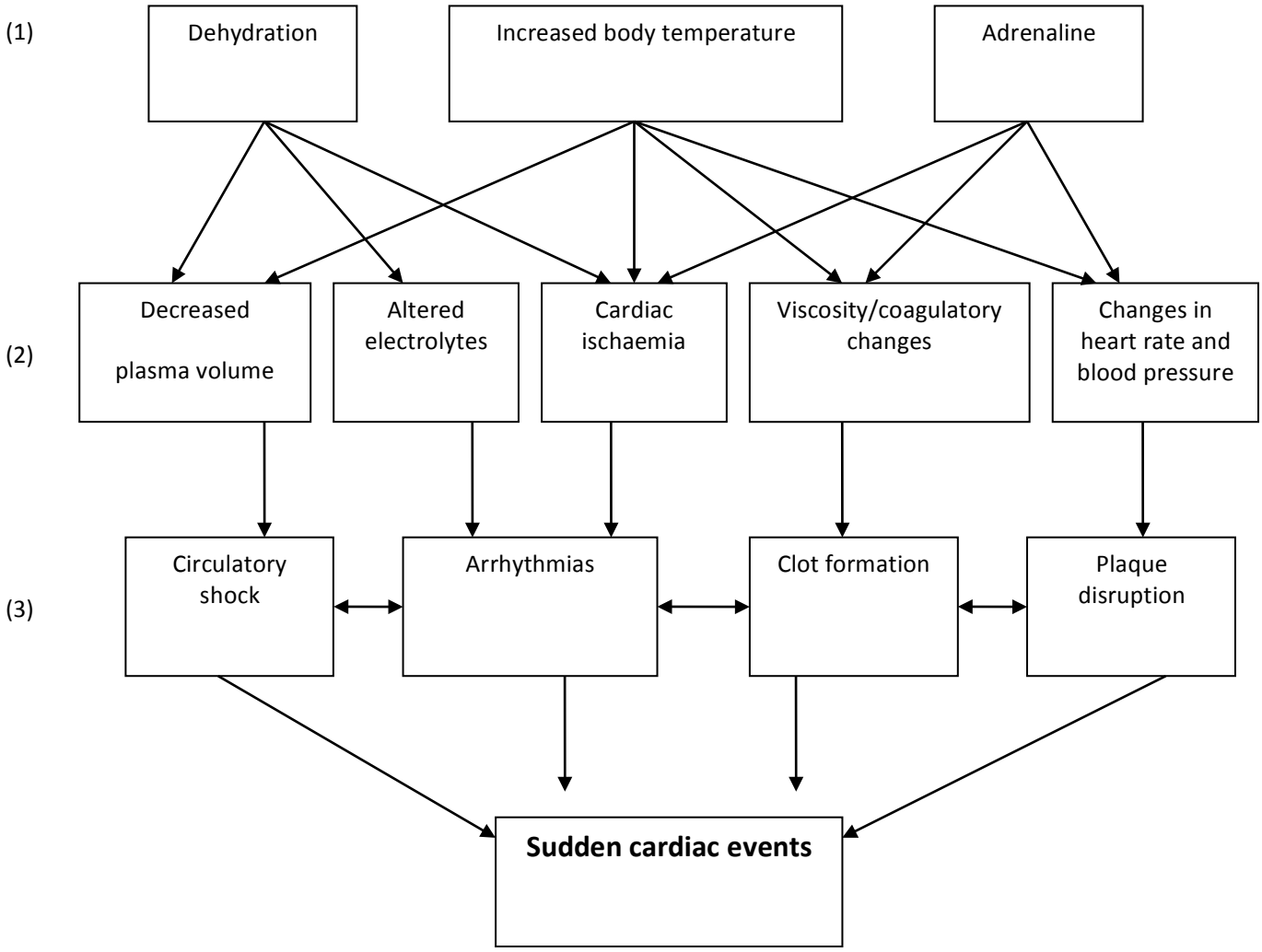
Firefighters are protected from carbon monoxide while wearing the self-contained breathing apparatus (SCBA); however, firefighters frequently remove their SCBA during activities such as overhaul, where there may still be significant concentrations of carbon monoxide. A SCBA is not routinely worn for bushfire firefighting, rather, firefighters wear the P2 mask, which does not protect them from carbon monoxide. Increased uptake of carbon monoxide is expected with increased breathing during hard work.

- **Shift work.** Permanent firefighters mostly work a '10/14' roster, consisting of two, 10-hour days, followed by two, 14-hour nights, followed by four days off. Some permanent firefighters may engage in secondary employment in between sets of shifts. Retained firefighters are on call and can work variable hours, usually in addition to primary employment. Many studies of various occupations have found an association between shift work and increased risk of cardiovascular disease. The mechanisms are likely to be multifactorial, including psychosocial, behavioural and direct metabolic pathways. Poor dietary habits, sleep disruption and less physical activity may increase the risk of metabolic syndrome. Sleep deprivation or sleep disturbance has been associated with insulin resistance, weight gain, hypertension and cardiovascular disease.
- **Other.** Intermittent noise exposure from alarms, sirens, engines and mechanised rescue equipment all increase blood pressure. Short-term exposure to particulate matter has been associated with triggering myocardial infarction, particularly among people with pre-existing heart disease. This has implications for firefighters, given their exposures to fire smoke particulate matter after removing their SCBA or mask in overhaul operations.

Active firefighting duties lead to hyperthermia, dehydration and considerable cardiovascular strain.

Several biologically plausible pathways may trigger acute cardiovascular events: rupture of vulnerable plaque from sheer stress, hypercoagulability leading to platelet aggregation and clot formation, and increase in myocardial oxygen demand exceeding myocardial oxygen supply.

Figure 46 Interaction of multiple events during firefighting that can combine to result in acute



cardiovascular events

11.1.2 Personal risk factors

US data show that on-duty cardiovascular deaths occur almost exclusively in susceptible individuals with underlying coronary artery disease – either previously diagnosed or latent. Thirty per cent of the cardiac deaths had prior known coronary artery disease, as determined by evidence of a history of myocardial infarction, angioplasty/stent procedures or bypass surgery. Of all autopsies, 56% revealed left ventricular hypertrophy, a major cause of which is chronically uncontrolled hypertension.

Increasing age and male gender are significant and uncontrollable risks for cardiovascular disease, and relevant to an ageing, largely male workforce. FRNSW data from 2010 show a median age of 42 years for permanent firefighters and 40 years for retained firefighters, with 23% of all operational personnel aged 50 and over.

Epidemiological studies show that, similar to the general population, the majority of incident cardiovascular disease events occur in emergency responders (firefighters and police officers) who are initially only prehypertensive or mildly hypertensive. The mean blood pressures observed in

those who subsequently developed disease were in the range of 140–146/88–92 mmHg. Data show that hypertension is poorly controlled in the general community.

Of all on duty deaths from acute cardiovascular events …

… 40%* had a previously documented history of coronary heart disease

… almost 100% of on duty cardiac deaths had underlying coronary heart disease.

*NIOSH data series 1994–2004. Of the 70% for whom medical information was available, 40% had a previous history.

11.2 Assessment and medical criteria

11.2.1 General assessment and management guidelines

The aim of assessment is to detect latent and symptomatic heart disease, and to detect risk factors that require management, to help prevent progression to critical disease. Cardiac risk level and clinical assessment is used for assessment.

Cardiovascular disease may also result in stroke, peripheral vascular disease and eye disease. The relevant chapters should be referred to for advice on assessment of these effects.

Medical criteria for medical fitness for duty are outlined in Table 2.

Cardiac risk assessment

Assessment of cardiac risk involves clinical assessment as well as determining the cardiac risk level. Clinical assessment includes evaluation of:

- symptoms such as undetermined chest pain
- family history such as first-degree relatives having cardiovascular events in mid-life
- past history
- comorbidities such as obesity, inactivity, obstructive sleep apnoea, depression and posttraumatic stress disorder.

A firefighter who is found to be at increased risk of a cardiac event, but is asymptomatic, requires a higher level of assessment than an ordinary patient because of:

- the risks inherent to firefighting that increase the risk of precipitating an event (as discussed in Section 11.1)
- the effect of acute incapacity on the safety of the individual firefighter and others.

All information should be taken into account. Clinical judgement and discussion with a FRNSW Occupational Physician may be needed to determine the individual's fitness for duty while further investigation is undertaken.

Cardiac risk level

The cardiac risk level is a tool for predicting the absolute risk of a cardiovascular event in asymptomatic persons. In particular, it is useful in predicting the risk of a heart attack over 5 years. Although it is a useful tool, it cannot replace clinical assessment. The tool is also useful in helping to guide risk factor management. Age is a major determinant of risk, and so application of this assessment is much more important for older firefighters than for young recruits.

To assess cardiac risk level, data need to be collected for:

- age and sex
- cigarette smoking
- blood pressure
- fasting total and HDL cholesterol
- fasting glucose levels or known diabetes (a fasting level of more than 7 mmol/L is 'diabetic' for calculations, and individuals with values of 5.5 mmol/L or more require an oral glucose tolerance test).

Determine risk level

To determine risk level, refer to Figure 47. An online calculator is available at www.cvdcheck.org.au.

Within the chart, choose the cell nearest to the person's age, systolic blood pressure and total cholesterol:HDL ratio. Individuals who fall exactly on a threshold between cells are placed in the cell indicating higher risk. Individuals below the age of 35 should be managed as if they are 35 years old.

Stratification and risk management

The cardiac risk level gives an estimation of probability of a cardiovascular event in the next 5 years. The higher the score, the higher the probability. Management of firefighters is determined by considering their risk level in conjunction with their overall cardiac risk assessment (again, refer to Figure 47):

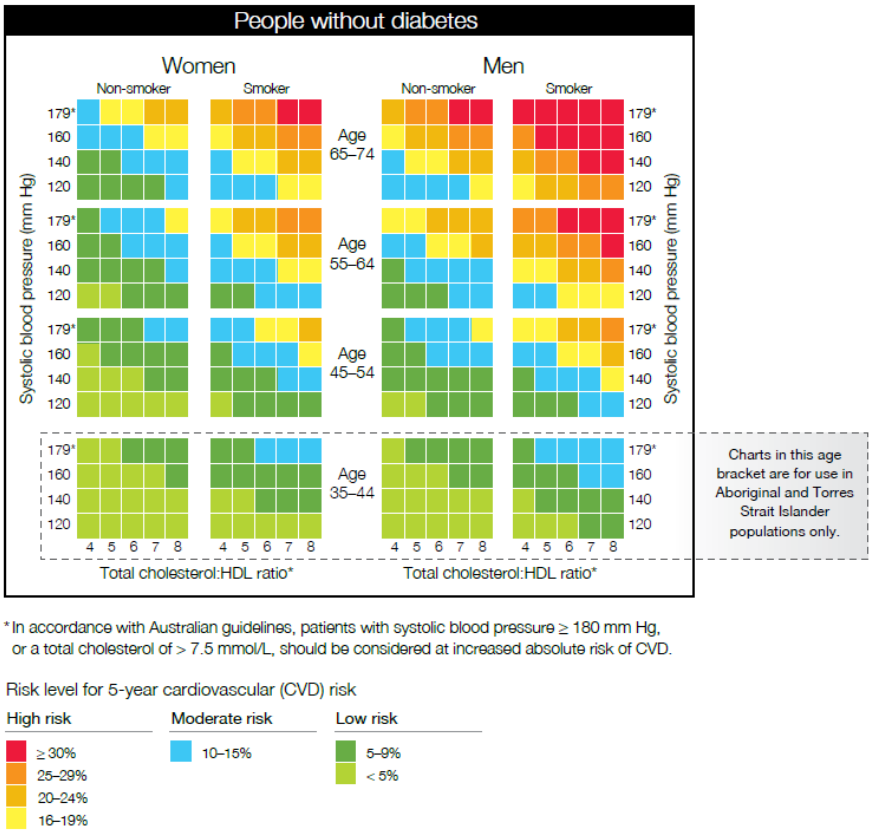
- Probability ≥16% in 5 years (red, orange, light orange and yellow cells). The firefighter is Unfit to Perform Firefighting Duties. They should be referred for an exercise stress test and classed as Temporarily Unfit to Perform Firefighting Duties pending results and appropriate management.
- Probability 10–15% in 5 years (blue cells). The firefighter is referred for an exercise stress test. While waiting for the results, the firefighter may be assessed as Fit to Perform Firefighting Duties Subject to Review (if there has been a normal exercise stress test within the past two years) or Temporarily Unfit to Perform Firefighting Duties.
- Probability 5–9% in 5 years (dark green cells). The firefighter is assessed for specific risk factors and overall cardiac risk, including obesity, physical activity and family history. The firefighter should be referred to their general practitioner for risk factor modification. An exercise stress test should usually be arranged. While awaiting results of further assessments or investigations, the firefighter may be classed as Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties, depending on the overall assessment.
- Probability <5% in 5 years (light green cells). The firefighter is assessed regarding overall cardiac risk assessment and managed accordingly, including referral to their general practitioner as required. They may be classed as Fit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review depending on the overall assessment.

Absolute risk is considered very high (5-year risk of >20%) in persons with previous cardiovascular disease event (including myocardial infarction, stents, bypass surgery, transient ischaemic attack, ischaemic stroke). Adults with any of the following conditions are also considered to be at very high or high risk – therefore the cardiac risk level need not be applied:

- diabetes and age >60 years

- diabetes with microalbuminuria (>20 mcg/min; or urinary albumin:creatinine ratio >2.5 mg/mmol for males or > 3.5 mg/mmol for females) (see also Section 17, Renal disorders)
- moderate or severe chronic kidney disease (persistent proteinuria or estimated glomerular filtration rate <45 mL/min/1.73 m^2) (see also Section 17, Renal disorders)
- a previous diagnosis of familial hypercholesterolaemia
- systolic blood pressure >180 mmHg or diastolic blood pressure >110 mmHg
- serum total cholesterol >7.5 mmol/L.

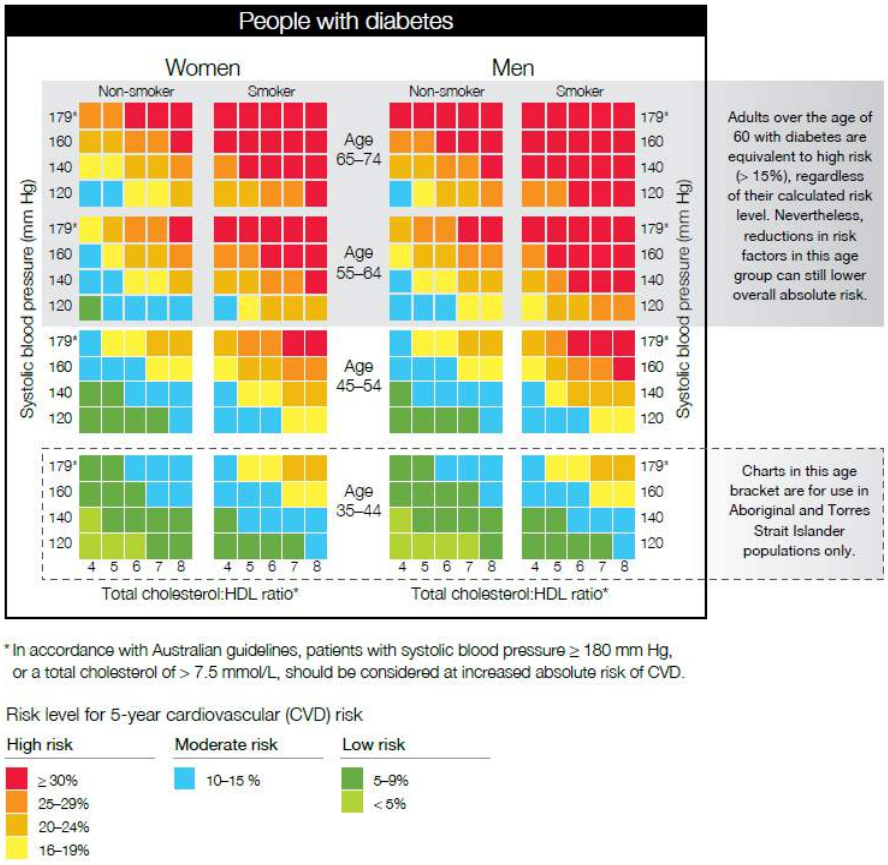
Figure 47 Coronary heart disease risk factor prediction charts



*In accordance with Australian guidelines, patients with systolic blood pressure ≥ 180 mm Hg, or a total cholesterol of > 7.5 mmol/L, should be considered at increased absolute risk of CVD.

Risk level for 5-year cardiovascular (CVD) risk

High risk	Moderate risk	Low risk
≥ 30%	10–15%	5–9%
25–29%		< 5%
20–24%		
16–19%		



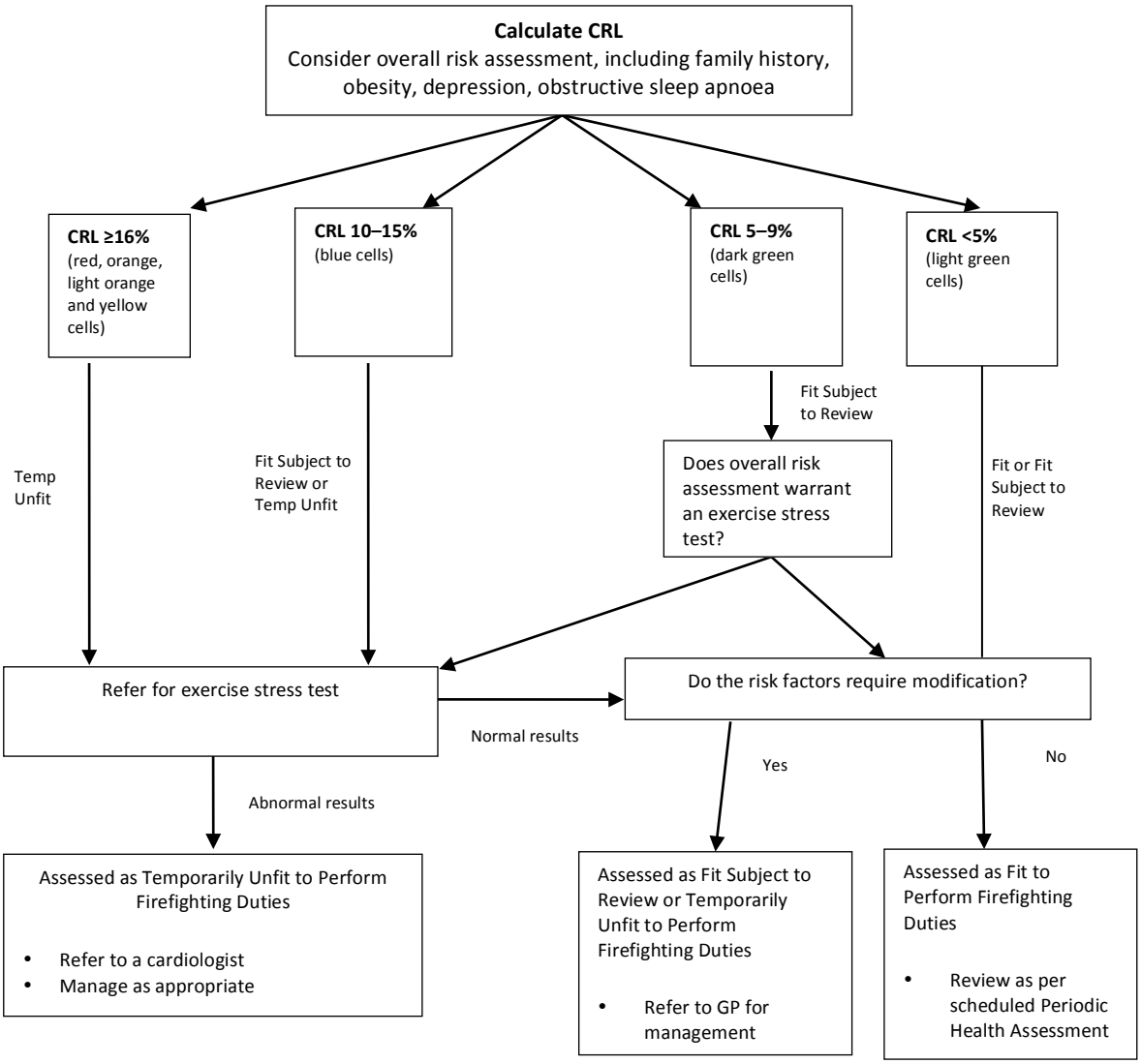
* In accordance with Australian guidelines, patients with systolic blood pressure ≥ 180 mm Hg, or a total cholesterol of > 7.5 mmol/L, should be considered at increased absolute risk of CVD.

Risk level for 5-year cardiovascular (CVD) risk

High risk	Moderate risk	Low risk
≥ 30%	10–15 %	5–9%
25–29%		< 5%
20–24%		
16–19%		

Reproduced with permission from Absolute cardiovascular disease risk assessment: quick reference guide for health professionals, *an initiative of the National Vascular Disease Prevention Alliance. © 2009 National Heart Foundation of Australia (https://heartfoundation.org.au/images/uploads/publications/aust-cardiovascular-risk-charts.pdf).*

Figure 48 Management of cardiac risk level (CRL)



GP = general practitioner
Refer to Figure 47 for CRLs.

Exercise stress test

The exercise stress test should be conducted using the Bruce protocol. The exercise capacity must be ≥90% of the age/sex predicted capacity. Where the stress test is abnormal (e.g. ischaemia, arrhythmia, hypertensive response, abnormal heart rate recovery) or clinical assessment warrants it, referral to a cardiologist should be made for further assessment and advice on clinical management.

In addition, it is desirable for the person to achieve a level of ≥12 METS. If this is not met, they should be referred for assistance in improving their aerobic capacity.

Choice of stress test

Exercise stress electrocardiogram without imaging would normally be the first choice of exercise stress testing for screening asymptomatic individuals.

Interpretation of results should include consideration of electrocardiogram changes suggestive of ischaemia, blood pressure response, heart rate recovery and exercise capacity.

Stress echocardiography (in preference to myocardial perfusion imaging, as it does not involve injection) should be requested for those with left bundle branch block, any other reason for uninterpretable electrocardiogram (ECG), left ventricular hypertrophy or paced rhythm. Stress echocardiography should also be considered where the history is suggestive of ischaemic heart disease and for high-risk groups – for example, in those with long-standing diabetes, where silent ischaemia is possible (stress echocardiography may show fixed wall motion abnormalities consistent with previous infarction).

Myocardial perfusion imaging (with exercise stress) may be required based on the opinion of a cardiologist.

Medication and exercise stress test

Some medications, such as beta blockers or digoxin, may impact on the results of exercise stress testing. Medication should be stopped at the appropriate time before the exercise stress test, only with the agreement of the treating doctor.

Electrocardiogram and echocardiograph

If voltage criteria for left ventricular hypertrophy are found on the ECG, an echocardiograph should be requested to assess for left ventricular hypertrophy. For the purpose of this standard, both the Sokolow-Lyon and Cornell criteria must be met:

- Sokolow-Lyon voltage criteria: R wave V_5 or V_6 + S wave V_1 >35 mm
- Cornell voltage criteria: R wave aVL + S wave V_3 >28 mm in men, or >20 mm in women

The ECG is specific, but not sensitive, for left ventricular hypertrophy; therefore, if the firefighter has a history of long-standing or poorly controlled hypertension, an echocardiograph should be considered, even if voltage criteria for left ventricular hypertrophy are not met. If confirmed, the presence of left ventricular hypertrophy is associated with increased risk of cardiovascular morbidity and mortality, and will need to be considered in the overall cardiac risk assessment.

Management of risk factors

Where risk factors are identified – for example, raised blood pressure and smoking – the firefighter should be referred to their general practitioner and FRNSW health promotion programs. A negative stress test – although making the current presence of significant disease unlikely – does not 100% exclude the presence of disease. There may be noncritical disease present that can progress; hence, the importance of risk factor management must be emphasised.

The firefighter should be reviewed to monitor the management of their risk factor profile. If appropriate, the general practitioner may be requested to provide a management plan to the assessing doctor.

Coronary heart disease and related interventions

When considering the likelihood of future events in a firefighter with known coronary artery disease under treatment, it is important to note that the medical literature on the benefits of treatments and interventions relates to risk in the general population, not in groups such as firefighters who are exposed to extreme conditions that can result in extreme cardiovascular strain and an increased prothrombotic risk. A review of on-duty cardiovascular deaths in the US between 1995 and 2004 revealed that 30% of decedents had a previous history or evidence of coronary heart disease –

myocardial infarction, angioplasty, stent or bypass surgery. There is overwhelming evidence of markedly higher relative risk of on-duty death and disability in firefighters with established coronary artery disease.

Many patients will consider themselves cured post–revascularisation procedures; however, the evidence does not support this. Coronary artery disease is a chronic disorder with a natural history that spans several decades. It is a progressive disease, so even after successful revascularisation, recurrent events are to be expected. The extreme conditions of firefighting increase the risk of acute cardiovascular events in vulnerable individuals. Previous cardiovascular events automatically place individuals in a high-risk group, with their clinical 5-year risk assumed to be >20%.

In those with known disease, stress testing may be used as a tool for further risk stratification (to help predict the risk of future events); however, given the background of elevated risk in those with treated coronary heart disease, plus the conditions of firefighting known to increase the acute risk in vulnerable persons, plus the safety implications of acute incapacity, it is unlikely that risk would be estimated to be at an acceptably low level. Furthermore, stress testing cannot replicate the physiological strain of firefighting and, therefore, cannot be relied on as predictive for events under those extreme conditions.

Acute coronary syndrome (including ST and non-ST elevation myocardial infarction, and unstable angina), bare-metal or drug-eluting stent surgery, or bypass surgery would normally preclude a firefighter from operational duties on a permanent basis. Such diagnoses must be verified by the appropriate specialist.

Other cardiovascular disorders

Suspected angina pectoris

Where chest pains of uncertain origin are reported, every attempt should be made to reach a positive diagnosis and the firefighter advised to not undertake firefighting duties while being evaluated. The firefighter should be classed as Temporarily Unfit to Perform Firefighting Duties until investigations have reasonably excluded cardiac origin for the symptoms. If investigations are positive or the firefighter remains symptomatic, requiring anti-anginal medication for symptom control, they should remain Temporarily Unfit to Perform Firefighting Duties until a final diagnosis is reached. Should coronary artery disease or other cardiac disease be confirmed as the cause for symptoms, reference will need to be made to the relevant section of this standard.

Cardiac surgery

Cardiac surgery may be performed for various reasons, including valve repair, valve replacement or correction of septal defects. In some cases, the surgery will be curative. However, in other cases there will be ongoing risks in relation to firefighting – for example, the requirement for lifelong warfarin or other anticoagulation with a mechanical heart valve. Each case therefore requires individual assessment and all firefighters should be classed as Temporarily Unfit to Perform Firefighting Duties until the assessment is finalised.

High blood pressure

Hypertension increases the risk of heart attack and stroke. Heart rate and blood pressures are elevated during firefighting and other emergency operations. The physical work demand and the emotionally charged environment require these physiological responses. The extent of the physiological demands is determined by the particular operation. The strenuous activity and sympathetic activation associated with active operational duties may interact with underlying already-elevated blood pressure to precipitate acute cardiovascular events. Uncontrolled

hypertension is an independent risk factor for on-duty cardiovascular events and deaths in firefighters.

The Health Standard reflects the importance of good blood pressure control for firefighters, and clinicians should encourage appropriate treatment so that firefighters do not continue to work for years with uncontrolled blood pressure.

The cut-off blood pressure value at which a firefighter is considered unfit to perform firefighting duties does not reflect the usual goals for managing hypertension. A firefighter should be deemed Temporarily Unfit to Perform Firefighting Duties if their blood pressure is ≥160 mmHg systolic or ≥100 mmHg diastolic, treated or untreated, irrespective of cardiac risk level. This cut-off has been set for firefighters because of the job-specific factors described previously, which can result in acutely higher blood pressures and potentially precipitation of acute cardiovascular events.

Side effects of antihypertensive medication must also be considered when assessing fitness for firefighting duties. A number of antihypertensive agents cause vasodilatation. Hypotensive episodes may therefore be precipitated when exposed to high temperatures, strenuous exercise and fluid loss. History should be elicited in relation to such effects, and the firefighter should also be counselled on the potential for these effects and the importance of maintaining adequate hydration.

Arrhythmia

The Health Standard takes into consideration the risk of acute incapacity from an arrhythmia, other limiting symptoms, risk of ventricular fibrillation and the potential effect of the physiological strain of firefighting duties in increasing the risk of recurrent arrhythmia or other complications. Any underlying causes, precipitants and treatment side effects must also be considered.

Atrial fibrillation

Atrial fibrillation is of significance for firefighters because of immediate clinical effects such as shortness of breath, syncope, palpitations, chest pain or limited exercise tolerance. Symptoms vary significantly between individuals. Longer-term complications, such as ventricular dysfunction or complications from thromboemboli, are also of significance for firefighters. Medication side effects such as proarrhythmic effects must also be considered. The use of anticoagulants is discussed below.

Conduction defects

Conduction defects are assessed for underlying cause, effect on exercise capacity, interaction with the extreme conditions of operational duties, risk of acute incapacity and treatment, including medication and pacemakers.

As an isolated finding, a first-degree heart block can be considered a variation of normal in the absence of syncope or presyncope, especially in a young and fit individual.

An incomplete right bundle branch block requires no further investigation. A complete right bundle branch block can occur as a normal finding in healthy individuals. Further assessment is, however, warranted to exclude or confirm the presence of a structural heart abnormality.

Incomplete left bundle branch block requires consideration of an underlying risk, such as hypertension and left ventricular hypertrophy. Left bundle branch block usually indicates underlying hypertension, coronary heart disease or cardiomyopathy, and must be assessed accordingly. The firefighter should be classed as Temporarily Unfit to Perform Firefighting Duties while further assessment is undertaken.

Long QT syndrome is a risk for tachyarrhythmias and ventricular fibrillation. Exercise, emotion and loud noises may precipitate an arrhythmic event. Long QT syndrome may also be caused by some medications. A long QT interval on an initial ECG should result in the firefighter being assessed as Temporarily Unfit to Perform Firefighting Duties while further specialist assessment is undertaken. A confirmed diagnosis of prolonged QT syndrome is incompatible with undertaking operational duties safely, and the firefighter should be assessed as Permanently Unfit to Perform Firefighting Duties.

Pacemakers

Consideration needs to be given to the underlying condition or indication, relative pacemaker dependence, risk to pacemaker function from electromagnetic interference (including the portable radio) and direct trauma, and risk of pacemaker lead fracture as a result of wearing or carrying equipment such as a SCBA. Careful assessment will be required in conjunction with the cardiologist and manufacturer.

Automatic internal cardiac defibrillators

Automatic internal cardiac defibrillators (AICDs) may be inserted post–ventricular fibrillation arrest or if a significant risk for ventricular fibrillation is present, such as cardiomyopathy. The indication for the AICD may be incompatible with undertaking firefighting duties effectively and safely; however, regardless of the indication for the device, there is a risk of sudden incapacity should the device activate. Persons with AICDs are not eligible to hold a commercial vehicle driver licence, and therefore cannot drive the appliance. Adhering to the same principles of the result of acute incapacity, a firefighter with an AICD cannot safely undertake firefighting duties because of the potential effect on safety. They should be classed as Permanently Unfit to Perform Firefighting Duties and appropriate restrictions advised.

Deep vein thrombosis

Deep vein thrombosis (DVT) may occur in association with surgery, clotting disorders, malignancy and prolonged immobility, or it may result from unidentified causes. Complication by pulmonary embolism is of significance to firefighters, as it may result in acute incapacitation. The risk of recurrence needs to be assessed, as does any additional thrombogenic risk posed by the conditions of firefighting that result in thermal strain and dehydration. A DVT arising from surgery is unlikely to have long-term implications on fitness for duty, because it is considered to be self-limiting. Treatment involving anticoagulation is incompatible with being able to undertake firefighting duties, and the section pertaining to anticoagulation should be consulted.

Anticoagulant therapy

Anticoagulant therapy may be used for short- or long-term treatment, and for preventing thrombus and thromboembolic events – for example, in those with cardiac rhythm disorders, cardiomyopathy, DVT, pulmonary embolism and mechanical heart valves. Firefighters work in emergency conditions with poor visibility conditions, slippery and uneven surfaces, structures that may be unstable, and at heights. These conditions place firefighters at increased risk of trauma and bleeding. An unexpected blow to the head while on anticoagulant treatment could result in intracranial haemorrhage, and a blow to a limb or a fracture may result in compartment syndrome. All firefighters requiring treatment with anticoagulation should be classed as Temporarily Unfit to Perform Firefighting Duties.

Where anticoagulation is required for a finite period, the underlying indication for the treatment will need to be considered and the relevant section of this standard should be referred to. If anticoagulation is required on an ongoing basis, the firefighter should be classed as Permanently Unfit to Perform Firefighting Duties and relevant restrictions should be advised.

Aneurysms

A firefighter presenting with abdominal aortic aneurysm of ≥ 4cm, thoracic aortic aneurysm of ≥3.5cm or significant aortic root dilatation should be classed as Permanently Unfit to Perform Firefighting Duties. If, however, surgical repair is undertaken, individualised assessment is required, taking into account the remainder of their cardiovascular status, postrepair surveillance results, information provided by the vascular or cardiothoracic surgeon (and other specialists as appropriate), and the opinion of the FRNSW Occupational Physician. If the aortic valve has been replaced with a mechanical valve, the firefighter will be classed as Permanently Unfit to Perform Firefighting Duties, because of the need for lifelong anticoagulation.

Peripheral vascular disease

Peripheral vascular disease may result in symptoms that limit exercise capacity. For the purpose of this standard, it should be treated as a coronary heart disease equivalent, and the firefighter should be classed as at least Temporarily Unfit to Perform Firefighting Duties. The presence of peripheral vascular disease should prompt thorough review of the rest of the cardiovascular system.

Other conditions

Other conditions are addressed in Table 2, including dilated cardiomyopathy, hypertrophic cardiomyopathy, heart failure, valvular disorders and congenital disorders.

Table 2 Medical criteria for operational firefighters – cardiovascular disorders[a]

Condition	**Criteria**
Cardiac risk level (refer to text and Figure 48) Note that conditions in the text where cardiovascular risk is considered high, and therefore the cardiac risk level is not applicable.	The cardiac risk level is to be interpreted in the context of overall cardiovascular risk assessment, including nonmodifiable risk factors. For details of management, refer to Section 12.2. If the cardiac risk level is: • Probability ≥16% in 5 years (red, orange, light orange and yellow cells), the firefighter is Unfit to Perform Firefighting Duties. Refer for exercise stress test, refer to GP for risk factor modification and classify Temporarily Unfit to Perform Firefighting Duties pending results. If the firefighter has been reviewed in the past 12 months, including a negative exercise stress test, **and** risk factors have not worsened **and** there are no relevant symptoms, Fit to Perform Firefighting Duties Subject to Review may be considered while awaiting stress test result. Subject to negative exercise stress test and satisfactory risk factor management, review annually. • Probability 10–15% in five years (blue cells). Refer for exercise stress test and refer to GP for risk factor modification. While awaiting results, classify Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties depending on the overall risk assessment. Subject to negative exercise stress test and satisfactory risk factor management, review annually. • Probability 5–9% in five years (dark green cells). Refer to GP for risk factor modification, and with exercise stress test if appropriate. Most in this group should be referred for exercise stress testing. While awaiting correspondence or results, classify as Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties depending on overall risk

Condition	Criteria
	assessment. Review annually. • Probability <5% in five years (light green cells). Assess risk factors and other clinical data and refer to GP as appropriate. Classify as Fit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review depending on the overall risk assessment. Review as appropriate. Refer to related criteria as required (e.g. hypertension, diabetes) and consider overall risk factor control. **If a contraindication to exercise stress testing is present, the firefighter is Temporarily Unfit to Perform Firefighting Duties until further assessment.** Contraindications include aortic stenosis (for the purpose of this standard, this includes known or suspected), hypertrophic cardiomyopathy and severe uncontrolled hypertension.
Ischaemic heart disease	
Angina or suspected angina	A firefighter is not Fit to Perform Firefighting Duties if they are subject to angina symptoms or symptoms that may be angina. If a cardiac cause is confirmed, please refer to the relevant section of the standard (e.g. angiographic findings, acute myocardial infarction, percutaneous interventions, bypass surgery). Fit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review may be determined taking into account the opinion of the appropriate specialist if the following criteria are met: • there is an exercise tolerance of ≥90% of age/sex-predicted exercise capacity according to the Bruce protocol, **and** • a stress testing shows no evidence of ischaemia, **and** • the specialist is of the opinion that there is unlikely to be a cardiac cause for the symptoms.
Myocardial infarction/acute coronary syndrome	A firefighter is not Fit to Perform Firefighting Duties if there is a history of myocardial infarction as verified by the treating specialist. Firefighters will subsequently be classed as Permanently Unfit to Perform Firefighting Duties.
Percutaneous intervention (bare-metal or drug eluting stent, angioplasty)	A firefighter is not Fit to Perform Firefighting Duties if they have undergone percutaneous intervention with a bare-metal stent, a drug-eluting stent or angioplasty, as verified by the treating specialist. Firefighters will subsequently be classed as Permanently Unfit to Perform Firefighting Duties.
Coronary artery bypass grafting	A firefighter is not Fit to Perform Firefighting Duties if the firefighter requires or has had coronary artery bypass grafting, as verified by the treating specialist. Firefighters will subsequently be classed as Permanently Unfit to Perform

Condition	Criteria
	Firefighting Duties.
Coronary angiography (not resulting in revascularisation procedure)	A firefighter is not fit to Perform Firefighting Duties if awaiting coronary angiography. A firefighter is Permanently Unfit to Perform Firefighting Duties if coronary angiography shows: • narrowing of **any** coronary artery ≥70%, or • narrowing of 50–70% in a **major artery** (left atrial dimension, circumflex or right coronary artery), or • narrowing of 50–70% in **any two or more** arteries, or • narrowing of ≥20% in the **left main** coronary artery. Fit to Perform Firefighting Duties Subject to Review on an annual basis may be determined for coronary artery narrowings of <50%, subject to: • ongoing risk factor modification, **and** • exercise tolerance of ≥90% of age/sex predicted exercise capacity according to the Bruce protocol, **and** • exercise stress test shows no evidence of ischaemia.
Hypertension	
Hypertension	A firefighter is Temporarily Unfit to Perform Firefighting Duties if blood pressure is ≥160 mmHg systolic or ≥100 mmHg diastolic (treated or untreated), irrespective of cardiac risk level. The firefighter should be referred back to their GP for further assessment and treatment as appropriate. At least two repeat blood pressure readings are required, at least one week apart, or ambulatory monitoring. Fit to Perform Firefighting Duties Subject to Review within 3 months may be determined if blood pressure falls within the range of 140–159 mmHg systolic and 90–99 mmHg diastolic, with or without treatment Fit to Perform Firefighting Duties may be determined once blood pressure falls below 140 mmHg systolic and 90 mmHg diastolic, with or without treatment. If hypertension is confirmed, GP assessment should include investigation for causes of secondary hypertension and assessment of renal function, and so on.[7] Echocardiography for left ventricular hypertrophy should be considered, especially where the history is one of uncontrolled or longstanding (≥5 years) hypertension.

[7] Note Heart Foundation, *Guide to management of hypertension 2008 (updated December 2010)*, 'Evaluation in patients with confirmed hypertension', 2010.

Condition	Criteria
	Treatment**.** Where a firefighter is on antihypertensive treatment, history should be elicited in relation to any hypotensive symptoms precipitated by exposure to heat, strenuous exercise and fluid loss, and medical fitness for duty be reviewed in accordance with any reported symptoms. The firefighter should also be counselled regarding the importance of hydration and reporting of any side effects that may impact adversely on the performance of firefighting duties. Adequate time (usually weeks) should be allowed if **starting or changing antihypertensive** medication to monitor for side effects that may impact on operational duties (e.g. dizziness, postural hypotension).
Disorders of rate, rhythm and conduction	
Atrial fibrillation	A firefighter is not Fit to Perform Firefighting Duties if: • the firefighter has a history of recurrent or persistent AF, **or** • there is a history of AF with syncope or presyncope. Fit to Perform Firefighting Duties Subject to Review every 3 months for the first 12 months, then at least annually, may be determined, taking into account information provided by the treating specialist as to whether the following criteria are met: • the condition has been successfully treated by percutaneous intervention and the firefighter is at least 4 weeks postprocedure; **and** there have been no prior thromboembolic events; **and** any anti-arrhythmic agents are unlikely to result in pro-arrhythmic side effects; **and** exercise tolerance of ≥90% of age/sex predicted exercise capacity according to the Bruce protocol **or** • the condition has been successfully treated by cardioversion; **and** warfarin or other anticoagulant has ceased; **and** risk of recurrence is low; **and** there have been no prior thromboembolic events; **and** any anti-arrhythmic agents are unlikely to result in pro-arrhythmic side effects; **and** there are no other disqualifying conditions; **and** exercise tolerance of ≥90% of age/sex predicted exercise capacity according to the Bruce protocol. Fit to Perform Firefighting Duties Subject to Review may be determined for persistent or chronic AF, considering information received from the treating cardiologist, including the history and course of the illness, and subject to the following criteria being met: • there is no syncope, presyncope, palpitations or other limiting symptoms such as shortness of breath, **and** • reversible underlying causes have been successfully treated, **and** • any known precipitants such as alcohol are avoided, **and** • there are no complications such as transient ischaemic attack or cerebrovascular accident, **and** • the condition is unlikely to be affected by strenuous exercise, dehydration,

Condition	Criteria
	heat stress or sympathetic activation, **and** • the condition is highly unlikely to result in acute incapacity, **and** • thromboembolic risk, including consideration of the effects of dehydration and heat stress, is considered extremely low, **and** • there are no side effects of treatment that would limit work capacity and treatment is not expected to interact adversely with the conditions of firefighting, such as strenuous exercise, dehydration, heat stress or sympathetic activation, **and** any anti-arrhythmic agents are unlikely to result in pro-arrhythmic side effect, **and** • exercise tolerance of ≥90% of age/sex predicted exercise capacity according to the Bruce protocol, **and** • there are no other conditions per this standard that would render the firefighter Unfit to Perform Firefighting Duties. If treatment includes warfarin, enoxaparin or other anticoagulant treatment, please refer to the anticoagulation section of this standard. Please refer to relevant section of the standard for syncope and for any underlying causes (e.g. coronary artery disease) or complications (e.g. cerebrovascular accident).
Paroxysmal and other arrhythmias or known conduction defects	A firefighter is not Fit to Perform Firefighting Duties if there is a history of arrhythmia or conduction defect. Discretion regarding immediate fitness to perform firefighting duties should be applied if the history is one of an isolated arrhythmia (other than ventricular fibrillation) more than 5 years ago. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account the opinion of the treating specialist as to whether the following criteria are met: • the condition has been successfully treated by percutaneous intervention and the firefighter is at least 6 weeks postprocedure **or** • risk of collapse is considered unlikely, **and** • there is no risk of ventricular arrhythmia, **and** • there are no symptoms such as shortness of breath that would impact on work capacity, **and** • any known precipitants are actively avoided, **and** • condition is unlikely to be aggravated by the conditions of firefighting, including strenuous exercise, dehydration, heat stress and sympathetic arousal, **and** • treatment, including anti-arrhythmic agents, will not adversely interact with the conditions of firefighting, including strenuous exercise, dehydration, heat

Condition	Criteria
	stress and sympathetic activation, **and** any anti-arrhythmic agents are unlikely to result in pro-arrhythmic side effects, **and** • the firefighter has been stabilised on treatment for at least 3 months. If the condition is considered cured and/or unlikely to recur, periodic review is not required specifically for that condition.
Cardiac arrest (also refer to the section on automatic implantable cardioverter defibrillators)	A firefighter is not Fit to Perform Firefighting Duties if they have suffered a cardiac arrest. Refer to the appropriate section regarding underlying causes. If a reversible cause is identified, further information should be sought regarding likelihood of recurrence and final medical fitness for duty will be determined by a FRNSW Occupational Physician, taking into account information supplied by the treating cardiologist and/or a cardiologist familiar with the conditions of firefighting. Mostly firefighters will be classed as Permanently Unfit to Perform Firefighting Duties.
Cardiac pacemaker	A firefighter is not Fit to Perform Firefighting Duties if a cardiac pacemaker is required, or has been implanted or replaced. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account any underlying pathology and information provided by the treating specialist as to whether the following criteria are met: • it is at least 4 weeks after insertion of the pacemaker, **and** • the risk of pacemaker dysfunction is considered unlikely and the following have been considered – risk to pacemaker function from electromagnetic interference (including the portable radio) and direct trauma – risk of pacemaker lead fracture as a result of wearing or carrying equipment such as a SCBA – degree of pacemaker dependence, **and** • there are normal haemodynamic responses on exercise stress testing, **and** • there are no other conditions as per this standard that would render the firefighter Unfit to Perform Firefighting Duties.
Automatic implantable cardiac defibrillator	A firefighter is Permanently Unfit to Perform Firefighting Duties if an automatic implantable defibrillator is required or has been implanted.
Electrocardiogram changes	
Left bundle branch block (suggestive of myocardial ischaemia or cardiomyopathy) or other	A firefighter is not Fit to Perform Firefighting Duties if there is an electrocardiographic abnormality, such as left bundle branch block, or changes suggestive of myocardial ischaemia or previous myocardial infarction.

Condition	Criteria
changes suggestive of myocardial ischaemia	Fit to Perform Firefighting Duties Subject to Review (or Fit to Perform Firefighting Duties) may be determined, taking into account the information provided by the treating specialist as to whether the following criteria are met: • follow-up investigation has excluded underlying cardiac disease, **and** • there are no other conditions as per this standard that would render the firefighter Unfit to Perform Firefighting Duties.
Strain pattern	The presence of strain pattern – ST depression and T-wave inversion – is associated with increased cardiovascular risk in individuals with hypertension. Further assessment is required, and the firefighter should be classed as Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties, depending on the clinical picture.
Left ventricular hypertrophy	A firefighter may be classed as Fit to Perform Firefighting Duties Subject to Review (or Temporarily Unfit to Perform Firefighting Duties if warranted by relevant clinical information) if an electrocardiograph shows left ventricular hypertrophy. Fit for to Perform Firefighting Duties Subject to Review may be determined taking into account the results of further assessment (including specialist opinion if required) as to whether the following criteria are met: • follow-up investigation (such as echocardiography) has excluded pathological cardiac abnormality, **and** • there are no other disqualifying conditions.
Complete right bundle branch block	A firefighter may be classed as Fit to Perform Firefighting Duties Subject to Review (or Temporarily Unfit to Perform Firefighting Duties if warranted by relevant clinical information) if an electrocardiograph shows a complete right bundle branch block. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account the results of further assessment (including specialist opinion if required) as to whether the following criteria are met: • follow-up investigation (such as an echocardiograph) has excluded underlying cardiac abnormality, **and** • there are no other disqualifying conditions.
Pre-excitation, prolonged QT, heart block (except first degree), other	A firefighter is not Fit to Perform Firefighting Duties if electrocardiography shows pre-excitation, prolonged QT or heart block (other than first degree heart block). Further cardiologist assessment is required. Permanently Unfit to Perform Firefighting Duties is applicable if long QT syndrome is confirmed, or if long QT is expected to persist because it is related to a medication that will be required long term. Permanently Unfit to Perform Firefighting Duties is applicable upon diagnosis of any other electrophysiological problem that can result in ventricular fibrillation (e.g. Brugada Syndrome). Please refer to other relevant sections (e.g. automatic

Condition	Criteria
	implantable cardiac defibrillator), if applicable. For other diagnoses that are confirmed after further cardiologist assessment, please refer to criteria in the section relating to **Disorders of rate, rhythm and conduction**. If the electrocardiograph shows first-degree heart block, no further assessment is required if there is no history of syncope or presyncope, especially in a young and fit individual.
Vascular disease	
Aortic, thoracic and abdominal aneurysms	A firefighter is not fit to Perform Firefighting Duties if they have a dilated aortic root, thoracic aortic aneurysm or abdominal aortic aneurysm. Refer to Section 11.2.1.
Deep vein thrombosis (DVT)	A firefighter is not Fit to Perform Firefighting Duties after a diagnosis of DVT and while undergoing anticoagulation treatment. Fit to Perform Firefighting may be considered, taking into account the opinion of the treating doctor as to whether the following criteria are met: • the DVT is considered adequately treated and anticoagulation treatment has ceased, **and** • there are no underlying predisposing factors that significantly increase risk of recurrent DVT, taking into account the conditions of firefighting, such as dehydration, that increase prothrombotic risk.
Pulmonary embolism	A firefighter is not Fit to Perform Firefighting Duties after a diagnosis of a pulmonary embolism and while undergoing anticoagulation treatment. Fit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account the opinion of the treating specialist as to whether the following criteria are met: • anticoagulation treatment has ceased, **and** • reported exercise capacity has not been adversely affected, **and** • there are no underlying predisposing factors that significantly increase risk of recurrent venous thromboembolism, taking into account the conditions of firefighting, such as dehydration, that increase prothrombotic risk. Exercise stress testing and echocardiography may be considered if there are any concerns regarding exercise capacity.
Valvular heart disease	
Valvular heart disease	A firefighter is not Fit to Perform Firefighting Duties if: • the firefighter has a history or evidence of valve disease, with associated haemodynamic compromise and/or symptoms of angina, syncope or dyspnoea; or history of cardiac enlargement, embolism, arrhythmia,

Condition	Criteria
	abnormal ECG or high blood pressure; **or** • the firefighter is taking long-term anticoagulation. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account information provided by the treating specialist as to whether the following criteria are met: • the cardiological assessment shows valvular disease of no haemodynamic significance, **and** • the conditions of firefighting, including strenuous exercise, dehydration, heat stress and sympathetic activation, will not impact adversely on the condition, **and** • exercise tolerance of ≥90% of age/sex according to the Bruce protocol, **and** • there is no other cardiac condition per this standard that would render the firefighter Unfit to Perform Firefighting Duties **or** • it is at least 3 months following successful surgery and there is no evidence of valvular dysfunction, and there are no electrocardiographic changes, arrhythmias, left ventricular dysfunction, cardiac failure, anticoagulant therapy, hypertension or other conditions per this standard that would render the firefighter Unfit to Perform Firefighting Duties, **and** • exercise tolerance of ≥90% of age/sex according to the Bruce protocol, **and** • the results of presurgical coronary angiography (if performed) have been reviewed and assessed as meeting the relevant section of this standard.
Myocardial disease	
Dilated cardiomyopathy (see also heart failure)	A firefighter is not Fit to Perform Firefighting Duties if the firefighter has dilated cardiomyopathy, as verified by the treating specialist. (Rare cases of transient cardiomyopathy should be referred to the FRNSW Occupational Physician for further assessment in conjunction with an appropriate specialist.) Firefighters will subsequently be classed as Permanently Unfit to Perform Firefighting Duties.
Hypertrophic cardiomyopathy (also refer to the section on automatic implantable cardiac defibrillator)	A firefighter is not Fit to Perform Firefighting Duties if they have hypertrophic cardiomyopathy, as verified by the treating specialist. Firefighters will subsequently be classed as Permanently Unfit to Perform Firefighting Duties.
Other conditions	
Anticoagulant therapy	A firefighter is not Fit to Perform Firefighting Duties if the firefighter is on anticoagulant therapy, including but not limited to warfarin, dabigatran or enoxaparin. Permanently Unfit to Perform Firefighting Duties should be determined if the

Condition	Criteria
	firefighter's treating doctor confirms that long-term anticoagulation is required. Fit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review (if warranted by the clinical picture) may be determined if anticoagulation is ceased on the advice of the treating doctor (this must be confirmed with the doctor) and taking into account the criteria as per other relevant sections of this standard (e.g. deep vein thrombosis, pulmonary embolism).
Congenital disorders	A firefighter is not Fit to Perform Firefighting Duties if the firefighter has a congenital heart disorder. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account the information provided by the treating specialist as to whether the following criteria are met: • there is no abnormality of haemodynamic significance within the heart, aorta or pulmonary vasculature, **and** • there is no other cardiac condition as per this standard that would render the firefighter Unfit to Perform Firefighting Duties. Discretion regarding medical fitness for operational duties should be applied if the history is one of successful repair or treatment of a noncomplex congenital heart disease (e.g. ventricular septal defect, atrial septal defect, patent ductus arteriosis, pulmonary stenosis) in infancy or childhood, with no ongoing cardiovascular issues.
Heart failure	A firefighter is not Fit to Perform Firefighting Duties if there is a history of heart failure, as verified by the treating specialist. (Rare cases of transient heart failure should be referred to the FRNSW Occupational Physician for further assessment in conjunction with an appropriate specialist.) Firefighters will subsequently be classed as Permanently Unfit to Perform Firefighting Duty.
Cardiac syncope or syncope due to hypotension (refer also to Section 10, Blackouts)	A firefighter may resume operational duties, taking into account information provided by the treating doctor if the episode was vasovagal in nature with a clear-cut precipitating factor (such as venesection) and the situation is unlikely to recur while performing firefighting duties. A firefighter should be classed as Temporarily Unfit to Perform Firefighting Duties for at least 3 months after syncope because of other cardiovascular causes. A firefighter is not Fit for to Perform Firefighting Duties if the condition is severe enough to cause episodes of loss of consciousness without warning. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account information provided by the treating specialist as to whether the following criteria are met:

Condition	Criteria
	• the firefighter has been symptom-free for 3 months, **and** • the underlying cause has been identified, **and** • satisfactory treatment has been instituted, **and** • risk of recurrence is extremely low, **and** • risk of recurrence will not be increased by the conditions of firefighting, including strenuous exercise, dehydration, heat stress and sympathetic activation, **and** • there are no other conditions per this standard that would render the firefighter Unfit to Perform Firefighting Duties.
Stroke	Refer to Section 15, Neurological disorders.
Other	Any other condition not addressed in this standard is to be assessed on a case by case basis in conjunction with a FRNSW Occupational Physician.

AF = atrial fibrillation; FRNSW = Fire & Rescue NSW; GP = general practitioner; SCBA = self-contained breathing apparatus

a *Some firefighters may already be under the review of a FRNSW Occupational Physician for a particular condition. If a firefighter states that they have been cleared to perform firefighting duties by the FRNSW Occupational Physician for a condition that renders them medically unfit for duty under this standard, the assessing doctor should contact the FRNSW Occupational Physician for advice regarding fitness to continue firefighting duties while further assessment is undertaken.*

11.3 Bibliography

Agarwal SK, Shawl F et al. Very late thrombosis of drug-eluting stents: a brief literature and case example. *J Invasive Cardiol* 2008, 20(12):655–88.

American College of Cardiology Foundation and the American Heart Association, Inc. *ACC/AHA 2002 Guideline update for exercise testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing),* 2002.

Elefteriades JA. Natural history of thoracic aortic aneurysms: indications for surgery, and surgical versus nonsurgical risks. *Ann Thorac Surg* 2002, 74:1877–80.

Fahy R, LeBlanc P, Molis J. *Firefighter fatalities in the United States, 2012*, National Fire Protection Association, 2013.

Indiana University Firefighter Health & Safety Research, School of Health, Physical Education & Recreation. *Physiological stress associated with structural firefighting observed in professional firefighters*. Department of Kinesiology, 2009.

Kales SN, Baur DM, Hostler D, Smith DL. Reader comments. Cardiac rehabilitation in firefighters. *Proc (Bayl Univ Med Cent)* 2013, 26(4):429–31.

Kales SN, Soteriades ES, Christophi CA et al. Emergency duties and deaths from heart disease among firefighters in the United States. *N Engl J Med* 2007, 356:1207–15.

Kales SN, Tsismenakis AJ et al. Blood pressure in firefighters, police officers, and other emergency responders. *Am J Hypertens* 2009, 22:11–20.

Lemesle G, Delhay C et al. Stent thrombosis in 2008. *Arch Cardiovasc Dis* 2008, 101(11–12):767–69.

Ministry of Health, New Zealand. *New Zealand cardiovascular guidelines handbook*, 2009.

National Fire Protection Association. *NFPA1582: Standard on comprehensive occupational medical program for fire departments*, 2007 and 2013 editions.

National Health and Medical Research Council. *Guidelines for the management of absolute cardiovascular disease risk*, National Vascular Disease Prevention Alliance, 2012.

National Heart Foundation of Australia. *Guide to management of hypertension 2008. Assessing and managing raised blood pressure in adults*, 2010 (update).

National Institute for Occupational Safety and Health. *NIOSH Alert. Preventing fire fighter fatalities due to heart attacks and other sudden cardiovascular events*, 2007.

National Transport Commission. *Assessing fitness to drive for commercial and private vehicle drivers. Medical standards for licensing and clinical management guidelines*, 2012.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

National Vascular Disease Prevention Alliance. *Australian absolute cardiovascular risk calculator*, 2016 (www.cvdcheck.org.au, accessed 6 May 2011).

NSW Government. *Maritime standard for health assessment of marine pilots (NSW)*, 2009.

Office of the Deputy Prime Minister London, UK. *Medical and occupational evidence for recruitment and retention in the Fire & Rescue Service*, 2004.

Perk J, De Backer, Gohlke H, Graham I, Zˇeljko R, Verschuren WM, Albus C, Benlian P, Boysen G, Cifkova R, Deaton C, Ebrahim S, Fisher M, Germano G, Hobbs R, Hoes A, 7 (The Netherlands), Karadeniz S, Mezzani A, Prescott E, Ryden L, Scherer M, Syva¨nne M, (Finland), Scholte W, Reimer O, Vrints C, Wood D, Zamorano J, Zannad F. European guidelines on cardiovascular disease prevention in clinical practice (version 2012). *Eur Heart J* 2012, 33:1635–701.

Powell T, Greenhalgh M. Small abdominal aortic aneurysms. *N Engl J Med* 2003, 348(19):1895–901.

Sciari R, Nihoyannopoulos P, et al. Stress echocardiography expert consensus statement – executive summary. *Eur Heart J* 2009, 30:278–89.

Smith DL, Barr DA, Kales SN. Extreme sacrifice: sudden cardiac death in the US Fire Service. *Extreme Physiology & Medicine* 2013, 2:6 (www.extremephysiolmed.com/content/2/1/6).

Smith DL, Liebig JP, Steward NM, Fehling PC. *Sudden cardiac events in the fire service: understanding the cause and mitigating the risk*, Skidmore College, Health and Exercise Sciences, First Responder Health and Safety Laboratory, 2010.

Soteriades E, Smith D, Tsismenakis A, Baur DM, Kales SN. Cardiovascular disease in US firefighters: a systematic review. *Cardiol in Review* 2011, 19(4):202–15.

Taggart D. Stents or surgery in coronary artery disease in 2013. *Ann Cardiothorac Surg* 2013, 2(4):431–4.

Taggart D, Altman D, Gray A, Lees B, Nugara F, Yu L, Campbell H, Flather M, on behalf of the ART investigators. Randomised trial to compare bilateral vs. single internal mammary coronary artery bypass grafting: 1 year results of the Arterial Revascularisation Trial (ART). *Eur Heart J* 2010, 31:2470–81.

11.4 Acknowledgements

Endorsement by Cardiac Society of Australia and New Zealand (November 2012)

12 Diabetes

12.1 Relevance to operational duties

Conditions of firefighting are unique and have the potential to impact on glycaemic control for those with diabetes. Diabetes may affect a firefighter's ability to safely and effectively perform firefighting duties, either through impairment or loss of consciousness during a hypoglycaemic episode, or from end-organ effects on relevant functions, including retinopathy, cardiovascular disease, nephropathy and peripheral neuropathy. In people with type 2 diabetes, sleep apnoea is also more common (refer to Section 19, Sleep disorders).

Hypoglycaemia

There is an increased risk of hypoglycaemia in firefighters because of the:

- irregular access to meals due to the emergency response nature of the service
- unpredictable energy demands – that is, strenuous exertion at unpredictable times and for unpredictable periods
- inability to safely and quickly access food or other forms of oral glucose while wearing full personal protective equipment in hazardous environments; quick egress from such environments is not always possible
- possible failure to recognise typical symptoms of hypoglycaemia in the midst of emergency situations.

Symptoms such as lack of concentration or change of behaviour resulting from hypoglycaemia can impact on situational awareness. Hypoglycaemia in an operational situation, including driving the appliance under emergency conditions, presents a considerable risk and may impact on the safety of the individual firefighter, their crew and members of the public. Hypoglycaemia may result in confusion and impaired judgement, and impaired motor control, thus impacting on the effective and safe performance of firefighting duties. It may also be more difficult for a firefighter and for others (such as colleagues who know about the firefighter's condition) to recognise symptoms or signs of hypoglycaemia in an emergency environment.

The risk of hypoglycaemia is greatest in those treated with insulin. There is still a risk, albeit lower, associated with treatment with sulfonylureas and secretagogues. There should be a very low risk of severe hypoglycaemia for those treated with diet alone, or with added metformin, acarbose or thiazolidinediones. Gliptins and SGLT2 transporters also have a low propensity for hypoglycaemia. For those treated with insulin, the risk is higher for those with type 1 diabetes than those with type 2 diabetes; however, hypoglycaemia is increasingly reported in insulin-treated type 2 diabetes and with sufficient frequency to cause significant morbidity.

Lifestyle factors, such as alcohol intake, can also increase the risk of hypoglycaemia.

Lack of hypoglycaemic awareness significantly increases the risk of severe hypoglycaemia. Lack of hypoglycaemic awareness is more common in people treated with insulin for more than 10 years.

12.1.1 Conditions of firefighting that can increase the likelihood of hypoglycaemia

The emergency response nature of firefighting duties can involve intense physical activity at unpredictable, irregular times, and for unpredictable periods. Unpredictable energy demands can adversely affect glycaemic control. Regular meal schedules are often interrupted and regular monitoring of blood glucose can be difficult. Common causes of hypoglycaemia are delaying or missing a meal, not eating enough carbohydrates, unplanned physical activity and more strenuous exercise than usual. These factors occur in the firefighting environment and, therefore, the conditions of firefighting increase the likelihood of hypoglycaemia.

12.1.2 Challenges to managing early hypoglycaemia in the firefighting environment

The cornerstone of managing hypoglycaemia is being able to treat it immediately (even if immediate testing is not practicable) to stop blood glucose from dropping even further. There are challenges to being able to address hypoglycaemia immediately in the operational environment – for example, breathing apparatus cannot be removed in a hazardous environment to self-administer treatment (e.g. consuming jelly beans or soft drink) and some hazardous environments are not easy to egress quickly. Failure to quickly address early hypoglycaemia can result in a continued drop of blood glucose, which may progress to loss of coordination, slurred speech, confusion, loss of consciousness and seizure. Suspending emergency duties to address hypoglycaemia immediately has the potential to impact on service delivery.

Shift work may also impact on glycaemic control. It should be noted that retained firefighters are on call, and hours worked can be irregular and are usually additional to those worked in primary employment.

12.1.3 Severe hypoglycaemia

A severe hypoglycaemic event is defined as a hypoglycaemic event of such severity that the person is unable to treat the hypoglycaemia themselves, and thus requires an outside party to administer treatment. The definition includes hypoglycaemia causing loss of consciousness. Severe hypoglycaemic events are relevant under this standard regardless of whether they occur at work or outside of work.

Severe hypoglycaemic events affect brain function, and can cause impairment of perception, motor skills or consciousness, or abnormal behaviour before unconsciousness – all of which are relevant for firefighters working in dangerous environments as part of a team, where others rely upon them for their own safety. Episodes of severe hypoglycaemia are associated with increased risk of subsequent episodes and may indicate lack of hypoglycaemic awareness (see Section 12.2.3).

Mild hypoglycaemic events can be distinguished from severe hypoglycaemic events in that mild episodes can, by definition, be self-treated by the person with diabetes without needing assistance from another person. Early symptoms of hypoglycaemia include sweating, tremulousness, hunger and tingling around the mouth, and can occur commonly in those treated with insulin and some non-insulin agents. When mild hypoglycaemia occurs, a combination of these early warning symptoms of hypoglycaemia is usual, enabling the person with diabetes to recognise the hypoglycaemia and to self-treat. This may not, however, be possible on the incident ground.

12.1.4 Cardiovascular disease

Cardiovascular disease is the major cause of death in people with diabetes, accounting for approximately 50% of all fatalities. This is significant given the association between firefighting and on-duty deaths from acute cardiovascular events. Refer to Section 11, Cardiovascular disorders.

12.2 General assessment and management guidelines

Treatment with insulin has been assessed by Fire & Rescue NSW (FRNSW) as representing an unacceptably high risk in the firefighting context and will therefore attract permanent restrictions on firefighting activities. This takes into account the significantly increased frequency with which hypoglycaemia occurs in those treated with insulin, compared with those on non-insulin agents.

Although there are strategies that could help reduce the likelihood of hypoglycaemia for those treated with insulin, these control measures rely solely on individual behaviour. Measures include

rushing meals when insulin has been administered already, administering insulin within minutes of completing a meal, testing blood glucose and ingesting additional carbohydrate on the way to a call (not possible if driver), always having access to testing kit, and carrying additional short- and long-acting carbohydrates (on the person or in the appliance). These strategies do not address the challenges to addressing hypoglycaemia when it does occur, and a firefighter would be required to recognise symptoms and egress the emergency environment to address symptoms immediately. Early signs of hypoglycaemia may also be similar to the adrenaline symptoms felt during a call-out, and may therefore be more difficult to recognise.

The outcome of an individual not acting on early signs of hypoglycaemia is the same as an individual who lacks hypoglycaemic awareness. There is often a relatively short window – minutes – between recognition of hypoglycaemic symptoms and the possibility of self-rescue, and progressing to the stage where the individual may become impaired and no longer able to help themselves. There are risks with relying on control measures that solely depend on individual behaviour in an environment that is inherently unpredictable. These measures may not be reliably successful. When such a system fails in the firefighting context and the individual is not able to manage the hypoglycaemic event, the consequence is potentially catastrophic.

The use of insulin pumps in the firefighting context is associated with potential problems. Removing insulin pumps, other than for short periods can result in accumulation of ketones. While these devices may be moisture resistant, they are not waterproof, and are normally only removed for planned activities and for limited periods, such as showering or swimming. Personal protective clothing such as the structural firefighting ensemble provides protection from heat, but limits the body's ability to dissipate heat, resulting in high fluid loss through sweating, thus creating a microclimate that is humid and where metabolic heat is trapped. Heat will also increase the absorption of subcutaneous insulin, and any subcutaneous insulin already delivered will continue to act and therefore increase the risk of hypoglycaemia. For example, NovoRapid® action will peak at 90 minutes and will continue to act for 3–4 hours.

The following information therefore relates to firefighters who are not on pharmacotherapy, or on non-insulin treatment.

When assessing a firefighter's medical fitness for firefighting duties, consideration must be given to:

- satisfactory glycaemic control
- absence of severe hypoglycaemia (i.e. hypoglycaemia that results in impaired level of consciousness)
- presence of hypoglycaemic awareness
- absence of complications that impact on medical fitness for firefighting duties.

12.2.1 Glycaemic control

Although HbA1c is used to assess long-term blood glucose control, and correlates with diabetes complications and outcomes, a degree of flexibility is required. Targets are often individualised depending on specific factors such as the type of diabetes, its duration, type of medication, age, presence of cardiovascular disease, risk of and problems from hypoglycaemia, and comorbidities. An individual may have a good HbA1c while experiencing extreme fluctuations of blood glucose levels; therefore, some caution is required in interpretation of the HbA1c and a review of a blood glucose diary is always helpful. When there is evidence of poor control, a review of blood glucose diary should form a part of the assessment, for evidence of improvement and stability.

Comparisons should be made with previous HbA1c of the particular individual. The general target in the community for HbA1c is ≤7.0%. High or increasing HbA1c will often indicate poor or deteriorating glycaemic control; however, it may also result from other conditions such as haemoglobinopathies or iron-deficiency anaemia. The benefits of good control must be balanced against the increased risk of hypoglycaemia associated with tighter control. An HbA1c level of ≥9.0% indicates that control may be suboptimal or poor, and requires referral to an endocrinologist or diabetes specialist to assist in assessment of medical fitness for operational duties.

12.2.2 Severe hypoglycaemia

Although the risk of hypoglycaemia for those not treated with insulin is considered acceptably low in the firefighting context, severe hypoglycaemia – should it occur in such individuals – requires very careful assessment and will attract a significant nonworking (non-firefighting) period. A return to firefighting duties may be considered by the FRNSW Occupational Physician, taking into account information provided by the treating endocrinologist regarding the reason for the episode, re-establishment of glycaemic control, hypoglycaemic awareness (see Section 12.2.3) and risk of recurrence.

Where multiple severe hypoglycaemic events have occurred, this requires further assessment, taking into consideration the overall history, including the spacing of the events and if they involved circumstances that are unlikely to be repeated. Where the history is of repeated episodes without extenuating circumstances, the firefighter may be assessed as Permanently Unfit to Perform Firefighting Duties.

12.2.3 Hypoglycaemic awareness

Hypoglycaemic awareness is crucial in managing the risks related to hypoglycaemia while on duty. Lack of hypoglycaemic awareness exists when an individual does not regularly sense the usual early warning symptoms of hypoglycaemia, such as sweating, tremulousness, hunger, tingling around the mouth, palpitations and headache. Lack of hypoglycaemic awareness is more common in people treated with insulin for more than 10 years and significantly increases the risk of a severe hypoglycaemic event. In the setting of a long duration of diabetes, it tends to be a persistent condition.

The outcome of an individual not acting on early signs of hypoglycaemia is the same as an individual who lacks hypoglycaemic awareness, and for the purpose of this standard, the failure to act (with the exception of extenuating circumstances) should be managed in the same way.

Lack of hypoglycaemic awareness may develop in someone who has experienced a severe hypoglycaemic event; however, it may then improve in subsequent weeks or months if further hypoglycaemia can be avoided.

Persistent lack of hypoglycaemic awareness is incompatible with firefighting duties and the firefighter should be deemed Permanently Unfit to Perform Firefighting Duties.

12.2.4 Reducing risk of hypoglycaemia

For those firefighters on non-insulin medication regimens associated with increased risk of hypoglycaemia, the following are some strategies to assist with reducing the risk of hypoglycaemia:

- having an in-depth knowledge of diabetes and self-care strategies
- being committed and motivated to self-management
- frequent and rational self-monitoring of blood glucose levels

- reacting appropriately to particular blood glucose levels
- having a readily available supply of short- and long-acting carbohydrate on the person and in the appliance.
- supplementing carbohydrate intake when increased physical activity is anticipated.

12.2.5 Diabetes complications

Cardiovascular disease

Cardiovascular disease is the most significant complication of diabetes for firefighters, and further assessment should be undertaken in line with Section 11, Cardiovascular disorders.

Renal function

Renal function should be reviewed for all firefighters with diabetes, including estimated glomerular filtration rate and albumin:creatinine ratio. Decreased renal reserve combined with dehydration may precipitate acute renal impairment. Firefighters are at an increased risk of heat stress and dehydration, because the firefighting ensemble and chemical suits inhibit normal cooling mechanisms. Firefighters may lose up to 2 L/h of sweat during active firefighting duties.

The presence of diabetic nephropathy should prompt further cardiovascular assessment regardless of cardiac risk level, as chronic renal disease in people with diabetes is a major risk factor for cardiovascular and all-cause mortality.

Peripheral neuropathy

Peripheral neuropathy affecting feet may affect the balance and stability required to negotiate uneven surfaces in poor visibility conditions, safe use of ladders and driving the appliance.

Other relevant chapters (e.g. on vision) should be consulted as needed.

12.2.6 Triggered assessment

The FRNSW Occupational Physician should be notified immediately:

- if there are significant changes in treatment
- following a severe hypoglycaemic episode.

12.2.7 Specialist review

Endocrinologist or diabetes specialist review is required if:

- the treating general practitioner (GP) (for those on non-insulin medication) has indicated that the diabetes is not well controlled
- there has been a severe hypoglycaemic event within the past 12 months
- there is a lack of hypoglycaemic awareness
- there is evidence of nephropathy.

12.2.8 Prediabetes

Type 2 diabetes mellitus may develop over many years, preceded by impaired fasting glycaemia (IFG) and impaired glucose tolerance (IGT) (i.e. prediabetes). Prediabetes is of relevance for firefighters, as it indicates a significantly increased risk of progression to type 2 diabetes. Furthermore, prediabetes is a known risk factor for cardiovascular disease.

A fasting blood glucose of ≥5.5 mmol/L requires a referral for an oral glucose tolerance test. Where IFG or IGT is diagnosed in a firefighter, Fit to Perform Firefighting Duties Subject to Review is required, with periodic review every 12–24 months depending on the overall clinical assessment. They should also be referred back to their GP for appropriate management and monitoring. In the event of progression to type 2 diabetes, the criteria for diabetes apply.

Table 3 Medical criteria for operational firefighters – diabetes[a]

Condition	**Criteria**
Prediabetes	Fit to Perform Firefighting Duties Subject to Review every 12–24 months is applicable for any firefighter with confirmed prediabetes. They should be referred back to their GP for appropriate management and monitoring.
Diabetes not requiring medication	Fit to Perform Firefighting Duties Subject to Review annually is applicable for any firefighter with type 2 diabetes controlled by diet and exercise alone. A report should be provided by the treating GP at each review outlining: • control, including HbA1c, and • results of screening for end organ disease, including albumin:creatinine ratio and eGFR. If, on review, a firefighte'rs diabetes does not appear to be well controlled or there is concern about end organ disease, the firefighter should be classed as Temporarily Unfit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review in 3 months while further assessment and/or treatment is undertaken. If treatment comes to include glucose-lowering agents, refer to the appropriate section of this Health Standard.
Type 2 diabetes treated with glucose-lowering agents other than insulin	A firefighter is not Fit to Perform Firefighting Duties if they have type 2 diabetes treated with glucose-lowering agents other than insulin. Fit to Perform Firefighting Duties Subject to Review, with review at least annually, may be determined taking into account information provided by the treating GP or endocrinologist/diabetes specialist as to whether the following criteria are met: • satisfactory control is demonstrated; there must be objective evidence of this, such as HbA1c with or without review of a blood glucose diary, **and** • the firefighter is compliant with treatment, **and** if treatment includes an agent or agents that can cause hypoglycaemia: • there is an absence of severe hypoglycaemic events in the past 12 months, **and** • hypoglycaemic awareness (the firefighter experiences early warning symptoms) is present and acted upon appropriately, **and** • the treatment regimen minimises the risk of hypoglycaemia, **and** • renal function is within normal limits, as demonstrated by urinary albumin: creatinine ratio and eGFR, **and** • there is an absence of other end organ effects (including cardiovascular

	disease and peripheral neuropathy affecting balance) that would render a firefighter Unfit to Perform Firefighting Duties per this standard.
Insulin-treated diabetes	A firefighter is not Fit to Perform Firefighting Duties if they have type 1 diabetes or type 2 diabetes treated with insulin. The medical practitioner, with the consent of the firefighter, should notify the FRNSW Occupational Physician so that appropriate restrictions can be advised.

eGFR = estimated glomerular filtration rate; FRNSW = Fire & Rescue NSW; GP = general practitioner
***a** FRNSW does not advise changing treatment for the purpose of meeting this standard. Any change of treatment must be made by the firefighter's treating doctor and based on clinical grounds.*

12.3 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2012.

Australian Diabetes Society. *Positions Statement: Individualization of HbA1c targets for adults with diabetes mellitus*, 2009.

Briscoe VJ, Davis SN. Hypoglycaemia in type 1 and type 2 diabetes: physiology, pathophysiology, and management. *Clinical Diabetes* 2006, 24(3):115–21.

Chadban H, Hwoell M, Twigg S et al. Assessment of kidney function in type 2 diabetes. *Nephrology* 2010, 15:S146–61.

Clarke W, Cox D, Gonder-Frederick L et al. Reduced awareness of hypoglycaemia in adults with IDDM. *Diabetes Care* 1995, 18(4):517–22.

Diabetes Australia, Hypoglycaemia. https://www.ndss.com.au/hypoglycaemia-diabetes-information-sheet.

Geddes J, Wright R, Zammitt N et al. An evaluation of methods of assessing impaired awareness of hypoglycaemia in type 1 diabetes. *Diabetes Care* 2002, 30(7):1868–70.

Holman R, Farmer A, et al. Three-year efficacy of complex insulin regimens in type 2 diabetes. *N Engl J Med* 2009, 361:1736–47.

Leckie A, Graham M, Grant J, et al. Frequency, severity and morbidity of hypoglycaemia occurring in the workplace in people with insulin-treated diabetes. *Diabetes Care* 2005, 28:1333–8.

National Health and Medical Research Council. *National evidence based guideline for blood glucose control in type 2 diabetes*, 2009.

National Health and Medical Research Council. *National evidence based guideline for case detection and diagnosis of type 2 diabetes*, 2009.

National Health and Medical Research Council. *National evidence based guideline for diagnosis, prevention and management of chronic kidney disease in type 2 diabetes*, 2009.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

National Fire Protection Association. *NFPA1582: standard on comprehensive occupational medical program for fire departments*, Avon, MA, 2012.

Office of the Deputy Prime Minister. *Medical and occupational evidence for recruitment and retention in the Fire and Rescue Service*, London, UK, 2004.

Smith DL, Liebig JP et al. Sudden cardiac events in the fire service: understanding the cause and mitigating the risk. Skidmore College, Health and Exercise Sciences, First Responder Health and Safety Laboratory, 2010.

13 Hearing

13.1 Relevance to firefighting duties

Firefighting is a hearing-critical occupation. Firefighting duties are often undertaken in poor visibility conditions because of smoke, where auditory cues may be heavily relied on for communication and for safety. Good hearing is required, particularly the ability to hear speech in background noise and to localise warning sounds. Failure to hear sounds of relatively low intensity, or to distinguish a voice or speech from background noise can lead to failure to respond to imminently hazardous situations, thus jeopardising the safety of the firefighter, their crew and members of the public.

Hearing takes place against a range of significant background noises caused by the fire itself, high winds in bushfires, firefighting equipment such as pumps, the self-contained breathing apparatus, and from sirens when driving the appliance.

Firefighters must have adequate hearing to be able to hear and localise auditory cues crucial for safety, such as a victim crying for help, the distress signal unit alarm of another firefighter, noises associated with fire behaviour or imminent structural collapse, or an appliance horn signalling urgent evacuation.

Firefighters must be able to hear speech from direct verbal communication with each other as well as from radio communications while wearing personal protective equipment, which attenuates sound against a noisy background.

Firefighters must also be able to hear vehicle, traffic and other road sounds when driving the appliance in emergency mode.

13.2 General assessment and management guidelines

The procedures for assessment of applicants and incumbent firefighters are summarised in Figure 49.

No hearing devices may be worn for Level 1 or Level 2 testing.

13.2.1 Level 1 testing

Firefighters are initially screened by pure tone audiometry at 0.5, 1, 2, 3, 4, 6 and 8 kHz as per Australian Standard AS 2586-1983. The standard is not met if hearing loss is >40 dB in any frequency between 0.5 and 3 kHz (inclusive) in either ear.

All who fail screening are referred to an audiologist for more detailed audiological evaluation – Level 2 testing. The audiologist should be a member of the Audiological Society of Australia Inc. For contacts of members, see www.audiology.asn.au.

13.2.2 Level 2 testing

The purpose of Level 2 testing is to provide the opportunity to demonstrate auditory fitness and to assist in diagnosis of conditions that may require referral for specialist medical assessment and/or treatment. There are three components to testing, and each component must be passed for the standard to be met:

- Step 1. Hearing thresholds

Air and bone conduction audiometry with masking is undertaken. Further assessment is not required if the threshold standard is met as per Level 1 testing (i.e. no loss >40dB in any frequency between 0.5 and 3 kHz inclusive in either ear). The firefighter should be classed as Fit to Perform Firefighting Duties. If the threshold standard is not met, steps 2, 3 and 4 must be undertaken.

- Step 2. Integrity of the middle ear system

  Tympanometry is performed as well as acoustic reflex thresholds for thresholds 0.5, 1 and 2 kHz. The hearing loss will then be identified as conductive, sensorineural or mixed.

- Step 3. Speech discrimination in quiet

  The pass level is set at 90% correct in each ear, with no significant rollover at high intensities in either ear.

- Step 4. Speech discrimination in noise

  This must be done, as per the Fire & Rescue NSW (FRNSW) referral instructions. The pass level is set at 70% correct binaurally.

A recommendation to see a ear, nose and throat specialist review may be considered if any of the following are detected:

- asymmetrical hearing (hearing threshold differential >15 dB at any frequency)
- air bone gap >15 dB
- abnormal tympanograms in either ear
- rollover[8] in performance–intensity function
- absent acoustic reflexes.

If treatment is undertaken as a result of specialist assessment, or the condition is one that has improved, retesting may commence with an audiologist, commencing at step 1 of Level 2 testing.

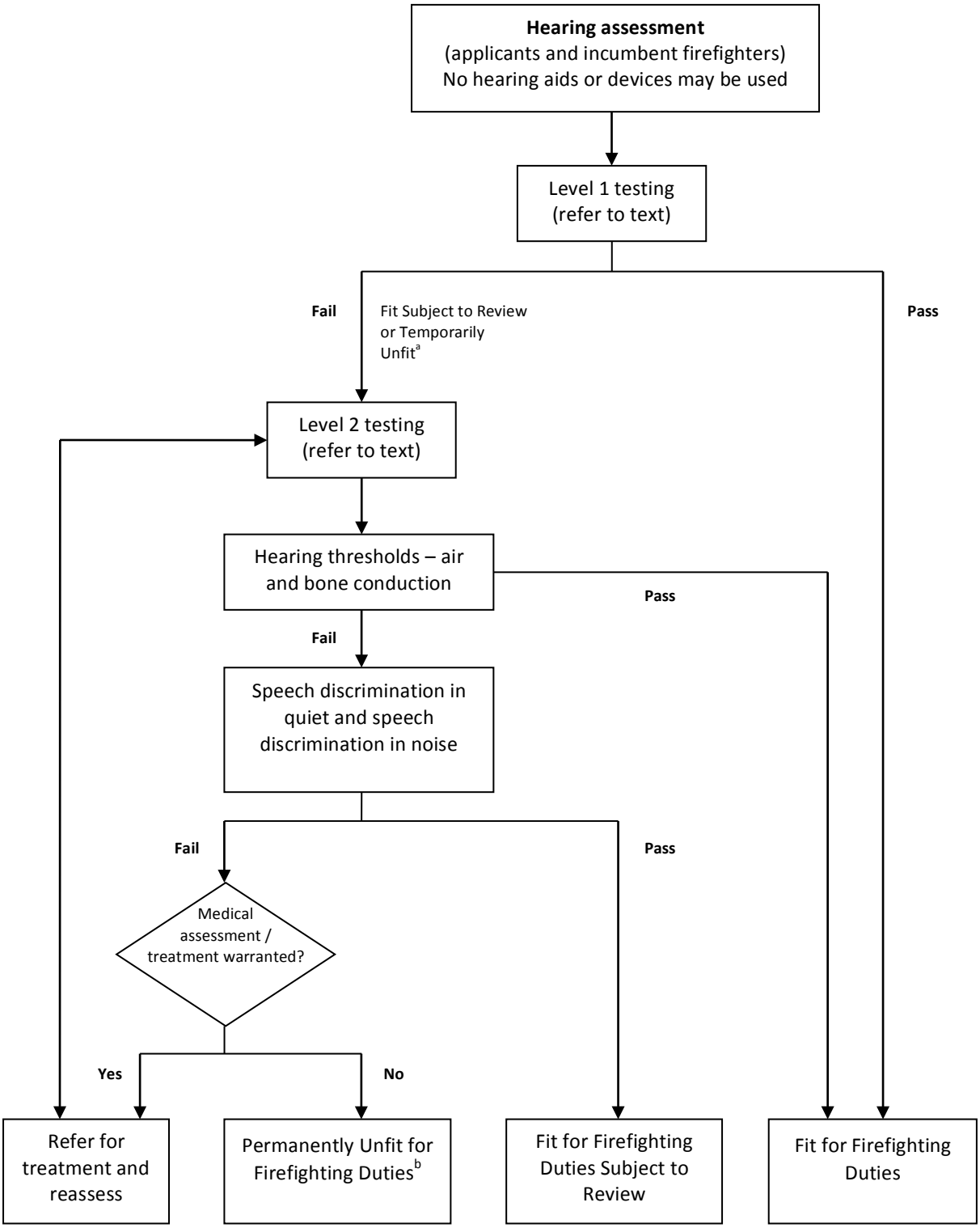
It is recognised that incumbent firefighters may adjust to some disabilities through years of operational experience. Therefore, an incumbent firefighter with a borderline fail result after Level 2 testing (including specialist assessment if indicated) may be referred to the FRNSW Occupational Physician for further consideration.

13.2.3 Hearing aids, cochlear implants and bone-anchored hearing aids

The risks associated with the use of hearing devices while firefighting have been assessed and no devices have been deemed suitable for the purpose of firefighting. Conditions experienced in firefighting increase the risk of device failure, and there are limitations in signal processing, which may result in failure to hear adequately in the operational environment.

[8] Reduced speech discrimination at high intensities relative to maximum discrimination ability.

Figure 49 Hearing assessment process (applicant and incumbent firefighters)



a *Classify as Temporarily Unfit for Firefighting Duties if loss is severe. Otherwise, classify as Fit for Firefighting Duties Subject to Review (by an audiologist) within one month.*
b *Borderline fail in an incumbent firefighter may be referred to the Fire & Rescue NSW Occupational Physician for further assessment.*

Table 4 Medical criteria for operational firefighters – hearing[a]

Condition	Criteria
Hearing for firefighting	**Level 1 testing** A firefighter is not Fit to Perform Firefighting Duties if Level 1 testing – air conduction (refer to text) shows there is hearing loss >40 dB in any frequency between 0.5 and 3kHz (inclusive) in either ear. If Level 1 criteria are not met, the firefighter may be referred to an audiologist for Level 2 testing (refer to text and below). If the loss is severe, Temporarily Unfit to Perform Firefighting Duties should be determined; otherwise, Fit to Perform Firefighting Duties Subject to Review should be determined, with review by an audiologist **within one month**. **Level 2 testing** A firefighter is not Fit to Perform Firefighting Duties if Level 2 threshold testing – bone and air conduction (refer to text) – shows there is hearing loss >40 dB in any frequency between 0.5 and 3kHz (inclusive) in either ear. If the loss is severe, Temporarily Unfit to Perform Firefighting Duties should be determined; otherwise, Fit to Perform Firefighting Subject to Review should be determined, with review by an audiologist **within one month** for speech discrimination test. Fit to Perform Firefighting Duties Subject to Review may be determined if the following are met: • speech discrimination in quiet, 90% correct in each ear, **and** • speech discrimination in noise, 70% correct binaurally. Where Level 2 criteria are not met, and the diagnostic component of Level 2 testing indicates that ear, nose and throat specialist review is indicated, Temporarily Unfit to Perform Firefighting Duties may be determined while further assessment and treatment (if appropriate) is undertaken. The firefighter may recommence the hearing assessment process after treatment, and medical fitness for duty determined in accordance with the results. If treatment is not an option and hearing is not expected to improve unaided, the firefighter should be classed as Permanently Unfit to Perform Firefighting Duties. Incumbent firefighters with only **borderline** fail may be referred to the Fire & Rescue NSW Occupational Physician for further review.

a *All testing is to be conducted without the use of hearing devices.*

13.3 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2012.

Collingridge L. *FRNSW hearing standards report*, 2011.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

14 Musculoskeletal disorders

14.1 Relevance to operational duties

Operational duties are physically demanding and many of the typical firefighting tasks required result in extremely high loading on the musculoskeletal system.

While wearing personal protective equipment, which weighs up to 21 kg and includes self-contained breathing apparatus, firefighters are required to perform firefighting tasks such as:

- handling charged lines of hose under high pressure
- extensive crawling, squatting, lifting and carrying heavy objects
- obtaining forcible entry
- carrying and handling rescue equipment including heavy power and hand tools
- raising of ladders
- working in awkward spaces and positions under emergency conditions that may not allow for best practice manual handling techniques
- climbing multiple flights of stairs (depending on location) while carrying equipment and tools
- climbing ladders
- undertaking search and rescue, which includes prolonged squatting or crouching, dragging or carrying victims ranging in weight from newborns to grossly overweight adults. Firefighters may need to rescue a collapsed fellow firefighter who is also wearing full personal protective equipment
- negotiating uneven and slippery surfaces.

Firefighting duties place high loads on the lower back, knees and shoulders, and this is supported by Fire & Rescue NSW (FRNSW) injury records. Significant histories or other findings involving these areas should prompt very careful assessment.

There are many musculoskeletal conditions, including those of a degenerative nature, with the potential to be aggravated or exacerbated by firefighting duties. This chapter does not aim to address every musculoskeletal diagnosis, rather, it focuses on conditions:

- that may result in acute incapacity
- where the risks of aggravation or exacerbation may be particularly high
- that may significantly impact on function.

All musculoskeletal conditions should be assessed with these same principles in mind.

14.2 General assessment and management guidelines

14.2.1 General

The examining doctor should take a thorough history, noting information such as:

- day-to-day functional capacity

- performance in other jobs (pre-employment, secondary or primary employment for incumbent firefighters)
- history of injuries, the circumstances of any injuries, their severity and recovery time (including time off work or time on suitable duties, and time off sports)
- treatment required and duration of treatment
- exacerbating and relieving factors.

Examination should evaluate the following:

- gait – the ability to walk on flat and uneven surfaces
- spine – range of movement of cervical and lumbosacral spine
- limbs – power, range of movement, stability of joints
- pain – presence of musculoskeletal pain that may impede movement or affect the ability to tolerate heavy loads
- balance.

14.2.2 Shoulder dislocation

A history of anterior glenohumeral joint dislocation requires assessment of the likelihood of recurrence. Forceful activities above shoulder height (e.g. raising ladders) may precipitate dislocation in a firefighter so predisposed. Glenohumeral joint dislocation is acutely incapacitating, with obvious implications for the safety of the individual firefighter and those relying on them for their own safety, such as their crew and members of the public.

A firefighter should be classified as Temporarily Unfit to Perform Firefighting Duties after isolated anterior glenohumeral joint dislocation. The younger the firefighter, the higher the risk of recurrence, although the risk reduces over time. The rate of redislocation ranges from 55% to 95%. If a sufficient period has passed, such that the risk of recurrence is considered low by an orthopaedic surgeon, Fit to Perform Firefighting Duties may be considered.

If there is a history of recurrent shoulder dislocation without repair, the firefighter is Permanently Unfit to Perform Firefighting Duties. Temporarily Unfit to Perform Firefighting Duties is appropriate if the firefighter is awaiting surgery. Further clinical assessment of medical fitness for duty may be undertaken after the appropriate postoperative period. Fit to Perform Firefighting Duties may be determined if repair is successful and the treating orthopaedic surgeon deems the risk of recurrence is low.

History of posterior shoulder dislocation is usually only because of seizure or electrical injury, and should be assessed with these underlying causes in mind.

14.2.3 Ruptured anterior cruciate ligament

Unrepaired ruptured anterior cruciate ligament (ACL) leaves the affected knee potentially unstable and at increased risk of accelerated degeneration. Excessive loads are placed on the knees, as well as the need to negotiate uneven surfaces, thereby further increasing risks. A knee giving way during firefighting duties because of a deficient ACL may be acutely incapacitating, with obvious safety implications for the firefighter and others relying on them for their safety, such as their crew and members of the public.

Fit to Perform Firefighting Duties may be determined for firefighters having undergone successful ACL reconstruction, after the appropriate postoperative and rehabilitation period.

14.2.4 Patellar dislocation

Recurrent dislocation of the patella is incompatible with undertaking firefighting duties safely because of the risk of acute incapacity, and the conditions of firefighting expected to increase the risk of dislocation in a firefighter with such a history. Permanently Unfit to Perform Firefighting Duties applies, or Temporarily Unfit to Perform Firefighting if the firefighter is awaiting surgery. Fit to Perform Firefighting Duties may be determined following successful surgical repair.

14.2.5 Degenerative knee disease

The potential to aggravate or exacerbate significant underlying degenerative disease of the knee is high with the activities of firefighting. Incumbent firefighters often continue until they are limited by their symptoms. Individualised assessment is required, including discussion of ongoing risks.

14.2.6 Lower back

Incumbent firefighters with a history of chronic or recurrent lower back symptoms require assessment on an individual basis, taking into account their experience in the job and tolerance of duties.

Successful first-time lumbar disc surgery does not necessarily require permanent restrictions; however, there is some increased risk of mechanical pain over time, such that operational duties may not be able to be sustained. This risk should be discussed with the firefighter and their treatment provider.

Any applicants with a history of chronic low back problems or lumbar surgery require referral to the FRNSW Occupational Physician for further assessment of their medical fitness for operational duties.

14.2.7 Inflammatory arthropathies

Many of these conditions – including rheumatoid arthritis, psoriatic arthritis and ankylosing spondylitis – are often seen in young people and can lead to chronic pain and mobility problems. The heavy physical work of firefighting is likely to aggravate conditions during periods of active inflammation. Consideration must also be given to aggravation of joints already affected by any destructive inflammatory processes. Corticosteroid medication is a risk for developing osteoporosis, even when used for short periods; therefore, fracture risk must also be considered, given the extraordinary forces and increased risk of trauma with firefighting duties. Other systems affected by the multisystem disease must also be considered in relation to any potential interaction with the conditions of firefighting – for example, vision. The opinion of the FRNSW Occupational Physician is required, in conjunction with information provided by a rheumatologist.

14.2.8 Joint replacement – knee and hip (including resurfacing)

Total knee replacement may result in difficulties with kneeling, deep squatting, and prolonged squatting or crouching. The heavy loading resulting from firefighting duties may increase the risk of accelerated wear of the prosthesis, resulting in early failure. Firefighters having undergone total hip replacement or hip resurfacing procedures must be assessed for their level of recovery and function, risk of acute incapacity because of dislocation of the joint, and risk of accelerated wear of the prosthesis from firefighting duties. The FRNSW Occupational Physician will make the final determination of medical fitness for firefighting duties, taking into account information provided by the treating and/or an independent orthopaedic surgeon.

14.2.9 Applicants

Applicants are unlikely to be accustomed to undertaking activities while so heavily loaded. Significant histories or other findings involving the lower back, knees and shoulders should prompt very careful assessment. For the purpose of this standard, all significant musculoskeletal conditions in applicants must be referred to the FRNSW Occupational Physician for a final determination on medical fitness for duty.

Applicants with a history of chronic nonspecific lower back pain must be assessed very carefully, as history is the most significant predictor of future problems, and the risk is increased, regardless of occupation. Lumbar disc herniation and nerve root involvement also require careful assessment of risk of recurrence, as the activities of firefighting may precipitate further episodes. Likewise, the risks for applicants who have had previous lumbar disc surgery need to be very carefully assessed. Where chronic lower back problems or surgery have been related to previous employment, it is important to determine if any permanent restrictions were placed on the applicant.

Applicants with a history of ACL repair should be assessed with regard to integrity of the repair and evidence of significant degenerative disease likely to be aggravated or exacerbated by firefighting duties. Careful clinical assessment is required, as well as review of the operation report. MRI may be considered depending on the time since surgery and the age of the firefighter, if further information is required regarding integrity of the repair and degenerative changes.

Applicants with a history of significant knee injury or symptoms, and/or examination findings consistent with degeneration or inflammation require further careful assessment. Applicants should provide copies of any existing imaging studies and operation reports. Further assessment may be required depending on these results. Findings such as large areas of chondral damage and advanced osteoarthritis are not compatible with safely undertaking firefighting duties.

Table 5 Medical criteria for operational firefighters – musculoskeletal disorders[a]

Condition	Criteria
Musculoskeletal disorders	A firefighter is not Fit to Perform Firefighting Duties if they have a musculoskeletal condition that: • may result in acute incapacity, or • is highly likely to be aggravated by firefighting duties, or • may significantly impact on capacity to effectively and safely undertake the physical requirements of firefighting duties. They may be classed as Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties while being further assessed or awaiting surgery, or Permanently Unfit to Perform Firefighting Duties. Refer to the text for guidelines regarding assessment and management.

a *For additional information regarding applicants, refer to text.*

14.3 Bibliography

National Fire Protection Association. *NFPA1582: standard on comprehensive occupational medical program for fire departments*, Avon, MA, 2013.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

Office of the Deputy Prime Minister. *Medical and occupational evidence for recruitment and retention in the Fire and Rescue Service*, London, UK, 2004.

15 Neurological disorders

This chapter covers epilepsy and other neurological conditions, including dementia.

15.1 Relevance to operational duties

The ability to effectively and safely undertake the inherent requirements of firefighting duties relies on a number of intact neurological functions. Firefighters are required to have awareness of what is happening in their environment and understand what that information means (situational awareness). They make decisions and act under conditions of extreme time pressure when the consequences of the decisions could impact lives and property.

The following functions are required for operational duties to be undertaken effectively and safely:

- visuospatial perception
- insight
- judgement
- attention and concentration
- reaction time
- memory
- sensation
- muscle power (also refer to Section 14, Musculoskeletal disorder)
- coordination
- balance and vertigo (also refer to Section 21, Vestibular disorders)
- vision (also refer to Section 22, Vision and eye disorders).

Loss of consciousness, seizure, confusional states, cognitive impairment, impairment of muscular power and coordination impact on the ability to effectively and safely undertake operational duties, including the ability to drive the appliance in emergency mode. Such impairments can jeopardise the safety of the individual firefighter, their crew and members of the public.

In addition, the risk of precipitating some neurological events is increased because of the conditions under which operational duties are undertaken:

- Shift work, sleep disruption and sleep deprivation can lower seizure threshold, thus precipitating a seizure in a firefighter at risk of seizures. In some cases, raised body temperature (refer to Section 11, Cardiovascular disorders, High thermal load) can also reduce the seizure threshold.
- The cardiovascular stressors of firefighting are well defined and may precipitate an ischaemic or haemorrhagic cerebrovascular accident in a firefighter with cerebrovascular disease or severe hypertension (refer to Section 11, Cardiovascular disorders).
- Hot and humid conditions may worsen symptoms of multiple sclerosis.
- Lifestyle factors, such as alcohol intake and social activities resulting in sleep deprivation, can also lower seizure threshold.

15.2 General assessment and management guidelines

This chapter provides guidance and medical criteria for the following conditions:

- seizures and epilepsy
- aneurysms (unruptured aneurysms and other vascular malformations)
- cerebrovascular accident
- dementia
- head injury
- intracranial surgery
- neurodegenerative disorders (multiple sclerosis, motor neurone disease, Parkinson's disease, Huntington's disease)
- space-occupying lesions
- subarachnoid haemorrhage.

15.2.1 Seizures and epilepsy

Epilepsy is characterised by the tendency to experience recurrent seizures. It is defined by two or more unprovoked seizures. Not all seizures constitute a diagnosis of epilepsy.

Epilepsy is a common disorder, with a cumulative incidence in the population of 2%, and 0.5% of the population affected and taking medication at any one time. Even with treatment, approximately 20% of those with epilepsy continue to experience seizures.

Firefighters experiencing an initial seizure should be referred to a specialist for accurate diagnosis, so that appropriate treatment can be instituted and risks related to firefighting can be determined, explained and managed appropriately.

If medical fitness to perform firefighting duties is being assessed after a specified seizure-free period, the assessing specialist in epilepsy should advise if a sleep-deprived electroencephalogram is warranted as part of the assessment, as firefighters work shifts or on call, with the potential for sleep disruption or sleep deprivation.

Consideration should also be given to conditions inherent to firefighting that have the potential to lower seizure threshold, such as shift work and on-call work – including how this may impact on medication dosing and high thermal load.

The default standard (all cases)

This standard applies to all firefighters who have had a seizure. In line with the current commercial vehicle driver medical standard, which considers the effect of acute incapacity, a seizure-free period of 10 years is required before firefighting duties can be considered. A number of defined situations, however, may attract a shorter seizure-free period. Adherence to medical advice and reviews at least annually would still apply in these cases.

Variations to the default standard

Variation to the default standard may be appropriate in some cases, thus allowing an earlier return to firefighting duties. These situations are discussed below.

Seizures in childhood

Some specific childhood epilepsy syndromes are characterised by cessation of seizures in teenage years, before working age. Firefighters may be classified as Fit to Perform Firefighting Duties if seizures have not occurred after 11 years of age. The default standard applies if a seizure has occurred after the age of 11 years.

First seizure

Approximately 50% of all people experiencing a first seizure will never have another seizure, while 50% will have another seizure (i.e. epilepsy.) Risk of recurrence decreases with time. If sufficient time has passed without further seizures – with or without medication – such that risk has reduced to an acceptably low level, firefighting duties may be considered. If a second seizure occurs, the risk of recurrence is much higher. A second seizure within 24 hours, however, is still considered a first seizure and does not worsen prognosis.

Epilepsy treated for the first time

When treatment with antiepileptic medication is commenced in a previously untreated person, sufficient time should pass to establish that the medication is effective. The default standard applies.

Acute symptomatic seizures

These seizures are caused by a transient brain disorder or metabolic disturbance, in individuals without previous epilepsy – for example, because of encephalitis, hyponatraemia, hypoglycaemia, head injury (posttraumatic epilepsy; see Section 15.2.5), benzodiazepine or alcohol withdrawal. Further seizures may follow weeks, months or years after resolution of the transient brain disorder. This may be as a result of permanent changes to the brain caused by the process underlying the acute symptomatic seizures, or because the transient brain disorder has recurred (e.g. benzodiazepine withdrawal).

Seizures during and resulting directly from a transient brain disorder or metabolic disturbance will result in exclusion from firefighting duties for a sufficient period to allow the risk of recurrence to fall to an acceptably low level.

The acute symptomatic seizures standard no longer applies if there is seizure recurrence after the causative acute illness has resolved, whether or not due to a second transient brain disorder or metabolic disturbance. For example, if an episode of encephalitis results in seizure and there is another seizure after recovery from the encephalitis, and the person commences treatment for epilepsy, the standard for epilepsy treated for the first time applies. Similarly, the default standard would apply for seizures related to two separate episodes of benzodiazepine withdrawal.

Other considerations

Epilepsy treated by surgery

Surgery to resect epileptogenic brain tissue may eliminate seizures completely in about two-thirds of individuals.

The default standard applies.

'Safe' seizures, including prolonged aura

Some seizures may not obviously impair consciousness. People may believe their consciousness is unimpaired when it actually is impaired. For example, some auras are associated with impaired consciousness that a person does not perceive. Seizures may begin with a subjective sensation (the

aura) that precedes impairment of consciousness. Auras are actually simple partial seizures in which consciousness is maintained. Such warnings cannot be relied upon in firefighting because of the emergency and time critical nature of duties.

The default standard applies.

Sleep-only seizures

The default standard applies.

Seizure in a person whose epilepsy has been previously well controlled, including 'provoked' seizures

Seizures may be provoked in those with epilepsy by factors such as sleep deprivation, missed doses of anti-epileptic medication, alcohol or acute illness.

The default standard applies.

Medication noncompliance

Compliance with medical advice regarding medication use is a requirement for fitness to perform firefighting duties. Drug-level monitoring may be recommended if noncompliance is suspected.

The default standard applies if a seizure results from noncompliance or a missed dose of medication.

Withdrawal, change or dose reduction of anti-epileptic medication

Withdrawal of anti-epileptic medication is incompatible with firefighting duties. Dose reduction of anti-epileptic medication is incompatible with firefighting duties, except if the dose reduction only because of the presence of side effects.

Exceptional cases

Where a neurologist experienced in the management of epilepsy considers that a firefighter with seizures or epilepsy does not meet the standard, but may be safe to undertake firefighting duties without undue risk of harm to the firefighter or others, the Fire & Rescue NSW (FRNSW) Occupational Physician may consider information provided by the neurologist in assessing fitness to perform firefighting duties. Generally, such cases will be based on extenuating circumstances. For all firefighters who are required to drive the appliance (i.e. all firefighters except Station Commanders), they must meet the criteria for holding a conditional commercial vehicle driver licence for consideration to be given to their case.

Concurrent conditions

Where epilepsy is associated with other impairments or conditions, the relevant section of this standard should be consulted.

Other conditions with risk of seizure

Seizures or risk of seizures may be associated with many brain disorders (e.g. intracranial surgery, traumatic brain injury). Neurological deficit associated with the brain disorder may impact on medical fitness to perform firefighting duties. Both the risk of seizures and the effect of any neurological deficit must be considered when assessing medical fitness to perform firefighting duties.

15.2.2 Aneurysms (unruptured intracranial aneurysms and other vascular malformations)

Sudden severe haemorrhage from an intracranial aneurysm or vascular malformation may cause acute incapacity.

Size is the most significant predictor of aneurysm rupture; however, the potentially catastrophic consequences should an aneurysm rupture while on duty must also be considered.

The annualised risk of haemorrhage from vascular malformations, such as cavernous haemangiomas (cavernomas) varies in the literature. A previous history of haemorrhage is a significant risk factor for clinically significant haemorrhage. Seizure risk is also a consideration.

Individualised assessment must be undertaken for firefighters with these conditions. The FRNSW Occupational Physician will determine fitness to perform firefighting duties taking into account information from the treating neurosurgeon or neurologist regarding:

- risk of haemorrhage
- risk of seizure
- any increased risk related to the physiological conditions of firefighting (such as acutely increased blood pressure)
- the potential for catastrophic consequence of haemorrhage and seizure while on duty.

Mostly, Permanently Unfit to Perform Firefighting Duties will be determined, unless the firefighter is awaiting surgery, in which case Temporally Unfit to Perform Firefighting Duties may be determined.

15.2.3 Dementia

Dementia is characterised by progressive deterioration of cognitive function, affecting memory, psychomotor abilities, attention, visuospatial functions and executive functions.

Dementia may rise from many causes, including Alzheimer's disease, Huntington's disease, Parkinson's disease and vascular dementia. Alzheimer's disease is the most common cause, accounting for 50–70% of cases. Although it mainly affects people over the age of 70, onset can occur younger than this, and it is of relevance for firefighters due to an ageing workforce.

Dementia may affect the ability to safely undertake operate firefighting duties because of the following effects:

- memory loss
- limited concentration or gaps in attention
- errors in judgement
- confusion when making choices
- poor decision making or difficulty problem solving
- poor insight and denial of deficits
- errors with navigation, including forgetting details of routes
- slowed reaction times, including failure to respond in a timely fashion to instructions
- poor hand–eye coordination.

Based on studies of road accidents, a diagnosis of dementia is associated with a moderately high risk of collision when compared with age-matched controls. This is of significance for firefighters who need to drive the appliance, including under emergency conditions, and can be extrapolated to other firefighting tasks that are complex, done under time pressures and have safety implications.

Dementia in a firefighter will eventually represent a risk to individual and others, because of the progressive and irreversible nature of the condition.

Impairment levels vary widely, with individuals experiencing different patterns and timing of impairment as their conditions progress. This presents diagnostic and management problems.

The following may assist with the assessment of dementia or suspected dementia. This assumes other causes of cognitive impairment have been considered and excluded (e.g. chronic alcohol misuse):

- Work history. Have they been involved in any incidents? Have they been referred for assessment by line management?
- Hearing. Can they hear speech and warning sounds?
- Reaction times. Can they respond to incident ground orders?
- Problem solving. Do they become upset or confused when more than one thing happens at the same time?
- Coordination. Have they become clumsy or started to walk differently because their coordination is affected?
- Praxis. Do they have difficulty using their hands and feet when asked to follow motor instructions?
- Alertness and perception. Are they aware of, and do they understand, what is happening around them? Do they experience hallucinations or delusions?
- Insight. Are they aware of the effects of their dementia? Is there denial?

Lack of insight and variable memory abilities are associated with most dementia syndromes; therefore, the individual may minimise or deny any difficulties with working. Reports of work performance, feedback from supervisors or co-firefighters may be useful when assessing overall coping and safety decision-making skills.

15.2.4 Head injury

Head trauma may result in various severities of injury. Loss of consciousness of less than one minute, with no complications, does not usually result in any long-term impairment. The individual should be free of symptoms of concussion before resuming duty.

More significant head injury can result in impairment of the neurological functions listed in Section 5.1. Personality or behavioural changes may affect judgement and tolerance, and may also be associated with psychiatric disorders such as depression or posttraumatic stress symptom. If assessment reveals concerns about neurocognitive function, formal neuropsychological assessment should be considered. Assessment for the risk of posttraumatic epilepsy (PTE) must also form part of any assessment for a firefighter with a significant head injury.

15.2.5 Posttraumatic epilepsy

PTE is a recurrent seizure disorder secondary to brain injury following head trauma. It is a nonhomogeneous condition and its onset may be several years after the head injury. It should be distinguished, however, from immediate posttraumatic (acute symptomatic) seizures that occur within 24 hours of a head injury, which are considered part of the acute process (refer to acute symptomatic seizures in Section 15.2.4). Seizures that occur within one week after injury are termed early posttraumatic seizures and seizures occurring more than one week after injury are termed late posttraumatic seizures. Single late traumatic seizures should not be labelled as PTE. The risk of having a second seizure, however, is high, with one population-based study showing 86% of individuals progressing to a second seizure within two years of the first.[9]

The risk of PTE increases with the severity of the traumatic brain injury. Risk factors for late posttraumatic seizures after traumatic brain injury include:

- early posttraumatic seizures (from 24 hours to 1 week after the trauma)
- penetrating brain injury
- brain contusion
- subdural haematoma/surgery for subdural haematoma
- depressed skull fractures
- loss of consciousness/alteration of consciousness or posttraumatic amnesia greater than 24 hours
- age older than 65 at time of injury.

After severe traumatic brain injury, the risk remains elevated for more than 10 years after the injury; however, the risk reduces with time.

15.2.6 Intracranial surgery

The risk of seizure must be considered after certain types of intracranial surgery, as well as any impairment related to the underlying condition or as a result of surgery. Supratentorial surgery, or surgery requiring retraction of the cerebral hemispheres, will attract a significant nonworking period. Individualised assessment will be undertaken by the FRNSW Occupational Physician in conjunction with the treating neurosurgeon.

15.2.7 Multiple sclerosis

Multiple sclerosis may produce a wide range of neurological deficits that impact on the ability to effectively and safely undertake firefighting duties. Deficits may be temporary or permanent, and the course of illness is variable. Many people with multiple sclerosis experience temporary worsening of symptoms with even small increases in body temperature from hot or humid weather or exercise. The conditions of firefighting are conducive to heat stress, with strenuous exercise undertaken in protective clothing that inhibits the body's normal cooling mechanisms. Other contributors to heat stress include hot, humid weather conditions, and radiant heat.

Medical fitness for duty will be determined by the FRNSW Occupational Physician, taking into account information provided by the treating neurologist.

---

[9] Frey L. Epidemiology of post traumatic epilepsy: a critical review. *Epilepsia* 2003, 44(Suppl. 10):11–17.

15.2.8 Neuromuscular disorders

Neuromuscular disorders include diseases of the peripheral nerves, muscles or neuromuscular junction. Severe weakness or problems with sensation, especially proprioception, will result in difficulties effectively and safely undertaking firefighting duties. Medical fitness for duty will be determined by the FRNSW Occupational Physician, taking into account information provided by the treating neurologist.

15.2.9 Parkinson's disease

Parkinson's disease is a common progressive disease. Motor, cognitive, autonomic nervous system and psychiatric manifestations all potentially impact on the ability to effectively and safely undertake firefighting duties. Motor fluctuations are incompatible with firefighting duties. Fitness to perform firefighting for duties will be determined by the FRNSW Occupational Physician, taking into account information provided by the treating neurologist.

15.2.10 Stroke (cerebral infarction or intracerebral haemorrhage)

Ischaemic stroke (atherosclerotic or embolic) stratifies an individual into a very high cardiovascular risk group (i.e. >20% 5-year risk of an acute cardiovascular event). Such high cardiovascular risk in the context of an overt cardiovascular event is incompatible with undertaking the inherent requirements of firefighting safely and Permanently Unfit to Perform Firefighting Duties applies.

The most common cause for haemorrhagic stroke is sustained or transient elevation of blood pressure. Regardless of level of recovery, Permanently Unfit to Perform Firefighting Duties applies due to the cardiovascular strain of firefighting and the associated increases in blood pressure that would increase the risk of recurrent stroke.

In unusual cases (e.g. embolic stroke from patent foramen ovale, which is subsequently closed percutaneously), Fit to Perform Firefighting Duties Subject to Review may be determined by the FRNSW Occupational Physician, taking into account information provided by the treating neurologist and other treatment providers regarding level of recovery and control of risk factors, if recurrence is considered unlikely.

If the firefighter has had an associated seizure, seizure and epilepsy standards also apply.

15.2.11 Transient ischaemic attack

Transient ischaemic attacks (TIAs) can be single or recurrent, and may be followed by a stroke. The risk of stroke can be as high as 15% at 90 days post-TIA. Up to 85% of strokes that follow TIA will be fatal or disabling. In the majority of cases, individuals who have suffered a TIA would be stratified into a very high cardiovascular risk group (i.e. >20% 5-year risk of an acute cardiovascular event). Such high cardiovascular risk in the context of an overt cardiovascular event is generally incompatible with undertaking the inherent requirements of firefighting safely and, therefore, Permanently Unfit to Perform Firefighting Duties is likely to apply. However, each individual firefighter must be assessed individually with regard to any underlying cause of the TIA, cardiovascular risk factors and likelihood of recurrence. Assessments of these cases are likely to be complex and require the input of an appropriate specialist.

15.2.12 Space occupying lesions, including brain tumours

Brain tumours and other space-occupying lesions may cause a range of effects depending on their location and the type of lesion. If a firefighter has a brain tumour or other space-occupying lesion, they are Unfit to Perform Firefighting Duties. The FRNSW Occupational Physician shall further

determine medical fitness for duty, taking into account information provided by the treating neurosurgeon or other relevant specialist regarding factors including:

- effect on neurological function
- treatment
- prognosis
- seizure risk.

Other sections of this standard may also apply (e.g. vision, seizures and epilepsy, intracranial surgery).

15.2.13 Subarachnoid haemorrhage

Any cases of subarachnoid haemorrhage should be classified as Temporarily Unfit to Perform Firefighting Duties while further assessment is undertaken. The FRNSW Occupational Physician will determine final fitness to perform firefighting duties. Assessment of fitness for firefighting duties may be considered after a nonworking period of at least 6 months, unless a poor prognosis is apparent before this.

Consideration shall be given to:

- underlying cause
- treatment, and if this is considered definitive
- level of recovery/residual neurological deficit
- presence of problems with concentration, attention and mood
- likelihood of recurrence
- risk of conditions of firefighting, such as physiological strain increasing the risk of recurrence.

Other sections of this standard may also apply (e.g. vision, seizures and epilepsy, intracranial surgery).

15.2.14 Other neurological conditions

Any condition affecting neurological function not covered by the above, must be assessed on first principles, considering the functional requirements of firefighting. For vertigo, refer to Section 21, Vestibular disorders.

Table 6 Medical criteria for operational firefighters – neurological conditions

Condition	**Criteria**
Seizures and epilepsy	
All cases: default standard Applies to all firefighters who have experienced a seizure. Exceptions may be considered for situations	A firefighter is not Fit to Perform Firefighting Duties if they have experienced a seizure. Fit to Perform Firefighting Duties Subject to Review, with at least annual review, may be determined, taking into account information provided by a specialist in epilepsy as to whether the following criteria are met:

Condition	Criteria
matching those listed below.	• there have been no seizures for at least **10 years**, **and** • the EEG shows no epileptiform activity **or**, if recommended by the specialist, a sleep-deprived EEG shows no epileptiform activity, **and** • the firefighter follows medical advice with respect to medication adherence, **and** • there are no adverse medication effects that would impact on the ability to effectively and safely undertake firefighting duties, **and** • due consideration has been given to potential triggers in the firefighting environment (e.g. shift and on-call work, including impact on medication dosing, and high thermal load).
Seizures and epilepsy – possible reductions in seizure-free periods	
History of a benign seizure or epilepsy syndrome limited to childhood	Fit to Perform Firefighting Duties applies if there have been no seizures after the age of 11. If a seizure has occurred after the age of 11, there is no reduction and the default standard applies.
First seizure (note, two or more seizures in a 24-hour period are considered a single seizure)	Fit to Perform Firefighting Duties Subject to Review, with at least annual review, may be determined, taking into account information provided by a specialist in epilepsy as to whether the following criteria are met: • there have been no seizures for at least **5 years** (with medication for the 5 years, or without medication for the 5 years), **and** • the EEG shows no epileptiform activity **or**, if recommended by the specialist, a sleep-deprived EEG shows no epileptiform activity, **and** • if medication has been taken for the preceding 5-year period, the firefighter adheres to the medication regimen, **and** • due consideration has been given to potential triggers in the firefighting environment (e.g. shift and on-call work, including impact on medication dosing, and high thermal load).
Epilepsy treated for the first time	The default standard applies.
Acute symptomatic seizures Seizures occurring only during temporary brain disorder or metabolic disturbance in a person without previous seizures. This includes seizures	In exceptional circumstances, a firefighter may be determined to be Fit to Perform Firefighting Duties Subject to Review by the FRNSW Occupational Physician, with at least annual review. Consideration must be given to the underlying cause, as well as information provided by a specialist in epilepsy as to whether the following criteria are met: • there have been no further seizures for at least **12 months, and** • the EEG shows no epileptiform activity **or**, if recommended by the specialist, a sleep-deprived EEG shows no epileptiform activity,

Condition	Criteria
within 24 hours of a head injury, and withdrawal from alcohol or drugs. This is not the same as provoked seizures in a person with epilepsy	**and** • due consideration has been given to potential triggers in the firefighting environment (e.g. shift and on-call work, including impact on medication dosing, and high thermal load). If there have been two or more transient disorders causing acute symptomatic seizures, the default standard applies.
'Safe' seizures	The default standard applies.
Sleep-only seizures	The default standard applies.
Seizure in a firefighter whose epilepsy was previously well controlled	The default standard applies.
Seizures and epilepsy – other factors that may influence medical fitness for operational duties	
Epilepsy treated by surgery	The default standard applies. The vision standard may also apply if there is a visual field defect (refer to Section 22, Vision and eye disorders). Withdrawal of any anti-epileptic medication is incompatible with operational duties.
Medication noncompliance	Refer to text above.
Planned withdrawal of one or more anti-epileptic medications in a firefighter who meets the criteria for Fit for to Perform Firefighting Duties Subject to Review	Withdrawal of anti-epileptic medication is incompatible with being Fit to Perform Firefighting Duties.
Reduction in dosage of anti-epileptic medication in a person who meets the criteria for Fit to Perform Firefighting Duties Subject to Review	Reduction in dosage of anti-epileptic medication is incompatible with being Fit to Perform Firefighting Duties, except if the dose reduction is only because of the presence of side effects.
Exceptional cases	Where a specialist experienced in the management of epilepsy considers that a firefighter with seizures or epilepsy does not meet the standards for firefighters, but may be safe to undertake firefighting duties without undue risk of harm to the firefighter or others, the FRNSW Occupational Physician may consider information provided by the neurologist in assessing medical fitness for duty. The firefighter will

Condition	Criteria
	be subject to at least annual review.
Other neurological conditions	
Aneurysms	A firefighter is not Fit to Perform Firefighting Duties if they have an unruptured intracranial aneurysm or other vascular malformation. Under exceptional circumstances, Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account information provided by the treating neurosurgeon and the opinion of the FRNSW Occupational Physician regarding the risk of bleeding the risk of seizure; and increases in these risks associated with the conditions of operational duties, such as acute increases in blood pressure and sleep disruption. Mostly, Permanently Unfit to Perform Firefighting Duties will be determined, unless awaiting surgery, in which case they should be classed Temporarily Unfit to Perform Firefighting Duties and may be reviewed after the appropriate postoperative period.
Dementia	Also refer to the text. Permanently Unfit to Perform Firefighting Duties will apply if dementia is confirmed.
Head injury (including risk of posttraumatic epilepsy)	A firefighter is not Fit to Perform Firefighting Duties if they have sustained a head injury resulting in impairment of any of the following: • visuospatial perception • insight • judgement • attention • reaction time • memory • sensation • muscle power • coordination • vision (including visual fields). Fit to Perform Firefighting Duties Subject to Review, with review at least annually, may be determined by the FRNSW Occupational Physician, taking into account information provided by the appropriate specialist, including assessment of risk of posttraumatic epilepsy and neuropsychological testing. A firefighter is not Fit to Perform Firefighting Duties if they have a high risk of posttraumatic epilepsy – that is:

Condition	Criteria
	• early posttraumatic seizures (from 24 hours to 1 week posttrauma) • penetrating brain injury • brain contusion • subdural haematoma/surgery for subdural haematoma • loss of consciousness/alteration of consciousness, or • posttraumatic amnesia greater than 24 hours, and • age older than 65 at time of injury. They should be classed as Temporarily Unfit to Perform Firefighting Duties for **at least 2–5 years** or longer depending on the severity of the injury, with a minimum of 5 years for a penetrating brain injury. Shorter non-operational periods may be considered on a case-by-case basis taking into consideration advice from a specialist experienced in the assessment and management of epilepsy. If a seizure has already occurred, refer to Section 15.2.1.
Intracranial surgery	A firefighter should be classified as Temporarily Unfit to Perform Firefighting Duties for at least 12 months following supratentorial surgery or surgery that involves retraction of the cerebral hemispheres. The nonworking period should be commensurate with the level of recovery and risk of seizure. If there are seizures or long-term neurological deficits, refer to Section 15.2.1 and 'Other neurological conditions', below.
Multiple sclerosis	A firefighter is not Fit to Perform Firefighting Duties if they have multiple sclerosis. Fit to Perform Firefighting Duties Subject to Review, with at least annual review, may be considered by the FRNSW Occupational Physician, taking into account information provided by the treating specialist regarding: • impairment affecting muscle power, sensation, balance, coordination, vision and cognition • the effect of heat on the firefighter's symptoms • the course of the firefighter's illness • the effect and side effects of treatment.
Neuromuscular conditions	A firefighter is not Fit to Perform Firefighting Duties if they have: • a peripheral neuropathy • muscular dystrophy • another neuromuscular disorder that significantly impairs muscle

Condition	Criteria
	power, sensation or coordination. Fit to Perform Firefighting Duties Subject to Review, with at least annual review, may be considered, taking into account information provided by the treating specialist regarding: • the level of impairment of muscle power, sensation, balance or coordination • the course of the illness.
Parkinson's disease	A firefighter is not Fit to Perform Firefighting Duties if they have Parkinson's disease. Permanently Unfit to Perform Firefighting Duties applies if the firefighter experiences fluctuations in motor control and/or problems with balance. In exceptional circumstances, Fit to Perform Firefighting Duties Subject to Review, with at least annual review, may be determined by the FRNSW Occupational Physician, taking into account information provided by the treating specialist regarding: • the level of motor impairment • the level of cognitive and mood impairment • the presence of autonomic nervous system impairment • the response to treatment.
Space-occupying lesions (including brain tumours)	A firefighter is not Fit to Perform Firefighting Duties if they have a space-occupying lesion. In exceptional circumstances, Fit to Perform Firefighting Duties may be considered by the FRSNW Occupational Physician, taking into account information provided by the treating specialist regarding: • any neurological impairment • seizure risk • prognosis.
Subarachnoid haemorrhage (also refer to aneurysms, intracranial surgery)	A firefighter is not Fit to Perform Firefighting Duties if they have had a subarachnoid haemorrhage. Temporarily Unfit to Perform Firefighting Duties applies for at least 6 months. Fit to Perform Firefighting Duties Subject to Review may be determined by the FRNSW Occupational Physician after 6 months (unless a poor prognosis is apparent before this time), taking into account information provided by the appropriate specialist(s) regarding:

Condition	Criteria
	• the level of impairment of any of the following: visuospatial perception, insight, judgement, attention, reaction time, memory, sensation, muscle power, coordination, vision (including visual fields), concentration and mood • the underlying cause • the nature of, and response to, treatment • likelihood of recurrence.
Stroke	A firefighter is not Fit to Perform Firefighting Duties if they have had a stroke. In unusual cases, Fit to Perform Firefighting Duties Subject to Review may be determined by the FRNSW Occupational Physician, taking into account information provided by the treating specialist regarding: • the level of impairment of visuospatial perception, insight, judgement, attention, reaction time, memory, sensation, muscle power, coordination, vision (including visual fields), concentration and mood • the underlying cause, and potential for definitive treatment or control of risk factors • the likelihood of recurrence • the risk associated with the of conditions of firefighting such as cardiovascular and thermal load, and dehydration increasing the risk of stroke recurrence. In all other cases, Permanently Unfit to Perform Firefighting Duties applies.
Transient ischaemic attack (TIA)	A firefighter is not Fit to Perform Firefighting Duties if they have suffered a TIA. Information should be sought from the treating specialist to confirm diagnosis, cause and treatment. Permanently Unfit to Perform Firefighting Duties may be applicable if the diagnosis is confirmed with due consideration of the underlying cause, cardiovascular risk factors and likelihood of recurrence.
Other neurological conditions	A firefighter is not Fit to Perform Firefighting Duties if they have any neurological condition that significantly impairs any of the following: • visuospatial perception • insight • judgement • attention • reaction time

Condition	Criteria
	• memory • sensation • muscle power • coordination • vision (including visual fields). Fitness to perform firefighting duties must be discussed with the FRNSW Occupational Physician.

EEG = electroencephalogram; FRNSW = Fire & Rescue New South Wales

15.3 Bibliography

Agrawal A, Jake T, et al. Post-traumatic epilepsy: an overview. *Clinical Neurology and Neurosurgery* 2006, 108:433–9.

Annegers F, Hauser A, et al. A population based study of seizures after traumatic brain injuries. *N Engl J Med* 1998, 38:20–4.

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2011.

Civil Aviation Safety Authority. *Designated aviation medical examiner's handbook*, 2010.

Frey L. Epidemiology of post traumatic epilepsy: a critical review. *Epilepsia* 2003, 44 (Suppl. 10):11–17.

Hartenbaum N, Hastings J, Bleecker M, Mandel S. *Traumatic brain injury and commercial motor vehicle driver safety*, Opinions of Expert Panel, 2009.

Ministry of Health NZ. *New Zealand cardiovascular guidelines handbook*, 2009.

Monash University Accident Research Centre*. Influence of chronic illness on crash involvement of motor vehicle drivers*, 2nd edition, 2010.

National Fire Protection Association. *NFPA1582: standard on comprehensive occupational medical program for fire departments,* Avon, MA, 2007 (+ ROP for 2012 edition).

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

16 Psychiatric disorders

16.1 Relevance to operational duties

Firefighters work as part of team in complex, hazardous and dynamic environments. Impairment of judgement, behaviour or psychomotor function in any individual member jeopardises the safety of the individual, their crew and members of the public.

Firefighters must make critical decisions that can affect others under emergency conditions, often when they are tired or feeling stressed. The cognitive and decision-making demands are relatively high, even for those not in command positions. For Station Commanders and Captains, there is the additional responsibility of decision making, operational planning and the overall responsibility for the safety of firefighters.

Firefighting duties also require good psychomotor function, which is dependent on complex coordination between the sensory and motor systems. Psychomotor function is influenced by factors such as arousal, perception, learning, memory, attention, concentration, emotion, reflex speed, time estimation, auditory and visual functions, decision making ability and personality. A coordinated behavioural response results from the interaction of complex feedback systems. Anything that interferes with any of these factors may impact adversely on situational awareness (being aware of what is happening in their environment and understanding what that information means now and in the future), and the ability to undertake appropriate and safe actions on the incident ground, which is dynamic and often complex.

Psychiatric disorders encompass a range of cognitive, emotional and behavioural disorders, such as depression, schizophrenia, anxiety disorders and personality disorders. They also include dementia and substance abuse disorders, which are discussed in Section 15, Neurological disorders, and Section 20, Substance misuse.

Psychiatric disorders may impact on behaviour, cognitive abilities and perception, and therefore impact on the safety of individual firefighters and others who rely on them for their own safety. There are, however, considerable differences in the aetiology, symptoms, course and severity of psychiatric disorders, and they may be intermittent or persistent.

The impact of psychiatric disorders is also influenced by an individual's social circumstances, personality and coping strategies. In most cases, individualised assessment is required to evaluate the pattern of illness, severity and potential impairments, rather than the diagnosis alone.

Impairments differ at different phases of the illness and vary from person to person. The range of potential impairments associated with various conditions is described in Table 7.

16.1.1 Effects of firefighting on mental health

All firefighters will witness the death or serious injury of victims. These situations can be violent, even horrific, giving rise to critical incident stress. Situations range from burns and accident victims to suicides. These incidents are managed through the Critical Incident Support Program; however, such events, especially when recurrent, may lead to depression, anxiety disorders and substance misuse. Such events may also compound an existing psychiatric disorder.

There are, however, vast interindividual differences in response to trauma and only a minority of those exposed will develop trauma-related mental health problems. Apart from the nature of the

trauma, the main risk for developing trauma-related pathology is the make-up of the individual, both in terms of past psychiatric problems and past experience of, and response to, trauma.

Table 7 Potential impairments associated with various conditions

Condition	Potential impairment or effects on firefighting
Schizophrenia	• Reduced ability to sustain concentration or attention • Reduced cognitive and perceptual processing speeds, including reaction time • Reduced ability to perform in complex situations, such as when there are multiple distractions • Abnormalities of perceptions such as hallucinations, which are distracting and pre-occupying • Delusional beliefs that interfere with working – for example, persecutory beliefs may include being followed and result in erratic working
Bipolar affective disorder	• Depression and suicidal ideation • Mania or hypomania, with impaired judgement about working safely, skill and associated recklessness • Delusional beliefs that may directly affect work • Grandiose beliefs that may result in extreme risk taking
Depression	• Disturbance of attention, information processing and judgement, including the reduced ability to anticipate situations • Psychomotor retardation and reduced reaction times • Sleep disturbance and fatigue • Suicidal ideation that may result in reckless conduct
Anxiety disorders	• Preoccupation or distraction • Decreased working memory • Panic attacks • Obsessional behaviours, including obsessional slowness, that impair the ability to work efficiently and safely
Posttraumatic stress disorder	• Avoidance of certain situations related to traumatic experience • Increased startle response • Poor sleep • Recurrent intrusive memories
Personality disorders	• Aggressive or impulsive behaviour • Resentment of authority or reckless behaviour • Disordered interpersonal relationships • Impaired decision making

Condition	Potential impairment or effects on firefighting
Adult attention deficit hyperactivity disorder	• Difficulty with sustaining attention, decision making, planning, organising and prioritising

Shift work, sleep disruption and sleep deprivation may impact adversely on those with mood disorders. People with bipolar disorders can be sensitive to disruptions of circadian rhythms and the sleep cycle. Sleep reduction can lead to precipitation of mania. Disruption of circadian rhythms may aggravate depressive disorders, further compounding sleep disruption from the illness.

16.1.2 Treatment considerations

Some medications prescribed for psychiatric conditions may impair performance of safety critical tasks. This possible impairment needs to be balanced against the deleterious effects of untreated or undertreated illness. Side effects that warrant consideration can include sedation, movement disorders and increased propensity to heat stress (e.g. medications with anticholinergic effects).

Self-reporting, observation, clinical assessment and collateral information should be used to determine if there are any effects of medication that can cause impairment.

Lithium is a mood stabiliser commonly prescribed for bipolar disorder, and lithium toxicity can result from severe dehydration, which may occur in firefighters. Firefighters can lose copious amounts of sweat, up to 2 L/h. Therefore, the use of lithium is not compatible with operational duties.

Anticholinergic side effects of some psychoactive medications may result in orthostatic hypotension, especially with increased fluid loss from firefighting.

Some antipsychotic medications can cause disruption of body temperature regulation. Heat stress associated with firefighting could increase the risk of neuroleptic malignant syndrome, which is life-threatening.

Medication regimens, such as those required for treating attention deficit hyperactivity disorder, are not compatible with emergency response work.

Consideration of dosing of medication in relation to shift and on-call work is also required.

Cardiovascular effects of amphetamine-type medication will add to the already significant cardiovascular load of firefighting; therefore, cardiovascular status must be closely considered.

Electroconvulsive therapy may cause cognitive impairment – notably, memory dysfunction.

16.2 General assessment and management guidelines

Mental illness must be individually assessed for manifestations that can impact on the psychomotor and cognitive abilities required for firefighting, as well as the potential impact on interpersonal behaviour, which can impact adversely on the safety of the individual firefighter and those that rely on them for their own safety.

Mild mental illness does not usually impact significantly on function. Moderate levels of mental illness may affect functioning; however, successful treatment can help minimise the effect on

occupational functioning. Long-standing or recurrent severe mental illness is unlikely to be compatible with the functions required of firefighters who work in dangerous environments where the safety of others is reliant upon appropriate judgement and behaviour.

Successful management of significant mental illness in the operational workplace is contingent upon a high level of insight, compliance and cooperation from the firefighter.

Good lines of communication with treatment providers, nominated family members and line management are also advantageous in helping to assess fitness to perform firefighting duties, and to monitor progress and detect early signs of relapse or decline. Recognition of these signs and development of a satisfactory management plan is important for early and effective management aimed at improving occupational and medical outcomes. Management plans may include documentation of individual's obligations and expected actions of the individual firefighter and Fire & Rescue NSW (FRNSW) when early signs or symptoms of illness are detected.

The assessment of significant mental illness will depend heavily on psychiatric assessment and neuropsychological testing, if indicated.

16.2.1 Insight

The presence or absence of insight has significant implications for the workplace management of firefighters with psychiatric disorders.

A firefighter with insight may recognise when they are unwell and self-limit their working.

Limited insight may be associated with a lack of awareness or deficits, which may result in impaired judgement or self-appraisal, and lack of awareness of the need for treatment. Temporarily Unfit to Perform Firefighting Duties should be assigned while further assessment is undertaken.

16.2.2 Mental state examination

The mental state examination (MSE) can be helpful in identifying areas of impairment that may affect fitness to perform firefighting duties. This includes assessment of the following:

- **Appearance**: This is suggestive of general functioning (e.g. attention to personal hygiene, grooming, sedation, indications of substance use).
- **Behaviour:** This may include observations of the firefighter's behaviour at the time of assessment, and reports from the workplace about the firefighter's behaviour.
- **Attitude:** For example, whether the firefighter is cooperative, uncooperative, hostile or guarded.
- **Mood and affect:** For example, elevated or low mood.
- **Speech:** For example, tangential, pressured or monotonous.
- **Thought form, stream and content:** Relates to the logic, quantity, flow and subject of thoughts, which may be affected by mania, depression, schizophrenia or dementia. Delusions with specific thought content may impact on the ability to work safely.
- **Perception:** Disturbances such as hallucinations may interfere with attention and concentration, and influence behaviour.
- **Cognition:** This relates to alertness, orientation, attention, memory, visuospatial functioning, language functions and executive functions.

- **Insight:** This relates to self-awareness of the effects of the condition on behaviour and thinking. Assessment requires exploration of the person's awareness of the nature and impacts of their condition, and has major implications for management.
- **Judgement:** The person's ability to make sound and responsible decisions has obvious implications for safety.

16.2.3 Treatment

As outlined above, the effects of prescribed medication should be assessed, including:

- how medication may help to control aspects of the condition that impact on the ability to work safely
- medication side effects such as sedation, impaired reaction time, impaired motor skills, hypotension or dizziness. Potential for exacerbation of heat stress must also be assessed
- potential adverse effects when combined with heat stress or dehydration
- additional cardiovascular load (e.g. from amphetamine-type medication).

Assessment of compliance with treatment is also required. Consideration of dosing of medication in relation to shift and on-call work is also required.

Lithium requires specific consideration and is incompatible with safe firefighting because of the risk of lithium toxicity with dehydration.

The potential for cognitive impairment after electroconvulsive therapy requires consideration.

16.2.4 Substance misuse

Specific assessment is required for concurrent alcohol abuse, and/or abuse of pharmaceutical and/or illicit drugs. Dual diagnoses (psychiatric disorders with comorbid substance abuse) require very careful assessment regarding medical fitness and will usually result in the person being classed as Temporarily, if not Permanently, Unfit to Perform Firefighting Duties. Assessment of any psychiatric disorder should specifically seek to identify the presence of:

- problematic alcohol consumption
- illicit substance use
- pharmaceutical drug misuse.

Refer also to Section 20, Substance misuse.

16.2.5 Severe chronic conditions

The presence of a severe or relapsing psychiatric condition is unlikely to be compatible with being able to sustain operational duties in the long run, and will usually result in the person being classed as Permanently Unfit to Perform Firefighting Duties.

16.2.6 Applicants

Applicants, on the whole, will not have the benefit of experience with firefighting duties. Therefore, for any applicant with past psychiatric illness, very careful consideration needs to be given to the issue of psychological resilience. Resilience will affect the risk of the psychological exposures of firefighting aggravating their condition, and the risk of increased vulnerability to trauma-related psychological illness.

Table 8 Medical criteria for operational firefighters – psychiatric disorders[a]

Condition	Criteria
Schizophrenia and other psychotic disorders	A firefighter is not Fit to Perform Firefighting Duties if they have schizophrenia or another psychotic condition. Further information should be sought from a psychiatrist to confirm diagnosis, prognosis, treatment and features of the illness likely to impact on operational duties. Fitness for firefighting duties shall be determined by the FRNSW Occupational Physician, taking into account information provided by the treating and/or independent psychiatrist. Permanently Unfit to Perform Firefighting Duties will apply if a psychiatrist confirms a chronic, relapsing psychotic condition.
Bipolar disorder	A firefighter is not Fit to Perform Firefighting Duties if they have bipolar disorder. Fit to Perform Firefighting Duties Subject to Review may be considered, taking into account information provided by the treating and/or independent psychiatrist, and the opinion of the FRNSW Occupational Physician as to whether the following criteria are met: • the condition has been well controlled (including no rapid cycling) and compliance with treatment has been demonstrated over a substantial period (years), **and** • there has been no recurrent psychosis or, if there has been an isolated episode of psychosis, it is considered unlikely to recur, **and** • the firefighter has good insight into the potential effects of their condition on their own safety and that of others reliant on them for their own safety, **and** • shift work and sleep disruption are not expected to aggravate the condition, **and** • treatment does not include lithium, **and** • there are no side effects of treatment such as sedation, motor or cognitive impairment, or increased risk of heat-related illness, **and** • there is no concomitant substance misuse, **and** • any recurrence is likely to be picked up early, **and** • the risk of inappropriate behaviour that could impact on safety in emergency situations is considered to be low, **and** • the psychiatrist considers that the firefighter is not at increased risk of trauma-related psychological illness because of their condition. **and** • where appropriate, the FRSNW Occupational Physician has collaborative information from line management that there are no impairment issues apparent while on duty.
Other –	A firefighter is not Fit to Perform Firefighting Duties if they have a psychiatric

Condition	Criteria
moderate or severe psychiatric conditions	disorder that is likely to impair behaviour, cognitive ability or perception required for operational duties. Fit to Perform Firefighting Duties Subject to Review may be determined, in consultation with the FRNSW Occupational Physician, taking into account information provided by a psychiatrist regarding: • the course and severity of the condition, hospital admissions (including involuntary), self-harm, psychosis • the level and duration of control of the condition and compliance with treatment • adverse medication effects, including sedation, motor or cognitive impairment, increased risk of heat-related illness, and additional cardiovascular load • insight • the likelihood of impulsive behaviour • the risk of adverse impact on the condition from shift work or sleep disruption • the likelihood of recurrence or deterioration being detected early • the presence of comorbidities (e.g. substance misuse) • the risk of aggravation with the psychological exposures of operational duties • any heightened risk of developing trauma related psychological illness because of their condition.

FRNSW = Fire & Rescue NSW
***a** For additional information regarding applicants, refer to text.*

16.3 Bibliography

Castle D, Bassett D. *A primer of clinical psychiatry*, Elsevier Australia, 2010.

Monash University Accident Research Centre. *Influence of chronic illness on crash involvement of motor vehicle drivers*, 2nd edition, 2010

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

17 Renal disorders

17.1 Relevance to operational duties

The kidneys help to regulate fluid balance. Good kidney function is required for firefighting duties because of the potential for significant dehydration. The kidneys also play a key role in acid–base metabolism and electrolyte balance, and, hence, in restoring homeostasis after vigorous activity. Underlying impairment of kidney function combined with significant dehydration may result in acute renal impairment. Chronic kidney disease is associated with increased cardiovascular risk, which is highly significant for operational firefighters (refer to Section 11, Cardiovascular disorders). Significant reduction in kidney function may jeopardise the safety of the firefighter, others in the crew and members of the public.

Persistent albuminuria and/or a reduced glomerular filtration rate (GFR) indicate the presence of chronic kidney disease and are the strongest independent predictors for progression to end-stage kidney disease. They are also strong independent predictors of adverse cardiovascular outcomes, including strokes, myocardial infarction, congestive cardiac failure and death.

17.2 General assessment and management guidelines

Figure 50 summarises the assessment and management of firefighters in relation to renal function and kidney disease.

17.2.1 Risk factors

Hypertension and diabetes are significant risk factors for kidney disease (refer to following sections). Other factors that increase the risk of chronic kidney disease include:

- being more than 50 years old
- smoking
- being obese
- having a family history of kidney disease
- being Aboriginal or Torres Strait Islander
- having established cardiovascular disease.

17.2.2 Estimated glomerular filtration rate

The health assessment for the purpose of this standard includes screening for kidney disease by estimated GFR (eGFR) and urinary albumin:creatinine ratio (UACR). For the general community, most mild to moderate kidney disorders can be appropriately managed by a general practitioner; however, for firefighters, the indications for referral to a nephrologist will differ. Specialist assessment and advice from nephrologists is desirable for firefighters, in view of the potential for the kidneys being exposed to severe stress.

eGFR is widely accepted as the best measure of kidney function. Unexpected abnormal results should be repeated in the first instance and factors such as diet (including creatine supplements), muscle mass and extremes of body size should be considered:

- eGFR 60–90 mL/min/1.73 m^2, in the **presence of albuminuria** may indicate mild kidney dysfunction and referral to a nephrologist is required. Temporarily Unfit to Perform Firefighting Duties should be determined.
- eGFR <60 mL/min/1.73 m^2 indicates at least moderate kidney dysfunction and requires referral to a nephrologist. Temporarily Unfit to Perform Firefighting Duties should be determined for incumbent firefighters and Permanently Unfit to Perform Firefighting Duties for applicants.
- eGFR falls from a starting point of >90 mL/min/1.73 m^2 by 10 mL/min/1.73 m^2 per decade, beyond the age of 40 in most healthy adults, **but** an eGFR <60 mL/min/1.73 m^2 is associated with increased cardiovascular risk and poorer outcomes for all ages.

17.2.3 Assessment of albuminuria

The following clinical notes relate to the measurement and interpretation of albuminuria.

- All urine specimens should be mid-stream and clean catch to avoid abnormalities related to specimen contamination.
- The preferred method for assessment for albuminuria in both diabetic and non-diabetic individuals is a UACR measurement in a first-void specimen. Where a first-void specimen is not possible or practical, a spot (random) urine specimen for UACR is acceptable.

Albuminuria is seldom, if ever, secondary to microscopic haematuria, even if on dipstick the amount of bleeding is strongly positive.

If haematuria accompanies albuminuria, an important underlying parenchymal lesion, such as glomerulonephritis, is highly likely.

Common causes for transient-isolated albuminuria include:

- strenuous exercise
- urinary contamination with vaginal mucus or semen
- orthostatic (postural) albuminuria – primarily seen in adolescents, rarely seen over age 30
- urinary tract infection
- fever
- emotional stress
- pregnancy.

Persistent albuminuria beyond 3 months (with the exception of orthostatic albuminuria in adolescents) is definitive for chronic kidney disease.

In investigating albuminuria, cut-off levels for albuminuria are gender specific (refer to Table 9):

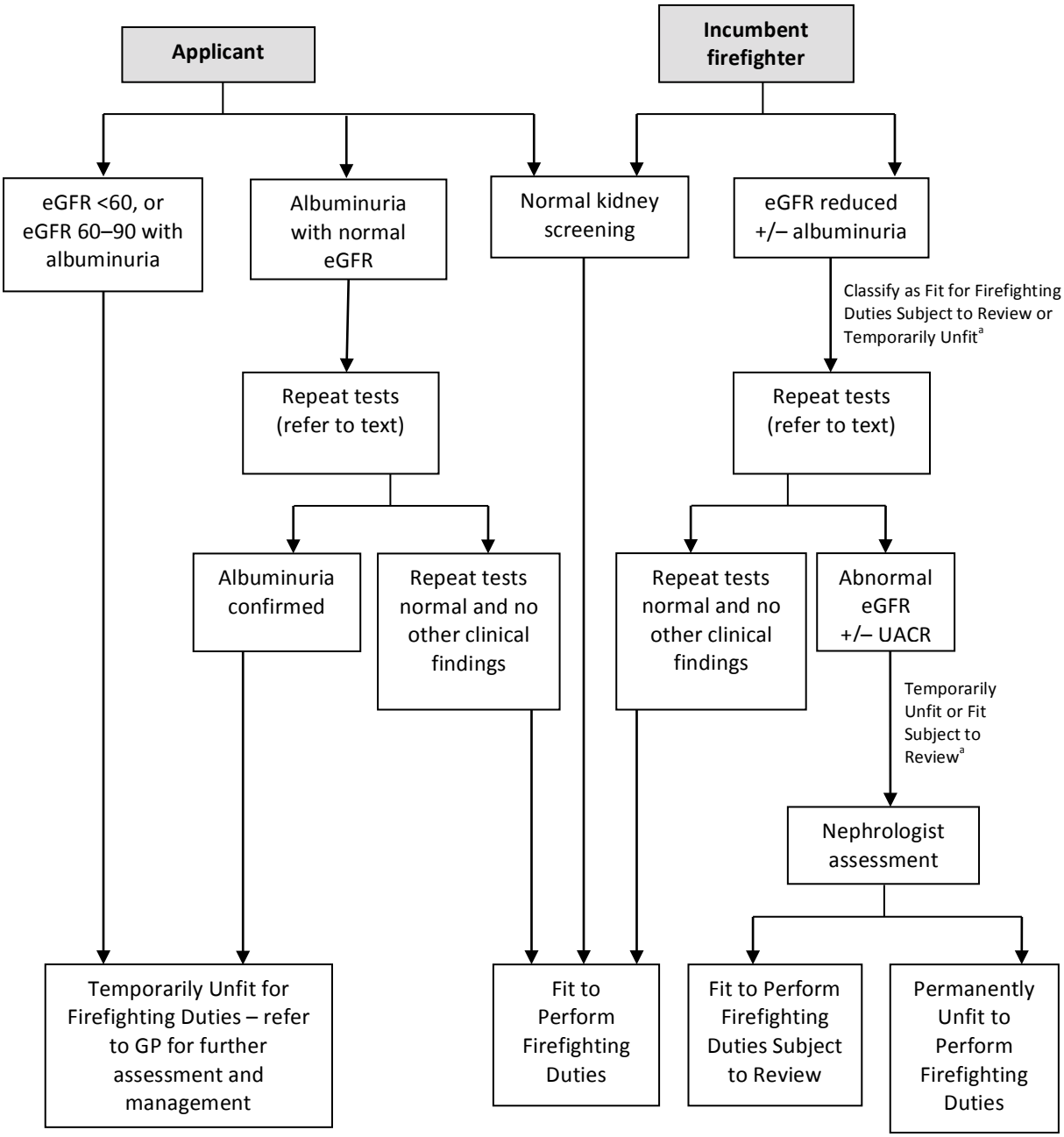
- For albuminuria, if UACR >2.5 mg/mmol for males, >3.5 mg/mmol for females and no other findings (including a normal eGFR), repeat the UACR in the first instance ensuring repeat specimen is **first void**, mid-stream and clean catch.

- If albuminuria >2.5 mg/mmol for males and >3.5 mg/mmol for females is confirmed on repeat specimen, for the purpose of this standard, arrange for nephrologist assessment. Temporarily Unfit to Perform Firefighting Duties should be determined.

Table 9 Interpretation of urine albumin in females and males

Albumin levels	**Females**	**Males**
Normal	<3.5 mg/mmol	<2.5 mg/mmol
Microalbuminuria	3.5–35 mg/mmol	2.5–25 mg/mmol
Macroalbuminuria	>35 mg/mmol	>25 mg/mmol

Figure 50 Assessment of firefighters for kidney disease



eGFR = estimated glomerular filtration rate; GP = general practitioner; UACR = urine albumin:creatinine ratio
***a** Classify as Temporarily Unfit to Perform Firefighting Duties if the person has diabetes mellitus or hypertension. Others to be classified as Temporarily Unfit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review depending on severity of abnormality and clinical history.*

17.2.4 The undiagnosed firefighter

Abnormalities such as persistent haematuria of glomerular origin, persistent albuminuria or an eGFR <60 mL/min/1.73 m^2 in an incumbent firefighter with no known kidney problems require investigation to exclude or confirm kidney disease. For the purpose of this standard, further investigation is required for albuminuria, reduced eGFR and glomerular haematuria (other forms of haematuria can be referred back to the general practitioner [GP] for further assessment).

Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties should be determined, based on the severity of the findings and overall clinical assessment, while further investigation is undertaken.

17.2.5 Confirmed kidney disease or kidney function reduction, not because of hypertension or diabetes mellitus

All cases of kidney disease or reduced kidney function require careful assessment of risk in relation to dehydration from firefighting. Unless cardiovascular risk or diabetes result in Permanently Unfit to Perform Firefighting Duties, the opinion of a nephrologist who has been briefed on the conditions of firefighting is required. Temporarily Unfit to Perform Firefighting Duties should be determined while further assessment is undertaken. Note, all decreased eGFR is associated with increased cardiovascular risk. A stable eGFR of 45–59 mL/min/1.73 m^2 need not preclude a firefighter from being considered medically fit for duty, subject to individual assessment and advice.

17.2.6 Hypertensive kidney disease

A firefighter with kidney disease resulting from hypertension needs to be assessed in the broader context of cardiovascular risk as well as the threat to kidney function from dehydration. Kidney damage from hypertension indicates high cardiovascular risk. If screening shows albuminuria or an eGFR <60 mL/min/1.73 m^2 the firefighter should be classed as Temporarily Unfit to Perform Firefighting Duties while further assessment is undertaken. Also refer to Section 11, Cardiovascular disorders.

17.2.7 Diabetic nephropathy

A firefighter with kidney disease resulting from diabetes must also be assessed in the broader contexts of diabetes control and cardiovascular risk. Kidney damage secondary to diabetes is usually evidence of poor diabetes and blood pressure control, and high cardiovascular risk. If screening shows albuminuria or an eGFR <60 mL/min/1.73 m^2, the firefighter should be classed as Temporarily Unfit to Perform Firefighting Duties while further assessment is undertaken. Under this standard, all firefighters with diabetes require assessment of renal function by way of albumin:creatinine ratio as part of their periodic assessment. Also refer to Section 11, Cardiovascular disorders, and Section 12, Diabetes.

17.2.8 Dialysis and transplantation

Any firefighter requiring peritoneal or haemodialysis should be classed as Permanently Unfit to Perform Firefighting Duties. Kidney transplantation also is unlikely to be compatible with operational duties. Factors for consideration include level and protection of renal function, comorbid disease, cardiovascular risk, bone density, immunosuppression and other medication effects.

17.2.9 Applicants

Applicants with any of the following should be referred back to their GP for further assessment and management:

- confirmed kidney disease, and/or
- an eGFR <60 mL/min/1.73 m^2, or
- an eGFR 60–90 mL/min/1.73 m^2 and albuminuria.

These applicants will usually be classed as Permanently Unfit to Perform Firefighting Duties but, in exceptional cases where kidney function is preserved, they may be referred to the FRNSW

Occupational Physician for further assessment of medical fitness for duty, taking into account information provided by a nephrologist.

Minor abnormalities may, however, be investigated under this standard to help determine if there is kidney disease.

17.2.10 Nephrologist referrals

Referrals to, or requests for reports from, nephrologists **must** include the following information about firefighting:

- Firefighters work under conditions that promote heat stress and dehydration.
- Contributing factors to heat stress and dehydration include personal protective clothing, which results in profuse sweating and inhibits normal cooling mechanisms (i.e. the structural firefighting ensemble is insulated and contains a moisture barrier, and fully encapsulated chemical suits), strenuous exercise, radiant heat, and hot and humid weather conditions.
- Significant and rapid fluid loss – up to 2L/h or more – which can easily progress to clinical dehydration.

The nephrologist's report **must** address the:

- diagnosis and aetiology
- current clinical status
- investigation results
- severity of kidney function reduction and impact on cardiovascular risk
- complications or sequelae of the kidney disease
- prognosis or expected course of illness
- treatment
- potential impact of the conditions of firefighting as outlined above on kidney function.

Table 10 Medical criteria for operational firefighters – renal disease[a]

Condition	Criteria
Suspected kidney disease based on abnormal assessment findings	A firefighter is not Fit to Perform Firefighting Duties if there is evidence of possible kidney disease or impairment on assessment. Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties may be determined while further assessment is undertaken depending on the clinical context.
Confirmed kidney disease or impairment (not related to hypertension or diabetes – refer below)	A firefighter is not Fit to Perform Firefighting Duties if they have a known or confirmed kidney disease, or moderate to severe kidney function reduction. Temporarily Unfit to Perform Firefighting Duties should be determined while further assessment by a nephrologist is undertaken. Refer to the text for referral details. Fit to Perform Firefighting Duties Subject to Review or Permanently

Condition	Criteria
	Unfit to Perform Firefighting Duties may be determined by the FRNSW Occupational Physician, taking into account the information provided by the nephrologist. Temporarily Unfit to Perform Firefighting Duties may be determined if the condition is expected to improve in the foreseeable future.
Kidney impairment secondary to hypertension	A firefighter is not Fit to Perform Firefighting Duties if they have suspected or confirmed hypertensive kidney disease. Temporarily Unfit to Perform Firefighting Duties should be determined while further assessment is undertaken. Refer to the text.
Diabetic nephropathy	A firefighter is not Fit to Perform Firefighting Duties if they have suspected or confirmed diabetic nephropathy. Temporarily Unfit to Perform Firefighting Duties should be determined while further assessment is undertaken. Refer to the text.

FRNSW = Fire & Rescue NSW
a *For additional information regarding applicants, refer to text.*

17.3 Bibliography

Chadban H, Hwoell M, Twigg S et al. Assessment of kidney function in type 2 diabetes. *Nephrology* 2010, 15:S146–S161.

Johnson DW, Mathew T. How to treat: proteinuria. *Australian Doctor*, February 2008, 17–24.

Kidney Health Australia. *Chronic kidney disease (CKD) management in general practice*, 2nd edition, Melbourne, 2012.

Mathew T. How to treat: microscopic haematuria. *Australian Doctor*, April 2007, 27–34.

Mathew T, Corso O. Review article: early detection of chronic disease in Australia: which way to go? *Nephrology* 2009, 14:367–73.

18 Respiratory disorders

18.1 Relevance to firefighting duties

Good pulmonary function is essential for the extreme workloads of firefighting, which require a VO_2 max of 33.9–45 mL/kg/min. Hard work such as firefighting typically requires a 10-fold increase in respiratory minute volume, from 4.5 L/min to 45 L/min. An adequate intake of oxygen and rapid exchange of O_2 and CO_2 is required to meet the demands of firefighting duties.

Respiratory function may be threatened by exposure to smoke and other respiratory irritants. Smoke contains many respiratory irritants, which vary with the type of fire, but typically include aldehydes, ammonia, acrolein, halogen gases, isocyanates, nitrogen oxides, sulfur dioxide and particulates. The vapours from chemical spills may also include respiratory irritants. These irritants can cause coughing, bronchospasm and pulmonary oedema. Conditions such as asthma and chronic airflow limitation can be aggravated by exposure to smoke and other respiratory irritants encountered in the course of operational duties.

Self-contained breathing apparatus (SCBAs) protect the lungs from respiratory hazards. However, SCBAs are not routinely worn at bushfires, because of the additional workload; rather, a P2 mask is worn. Also, smoke exposure may occur at structural fires despite the use of SCBAs, because respiratory irritants may still be present even when an atmosphere has been deemed by monitoring to not be immediately dangerous to life, or in the vicinity of a fire.

18.1.1 Asthma

The conditions of firefighting can aggravate asthma. An asthma attack can result in acute incapacity.

Asthma is a chronic lung disease characterised by the presence of both excessive variation in lung function and respiratory symptoms (e.g. wheeze, shortness of breath, cough, chest tightness) that vary over time, and may be present or absent at any point in time.[1] Airway hyperresponsiveness is a central feature of asthma and is associated with triggering of symptoms by factors such as exercise, cold air and inhaled irritants. One in 10 Australians have current asthma symptoms, and 19% of Australians aged 16 years or older have been diagnosed with asthma at some time in their lives.[2]

Occupational asthma is asthma caused by workplace conditions. Irritant-induced asthma is a form of occupational asthma that develops following one or more exposures to high-level respiratory irritants and has been described in firefighters. Work-exacerbated asthma is asthma that is made worse, but was not initially caused, by workplace conditions such as exposure to smoke, exercise or stress. Previous studies have shown an underdiagnosis of asthma in the occupational setting, including firefighters.[3]

An asthma attack during a firefighting situation can result in acute incapacity, thus impacting on the safety of the firefighter, their crew and members of the public. The urge to remove the SCBA mask should a firefighter suffer asthma symptoms in a hostile environment would result in an immediate risk to the firefighter and others.

Many of the typical triggers for asthma are present in the firefighting environment, including:

- **Smoke and other respiratory irritants**. The chemistry of smoke and other exposures has been discussed above. The bushfire season is acknowledged to be problematic for those with asthma and the Asthma Foundation (NSW) advises individuals with asthma to avoid physical activities

outdoors when there is smoke around. The Asthma Foundation acknowledges that bushfire volunteers and other emergency personnel are at an increased risk of asthma attacks.

- **Physical exertion**. Firefighting requires strenuous physical exertion, which increases oxygen demand and ventilation, thus further increasing the risk of exposure to inhaled irritants during tasks where SCBAs are not used.
- **Exercise.** Exercise-induced bronchoconstriction is a well-recognised aspect of asthma, affecting 50–65% of asthmatics who are otherwise well controlled on an inhaled corticosteroid. Firefighting is hard work, and thus presents a particular risk in this regard.
- **Cold dry air**. Cold dry air is a well-recognised trigger for asthma, as it is very irritating to asthmatic airways. The compressed air in SCBAs is dry and, when released through a small valve, becomes cooled. The challenge to the airways from the cold dry air from SCBAs can be increased further with strenuous exercise.

Even though successful treatment of asthma may abolish symptoms, it does not mean that an individual no longer has asthma. Some people who have not experienced asthma symptoms for several years still have evidence of airway hyperresponsiveness on bronchial provocation.

There are no studies of the effectiveness of anti-inflammatory medication (e.g. inhaled corticosteroids) in preventing or adequately controlling asthma in the firefighting environment; therefore, the effectiveness of such medications in this context has not been established. In addition, it is not acceptable to use or rely on bronchodilator medications for this purpose because:

- their use is for rescue after an asthma attack and not for prevention in an irritant environment
- there are no studies that support or deny that their use is effective in a fire or smoke environment
- it is impractical and dangerous to remove SCBAs to use an inhaler.

18.2 General assessment and management guidelines

Note that Fire & Rescue NSW (FRNSW) does not advise changes of treatment for the purpose of meeting this standard. Any change of treatment must be made by the firefighter's treating doctor and based only on clinical grounds.

Establishing that asthmatics are stable in a normal environment, and are not at risk of an asthma attack in a fire or other irritant environment is difficult. There is no test that an individual can be subjected to that will simulate or provide a reliable proxy for such environments.

18.2.1 Spirometry

Spirometry may be normal in between episodes of asthma; therefore, normal spirometry does not exclude the presence of asthma. A pattern of obstructive spirometry (FEV1/FVC <0.7) and/or FEV1 ≤80% in the absence of a history of obstructive lung disease would usually prompt further investigation, which may include a bronchial provocation test (BPT), provided it is safe to do so. In some cases, respiratory physician review may be required for further evaluation.

18.2.2 Bronchial provocation test

For the purpose of this standard, the BPT is used as an objective test to identify or exclude active asthma. Only 'indirect BPT' using mannitol dry powder will be accepted for the purpose of this standard. These hyperosmolar stimuli cause smooth muscle contraction 'indirectly' via the action of

mediators released from inflammatory cells in response to the osmotic stimulus and, unlike 'direct' BPT, these mediators can act on many cells and receptors. Testing should be conducted in laboratories accredited by the Thoracic Society of Australia and New Zealand.

A positive result for an indirect BPT (mannitol) is defined as a fall in FEV1 of ≥15% from baseline. Applicants are eligible to undergo BPT only if they have not had any symptoms of asthma or required any asthma treatment whatsoever for at least 3 years, and respiratory examination and spirometry is normal. If there is any concern in relation to history, examination or spirometry (e.g. low reserve or obstructive pattern), referral for a BPT is not appropriate, as current asthma may be a possibility and a respiratory physician assessment may be required for further confirmation of asthma.

Incumbent firefighters eligible to undergo a BPT may perform the test on or off medication, according to their treatment regimen. If a firefighter's symptoms are well controlled on low-dose corticosteroid, leukotriene receptor antagonists or cromones, they may undertake the test (after respiratory physician review) while on this treatment; however, they should not have used a short- or long-acting bronchodilator in the previous 24 hours.

For incumbent firefighters, once a BPT is found to be negative, it does not need to be repeated annually and should only be repeated if clinically indicated.

18.2.3 Assessment and management of established asthma

Figure 51 summaries the steps in assessing applicants and incumbents.

18.2.4 Applicants

Applicants with a history of childhood asthma, or those who have not had any asthma symptoms or treatment for at least 3 years, should provide a statement from their respiratory physician or general practitioner to confirm that their asthma has resolved, and they have been without symptoms and without medication for at least 3 years. Spirometry should then be conducted and, if this is satisfactory, a BPT can be arranged provided:

- a clear and reliable history of long-standing absence of symptoms or treatment is established, and
- normal examination and spirometry, and
- no history ever of high-risk features (e.g. severe asthma, brittle asthma, previous intensive care unit admission), and
- no significant current issues with other atopic conditions.

If there are any doubts about the safety of a BPT in the clinical presentation, referral to a respiratory physician is recommended.

Applicants who currently require regular treatment with preventer (inhaled anti-inflammatory) or a symptom controller (long-acting beta agonist), and/or reliever medication (short-acting beta agonist), whether well controlled or not, are Permanently Unfit to Perform Firefighting Duties.

18.2.5 Firefighters

Wheeze associated with upper respiratory tract infection is not necessarily asthma. Short temporary incidents such as these, once resolved, do not compromise a firefighter's ability to safely undertake firefighting duties. This must, however, be distinguished from asthma exacerbated by upper respiratory tract infection.

Figure 51 and the following summarise the steps in assessing incumbent firefighters who have asthma:

a. The firefighter's asthma history should be assessed, including information provided by the treating doctor where necessary.

b. If, after a minimum of 3 months, they are considered stable on treatment and they meet the adapted *Australian asthma handbook* definition of 'good control' and 'mild severity asthma', and have no high-risk features (Table 11), further individualised assessment will be undertaken by a respiratory physician.

c. The respiratory physician should be familiar with the conditions of firefighting, so occupational causes are also considered. In cases of irritant-induced asthma, airways will be generally hyperresponsive to irritants, but can be managed under this standard as per other asthma symptoms. As part of the assessment, the firefighter requires a BPT. The respiratory physician will need to determine if safe to proceed to a BPT.

d. If the firefighter meets the relevant criteria in Table 11, they can be classed as Fit to Perform Firefighting Duties Subject to Review. The importance of wearing a SCBA for all fire suppression duties, including overhaul, should be emphasised.

e. Firefighters with asthma should not fight wildfires, as SCBAs are not routinely worn. They should be classed Fit to Perform Firefighting Duties Subject to Job Modification.

f. A BPT will not be required at subsequent assessments unless clinically indicated.

g. If the firefighter does not meet the criteria for stability, or 'good control' and 'mild severity', or the respiratory physician assessment is unfavourable, or the criteria in Table 11 are not met, the assessing medical practitioner must determine if treatment has been optimised (based on information from the treating doctor). If further treatment optimisation is warranted, the firefighter will be classified as Temporarily Unfit to Perform Firefighting Duties, will attend to their treating doctor and their fitness for duty can be reviewed (as above) after a minimum of 3 months. If further treatment is deemed unlikely to alter the fitness assessment, the firefighter should be classified Permanently Unfit to Perform Firefighting Duties.

Table 11 Risk assessment of asthma in firefighters

Control of asthma	**Symptoms and treatment**	
Good control	• No daytime symptoms, and • No need for reliever[a], and • No limitation of activities, and • No symptoms during night or on waking	
Mild severity	Good control can be achieved with (any of): • low-dose inhaled corticosteroid (see 'Inhaled corticosteroid dose level in adults') • leukotriene receptor antagonist • cromone Note that an intermittent reliever is not acceptable.	
Inhaled corticosteroid dose levels in adults	***Inhaled corticosteroid***	***Daily dose (mcg) – low***
	Beclomethasone dipropionate[b]	100–200

	Budesonide	200–400
	Ciclesonide	80–160
	Fluticasone furoate[c]	—
	Fluticasone propionate	100–200
No high-risk features	• Exercise-induced symptoms • Any asthma flare-up during the previous 12 months • Intubation or admission to intensive care unit due to asthma (ever) • Two or more hospitalisations for asthma in the past year • Three or more emergency department (ED) visits for asthma in the past year • Hospitalisation or ED visit for asthma in the past month • High short-acting beta2 agonist use (>2 canisters per month) • History of delayed presentation to hospital during flare-ups • History of sudden-onset acute asthma	

a *SABA taken prophylactically before exercise is not acceptable.*
b *Dose equivalents for Qvar (TGA-registered CFC-free formulation of beclomethasone dipropionate).*
c *Fluticasone furoate is not available as low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate in combination with vilanterol (a long-acting beta*2 *agonist) and should only be prescribed as one inhalation once daily.*
Source: adapted from the Australian asthma handbook

Figure 51 Assessment of incumbent firefighters

BPT = bronchial provocation test

18.2.6 Chronic airflow limitation

The criteria for Fit to Perform Firefighting Duties are not met if an applicant or firefighter has chronic airflow limitation (CAL), including chronic obstructive pulmonary disease. Individuals with CAL are unlikely to be able to meet the physical demands of firefighting duties. Fit to Perform Firefighting Duties Subject to Review may be considered, taking into account information provided by a respiratory physician familiar with firefighting duties and the opinion of the Occupational Physician. Careful individual assessment is required to determine lung function, the presence of bronchial hyperresponsiveness, oxygen saturation with exercise and objective evidence of exercise capacity.

18.2.7 Spontaneous pneumothorax

Fit to Perform Firefighting Duties may be determined after appropriate successful rehabilitation, usually a minimum of 3 months. A history of recurrent pneumothorax will require information from the treating specialist to assist with assessment of risk of recurrence.

No further assessment is required if successful pleurodesis has been undertaken.

18.2.8 Other chronic respiratory conditions

Other conditions should be assessed on an individual basis, taking into account lung capacity, exercise and functional capacity, gas exchange and risk of aggravation with the duties of firefighting.

Table 12 Medical criteria for firefighters – asthma

Condition	**Criteria**
Applicants with a past history of asthma	Fit to Perform Firefighting Duties may be determined if there is a past history of asthma, including childhood asthma, if: • information provided by the applicant's usual treating practitioner and the assessing medical practitioner's assessment confirms that there have been no asthma symptoms **and** no requirement for asthma medication for at least 3 years, **and** • clinical assessment, including examination and spirometry, is normal, **and** • the BPT is negative.
Applicants with current asthma	Applicants with evidence of current asthma shall be deemed Permanently Unfit to Perform Firefighting Duties.

Condition	Criteria
Firefighter with current asthma	Fit to Perform Firefighting Duties Subject to Review and Subject to Job Modification (see below) may be determined if: • information provided by the applicant's usual treating practitioner and the assessing medical practitioner confirms that the asthma meets the criteria of 'good control' and 'mild severity' for 6 months, and there is an absence of high-risk features, **and** • clinical assessment, including examination and spirometry, is normal, **and** • there have been no asthma symptoms and reliever medication has not been required at any time during strenuous exertion, temperature or humidity extremes, SCBA use, irritant exposures, fire suppression activities, Hazmat duties, rescue duties, training activities (in newly diagnosed firefighters, confirm there have been no asthma symptoms and reliever medication has not been required at any time during strenuous exertion since the condition has been considered stable), **and** • respiratory physician (briefed on the requirements of firefighting) clears the applicant for BPT, and the BPT is negative, **and** • the firefighter is compliant with treatment and has a current asthma plan. Should the above conditions be met, the following permanent **job modifications** must be advised: • SCBA to be worn for **all** fire suppression duties, including overhaul and whenever there is expected to be exposure to particulate matter, smoke or inhaled irritant, **and** • no wildfire firefighting. BPT is not required annually and should only be repeated if clinically indicated. Temporarily Unfit to Perform Firefighting Duties may be determined if further treatment optimisation is warranted to assist the firefighter in meeting the criteria. Fitness to Perform Firefighting duties can be reviewed after a minimum of 3 months. Permanently Unfit to Perform Firefighting Duties may be determined if, despite treatment optimisation, firefighters do not meet the above criteria.

BPT = bronchial provocation test; SCBA = self-contained breathing apparatus

18.3 Bibliography

Australian Centre for Asthma Monitoring. *Asthma in Australia 2011*, AIHW Asthma Series No. 4, cat. no. ACM 2, Canberra, AIHW, 2011.

Bailey J, Williams F. Asthma and eligibility for the Australian Defence Force. *Australian Family Physician* 2009, 38(11):897–900.

Freed R, Anderson SD, Wyndham J. The use of bronchial provocation tests for identifying asthma. A review of the problems for occupational assessment and a proposal for a new direction. *ADF Health* 2002, 3:77–85.

Miedinger, Baluenstein A, Wolf N, et al. Evaluation of fitness to utilize self-contained breathing apparatus (SCBA). *Journal of Asthma* 2010, 47:178–84.

Miedinger D, Chhajed P, Stolz D, et al. Respiratory symptoms, atopy and bronchial hyperreactivity in professional firefighters. *Eur Resp J* 2007, 30:538–44.

Miedinger D, Chhajed PN, Tamm M, et al. Diagnostic tests for asthma in firefighters. *Chest* 2007 Jun, 131(6):1760–7.

National Asthma Council Australia. *Australian asthma handbook*, version 1.1, Melbourne, 2015 (http://www.asthmahandbook.org.au).

National Fire Protection Association. *NFPA1582: standard on comprehensive occupational medical program for fire departments*, Avon, MA, 2007 and 2013.

Office of the Deputy Prime Minister. *Medical and occupational evidence for recruitment and retention in the Fire and Rescue Service*. London, UK, 2004.

Ribeiro M, de Paula Santos U, Bussacos MA, Terra-Filho M. Prevalence and risk of asthma symptoms among firefighters in Sao Paulo, Brazil: a population-based study. *Am J Ind Med* 2009 Mar, 52(3):261–9.

19 Sleep disorders

19.1 Relevance to operational duties

The focus of this chapter is on sleep apnoea. Other sleep disorders have the potential to impact on medical fitness to undertake firefighting duties, and should be assessed on a case-by-case basis.

Sleep apnoea is of significance for firefighting duties as it may result in:

- sleepiness or daytime somnolence and fatigue, with increased risk of injury, accidents and falling asleep while driving (including to and from work)
- impaired cognition and analytical skills, resulting in poor decision making.

Also of significance for firefighting duties are the long-term health effects of sleep apnoea, including:

- hypertension (refer to Section 11, Cardiovascular disorders)
- coronary artery disease (refer to Section 11, Cardiovascular disorders). Multiple episodes of low oxygen from apnoeas can also lead to sudden death from a cardiac event if there is underlying heart disease. Obstructive sleep apnoea has also been shown to be associated with atrial fibrillation and congestive cardiac failure
- stroke (refer to Section 15, Neurological disorders).

Sleep apnoea may also worsen pre-existing conditions such as hypertension and depression. Sleep apnoea is associated with type 2 diabetes. Chronic snoring is an indicator of potential obstructive sleep apnoea and, anecdotally, it can cause interpersonal problems for firefighters staying overnight in close quarters.

Risk factors for obstructive sleep apnoea include male gender, middle age and obesity, which is of significance given the Fire & Rescue NSW (FRSNW) firefighters' demographic and increasing prevalence of obesity in the general population.

Also, shift work may compound the effects of poor-quality sleep from sleep apnoea. Additionally, secondary employment or, in the case of retained firefighters, primary employment, may impact on sleep time.

19.2 General assessment and management guidelines

19.2.1 General considerations

Excessive daytime sleepiness, which manifests as a tendency to doze at inappropriate times when intending to stay awake, can arise from many causes. It is important to distinguish sleepiness (the tendency to fall asleep) from fatigue or tiredness that is not associated with a tendency to fall asleep. Many chronic illnesses can cause fatigue without causing sleepiness.

Increased sleepiness during the daytime may be because of sleep deprivation, poor sleep hygiene habits or irregular sleep–wake schedules, or the influence of sedative medication, including alcohol. Insufficient sleep (less than 5 hours) before driving is strongly related to motor vehicle crash risk.

Excessive daytime sleepiness may also result from a number of sleep disorders, including sleep apnoea syndromes (obstructive sleep apnoea, central sleep apnoea and nocturnal hypoventilation),

periodic limb movement disorder, circadian rhythm disturbances (e.g. advanced or delayed sleep phase syndrome), some forms of insomnia and narcolepsy.

Unexplained episodes of sleepiness may also require consideration of the several causes of blackouts (refer to Section 10, Blackouts).

Firefighters who are sleepy or otherwise found to be at high risk should be classed as Temporarily Unfit to Perform Firefighting Duties while further investigation and effective treatment is undertaken.

High-risk individuals include those who:

- experience moderate to severe excessive daytime sleepiness (Epworth Sleepiness Scale [ESS] score of 16–24)
- have a history of frequent self-reported sleepiness while driving or working
- have had a motor vehicle crash or other incident caused by inattention or sleepiness.

High-risk individuals have a significantly increased risk of sleepiness-related incidents and require referral to a specialist in sleep disorders to assess if sleep apnoea or another medical condition is responsible for their symptoms.

Others at risk of obstructive sleep apnoea include those with:

- BMI ≥40
- BMI ≥35, and
    - type 2 diabetes, or
    - hypertension requiring two or more medications for control, or
    - history of habitual loud snoring during sleep or of witnessed apnoeic events (such as in bed by a partner).

Sleep apnoea is present on overnight monitoring in 9% of adult women and 24% of adult men. Sleep apnoea syndrome (excessive daytime sleepiness in combination with sleep apnoea on overnight monitoring) is present in 2% of women and 4% of men.

19.2.2 Screening for excessive daytime sleepiness – the Epworth Sleepiness Scale

Screening tools may assist in determining excessive daytime sleepiness. The ESS is a subjective measure and is included in the Health Assessment Questionnaire. The ESS is scored by summing the numeric values in the boxes in the questionnaire. The maximum possible is 8 × 3 = 24:

- A score of 0–10 is in the normal range.
- A score of 11–15 indicates mild to moderate self-reported sleepiness, and may be associated with a significant sleep disorder. The degree of sleepiness-related motor vehicle accidents in this range is unknown.
- A score of 16–24 is consistent with moderate to severe sleepiness, and is associated with increased risk of sleepiness-related motor vehicle accidents.
- A score of ≥16 or the presence of other clinical findings should prompt discussion with the firefighter to determine possible explanations such as sleep deprivation or sleep disorders. Referral may be required to the firefighter's general practitioner or to a sleep clinic for polysomnography.

19.2.3 Referral and management

Firefighters in whom sleep apnoea, chronic excessive sleepiness or another medical sleep disorder is suspected should be referred to a specialist sleep physician for further assessment, investigation with overnight polysomnography and management. Referral to a sleep disorder specialist should be considered for any firefighter who has unexplained daytime sleepiness while driving, or who has been involved in a motor vehicle crash that may have been caused by sleepiness.

Home polysomnography may be helpful for those in rural and remote areas. The investigation should include (during a period of sleep):

- a continuous electrocardiograph recording
- a continuous electroencephalograph recording
- respiratory function testing (including oronasal airflow, rib cage/abdominal movement, body position, oximetry).

These parameters should be interpreted and reported on by a sleep physician who has established quality-assurance procedures for the data acquisition.

Firefighters who are diagnosed with obstructive sleep apnoea syndrome and require treatment should have annual review to ensure that adequate treatment is maintained.

Firefighters with moderate sleep apnoea based on a diagnostic sleep study, and who do not report moderate to excessive sleepiness, should be assessed as Fit to Perform Firefighting Duties Subject to Review annually. Repeat sleep studies may be recommended depending on the clinical review.

Firefighters treated with continuous positive airway pressure (CPAP) are recommended to use CPAP machines with a usage meter to allow objective assessment and recording of treatment compliance.

Objective measurement of sleepiness should be considered (maintenance of wakefulness test and/or multiple sleep latency test) if there is concern regarding persisting sleepiness or treatment compliance.

19.2.4 Advice to firefighters

All firefighters suspected of having, or found to have, sleep apnoea or other sleep disorders should be advised about the potential impact on firefighting duties and strategies for maintaining fitness for duty. General advice should include:

- minimising unnecessary working at times when normally asleep
- allowing adequate time for sleep
- avoiding working after having missed a large portion of their normal sleep
- avoiding alcohol and sedative medications
- resting if sleepy.

The firefighter is responsible for:

- avoiding work if they are sleepy
- complying with treatment, including management of lifestyle factors
- maintaining their treatment device

- attending review appointments
- honestly reporting their condition to their treating physician.

Table 13 Medical standard for firefighters – sleep disorders

Condition	Criteria
Sleep disorder risk assessment	A firefighter is likely to be at increased risk of sleep disorder if they have a: • BMI ≥40;, or • BMI ≥35 and one of – type 2 diabetes – high blood pressure requiring 2 or more medications for control, or – a history of habitual loud snoring or of witness apnoeic events (such as in bed by a spouse/partner). A firefighter meeting the above criteria should be promptly assessed in relation to a possible sleep disorder. They should be classed as Fit to Perform Firefighting Duties Subject to Review. Some discretion should be applied for subsequent review. Persons with or without the above risks and with evidence of excessive sleepiness should be classed as Temporarily Unfit to Perform Firefighting Duties while further assessment is undertaken. Evidence of sleepiness may include: • an ESS score of ≥16, **or** • frequent self-reported episodes of sleepiness or drowsiness while working or driving, **or** • work performance reports indicating excessive sleepiness, **or** • an incident plausibly caused by inattention or sleepiness.
Sleep apnoea	A firefighter is not Fit to Perform Firefighting Duties if: • they have established sleep apnoea syndrome – sleep apnoea on a diagnostic sleep study **and** moderate to severe excessive daytime sleepiness, **or** • the person has severe sleep apnoea on a diagnostic sleep study with or without self-reported excessive daytime sleepiness, or • Temporarily Unfit to Perform Firefighting Duties should be determined until the treating specialist confirms compliance with treatment and the condition is well controlled, with an absence of moderate to severe excessive daytime sleepiness. Fit to Perform Firefighting Duties Subject to Review on an annual basis may be determined for those with treated sleep apnoea (without moderate to excessive daytime sleepiness), **and** taking into account information provided by a sleep specialist or the treating GP as to

Condition	Criteria
	whether the following criteria are met: • the firefighter is compliant with treatment (where possible, this should include objective evidence such as usage meter download), **and** • the response to treatment is satisfactory. GP management may be determined to be sufficient if there is an established pattern of compliance and good response to treatment. Fit to Perform Firefighting Duties Subject to Review on an annual basis may be determined for those with moderate sleep apnoea diagnosed on diagnostic sleep study (without moderate to excessive daytime sleepiness).

GP = general practitioner

19.3 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2012.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

20 Substance misuse

This standard applies to firefighters seeking to resume duty after a period of treatment or if a firefighter is referred for assessment of medical fitness for duty after a positive test undertaken under Fire & Rescue NSW's (FRNSW's) Alcohol and Other Drugs Policy.

20.1 Relevance to operational duties

Firefighting, including driving the appliance in emergency mode, requires accurate perception of a situation, rapid decision making, and quickness and strength of action. These cognitive attributes may be adversely affected by substance misuse. Acute or chronic effects of alcohol and other drugs, including illicit and pharmaceutical, can result in acute incapacity or impairment, thus impacting on the safety of the individual firefighter, their crew and members of the public.

The focus of this chapter is mainly on the chronic, regular heavy use and dependence on alcohol and other substances, including illicit and pharmaceutical drugs. Acute intoxication is addressed in the FRNSW Alcohol and Other Drugs Policy, and does not form part of the assessment of fitness for firefighting duties in this standard. In a long-term dependent person, impairment can, however, result from both chronic use and recent consumption, and both these risks must be assessed in determining fitness to perform firefighting duties.

20.1.1 Features of chronic substance misuse

Abuse is characterised by the continued use of a substance, resulting in a negative effect on a person's life.

Chronic misuse of alcohol and other substances can lead to a syndrome of dependences, characterised by several of the following features:

- tolerance, as defined by a need for markedly increased amounts of the substance to achieve intoxication or the desired effect, or a markedly diminished effect with continued use of the same amount of substance
- withdrawal, as manifested by the characteristic withdrawal syndrome for the substance, or the same (or closely related) substance is taken to relieve or avoid withdrawal symptoms
- the substance is often taken in larger amounts over a longer period than was intended
- there is a persistent desire or unsuccessful efforts to cut down or control substance use
- a great deal of time is spent in activities to obtain the substance, use the substance or recover from its effects
- important social, occupational or recreational activities are given up or reduced because of substance use
- the substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance (e.g. continued drinking despite recognition that an ulcer was made worse by alcohol consumption).

20.1.2 Effects of long-term alcohol and other substance use on operational duties

Alcohol

Neurocognitive deficits relevant to the capability to undertake firefighting duties are a common and potentially severe consequence of heavy long-term alcohol consumption. Such deficits include:

- short-term memory and learning impairments, which become more evident with increasing difficulty of the task
- impairment of perceptual motor speed
- impairment of visual search and scanning strategies
- executive function deficits such as mental flexibility and problem-solving skills; difficulty in planning, organising and prioritising tasks; difficulty focusing attention, sustaining focus, shifting focus from one task to another or filtering out distractions; difficulty monitoring and regulating self-action; or impulsivity.

Verbal abilities are among the few cognitive functions that are relatively spared in chronic alcohol abuse; therefore, such individuals may often give the mistaken impression of being more capable than they are.

Alcohol may also act to increase the effects of sleep deprivation, sleep disorders and fatigue.

Various other pathologies of relevance for firefighting duties may also result from long-term heavy alcohol use, including:

- hypertension (refer to Section 11, Cardiovascular disorders)
- Wernicke–Korsakoff syndrome (dementia and neurological impairments)
- peripheral neuropathy
- cardiomyopathy (refer to Section 16, Cardiovascular disorders)
- bleeding diatheses
- chronic liver disease.

Cessation or significant reduction in alcohol dependent persons may result in a withdrawal syndrome, which carries the risk of generalised seizure, states of confusion and hallucinations.

Other substances

Illicit drugs, and prescribed or over-the-counter medications can be used for their intoxicating, sedative or euphoric effects. These drugs may cause impairments that are clearly incompatible with undertaking firefighting duties safely, including risk taking, aggression, feelings of invulnerability, narrowed attention, altered arousal states and poor judgement. The effects of sleep deprivation, sleep disorders and fatigue may also be compounded by substance use. Some of the physiological effects of these drugs may interact with the conditions of firefighting to increase cardiovascular strain and risk of heat-related illness.

Illicit substances are a heterogeneous group. The effects of chronic use vary and are not as well understood as those of alcohol. There is some evidence that chronic use of stimulants, opioids and benzodiazepines may be associated with cognitive impairment.

Illicit substance users may be at risk of brain injury through hypoxic overdose, trauma or chronic illness.

End-organ damage, including cardiac, neurological and hepatic damage, may be associated with some forms of illicit drug use, particularly injecting drug use.

Amphetamine-type stimulants (including prescribed) can be associated with a range of acute and long-term effects of direct relevance to operational duties. Short- and long-term use can impact on the cardiovascular system – increasing heart rate and blood pressure, and causing arrhythmia and palpitations – sometimes resulting in myocardial infarction or stroke. Amphetamine-type stimulants can also impact on the ability to regulate body temperature, contributing to hyperthermia. These effects are significant, given the cardiovascular and thermal loads of firefighting, and in combination, may be enough to result in acute, if not fatal, events. Evidence suggests that amphetamine-type stimulants can also impact on cognition, which may sometimes persist even after abstinence.

Cannabis can cause changes in heart rate and blood pressure, which may pose an acute health threat to those with hypertension, coronary atherosclerosis and cerebrovascular disease (all of which may be latent). These effects are of additional significance for firefighters because of the additional cardiovascular strain of firefighting duties.

In the event of end-organ effects relevant to firefighting duties, the appropriate requirements should be applied as set out elsewhere in this publication.

20.1.3 Effect of alcohol and drugs on other conditions

Frequent intoxication when combined with certain other medical conditions means that the person may not necessarily give the care and attention required to their medical condition. This may have implications for undertaking operational duties safely.

Diabetes

People with diabetes requiring insulin may not only forget to take their insulin at the proper time or dosage if intoxicated, but their food balance may also fall out of balance with their insulin dosage. Hypoglycaemia or slow onset of diabetic coma may follow.

Epilepsy

Many people with epilepsy are quite likely to have a seizure if they miss their prescribed medication even for a day or two, particularly when this omission is combined with inadequate rest, irregular meals, and alcohol or other substances. Even without omitted doses of medication, alcohol misuse, especially if combined with inadequate sleep, may precipitate a seizure in someone with epilepsy.

20.2 General assessment and management guidelines

20.2.1 Screening for substance misuse disorders

The Alcohol Use Disorders Identification Test (AUDIT) is a useful tool to screen for a spectrum of alcohol misuse, and is included in Firefighter Heath Assessment Questionnaires. The questionnaire should be used in combination with clinical judgement, as some people may understate their alcohol use in the context of an employment health assessment. If a firefighter has a total score of >8 on the AUDIT, the accuracy of the high-scoring questions should be checked with the firefighter and additional questions should be asked to help determine the potential for alcohol dependence. A score of >8 indicates strong likelihood of hazardous or harmful alcohol consumption, and requires careful assessment.

20.2.2 Assessment of firefighters with misuse disorders

Careful individual assessment is required for firefighters with declared or suspected misuse of alcohol or other substances (illicit, prescribed or over the counter). The standard is also intended to apply to firefighters seeking to resume duty after a period of treatment or if referral for assessment of fitness to perform firefighting duties is made after a positive test undertaken under FRNSW Alcohol and Other Drugs Policy.

In employment health assessments, people may understate or even deny substance use for fear of the consequences of disclosure. Acute and chronic cognitive effects of some substance use may also lead to difficulty in obtaining an accurate history and identification of substance misuse. Assessment should therefore incorporate a range of indicators of substance use in addition to self-reporting.

The opinion of an appropriate specialist, such as an addiction medicine specialist or addiction psychiatrist may be required. Neuropsychological assessment may be indicated. Firefighters with a dual diagnosis (substance use disorder combined with a mental illness) require specialist assessment due to the complexity of issues.

Specialised assessment requires consideration of the firefighter's substance use history, previous treatment episodes, readiness to change, signs of harmful alcohol and other drug use, signs of intoxication or withdrawal, mental health, cognitive function, psychosocial history, occupational history, legal issues, support networks, response to treatment and level of insight.

Occasional use of drugs also requires very careful assessment. In particular, the FRNSW Occupational Physician must be satisfied that such use is not going to affect a firefighter in their performance of firefighting duties, and that it is unlikely to result in a positive drug or alcohol test at work or other breach of FRNSW's Alcohol and Other Drug Policy. After appropriate specialist assessment, firefighters who have been determined to have nonproblematic use of alcohol or other drugs (use at a rate, level, time and in a context that represents no evident or identifiable risk or problem for the individual in the workplace), a tailored approach to assessing fitness to perform firefighting duties and return to work is required. This may include counselling, negative tests before returning to work and follow-up workplace testing.

For firefighters assessed as having anything other than nonproblematic use of alcohol or other drugs (e.g. abuse or dependence), the medical criteria as outlined in Table 14 must be met. Return to work will also be subject to a comprehensive return-to-work plan, which will include details regarding follow-up workplace testing.

Chronic misuse of alcohol or drugs is not compatible with undertaking firefighting duties safely. Firefighters should be classed as Temporarily Unfit to Perform Firefighting Duties while their condition is assessed and treated.

20.2.3 Remission

Fit to Perform Firefighting Duties Subject to Review may be considered if there is evidence of remission:

- a strong response to treatment, **and**
- **well-documented** abstinence and recovery.

For the purpose of this standard, remission is defined by:

- an abstinence from illicit drugs, **or**

- the use of other substances, such as alcohol, has reduced in frequency to the point where it is **unlikely** to cause impairment or result in a positive test at work.

Remission should be confirmed by biological monitoring (e.g. urine drug tests, alcohol breath test, carbohydrate-deficient transferrin, liver function tests, full blood count) over a period of at least 3–6 months, depending on the severity and complexity of the presentation.

The following must be considered when assessing fitness to perform firefighting duties:

- the firefighter's substance use history
- response to treatment
- level of insight
- FRNSW's Alcohol and Other Drugs Policy.

Firefighters with severe substance use problems, with previous high rates of relapse and fluctuation in stabilisation, would not be considered medically fit to undertake firefighting duties.

20.2.4 Firefighters being treated for opioid dependence

Stable doses of buprenorphine and methadone for opioid dependency may not result in impairment, providing the dose is stable and there is no abuse of other drugs that could cause impairment. Impairment due to unsanctioned use of opioids or other substances must be considered in determining medical fitness for duty.

Firefighters treated with buprenorphine or methadone should be referred for assessment by an appropriate specialist, such as an addiction medicine specialist or addiction psychiatrist. The opinion of a clinical psychologist experienced in substance misuse may be of additional benefit. Fitness to perform firefighting duties will be determined by the FRNSW Occupational Physician, taking into account information provided from the specialist assessment(s).

Short-acting opioids may cause fluctuations in blood levels of opioids, which are considered to be not compatible with operational duties.

20.2.5 Drug and alcohol screening

Drug and alcohol screening does not form part of periodic health assessments; however, testing may occur as part of a return-to-work program for a substance misuse condition, for objective confirmation of abstinence. Where drug testing is required, urine drug testing will be used. Other tests may include alcohol breath testing, and other biomarkers such as full blood count, liver function tests and carbohydrate deficient transferrin.

If a firefighter is suspected of being intoxicated by alcohol or drugs at the time of assessment, the assessing doctor should assess them and enquire of possible reasons for their condition. If drug or alcohol intoxication is suspected or admitted to by the firefighter, the doctor should cease the examination, classify the firefighter as Temporarily Unfit to Perform Firefighting Duties and must contact the designated FRNSW person so that Workplace Standards can be notified.

20.2.6 Applicants

Applicants will not usually have the benefit of experience with the psychological stressors of firefighting duties. Any applicant deemed to be in remission from a substance misuse disorder must be assessed very carefully regarding their psychological resilience, risk of relapse and if the psychological stressors of operational duties would increase any such risk.

Table 14 Medical criteria for operational firefighters – substance misuse[a]

Condition	Criteria
AUDIT questionnaire	**Score of 8–15.** The firefighter may be managed within the consultation by providing simple advice and information on alcohol guidelines and risk factors. They may be classified as Fit to Perform Firefighting Duties if, on overall assessment, the risk is considered to be low. If there are any concerns, the firefighter should be classified as Fit to Perform Firefighting Duties Subject to Review. **Score of 16–19.** The firefighter may be managed with a combination of simple advice, counselling and monitoring. Follow-up and referral to the firefighter's GP are required and the GP should be provided with a copy of this standard. They should be classified as Fit to Perform Firefighting Duties Subject to Review or Temporarily Unfit to Perform Firefighting Duties, pending further assessment. **Score of ≥20, or where combined scores on questions 4, 5, and 6 are >4.** The firefighter should be referred for specialist service assessment for consideration of treatment and an opinion regarding prognosis. (If the FRNSW nominated specialist recommends treatment, and the firefighter is willing to engage in treatment, the firefighter should be referred back to their GP for referral to an appropriate treatment provider. All treatment providers should be provided with this standard for substance misuse.) The firefighter should be classed as Temporarily Unfit to Perform Firefighting Duties, pending further assessment. Firefighters not willing to engage in treatment should be classed as Permanently Unfit to Perform Firefighting Duties.
Substance misuse	A firefighter is not Fit to Perform Firefighting Duties if there is evidence of illicit drug use, or abuse or dependence of any substance. Fit to Perform Firefighting Duties Subject to Review, with at least annual review, may be determined by the FRNSW Occupational Physician, taking into account the opinion of an appropriate specialist (such as an addiction medicine specialist or addiction psychiatrist) as to whether the following criteria are met: • the firefighter is involved in a treatment program and has been in remission for a minimum of 3–6 months (refer to the text for the definition of remission), **and** • biological monitoring confirms remission, **and** • there is an absence of cognitive impairments, **and** • there is an absence of end-organ effects that impact on medical fitness for operational duties (as described elsewhere in this standard), **and** • the risk of further illicit drug use or other substance misuse is assessed as being low.

FRNSW = Fire & Rescue NSW; GP = general practitioner

a *It is important that assessing doctors familiarise themselves with both the general information above and the tabulated standards before making an assessment of a person's medical fitness for duty.*

20.3 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2012.

Civil Aviation Safety Authority. *Problematic alcohol and other drug use in the Australian aviation sector. Comprehensive assessment guidelines*, 2010.

National Drug Research Institute, Australian Institute of Criminology. *National amphetamine-type stimulant strategy background paper*, Monograph Series No. 69, November 2007.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

National Alcohol and Drug Research Centre, University of NSW. *The health and psychological effects of cannabis use*, Monograph Series No. 44, 2001.

21 Vestibular disorders

21.1 Relevance to firefighting duties

Many tasks undertaken by firefighters require good balance. In addition, a lack of balance may lead to serious injury in the firefighting environment. Situations include climbing and working from ladders, working at heights, working in awkward spaces and in awkward positions, stooping, looking overhead, and negotiating uneven and slippery surfaces in poor visibility conditions. Loss of balance causing acute incapacity in an operational situation jeopardises the safety of the individual firefighter, their crew and members of the public.

A number of conditions may affect balance, including diseases of the vestibular system, abnormal proprioception or disorders of the central nervous system, particularly of the extra-pyramidal system and cerebellum. Blackouts or presyncope resulting from cardiac and other causes are not dealt with in this chapter (refer to Section 10, Blackouts, Section 11, Cardiovascular disorders (syncope) and Section 12, Diabetes).

Of most significance are recurrent vestibular conditions that can result in sudden, unheralded attacks of vertigo. Some vestibular disorders also affect hearing (refer to Section 13, Hearing).

21.2 General assessment and management guidelines

A firefighter who suffers unheralded attacks of vertigo is not medically fit to perform firefighting duties.

Vestibular disorders may change between the asymptomatic and symptomatic state with little warning. The subsequent vestibular dysfunction can occur suddenly and result in acute incapacity.

21.2.1 Meniere's disease

Meniere's disease often results in recurrent vertigo despite treatment. The timing and frequency of the attacks vary. Some individuals can regularly predict when they will have an attack. Others note a completely random pattern. One in 25 people with Meniere's disease also experience drop attacks – sudden falls without loss of consciousness. The natural history is one of progression in the affected ear associated with increasing hearing loss. In extreme cases, total loss of vestibular function and partial loss of cochlear function can occur in the affected ear. Attacks are often heralded by a sense of fullness in the affected ear; however, quick egress from emergency or hostile environments is not always practicable. Meniere's disease may not be compatible with operational duties in the long run.

21.2.2 Benign paroxysmal positional vertigo

Symptoms of benign paroxysmal positional vertigo (BPPV) are typically triggered by changing head position, lying down, turning over in bed and sitting up from lying, and by stooping or extending the neck to look up. Given the emergency nature of firefighting duties, which may require frequent variation of posture and working in awkward positions, symptoms of BPPV may be precipitated by firefighting duties and firefighters would usually be required to be symptom-free for a minimum of 6 months before a return to firefighting duties can be considered.

21.2.3 Central causes

Given the increased risk in those with underlying cardiovascular disease of precipitation of acute cardiovascular events with firefighting, the clinical history should be considered carefully, and the

possibility of a cerebrovascular cause for vertigo or other balance problems may need to be considered if clinically appropriate. Note that cerebellar infarction is the main differential diagnosis for vestibular neuritis.

For central causes of vertigo (such as stroke or transient ischaemic attack) please refer to Section 15, Neurological disorders.

21.2.4 Acute peripheral vestibulopathy – vestibular neuritis (syn vestibular neuronitis, neurolabyrinthitis) and labyrinthitis

Vestibular neuritis and labyrinthitis are thought to result mostly from viral infections. Generally, they are self-limiting conditions; however, symptoms such as vertigo may become persistent in some individuals. Where symptoms persist, medical fitness to resume firefighting duties will be assessed by the FRNSW Occupational Physician on a case-by-case basis; however, a significant symptom-free period will be required before resuming operational duties. Persistence of symptoms beyond 2–3 months should prompt review of diagnosis.

Table 15 Medical criteria for operational firefighters – vestibular disorders

Condition	Criteria
Meniere's disease	A firefighter is not Fit to Perform Firefighting Duties if they have Meniere's or suspected Meniere's disease. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account information provided by the treating ENT specialist, including response to treatment and whether the following criteria are met: • the firefighter has been free of vertigo for 12 months, **and** • the hearing standard is met.
Benign paroxysmal positional vertigo (BPPV)	A firefighter is not Fit to Perform Firefighting Duties if they have BPPV in any direction. Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account information provided by the treating GP and/or ENT specialist, including response to treatment, pattern of disease and whether the following criterion is met: • the firefighter has been free of vertigo for at least 6 months. A shorter period may be considered by the FRNSW Occupational Physician, taking into the account information provided by an ENT specialist if further episodes after appropriate treatment is considered unlikely.

ENT = ears, nose and throat; FRNSW = Fire & Rescue NSW; GP = general practitioner

21.3 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2012.

Kuo CH, Pang L, Chang R. Vertigo. Part 2 – management in general practice. *Australian Family Physician* 2008, 37(6):409–13.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

NSW Government, Maritime. *Standard for health assessment of marine pilots (NSW)*, 2009.

22 Vision and eye disorders

22.1 Relevance to operational duties

Firefighting requires good eyesight, specifically acuity and fields. Firefighting duties are often undertaken under emergency and adverse conditions that impact on visibility, such as smoke, poor weather and at night. Failure to adequately see and respond to imminently hazardous situations jeopardises the safety of the firefighter and others dependent on the firefighter for their safety. Driving of the appliance, particularly in emergency mode is also a major consideration in assessing visual fitness.

The following visual attributes are required:

- **Visual acuity**. Good visual acuity is crucial to driving safely in emergency mode. Good acuity is also essential for other tasks, including those undertaken in conditions of poor visibility, so that a firefighter may be operationally effective. Good acuity is crucial for tasks such as reading street signs and chemical placards, and identifying casualties and hazards to firefighters when moving through the incident ground. Abnormal vision may impact on reaction time, mobility and casualty recognition.
- **Visual fields**. Good peripheral vision is crucial to driving safely under emergency conditions and for working on roads near traffic. However peripheral vision is of limited importance in many firefighting situations because of personal protective equipment limiting the fields of vision.
- **Colour vision**. All colour vision tasks for firefighting were risk assessed by Dr John Parkes in 2009 and none were deemed safety critical. Risk mitigation in relation to these task include crew members working together and not in isolation, positional cues, use of monitors instead of detection papers, written labels or symbols in addition to colours on cylinders, and judicious purchasing of certain equipment. The same risk assessment also determined that colour vision is not essential to safe driving due to redundancy of traffic lights, based on the position of red and green lights.

22.2 General management guidelines

22.2.1 Visual acuity

For the purpose of this standard, visual acuity is defined as a firefighter's clarity of vision with or without corrective glasses or contact lenses. However, given the risk and consequence of damaged or dislodged visual aids, a minimum uncorrected visual acuity requirement has been set. If the visual acuity standard is not met at initial assessment, the firefighter may be referred to an optometrist or ophthalmologist for further assessment.

Assessment method

Visual acuity should be measured for each eye separately, then binocular without optical correction. If correction is needed, acuity should be retested with appropriate corrective lenses. (Refer to Figure 52.)

Acuity should be tested using a standard visual acuity chart (Snellen or equivalent, with five letters on the 6/12 line). Standard charts should be placed 6 metres from the person tested, or 3 metres for other calibrated charts. More than two errors in reading the letters of any line is regarded as a failure to read that line. The standard is not met if visual acuity is worse than 6/9 in the better eye, or worse than 6/18 in either eye (uncorrected or corrected). There is some flexibility providing the

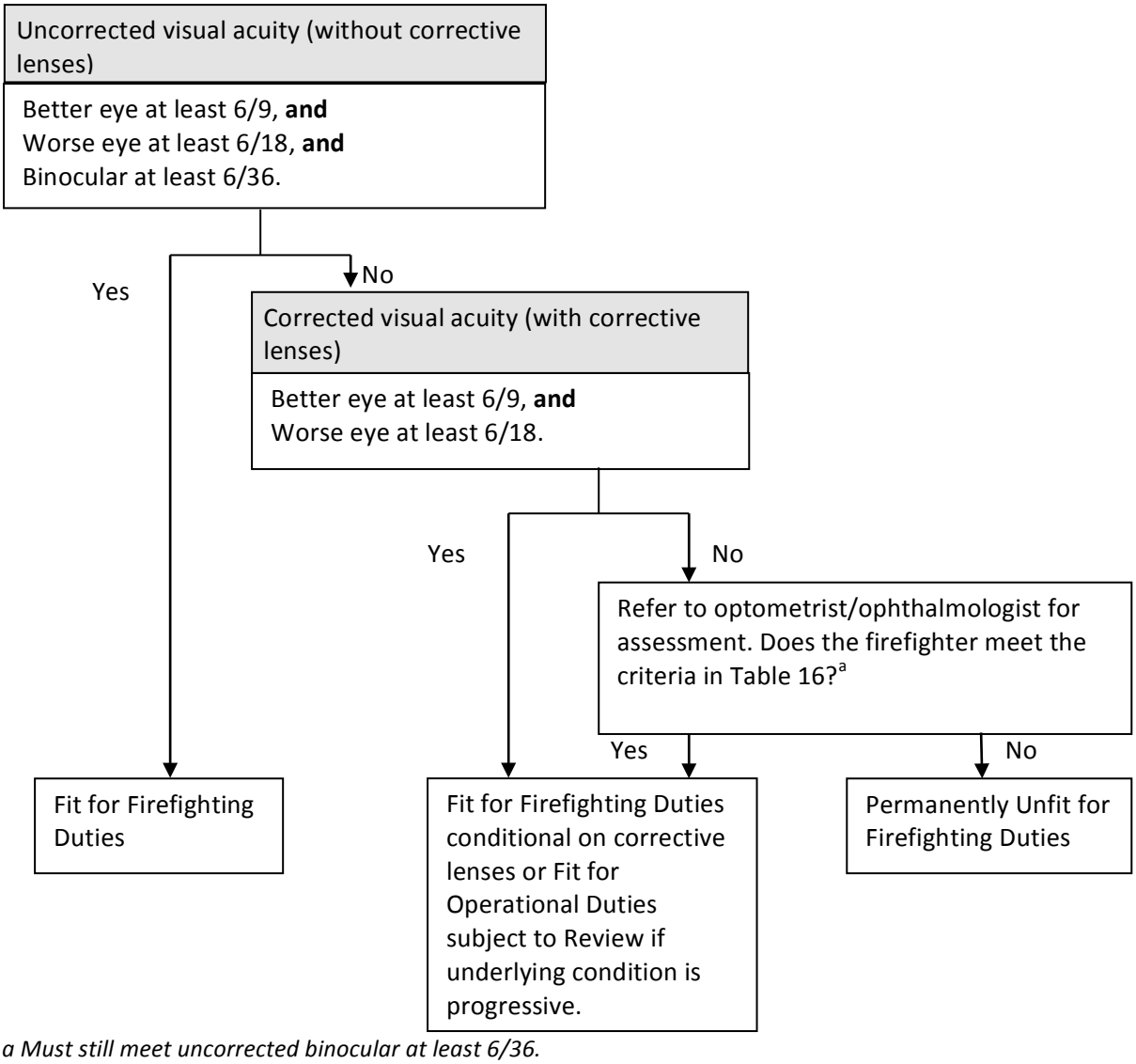
visual acuity in the better eye, with or without correction is 6/9 or better, taking into account the opinion of an optometrist or ophthalmologist. A copy of *Inherent requirements (*Part 2 of Health Standard) should be included in the referral to the assessing optometrist or ophthalmologist

In addition, firefighters who meet the standard corrected with glasses or contact lenses must meet a minimum uncorrected standard of 6/36 or better binocular, so that a minimum level of vision is present should their visual aids become damaged or dislodged during operational duties.

All firefighters who meet the standard with correction are encouraged to carry a spare pair of glasses on duty.

Corrective glasses and contact lenses may be worn with personal protective equipment. Custom made frames clip into the self-contained breathing apparatus mask (see Figure 53).

Figure 52 Vision assessment method



a Must still meet uncorrected binocular at least 6/36.

Figure 53 Corrective lenses

Breathing apparatus corrective lens frames

Breathing apparatus corrective lens frames clipped into mask

22.2.2 Visual fields

For the purpose of this standard, visual fields are defined as a measure of the extent of peripheral (side) vision. Visual fields may be reduced as a result of many neurological or ocular diseases or injuries.

Assessment method

Visual fields may initially be screened by confrontation. Sit close to and directly opposite the person and instruct the person to cover one eye. Occlude your opposite eye like a mirror image. Ask the person to fixate on your non-occluded eye and to count the number of fingers held up in each of the four corners of your own visual field. Other extreme upper, lower and side points may also be tested. Repeat for the other eye.

Confrontation is an imprecise test. Any person who has, or is suspected of having, a visual field defect should be referred for assessment by an optometrist or ophthalmologist. Assessment will involve automated perimetry using an automated static perimeter (Kinetic Goldman Visual Field, Humphrey Field Analyser, Medmont M700, Octopus).

22.2.3 Monocular vision

People with monocular vision have a reduction of visual field due to obstruction of the medial visual field by the nose. This may be compensated for by increased scanning and head movements. Persons with monocular vision usually have satisfactory depth perception on the basis of monocular cues; however, any loss of depth perception from lack of stereopsis (a binocular cue) is not expected to affect a firefighters' ability to safely perform the inherent requirements of operational duties.

Persons with monocular vision do not meet the criteria for an unconditional commercial vehicle driver licence. However, in some cases, a conditional licence may be granted, taking into account the nature of the driving task and information provided by the treating ophthalmologist or optometrist.

The current medical guidelines for commercial vehicle drivers do not specifically take into account emergency driving conditions. There is an increased dependence on visual cues when driving under emergency conditions. Good quality cues are relied on, as large amounts of visual and other information must be acted on quickly by the driver. Those with monocular vision are therefore permanently restricted from driving in emergency mode. This also takes into consideration that the appliance is driven with passengers.

A firefighter with monocular vision may undertake all firefighting duties except in relation to driving the appliance in emergency mode (as outlined above), subject to assessment by an ophthalmologist and conditions outlined in Table 16 being met.

22.2.4 Sudden loss of unilateral vision

A firefighter who has lost an eye or most of the vision in an eye on a long-term basis has to adapt to their new visual circumstances and re-establish depth perception. They should therefore be classed as Temporarily Unfit to Perform Firefighting Duties for an appropriate period (usually 6 months) and be assessed for monocularity.

22.2.5 Colour vision

Defective colour vision mainly affects the perception of red and green colours. Various degrees of colour vision affect up to 5% of men. Based on the above mentioned risk assessment of tasks requiring colour vision, colour vision is still assessed, but carries no medical fitness for duty implications. Where an abnormality of colour vision is confirmed, the individual is counselled about the impairment and how this impacts on particular tasks.

Assessment method – for applicants only

Colour vision is initially screened using 12 Ishihara plates; ≥3 errors per 12 plates constitutes a fail. No colour lenses or sunglasses should be used when testing. If the firefighter fails the Ishihara test, they should undergo further testing with the Farnsworth D15 test. Failure of the Farnsworth D15 indicates a deficiency of surface colour recognition.

Applicants who fail the Farnsworth D15 are given a Fire & Rescue NSW (FRNSW) fact sheet explaining how their colour vision abnormality affects particular tasks requiring colour vision. Once read, they must then sign a statement to indicate that they have read and understood the information given. Should they be unsure about any aspect of the information, they should contact a FRNSW Occupational Physician before signing the statement.

Colour vision testing is not required for incumbent firefighters.

22.2.6 Other

Diplopia

A firefighter with permanent diplopia is Permanently Unfit to Perform Firefighting Duties. Transient diplopia requires appropriate medical assessment for any underlying cause relevant to firefighting as outlined in this standard.

Nystagmus

A firefighter with nystagmus must meet the visual acuity standard. Any underlying cause must be assessed to ensure that there is no other condition that would render the firefighter Unfit to Perform Firefighting Duties as per this standard.

Table 16 Medical criteria for operational firefighters – vision

Visual attribute	Standard
Acuity	A firefighter is not Fit to Perform Firefighting Duties if: • visual acuity is worse than 6/9 in the better eye, **or** • visual acuity is worse than 6/18 in either eye. Fit to Perform Firefighting Duties may be determined if: • the standard is met with corrective lenses, **and** • uncorrected binocular visual acuity is no worse than 6/36. Fit to Perform Firefighting Duties may be considered taking into account the opinion of an optometrist or ophthalmologist if: • vision is worse than 6/18 in the worse eye, provided that visual acuity in the better eye is 6/9 or better, **and** • uncorrected binocular visual acuity is no worse than 6/36. Fit to Perform Firefighting Duties Subject to Review may be recommended if the underlying disorder is progressive.
Visual fields	A firefighter is not Fit to Perform Firefighting Duties if there is a visual field defect. Fit to Perform Firefighting Duties or Fit to Perform Firefighting Duties Subject to Review may be determined, taking into account the opinion of an optometrist or ophthalmologist, and as to whether the following criteria are met: • if the binocular visual field has an extent of at least 140 degrees within 10 degrees above and below the horizontal midline, **and** • there is no significant visual field loss (scotoma, hemianopia, quadrantanopia) that is likely to impact on the effective and safe undertaking of operational duties, **and** • the visual field loss is static and unlikely to progress rapidly.

Visual attribute	Standard
Monocular vision	A firefighter is not Fit to Perform Firefighting Duties if they have monocular vision. If the following criteria are met, a permanent restriction on emergency driving is applicable. If the driver licensing authority has granted a conditional commercial vehicle driver licence, the appliance may be driven under non-emergency conditions, subject to FRNSW being able to accommodate this job modification. Fit to Perform Firefighting Duties Subject to Review and **subject to the above job modification** may be determined, taking into account the opinion of an ophthalmologist as to whether the following criteria are met: • uncorrected visual acuity in the better eye is ≥6/9, **and** • at least 6 months have passed since the onset of the impairment and the firefighter has adjusted well to being monocular, **and** • visual field in the good eye is normal, **and** • there is no underlying disease of the good eye that would reasonably be expected to deteriorate rapidly.
Colour vision – for applicants only	Refer to text.
Diplopia, nystagmus	Refer to text.

22.3 Bibliography

Austroads, National Transport Commission. *Assessing fitness to drive for commercial and private vehicles*, 2011.

National Fire Protection Association. *NFPA1582: standard on comprehensive occupational medical program for fire departments*, Avon, MA, 2007.

National Transport Commission. *National standard for health assessment of rail safety workers*, 2012.

Parkes J. *Risk assessment of safety critical and other duties performed by NSWFB personnel requiring colour vision,* 2009.