

# Metabolic heat stress

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Owner: **Assistant Director, Health,Safety and Wellbeing**  
Responsible work team: **Health,Safety and Wellbeing**

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## Contents

1 Introduction ..... 2  
2 The effects of heat stress on firefighters ..... 2  
3 Prevention ..... 4  
4 Treatment ..... 4  
**Document history ..... 5**

# 1 Introduction

- 1.1 This policy provides information on metabolic heat stress, its symptoms and the effect of heat stress on the human body. It also provides advice on how it can be prevented and the action to be taken if a firefighter suffers heat stress.

## 2 The effects of heat stress on firefighters

Heat stress can affect firefighters both physically and psychologically. The effects are likely to be gradual, and can easily be overlooked in the early stages. Age, weight, health and experience can influence the degree to which a firefighter may be affected.

### What is heat stress

- 2.1 The human body is designed to maintain the body's core temperature around 37 degrees Celsius. Any variation from this becomes a problem and the body has a number of mechanisms to maintain this temperature balance. The efficiency of this process is improved by fitness but this can mean that fit individuals may suffer from the effects of dehydration more quickly as they sweat more readily. However, lack of fitness and obesity are significant risk factors in causing heat stress.
- 2.2 When exposed to high temperatures caused by heat and or, a heavy workload, the mechanisms may become overloaded causing a rise in body heat storage. Factors affecting this are; air temperature, radiant temperature, humidity, air velocity, thermal properties of clothing and metabolic rate (workload). The resulting **heat strain** on the individual can be seen as heat cramps, prickly heat, headaches, nausea, vertigo, weakness, thirst, giddiness and fainting. More severe heat stress can cause unconsciousness, convulsions or mental confusion (heat stroke), and can be fatal.

### Reasons for heat stress

- 2.3 At any incident involving strenuous physical activity, there is a possibility of personnel succumbing to heat stress. This risk is heightened when working in a hot or humid environment, when wearing personal protective clothing or chemical or gas tight suits. The likelihood of this occurring is increased during periods of hot weather. **Dehydration**, is an important factor in the onset and severity of heat stress and personnel can reduce the chances of suffering these effects by ensuring that they keep well hydrated throughout their working shift. **The average person needs to drink about 2 to 3 litres of water per day to maintain a well-hydrated state.**
- 2.4 People should take the opportunity to drink fluid whilst on duty and water is available on appliances for use during operational activity when away from the fire station. This includes use during outside activities such as hydrant inspection.
- 2.5 The overall effects of these variables on heat balance are that core body temperatures will rise and the body will become dehydrated (unless the fluid lost is replaced) producing the signs and symptoms of heat stress. The effects do not follow a predictable pattern; for example there may be few signs to a team member, or others that anything is amiss before an individual collapses.

## The effect of PPE on heat loss

2.6 The insulating effects of PPE significantly reduces the body's ability to dissipate heat and will make heat stress more likely. Adding additional layers of PPE, such as CCPS, will compound this effect. PPE is worn to protect against physical, chemical, biological and especially thermal hazards. Although essential, it can affect the heat balance of the body in several ways.

2.7 These include:

- The work rate (**metabolic load**) can be increased by the weight of the PPE, and through any restriction of normal movements.
- **Evaporation** from the skin can be affected by the amount of the body covered by PPE. Despite advances in "breathable" garments that allow water vapour to pass through, if the sweat rate is such that the atmosphere inside the garment is saturated, or the external environment has very high humidity, the overall effectiveness of the sweating/ evaporation mechanism is much reduced. Similarly, the breathable membrane can be overwhelmed as a result of the work rate as a wearer may be sweating more fluid than the membrane can transfer.
- Heat loss by **convection**, (the flow of air over the body surface), which is an additional heat balance mechanism, will be restricted if the body is covered. Wearing harnesses or other constrictions reduces any venting/bellows effect created by loose clothing.
- Heat gain by **radiation** – heat naturally flows from a hotter to a cooler body. A high ambient temperature (such as a fire) will result in the body absorbing heat by radiation. The amount will depend on the temperature difference, and also the insulating properties and design of the PPE. However, the insulation provided intentionally by the PPE will adversely affect the body's ability to lose heat.

## Effect of heat and humidity

2.8 High heat and humidity levels reduce the evaporation of sweat from the skin surface. This slows body cooling and increases the risk of heat stress. Extremely high humidity is present immediately after water is applied to a fire in a compartment and firefighters operating in such environments may be more susceptible to heat stress as a result.

## Psychological effects

2.9 Heat stress causes a deterioration in co-ordination, manipulation, visual skills, and reasoning, affecting performance. Frequently, individuals suffering from early symptoms are unable to recognise them. It is therefore important that crew members are watchful of their colleagues. Crews should withdraw to safety before any individuals become disorientated and are unable to complete tasks safely.

## Physical effects

2.10 Heat stress may cause firefighters to suffer, progressively from:

- **Heat cramps:** This is the earliest physical indicator of heat stress, and involves muscular contractions caused by salt losses in perspiration.
- **Heat exhaustion:** The next stage, and a more serious condition. Dehydration will give rise to thirst, fatigue, nausea and mental confusion.
- **Heat stroke:** A medical emergency which needs prompt medical attention. Heat stroke is characterised by the cessation of sweating and partial or complete loss of consciousness, possibly accompanied by convulsions. This condition can be life threatening.

### **3 Prevention**

- 3.1 Incident commanders must take account of the effects that working in hot/humid conditions can have on the body and also how the use of protective equipment can increase the risk of heat stress. Similarly, all firefighters must be aware that physiological stress may occur at any time and not just when wearing PPE with BA. When strenuous activity is necessary, whether full protective clothing is worn or not, a system of reliefs may need to be arranged, enabling crew rotation, thus limiting exposure to the risk.
- 3.2 Research has identified that there are various methods of limiting heat build up to ensure that these effects are minimised:
- Establish a holding/recovery area in the shade, in a safe area, where crews can rest.
  - Make drinking water available at the holding/recovery area, to allow personnel to hydrate before work and re-hydrate following reliefs.
  - Encourage personnel to cool their hands, head, neck and wrists in cold water.
  - Recognise the stresses and effects of the tasks that crews are asked to complete, and ensure that crews are relieved or rotated as soon as practicable.
  - Encourage reserve crews within the holding/recovery area to relax their dress until they are called forward for briefing.
  - Allow crews to relax the requirement to wear full fire kit, where conditions permit.

### **4 Treatment**

#### **On site first aid care**

- 4.1 Current first aid practices, including oxygen therapy, should be practiced as soon as the person is removed from the hazard area.

#### **Arrangements for care by London Ambulance Service (LAS)**

- 4.2 There may be occasions when the effects of working in heated environments require that specialist medical supervision be provided to personnel. If heat stress is suspected, an ambulance must be called if not already in attendance. In these circumstances, firefighters showing the signs and symptoms of heat stress must be placed in the care of the LAS, who will maintain basic care, or transport them to hospital for more expert treatment.

# Document history

## Assessments

An equality, sustainability or health, safety and welfare impact assessment and/or a risk assessment was last completed on:

EIA	27/03/26	SDIA	L - 26/05/26	HSWIA		RA	
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## Audit trail

Listed below is a brief audit trail, detailing amendments made to this policy/procedure.

Page/para nos.	Brief description of change	Date
Page 1	Changes made to owner title to reflect the change in organisational governance.	04/12/2018
Throughout	Reviewed as current with no changes.	03/10/2019
Throughout	Reviewed as current with no changes.	28/05/2026

## Subject list

You can find this policy under the following subjects.

Fire hazards	Heat
Heat stress	Medical

## Freedom of Information Act exemptions

This policy/procedure has been securely marked due to:

Considered by: (responsible work team)	FOIA exemption	Security marking classification