European Agency for Safety and Health at Work

EU GUIDANCE

HEAT AT WORK – GUIDANCE FOR WORKPLACES

Contents

Background and scope of guidance

The increase in average ambient temperature expected with climate change can have a significant impact on workplaces. Extreme heat events can cause significant health issues such as heat exhaustion, heat stroke, and other heat stress related illnesses. Higher temperatures for longer periods of time can also increase the risk of injuries due to fatigue, lack of concentration, poor decision making, and other factors. A reduction in productivity may also occur. Increasing temperatures may cause increased stress levels in workers, including workers involved in emergency services and outdoor workers who have to work altered time schedules to avoid periods of high temperature. Some materials and equipment may also be affected by higher temperatures and higher exposures to chemicals may be related to working in hot environments, for example when working with solvents and other volatile substances. Finally, hotter temperatures can increase the levels of air pollution and harmful exposures to workers, such as ground-level ozone and fine particulate matter (e.g., smog) and favour the build-up of air contaminants due to stagnating air.

All workers are entitled to an environment where risks to their health and safety are properly controlled, and temperature at work is one of the risks that employers should assess whether the work is being done indoors or outdoors.

This guide provides practical guidance on how to manage the risks associated with working in heat and information on what to do if a worker begins to suffer from a heat-related illness. The guide was drafted based on existing guidance from the US National Institute for Occupational Safety and Health (NIOSHA), the UK Health and Safety executive (HSE), the Canadian Centre for Occupational Safety and Health (CCOSH), and Safe Work Australia.

Who can be affected

Workers in nearly every sector can be affected by increasing ambient temperatures, resulting in heat stress, but those most in the focus of current attention are outdoor workers in agriculture, forestry and construction, first responders and healthcare workers. Indoor workers can also be at risk, especially if they work in heat-intensive industries or carry out physical work. Occupational risks from heat stress depend on the geographical location and the severity of health problems may be influenced by other factors such as age or pre-existing medical conditions. These factors need to be taken into account when setting preventive and protective measures.

Outdoor workers

The sectors where workers are likely to do intense physical work in direct exposure to sunlight and heat include agriculture, forestry, public spaces and road repair and maintenance, fisheries, construction, mining and quarrying, transport, postal services, waste collection, and maintenance and utilities supplies. Emergency workers such as firefighters, police officers and military staff, emergency medical staff and rescue workers can also be affected, for example, when natural disasters or forest fires occur. During extreme weather events or natural disasters, emergency workers often must work at maximum capacity while wearing personal protective clothing or equipment, which can cause additional mental and physical strain.

Indoor workers

Indoor workers are also at risk of heat stress that may increase during heatwaves, especially those who work in poorly cooled buildings, in cabin-operated machinery without cooling (e.g. cranes) and in settings with high industrial heat production, and those who carry out heavy physical work or must use personal protective equipment (PPE) in hot conditions. Examples of occupations and sectors at risk include animal and horticultural workers, the electricity, gas and water supplies and manufacturing sectors, for example foundries and smelting operations, steel mills, glass and rubber manufacturing plants, compressed-air tunnels, power plants, brick-firing and ceramics plants, boiler rooms, smelters and furnaces where extremely hot or molten material is the main source of heat, but also many services, such as laundries, restaurant kitchens, bakeries and canneries, as well as cleaners, food service workers and warehouse workers. High humidity adds to the heat burden. Healthcare workers can also be impacted by heatwaves, for instance, the use of PPE in hot conditions can unintendedly contribute to heat stress. Healthcare workers may also face a massive influx of patients during heatwaves, leading to high workload and stressful and physically strenuous conditions.

Heat stress – heat-related illness

Working in heat can be hazardous and can cause harm to workers. The human body needs to maintain a body temperature of approximately 37 °C. If the body has to work too hard to keep cool or starts to overheat, a worker begins to suffer from heat-related illness.

‘Heat stress’ is the ‘overall heat load a worker may be exposed to from the combined contributions of metabolic heat, clothing, and environmental factors (i.e. air temperature and movement, humidity and radiant heat). Mild or moderate heat stress can lead to discomfort and negatively impact performance and safety, but it is not harmful to health. Temperature extremes directly affect health by compromising the body’s ability to regulate its internal temperature. They can also worsen chronic conditions such as cardiovascular disease, respiratory disease, cerebrovascular disease and diabetes-related conditions. A range of studies have also linked higher temperatures with increases in suicide rates, emergency department visits for mental illness and poor mental health.


©AdobeStock Quality Stock Arts_437739710

The body exchanges heat with its surroundings mainly through radiation, convection and evaporation of sweat.

Radiation is the process by which the body gains heat from surrounding hot objects, such as hot metal, furnaces and steam pipes, and loses heat to cold objects, such as chilled metallic surfaces, without coming into contact with them. The sun is a common example of a source of radiant heat. No radiant heat gain or loss occurs when the temperature of surrounding objects is the same as the skin temperature (about 35 °C).

Convection is the process by which the body exchanges heat with the surrounding air. The body gains heat from hot air and loses heat to cold air that comes in contact with the skin or when exhaling and inhaling. Convective heat exchange increases with increasing air speed and increased differences between air and skin or breath temperature.

Evaporation of sweat from the skin cools the body. Evaporation occurs more quickly, and the cooling effect is more noticeable with high wind speeds and low relative humidity. In hot and humid workplaces, the cooling of the body due to sweat evaporation is limited because the air cannot accept more moisture. In hot and dry workplaces, the cooling due to sweat evaporation is limited by the amount of sweat produced by the body.

In moderately hot environments, the body tries to get rid of excess heat so it can maintain its normal body temperature. The heart rate increases to pump more blood through outer body parts and skin so that excess heat is lost to the environment, and sweating occurs. These changes place additional demands on the body. Changes in blood flow and excessive sweating reduce a person's ability to do physical and mental work. Manual work creates additional metabolic heat and adds to the body heat burden.

People are generally unable to notice their own heat stress-related symptoms. Their survival may depend on their co-workers' ability to recognise these symptoms and seek timely first aid and medical help. Below, the different health effects of heat stress are explained and advice is given on what to do to support an affected worker.

Heat stroke

Heat stroke is the most serious heat-related illness. It is a medical emergency. Sweating is not a good sign of heat stress as there are two types of heat stroke: non-exertional or 'classical' where there is little or no sweating (usually occurs in children, persons who are chronically ill and the elderly), and 'exertional' where body temperature rises because of strenuous exercise or work, and sweating is usually present.

Heat stroke occurs when the body can no longer control its temperature: the body's temperature rises rapidly, the sweating mechanism fails and the body is unable to cool down. When heat stroke occurs, the body temperature can rise to 40 °C or higher within 10 to 15 minutes. Heat stroke requires immediate first aid and medical attention. It can cause permanent disability or death if the person does not receive emergency treatment.

Symptoms of heat stroke include:

- confusion, altered mental status, slurred speech, irrational behaviour;
- complete or partial loss of consciousness (coma);
- hot, dry skin or profuse sweating;
- seizures;
- very high body temperature; and
- death if treatment is delayed.

First aid for treating heat stroke

Take the following steps to treat a worker with heat stroke:

- call 112 for emergency medical care;
- stay with the worker until emergency medical services arrive;
- move the worker to a shaded, cool area and remove outer clothing;
- cool the worker quickly, using the following methods:
- administer a cold water or ice bath, if possible,
- wet the skin,
    - place cold wet cloths or ice on the head, neck, armpits and groin, or soak the clothing with cool water,
    - circulate the air around the worker to speed cooling, and
- do not force the person to drink liquids.

©AdobeStock_kokliang1981_443138350

Heat exhaustion

Heat exhaustion is the body's response to an excessive loss of water and salt, usually through excessive sweating. It can lead to heat stroke if left untreated. Heat exhaustion is most likely to affect:

- the elderly,
- people with high blood pressure, and
- those working in a hot environment.

Signs and symptoms of heat exhaustion include

- headache;
- nausea;
- dizziness;
- weakness;
- visual disturbances;
- irritability;
- intense thirst;
- heavy sweating;
- tingling and numbness of extremities after exposure to a hot environment;
- muscle cramps;
- breathlessness;
- palpitations;
- elevated body temperature;
- decreased urine output; and
- skin that is pale, cool and moist.

First aid for treating heat exhaustion

Treat a worker who has heat exhaustion by doing the following:

- Get medical attention. Take the worker to a clinic or emergency room for medical evaluation and treatment.
- Call 112 if medical care is unavailable.
- Do not leave the worker alone. Have someone stay with them until help arrives.
- Remove the worker from the hot area and give liquids to drink. Encourage frequent sips of cool water.
- Remove unnecessary clothing, including shoes and socks.
- Cool the worker with cold compresses or have them wash their head, face and neck with cold water.

Rhabdomyolysis

Rhabdomyolysis (rhabdo) is a medical condition associated with heat stress and prolonged physical exertion. Rhabdo causes the rapid breakdown, rupture and death of muscle. When muscle tissue dies, electrolytes and large proteins are released into the bloodstream. This can cause irregular heart rhythms, seizures and damage to the kidneys.

While rhabdo can be asymptomatic, symptoms include:

- muscle cramps/pain,
- abnormally dark (tea or cola-coloured) urine,
- weakness, and
- exercise intolerance.

First aid for symptoms of rhabdomyolysis

Workers with symptoms of rhabdo should:

- stop activity;
- drink more liquids (water preferred);
- seek immediate care at the nearest medical facility; and
- ask to be checked for rhabdomyolysis (i.e. blood sample analysis for creatine kinase).

Heat syncope

Heat syncope is a fainting (syncope) episode or dizziness induced by temporarily insufficient flow of blood to the brain that usually occurs when standing for too long or suddenly standing up after sitting or lying. It can also be caused by vigorous physical activity for two or more hours before the fainting happens. It is caused by the loss of body fluids through sweating, and by lowered blood pressure due to pooling of blood in the legs. Factors that may contribute to heat syncope include dehydration and lack of acclimatisation.

Symptoms of heat syncope include:

- fainting (short duration);
- dizziness; and
- light-headedness from standing too long or suddenly rising from a sitting or lying position.

First aid for treating heat syncope

Recovery is normally rapid after rest in a cool area. Workers with heat syncope should:

- sit or lie down in a cool place; and
- slowly drink water, clear juice or a sports drink.

Heat cramps

Heat cramps are sharp pains in the muscles that may occur alone or be combined with one of the other heat stress disorders. Heat cramps usually affect workers who sweat a lot during strenuous activity. Cramps are caused by a salt imbalance from heavy sweating. This sweating depletes the body's salt and moisture levels. Low salt levels in muscles cause painful cramps. Heat cramps may also be a symptom of heat exhaustion. Salt can build up in the body if water lost through sweating is not replaced. Inadequate fluid intake often contributes to this problem. The worker should move to a cooler area and they should hydrate.

Symptoms include muscle cramps, pain, or spasms in the abdomen, arms or legs.

First aid for treating heat cramps

Workers with heat cramps should do the following:

- drink water and have a snack or a drink that replaces carbohydrates and electrolytes (such as sports drinks) every 15 to 20 minutes; and
- avoid salt tablets.

Get medical help if the worker:

- has heart problems;
- is on a low-sodium diet; and
- has cramps that do not subside within an hour.

Heat rash

Heat rashes (prickly heat or miliaria) are tiny red spots on the skin with severe itching, a skin irritation caused by excessive sweating when in a hot, humid environment. The spots are the result of inflammation caused when the ducts of sweat glands become plugged.

Symptoms of heat rash include red clusters of pimples or small blisters. They usually appear on the face, neck, upper chest, groin, thighs, under the breasts and in elbow creases.

First aid for treating heat rash

In most cases, heat rash will disappear when the individual returns to a cooler environment. Workers who have heat rash should:

- work in a cooler, less humid environment, if possible;

- keep the rash area dry;
- apply powder to increase comfort; and
- not use ointments and creams.

Heat oedema

Heat oedema is swelling that generally occurs among people who are not acclimatised to working in hot conditions. Swelling is often most noticeable in the ankles.

First aid for treating heat oedema

If swelling is caused by heat, there are several ways to cool down the lower limbs, boost poor circulation and return fluid to the blood vessels:

- elevating the feet as often as possible
- avoiding heat whenever possible; taking breaks in cooler or air-conditioned areas
- regular walking breaks, in particular when being stationary for long periods of time (prolonged sitting or standing)
- drinking sufficient amounts of water
- supporting the feet, ankles, and legs. Compression socks or support tights can help prevent the collection of fluids in ankles and feet, but may affect heat exchange in hot conditions.

Long-term effects of heat exposure

Certain heart, kidney and liver damages are thought by some researchers to be linked to long-term heat exposure. However, the evidence is not conclusive. Chronic heat exhaustion, sleep disturbances, and susceptibility to minor injuries and sicknesses have all been attributed to the possible effects of prolonged exposure to heat.

Heat exposure has been associated with temporary infertility in both women and men, with the effects being more pronounced in men. Sperm density and motility and the percentage of normally shaped sperm can decrease significantly when the temperature of the groin is increased above a normal temperature. Workers exposed to high heat loads should therefore also be followed by the occupational health services or occupational physicians.

Accident risks

Heat exposures can increase the risk of workplace injuries caused by sweaty palms, fogged-up safety glasses, dizziness and reduced brain function. Prolonged exposure to heat may result in effects such as disorientation, impaired judgement, loss of concentration, reduced vigilance, carelessness and fatigue, and thereby increase the accident risk. The reduction of cognitive abilities and longer reaction times may affect workers in high-risk tasks (e.g. drivers). Direct exposure to solar radiation can also potentially impair cognitive performance and combined with high ambient temperature it may increase the risk of injuries.

However, some of the proposed measures to reduce heat stress can also lead to higher accident risk: when working patterns are modified to avoid the hottest and sunniest periods of the day, moving work into time periods that are normally covered by night work may increase the risk of work-related injuries, due to reduced concentration and speed of reflexes, or reduced visibility.

Increased ambient temperatures can also influence the operations of industrial installations. High ambient temperature increases the risk of fires by fermentation or self-heating of materials, products or waste, and magnifying glass effects, but also by electrical equipment overheating or by pressure rises. These effects will therefore have to be taken into account in the workplace risk assessment to ensure all risks are covered, and that technical or organisational changes do not increase the risk for workers.

Is there a maximum temperature which workers can safely be exposed to at work?

In most cases, legislation is not specific about what is an acceptable range for temperature conditions at work, especially when working outdoors. In some cases, national legislation does provide a range of acceptable temperatures for specific circumstances. It is therefore recommended to consult national regulations and guidance documents on the limits that may be set under different conditions. It is however important to only follow guidance that has been issued by reputable sources. Limits set normally depend on the type of work

done (whether it is light, medium or heavy physical work) and the workplace (office, industrial environment or outdoors) and give indication for employers that they have to set additional measures to ensure the safety and health of workers.

Guidelines for exposure to high temperatures depend on several factors, not just the temperature. These other factors include:

- relative humidity;
- exposure to sun or other heat sources;
- amount of air movement;
- work demands – i.e. how physically demanding the work is;
- whether the worker is acclimatised or unacclimatised to the workload under the conditions of work;
- what clothing is worn (including protective clothing); and
- what the work–rest regimen is (% time work vs % time rest break).

Heat stress indices

Temperature is not the only environmental factor that creates heat stress for the human body. Humidity in particular but also wind and solar radiation are very significant. Therefore, heat stress indices are used to assess hot environments and predict likely thermal strain on the body. Many heat stress indices are described in the literature, for instance the WGBT[1] index and the UTCI[2], but no index can perfectly cover all occupational heat stress scenarios. Within the EU-funded HEAT-SHIELD project, a heat stress index has been developed based on a modified Wet Bulb Globe Temperature index calculated from validated formulas, using weather station data from across Europe.

Heat stress – measures and recommendations

Legislation

There is legislation in place in the EU to address all risks to the health and safety of workers, including those caused by excessive heat. The legislation makes employers responsible for the health and safety of their workers. According to the “OSH Framework Directive[3]”, employers need to assess workplace risks and set preventive measures to either eliminate or minimise the workplace risks. There are specific references to temperature in other Directives based on the framework Directive, for example in the “temporary or mobile construction sites” Directive[4] and the “Workplaces” Directive[5]. Both Directives specify that “during working

[1] Wet Bulb Globe Temperature

[2] Universal Thermal Comfort Index

[3] Council Directive of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (89/391/EEC). See https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1 for more information.

[4] Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile constructions sites (eighth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC), in particular in Annex IV: Part A, point 7, and in Part B, section 1, point 4. See https://osha.europa.eu/en/legislation/directives/15 for more information.

[5] Council Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace (first individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC), in particular in Annex I, point 7, and in Annex II, point 7. See https://osha.europa.eu/en/legislation/directives/2 for more information.

hours, the temperature in rooms containing workstations must be adequate for human beings, having regard to the working methods being used and the physical demands placed on the workers". The Directive on workplaces also mentions that "the temperature in rest areas, rooms for duty staff, sanitary facilities, canteens and first aid rooms must be appropriate to the particular purpose of such areas." These requirements have been transposed into national legislation and the EU Member states may go beyond or be more detailed and specific about what is required when workers could be exposed to heat at work. It is therefore important that you check the national legislation for the requirements in your country.

Workplace risk assessment

Where there is a possibility of heat stress occurring, employers must assess the risks to workers. They need to consider:

- work requirements and work rate – the harder someone works the more body heat generated;
- working climate – this includes air temperature, humidity, air movement and working near a heat source;
- work clothing and PPE – these may prevent sweating and other ways of regulating temperature; and
- a worker's age, body type and medical factors (e.g. a hormonal imbalance or a pre-existing disease) may affect their tolerance of heat.

A risk assessment can help determine:

- how severe the risk is;
- whether existing control measures are effective;
- what action should be taken to control the risk; and
- how urgently you need to take action.

To assess the risk the employer should consider:

- what the impact of the hazard is; and
- how likely the hazard is to cause harm.

How hot a worker feels will be different in every situation, depending on the individual worker, the work they are doing and the environment they are working in. Firstly, employers should talk to the workers (and their representatives) to see if they are suffering early signs of heat stress. If there is a problem, expert advice from occupational health professionals may be needed.

The risk assessment for heat stress needs to be part of and aligned with the overall workplace risk assessment and all risks should be considered, including those that may be generated by the measures to avoid heat stress. It needs to be revised regularly and also when conditions change, for example, when tasks have been automated to avoid physical load or when ventilation or air conditioning are adapted.

Control of heat stress

The risk of workplace heat stress can be reduced through technical and organisational measures and by setting up a heat action plan, if possible, in combination with an early warning system that can generate heat alerts. The implementation of safe work practices to limit exposure to heat at work requires first assessing the risks, and then implementing the hierarchy of controls. This means putting in place control measures to first eliminate the risk and if this is not possible, minimise worker exposure. Start first with collective measures and if necessary, supplement them with individual measures, for example to address additional risk to vulnerable workers. Below are some examples of control measures, however, not all of them will be applicable to all workplaces or jobs due to their nature. A technical measure could be a change to the design of the workplace that reduces exposure to heat, or an adaptation of machinery used at the workplace. Organisational measures are, for example, changes to tasks or schedules to reduce heat stress. Prevention measures such as those described below should be taken in advance, regardless of whether there is an ongoing heatwave. They should be included in the overall workplace risk assessment that covers all risks, including those that may be caused by application of prevention measures, for example, by wearing protective clothing against UV radiation or PPE. In extreme environments, an emergency plan is needed. The plan should include procedures for providing affected workers with first aid and medical care.

Infrequent or irregular tasks such as emergency repairs of hot process equipment often result in heat exposure and should also be included in the assessments.

Technical measures

Engineering controls might include:

- adapting work processes, e.g. reducing heat release;
- using reflective or heat-absorbing shielding or barriers;
- insulating or enclosing processes, machinery or plants that generate heat (or separating them from workers);
- insulating hot surfaces or covering them with sheets of low-emissivity material such as aluminium or paint that reduces the amount of heat radiated from the hot surface into the workplace;
- reducing radiant heat, for example, by allowing the plant to cool down before use;
- providing vehicles with air-conditioned closed cabins (e.g. on tractors, trucks, loaders, cranes);
- reducing humidity, avoiding wet floors, eliminating open hot water baths, drains, and leaky steam valves;
- removing heated air or steam from hot processes using local exhaust ventilation;
- using automated equipment or processes to access hot locations – for example, using a drone to inspect a fire ground;
- monitoring the temperature;
- providing shade to reduce radiant heat from the sun, shading workers from direct sunlight with blinds or using reflective film on windows;
- using non-reflective surfaces to avoid UV reflection into the work area;
- providing air cooling or air conditioning and adequate ventilation, dehumidification;
- sustainable cooling systems;
- providing air-conditioned, shaded or cool break areas as close as possible to the work site;
- providing fans, such as desk, pedestal or ceiling-mounted ones;

- increasing air velocity, making sure the workspace has good air flow – installing fans or generating air movement, for example, via windows and vents, particularly in humid conditions;
- ensuring windows can be opened to keep air circulating, but without compromising technical ventilation, such as local exhaust ventilation installed on machinery; and
- positioning workstations away from direct sunlight or sources of heat.

In very hot industrial areas:

- Ventilation, localised air conditioning and cooled observation booths are commonly used to provide cool workstations. Cooled observation booths allow workers to cool down after brief periods of intense heat exposure while still allowing them to monitor equipment.
- Shielding: Two types of shields can be used. Stainless steel, aluminium or other bright metal surfaces reflect heat back towards the source. Absorbent shields, such as water-cooled jackets made of black-surfaced aluminium, can effectively absorb and carry away heat.

The following help to reduce physical load:

- automation and mechanisation of tasks minimise the need for heavy physical work and the resulting build-up of body heat;
- installing automated or remote-controlled machinery so that workers don't have to do physically demanding work by hand;
- using plant or other equipment to reduce manual labour, for example, using a crane or forklift to lift heavy objects, or using an earth-moving plant for digging;
- providing lifting and handling aids to reduce handling loads; and
- using tools intended to minimise manual strain.

Organisational measures

Work modifications and hygienic practices should be introduced to reduce both environmental and metabolic heat, for example when engineering controls or mechanisation of tasks are not adequate or are not feasible. Organisational measures include the following:

- Limiting time in the heat and/or increasing recovery time spent in a cool area.
- Encouraging workers to pace themselves.
- Introducing flexible working patterns, such as job rotation, moving workers to cooler parts of the building where possible.
- Allowing enough breaks to ensure workers can get cold drinks or cool down.
- Introducing temperature-dependent breaks.
- Modifying targets and work rates to make the work easier and reduce physical exertion.
- Relaxing formal dress codes. Modifying uniforms so workers can wear cooler, more breathable clothing.
- Adapting working hours to avoid times of the day or year with high temperatures and UV exposure.
- Planning physically demanding work when it is cooler (early morning/late evening).
- Reducing the metabolic (physically difficult) demands of the job.
- Organising work to minimise physically demanding tasks, for example, conducting work at ground level to minimise climbing up and down stairs or ladders.
- Increasing the number of workers per task.

- Ensuring workers are not working alone, or if they must work alone, monitoring them and making sure that they can easily call for help.
- Providing adequate amounts of cool (10-15 °C), potable water near the work area and encouraging all workers who have been in the heat for up to two hours and involved in moderate work activities to drink a cup of water every 15 to 20 minutes. During prolonged sweating lasting more than two hours, workers should be provided with drinks that contain balanced electrolytes to replace those lost during sweating, as long as the concentration of electrolytes/carbohydrates does not exceed 8% by volume. Individual, not communal, drinking cups should be provided.
- Putting in place a heat acclimatisation plan and encouraging increased physical fitness.
- Providing information such as warning signs at the workplace to reinforce training.

To identify early signs of heat effects, the following could be applied:

- Developing and implementing emergency procedures. Assigning one person trained in first aid to each work shift.
- Training supervisors and workers to recognise early signs and symptoms of heat illnesses and to administer relevant first aid procedures.
- Implementing a buddy system in which workers are responsible for observing fellow workers for early signs and symptoms of heat intolerance, such as weakness, unsteady gait, irritability, disorientation, changes in skin colour or general malaise.
- Requiring workers to conduct self-monitoring and creating a work group (i.e. workers, a qualified healthcare provider and a safety manager) to make decisions on self-monitoring options and standard operating procedures.
- Using a heat alert programme whenever the weather service forecasts a heatwave.

Protective clothing and equipment

In addition to engineering controls and safe work practices, one measure applied can be wearing loose clothing that permits sweat evaporation but stops radiant heat. For extreme conditions, protective clothing and equipment (e.g. water-cooled garments, air-cooled garments, ice-packet vests, wetted overgarments, and heat-reflective aprons or suits) should be provided by the employer to the workers when extreme temperatures are reached.

During rest breaks

Wearable personal cooling systems could also be used during a rest period when the worker is not actively engaged in work. Core body temperature decreases relatively slowly, and simply stopping hard work will not result in an immediate decrease. Using wearable personal cooling systems could reduce the time required to lower core body temperature.

For example, during rest breaks:

- remove PPE and clothing ensembles; and
- while rehydrating, apply active (e.g. cold packs; cool, wet towels; wearable personal cooling system) or passive cooling (e.g. physical rest, move to a cool environment (e.g. air-conditioned room) or shaded area) methods.

These actions reduce core body temperature and allow for a more rapid ‘rehabilitation’ during the rest break.

Limitations

Wearable personal cooling systems have limitations within a work setting, such as:

- Ice vests are cheap, but their temperature cannot be controlled and they often do not stay cool long enough to be practical.
- If the cooling system is too cold, this will result in reduced heat transfer from the body to the environment.
- Water-cooled garments require that the worker be connected to a system that circulates the cool water, which limits the person’s range of operation.
- Many of the wearable personal cooling systems are too heavy or too cumbersome to be practical in a work environment.

Personal protective equipment and heat

People adapt to hot conditions by cooling down through removing clothing, having cool drinks, using the shade or reducing work rate. However, in many work situations such changes may not be possible, for example, during asbestos removal, where workers need to wear PPE throughout the work process and follow strict decontamination procedures.

If the PPE is awkward to wear, or heavy, it may contribute to an increase in body heat. Where PPE is required, it can cause heat stress due to its weight and the fact that it prevents sweat evaporating from the skin.

Workers should be encouraged to remove PPE immediately after it is needed. This will prevent any heat retained in their clothing from continuing to heat them. Where necessary, they should allow the PPE to dry out before using it again, where allowed, or replace it.

PPE may prevent workers from removing clothing in case this exposes them to the hazard the PPE is protecting them from. In these situations, employers should:

- allow slower work rates;
- rotate staff out of this environment on a more frequent basis;
- allow longer recovery times;
- provide facilities for PPE to be dried so it can be worn again;
- review the workplace risk assessment to see if automated or alternative systems of work can be introduced; and
- re-evaluate the equipment as newer PPE may be lighter and provide improved levels of protection and operator comfort.

It is important to make sure people continue to wear PPE correctly despite workplace temperatures. For example, they should not endanger themselves by undoing fasteners to increase air movement into clothing.

People can sometimes wear too much PPE, so it is important to look at the reasons for using it. For example:

- Can the workers wear less PPE and still have the protection they require, or can other controls reduce or eliminate the need for it?
- Can the task be automated, or can additional or more effective safeguards be adopted?

Hydration

A person working in a very hot environment loses water and salt through sweat. This loss should be compensated by water and salt intake. On average, about one litre of water every hour may be required to replace the loss. Plenty of cool (10-15 °C) drinking water should be available on the job site and workers should be encouraged to drink water every 15 to 20 minutes even if they do not feel thirsty. Alcoholic drinks should NEVER be consumed as alcohol dehydrates the body.

An acclimatised worker loses relatively little salt in their sweat and, therefore, the salt in the normal diet is usually sufficient to maintain the electrolyte balance in the body fluids. For unacclimatised workers who may sweat continuously and repeatedly, additional salt in the food may be used. Salt tablets are not recommended because the salt does not enter the body system as fast as water or other fluids. Too much salt can cause higher body temperatures, increased thirst and nausea. Workers on salt-restricted diets should discuss the need for supplementary salt with their doctor

Sports drinks

Drinks specially designed to replace body fluids and electrolytes may be taken, but for most people they should be used with moderation. They may be of benefit for workers who have very physically active occupations, but it should be kept in mind they may add unnecessary sugar or salt to the diet. Natural fruit juice or sports and electrolyte drinks, diluted to half the strength with water, are an option. Drinks with alcohol or caffeine should never be consumed at work, as they dehydrate the body and have other adverse health impacts. For most people, water is the most efficient fluid for rehydration.

Employers should provide the means for appropriate hydration of workers.

- Water should be potable, <15 °C and made accessible near the work area.
- Estimate how much water will be needed and decide who will get and check on water supplies.
- Provide individual drinking cups for each worker.
- Encourage workers to hydrate themselves.

Workers should drink an appropriate amount to stay hydrated.

- For moderate activities in the heat that last less than two hours, they should drink one cup of water every 15 to 20 minutes.
- If sweating lasts for several hours, they can drink sports drinks containing balanced electrolytes.
- Avoid alcohol and drinks with high caffeine or sugar.
- Generally, fluid intake should not exceed six cups per hour.

Rest breaks

If practical, workers in hot environments should be encouraged to set their own work and rest schedules. Experienced workers can often judge heat strain and limit their exposure accordingly. Inexperienced workers may need special attention as they may continue to work beyond the point at which signs of heat strain appear. Ensure workers take appropriate rest breaks to cool down and hydrate, and encourage the following practices:

- permitting rest and water breaks when a worker feels heat discomfort;
- modifying work/rest periods to give the body a chance to get rid of excess heat;
- assigning new and unacclimatised workers lighter work and longer, more frequent rest periods;
- shortening work periods and increasing rest periods
    - as temperature, humidity and sunshine increase;
    - when there is no air movement;
    - if protective clothing or equipment is worn; and
    - for heavier work.


©EU-OSHA, Giorgio Maniago

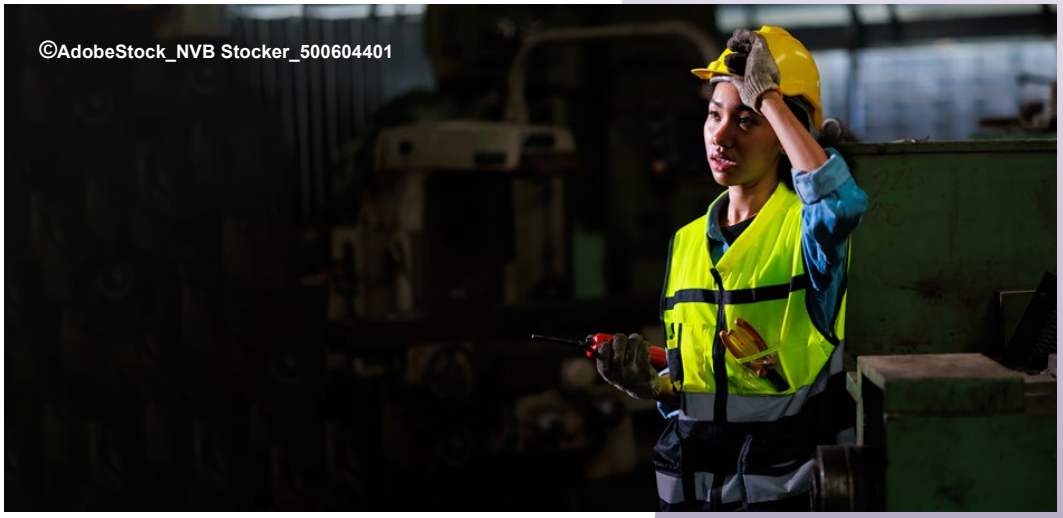
Protecting vulnerable workers

When carrying out a workplace risk assessment and setting preventive measures, it is important to identify workers who are more susceptible to heat stress and take measures to protect them. This could be due to inexperience, medication, or a condition making them more vulnerable to heat stress, for example, heart disease. Advice from an occupational health professional or medical practitioner may be needed.

Several studies have concluded that women are less heat-tolerant than men. Women tend to have a lower sweat rate than men of equal fitness, size and acclimatisation. This lower sweat rate means that there can be an increase in body temperature.

Workers with pre-existing cardiovascular disease and older workers are at increased cardiovascular risk from heat exposure. Individuals with impaired cardiovascular function have a limited ability to increase stroke volume, cardiac output and blood flow to the skin, increasing the risk of heat stroke. In turn, people whose cardiac condition is already compromised are susceptible to cardiovascular complications of heat stroke, including arrhythmias, myocardial ischaemia, heart failure, shock and sudden death. Temperature extremes can also worsen chronic conditions such as cardiovascular respiratory disease, cerebrovascular disease, and diabetes-related conditions or kidney disease. People with skin diseases and rashes may also be more susceptible to heat.

Young workers may be at risk because of their physiological vulnerability and their lack of experience. Exposure to labour-intensive work, less experience in managing heat stress and a propensity to avoid acknowledging they're affected by heat may contribute to the higher risk for younger workers.


©AdobeStock_NVB Stocker_500604401

Your risk assessment should already address risks to pregnant workers. However, you may choose to review it when a worker tells you they are pregnant, to help you decide if you need to do any more to control the risks. A pregnant mother's circulation helps protect the developing baby, but in very hot work environments or specific work situations a pregnant woman's core (internal body) temperature may rise. In some cases, this has been linked to birth defects and other reproductive problems. Pregnant women are more likely to get heat exhaustion or heat stroke sooner than a non-pregnant worker. This is because of additional effort to cool down both her body and the unborn baby. Pregnant women are also more likely to become dehydrated.

Specific measures should be taken to avoid heat stress in vulnerable workers. Consult the occupational health service or occupational physician to determine what to do and eventually include medical advice from physicians treating the worker. Measures can include more frequent breaks and avoiding some physically strenuous tasks or reducing their duration, and these should be consulted and agreed with the workers concerned.

In addition to workers with a physiological vulnerability, employers should draw up procedures for workers who:

- work outside;
- travel and visit multiple work locations;
- are in remote areas;
- work alone; and
- are responsible for overseeing critical processes and equipment.

Acclimatisation

The body adapts to a new thermal environment by a process called acclimatisation. Acclimatisation is the physiological adaptation that occurs during repeated exposure to a hot environment. This includes:

- increased sweating efficiency (earlier onset of sweating, greater sweat production and reduced electrolyte loss in sweat);
- stabilisation of the circulation;
- the ability to perform work with lower core body temperature and heart rate; and
- increased skin blood flow at a given core body temperature.

Complete heat acclimatisation generally takes six to seven days, but some workers may need longer. Loss of acclimatisation occurs gradually when a person is moved permanently away from a hot environment. However, a decrease in heat tolerance occurs even after a long weekend, so it is often not advisable for anyone to work under very hot conditions on the first day of their return to work.

Employers should ensure that workers are acclimatised before they work in a hot environment.

New workers should acclimatise before assuming a full workload. It is advisable to assign about half of the normal workload to a new worker on the first day of work and gradually increase it over subsequent days. A recommended schedule is provided below.

Although well-trained, physically fit workers tolerate heat better than people in poor physical condition, fitness and training do not substitute for acclimatisation. Taking breaks in air conditioning will not affect acclimatisation.

Some medications may interfere with acclimatisation. For example, hypotensives (drugs causing low blood pressure), diuretics, antispasmodics, sedatives, tranquillizers, antidepressants and amphetamines may decrease the body's ability to cope with heat. Workers should seek a doctor's advice on the suitability of a medication for them if they work in hot environments. Consumption of alcohol also interferes with acclimatisation.

A recommended schedule for acclimatisation is provided below.

- Gradually increase workers' time in hot conditions over seven to 14 days.
- For new workers, the schedule should be:
  - no more than 20% of the usual duration of work in the heat on day one; and
  - no more than 20% increase on each additional day.
- For workers with previous experience, the schedule should be:
  - no more than 50% of the usual duration of work in the heat on day one;
  - no more than 60% of the usual duration of work in the heat on day two;
  - no more than 80% of the usual duration of work in the heat on day three; and
  - no more than 100% of the usual duration of work in the heat on day four.
- Closely supervise new workers for the first 14 days or until they are fully acclimatised.
- Workers who are not physically fit need more time to fully acclimatise.
- Acclimatisation can be maintained for a few days of non-heat exposure.

In addition, the level of acclimatisation each worker reaches is relative to the initial level of physical fitness and the total heat stress experienced by the individual.

Maintaining acclimatisation

Workers can maintain their acclimatisation even if they are away from the job for a few days, such as when they go home for the weekend. However, if they are absent for a week or more then there may be a significant loss in their ability to adapt, which may lead to heat-related illness, and workers may need to gradually reacclimate to the hot environment.

Some additional information on maintaining acclimatisation:

- it can often be regained in two to three days upon returning to a hot job;
- it appears to be better maintained by those who are physically fit;
- seasonal shifts in temperatures may result in difficulties; and
- working in hot, humid environments helps adapt in hot, desert environments, and vice versa.

Recovery from heat outside working hours

The exposure to heat outside working hours is also an important factor: workers may not adequately recover from heat stress between work shifts, particularly if they live in urban areas and/or poor and overcrowded conditions or during heatwaves. Employers who provide housing to workers (for example, seasonal workers) should consider these factors and adapt housing conditions to enable workers to recover from heat stress during working hours, for example, by improving ventilation. Training of workers should preferably also provide advice for recovery outside of working hours.

Consultation of workers

Employers must consult workers or their representatives when deciding how to manage the risks of working in heat. If there is more than one business or undertaking at the workplace, each one must be consulted to find out who is doing what and work together so risks are eliminated or minimised. They should exchange any heat plans and ensure that measures introduced to address heat do not put workers more at risk (for example, the use of protective clothing or respiratory devices).

Workers should be consulted:

- when identifying hazards and assessing risks to health and safety arising from the work carried out or to be carried out;
- when making decisions about ways to eliminate or minimise those risks;
- when making decisions about the adequacy of facilities such as housing areas, rest areas and areas for cooling down; and

- when monitoring the conditions at any workplace or carrying out health surveillance.

Occupational health services – health surveillance

Where a residual risk remains despite the control measures, employers may need to monitor the health of workers exposed to the risk. They should seek advice from occupational health professionals experienced in the risks associated with heat stress. Previous heat-related illness, certain medications and medical conditions can make a worker more susceptible to heat-related illness and may affect how the worker can be treated. Workers should be alerted to this risk and may have to be monitored. Workers should be informed about and consulted on the purposes for and descriptions of any environmental and medical monitoring programmes and the advantages to the worker of participating in these surveillance programmes and what this entails. Confidentiality of health data must be respected. Before health surveillance is applied, the agreement of each worker must be sought. Workers must receive information about what the health surveillance entails and why and how it is being carried out. They must receive their individual results and have these explained to them, ideally via the occupational health service or occupational physician.

Worker information and training

The employer should set up a training programme, carried out by persons trained in occupational safety and health. This should ensure that all workers potentially exposed to heat stress and their supervisors have knowledge about heat health effects and the measures to be taken as well as whom to report any incidents to. In particular, in the form of information on and instructions specific to the workstation or job, workers should be trained before work in heat begins and the training should be tailored to work site conditions.

For each affected worker, the instructional programme should include adequate verbal and/or written instructions in a language accessible to the worker. It is recommended that employers develop a written plan of the training programme that includes a record of all instructional materials. The employer should inform all affected workers of the location of written training materials and make these materials readily available, without cost to the affected workers.

Information and training must also be ensured for workers who are employed by subcontractors or other enterprises active at the work site. Good coordination is key to everyone's protection.

All new and current workers who work in areas where there is reasonable likelihood of heat injury or illness, and their supervisors, should be trained and kept informed of the following:

- The technical and organisational measures defined for work in heat stress areas.
- Heat stress hazards.
- Predisposing factors.
- Relevant signs and symptoms of heat injury and illness.

- Causes of heat-related illnesses and steps to reduce the risk. These include drinking enough water and monitoring the colour and amount of urine output.
- Effects of other factors (drugs, alcohol, pre-existing disease, etc.) on tolerance to occupational heat stress.
- General first aid as well as work site-specific first aid procedures.
- Proper use of protective clothing and equipment.
- The effects of therapeutic drugs, alcohol or caffeine that may increase the risk of heat injury or illness by reducing heat tolerance.
- Workers' responsibilities for following proper work practices and control procedures.
- The importance of acclimatisation.
- The importance of immediately reporting any symptoms or signs of heat-related illness in themselves or in co-workers to the supervisor.
- Procedures for responding to symptoms of possible heat-related illness and for contacting emergency medical services.
- Proper care and use of heat-protective clothing and equipment and the added heat load caused by exertion, clothing and PPE.
- Common attitude toward heat stress. A misperception may exist that someone can be 'hardened' against the requirement for fluids when exposed to heat by deliberately becoming dehydrated before work on a regular basis. This misperception is dangerous and must be counteracted through educational efforts.

It is important to ensure workers and supervisors are trained to:

- identify and report hazards associated with heat and heat-related illness;
- understand how to prevent heat-related illness and apply the preventive measures foreseen by the employer; this includes technical, organisational and personal protective measures;
- recognise symptoms and signs of heat-related illness in themselves and others;
- call for assistance if necessary;
- identify and use appropriate first aid procedures;
- look out for each other's wellbeing;
- modify work intensity and take more regular breaks when working in heat;
- drink sufficient water to stay hydrated;
- recognise the dangers of diuretic drinks;
- be aware of individual risk factors;
- understand acclimatisation;
- recognise the potential dangers associated with the use of alcohol and/or drugs when working in heat; and
- use appropriate PPE correctly.

Supervisors should also be trained on the following:

- implementing appropriate acclimatisation;
- what procedures to follow when a worker has symptoms of heat-related illness, including emergency response procedures;
- monitoring weather reports;
- responding to hot weather advisories; and
- monitoring and encouraging adequate fluid intake and rest breaks.

Guidance and legislation

Guidance related to heat stress is available from several countries and a selection is listed below. It is however important to only follow guidance that has been issued by reputable sources. Legislation may have been set in your Member state, for example on temperature limits for specific workplaces. Check the websites of your national OSH authority or institute for further examples of guidance and national legislation.

References

Canadian Centre for Occupational Safety and Health (CCOHS), *Climate change*, webpage, last updated 23 December 2021. Available at https://www.ccohs.ca/oshanswers/safety_haz/climate/extreme_weather_heat.html, accessed 18 April 2023.

Canadian Centre for Occupational Safety and Health (CCOHS), *Hot environments – Health effects and first aid*, *Control measures*, *Temperature conditions – hot,* webpages. Available at https://www.ccohs.ca/oshanswers/phys_agents/heat , accessed 18 April 2023.

Health and Safety Executive (UK), *Temperature in the workplace*, webpage. Available at https://www.hse.gov.uk/temperature/employer/index.htm, accessed 18 April 2023.

Health and Safety Executive (UK), Heat stress check list. Available at https://www.hse.gov.uk/temperature/assets/docs/heat-stress-checklist.pdf, accessed 18 April 2023.

National Institute for Occupational Safety and Health (NIOSH, US), *Heat stress*, webpage. Available at https://www.cdc.gov/niosh/topics/heatstress/default.html, accessed 18 April 2023.

National Institute for Occupational Safety and Health (NIOSH, US), 2016, Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments. Available at https://www.cdc.gov/niosh/docs/2016-106/.

Safe work Australia, 2021. Managing the risks of working in heat. Guidance material. Available at https://www.safeworkaustralia.gov.au/doc/guide-managing-risks-working-heat.