# Work-Related Heat Stress

The Federal Government estimates that six million U.S. workers are exposed to extreme heat.[1] Workers in the transportation industry have a higher than average rate of heat-related fatalities.[2]

## What is Work-Related Heat Stress?

Work-related heat stress is extreme heat that may result in injury, illness or death. Transit workers such as bus operators and maintenance workers may be exposed to excess heat on the job. If maintenance or inspection of vehicles or track takes place outdoors in the hot summer sun, or in enclosed, inadequately ventilated spaces, workers can get overheated. Hot work such as welding or brazing can increase the exposure. High temperatures can also affect bus operators driving in the hot summer sun without adequate ventilation or shade.

## What are the Effects of Work-Related Heat Stress?

Several workplace factors combine to determine how workplace heat affects workers:

- temperature
- humidity (the amount of moisture in the air)
- radiant heat (such as from the sun, from a hot engine, or from a welding torch)
- air circulation
- workload (level of activity)

Several characteristics of individual workers may also come into play:

- age
- weight
- physical fitness
- health status
- medications
- alcohol intake
- water and salt balance
- acclimatization (how accustomed a worker is to the heat)

The body tries to protect its core temperature against high external temperatures by changes in blood circulation and alterations in the composition and amount of sweat. By increasing blood flow to the skin, the body uses sweat and conduction to cool the skin and remove excess heat. When workers are engaged in hard physical labor, less blood is available to flow to the skin to dispose of body heat.

Sweating is only effective when the humidity is low enough to allow evaporation. Fluids and salts lost through sweating need to be replaced by drinking water or electrolyte-carbohydrate solutions. Electrolyte-carbohydrate solutions such as those used by athletes, replace potassium, calcium, and magnesium salt in the body.

There are several types of heat-related illnesses. It is important to remember that more than one heat-related illness may be present.

**Heat Stroke**
This is the most severe heat ailment. It is characterized by a sharp rise in body temperature resulting from a failure of

[1 & 2] Adelakun, Schwartz, Blais, OSHA Compliance Issues - Occupational Heat Exposure. Applied Occupational and Environmental Hygiene, Vol. 14:153-154, 1999.

NTI's Hazard Factsheets provide transit workers and management with information to help recognize and resolve health and safety hazards. NTI offers a variety of other workplace health and safety training and educational resources. For more information, visit our website at www.NTIONLINE.com or call 732/932-1700.

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Exposure to extreme heat can cause several types of heat-related illnesses and safety problems.

the body's sweating mechanism. A person suffering from heat stroke can experience mental confusion, convulsions, loss of consciousness, or coma. The skin is at first hot, dry, and red, later turning gray in color. Body temperature may reach 106°F or higher.

Heat stroke can be fatal if not treated promptly. First aid includes removal to a cool area, cool water sponge-downs or baths, and vigorous fanning. Prompt administration of first aid may prevent damage to the brain, liver, kidneys, and heart. Take the victim immediately to a hospital. Even among treated cases, there is a 20% mortality rate.

**Heat Exhaustion**
This reaction occurs in healthy persons exposed to a hot environment to which they are unaccustomed or not acclimatized. When a rise in skin temperature results in sweating, sweat production may be inefficient, producing little and excessively salty sweat. Inefficient sweating and inadequate fluid replacement can lead to a loss of necessary fluids and salt.

The victim may become irritable, confused, giddy, nauseous, or dizzy, and may experience headache and muscular fatigue. Skin will be moist and clammy, and complexion pale or flushed. Pulse may be weak and slow, and blood pressure low. In contrast with heat stroke, body temperature may be normal or only slightly elevated. Treatment entails removal to a cool environment and drinking electrolyte-carbohydrate solutions. Severely ill individuals may require hospitalization.

**Heat Cramps**
When a person suffering from heat exhaustion tries to quickly replace lost body fluids, cramping may occur. This heat reaction includes painful muscle spasms due to liquid intake without adequate salt replacement. Cramps may occur during or after work. First aid includes removal to a cool environment and drinking a saline replacement solution. In some cases, saline solution may have to be administered intravenously.

**Fainting ("heat syncope")**
People not acclimatized to high temperatures who stand still at work may experience lightheadedness or fainting. This condition occurs when blood vessels throughout the body dilate, resulting in lower blood pressure. Recovery is rapid when the victim rests lying down in a cool environment and takes liquids orally. Moving around, rather than standing still at work, usually reduces the possibility of fainting.

**Heat Rash ("prickly heat")**
Clogging or inflammation of sweat glands or ducts may prevent evaporation of sweat and result in a rash. Heat rash can be severe enough to result in temporary total disability. Treatment consists of rest in a cool place and permitting the skin to dry. Individuals who have poorly functioning sweat glands, as evidenced by the onset of prickly heat, may be at greater risk for heat stroke.

**Safety Problems**
Heat increases the risk of accidents. Hazards include dizziness, sweaty palms that become slippery, and fogged safety goggles and glasses. Working in a hot environment lowers mental alertness and physical performance. People also become more irritable and angry in hot environments, and this can divert attention from difficult tasks and safety procedures.

## What Can Be Done to Prevent Heat-Related Hazards?

Monitoring extremely hot environments is important. This may require measurements by an industrial hygienist. Special instruments are used to measure air temperature, humidity, air velocity, and surface heat radiation. The results are used in conjunction with standard formulas to obtain a measurement called the *Wet Bulb Globe Temperature Index (WBGT)*.

Exposure to extreme heat can be limited through the use of engineering controls, administrative controls, personal protective equipment, or a combination of these three methods.

**Engineering Controls**
Ventilation is the primary method that employers can use to control heat. Air-conditioning and adequate comfort ventilation on buses as well as in work and maintenance areas reduces the risk of excess heat exposure. Fans will provide some comfort by creating air movement that can assist in evaporation of sweat and conduction of heat. It is important to note that ventilation for comfort is different than ventilation for contaminants.

Heat shielding can minimize heat from radiant sources such as engines. The use of power tools and mechanized processes to minimize exhausting manual labor can reduce the risk of heat stress in maintenance areas.

Cool rest areas for bus operators waiting for scheduled departures reduce the risk of heat stress. These cool areas can be air-conditioned trailers, rooms or station houses. A rest area temperature of around 76°F is comfortable for those working in a hot environment.

**Administrative Controls**
Scheduling rest breaks in a cool area is important. Work-rest cycles allow the body an opportunity to get rid of excess heat, slow down the production of internal heat, and provide greater blood flow to the skin. Shorter but frequent rest cycles are best for those working in hot environments. Ideally, schedule the heaviest work during the coolest parts of the day. During unusually hot weather or heat waves, special considerations may be appropriate. For example, schedule only priority tasks in these instances.

Have non-carbonated beverages and water readily available. Workers often don't replenish the two to three gallons of liquid they sweat daily. Thirst is not a reliable signal of the need for fluid intake. Workers should drink five to seven ounces of fluid every 15 or 20 minutes when working in a hot environment. In particularly hot environments, liquids with salt or other special additives are important. However, individuals with medical conditions requiring a low-sodium diet need to control their intake of salted beverages. The use of salt tablets is not recommended.

Identification of individuals with special medical problems is necessary. For example, people with heart or kidney problems and anyone who is overweight or not physically fit are more susceptible to heat stress.

Education and training for supervisors and workers about the recognition, prevention, and treatment of heat stress is critical.

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Acclimatization is appropriate if an individual is going to be exposed to heat for an extended period of time. OSHA recommends that new employees and workers returning from an absence of two weeks or more begin with 50% of the normal workload and time exposure the first day and gradually build up to 100% over five work days.

**Personal Protective Equipment**
Certain types of protective clothing may alleviate heat stress. Cool and comfortable summer work clothing is important. Loose-fitting, light-colored clothing, made out of natural fibers such as 100% cotton, is the most comfortable. Outdoors in the sun, head covering is essential. For extremely hot environments, there is special clothing that is reflective, air-cooled, or insulated with ice.

## What Are the Legal Requirements and Professional Guidelines for Limiting Heat Exposure?

OSHA has not adopted a standard for heat exposure. Nonetheless, federal and state OSHA agencies may issue general duty clause citations to employers whose workers are working in unsafe hot conditions based upon guidelines published by the American Conference of Governmental Industrial Hygienists (ACGIH). ACGIH, a private professional organization, has adopted threshold limit values (TLVs) for heat stress conditions designed to prevent the core temperature of workers from exceeding 100°F. TLVs are recommended limits for maximum exposures to hazards over an 8-hour work shift.

Using the WBGT Index described earlier, the ACGIH TLV for heat exposure establishes recommended work-rest regimes ranging from 25% to 75% rest during each work hour. The amount of work and rest each hour depends on the WBGT Index, clothing worn and physical workload being performed.

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