

HAZARD ALERT:

HEAT STRESS GUIDELINES

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Legal Requirement

Employers have a duty under clause 13(1) of the *Occupational Health and Safety Act* to take every reasonable precaution to ensure the health and safety of persons at or near the workplace.

Under clause 2(3) of *Workplace Health and Safety Regulations*, an employer must comply with, and ensure compliance with, the threshold limit values for exposure to physical agents, as listed in the latest version of the publication of the American Conference of Governmental Industrial Hygienists on Threshold Limit Values and Biological Exposure Indices (ACGIH TLVs and BEIs). Heat stress is covered as a physical agent with guidance on how to assess it and the controls needed.

Owners have a duty under clause 19 of the *Occupational Health and Safety Act* to take every reasonable precaution to provide and maintain the owner's premises being used as a workplace in a manner that ensures the health and safety of persons at or near the workplace and the owner shall give to the employer at the workplace the information that is known to the owner or that the owner could reasonably be expected to know and necessary to identify and eliminate or control hazards to the health or safety of persons at the workplace.

Hazard summary

We all enjoy the hot days of summer, but care needs to be taken when we are physically active on those days. Physical exertion on hot and humid days may make us susceptible to the risk of Heat Stress. Care also needs to be taken indoors in areas of high temperature.

What is heat stress?

Heat stress is the buildup of heat in the body to the point where the body's thermostat has difficulty maintaining normal internal body temperature. When the body is unable to cool itself through sweating, serious heat illnesses may occur. The most severe heat induced illnesses are heat exhaustion and heat stroke. If actions are not taken to treat heat exhaustion, the illness could progress to heat stroke and possibly death.

Symptoms and effects from heat stress

Table 1 Symptoms and Health Effects from Heat Stress Exposure

Symptoms	Health Effects
Heat Fatigue	<p>Signs include impaired performance of skills, mental concentration, or vigilance. Heat fatigue is generally due to the individual not being used to working in heat.</p> <p>There is no specific treatment except to remove the person to a cooler environment before more serious conditions develop.</p>
Heat Rashes	<p>Most common problem. Prickly heat rash shows itself as red bumps normally where clothing is restrictive or chafes. As sweating increases the bumps begin to feel prickly. Prickly heat occurs in skin that is persistently wet from unevaporated sweat. Rash may become infected if not careful.</p> <p>In most cases heat rash will disappear when the individual returns to a cooler environment.</p>
Heat Collapse	<p>In a collapse or faint, the brain does not receive enough oxygen because blood pools in the extremities. The individual may lose consciousness. The onset of collapse is rapid and unpredictable.</p> <p>Move to cooler area, loosen clothing, and give fluids.</p>
Heat Cramps	<p>Usually caused by performing hard physical labour in a hot environment. Cramps are caused by the lack of water - note: excess salt can build up in the body if water lost through sweating is not replaced; do not use salt pills. Thirst cannot be relied on as a guide to the need for water.</p> <p>Water must be taken every 15 to 20 minutes in hot environments - avoid alcohol, coffee, tea, carbonated drinks (pop).</p>
Heat Exhaustion	<p>Signs are headache, nausea, dizziness, blurred vision, weakness, giddiness, thirst. Skin is damp and looks muddy or flushed. Fortunately, this condition responds readily to prompt treatment. Symptoms in heat exhaustion are similar to heat stroke.</p> <p>People suffering from heat exhaustion should be removed from the hot environment, given fluids, loosen clothing, shower or sponge bath with cool water and rest in a cool place.</p>
Heat Stroke	<p>Heat stroke is a medical emergency. It occurs when the body's system of temperature regulation fails and body temperatures rise to critical levels. This condition is caused by a combination of highly variable factors and is difficult to predict. Primary signs and symptoms of heat stroke are confusion, irrational behaviour, loss of consciousness, convulsions, hot dry skin, lack of sweating (usually), and an abnormally high body temperature. If body temperature is too high it causes death. The elevated metabolic temperatures caused by a combination of work load and environmental heat load are also highly variable and difficult to predict.</p> <p>Seek medical attention immediately.</p>

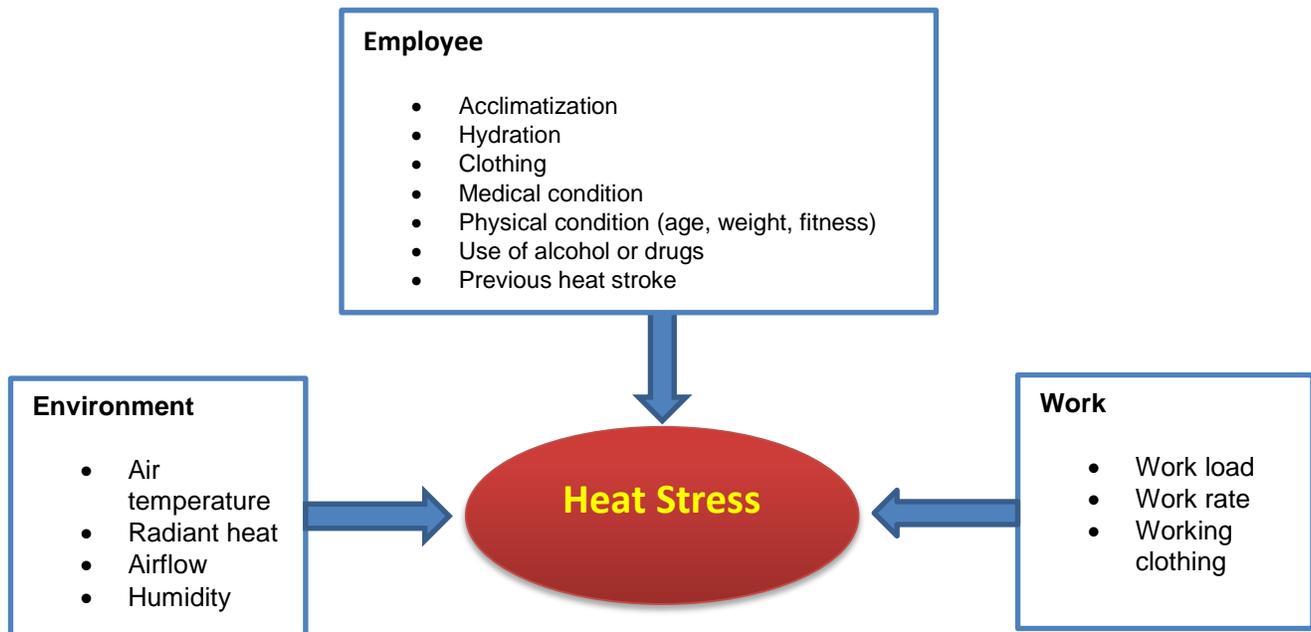
This table is based on OSHA Technical Manual, Section III: Chapter 4 Heat Stress - http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html

Primary parameters contributing to heat stress

Generally speaking:

High temperature + high humidity + work load + clothing effects + physical conditions → heat stress

While heat stress is commonly associated with warm weather, it can occur any time the temperature is above normal (working in a boiler room for example). Some factors involved in causing heat stress are:



It is difficult to predict just who will be affected and when, because individual susceptibility varies. Even at lower temperatures but with high humidity there is a risk of heat illnesses. Caution should be used when working in hot conditions. It is important to recognize the symptoms of heat stress disorders and take immediate and appropriate remedial actions and pay particular attention to persons performing strenuous physical labor.

What are the Threshold Limit Values (TLVs) for a heat stress assessment?

In Nova Scotia, working in hot conditions is governed by the Workplace Health and Safety Regulations (WHSR). Wet Bulb Globe Temperature (WBGT) index adopted by American Conference of Governmental Industrial Hygienists (ACGIH) is used as regulatory criteria to assess environmental heat at a workplace. WBGT is influenced by air temperature, radiant heat, air movement, and humidity. Portable heat stress meters or monitors used to measure WBGT are commercially available. WBGT is calculated using the following equations:

For indoor and outdoor conditions with no solar load, WBGT is calculated as:

$$WBGT = 0.7NWB + 0.3GT$$

For outdoors with a solar load, WBGT is calculated as

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

Where: WBGT = Wet Bulb Globe Temperature Index
 NWB = Nature Wet-Bulb Temperature
 DB = Dry-Bulb Temperature
 GT = Globe Temperature

Because WBGT is only an index of the environment, when jobs require wearing impermeable clothing, like chemical protective clothing, the WBGT does not indicate what the worker is experiencing inside the clothing. Therefore, monitored WBGT must be adjusted for the contribution of clothing for clothing ensembles listed in Table 2 (below). Besides the clothing factors, a correct work demand assessment is of equal importance to an environmental assessment in evaluating heat stress. As work demand increases, metabolic rate increases and core body temperature increases. Broad guidance for selecting the work demand is summarized in Table 3 (below). Based on the work demand and the approximate proportion of work within an hour, the heat stress TLVs can be found in Table 4 (below).

The risk and severity of excessive heat strain may vary widely among people, even under identical heat stress conditions. If the measured time-weighted average WBGT adjusted for clothing exceeds the selected TLVs in table 4, physiological monitoring must be conducted. There are two physiological parameters that can be used to monitor a worker's state of heat stress: measurement of the core body temperature and heart rate. On an individual basis, the heat strain indicators listed below represent a guide for the time to cease an exposure and allow for recovery:

- Sustained (several minutes) heart rate is in excess of 180 bpm (beats per minute) minus the individual's age in years, for individuals with assessed normal cardiac performance; or
- Body core temperature is greater than 38.5 degree for medically selected and acclimatized personnel; or greater than 38 degree in unselected, unacclimatized workers; or
- Recovery heart rate at one minute after a peak work effort is greater than 120 bpm; or
- There are symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness.

Further information on physiological monitoring can be obtained from the 1986 NIOSH document *Criteria for a Recommended Standard: Occupational Exposure to Hot Environments* available on the NIOSH web site: <http://www.cdc.gov/niosh/docs/86-113/>

Table 2 Clothing-Adjustment Factors

Clothing type	Adjustment to WGBT (°C)
Work Clothes (Baseline long sleeve shirt and pants)	0.0
Cloth Coveralls (woven material)	0.0
Double Layer Cloth Clothing	3.0
SMS Polypropylene Coveralls	0.5
Polyolefin Coveralls	1.0
Limited-use Vapor-Barrier Coveralls	11.0
Note: these values must not be used for completely encapsulating suits. Clothing adjustment factors cannot be added for multiple layers. The coveralls assume that only modesty clothing is worn underneath, not a second layer of clothing.	

Table 3 Work Demand Categories with Examples

Category	Examples	Metabolic Rate [w]
Rest	Sitting	115
Light	Sitting with light hand/arm work; Driving; Standing with some light arm work; or occasional walking.	180
Moderate	Sustained moderate hand and arm work; Moderate arm and leg work; Moderate arm and trunk work; Light pushing and pulling; or Normal walking.	300
Heavy	Intense work such as carrying, shoveling, manual sawing; Pushing and pulling heavy loads; or Walking at a fast pace.	415
Very Heavy	Very intense activity at fast to maximum pace.	520

Table 4 Screening Criteria for TLV for Heat Stress Exposure

Work Demand	Percentage of work in a cycle of work and recovery in an hour			
	75 – 100%	50 – 75%	25 – 50%	0 – 25%
Light	31.0°C	31.0°C	32.0°C	32.5°C
Moderate	28.0°C	29.0°C	30.0°C	31.5°C
Heavy	-	27.5°C	29.0°C	30.5°C
Very Heavy	-	-	28.0°C	30.0°C

Notes:

1. These TLVs are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4° F).
2. The TLVs are also based on the assumption that the WBGT of the resting place is the same or very close to that of the workplace.
3. Where the WBGT of the work area is different from that of the rest area, a time-weighted average should be used.
4. When the TLV for one work-rest regimen is reached, the workers should be assigned to another work/rest regimen of lower work percentage that has a higher TLV than the calculated WBGT.

Criteria for working in heat related conditions are a difficult item to measure and require specialized equipment. It is recommended that factors related to heat stress be measured professionally. Consultants who offer this service may be found by on our [Consultant's List](#).

For more questions regarding the heat stress assessment and analysis, the OHS Division's occupational hygienists can be reached at 1-800-9LABOUR (952-2687).

What to do if a person is suffering from heat stress?

If you believe you or another person may be subject to heat stress at your workplace, seek first aid immediately and notify your supervisor.

Your rights under the OHS Act

Everyone has a right to a safe working environment and if the supervisor does not respond to your concern to your satisfaction, you should raise the issue with the Joint Occupational Health and Safety Committee or Representative. If this still does not satisfy your concern, you may contact the OHS Division. You have a right to refuse to work in the conditions if you believe there is a risk to your health or safety due to heat stress.

How to prevent heat stress?

The employer must develop a heat stress strategy where an employee may be exposed to environmental conditions that could cause adverse health effects due to heat stress. The main components of a heat stress strategy are:

- Employee training and education;
- Heat stress assessment;
- Heat stress controls.

It is important for workers to recognize the early stages of signs and symptoms of heat stress. The employer must provide adequate training and education to all workers at risk for heat stress. If workers are aware of the signs and symptoms of heat stress and are able to remove themselves or co-workers from a hot environment in the early stages, a serious illness can be avoided.

A Heat stress assessment must contain an initial environmental assessment, WBGT monitoring, clothing factors adjustment, and work demand analysis. If the adjusted WBGT is higher than the screening TLV, then the personal physiological monitoring needs to be performed to determine if an employee is suffering from heat strain.

Heat stress controls include:

- Elimination or substitution of another process that removes the risk of exposing a worker to a heat stress environment;
- Worker acclimatization;
- Engineering controls (air conditioning, mechanical ventilation/fan, shaded work area, control the heat at source, etc.);
- Administrative controls (reassign the work-rest regimen, cool drinking water, schedule jobs to cooler time of the day, etc.); and
- Protective clothing (water or ice-cooled insulated clothing, light summer clothing, light colored clothing, head covering, etc.).

If it is not possible to eliminate the heat sources or substitute another process, engineering controls are the most effective means of reducing excessive exposure conditions that could cause heat stress. Appropriate controls to be used at a workplace must be based on the results of a heat stress assessment. Examples of some heat stress controls are listed in Table 5.

Table 5 Examples of Heat Stress Controls

Controlling the heat stress	Guard against heat illness
Work in ventilated areas. All workplaces should have good general ventilation as well as spot cooling in hot work areas	Drink cool water in small amounts frequently, one cup every 20 minutes - even when you are not feeling thirsty. Avoid alcohol, coffee, tea and caffeinated soft drinks which cause dehydration
Do not use fans when the thermometer reads 35° Celsius as this actually can increase the heat load	Make water supply easily accessible, place closer to work area
Take regular rest breaks, increase frequency in times of higher temperature and humidity. Short, frequent work-rest cycles are best	Ask how workers are feeling. Supervisors should monitor workplace temperature and humidity and check workers' condition. Allow workers to stop their work if they become extremely uncomfortable.
During breaks rest in an air conditioned area if possible, or at least in shaded areas	Employees and employers should learn to spot signs of heat stroke. Get emergency medical attention if someone has one or more of these symptoms: mental confusion or loss of consciousness, flushed face, hot dry skin or has stopped sweating.
Turn off heat generating equipment that's not being used	Train first-aid workers to recognize and treat signs of heat stress; be sure all workers know who is trained to give first-aid.

Schedule more physically demanding tasks in the cooler times of the day	Reduce work for anyone at risk. Employers should use common sense in determining fitness for work in hot environments. Some factors to consider: age, poor conditioning, pregnancy, previous heat injuries, certain medical conditions, lack of acclimatization.
Rotate people through hot, heavy demand jobs, if possible	Check with your doctor for medical conditions - heart conditions and diabetes can increase the risk of injury from heat exposure.
Pay special attention to person having to wear impermeable clothing - rubber aprons, or full body protective wear - they may be at risk at temperatures of 21°C or over	Avoid eating heavy meals before working in the heat
Where possible wear lightweight, light-coloured, loose fitting clothing. Use sunscreen and wear a hat when working outdoors	In general regular exercise and improving fitness will help reduce risk of heat illnesses

I work in an office; are there guidelines?

There is a Humidex chart that can be used as a guideline for working in an office environment. The Humidex combines the temperature and humidity into one number to reflect the perceived temperature. Further information on heat, humidity and the Humidex may be found at http://www.ccohs.ca/oshanswers/phys_agents/humidex.html

Also CSA Standard Z412-00 “[Guideline on Office Ergonomics](#)” section 6.6.2 defines parameters for thermal comfort.

Can I use the Humidex for an industrial environment?

The Occupational Health Clinics for Ontario Workers Inc. (OHCOW) has prepared a document, Humidex Based Heat Stress Plan, that translates wet bulb globe temperatures (WBGT) into Humidex values.

The Humidex Based Heat Response Plan is available on the OHCOW website at http://www.ohcow.on.ca/uploads/Clinics/Humidex_Based_Heat_Response_Plan_Fact_Sheet.pdf

In the translation process, some simplifications and assumptions have been made. As a result, the plan may not be applicable in some circumstances and/or workplaces, and heat stress may be overestimated. Caution must be used when applying the Humidex values to a non-office environment.

Be sure that conditions at your workplace are appropriate for the use of the Humidex Based Heat Stress Plan in your workplace. Should you have any questions regarding the application of this plan can in your workplace, the OHS Division’s occupational hygienists can be reached at 1-800-952-2687.

Other resources

ACGIH

<http://www.acgih.org/home.htm> (documents available for purchase)

U.S. Occupational Safety and Health Administration (OSHA)

http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html (documents available for free)