

Heat Stress and Cold Stress

Program



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PURPOSE

This Program describes the minimum safety standards and guidelines for exposure to heat stress and cold stress at the University of Ottawa.

APPLICATION

All uOttawa workers working in indoor office environments, mechanical rooms, power plants, cold rooms and outdoors must follow this Program.

Most workers at uOttawa will likely experience heat stress or cold stress at some point. Work tasks in which they may be experienced include:

- Construction or repair activities
- Servicing, cleaning or maintenance
- Operating processes or equipment (furnaces, ovens, laundry facilities, etc.)
- Working in cold rooms

Employees and contractors performing work on behalf of the University must meet the requirements of this Program, as well as Environment Canada heat warnings and frost advisories.

APPLICABLE LEGISLATION, GUIDES AND POLICIES

- Ontario Occupational Health and Safety Act (OHSA)
- CSA Standard Z1010-18 — Management of Work in Extreme Conditions
- 2020 TLVs® and BEIs® Based on the Documentation of the Threshold Limits Values for Chemical Substances and Physical Agents & Biological Exposure Indices. American Conference of Governmental Industrial Hygienists.
- Heat Stress Awareness Guide. Occupational Health and Safety Council of Ontario's (OHSCO) Heat Stress Awareness Toolkit. 2009.
- Managing heat stress at work. Ontario Ministry of Labour, Training and Skills Development. October 21, 2019.
- Heat Stress. Ontario Ministry of Labour. June 2014.
- Hot Environments – Health Effects and First Aid. OSH Answers Fact Sheets. August 4, 2016.
- Spring and Summer Weather Hazards. Environment and Climate Change Canada. July 8, 2013.
- Ottawa Public, Extreme Heat and Cold Weather Information.

HEAT STRESS AND COLD STRESS IN ONTARIO

The Ontario Occupational Health and Safety Act, section 25(2) (h) states that employers must “take every precaution reasonable in the circumstances for the protection of a worker.” The Ministry of Labour, Training and Skills Development endorses the threshold limit values (TLVs®) published by the American Conference of Governmental Industrial Hygienists (ACGIH), which are based on preventing the core body temperatures of acclimatized workers from rising above 38°C or falling below 36°C.

DEFINITIONS

Acclimatization — A gradual physiological adaptation improving someone’s ability to tolerate heat stress.

Acute injury/illness — Injuries and illnesses that (a) are characterized by sharpness or short duration of pain, (b) have a sudden onset, sharp rise and short duration or (c) require short-term medical care (e.g., for a serious illness or traumatic injury).

American Conference of Government Industrial Hygienists (ACGIH) — A professional association of industrial hygienists and practitioners of related professions. One of its goals is to advance worker protection by providing timely, objective scientific information to occupational and environmental health professionals.

Chilblains — Mild cold injury which, while painful, causes little or no permanent impairment. It appears as red, swollen skin that is tender, hot to the touch and possibly itchy. This can worsen to an aching, prickly (“pins and needles”) sensation, and then numbness.

Chronic exposure — Repeated, long-term exposure to hot or cold conditions.

Chronic illness — A persistent disorder that occurs over a long period, affecting normal function (e.g., physical, emotional, intellectual, vocational, social)

Dehydration — Loss or deficiency of water in body tissues that may result from sweating, vomiting or diarrhea. A dehydrated individual can experience excessive thirst, nausea or exhaustion.

Frostnip — Mild cold injury that occurs when ice crystals form under the skin, but only the superficial layer is frozen and there is no tissue destruction. The affected area turns white and might feel numb. If not treated, frostnip can develop into frostbite in as quickly as 30 seconds to a minute of additional cold exposure.

Frostbite — The second most common cold injury, usually caused by contact with extremely cold objects or by exposure to cold temperatures. Frostbite occurs when the skin and underlying layers of tissue freeze and lose water, resulting in damaged blood vessels.

Hazard — A potential source of harm to a worker.

Heat edema — Swelling which generally occurs among people not acclimatized to working in hot conditions. Swelling is often most noticed in the ankles. Recovery occurs after a day or two in a cool environment.

Heat rashes — Tiny red spots on the skin that cause a prickling sensation during heat exposure. They are the result of inflammation caused when sweat gland ducts become plugged.

Heat cramps — Sharp pains in the muscles that can occur alone or be combined with another heat stress disorder. The cause is salt imbalance resulting from the failure to replace salt lost with sweat.

Heat exhaustion — Caused by loss of body water and salt through excessive sweating. Signs and symptoms of heat exhaustion include heavy sweating, weakness, dizziness, visual disturbances, intense thirst, nausea, headache, vomiting, diarrhea, muscle cramps, breathlessness, palpitations, tingling or numbness of the hands and feet.

Heat syncope — Heat-induced dizziness and fainting induced by temporarily insufficient flow of blood to the brain while a person is standing.

Heat stroke — The most serious type of heat illness. Signs of heat stroke include body temperature often greater than 41 °C and complete or partial loss of consciousness.

Hypothermia — The most common cold injury. It occurs when the body is unable to compensate for heat loss and the core body temperature falls below 36 °C.

Incident — An event that results or could have resulted in injury, illness, adverse health effects or a fatality.

Illness (acute or chronic) — A specific condition, sickness or disease preventing the normal function of a worker's body or mind.

Metabolic heat — Energy production in the form of body heat. It is associated with activity level.

Radiant heat — Energy in the form of electromagnetic, infrared waves that transfer heat directly from a source to an object or person. The energy is absorbed and can be radiated to other objects or persons in the room.

Relative humidity — The ratio of current water vapour in the air compared to the actual water vapour that could be held in the air at the same temperature and air pressure.

Threshold limit value — Condition under which nearly all workers can be repeatedly exposed to airborne concentrations of chemical substances, day after day, over a working lifetime, without adverse health effects.

Wet-bulb globe temperature (WBGT) — A measure of environmentally-induced heat stress based on air temperature, radiant heat, air movement and humidity.

RESPONSIBILITIES

Employer

- Provides and maintains a heat stress and cold stress program for workers performing tasks in hot and/or cold environments.
- Performs periodic formal and informal audits to verify compliance with this program.

Management

- Provides and coordinates program training in performing work tasks in hot and/or cold environments.
- Implements and periodically revises program.
- Ensures appointment of competent supervisors.

Supervisors / lead hands

- Conduct pre-work risk assessments to determine the potential of exposure to thermal conditions that could cause heat or cold stress. (see **Appendix A**, Heat/Cold Stress Pre-Work Checklist)
- Develop and implement a control plan for exposure to hot and cold environments (with worker input).
- Provide equipment necessary to work in hot and/or cold environments.
- Develop ability to recognize signs and symptoms of heat or cold stress in workers and know where to get first aid.

Workers

- Be familiar with the Ontario Occupational Health and Safety Act and applicable regulations.
- Complete training on these guidelines and any site-specific requirements.
- Recognize possible signs and symptoms of heat stress, cold stress or injury.
- Wear and maintain personal protective equipment prescribed by uOttawa and follow control plan in place to protect from exposure to hot and cold environments.

Joint Health and Safety Committees (JHSC)

- Participates in the consultation and review of the Heat Stress and Cold Stress Program.
- Makes recommendations to improve worker health and safety.

HEAT STRESS

Heat stress is the result of a combination of metabolic heat, environmental conditions (e.g., air temperature, humidity, air movement or radiant heat) and clothing worn in these conditions. Mild to moderate heat stress may cause some discomfort and affect work performance and safety, but worker health will not be adversely affected. As heat stress levels increase, however, the risk of heat-related illness or injury increases.

Typical comfort levels are between 20°C and 27°C for air temperature and between 35% and 60% for relative humidity. The body typically deploys coping mechanisms to adjust to additional heat when exposed to higher air temperatures or relative humidity.

Wet-bulb globe temperature (WBGT) measures air temperature, radiant heat, air movement and humidity to approximate the environmental effects of heat stress. A qualified individual can use WBGT as a screening component, along with metabolic rates (e.g., work demands) and clothing adjustments, to determine a heat stress TLV® and action limit for a worker.

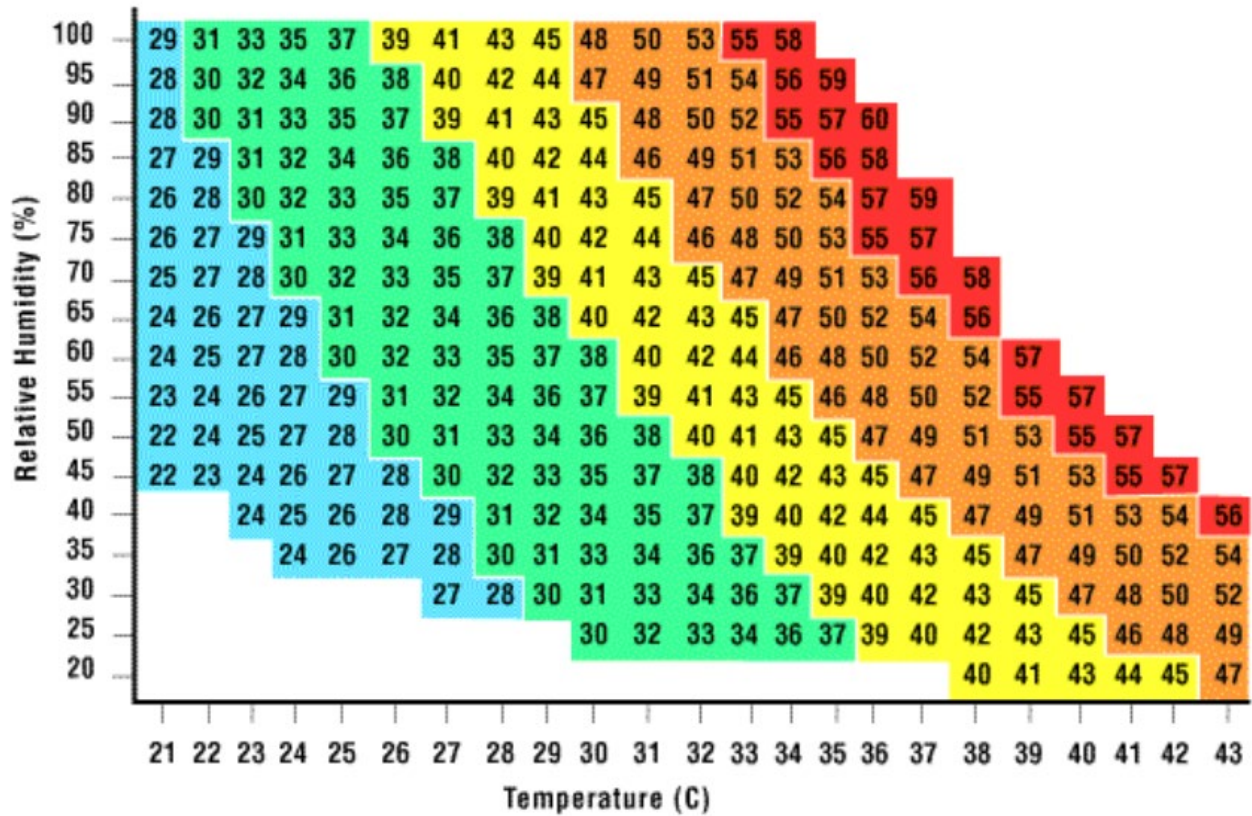
HEAT STRAIN

Heat strain is the body's physiological response to heat stress, an attempt to release excess heat from the body. As body temperature rises in a warm, hot environment, sweat is produced. The evaporation of sweat removes excess heat, allowing the body to return to a normal temperature. However, when the body is incapable of cooling itself through evaporation, the body's core temperatures rises, adversely affecting cognition, concentration and task performance.

HUMIDEX

The humidex is an indicator of how a person will feel in hot, humid weather. The chart below depicts a person's "degree of comfort" in terms of the humidex range. Environment and Climate Change Canada indicates that 40 or higher is to be an extremely high humidex reading, and recommends all unnecessary activity to be reduced or deferred temporarily until the humidex decreases. If a worker must perform tasks outdoors, hydration and frequent rest breaks are key to preventing severe heat-related illnesses.

Humidex – Temperature vs. Relative Humidity



LEGEND	HUMIDEX RANGE	DEGREE OF COMFORT
	Less than 29	No discomfort
	30 - 39	Some discomfort
	40 - 45	Great discomfort; avoid exertion
	Above 45	Dangerous
	Above 54	Heat Stroke imminent

*Source: Environment Canada (<https://www.worksafesask.ca/wp-content/uploads/2013/12/Humidex-chart.gif>)

WORK CONDITIONS CAUSING HEAT STRESS

- Working in direct sunlight in the summer
- Over 50% relative humidity in the workplace
- Working with processes or equipment that radiate heat (e.g., boilers)
- High workplace temperatures
- Personal protective equipment (e.g., respirators, reusable or disposable coveralls)
- Physical exertion

Recommendations for special workplaces

Areas that might present cold stress risks include mechanical rooms, server rooms, incubation chambers, clean rooms and temperature-controlled areas.

Working in warm rooms may require additional precautions such as ventilation. Workers should exercise caution when handling toxic or flammable substances, as the room’s heat can affect volatility and combustibility.

For buildings without central air or air conditioning, take action in extreme weather for employee comfort. Temperature, humidity, body temperature and symptoms are some factors to monitor on a case-by-case basis.

RISK FACTORS

- Hydration
- Weight or body size
- Physical activity or fitness
- Fatigue
- Age
- Physiology
- Pre-existing medical conditions
- Clothing
- Alcohol, caffeine and nicotine intake
- Type of work tasks
- Work environment and external sources of heat

ACUTE HEALTH EFFECTS FROM HEAT STRESS

The following acute illnesses may result from heat stress:

Illness/Injury	Cause	Signs/Symptoms	Treatment	Prevention
Heat edema	Working in hot conditions when not acclimatized.	Swelling (often most noticeable in ankles).	Rest in a cool environment for 1 or 2 days.	Gradually increase activity level over 1 or 2 weeks
Heat rash	Hot humid environment; plugged sweat glands.	Red bumpy rash with severe itching.	Change into dry clothes and avoid hot environments. Rinse skin with cool water.	Wash regularly to keep skin clean and dry.
Heat cramps	Heavy sweating from strenuous physical activity drains a person’s body of fluid and salt, which can’t be replaced just by drinking water. Heat cramps occur from salt imbalance resulting from	Painful cramps occurring commonly in the most worked muscles (arms, legs or stomach); this can happen suddenly at work or later at home.	Move to a cool area; loosen clothing, gently massage and stretch affected muscles and drink cool salted water (1½ to 2½ mL salt in 1 litre of water) or balanced commercial fluid electrolyte	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help identify the

Illness/Injury	Cause	Signs/Symptoms	Treatment	Prevention
	failure to replace salt lost from heavy sweating.	Heat cramps are serious because they can be a warning of other, more dangerous heat-induced illnesses.	replacement beverage (e.g., Gatorade®). If the cramps are severe or don't go away after salt and fluid replacement, seek medical aid. Salt tablets are not recommended.	symptoms that often precede heat stroke.
Fainting	Fluid loss, inadequate water intake and standing still, resulting in decreased blood flow to brain. Usually occurs in unacclimatized persons.	Sudden fainting after at least two hours of work; cool moist skin; weak pulse.	GET MEDICAL ATTENTION. Assess need for cardiopulmonary resuscitation (CPR). Move to a cool area; loosen clothing; have the person lie down; and if the person is conscious, offer sips of cool water. Fainting may also be due to other illnesses.	Reduce activity levels and/or heat exposure. Drink fluids regularly. Move around and avoid standing in one place for too long. Workers should check on each other to help spot the symptoms that often precede heat stroke.
Heat exhaustion	Fluid loss and inadequate salt and water intake causes a person's internal cooling mechanism to start to break down.	Nausea or irritability; dizziness; muscle cramps or weakness; headache; heavy sweating; cool moist skin; body temperature over 38°C; weak pulse; normal or low blood pressure; person is tired and weak, and has nausea and vomiting; is very thirsty; or is panting or breathing rapidly; vision may be blurred.	GET MEDICAL ATTENTION. This condition can lead to heat stroke, which can cause death quickly. Move the person to a cool shaded area; loosen or remove excess clothing; provide cool water, clear juice, or a sports beverage to drink; fan and spray with cool water. Don't leave the affected person alone.	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms that often precede heat stroke.

Illness/Injury	Cause	Signs/Symptoms	Treatment	Prevention
Heat stroke	<p>There are two types of heat stroke:</p> <ul style="list-style-type: none"> • Classic heat stroke can occur in older adults and in persons with chronic illnesses exposed to excessive heat. When the body has used up its water and salt reserves, it stops sweating, causing a rise in body temperature. • Exertional heat stroke generally occurs in young persons who engage in strenuous physical activity for a prolonged period of time in a hot environment when the body's cooling mechanism can't get rid of the excessive heat. <p>Heat stroke can develop suddenly or follow heat exhaustion.</p>	<p>High body temperature (over 40°C) and any one of the following: weakness, confusion, upset or strange actions; hot, dry, red skin (classic heat stroke) or profuse sweating (exertional heat stroke); a fast pulse; headache or dizziness. In later stages, a person may pass out and have convulsions or seizures.</p>	<p>CALL 9-1-1 (AMBULANCE). This condition can kill a person quickly. Remove excess clothing (including socks and shoes); fan and spray the person with cool water; offer sips of cool water if the person is conscious; DON'T force the person to drink liquids.</p>	<p>Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms that often precede heat stroke.</p>

Source: Adapted from *Heat-Stress-related disorders*. Heat Stress. Ontario Ministry of Labour. June 2014, and *Hot Environments – Health Effects and First Aid*. OSH Answers Fact Sheets. Canadian Centre for Occupational Health and Safety. August 4, 2016.

CHRONIC HEALTH EFFECTS FROM HEAT STRESS

Chronic heat exhaustion, inconsistent sleep, susceptibility to minor illness, injury and sickness, and temporary infertility have all been associated with prolonged exposure to heat.

MANAGING HEAT STRESS AT WORK

The first step to managing heat stress at work is assessing the conditions. Heat stress procedures and control plans should cover both process heat and hot weather. Follow ACGIH TLV® guidance when developing these documents, and put your plans in action under the following environmental conditions:

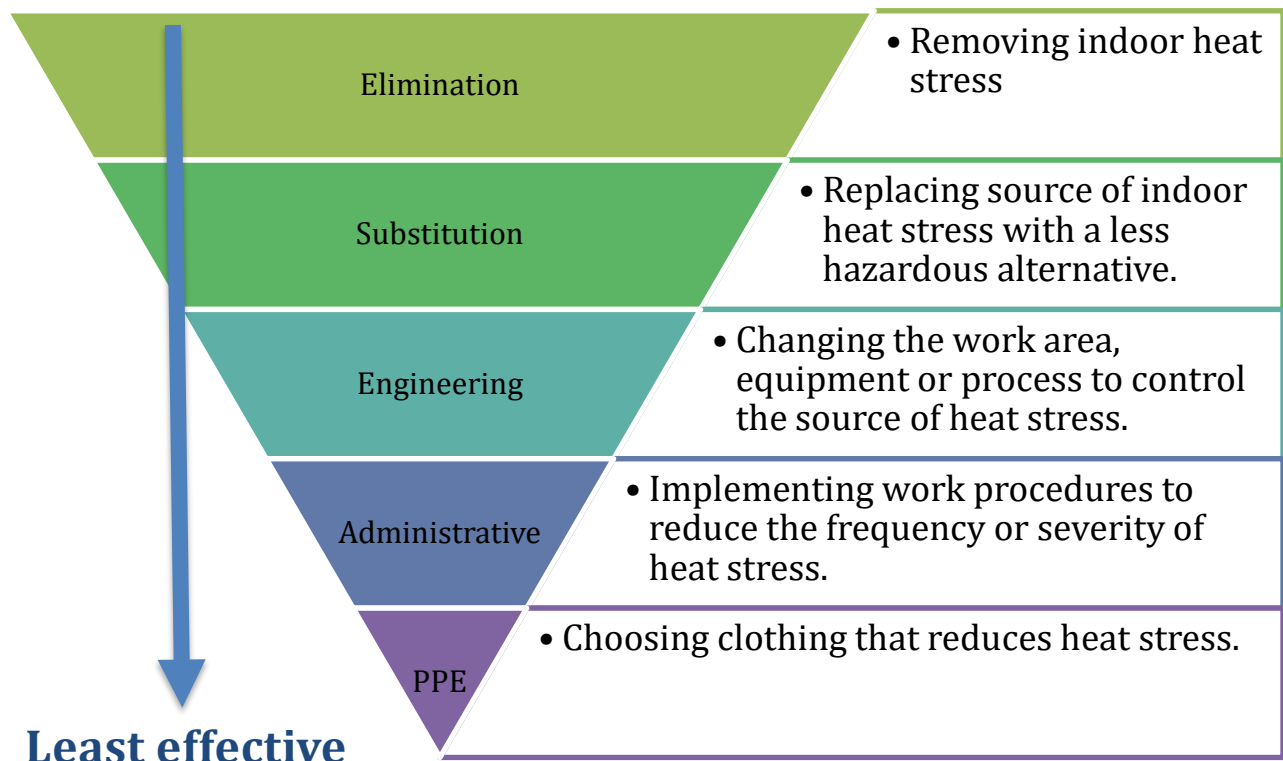
- Humidex equal to or above 35
- Environment Canada reporting an air temperature of over 30°C **and** a humidex equal to or above 40
- Heat waves equal to or above 32°C forecast for three days or more
- Ontario Ministry of the Environment, Conservation and Parks issuing a smog alert

The Health and Safety Committee should be involved in developing site-specific procedures for operations in which exposure to heat stress is a major factor.

To manage heat stress, use this hierarchy of controls for reducing workplace hazards:

Hierarchy of Controls – Heat

Most effective



Elimination

Eliminating sources of heat stress is the best way to reduce risk, by removing the likelihood of occurrence or severity of harm.

Sources of indoor heat stress can be eliminated by design or redesign of the workplace, task, process or equipment. For outdoor work, elimination or substitution of the hazard (the sun) isn't possible. The only options are engineering, administrative or PPE controls.

Substitution

Substitution can eliminate or reduce risks related to heat stress by offering a less hazardous alternative. Specific elements in the workplace, task, process or equipment can be substituted, and the need for and/or frequency of worker interaction with these elements can also be considered.

For outdoor work, elimination or substitution of the hazard (the sun) isn't possible. The only options are engineering, administrative or PPE controls.

Engineering controls

Use engineering controls to reduce sources of heat stress in the work environment. For example:

- Provide shade from radiant heat.
- Use ventilation during processes, including when deploying equipment, to reduce introduction of heated air and/or steam into the work area.
- Install insulating and/or reflective barriers to redirect heat.
- Provide air-conditioned rest areas.
- Use fans for air temperatures below 35°C.
- Use machines, equipment or supports (e.g., lifts, carts or hoists) to reduce physical demands from work tasks.

Administrative controls and work practices

- Implement work procedures for specific operations or hot environments.
- Increase the frequency and length of breaks.
- Provide cool, potable water; workers should keep hydrated by drinking a cup of water every 15 to 20 minutes.
- Shift work schedules so that workers performing physically demanding tasks can do so at cooler times of the day.
- Allow appropriate time for workers to acclimatize to the work environment.
- Pair workers ("buddy system").
- Train workers on the principles of heat stress and recognition of signs and symptoms.
- Investigate heat-related incidents.
- Install visual and audible hazard warning signals or devices.
- Train workers in first aid and the emergency response plan for heat-related incidents.

- Accommodate pregnant workers or workers with medical conditions, based on consultation with a physician.

Acclimatization

The more time a worker spends working in a hot environment, the more likely the worker's body will adjust. Workers with underlying health conditions may require more time.

If workers are new to working in hot conditions, they can either acclimatize themselves by gradually increasing their activity level over one or two weeks, or by spending an increased amount of time working in these conditions.

If experienced workers haven't worked in hot conditions for more than eight days, they will need to reacclimatize themselves.

Personal protective clothing

In addition to engineering controls, administrative controls and/or work practices, workers should wear clothing with some of the following properties:

- Light and breathable material allowing evaporation of sweat (polyester, dry fit, etc.)
- Head covering to prevent direct exposure to sunlight
- Reflective clothing for high radiant heat
- Insulated clothing with air, water or ice for very hot environments

Only use impermeable protective clothing (such as chemical protective clothing or fully encapsulating suits) when absolutely necessary for the work. Supervisors and fellow coworkers should monitor vital signs and look for signs and symptoms of heat stress illness or injuries.

COLD STRESS

Cold stress results from exposure to cold environments. The body can't warm itself, leading to a reduction in internal core body temperature.

In a cold environment, most of the body's energy is used to keep the core internal temperature at approximately 37°C. With prolonged exposure to cold environments, the body shifts blood flow (and heat) from the extremities (hands, feet, arms and legs) and the outer skin to the body core (chest and abdomen). Hypothermia and frostbite are the most severe health effects resulting from cold stress.

Workers should not work full time in the extreme cold until they become accustomed to the working conditions and required protective clothing.

FROSTBITE

Frostbite occurs due to freezing body tissue and subsequent loss of water. It can affect fingers, toes, arms and legs.

HYPOTHERMIA

Hypothermia is a life-threatening condition which occurs when there's a sharp decrease in the body's core temperature, to below 35°C. The body loses heat more quickly than it can be replaced.

Core body temperature is between 36.5°C and 38.5°C. When it drops below 36°C, signs and symptoms of cold stress can begin to appear, such as shivering, loss of coordination, slurred speech or hands fumbling with items. The skin usually appears pale and feels cold. As the core body temperature continues to drop, these signs and symptoms will worsen, and shivering will stop. At this point, the worker may be unable to stand.

When the core body temperature decreases to approximately 29.4°C, the worker will likely develop severe hypothermia and may become unconscious. A core body temperature below 25.6°C could result in death.

WIND CHILL

Wind chill is the combined effect of air temperature and wind on exposed skin. It is a common indicator for cold stress.

When wind speeds increase and temperatures drop in the work environment, the wind chill decreases. Wind chill relates wind and temperature to its effect on exposed skin at a five-foot elevation, the typical height of an adult face.

Environment Canada issues wind chill advisories and warnings for extremely dangerous weather conditions. They indicate life-threatening conditions. Exposure to temperatures below 0°C can lead to serious medical conditions.

Prior to leaving for a work site, check current and forecast weather conditions. Online calculators are available to determine wind chill.

The chart below shows the time it takes to develop frostbite without protection.

Environment Canada Wind Chill Chart

Actual Air Temperature T_{air} (°C)

Wind Speed $V_{10\text{ m}}$ (km/h)	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70
30	0	-6	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-69	-76
55	-2	-8	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

where

T_{air} = Actual Air Temperature in °C

$V_{10\text{ m}}$ = Wind Speed at 10 metres in km/h (as reported in weather observations)

Notes:

1. For a given combination of temperature and wind speed, the wind chill index corresponds roughly to the temperature that one would feel in a very light wind. For example, a temperature of -25°C and a wind speed of 20 km/h give a wind chill index of -37. This means that, with a wind of 20 km/h and a temperature of -25°C, one would feel as if it were -37°C in a very light wind.
2. Wind chill does *not* affect objects and does *not* lower the actual temperature. It only describe how a human being would feel in the wind at the ambient temperature.
3. The wind chill index does *not* take into account the effect of sunshine. Bright sunshine may reduce the effect of wind chill (make it feel warmer) by 6 to 10 units.

Frostbite Guide
Low risk of frostbite for most people
Increasing risk of frostbite for most people within 30 minutes of exposure
High risk for most people in 5 to 10 minutes of exposure
High risk for most people in 2 to 5 minutes of exposure
High risk for most people in 2 minutes of exposure or less

Source: Environment Canada

WORK CONDITIONS CAUSING COLD STRESS

- Working in cold air temperatures or high wind
- Working in high relative humidity
- Contact with cold water or surfaces
- Inadequate cold-weather clothing for a particular temperature
- Indoor cold environments (e.g., a cold room)

Manual dexterity

If fine work is to be performed with bare hands for more than 10 to 20 minutes in a work area below 16°C, consider measures such as these to keep workers' hands warm:

- Warm air jets
- Radiant heaters
- Contact warm plates
- Covering metal handles of tools and control bars with thermal insulating material when temperatures drop below -1°C

Wear gloves if the air temperature falls below:

- 16°C for sedentary work (e.g., quietly seated)
- 4°C for light work (e.g., walking on a level surface at 3 or 4 km/h)
- -7°C for moderate work (e.g., walking on a hard surface at 5.6 km/h with a load of less than 40 pounds) or when fine manual dexterity not required

Recommendations for special workplaces

Areas that might present cold stress risks include arenas, fresh air intakes, domes and rooftops.

Cold rooms

Working in cold rooms requires additional precautions. The air velocity in a cold room should be minimized (equal to or less than 1 m/s). Provide special wind-protective clothing based on existing air velocities to which workers are exposed.

Workers should exercise caution when handling toxic substances or if they're exposed to vibrations. If this is the case, exposure limits to cold stress may need to be reduced.

Other considerations

- Where the workplace temperature is below 16°C, arrange for suitable temperature measurement devices to maintain compliance with TLV® requirements.

- If the air temperature at a workplace is below -1°C, measure and record the air temperature at least every four hours.
- In indoor workplaces, record wind speed at least every four hours when air movement is less than 2 m/s.
- In outdoor work environments below -1°C, measure and record air temperature and wind speed together.
- Record wind chill temperature with air temperature and wind speed when it's below -7°C.

RISK FACTORS

- Inactivity
- Energy depletion
- Endocrine disorders
- Age (old and young)
- Burns and skin disorders
- Trauma
- Neuropathies
- Drug or alcohol use

As temperatures decrease and the length of exposure increases, the following symptoms may appear:

- Reduced dexterity of hands and feet
- Reduced tactile sensation
- Impaired ability to perceive heat, cold and pain
- Reduced joint mobility
- Reduced grip strength
- Hypothermia
- Frostbite
- Reduced coordination
- Reduced decision-making ability

Clothing that is worn to protect against cold exposure may also limit performance:

- Hats and hoods may interfere with hearing, vision and movement.
- Bulky clothing layers restrict movement.
- Gloves, mittens or over-mittens can reduce dexterity and “feel.”
- Footwear may be heavy and bulky, compromising the ability to use footholds and vehicle foot pedals.
- The weight and bulk of added clothing increases the amount of effort while moving.

Careful selection of appropriate clothing for the tasks being performed will help reduce some of these limitations.

ACUTE HEALTH EFFECTS FROM COLD STRESS

The following acute illnesses may result from cold stress:

Illness/Injury	Cause	Signs/Symptoms	Treatment	Prevention
Hypothermia	When the core body temperature falls below 35°C.	<p>Mild: Shivering, blue lips and fingers, poor coordination.</p> <p>Moderate: Mental impairment, confusion, poor decision-making, disorientation, inability to take precautions against the cold, reduction in heart rate, slow breathing.</p> <p>Severe: Unconsciousness, extremely slow heartrate (pulse is irregular or difficult to detect), no detectable breathing, no shivering.</p>	<p>CALL 9-1-1 (AMBULANCE). Remove wet clothes, increase insulation (with dry clothes, blankets, and sleeping bags), and move to a sheltered area. Consider exercise to increase heat production. External re-warming should be initiated by trained medical personnel.</p>	<p>Provide whole-body protection from extremely cold air, cold-wet conditions and cold water immersion. Keep hydrated.</p>
Frostbite	When tissue temperature drops below 0°C and there is a subsequent loss of water. Fingers, toes, arms, and/or legs are typically affected.	<p>Pain in hands and feet (not in all cases).</p> <p>Skin appears waxy and feels numb.</p> <p>Before freezing, skin (especially the face) becomes bright red.</p> <p>Tissues becoming hard indicates a severe medical emergency.</p>	<p>GET MEDICAL ATTENTION.</p> <p>Warm affected areas by placing warm hands against them (don't rub), blowing on them or moving to a warm area.</p> <p>Don't thaw frostbitten tissue if there's any risk it may freeze again.</p> <p>Warm entire fingers or toes by immersion in warm — not hot — water for 20 to 30 minutes.</p>	<p>Wear loose clothing that doesn't restrict blood flow to the limbs. Routinely inspect exposed body parts.</p>

Illness/Injury	Cause	Signs/Symptoms	Treatment	Prevention
			After seriously injured tissue has been warmed, wrap it in soft material, elevate the affected area and seek medical assistance as soon as possible.	

MANAGING COLD STRESS AT WORK

The first step to managing cold stress at work is assessing the conditions. Some conditions may warrant alternating work and warm-ups. The table below applies to four-hour periods with workers wearing dry clothing. Breaks are at least 10 minutes in a warm environment.

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*											
Air Temperature Sunny Sky		No Noticeable Wind		8 kph Wind		16 kph Wind		24 kph Wind		32 kph Wind	
°C (approx)	°F (approx)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1		(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20° to -24°	(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	↓ Non-emergency work should cease ↓	
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	↓ Non-emergency work should cease ↓			
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5	↓ Non-emergency work should cease ↓					
-40° to -42°	-40° to -44°	30 min.	5	↓ Non-emergency work should cease ↓							
-43° and below	-45° and below	↓ Non-emergency work should cease ↓									

Adapted from CSA Standard Z1010-18 — Management of Work in Extreme Conditions.

If wind values are not known or available, estimate the wind value using the following reference:

- An 8 km/h wind will move a light flag.
- A 16 km/h wind will fully extend the flag.
- A 24 km/h wind will blow a newspaper sheet.
- A 32 km/h wind will cause blowing or drifting snow.

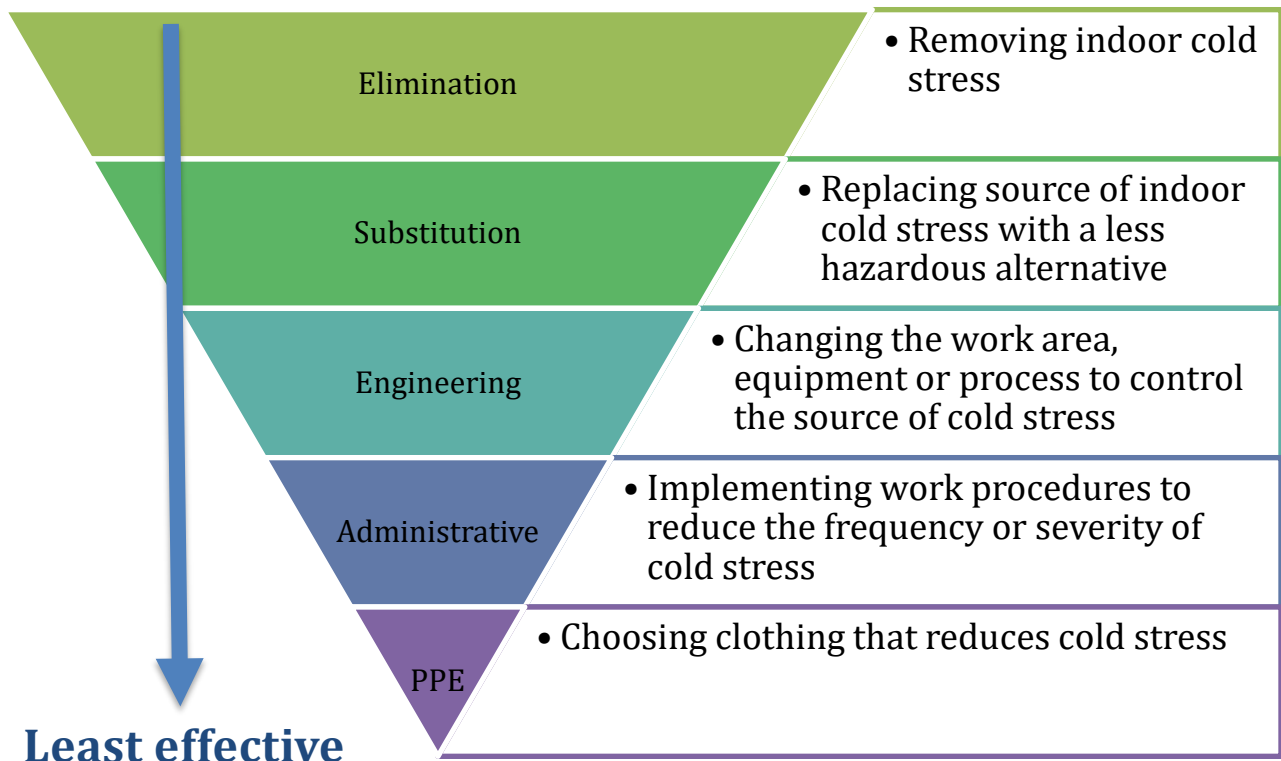
When developing cold stress procedures and control plans, follow ACGIH TLV® guidance.

When exposure to cold stress is a major concern, the Health and Safety Committee should be involved in developing site-specific procedures for operations.

Use this hierarchy of controls to reduce workplace hazards and manage cold stress.

Hierarchy of Control – Cold Stress

Most effective



Least effective

Elimination

Eliminating sources of cold stress is the best way to reduce risk, by removing the likelihood of occurrence or severity of harm. Sources of cold stress can be eliminated by design or redesign of the workplace, task, process or equipment.

For outdoor work, elimination or substitution of the hazard (cold air) isn't possible. The only options are engineering, administrative or PPE controls.

Substitution

Substitution can eliminate or reduce risks related to cold stress by offering a less hazardous alternative. Specific elements in the workplace, task, process or equipment can be substituted. The need for and/or frequency of worker interaction with these elements should also be considered.

For outdoor work, elimination or substitution of the hazard (cold air) isn't possible. The only options are engineering, administrative or PPE controls.

Engineering controls

Use engineering controls to reduce the sources of cold stress from the work environment. For example:

- Provide devices to shield workers from the cold.
- Provide radiant heat while performing tasks.
- Wrap handles of metal tools to prevent contact with cold surfaces.

Administrative controls and work practices

- Schedule outdoor work for the warmest part of the day.
- Set limits on work outdoors.
- Provide heated rest areas.
- Implement a "buddy system."
- Provide a break schedule that permits workers to warm up.
- Set a work pace that doesn't cause sweating.
- If heavy work must be performed, provide rest periods in heated areas and the chance to change into dry clothing.
- Remove outer clothing during breaks in heated areas to prevent overheating and allow for the evaporation of sweat.
- Consume warm fluids to provide hydration and warmth.

Personal protective clothing

Wearing personal protective clothing in cold weather is one of the most practical measures to avoid cold stress. Consider the following when selecting protective clothing:

- Avoid cotton fabrics as they lose their insulation properties when wet.
- Wear layers, which can be added or removed:
 - Inner layer: Light-weight polyester or polypropylene) in direct contact with skin wicks moisture away to outer layers where it can evaporate.
 - Middle layers: Polyester fleece or wool, providing insulation.
 - Outer layer: Allows moisture transfer to the air while repelling wind and rain (should not be worn during moderate or heavy work unless rainy or windy).
- Choose clothing made of moisture-wicking, insulating materials.
- Choose clothing with ventilation openings.
- Consider clothing weight and bulkiness and its limitations on work performance.
- Have a clean, dry set of spare clothes in case clothing layers become damp.
- Wear eye protection in work environments where you may encounter ultraviolet light, glare or blowing snow or ice crystals.

WORKER TRAINING

University of Ottawa workers at risk of exposure to heat stress or cold stress must take a four-part training series, including information on these guidelines, to ensure that they are competent to work in warm, hot or cold environments.

A written test is provided to evaluate participants' knowledge of these guidelines.

All employees should complete refresher training every three years. The training checklist includes participation in the training course, completion of a written test and sign-off by the trainee and instructor.

All training documentation should be kept on file by the department as long as the worker is employed by the University of Ottawa.

DOCUMENT REVIEW AND MAINTENANCE

This program must be reviewed when work tasks, environments, processes or equipment are changed or modified, or when deficiencies related to heat stress or cold stress are identified. All information should be reviewed periodically to ensure it is up-to-date, and a record should be maintained, including the date of creation, review and revision.

APPENDIX A — HEAT/COLD STRESS PRE-WORK CHECKLIST

Calculation tools to determine what precautions to take to protect workers from cold stress- or heat stress-related adverse health outcomes: [Cold stress calculator](#)

Heat stress - <https://www.ohcow.on.ca/posts/humidex-based-heat-stress-calculator/>

Building: _____ uOttawa Field Staff: _____ Date: _____
 Room: _____ Supervisor: _____ Supervisor: _____
 Type of Work: Construction () Maintenance () Repair () Cleaning () Equipment Operation () Other _____

1.0 Worker's Responsibilities		Y	N	N/A
1.1	Familiar with the Occupational Health and Safety Act & Regulations			
1.2	uOttawa Heat Stress Cold Stress Program has been reviewed.			
1.3	Trained to recognize signs & symptoms of heat / cold stress			
1.4	Trained in the selection, use, care, and maintenance of PPE prescribed by uOttawa			

2.0 Heat Stress		Y	N	N/A
2.1	Temperature:			
2.2	Humidity:			
2.3	Humidex rating greater than or equal to 30?			
2.4	Work in direct sunlight?			
2.5	Indoor hot process (e.g., equipment)?			
2.6	Additional personal protective equipment (e.g., disposable coveralls)?			
2.7	Physical exertion required?			
2.8	Hydration available?			
2.9	For outdoor work, is shade available?			
2.10	For indoor work, is venting or reflective barriers available?			
2.11	A/C available?			
2.12	Fans available?			
2.13	Equipment available to reduce physical demands (e.g., hoist)?			
2.14	Work/rest schedule implemented?			
2.15	Work/rest schedule: Work _____ / Rest _____			
2.16	Ability to conduct work during cooler times of the day (e.g., morning/afternoon)?			
2.17	Buddy system implemented?			
2.18	Visual/audible hazard warning used?			
2.19	EFA/SFA- trained worker(s) on site?			

3.0 Cold Stress		Y	N	N/A
3.1	Temperature:			
3.2	Wind speed:			
3.3	Wind chill:			
3.4	Risk of frostbite?			
3.5	Contact with cold water or surfaces?			
3.6	Cold-weather PPE required?			
3.7	Work in indoor cold environment (e.g., Cold Room)?			
3.8	Heating equipment used (e.g., radiant heater)?			
3.9	Gloves required? Refer to Manual Dexterity section in Program			
3.10	Work/warm-up schedule implemented?			
3.11	Work/warm-up schedule: Work _____ / Warm-Up _____			
3.12	Ability to conduct work during warmer times of the day (e.g., noon)			
3.13	Buddy system implemented?			
3.14	Visual/audible hazard warning used?			
3.15	Rate of work limited to prevent sweating?			
3.16	Change area (and dry clothes) available?			
3.17	EFA/SFA- trained worker(s) on site?			

4.0 Final Result		Y	N	N/A
4.1	Final result satisfactory to the Supervisor?			

Comments:

uOttawa Employee Signature: _____ **uOttawa Supervisor Signature:** _____