

# Thermal Stress Program

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**OCCUPATIONAL HEALTH & SAFETY**

## Program Overview

The purpose of this program is to identify the potential health hazards associated with exposure to extreme temperatures, providing guidance on control measures, in order to reduce the risk of illness and injury.

## Scope

This program applies to all College staff and departments, volunteers and contractors, who have workers who are, or could be exposed to heat or cold throughout the course of their workday.

## Applicable Legislation

- Regulation 851: Industrial Regulations, Sec. 129 (1)&(2)
- OHSA 25 (2)(h)

Employers have a duty under section 25(2)(h), of the Occupational Health and Safety Act, to take every precaution reasonable in the circumstances for the protection of a worker. This includes developing policies and procedures to protect workers in environments that are hot or cold, because of processes and/or weather.

For compliance purposes, the Ministry of Labour recommends the Threshold Limit Values (TLVs) for Heat Stress and Heat Strain published by the American Conference of Governmental Industrial Hygienists (ACGIH). These values are based on preventing workers' core body temperatures from rising above 38°C.

- Ministry of Labour Guideline No. 33L Working in Extreme Temperature Conditions
- ASHAE Standard 62.1-2013

## Definitions

### **Acclimatization:**

The gradual process in which the body becomes accustomed to temperature extremes.

### **Air Temperature:**

Air temperature is measured by an ordinary thermometer in degrees Celsius (°C) or degrees Fahrenheit (°F).

### **Air Velocity:**

The rate of motion of air in a given direction; in mine ventilation it is usually expressed in meters per second.

**ASHRAE:**

ASHRAE develops standards for both its members and others professionally concerned with refrigeration processes and the design and maintenance of indoor environments.

**Heat Cramps:**

Painful muscle spasms, as a result of exposure to excess heat.

This occurs when a worker drinks a lot of water, but does not replace salts lost from sweating.

**Heat Syncope:**

Weakness, fatigue and fainting due to loss of salt and water in sweat and exercise in the heat.

**Heat Exhaustion:**

A condition usually caused by loss of body water because of exposure to excess heat. Symptoms include headache, tiredness, nausea, and sometimes fainting.

**Heat Rash:**

Skin irritation caused by excessive sweating during hot, humid weather.

**Heat Stress:**

Relative amount of thermal strain from the environment.

**Heat Stroke:**

A serious disorder resulting from exposure to excess heat. It results from sweat suppression and increased storage of body heat. Symptoms include hot dry skin, high temperature, mental confusion, convulsions, and coma. Heatstroke is fatal if not treated properly.

**Humidity (wetness):**

Water conducts heat away from the body 25 x faster than dry air.

**Metabolic Rate:**

The rate at which our body burns calories.

**Physical Activity:**

The production of body heat by physical activity (metabolic rate) is difficult to measure. However, tables are available in literature showing metabolic rates for a variety of activities. Metabolic heat production is measured in kilo calories (kcal) per hour. One kilocalorie is the amount of heat needed to raise the temperature of one kilogram of water by 1°C.

**Radiant Temperature:**

The uniform temperature of an imaginary enclosure in which the radiant heat transfer from the human body is equal to the radiant heat transfer in the actual non-uniform enclosure.

**Thermal Comfort:**

Refers to a person's state of mind in terms of whether they feel too hot or too cold.

**Ultraviolet (UV) Radiation:**

Type of radiation produced by the sun and some artificial sources, and constitutes about 10% of the total light output of the sun.

**Wind Speed:** Different types of commercially-available anemometers are used to measure wind speed or air movement. These are calibrated in meters per second (m/s), kilometers per hour (km/h) or miles per hour (mph). Air movement is usually measured in m/s while wind speed is usually measured in km/h or mph.

## Responsibilities

### Employer

- Implement a thermal stress program that outlines the potential risks associated with exposure to heat or cold
- Provide training to workers regarding thermal stress
- Provide engineering and administrative controls to protect workers
- Ensure that workers have proper supervision

### Supervisor

- Ensure that all workers receive training regarding thermal stress
- Enforce the thermal stress program requirements, and implement necessary controls
- Conduct a risk assessment of all tasks where workers may be exposed to extreme temperatures/ thermal stress
- Communicate all actual and potential hazards associated with the tasks performed while exposed to hot or cold temperatures
- Regularly monitor and assess temperatures to ensure that the appropriate controls are in place
- Ensure that workers have reasonable access to fluids throughout the day
- Monitor workers for signs of heat and cold related injuries or illnesses
- Plan work and schedule around peak/ critical temperature times throughout the day
- Allow workers to become acclimatized when they are required to perform tasks in extreme heat or cold
- Ensure that workers are provided with the appropriate PPE and are wearing it as required
- Ensure that workers are dressed (protected) appropriately for the circumstance

### Worker

- Wear all necessary PPE
- Dress appropriately for the circumstances
- Avoid alcohol or excessive caffeine (which can lead to dehydration)
- Monitor yourself for signs and symptoms of heat stress or thermal stress and seek medical attention if necessary.
- Report to your supervisor if circumstances change such that it poses a risk to your (or your co-workers') health and safety
- Report to your supervisor immediately if you suspect a co-worker to be suffering from a temperature related illness or injury and request medical attention.

## **Contractor**

- Read Algonquin College's Thermal Stress Program
- Communicate the Thermal Stress Program to their staff and ensure that a workplace/ job specific control program is in place
- Provide training on heat stress and cold stress

## **Occupational Health and Safety**

- Develop and revise the Thermal Stress Program and associated training
- Provide guidance and information regarding the risk associated with thermal stress
- Provide guidance regarding the implementation of appropriate controls

## **Thermal Exposures**

Thermal stress occurs when a worker is exposed to temperature extremes as a result of a process, the outdoor weather/ temperature, as a result of the physical activity required to perform a task, and any combination thereof. Since illnesses and injuries associated with thermal stress are quite serious and pose a serious risk, the College is required to ensure that precautions are taken to ensure workers' health and safety.

### **Exposure to Heat**

The risk of heat-related illness varies from person to person. A person's general health influences how well the person adapts to heat (and cold).

Those with extra weight often have trouble in hot situations as the body has difficulty maintaining a good heat balance. Age (particularly for people about 45 years and older), poor general health, and a low level of fitness will make people more susceptible to feeling the extremes of heat.

Medical conditions can also increase how susceptible the body is. People with heart disease, high blood pressure, respiratory disease and uncontrolled diabetes may need to take special precautions. In addition, people with skin diseases and rashes may be more susceptible to heat. Other factors include circulatory system capacity, sweat production and the ability to regulate electrolyte balance.

Substances, such as alcohol, prescription and non-prescription drugs can also have an impact on how people react to heat.

### **Heat Stress**

The body is always generating heat and passing it to the environment. The harder the body is working, the more heat it has to lose. When the environment is hot or humid or has a source of radiant heat (for example, a furnace or the sun), the body must work harder to get rid of its heat. If the air is moving (for example, from fans) and it is cooler than the body, it is easier for the body to pass heat to the environment.

The longer you do hard work in the heat the better your body becomes at keeping cool. This is known as acclimatization. Generally, you can become acclimatized by gradually introducing your body to physical work in a hot environment by adjusting the exposure times or the physical demands and

increasing these over a period of a week or two. Hot spells in Ontario seldom last long enough to allow for proper acclimatization.

Humidex is a calculation that combines temperature and humidity into one number and is used to describe how hot humid weather feels to the average person. A humidex over 40<sup>o</sup> is considered extremely high and represents conditions under which activity should be curtailed.

### **Humidex vs. Degree of Comfort**

Less than 29°C	No discomfort
30 – 39°C	Some discomfort
40 – 45°C	Great discomfort
Above 45°C	Dangerous
Above 54°C	Heat Stroke imminent

## **Controlling Heat Stress**

### ***Acclimatization***

Acclimatization is an important part of working in heat extremes. Acclimatization is a gradual process in which the body becomes accustomed to temperature extremes. During initial exposures to hot a hot environment, workers often feel very tired, irritable and too hot. Body temperatures often rise. After repeat exposures, these symptoms decrease and eventually disappear; when this occurs, the person is considered to be acclimatized. The rate of acclimatization differs from person to person and are based on various factors.

As a rule, acclimatization may take 5 to 7 days for a healthy worker to achieve. The longer you work in a hot environment, the better your body acclimatizes to the heat. If you are ill or away from work for a week or so, you can lose your acclimatization.

To become acclimatized, consider the following acclimatization schedule:

- New workers (with no recent exposure to heat exposure (first day): 50% or normal workload, increased by 10% each day until a full workload is achieved.

If you have health problems or are not in good physical condition, you may need longer periods of acclimatization. Hot spells in Ontario seldom last long enough to allow acclimatization. However, exposure to workplace heat sources may permit acclimatization.

Workers may be assigned to work in cooler areas for portions of the day until fully acclimatized.

When there is a potential for exposure to heat stress, control measures must be taken to prevent heat exposure in the workplace. These include engineering controls, administrative controls and protective clothing. Selection of appropriate workplace controls will vary, depending on the type of work being performed. Some measures may include:

## Engineering Controls

- Control the heat at source through the use of insulating and reflective barriers (insulate furnace walls).
- Exhaust hot air and steam produced by specific operations.
- Reduce the temperature and humidity through air cooling.
- Provide air-conditioned rest areas.
- Increase air movement if temperature is less than 35°C (fans).
- Reduce physical demands of work task through mechanical assistance (hoists, lift-tables, etc.).

## Administrative Controls

- Establish a work / rest regime and adjust the frequency of work and rest periods accordingly. During rest periods workers are provided an opportunity to take on water, spend time in a cooler environment and reduce physical demands.
- When working in the heat, workers should put salt on their food (if on a low-salt diet, this should be discussed with a doctor).
- Schedule hot jobs to cooler times of the day.
- Provide cool drinking water near workers and remind them to drink a cup every 20 minutes or so.
- Assign additional workers or slow down work pace.
- Train workers to recognize the signs and symptoms of heat stress and start a 'buddy system' since people are not likely to notice their own symptoms. *(see attached table)*
- Pregnant workers and workers with a medical condition should discuss working in the heat with their doctor.

## Personal Controls/ Protective Clothing

- Light summer clothing should be worn to allow free air movement and sweat evaporation.
- Outside, wear light-colored clothing.
- In a high radiant heat situation, reflective clothing may help.
- Vapor barrier clothing, such as acid suits, greatly increases the amount of heat stress on the body, and extra caution is necessary.

## Heat Stress Related Disorders and Symptoms:

CONDITION	Cause	Symptoms	Treatment	Prevention
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.

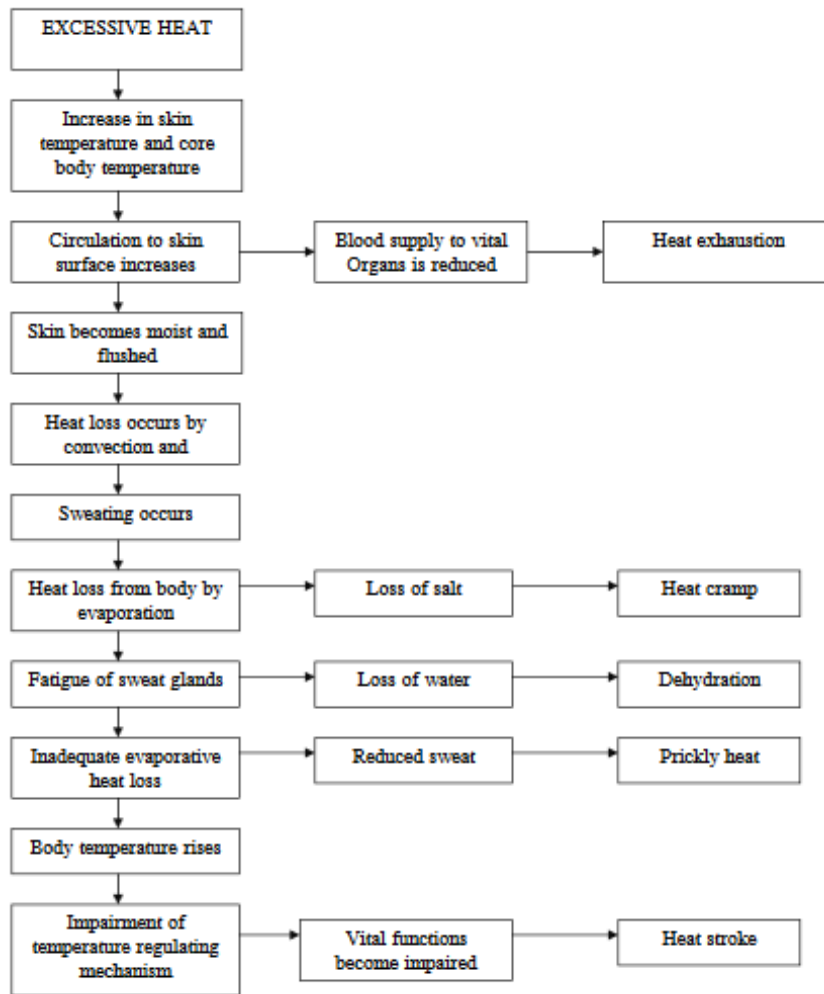
<b>Heat Cramps</b>	Heavy sweating drains a person's body of salt, which cannot be replaced just by drinking water.	Painful cramps in arms, legs or stomach which occur suddenly at work or later at home	Move to a cool area; loosen clothing and drink cool salted water ( 1 tsp. salt per gallon of water) or commercial fluid replacement beverage. If the cramps are severe or don't go away, seek medical aid.	When working in the heat, workers should put salt on their food (if on a low-salt diet, this should be discussed with a doctor). This will give the body all the salt it needs; don't take salt tablets.
<b>Fainting</b>	Not enough blood flowing to the head, causing loss of consciousness.	Sudden fainting after at least two hours of work; cool moist skin; weak pulse.	Fainting may be due to a heart attack or other illness. GET MEDICAL AID Assess need for CPR. Move to a cool area; loosen clothing; make person lie down; and if the person is conscious, offer sips of cool water.	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms which often precede heat stroke.
<b>Heat Exhaustion</b>	Inadequate salt and water intake causes a person's body's cooling system to start to break down.	Heavy sweating; cool moist skin; body temperature over 38oC; weak pulse; normal or low blood pressure; person is tired, weak, clumsy, upset or confused; is very thirsty; or is panting or breathing rapidly, vision may be blurred.	GET MEDICAL AID. This condition can lead to heat stroke, which can kill. Move the person to a cool shaded areas; loosen or remove excess clothing; provide cool water to drink (salted if possible); fan and spray with cool water.	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms which often precede heat stroke.
<b>Heat Stroke</b>	If a person's body has used up all its water and salt, it will stop sweating. This can cause body temperature to rise.	High body temperature (over 41°C) and any one of the following: the person is weak, confused, upset or acting strangely; has hot, dry, red skin; a fast pulse; a headache or	GET MEDICAL AID This condition can kill a person quickly. Remove excess clothing; fan and spray the person with cool water; offer sips of cool water if the person is	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms which often precede heat



		dizziness. In later stages, a person may pass out and have convulsions.	conscious. Heat stroke can result in death if first aid and medical attention are not applied immediately.	stroke.
<b>Heat Syncope</b>	Occurs when there is insufficient blood flow to the brain while the person is standing. Typically occurs among people who are not acclimatized. Caused by the loss of bodily fluids due to sweating, and by lowered blood pressure due to pooling in the legs.	Causes dizziness and fainting.	GET MEDICAL AID. If safe to do so, move the person to a cool area.	Recovery is usually rapid once the person is moved to a cool area.

Reference: - Condensed from the Ontario Ministry of Labour Guidelines

## The Body Response to Excessive Heat



Courtesy of Workplace Health and Safety, University of Manitoba : Guideline to Thermal Stress

## Ultraviolet (UV) Radiation

Ultraviolet (UV) radiation is a form of electromagnetic radiation, like radio waves, x-rays and light. It is divided according to its effects on living tissue into three wavelength bands: UV-A, UV-B and UV-C

Sources of UV radiation in the workplace include various kinds of welding arcs, UV lasers and UV lamps. The sun is the main source of UV radiation out of doors. Outdoor workers may easily be overexposed to UV radiation from the sun during spring and summer.

### Effects of Overexposure

Acute effects of overexposure include sunburn (erythema) and arc-eye, otherwise known as

welder's flash or snow-blindness (photokeratoconjunctivitis).

Sunburn is a reddening of the skin, with blistering and peeling in severe cases. Of the three UV bands, UV-B is most effective in causing sunburn. To protect itself against UV radiation, the skin "tans". Prolonged exposure to UV radiation causes a thickening of the skin's outer layer. Since people with lighter skin, hair and eyes have less pigment, they are more sensitive to UV exposure. Typically sunburn is not noticeable until a few hours after exposure and, given time, sunburned skin repairs itself.

Arc-eye is a painful irritation of the cornea and the conjunctiva (the membrane connecting the eyeball with the inner eyelid). There is a feeling of "sand in the eye" and sensitivity to light. UV-B is most effective in causing this "sunburn of the eye". Symptoms appear from six to 24 hours after exposure and usually disappear within the following 48 hours. No permanent damage to the eye results unless a severe exposure has occurred.

**Note:** Hypersensitivity to UV radiation may result from the use of certain prescription drugs, such as tetracycline (a common antibiotic), or from exposure to some industrial chemicals, such as coal-tar distillates. Workers who may be exposed to UV radiation should ask their physicians about the possibility of sensitization when given any new prescriptions.

Chronic effects of overexposure include skin cancer and senile cataracts.

A person's risk of contracting skin cancer has been shown to increase with excessive exposure to UV radiation over many years. The most common types of skin cancer, basal cell carcinoma and squamous cell carcinoma, are not usually life-threatening if treated early. Malignant melanoma is a more rare, but much more dangerous, form of skin cancer.

A senile cataract is a clouding of the lens of the eye in older people, often impairing vision and eventually requiring surgery. Long-term UV exposure has been shown to be an important factor in the development of this disease.

## **Exposure Guidelines**

Threshold limit values recommended by the American Conference of Government Industrial Hygienists (ACGIH) are adopted by the Ontario Ministry of Labour and are applicable in Ontario workplaces. The guidelines limit the "effective UV radiant exposure" to three millijoules per square centimetre, accumulated over an eight-hour period.

Additionally, the total irradiance of "near UV radiation" (320 to 400 nm) on the unprotected eye is limited to 1.0 milliwatt per square centimetre for periods greater than 16.7 minutes and to 1.0 joule per square centimetre for shorter periods. These guidelines do not apply to UV lasers or to workers exposed to hypersensitizing substances.

## **REQUIREMENT:**

### ***Engineering Controls***

UV radiation should be contained or confined to a restricted area when practicable. UV radiation can be easily contained with opaque materials, such as cardboard or wood. Transparent materials, such

as glass, PVC (polyvinylchloride), Plexiglass and Perspex, block UV radiation in varying degrees.

A high-power UV source should have interlocked access, so that it is shut off when the protective enclosure is open.

### **Administrative Controls**

Whenever UV radiation cannot be contained or confined, worker exposure should be minimized by limiting exposure times and increasing the distance between workers and the sources. Areas where exposure to UV radiation is possible should have appropriate warning signs.

The exposure of outdoor workers to solar UV radiation should be minimized by: making use of natural or artificial shade scheduling alternative tasks when the sun is most intense

### **Personal Controls**

Workers exposed to UV radiation in excess of the above guidelines should use the following personal protective equipment:

- UV-blocking safety eyewear (goggles, spectacles, face shields, welding shields, etc.) with side-shields
- Long-sleeved, closely-woven clothing that covers as much of the body as practicable
- Sun-screen with a sun-protection factor (SPF) of 15 or higher and effective against UV-A and UVB on all exposed skin.

### **Outdoor workers should:**

- Wear a wide-brimmed hat
- Wear long-sleeved, closely-woven clothing that covers as much of the body as practicable
- Use sun-screen with a sun-protection factor (SPF) of 15 or higher, effective against UV-A and UV-B on all exposed skin protect their lips with sunscreen or lipstick with an SPF of 15 or higher

use UV-blocking sunglasses

**Note:** The use of UV-safety measures should not lead to other safety risks--the risk of head injuries from using hats with inadequate impact protection, for example, or the risk of heat stress from wearing heavy clothing in hot environments.

## **Exposure to Cold Temperatures**

Cold temperatures can be a serious occupational hazard for workers. Workers who are exposed to cold temperatures are not necessarily those who work outdoors, but also include workers who work in refrigerated rooms or unheated buildings, and run the risk of experiencing hypothermia.

Cold environments pose challenges to workers in various ways: by air temperature, air movement (wind speed), and humidity. In order to ensure that workers are able to work safely, controls must be implemented to counterbalance the effects such as proper insulation, physical activity and controlled exposure through work/rest scheduling.

## Cold Stress

Exposure to cold temperatures can cause various health issues, which if not treated immediately, such as hypothermia, can be fatal. Cold stress can affect people working in cold or wet environments.

Workers can be affected by the following factors, which can lead to cold stress:

- Naturally or artificially cooled environments
- Wind, which pulls heat away from the body
- Wet clothing, from sweat or water
- Cold water immersion, which cools the body 25 times faster than cold air
- Fatigue, which makes it harder for the body to create heat
- Workers with a pre-existing condition such as hypertension, hypothyroidism, diabetes and poor physical conditioning

## Wind Chill

At any temperature, you feel colder as the wind speed increases. The combined effect of cold air and wind speed is expressed as "equivalent chill temperature" (ECT) or simply "wind chill" temperature in degrees Celsius or Fahrenheit. It is essentially the air temperature that would feel the same on exposed human flesh as the given combination of air temperature and wind speed. It can be used as a general guideline for deciding clothing requirements and the possible health effects of cold.

In some parts of Canada the term "wind chill factor" is used. This is a measurement of a heat loss rate caused by exposure to wind and it is expressed as the rate of energy loss per unit area of exposed skin per second.

Estimated wind speed (in km/h)	Actual temperature reading (°C)												
	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
	Equivalent chill temperature (°C)												
<b>Calm</b>	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
<b>8</b>	9	3	-2	-7	-12	-18	-23	-28	-33	-38	-44	-49	-54
<b>16</b>	4	-2	-7	-14	-20	-27	-33	-38	-45	-50	-57	-63	-69
<b>24</b>	2	-5	-11	-18	-25	-32	-38	-45	-52	-58	-65	-72	-78
<b>32</b>	0	-7	-14	-21	-28	-35	-42	-50	-56	-64	-71	-78	-84
<b>40</b>	-1	-8	-16	-24	-31	-38	-46	-53	-60	-67	-76	-82	-90
<b>48</b>	-2	-10	-17	-25	-33	-40	-48	-55	-63	-70	-78	-86	-94
<b>56</b>	-3	-11	-18	-26	-34	-42	-50	-58	-65	-73	-81	-89	-96
<b>64</b>	-3	-11	-19	-27	-35	-43	-51	-59	-66	-74	-82	-90	-98
(Wind speeds greater than 64 km/h have little additional effect.)	LITTLE DANGER In < 1 hr with dry skin. Maximum danger of false sense of security.			INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.					
Trenchfoot and immersion foot may occur at any point on this chart.													

Equivalent chill temperature requiring dry clothing to maintain core body temperature above 36°C (96.8° F) per cold stress TLV.

To determine wind chill (approximation) when no measuring device is available, the following may be used as a guideline:

- 8km/h (5mph) wind will move a light flag
- 16 km/h (10 mph) wind will fully extend the flag
- 24 km/h (15 mph) wind will raise a newspaper sheet
- 32km/h (20 mph) wind will produce blowing and drifting snow

In refrigerated rooms, the air speed should not exceed 1 meter per second. If workers are simultaneously exposed to vibration and/or toxic substances, reduced limits for cold exposure may be necessary.

### Cold Stress Related Disorders and Symptoms:

Wind Chill	Exposure Risk	Symptoms	Treatment
0 to -9	Low risk	<ul style="list-style-type: none"> <li>• Slight increase in discomfort</li> </ul>	<ul style="list-style-type: none"> <li>• Dress warmly</li> <li>• Stay dry</li> </ul>
-10 to -27	Moderate risk	<ul style="list-style-type: none"> <li>• Uncomfortable</li> <li>• Risk of hypothermia and frostbite if outside for long periods without adequate protection.</li> </ul>	<ul style="list-style-type: none"> <li>• Dress in layers of warm clothing, with an outer layer that is wind-resistant.</li> <li>• Wear a hat, mittens or insulated gloves, a scarf and insulated, waterproof footwear.</li> <li>• Stay dry.</li> <li>• Keep active.</li> </ul>
-28 to -39	<b>High risk:</b> exposed skin can freeze in 10 to 30 minutes	<ul style="list-style-type: none"> <li>• High risk of frostnip frostbite: Check face and extremities for numbness or whiteness.</li> <li>• High risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.</li> </ul>	<ul style="list-style-type: none"> <li>• Dress in layers of warm clothing, with an outer layer that is wind-resistant.</li> <li>• Cover exposed skin</li> <li>• Wear a hat, mittens or insulated gloves, a scarf and insulated, waterproof footwear.</li> <li>• Stay dry.</li> <li>• Keep active.</li> </ul>
-40 to -47	<b>Very high risk:</b> exposed skin can freeze in 5 to 10	<ul style="list-style-type: none"> <li>• Very high risk of frostbite: Check face and</li> </ul>	<ul style="list-style-type: none"> <li>• Dress in layers of warm clothing, with an outer layer that</li> </ul>

	minutes  (In sustained winds over 50 km/h, frostbite can occur faster than indicated.)	extremities for numbness or whiteness. <ul style="list-style-type: none"> <li>• Very high risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.</li> </ul>	is wind-resistant. <ul style="list-style-type: none"> <li>• Cover all exposed skin</li> <li>• Wear a hat, mittens or insulated gloves, a scarf and insulated, waterproof footwear.</li> <li>• Stay dry.</li> <li>• Keep active.</li> </ul>
-48 to -54	<b>Severe risk:</b> exposed skin can freeze in 2 to 5 minutes  (In sustained winds over 50 km/h, frostbite can occur faster than indicated.)	<ul style="list-style-type: none"> <li>• Severe risk of frostbite: Check face and extremities frequently for numbness or whiteness.</li> <li>• Severe risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.</li> </ul>	<ul style="list-style-type: none"> <li>• Be careful. Dress very warmly in layers of clothing, with an outer layer that is wind-resistant.</li> <li>• <b>Cover all exposed skin</b></li> <li>• Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask and insulated, waterproof footwear.</li> <li>• <b>Be ready to cut short or cancel outdoor activities.</b></li> <li>• Stay dry.</li> <li>• Keep active.</li> </ul>
-55 and colder	<b>Extreme risk:</b> exposed skin can freeze in less than 2 minutes	<ul style="list-style-type: none"> <li>• <b>DANGER!</b> Outdoor conditions are hazardous.</li> </ul>	<ul style="list-style-type: none"> <li>• Stay indoors.</li> </ul>

Courtesy of: Environment Canada

## Hypothermia

Cold stress can lead to hypothermia. This is a gradual process, and because it happens slowly, is particularly dangerous because workers may not be aware of it until it is too late. Feeling cold is the most important warning sign to note. If a worker feels cold, their bodies are likely losing heat faster than their bodies are making it.

There are 3 stages of hypothermia, with key symptoms to be aware of:

<b>Mild</b>	<ul style="list-style-type: none"> <li>• Shivering</li> <li>• Grogginess</li> <li>• Poor judgement or confused thinking</li> </ul>
<b>Moderate</b>	<ul style="list-style-type: none"> <li>• Violent shivering</li> <li>• Inability to think or pay attention</li> <li>• Slow, shallow breathing</li> <li>• Slurred speech</li> <li>• Poor body coordination</li> </ul>
<b>Severe</b>	<ul style="list-style-type: none"> <li>• Loss of consciousness</li> <li>• Little or not breathing</li> <li>• Weak, irregular, or non-existent pulse</li> </ul>

### **Treatment**

If a worker is suffering from any stage of hypothermia, they should be provided with medical attention immediately and moved to a dry, warm area. Wet clothing should be removed and replaced with dry clothing, and the body should be covered, including the head and neck with layers of blankets, and with a vapour barrier (like a tarp or garbage bag). The face should not be covered.

If medical attention is more than 30 minutes away, workers should be given sweetened drink, if they are alert (no alcohol), to help increase body temperature. Drinks should never be administered to an unconscious person.

Place warm bottles or hot packs in the armpits, sides of the chest, and groin.

If the person is not breathing or has no pulse, call 9-1-1 immediately and treat the person for hypothermia as stated above; do not give them fluids.

Check them for signs of breathing and a pulse and check again in 60 seconds. If the person is still not breathing, rescue breaths for 3 minutes may be administered by a first aid trained individual. Only begin chest compressions at the advice of 9-1-1.

### **Frostbite**

Frostbite is an injury to the body that is caused by freezing of the skin and underlying tissues. The lower the temperature, the more quickly frostbite will occur. Frostbite typically affects the extremities, particularly the feet and hands. Amputation may be required in severe cases.

### **Symptoms of Frostbite**

- Reddened skin develops gray/ white patches
- Numbness in the affected areas
- Feels firm or hard
- Blisters may occur in the affected part, in severe cases

### **Treatment**



- Treat as you would for hypothermia
- Do not rub area to warm it as this may cause more damage
- Do not apply snow or water.
- Do no break blisters
- Loosely cover and protect the area from contact
- Do not try to rewarm the frostbitten area before seeking medical attention, such as placing under warm water. If a frostbitten area is rewarmed and gets frozen again, more tissue damage will occur.
- Give warm sweetened drinks if the person is alert

## **Trench Foot**

Trench foot, or immersion foot, is caused by prolonged exposure to wet and cold temperatures. It can occur at temperatures as high as 15 C if the feet are constantly wet. Non-freezing injury occurs because wet feet lose heat 25-times faster than dry feet. To prevent heat loss, the body constricts the blood vessels to shut down circulation in the feet. The skin tissue begins to die due to lack of oxygen, nutrients and toxin build-up.

## **Symptoms**

- Redness of the skin
- Swelling
- Numbness
- Blisters

## **Treatment**

Remove shoes, boots and wet socks and dry feet. Seek medical attention as soon as possible or call 9-1-1.

## **Chilbains**

Chilbains are a painful inflammation of the small blood vessels that occurs when skin is exposed to the cold, but not freezing air. Chilblains can cause itchy skin, red patches, swelling and blistering on exposed skin. These patches usually clear up within 1-3 weeks, particularly if the weather becomes warmer, but the potential exists for reoccurrences when seasonally for years. They do not usually result in permanent injury, however; the condition can lead to ulcers or infection which could cause damage if left untreated or lead to a life-threatening condition.

## **Symptoms**

- Small, itchy red patches on the skin
- Possible blisters or skin ulcers
- Swelling of the skin
- Burning sensation on the skin
- Changes in skin color from red to dark blue accompanied by pain.

## Treatment

Although chilblains tend to heal on their own, you should seek medical attention should any complications arise such as unusually severe pain, if infection is suspected or symptoms do not improve within 1-2 weeks. If symptoms extend into warmer seasons, you should see a doctor and be assessed. If you have poor circulation or diabetes, healing may be impaired. Seek medical attention at the first signs of chilblains.

## Risk Factors

- **Clothing that is too tight or exposes skin to the cold**  
Wearing tight-fitting clothing and shoes in cold, damp weather can cause you to be more vulnerable to chilblains. Skin that is exposed to cold, damp conditions are more likely to develop chilblains.
- **Your sex and weight**  
Women are more susceptible as are people who are 20% less than average weight. Women are more likely to get chilblains than are males or children. The cause for this is unknown. People who weigh 20% less than average for their height also have an increased risk.
- **Environment and season**  
Greater risk in areas with high humidity and cold, but not freezing temperatures. November to April are the most common months when chilblains occur.
- **Having poor circulation**
- **Having been diagnosed with Raynaud's disease**  
People with Raynaud's disease are more susceptible to chilblains. Either condition can result in sores, but Raynaud's causes different types of color changes to the skin.

## Controlling Cold Stress

To reduce the potential for injury or illness, effective controls must be implemented to ensure that the risk of exposure is minimal. Work that exposes workers to cold stress should be assessed for risk and planned accordingly, with the proper controls in place. Supervisors should have regular and ongoing communication with staff, particularly if conditions change. Whenever possible, the hazard should be eliminated or substituted, for example, performing the work in an alternative environment or using a process that generates less or cold or water.

## Engineering Controls

When the possibility to eliminate or substitute are not viable options, engineering controls can be used. Physical modifications, equipment or processes that can reduce exposure can be considered such as:

- Heated shelters
- Machines or tools that are designed to be used with mittens or gloves

## Administrative Controls

Work should be planned to ensure that workers's exposures are minimal, and workers need to be aware of the hazards and symptoms associated with cold stress illnesses. These controls include:

- Training, education and awareness of the signs and symptoms of cold stress
- Work planning/ task rotation/ break schedules
- Reasonable access to fluids
- Safe operating procedures
- Risk assessments
- Personal protective equipment

## Protective Clothing

It is vital that workers are properly dressed to prevent cold stress. In addition to layering clothing, the types of fabrics also make a difference. Cotton loses its insulation value when it becomes wet. Wool, silk, and most synthetic fabrics that retain their insulation even when wet. Polyesters and polypropylene thermal undergarments are designed to wick away moisture, keeping the skin dry and the second layer of clothing away from the skin.

- Wear at least 3 layers of loose fitting clothing. Layering provides better insulation. Do not wear fitted clothing. **Recommended:**
  - ✓ An inner layer of wool, silk or synthetic clothing to provide insulation even when wet
  - ✓ A middle layer of wool or synthetic clothing
  - ✓ An outer wind and rain protection layer that allows some ventilation to prevent overheating
- Wear a hat or hood to keep your whole body warmer. Hats reduce the amount of body heat lost through the head
- Use a knit mask to cover the face and mouth (when appropriate)
- Use insulated gloves to protect hands (water resistant if necessary). If fine manual dexterity is not required, gloves should be used below 4°C for light work and below -7°C for moderate work. For work below -17°C, mittens should be used.
- Wear insulated and waterproof footwear
- Clothing should be kept clean since dirt fills air cells in fibers of clothing and destroys its insulating ability.

## Footwear

Felt-lined, rubber bottomed, leather-topped boots with removable felt insoles are best suited for heavy work in cold since leather is porous, allowing the boots to "breathe" and let perspiration evaporate. Leather boots can be "waterproofed" with some products that do not block the pores in the leather. However, if work involves standing in water or slush, the waterproof boots must be worn. While these protect the feet from getting wet from cold water in the work environment, they also prevent the perspiration to escape. The insulating materials and socks will become wet more quickly than when wearing leather boots and increase the risk for frostbite.

## **Socks**

Workers may want to consider wearing one pair of thick, bulky socks or two pairs - one inner sock of silk, nylon, or thin wool and a slightly larger, thick outer sock. Liner socks made from polypropylene will help keep feet dry and warmer by wicking sweat away from the skin. However, as the outer sock becomes damper, its insulation properties decrease. If work conditions permit, have extra socks available so you can dry your feet and change socks during the day. If two pairs of socks are worn, the outer sock should be a larger size so that the inner sock is not compressed.

Workers should always wear the right thickness of socks for their boots. If they are too thick, the boots will be "tight," and the socks will lose much of their insulating properties when they are compressed inside the boot. The foot would also be "squeezed" which would slow the blood flow to the feet and increase the risk for cold injuries. If the socks are too thin, the boots will fit loosely and may lead to blisters.

## **Face and Eye Protection**

In extremely cold conditions, where face protection is used, eye protection must be separated from the nose and mouth to prevent exhaled moisture from fogging and frosting eye shields or glasses. Select protective eye wear that is appropriate for the work you are doing, and for protection against ultraviolet light from the sun, glare from the snow, blowing snow/ice crystals, and high winds at cold temperatures.

## **Safe Work Practices**

In addition to scheduling work and pre-planning tasks so that they take place during warmer parts of the day, other safe work practices include:

- Workers should have access to fluids, in particular warm, sweetened liquids, in order to prevent dehydration. Avoid alcoholic beverages.
- Eat regular balanced meals to keep sustain energy
- Assign workers to tasks in pairs (buddy system) so that they can monitor each other for signs of cold stress.
- Allow for more frequent breaks in warm areas
- Acclimize new and returning workers after being away from work by gradually increasing their workload so that they are able to build up a tolerance for working in cold environments

## **Guideline for Warm-Up Breaks**

There are no maximum exposure limits for cold working environments, rather, there are guidelines that can be used to conduct work/task assessments, create safe work plans, and monitor conditions to protect the health and safety of workers who may be exposed to cold temperatures. The "work warm-up schedule" developed by the Saskatchewan Department of Labour has been adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) as Threshold Limit Values (TLVs) for cold stress.

The "work warm-up schedule" provides guidance on warm-up breaks that may be needed when working in cold conditions. As the wind increased or as the temperature decreases, additional breaks should be taken (which shortens the length of time when working in the cold). Consider having warm-

up breaks when the temperature reaches -26 °C (-15 °F) and when the winds are 16 km/h (10mph) or greater. All non-emergency work should be stopped at temperatures of -43 °C (-45°F) if there is no noticeable wind. Refer to the chart for other scenarios when non-emergency work should be stopped.

Sunny sky Air Temperature		No noticeable wind		Wind 8 km / h (10 mph)		Wind 16 km / h (10 mph)		Wind 24 km / h (15 mph)		Wind 32 km / h (20 mph)	
°C below zero	°F below zero	Max. work period	Number of work breaks	Max. work period	Number of work breaks	Max. work period	Number of work breaks	Max. work period	Number of work breaks	Max. work period	Number of work breaks
26 to 28	15 to 19	normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	40 minutes	4
29 to 31	20 to 24	normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
32 to 34	25 to 29	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Non-emergency work should stop	
35 to 37	30 to 34	55 minutes	3	40 minutes	4	30 minutes	5	Non-emergency work should stop			
38 to 39	35 to 39	40 minutes	4	30 minutes	5	Non-emergency work should stop					
40 to 42	40 to 44	30 minutes	5	Non-emergency work should stop							
43 and below	45 and below	Non-emergency work should stop									

Source: Adapted from Threshold Limit Values (TLV) and Biological Exposure Indices (BEI) booklet: published by ACGIH, Cincinnati, Ohio, 2016, page 210.

**Considerations:**

1. Applies to moderate to heavy physical work in any 4 hour period.
2. Warm-up breaks should be in a warm environment for 10 minutes.
3. Norm breaks means the normal break after 2 hours of work.
4. Guidelines apply to workers wearing dry clothing.
5. If there is limited physical activity, apply the schedule one step lower (more protective).

For work with limited physical activity, apply this schedule on step lower. For example, at -35C, with no noticeable wind, a worker with a job requiring little physical movement, should have a maximum period of 40 minutes with four breaks in a 4-hour period.

**Indoor Thermal Comfort**

“Thermal comfort” means that a person wearing a normal amount of clothing feels neither too cold nor too warm. Thermal comfort is important both for one’s well-being and for productivity. It can be achieved only when the air temperature, humidity and air movement are within the specified range often referred to as the "comfort zone".

**Humidity**

The ASHRAE Standard 55-2013 uses a graphic comfort zone method that takes into account the factors of relative humidity, humidity ratio, operative temperature, and wet bulb temperature with notes on clothing, metabolic rate, radiant temperature, and air speeds. In Appendix F, ASHRAE states “there are no established lower humidity limits for thermal comfort; consequently, this standard does not specify a minimum humidity level.”

CSA recommendations for temperature (above) are listed at an average of 50% humidity.

Relative humidity levels below 20% can cause discomfort through drying of the eyes and mucous membranes and skin. Low relative humidity levels may also cause static electricity build-up and negatively affect the operations of some office equipment such as printers and computers. Relative humidity levels above 70% may lead to the development of condensation on surfaces and within the interior of equipment and building structures. Left alone, these areas may develop mold and fungi. Higher humidity also makes the area feel stuffy.

The Health and Safety Executive (UK) states that a relative humidity between 40% and 70% does not have a major impact on thermal comfort.

## **Air Velocity**

Air velocity can be created by the air conditioning or ventilation system, and by cold surfaces (e.g., air flowing towards the floor). Thermal comfort is affected by this air movement. Drafts, especially on the head region (head, neck, and shoulders) and leg region (ankles, feet, legs) can cause discomfort.

Generally speaking, temperatures considered in the comfort zone will increase with increased air speed.

## **Other Factors**

Thermal comfort also depends on the metabolic rates (activities being done), the clothing a person wears, and radiant temperatures of other surfaces.

Metabolic rate (activities) and clothing will vary from person to person, even if every person wears the same clothing and performs the same activity. Where possible, allow individuals to have some control over clothing options and pace of work.

Radiant temperature sources include floors and windows. For example, poorly insulated windows can create a cold area in the winter, and sunshine can create a warm area in the summer. CSA states that humans are most sensitive to warm ceilings, and to cold vertical surfaces such as windows. Floor surface temperatures that are too high or too low, and that are different than air temperatures also contribute to thermal discomfort.

## **Controls**

Where air movement is virtually absent and when relative humidity can be kept at about 50%, the ambient temperature becomes the most critical factor for maintaining thermal comfort indoors.

However, temperature preferences vary greatly among individuals and there is no one temperature that can satisfy everyone. Nevertheless, an office which is too warm makes its occupants feel tired; an office that is too cold causes the occupants' attention to drift, making them restless and easily distracted.

Maintaining constant thermal conditions in the offices is important. Even minor deviation from comfort may be stressful and affect performance and safety. Workers already under stress are less tolerant of uncomfortable conditions. A general recommendation is that the temperature be held constant in the range of 21-23°C (69-73°F). In summertime when outdoor temperatures are higher it is advisable to keep air-conditioned offices slightly warmer to minimize the temperature discrepancy between indoors and outdoors.

The minimum temperature for a workplace in the province of Ontario is 18°C C (where it is practical to maintain a consistent temperature). Where the College is unable to maintain a temperature of 18°C in an office environment, other measures should be taken to ensure that workers are warm and comfortable, such as: allowing them to wear additional clothing, temporary alternative work arrangements such as alternative work locations or tele-work, and providing alternative sources of heat.