



Guidelines on Cold Stress – Working in Cold Environments

1.0 INTRODUCTION

Workers who are exposed to extreme cold, or work in cold environments may be at risk of “Cold Stress”. Cold stress is the response of the body to cold temperatures resulting from heat loss and the opposite of Heat Stress (refer to University of Toronto’s Guidelines on Heat Stress – Working in Hot Environments). Various factors can affect the body’s ability to tolerate or maintain internal core body temperatures. Factors include: the heat generated within the body from the work activity, how we lose heat to the environment (conduction, convection, radiation, evaporative heat loss), environmental conditions (e.g. air temperature, humidity, air movement) and the clothing worn.

Working in cold environments can potentially be dangerous to untrained and unprepared individuals. Cold related injuries can happen to anybody, although there are various risk factors where certain individuals may become more susceptible to cold-related injuries. In Ontario, cold stress can occur to those who work outdoors in the winter, but could also include some indoor workers (such as meat packaging and meat storage workers, or workers in refrigerated warehouses). At the University of Toronto, cold stress is usually a concern in the winter weather and working outdoors, such as grounds and trades maintenance crews, building engineers, campus police officers, and parking enforcers. In some cases, academic staff may also spend significant time outdoors in field research.

There are various cold-related injuries that can occur with exposure to extreme cold, ranging from non-freezing injuries, freezing injuries, or hypothermia. Information and specific signs and symptoms on cold-related injuries are provided in Appendix 1. Individuals with previous cold-related injuries, pre-existing conditions, or on specific medications, may be more susceptible to cold-related injuries and should therefore discuss their concerns with their physicians and their supervisor.

Scope

This procedure applies to all University of Toronto staff who may be exposed to extreme cold, either indoors or outdoors, during their work. It also applies to external workers (e.g. contractors) who may be contracted to work in cold environments for the University.

2.0 RESPONSIBILITIES

The roles and responsibilities for management, supervisors and workers are documented below. Workers should report concerns to their supervisors and at any time, the Office of Environmental Health and Safety (EHS) can be contacted for assistance or consultation.

Supervisors/management/principle investigators

- Identify work areas/activities where exposure to cold may occur.
- Identify workers who may be exposed to cold during the course of their work (see Section D: Medical Surveillance)
- Develop, document, and implement appropriate measures and precautions by using these procedures or in conjunction with the Office of Environmental Health and Safety (EHS).
- Ensure that a Job Safety Analysis (JSA) or written work procedure is completed where necessary and that they are readily available to workers.



- Ensure controls identified in the JSA or other work procedures are followed.
- Ensure that workers who are exposed to cold environments are provided with the equipment, personal protective equipment (PPE), training or other resources as identified by the JSA or other work procedures.
- Where work is contracted to external parties, equivalent procedures should be followed.

Workers

- Report health and safety hazards, including any signs or symptoms of cold related injuries, to supervisors
- Where requested, assist supervisors in identifying cold environments or situations with potential and participate in the development of the JSA or work procedure.
- Review applicable JSA or other work procedures before start of work.
- Follow safety procedures and use equipment and/or PPE as defined in the JSA or work procedure.

Office of Environmental Health & Safety

- Provide consultation and perform assessments on cold stress-related matters as needed.
- Update and maintain online training module on Working in Cold Environments (EHS530 Working in Cold Environments). Supervisors and workers may register via the EHS Training Registration website (<https://ehs.utoronto.ca/training/my-ehs-training/>)
- Update and maintain these Guidelines on a regular basis and/or when new information becomes available.

3.0 GENERAL CONTROLS TO REDUCE COLD EXPOSURE

Controls for reducing cold exposure fall into 4 categories:

- A. Engineering controls**
- B. Administrative controls and work practices**
- C. Personal Protective Equipment (PPE)**
- D. Training**

Generally, the hierarchy of controls starts with engineering controls since they have the ability to reduce or eliminate the hazard. The other controls do not eliminate or reduce the hazard but try to reduce its impact on the worker and provide workers with information to recognize early symptoms of cold stress.

A: Engineering Controls

- Review equipment design. Metal handles and bars should be covered by thermal insulating material. Machines and tools should be designed so that they can be operated without having to remove mittens or gloves. Unprotected metal chair seats should not be used.
- Reduce cold weather exposure of the work task through mechanical assistance (snow-blowers, etc.).
- Provide warm areas for break (portable heating units, heated shelters, access to warm buildings, etc.)
- Protect the worker from drafts to the greatest extent where possible (e.g. shielding)
- For refrigeration rooms, air velocity should be minimized and not exceed 1 m/s
- Review and minimize potential for simultaneous exposure to vibration and/or toxic substances

B: Administrative Controls and Work Practices



- Assess the demands of all jobs and have monitoring and control strategies in place for cold days and cold workplaces. Below is a list of charts that can be used to develop and implement control strategies:
 - Risk Management Process for Evaluating Cold Stress and Strain (ACGIH booklet 2019)
 - Approximate amount of clothing insulation needed at different air temperatures and physical activity levels (ACGIH booklet 2019)
 - Intensity of Exercise for Selected Outdoor Activities (ACGIH booklet 2019)
 - Cold-Water Immersion Time Limits (Hours) for Reaching a Core Temperature of 35.5°C at Different Water Temperatures and Immersion Depths (ACGIH booklet 2019)
 - Wind Chill Temperature Index. Frostbite Times are for Exposed Facial Skin
 - “Work Warm-Up Schedule”
(https://www.labour.gov.on.ca/english/hs/pubs/filmguide/appendix_c.php)
 - Environment Canada weather reports
- Increase the frequency and length of rest breaks – EHS can assist in interpreting available guidelines.
- Schedule outdoor jobs to warmer times of the day.
- Review monitoring needs. A thermometer to monitor cold environments can be considered for installation.
- Avoid sugary, caffeinated or alcoholic drinks.
- Avoid assigning workers sitting or standing tasks for prolonged periods (e.g. inactivity)
- Train workers to recognize the signs and symptoms of cold stress and start a buddy system since people are not likely to notice their own symptoms.

Investigate any cold-related incidents.

- Where appropriate, develop an emergency response plan should be in place in the event of a cold related illness.
- Workers with a medical condition – or those taking certain medications – should discuss with their physicians and their supervisors regarding working in the cold.

C: Personal Protective Equipment (PPE)

- Protective clothing may be needed for work at or below 4°C. They must be properly selected to suit the temperature, weather conditions, duration of activity and job design:
 - Multiple layers of clothing, inner layer to ‘wick’ moisture away from body to keep it dry. Waterproof outer layer for wet conditions.
 - Wool knit cap or a liner under a hard hat
 - Appropriate gloves or mittens (e.g. gloves for work below 4°C for light work and below -7°C for moderate work; mittens for work below -17°C).
 - Appropriate boots (e.g. felt-lined, rubber-bottomed, leather-topped boots with removable felt insoles for heavy work; waterproof boots if standing in water or slush)
 - Appropriate socks (e.g. one pair thick bulky socks or two pairs – inner lining and outer thicker socks). Where possible, have extra socks available.
 - Eye and face protection, such as glasses/goggles, scarfs (from wind, blowing snow, glare, UV, etc.). In extremely cold conditions, eye protection must be separated from the nose and mouth to prevent exhaled moisture from fogging and frosting eye shields or glasses.
- Keep clothing clean.
- Keep clothing dry. Remove any snow on outerwear clothes prior to entering heated shelters.



- Use of some waterproof personal protective equipment may not allow sweat to escape - insulating materials (e.g. socks) can become wet more quickly and increase risk of cold-related injuries and must be considered when reviewing the job task.

D: Training

- Workers who are exposed to cold as part of their job and their supervisors should take the online training course EHS530 Working in Cold Environments. Supervisors and workers may register via the EHS Training Registration website (<https://ehs.utoronto.ca/training/my-ehs-training/>).
- Supervisors and managers should also take the course on Job Safety Analysis. This tool assists supervisors and managers in planning out a job safely from beginning to end. Visit the above EHS Training Registration Website if interested (EHS303 Job Safety Analysis).
- In addition to formal training such as the online course, supervisors can also take the opportunity to review department- or work-specific procedures for cold stress (or other health and safety requirements) in other forums such as toolbox talks, operations meetings, etc.

D: Medical Surveillance

- Supervisors/management/principle investigators who identify workers who may be exposed to cold (continuous work of greater than 30 minutes with the air temperature is lower than -15 °C, or when wind chill is lower than -25 °C) during the course of their work are recommended to have those employees partake in the medical surveillance survey. The Hot/Cold Exposure Medical Surveillance Survey (word document form available in separate links on the EHS website), is a screening tool that can be used by the department to determine if there are any workers exposed to cold working environments who have health conditions which requires an additional review by Occupational Health Services.
- For those identified workers who may be exposed to the cold, and do NOT use respiratory protection:
 - Complete the Hot/Cold Exposure Medical Surveillance Survey.
 - Completed surveys are to be kept on file by the department.
 - If your employee indicates “Yes” to any of the medical conditions listed in the survey in, Supervisor/management/principle investigators are to contact Occupational Health Services.
- For those identified workers who may be exposed to the cold, and do USE respiratory protection:
 - The survey as required in the Respiratory Protection Program takes into account the medical surveillance for cold stress and cold exposure, and therefore does not need to be completed.



Appendix 1: Cold-Related Illnesses and Disorders

Sources: Canadian Centre for Occupational Health and Safety (November 2019), American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices booklet (2019)

Injury type	Illness or Disorder	Cause	Signs and Symptoms
Non-Freezing Injury	Chillblains	Prolonged and repeated exposure for several hours to air temperatures from above freezing (0°C or 32°F) to as high as 16°C (or about 60°F).	Redness, swelling, tingling and pain.
	Immersion Foot	Occurs in individuals whose feet have been wet, but not freezing cold, for days or weeks. It can occur at temperatures up to 10°C (50°F). The primary injury is to nerve and muscle tissue.	Tingling and numbness; itching, pain, swelling of the legs, feet, or hands; or blisters may develop. The skin may be red initially and turn to blue or purple as the injury progresses. In severe cases, gangrene may develop.
	Trenchfoot (wet cold disease)	Prolonged exposure in a damp or wet environment from above the freezing point to about 10°C (50°F). Trenchfoot is more likely to occur at lower temperatures whereas an immersion foot is more likely to occur at higher temperatures and longer exposure times.	Tingling and numbness; itching, pain, swelling of the legs, feet, or hands; or blisters may develop. The skin may be red initially and turn to blue or purple as the injury progresses. In severe cases, gangrene may develop.
Freezing Injury	Frostnip	Mildest form of freezing cold injury and occurs when ear lobes, noses, cheeks, fingers, or toes are exposed to the cold and the top layers of a skin freeze. Frostnip can be prevented by wearing warm clothing and foot wear. It is treated by gentle rewarming.	The skin of the affected area turns white and it may feel numb. The top layer of skin feels hard but the deeper tissue still feels normal (soft).
	Frostbite	Caused by exposure to extreme cold or by contact with extremely cold objects (e.g metal). It may also occur in normal temperatures from contact with cooled or compressed gases. Frostbite occurs when tissue temperature falls below the freezing point (0°C/32°F), or when blood flow is obstructed. Blood vessels may be severely and permanently damaged, and blood circulation may stop in the affected tissue.	In mild cases, the symptoms include inflammation of the skin in patches accompanied by slight pain. In severe cases, there could be tissue damage without pain, or there could be burning or prickling sensations resulting in blisters. Frostbitten skin is highly susceptible to infection, and gangrene (local death of soft tissues due to loss of blood supply) may develop.



Stage	Core Temperature		Physiological Changes
	°F	°C	
Mild Hypothermia	98.6	37.0	Maximal shivering; increased blood pressure
	95.0	35.0	Amnesia; dysarthria; poor judgement; behaviour change
	91.4	33.0	Ataxia; apathy
Moderate Hypothermia	89.6	32.0	Stupor
	87.8	31.0	Shivering ceases; pupils dilate
	85.2	30.0	Cardia arrhythmias; decreased cardiac output
	84.2	29.0	Unconsciousness
Severe Hypothermia	82.4	28.0	Ventricular fibrillation likely; hypoventilation
	80.6	27.0	Loss of reflexes and voluntary motion
	78.8	26.0	Acid-base disturbances; no response to pain
	77.0	25.0	Reduced cerebral blood flow
	75.2	24.0	Hypotension; bradycardia; pulmonary edema
	73.4	23.0	No corneal reflexes; areflexia
	66.2	19.0	Electroencephalographic silence
	64.4	18.0	Asystole
	59.2	15.2	Lowest infant survival from accidental hypothermia
56.7	13.7	Lowest adult survival from accidental hypothermia	

First aid for frostbite, as well as immersion or trench foot, includes:

- Seek medical attention.
- If possible, move the victim to a warm area.
- Gently loosen or remove constricting clothing or jewellery that may restrict circulation.
- Loosely cover the affected area with a sterile dressing. Place some gauze between fingers and toes to absorb moisture and prevent them from sticking together.
- Quickly transport the victim to an emergency care facility.
- DO NOT attempt to rewarm the affected area on site (but do try to stop the area from becoming any colder) - without the proper facilities tissue that has been warmed may refreeze and cause more damage.
- DO NOT rub area or apply dry heat.
- DO NOT allow the victim to drink alcohol or smoke.

Hypothermia is a medical emergency. At the first sign, find medical help immediately. The survival of the victim depends on their co-workers ability to recognize the symptoms of hypothermia. The victim is generally not able to notice his or her own condition.

First aid for hypothermia includes the following steps:

- Seek medical help immediately. Hypothermia is a medical emergency.
- Ensure that wet clothing is removed.
- Place the victim between blankets (or towels, newspaper, etc.) so the body temperature can rise **gradually**. Body-to-body contact can help warm the victim's temperature slowly. Be sure to cover the person's head.
- Give warm, sweet (caffeine-free, nonalcoholic) drinks unless the victim is rapidly losing consciousness, unconscious, or convulsing.
- Quickly transport the victim to an emergency medical facility.
- Do not attempt to rewarm the victim on a site (e.g., do not use hot water bottles or electric blankets).
- Perform CPR (cardiopulmonary resuscitation) if the victim stops breathing. Continue to provide CPR until medical aid is available. The body slows when it is very cold and in some cases,



hypothermia victims that have appeared "dead" have been successfully resuscitated.



Hot/Cold Exposure Medical Surveillance Survey

Parts A and B of this form to be completed by the supervisor of any worker identified with potential exposure to hot or cold working environments.

Part C of this form is to be completed by the worker

- Completed surveys are to be kept on file by the department
- If the employee indicates “Yes” to any of the medical conditions listed in Part C, the supervisor is required to contact Occupational Health Services <https://ehs.utoronto.ca/aboutus/contact-us/>

Part A: PERSONNEL INFORMATION

Last Name:	First Name: _
Personnel Number:	Telephone:
Department:	Job Title:
Supervisor name:	

Part B: CONDITIONS PERTAINING TO HEAT OR COLD STRESS

Check all that apply:

<input type="checkbox"/>	Indoor/Outdoor Humidex > 30 degrees Celsius (C)
<input type="checkbox"/>	Continuous work; >30 minutes in hot indoor areas (e.g. steam plant, mechanical rooms)
<input type="checkbox"/>	Continuous work; >30 minutes in temperatures <-15C or wind chill < -25C
<input type="checkbox"/>	

Part C: WORKER HEALTH CONDITIONS

(Circle or mark an ‘X’ at YES or NO only. **Do not specify health condition**)

Some conditions can seriously affect your ability to safely work in hot or cold environments. Do you have or do you experience any of the following, or other conditions that may affect working in hot or cold environments?

Hot Environment –	Yes	No	Cold Environment –	Yes	No
Shortness of breath			Shortness of breath		
Breathing difficulties			Breathing difficulties		
Chronic Bronchitis			Chronic Bronchitis		
Emphysema			Emphysema		
Lung Disease			Lung Disease		
Severe Allergies			Heart Problems		
Heart Problems			Chest pain on exertion		
Chest pain on exertion			Hypertension		



Hot Environment – Yes No

- Cardiovascular disease
- Diabetes
- Fainting spells
- Seizures
- Asthma
- Pacemaker
- Skin conditions
- Peripheral Vascular Disease
- Anhidrosis

Cold Environment – Yes No

- Diabetes
- Fainting spells
- Seizures
- Panic attacks
- Asthma
- Pacemaker
- Chronic Obstructive Pulmonary Disease (COPD)
- Cystic Fibrosis
- Cold Agglutinins Disease
- Raynaud's Disease
- Any Rheumatic Disease (Systemic lupus erythematosus, SLE, rheumatoid arthritis, RA, spondyloarthritis, SA)

Other condition(s) affecting ability to work in hot or cold environments not indicated above (circle 'Yes').

Signature of Employee: _____	Date: _____
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