Penn EHRS
Environmental Health & Radiation Safety

Cold Stress Prevention Program

Environmental Health & Radiation Safety
4-2-2025

Contents

1. PURPOSE

The University of Pennsylvania, in coordination with the Office of Environmental Health and Radiation Safety (EHRS), is committed to providing the Penn community with a safe and healthful environment.
The Cold Stress Prevention Program provides guidance to assist faculty, staff, and students in preventing cold stress-related illnesses and injuries.

2. BACKGROUND

Cold stress occurs when the body loses heat faster than it can be produced, often due to low temperatures, wind, dampness, or cold-water exposure. While exact statistics vary, cold-related stress affects hundreds of workers annually, particularly in outdoor or unheated indoor settings.

Prevention of cold stress relies on education, environmental assessment, implementation of safe work practices, proper clothing, acclimatization, and response plans to warm affected individuals.

3. APPLICATION

This program applies to Penn faculty and staff. Penn faculty and staff shall also apply the relevant parts of this program to at-risk students under their supervision. Cold stress risks arise from low air temperatures, high winds, dampness, and exposure to cold water.

4. GLOSSARY OF TERMS

4.1. **Acclimatization**: Gradual adaptation of the body to tolerate cold conditions.

4.2. **Cold Stress:** Strain on the body when heat loss exceeds normal levels, requiring thermoregulatory responses.

4.3. **Hypothermia:** A condition that occurs when the core body temperature (98.6°F) drops below 95°F, impairing normal metabolic, muscular, and brain functions.

4.4. **Frostbite:** An injury caused by freezing of the skin and deeper tissues, resulting in the loss of feeling and color from the affected area. Frostbite typically affects extremities, particularly the feet and hands.

4.5. **Trench Foot:** Nerve and muscle injury from prolonged wet, cold (non-freezing) exposure. Also known as “immersion foot.”

4.6. **Chilblains:** Painful inflammation of small blood vessels from repeated cold exposure, resulting in redness, and itching during additional exposures.

4.7. **Wind Chill:** Rate of heat loss from the body due to combined low temperature and wind speed.

4.8. **The Cold Stress Equation:** OSHA incorporated information obtained from the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values into the Cold Stress Equation. ***As the temperature decreases and/or the wind speed increases, the potential for cold stress related illnesses and injuries increases.***

4.9. **Cold Stress Emergency Action Plan (CSEAP):** A brief plan that defines the methods of response when individuals are exposed to cold conditions and are experiencing symptoms of cold stress. Plan is implemented while emergency responders are enroute.

5. RESPONSIBILITIES

5.1. **Environmental Health & Radiation Safety (EHRS):**

5.1.1. Develop, periodically review, and update the Cold Stress Prevention Program.
5.1.2. Perform cold stress exposure assessments with findings and recommended mitigation measures documented in a job safety analysis (JSA) form.
5.1.3. Provide or coordinate training.

5.2. **Penn Faculty, Management, Supervisors & Athletic Trainers:**

5.2.1. Monitor current weather conditions.
5.2.2. Implement this program with employees or students under their supervision.
5.2.3. Assess or request assessment of cold risk tasks and locations.
5.2.4. Ensure supervision or implement a buddy system to monitor employees for signs or symptoms.
5.2.5. Schedule work for the warmest times of the day when possible and have an established work/warm-up cycle.
5.2.6. Identify those who require training and contact EHRS to schedule.
5.2.7. Develop a Cold Stress Emergency Action Plan and train those responsible for implementing it.

5.3. **At Risk Penn Personnel:**

5.3.1. Understand personal risk factors. If these risk factors increase the likelihood of cold stress illness or injury, notify supervisor, manager, or faculty member to ensure the appropriate measures are implemented to reduce the risk.
5.3.2. Follow acclimatization process and safe work practices.
5.3.3. Request assessment of suspected cold risk tasks.
5.3.4. Participate in cold stress illness prevention training sessions.
5.3.5. Participate in the buddy system and immediately notify someone if cold stress related symptoms are experienced or observed in someone else.

6. TRAINING

6.1. **Training Frequency** - Employees or students at risk of cold stress related illness shall receive cold stress illness prevention training prior to beginning work or studies in the high-risk environment and annually thereafter.

6.2. **Training Content** – Cold Stress prevention training shall at minimum cover the following subject areas:

- Information contained in Penn's Cold Stress Prevention program.
- Cold Stress Emergency Action Plan details.
- Types of cold stress related illness and their common signs and symptoms.
- Job-related and personal risk factors for cold stress-related illnesses.
- How to assess the environment and apply cold stress prevention safe work practices.
- Importance of acclimatization for new or unacclimated workers.
- Appropriate work/warm up cycles (i.e., mandatory rest breaks) when wind chill is high.
- Importance of taking rest breaks in areas that are warmer than the work or study site. Examples: heated indoor area or heated vehicle.
- Fluid intake guidelines.
- First Aid for cold stress and emergency procedures.

7. SAFE WORK PRACTICES

7.1. **Cold Acclimatization** – Cold acclimatization shall be implemented for the following people and conditions:

7.1.1. New workers, those returning after a week away or longer, or when colder weather begins.

7.1.2. **Acclimatization Process** – Individuals new to a cold environment or those returning after time away should gradually increase their workload while allowing for more frequent breaks in warm areas as they build up tolerance for working in a colder environment. Some people with personal risk factors may take longer to build up a tolerance. Individuals should be monitored closely during the acclimatization period to ensure the best possible transition.

7.2. **Recommended Clothing -** Wear layers of loose-fitting, insulating clothing. Do not wear cotton; it loses its insulation value when wet.

- Inner layer - wool, silk or synthetic material to wick moisture away from the body.
- Middle layer - wool, fleece, or synthetic material to provide insulation even when wet.
- Outer layer - wind and rain protection that allows some ventilation to prevent overheating.
- Pack extra clothing in case you need to add a layer or get wet and need to change.
- Use insulated gloves, wear hats or other head coverings, socks, and face protection.

Figure 1 – NOAA Wind Chill Chart

7.3. **Cold Stress Assessment**:

7.3.1. Wind Chill Index- A widely used method for assessing cold stress. It combines the effects of wind speed and air temperature to estimate the cooling effect on the human body and provides an understanding of the "real feel" of the conditions. As the temperature decreases and/or the wind speed increases, the potential for cold stress related illnesses and injuries increases. This can be seen in the NOAA Wind Chill Chart.

7.3.2. NOAA Wind Chill Chart – This chart can be used when the temperature and wind (mph) of the location are known.

Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

7.4. **Engineering Controls** - Where possible, implement the following engineering controls to reduce cold stress:

- Radiant heaters
- Windbreaks
- Insulated surfaces
- Heated shelters
- Use of mechanical equipment to reduce manual work and exposure time.

7.5. **Administrative Controls** - Implement the following administrative controls:

7.5.1. Supervision and Buddy System – Implement close supervision and/or a buddy system where personnel can watch out for one another and identify onset of cold stress symptoms.

7.5.2. Hydration: Support hydration and provide warm fluids as needed.

- Water - Drink at least 8-ounces of water every 15 to 20 minutes regardless of thirst.
- Electrolyte Drinks – In higher stress environments, having electrolyte drinks available in addition to water is recommended.

7.5.3. Warm-Up Breaks - Mandate breaks in heated areas; increase duration as wind chill drops. See Appendix 3 for an example schedule.

8. SYMPTOMS AND CARE

8.1. **Personal Risk Factors** – Personal risk factors must be assessed and considered when assigning tasks in cold environments. Personal risk factors include the following:

- Age
- Obesity (body mass index greater than or equal to 30).
- Diabetes
- High blood pressure
- Heart disease
- Lower level of physical fitness.
- Use of certain medications such as diuretics (beta-blockers).
- Alcohol use
- Use of illicit drugs such as opioids, methamphetamine, or cocaine.

8.2. **Hypothermia:**

8.2.1. Symptoms:

- Shivering
- Fatigue
- Loss of coordination
- Confusion & disorientation

8.2.2. What to do – Get immediate medical help. Move to a warm area, remove wet clothing, wrap in blankets to warm body core, provide warm drinks if conscious.

8.3. **Frostbite:**

8.3.1. Symptoms:

- Numbness
- Tingling or stinging
- Aching
- Bluish or pale, waxy skin

- Blisters in extreme cases

8.3.2. What to do

- Move to a warm location.
- Immerse affected area in warm (not hot) water or warm using body heat.
- Do not rub.
- Seek medical help if severe.

8.4. **Trench Foot:**

8.4.1. Symptoms:

- Redness
- Numbness
- Leg cramps
- Swelling
- Blisters/ulcers
- Tingling pain
- Bleeding under the skin,
- Gangrene (foot may turn dark purple, blue, or gray)

8.4.2. What to do:

- Remove shoes/boots and wet socks, dry feet, avoid walking on feet, seek medical help if severe.

8.5. **Chilblains:**

8.5.1. Symptoms:

- Redness
- Itching
- Possible blisters
- Inflammation
- Ulcers in severe cases

8.5.2. What to do:

- Avoid scratching, slowly warm the skin, use corticosteroid creams to relieve itching and swelling, keep blisters clean and covered.

8.6. **Medical Care and Reporting**

8.6.1. Main Campus Emergency - Contact PennComm at 511 from a campus phone or (215) 573-3333 from a cell phone to request an ambulance.

- For non-emergency situations:
- Faculty and Staff - Visit Occupational Medicine located at HUP - 3400 Spruce Street - Ravdin Building 2nd floor during normal work hours or the HUP emergency department located in the Pavilion at 1 Convention Avenue, after hours.
- Students - Visit Student Health Services, located at 3535 Market Street during normal business hours or the HUP emergency department located at the Pavilion at 1 Convention Avenue after hours.

8.6.2. Morris Arboretum Emergency – For emergency, call 911. For less severe cases, transport to Chestnut Hill Hospital located at 8835 Germantown Ave, Philadelphia.

8.6.3. New Bolton Center Emergency – For emergency, call 911. For less severe cases, transport to Chester County Hospital at 701 East Marshall Street, West Chester.

8.6.4. Other off Campus Location – Call 911. Preplan when traveling to ensure there is cell phone signal or other means to summon help. Identify availability and contact information for emergency services at the beginning of the trip.

8.7. **Injury/illness Reporting** - Notify EHRS of all cases of cold stress related incidents. In cases requiring medical treatment, report to EHRS at 215-898-4453 (monitored 24/7) as soon as possible.

8.7.1. See appendix 4 for Smartsheet QR codes for both NBC and Main Campus, including Pennovation, and Morris Arboretum.

9. RECORDKEEPING

9.1. EHRS shall maintain cold assessments and job safety analysis (JSA) forms.

9.2. Managers and Supervisors shall maintain copies of JSA forms that define task specific safety requirements, including those related to cold stress.

9.3. EHRS/Workday system shall maintain training records of any EHRS-coordinated training.

10. REFERENCES/RESOURCES

10.1. OSHA Cold Stress Guide: https://www.osha.gov/emergency-preparedness/guides/cold-stress

10.2. OSHA Work/Warm up Schedule: https://www.osha.gov/sites/default/files/windchill_table.pdf

10.3. NIOSH Cold Stress: https://www.cdc.gov/niosh/cold-stress/about/index.html

10.4. NOAA Wind Chill Chart: https://www.weather.gov/safety/cold-wind-chill-chart

10.5. BLS- Ice, sleet, and snow related occupational injury and illness rates: https://www.bls.gov/opub/ted/2019/ice-sleet-and-snow-related-occupational-injury-and-illness-rate-down-in-2017.htm

11. APPENDIX 1 CHECKLIST - PLANNING AHEAD for COLD WEATHER

Use the following checklists to prepare for cold weather and to make sure that all appropriate precautions are in place.

PLANNING AHEAD for COLD WEATHER: EMPLOYER CHECKLIST

	Develop a list of cold weather supplies (e.g., heaters, blankets, warm fluids, etc.). Estimate quantities that will be needed, and decide who will be responsible for obtaining and transporting supplies and checking that supplies are not running low.
	Create emergency action plan for cold stress related illnesses (who will provide first aid and emergency services, if necessary. Identify methods to warm the person accordingly.)
	Develop an acclimatization schedule for new workers or workers returning from absences longer than one week.
	Access real time weather data (NOAA, weather radio, etc.). Ensure the information is available at outdoor work sites (e.g., laptop computer, cell phone, or another internet ready device, weather radio).
	Plan work schedule adjustments and warm up breaks.
	Train workers on cold stress risks, recognition, prevention and emergency response.
	Plan to have a knowledgeable person on the worksite who can develop and enforce work and warm up break schedules and conduct physiological monitoring, when necessary, at high and very high/extreme risk levels for cold stress related illness.

12. APPENDIX 2 - DAILY CHECKLIST

DAILY CHECKLIST

Water	Is there plenty of drinking water with warm fluid options located as close as possible to the workers?	
	Is the water and warm fluid refilled or replenished throughout the day or task? (Is there a designated person to check and make sure supplies are not low?	
Heated Areas	Are heated areas available for warm up breaks?	
Training	Do workers know the:	
	Common signs and symptoms of cold stress related illness?	
	Proper precautions to prevent cold stress illnesses?	
	Importance of acclimatization?	
	Importance of maintaining hydration in cold weather and the benefits of warm fluids?	
	Steps to take if someone has symptoms?	
Emergencies	Does everyone know who to notify if there is an emergency?	
	Does everyone know who will provide first aid?	
	Can workers explain their location if they need to call an ambulance?	
	Are methods identified to provide aid to the person while help is enroute?	
Knowledgeable Person	Where the risk of cold stress is high, is there a knowledgeable person at the site who is well-informed about cold stress related illness and able to determine appropriate work/warm up schedules and health monitoring as necessary?	
Worker Reminders	Drink water often and have warm fluids as needed.	
	Use heated areas for breaks.	
	Report cold stress related symptoms early.	

13. APPENDIX 3 - EXAMPLE WORK/WARM UP SCHEDULE

Use the following schedule as a guide to set up work/warm-up schedules for cold environments. This schedule is adapted from OSHA and the American Conference of Governmental Industrial Hygienists (ACGIH) and applies to a 4-hour work period with moderate to heavy work activity.
It is based on air temperature and wind speed, which together determine the wind chill effect.

Assumptions: Workers are physically fit, well-rested, fully hydrated, under age 40, and wearing the appropriate cold-weather clothing (layered wicking, insulating, and windproof garments).
Warm-up breaks should occur in a heated area (e.g., shelter, vehicle).
Non-emergency work should cease when indicated due to extreme cold.

Work/Warm-up Schedule for a 4-Hour Shift

Air Temperature--Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approximate)	°F (approximate)	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks
-26 to -28	-15 to -19	(Normal Breaks) 1		(Normal Breaks) 1		75 min	2	55 min	3	40 min	4
-29 to -31	-20 to -24	(Normal 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 & below	-45 & below	Non-emergency work should cease									

Schedule applies to any 4-hour work period with moderate to heavy work activity; with warm-up periods of ten (10) minutes in a warm location and with an extended break (e.g. lunch) at the end of the 4-hour work period in a warm location.

Adapted from ACGIH 2012 TLVs

14. APPENDIX 4 - INJURY/ILLNESS REPORTING QR CODES

Please use the following QR codes to enter an incident, injury, near miss, property damage etc. There are two, one is specific to New Bolton Center (NBC) while the other is for Main Campus, Pennovation, and Morris Arboretum.

NBC Incident Form

What do I report?
- All events that result in employee, student, or client injury
- All events that result in patient injury
- All events that result in property / equipment damage
- All events that could have resulted in any of the above, if was not caught

PennVet New Bolton Center

IF THIS IS AN EMERGENCY, PLEASE CALL
215-573-3333