

COLD STRESS

1. Task

To prevent the exposure of workers to cold stress hazards.

2. Hazards

Illness or possible fatality due to excessive cold.

3. Controls

Pre-Job Safety Assessment (PSA), CSA/ANSI approved PPE, appropriate clothing, snow, ice, and water removal equipment, temporary heating, weather reports, emergency planning, worker training, competent supervision.

Hypothermia: A condition in which core body temperature has dropped to significantly below normal and normal metabolism begins to be impaired.

Cold Stress Detection

Working in cold environments can be a potential health hazard and can also be life threatening, if precautions and appropriate controls are not established; it is critical that the body be able to preserve core body temperature steady at 37C (98.6F).

Excessive exposure to very cold temperatures is referred to as cold stress.

Heat is lost to the environment through:

- ❖ Radiation - the loss of heat through the temperature gradient (i.e. the difference between the temperature of the air and the temperature of the body).
- ❖ Conduction – the loss of heat through direct contact with a cooler object; heat loss is greatest if the body is in direct contact with cold water.
- ❖ Convection – the loss of heat from the body to the surrounding air as the air moves across the surface of the body.
- ❖ Evaporation – the loss of heat due to sweating and respiration.

Cold Stress can be affected by one or more of the following factors:

- ❖ Environmental factors such as air temperature, air movement (wind speed) and humidity (wetness).
- ❖ Personal factors such as age, weight, fitness level, impaired circulation, previous cold injury and acclimatization to cold.
- ❖ Other factors such as clothing, physical activity, fatigue, work/rest schedule, consumption of alcohol or nicotine and a worker's use of medication.

Exposure to cold may result in various cold injuries – non-freezing injuries, freezing injuries and hypothermia, which is the most serious (Refer to Attachment - Symptoms, Treatment and Prevention of Cold Stress).

People are generally unable to notice their own cold stress related symptoms; workers should monitor each other for signs of cold stress. If working alone in a potential cold stress situation, ensure that the Working Alone procedure has been implemented; cold stress hazards should be taken into consideration when determining the check-in frequency (i.e. establish more frequent check-ins with the Internal Contact).

In order to survive in the cold, heat loss must be balanced by the production of heat; factors important for heat production include:

- ❖ Food intake
- ❖ Fluid balance
- ❖ Physical activity
- ❖ Shivering (increases the body's heat production)
- ❖ Size and shape of the body

- ❖ Layer of fat under the skin
- ❖ Insulation (layering and type of clothing) The following methods are examples of actions that can be taken to help prevent the adverse effects of cold.

Educate Workers

Ensure all workers are instructed in appropriate first aid treatment, proper clothing practices, proper eating and drinking habits, recognition of impending frostbite, recognition of the signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur, and safe work practices associated with working in the cold. Refer to attachment (Symptoms, Treatment and Prevention of Cold Stress).

Control the Temperature

- ❖ Determine the temperature and wind conditions at the work location.
- ❖ Protect workers from the wind; wind, in combination with low temperatures can create dangerous working conditions. Refer to attachment (The Cooling Power of Wind)
- ❖ Equip the workplace with a thermometer and monitor temperature changes at least every four hours; in outdoor workplaces with air temperature below the freezing point, both air temperature and wind speed should be monitored if possible.

Implement Appropriate Work Practices

- ❖ Work with a partner or be sure to inform your immediate supervisor where you will be and your expected return time -- The effects of hypothermia can be gradual, and often go unnoticed until it's too late.
- ❖ Implement a schedule of work and rest intervals and provide heated rest areas; rest breaks should be no less than 10 minutes in length; outer clothing should be removed to prevent overheating and sweating when in the heated area; rest breaks should be based on Threshold Limit Values (TLVs) attached.
- ❖ The cold stress TLVs are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed nearly all workers can be repeatedly exposed without adverse effects.
- ❖ Arrange work to minimize periods of standing or sitting still.
- ❖ Special care should be taken when working with vibrating equipment / tools, as vibration can reduce circulation in the extremities, increasing a worker's susceptibility to cold injury.
- ❖ For work below the freezing point, metal handles and bars can be covered by thermal insulating material.

Wear Appropriate Clothing

- ❖ Dress in layers so that layers may be shed, as needed:
- ❖ Inner layer should retain body heat when wet and wick perspiration to outer clothing layers for evaporation, leaving the body dry, NOT COTTON (e.g. silk or wool long underwear).
- ❖ Middle layer should consist of several thin layers of clothing, which provide freedom of movement and which can be easily added or removed.
- ❖ The outer layer should provide protection from the elements. Consider taking along a dry set of clothing and wear waterproof boots in damp or snowy weather.
- ❖ In situations where the wearing of fire-retardant clothing is mandated and the fire-retardant clothing does not have the above-mentioned properties, the wearing of fire-retardant clothing shall take precedence.
- ❖ Stay Hydrated
- ❖ Significant fluid loss can occur in the cold due to sweating, increasing susceptibility to hypothermia.
- ❖ Recall that the consumption of caffeine-containing beverages in the cold should be limited because caffeine acts as a diuretic, affecting hydration.

Special Precautions



Best Personnel Safe Work Practices & Procedures Manual

- ❖ Workers with health conditions that affect normal body temperature regulation or impair circulation (e.g. Raynaud's syndrome, diabetes, and thrombophlebitis) should take appropriate precautions when working in the cold; these employees should consult their personal health care provider for confidential advice.

Vehicles & Equipment

When using vehicles and equipment in cold weather conditions, take the following additional precautions:

- ❖ Top off vehicles at the start of the shift

If you become stranded in a vehicle:

- ❖ Do not eat the snow or melt it and drink the water.
- ❖ Keep the exhaust area cleared out so you can warm yourself up in the vehicle.
- ❖ Keep a window on the downwind side cracked when running the vehicle.
- ❖ Stay with the vehicle. Do not try to walk out even if you can see a light in the distance.
- ❖ Keep a winter survival kit in vehicle i.e. blanket, flashlight, safety flares.
- ❖ Carbon monoxide is heavier than air and will accumulate in low lying areas; park idling vehicles away from open excavations; Be aware of wind direction so the CO isn't blowing back into the trench.

Machinery will operate differently in cold and extreme cold conditions; pay special attention to hydraulic equipment in extreme cold weather conditions; booms and track hose will bleed off quicker and chances of frozen or blown lines is greater.

COLD STRESS - SYMPTOMS, TREATMENT AND PREVENTION

Cold Stress Signs & Symptoms	Cause	Treatment	Prevention
<p>FROSTBITE</p> <ul style="list-style-type: none"> • Loss of sensation • Cold, pale, waxy skin • Formation of ice crystals (freezing) in tissue • Usually affects nose, fingers, or toes 	<ul style="list-style-type: none"> • Exposure to cold of an extended period with improper or no protection • Touching very cold metal surfaces such as a fence, door handle, or tool • Blood supply to extremities reduced or obstructed • Contact with fluids such as gasoline, cleaning fluid, etc. that evaporated very quickly 	<ul style="list-style-type: none"> * Affected areas should be warmed by placing warm hands against them (do not rub), by blowing on them, or by moving to a warm area • Frostbitten tissue must not be thawed if there is any chance that it will refreeze • If the injury affects entire fingers or toes, they should be warmed by immersion in warm – not hot – water for approximately 20-30 minutes. The use of other heat sources such as flames and radiant heaters that may warm injured tissue unevenly or too quickly should be avoided • Once seriously injured tissue has been warmed, it should be wrapped in soft material and the affected area elevated • Medical help should be obtained as soon as possible 	<ul style="list-style-type: none"> • Adequate clothing must be worn • Exposure to cold should be limited • Warm-up breaks should be taken • Fellow workers should be warned of white waxy areas on the skin
<p>TRENCH FOOT OR IMMERSION FOOT</p> <ul style="list-style-type: none"> • Minor – reddening of the skin, slight numbness • Mild – swelling, numbness (reversible) • Moderate – swelling, redness, bleeding into the skin, nerve damage • Severe – swelling, bleeding into the skin, tissue death; intense foot pain with swelling 	<ul style="list-style-type: none"> • Results from continuously having wet feet in cold water at near-freezing temperatures • Water temperature needs not be below freezing to cause injury 	<ul style="list-style-type: none"> • Warm and dry feet. Further exposure should be prevented, and medical aid sought out 	<ul style="list-style-type: none"> • Footwear should be comfortable, waterproof, and not too tight. Feet and socks must be kept dry • Feet should not be allowed to remain wet for prolonged periods of time • A spare pair of dry socks should be available • Boots and wet socks should be removed as soon as possible. Feet should be dried and massaged well to promote circulation
<p>HYPOTHERMIA</p> <ul style="list-style-type: none"> • Cold extremities which are numb and clumsy; severe shivering; reduced mental alertness with irritability; lack of concentration; unusual or bizarre behavior • The normal shivering response stops in severe hypothermia • Loss of consciousness, coma and death can occur if not treated 	<ul style="list-style-type: none"> • Overcooling of the body due to excessive loss of body heat • Dehydration and fatigue are contributing factors 	<ul style="list-style-type: none"> • The person should be removed from the cold and further exposure prevented • Wet clothing should be removed, and the victim warmed by wrapping in blankets. In severe cases, the victim's outer clothing should be removed, and the victim placed in a sleeping bag or blanket with one or two warm people. Medical aid should be contacted as soon as possible for advice and assistance • Full body immersion in warm water at 38→C to 40→C (100.4→F to 104→F) may be necessary in serious cases • A conscious victim should be given sips of warm, non-alcoholic drinks. 	<ul style="list-style-type: none"> * Adequate clothing must be worn to remain warm and dry * Exposure to cold should be limited * Workers must remain hydrated and well fed * Warm-up breaks should be taken * If possible, working alone should be avoided and workers should watch for signs of hypothermia

TLVs Work/Warm-up Schedule for Outside Workers based on a Four-Hour Shift*											
Air Temperature - Sunny Sky		No Noticeable Wind		Wind 8 km/h (5 mph)		Wind 16 km/h (10 mph)		Wind 24 km/h (15 mph)		Wind 32 km/h (20 mph)	
°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° & below	-45° & below	Non-emergency work should cease									

*2013 TLVs® and BEIs® - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati: American Conference of Governmental Industrial Hygienists (ACGIH), 2013.

The cooling power of wind (°F)

Estimated wind speed (in mph)	Actual temperature reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent chill temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-98	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < 1hr 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.

