



**Working in Cold Temperatures SWP 005**

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**A. Purpose**

The purpose of this safe work practice is to provide proper information and practices to mitigate the risk of exposure to cold temperatures and cold water during work activities. Workers exposed to cold conditions may have their health, safety, and productivity affected.

**B. Application**

The conditions of this practice shall be considered whenever work is to be conducted where district workers will be exposed to cold temperatures, wind, and/or rain for an extended period of time.

**C. Guidelines**

The human body functions most effectively within a narrow temperature range. At 2°C above or below the body’s normal temperature of 37°C, additional stress is placed on the body to regulate its temperature (e.g., shivering to keep warm and perspiring to keep cool). Sources of heat external to the body can help to maintain and regain body temperature. However, preserving the heat generated internally by the body and maintaining the body’s ability to produce this heat are key elements to maintaining personal comfort and performance in the cold.

Susceptibility to cold injury varies from person to person. Table 1 summarizes some of the factors involved in cold stress.

**Table 1 – Factors Involved in Cold Stress**

<b>Environment</b>	<b>Personal Characteristics</b>	<b>Other</b>
<ul style="list-style-type: none"><li>• Temperature;</li><li>• Wind; and</li><li>• Humidity.</li></ul>	<ul style="list-style-type: none"><li>• Age;</li><li>• Weight;</li><li>• Fitness;</li><li>• Impaired circulation;</li><li>• Previous cold injury; and</li><li>• Acclimatization to cold.</li></ul>	<ul style="list-style-type: none"><li>• Clothing;</li><li>• Physical activity;</li><li>• Fatigue;</li><li>• A workers use of medication(s); and</li><li>• Consumption of alcohol or use of nicotine.</li></ul>



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**D. Wind Chill**

Wind chill accounts for the loss heat from people by replacing the micro-layer of warm air surrounding the body with a layer of colder air. When there is no wind, or when air is not moving, the layer of warm air surrounding the body acts as an insulator. When that insulation layer is blown away, the body then tries to heat up the new, colder layer which causes the body to lose heat. This constant loss of heat causes you to feel like the temperature outside is cooler than the thermometer indicates.

Dress for the effects of wind chill. Remember that wind chill is just one of the many factors that may affect how cold you feel in the winter. Others include your age and body type as well as the type of clothes you are wearing, the amount and type of exercise you are engaged in and whether or not your clothes are damp from snow, rain or even perspiration.

**Wind Chill Hazards**

Check the wind chill before you go outdoors in the winter, and make sure you are well prepared for the weather. Even moderate wind chills can be dangerous if you are outside for long periods.



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Table 2 – Wind Chill Calculation Chart

COMBINED SPEED OF WIND AND AIR K.P.H.	ACTUAL TEMPERATURE											
	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
	EQUIVALENT TEMPERATURE											
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-31	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-45	-51	-57	-64	-70
30	0	-7	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-70	-76
55	-2	-9	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-37	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-59	-66	-73	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81
Wind Speeds Greater than 70 KPH have little additional effect	LITTLE *DANGER Risk of frostbite in prolonged exposure if wind chill is below -25					INCREASING *DANGER Frostbite possible in 10 minutes at -35 if warm skin is suddenly exposed. Shorter time if skin is cool at the start.			GREAT *DANGER Frostbite possible in less than 2 minutes at -60 if warm skin is suddenly exposed. Shorter time if skin is cool at the start.			

Note: Wind chill is used to warn people of dangerous conditions due to low temperatures and winds so wind chill is not normally calculated for air temperatures above 5C or wind speeds below 5 kph.



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Table 3 – Wind Chill Hazards

Wind Chill Hazards			
Wind Chill	Description	Health Concern	What to do
0 to -10	Low	Slight increase in discomfort	> Dress warmly, with the outside temperature in mind.
-10 to -25	Moderate	<ul style="list-style-type: none"> <li>&gt; Uncomfortable</li> <li>&gt; Exposed skin feels cold</li> <li>&gt; Risk of hypothermia if outside for long periods without adequate protection</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Dress in layers or warm clothing, with an outer layer that is wind-resistant.</li> <li>&gt; Wear a hat, mittens and scarf.</li> <li>&gt; Keep active.</li> </ul>
-25 to -45	Cold	<ul style="list-style-type: none"> <li>&gt; Risk of skin freezing (frostbite)</li> <li>&gt; Check face and extremities (fingers, toes, ears and nose) for numbness or whiteness</li> <li>&gt; Risk of hypothermia if outside for long periods without adequate protection</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Dress in layers of warm clothing, with an outer layer that is wind-resistant.</li> <li>&gt; Cover all exposed skin, particularly your face and hands. Wear a hat, mittens and a scarf, neck tube or face mask.</li> <li>&gt; Avoid exposing the skin directly to the wind.</li> <li>&gt; Keep active.</li> </ul>
<p><b>WARNING LEVEL</b></p> <p>-45 to -59</p>	Extreme	<ul style="list-style-type: none"> <li>&gt; Exposed skin may freeze in minutes</li> <li>&gt; Check face and extremities frequently for numbness or whiteness (frostbite)</li> <li>&gt; Serious risk of hypothermia if outside for long periods</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Be careful. Dress very warmly in layers of clothing, with an outer layer that is wind-resistant.</li> <li>&gt; Cover all exposed skin, particularly your face and hands. Wear a hat, mittens and a scarf, neck tube or face mask.</li> <li>&gt; Limit outdoor activities to short periods.</li> <li>&gt; Be ready to cut short or cancel outdoor activities.</li> <li>&gt; Keep active.</li> </ul>



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**E. Hypothermia**

Cold can kill. When you are in the cold you can become disorientated, less alert, and less attentive to the job. This can cause incidents.

Be sure you wear adequate, warm clothing to prevent cold and rain from causing discomfort and hypothermia. Wear several layers of loose, warm clothing rather than one layer. Avoid skin tight clothes. Warm, safety-toed CSA approved footwear is also required in winter.

**F. Risk mitigation**

**Clothing**

Protective clothing is needed for work at or below 4°C. Clothing should be selected to suit the temperature, weather conditions (e.g., wind speed, rain), the level and duration of activity, and job design. These factors are important to consider so that you can regulate the amount of heat and perspiration you generate while working. If the work pace is too fast or if the type and amount of clothing are not properly selected, excessive sweating may occur. The clothing next to body will become wet and the insulation value of the clothing will decrease dramatically. This increases the risk for cold injuries.

- Clothing should be worn in multiple layers which provide better protection than a single thick garment. The air between layers of clothing provides better insulation than the clothing itself. Having several layers also gives you the option to open or remove a layer before you get too warm and start sweating or to add a layer when you take a break. It also allows you to accommodate changing temperatures and weather conditions. Successive outer layers should be larger than the inner layer, otherwise the outermost layer will compress the inner layers and will decrease the insulation properties of the clothing.
- The inner layer should provide insulation and be able to "wick" moisture away from the skin to help keep it dry. Thermal underwear made from polyesters or polypropylene is suitable for this purpose. Polypropylene wicks perspiration away from the skin. It also keeps the second layer away from the skin.
- The additional layers of clothing should provide adequate insulation for the weather conditions under which the work being done. They should also be easy to open or remove before you get too warm to prevent excessive sweating during strenuous activity. Outer jackets should have the means for closing off and opening the waist, neck and wrists to help control how much heat is retained or given off. Some jackets have netted pockets and vents around the trunk and under the arm pits (with zippers or Velcro fasteners) for added ventilation possibilities.
- For work in wet conditions, the outer layer of clothing should be waterproof. If the work area cannot be shielded against wind, an easily removable windbreak garment should be used. Under



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extremely cold conditions, heated protective clothing should be made available if the work cannot be done on a warmer day.

- Almost 50 percent of body heat is lost through the head. A wool knit cap or a liner under a hard hat can reduce excessive heat loss. Consult with the hard hat supplier or manufacturer for appropriate liners that do not compromise the protection provided by the hard hat.
- Clothing should be kept clean since dirt fills air cells in fibres of clothing and destroys its insulating ability.
- Clothing must be dry. Moisture should be kept off clothes by removing snow prior to entering heated shelters. While the worker is resting in a heated area, perspiration should be allowed to escape by opening the neck, waist, sleeves and ankle fasteners or by removing outerwear. If the rest area is warm enough it is preferable to take off the outer layer(s) so that the perspiration can evaporate from the clothing.
- 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.
- Cotton is not recommended. It tends to get damp or wet quickly, and loses its insulating properties. Wool and synthetic fibres, on the other hand, do retain heat when wet.

### 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

You may prefer to wear 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.

Always wear the right thickness of socks for your 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.



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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.

### Additional prevention tips

- To prevent excessive sweating while working, remove clothing in the following order:
  - mittens or gloves (unless you need protection from snow or ice),
  - headgear and scarf.
- Then open the jacket at the waist and wrists, and
- Remove layers of clothing.

As you cool down, follow the reverse order of the above steps.

Prevent contact of bare skin with cold surfaces (especially metallic) below  $-7^{\circ}\text{C}$  as well as avoiding skin contact when handling evaporative liquids (gasoline, alcohol, cleaning fluids) below  $4^{\circ}\text{C}$ . Sitting or standing still for prolonged periods should also be avoided.

Balanced meals and adequate liquid intake are essential to maintain body heat and prevent dehydration. Eat properly and frequently. Working in the cold requires more energy than in warm weather because the body is working to keep the body warm. It requires more effort to work when wearing bulky clothing and winter boots especially when walking through snow.

Drink fluids often especially when doing strenuous work. For warming purposes, hot non-alcoholic beverages or soup are suggested. Caffeinated drinks such as coffee should be limited because it increases urine production and contributes to dehydration. Caffeine also increases the blood flow at the skin surface which can increase the loss of body heat.

Alcohol should not be consumed as it causes expansion of blood vessels in the skin (cutaneous vasodilation) and impairs the body's ability to regulate temperature (it affects shivering that can



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increase your body temperature). These effects cause the body to lose heat and thus increase the risk of hypothermia.

If workers are simultaneously exposed to vibration reduced limits for cold exposure may be necessary.

Utilize a work warm up schedule if conditions are extreme

### Related References

- British Columbia Occupational Health and Safety Regulation Part 7: Division 2 Vibration Exposure, Division 4 Thermal Exposure  
<http://www2.worksafebc.com/Publications/OHSRegulation/Home.asp>.
- Canadian Centre for Occupational Health and Safety, Cold Weather Worker's Safety Guide. <http://www.ccohs.ca/products/print.html>.