Cold Stress Prevention

Background
The four environmental conditions that cause cold related stress are low temperatures, cool high wind, dampness and cold water. Wind chill, a combination of temperature and velocity, is a crucial factor to evaluate when going outside. A dangerous situation of rapid heat loss may occur from an individual exposed to high winds and cold temperatures.

How the Body Reacts to Cold Conditions
When in cold environments, most of the body’s energy is used to maintain the internal body (core) temperature of approximately 37°C (98.6°F). This is done by reducing heat loss and increasing heat production. Under cold conditions, blood vessels in skin, arms and legs constrict, decreasing blood flow. Over time, the body will shift blood flow from the extremities (hands, feet, arms, and legs) and outer skin to the core (chest and abdomen). This allows exposed skin and extremities to cool rapidly and increases the risk of frostbite and hypothermia. Trench foot or Immersion foot occurs when feet are cold and damp while wearing constricting footwear. Unlike frostbite, immersion foot does not require freezing temperatures and can occur in temperatures up to 60° F (about 16° C). The condition can occur with as little as eleven hours’ exposure.

At Risk Employees
Anyone working in a cold environment may be at risk for cold stress. Older people may be at more risk than younger adults, since older people are not able to generate heat as quickly.

Certain medications may prevent the body from generating heat normally. Medications of concern include antidepressants, sedatives, tranquilizers and heart medications. Various medical conditions can also increase the risk of cold injury and include: heart disease, asthma/bronchitis, diabetes, and vibration/white finger disease.

Cold Stress Disorders

Hypothermia
Hypothermia means “low heat” and is a potentially serious health condition. This occurs when body heat is lost from being in a cold environment faster than it can be replaced. When the body can no longer maintain core temperature by constricting blood vessels, it shivers to increase heat production. When the body temperature drops below the normal 98.6°F to around 95°F, the onset of symptoms normally begins.

Frostbite
Frostbite occurs when the skin actually freezes and loses water. Frostbite occurs more readily from touching cold metal objects than from exposure to cold air. The body parts most commonly affected by frostbite are the face, ears, fingers and toes. When tissue freezes, blood vessels are damaged causing reduced blood flow that may lead to gangrene. In severe cases, amputation of the frostbitten area may be required. Frostbite symptoms vary, are not always painful, but often include sharp prickling sensations. The first indication of frostbite is skin that looks waxy and feels numb. Once
tissue becomes hard, the case is considered a severe medical emergency. Severe frostbite results in blistering that usually takes ten days to subside. Once skin is damaged, tissues will always be more susceptible to frostbite in the future.

*Trench Foot*  
Trench foot or immersion foot is a medical condition caused by prolonged exposure of the feet to damp, unsanitary and cold conditions. Affected feet become numb and then turn red or blue. As the condition worsens, they may swell. Advanced immersion foot often involves blisters and open sores, which lead to fungal infections; this is sometimes called Jungle Rot.

The following table identifies each condition, the signs and symptoms, and recommended first aid;

<table>
<thead>
<tr>
<th>Cold Stress Disorders</th>
<th>Condition</th>
<th>Signs and Symptoms</th>
<th>First Aid</th>
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</table>
| **Mild Hypothermia**   | Usually occurs when the core body temperature drops between 98 - 90°F | • Shivering;  
• Lack of coordination, stumbling, fumbling hands;  
• Slurred Speech;  
• Memory Loss; and/or  
• Pale, cold skin. | • Move to warm area;  
• Stay active;  
• Remove wet clothes and replace with dry clothes or blankets and cover head; and/or  
• Drink warm (not hot) sugary drink. |
| **Moderate Hypothermia** | Usually occurs when the core body temperature drops between 90 - 86°F | • Shivering stops;  
• Unable to walk to stand; and  
• Confused and irrational | • All of the above plus:  
• Call 911 for an ambulance  
• Cover all extremities; completely; and  
• Place very warm objects, such as hot packs or water bottles on the victim’s head, neck, check and groin. |
| **Severe Hypothermia**  | Usually occurs when the core body temperature drops between 86 - 78°F | • Severe muscle stiffness;  
• Very sleepy or unconscious;  
• Ice cold skin; and  
• Death. | • Call 911 for an ambulance;  
• Treat the victim very gently; and  
• Do not attempt to re-warm. The victim should receive treatment in a hospital. |
| **Frostbite** | Usually occurs when the skin actually freezes and loses water. Frostbite usually occurs when temperatures are below 30°F. Wind chill factors can allow frostbite to occur in above freezing temperatures. | • Cold, tingling, stinging or aching feeling in the frostbitten area. This is followed by numbness;  
• Skin color turns red, then purple, then white or very pale. The skin is cold to the touch; and  
• Blistering in sever cases. | • Call 911 for an ambulance;  
• Do not rub the area;  
• Wrap frostbitten area with a soft cloth;  
• If help is delayed, immerse in warm, not hot, water. Do not pour water on affected area; and  
• Apply sterile dressings to blisters to prevent breaking. |
| **Trench Foot** | Usually occurs by having feet immersed in cold water for long periods of time. Similar to frostbite, but less severe | • Tingling, itching or burning sensation; and  
• Blisters may also be present. | • Soak feet in warm, not hot, water;  
• Wrap with a dry soft cloth or bandage; and  
• Drink a warm, sugary drink. |

**Cold Stress Prevention**
Supervisors
- Allow time for employees to acclimate to the cold temperatures;
- Ensure that workers are medically fit to work in excessive cold, especially those employees that are at risk from the information listed above;
- Caffeine should be discouraged because it increases the water loss and blood flow to the extremities;
- Ensure that employees drink warm sweet drinks and soups to maintain caloric intake and fluid volume;
- Make sure workers understand the wind-chill factor and the effects that it can have on the body;
- Allow employees working in isolated cold environments to use the buddy system. Have two or more employees working together when there is a potential for extreme cold environments;
- Provide hot drinks and regular breaks under extremely cold working conditions; and
- Direct workers that are shivering severely to get inside out of the cold.

Employees
- Use the Cold Stress Disorders table to recognize the signs and symptoms of cold stress;
- Recognize the signs and symptoms of overexposure in themselves and others. Refer to the Cold Stress Disorder table for further information;
- Wear proper clothing using the information listed below;
- Minimize skin contact with cold metal handles and other cold metal equipment;
- Using the information listed in the at risk employees section, communicate with your supervisor any risk factors you may have;
- Workers showing signs or symptoms of any cold stress disorder should get inside out of the cold and refer to the Cold Stress Disorder table for further instructions; and
- Workers seeking shelter out of the cold should remove their outer layer of clothing and loosen other clothing to let sweat evaporate.

General Tips

Clothing
Protective clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool retains its insulation value even when wet. The following are recommendations for working in cold environments:
- Wear at least three layers of clothing:
  - An outer layer to break the wind and allow some ventilation (Gortex or nylon)
  - A middle layer of down or wool to absorb sweat and provide insulation even when wet;
  - An inner layer of cotton or synthetic weave to allow for ventilation.
- Wear a hat. Up to 40% of body heat can be lost when the head is left exposed;
- Wear insulated boots or other footwear. Tight fitting footwear restricts blood flow. Footwear should be large enough to allow wearing either one thick or two thin pairs of socks;
- Wear mittens instead of gloves, if possible;
- Keep a change of dry clothing available in case worn clothes become wet;
- Do not wear tight clothing. Loose clothing allows for better ventilation;
- Cover your mouth to protect your lungs, avoid taking deep breaths and minimize talking; and
- Employees who get hot while working should open their jackets but keep hats and gloves on.

Work Practices

Engineering Controls
Radiant heaters may be used to warm workers. Shield work area from drafts or wind to reduce the wind chill. Use insulating materials on equipment handles when temperatures drop below 30°F, especially metal handles.

**Drinking**

Drink plenty of liquid, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.

**Work Schedule**

If possible, heavy work should be scheduled for the warmer parts of the day. Workers should take frequent breaks out of the cold. Try to work in pairs so workers can keep an eye on each other and watch for signs of cold stress. Avoid fatigue since energy is needed to keep muscles warm. Take frequent breaks and eat warm, high calorie food such as pasta to maintain energy reserves.

**Wind-Chill Index**

Wind-chill involves the combined effect of air temperature and air movement. Wind-chill cooling rate is defined as heat loss (expressed in watts per meter squared) resulting from the effects of air temperature and wind velocity upon exposed skin. The higher the wind speed and the lower the temperature in the work environment, the greater the insulation value of the protective clothing required. The chart below illustrates the wind chill temperature and the levels at which frostbite can occur in 15 minutes or less.

### Wind Chill Chart

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**Frostbite Times**

- 30 minutes
- 10 minutes
- 5 minutes