Best Practice – *Working Safely in the Heat and Cold*

WORK SAFE ALBERTA

Alberta Government

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Introduction

For many people, seeing that brilliant blue sky on a cold winter's day or heading to the lake on a hot summer day can be some of the best benefits of living in Alberta. However, people who have to work on that extremely cold or hot day may feel very differently.

The goal of this publication is to help you understand the health risks associated with working in extreme heat and cold situations, and to suggest reasonable solutions for workplaces.

While many workplaces can benefit from this information, this publication is written primarily for people who work outdoors. Examples of these situations include road paving, construction, forestry, agriculture, ranching, oil and gas industry, greenhouse or horticultural work, power line maintenance, and outdoor municipal work.

This guidance may also be helpful to workplaces that have hot indoor environments such as kitchens, bakeries, pizza parlours, steam presses, laundries, or dry cleaning businesses. Cold indoor workplaces include those that have walk-in freezers, meat processing, or cold storage facilities.

This publication will help you to

- Understand how your body reacts in cold or hot environments
- Recognize when it is "too" cold or "too" hot
- Know the health risks associated with working in these temperatures
- Be able to understand weather information or take simple measurements
- Know what steps to take to control the hazards of exposure.

Section 1: Exposure to Heat and Cold

The Body's Response to Heat and Cold

Your body works best when it has an internal "core" temperature of 37°C. 37°C might seem warm, but this is your internal temperature (not the air temperature). This temperature is necessary for your vital organs to function normally. During a regular day, your body temperature may vary by about 1°C depending on the time of day, your level of physical activity and how you are feeling (emotional reactions). The body's metabolic processes produce the right amount of heat you need when you digest your food and when you perform physical activity.

Maintaining Balance

When you work in extreme temperatures, your body has to adapt. To maintain a constant inner body temperature, the body must continually keep or gain heat in cold environments and lose heat in hot environments.

To stay warm in cold environments, the body

- Shivers – moving muscles help increase heat production, and
- Reduces blood flow to the skin and extremities (hands and feet) to reduce heat loss from the surface.

To stay cool in hot environments, the body

- Sweats – evaporating sweat cools the body, and
- Increases blood flow to the skin – to speed up the loss of heat from the skin (radiate away the excess heat) if the outside air is cooler.

By sweating, shivering, and changing the rate of blood flow, the body can adapt to a fairly wide range of temperatures. However, there are limits to what the body can adapt to and its ability to maintain its core temperature can fail.

Acclimatization

People can adapt to hotter temperatures through a process called "acclimatization." At the workplace, acclimatization is important because it allows you to work more safely and efficiently. However, becoming acclimatized takes time.

In cold conditions, the body can also adapt. There is some research that suggests that the body does not adapt as well to cold as it does to hot conditions. How the body adapts to cold is not as clearly understood.

Heat

When working in hot conditions, people need at least 4 to 7 working days to become fully acclimatized, but the process may take up to three weeks. A scheduled exposure is recommended. For example, doing physical work for less than a full working day on the first hot day and slowly increasing the time spent working over the next week. Each person must be monitored to ensure that he or she is adapting to working in the heat.

Important…

Each person is different. People who are in good health and physically fit tend to adjust faster and more easily. However, some individuals may not be able to fully acclimatize regardless of their health or physical condition.

Always monitor yourself and your co-workers. People who are used to working in extreme temperatures can have an underlying condition (such as coming down with a flu or cold) that changes how their body reacts to the temperature. Details about symptoms of exposure are in Section 3.

Did you Know?

As your hands get used to the cold, the body diverts more blood to them. Acclimatized workers at a fish processing facility can fillet fish with their hands in near freezing water for long periods of time. A non-acclimatized person would be in severe pain.

Factors affecting how you feel

How “hot” or “cold” you feel depends on 6 main factors:

1. ***Air temperature*** – Air temperature is what can be measured with a thermometer. However, in situations where there is a lot of radiant heat (see below for examples) it is not always an accurate indication of how hot or cold you feel.

2. Other sources of heat **(*radiant heat*)**. These sources can include direct sunlight, machinery that generates heat, hot water, heaters or open flames, asphalt, etc. Over time on a hot day, these sources can radiate heat into the air and add to the amount of heat you “feel”.

3. ***Relative humidity*** is the amount of moisture (water) in the air. The warmer the air, the more moisture it can hold. High humidity makes people feel hotter because sweat does not evaporate off the skin (it is the evaporation of sweat that makes you feel cooler). Cold air with high relative humidity “feels” colder than dry air at the same temperature.

Why? Because high humidity in cold weather increases the conduction (loss) of heat from the body to the surrounding air.

4. ***Moving air*** (speed) usually cools a person. This cooling provides relief in a hot environment as long as the moving air is cooler than the person. In cold situations, air movement can create wind chill and make you feel much colder than the temperature may indicate.

5. ***Physical exertion*** (how hard you are working) also influences how hot or cold you feel. Moving around or working generates heat. When working on a very hot day, this movement increases your heat stress.

6. ***Clothing*** can help you stay warmer. However, when mist, rain or sweat is heavy enough to make your clothing wet, you feel colder as wet clothing loses its insulating properties.

Other Factors

A person's general health also influences how well the person adapts to heat and cold. Those with extra weight often have trouble in both cold and hot situations due to the body having difficulty maintaining a good heat balance. Age (particularly for people about 45 years and older), poor general health, and a low level of fitness will make people more susceptible to feeling the extremes of heat and cold.

Medical conditions can also increase how susceptible the body is to heat and cold. People with heart disease, high blood pressure, respiratory disease and uncontrolled diabetes may need to take special precautions.

In addition, people with skin diseases and rashes may be more susceptible to heat, while people with Raynaud's disease (also known as white finger or vibration disease) will be more susceptible to the cold.

Substances – both prescription or otherwise – can also have an impact on how people react to heat and cold. See Table 1 for some examples.

Table 1: Substances that Can Affect a Person's Tolerance to Heat and Cold

More Susceptible to Heat	More Susceptible to Cold
• Alcohol • Amphetamines • Anaesthetics • Anticholinergics (e.g. atropine) • Antidepressants • Cannabis (marijuana) • Cocaine • Hypnotics (e.g. barbiturates) • Morphine • Psychotropic drugs	• Alcohol • Amphetamines • Antidepressants • Antithyroid drugs • Cannabis (marijuana) • Hypnotics • Hypoglycaemic drugs Insulin • Morphine • Organophosphates • Psychotropic drugs • Sympathetic and ganglion-blocking agents • Tranquilizers

(Adapted From: Occupational Safety and Health Service, Department of Labour, New Zealand "Guidelines for the Management of Work in Extreme Temperature" http://www.business.govt.nz/worksafe/information-guidance/all-guidance-items/temperature-guidelines-for-the-management-of-work-in-extremes-of/temperat.pdf)

Tip! When 'normal' is your norm

Thermal comfort is also very important. Ideally, air temperature should be kept within a range that most people find comfortable. The season, relative humidity, clothing and activity level of building occupants may factor into the comfort zone. In summer, temperatures of 23-28°C are recommended, while in the winter when relative humidity is closer to 30%, recommended temperatures are from 20-25°C.

Please see the Indoor Air Quality Tool Kit published by Occupational Health and Safety, Government of Alberta for more information about indoor situations.

http://work.alberta.ca/documents/WHS/WHS-PUB_gh015.pdf

Section 2: Thermal comfort

What is it?

"Thermal comfort" refers to whether a person feels comfortable - not too hot nor too cold. Achieving thermal comfort is challenging because you need to account for the six factors (air temperature, radiant heat, relative humidity, moving air, physical exertion and clothing) described in Section 1.

Human variability

Variability between people - different metabolic rates, levels of physical fitness, medical conditions (including medication), acclimatization, level of hydration, age, smoking, etc. makes achieving thermal comfort a challenge. These factors all affect how people perceive their comfort levels, even if they are doing the same work in the same environment.

Humidex

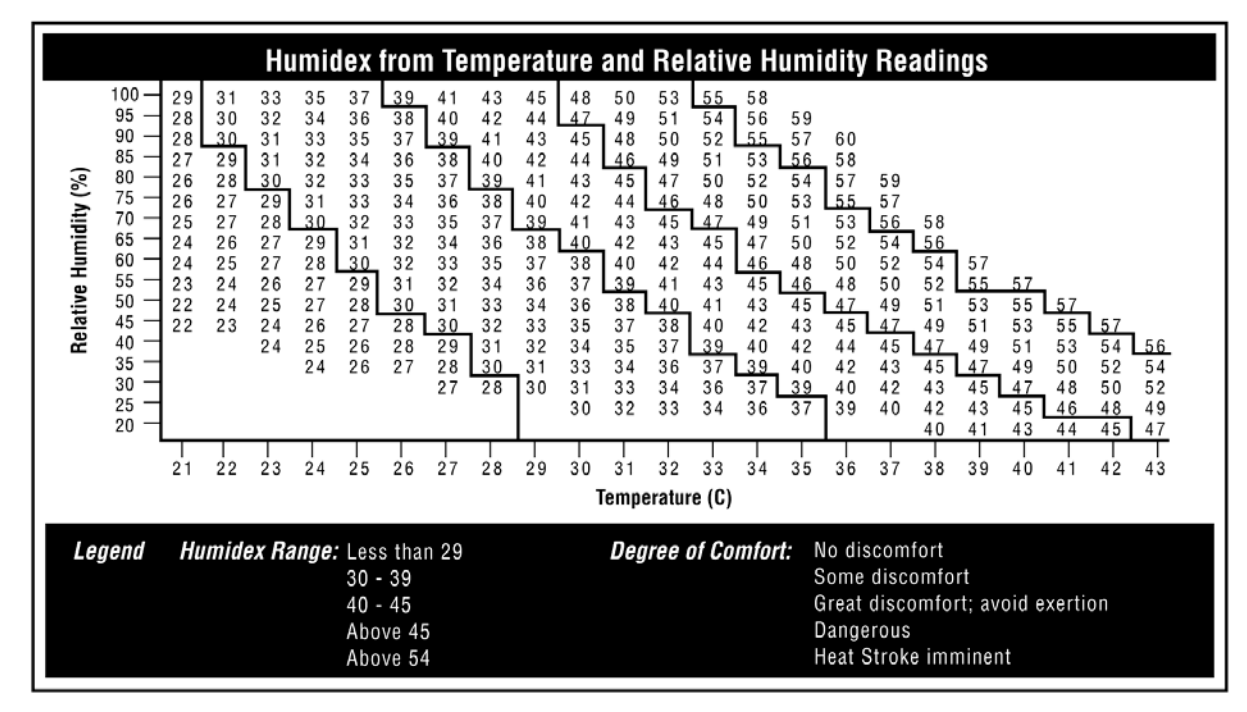
Canadian meteorologists created the humidex index in 1965. Humidex combines temperature and humidity readings into one number as a way of indicating how your body "*perceives*" the combination of temperature and moisture in the air. It can be a better measure of how stifling or stuffy the air *"feels"* versus temperature alone. It is expressed as a value, not as an actual temperature or "degrees", because it is an interpretation of how people might feel.

Humidex becomes a significant factor when the index value is more than 30. The Weather Office of Environment Canada reports humidex when the value is more than 25.

Humidex is intended for the general public and is not always appropriate to use as an indication of when work should be stopped. Heat-related illnesses depend on many other workplace factors such as wind speed or air movement, workload, radiant heat sources and a person's physical condition. Under certain workplace conditions, the humidex may serve as an indicator of discomfort resulting from occupational exposure to heat. For example, when humidity is high, but when workload, wind speed and radiant heat sources do not significantly contribute to the heat burden, humidex may be useful.

If using humidex is appropriate for your work situation, Table 2 shows how to determine humidex by using the air temperature and the relative humidity.

Table 2: Determining Humidex from Temperature and Relative Humidity Readings



Source: Adapted from Environment Canada

Wind Chill

Wind chill is based on a mathematical calculation and represents how on a windy day the temperature would feel on your skin if the wind were reduced to a walking pace of 4.8 km/h (3 mph). Like humidex, wind chill is expressed in temperature-like units but it is not an actual temperature. For example, the weather report will state that the outside temperature is -15°C with a wind chill of -30. This wind chill means that your face will feel as cold as it would on a calm day when the temperature is -30°C. Wind chill only affects objects that are warmer than the air temperature.

Why does wind speed matter? On a calm day, your body is insulated because it warms up a thin layer of air very close to your skin (called the "boundary layer"). Wind removes this protective layer. Warming up a new boundary layer takes energy. As the wind blows away each new boundary layer, you feel colder. The wind also contributes to evaporation of moisture from your skin or from damp clothing against the skin, which makes you feel colder by drawing more heat away from the body. In addition, wet skin loses heat much faster than dry skin (a fact that helps you stay cool in the summer, but also makes you colder in the winter).

Wind Chill Hazards and Risk of Frostbite

In most of Canada, wind chill is included in the forecast when it reaches –25, as this is the point where frostbite becomes a risk. A *wind chill warning* is issued by Environment Canada when conditions become hazardous. See Table 3 for a list of wind chills and relative health risks.

Table 3: Environment Canada's Wind Chill Chart

(for general public, with limited outdoor exposure)

Wind Chill	Risk of frostbite	Health Concern	What to do
0 to -9	Low	Slight increase in discomfort	Dress warmly, with the outside temperature in mind.
-10 to -27	Low	Uncomfortable Risk of hypothermia if outside for long periods without adequate protection	Dress in layers of warm clothing, with an outer layer that is wind-resistant. Wear a hat, mittens and scarf. Keep active.
-28 to -39	Increasing risk: exposed skin can freeze in 10 to 30 minutes	Check face and extremities (fingers, toes, ears and nose) for numbness or whiteness Risk of hypothermia if outside for long periods without adequate protection	Dress in layers of warm clothing, with an outer layer that is wind-resistant. Cover exposed skin: wear a hat, mittens and a scarf, neck tube or facemask. Keep active.
-40 to -47	High risk: exposed skin can freeze in 5 to 10 minutes*	Check face and extremities (fingers, toes, ears and nose) for numbness or whiteness (frostbite) Risk of hypothermia if outside for long periods without adequate protection	Dress in layers of warm clothing, with an outer layer that is wind-resistant. Cover all exposed skin: wear a hat, mittens and a scarf, neck tube or face mask. Keep active.
WARNING LEVEL** -48 to -54	High risk: exposed skin can freeze in 2 to 5 minutes*	Check face and extremities frequently for numbness or whiteness (frostbite) Serious risk of hypothermia if outside for long periods	Be careful. Dress very warmly in layers of clothing, with an outer layer that is wind-resistant. Cover all exposed skin: wear a hat, mittens and a scarf, neck tube or facemask. Be ready to cut short or cancel outdoor activities. Keep active.
-55 and colder	High risk: exposed skin can freeze in less than 2 minutes	DANGER! Outdoor conditions are hazardous	Stay indoors.

* In sustained winds over 50 km/h, frostbite can occur faster than indicated. **In parts of the country with a milder climate (such as southern Ontario and the Atlantic provinces except Labrador), a wind chill warning is issued at about -35. Further north, people have grown more accustomed to the cold, and have adapted to the more severe conditions. Because of this, Environment Canada issues warnings at progressively colder wind chill values as you move north. Most of Canada (western Canada, northern Ontario) receives a wind chill warning at about -45. Residents of the Arctic, northern Manitoba and northern Quebec are warned at about -50, and those of the high Arctic at about -55. Source: Meteorological Services Canada.

Heat loss also depends on:

- ***Quality of clothing*** - good quality clothing with high insulating properties will trap air creating a thicker boundary layer
- ***Wet clothing or footwear*** - wet items lose their insulating value and cause heat loss nearly equal to that of exposed skin
- ***Body type*** – while everyone is different, people with a tall slim build tend to become cold much faster than those that are shorter and heavier
- ***Metabolism*** - physical activity (e.g. walking) increases your body's metabolism and generates more body heat
- ***Exposure to the sun*** - bright sunshine may reduce the effect of wind chill (make it feel warmer) by 6 to 10 units. (Wind chill index does *not* take into account the effect of sunshine.)
- ***Age and physical condition*** – for example, elderly people and children have less muscle mass, so they generate less body heat
- ***Adaptation*** - Over time, the body can adapt to the cold. People who live in a cold climate are often able to withstand cold better than those from warmer climates.

Did you Know?

In 2006, Medicine Hat recorded the highest temperature at 35.7°C, while High Level recorded the lowest at –39.4°C.

Want to know what highest or lowest temperature recorded for your town or city is? Check Appendix A for examples!

Section 3: Human Performance

Health issues

Serious health issues can happen when you are exposed to extremes of heat or cold.

Heat

Heat stress is the overall heat load on the body, including environmental heat and inner body heat production due to working hard. Mild or moderate heat stress may be uncomfortable and may affect performance and safety, but it is not usually harmful to your health. When heat stress is more extreme, the possible health effects include:

Heat edema is swelling which generally occurs among people who are not acclimatized to working in hot conditions. Swelling is often most noticeable in the ankles.

Heat rashes are tiny red spots on the skin, which cause a prickling sensation. The spots are the result of inflammation caused when sweat glands become plugged.

Heat cramps are sharp pains in the muscles that may occur alone or be combined with one of the other heat stress disorders. The cause is salt imbalance resulting from the failure to replace salt lost with sweat. Cramps most often occur when people drink large amounts of water without sufficient salt (electrolyte) replacement.

Heat exhaustion is caused by excessive loss of water and salt. Symptoms include heavy sweating, weakness, dizziness, nausea, headache, diarrhea, muscle cramps, and more (see table 4).

Heat syncope is heat-induced giddiness and fainting induced by temporarily insufficient flow of blood to the brain while a person is standing. It occurs mostly among unacclimatized people. It is caused by the loss of body fluids through sweating, and by lowered blood pressure due to pooling of blood in the legs.

Heat stroke and hyperpyrexia (elevated body temperature) are the most serious types of heat illnesses. Signs of heat stroke include body temperature often greater than 41°C, and complete or partial loss of consciousness. The signs of heat hyperpyrexia are similar except that the skin remains moist. Sweating is not a good symptom of heat stress as there are two types of heat stroke – “classical” where there is little or no sweating (usually occurs in children, persons who are chronically ill, and the elderly), and “exertional” where body temperature rises because of strenuous exercise or work and sweating is usually present.

TIP! Intense thirst is not a good warning sign of heat stress, as unacclimatized workers may not experience thirst.

Table 4: Signs and Symptoms of Heat Exposure (Hyperthermia)

Early Warning Signs	As Heat Stress Worsens…
• Headache • Dizziness / faintness • Irritability / anger / mood change • Fatigue • Heavy sweating • Prickly heat (heat rash) • Muscle cramps (especially after several days of exposure) • Changes to breathing and pulse rate • Dehydration	• Breathlessness (having trouble catching your breath) • A strong rapid pulse changes to a weak rapid pulse • Severe headache • Severe muscle cramps • Confusion • Skin goes from feeling cold and clammy to hot and dry • Severe dehydration • Sweating may stop • Exhaustion • Coma and possible death

Long term (chronic) illnesses from heat exposure

Some research has shown that certain disorders of the kidney, liver, heart, digestive system, central nervous system and skin may be linked to heat exposure. However, there is no conclusive scientific evidence linking such effects and long-term exposure to heat. The exception is damage to the eye, in particular the lens, from radiant heat and infrared radiation. Occupations at risk for eye damage include glass manufacturing, foundries, ceramics, bakeries, and outdoor activities in brilliant sunshine without sunglasses (particularly at high elevations). Other probable health effects that have been reported include chronic heat exhaustion, sleep disturbances, and susceptibility to minor injuries.

Cold

Health problems associated with cold exposure include:

Frostnip is the mildest form of a freezing cold injury. It occurs when ear lobes, noses, cheeks, fingers, or toes are exposed to the cold and the top layers of the skin freeze. 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). The top layer of skin sometimes peels off the affected area.

Frostbite is caused by exposure to extreme cold or by contact with extremely cold objects (e.g., metal). It may also occur at normal temperatures from contact with cooled or compressed gases. Frostbite occurs when tissue temperature falls below freezing (0°C), or when blood flow is obstructed under cold conditions. Blood vessels may be severely and permanently damaged, and blood circulation may stop in the affected tissue.

In mild cases, the symptoms include inflammation (redness and swelling) of the skin in patches accompanied by slight pain. In severe cases, tissue damage without pain, or burning or prickling sensations and blistering can happen. Frostbitten skin is highly susceptible to infection, and gangrene (local death of soft tissues due to loss of blood supply) may develop.

Hypothermia occurs when the body is unable to compensate for its heat loss and the body's core temperature starts to fall. You first feel cold followed by pain in exposed parts of the body. As the body’s core temperature continues to drop, the feeling of cold and pain starts to diminish because of increasing numbness (loss of sensation). If no pain can be felt, serious injury can occur without the victim noticing it.

As the body continues to cool, muscular weakness, an inability to think clearly, and drowsiness are experienced. This condition usually occurs when the body’s internal or core temperature falls below 33°C. Additional symptoms include shivering coming to a stop, diminished consciousness and dilated pupils. When the core temperature reaches 27°C, coma (profound unconsciousness) sets in.

More details about the signs and symptoms of cold exposure are listed in Table 5.

Other health effects of cold exposure include:

Chilblains are a mild cold injury caused by prolonged and repeated exposure for several hours to air temperatures from the freezing point (0°C) to as high as 16°C. Where the skin is affected, there will be 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. The primary injury is to nerve and muscle tissue. Symptoms include 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 (or hand) is "wet cold disease" resulting from prolonged exposure in a damp or wet environment from the freezing point to about 10°C. Depending on the temperature, symptoms may begin within several hours to many days, but the average is three days.

Did you Know?

Body heat is lost up to 25 times faster in water than on dry land.

Table 5: Signs and Symptoms of Cold Exposure (Hypothermia)

Stage	Body Core Temperature	Signs & Symptoms
Mild Hypothermia	37.2-36.1ºC	Normal, shivering may begin.
	36.1-35ºC	"Feeling cold", goose bumps, unable to perform complex tasks with hands, shivering can be mild to severe, hands numb.
Moderate Hypothermia	35-33.9ºC	Shivering, intense loss of muscular coordination, movements slow and laboured, stumbling pace, mild confusion but may appear alert. Use a sobriety-like test - if unable to walk a 9 metre straight line, the person is likely hypothermic.
	33.9-32.2ºC	Violent shivering continues, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, stumbles frequently, signs of depression or withdrawn.
Severe Hypothermia	32.2-30ºC	Shivering stops, exposed skin is blue or puffy, muscle coordination very poor, inability to walk, confusion, incoherent/irrational behaviour, but may be able to maintain posture and appearance of awareness.
	30-27.8ºC	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation.
	27.8-25.6ºC	Unconscious, heartbeat and breathing is erratic, a pulse may not be obvious.
	25.6-23.9ºC	Pulmonary edema, heart and breathing failure, death. Death may occur before this temperature is reached.

Source: Canadian Centre for Occupational Health and Safety, OSH Answers "Cold Environments – Health Effects and First Aid" http://www.ccohs.ca/oshanswers/phys_agents/cold_health.html

Treatment and Prevention

Heat

Being aware of the signs of heat stress is the first step for prevention. Remember that lack of acclimatization, poor levels of physical fitness, and conditions such as diarrhea or fever increase susceptibility to heat stress because the body is already in a weakened state. Certain drugs such as tranquilizers and diuretics can also increase susceptibility. Heat stroke occurs more easily when the body has suffered a previous heat disorder.

Heat stroke and hyperpyrexia require **immediate** first aid and medical attention. Delayed treatment may result in damage to the brain, kidneys and heart.

A heat stroke victim is usually unable to recognize the heat stroke signs and symptoms. His or her survival depends on a co-worker's ability to recognize the symptoms and seek immediate medical help.

- If one person is showing signs of heat stress, take it as a sign that other workers may also be affected. Workers should report to a cool area and be assessed individually before work continues.

First Aid For Heat Exposure

- Get medical help, or bring the person to a medical facility.
- Move the person to a cooler area where they can rest (such as an air-conditioned building or vehicle, or into the shade)
- Take off excess clothing (hard hat, boots, shirt, coveralls, etc.)
- Give the person water to drink (only if they are able to drink it on their own)
- Cool the person with cold compresses and rapid fanning

For *heat cramps/heat exhaustion*, take the person to a cooler place and have them rest in a comfortable position. Give a half glass of cool water every 15 minutes. Do not let the person drink too quickly. Do not give liquids with alcohol or caffeine as these ingredients can make conditions worse. Remove or loosen tight clothing and apply cool, wet cloths such as towels or wet sheets.

IMPORTANT

Heat stroke is a life-threatening situation and requires immediate medical attention.

While getting help, you can

- Move the person to a cooler place. Keep the person lying down.
- If the person is conscious, have them drink cool water slowly but regularly.
- If possible, help the person's body cool faster by wrapping wet sheets around the body and then fanning the body.
- If ice packs or cold packs are available, wrap the packs in a cloth and place them on each of the victim's wrists and ankles, in the armpits, and on the neck to cool the large blood vessels.
- NOTE: Immersing the victim in cold water more efficiently cools the body but it can result in harmful overcooling. This can interfere with vital brain functions so it must only be done under close medical supervision. Do not use rubbing alcohol because it closes the skin's pores and prevents heat loss.
- Watch for signals of breathing problems and make sure the airway is clear.

What and When to Drink

How do you know if you are dehydrated?

Being dehydrated is a serious issue. Since you cannot rely on "feeling thirsty", watch for signs of fatigue, irritability, headaches, nausea, and giddiness. The clinical (medical) signs are not passing urine and changes to a person's personality or mental state. When dehydrated, urine will be dark yellow to orange in colour and there will be far less of it. Unacclimatized workers can lose up to 5 or 6 litres of fluid in an 8-hour shift.

While working, drink about 250 ml (1 cup) of water every 15-20 minutes. Workers should be well hydrated before work in the heat begins. A person working in a hot environment loses water and salt through sweat. On average, about one litre of water each hour must be drunk to replace lost fluid. Workers in hot environments should be encouraged to drink water **even if they do not feel thirsty.** A person is adequately hydrated when the person has to urinate slightly more often than usual. Make sure plenty of cool (10-15°C) or room temperature (20°C) drinking water is available at the worksite.

Salt supplements

An acclimatized worker loses relatively little salt in their sweat and, therefore, salt in the normal diet is usually enough to maintain the electrolyte balance in body fluids. For unacclimatized workers who may sweat continuously and repeatedly, additional salt in the food may be used.

In most cases, people will eat enough salt to maintain their electrolyte balance. Salt tablets are **not** recommended because the salt does not enter the body system as fast as water or other fluids. Too much salt can cause higher body temperatures, increased thirst and nausea. Workers on salt-restricted diets should discuss their job tasks and the need for supplementary salt with their doctor.

Sport drinks, fruit juice, etc

Drinks specially designed to replace body fluids and electrolytes may be taken but for most people, they should be used in moderation. They may be of benefit for workers who have very physically active occupations but keep in mind they may add unnecessary sugar or salt to your diet. Fruit juice or sport and electrolyte drinks, diluted to half the strength with water, is an option. Drinks with alcohol or caffeine should **never** be taken, as they dehydrate the body. For most people water **is** the most efficient fluid for re-hydration.

Cold

Being aware of the signs and symptoms of cold stress is the first step to preventing health effects. See Table 6 for more details.

Table 6: Warning signs of Cold Stress

Early Warning Signs	As Cold Stress worsens…
• Physical discomfort (feeling cold) • Possible injuries such as pulled muscles • Loss of feeling and dexterity in fingers, hands and toes • Frost nip (outermost layers of skin turn white)	• Extreme discomfort • Extreme shivering (core temperature down to 35ºC), and then shivering stops • Severe hypothermia (core temperature about 33ºC) • Frost bite (skin freezes deeply) • Loss of consciousness (core temperature 30ºC) • Heart stops

IMPORTANT

Any worker who was shivering but has now stopped shivering is at extreme risk for hypothermia! Do not assume that they are "getting used to the cold". **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 Cold Exposures

Prevent frostnip by covering exposed skin surfaces. Cover the cheeks, chin, nose, ear lobes and forehead. A thin layer of a product such as Vaseline® may help.

Treat frostnip or frostbite by gentle rewarming (e.g., holding the affected tissue next to unaffected skin of the victim or of another person). For cold-induced injuries, never rub the affected parts - ice crystals in the tissue could cause damage if the skin is rubbed. Do not use hot objects such as hot water bottles or electric blankets to rewarm the area or person.

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

- Get medical help.
- If possible, move the victim to a warm area.
- Gently loosen or remove constricting clothing or jewellery that may restrict blood circulation.
- Loosely cover the affected area with a sterile dressing such as gauze. 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 stop the person from getting any colder). If there is a chance that the affected area will get cold again, do not rewarm the skin. If the skin is rewarmed and then freezes again, severe tissue damage can result.
- DO NOT rub the area or apply dry heat.
- DO NOT allow the victim to drink alcohol or smoke.
- DO NOT rub the area with snow or ice.

First aid for hypothermia includes the following steps:

- Get medical help immediately. Hypothermia is a medical emergency.
- Remove any wet clothing.
- Place the victim between blankets (or towels, newspapers, etc.) so the body temperature can rise gradually. Be sure to cover the person's head. If medical help is not available immediately, body-to-body contact can help rewarm the victim slowly. Do not use hot water bottles or electric blankets, as these can heat the victim too quickly.
- Give warm, sweet (caffeine-free, non-alcoholic) drinks unless the victim is rapidly losing consciousness, is unconscious, or is convulsing.
- Quickly transport the victim to an emergency medical facility.
- 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 appeared "dead" have been successfully resuscitated.

TIP! Staying hydrated is also important when you are working in the cold. Don't forget to drink regularly – warm fluids can include caffeine-free drinks, soup, and water.

Heat

Working in the heat can have both mental and physical effects. These include:

Mental Changes – increased irritation, mood changes, depression, aggression, and anger.

Physical Responses – increased heart rate, increased sweating, muscle cramps, changes in breathing patterns, dizziness, faintness, or "prickly heat" (heat rash).

The combination of heat stress and dehydration means that people performing skilled tasks may become tired faster than normal, and have trouble concentrating. There is a higher risk of errors in this situation. Aside from health effects, the U.S. National Institute for Occupational Safety and Health (NIOSH) reports that the frequency of accidents, in general, appears to be higher in hot environments. Working in a hot environment can lower the mental alertness and physical performance of an individual. Increased body temperature and physical discomfort promote irritability, anger, and other emotional states that sometimes cause workers to overlook safety procedures or to divert their attention from hazardous tasks

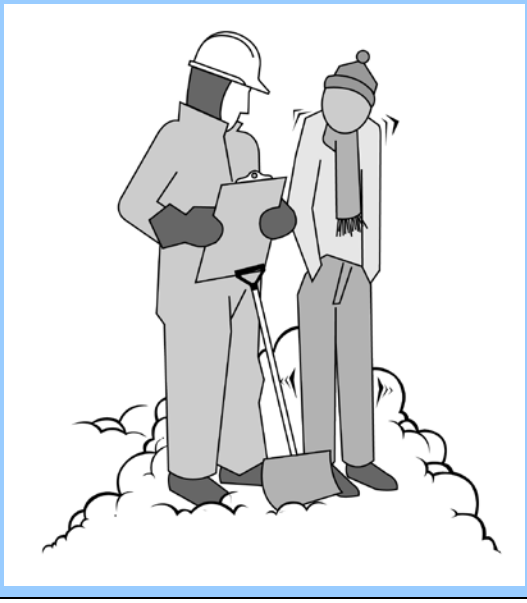
Heat can contribute to accidents in other ways such as the slipperiness of sweaty palms, dizziness, the fogging of safety glasses or respirator facepieces, or trouble concentrating. Wherever there are hot surfaces (including those heated by the sun), there is a possibility of burns from contact.

Cold

Like heat, cold can also have mental and physical effects.

Mental Changes – loss of alertness, slurred speech, fatigue, lethargy or apathy.

Physical Responses – general discomfort (feeling cold), and a loss of sensitivity and dexterity in fingers, hands and toes. At lower temperatures, deep muscles can be affected, reducing muscle strength and flexibility.



Tip! Whether it's hot or cold, watch for signs of **"unusual -umbles"** in yourself and your co-workers…stumbles, mumbles, fumbles and grumbles.

These are warning signs, along with the other signs discussed, that the individual is not coping well with the temperature and their condition should be investigated further.

Section 4 - Measuring Hot and Cold Conditions

There are several methods available to measure whether the environment is too hot or too cold for workers. Because there can be variations between specific work locations, it is necessary to evaluate whether it is too hot or too cold in the actual spot where the work is being done.

Heat

Measurement Techniques for Heat Stress

There are two common methods for determining heat stress

1) Wet-bulb Globe Temperature (WBGT) Index
2) Environment Canada's Weather Service's Humidex values.

1) Wet-bulb Globe Temperature (WBGT) Index

The WBGT Index is the "gold standard" because it is an indicator of workplace heat stress that factors in the effects of air temperature, humidity, air movement and radiant energy. It provides a single number measure of "perceived heat". The index can be calculated automatically using a portable instrument called a wet-bulb globe temperature meter often referred to as a heat stress monitor. This device is essentially a combination of three thermometers:

- A conventional thermometer (called a "dry bulb") that measures air temperature and is shielded from heat radiation
- A black bulb globe thermometer (a hollow 150 mm diameter copper ball painted black, with a conventional thermometer located at the centre) which measures the combined effects of radiant heat and wind
- A wet bulb thermometer (a conventional thermometer with the bulb wrapped in a wet cotton wick moistened with distilled water from a reservoir) which measures the cooling effects of movement and evaporation.

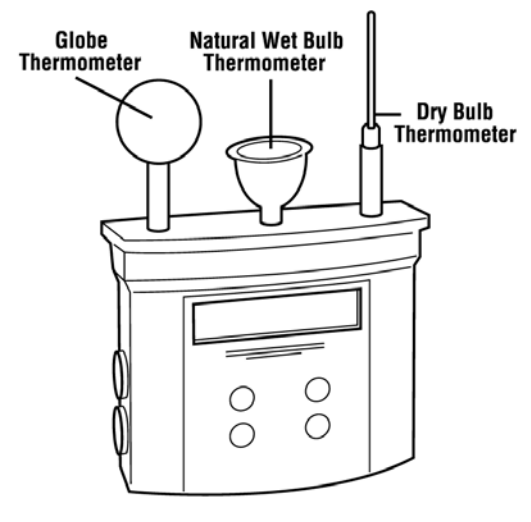


Figure 1: Wet-Bulb Globe Temperature Thermometer

Calculating the WBGT Index

Modern heat stress monitors do the calculations and display the results automatically. The wet bulb globe temperature (WBGT) is calculated by giving "weight" to each of the three temperature readings.

For outdoors with direct sun exposure:

WBGT = 70% of the wet bulb temperature + 20% of the black bulb globe reading + 10% of the air temperature

or… $WBGT = 0.7 \times T_{wet\ bulb} + 0.2 \times T_{globe} + 0.1 \times T_{air}$

For indoors or outdoors without direct sun exposure:

WBGT = 70 % of the wet bulb temperature + 30% of the black bulb globe reading

= $WBGT = 0.7 \times T_{wet\ bulb} + 0.3 \times T_{globe}$

where:

T_{wet} = bulb natural wet bulb temperature

T_{globe} = black bulb globe temperature

T_{air} = conventional air temperature

Example: Groundskeepers are working outdoors with direct exposure to the sun. Measurement of workplace conditions produced the following results.

T_{wet} bulb = 24°C

T_{globe} = 42°C

T_{air} = 40°C

Therefore the WBGT = (0.7 x 24) + (0.2 x 42) + (0.1 x 40) = **29.2°C**

Time-Weighted Average (TWA)

Workplace WBGT readings should be considered with other variables such as the type of clothing the worker is wearing, intensity of the work being done and the extent to which the worker has acclimatized to the work in establishing threshold limit values (TLVs) for heat exposure.

When thermal conditions fluctuate widely at different times during the workday, time-weighted average (TWA) WBGT is used to assess heat exposure.

$$\text{TWA WBGT} = \frac{WBGT1 \times t1 + WBGT2 \times t2 + ... + WBGT_n \times t_n}{t1 + t2 + ... + t_n}$$

Where:

WBGT1, WBGT2, etc. are the wet bulb globe temperatures (measured or calculated)

t1, t2, etc. is the elapsed time spent in the corresponding conditions described by WBGT1, WBGT2, etc., respectively.

Example: Measurement and/or calculation of WBGT during a two-hour job produced the following results.

Exposure duration (hours)	WBGT (°C)	TWA = $\frac{(25 \times 0.5) + (27 \times 1.0) + (28 \times 0.5)}{0.5 + 1.0 + 0.5}$ = 26.75°C
0.5	25	
1.0	27	
0.5	28	

2) Humidex

The humidex value is especially important when its value exceeds 30. See Section 6 for more information on using Humidex as a guide to heat stress. Further information on calculating the Humidex value is available from Environment Canada's "Frequently Asked Questions" http://www.meteo.gc.ca/mainmenu/faq_e.html#weather2c

Comparing WBGT and Humidex

WBGT Index

- WBGT instruments are commercially available and easy to use but they can be expensive, and require regular maintenance to produce accurate values.
- Compensates for heat caused by direct or reflected sunshine when used outdoors.
- Does not account for personal factors (e.g., health and physical condition) that might affect susceptibility to heat stress.
- Does not account for effect of clothing (e.g., index represents completely wet clothing).

Workplaces without heat stress specialists are not likely to calculate WGBT, but will listen to the radio to get humidex ratings. If using the humidex value only, remember the following precautions.

Humidex

- Portable instruments for measuring temperature and relative humidity to calculate humidex are inexpensive and easy to use. They allow for an on-site assessment of humidex value.

- Humidex is an *indication* of physiological reactions, not an absolute measure. It does not account for personal factors, acclimatization, or clothing.
- Outdoor humidex readings may not accurately reflect conditions at an indoor workplace. Humidex readings do not account for workplace-specific factors such as air movement and the presence of radiant heat sources.

Wind Chill

Wind chill is the effect of the wind in combination with a low air temperature. Various terms are used to describe this effect – wind chill factor, wind chill index, wind chill equivalent temperature and simply, wind chill.

Bright sunshine can influence the effect of wind chill by making it feel warmer and reduce the wind chill by as much as 6 to 10 units. For example, an outside temperature of -15°C on a bright sunny day with a wind chill of –30 may feel like a wind chill of –24 to –20.

Calculating Wind Chill

Most workplaces are not equipped to accurately measure wind speed and air temperature. Employers and workers should refer to local weather reports.

Environment Canada offers a free on-line calculator that determines the wind chill value – all you need is the wind speed and temperature. The Environment Canada web site is http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=0F42F92D-1. The “Chilldex downloadable program” can be downloaded from the same web page.

Wind Chill Warnings

Wind chill warnings in Alberta are issued when there is a wind speed of 15 km/h or more and a wind chill of – 40 and these conditions are expected to last for 3 hours or more.

Did you Know?

It feels just as cold at -1°C with a 60 km/h wind speed as it does at -18°C with an 8 km/h wind.

Did you know that windy conditions are quite rare at extremely low temperatures?

Did you know that wind speeds greater than 64 km/h have little additional effect on cooling?

Section 5: Case Studies and Weather Data

Case Studies: What would you do?

As you read these case studies, think about what you would do in these situations. How many action steps did you think of before reading them? Steps to control exposure to both heat and cold are discussed in Section 7 in more detail.

Heat

It's late June near Medicine Hat, and an asphalt paving crew is working 50 km from town on a clear sunny day. The temperature rises to 29°C. The radio reports there is a humidex value of 33.

The hazard assessment reveals a few more facts…

- A humidex of 33 is unusual and it is the first humidex value reported for the year.
- There are no buildings or shelters available in the immediate area.
- The crew is laying asphalt – the asphalt has radiant heat that will add to the overall heat felt by workers.
- There are new members on the team.

Action

- A work-rest schedule is put into effect. Since this is the first heat wave of the paving season, all crew members are considered new and unacclimatized. They opt for a conservative plan by working for 45 minutes with a 15-minute break each hour. (See Table 10 in Section 6)
- In addition, every 15 minutes workers rotate between workstations – sharing the workload between shovelling the asphalt and driving.
- Extra water (3 cups per person, per hour) is brought to the site.
- Everyone has reviewed the health effects and symptoms of heat strain. Crew members are encouraged to "buddy-up" and watch each other for warning signs.
- One worker offers a camping dining tent, which is set up to provide shade for the water and rest area.
- Workers continually monitor each other for warning signs of heat strain.
- Workers also listen to the radio for updates. At the end of the day, the radio announces that the heat and humidity will continue. The crew boss calls in extra workers so they can rotate job positions more often, and still keep the work on schedule.

Cold

In Red Deer, a carpenter is working outside on a -20°C in February on a building under construction on the 9th floor. The radio reports a general wind chill of –27.

Hazard assessment

- On the ninth floor, the wind is blowing work orders (papers) around the space. Workers estimate the wind at between 20 and 25 km/h (about 15 mph).
- The wind is blowing from a side that has support beams (but no walls).
- The carpenter is doing work that requires dexterity and needs to work without gloves. The work involves moderate physical activity.
- All members of the crew are experienced, and have been working at this location for at least 2 months.

Action

- The wind speed on the 9th floor may be more than the wind chill value reported on the radio so workers decide to use a work/warm-up schedule matching –26 to –28 at 20-25 km/h (15 mph) which equals 55 minutes of work maximum, with 3 breaks, in a 4-hour shift. (See Table 13 in Section 6)
- Breaks will be taken on the first floor, which is completely enclosed and heated, in the area currently being used as a meeting area. Since the meeting room is needed in the afternoon, later breaks will be taken in the crew vans.
- The carpenter will do as much measuring and layout as possible on the 8th floor, which has more walls that provide a better wind break than the structure on the 9th floor.
- The crew reviews the health effects and signs/symptoms of cold exposure. Since many of the crew work in isolation, they agree to check in every 30 minutes with their assigned “buddy”.
- They confirm that everyone is dressed appropriately – three layers including an inner layer to wick away sweat, a middle layer to retain heat, and a third outer layer to break the wind. The two outer layers are to be removed when in the break room. Hats and extra socks are also important. Workers are encouraged to wear their mittens or gloves whenever possible. A change of clothes is necessary if excess sweating occurs.
- Warm drinks, soup and extra water are provided in the break room.

Heat – a true case

A 23-year old man started to dig a ditch with other workers on an oil rig site at 3 pm, in August. He took one break for a drink of water. At 6 pm, he complained of dizziness and retired to a shaded area. After about 10 minutes, he came running out in a highly agitated state and began screaming obscenities at his co-workers. He was taken to an air-conditioned kitchen in the camp. His skin felt very hot and dry, and wet towels were used for cooling. He was transported by truck to the nearest hospital, 90 miles away.

Despite aggressive treatment at hospital, the worker died 33 days after the onset of heat stroke.

From: Sherman, R. et al. "Occupational death due to heat stroke: report of two cases", 1989, Canadian Medical Association Journal, Vol. 140, p1057-1058

Hazard Assessment and Investigation

- Temperature and relative humidity varied greatly that day, with the maximums reaching 31°C and 87% respectively. There had been no wind.
- The worker collapsed on his first day at work after an 18-day layoff.
- There was no evidence of drug or alcohol consumption during the few days before his return to work.
- His fluid intake had been low on the day of the incident.

Action

- Ensure good hydration and fluid intake by all workers (at least 250 ml (1 cup) for every 15-20 minutes of work).
- Initiate a work-rest schedule for unacclimatized workers despite the fact that the temperature and humidity were likely below the levels at which a 75% work-25% rest regimen is recommended. The American Conference of Government Industrial Hygienists (ACGIH) (see Section 6) recommendations assume that workers are acclimatized, fully clothed, and have adequate water and salt intake.
- Due to the lay-off, the worker was likely not physically accustomed to the work. A "return-to-work" type schedule should be implemented for physically demanding jobs.
- Train all workers about the signs and symptoms of heat stress.

The authors of this report indicate that heat stroke has a 50% death rate, even with aggressive medical treatment. Therefore, the best way to manage heat stroke is to control the factors that cause a person to over-heat.

Seasonal Temperatures, Humidex and Wind Chill Data for Specific Locations

If you don't think that the case study scenarios apply to your workplace, think again.

Appendix 1 lists weather data from the following locations in Alberta

- Banff
- Calgary
- Edmonton
- Fort McMurray
- Grande Prairie
- High Level
- Lethbridge
- Lloydminster
- Medicine Hat
- Red Deer

All weather data was taken from Environment Canada's "Climate Data On-Line" service at http://climate.weather.gc.ca/index_e.html

When looking at these charts, note that while, for example, hot and humid days may not be common in Alberta, they can and do happen. Take a look at the July data for Fort McMurray. In 2013, there was a maximum humidex value of 39 but historically, the maximum humidex has been as high as 45.6 (in 1955), but there has also been a wind chill of –2.7 (in 1956).

Alberta weather can change quickly and often. This fact makes it all the more important to be continually aware of the potential effects of weather and the health hazards – both heat and cold – during all 12 months. In many situations, workers will not have time to acclimatize, especially to the heat. Workplaces should always be ready to implement policies for extreme temperature and work conditions at any time.

Did you Know?

May 28, 1972: Only a trace of rain had fallen all month in Grande Prairie, AB. That, coupled with a heat wave with 40°C temperatures, had residents gobbling up enormous amounts of water. Then a pump at the treatment plant broke. The city engineer's solution to the crisis? "Drink beer."

July 24, 1996: Calgary was pounded by the second severe hail and rainstorm in eight days. Hail the size of oranges clogged storm sewers and caused massive flooding. Drivers were marooned on top of their vehicles. Eight days before, hail was so deep that children made "hailmen" and enjoyed some mid-summer tobogganing.

December 27 and 28, 1999: It was so warm in parts of Alberta (as high as 20.6°C in Claresholm) that grass fires broke out and trees sprouted leaves. It was hotter in Alberta than in parts of Mexico. In Saskatoon, a skating rink sprouted patches of grass as temperatures hit 7.8°C.

From: Severe Weather Excerpts from Prairie and Northern Region Green Lane, Environment Canada

Section 6 - Standards and guidelines

This section summarizes the existing regulations, standards and guidelines that can help Alberta employers address extreme temperature issues.

Regulations and Adopted Codes cite measures that must be complied with under the law.

Standards are set by voluntary organizations with expertise but are not legally binding unless cited within a regulation or adopted code. The heat/cold values cited in standards are useful as a guide for workplaces.

Guidelines are recommended practices or values that are useful but not mandatory.

Exposure Limits

Heat

Occupational exposure limits are used to protect workers from heat-related illness. Some Canadian jurisdictions have adopted the American Conference of Governmental Industrial Hygienists (ACGIH)'s "Threshold Limit Values" (TLVs®) as their exposure limits while others use them as guidelines. See Table 7 for legislation in Canada, and Table 8 for the ACGIH values.

Table 7: Specific Jurisdiction Regulations and Guidelines for Outdoor Heat Exposure

Jurisdiction	Standard/Guideline
British Columbia *(Occupational Health and Safety Regulation, B.C. Reg. 296/97; Amended to 320/2007)*	Part 7 - Noise, vibration, radiation and temperature; Thermal Exposure, Sections 7.26 - 7.32 - Heat Exposure Requirements to comply with ACGIH TLV®s and clothing protection provisions as well as requirements for a heat stress assessment control plan, controls, provision of water, removal and treatment.
Alberta *(Occupational Health and Safety Act,* Occupational Health and Safety Code)	While there are no specific requirements related to working in the heat or cold, the *Act* requires employers to ensure the health and safety of workers at their work sites. Part 2 of the Code requires employers to assess and control hazards workers may be exposed to at the work site.
Saskatchewan *(*Occupational Health and Safety Regulations, 1996, R.R.S., c. O-1, r. 1; *Amended to Sask. Reg. 91/2007)*	Section 70 - Thermal conditions 70 (1) Subject to subsection (3), in an indoor place of employment, an employer, contractor or owner shall provide and maintain thermal conditions, including air temperature, radiant temperature, humidity and air movement, that (a) are appropriate to the nature of the work performed; (b) provide effective protection for the health and safety of workers; and (c) provide reasonable thermal comfort for workers. (2) At an indoor place of employment where the thermal environment is likely to be a health or safety concern to the workers, an employer, contractor or owner shall provide and maintain an appropriate and suitably located instrument for measuring the thermal conditions. 70. (3) Where it is not reasonably practicable to control thermal conditions or where work is being performed outdoors, an employer, contractor or owner shall provide and maintain measures for: (a) the effective protection of the health and safety of workers; and (b) the reasonable thermal comfort of workers. (4) Measures for the purposes set out in subsection (3) may include, but are not limited to, the following: (a) frequent monitoring of thermal conditions; (b) the provision of special or temporary equipment, including screens, shelters and temporary heating or cooling equipment; (c) the provision of suitable clothing or personal protective equipment;

Jurisdiction	Standard/Guideline
	(d) the provision of hot or cold drinks; (e) the use of acclimatization or other physiological procedures; (f) the use of limited work schedules with rest and recovery periods, changes in workloads, changes in hours or other arrangements for work; (g) frequent observation of workers by a person who is trained to recognize the symptoms of physiological stress resulting from extreme temperatures; (h) the provision of emergency supplies for use when travelling under extremely cold or inclement weather conditions. (5) Where a worker is required to work in thermal conditions that are different from those associated with the worker's normal duties, an employer or contractor shall provide, and require the worker to use, any suitable clothing or other personal protective equipment that is necessary to protect the health and safety of the worker.
Manitoba *(Workplace Safety and Health Regulation, Man. Reg. 217/2006)*	Section 4.12 - Thermal stress When a workplace or work process exposes a worker to conditions that may create a risk to the worker's safety or health because of heat or cold, an employer must implement safe work procedures and control measures to ensure that (a) the threshold limit values for thermal stress established by the ACGIH in its publication, Threshold Limit Value for Chemical Substances and Physical Agents and Biological Indices, are followed. Guidelines are provided in the document "Guidelines for Thermal Stress", Sept 2007 available at www.safemanitoba.com/uploads/guidelines/thermalstress.pdf
Ontario (*Occupational Health and Safety Act,* RSO 1990, Chapter 0.1) (Ontario Ministry of Labour Health and Safety Guideline - Heat Stress, 2009)	While there are no specific requirements in the Occupational Health and Safety Legislation, there is a general duty to protect workers in the *Occupational Health and Safety Act.* This includes developing hot environment policies and procedures to protect workers in hot environments due to hot processes or hot weather. More information on developing and implementing policies to prevent heat-stress related illness at the work site is provided in the heat stress guidelines available at: http://www.labour.gov.on.ca/english/hs/pubs/gl_heat.php

Quebec *(Regulation respecting occupational health and safety, R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001;* Amended to 2009)	Heat Stress (Sections 121-124; Schedule V) 121. Compulsory measurements: In any establishment employing 50 workers or more where workers are exposed to heat stress conditions in which the heat stress index reaches or exceeds the continuous work curve in the graph of Schedule V, this index shall be measured twice a year, once during the summer, at each work station where the index is reached or exceeded. The measurements obtained in accordance with the first paragraph shall be entered in a register. The register shall be kept for at least 5 years. 122. Method: For the purposes of enforcing this Regulation, the heat stress index is measured by the Wet Bulb Globe Temperature Index (W.B.G.T. method) as established in Schedule V. 123. Index exceeds the continuous work curve: In any establishment where workers are exposed to heat stress conditions such that the heat stress index exceeds the continuous work curve in the graph of Schedule V, the employer shall ensure that the workers thus exposed undergo medical supervision and shall provide them with water at a temperature of between 10^0C and 15^0C, and one shower per 15 exposed workers. 124. Special measures: In any establishment where workers are exposed to heat stress conditions such that the heat stress index exceeds the continuous work curve in the graph of Schedule V, the following measures shall be taken: (1) re-equipping the exposed work station with reflecting screens, additional insulation or ventilation to reduce the heat stress index of the work station to a value less than or equal to the values of the continuous curve; (2) if the application of subparagraph 1 proves impossible or does not allow the continuous work curve to be reached, control the work load, the time of exposure and the rest time in accordance with the alternate work-rest regimen prescribed for the purpose in Schedule V; (3) if the application of subparagraphs 1 and 2 proves impossible or does not allow the continuous work curve indicated in the graph in Schedule V to be reached or while waiting for the alterations required under subparagraph 1 to be done, ensure that the workers wear appropriate individual equipment in accordance with the nature of the heat stress.

New Brunswick *(Regulation 91-191 - Occupational Health and Safety Act, OC 91-1035)*	Sections 22 and 23- Extremes of Temperature 22. Where an employee is exposed to work conditions that may present a hazard because of extreme heat or extreme cold, an employer shall ensure that (a) a competent person measures and records the thermal conditions at frequent intervals and makes the findings available to a committee, if any, and to an officer on request, and (b) the threshold limit values for protection against heat stress and cold stress are followed as well as the work-rest regimen for heat and the work-warming regimen for cold and other advice found from pages 125 to 140 of the ACGIH publication "1997 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices". 23(1) Where an employee is exposed to work conditions that may present a hazard because of excessive heat, an employer shall ensure that a competent person instructs the employee in the significance of symptoms of heat stress such as heat exhaustion, dehydration, heat cramps, prickly heat and heat stroke and in the precautions to be taken to avoid injury from heat stress.
Nova Scotia *(Occupational Health Regulations, N.S. Reg. 112/76)*	Section 4 - Occupational Health Standards 4. (1) The occupational health standards relating to gases, vapours, mists, fumes, smoke, dust, and other chemical substances and physical agents shall be as listed in the Threshold Limit Values for chemical substances and physical agents for 1976, published by the American Conference of Governmental Industrial Hygienists and its subsequent amendments or revisions.
Prince Edward Island *(Occupational Health and Safety Act General Regulations, EC180/87;* Amended to EC2006-43*)*	Part 42 - Extremes of Temperature Section 42.1 - Standards: Permissible heat and cold exposure shall conform to Threshold Limit Values (TLVs) as laid down by the American Conference of Governmental Industrial Hygienists (ACGIH).

Newfoundland/Labrador *(Occupational Health and Safety Regulations 2009, NLR 70/09)*	Section 44 - Thermal Environment 44. (1) An employer shall ensure that a thermal environment which is reasonable and consistent with the nature and degree of the work performed, as established by the ACGIH, is provided and maintained in a workplace. (2) An employer shall provide appropriate and suitable monitoring equipment in a workplace where the thermal environment is likely to pose a hazard to a worker. (3) Under unusually hot or cold working conditions an employer shall make further provision for the health and safety and reasonable thermal comfort of a worker, which may include: (a) regular monitoring, posting of warning devices and additional first aid measures; (b) provision of special equipment and clothing; (c) provision of screens or shelters; (d) medical supervision, hot or cold drinks and acclimatization procedures; (e) limited work schedules with rest periods: and (f) other appropriate controls and measures. (4) In a workplace, an open flame, steampipe or other high temperature source shall be identified at the source and positioned or shielded to prevent contact by a worker, unless the exposed source is necessary for work processes and cannot be appropriately controlled by engineering means. (5) Where a source referred to in subsection (4) is necessarily exposed, a worker shall wear appropriate personal protective equipment.
Yukon *Occupational Health Regulations,* O.I.C. 1986/164	Section 9 – Thermal Environment 9. (1) Every employer shall provide and maintain in every indoor place of employment thermal conditions, including air temperature, radiant temperature, humidity and air movement, which are reasonable and appropriate to the nature of the work performed. (2) At every indoor place of employment where thermal environment is likely to be of discomfort or danger to the workers, the employer shall provide an appropriate and suitably located instrument for measuring the thermal conditions.

	(3) Where it is not reasonably practicable to control thermal conditions pursuant to subsection (1) or where the work is being performed outdoors, the employer shall provide effective protection for the health and safety and reasonable thermal comfort of workers; such protection may include: (a) frequent monitoring of thermal conditions' (b) special or temporary equipment such as screens, shelters and temporary heating or cooling equipment; (c) special clothing or personal protective equipment; (d) hot or cold drinks, acclimatization or other physiological procedures; (e) limited work schedules with rest and recovery periods, changes in workloads, changes in hours or other arrangements for work; (f) any other appropriate measure. Section 12 - Heat Stress 12. (1) Where hot environment work conditions may cause heat disorders in workers employed in such conditions, the employer shall determine and record the thermal index using: (a) Wet Bulb Globe Temperature (WBGT) according to the formulae: INDOOR OR OUTDOOR WITH0UT SOLAR LOAD: WBGT = 0.7WB + 0.3GT OUTDOOR WITH SOLAR LOAD: WBGT=0.7WB+0.2GT+0.1DB WHERE: WB= natural wet-bulb temperature DB=dry-bulb temperature GT = globe thermometer temperature or (b) Wet Globe Temperature (WGT) (2) Workers shall not be permitted to work continuously when the thermal index as measured in clause (1), exceeds the following limits … (3) Where the thermal index exceeds the levels in clause (2), the employer shall (a) implement engineering methods to reduce the thermal index or isolate the worker from the source of heat, or (b) implement work-rest regimes so that the thermal index averaged over the hottest 2 hour period is below that listed in clause (2),

	(c) ensure that the worker is wearing appropriate protective clothing, or (d) implement a combination of (a), (b) and (c). (4) Where workers are exposed to hot work conditions, the employer shall: (a) instruct the workers in the recognition of symptoms of heat disorders including heat exhaustion, dehydration, heat cramps, prickly-heat, and heat stroke, and (b) provide an adequate supply of potable water and salt supplement or a 0.10.2% saline drinking solution.
Northwest Territories (Safety Act, RSNWT 1988, c.S.1)	While there is a general duty in the Act to protect workers from hazards at the work site, there is no specific mention of thermal, heat or other environmental temperature conditions in the Act or Regulations
Nunavut (Consolidation of Safety Act RSNWT 1988, c.S1, amended up to 1996)	While there is a general duty in the Act to protect workers from hazards at the work site, there is no specific mention of thermal, heat or other environmental temperature conditions in the Act or Regulations
Federal jurisdiction *(Canada Occupational Health and Safety Regulations SOR/86-304 under the Canadian Labour Code)*	Section 9.9 - In each personal service room and food preparation area, the temperature, measured one metre above the floor in the centre of the room or area, shall be maintained at a level of not less than 18^0C and, where reasonably practicable, not more than 29°C. Section 14.9 Protection from Elements 14.9 (1) Motorized materials handling equipment that is regularly used outdoors shall be fitted with a roof or other structure that will protect the operator from exposure to any weather condition that is likely to be hazardous to the operator's health or safety. (2) Where the heat produced by motorized materials handling equipment results in a temperature above 26°C in the compartment or position occupied by that operator, the area shall be protected from the heat by an insulated barrier

ACGIH Recommended Exposure Limits

The ACGIH limits are given in WBGT units (wet bulb globe temperature) in degrees Celsius (°C). The WBGT unit takes into account air temperature, heat from radiant sources, humidity and air movement, as it is these factors that contribute to human perception of hotness. (WBGT was discussed in more detail in Section 4.)

The ACGIH publication "2009 TLVs® and BEIs®" provides recommended screening criteria for heat stress exposure for workers acclimatized and those who are not acclimatized for the intensity of the work being done (Table 8). The occupational exposure limits are generally given as a work/rest regimen. The publications "2007 TLVs® and BEIs®" and "Documentation of TLVs® and BEIs®" should be consulted for more detailed information on these screening criteria, categories of work demands, guidelines for limiting heat stress and heat stress management.

Table 8 – ACGIH Screening Criteria for Heat Stress Exposure (WBGT values in °C)

Allocation of Work in a Work/Rest Cycle	TLV				Action Limit			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75-100%	31.0	28.0	--	--	28.0	25.0	--	--
50-75%	31.0	29.0	27.5	--	28.5	26.0	24.0	--
25-50%	32.0	30.0	29.0	28.0	29.5	27.0	25.5	24.5
0-25%	32.5	31.5	30.5	30.0	30.0	29.0	28.0	27.0

Notes:

Assumes 8-hour workdays in a 5-day workweek with conventional breaks.

TLVs assume that workers exposed to these conditions are adequately hydrated, are not taking medication, are wearing lightweight clothing, and are in generally good health.

Examples of work loads:

Rest - Sitting

Light work - Sitting with light manual work with hands or hands and arms and driving. Standing with occasional walking

Moderate work – Normal walking, sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, light pushing and pulling

Heavy work – Intense arm and trunk working carrying, shovelling, manual sawing, pushing and pulling heavy loads, walking at a fast pace

Very Heavy - Very intense activity at fast to maximum pace; e.g. shovelling wet sand

Adapted from: 2009 TLVs® and BEIs® - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati: American Conference of Governmental Industrial Hygienists (ACGIH), 2009, p. 229

Clothing

Evaporation of perspiration from the skin is the main way the body cools itself. Clothing such as water-vapour-impermeable, air-impermeable, thermal insulation or in multiple layers will greatly restrict this heat removal process. The result can be excessive heat strain even when environmental conditions are not hot.

The ACGIH exposure limits assume the worker is wearing loose fitting cotton clothing. If a person is wearing heavier clothing then the exposure limit should be corrected. ACGIH recommendations for such situations are provided in Table 9.

Table 9 - Correction of TLV for Clothing (Values cannot be added when wearing multiple layers)	
Clothing Type	WBGT Correction (°C)
Work clothes (long sleeve shirt and pants)	0
Cloth (woven material) coveralls	0
SMS (Spunbonded - Meltdown - Spunbonded) polypropylene coveralls	+ 0.5
Polyolefin coveralls	+ 1
Double-layer woven clothing	+ 3
Limited-use vapour-barrier coveralls	+ 11
Note: These values are not to be used for completely encapsulating suits. Coveralls assume only modest clothing is underneath, not a second layer of clothing. For example, an acclimatized worker wearing double-layer woven clothing doing moderate work would have a corrected exposure level of: 30.0 + 3 = 33ºC, which would lower his or her allowable exposure to 0-25% work (from 25-50% work)	

Adopted from: 2009 TLVs® and BEIs®: Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, 2009, p. 227.

Humidex as a Guide for Heat Stress

As previously discussed, Environment Canada uses a humidex scale to inform the public about hot weather conditions. For a given temperature, the humidex increases as the relative humidity (moisture content) of the air becomes greater.

The Occupational Health Clinics for Ontario Workers Inc. (OHCOW) created a “Humidex-based response plan” which translated TLVs® WBGTs into humidex values and developed recommended responses for each humidex range. This plan was developed as a tool to help workplaces as most workplaces find using the WBGT

complicated and expensive. See Table 10 for a summary of the recommended actions. See Appendix 2 for full details.

Table 10: Recommended Actions Based on the Humidex Reading

Humidex Reading		Action
Moderate physical work, unacclimatized worker, OR Heavy physical work, acclimatized worker	Moderate physical work, acclimatized worker, OR Light physical work, unacclimatized worker	
45+	50+	Workers must be under medical supervision during work
42-44	47-49	Work with 45 min/hour rest
40-41	45-46	Work with 30 min/hr rest
38-39	43-44	Work with 15 min/hr rest
34-37	40-42	Warn workers of symptoms and provide extra water
30-33	36-39	Alert workers of symptoms and provide extra water
25-29	32-35	Provide water as needed

Note: Environment Canada describes the degree of comfort from humidex ranges slightly differently but their "calculations" of comfort do not discuss being physically active or working outdoors (Table 11).

Table 11: Range of Humidex and Degree of Comfort (for anyone)	
Humidex Range	**Degrees of Comfort**
Less than 29	No discomfort
30 - 39	Some discomfort
40 - 45	Great discomfort; avoid exertion
Above 45	Dangerous
Above 54	Heat stroke imminent

Source: Environment Canada - Humidity https://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=6C5D4990-1

Cold Exposure Limits

Standards and guidelines for working in the cold for each jurisdiction are listed in Table 12.

Table 12: Specific Jurisdiction Regulations and Guidelines for Outdoor Cold Exposure

Jurisdiction	***Standard/Guideline***
British Columbia *(Occupational Health and Safety Regulation, B.C. Reg. 296/97; Amended to 320/2007)*	Sections 7.33 to 7.38 (Cold Exposure) 7.33 Sections 7.34 to 7.38 apply to a workplace if a worker is or may be exposed to (a) thermal conditions that could cause cold stress or injury, (b) thermal conditions that could cause a worker's core body temperature to fall below 36 ºC (96.8 ºF), or (c) thermal conditions that are below the levels classified as "little danger" to workers in the criteria for the cooling power of wind on exposed flesh in the cold stress section of the ACGIH Standard. Requirements for assessment and control plan, controls, heated shelters, clothing and PPE, removal and treatment.
Alberta *(Occupational Health and Safety Act,* Occupational Health and Safety Code)	While there are no specific requirements related to working in the heat or cold, the *Act* requires employers to ensure the health and safety of workers at their work sites. Part 2 of the Code requires employers to assess and control hazards workers may be exposed to at the work site.
Saskatchewan (*Occupational Health and Safety Regulations, 1996, R.R.S., c. O-1, r. 1,* As amended to 91/2007*)*	Section 70 - Thermal conditions See Table 7 (same legislation as for Heat exposure limits) Detailed guidelines for working in the cold are in *"Cold Condition Guidelines for Outside Workers"* (Jan. 2000), Available at: http://www.lrws.gov.sk.ca/cold-condition-guidelines-working-outside).

Manitoba *(Workplace Safety and Health Regulation, Man. Reg. 217/2006)*	Section 4.12 - Thermal stress When a workplace or work process exposes a worker to conditions that may create a risk to the worker's safety or health because of heat or cold, an employer must implement safe work procedures and control measures to ensure that (a) the threshold limit values for thermal stress established by the ACGIH in its publication, Threshold Limit Value for Chemical Substances and Physical Agents and Biological Indices, are followed Continuous skin exposure not permitted when wind chill is < -32 (From: Manitoba Workplace Safety & Health Division, "Guidelines for Thermal Stress", Sept. 2007, available at: http://safemanitoba.com/uploads/guidelines/thermalstress.pdf
Ontario (*Occupational Health and Safety Act, RSO 1990, Chapter 1)*	While there are no specific requirements in the Occupational Health and Safety Legislation, there is a duty to protect workers in the Act. There are minimum temperature limits set for healthcare facilities or industrial establishments (18^0C, subject to some exceptions such as work outdoors or in freezers), there are no set minimum or maximum temperatures for other workplaces. Nevertheless, because either extreme heat or cold may be a hazard, temperature is a legitimate issue in determining workplace safety. (From: Ontario Ministry of Labour Health and Safety FAQs - In the Workplace. Available at: http://www.labour.gov.on.ca/english/hs/faqs/workplace.php#temperature
Quebec *(Regulation respecting occupational health and safety,* R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001; Amended to 2009)	Heating Environment (Sections 116-117), Schedule IV 116. Subject to sections 117 and 118, in any closed rooms, an appropriate temperature shall be maintained considering the nature of work performed therein as well as outdoor climatic conditions; if such temperature cannot be reasonably maintained, a warm place shall be put at the disposal of workers. 117. Stationary work station: In any establishment, the minimum temperature prescribed in Schedule IV shall be maintained at any stationary work station inside a building according to the type of work performed, except if the purpose for which the rooms are used or the nature of a process or of the products handles requires a cooler temperature, and unless the work station is situated in a motor vehicle, or the work involves maintenance, inspection or repairs outside the workshop.

	118. Lunch room: Where a lunch room is put at the disposal of workers for eating their meals, the room shall be kept at a minimum temperature of 20^0C. This section does not apply to facilities used as offices. Schedule IV contains Standards of Temperature in Establishments
New Brunswick *(Regulation 91-191 - Occupational Health and Safety Act, OC 91-1035)*	Section 22 and 23 Extremes of Temperature 22. Where an employee is exposed to work conditions that may present a hazard because of extreme heat or extreme cold, an employer shall ensure that (a) a competent person measures and records the thermal conditions at frequent intervals and makes the findings available to a committee, if any, and to an officer on request, and (b) the threshold limit values for protection against heat stress and cold stress are followed as well as the work-rest regimen for heat and the work-warming regimen for cold and other advice found from pages 125 to 140 of the ACGIH publication "1997 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices". 23(2) Where an employee is exposed to work conditions that may present a hazard because of excessive cold, an employer shall ensure that a competent person instructs the employee in the significance of symptoms of cold stress such as severe shivering, pain in the extremities of the body and reduced mental awareness and in the precautions to be taken to avoid injury from cold stress.
Nova Scotia *(Occupational Health Regulations,* OIC 76-1510 (December 21, 1976) *N.S. Reg. 112/76)*	Section 4 - Occupational Health Standards 4. (1) The occupational health standards relating to gases, vapours, mists, fumes, smoke, dust, and other chemical substances and physical agents shall be as listed in the Threshold Limit Values for chemical substances and physical agents for 1976, published by the American Conference of Governmental Industrial Hygienists and its subsequent amendments or revisions.
Prince Edward Island (*Occupational Health and Safety Act*, General Regulations EC180/87, Amended to EC2006-43	Part 42: Extremes of Temperature Section 42.1 - Standards: Permissible heat and cold exposure shall conform to Threshold Limit Values (TLVs) as laid down by the American Conference of Governmental Industrial Hygienists (ACGIH).

Newfoundland/Labrador *Occupational Health and Safety Regulations* 2009,N.L.R. 70/09	Section 44 - Thermal Environment 44. (1) An employer shall ensure that a thermal environment which is reasonable and consistent with the nature and degree of the work performed, as established by the ACGIH, is provided and maintained in a workplace. (2) An employer shall provide appropriate and suitable monitoring equipment in a workplace where the thermal environment is likely to pose a hazard to a worker. (3) Under unusually hot or cold working conditions an employer shall make further provision for the health and safety and reasonable thermal comfort of a worker, which may include: (g) regular monitoring, posting of warning devices and additional first aid measures; (h) provision of special equipment and clothing; (i) provision of screens or shelters; (j) medical supervision, hot or cold drinks and acclimatization procedures; (k) limited work schedules with rest periods: and (l) other appropriate controls and measures. (4) In a workplace, an open flame, steampipe or other high temperature source shall be identified at the source and positioned or shielded to prevent contact by a worker, unless the exposed source is necessary for work processes and cannot be appropriately controlled by engineering means. (5) Where a source referred to in subsection (4) is necessarily exposed, a worker shall wear appropriate personal protective equipment.

Yukon *(Occupational Health Regulations, O.I.C. 1986/164)*	Section 9 – Thermal Environment 9. (1) Every employer shall provide and maintain in every indoor place of employment thermal conditions, including air temperature, radiant temperature, humidity and air movement, which are reasonable and appropriate to the nature of the work performed. (2) At every indoor place of employment where thermal environment is likely to be of discomfort or danger to the workers, the employer shall provide an appropriate and suitably located instrument for measuring the thermal conditions. (3) Where it is not reasonably practicable to control thermal conditions pursuant to subsection (1) or where the work is being performed outdoors, the employer shall provide effective protection for the health and safety and reasonable thermal comfort of workers; such protection may include: (g) frequent monitoring of thermal conditions' (h) special or temporary equipment such as screens, shelters and temporary heating or cooling equipment; (i) special clothing or personal protective equipment; (j) hot or cold drinks, acclimatization or other physiological procedures; (k) limited work schedules with rest and recovery periods, changes in workloads, changes in hours or other arrangements for work; (l) any other appropriate measure.
Northwest Territories (Safety Act, RSNWT 1988, c.S.1) Amended up to SNWT 2010, c.16	While there is a general duty in the Act to protect workers from hazards at the work site, there is no specific mention of thermal, heat or other environmental temperature conditions in the Act or Regulations
Nunavut (Consolidation of Safety Act RSNWT 1988, c.S1, current to July 20, 2006)	While there is a general duty in the Act to protect workers from hazards at the work site, there is no specific mention of thermal, heat or other environmental temperature conditions in the Act or Regulations

Federal jurisdiction *(Canada Occupational Health and Safety Regulations SOR/86-304under the Canadian Labour Code)*	Section 9.9 - In each personal service room and food preparation area, the temperature, measured one metre above the floor in the centre of the room or area, shall be maintained at a level of not less than 18^0C and, where reasonably practicable, not more than 29°C. Section 14.9 Protection from Elements 14.9 (1) Motorized materials handling equipment that is regularly used outdoors shall be fitted with a roof or other structure that will protect the operator from exposure to any weather condition that is likely to be hazardous to the operator's health or safety. (2) Where the heat produced by motorized materials handling equipment results in a temperature above 26°C in the compartment or position occupied by that operator, the area shall be protected from the heat by an insulated barrier

Cold Exposure Guidelines

The ACGIH has adopted guidelines developed by Saskatchewan Labour for working outdoors in cold weather conditions (Table 13). The recommended exposure times are based on the wind chill factor and assume workers are wearing dry clothing. The work-break schedule applies to any 4-hour period with moderate or heavy activity. The warm-up break periods are 10-minutes long in a warm location. The schedule assumes that "normal breaks" are taken once every two hours. At the end of a 4-hour period, an extended break (e.g. lunch break) in a warm location is recommended. More information is available in the ACGIH publications "2009 TLVs® and BEIs®" and on the Saskatchewan Labour web page "Cold Conditions Guidelines for Outside Workers" (http://www.lrws.gov.sk.ca/cold-condition-guidelines-working-outside).

Table 13: Work Warm-up Schedule for Outdoor Activities

<table>
<tr><th colspan="2">Air Temperature – Sunny Sky</th><th colspan="2">No Noticeable Wind</th><th colspan="2">5 mph Wind</th><th colspan="2">10 mph Wind</th><th colspan="2">15 mph Wind</th><th colspan="2">20 mph Wind</th></tr>
<tr><td>°C (approx)</td><td>°F (approx)</td><td>Max. Work Period</td><td>No. of Breaks**</td><td>Max. Work Period</td><td>No. of Breaks</td><td>Max. Work Period</td><td>No. of Breaks</td><td>Max. Work Period</td><td>No. of Breaks</td><td>Max. Work Period</td><td>No. of Breaks</td></tr>
<tr><td>-26° to -28°</td><td>-15° to -19°</td><td>120 min.</td><td>1</td><td>120 min.</td><td>1</td><td>75 min.</td><td>2</td><td>55 min.</td><td>3</td><td>40 min.</td><td>4</td></tr>
<tr><td>-29°to -31°</td><td>-20°to -24°</td><td>120 min.</td><td>1</td><td>75 min.</td><td>2</td><td>55 min.</td><td>3</td><td>40 min.</td><td>4</td><td>30 min.</td><td>5</td></tr>
<tr><td>-32° to -34°</td><td>-25°to -29°</td><td>75 min.</td><td>2</td><td>55 min.</td><td>3</td><td>40 min.</td><td>4</td><td>30 min.</td><td>5</td><td colspan="2" rowspan="5">Non-emergency work should cease</td></tr>
<tr><td>-35° to -37°</td><td>-30° to -34°</td><td>55 min.</td><td>3</td><td>40 min.</td><td>4</td><td>30 min.</td><td>5</td><td colspan="2">Non-emergency work should cease</td></tr>
<tr><td>-38° to -39°</td><td>-35° to -39°</td><td>40 min.</td><td>4</td><td>30 min.</td><td>5</td><td colspan="2" rowspan="3">Non-emergency work should cease</td><td colspan="2" rowspan="3"></td></tr>
<tr><td>-40° to -42°</td><td>-40° to -44°</td><td>30 min.</td><td>5</td><td colspan="2" rowspan="2">Non-emergency work should cease</td></tr>
<tr><td>-43° & below</td><td>-45° & below</td><td colspan="2">Non-emergency work should cease</td></tr>
</table>

* Saskatchewan Labour "Cold Conditions Guidelines for Outside Workers" http://www.lrws.gov.sk.ca/cold-condition-guidelines-working-outside.

** This includes a normal break after 2 hours and the additional warm-up breaks needed.

Wind Chill

The Saskatchewan Department of Labour has produced the following useful guide to help estimate the wind speed.

8 kilometres per hour (kph) (5 mph)—moves a light flag;

16 kph (10 mph)—fully extends a light flag;

24 kph (15 mph)—raises a newspaper sheet;

32 kph (20 mph)—blowing and drifting snow.

Another suggestion for estimating wind or air movement without a measuring instrument is shown in Table 14.

Table 14: Estimating Wind Speed

Wind Speed (km/h)	What to Look For
10	Wind felt on face; leaves rustle; wind vanes begin to move.
20	Leaves & small twigs constantly moving; small flags extended.
30	Dust, leaves, & loose paper lifted; large flags flap; small tree branches move.
40	Small trees begin to sway; large flags extend and flap.
50	Larger tree branches moving; whistling heard in power lines; large flags extend and flap more wildly.
60	Whole trees moving; resistance felt in walking against wind; large flags extend fully and flap only at the end

Source: http://www.environment.nsw.gov.au/resources/airwatch/atmos_8.pdf

The danger warnings in the wind chill chart are applicable if a person's clothes and skin are dry. When a person is wet, cold injury can happen at much warmer temperatures. High wind speed doesn't only occur when it's windy. Driving in an open vehicle creates air movement similar to a strong wind. Table 15 can be used to estimate wind chill values using air temperature and wind speed.

Table 15: Wind Chill Calculation Chart

Wind Chill Calculation Chart

Wind chill for temperatures from +5 to -20°C						
Tair (°C) V10 (km/h)	5	0	-5	-10	-15	-20
5	4	-2	-7	-13	-19	-24
10	3	-3	-9	-15	-21	-27
15	2	-4	-11	-17	-23	-29
20	1	-5	-12	-18	-24	-30
25	1	-6	-12	-19	-25	-32
30	0	-6	-13	-20	-26	-33
35	0	-7	-14	-20	-27	-33
40	-1	-7	-14	-21	-27	-34
45	-1	-8	-15	-21	-28	-35
50	-1	-8	-15	-22	-29	-35
55	-2	-8	-15	-22	-29	-36
60	-2	-9	-16	-23	-30	-36
65	-2	-9	-16	-23	-30	-37
70	-2	-9	-16	-23	-30	-37
75	-3	-10	-17	-24	-31	-38
80	-3	-10	-17	-24	-31	-38

where
Tair = Actual Air Temperature in °C
V10 = Wind Speed at 10 metres in km/h (as reported in weather observations)

Wind chill for temperatures from -25 to -50°C						
Tair (°C) V10 (km/h)	-25	-30	-35	-40	-45	-50
5	-30	-36	-41	-47	-53	-58
10	-33	-39	-45	-51	-57	-63
15	-35	-41	-48	-54	-60	-66
20	-37	-43	-49	-56	-62	-68
25	-38	-44	-51	-57	-64	-70
30	-39	-46	-52	-59	-65	-72
35	-40	-47	-53	-60	-66	-73
40	-41	-48	-54	-61	-68	-74
45	-42	-48	-55	-62	-69	-75
50	-42	-49	-56	-63	-69	-76
55	-43	-50	-57	-63	-70	-77
60	-43	-50	-57	-64	-71	-78
65	-44	-51	-58	-65	-72	-79
70	-44	-51	-58	-65	-72	-80
75	-45	-52	-59	-66	-73	-80
80	-45	-52	-60	-67	-74	-81

Reproduced with the permission of Environment Canada, 2005

Wind Chill Range	Frost Bite Risk
4 to -27	Low risk of frostbite for most people
-28 to -39	Increasing risk of frostbite for most people within 30 minutes of exposure
-36 to -47	High risk for most people in 5 to 10 minutes of exposure
-44 to -54	High risk for most people in 2 to 5 minutes of exposure
-55 to -81	High risk for most people in 2 minutes of exposure or less

Limitations of Occupational Exposure Limit and TLV Guidelines

While exposure limits provide useful guidelines to help control worker exposure to heat and cold, these values and guidelines do have limitations. An exposure limit alone cannot be used to assess the hazard. ALL aspects of the potential hazards and risks in the workplace, including work procedures and current control measures, should be considered in a hazard assessment.

In addition, occupational heat or cold exposure limits do not account for variations in worker characteristics (weight, effects of medication, etc). Workers may reach a danger zone even when exposure is below an exposure limit.

OELs: 8 hours vs. longer shifts

OELs are based on an 8-hour exposure with 16 hours of "rest" (non-exposure). Methods for determining exposure levels for the extended workday should be used with caution. Expert advice may be necessary to determine acceptable exposures for an extended workday.

Did you Know?

Mild cold impairs nerve function and decreases sensation and manual dexterity. The difficulty you experience on a cold frosty morning fastening the buttons of your coat is due to the slowing of the nerve signals from your brain to your fingers. Cold muscles also work slower, making the fingers stiff and clumsy. The critical air temperature for manual dexterity is 12°C and that for touch sensitivity is 8°C. Low temperatures also impair the function of the sensory nerves that transmit pain.

And on the other extreme…

Brain cells are extremely sensitive to heat. 42°C is all they can bear. An increase of a few degrees in the temperature of the blood can have a profound effect on brain function.

Section 7: Controlling Exposure

Controlling Exposure

If a hazard assessment suggests that measures should be taken to reduce the potential for harm to workers, the employer is required to follow the hazard control hierarchy as outlined in Alberta's Occupational Health and Safety Code:

1. Explore ways to **eliminate** the hazard;
2. Reduce exposure by applying **engineering controls** such as methods of designing or modifying plants, equipment, ventilation systems, and processes to reduce exposure;
3. Apply **administrative controls** such as work practices, standards and operating procedures including training, timing of work, policies and other rules to reduce exposure; and
4. Use **personal protective equipment** if necessary as a last resort.
5. Use a combination of engineering controls, administrative controls or personal protective personal equipment if there is a greater level of worker safety because a combination is used.

The best way to control a hazard is to eliminate it. Naturally, this step is practically impossible when the hazard is an outdoor environmental condition.

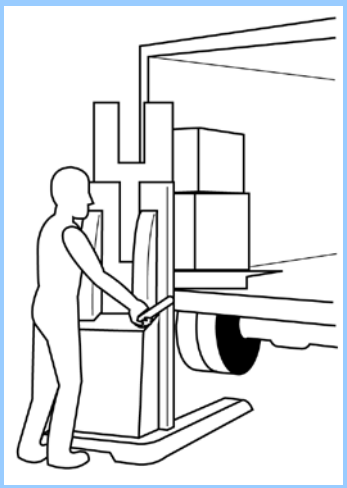
The measures for control, therefore, should focus on engineering and administrative controls, and if necessary, personal protective equipment.

See Appendix 3 for sample policies for both heat and cold.

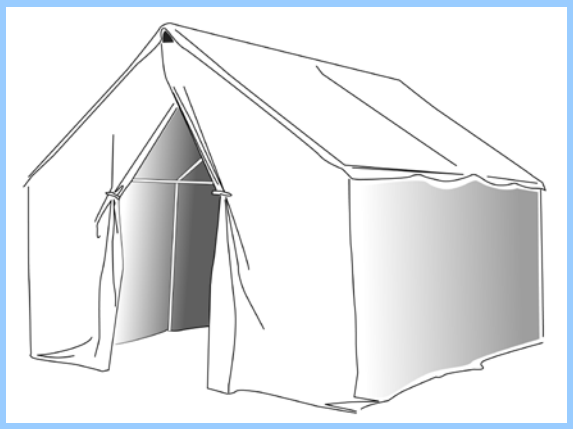
Don't forget! Although they are not referenced in Alberta's Occupational Health and Safety Code, Alberta recommends using the ACGIH exposure guidelines as outlined in Section 6 for both heat and cold exposure.

Heat

Engineering Controls



- Reduce the level of physical activity required. Reducing heavy physical activity will lower the body's metabolic heat production and thus the risk of heat stress. Some examples include using carts, conveyors, or mechanical lifting devices.
- Where possible, change the location of the work to a cooler work area – determine if some or all of the work can be done in the shade, or better, in a ventilated or air-conditioned space. Examples would be to load vehicles inside a cooled warehouse, provide a shade shelter for groundskeepers while they work in a garden, etc.



- Establish a cooling station where workers can rest in a ventilated and air-conditioned space – either a booth or vehicle. For example, outdoor municipal workers may take breaks and lunches in the closest recreation centre, a large van can provide an enclosed cool space, or provide shade (tarps, tents, etc).
- Adjust the clothing requirements, when possible. For example, can certain tasks be done in lighter t-shirts and shorts vs. coveralls?
- Use fans to increase air movement and help encourage sweat evaporation. **NOTE!** This control method is **only** effective when the air temperature is less than the skin temperature (about 35°C). When extremely hot air is blown on a person, heat exhaustion can happen faster.

Indoor environments may also be able to insulate or shield objects that give off radiated heat, use local exhaust to remove hot air or steam produced by processes, or use air conditioning to control the temperature and amount of humidity in the workspace.

Administrative Controls

- Reduce the physical effort needed for the task by:
    - lowering the pace of work (how fast) or the intensity (how “hard” the job is)
    - shortening the duration (how long)
    - increasing the number and/or length of rest breaks
    - substituting light tasks for heavy ones
    - increasing the number of staff so that more workers share the workload
- Allow time for acclimatization. As discussed in Section 1, acclimatization is an important control step.
- Use a work-rest schedule. See Table 8 in Section 6 for an example. This schedule reduces the amount of time spent at physical activities and allows for a rest period for the body to recover and cool. Recommendations for how long the work and rest periods are will depend on the temperature, humidity, acclimatization, and company policy. Rest breaks allow the body time to cool (rid itself of excess heat), reduce the production of internal body heat, and provide greater blood circulation to the skin.
- If practical, workers in hot environments should be encouraged to set their own work and rest schedules. Experienced workers can often judge heat stress and limit their exposure accordingly. Inexperienced workers may need special attention as they may continue to work beyond the point at which signs of heat stress begin to appear.
- Schedule physically demanding jobs for cooler periods of the day (usually early morning or evening).
- Carefully monitor infrequent or irregular tasks such as emergency repairs or working near hot process equipment as these tasks often result in heat stress.
- Provide appropriate training and education to increase workers’ awareness of the potential hazards and what to do when they recognize warning signs in themselves or others.
- Pay attention to workers with special needs, including those with medical conditions or pregnant workers. Workers should discuss limitations and precautions with their doctor.

If workers are routinely expected to work in hot conditions, the employer should prepare safe work practices regarding working in hot conditions.

- Provide training and education. Create a high level of awareness about the hazards of working in hot conditions.
- Establish how you will determine when work should be reduced, or when it is "too hot" to do certain types of work.
- Know what steps to take to prevent health effects.
- Establish a "buddy system". Everyone should be able to recognize early warning signs of health effects in themselves and their co-workers, and be able to respond appropriately.

Always provide enough drinking water for all workers. Each individual should drink about 250 ml (1 cup) every 15-20 minutes when working in hot conditions.

Reminder! Staying hydrated is essential. Level of acclimatization and personal factors also play a large role in how we adapt to heat and cold. See Section 3 of this guide for more information.

Personal Protective Equipment (PPE)

When selecting clothing to help prevent heat stress, the type selected should be balanced against other health and safety needs. For example, short sleeved or sleeveless t-shirts and shorts may expose more skin (better for sweat evaporation), but will also increase ultra violet (UV) radiation exposure. On the other hand, types of protective equipment (hard hats, coveralls, impermeable clothing, gloves, etc.) may be necessary to protect from other hazards, but this clothing or equipment will increase the heat stress burden experienced by an individual.

Examples of PPE for hot conditions include

- Self-contained air conditioner in a backpack
- A compressed air source which feeds cool air into a jacket or coveralls
- A jacket which has pockets that can be filled with ice packs
- Specifically designed gel packs (that fit, for example, inside a hard hat)
- Effective cooling units are available for use with supplied-air units. A vortex tube separates the air into cool and warm components, releasing the warm air outside the suit.

“Middle Management”

Do not assume that heat or cold stress can only happen when the temperature is high or low.

- Military infantrymen wearing chemical protective clothing while doing medium to heavy work have experienced heat stress at temperatures below 20°C.
- People working in the cold can experience heat stress by overdressing, or when they enter a warm environment and then get hot and begin to sweat. When they return to the cold environment with damp clothes, the wet clothing and skin can lead to excessive cooling known as “after chills” and result in health risks.

(From: Havenith, G, 1999. “Heat Balance When Wearing Protective Clothing”, Annals of Occupational Hygiene, Vol. 43, No 5, pp 289-296)

Cold

Engineering Controls

- Use controls such as enclosures and heating systems where practical and possible.
- Protect the hands, face, and feet from frostbite with an on-site source of heat. Air heaters, radiant heaters, or contact warm plates may be used. (Heaters that emit carbon monoxide should be used with caution.)
- Provide a heated shelter for workers to do their work in, where possible, but at minimum as a shelter for a work/warm-up break.
- Shield work areas from drafts or winds as much as possible.
- Use thermal insulating material on equipment (such as when touching metal handles, or when you have to sit or kneel on concrete).

Administrative Controls

- Use a work/warm-up schedule. A warm shelter or vehicle should be available so workers can warm up.
- Allow a period of adjustment to the cold before assigning a full work schedule.
- Allow individuals to set their own pace and take extra work breaks when needed.

- Educate new or newly transferred workers on the hazards of working in a cold environment.
- Avoid activities, whenever possible, that lead to heavy sweating.
- Do as many tasks as possible indoors and minimize the length of time people must work outdoors.
- Work outside during the warmer hours of the day (mid-day/early afternoon).
- Minimize activities that reduce blood circulation, such as sitting or standing for long periods of time.
- Use a buddy system and avoid working alone in very cold weather. If you see symptoms in a co-worker, take appropriate preventive steps.
- Do not sit or kneel on cold, unprotected surfaces.
- Older workers, or those with certain medical problems, need to be extra alert about the effects of cold stress. Check with a doctor about special needs and precautions.
- Avoid using alcohol or drugs that may impair judgment while working in a cold environment. Hypothermia commonly occurs in association with alcohol abuse. In addition to its effects on judgment, alcohol increases heat loss by dilating the blood vessels and it may prevent a person from shivering (a warming mechanism).

- Keep energy levels up and prevent dehydration by consuming warm, sweet, caffeine-free, non-alcoholic drinks and soup.

Personal Protective Equipment and Clothing

Multiple thin layers of clothing help to create air pockets that retain body heat. Layering also makes adapting to changes in weather and level of physical exertion easier because layers can be removed and then added back as conditions and work effort change. See Table 16 for examples of clothing and fabric types.

- Wear at least three layers.
    - an outer layer that is windproof but still allows some ventilation,
    - a middle layer of wool, quilted fibres, or synthetic fleece to create an insulating layer, and
    - an inner layer of synthetic fabric or wool to provide ventilation and allow moisture to escape. The inner or base layer should not be cotton. Cotton stays wet and speeds heat loss.

NOTE: The type of fibre used is less important as long as the garment is thick enough. As the material gets thinner, the type of fabric and any coatings or membranes used become more important, especially to vapour resistance.

- Protect your feet, hands, head, and face.
    - Wear mittens when possible rather than gloves (mittens are warmer because your fingers stay together). Nylon overmitts can be easily put on and taken off if gloved hands are necessary. Fingers and hands lose their dexterity at colder temperatures. However, be careful about wearing gloves or scarves that can get caught in moving parts of machinery.
    - Keep your head covered (up to 40 to 50% of your body heat can be lost when the head is exposed).
    - Use an appropriate hardhat liner with your hard hat.
    - Wear a facemask or balaclava when working in very cold conditions.

- Wear socks to protect your ankles and feet. Bring extra socks if moisture or sweat is likely and change when necessary.
- Use footwear that protects against cold and dampness. Footwear should be insulated and fit comfortably when socks are layered. Boots with linings are preferred as they can be taken apart to dry more easily, or new linings can be used.

- Wet clothing causes the body to lose heat quickly, because evaporating water takes up a lot of heat. Cotton especially is *not* recommended. It tends to get damp or wet quickly, stays this way, and loses its insulating abilities. Wool and synthetic fabrics, on the other hand, do retain heat when wet.
- Have a change of clothes available in case your clothes get wet.
- Dirty or greasy clothing has poor insulating properties.

Table 16: Examples of Cold Weather Clothing

Examples of Cold Weather Clothing	
Clothing	**Type**
Long underwear	Wool, silk, synthetic fabric
Pants	Wool, synthetic fabric
Shirts, sweaters, turtlenecks	Wool, fleece, synthetic fabric
Head gear	Wool, synthetic fabrics, wind barrier fabric if necessary
Gloves, mittens	Loose fitting with wool or synthetic fabric liners, gloves inside mittens plus windproof overmitts for extremely cold conditions
Socks	Two pairs – light or medium inner and heavy wool or synthetic outer socks
Parka / Jacket	Loose fitting, filled with down or insulating fibre, attached hood, outer layer of windproof fabric

If you start to sweat

Most people will dress to be warm when they are “inactive”. Once we start working, we often start sweating. Sweat dampened clothes lose their insulation value. Remove items as you warm up, but don’t forget to put the items back on when you stop working (don’t wait until you get cold).

- Start by opening your jacket
- Next, remove one or more layers of clothing
- Then, remove head gear
- Finally, remove gloves or mittens unless protection is needed from snow and ice.

Personal Measures

Healthy, fit, well-hydrated individuals will be able to adapt better to the cold, as they will for the heat. Medical conditions, medications/drugs, and general acclimatization will all affect how a person adapts to the cold.

Be aware that working in the cold can exaggerate other issues, such as…

- Avoid getting gasoline on your skin while fuelling your car or snow blower. Gasoline evaporates quickly and greatly increases heat loss. Other solvents have the same effect.
- Working in the cold can put extra strain on your body. Your body is already working hard to stay warm, so extra tasks such as shovelling put extra strain on the heart and muscles.

Remember!

Whether it is hot or cold, weather conditions can change throughout the day, and even hour-by-hour. Always be prepared to adjust the work plan, implement your program or policy at quick notice.

Did you Know?

How many was that?

We have around three million sweat glands, about half of which are found on the skin of the chest and back. Large numbers also occur on the forehead, and palms of the hands. Women only produce about half as much sweat as men when exposed to the same amount of heat.

Appendix 1: Weather Data for Selected Alberta Locations

Data is presented here for:

Banff

Calgary

Edmonton

Fort McMurray

Grande Prairie

High Level

Lethbridge

Lloydminster

Medicine Hat

Red Deer

To find data for your location, use the customize search option of the "Canadian Climate Data On-Line" service from Environment Canada, available on the Internet at

http://www.climate.weatheroffice.ec.gc.ca/climateData/canada_e.html

Banff, AB

Latitude: 51° 10.800' N **Longitude:** 115° 34.200' W **Elevation:** 1383.70 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-7.1	5.9	-27.4		-29	-9.3	12.2	-51.2	12.2	-52.1
February	-2.5	6.4	-16.1		-20	-6	14.7	-45	14.3	-49.1
March	-2.4	13.2	-18.4		-24	-1.4	17.2	-40.6	16.1	-41.8
April	1.3	16.2	-13.2		-15	3.5	25.6	-27.2	24.4	-37
May	7.8	25.6	-9.6	NR	-11	8.1	29.4	-17.8	29	-21.1
June	11.2	27.9	-0.5	26		12	33.3	-3.9	30	-5.3
July	15.2	31.8	1.3	31		14.6	34.4	-1.7	33	-3.2
August	14.7	27.4	1.1	25		14.1	33.9	-4.5	32.8	-4.7
September	11.3	29.6	-1.1	26		9.5	31	-16.7	30.4	-14.4
October	3.6	16.6	-9.7		-13	4.4	26.5	-27	24.9	-28.7
November	-5.3	7.2	-26.3		-31	-4.1	16.5	-40.6	15	-43.1
December	-9.2	5.2	-38.1		-42	-9.2	12.5	-48.3	12.2	-50.6

NR = none recorded

Calgary, AB

Latitude: 51° 6.600' N **Longitude:** 114° 1.200' W **Elevation:** 1084.10 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-4.9	9.4	-24.0		-36	-8.9	16.5	-44.4	15.6	-52.1
February	-1.5	11.3	-13.1		-20	-6.1	22.6	-45	21.9	-52.6
March	-5.4	13.9	-15.3		-23	-1.9	22.8	-37.2	21.7	-44.7
April	2.0	19.2	-10.0		-12	4.6	29.4	-30	27.2	-37.1
May	12.1	28.6	-8.3	28	-13	9.8	32.4	-16.7	31.6	-23.7
June	14.0	25.6	3.0	30		13.8	35	-3.3	33.3	-5.8
July	16.5	32.8	3.9	40		16.2	36.1	-0.6	36.9	-4.1
August	17.5	29.4	5.2	31		15.6	35.6	-3.2	36	-5.2
September	14.2	30.1	-0.3	29		10.8	33.3	-13.3	32.9	-12.5
October	5.5	21.9	-11.2		-19	5.4	29.4	-25.7	28.7	-34.3
November	-3.3	10.8	-22.3		-31	-3.1	22.8	-35	22.2	-47.9
December	-9.5	10.6	-30.1		-41	-7.4	19.5	-42.8	19.4	-55.1

NR = none recorded

Edmonton, AB

Latitude: 53° 19.200' N **Longitude:** 113° 34.800' W **Elevation**: 723.30 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-11.7	6.4	-28.1		-42	-13.5	9.6	-48.3	8.6	-61.1
February	-6.6	5.5	-20.2		-24	-10.5	13.3	-43.9	12.8	-53.6
March	-8.7	7.1	-27.0		-32	-4.5	17.6	-42.2	16.5	-47.2
April	-1.7	16.1	-20.7		-24	4.3	30.5	-28.3	30	-33.7
May	12.1	30.5	-7.9	29	-13	10.4	32.8	-11.1	33.6	-16.3
June	14.3	26.6	4.4	32		14.1	34.4	-6.1	37.3	-7.3
July	14.9	32.2	0.2	43		15.9	35	0	37	-2
August	16.4	27.6	3.9	34		15.1	35.3	-3.8	38.7	-5.8
September	12.5	31.0	-6.8	33	-9	10.1	34.9	-9.6	33.9	-14.3
October	4.2	19.4	-15.1		-19	4.3	29.1	-26.5	28.4	-34.9
November	-8.3	10.4	-33.6		-43	-5.7	18.3	-35.6	18.3	-51.5
December	-15.0	5.3	-39.0		-49	-11.3	13.4	-44.5	13	-57.4

NR = none recorded

Fort McMurray, AB

Latitude: 56° 39.000' N **Longitude:** 111° 13.200' W **Elevation:** 369.10 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-16.8	1.1	-35.8		-43	-18.8	13.1	-50	12.5	-58.4
February	-9.2	5.9	-23.4		-31	-13.7	15	-50.6	13.4	-59.6
March	-9.4	11.2	-30.6		-37	-6.5	18.9	-44.4	17.8	-56.8
April	-1.0	14.9	-18.3		-23	3.4	30.2	-34.4	30.4	-45.8
May	12.7	27.5	-13.8	26	-16	10.4	34.8	-13.3	35.6	-21
June	16.1	28.4	5.8	32		14.7	36.1	-4.4	38.3	-6.3
July	16.9	33.4	4.9	39		16.8	35.6	-3.3	45.6	-2.7
August	17.6	29.6	5.6	34		15.3	37	-2.9	40.5	-6.1
September	13.4	31.1	-2.3	33		9.4	32.4	-15.6	33.7	-16
October	3.6	14.2	-15.3		-19	2.8	28.6	-24.5	28.4	-31.7
November	-10.1	9.5	-33.5		-42	-8.5	18.9	-37.8	15.5	-50.1
December	-24.6	-3.3	-40.2		-47	-16.5	10.7	-47.2	10.4	-53.2

NR = none recorded

Grande Prairie, AB

Latitude: 55° 10.800' N **Longitude:** 118° 53.400' W **Elevation:** 669.00 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-11.3	6.0	-33.6		-45	-15	12.6	-52.2	12	-63
February	-3.7	6.2	-18.0		NR	-11.5	11.8	-48.3	11.1	-55
March	-7.9	8.3	-25.2		-33	-4.9	16.1	-42.8	15.6	-53.1
April	0.7	16.2	-15.4		-18	4.1	29.2	-35.6	28.6	-46.7
May	12.0	29.0	-5.4	26		10.3	31.3	-8.1	30.8	-16.1
June	14.7	28.5	3.7	30		14.1	33.3	-2.2	34	-4.3
July	15.6	31.9	3.0	37		15.9	33.3	0.6	40.8	-2.4
August	16.8	27.7	4.2	30		14.9	34.5	-2.8	36.6	-6.2
September	16.8	29.0	3.7	30		10.1	31.1	-10.6	34.7	-15.3
October	NR	NR	NR	NR	NR	4	28.9	-31.7	27.1	-33.9
November	NR	NR	NR	NR	NR	-6.6	22.2	-40.6	17.2	-56.1
December	NR	NR	NR	NR	NR	-12.6	13.3	-47.2	12.1	-56.3

NR = none recorded

High Level, AB

Latitude: 58° 37.200' N **Longitude:** 117° 9.600' W **Elevation:** 338.30 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-17.3	2.1	-38.2		-37	-21.6	10.5	-50.6	10.3	-57.1
February	-11.4	7.1	-23.0		-28	-17.5	14.6	-46.1	14.2	-51.1
March	-11.7	5.6	-31.6		-36	-9.6	14	-45	13.7	-47.2
April	-3.0	12.1	-22.1		-32	2	30.2	-32.2	29.8	-35.2
May	11.7	26.5	-10.4	25	-13	9.6	33.9	-11.2	33.8	-22.1
June	16.3	30.7	5.3	33		14.3	31.5	-3.6	35	-4
July	15.7	32.5	1.2	34		16.2	34.4	-0.2	39.8	-0.8
August	15.7	28.1	5.0	30		14.3	35.2	-4.4	36.4	-6.1
September	11.2	28.2	0.1	31		8.4	30.2	-13.9	32.2	-17.5
October	2.8	13.9	-7.6		-13	0.7	25.2	-36.3	24.7	-36.2
November	-12.7	8.4	-37.2		-36	-12.3	15	-43.4	13.4	-53
December	-23.9	-2.0	-40.1		-43	-19.7	14.2	-47.2	13.7	-54.5

Lethbridge, AB

Latitude: 49° 37.800' N **Longitude:** 112° 48.000' W **Elevation:** 928.70 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-4.5	10.5	-20.8		-31	-7.8	16.7	-42.8	15.8	-54.5
February	-0.3	12.4	-14.5		-20	-4.6	21.8	-42.2	21.8	-51.3
March	-2.0	15.5	-19.6		-27	-0.2	23.3	-38	23.3	-49.7
April	3.2	22.6	-13.1		-20	6	31.1	-25.6	30.2	-32.6
May	11.3	24.6	-9.3	NR	-15	11.3	34.2	-11.7	35.4	-16.3
June	14.3	27.9	2.0	33		15.5	38.3	-1.7	36.9	-6.9
July	17.4	33.1	4.2	42		18	39.4	0.9	40.9	-4.3
August	18.3	30.9	3.7	31		17.7	38.9	-1	39.8	-5.6
September	14.8	32.0	0.0	30		12.6	36.7	-9.4	36.1	-13.6
October	6.1	22.5	-17.4	NR	-24	7	31.7	-26.7	30.1	-36
November	-3.1	11.9	-23.2		-31	-1.5	22.8	-34.7	22.5	-47.1
December	-11.7	12.1	-36.5		-49	-6.1	19.6	-42.8	17.8	-55.7

NR = none recorded

Lloydminster, AB

Latitude: 53° 18.600' N **Longitude:** 110° 4.200' W **Elevation:** 668.40 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-12.3	4.6	-32.2		-43	-14.5	8.2	-39.6	7.4	-51.9
February	-8.8	5.0	-22.2		-37	-11.6	8.6	-42.5	8.2	-54.5
March	-9.9	3.6	-23.8		-33	-5.2	16.7	-31.2	16.2	-43
April	-1.6	19.2	-19.0		-25	4	27.6	-22.6	27.1	-30.3
May	12.7	29.8	-8.4	29		10.3	32.3	-9	34.7	-15.7
June	13.8	24.0	4.8	28		14.7	35.4	-2.2	39	-4.9
July	15.9	29.1	5.5	33		16.6	36.8	2.9	42.5	0.2
August	17.4	29.4	5.9	33		15.9	37.4	-1.8	38.4	-6.1
September	13.8	30.0	-1.4	32		10.2	31.7	-9	31.5	-14.7
October	3.8	16.6	-15.6		-20	3.6	26.9	-24	26.5	-35.8
November	-9.4	9.0	-29.0		-32	-7.4	13	-34.4	12.4	-50.9
December	-17.7	5.3	-33.5		-47	-13.3	10	-40.7	8.9	-54

Medicine Hat, AB

Latitude: 50° 1.200' N **Longitude:** 110° 43.200' W **Elevation:** 716.90 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-6.6	8.2	-21.8		-30	-10.2	18.3	-46.1	15.1	-54.2
February	-1.3	10.9	-13.4		-18	-6.2	21.1	-46.1	20.9	-50.7
March	-1.5	16.3	-18.9		-26	-0.3	28.9	-38.9	23.3	-44.5
April	4.1	25.3	-12.4	NR	-17	6.8	35.6	-26.7	30.5	-31
May	13.7	30.1	-7.6	29	-11	12.5	37.2	-11.1	37	-12.6
June	16.7	32.1	2.0	33		16.8	41.7	-1.1	39	-2.9
July	19.8	36.2	6.3	39		19.5	42.2	1.2	42.3	0.3
August	20.8	35.4	8.1	34		19.1	41.1	-0.6	41.1	-5
September	17.2	36.6	-0.7	35		13.1	37.8	-12.8	38.4	-12.8
October	6.2	22.6	-10.8		-16	7	33.9	-28.7	30.7	-37.6
November	-3.5	12.5	-22.9		-29	-2.2	24.4	-37.8	22.8	-49.2
December	-11.0	7.9	-35.6		-46	-7.9	20	-45.6	17.2	-58.9

NR = none recorded

Red Deer, AB

Latitude: 52° 10.800' N **Longitude:** 113° 53.400' W **Elevation:** 904.60 m

	2013					Climate Normals (30 Years: 1971-2000)				
Month	Daily Average Temp.	Extreme Maximum Temp.	Extreme Minimum Temp.	Extreme Humidex	Extreme Wind Chill	**Daily Average Temp.**	**Extreme Maximum Temp.**	**Extreme Minimum Temp.**	**Extreme Humidex**	**Extreme Wind Chill**
January	-9.8	8.3	-27.9		-35	-13.2	10.9	-46.1	10.5	-60.1
February	-6.8	8.3	-19.9		-26	-10	18.1	-43.9	17.3	-54.4
March	-7.1	8.9	-25.6		-30	-4.1	19.4	-42.8	18.6	-49.8
April	0.9	21.9	-13.4		-17	4.2	32.8	-32.8	28.2	-39.3
May	12.3	29.2	-5.2	26		9.8	34.5	-15.6	37	-20.9
June	14.0	26.7	1.4	30		13.7	32.8	-5	35	-7.3
July	15.9	31.8	3.6	40		15.6	36.1	0.2	38.5	-2.8
August	16.7	28.1	2.7	29		14.9	35	-5.1	36.4	-5.3
September	13.1	30.1	-5.1	30	-7	9.9	35	-11.7	32.4	-13.5
October	4.3	19.5	-12.3		-18	4.1	28.9	-28.8	27.8	-37.9
November	-8.9	9.4	-32.2		-35	-5.4	22.8	-38.4	21.7	-48.6
December	-13.9	5.2	-39.5		-49	-11.1	17.2	-44.1	14.8	-57.4

NR = none recorded

Appendix 2: Humidex Based Response Plan (by OHCOW)

The Occupational Health Clinics for Ontario Workers Inc. (OHCOW) created a humidex-based response plan that translated the TLVs® WBGTs into humidex values and developed recommended responses for each humidex range. This plan was developed as a tool to help workplaces as most find using the WBGT complicated and expensive.

While technically there is no way to directly compare WBGT and humidex values, this humidex response plan provides an additional guideline that uses information that is easily available to most employers. OHCOW notes, "in the translation process some simplifications and assumptions have been made, therefore, the plan may not be applicable in all circumstances and/or workplaces (follow steps 1 through 5 to ensure the humidex plan is appropriate for your workplace)." See Table 17 for details.

Notes: These humidex levels are for unacclimatized workers performing moderate physical activity. The ACGIH specifies an action limit and a TLV® to prevent workers' body temperature from exceeding 38°C (38.5°C for acclimatized workers). Below the action limit (Humidex 1 for work of moderate physical activity) most workers will not experience heat stress. Most healthy, well-hydrated, acclimatized workers not on medications will be able to tolerate heat stress up to the TLV®. (Humidex 2 for moderate physical activity). Between Humidex 1 and Humidex 2, general heat stress controls are needed and above Humidex 2 job-specific controls are needed.

Table 17 – Humidex Based Response Plan by OHCOW

Humidex 1 – Moderate physical work, unacclimatized worker. OR Heavy physical work, acclimatized worker	Response	Humidex 2 – Moderate physical work, acclimatized worker. OR Light physical work, unacclimatized worker
25-29	• supply water to workers on an "as needed" basis	32-35
30-33	• post Heat Stress Alert notice • encourage workers to drink extra water • start recording hourly temperature and relative humidity	36-39
34-37	• post Heat Stress Warning notice • notify workers that they need to drink extra water • ensure workers are trained to recognize symptoms	40-42
38-39	• provide 15 minutes relief per hour • provide adequate cool (10-15°C) water • at least 1 cup (240 mL) of water every 20 minutes • workers with symptoms should seek medical attention	43-44
40-42	• provide 30 minutes relief per hour in addition to the provisions listed previously	45-46*
43-44	• if feasible provide 45 minutes relief per hour in addition to the provisions listed above • if a 75% relief period is not feasible then stop work until the Humidex is 42°C or less	47-49
45 or over	• stop work until the Humidex is 44°C or less	50* and over

Source: Occupational Health Clinics for Ontario Workers (OHCOW) - "Humidex Based Heat Response Plan",http://www.ohcow.on.ca/uploads/Resources/Humidex%20Heat%20Stress%20Response%20Plan%20Chart%20Revised.pdf

Steps 1-5

Step Number 1: Training

- the Humidex plan by itself cannot guarantee that workers will not be affected by heat stress. It is absolutely essential that workers learn to recognize the early signs and symptoms of heat stress and know what to do to prevent them!
- if at all possible, workers need to be able to alter their pace of work, rest breaks, and fluid intake in response to early symptoms (240 mL every 20 minutes).
- the ideal heat stress response plan would let workers regulate their own pace by "listening to their body" without need for measurements.

Step Number 2: Select a Measurement Location

- split the workplace into heat stress zones and put a thermal hygrometer in each zone. A thermal hygrometer (usually $20-$60 at hardware or office supply stores) is a simple instrument that measures the temperature and relative humidity.
- identify a representative location within the zone where measurements can be taken (if you want to base your actions on a single reading, select the highest heat stress zone).

Note: the Humidex Heat Stress Response Plan is based on workplace measurements not weather station/media reports (temperatures inside buildings do not necessarily correspond with outside temperatures)

Step Number 3: Measure Workplace Humidex

- once you have the temperature and humidity, use Table 17 to determine the corresponding Humidex value and the appropriate heat stress prevention response (remember to adjust for clothing (step Number 4) and radiant heat (step Number 5))
- measurements should be recorded at least hourly if the Humidex is above 30° or temperature is above 26°C

NEVER IGNORE ANYONE'S SYMPTOMS NO MATTER WHAT THE HUMIDEX!

Step Number 4: Adjust for Clothing

- evaporating sweat is the primary way the body gets rid of excess heat build-up The best clothing is the kind that makes it easiest for sweat to evaporate. The Humidex plan assumes regular summer clothes (light shirt & pants, underwear and socks and shoes).
- for workers who wear cotton overalls on top of summer clothes one should add 5° Humidex (roughly equal to 3°C WBGT) to the workplace Humidex measurement.
- for different clothing combinations, estimate the correction factor by comparing them with cotton overalls (e.g. gloves, hard hat, apron, protective sleeves might be equivalent to a little less than half the evaporation resistance as overalls so add 1° or 2° Humidex).
- If clothes do not allow sweat evaporation (encapsulated suits) heat stress should be managed by monitoring vital signs (see ACGIH TLV®)

Step Number 5: Adjusting for Radiant Heat

- for outdoor work in direct sunlight between the hours of 10 am and 4 pm, add 2-3º (pro-rate according to percentage cloud cover) to your Humidex measurement
- for indoor radiant heat exposures, use common sense to judge whether the exposure of concern involves more or less radiant heat than direct sunlight and adjust the 2-3º correction factor appropriately

For full details, see
http://www.ohcow.on.ca/uploads/Resources/Humidex%20Heat%20Stress%20Response%20Plan%20Chart%20Revised.pdf

Appendix 3: Samples of Heat and Cold Stress Policies

Heat Stress

Purpose and Application

This policy is intended to protect workers from potential adverse effects of overexposure to heat. It applies to all _____ (company name) workers who work in high temperature conditions for significant time periods.

Responsibilities

Departments/divisions will:

- identify jobs with a potential risk of heat stress and develop job-specific safe work practices which address this hazard
- inform workers and their supervisors where their work involves potential risk of heat stress
- develop a process to ensure supervisors and workers are advised of:
    - factors which can predispose them to heat stress
    - the warning signs and symptoms of heat stress conditions (heat rash, heat cramps, heat exhaustion and heat stroke), and
    - the measures to be taken to protect against this hazard (e.g. having water available to drink during work shift, wearing appropriate clothing and pacing oneself while working)
- post information on heat stress in the workplaces of workers potentially exposed to this hazard
- ensure workers have access to a drinking water source for filling personal containers at the beginning of the shift, if water is not accessible throughout the shift
- if uniforms or clothing are being provided by the department, ensure that clothing specifications reduce the risk of heat stress (while providing appropriate protection from other hazards, where necessary)

- allow a gradual period of acclimatization to work in hot environments for new and other non-acclimatized workers [Note: Even workers who work outside on an ongoing basis may not be acclimatized if temperatures rise steeply within a short time period early in the spring or summer.]
- re-schedule work on hot days to cooler times of the day, when feasible
- where feasible and necessary, reduce temperature and humidity through air cooling and conditioning of enclosed work environments or shading of open areas

Supervisors will:

- schedule information sessions for workers whose work places them at risk of heat stress
- on days where environmental conditions have reached designated threshold levels according to the attached guideline:
- implement safe work procedures established to prevent heat-induced illness
- determine any additional rest breaks that may be required as a result of workload and local conditions
- advise workers to:
    - drink enough fluids to replace those lost through sweating and breathing
    - take breaks in the shade or a cool area, as needed to avoid heat exhaustion or collapse
    - report to their supervisor heat stress-related symptoms in themselves or their co-workers
    - adhere to the recommended rest break schedule, established to avoid heat exhaustion or collapse.

Workers will:

- be familiar with heat stress hazards, predisposing factors and preventative measures
- follow safe work practices established to prevent heat related illness
- drink enough fluids to replace those lost through sweating and breathing

- report to their supervisor heat stress-related symptoms in themselves or their co-workers
- follow recommended schedule of rest breaks, as advised by supervisors, to avoid heat exhaustion or collapse

Occupational health and safety staff, in conjunction with supervisory staff and the Joint Work Site Health and Safety Committee (if there is one), will:

- provide assistance in the development of safe work procedures
- provide assistance in the provision of information sessions
- prepare information related to heat stress
- address heat stress concerns of workers
- make recommendations during the development of or on the improvement of existing safe work procedures, as needed

Cold Stress

Purpose and Application:

This policy is intended to protect workers from potential adverse effects of overexposure to cold. It applies to all _____ (company name) workers who work in low temperature, wind and/or moisture for significant time periods.

Responsibilities:

Departments/divisions will:

- identify jobs with a potential risk of cold stress
- develop and maintain written job-specific safe work procedures
- inform workers and their supervisors where their work involves potential risk of cold stress
- develop a process to ensure supervisors and workers are advised of:
    - factors which can predispose them to cold stress
    - the warning signs and symptoms of cold stress conditions (frostbite and hypothermia
    - the measures to be taken to protect against this hazard (e.g. wearing appropriate clothing)

    - the job-specific safe work procedures

- post information on cold stress in the workplaces of workers potentially exposed to this hazard
- if uniforms or clothing are being provided by the department, ensure that clothing specifications reduce the risk of cold stress (while providing appropriate protection from other hazards, where necessary)

Supervisors will:

- be familiar with all jobs under their supervision which have been identified to have potential risk of cold stress and their associated safe work procedures
- ensure training/information sessions are provided to workers whose work places them at risk of cold stress
- monitor environmental conditions (i.e. temperature and wind velocity and/or wind chill), as appropriate, on cold days and on days where brisk wind and cold air temperature combine to reach levels considered hazardous
- implement safe work procedures established to prevent cold-stress related injuries
- advise workers to:
    - wear multiple layers of light, loose fitting clothing
    - pay special attention to protecting feet, hands, face & head
    - report to their supervisor cold stress-related symptoms in themselves or their co-workers
    - adhere to the recommended work-warm-up schedule, established to prevent frostbite or hypothermia
- reinforce personal protection strategies to workers verbally, on a continual basis

Workers will:

- be familiar with cold stress hazards, predisposing factors and preventative measures
- follow safe work procedures established to prevent cold-stress related injuries
- report to their supervisor cold stress-related symptoms in themselves or their co-workers
- follow recommended schedule of rest breaks, as advised by supervisors, to prevent frostbite or hypothermia
- understand and be able to recognize frostbite and hypothermia

Occupational health and safety staff, in conjunction with supervisory staff and the Joint Work Site Health and Safety Committee (if there is one), will:

- provide assistance in the development of safe work procedures
- provide assistance in the provision of information sessions
- prepare information related to cold stress
- address cold stress concerns of workers
- make recommendations during the development of or on the improvement of existing safe work procedures, as needed

(Source: Adopted from the City of Toronto; by permission.)

Resources

Heat

Preventing Heat Stress At Work
From: WorkSafe BC
http://www.worksafebc.com/publications/health_and_safety/by_topic/assets/pdf/heat_stress.pdf

Humidex Based Heat Response Plan
From: Occupational Health Clinics for Ontario Workers
http://www.ohcow.on.ca/uploads/Resources/Humidex%20Heat%20Stress%20Response%20Plan%20Chart%20Revised.pdf

"Heat Stress" – OSHA Quick Card
From: Occupational Safety and Health Administration, USA
http://www.osha.gov/Publications/osha3154.pdf

Cold

Cold Condition Guidelines for Outside Workers
From: Saskatchewan Labour
http://www.lrws.gov.sk.ca/cold-condition-guidelines-working-outside

Hypothermia: Surviving the Cold
From: WorkSafeBC
http://www.worksafebc.com/publications/health_and_safety/by_topic/assets/pdf/hypothermia.pdf

Cold Environments - Working in the Cold
From: CCOHS
http://www.ccohs.ca/oshanswers/phys_agents/cold_working.html

Both Heat and Cold

Guidelines for the management of Work in Extremes of Temperature
From: Occupational Safety & Heath Service, Department of Labour, New Zealand
http://www.business.govt.nz/worksafe/information-guidance/all-guidance-items/temperature-guidelines-for-the-management-of-work-in-extremes-of/temperat.pdf

ACT WorkCover Guidance to Working in hot or cold environments,
From: WorkCover, New South Wales (Australia)
http://www.workcover.nsw.gov.au/formspublications/publications/Documents/cop_2001_work_hot_cold%20environments_0309.pdf

Weather Information

Weather and Meteorology
From: Environment Canada
https://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=FDF98F96-1

Humidex (including calculator)
From: PhyLink.com
http://www.physlink.com/reference/weather.cfm

Wind Chill Fact Sheet
From: Environment Canada
http://www.msc.ec.gc.ca/education/windchill/windchill_fact_sheet_aug_10_e.cfm

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