PURPOSE/APPLICATION

Strike shall attempt to minimize risks to personnel, equipment and property by conducting operations during safe and tolerable working weather conditions. Every effort will be made to ensure that workers will not be exposed to levels that exceed those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard. In extreme conditions workers will be provided with an adequate supply of cool potable water and clothing corrections will be applied in accordance with the heat stress and strain section of the ACGIH Standard. When temperature conditions are extreme, the following safe work practice and exposure plan will be adhered to.

PPE

- Strike minimum requirements

TRAINING

HAZARDS & CONCERNS

- Heat Stress
- Heat Exhaustion
- Heat Cramps
- Heat Stroke

PRECAUTIONS

The Body's Response to Temperature

Your body works best when it has an internal "core" temperature of approximately 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 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.

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.

Factors affecting how you feel
How "hot" or "cold" you feel depends on 6 main factors:

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.

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".

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.

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.

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.

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.
Substances that Can Affect a Person's Tolerance to Heat include:

- Alcohol
- Amphetamines
- Anaesthetics
- Anticholinergics (e.g. atropine)
- Antidepressants
- Cannabis (marijuana)
- Cocaine
- Hypnotics (e.g. barbiturates)
- Morphine
- Psychotropic drugs

Health Effects of Extremes 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 is the most serious type of heat illness and represents a medical emergency (call 911). Signs of heat stroke include body temperature often greater than 41°C, and could include complete or partial loss of consciousness.

Signs and Symptoms of Heat Exposure (Hyperthermia)

Early Warning Signs

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

As Heat Stress Worsens…

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

Treatment and Prevention
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 advanced medical attention**. Delayed treatment may result in damage to the brain, kidneys and heart, or death.

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.

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.
Watch for signals of breathing problems and make sure the airway is clear.

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.

What and When to Drink
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.

Measuring Hot Conditions

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.

2) Humidex

The humidex value is especially important when its value exceeds 30.

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.

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 5.) The ACGIH publication "2007 TLVs® and BEIs®" provides a recommended screening criteria for heat stress exposure for workers acclimatized and those who are not acclimatized for the intensity of the work being done. 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.

ACGIH Screening Criteria for Heat Stress Exposure (WBGT values in °C) for 8 hour work day, five days per week with conventional breaks

Allocation of Work in a Work/Rest Cycle	TLV/Acclimatized				Action Limit/Unacclimatized			
	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	31.50	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 workloads:

Rest - sitting (quietly or with moderate arm movements)

Light work - sitting or standing to control machines; performing light hand or arm work (e.g. using a table saw); occasional walking; driving

Moderate work - walking about with moderate lifting and pushing or pulling; walking at moderate pace; e.g. scrubbing in a standing position

Heavy work - pick and shovel work, digging, carrying, pushing/pulling heavy loads; walking at fast pace; e.g. carpenter sawing by hand

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

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 the following Table.

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)

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.

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

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.

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

Humidex Based Response Plan by OHCOW		
Humidex 1 – Moderate physical workl, 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	47 - 49

	Humidex is 42°C or less	
45 or over	stop work until the Humidex is 44ºC or less	50* and over

Controlling Heat Exposure

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. Acclimatization is an important control step.

Use a work-rest schedule. 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.

REFERENCES / ADDITIONAL INFORMATION

Developed by:	1.	Angie Anton	2.		Date:	August 5, 2008
Revised by:	1.	Todd Penney	2.		Date:	August 5, 2020