Methods for Measuring Heat Strain or Stress

WorkSafeBC

About WorkSafeBC

At WorkSafeBC, we're dedicated to promoting safe and healthy workplaces across B.C. We partner with workers and employers to save lives and prevent injury, disease, and disability. When work-related injuries or diseases occur, we provide compensation and support injured workers in their recovery, rehabilitation, and safe return to work. We also provide no-fault insurance and work diligently to sustain our workers' compensation system for today and future generations. We're honoured to serve the workers and employers in our province.

Prevention Information Line and contact information

We provide information and assistance with health and safety issues in the workplace.

Call the information line 24 hours a day, 7 days a week to report unsafe working conditions, a serious incident, or a major chemical release. Your call can be made anonymously. We can provide assistance in almost any language.

If you have questions about workplace health and safety or the Regulation, call during our office hours (Monday to Friday, 8:05 a.m. to 4:30 p.m.) to speak to a WorkSafeBC officer.

If you're in the Lower Mainland, call 604.276.3100, or toll-free at 1.888.621.7233 (621.SAFE) in Canada.

Health and safety resources

You can find our health and safety resources at worksafebc.com/forms-resources.
Printed copies are available for some resources and can be ordered from worksafebcstore.com.

Methods for Measuring Heat Strain or Stress

WorkSafe BC

Copyright disclaimer

Contents

Using this guide

When workers are exposed to hot or humid conditions, measuring heat stress or strain may be necessary to:

- Protect them against heat-related illnesses
- Ensure compliance with the requirements of the Occupational Health and Safety Regulation

WorkSafeBC has developed a Heat stress screening tool to assist employers in evaluating when workers may be at risk of heat stress or strain. The tool also helps determine the types of controls that can be used to eliminate or minimize the risk.

However, the screening tool cannot be used by all workplaces or work situations. For example, the screening tool may not apply:

- When workers carry out heavy work at high temperatures that requires physiological monitoring
- In situations where hazardous materials workers wear chemical-impervious suits or special effects actors wear full-body costumes

If you can't use the screening tool, you'll need to evaluate the risk in your workplace using one of the four methods described in this guide. This guide will help you:

- Understand the types of situations where the heat stress screening tool may not apply
- Identify the most appropriate methods to use in those situations
- Conduct physiological or environmental measurements

For more information on when to conduct a heat stress assessment and how to recognize contributing risk factors, see the WorkSafeBC publication Preventing Heat Stress at Work and G7.27(1) to G7.31 of the OHS Guidelines.

Exposure control plans

If workers are or may be exposed to thermal conditions that could cause heat stress, you must develop a heat stress exposure control plan. This requirement doesn't apply if thorough heat stress assessment and monitoring have confirmed that workers are not at risk.

For examples of workplaces where the hazards of heat stress would normally be expected, see guideline G7.27(1). For more information on developing an exposure control plan, see guideline G7.29-5.

Determine an appropriate method for monitoring heat stress

Heat stress vs. heat strain

Heat stress is a condition that occurs when a worker is exposed to environmental factors that cause them to overheat. Heat stress can lead to heat-related illnesses that range from heat cramps to potentially life-threatening heat stroke.

Heat strain is the body's response to heat stress. You can assess the degree of heat strain experienced by workers through physiological measures such as body temperature and heart rate.

The first step in assessing the risk of heat stress to workers is to identify the risk factors. For more information on risk factors, see guideline G7.29-1.

Once you have identified the risk factors as thoroughly as possible, select an appropriate method of monitoring for heat stress. The flow chart on page 5 will help you identify the appropriate method for your situation.

The monitoring method you use will depend on the circumstances in your workplace. Methods for monitoring heat strain or stress can be divided into two categories:

- Physiological measures (methods 1 and 2 in this guide)
- Environmental measures (methods 3 and 4 in this guide)

WorkSafeBC accepts the monitoring methods for heat stress and strain listed in the ACGIH Standard, as well as the Humidex method developed by Occupational Health Clinics for Ontario Workers.

The "ACGIH Standard" means the American Conference of Governmental Industrial Hygienists publication *Threshold Limit Values and Biological Exposure Indices.*

Physiological measures

Physiological measures such as body temperature, heart rate, or sweat production are used to measure heat strain in a worker. A qualified person should select the appropriate frequency and method of physiological monitoring. According to the Regulation, *qualified* "means being knowledgeable of the work, the hazards involved and the means to control the hazards, by reason of education, training, experience or a combination thereof."

Environmental measures

Environmental measures are a more common method of predicting heat stress and can be used in many workplaces. These involve measuring environmental conditions such as air temperature, air velocity, air humidity, and radiant heat. These measures predict heat stress conditions when values are adjusted for clothing, work rate, and other factors.

For more information on physiological and environmental measures, see guideline G7.29-1.

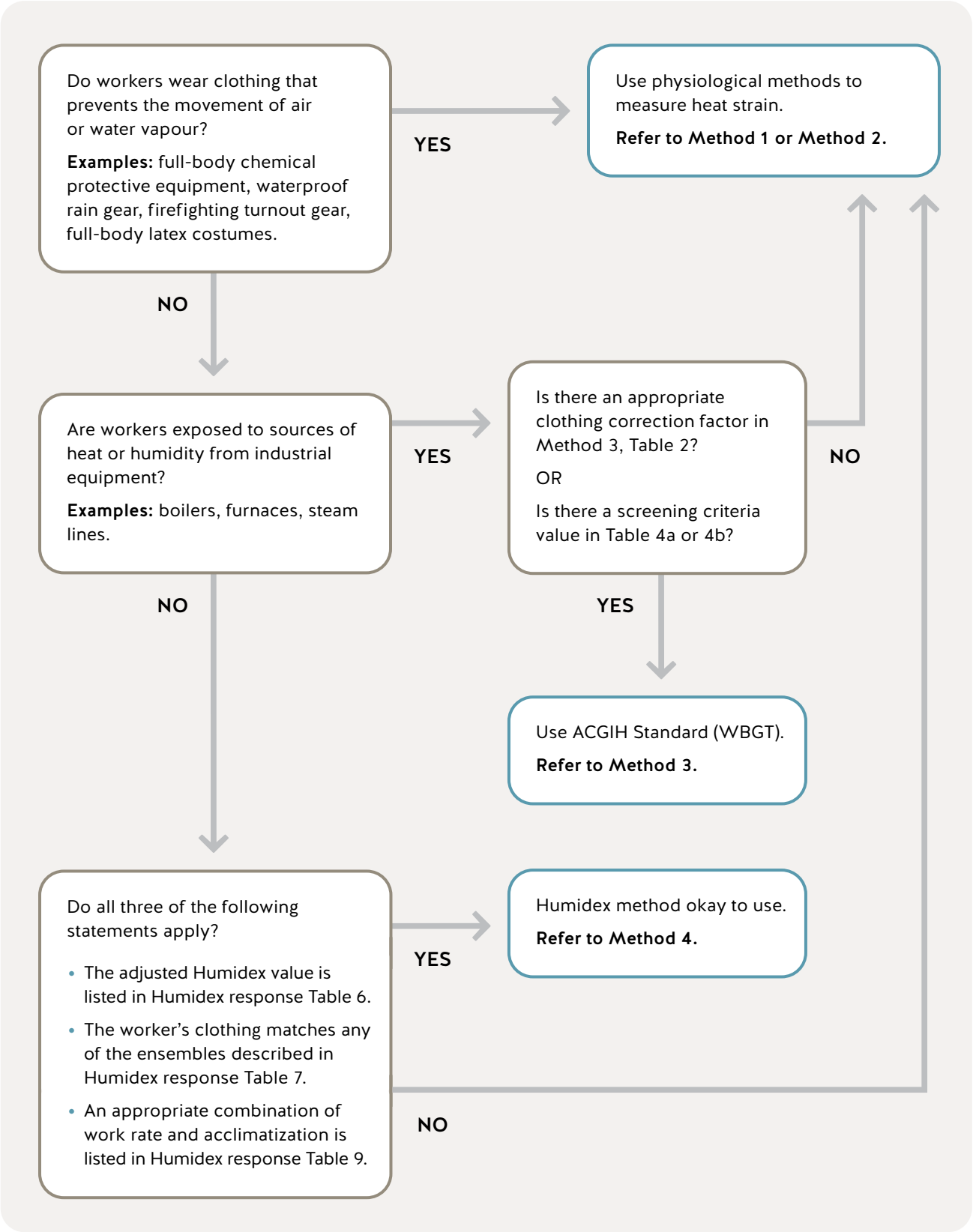
Addressing personal risk factors

Personal risk factors are individual characteristics or conditions that increase a worker's susceptibility to heat-related illnesses. Personal risk factors may result in some workers experiencing heat strain even when an assessment has indicated that they are not being exposed to conditions that exceed heat stress exposure limits and other workers are not reporting symptoms. If a worker experiences heat strain as a result of personal risk factors, you must address the worker's susceptibility to heat just as you would address other medical conditions that put workers at a higher risk of injury.

Workers who show signs or report symptoms of heat stress (e.g., fatigue, nausea, dizziness, or light-headedness) must be removed from the heat and provided with medical attention. For more information on the signs, symptoms, and treatment of heat stress, see Preventing Heat Stress at Work.

Determining a monitoring method

Note: The tables referred to in the flow chart appear in methods 3 and 4 in this guide.



The four measurement methods

This guide describes four methods for measuring heat strain or stress. Methods 1 and 2 are physiological measures for assessing heat strain in workers. Methods 3 and 4 are environmental measures for conducting a workplace heat stress assessment. Table 1 lists each method, with a summary of the equipment needed to perform measurements.

Methods listed higher up in the table can also be used for industries or tasks listed lower down in the table. For example, physiological measures may be used for any workplace or task. Wet bulb globe temperature (the screening method used in the ACGIH Standard) may be used as an alternative to the Humidex method.

As an employer, you should consider the range of tasks and workplaces you may need to assess when determining the most effective method to use and the most appropriate equipment to purchase.

Table 1: Methods for measuring heat stress or strain

Method	Measuring equipment needed	Examples of industries or tasks where the method can typically be used*
Physiological measures		
Method 1: Assessing heat strain by directly measuring body temperature	Thermometer — oral, aural (ear), ingestible sensor, or rectal**	• Hazardous materials cleanup performed in chemical-impervious suits • Special effect performers in full-body costumes
Method 2: Assessing heat strain by measuring heart rate	Radial pulse check or chest straps**	
Environmental measures		
Method 3: Performing a heat stress assessment using the wet bulb globe thermometer (WBGT) method	WBGT meter	• Pulp mills and sawmills • Smelters • Cement kilns • Industrial kitchens • Industrial laundries • Asbestos abatement • Lifeguarding — indoor pool
Method 4: Assessing heat stress using the Humidex	Digital thermo-hygrometer OR Thermometer + sling psychrometer OR Another combination of devices that can accurately measure air temperature and relative humidity	• Outdoor agricultural work • Tree planting • Landscaping • Construction • Office buildings • Retail facilities • Health care facilities • Commercial kitchens • Hospitality industry • Warehouses • Lifeguarding — outdoor pool

* The listed industries are based on typical equipment and processes. As an employer, you must consider factors contributing to heat stress at your specific workplace to determine the appropriate method.

** Devices used to measure physiological response must be certified for use on humans and may require medical supervision for use.

Method 1: Assessing heat strain by directly measuring body temperature

Heat strain results from elevated internal body temperature, so the most direct method for assessing heat strain is to measure core body temperature. A worker's core body temperature should not increase by more than 1°C from their pre-work temperature during prolonged daily work, if their pre-work temperature is 37°C or less.

There are several ways to measure body temperature, but some of them are more practical than others in a work setting. Physiological monitoring requires worker consent and may require medical supervision.

Oral measurements

Oral temperatures are determined by measuring temperature at the base of the tongue with a clinical thermometer. Follow these guidelines:

- The worker's temperature should be measured:
  - At rest in a cool environment to start
  - At the highest anticipated heat load (temperature and workload)
  - After the work period
- The worker must not drink or eat anything cold or hot for at least 15 minutes before measurement.
- The thermometer must be inserted under the tongue, as far as possible, for about five minutes, or per the manufacturer's instructions.
- The worker should keep their mouth closed as much as possible during the measurement.
- Oral temperatures are about 0.5°C lower than core body temperatures and should not exceed 37.5°C.

Aural (ear) measurements

Using an infrared thermometer to measure temperature of the skin or in the ear canal is not recommended unless there is a robust method of calibration and baseline temperature measurements for each worker. Aural measurements can be affected by ear conditions, such as wax buildup or ear infections, and may not be suitable for all workers. If you want to use aural measurements, you must apply to WorkSafeBC for an acceptance under the OHS Regulation.

Ingestible sensors

Single-use, ingestible thermistor capsules can be used to transmit core body temperatures. Typically, the worker being monitored will swallow a sensor with food or water the night before a shift. As a result, the sensor has time to move to the small intestine before work begins.

These devices must only be used with the supervision and oversight of medical personnel familiar with their uses and risks. The details of the monitoring program must follow manufacturers' instructions and include consultation with medical personnel. Workers must be screened first for medical conditions that may prevent them from ingesting the sensor safely.

During use, drinking cold fluids may temporarily affect the accuracy of measurements. It may be possible for a sensor to pass from the worker's body before their shift ends. In such cases, an alternative method of monitoring for heat stress must be used if workers are still exposed to stress conditions.

Rectal measurements

Rectal temperature measurements are a well-established way to measure core body temperature, and WorkSafeBC accepts these as a valid method. However, rectal measurements are invasive and may be unacceptable to many workers. These measurements must be administered by a medical professional who will help the employer determine an appropriate monitoring frequency and method.

Method 2: Assessing heat strain by measuring heart rate

Heart rate can be used as an indicator of heat strain in healthy individuals with normal cardiac response. Heart rate will increase when there is an excess of body heat. It will remain elevated for some time after the worker moves to a cooler environment and is allowed to rest.

How to measure heart rate

Heart rate can be measured using various methods, including radial pulse checks or chest straps. As an employer, you'll need to obtain worker consent for the collection of heart rate data. You'll also need to ensure they undergo a medical screening to ensure normal cardiac response.

Heart rate should be monitored before work (at rest) and after peak heat exposure (between one and three minutes after work ends).

Heat strain is indicated if the worker's pulse rate is greater than either of the following:

- 120 beats per minute after recovering for at least one minute after peak heat exposure
- 180 beats per minute minus the worker's age in years

Who can measure heart rate

First aid attendants or other properly trained and supervised workers may measure heart rate. If workers are trained to monitor their own heart rates, you must ensure they are provided with enough supervision to ensure that self-monitoring is effective. Heat strain can make it difficult for some workers to measure their own heart rates.

Method 3: Performing a heat stress assessment using the WBGT method

The method of estimating heat stress using environmental conditions that applies in the most situations is the wet bulb globe temperature (WBGT) method, which requires a WBGT meter. This method takes into account the combined effects of:

- Temperature and humidity (natural wet bulb temperature)
- Ambient air temperature (dry bulb temperature)
- Radiant heat (globe temperature)

WorkSafeBC's Heat stress screening tool includes a basic version of the WBGT method. The screening tool walks you through the steps described below and automatically performs the required calculations. However, the screening tool doesn't provide the full WBGT method, which includes the calculation of time-weighted averages or the use of customized clothing adjustment values. The full WBGT method is described in detail here.

The WBGT method consists of six steps:

1. Take environmental measurements at the workplace.
2. Adjust the value for clothing worn by workers.
3. Determine the workload (metabolic rate).
4. Determine the acclimatization status of workers.
5. Compare results to the ACGIH heat stress screening criteria.
6. Implement controls where necessary.

Step 1: Take environmental measurements at the workplace

Device accuracy

Some newer, less-expensive WBGT meters use sensors to estimate wet bulb temperature. When using these devices, you are responsible for ensuring that they can measure WBGT accurately in the ranges expected at the workplace.

WBGT meters designed to measure environmental heat stress are commercially available. They measure wet bulb, dry bulb, and globe temperatures to calculate two values: WBGTin and WBGTout.

"In" can refer to either indoor values or outdoor values without direct exposure to sunlight. "Out" can refer to either outdoor values or indoor values where there is a significant industrial source of radiant heat (e.g., a piece of equipment or a process that emits more heat than direct sun exposure on a hot summer day).

Direct-reading heat-stress devices for measuring WBGT are commercially available.

Take measurements near workers. If workers are in the sun, place the WBGT meter in the sun. If they are in the shade, place the device in the shade. Follow the manufacturer's instructions for device calibration, positioning, equilibration time, and measuring time.

If your WBGT meter does not automatically calculate WBGTin and WBGTout, you can calculate these measures manually using the following formulas.

For indoor or outdoor environments without direct exposure to sunlight or other radiant heat sources:

$$(WB \times 0.7) + (GT \times 0.3) = WBGT_{in}°C$$

where WB is natural wet bulb temperature and GT is globe temperature

For outdoor environments with direct exposure to sunlight, or for indoor environments with exposure to a radiant heat source:

$$(WB \times 0.7) + (GT \times 0.2) + (DB \times 0.1) = WBGT_{out}°C$$

where WB is natural wet bulb temperature, GT is globe temperature, and DB is dry bulb temperature

Calculating a time-weighted average (TWA)

The WBGT method calculates heat stress based on work conducted over a one-hour period. If workers are in two or more areas with significantly different temperature or humidity over the course of an hour, calculate a time-weighted average WBGT. Follow these steps:

1. Measure the WBGT for each location where tasks are performed.
2. Multiply each measurement by the duration of each task.
3. Add together the results for all the locations.
4. Divide the sum by the total duration of all tasks performed during the hour.

Use the following formula to calculate a time-weighted average WBGT:

$$\text{WBGT (TWA)} = \frac{(WBGT_1 \times T_1) + (WBGT_2 \times T_2) + \ldots + (WBGT_n \times T_n)}{T_1 + T_2 + \ldots + T_n}$$

where $WBGT_1$ = WBGT measured during task 1 (in °C)

T_1 = duration of task 1 (in minutes)

For more information and examples, see the webpage Hot Environments — Control Measures (Canadian Centre for Occupational Health and Safety).

Step 2: Adjust the value for clothing worn by workers

Once you have measured the environmental conditions at the worksite, consider the types of clothing worn by workers. If your workers are only wearing regular summer clothing (e.g., lightweight pants and shirt), you don't need to make any adjustments. However, if they are wearing additional clothing that may reduce workers' ability to cool off, adjust the measured WBGT value to account for the reduced cooling ability.

Table 2 lists acceptable clothing adjustment values (CAVs) for several types of clothing. Find the clothing type that best matches what your workers are wearing. Then, add or subtract the corresponding value from the WBGT value that you calculated in step 1. You can also use CAVs for other clothing described in scientific literature as long as you exercise good professional judgment.

Table 2: Clothing adjustment values (CAVs) for some clothing ensembles*

Clothing type	Addition to WBGT (°C)
Short sleeves and pants of woven material	−1
Work clothes (shirt and pants)	+0
Cloth coveralls (woven material)	+0
SMS polypropylene coveralls	+0.5
Polyolefin coveralls	+1
Double-layer woven clothing	+3
Limited-use vapour-barrier coveralls with hood	+11
Added hood (full head and neck covering, not face)	+1

* From 2023 ACGIH threshold limit values (TLVs)

Notes:

- These values must not be used for completely encapsulating suits, often called Level A clothing. Physiological measurements must be used to assess heat stress if one of the following applies:
  - Workers are wearing clothing that does not allow movement of air or water vapour.
  - Multiple layers of clothing are worn where no data are available for adjustment.
- CAVs cannot be added together for multiple layers. The values for coveralls assume that only basic underwear is worn with the coveralls, not a second layer of clothing.
- There is no evidence to suggest that respirators or face coverings add to the heat stress burden.

Step 3: Determine the workload (metabolic rate)

Once you have adjusted the WBGT value for the clothing worn by workers, consider the heat generated from the physical workload. This is described as the metabolic rate, which is measured in watts. There are four workload categories: light, moderate, heavy, and very heavy. Table 3 has examples of activities within each category.

Table 3: Workload categories and examples of activities

Workload category	Metabolic rate (watts)*	Examples
Light	180	• Sitting with light manual work using hands or hands and arms, or driving • Standing with some light arm work and occasional walking
Moderate	300	• Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling • Normal walking
Heavy	415	• Pushing, pulling, or carrying heavy loads • Intense arm and trunk work such as shovelling or manual sawing • Walking at a fast pace
Very heavy	520	• Very intense activity at a fast to maximum pace

* To account for the effect of body weight on the estimated workload, multiply the metabolic rate by the ratio of actual body weight divided by 70 kg (154 lb.).

Over a one-hour period, record the time workers spend performing work. When determining the minutes of work per hour, non-work time does not necessarily mean a complete break from work. It can include brief rests or lighter tasks such as those listed in the Light workload category of Table 3.

If workers perform several tasks with different workloads over a one-hour period, use a time-weighted average to calculate an average workload. You can then compare that rate to the categories in Table 3 to determine the appropriate workload category.

Use the following formula to calculate a time-weighted average metabolic rate:

$$\text{Average metabolic rate (TWA)} = \frac{(M_1 \times T_1) + (M_2 \times T_2) + \ldots + (M_n \times T_n)}{T_1 + T_2 + \ldots + T_n}$$

where M_1 = metabolic rate of task 1 (in watts)

T_1 = duration of task 1 (in minutes)

Step 4: Determine the acclimatization status of workers

Exposure limits for unacclimatized workers are lower than for acclimatized workers who are used to working in the heat. For information on determining the acclimatization status of workers, see guideline G7.28(1)-2. If you don't know the acclimatization status, or if controls will be implemented for a group of workers who may have differing levels of acclimatization, assume that the workers are unacclimatized.

Acclimatization

An *acclimatized worker* is a worker who has gone through the time it takes to get used to a new climate or conditions. Acclimatization results in physiological changes that make the body more efficient at dissipating heat and reduces the risk of heat stress.

Under section 7.26 of the Regulation, an unacclimatized worker means a worker who is not accustomed to working in a hot environment or who has been out of a hot environment for seven consecutive days.

Step 5: Compare results to the ACGIH heat stress screening criteria

The ACGIH threshold limit values (TLVs) provide heat stress screening criteria. These criteria represent conditions that most workers may be repeatedly exposed to without adverse health effects if the workers are:

- Healthy
- Unmedicated
- Adequately hydrated
- Working a typical eight-hour shift with conventional breaks

If workers do not meet this description, the TLVs may not be protective. In such cases, physiological monitoring of workers must be used unless a medical professional determines otherwise.

If your workers are unacclimatized

In Table 4a, select the amount of time that unacclimatized workers spend working in a one-hour period. Choose a one-hour period when the workload is at maximum to ensure that the measurements accurately reflect the most difficult working conditions.

Table 4a: Heat stress screening criteria for unacclimatized workers*

Minutes of work per hour	Workload category for threshold limit value (TLV)			
	Light	Moderate	Heavy	Very heavy
46–60	28	25	—	—
31–45	28.5	26	24	—
16–30	29.5	27	25.5	24.5
0–15	30	29	28	27

* Adapted from the 2025 ACGIH guidelines for TLVs and biological exposure indices
This table corresponds to the values associated with "Action Limit" in the ACGIH Heat Stress and Strain documentation.

Next, select the column that corresponds to the workload of the worker, as determined in Step 3. Compare the value you find in Table 4a with the adjusted WBGT value you determined in Step 2.

If your adjusted WBGT value is greater than the value listed in Table 4a, then your workers are being exposed to heat stress conditions that exceed the exposure limits defined in section 7.28 of the Regulation. Work must stop until control measures are implemented to reduce worker exposure or physiological monitoring is conducted to ensure workers do not experience heat stress (see Step 6).

If the adjusted WBGT value is less than the corresponding value in the table, do the following:

- Measure environmental conditions periodically to ensure that heat stress conditions do not worsen.
- Continue monitoring workers for signs and symptoms of heat stress.

If the corresponding cell doesn't contain a value, refer to the "Heavy and very heavy workloads" section below.

If your workers are acclimatized

In Table 4b, select the amount of time a worker spends working in a one-hour period. Choose a one-hour period when the workload is at maximum. This ensures that the measurements accurately reflect the most difficult working conditions. During that hour, non-work time does not necessarily mean a complete break from work. It can include brief rests or lighter tasks such as those listed in Table 3.

Table 4b: Heat stress screening criteria for acclimatized workers*

Minutes of work per hour	Workload category for threshold limit value (TLV)			
	Light	Moderate	Heavy	Very heavy
46–60	31	28	—	—
31–45	31	29	27.5	—
16–30	32	30	29	28
0–15	32.5	31.5	30.5	30

*Adapted from the 2025 ACGIH guidelines for TLVs and biological exposure indices

Next, select the column that corresponds to the workload of the worker, as determined in Step 3. Compare the value you find in the table with the adjusted WBGT value you determined in Step 2.

If the adjusted WBGT value is greater than the value in Table 4b, your workers are being exposed to heat stress conditions that exceed the exposure limits defined in section 7.28 of the Regulation. Work must stop until control measures are implemented to reduce the worker's heat load or physiological monitoring is implemented to ensure workers do not experience heat stress (see Step 6).

If the adjusted WBGT value is less than the corresponding value in the table, do the following:

- Measure environmental conditions periodically to ensure that heat stress conditions do not worsen.
- Continue monitoring workers for signs and symptoms of heat stress.

If the corresponding cell doesn't contain a value, refer to the "Heavy and very heavy workloads" section below.

Heavy and very heavy workloads

Tables 4a and 4b do not provide exposure limits for some heavy and very heavy workloads. This is because of the high physiological strain associated with these workloads among less-fit workers. In such cases, a more detailed analysis and/or physiological monitoring must be used to assess heat stress.

If the cell in Table 4a or 4b that corresponds to the adjusted WBGT value doesn't contain a value, then your workers are exposed to heat stress conditions that exceed the exposure limits defined in section 7.28 of the Regulation. Unless physiological monitoring is conducted to ensure workers do not experience heat strain, decrease the work rate or reduce the amount of time spent doing tasks with heavy or very heavy workloads.

Step 6: Implement controls

If your adjusted WBGT value exceeds the exposure limits defined in section 7.28 of the Regulation, or if workers report symptoms of heat stress, you must do one of the following:

- Implement control measures immediately to reduce the worker's heat load
- Stop work until the risk to workers is controlled

Elimination

Whenever practicable, eliminate the risk of heat stress by postponing work or rescheduling it to a cooler time.

Multiple controls

Sometimes it takes more than one type of control to reduce the risk of heat stress to acceptable levels. You may need a combination of engineering and administrative controls. Alternatively, you may need to provide workers with personal cooling equipment in addition to the other controls that are in place. For more information on specific controls, see guideline G7.30.

Engineering controls

If elimination is not practicable, implement engineering controls. Engineering controls may include the following:

- Provide general air movement (e.g., fans) or air conditioning.
- Reduce process heat or water vapour release.
- Provide shade.
- Provide cooling centres or misting stations (in low-humidity environments only).
- Shield radiant heat sources.

Administrative controls

If engineering controls are not feasible or sufficient to reduce the risk of heat stress to workers, you must implement the following measures:

- Provide verbal and written information and training to workers on heat stress. See the "Education and training" section of guideline G7.29-5.
- Provide water, and encourage workers to drink at least 250 mL (1 cup) of water every 20 minutes.

- Encourage workers to report signs or symptoms of heat stress in themselves or their co-workers. Signs or symptoms may include disorientation, dizziness, feelings of nausea, or unusual irritation. Assign workers to work in pairs so they will be more likely to recognize heat stress symptoms.
- Allow workers to self-adjust their work rate, if possible.
- Implement a work-rest schedule.

Work-rest schedules

Allowing workers to take periodic breaks for their bodies to cool down can help prevent heat-related medical conditions. Recovery can include spending time in a cooler area, reducing workload for a period of time, or preferably both. Recovery time must be long enough to allow workers to recover effectively from heat stress conditions. If adjusted WBGT values exceed the limits established in Table 5, a work-rest schedule will no longer be sufficient to control the risk to workers. All work must stop unless physiological monitoring is conducted to ensure workers do not experience heat strain or until other controls are implemented (e.g., engineering, administrative) to reduce the risk.

Table 5: Maximum adjusted WBGT for implementing work-rest schedule

	Workload category			
	Light	Moderate	Heavy	Very heavy
Unacclimatized workers	30°C	29°C	28°C	27°C
Acclimatized workers	32.5°C	31.5°C	30.5°C	30°C

Method 4: Assessing heat stress using the Humidex

What is the Humidex?

The Humidex is a Canadian index that reflects how the combination of heat and humidity affects how hot it feels to the average person. When humidity is high, sweat evaporates more slowly, making it harder for the body to cool. This makes it feel hotter than it actually is.

The Humidex method is an alternative way to assess heat stress that WorkSafeBC accepts under specific circumstances. This method was developed by the Occupational Health Clinics for Ontario Workers. It uses dry bulb temperature and humidity along with a heat response plan to manage heat stress. It is typically used in workplaces where sources of heat and humidity from machinery or equipment are relatively minor, such as office buildings, retail facilities, commercial kitchens, and warehouses.

The Humidex method cannot be used to assess heat stress in workplaces where workers are exposed to significant process-related heat or industrially produced high humidity levels — for example, from boilers, furnaces, steam lines, molten metal, pulp or paper machines, or open sources of high-temperature steam. In these circumstances, you must use the WBGT method or physiological measurements.

The Humidex method cannot be used to assess heat stress for workers wearing clothing that prevents heat loss through sweating (e.g., limited-use vapour-barrier coveralls, fire-resistant clothing, rain gear). Use physiological measurements to assess workers wearing impervious clothing.

The Humidex method consists of eight steps.

Step 1: Take environmental measurements at the workplace

Measure temperature and relative humidity at the workplace with a dry bulb thermometer and a sling psychrometer or another hygrometer. You can also measure both temperature and relative humidity using a digital thermo-hygrometer, a device that is readily available at many hardware stores.

It is important to take several measurements at the actual workplace because Humidex values can vary substantially from location to location. Avoid taking measurements in direct sunlight or in contact with hot surfaces, even if workers are working in direct sunlight. The Humidex method uses a correction factor to account for radiant heat such as sunlight and hot surfaces.

Step 2: Determine a Humidex value

Once you have taken measurements, use Table 6 to determine the Humidex value for each of your measured values. Measured temperatures in Celsius are listed in the left column of the table. Measured relative humidity is listed in the top row. Look for the Humidex value in the box where your two measured values intersect. For example, with a temperature of 37°C and a relative humidity of 50 percent, the Humidex value is 49°C.

If your measured values intersect in the top-left area of Table 6 where there are no Humidex values, select an alternative method to assess heat stress. If your measured values intersect in the bottom-right area where there are no Humidex values, most workers would be unlikely to experience heat stress.

You should generally use the highest Humidex value obtained from your workplace samples to determine safe work procedures.

Table 6: Humidex

°C	Relative Humidity (in person)																		
	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10
49																			50
48																			49
47																		50	47
46																		49	46
45																	50	47	45
44																	49	46	43
43																49	47	45	42
42															50	48	46	43	41
41															48	46	44	42	40
40														49	47	45	43	41	39
39													49	47	45	43	41	39	37
38												49	47	45	43	42	40	38	36
37											49	47	45	44	42	40	38	37	35
36									50	49	47	45	44	42	40	39	37	35	34
35								50	48	47	45	43	42	40	39	37	36	34	33
34							49	48	46	45	43	42	40	39	37	36	34	33	31
33					50	48	47	46	44	43	41	40	39	37	36	34	33	32	30
32			50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29
31	50	49	48	47	45	44	43	42	40	39	38	37	35	34	33	32	30	29	28
30	48	47	46	44	43	42	41	40	39	37	36	35	34	33	31	30	29	28	27
29	46	45	43	42	41	40	39	38	37	36	35	33	32	31	30	29	28	27	26
28	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
27	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25		
26	39	38	37	36	35	34	33	33	32	31	30	29	28	27	26	25			
25	37	36	35	34	33	33	32	31	30	29	28	27	26	26	25				
24	35	34	33	33	32	31	30	29	28	28	27	26	25						
23	33	32	31	31	30	29	28	28	27	26	25								
22	31	30	30	29	28	27	27	26	25	25									
21	29	29	28	27	26	26	25												

Step 3: Adjust the Humidex value for clothing worn by workers

Once you have determined the Humidex value, consider the type of clothing worn by your workers. If they are only wearing the equivalent of summer clothing (e.g., lightweight pants and shirt, underwear, socks, and shoes), you don't need to make any adjustments. However, if they are wearing additional clothing (e.g., coveralls) or other personal protective equipment (PPE), use Table 7 to adjust the Humidex value.

Table 7: Clothing adjustment values (CAVs) for Humidex method

Clothing type	Addition to Humidex (°C)
Lightweight shirt, pants, underwear, socks, and shoes	0
Gloves	+1
Hard hat	+1
Apron or vest	+2
Cotton overalls over summer clothes	+5

The Humidex method has only been validated for a limited number of clothing ensembles. If workers are wearing clothing or PPE that is substantially different from the items in Table 7, select an alternative method to assess heat stress. Clothing adjustment values available for the WBGT method cannot be used in the Humidex method without prior approval from WorkSafeBC. See Variances to & acceptances under the OHS Regulation on worksafebc.com for information on the approval process.

Step 4: Adjust the Humidex value for radiant heat

To adjust for radiant heat from direct sunlight between 10 a.m. and 4 p.m., add 2–3°C to the Humidex value (pro-rate according to the percentage of cloud cover). For indoor exposures to minor radiant heat sources (such as commercial equipment or sunlight shining through windows), increase the Humidex value by up to 3°C by comparing the feel of the radiant heat to outdoor sun exposure. If radiant heat exceeds the feel of direct sun, then the WBGT method should be used.

Table 8: Humidex adjustment for radiant heat

Indoor	Outdoor	Humidex adjustment
No radiant heat source	Overcast, no sun	0
Some radiant heat, but not as hot as being in direct sun	Mostly cloudy, with some sun	+1
	Sunny with some cloud	+2
Radiant heat that is as hot as being in direct sun	Sunny and clear skies	+3

Step 5: Consider the workload of workers

Workload is determined in the same way for the Humidex method as in the WBGT method. Refer to Step 3 in the WBGT method (Method 3 of this guide), and compare the tasks being performed by workers to the workload descriptions in Table 3.

Step 6: Determine the acclimatization status of workers

Acclimatization status is determined in the same way for the Humidex method as in the WBGT method. Refer to Step 4 in Method 3 of this guide.

Step 7: Determine appropriate controls

Take the adjusted Humidex value that you calculated in steps 2, 3, and 4 and compare it to the values in Table 9. Whether you use Humidex 1 or 2 depends on the workload as determined in Step 5 and whether the workers are acclimatized or not.

Use Humidex 1 if either of the following apply:

- Workers are unacclimatized and performing moderate workloads
- Workers are acclimatized and performing heavy workloads

Use Humidex 2 if either of the following apply:

- Workers are performing light work (regardless of acclimatization status)
- Workers are acclimatized and performing moderate work

If the workplace conditions do not match Humidex 1 or Humidex 2, then you must use the WBGT method or another heat-assessment method.

Table 9: Humidex-based heat response plan

Risk level	Humidex 1 Moderate unacclimatized and heavy acclimatized	Humidex 2 Moderate acclimatized and light unacclimatized	Work-rest schedule	Actions	Next steps
Extreme	45* or more	50* or more	Only medically supervised work can continue.	Immediately reduce worker exposure to heat stress conditions with one or more of the following: • Implement engineering controls where possible. • Implement a heat ECP. • Supply workers with cooling clothing or equipment if appropriate. Conditions must be reassessed to demonstrate that controls have been effective at reducing heat stress exposure to an acceptable level.	• Implement a heat exposure control plan (ECP).
Severe	42–44	47–49*	Work 15 minutes, recover 45 minutes.	• Post heat stress warning signs. • Provide at least 250 mL (1 cup) of cool (10–15°C) water every 20 minutes. • Notify workers that they need to drink extra water and monitor for heat stress symptoms in themselves and others. • Monitor and record environmental conditions (relative humidity and temperature) hourly. • Re-do the evaluation if changes in conditions are identified. • Ensure that workers are trained to recognize heat stress signs and symptoms.	• Implement engineering controls where possible. • Implement a heat ECP. • Supply workers with cooling clothing or equipment if appropriate.
Significant	40–41	45–46*	Work 30 minutes, recover 30 minutes.		
Moderate	38–39	43–44	Work 45 minutes, recover 15 minutes.		

Table 9: Humidex-based heat response plan

Risk level	Humidex 1 Moderate unacclimatized and heavy acclimatized	Humidex 2 Moderate acclimatized and light unacclimatized	Work-rest schedule	Actions	Next steps
Some	34–37	40–42	None required.	• Provide water to workers. • Record environmental conditions and re-evaluate if changes in conditions are identified. • Ensure that workers are trained to recognize heat stress signs and symptoms if heat stress conditions are expected. • Post heat stress warning signs.	• Identify potential engineering controls that could be used if heat stress conditions worsen. • Implement a heat ECP where required. • Acquire cooling clothing or PPE if heat stress conditions are expected and if appropriate.
Low	30–33	36–39	None required.	• Supply water to workers as needed. • Ensure that workers are trained to recognize heat stress signs and symptoms if heat stress conditions are expected.	• Identify potential engineering controls that could be used if conditions worsen. • Implement a heat ECP where required.
Very low	25–29	32–35	None required.	• Supply water to workers as needed.	• Continue to monitor environmental conditions hourly. Re-evaluate if conditions change.

* When Humidex exposures are greater than 45, work must stop, you must implement controls to reduce heat stress conditions, or physiological monitoring of workers must be implemented.

Adapted from the table of Humidex responses published by the Occupational Health Clinics for Ontario Workers.

Step 8: Implement controls

Unless your calculated Humidex value is in the range of "Very low" or lower, you must develop and implement a heat stress exposure control plan (ECP). See guideline G7.29-5.

Use the administrative control measures described in the columns for "Work-rest schedule" and "Actions" in Table 9, in combination with the engineering or other controls that are part of your ECP. If you implement engineering controls, repeat the heat stress monitoring process to determine if you still need administrative controls to manage the risk.