Heat Stress: cool solutions

Version 5.0

Amid the global climate crisis, a report by the International Labour Organization estimates about 2.4 billion workers are likely to be exposed to excessive heat at some point during their work. With increasingly hot summers Ontario workers need better protection now to prevent occupational heat illness.

One bakery worker's death galvanized health and safety activists. Kim Douglas Warner, 44, died from heat stroke in Barrie, Ontario during a 12-hour shift where temperatures were estimated at 49°C. Lack of water and rest breaks also contributed to his death. Warner's core body temperature rose to a staggering 42.5°C at time of death. The employer was fined $215,000 under the *Occupational Health and Safety Act.*

What is heat stress?

Heat stress is our body's response to extreme heat. Heat comes from hot work environments, but it also comes from the body itself. The harder the work, the more metabolic heat is generated inside a worker's body.

This combination of hot working environments and heavy manual work poses the greatest health threat.

Heat transfer

To stay healthy, the body must maintain a constant core temperature of approximately 36°C to 38°C regardless of external conditions. The body does this by gaining heat from food (calories) and muscular work or losing it through radiation and sweating. Rates of heat gain and heat loss must balance to maintain this constant body temperature.

Most people feel comfortable when the air temperature ranges from 22°C to 25°C and the relative humidity is about 45 per cent.

As the body warms up after exposure to heat and/or exertion, blood is circulated to the skin, which increases skin temperature and allows the body to give off excess heat through the skin as sweat. Evaporation of sweat cools the skin, eliminating large amounts of heat. Unfortunately, sweating does not cool the body unless the moisture is removed from the skin. Under conditions of high humidity, the evaporation of sweat is decreased and the body's efforts to maintain an acceptable core temperature may be significantly impaired. Maintaining an acceptable core temperature is also difficult for workers exposed to excessive radiant heat (e.g. from a furnace or the sun), or those workers required to perform extremely physical work. Either way, when this happens, we say the individual is experiencing "heat stress."

Who is at risk?

Kim Warner's death is not an isolated incident. An estimated 220 workers in Canada die annually from occupational heat stress. Moreover, scientists tell us the worst is yet to come. A study released by Toronto Public Health and Environment Canada predicts heat-related deaths will double by 2050 and triple by 2080 because of global warming.

Those most at risk are employed in bakeries, food processing, canneries, restaurants, laundries, mines, smelters, and foundries, where temperatures can rise to extreme levels, particularly in summer. Roofers, road crews, farm workers, parks and recreation staff, landscapers, and surface miners are also susceptible to heat stress when working outside in hot weather.

Education workers can confront heat stress too. Aging, poorly ventilated classrooms without air conditioning can see indoor temperatures rise to hazardous levels.

Older workers, those with medical conditions and individuals taking blood pressure medication are also at higher risk when exposed to high temperatures.

What are the health effects?

Too much exposure in a very hot work environment can cause a variety of acute health effects. They include the following:

Heat stroke is the most serious. It occurs when a person's own temperature-regulating system fails, and sweating becomes inadequate to keep the body temperature within normal range. The body's core temperature rises. Signs and symptoms include hot and unusual dry skin that is red or spotted, a temperature above 41°C, mental confusion, delirium, convulsions, or unconsciousness. If heat stroke is not treated immediately, permanent damage to organs (such as the heart, brain, kidneys) or even death can occur.

Heat exhaustion is caused by the loss of large amounts of fluids by sweating (and sometimes excessive loss of salt) from continuous work in high temperatures. A worker suffering from heat exhaustion still sweats, but experiences some or all these symptoms: extreme weakness, dizziness, headache, nausea, vomiting, muscle cramps, breathlessness and numbness of the hands or feet.

Heat cramps are sharp muscle spasms that occur in those who sweat copiously in heat, drink plenty of water, but do not adequately replace the body's loss of salt.

Fainting, heat rash and transient heat fatigue are also consequences of prolonged exposure to hot conditions. 'Transient' heat fatigue is a short and temporary state of physical and mental emotional discomfort and can cause a decline in work performance and alertness.

Safety Hazards

Heat stress can also create safety hazards from fogging of safety glasses, sweaty palms, and dizziness. Mental alertness and physical capacity also may suffer as temperatures rise.

Long-term health effects

Heat stress can also contribute to long-term health effects. Workers who have suffered heat stroke or exhaustion can develop heat intolerance which may persist leaving them vulnerable to future heat stroke. Heat exposure can also be associated with temporary infertility in males and females with the effects more pronounced in males. When heat accumulates in the body, it can damage cells in the brain, heart, kidneys, liver, and muscles. Evidence suggests workers with long-term exposure to heat stress on the job may be more prone to developing chronic kidney disease.

What is the law?

Ontario does not have specific regulations governing heat exposure and heat stress under the *Occupational Health and Safety Act.* In the absence of an enforceable, standalone regulation, the Ministry of Labour, Immigration, Training and Skills Development (MLITSD) relies upon Threshold Limit Values (TLVs) for heat stress set by the American Conference of Governmental Industrial Hygienists (ACGIH). MLITSD inspectors use these TLVs as a guideline for enforcing the *Act's* general duty clause, which requires employers to take every precaution reasonable to protect workers' health and safety. The ACGIH specifies both a TLV and an action limit to prevent unacclimatized workers' core body temperatures from rising above 38°C (38.5°C for acclimatized workers).

The heat stress TLVs refer to conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects.

Unfortunately, the limits do not address thermal discomfort, a significant and unaddressed issue for many workers.

The TLVs assume all workers are fully clothed with adequate water and salt intake. They also differentiate between acclimatized and unacclimatized workers.

These assumptions are problematic. Personal factors can make a person more vulnerable to heat stress. Few workers ever become acclimatized. Acclimatization is a series of measurable physiological changes a person undergoes over a period of about five to 10 days that supposedly enables the body to rid itself of excess heat.

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Once acclimatized, the body begins to sweat at lower skin and body temperatures, and that will result in a lower accumulated heat load and less stress.

According to the MLITSD though, "hot spells in Ontario seldom last long enough for most workers to acclimatize." Workers performing "heavy work" (e.g., shoveling dry sand) or exposed to significant radiant heat (e.g., working in a foundry) could possibly acclimatize once warm weather arrives. Given that TLVs are based upon data derived from 20-year-old male workers weighing 154 lbs., they also fail to reflect a majority of the workforce, including differences between how male and female workers' bodies manage heat stress.

Also problematic, ACGIH TLVs rely on the Wet Bulb Globe Temperature Index (WBGT), which requires use of a black globe thermometer, a natural (static) wet bulb thermometer and a dry-bulb thermometer. Using these instruments can be confusing, expensive, and time-consuming.

What can be done?

A report from Canada's federal and provincial auditor's general states by 2100, the number of days above 30°C is expected to double in Canadian cities. Workers need greater protection now.

Workplaces need a practical and simplified way to assess and control heat in their workplace. Focusing on the Humidex, a combination of temperature and relative humidity measurements, the Occupational Health Clinics for Ontario Workers (OHCOW) devised a Humidex/WBGT Estimate Based Heat Response Plan based on ACGIH TLVs. The plan, among other things, consists of a Heat Stress Calculator and a table listing Humidex measurements with corresponding recommended response measures (see chart below). General and job-specific controls are recommended for all workers, no matter what the Humidex. **Never ignore any worker's heat stress symptoms.**

The resource is part of a **Heat Stress Toolkit** created by OHCOW in collaboration with the Centre for Research in Occupational Safety and Health and in consultation with Ontario Health and Safety Prevention System partners, workers, their representatives, and their unions.

The Toolkit includes a Heat Stress Awareness Guide, A Prevention Tools & Strategies Guide, a Physiological Monitoring Guide, posters, infographics, videos, and an updated online Heat Stress Calculator.

What more can be done?

Like many other dangers, indoor heat stress hazards can be controlled at the source, along the path, and at the worker. Controls at the source of the hazard can best reduce or eliminate heat stressors. Better building design and air-cooling systems using renewable energy sources reduce worker risk and hot weather-promoting greenhouse gas emissions. Air-cooling systems can help reduce the compounding problem of humidity. Dehumidifiers and the elimination of open hot water baths, drains, and leaky steam valves can similarly help. Automating some work procedures and installing better insulation on stoves and furnaces are two more ways to curb heat stress.

Exhausting hot air and steam produced by operations and installing fans can reduce heat along the path. However, fans have little benefit when relative humidity levels rise above 70 per cent, as very little evaporation occurs. Further, if air and skin temperatures are the same (36°C) or higher, moving air may heat up the body, especially if humidity is high.

When it comes to outdoor work much can be done too. These controls include:

- Scheduling heavy work during the coolest time of day, avoiding where possible work in direct sunlight, assigning extra workers to heavy tasks, slowing the pace of work, postponing non-essential work altogether;
- Allowing workers to pace their work, take frequent breaks in cool, shaded locations or in nearby air-conditioned buildings or vehicles;
- Wearing loose-fitting, light clothing and, water-cooled jackets and air-cooled space suits for extreme heat, and reflective clothing in high radiant heat situations, and
- Providing readily accessible cool drinking water (slightly salted water in extreme heat) especially in response to early symptoms of heat stress.

In the case of firefighters, a Workplace Safety and Insurance Board funded study and many since have also found forearm submersion in water 18°C or cooler to be an effective intervention during rest periods.

All controls, including emergency measures, should be identified in a formal heat stress monitoring and control plan developed by the joint health and safety committee (JHSC). With proper training JHSCs will be able to fully participate in the development of a heat stress policy and program. **Training for workers and supervisors, including training on the signs and symptoms of heat stress is essential too as is a buddy system to help identify early warning signs of heat-related illness.**

In the absence of proper heat stress controls and lack of response to expressed concerns, as a last resort, workers should exercise their right to refuse unsafe work under the *Occupational Health and Safety Act.* This isn't just good advice — it may literally save lives.

NOTE: The Workers Health & Safety Centre offers training on heat stress and its control. To learn more visit **www.whsc.on.ca** or contact a Training Services Representative near you. Download the **Heat Stress Toolkit** from the OHCOW website **www.ohcow.on.ca**.

Adjusted* Humidex	Response	Effective** WBGT (°C)
25 – 29	supply water to workers on an "as needed" basis	≤ 23.0°C
30 – 33	post Heat Stress Alert notice; encourage workers to drink extra water; start recording hourly temperature and relative humidity	23.1 – 24.0°C
34 – 37	post Heat Stress Warning notice; notify workers that they need to drink extra water; ensure workers are trained to recognize symptoms	24.1 – 25.0°C
38 – 39	work with 15 minutes relief per hour can continue; provide adequate cool (10-15°C) water; at least 1 cup (240 mL) of water every 20 minutes worker with symptoms should seek medical attention	25.1 – 26.0°C
40 – 41	work with 30 minutes relief per hour can continue in addition to the provisions listed previously	26.1 – 27.0°C
42 – 44	if feasible, work with 45 minutes relief per hour can continue in addition to the provisions listed above	27.1 – 29.0°C
45*** or over	only medically supervised work can continue	29.1°C*** or over

* "adjusted" means adjusted for additional clothing and radiant heat (see steps #4 & #5)

** "Effective" means adjusted for clothing (step #4) if the WBGT includes the globe temp

***at Humidex above 45 (29.0°C WBGT), heat stress to be managed as per the ACGIH TLV®

Source: OHCOW Humidex/WBGT Estimate Based Heat Response Plan available at www.ohcow.on.ca

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