



1600 20th Street, NW • Washington, D.C. 20009 • 202/588-1000 • www.citizen.org

July 17, 2018

Loren Sweatt
Acting Assistant Secretary of Labor for Occupational Safety and Health
U.S. Department of Labor
200 Constitution Ave. NW
Washington, D.C. 20210

Dear Ms. Sweatt,

Public Citizen, a consumer and health advocacy group with more than 500,000 members and supporters nationwide, Farmworker Justice, United Farm Workers, former OSHA directors Drs. Eula Bingham and David Michaels as well as former CalOSHA director, Ellen Widess, U.C. Davis heat illness prevention expert Dr. Marc Schenker, 131 other organizations and 89 other individuals hereby petition the Occupational Safety and Health Administration (OSHA), pursuant to section 6(c) of the Occupational Safety and Health (OSH) Act, 29 U.S.C. § 655(c), to initiate the rulemaking process for the first federal standard that would protect outdoor and indoor U.S. workers from occupational exposure to excessive heat.

It is now more than 47 years since the OSH Act went into effect, and three states with their own state OSHA plans—California, Washington, and Minnesota—have subsequently implemented some form of protective heat standards for their workers. But approximately 130 million workers in the rest of the country lack the protections of a national OSHA heat standard. The National Institute for Occupational Safety and Health (NIOSH), a component of the Centers for Disease Control and Prevention that provides research-based evidence to support OSHA’s regulatory mission, explained it is generally estimated that two in 1,000 workers are at risk of heat stress.¹ This suggests that approximately 260,000 workers outside of California, Washington, and Minnesota are at risk of heat-related illnesses and deaths with no standard in place to protect them.

The proposed standard should include the following elements, based largely on NIOSH’s latest (2016) iteration of its criteria for a recommended standard for occupational exposure to heat and hot environments:²

- **Heat stress thresholds:** At NIOSH’s Recommended Exposure Limit (REL) for acclimatized workers and Recommended Alert Limit (RAL) for unacclimatized workers,

¹ NIOSH [2016]. NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments. By Jacklitsch B, Williams WJ, Musolin K, et al. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2016-106. <https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf>. Accessed March 12, 2018. Hereafter referred to as “NIOSH 2016 Criteria Recommendations.” p. 96.

² NIOSH 2016 Criteria Recommendations.

employers would be required to initiate robust protective measures. These include the following:

- **Mandatory rest breaks**: Rest breaks away from the hot environment should range in duration from 15 to 45 minutes per hour, depending on the workplace temperature and worker activity level (see Table 8 and Figure 5 and Figure 6). At certain wet bulb globe temperatures,³ work must be stopped entirely.
- **Personal protective equipment (PPE)**: At all times when total heat stress load reaches the RAL or REL, employers must provide PPE (e.g., water-cooled garments, air-cooled garments, or cooling vests) to protect workers from heat-related illness.
- **Shade**: In outdoor environments, employers must provide access to sufficient areas of shade during the rest breaks.
- **Hydration**: Workers must be given access, at no cost to themselves, to water in quantities sufficient to maintain adequate levels of hydration at varying levels of heat (the baseline is one cup of cool water per 15 to 20 minutes), as well as electrolytes if workers are sweating for more than two hours.
- **Heat acclimatization plan**: All workers beginning work in high-heat environments, or who will be working in hotter conditions than usual (e.g., during a heat wave), must be gradually acclimatized to the work over a period of at least 7–14 days.
- **Exposure monitoring**: Employers must monitor both environmental heat exposure and employee workloads to ensure that no worker is exposed to heat stress at or above the RAL/REL.
- **Medical monitoring**: Employers must institute a medical monitoring program for all workers who are or may be exposed to heat stress at or above the RAL/REL.
- **Hazard notification**: Employers must post prominent signs, in languages their workers understand, in high-heat areas warning of the dangers of heat stress.
- **Heat Alert Program**: Employers must develop a written Heat Alert Program to be implemented whenever the National Weather Service or other authoritative weather service forecasts a heat wave for the coming day or days in order to help improve worker awareness and preparedness.
- **Worker information and training**: All workers and supervisors who work in areas where there is a reasonable likelihood of heat illness must be trained on measures to

³ Wet bulb globe temperature is a measure of heat stress in direct sunlight. It takes into account temperature, humidity, wind speed, sun angle and cloud cover. By contrast, the heat index takes into account only temperature and humidity and is calculated for shady areas. National Weather Service. WetBulb Globe Temperature. <https://www.weather.gov/tsa/wbgt>. Accessed July 9, 2018.

prevent and mitigate the risk. A written training program must be developed to serve as the basis for this training.

- **Heat-related surveillance and recordkeeping:** Employers should proactively obtain and analyze data on all heat-related injuries and deaths, environmental and physiological measurements related to heat, and other heat-related information.
- **Whistleblower protections:** Each employer must institute an independent whistleblower protection program for employees and supervisors to report violations of the heat stress standard. OSHA should provide criteria or model language to serve as the basis for the whistleblower protection programs.

Contents

I.	Background.....	4
II.	Health effects of excessive heat exposure	5
	A. The body’s normal response to high heat levels: The crucial importance of the sweat response	6
	B. Dehydration	6
	C. Acclimatization.....	7
	D. Acute heat-related illnesses	7
	E. Chronic heat-related illnesses	8
III.	The prevalence and preventability of heat-related illness	8
	A. Reported heat stress deaths and injuries vastly understate the problem	8
	B. Studies of OSHA enforcement and the agency’s successful heat-stress policy for the Deepwater Horizon cleanup demonstrate that a heat-stress standard based on NIOSH’s recommendations will save numerous lives	14
	C. The contrast between OSHA’s and California’s enforcement records further shows the importance of a heat stress standard	16
IV.	Current regulatory landscape: Three states, the U.S. military, and other countries have moved ahead with heat protections.....	19
	A. State standards	19
	B. U.S. military guidelines	21
	C. Heat stress standards in other countries.....	24
V.	NIOSH criteria for a recommended standard	25
	A. Heat stress threshold, mandatory rest breaks, cool rest areas, hydration, and personal protective equipment.....	25
	B. Heat acclimatization plan.....	29

C. Exposure monitoring.....	30
D. Medical monitoring.....	30
E. Emergency medical procedures	31
F. Hazard notification	31
G. Heat Alert Program.....	31
H. Worker information and training	31
I. Heat-related surveillance and recordkeeping.....	32
VI. Whistleblower protections	32
VII. Petition requests.....	34
VIII. Environmental impact statement	35
IX. Certification	36
Appendix.....	43

I. Background

Global warming is resulting in more frequent days of extreme heat, and record-breaking summers are now becoming the norm. 2017 was the second-hottest year on record, surpassed only by 2016.⁴ Indeed, 17 of the 18 hottest years on record have occurred since 2001.⁵ According to the Fourth U.S. National Climate Assessment, average annual temperatures in the contiguous U.S. have already risen by 1.2°F (0.7°C) for the period 1986–2016 relative to 1901–1960 and by 1.8°F (1.0°C) for the period 1895–2016.⁶ This warming trend will not only continue, but accelerate. Record-setting years will be common in the coming decades, as temperatures are projected to increase by 2.5°F (1.4°C) for the period 2021–2050 relative to 1976–2005 even if we aggressively reduce greenhouse gas pollution worldwide.⁷

Extreme high temperatures are projected to increase even more than average temperatures, with cold waves becoming less intense and heat waves becoming more intense.⁸ On our current

⁴ YaleEnvironment360. It's Official: 2017 Was the second hottest year on record. *E360 Digest*. Jan 4, 2018. <https://e360.yale.edu/digest/its-official-2017-was-the-second-hottest-year-on-record>. Accessed July 12, 2018.

⁵ Fountain H, Patel JK, Popovich N. 2017 was one of the hottest years on record. And that was without El Niño. *New York Times*. Jan 18, 2018. <https://www.nytimes.com/interactive/2018/01/18/climate/hottest-year-2017.html>. Accessed July 12, 2018. The record of global-scale instrumental temperature observations begins in the mid-1800s, and diverse sets of observations are available beginning in 1950. IPCC, 2013: Climate Change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. T.F. Stocker, et al., eds. p.4.

⁶ Vose RS, Easterling DR, Kunkel KE, et al. 2017: Temperature changes in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Vol I [Wuebbles DJ, Fahey DW, Hibbard KA, et al. (eds.)]. U.S. Global Change Research Program, Washington, DC. p. 185.

⁷ *Ibid.* (noting the same projected increases for 2021–2050 under all mitigation scenarios). By later in the century, 2071–2100, temperatures are projected to increase by 2.8°–7.3°F (1.6°–4.1°C) under a moderate mitigation scenario (the Intergovernmental Panel on Climate Change's Representative Concentration Pathway (RCP) 4.5) and 5.8°–11.9°F (3.2°–6.6°C) under a business-as-usual scenario (RCP 8.5). *Ibid.*

⁸ *Ibid.*

greenhouse gas emissions path, by 2100 nearly the entire southeastern U.S., from Virginia to the southern tip of Texas, will experience on average more than 85 “deadly heat” days per year—days on which the combined heat and humidity overwhelm human thermoregulatory capacity even for people at rest. Large portions of the region will experience more than 150 deadly heat days per year.⁹

Workers are laboring in extreme heat, often with no protections from heat stress, in a wide range of indoor and outdoor workplaces, including farms, construction sites, steel mills, warehouses, manufacturing and meat-packing plants, and vehicles. According to the Bureau of Labor Statistics, from 1992 through 2016, exposure to excessive environmental heat killed 783 U.S. workers and seriously injured 69,374 (Figure 1 and Figure 2).¹⁰ These figures are in all likelihood vast underestimates due to underreporting. And with accelerating global warming, the United Nations reported in 2016 that worker injuries and deaths due to excessive heat exposure are projected to increase in the coming years.¹¹ Outdoor laborers will be put at greater risk due to workplace heat stress, but indoor workers will be at greater risk too as extreme heat and higher overnight low temperatures make it more difficult to cool down outside of work, increasing vulnerability on the job.

In addition to the acute risks of death and illness, heat stress likely poses long-term risks. For example, in recent decades an epidemic of chronic kidney disease of unknown etiology has taken hold in Central America, becoming the second-leading cause of death among men in El Salvador, and chronic heat stress is strongly suspected to be a contributing factor to the illness (see section below on “chronic heat-related illness”). Such illnesses can be expected to occur more widely globally as temperatures rise and, indeed, there is already some evidence that rates of kidney disease may be abnormally high among migrant farm workers in California’s Central Valley.¹²

II. Health effects of excessive heat exposure

The human body needs to maintain a core, or internal, temperature of 37 degrees Celsius (98.6 Fahrenheit) and can tolerate only small deviations from this temperature.¹³ Two sources of heat can raise the body’s temperature: (1) environmental heat, such as that from a hot summer day or a furnace, and (2) metabolic heat, or the heat that the body generates internally, especially with physical activity.¹⁴ Workers who perform strenuous physical labor while exposed to

⁹ Mora C, Dousset B, Caldwell IR, et al. Global risk of deadly heat. *Nature Climate Change*. 2017;7:501–506. (Figure 3 on p. 503). For an interactive map of deadly heat projections, see <https://maps.esri.com/globalriskofdeadlyheat/#>. Accessed July 12, 2018.

¹⁰ Bureau of Labor Statistics. Occupational injuries/illnesses and fatal injuries profiles. <https://data.bls.gov/gqt/InitialPage>. Accessed March 6, 2018. Serious injuries are defined as those resulting in at least one day away from work.

¹¹ Workers face ‘epidemic of heat-related injuries’ due to climate change. *The Guardian*. Apr 28, 2016. <https://www.theguardian.com/environment/2016/apr/28/workers-epidemic-heat-related-injuries-climate-change-un-report>. Accessed July 12, 2018.

¹² Glaser J, Lemery J, Rajagopalan B, et al. Climate change and the emergent epidemic of CKD from heat stress in rural communities: the case for heat stress nephropathy. *Clin J Am Soc Nephrol*. 2016;11(8):1472.

¹³ NIOSH 2016 Criteria Recommendations. p. 13

¹⁴ *Ibid.* p. 13.

environmental heat will rapidly increase their body temperature through both mechanisms simultaneously, leaving them especially vulnerable to heat stress.

A. The body's normal response to high heat levels: The crucial importance of the sweat response

Any increase in the body's core temperature induces a series of compensatory responses to emit the excess heat and cool the body. In a hot environment, by far the most important response to an increase in core temperature is sweating.¹⁵ The evaporation of sweat from the skin, either from ambient heat or moving air (e.g., wind) removes heat from the body's surface and serves as the body's best defense against heat stress. Small arteries in the skin also dilate in response to high temperatures to expedite the removal of excess heat through the skin. This shunting of blood away from vital organs, such as the brain and kidneys, causes an increase in heart rate, a key indicator of heat strain.¹⁶

Several factors can impede the critical sweat response. Certain types of clothing, such as the PPE worn by many agricultural or manufacturing workers, serve as a physical barrier to the evaporation of sweat (although certain types of PPE can actually mitigate the risk of heat stress; see below for more details). Humidity in the air causes an increase in vapor pressure, which also reduces the evaporation of sweat from the skin. Humidity is such a strong influence on the body's ability to cool itself that at high rates of relative humidity, heat loss from sweating "is virtually nonexistent."¹⁷ Finally, dehydration (as explained below) depletes the body's supply of water, which is essential for sweating.

B. Dehydration

Even in the absence of heat exposure, the average person requires approximately a liter of water per day to replace the amount lost through urine, evaporation from the skin, and respiration.¹⁸ Physical exertion and higher temperatures accelerate this water loss. Workers performing physical labor under hot conditions can lose up to 6 to 8 liters of water through sweat throughout the workday.¹⁹ Other factors, including older age, coffee or alcohol consumption, and taking certain drugs (e.g., diuretics) can increase the risk of dehydration.²⁰ Since merely satisfying thirst is not a sufficient mechanism to replace lost fluids, workers and others at risk of dehydration must proactively consume water or other fluids — non-alcoholic and non-caffeinated — every 15 to 20 minutes.²¹

Dehydration can cause a number of serious effects on the body, including dangerously low blood pressure, heart attacks in those with cardiovascular disease, kidney failure, and severe

¹⁵ *Ibid.* p. 27.

¹⁶ *Ibid.* p. 27.

¹⁷ *Ibid.* p. 28.

¹⁸ Institute of Medicine of the National Academies. Dietary reference intakes: Water, potassium, sodium, chloride, and sulfate. Consensus report. 2005. Figure C-1, p. 488.

http://books.nap.edu/openbook.php?record_id=10925&page=488. Accessed July 12, 2018.

¹⁹ NIOSH 2016 Criteria Recommendations. p. 118.

²⁰ Government of Australia. Healthdirect. Dehydration. <https://www.healthdirect.gov.au/dehydration>. Accessed July 12, 2018.

²¹ NIOSH 2016 Criteria Recommendations. p. 118.

neurological effects such as fainting or convulsions. Dehydration also affects the body's ability to deal with heat stress. As water stores are depleted, dehydrated workers gradually lose the ability to sweat, resulting in a dangerous cycle of faster increasing in core temperature and further dehydration. Chronic, periodic dehydration that can result from long-term outdoor physical labor also can damage the kidneys, potentially contributing to chronic kidney disease (see section below on "chronic heat-related illness").²²

C. Acclimatization

Acclimatization refers to the body's ability to gradually and partially adapt over time to high environmental heat exposure. When a person is exposed to heat levels higher than he or she is accustomed to, the body gradually adapts, primarily by developing a more robust sweat response, among other physiological adjustments, to emit excess heat more optimally.²³ This process requires exposure to the hot conditions for at least two hours per day²⁴ over a period of seven to 14 days, with a phased increase in work rate each day.^{25,26} Workers must be adequately hydrated and given adequate rest breaks in shaded or air-conditioned surroundings throughout the acclimatization process.²⁷ Re-acclimatization to higher heat exposure is necessary for any sudden increases in the environmental heat level.²⁸

D. Acute heat-related illnesses²⁹

Heat syncope is dizziness, light-headedness, or fainting that results from prolonged standing or sudden rising from a sitting or lying position within a hot environment.³⁰ It is more likely to occur when a person is dehydrated, not acclimatized to hot weather, or both. Heat syncope is treated by sitting or lying in a cool place and slowly drinking fluids.

Heat rash involves skin irritation, which can appear as pimples or small blisters on the neck, chest, and groin, among other places.³¹ It is treated by getting away from hot and humid areas, keeping the rash dry, and applying powder to the affected area.

Prolonged physical exertion in hot weather can lead to muscle cramps³² and, in severe cases, a life-threatening condition known as rhabdomyolysis, which involves rapid breakdown and death of muscle tissue and can lead to acute kidney injury.³³ Symptoms of rhabdomyolysis include

²² National Institute for Occupational Safety and Health. Chronic kidney disease of unknown etiology: NIOSH pesticide exposure study in El Salvador sugarcane workers. Sept 27, 2016.

<https://www.cdc.gov/niosh/docket/archive/pdfs/niosh-278/curwinbscsept2016.pdf>. Accessed July 12, 2018.

²³ NIOSH 2016 Criteria Recommendations. p. 32.

²⁴ *Ibid.* p. 32.

²⁵ *Ibid.* p. 34.

²⁶ Occupational Safety and Health Administration. OSHA technical manual. Section III: Chapter 4 (Heat stress). Updated September 15, 2017. https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html. Accessed July 12, 2018.

²⁷ NIOSH 2016 Criteria Recommendations. p. 32.

²⁸ *Ibid.* p. 33.

²⁹ Centers for Disease Control and Prevention. Heat Stress – Heat-related Illness. <https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html>. Accessed July 12, 2018.

³⁰ *Ibid.*

³¹ *Ibid.*

³² *Ibid.*

³³ *Ibid.*

severe muscle cramps or pain, dark (tea or cola-colored) urine, and weakness. If such symptoms occur, it is essential to stop physical activity, drink fluids, and see a medical professional immediately.

Heat exhaustion results from prolonged exposure to heat and a loss of body fluids and salt, usually through excessive sweating.³⁴ The symptoms of heat exhaustion are headache, nausea, dizziness, weakness, irritability, thirst, heavy sweating, elevated body temperature, or decreased urination. Heat exhaustion is treated by lying down away from the heat; removing unnecessary clothing; cooling down with cold compresses; washing the head, face, and neck with cold water; and slowly drinking cool fluids.

If heat exhaustion is severe and not adequately treated, then heat stroke, a life-threatening medical emergency, can occur. Heat stroke occurs when the body rapidly loses the ability to control its temperature and is no longer able to sweat.³⁵ The body's temperature can rise to 106°F or higher within 10 to 15 minutes. Symptoms of heat stroke include confusion, slurred speech, hot and dry skin or profuse sweating, seizures, and loss of consciousness (coma). Immediate medical attention must be sought by calling 911 and giving treatment similar to that recommended for heat exhaustion.

E. Chronic heat-related illnesses

Chronic kidney disease (CKD) of unknown etiology is a devastating condition that primarily affects young male agricultural workers in Central America, certain parts of Asia, and other tropical regions of the world.³⁶ Its detection has been fairly recent, over the past two decades, but the disease has risen to startling levels in Nicaragua and El Salvador. In the latter, CKD has become the second most common cause of death in men, with males affected three times as frequently as females.³⁷ The precise causes are not yet fully understood, as the affected patients do not have the traditional risk factors for CKD, such as diabetes or hypertension.³⁸ It is likely multifactorial, and chronic heat stress and recurrent dehydration from long periods of intensive farm labor are strongly suspected to be contributing factors.^{39,40}

III. The prevalence and preventability of heat-related illness

A. Reported heat stress deaths and injuries vastly understate the problem

According to data compiled from the Bureau of Labor Statistics (BLS) annual Survey of Occupational Injuries and Illnesses, exposure to excessive environmental heat stress killed 783

³⁴ *Ibid.*

³⁵ *Ibid.*

³⁶ Orantes-Navarro CM, Herrera-Valdés R, Almaguer-López M, et al. Toward a comprehensive hypothesis of chronic interstitial nephritis in agricultural communities. *Adv Chronic Kidney Dis.* 2017;24(2):101–106.

³⁷ *Ibid.*

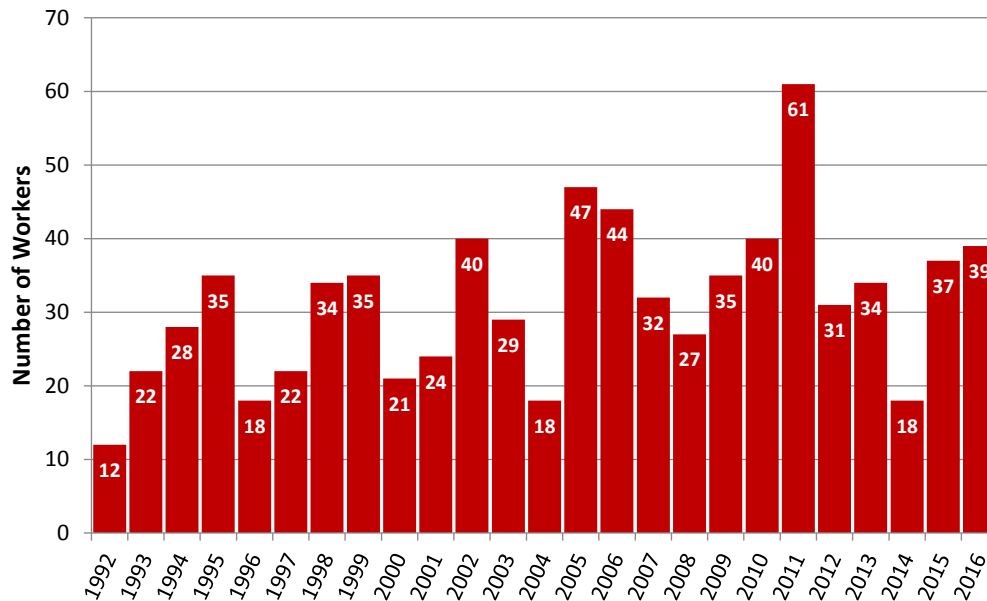
³⁸ *Ibid.*

³⁹ *Ibid.*

⁴⁰ Nerbass FB, Pecoits-Filho R, Clark WF, et al. Occupational heat stress and kidney health: From farms to factories. *Kidney Int Rep.* 2017 31;2(6):998–1008.

U.S. workers and seriously injured 69,374 workers from 1992 through 2016 (Figure 1 and Figure 2).⁴¹

Figure 1. BLS counts of U.S. workers killed by heat stress



Source: Bureau of Labor Statistics. Occupational Injuries/Illnesses and Fatal Injuries Profiles.

<https://data.bls.gov/gqt/InitialPage>. Accessed May 24, 2018. Includes private sector and state and local government workers.⁴²

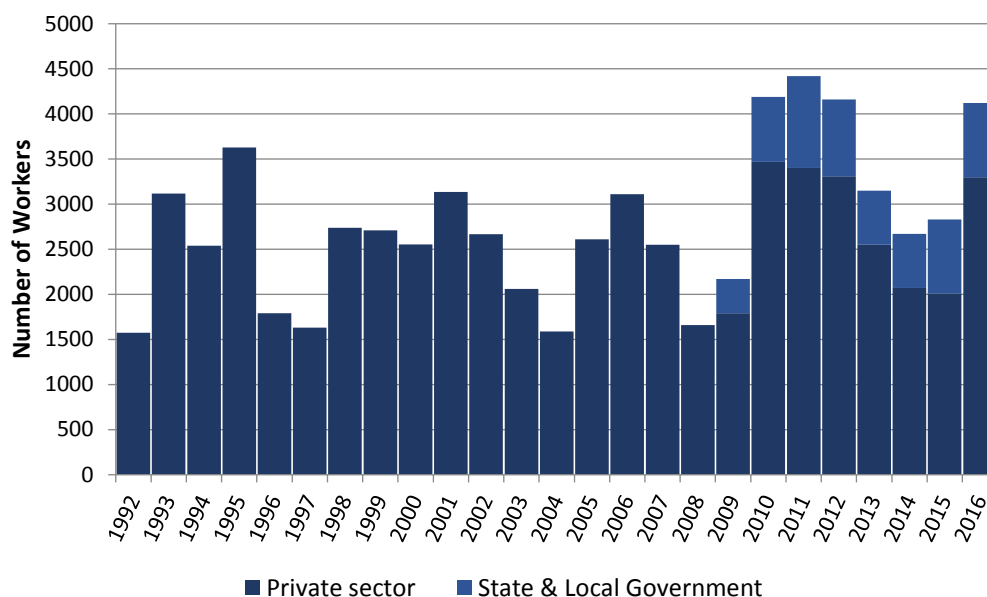
⁴¹ Bureau of Labor Statistics. Occupational injuries/illnesses and fatal injuries profiles.

<https://data.bls.gov/gqt/InitialPage>. Accessed March 6, 2018. Serious injuries are defined as those resulting in at least one day away from work.

⁴² BLS counts occupational fatalities by using a number of sources, such as death certificates, workers' compensation reports, and media accounts. BLS. Census of fatal occupational injuries. Table 1. Nov 3, 2017.

<https://www.bls.gov/opub/hom/cfoi/pdf/cfoi.pdf>. Accessed July 12, 2018.

Figure 2. Reports of serious injuries to U.S. workers from heat stress, 1992–2016 (not including state and government workers before 2009)



Source: Bureau of Labor Statistics. Occupational Injuries/Illnesses and Fatal Injuries Profiles. <https://data.bls.gov/gqt/InitialPage>. Accessed May 24, 2018. Serious injuries are defined as those resulting in at least one day of absence from work. The BLS database does not capture injury data for state and local government workers prior to 2009.⁴³

But the BLS data vastly understate the number of injuries and fatalities for several reasons. Regarding injuries, some of the shortcomings stem from the fact that BLS relies on employer logs.⁴⁴ The Occupational Safety and Health (OSH) Act of 1970 requires most employers to record injuries and illnesses sustained by their workers on a form known as the Form 300 Log of Injury (or Form 300 log).⁴⁵ But the OSH Act does not apply to federal government agencies, self-employed persons, and household workers.⁴⁶ The Act also exempts small farms with fewer than 11 workers, which means that BLS injury data do not capture heat-related events for a significant number of agricultural workers, the sector at highest risk of heat-related illness.⁴⁷ Moreover, OSHA does not require that an injury be reported if it does not lead to one or more of the following: death, days away from work, restricted work or transfer to another job, medical

⁴³ BLS collects injury data from logs that employers are required to keep under the OSH Act. BLS. Injuries, Illnesses, Fatalities, Frequently Asked Questions. <https://www.bls.gov/iif/oshfaq1.htm>. Accessed July 12, 2018.

⁴⁴ Bureau of Labor Statistics. Injuries, illnesses, and fatalities. Frequently asked questions. <http://www.bls.gov/iif/oshfaq1.htm>. Accessed July 12, 2018.

⁴⁵ 29 CFR 1904.7.

⁴⁶ Bureau of Labor Statistics. Injuries, illnesses, and fatalities. Frequently asked questions. <http://www.bls.gov/iif/oshfaq1.htm>. Accessed July 12, 2018.

⁴⁷ Gubernot DM, Anderson GB, Hunting KL. Characterizing occupational heat-related mortality in the United States, 2000–2010: An analysis using the census of fatal occupational injuries database. *Am J Industrial Med.* 2015;58(2):203-211.

treatment beyond first aid, loss of consciousness, or a diagnosis of significant injury by a health care professional.⁴⁸

Even for employers covered by the OSH Act, the injury and illness data are still underestimates for several reasons, as outlined in a 2009 Government Accountability Office (GAO) review.⁴⁹ First, the Form 300 logs rely on self-reports by employers, employees, and company doctors. As GAO noted, employers are likely to underreport because they do not want to increase their workers' compensation costs or jeopardize their standing as safe workplaces for potential contracts.⁵⁰ In addition, some employers hire independent contractors to avoid reporting requirements.⁵¹

For their part, many employees do not report injuries due to fear of retaliation, including the potential to lose their jobs. Sixty-seven percent of occupational health practitioners surveyed by the GAO reported observing worker fear of disciplinary action for reporting an injury or illness, and 46 percent said workers' fear had at least a minor impact on injury and illness records.⁵² In addition, many employers have adopted incentive programs that reward workers when there are few recordable injuries and illnesses in the workplace. In addition to encouraging safe practices, these programs discourage reporting. Over 75 percent of health practitioners said they believed workers sometimes avoid reporting injuries and illnesses because of incentive programs.⁵³

The desire among employers and workers to avoid recording injuries and illnesses also results in pressure on health care practitioners to facilitate non-reporting. Over one-third of surveyed practitioners said that they had been asked to provide limited treatment that would bring an injury or illness below the threshold for recording but was not sufficient to properly treat the injury or illness. Forty-four percent of providers said that this pressure had at least a minor impact on records, and 15 percent said it had a major impact.⁵⁴

Heat stress injuries are more likely to be underreported than injuries generally. First, the industries at highest risk of heat stress injuries and deaths are agriculture and construction. Both sectors rely heavily on undocumented and otherwise vulnerable workers, who are more likely to avoid reporting injuries themselves or have their injuries or deaths reported by their employers.⁵⁵ Accurate reporting among farm workers is hindered by unique features of the agricultural workforce and workplace, including the migrant and seasonal nature of the workforce; poor English skills and educational attainment of workers; and economic and social factors that

⁴⁸ 29 CFR 1904.7.

⁴⁹ Government Accountability Office. Workplace safety and health: Enhancing OSHA's records audit process could improve the accuracy of worker injury and illness data. October 2009. <http://www.gao.gov/new.items/d1010.pdf>. Accessed July 12, 2018.

⁵⁰ *Ibid.* p. 18.

⁵¹ *Ibid.*

⁵² *Ibid.* p. 17.

⁵³ *Ibid.* p. 18.

⁵⁴ *Ibid.* p. 19.

⁵⁵ AFL-CIO. (2005). Immigrant workers at risk: The urgent need for improved workplace safety and health policies and programs [Electronic version]. Washington, DC: Author. <http://digitalcommons.ilr.cornell.edu/laborunions/28/>. Accessed July 12, 2018.

prevent workers from speaking out about workplace conditions.⁵⁶ Many agricultural workers with heat-related illness short of severe exhaustion are likely to self-treat, do not report illness, and do not (or are not able to) take time off to recuperate.⁵⁷ A recent study has demonstrated that non-U.S. citizens have a risk of heat-related mortality that is 3.4 times greater than that of U.S. citizens, and Hispanic and younger non-citizens are at even greater risk.⁵⁸ Many farmworkers are poor, can ill afford to stop working to treat or recover from injuries, fear losing their jobs if they take time off, lack awareness of employment rights, and may perceive that reporting injuries would be construed by employers as complaints and thus result in reprisal. Many are immigrants, often lacking proper work permits and fearful of deportation if they raise concerns about heat stress or request the most basic protections from it.

Two additional factors lead not only to underreporting of heat illness but also to undercounting of heat deaths, which does not rely on employer logs.⁵⁹ First, heat stress is not always recognized as a cause of heat-induced illness or death because many of the symptoms, such as rash, sweating, headache, and fatigue, are nonspecific and overlap with more common diseases. Indeed, one recent study of OSHA heat enforcement actions in 2012 and 2013 found that, in five of the 23 cases (21.7 percent) in which there was a fatality, medical examiners attributed the cause to a cardiac event without considering whether heat triggered or contributed to the event.⁶⁰ This problem is especially acute in the agriculture sector, where signs of heat stress can be confused with similar symptoms encountered with exposure to pesticides.⁶¹ Second, heat stress also diminishes performance and makes other accidents and injuries more likely,⁶² giving rise to the possibility that heat stress is a significant factor in an untold number of fatalities or serious injuries that are not recorded as having anything to do with heat.

Together, all of these reasons for underreporting or undercounting virtually guarantee that the BLS's injury data greatly understate the devastating effects of heat exposure on workers.

Indeed, a few data points suggest that the BLS numbers may fall short by multiple orders of magnitude. According to NIOSH, it is generally estimated that two in 1,000 of all workers are at risk of heat stress and that those in certain occupations (firefighting, agriculture, construction,

⁵⁶ Mines R. An evaluation of the gathering of occupational injury data by the national agricultural workers survey (NAWS), submitted to the Office of the Assistant Secretary for Policy, U.S. Department of Labor, July 13, 2004, at p. 30; Jackson L, Rosenberg R. Preventing heat-related illness among agricultural workers. *J Agromedicine*. 2010;15:200-215; Hofmann J, Snyder K, Keifer M. A descriptive study of workers' compensation claims in Washington state orchards. *Occupational Medicine*. 2006;56:251-257; and Hansen E, Donahoe M. Health issues of migrant and seasonal farmworkers. *J Health Care for the Poor and Underserved*. May 2003; 14(2):153-164.

⁵⁷ Jackson L, Rosenberg R. Preventing heat-related illness among agricultural workers. *J Agromedicine*. 2010;15:200-215.

⁵⁸ Taylor EV, Vaidyanathan A, Flanders D, et al. Differences in heat-related mortality by citizenship status: United States, 2005-2014. *Am J Public Health*. 2018;108:S131-S136.

⁵⁹ BLS counts occupational fatalities by using a number of sources, such as death certificates, workers' compensation reports, and media accounts. BLS. Census of fatal occupational injuries. Table 1. November 3, 2017. <https://www.bls.gov/opub/hom/cfoi/pdf/cfoi.pdf>. Accessed July 12, 2018.

⁶⁰ Arbury S, Lindsley M, Hodgson M. A critical review of OSHA heat enforcement cases: Lessons learned. *J Occup Environ Med*. 2016;58(4):359-363. p. 361.

⁶¹ Environmental Protection Agency (EPA). A Guide to Heat Stress in Agriculture (1993). Page 7. http://nepis.epa.gov/EPA/html/Pubs/pubalpha_A.html. Accessed July 12, 2018.

⁶² NIOSH 2016 Criteria Recommendations. p. 110.

forestry, mining, and manufacturing) are at greater risk.⁶³ There are roughly 155.2 million Americans employed at present,⁶⁴ so two in 1,000 translates to more than 300,000 American workers at risk. Of those, more than 260,000 reside in states with no heat stress standard at all,⁶⁵ and those in states with heat stress standards are not fully protected.⁶⁶

A study of Florida emergency room visits also indicates that occupational heat-related illness is an extensive problem. The researchers found 2,198 cases in five years, from 2005 to 2009. They also noted limitations of the study and suggest that it might “greatly underestimate[]” the rate of occupational heat-related illness.⁶⁷

A final point for rough comparison is the reported burden of heat stress in the U.S. military. In 2017, there were 2,136 cases of heat stroke or heat exhaustion among active military service members, or a rate of 1.79 per 1,000 person-years.⁶⁸

Critically, even the limited BLS data suggest that the rate of heat stress fatalities has been rising since 1992, the first year for which numbers are available. The rise appears to be correlated with the increase in average annual temperature, as shown in Figure 3 (it is not possible to consider the same question for non-fatal injuries because the BLS lacks injury data for state and local government workers before 2009).

⁶³ NIOSH 2016 Criteria Recommendations. p. 96.

⁶⁴ BLS seasonally adjusted employment data for April 2018.

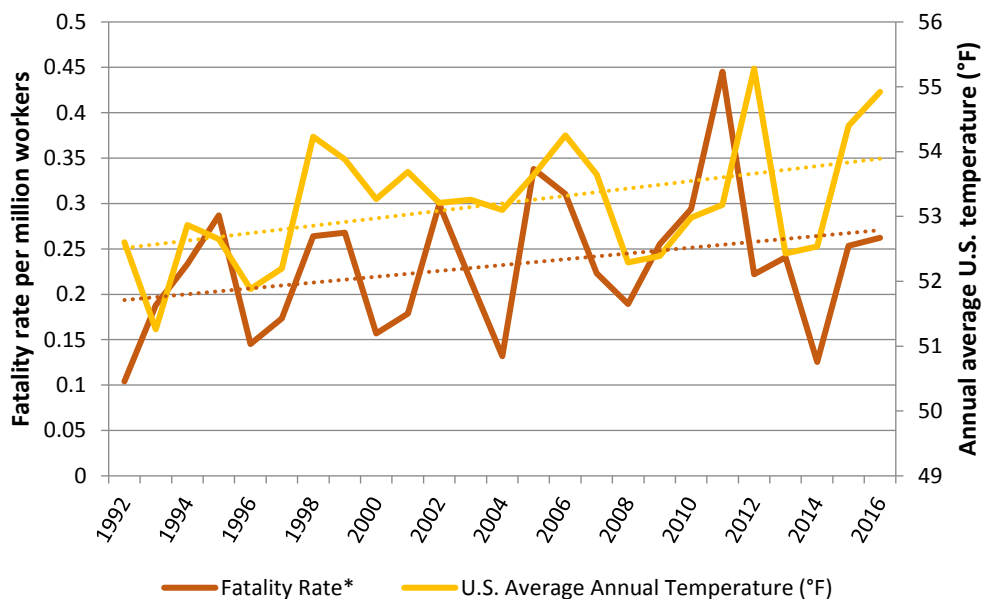
⁶⁵ BLS seasonally adjusted employment for California, Minnesota, and Washington totals 25.1 million.

⁶⁶ See Table 1 for elements of existing state standards.

⁶⁷ Florida Department of Health. Descriptive analysis of occupational heat-related illness treated in Florida hospitals and emergency departments. June 2011.

⁶⁸ The numbers for heat stroke are 464 and 0.38 cases per 1,000 person-years; for heat exhaustion they are 1,699 and 1.41 cases per 1,000 person-years. Defense Health Agency. Work/rest times and fluid replacement guide. *Medical Monthly Surveillance Report*. 2018;25(4):8. Only 69 of these cases were diagnosed in Iraq or Afghanistan. *Ibid.* p. 10.

Figure 3. Average annual U.S. temperature (°F) and rate of reported worker fatalities from heat stress



* Fatality rate per 1 million workers, derived by dividing reports of fatalities by total U.S. employees in private sector and state and local governments. Sources: National Oceanic and Atmospheric Administration (temperature data) and BLS (fatality rate data).

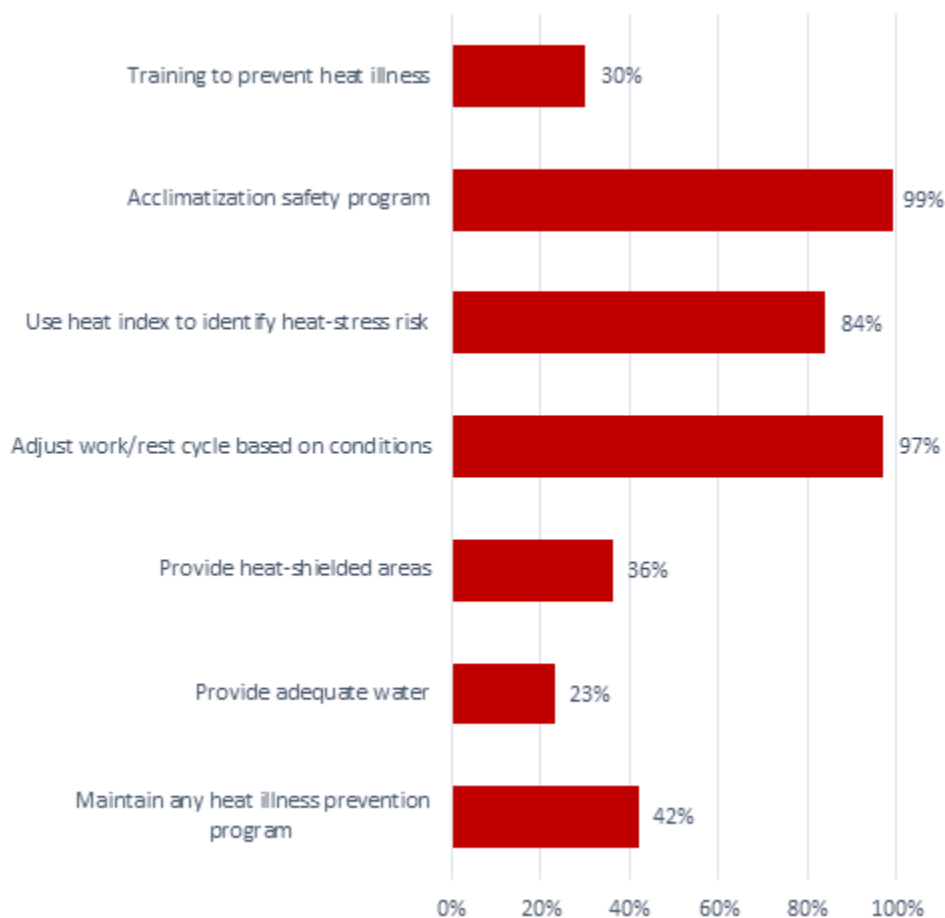
B. Studies of OSHA enforcement and the agency’s successful heat-stress policy for the Deepwater Horizon cleanup demonstrate that a heat-stress standard based on NIOSH’s recommendations will save numerous lives

The available evidence indicates that an extraordinarily high percentage of occupational heat stress fatalities occur in workplaces that lack the protections that NIOSH recommends. A recent study examined OSHA’s 84 heat enforcement cases in 2012 and 2013 and found that only one of the employers had a heat acclimatization program in place. Only 42 percent of the employers had any heat illness prevention program at all. Twenty-three percent did not provide employees water or limited access to it. Only 16 percent used the daily heat index to identify the risk of illness.⁶⁹ And 97 percent did not adjust work/rest schedules to allow for heat conditions or intensity of workload.⁷⁰ See Figure 4 for the full range of findings from the study.

⁶⁹ The heat index is a measure of how hot it feels when relative humidity of the air is taken into account along with air temperature. NIOSH 2016 Criteria Recommendations. p. 158.

⁷⁰ Arbury S, Lindsley M, Hodgson M. A critical review of OSHA heat enforcement cases: Lessons learned. *J Occup Environ Med.* 2016;58(4):359-363. p. 361.

Figure 4. U.S. employer heat illness prevention programs: percentage of missing safety components in 84 OSHA enforcement cases (2012–2013)



Source: Arbury S, Lindsley M, Hodgson M. A critical review of OSHA heat enforcement cases: Lessons learned. *J Occup Environ Med.* 2016;58(4):359–363. p. 361, Figure 1.

Another study examined the 38 heat-related illness enforcement cases between 2011 and 2016 in which the Office of Occupational Medicine and Nursing was consulted. In the cases for which data were available, the study found that none of the employers (0 of 31) had a heat acclimatization plan, none (0 of 34) enforced mandatory rest breaks above recommended heat exposure limits, and only 10 percent (3 of 30) had the ability to monitor environmental heat.⁷¹

By contrast, OSHA itself demonstrated that robust heat protections worked in the summer of 2010, during the response to the Deepwater Horizon oil spill in the Gulf of Mexico. Heat stress was a serious risk to those involved in response and clean-up efforts. Many worked 12-hour days in hot and humid weather. OSHA required the oil company, BP, to implement robust protections against heat-related illness, including “work/rest requirements, shaded rest areas, hydration

⁷¹ Tustin A, Cannon D, Arbury S, et al. Risk factors for heat-related illness in U.S. workers: An OSHA case series. *J Occup Environ Med.* May 30, 2018 – Volume Publish Ahead of Print. p. 7.

liquids, and onsite heat monitoring.”⁷² The rest requirements were particularly controversial, as some observers were unaccustomed to seeing laborers resting in the shade.⁷³ But the results were clear. Across a workforce of more than 42,000 response and cleanup workers, operating in plainly dangerous heat stress conditions, not a single serious heat-related illness or fatality was recorded. A review of the response explains the following:

Even though on many days the temperature reached above 100° F (37.8° C) no workers involved in the clean-up and response developed serious heat illness. Heat did, however, pose a significant hazard: as of September 2, when OSHA began transitioning out of the spill response, there were 978 heat stress incidents reported. The heat protection program likely prevented serious heat illnesses and possible deaths among workers.⁷⁴

C. The contrast between OSHA’s and California’s enforcement records further shows the importance of a heat stress standard

California implemented its outdoor heat standard as an emergency measure in 2005 in response to a spike in heat-related worker deaths,⁷⁵ then made the measure permanent in 2006.⁷⁶ The main provisions of the standard are summarized in Table 3. They include requirements for employers to: (1) provide one quart of potable drinking water per worker per hour; (2) monitor, and provide shade for, all employees on particularly hot days; (3) provide rest breaks for employees upon request; and (4) train new employees and supervisors on heat-related illness and preventive measures.⁷⁷

In the first five years after implementation of California’s standard in 2005, thousands of inspections were conducted, finding hundreds of violations, which resulted in millions of dollars in penalties (Table 1). California targets its inspections at what have traditionally been the highest-risk industries for outdoor heat-related injuries: the agriculture and construction sectors.

⁷² Michaels D, Howard J. Review of the OSHA-NIOSH response to the Deepwater Horizon oil spill: protecting the health and safety of cleanup workers. *PLOS Currents Disasters*. 2012 July 18.

⁷³ *Ibid.*

⁷⁴ *Ibid.*

⁷⁵ California Department of Industrial Relations. Cal/OSHA Standards Board adopts emergency regulations on heat illness prevention. <https://www.dir.ca.gov/DIRNews/2005/IR2005-33.html>. Accessed July 12, 2018.

⁷⁶ Wilson E. Heat stress prevention heats up in California. *EHS Today*. June 1, 2008. http://ehstoday.com/mag/heat_stress_prevention/. Accessed July 12, 2018.

⁷⁷ California Code of Regulations. Title 8, section 3395, Heat illness prevention. <http://www.dir.ca.gov/title8/3395.html>. Accessed July 12, 2018.

Table 1. Cal/OSHA enforcement of its heat illness prevention standard (presented as obtained from Cal/OSHA)⁷⁸

Cal/OSHA Action	2005	2006	2007	2008	2009	2010	2011
Inspections coded S18 Heat*	39	234	1,018	2,586	3,574	3,183	1,265
Inspections w/ § 3395 violations**	9	158	490	899	935	788	195
Citations for violations of § 3395	2	136	614	1,121	1,163	957	349
Assessed initial penalties	\$7,085	\$535,140	\$822,990	\$1,775,071	\$1,041,527	\$578,995	\$152,890
Heat outreach (enforcement, consultation)***	14	96	284	1,145	2,562	2,482	1,065

* Inspections “coded S 18 Heat” refer to the total number of inspections.

** Inspections resulting in at least one violation of the heat standard (§ 3395). The number of § 3395 violations cited is generally higher than the number of inspections with 3395 violations; a single inspection may yield multiple citations. For some years, the number of citations is lower than the number of inspections due to a time lag between inspections and citations.

*** Cal/OSHA Consultation heat illness outreach activities for CY 2008–2011 include workshops, seminars, training related to on-sites, etc.

Despite the absence of a federal heat standard, OSHA can cite companies for heat stress violations under its General Duty Clause (GDC). As seen in Table 2 below, California completed 7,082 inspections resulting in at least one heat standard citation or violation between 2013 and 2017.⁷⁹ During that same timeframe, federal OSHA conducted 142 inspections resulting in at least one heat citation or violation under the general duty clause.⁸⁰ These means that California conducted 50 times more (7082/142) inspections resulting in a citation or violation for unsafe heat exposure practices as OSHA did nationwide between 2013 and 2017. This alarming disparity clearly shows why a specific, enforceable heat standard is urgently needed on a federal level rather than relying on the relatively ineffective OSHA GDC. This disparity between California’s state OSHA (Cal/OSHA) and the federal OSHA is even more striking given that California represents only one-eighth of the U.S. population and therefore has a true inspection rate much greater than 50 times that of OSHA.

⁷⁸ Obtained from Cal/OSHA on August 2, 2011, thus 2011 data are incomplete. Data compiled from federal IMIS database.

⁷⁹ Data obtained from Cal/OSHA on July 11, 2018. Per Cal/OSHA, the 2017 data may be incomplete.

⁸⁰ Occupational Safety and Health Administration. General Duty Standard search. <https://www.osha.gov/pls/imis/generalsearch.html>. Accessed July 11, 2018.

Table 2. Number of inspections resulting in at least one citation or violation for unsafe heat load conditions, 2013–2017⁸¹

Calendar Year	Cal/OSHA*	Federal OSHA**
2013	1,175	11
2014	1,324	3
2015	1,489	32
2016	1,599	64
2017	1,495	32
Total	7,082	142
Annual Average	1,416	28

* Cal/OSHA inspections conducted under the authority of its outdoor heat exposure standard (Cal/OSHA Standard 3395).

** Federal OSHA inspections conducted under the authority of the General Duty Clause and include both outdoor and indoor inspections.

The importance of a national heat standard backed up by OSHA’s enforcement authority is highlighted in a study published last year entitled *Recruitment, Methods, and Descriptive Results of a Physiologic Assessment of Latino Farmworkers: The California Heat Illness Prevention Study*.⁸² The researchers point out that “The California Occupational Safety and Health Administration (Cal-OSHA) has launched informational and regulatory programs to reduce HRI among farmworkers since 2008 and conducts enforcement activities throughout the summer.”

⁸¹ Data obtained from Cal/OSHA on July 11, 2018. Per Cal/OSHA, the 2017 data may be incomplete; Occupational Safety and Health Administration. General Duty Standard search. <https://www.osha.gov/pls/imis/generalsearch.html>. Accessed July 11, 2018.

⁸² Mitchell DC, Castro J, Armitage TL, et al. Recruitment, methods, and descriptive results of a physiologic Assessment of Latino farmworkers: The California heat illness prevention study. *J Occup Environ Med*. 2017;59:649–658.

IV. Current regulatory landscape: Three states, the U.S. military, and other countries have moved ahead with heat protections

Despite NIOSH having issued three separate *Criteria for a Recommended Standard* documents for heat stress (in 1972,⁸³ 1986,⁸⁴ and 2016),⁸⁵ OSHA has never promulgated a federal standard to protect workers from heat stress, as recommended by its sister agency. But three states, the military, and numerous countries have developed standards to protect workers from dangerous heat.

A. State standards

Three states — California,⁸⁶ Minnesota,⁸⁷ and Washington⁸⁸ — have implemented standards protecting outdoor (California and Washington) or indoor (Minnesota) workers from heat stress. In addition, California is scheduled to propose a heat stress standard for indoor workers in January 2019.⁸⁹ Although these state standards fall short of the NIOSH recommendations (see Table 3 for a comparison), they demonstrate the feasibility of heat stress regulations at the state and federal levels. California's heat stress standard, although limited to outdoor workers, is the most comprehensive and detailed. A summary of the three state standards is found in Table 3.

⁸³ National Institute for Occupational Safety and Health. *Criteria for a recommended standard: Occupational exposure to hot environments*. DHHS (NIOSH) Publication Number 72-10269. 1972. <https://www.cdc.gov/niosh/docs/72-10269/>. Accessed July 12, 2018.

⁸⁴ National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 86-113. *Criteria for a recommended standard: Occupational exposure to hot environments (Revised Criteria 1986)*. April 1986. <https://www.cdc.gov/niosh/docs/86-113/86-113.pdf>. Accessed July 12, 2018.

⁸⁵ NIOSH 2016 Criteria Recommendations.

⁸⁶ Cal/OSHA - Title 8, Section 3395. Heat Illness Prevention. <https://www.dir.ca.gov/title8/3395.html>. Accessed July 12, 2018.

⁸⁷ Minnesota Administrative Rules. 5205.0110 Indoor ventilation and temperature in places of employment. <https://www.revisor.mn.gov/rules/?id=5205.0110>. Accessed July 12, 2018.

⁸⁸ Washington State Legislature. General occupational health standards. 296-62-095. Outdoor heat exposure. <http://app.leg.wa.gov/WAC/default.aspx?cite=296-62&full=true#296-62-095>. Accessed July 12, 2018.

⁸⁹ California Legislative Information. Senate Bill No. 1167. Employment safety: indoor workers: heat regulations. Chapter 839. http://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1167. Accessed July 12, 2018.

Table 3. Comparison of state and military heat standards with NIOSH and ACGIH recommendations

Key Element of Standard	California*	Washington**	Minnesota***	Military†	NIOSH‡	ACGIH§
Worksites	Outdoor	Outdoor	Indoor	All worksites	All worksites	All worksites
Time of Year	Year-round	May 1 – Sept. 30	Year-round	Year-round	Year-round	Year-round
Exposure Monitoring	No	No	No	Yes	Yes	Yes
Acclimatization Plan	“Close supervision” for first 14 days	No	No	Yes	Yes	No, but separate limits for unacclimatized workers.
Heat Stress Thresholds	Varying requirements at 80°F and 95°F.	Rule applies ≥89°F; lower if wearing certain clothing.	PEL between 77°F and 86°F (WBGT) based on workload.	Navy: PHELs Others: Work/rest and hydration tables.	RAL and REL curves	Threshold Limit Values.
Ceiling Exposure Limits	No	No	Yes	Yes	Yes	Yes
Rest breaks	Mixed. In agriculture, 10 mins every two hours at >95°F. In other industries, only on request.	No	Yes, in the sense that the threshold is a firm PEL.	Rigorous work-rest cycles based on WBGT thresholds.	Threshold limit curves differ depending on amount of work per hour.	Indirectly. Temps at which extra precautions needed vary with duration of work per hour.
Personal Protective Equipment	No	No	No	No	Yes	Yes
Hydration	Yes. Water, 1 qt/hr.	Yes. Water, 1 qt/hr.	No	Water, 0.5–1.5 qt/hr based on work intensity and WBGT. Salt or sports drinks during >4 hours sweating if salt from meals is insufficient.	Provide 1 cup cool (50–59°F), potable water every 15–20 mins. For workers sweating more than 2 hours, provide electrolytes.	Employers should encourage workers to drink 1 cup of cool, palatable water every 20 mins.
Shade Requirements	Required when temp >80°F. Upon request when temp ≤80°F.	No	N/A	Rest should be given in shade.	Provide air-conditioned or shaded area for rest.	No specific guidelines on shade.
Hazard Notification	No	No	N/A	Flag indicating conditions.	Yes	No
Employee Training	Upon hiring.	Upon hiring and annually thereafter.	Upon hiring and annually thereafter.	Vague guidance on need to educate on signs of heat stress.	Upon hiring and continuously thereafter.	No specific guidelines on training.
Medical Monitoring	Proactive monitoring for heat-related illness when temp ≥95°F.	Reactive monitoring and rest breaks for heat-related injuries.	No	Language on monitoring throughout guidance, but no strict criteria.	Medical screening and surveillance program.	Monitor heat stress [WBGT thresholds] and heat strain [signs and symptoms].
Emergency Medical Response Plan	Yes	Yes	No	Yes	Yes	No
Injury Surveillance	Yes	Yes	No	Yes	Yes	No
Record-keeping	Yes. Written exposure control and emergency response plan.	Yes. Written accident prevention program and worker training.	General req. for accident and injury reduction program, not specific to heat.	N/A	Written Heat Alert Program; record-keeping of heat measurements, surveillance records.	No specific guidelines on record-keeping.

* Cal/OSHA - Title 8, Section 3395. Heat Illness Prevention. <https://www.dir.ca.gov/title8/3395.html>. Accessed July 12, 2018.

** Washington State Legislature. General occupational health standards. § 296-62-095–296-62-09560. Outdoor heat exposure. <http://app.leg.wa.gov/WAC/default.aspx?cite=296-62&full=true#296-62-095>. Accessed July 12, 2018.

*** Minnesota Administrative Rules. 5205.0110 Indoor ventilation and temperature in places of employment. <https://www.revisor.mn.gov/rules/?id=5205.0110>. Accessed July 12, 2018.

[†] Technical bulletin: Heat stress control and heat casualty management. Headquarters, Departments of the Army and Air Force. TB MED 507 / AFPAM 48-152 (I). March 7, 2003.

[‡] NIOSH 2016 Criteria Recommendations.

[§] ACGIH 2018 Threshold Limit Values. pp. 227–36.

B. U.S. military guidelines

The U.S. Navy first developed Physiological Heat Exposure Limit (PHEL) curves based on metabolic and environmental heat load in 1973.⁹⁰ The PHELs represent “maximum allowable” exposure limits.⁹¹ See Figure 7 and Table 10 in the Appendix for the Navy’s PHEL curves and a table of time limits for each curve. In addition, the Navy curtails training as wet bulb globe temperatures (WBGTs) rise, signified by colored flags flown at installations, with all nonessential outdoor activity halting at WBGTs greater than 90°F (Table 4).

The U.S. Marine Corps has issued heat stress guidelines in the past and has been following the Navy’s on an interim basis since 2015.⁹² The order issued by Base Quantico to implement Marine Corps guidelines in 2002 noted that “each year” personnel at the base experienced “several heat casualties with many resulting in emergency MEDEVAC” between May and September.⁹³

Table 4: U.S. Navy heat/flag index

Flag Condition	Current WBGT (°F)	Intensity of Physical Exercise
Green	80.0 – 84.9	Discretion required in planning heavy exercise for unseasoned personnel.
Yellow	85.0 – 87.9	Strenuous exercise and activity (e.g., close order drill) should be curtailed for new and unacclimated personnel during the first 3 weeks of heat exposure.
Red	88.0 – 89.9	Strenuous exercise curtailed for all personnel with less than 12 weeks of training in hot weather.
Black	90.0+	Physical training and strenuous exercise suspended for all personnel (excludes operational commitment not for training purposes).

Adapted from *Manual of Naval Preventive Medicine*. Department of the Navy. NAVMED P-5010-3 (Rev. 2-2009). p. 3–15, Table 3-3.

⁹⁰ *Manual of Naval Preventive Medicine*. Department of the Navy. NAVMED P-5010-3 (Rev. 2-2009). pp. 3-15–3-19.

⁹¹ *Ibid.* p. 3–17.

⁹² Marine Corps Heat and Cold Stress Injury Prevention Program. MARADMIN 111/15. March 9, 2015. <https://www.marines.mil/News/Messages/Messages-Display/Article/897018/marine-corps-heat-and-cold-stress-injury-prevention-program/>. Accessed July 12, 2018.

⁹³ Marine Corps Base Order 6200.1A. July 22, 2002. pp.1–2.

In 2003, the U.S. Army and U.S. Air Force issued a technical bulletin on heat stress and effective measures to prevent heat-related injury in soldiers in both outdoor and indoor workplaces.⁹⁴ The main features of the guidelines are outlined in Table 3. The bulletin provides detailed instructions on acclimatization, with gradually increasing workload and environmental heat exposure over a two-week period. A rigorous WBGT threshold is calculated for differing work intensities and environmental temperatures, with a recommended work-rest cycle developed based on these values.⁹⁵ The recommendations limit continuous work after temperatures rise above 82°F for “moderate” intensity work and above 78°F for “hard” work (Table 5).

⁹⁴ Technical Bulletin: Heat Stress Control and Heat Casualty Management. Headquarters, Departments of the Army and Air Force. TB MED 507 / AFPAM 48-152 (I). March 7, 2003.

⁹⁵ Technical Bulletin: Heat Stress Control and Heat Casualty Management. Headquarters, Departments of the Army and Air Force. TB MED 507 / AFPAM 48-152 (I). March 7, 2003. p. 16–18, Table 3-3.

Table 5. U.S. Army and U.S. Air Force fluid replacement and work/rest guidelines for warm-weather training conditions

		Easy Work (250 W)		Moderate Work (425 W)		Hard Work (600 W)	
Heat Category	WBGT Index (°F)	Work/Rest (minutes)	Water Intake (qt/hr)	Work/Rest (minutes)	Water Intake (qt/hr)	Work/Rest (minutes)	Water Intake (at/hr)
1	78 – 81.9	NL*	0.5	NL	0.75	40/20 (70)**	0.75 (1)**
2 (green)	82 – 84.9	NL	0.5	50/10 (150)**	0.75 (1)**	30/30 (65)**	1 (1.25)**
3 (yellow)	85 – 87.9	NL	0.75	40/20 (100)**	0.75 (1)**	30/30 (55)**	1 (1.25)**
4 (red)	88 – 89.9	NL	0.75	30/30 (80)**	0.75 (1.25)**	20/40 (50)**	1 (1.25)**
5 (black)	>90	50/10 (180)**	1	20/40 (70)**	1 (1.25)**	10/50 (45)**	1 (1.5)**
		Easy Work		Moderate Work		Hard Work	
		<ul style="list-style-type: none"> • Weapon maintenance • Walking hard surface at 2.5 mph, < 30-pound (lb) load • Manual of arms • Marksmanship training • Drill and ceremony 		<ul style="list-style-type: none"> • Walking loose sand at 2.5 mph, no load • Walking hard surface at 3.5 mph, < 40-lb load • Calisthenics • Patrolling • Individual movement techniques--that is low crawl, high crawl • Defensive position construction 		<ul style="list-style-type: none"> • Walking hard surface at 3.5 mph, ≥ 40-lb load • Walking loose sand at 2.5 mph with load • Field assaults 	

* NL = No limit equals no limit to work time per hour for up to four continuous hours.

** Use the amounts in parentheses for continuous work when rest breaks are not possible.

Sources: Adapted from Technical Bulletin: Heat Stress Control and Heat Casualty Management. Headquarters, Departments of the Army and Air Force. TB MED 507 / AFPAM 48-152 (I). March 7, 2003. p. 13, Table 3-1, p. 17, Table 3-3; Defense Health Agency. Work/rest times and fluid replacement guide. *Medical Monthly Surveillance Report*. 2018;25(4):12.

Weaknesses of the military guidelines include the absence of recordkeeping requirements to verify compliance, the lack of shade requirements, and the lack of exposure limits (with the exception of the Navy's PHEL). Also, it is unclear on reading the military materials whether they are merely advisory and, if so, the extent of compliance. Nevertheless, the military's work-rest cycle and acclimatization protocols, in addition to the Navy's PHEL, clearly represent rigorous and feasible model provisions on which to base a nationwide federal standard.

C. Heat stress standards in other countries

Other industrialized countries also have implemented heat stress standards. Most Canadian provinces have adopted, as either rules or guidelines, Threshold Limit Values based on those recommended by the American Conference of Governmental and Industrial Hygienists (ACGIH) (Table 6).⁹⁶ For the basic provisions of the Canadian provinces' heat stress standards, see Table 9 in the Appendix. Canada's federal government has established permissible temperature ranges for food service workers⁹⁷ and workplace first aid rooms,⁹⁸ as well as a temperature at which a heat barrier must be provided to protect the operator of motorized materials handling equipment.⁹⁹

**Table 6. Canadian threshold limit values for WBGTs in hot conditions
(based on ACGIH recommendations)**

Work/rest ratio (mins per hour)	Light, °C (65– 130 W/m ²)	Moderate, °C (130–200 W/m ²)	Heavy, °C (200–260 W/m ²)	Very heavy, °C (>260 W/m ²)
Acclimatized population				
60/0	29.5	27.5	26	–
45/15	30.5	28.5	27.5	–
30/30	31.5	29.5	28.5	27.5
15/45	32.5	31	30	29.5
Unacclimatized population				
60/0	27.5	25	22.5	–
45/15	29	26.5	26.5	–
30/30	30	28	28	25
15/45	31	29	29	26.5

Assumes an 8-hr working day in a 5-day week. Examples of work rates are standing with moderate arm movements at machine or bench (light); walking with moderate lifting or pushing (moderate); shoveling dry sand or intermittent heavy lifting (heavy); shoveling wet sand or constant heavy lifting (very heavy).

Source: Jay O, Kenny GP. Heat exposure in the Canadian workplace. *Am J Indus Med.* 2010;53:842–53. p. 846, Table II.

Japan also has implemented occupational exposure limits for heat stress, setting temperature exposure limits that decline with increased workloads, similar to NIOSH's recommended RELs for acclimatized workers, as shown in Table 7.

⁹⁶ Jay O, Kenny GP. Heat exposure in the Canadian workplace. *Am J Indus Med.* 2010;53:842–53. p. 845.

⁹⁷ Canada Occupational Health and Safety Regulations § 9.9. <http://laws.justice.gc.ca/eng/regulations/SOR-86-304/page-18.html#h-96>. Accessed July 12, 2018.

⁹⁸ Canada Occupational Health and Safety Regulations § 16.10(2)(b). <http://laws.justice.gc.ca/eng/regulations/SOR-86-304/page-42.html#h-259>. Accessed July 12, 2018.

⁹⁹ Canada Occupational Health and Safety Regulations § 14.9(2). <http://laws.justice.gc.ca/eng/regulations/SOR-86-304/page-35.html#h-202>. Accessed July 12, 2018.

Table 7. Occupational exposure limits for heat stress in Japan compared with NIOSH’s recommended limits for the same workloads

Workload	Exposure Limit (WBGT [°C])		
	Japan ¹⁰⁰	NIOSH REL	Difference
RMR*-1 (Very light, -130 kcal/h)	32.5	31.6	0.9
RMR-2 (Light, -190 kcal/h)	30.5	29.8	0.7
RMR-3 (Moderate, -250 kcal/h)	29.0	28.4	0.6
RMR-4 (Moderate, -310 kcal/h)	27.5	27.3	0.2
RMR-5 (Heavy, -370 kcal/h)	26.5	26.4	0.1

* Relative Metabolic Rate (RMR) = (Metabolic energy expenditure during work—Metabolic energy expenditure at rest)/Basal metabolic rate corresponding to the work period.

V. NIOSH criteria for a recommended standard

In 2016, NIOSH issued the third iteration of its criteria for a recommended standard for occupational exposure to heat and hot environments, which includes the following elements:¹⁰¹ heat stress threshold, rest breaks, hydration, shade, heat acclimatization plan, PPE, exposure monitoring, hazard notification, worker training, medical monitoring, injury surveillance, and recordkeeping. This section provides more detail on this nonexclusive list of recommended provisions.

If a heat hazard cannot be eliminated, then in most situations employers should take measures in an order reflected in NIOSH’s “Checklist for controlling heat stress and heat strain”: engineering controls (e.g., air conditioners, fans, shade tents or tarps), then administrative controls (scheduling work in cooler parts of the day, rest breaks, hydration), then PPE.

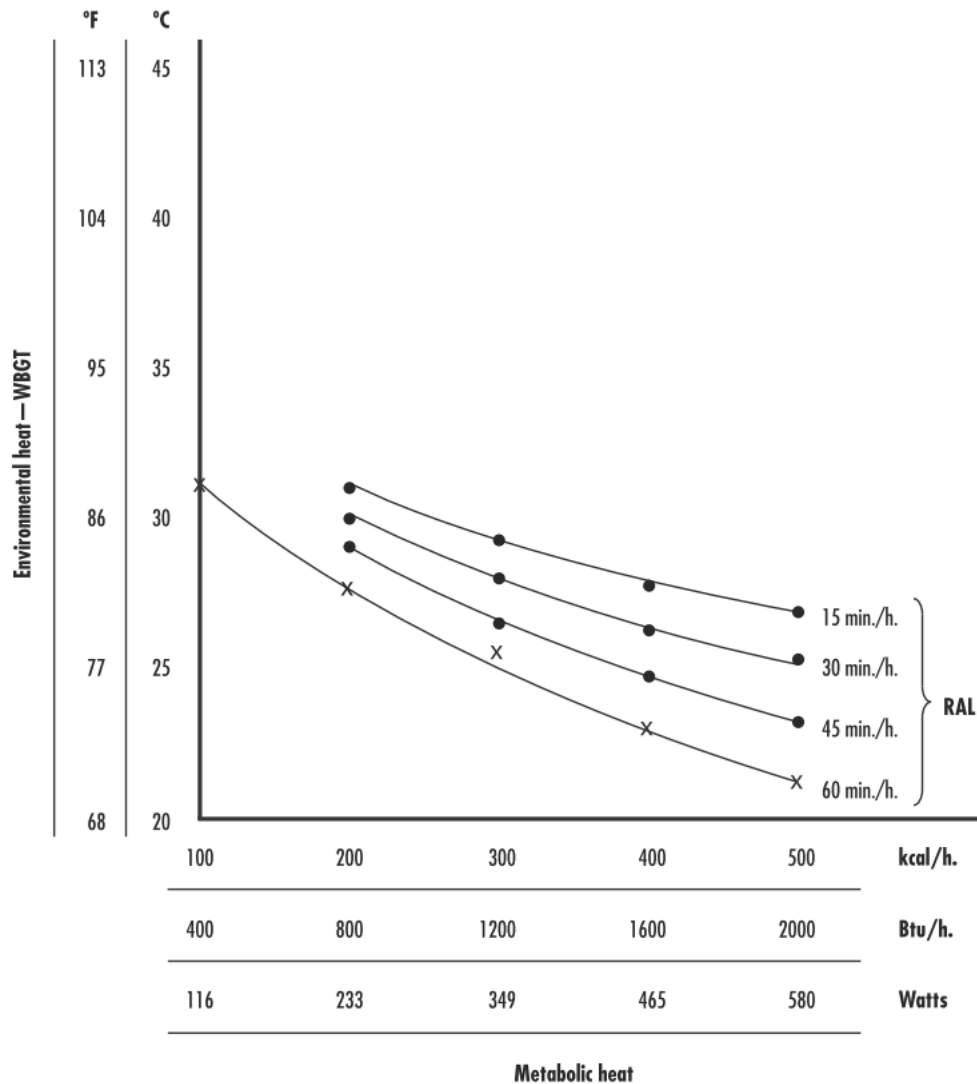
A. Heat stress threshold, mandatory rest breaks, cool rest areas, hydration, and personal protective equipment

NIOSH recommends that no worker be “exposed to combinations of metabolic and environmental heat greater than” the applicable recommended alert limits (RALs) or recommended exposure limits (RELs) for unacclimatized and acclimatized workers, respectively (Figure 5 and Figure 6).

¹⁰⁰ NIOSH 2016 Criteria Recommendations. p. 108. Taken by NIOSH from: Tanaka M. Heat stress standard for hot work environments in Japan. *Ind Health*. 2007;45(1):85–90.

¹⁰¹ NIOSH 2016 Criteria Recommendations. pp. 1–10.

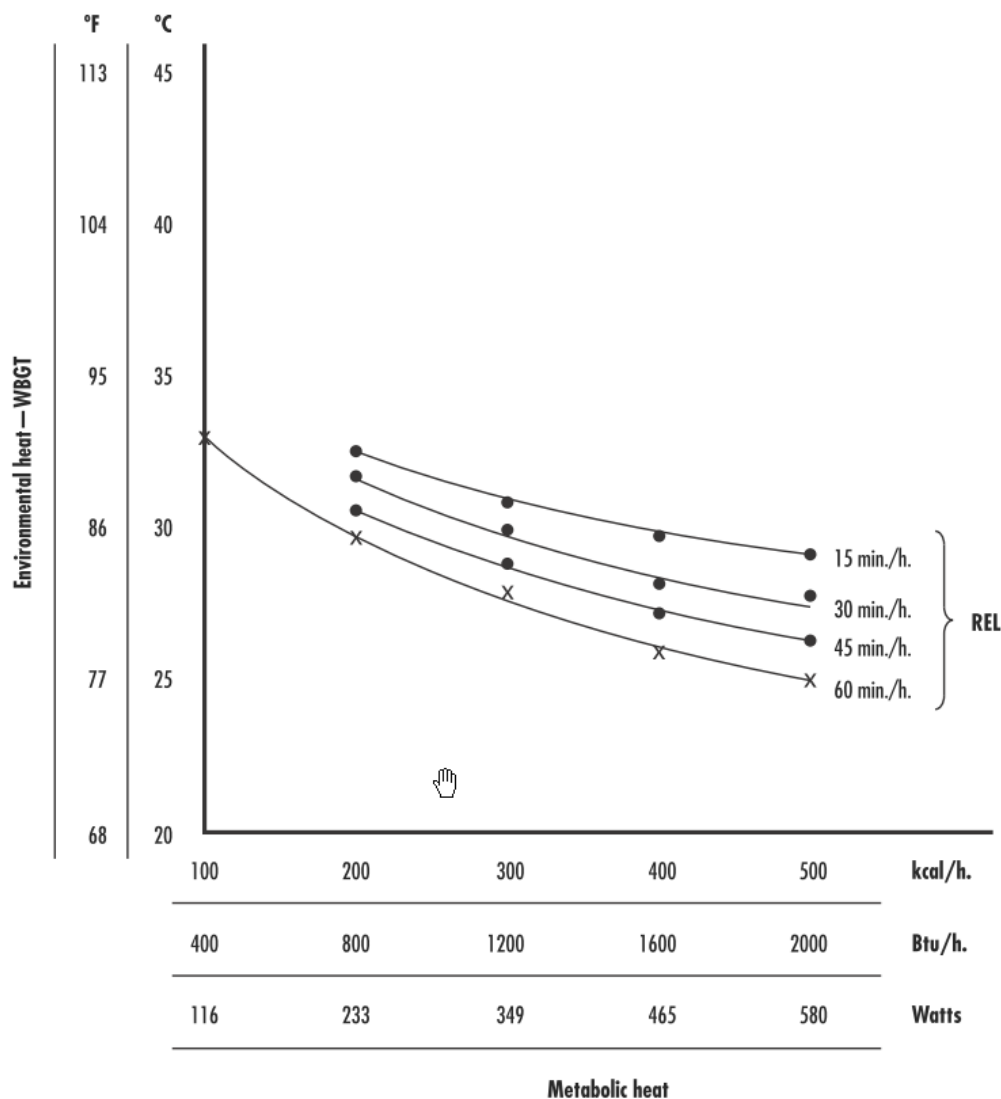
Figure 5. NIOSH recommended heat stress alert limits (RALs) for unacclimatized workers*.¹⁰²



* Values shown are for a “standard man” of 70 kg (154 lb) body weight and 1.8 m² (19.4 ft²) body surface. The “standard man” is used to normalize the data from the variability found in human beings. Both men and women adapt well to heat exposure, and given the similar physiological ability to tolerate heat, there are no significant differences between the sexes.

¹⁰² NIOSH 2016 Criteria Recommendations. p. 94.

Figure 6. NIOSH recommended heat stress exposure limits (RELs) for acclimatized workers*.¹⁰³



* Values shown are for a “standard man” of 70 kg (154 lb) body weight and 1.8 m² (19.4 ft²) body surface. The “standard man” is used to normalize the data from the variability found in human beings. Both men and women adapt well to heat exposure, and given the similar physiological ability to tolerate heat, there are no significant differences between the sexes.

Calculating the total heat load (environmental + metabolic) is relatively straightforward, even for small employers. In most situations, environmental heat loads are obtained most accurately by directly measuring, using a WBGT meter, or by indirectly calculating the WBGT,¹⁰⁴ and should be measured hourly.¹⁰⁵ Metabolic heat loads can be approximated roughly according to the

¹⁰³ NIOSH 2016 Criteria Recommendations. p. 95.

¹⁰⁴ Occupational Safety and Health Administration. OSHA Technical Manual. Section III: Chapter 4 (Heat Stress). Updated September 15, 2017. https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html. Accessed July 12, 2018.

¹⁰⁵ NIOSH 2016 Criteria Recommendations. p. 3.

ACGIH metabolic-work-rate guide, presented in Table 8, and recommended by the OSHA Technical Manual on heat stress.¹⁰⁶

Table 8. Metabolic work rates

Work Category	Metabolic Rate (Watts)	Examples
Rest	115	Sitting
Light	180	Sitting, standing, light arm/hand work and occasional walking
Moderate	300	Normal walking, moderate lifting
Heavy	415	Heavy material handling, walking at a fast pace
Very Heavy	520	Pick and shovel work

Adapted from: ACGIH “2017 TLVs and BEIs” Table 3 and presented here as shown by OSHA’s Technical Manual for heat stress (OSHA Technical Manual: Heat Stress. Section III: Chapter 4.

https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html#metabolic. Accessed March 17, 2018.)

Mandatory rest breaks

If the RAL/REL is reached during the work day, employers should initiate various protective measures, including, if necessary, a rest break, which should range in length from 15 to 45 minutes per hour depending on the total heat load (environmental + metabolic).¹⁰⁷ These rest breaks should be taken away from the hot environment and, for outdoor environments, in the shade.¹⁰⁸

Many outdoor workers typically perform at least “moderate” work, the equivalent of normal walking and moderate lifting (Table 8) throughout the day on most days. Using NIOSH’s RAL chart (Figure 5), such unacclimatized workers therefore require 15-minute rest breaks every hour once the WBGT reaches approximately 81°F and require progressively longer breaks at higher temperatures, to the point at which they can safely work just 15 minutes per hour at WBGT temperatures of approximately 86°F (according to NIOSH’s REL chart, temperature thresholds for acclimatized workers are a few degrees higher).

It is likely that most farmworkers perform “heavy” (heavy material handling, walking at a fast pace; 415 Watts per hour) to “very heavy” (pick and shovel work; 520 Watts per hour) work throughout most days. Therefore, per Figure 5, a typical unacclimatized farmworker requires 15-minute rest breaks every hour once the WBGT reaches approximately 75°F and requires progressively longer breaks at higher temperatures, to the point that they can safely work just 15 minutes per hour at WBGT temperatures of approximately 82°F (with temperature thresholds a few degrees higher for acclimatized workers).

¹⁰⁶ Occupational Safety and Health Administration. OSHA Technical Manual: Heat Stress. Section III: Chapter 4. https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html#metabolic. Accessed July 12, 2018.

¹⁰⁷ NIOSH 2016 Criteria Recommendations. p. 94–95. Note that the minutes per hour represent the amount of allowed work per hour, gradually decreasing as the WBGT (Y-axis) increases, keeping metabolic load constant.

¹⁰⁸ *Ibid.* p. viii.

Cool area for rest breaks

Workers should be given access to a cool area (e.g., air-conditioned or shaded) during rest breaks.¹⁰⁹

Hydration

Employers should provide “adequate amounts of cool (i.e., less than 15°C [59°F]), potable water near the work area” and “encourage all workers that have been in the heat for up to 2 hours and involved in moderate work activities to drink a cup of water (about 8 oz.) every 15 to 20 minutes.”¹¹⁰ To prevent the spread of potential infections, workers should be provided this water in individual, not communal, cups. Workers who have been in the heat for more than 2 hours and therefore have been sweating for a long time should be provided adequate amounts of both water and electrolytes, such as sports drinks. The concentration of electrolytes and carbohydrates (e.g., added sugars) should not exceed 8 percent by volume.

Personal protective equipment

Various types of PPE, such as water-cooled garments, air-cooled garments, and cooling vests, can prevent a worker from experiencing heat stress and more rapidly decrease core body temperature for workers suffering from heat strain.¹¹¹ NIOSH recommends that such PPE be provided to workers when total heat stress load reaches the RAL/REL.¹¹²

B. Heat acclimatization plan

Employers should have a heat acclimatization plan.¹¹³ For new workers, this involves a gradual phase-in to the workload, with 20 percent of the usual duration of work in the hot environment on the first day, and a maximum of an additional 20 percent on each subsequent day.¹¹⁴ For workers with previous experience in the job, the corresponding maximum durations of work are 50 percent on day one, 60 percent on day two, 80 percent on day three, and 100 percent of the usual duration of work on day four. The process must be repeated if the worker is absent from the job for a week or longer¹¹⁵ or if there is a sudden, significant increase in the environmental or metabolic heat loads.¹¹⁶ Throughout the acclimatization process, workers must be given adequate rest in cool, air-conditioned surroundings and be sufficiently hydrated, due to increased sweating brought on by the acclimatization process.¹¹⁷

¹⁰⁹ *Ibid.*

¹¹⁰ *Ibid.* p. 9–10.

¹¹¹ *Ibid.* p. 83–84.

¹¹² *Ibid.* p. 7.

¹¹³ *Ibid.* p. viii, 33, 34.78

¹¹⁴ *Ibid.* p. 34.

¹¹⁵ *Ibid.* p. 34.

¹¹⁶ *Ibid.* p. 33. Note that NIOSH refers only to environmental heat load here, but metabolic heat changes (with increasing workload) would also, per NIOSH’s logic employed in its REL/RAL calculations, require re-acclimatization.

¹¹⁷ *Ibid.* p. 32.

The vital importance of proper acclimatization was demonstrated in a 2016 OSHA study that analyzed all of the agency's GDC citations for heat stress violations that were issued in 2012 and 2013.¹¹⁸ In 2012 and 2013, OSHA issued citations in 84 cases, 37 of which concerned outdoor workplaces and 47 of which were for indoor workplaces.¹¹⁹ Twenty-three of the cases involved worker deaths,¹²⁰ with 17 of the 23 (74 percent) occurring within the worker's first three days on the job and eight (35 percent) on the very first day of work.¹²¹ This was not surprising given that, with one exception, none of the employers had established heat acclimatization plans.¹²²

C. Exposure monitoring

Employers should monitor the environmental heat load "at least hourly, during the hottest portion of each work shift, during the hottest months of the year, and when a heat wave occurs or is predicted."¹²³ If two sequential measurements show that the ambient conditions exceed the RAL/REL, then the employer should institute a variety of engineering and work practice controls until two sequential measurements again fall below the RAL/REL.¹²⁴ Employers also should develop estimates of the metabolic heat load for each worker who is performing light, moderate, or heavy work.¹²⁵

D. Medical monitoring

Employers should be required to institute a medical monitoring program for all workers who are or may be exposed to heat stress at or above the RAL/REL. Comprehensive medical evaluations, which are designed to assess a worker's risk for heat stress injury, should be given to all workers at the time of hiring and at least annually thereafter. All relevant medical and risk information should be made available to the responsible health care provider at the jobsite, and the provider should then be required to provide to the employer a written report of his or her findings and recommendations regarding the worker's risk of heat stress injury. Emergency medical care should be given to all workers who develop signs or symptoms of heat exhaustion or heat stroke.¹²⁶

OSHA should specify that no employee may be required to perform tasks requiring exposure to heat stress at levels that, based on their most recent medical examination, the examining physician determines would impair the safety or health of the employee or other employees. The employer may take extra precautions (e.g., more frequent rest breaks) to reduce heat stress to safe levels for that employee, or the employee may be assigned to another job or given the opportunity to transfer to a different position, the duties of which they can perform. If such a transfer position is available, the position must be with the same employer, in the same

¹¹⁸ Arbury S, Lindsley M, Hodgson M. A critical review of OSHA heat enforcement cases: Lessons learned. *J Occup Environ Med.* 2016;58(4):359-363.

¹¹⁹ *Ibid.*

¹²⁰ *Ibid.*

¹²¹ *Ibid.*

¹²² *Ibid.*

¹²³ NIOSH 2016 Criteria Recommendations. p. 3.

¹²⁴ *Ibid.*

¹²⁵ *Ibid.*

¹²⁶ *Ibid.* p. 4-6.

geographical area, and with the same seniority, status, and rate of pay the employee had just prior to such transfer.

E. Emergency medical procedures

Employers must establish emergency medical procedures in the event that a worker develops signs or symptoms of heat illness.¹²⁷ First, employers must ensure that effective communication is maintained at all times by voice, observation, or electronic means, so that employees can contact a supervisor or emergency medical services when necessary.¹²⁸ Second, employers must establish procedures to ensure that supervisors respond immediately to signs or symptoms of heat illness in a manner commensurate with the severity of illness, including steps such as calling 911 for emergency medical care; moving the worker to a cool area (shaded or air-conditioned) and removing unnecessary clothing; cooling the worker quickly with cold water, ice bath, or wet cloths on skin; circulating air around the worker; and encouraging frequent sips of cool water.¹²⁹

F. Hazard notification

Employers should provide visible warning signs, in all languages their workers understand and in nonverbal language (e.g., using cartoon characters), in all work areas in which there is a “reasonable likelihood” of the total heat load exceeding the RAL/REL.¹³⁰ The signs should contain information on the risk of heat stress and ways to mitigate the risk, including emergency and first aid instructions.

G. Heat Alert Program

Employers should develop a written Heat Alert Program to be implemented whenever the National Weather Service or other authoritative weather service forecasts a heat wave in the coming day or days.¹³¹ A heat wave is defined as a daily maximum temperature exceeding 95°F (35°C) or exceeding 90°F (32°C) and rising 9°F (5°C) or more above the maximum reached on the preceding days.¹³² Such a program should involve a committee, of which workers comprise at least half of the membership, tasked with planning all necessary procedures to be taken in the event of a heat wave, including postponing non-urgent work, increasing the number of workers on each shift, increasing rest breaks, and heightened medical surveillance of workers.¹³³

H. Worker information and training

All new and current workers who may be put at risk of heat injury or illness should be informed, through continuing education programs, of heat stress hazards, preventive measures, signs and symptoms of heat-related illness, first aid procedures, and other key information related to heat stress risk and mitigation. A written training program containing all of this information should be

¹²⁷ NIOSH 2016 Criteria Recommendations. pp. 5, 48–51 (Table 4-3).

¹²⁸ See, e.g., California Code of Regulations. Title 8, section 3395(f)(1), <http://www.dir.ca.gov/title8/3395.html>. Accessed July 12, 2018.

¹²⁹ NIOSH 2016 Criteria Recommendations. pp. 48–51 (Table 4-3).

¹³⁰ *Ibid.* p. 6–7.

¹³¹ *Ibid.* p. 10.

¹³² *Ibid.*

¹³³ *Ibid.* p. 80–81.

developed. In addition, a heat stress safety data sheet should be posted in all at-risk work areas. Trainers should be conducted by instructors qualified by training or experience in occupational safety and health.¹³⁴

I. Heat-related surveillance and recordkeeping

Employers should proactively obtain and analyze data on susceptible workers, workplace modifications to mitigate the risk of heat stress, all heat-related injuries and deaths, and all environmental and physiological measurements related to heat.¹³⁵ Whistleblower protections

VI. OSHA should require each employer to institute a whistleblower protection program for workers and supervisors to report violations of the heat stress standard.

The agency should adopt specific criteria for employer whistleblower protection policies, provide model language, or both, as well as refer employers to the agency's guidance on anti-retaliation programs.¹³⁶

Key criteria for a credible whistleblower protection policy include:

- scope of coverage that includes any employee who disclosed what he or she reasonably believes to be a violation of the heat stress standard;
- a “clear and convincing evidence” standard for employers to prove claims of non-retaliation;
- an option for employees to choose consensus-selection, shared-cost, independent binding arbitration;
- appropriate relief, including reinstatement with back pay; and
- a provision that rights and remedies under the whistleblower protection policy cannot be waived.

Model language for the agency's rule is as follows:

No employer shall terminate or in any other way discriminate against any person because the person assists in, discloses, or is about to disclose information that the person reasonably believes to be evidence of a violation of this standard; assists in any other action to carry out the purposes of this standard; or objects to or refuses to obey an order that the person reasonably believes would cause violation of this standard or the law.

Each employer shall designate an official to establish and implement the employer's whistleblower protection policy. The designated official should be

¹³⁴ *Ibid.* p. 7–8.

¹³⁵ *Ibid.* p. 6.

¹³⁶ An example of current guidance is the following: OSHA. Recommended practices for anti-retaliation programs. <https://www.osha.gov/Publications/OSHA3905.pdf>. July 12, 2018.

free of any real or apparent conflicts of interest in any particular case and shall be free of pressure from, or the influence of, the employer regarding particular cases or in the official's general course of administering the whistleblower protection policy and deciding cases.

An employee who believes that he or she has been terminated or otherwise discriminated against in violation of this standard may file a complaint with the designated official by the employer.

The designated official shall conduct a timely, thorough, objective, and competent investigation of the complaint, examining all relevant evidence. The employer shall cooperate fully with the investigation, including but not limited to securing and making available evidence. The confidentiality of all participants in the investigation shall be maintained to the maximum extent possible.

The designated official shall make a final decision whether retaliation occurred. The official shall determine that a violation has occurred if the complainant has demonstrated, by a preponderance of evidence, that any behavior protected by this section was a contributing factor in the discrimination alleged in the complaint. Relief may not be ordered if the employer demonstrates by clear and convincing evidence that it would have taken the same unfavorable personnel action for independent, lawful reasons in the absence of such behavior.

In response to a complaint, if the designated official finds that an employer was in violation of this standard, the designated official shall determine what remedies are appropriate, including affirmative action to abate the violation; reinstatement of the complainant to the former position with the same pay and terms and privileges of employment; payment of compensatory damages, including back-pay with interest and compensation for any special damages sustained as a result of the retaliation; public or private statements or announcements to restore the whistleblower's position or reputation; and any other relief necessary to make the employee whole. The designated official also may impose further protections, such as monitoring or disciplinary action for the retaliator.

If the complainant is not satisfied with the result, the employer designated must offer the complainant the opportunity to submit the dispute to consensus-selection, independent, binding arbitration. The arbitration shall be conducted by an arbitrator who is agreed upon by both the complainant and the employer, who has no real or apparent conflicts of interest, and who has no personal or professional relationship with the employer, the whistleblower, the alleged retaliator, or any person who is a subject of the investigation. The employer and the whistleblower shall share the costs of the arbitration, but the arbitration agreement shall specify that the arbitrator shall require the employer to compensate the whistleblower for all of his or her arbitration costs, including attorney fees, if the arbitrator finds in favor of the whistleblower.

The rights and remedies provided for in this section may not be waived by any agreement, policy form, or condition of employment, including by a predispute arbitration agreement. Nothing in this section preempts or in any other way diminishes any employee rights or any other safeguards against discrimination, demotion, discharge, suspension, threats, harassment, reprimand, or any other manner of retaliation provided by federal or state law.

This model language generally reflects best-practice provisions included in OSHA-administered whistleblower statutes enacted since 2000, including the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century, the Moving Ahead for Progress in the 21st Century Act, the Pipeline Safety Improvement Act, the Sarbanes-Oxley Act, Energy Reorganization Act, the Surface Transportation Assistance Act, the Federal Railroad Safety Act, the National Transit Systems Security Act, the Consumer Product Safety Improvement Act, the Seaman's Protection Act, and the FDA Food Safety Modernization Act.

VII. Petition requests

Given the clear evidence on the risks of heat stress for both outdoor and indoor workers and the demonstrated feasibility of a regulation protecting workers from these dangers, citing evidence from a state such as California and the military, there is no valid, evidence-based reason for OSHA not to immediately initiate the rulemaking process for a federal heat stress standard. We request that such a standard include all of the measures recommended in detail by NIOSH in its 2016 Criteria for a Recommended Standard for heat stress, in addition to a robust whistleblower protection provision to help ensure that the standard's provisions are complied with. These requested provisions are as follows (see Section V. NIOSH Criteria for a Recommended Standard section of the petition for details of each provision):

- **Heat stress thresholds**: At NIOSH's RAL/REL, employers would be required to initiate robust protective measures. These include the following:
 - **Mandatory rest breaks**: These should range in duration from 15 to 45 minutes per hour, away from the hot environment. At certain WBGT heat levels, work must be stopped entirely.
 - **Shade**: In outdoor environments, employers must provide access to sufficient areas of shade. In addition, we request that shaded areas be provided to all workers upon request.
 - **PPE**: Employers must provide PPE (e.g., water-cooled garments, air-cooled garments, or cooling vests), light-colored, breathable fabric garments where workplace conditions permit, to protect workers from heat-related illness, at all times when total heat stress load reaches the RAL/REL, especially during mandatory rest breaks.
- **Hydration**: Workers must be given access — at no cost to themselves — to recommended quantities of water and electrolytes sufficient to maintain adequate levels of hydration at varying levels of heat.

- **Heat acclimatization plan:** All workers beginning work in high-heat environments, or who will be working in hotter conditions than usual (e.g., during a heat wave), must be gradually acclimatized to the work over a period of at least 7 to 14 days.
- **Exposure monitoring:** Employers must monitor both environmental heat exposure and employee workloads to ensure that no worker is exposed to heat stress at or above the RAL/REL.
- **Medical monitoring:** Employers must institute a medical monitoring program for all workers who are or may be exposed to heat stress at or above the RAL/REL.
- **Hazard notification:** Employers must post prominent signs, in all relevant languages their workers understand, in high-heat areas warning of the dangers of heat stress.
- **Heat Alert Program:** Employers must develop a written Heat Alert Program to be implemented whenever the National Weather Service or other authoritative weather service forecasts a heat wave in the coming day or days.
- **Instructor-led worker information and training:** All workers and supervisors who work in areas where there is a reasonable likelihood of heat injury must be trained by qualified instructors on measures to prevent and mitigate the risk. A written training program must be developed to serve as the basis for this training.
- **Heat-related surveillance and recordkeeping:** Employers should obtain and analyze data on all heat-related injuries and deaths, environmental and physiological measurements related to heat, and other heat-related information. This information, in addition to medical monitoring data, acclimatization plans, and other key information related to the recommended heat stress standard should be recorded, reported electronically to OSHA, and made available to workers and their representatives.
- **Whistleblower protections:** Each employer must institute an independent whistleblower protection program for employees and supervisors to report violations of the heat stress standard. OSHA should provide criteria or model language to serve as the basis for the whistleblower protection programs.

VIII. Environmental impact statement

Nothing requested in this petition will have an impact on the environment.

IX. Certification

We certify that, to the best of our knowledge and belief, this petition includes all information and views on which this petition relies, and that it includes representative data and information known to the petitioners which are unfavorable to the petition.

Sincerely,



Sidney Wolfe, M.D.
Founder and Senior Adviser
Public Citizen's Health Research Group



David J. Arkush
Managing Director
Public Citizen's Climate Program

Farmworker Justice

United Farm Workers



Sammy Almashat, M.D., M.P.H.



Dr. Eula Bingham
Professor Emerita, Environmental Health
College of Medicine
University of Cincinnati
Former Assistant Secretary of Labor for OSHA (1977-1981)



David Michaels, Ph.D., M.P.H.
Professor, Department of Environmental and Occupational Health
Milken Institute School of Public Health
The George Washington University
Former Assistant Secretary of Labor for OSHA (2009-2017)



Ellen Wildess
Former Chief of Cal/OSHA and Board Member of Farmworker Justice



Marc Schenker, M.D., M.P.H.
Distinguished Professor Emeritus
University of California at Davis

Additional Organizational Co-Petitioners

350 Spokane
350.org
Academic Health Resources
Alliance of Nurses for Healthy Environments
American Federation of State
County and Municipal Employees - AFL-CIO
American Federation of Teachers
Association of Farmworker Opportunity Programs
Association of Western Pulp and Paper Workers
Boston University School of Public Health
California Rural Legal Assistance Foundation
California State University East Bay
CATA – The Farmworkers Support Committee
Catskill Mountainkeeper
Center for Biological Diversity
Center for Progressive Reform
Change to Win
Child Labor Coalition
Cincinnati Interfaith Workers Center
Citizens' Environmental Coalition
Climate Law & Policy Project
Colorado School of Public Health

Columbia Legal Services
Communication Workers of America
Cook County Department of Public Health
CR Research/Consulting
DC 37
Del Cerro Nuevos Horizontes
Earth Action, Inc.
Earthjustice
Earthkeeping
Earthworks
ECPAT USA
El Paso Social Justice Education Project
Elders Climate Action
Emory University Nell Hodgson Woodruff School of Nursing
Empire State Consumer Project, Inc.
Environmental and Energy Study Institute
Evergreen State College
Fair Farms
Farmworker and Landscaper Advocacy Project
Farmworker Association of Florida
Fe y Justicia Worker Center
Four Twenty Seven
Friends of the Earth
Government Accountability Project
Greenpeace
Health Professionals and Allied Employees AFT - AFL-CIO
Hesperian Health Guides
Hip Hop Caucus
Interfaith Power & Light
Interfaith Worker Justice
International Brotherhood of Teamsters
International Chemical Workers Union Council
International Labor Rights Forum
United Automobile Workers
JAPRI.ORG
Johns Hopkins University
Justice at Work (formerly Friends of Farmworkers)
Justice in Motion
Laborers' Health and Safety Fund of North America
League of Conservation Voters
Legal Aid Justice Center
Made Safe
Maine Labor Group on Health
MassCOSH
Media Voices for Children
Migrant Clinician Network

Mississippi Worker's Center for Human Rights
National Association of Nurse Practitioners in Women's Health
National Child Labor Committee
National Consumers League
National Council for Occupational Safety and Health
National Employment Law Project
National Farm Worker Ministry
National Nurse Alliance of SEIU Healthcare
Natural Resources Defense Council
NC Justice Center, New Mexico State University
North Carolina Council of Churches
Northeast NY Coalition for Occupational Safety & Health
Northwest Workers' Justice Project
OneAmerica
Orange County Chapter of the National Association of Hispanic Nurses
Oregon Environmental Council
Oxfam
Physicians for Social Responsibility
Physicians for Social Responsibility - Arizona Chapter
Physicians for Social Responsibility - Florida Chapter
Physicians for Social Responsibility - Maine Chapter
Physicians for Social Responsibility - Oregon Chapter
Physicians for Social Responsibility - Pennsylvania Chapter
Physicians for Social Responsibility - Philadelphia Chapter
Physicians for Social Responsibility - San Francisco Bay Area Chapter
Physicians for Social Responsibility - Texas Chapter
Planning Alternatives for Change
Progressive Democrats of America
Progressive Democrats of America – Tucson, AZ Chapter
Projects for Environmental Health Knowledge & Action, Inc.
Public Justice Center
Puerto Rico Legal Service - Farm Workers Project
PV Health Solutions
Responsible Sourcing Network
Retail, Wholesale and Department Store Union/United Food and Commercial Workers
Rhode Island Committee on Occupational Safety and Health
SafeWork Washington
Service Employees International Union
Service Employees International Union - Local 49
Sierra Club
South Florida Interfaith Worker Justice
Southern Poverty Law Center
Student Action with Farmworkers
The Labor Institute
Union of Concerned Scientists
UNITE HERE

United Food and Commercial Workers Union
United Steelworkers
University of Arizona
University of California San Diego
University of Massachusetts Lowell - College of Health Sciences
University of Michigan
University of New Mexico
University of Wisconsin School for Workers
University Texas El Paso
Vermont Climate and Health Alliance
Vermont Public Health Association
Virginia Clinicians for Climate Action
Virginia Justice Project for Farm and Immigrant Workers - project of Legal Aid Justice Center
Worker Justice Center of New York, Inc.
Workers Defense Project
Worksafe
Yale School of Public Health

Additional Individual Co-Signatories

Alexandria Jones
Amber Mitchell
Anna Aragon
Barbara Polivka
Beatriz Vera
Beth Rosenberg
Bill Hoerger
Carla Campbell
Carmen Y Mendoza
Celeste Monforton, DrPH, MPH, Lecturer, Dept of Health & Human Performance, Texas State University
Cesar Mario Fuentes
Charles Levenstein
Christina Convertino
Colleen Reid
David H. Wegman, Professor Emeritus, University of Massachusetts Lowell
David Wegman
Derek Shendell
Diane Rohlman
Donna Maldonado
Donna Zankowski, MPH, RN
Dr. Mark Lusk, Professor, University of Texas at El Paso
Dr. Rita Million, Nurse educator
Dr. Stephanie Chalupka, Professor, Worcester State University
Dr. Lia van Rijswijk, RN
Eldonna Chesnut, Division Director
Elgin Avila, MPH, University of Arizona

Elizabeth Montes
Emily Prechtl
Emily Wilson
Eric Jones
Eva M. Moya
Guillermina Solis
Howard B Campbell
J Tsai
Jacob Bueno de Mesquita
Jagjiwan Dhatt
James Leon Scalise II, Communication Workers of America
James M Deshotels, SJ, MSN, MPH
James Martus
Jason Kordosky
Jenise Porter
Jennifer Banes
John Convertino
Josiah Heyman
Judith Wold
Karen B. Mulloy, DO, MSCH
Kyle P. Sullivan
Laura Allen, Program Manager, University of Maryland School of Nursing
Leslie Vallarta
Lilian Saldaña
Lisa Campbell, RN
Liz Borkowski, MPH
Maddie Adkins
Margaret Kitchell, MD, Washington Physicians for Social Responsibility
Maria Tabuenca
Marian Morris, PhD, MPH, RN
Marilyn Arevalo
Mario Terminel
Mary E Miller
Mayra Ruiz
Meg Buckwalter
Michelle Del Rio
Nancy Krieger
Nathaniel Matthews-Trigg
Ophra Leyser-Whalen
Pam Aaltonen
Pamela Gehrke
Patricia LeDoux
Patricia M. Juarez-Carrillo, University of Texas at El Paso-Center for Inter- American and Border Studies
Paul Landsbergis, Associate Professor, SUNY Downstate School of Public Health
Rachel Behrend

Randee Greenwald

Raquel Garzon

Richard Rabin, Trainer and Technical Consultant, MassCOSH

Rosemary Sokas, MD, Professor, Human Science, Georgetown University

Roxana Chicas, BSN, RN

Sally Moyce

Samuel Diaz

Sarah Cornett

Sarah LeRoy, Assistant Staff Scientist, University of Arizona

Sonda Oppewal, Clinical Associate Professor, UNC School of Nursing at Chapel Hill

Stephanie Chalupka

Stephanie Thomas

Stephanie Williams

Taylor Arnold, Project Manager

TsiTsi McLure, Infection Preventionist, MedStar NRH

Yannic Gagnon

Yolanda Whyte, MD

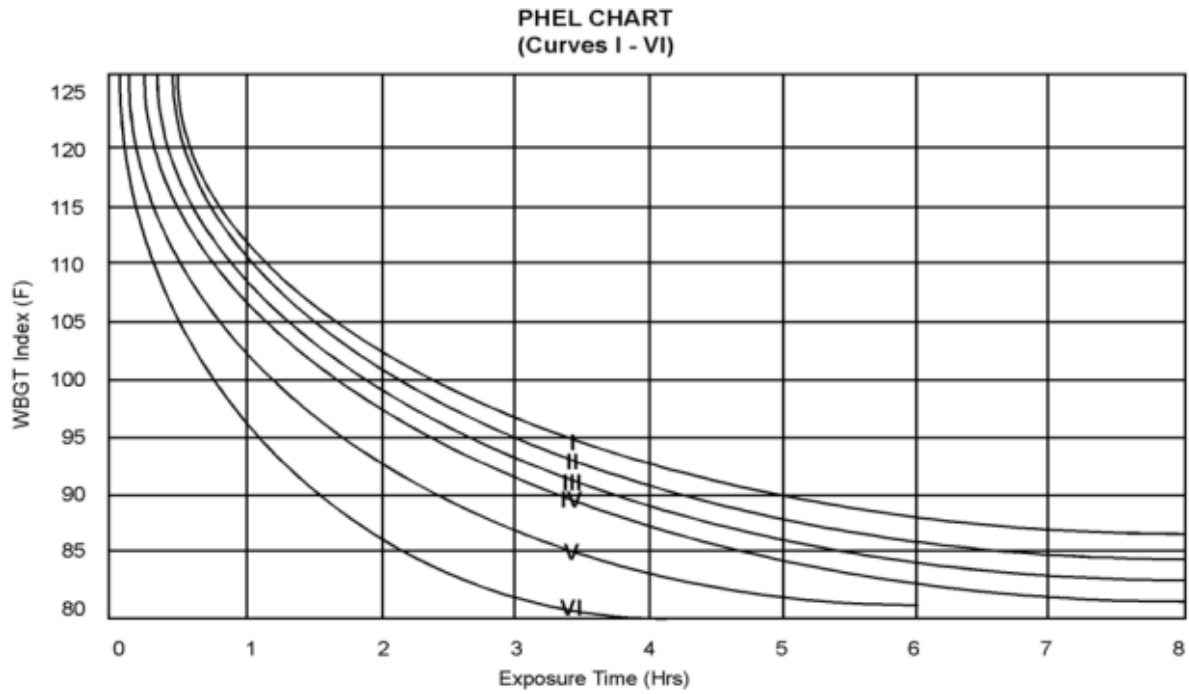
Appendix

Table 9. Heat stress standards of Canadian provinces

Province/territory	Legislation	Environment	Required controls
British Columbia	Part 7(28) of B.C. Occupational Health and Safety Regulation, 2004. Required to adhere to 2003 ACGIH standard (TLVs)	All working environments except firefighting	Administrative and engineering controls must be implemented to reduce exposure of workers to levels below ACGIH criteria.
Alberta	No legal requirements. Recommended to use 2002 ACGIH standard (TLVs) or Humidex	All workplaces	None required
Saskatchewan	Section 70 of Saskatchewan Occupational Health and Safety Regulations 1996, requires employers to maintain reasonable thermal conditions for work performed using ACGIH standard (TLVs)	Indoor working environments	"Must use effective measures to protect workers from heat stress disorders" including administrative and engineering controls.
Manitoba	Part 4.12 of Manitoba General Workplace Requirements Regulation 217/2006. Required to adhere to 2006 ACGIH standard (TLVs)	All workplaces	"Must provide worker with information, instruction and training in heat stress symptoms and precautions to be taken".
Ontario	Legally required under section 25(2) h of Ontario Occupational Health and Safety Act to protect workers from heat stress. Recommends adhering to latest "unacclimatized" ACGIH standard (TLVs)	Workers in hot environments due to "hot processes" or hot weather	"Must take every precaution reasonable in circumstances to protect worker . . . including hot environment policies and procedures." Suggests administrative and engineering controls, and protective clothing.
Quebec	Section 2.1, regulation 15 of Quebec Règlement sur la qualité du milieu de travail, requires hot environments to be monitored using WBGT index and adhere to TLVs similar to ACGIH standard	All workplaces	Translated in English: "When individuals are to be exposed to temperatures above those indicated; the following conditions apply: The worker must be submitted to medical surveillance and it must be established that his heat tolerance is better than the average individual".
New Brunswick	Section 22 to 23 of New Brunswick Occupational Health and Safety Act (O.C.91-1035) "employer shall ensure 1997 ACGIH standard (TLVs) is followed"	All workplaces	"Ensure a competent person instructs employee in significance of heat stress symptoms and in precautions to be taken to avoid injury".
Prince Edward Island	Prince Edward Island Occupational Health and Safety Regulation 42.1 legislatively requires that 2006 ACGIH standard (TLVs) is followed	All workplaces	Where there is a risk of injury or illness from heat, employer is required to take "every reasonable precaution to ensure worker safety" including management plan to minimize health risk, writing procedures, and provide equipment and training workers in preventative measures.
Nova Scotia	Nova Scotia Occupational Health Regulations for Construction states occupational exposure limits in the heat must adhere to values similar to ACGIH standard (TLVs)	Construction	Suggests administrative and engineering controls.
Newfoundland and Labrador	Section 10 of the Occupational Health and Safety Act of the Consolidated Newfoundland Regulation (1165/96) requires workplace conditions of a thermal environment which are reasonable and consistent with degree of work as established by latest ACGIH standard (TLVs)	All workplaces	"Shall make further provisions for health and safety and reasonable thermal comfort of workers." Suggests administrative and engineering controls and protective clothing.
Yukon Territory	Section 9 of the Yukon Occupational Health Regulations 2005, requires thermal conditions to be reasonable and appropriate to the nature of work. Suggests monitoring conditions but does not recommend specific method	Indoor workplaces	"Provide effective protection for the health and safety and reasonable thermal comfort of workers." Suggests administrative and engineering controls, acclimatization, and protective clothing.
Northwest Territories	Section 9.60 of Revised Regulations of the Northwest Territories 1990, requires hot environments be monitored. Requires adherence to 1994–1995 ACGIH standard (TLVs)	Underground mines	"Manager shall institute a program" including informing and training employees for recognizing symptoms. Protective measures are also required to "adequately protect employees".
Nunavut	Section 9.60 of Nunavut Mine Health and Safety Act, Mine Health and Safety Regulations 2003, requires hot environments be monitored. Requires adherence to 1994–1995 ACGIH standard (TLVs)	Underground mines	"Manager shall institute a program" including informing and training employees for recognizing symptoms. Protective measures are also required to "adequately protect employees".

Source: Jay O, Kenny GP. Heat exposure in the Canadian workplace. *Am J Indus Med.* 2010;53:842–53. p. 847, Table III.

Figure 7. U.S. Navy PHEL curves



Source: Manual of Naval Preventive Medicine. Department of the Navy. NAVMED P-5010-3 (Rev. 2-2009). p. 3-17, Figure 3-5.

Table 10. U.S. Navy PHEL time limits for PHEL curves I-VI without the presence of fuel combustion gases/fuel vapors

WBGT Index (F)	Total Exposure Time in Hours:Minutes					
	I	II	III	IV	V	VI
80.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
81.0	>8:00	>8:00	>8:00	7:45	6:00	4:05
82.0	>8:00	>8:00	8:00	7:05	5:25	3:40
83.0	>8:00	8:00	7:45	6:25	4:55	3:20
84.0	>8:00	8:00	7:05	5:55	4:30	3:05
85.0	8:00	7:45	6:30	5:20	4:05	2:50
86.0	8:00	7:05	5:55	4:55	3:45	2:35
87.0	7:25	6:30	5:25	4:30	3:25	2:20
88.0	6:45	5:55	4:55	4:05	3:10	2:10
89.0	6:10	5:25	4:30	3:45	2:50	2:00
90.0	5:40	5:00	4:10	3:25	2:40	1:50
91.0	5:15	4:35	3:50	3:10	2:25	1:40
92.0	4:50	4:10	3:30	2:55	2:15	1:30
93.0	4:25	3:50	3:15	2:40	2:00	1:25
94.0	4:05	3:35	3:00	2:25	1:50	1:15
95.0	3:45	3:15	2:45	2:15	1:45	1:10
96.0	3:25	3:00	2:30	2:05	1:35	1:05
97.0	3:10	2:45	2:20	1:55	1:25	1:00
98.0	2:55	2:35	2:10	1:45	1:20	0:55
99.0	2:40	2:20	2:00	1:40	1:15	0:50
100.0	2:30	2:10	1:50	1:30	1:10	0:45
101.0	2:20	2:00	1:40	1:25	1:05	0:45
102.0	2:10	1:50	1:35	1:15	1:00	0:40
103.0	2:00	1:45	1:25	1:10	0:55	0:35
104.0	1:50	1:35	1:20	1:05	0:50	0:35
105.0	1:40	1:30	1:15	1:00	0:45	0:30
106.0	1:35	1:25	1:10	0:55	0:45	0:30
107.0	1:30	1:15	1:05	0:50	0:40	0:25
108.0	1:20	1:10	1:00	0:50	0:35	0:25
109.0	1:15	1:05	0:55	0:45	0:35	0:25
110.0	1:10	1:00	0:50	0:40	0:30	0:20
111.0	1:05	1:00	0:50	0:40	0:30	0:20
112.0	1:00	0:55	0:45	0:35	0:25	0:20
113.0	0:55	0:50	0:40	0:35	0:25	0:15
114.0	0:55	0:45	0:40	0:30	0:25	0:15
115.0	0:50	0:45	0:35	0:30	0:20	0:15
116.0	0:45	0:40	0:35	0:25	0:20	0:15
117.0	0:45	0:40	0:30	0:25	0:20	0:10
118.0	0:40	0:35	0:30	0:25	0:15	0:10
119.0	0:35	0:35	0:25	0:20	0:15	0:10
120.0	0:35	0:30	0:25	0:20	0:15	0:10
121.0	0:35	0:30	0:25	0:20	0:15	0:10
122.0	0:30	0:25	0:20	0:15	0:15	0:10
123.0	0:30	0:25	0:20	0:15	0:10	0:10
124.0	0:25	0:25	0:20	0:15	0:10	0:05
125.0	0:25	0:20	0:20	0:15	0:10	0:05