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Section I. Introduction

The Occupational Safety and Health Administration (OSHA) may propose a new standard to protect outdoor and indoor workers from hazardous heat. OSHA promulgates and enforces occupational safety and health standards under authority granted by the Occupational Safety and Health (OSH) Act of 1970 (29 U.S.C. § 651 et seq.). OSHA must promulgate its standards by following specific procedures set forth in the OSH Act. See 29 U.S.C. § 655.

OSHA has developed and published guidance with recommendations for heat injury and illness prevention. However, in the absence of a federal standard, multiple states have issued regulations to address heat hazards in the workplace. Five states have enacted laws that aim to protect employees exposed to hazardous heat conditions: Minnesota (Minn. R. 5205.0110 (1997)); California (Cal. Code of Regs. tit. 8, § 3395 (2005)); Washington (Wash. Admin. Code § 296-62-095 through § 296-62-09560 (2008); § 296-307-097 through § 296-307-09760 (2009); § 296-62-09560 (2022)); Oregon (Or. Admin. R. 437-002-0156 (2022); Or. Admin. R. 437-004-1131 (2022)); and Colorado (7 Colo. Code Regs. § 1103-15 (2022)). While Minnesota was the first state to adopt an occupational safety and health standard covering employees exposed to indoor environmental heat conditions, California was the first state to adopt a standard covering employees exposed to outdoor environmental heat conditions. Washington, Oregon, and Colorado have since enacted similar regulations to California's, requiring employers to implement controls and monitor for signs and symptoms of heat-related injury or illness, among other

requirements. In addition, four states have proposed new standards to address heat hazards in the workplace or revisions to current standards: California (2023), Washington (2023), Maryland (2022), and Nevada (2022). In July 2023, Washington adopted the proposed updates to their existing standards (Wash. Admin. Code § 296-62-095 through 296-62-09560; § 296-307-097 through § 296-307-09760 (2023)). Though California's existing standard covers outdoor work environments, their proposed standard would cover indoor work environments and include other requirements that differ from the existing standard. Washington's updated standards uphold similar provisions to their emergency temporary standard (ETS) enacted in 2022, which broadens protection for outdoor workers and requires employers to comply with additional protective measures at lower temperature thresholds regardless of the time of year.

OSHA has received multiple petitions to promulgate a heat injury and illness prevention standard in recent years, including in 2018 from Public Citizen, on behalf of approximately 130 organizations. OSHA has also been urged by members of Congress to initiate rulemaking for a federal heat standard. Based on current academic literature, best practices from state standards and scientific organizations, and input from experts, stakeholders, and the public through various channels, OSHA has developed a regulatory framework for a potential heat standard. The regulatory framework accompanies this document.

Workers in both outdoor and indoor work settings without adequate climate controls are at risk of hazardous heat exposure. Heat is the leading cause of death among all weather-related phenomena in the United States (National Weather Service [NWS], 2022a; NWS, 2022b). Excessive heat exacerbates existing health conditions like asthma, kidney failure, and heart disease, and can cause heat stroke and even death if not treated properly and promptly. Certain heat-generating processes, machinery, and equipment (e.g., hot tar ovens, furnaces) can also cause hazardous heat when cooling measures are not in place. In an evaluation of 66 heat-related illness enforcement investigations from 2011–2016, 80% of heat-related fatalities occurred in outdoor work environments. However, 61% of non-fatal heat-related illness cases occurred during or after work in an indoor work environment (Tustin et al., 2018). Some groups may be more likely to experience adverse health effects from heat, such as pregnant workers (NIOSH, 2017), while others are disproportionately exposed to hazardous levels of heat, such as workers of color in essential jobs, who are more often employed in work settings with a high risk of hazardous heat exposure (Gubernot et al., 2015).

According to the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries, exposure to environmental heat has killed 999 U.S. workers from 1992–2021, with an average of 33 fatalities per year during that period (BLS, 2023a). In 2021 BLS reported 36 work-related deaths due to environmental heat exposure (BLS, 2023a). A recent analysis of BLS data by National Public Radio and Columbia Journalism Investigations found that the three-year average of heat-related fatalities among U.S. workers has doubled since the early 1990s (Shipley et al., 2021). The BLS Annual Survey of Occupational Injuries and Illnesses estimates 33,890 work-related heat injuries and illnesses involving days away from work from 2011–2020, which is an average of 3,389 injuries and illnesses occurring each year during this period (BLS, 2023b).

However, the estimates provided here on occupational heat-related illnesses, injuries, and fatalities are likely vast underestimates, as these events are underreported for several reasons. First, heat is not

always recognized as a contributing factor to an illness, injury, or fatality and the criteria for defining a case may vary by jurisdiction and among medical professionals (Gubernot et al., 2014). As the nature of heat-related symptoms (e.g., headache, fatigue) vary, some cases may be attributed to other illnesses rather than heat. Further, some cases may go unreported, as employers are only required to report incidents that meet OSHA's existing injury reporting requirements (see 29 CFR 1904.7(a)). There may also be situations where heat exposure at work contributes to illness, injury, or fatality, but is deemed unrelated to work (Gubernot et al., 2014; Shipley et al., 2021).

Second, hazardous heat can impair job tasks related to complex cognitive function (Ebi et al., 2021) and reduce decision-making abilities and productivity. This has been linked to an increase in occupational injuries that are not currently included in assessments of the health hazards resulting from occupational heat exposure (Park et al., 2021).

Third, self-reporting of health outcomes can result in bias which can lead to over- or under-estimates of health outcomes (Althubaiti, 2016). The BLS Survey of Occupational Injuries and Illnesses, which relies heavily on employer self-reporting of non-fatal injuries and illnesses, may underreport employer-reported injury and illness data (GAO, 2009). This underreporting of non-fatal illnesses and injuries may be particularly present in some industries, like agriculture, where some employers (e.g., employers with 10 or fewer employees) are excluded from reporting requirements (Leigh et al., 2014). Employers and employees may also be disincentivized from reporting injuries and illness, due to factors such as an increase in an employer's workers' compensation costs or impact on their reputation, or an employee's fear of retaliation or lack of awareness of their right to speak out about workplace conditions (BLS, 2020).

A standard specific to heat-related injury and illness prevention would more clearly set forth employer obligations and the measures necessary to more effectively protect employees from hazardous heat. The ultimate goal is to prevent and reduce the number of occupational injuries, illnesses, and fatalities caused by exposure to hazardous heat.

OSHA uses several terms related to excessive heat exposure throughout this document. Heat stress means the combined load of heat that a person experiences from sources of heat (i.e., metabolic heat and the environment) and heat retention (e.g., from clothing or personal protective equipment). Heat strain refers to the physiological responses to heat exposure (American Conference of Governmental Industrial Hygienists [ACGIH], 2023). Heat-related illness means adverse clinical health outcomes that occur due to exposure to hazardous heat. Heat-related injury means an injury linked to heat exposure that is not considered one of the typical symptoms of heat-related illness, such as a fall or cut. The document also uses the combined term "heat injury and illness" when both heat injury and illness should be considered.

This document provides an overview of several options that OSHA is considering for a standard to protect outdoor and indoor workers from hazardous heat. OSHA is interested in learning about the experience of employers who have implemented any of these options as well as the effectiveness of these options to protect workers from hazardous heat. OSHA is also interested in information on the

number, percent, or types of employers who are currently implementing these various options to protect workers from hazardous heat.

This document also provides estimates of the time and resources needed for each option. Depending on wages and prices, these will translate into varying dollar costs for different employers. Because the relevant wages, prices, and dollar costs vary for different employers, these wages, prices, and costs are not estimated in this document. OSHA is interested in additional information on the time, resources, costs, and feasibility or difficulties in implementing any of these options.

Events Leading to SBREFA

On October 27, 2021, OSHA published an Advance Notice of Proposed Rulemaking (ANPRM) for Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings (referred to as "the ANPRM" hereafter) in the Federal Register. The ANPRM outlined key issues and challenges in occupational heat-related injury and illness prevention and aimed to collect evidence, data, and information critical to informing how OSHA proceeds in the rulemaking process. The ANPRM included background information on injuries, illnesses, and fatalities due to heat, underreporting, scope, geographic region, and inequality in exposures and outcomes. The ANPRM also covered existing heat illness prevention efforts including OSHA's efforts, the National Institute for Occupational Safety and Health (NIOSH) criteria documents, state standards, and other standards. The initial public comment period was extended and closed on January 26, 2022. In response to the ANPRM, OSHA received 965 unique comments, including from small business representatives.

Following the publication of the ANPRM, OSHA presented ANPRM-related topics to several stakeholders including several trade associations, the Small Business Administration's Office of Advocacy (SBA's Office of Advocacy, or Advocacy) Labor Safety Roundtable (November 19, 2021), and NIOSH National Occupational Research Agenda (NORA) councils, including the Construction Sector Council (November 17, 2021), Landscaping Safety Workgroup (January 12, 2022), and Oil and Gas Extraction Sector (April 7, 2022).

On May 3, 2022, OSHA held a virtual public stakeholder meeting on the Agency's Initiatives to Protect Workers from Heat-Related Hazards. A total of over 1,300 people attended the virtual meeting, and the recorded video has been viewed over 3,300 times (see https://www.youtube.com/watch?v=Ud29WsnsOw8). The six-hour meeting provided stakeholders, including small business representatives, an opportunity to learn about and comment on efforts OSHA is taking to protect workers from heat-related hazards and ways the public can participate in the Agency's rulemaking process.

OSHA also established a Heat Injury and Illness Prevention Work Group of the National Advisory Committee on Occupational Safety and Health (NACOSH) to support the Agency's rulemaking and outreach efforts. The Work Group was tasked with reviewing and developing recommendations on OSHA's heat illness and prevention guidance materials, evaluating stakeholder input, and developing recommendations on potential elements of any proposed heat injury and illness prevention standard. On May 31, 2023, the Work Group presented its recommendations on potential elements of a proposed heat injury and illness prevention standard for consideration by the full NACOSH committee. After

deliberations, NACOSH amended the report to ask OSHA to include a model written plan and then submitted its recommendations to the Secretary of Labor. NACOSH meetings are open to the public and are announced in the Federal Register. These meetings routinely have over 100 participants from the public in attendance.

The SBAR Panel Process

As an initial rulemaking step, and prior to the publication of a proposed rule, OSHA is convening a Small Business Advocacy Review Panel (SBAR Panel) in accordance with the Regulatory Flexibility Act, or RFA (Sections 601 through 612 of Title 5 of the United States Code). This Panel consists of members from OSHA, the SBA's Office of Advocacy, and the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB). The SBAR Panel identifies individual representatives of affected small entities, termed Small Entity Representatives (SERs), which includes small businesses, small not-for-profit organizations, and small local government entities. This process enables OSHA, with the assistance of Advocacy and OIRA, to obtain advice and recommendations from SERs about the potential impacts of the regulatory options outlined in the regulatory framework and about additional options or alternatives to the regulatory framework that may alleviate those impacts while still meeting the objectives and requirements of the OSH Act.

The SBAR Panel has several purposes under the RFA, which establishes the requirements for a Panel. First, the Panel provides an opportunity early in the rulemaking process for affected SERs to provide comments. Second, after reviewing the regulatory framework and estimates of the potential impacts of options for a rule, SERs can offer recommendations to the Panel on ways to tailor options for provisions to make them more cost effective and less burdensome for affected industries. Third, early comments permit identification of additional options or alternatives to the regulatory framework for the Panel to consider. Finally, SERs can provide specific recommendations for the Panel to consider on issues such as reporting requirements, timetables of compliance, and whether some groups or industries should be exempt from all or part of the rule. A final report containing the findings, advice, and recommendations of the Panel will be submitted to the Assistant Secretary of Labor for Occupational Safety and Health to help inform the agency's decision making with respect to this possible rulemaking.

This SER Background Document has been prepared to facilitate the SBAR Panel process. In addition to this introductory section, the SER Background Document contains the following sections:

- **Section II** summarizes and explains potential elements and options for a standard as outlined in OSHA's regulatory framework;
- **Section III** provides information on the potential impacts of a standard as outlined in the regulatory framework;
- **Appendix A** describes potentially overlapping Federal rules; and
- **Appendices B and C** identify the types of small entities that would likely be affected by a standard as outlined in the regulatory framework.

Some of the most valuable contributions SERs make in the SBAR Panel process are their comments on the options presented and their suggestions for other possible options.

Section II. Description of Potential Elements and Options OSHA is Considering

Introduction

OSHA envisions a programmatic standard that could require employers to develop a heat injury and illness prevention plan to evaluate and control heat hazards in their workplace. The standard could allow for flexibility for employers to customize the plan to their workplace but could also include some elements that set specifications related to heat exposure levels. This section is meant to provide additional information about and rationale for the potential options for the elements listed in the accompanying regulatory framework. These options are designed to serve as discussion points with SERs during the SBAR Panel. Many of the options described in the regulatory framework and discussed below are based on existing and proposed state standards, stakeholder comments, the American Conference of Governmental Industrial Hygienists' (ACGIH) 2023 *TLVs and BEIs* book, and the NIOSH *Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments* (2016) (referred to as the "Criteria Document" hereafter).

The elements in this regulatory framework represent provisions that OSHA believes, at this point, are important elements of any standard to protect outdoor and indoor workers from hazardous heat, while providing flexibility and not unnecessarily burdening affected entities. While the options for some elements could eventually be reduced to a single requirement in the regulatory text of a potential rule, there could also be instances in which the regulatory text contains multiple options for a particular element from which employers could choose. Some existing state standards have taken this approach of having multiple compliance options for required elements, such as rest breaks (OR, 2022a; OR, 2022b), acclimatization (OR, 2022a; OR, 2022b), and supervision (WA, 2009; WA, 2022). In addition, while some elements might be required for all covered workplaces, others might only be required when the temperature is at or above an initial heat trigger or a high-heat trigger.

Figure 1 below summarizes potential elements and when they might be required.

Figure 1. Potential elements and when they might be required

Potential Elements	All Covered Workplaces (see Scope)	At or Above Initial Heat Trigger	At or Above High-Heat Trigger
Hazard identification and monitoring (based on forecast or workplace measurements)	●	●	●
Drinking water	●	●	●
Emergency response procedures	●	●	●
Training for employees and supervisors	●	●	●
Heat injury and illness prevention plan	●	●	●
Recordkeeping	●	●	●
Shade or cool-down area		●	●
Indoor air movement and humidity control		●	●
Acclimatization for new or returning workers, and during heat waves		●	●
Rest breaks (as needed or 10 min every 2 hours)		●	●
Effective communication means with employees		●	●
Rest breaks (minimum 15 min every 2 hours)			●
Supervisor or buddy system to observe for signs and symptoms			● (+ during acclimatization)
Pre-shift meetings or employee notifications			●

Scope

Workers across hundreds of industries are at risk for hazardous heat exposure. OSHA is considering coverage of outdoor and indoor workers in any/all General Industry, Construction, Maritime, and Agriculture sectors where OSHA has jurisdiction. Therefore, OSHA has sought participation from a wide range of sectors and welcomes SERs from any industry that might be affected. The agency is particularly interested in feedback from the core industries, identified in Appendix B, which it expects to be most affected by such a standard.

Regulating both outdoor and indoor work is consistent with NIOSH recommendations and regulations from several of the states that have enacted or proposed heat-specific standards. The NIOSH Criteria Document highlights the need to protect "workers who are exposed to extreme heat or work in hot environments indoors or outdoors" (p. v). Of the states that have enacted and proposed heat standards, several consider any outdoor work (CA, 2005; WA, 2008; WA, 2009; WA, 2022; WA, 2023) or any indoor work (MN, 1997, CA, 2023) to be within their scope. Others consider all outdoor and indoor work settings to be within scope, so long as they exceed a certain temperature (OR, 2022a; OR, 2022b; MD, 2022; NV, 2022). Finally, in their state regulation, Colorado considers only agricultural work sites, both outdoor and indoor, to be within scope, so long as they exceed a certain temperature (CO, 2022).

OSHA is considering exempting short exposures to hazardous heat (e.g., 15 minutes of work every 60 minutes), which is consistent with enacted and proposed state standards (OR, 2022a; OR, 2022b; WA, 2008; WA, 2009; WA, 2022; WA, 2023; CO, 2022; MD, 2022). OSHA could also exempt emergency operations, such as those already covered under 29 CFR 1910.156 or 29 CFR 1910.120, which is consistent with Oregon's standards and Maryland's proposed standard (OR, 2022a; OR, 2022b; MD, 2022). OSHA is also considering exempting work in spaces where mechanical ventilation keeps work areas below certain conditions (e.g., the ambient temperature of 80°F), as well as work done from home (e.g., telework, remote, and hybrid employees); both exemptions are largely consistent with Oregon's standards that exempt these types of work from many or all of the provisions (OR, 2022a; OR, 2022b). Finally, OSHA could exempt sedentary or light work activities performed indoors, if these are the only activities performed during the work shift. This exemption is in line with Oregon's standards, which exempt this type of work at a heat index below 90°F (OR, 2022a; OR, 2022b). OSHA is also interested in whether the Agency should exempt outdoor sedentary activities and how such activities might be best defined.

Heat Injury and Illness Prevention Program

OSHA is considering requiring employers to create a written Heat Injury and Illness Prevention Program (HIIPP), developed with the input of employees, that could include:

- Procedures to identify when heat hazards exist for employees, including procedures for environmental monitoring and the identification of work processes and external factors that increase the likelihood of heat-related injury and illness
- Procedures for implementing engineering controls
- Procedures for implementing administrative controls, including the provisions of drinking water, rest breaks in a cool and/or shaded area, acclimatization protocols for new and returning employees, and supervision of employees for signs and symptoms of heat-related illness
- Procedures for high heat
- Procedures for when employees are exhibiting symptoms of heat-related illness and emergency response procedures
- Training of employees and supervisors
- Selection of designated individual(s) to oversee and implement the HIIPP, including environmental monitoring

Requiring a HIIPP is consistent with regulations from several of the states that have enacted or proposed heat-specific standards. A combination of the elements OSHA is considering (above) are currently included in existing heat standards from California, Washington, and Oregon (CA 2005; WA, 2008; WA, 2009; WA, 2022; WA, 2023; OR, 2022a; OR, 2022b). Currently, Maryland and Nevada have proposed heat standards that would also require a combination of the elements listed above in a HIIPP (MD, 2022; NV, 2022). These elements are also found in the NIOSH Criteria Document (NIOSH, 2016).

OSHA is considering exempting very small employers (e.g., those with 10 or fewer employees) from requirements to have a written HIIPP.

OSHA could require employers to make the HIIPP available at the work site to employees and governmental representatives. Additionally, OSHA could require employers to review and update the HIIPP on a periodic basis, with the involvement of employees. Options for frequency of review include: 1) whenever necessary to ensure its ongoing effectiveness; 2) whenever a heat-related illness or injury occurs; 3) annually; or 4) whenever a heat-related illness or injury occurs, but no less than annually.

Hazard Identification and Assessment

The standard could require employers to identify if and when heat hazards exist for their employees.

Multiple metrics exist for assessing heat hazards and are used in existing and proposed state heat-specific standards: ambient temperature (CA, 2005; WA, 2008; WA, 2009; WA, 2022; WA, 2023; CO, 2022; NV, 2022), heat index (OR, 2022a; OR, 2022b; MD, 2022), and wet bulb globe temperature (WBGT) (MN, 1997).

- Ambient temperature, which can be measured using a common thermometer
- Heat index combines ambient temperature and humidity and is a widely reported weather statistic that is often referred to as the ‘‘feels like’’ or ‘‘apparent’’ temperature
- WBGT incorporates air temperature, wind, radiant heat, and humidity

Outdoor Work Sites

For outdoor work sites, OSHA is considering requiring employers to monitor weather conditions at their work site to determine when there is a heat hazard. OSHA is currently considering two options—having employers track local weather forecasts and/or having them conduct onsite monitoring (i.e., measurements). If employers rely on forecasts alone, OSHA is considering requiring them to implement controls for the whole day when local forecasted conditions meet or exceed certain heat triggers (see *Heat Triggers* section below). If employers rely on onsite monitoring, they could conduct monitoring routinely during the work shift every day or rely on forecasts to determine which days would warrant onsite monitoring (i.e., when the local forecasts indicate the initial heat triggers might be met or exceeded).

For outdoor work sites, OSHA is considering the following options for monitoring weather conditions to determine when there is a heat hazard:

- **Track local forecasts** of ambient temperature and humidity provided by the National Weather Service (or others) to determine daily maximum heat index
    - ***Optional to account for dry climates*:** For low forecasted relative humidity (e.g., below 30%), the employer could rely on ambient temperature alone.

- **Measure work area heat conditions** every day or when local forecasted conditions meet or exceed relevant triggers (see forecast heat triggers in Table 1)
    - **Option:** Employers measure heat index or ambient temperature and humidity to calculate heat index (employers could use the OSHA-NIOSH Heat Safety Tool App as a calculator or the online calculator available from the National Weather Service) at or as close as feasible to the work area at some periodic interval (e.g., hourly)

- ***Optional to account for dry climates***: For low forecasted relative humidity (e.g., below 30%), the employer could rely on ambient temperature alone.
- ***Optional for employees in non-breathable PPE*:** Employers could rely on ambient temperature triggers when employees are wearing vapor-impermeable protection (i.e., coveralls or other non-breathable clothing that prevents the transfer of moisture and impairs the ability of the body to cool down via sweat evaporation.)

- **Option**: Employers measure wet bulb globe temperature at or as close as feasible to the work area (i.e., area where one or more employees are working within the work site) at some periodic interval (e.g., hourly)

Exception: OSHA is considering permitting an employer to assume that a work area meets or exceeds both heat triggers (see *Heat Triggers* section) instead of tracking forecasts or conducting onsite monitoring. Employers that use this exception would be required to comply with the relevant control measures outlined in this document whenever employees are on site.

Indoor Work Sites

OSHA is considering requiring employers to conduct a hazard assessment to identify the indoor work areas or processes where there is the potential for employees to be exposed to heat hazards, including a determination of whether and when outdoor heat affects indoor conditions at the work site (e.g., regularly, during heat waves). When information gathered during the hazard assessment indicates that any employee's exposure may equal or exceed relevant heat triggers (see *Heat Triggers* section), the employer could be required to develop a monitoring program to identify when employees are exposed to heat at or above the relevant triggers. Employers could be required to conduct additional monitoring or a new hazard assessment whenever a change in production, process, equipment, or controls has the potential to increase heat exposure.

For indoor work sites, OSHA is considering the following monitoring options:

- **Option**: Employers measure heat index or ambient temperature and humidity to calculate heat index (employers could use the OSHA-NIOSH Heat Safety Tool App as a calculator or the online calculator available from the National Weather Service) at or as close as feasible to the work area
  - ***Optional to account for dry work sites***: If the indoor relative humidity is below a certain threshold (e.g., 30%), the employer could rely on ambient temperature alone.
  - ***Optional for employees in non-breathable PPE*:** Employers could rely on ambient temperature triggers when employees are wearing vapor- impermeable protection (i.e., coveralls or other non-breathable clothing that prevents the transfer of moisture and impairs the ability of the body to cool down via sweat evaporation.)
- **Option**: Employers measure wet bulb globe temperature at or as close as feasible to the work area

Exception: OSHA is considering permitting an employer to assume that a work area meets or exceeds both heat triggers (Table 1) instead of monitoring. Employers that use this exception would be required to comply with the relevant control measures outlined in this document whenever employees are on site.

Heat Triggers

The standard could specify that certain control measures would be required at a temperature-based "initial heat trigger." Additional measures (referred to as "high-heat procedures") could be required at a "high-heat trigger." OSHA is considering having different heat triggers for employers who track local weather forecasts in lieu of conducting onsite monitoring due to the anticipated variability between forecasted conditions and onsite conditions.

Table 1. Options for heat triggers being considered by OSHA

	Initial Heat Trigger			High-Heat Trigger		
	Ambient	Heat Index	WBGT	Ambient	Heat Index	WBGT
When using a forecast	78°F or higher	76°F or higher	N/A	86°F or higher	83°F or higher	N/A
When measuring onsite	82°F or higher	80°F or higher	ACGIH AL or NIOSH RAL	90°F or higher	87°F or higher	ACGIH TLV or NIOSH REL

Note: The values in this table represent the minimum values currently being considered.

OSHA recognizes that WBGT measurements may be more challenging for some small employers, and thus is considering heat trigger options using simpler heat index or ambient temperature measurements consistent with most state heat-specific standards (see below). As such, OSHA does not currently envision a standard that would require WBGT measurements without providing employers with one or more options for simpler heat index or ambient temperature measurements. However, for employers that choose to use WBGT measurements and the ACGIH approach to calculate the Threshold Limit Value (TLV) or the NIOSH approach to calculate the Recommended Exposure Limit (REL), as detailed in the ACGIH 2023 *TLVs and BEIs* book and NIOSH Criteria Document, respectively, OSHA is considering allowing these employers to treat these limits as the high-heat trigger. Similarly, OSHA is considering allowing these employers to treat the ACGIH Action Limit (AL) or the NIOSH Recommended Alert Limit (RAL) as the initial heat trigger.[1] OSHA welcomes feedback on the appropriateness of this potential approach and could also consider presenting set WBGT triggers, as is currently proposed for heat index and ambient temperature. OSHA is open to comments or suggestions addressing how best to allow employers who choose to measure WBGT and use the ACGIH and/or NIOSH limits in their workplace to continue doing so.

OSHA is considering requiring high-heat procedures (i.e., those that would normally be required at the "high-heat trigger") when workers are required to wear vapor-impermeable clothing or an additional layer of clothing (e.g., coveralls) and the temperature is at or above some other heat trigger. OSHA is considering the possibility of a lower heat trigger for high-heat procedures under these circumstances

[1] OSHA acknowledges that these exposure limits (ACGIH TLV and NIOSH REL) and action limits (ACGIH AL and NIOSH RAL) may not have been intended by NIOSH and ACGIH to be used as triggers in the way that the agency is currently considering, and they were designed to account for acclimatized and unacclimatized workers, respectively. However, as outlined in their most recent TLV guidelines, ACGIH describes as "Method 2" an approach for using the AL and TLV to determine when to implement general and job-specific controls, respectively, (ACGIH, 2023), like the approach outlined here.

because these types of clothing impair ability to cool down. OSHA welcomes feedback on options for this trigger.

OSHA is also considering providing a definition for a "heat wave," and additional requirements could be triggered whenever there is a heat wave, such as an additional acclimatization protocol. Options for heat wave definitions that OSHA is considering include 1) whenever the National Weather Service issues a heat advisory or heat warning for the local area, or 2) when the daily maximum temperature exceeds 90°F and is 9°F or more above the maximum reached on the preceding days. OSHA acknowledges that the specific conditions that constitute a heat wave vary across the country; the Agency is open to suggestions for easy-to-use approaches for heat wave definitions that can account for this variability.

The minimum options OSHA is currently considering for initial ambient temperature and heat index triggers are 82°F and 80°F, respectively, for on-site measurements. These are comparable with those in heat-specific standards adopted or proposed by states. As indicated in the table below, the states use various initial heat triggers, some of which are dependent on the clothing or gear worn by workers. Some of the options for initial heat triggers OSHA is considering are the same as those used by states (CA, 2005; OR, 2022a; OR, 2022b; CO, 2022; WA, 2023). Although other states use different triggers, they are comparable with the options OSHA is considering. California and Colorado use an ambient temperature trigger of 80°F for outdoor work sites and agricultural sites, respectively, as does the Washington updated standard for workers wearing breathable clothing (CA, 2005; CO, 2022; WA, 2023). California's proposed indoor standard uses an ambient temperature trigger of 82°F, while Nevada's proposed standard for indoor and outdoor work sites uses 90°F (CA, 2023; NV, 2022). The states using heat index for outdoor and indoor work sites vary in their triggers: 80°F in Oregon and 88°F in the Maryland proposal (OR, 2022a; OR, 2022b; MD, 2022).

The minimum options OSHA is currently considering for high-heat ambient and heat index triggers are 90°F and 87°F, respectively, for on-site measurements. These are also comparable with those in adopted or proposed heat-specific state standards. While California and Colorado use an ambient temperature high-heat trigger of 95°F, the Washington updated standard uses 90°F and the Washington ETS and Agriculture standard use 89°F (CA, 2005; CO, 2022; WA, 2023; WA, 2022; WA, 2009). The California indoor proposal uses an ambient temperature or heat index trigger of 87°F to impose additional requirements (CA, 2023). Oregon uses a heat index of 90°F for both outdoor and indoor work sites to trigger additional high-heat requirements (OR, 2022a; OR, 2022b).

OSHA welcomes feedback on the temperature thresholds it is currently considering for initial and high-heat triggers.

These heat triggers from state heat-specific standards are summarized in the table below:

Table 2. Heat triggers in state heat standards

	Setting	Initial Heat Trigger	High-Heat Trigger
California	Outdoor	80°F (Ambient)	95°F (Ambient)
Washington ETS, Ag, and General Industry	Outdoor	89°F (Ambient) (all other clothing); 77°F (double-layer woven clothes); 52°F (non-breathable clothes)	89°F (Ambient, Ag + ETS only)
Washington (updated)	Outdoor	80°F (Ambient) (all other clothing); 52°F (non-breathable clothes)	90°F (Ambient)
California (proposal)	Indoor	82°F (Ambient)	87°F (Ambient or Heat Index), except for certain clothing or in high radiant heat (82°F)
Minnesota[1]	Indoor	86°F (WBGT), Light work; 80°F, Moderate work; 77°F, Heavy work	
Oregon Ag and General Industry	Indoor/Outdoor	80°F (Heat Index)	90°F (Heat Index)
Maryland (proposal)	Indoor/Outdoor	88°F (Heat Index) and the presence of external influencing factors	
Nevada (proposal)	Indoor/Outdoor	90°F (Ambient)	
Colorado	Indoor/Outdoor Agriculture only	80°F (Ambient)	95°F (Ambient) or other conditions

[1]-Minnesota uses a 2-hour time-weighted average permissible exposure limit rather than a trigger

Note that there are different provisions required at each trigger by each state.

Hazard Prevention and Control Measures

OSHA is considering requiring some combination of engineering and administrative controls. Possible options are described below.

Engineering Controls

Engineering controls aim to isolate workers from a hazard and can include adjusting a work site or equipment (e.g., using quieter tools to reduce the risk of hearing loss), ventilating a workspace (e.g., using local exhaust ventilation to capture and remove airborne emissions), and installing protective barriers (e.g., machine guards), among others (NIOSH, 2023, Hierarchy of Controls section). These controls can be highly effective in protecting workers, as many entail physical alteration of the work site and are independent of worker and supervisor behavior (NIOSH, 2015, Directory of Engineering Controls section).

A potential standard could require employers to implement engineering controls in areas where the temperature is at or above the initial heat trigger (see Table 1). Options for engineering controls OSHA is currently considering for different types of work sites are discussed below.

Outdoor Work Sites

OSHA is considering requiring the provision of a designated cool-down area(s) for outdoor work sites. The provision of cool-down areas for breaks is consistent with several state regulations (CA, 2005; CO, 2022; OR, 2022a; OR, 2022b; WA, 2009; WA, 2022). The Agency is considering the following options for cool-down areas at outdoor work sites, which are described in further detail below: 1) cooling measures, if the employer can demonstrate that they are at least as protective as shade; 2) shade that provides complete blockage of sunlight; 3) air-conditioned space; and 4) any combination of options 1 through 3.

Cooling measures could include cooling fans and misting machines that are demonstrated by the employer to be at least as protective as shade. According to the NIOSH Criteria Document, the use of cooling fans and misting machines can increase air velocity and evaporative and convective heat loss (NIOSH, 2016). In addition, California, Oregon, and Washington allow for the use of alternative cooling measures, such as fans and misting systems, when it is not feasible or safe to provide shade, as long as the alternative provides equivalent protection (CA, 2005; OR, 2022a; OR, 2022b; WA, 2009; WA, 2022; WA, 2023).

Shaded areas could be natural shade, such as from trees, or artificial shade from tents, canopies, or pavilions, that provide a complete blockage of sunlight (i.e., workers must not be able to see their shadow) and are open to the outside air to allow natural air flow or be equipped with mechanical ventilation for cooling. Shade should not be from equipment, which presents potential safety concerns. A shaded area needs to be large enough to accommodate the number of employees on recovery or rest periods and located as close as practical to the work area. Several state heat-specific standards contain provisions for a shaded area. Colorado, California, Oregon, and Washington all require access to shade for breaks and require that the shade be located as close as practical to areas where employees are working and provided with ventilation if the shaded area is not open to the air (CO, 2022; CA, 2008; OR 2022a; OR, 2022b; WA, 2009; WA, 2022; WA, 2023). Oregon specifically requires that if trees or other vegetation are used to provide shade, the thickness and shape of the shaded area must provide sufficient shadow to protect employees (OR, 2022a; OR, 2022b).

Air-conditioned cool-down areas (e.g., trailers, vehicles, structures) need to be large enough to accommodate the number of employees on recovery or rest periods and located as close as practical to the work area. It is important to keep in mind that certain spaces equipped with air conditioning can also be a source of heat exposure (e.g., a vehicle that has been parked in the sun). Therefore, employers would need to allow the inside of air-conditioned cool-down areas to cool prior to using them for employee rest breaks. The use of air-conditioned spaces reduces the air temperature workers are exposed to and increases convective heat loss (NIOSH, 2016). Additionally, the use of air-conditioned spaces is consistent with state requirements. In their state regulations, both Colorado and Washington include the use of an air-conditioned site, such as a vehicle or structure, as an alternative to providing shade for employee rest breaks (CO, 2022; WA, 2009; WA, 2022; WA, 2023).

Indoor Work Sites

OSHA is also considering a variety of options for the use of engineering controls for indoor work sites. Those options are as follows:

- Employee cool-down areas (e.g., break room or trailer) provide employees a place for rest and recovery. Cool-down areas need to be large enough to accommodate the number of employees on recovery or rest periods and be located as close as practical to the work area. Cool-down areas should have some combination of air movement and humidity control or the area could be air-conditioned. To accomplish this, employers could use portable air coolers and/or fans, as well as dehumidifiers in humid conditions; in arid environments, evaporative coolers could be used.

- Where employees work primarily from fixed or designated locations in the workplace, controls can be used to reduce heat exposure at the specific work area. For example, fans or natural ventilation could be used to increase air movement at the work areas (where it would not increase the exposure to contaminants). Additionally, work area controls could provide some combination of increased air movement (except where it would increase exposure to contaminants) and humidity control (depending on temperature and humidity status of work area). When feasible, air-conditioning for work areas or control booths (if applicable) is also an option.

- Where the source of heat is from a fixed heat-generating source, controls can be used to reduce exposures to radiant heat. Options include: installing a hood with local exhaust ventilation over or around heat-generating sources to pull heated air away from the worker; installing shielding or barriers that are radiant-reflecting or heat-absorbing to reduce the amount of radiant heat to which the worker would otherwise be exposed; isolating the source of radiant heat; adding thermal insulation on hot pipes and surfaces; increasing the distance between workers and the heat source; modifying the hot process or operation; and installing waste heat recovery technology.

These control methods are consistent with those described in a Minnesota heat stress guidance product (MNOSHA, 2009).

Vehicles

Lastly, OSHA is considering requirements for cooling mechanisms in the cabs of employer-provided vehicles (e.g., company delivery vehicles, company vehicles for travel between work sites, etc.). The use of cooling mechanisms could be limited to certain conditions, such as where temperatures are regularly above the high-heat trigger or when workers spend most of their shift working in or from the vehicles (e.g., delivery drivers).

Administrative Controls

Administrative controls modify work practices to reduce the duration, frequency, or intensity of exposure to hazards, primarily through establishing procedures, trainings, and warnings, and in conjunction with other controls (e.g., engineering) (NIOSH, 2023, Hierarchy of Controls section). Below are the options OSHA is currently considering for administrative controls.

Water

While there are existing OSHA requirements for employers to provide potable drinking water (e.g., 29 CFR 1910.141(b)(1)), the Agency is considering specifying additional requirements for location, temperature, and quantity to reduce the risks associated with hazardous heat exposure. The standard could require that employers provide drinking water located as close as practical to the work area, with each employee having access to at least one quart (32 fluid ounces) of suitably cool drinking water per hour and having ample opportunity and encouragement to drink small amounts of water or other acceptable beverages.

Several state standards currently require access to sufficient drinking water. California requires employers to provide potable drinking water that is suitably cool and located as close as practical to areas where employees are working at all times (CA, 2005). Where drinking water is not plumbed, California requires employers to provide one quart of drinking water per hour to employees for the entire shift (CA, 2005). At certain temperature triggers, Oregon, Washington and Colorado require employers to supply at least one quart of suitably cool drinking water per hour to employees (OR, 2022a; OR, 2022b; WA, 2008; WA, 2009; WA, 2022; WA, 2023; CO 2022). Colorado requires that drinking water temperature be kept at 60 degrees or cooler (CO, 2022), while Oregon defines cool water as 66-77°F (OR, 2022a; OR, 2022b). At the time of publication of this document, Maryland, Nevada, and California also include provisions on drinking water in their proposed standards (MD, 2022; NV, 2022; CA, 2023; WA, 2023).

Protections for Unacclimatized Workers

The standard could require employers to adopt protections for new and returning employees who may not be acclimatized to working in the heat at or above the initial heat trigger. Similar protections could also be adopted for all employees during a local heat wave because heat waves represent abnormal conditions for workers.

OSHA investigations have shown that approximately 70% of heat-related deaths occur in the first few days of work (i.e., among new or unacclimatized employees) (Tustin et al., 2018). Even employees who *have* been acclimatized may not retain the physiological benefits associated with acclimatization if they are away from work for several days (i.e., returning employees), or if they are working during a heat wave.

Workers can improve their bodies' tolerance to heat by undergoing an acclimatization protocol, which involves brief daily exposures to work in the heat (NIOSH, February 2016). Acclimatization is a key administrative control that enhances workers' ability to work in hot environments and reduces their risk for heat-related injury and illness, as well as death (NIOSH, February 2016). OSHA is considering a variety of options for acclimatization for new and returning workers (i.e., workers who have previous experience with the job but have been away from the job for some period), as well as for all workers during local heat waves. All acclimatization options would only apply when employees are working in heat at or above the initial heat trigger.

OSHA is considering three options that could apply to new and returning employees, as well as all employees during a local heat wave. The first option would require employers to develop a plan that

includes training on heat hazard awareness before work begins in addition to increased monitoring and communication by the supervisor for the first week of work. This option is consistent with several state standards and proposed standards (CA, 2005; WA, 2009; WA, 2022; OR, 2022a; OR, 2022b; CO, 2022; CA, 2023; MD, 2022; NV, 2022; CA, 2023; WA, 2023) that require employers to: 1) provide heat hazard awareness training before work begins; and/or 2) increase monitoring and communication during the first week. The second option would require employers to develop their own acclimatization protocol. An employer-developed protocol would need to account for the work tasks performed by employees, clothing/PPE worn, and environmental risk factors, which is consistent with Oregon's heat standards (OR, 2022a; OR, 2022b). OSHA could establish a minimum protocol for this option. The third option would require employers to follow the *high-heat procedures* at the *initial* heat trigger (Table 1) for the first week of work. Colorado's heat standard includes a similar provision that applies to new and returning employees, working at or above the initial heat trigger, during their first four days of work (CO, 2022).

Another option OSHA is considering is the implementation of an acclimatization schedule. If OSHA were to include this option in any proposed rule, OSHA is considering different schedules for new and returning employees. For new employees, OSHA could require an acclimatization schedule based on the ''Rule of 20 Percent.'' That is, "the schedule should be no more than 20% of the usual duration of work in the hot environment on day 1, increasing by no more than 20% each day [to 40% on day 2, 60% on day 3, 80% on day 4, and 100% on day 5] (NIOSH, 2016 Table 4-1; OSHA, 2021). This acclimatization schedule is also referenced in Oregon's heat standards (OR, 2022a; OR, 2022b) and recommended in OSHA/NIOSH guidance (OSHA, 2014; NIOSH, 2018).

For returning employees who have previous experience with the job but have been away from the job for some period (e.g., 7, 14, or 30 days), OSHA could require employers to implement an acclimatization schedule that "should be no more than 50% of the usual duration of work in the hot environment on day 1, 60% on day 2, 80% on day 3, and 100% on day 4" (NIOSH, 2016 Table 4-1; OSHA, 2021). This acclimatization schedule is also referenced in Oregon's heat standards (OR, 2022a; OR, 2022b) and OSHA/NIOSH guidance (OSHA, August 2014; NIOSH, 2018). Returning workers are more likely to have some level of acclimatization based on previous work exposures prior to their leave of absence. OSHA is also considering this acclimatization schedule for all employees during a local heat wave.

The options listed above would also apply to temporary employees. However, OSHA is considering exempting newly hired employees who report having recently (e.g., in the prior week) performed the same work tasks in similar heat conditions.

Rest/Work-Rest

OSHA is considering requiring employers to provide employees with rest breaks in a cool and/or shaded area to limit employees' exposure to hazardous heat, which is consistent with the NIOSH Criteria Document and several state standards and proposed standards (NIOSH, 2016; CA, 2005; CA, 2023; WA, 2009; WA, 2022; WA, 2023; OR, 2022a; OR, 2022b; CO, 2022). Rest breaks are an important control that allow workers to cool down after exposure to hazardous heat. Taking breaks slows down the body's heat accumulation (Dukes-Dobos & Henschel, 1973), thereby reducing heat strain.

Personal Protective Equipment

Many forms of PPE used to protect workers from workplace hazards may contribute to heat stress. To address this, OSHA is considering two potential requirements. First, OSHA could require employers to take this into consideration when assessing the risks to workers posed by heat (such as during their hazard assessments) and when developing and implementing their HIIPPs. The Agency could also require employers to take additional precautions (such as implementing high-heat procedures) when employees are wearing vapor barrier clothing or an additional protective layer (e.g., coveralls) when a specific trigger is met or exceeded. Colorado's heat standard has a similar requirement for workers wearing these types of PPE (CO, 2022).

PPE designed to provide cooling benefits to workers can assist in reducing the risks of heat-related injury and illness. OSHA's PPE standard, at 29 CFR 1910.132(d)(1), requires employers to "assess the workplace to determine what hazards are present, or are likely to be present, which necessitate the use of PPE. If such hazards are present, or likely to be present, the employer shall select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment." OSHA could make explicit that the hazard assessment provision of the existing PPE standard requires employers to consider heat hazards specific to their work site and evaluate the potential use of cooling PPE (such as cooling vests and wetted garments). Alternatively, OSHA could include a standalone, heat-specific requirement in the new standard. Either way, when use of cooling PPE is warranted, cooling properties of the equipment must be always maintained during use.

Medical Treatment and Heat-Related Emergency Response

Medical treatment and emergency response plans can ensure that employers and their employees understand how to respond in an emergency and help prevent heat-related illness from progressing to heat stroke or death. OSHA is considering multiple options for provisions related to medical treatment and emergency response procedures.

OSHA could require employers to have written medical treatment and emergency response procedures describing how they will prepare for and respond to emergency and non-emergency heat-related medical events. Having these procedures in place is important to ensure swift action is taken to protect the health of the affected worker. OSHA could establish minimum requirements for these procedures.

OSHA could require employers to:

- Develop and include communication protocols in their procedures that detail how communication is maintained with employees at work sites and how employees may contact their supervisor and emergency medical services when necessary. Protocols should account for all settings where an employee may be working and exposed to hazardous heat and list the type of communication device(s) employees will use. Modes of communication should be reliable and accessible in all situations. OSHA could require employers to include in these procedures a description of how to transport employees to a location accessible to an emergency medical provider, along with clear and precise directions to the work site, which can be provided to emergency dispatchers. Finally, OSHA could require employers to identify a designated, trained person(s) to ensure that emergency procedures are invoked when appropriate.

- Relieve employees experiencing symptoms of heat illness, closely monitor them while attempting to lower their body temperatures, and determine what other follow-up actions are warranted, such as contacting emergency medical services. Employers should provide sufficient and accessible means to assist employees with reducing their body temperature. This may include taking a rest break in a shaded or cool-down area, fans to circulate the air, loosening or removing clothing, and cold water for the soaking and application of cloths or towels on the body or direct pouring of water onto the body (OSHA, 2014). Employees should continue to rest and be monitored until signs and/or symptoms have resolved and be offered on-site first aid or medical before returning to work or leaving the work site. This is consistent with California's standard, which requires that any employee that shows any sign or reports symptoms of heat illness be offered first aid or medical attention before leaving the work site for home (CA, 2005). If transportation by emergency medical services is necessary, the standard could require that affected employees be cooled down before leaving the work site. Employers would be required to take immediate action to cool down employees with suspected heat stroke. Emergency medical services should be immediately contacted if employees begin to show any signs or report symptoms of severe heat illness, such as confusion, slurred speech, loss of consciousness, seizures, profuse sweating, or hot, dry skin (NIOSH, 2022).

Many states that have enacted (CA, 2005; WA, 2008; WA, 2009; OR, 2022a; OR, 2022b; CO, 2022) or proposed standards (NV, 2022; MD, 2022; CA, 2023; WA, 2023) for heat exposure include requirements for medical treatment and emergency response procedures. Both Colorado and California have implemented standards that specify a length of time an employee must wait until they may return to work (CA, 2005; CO, 2022).

Worker Training

The standard could require employers to institute a training program that is provided to workers and supervisors who work in areas where there is reasonable likelihood of heat exposure. Workplace trainings can better prepare supervisors and workers to stay safe in hot conditions and can help reduce and prevent heat injury and illness. NIOSH also recommends keeping workers and their supervisors informed through training and continuing education programs (NIOSH, 2016).

OSHA could require that the training program for employees cover any or all of the following topics:

- Heat stress hazards
- Different types of heat injury and illness
- Risk factors for heat injury or illness, including the contributions of physical exertion, clothing, PPE, and a lack of acclimatization, as well as the effects of therapeutic drugs, over-the-counter medications, and alcohol
- Common signs and symptoms of heat-related injury and illness and which symptoms require immediate emergency action
- Work site-specific first aid and emergency response procedures for heat-related injuries and illnesses
- Proper precautions for work in hot areas

- The location of shaded/cool-down areas, procedures for ensuring effective observation and communication with employees, and how emergency medical services will be provided in the event of an emergency
- Importance of frequent consumption of small quantities of water when the work environment is hot
- Importance of taking rest breaks to prevent heat-related illness or injury
- Proper use of PPE, and the importance of removing PPE that may impair cooling during breaks
- Description of the employer's acclimatization procedures and the importance of acclimatization
- Employees' responsibilities for following proper work practices and control procedures, including the importance of reporting symptoms of heat-related illness
- A description of the environmental monitoring program at the work site
- Perceptions toward heat stress and common misperceptions
- The location of written training materials

OSHA could require training for supervisors to include any or all of the following topics:

- The topics listed above
- The procedures for implementing the applicable provisions of the rule
- The procedures the supervisor must follow if an employee exhibits signs or symptoms of heat-related illness
- The procedures for environmental monitoring at the work site

OSHA could require that training be conducted in a language and at a literacy level that the employee(s) and supervisor(s) understand. This requirement is consistent with existing heat-specific state standards: Oregon currently requires training to be done in a language and vocabulary readily understood by employees (OR, 2022a; OR, 2022b). Washington requires training in a language the employee and supervisor understands (WA, 2008; WA, 2009; WA, 2022; WA, 2023). In Colorado, for employees who are not fluent in English, employers are required to provide training or written materials in the employee's primary language to fulfill this requirement (CO, 2022). The proposed rule in Maryland also includes a language accessibility requirement for a training program (MD, 2022).

OSHA is considering requiring training to be conducted at certain frequencies, such as: (1) upon hiring and annually after; or (2) upon hiring, annually after, and a refresher course as necessary (e.g., following a heat-related injury or illness at the work site). For indoor employees, employers may be required to conduct training prior to any work in hot environments or near heat-generating processes, annually after that, and a refresher course as necessary (e.g., following a heat-related injury or illness at the work site). OSHA could also require employers to document attendance at heat-related trainings, as Oregon's heat standard requires (OR, 2022a; OR, 2022b).

Minnesota, Oregon, Washington, and Colorado have implemented standards that specify the frequencies at which training should be conducted (MN, 1997; OR, 2022a; OR, 2022b; WA, 2008; WA, 2009; WA, 2022; WA, 2023; CO, 2022). Oregon, Washington, and Colorado specify that the training should be provided annually or at least annually (OR, 2022a; OR, 2022b; WA, 2008; WA, 2009; WA, 2022; WA, 2023; CO, 2022). The Minnesota standard specifies the training should be repeated at intervals not greater than one year (MN, 1997).

The updated rule in Washington requires training for employees prior to work where hazardous heat exposure is reasonably expected and at least annually thereafter (WA, 2023). The rule also specifies the training requirement for outdoor work (WA, 2023). Maryland and Nevada's proposed rule also include a training requirement (MD, 2022; NV, 2022).

Recordkeeping

OSHA is considering requiring employers to maintain additional heat-specific records beyond what is already required by existing recordkeeping standards. The standard could require employers to maintain any or all of the following: environmental monitoring data for a certain period of time; a record of any heat-related illness or injury, including those that only require first aid, and the environmental and work conditions at the time of the illness or injury; and an accurate record of all heat acclimatization for new and returning employees. These records would need to be maintained and made available in accordance with OSHA's Records Access standard (29 CFR 1910.1020).

Additional recordkeeping for heat illness and injury prevention is consistent with several state standards. Oregon requires that employers prepare and maintain written or electronic training records that can be provided upon request (OR, 2022a; OR, 2022b). These records must contain the name or identification of each employee trained, the date(s) of the training, and the name of the person who conducted the training (OR, 2022a; OR, 2022b). In addition, the employers must maintain the most recent annual training record for each affected employee (OR, 2022a; OR, 2022b). In its proposed standard, California is considering requiring employers to establish and maintain accurate records of temperature or heat index measurements which include the date, time, and specific location of all measurements (CA, 2023). In addition, California is considering requiring these records be retained for up to 12 months or until the next measurements are taken, whichever is later, and made available at the worksite to employees and representatives upon request (CA, 2023). These heat-specific recordkeeping measures are also recommended in the NIOSH Criteria Document (NIOSH, 2016).

Communication on Multi-Employer Work Sites

Multi-employer work sites present special challenges due to the need for close coordination across employers on health and safety issues such as training and monitoring safe work practices. Per OSHA's *Recommended Practices for Safety and Health Programs*, "if different employers have inconsistent policies for when and where to wear personal protective equipment, workers may mistakenly believe that the equipment is not needed, leading to injury. Inconsistent safety policies may also cause workers to question the credibility of safety and health programs, resulting in less meaningful employee engagement and participation" (OSHA, 2016).

In several OSHA standards, additional measures are required at multi-employer work sites to protect the health and safety of all employees present at the work site (29 CFR 1910.119, 29 CFR 1910.146, 29 CFR 1910.147, 29 CFR 1910.1200). A multi-employer work site often includes a "host employer" along with "other employers" such as contractors, vendors, temporary staff provided by staffing agencies, and licensed independent practitioners with privileges. Examples of multi-employer work sites include, "electrical or mechanical contractors working in a facility, a vendor installing or maintaining equipment, or long-term contractors providing building cleaning and maintenance" (OSHA, 2016).

This standard could require employers to establish and implement procedures to effectively communicate and coordinate with other employers at the same work site (similar to 29 CFR 1910.119(h)(3)(v), 29 CFR 1910.146(c)(8)(iv)-(v), 29 CFR 1910.146(c)(9)(i)-(ii), 29 CFR 1910.147(f)(2)(i)-(ii), 29 CFR 1910.1200(e)(2)). The purpose of these procedures is to ensure that all employees on a multi-employer work site are aware of and protected from heat-related hazards.

OSHA could require host employers to include a description of procedures to protect all employees on site (e.g., contractors, vendors, staffing agencies, and licensed independent practitioners with privileges) from heat-related hazards (similar to 29 CFR 1910.119(f)(4), 29 CFR 1910.119(h)(2)(iii)-(iv), 29 CFR 1910.146(c)(8)(i)-(iii)), 29 CFR 1910.1200(e)(2)(i)-(iii)). The host employer could also be required to establish procedures to facilitate communication regarding the implementation of the HIIPP between the host employer and other employers on site (similar to 29 CFR 1910.119(h)(2)(ii)-(iv); see also OSHA, 1991).

Lastly, OSHA could require other employers on a multi-employer work site to include a description of how their HIIPP coordinates with that of the host employer.

Section III: Time and Equipment Associated with Potential Elements and Options OSHA is Considering

Unless otherwise noted in this section, the time and equipment estimates for complying with the options OSHA is considering for a potential standard are based on OSHA's professional expertise, considering the hours and equipment necessary to comply with similar requirements in other OSHA standards. In this document, OSHA is preliminarily using the term "designated person" to identify who would perform the described tasks. While this term does not necessarily imply specialized skills or knowledge, certain tasks may require some skills or knowledge. OSHA does not have an estimate of current compliance or baseline compliance with the suggested elements in the Regulatory Framework. The Agency requests small entity representatives' (SERs') feedback on all aspects of these burden estimates.

Heat Injury and Illness Prevention Program

The standard could require that employers create a written Heat Injury and Illness Prevention Program (HIIPP), with the input of employees. (The procedures that should be described in the HIIPP are outlined in the regulatory framework and discussed in Section II of this Background Document.) OSHA acknowledges that some employers will have an existing HIIPP that may only need to be modified to comply with a potential standard.

For employers with an existing HIIPP in place, OSHA assumes that employers will designate someone to review their HIIPP and make any modifications necessary to comply with a potential standard. OSHA estimates this process will require 2.5 hours of the designated person's time. Employers that do not have an existing HIIPP could have two options. Employers could choose to use a HIIPP template provided by OSHA[2] or write a HIIPP from scratch. The Agency estimates that customizing a HIIPP template would require approximately 6 hours of a designated person's time to access OSHA's website, review, determine what sections to use and/or revise, and fill in worksite-specific information on hazards, controls, and procedures. Alternatively, if employers choose to write a HIIPP from scratch, OSHA estimates that it would take 40 hours of a designated person's time to prepare.[3] The Agency expects that most employers would choose the less costly option of utilizing OSHA's template.

Additionally, the standard could require employers to review and update the HIIPP periodically, with the input of employees.[4] Regardless of how employers develop their HIIPPs initially, OSHA estimates that the process of reviewing and updating the HIIPP would take the person designated to do so approximately one hour each time. Where updates to the HIIPP occur more frequently, these updates could take less time.

The standard could also require that employers involve workers in the creation or initial modification of the HIIPP, as well as the process of periodically reviewing and updating of the HIIPP. OSHA assumes that

[2] OSHA does not currently have a HIIPP template but plans, in accordance with past practice, to publish one on its website as part of the rollout of any potential heat standard.
[3] These estimates do not include time for rule familiarization, as the length of the rule has not been determined.
[4] OSHA is considering the following frequency options for reviewing and updating the HIIPP: (1) whenever necessary to ensure its ongoing effectiveness; (2) whenever a heat-related illness or injury occurs; (3) annually; (4) whenever a heat-related illness or injury occurs, but no less than annually.

a representative group of employees will take one hour each during the initial development of the HIIPP and the periodic review and update of the HIIPP to provide feedback, regardless of whether the employer has an existing HIIPP.

Table 3. Compliance Estimates for Heat Injury and Illness Prevention Program

Regulatory Option	Labor Category	Value	Unit	Frequency
Initial HIIPP Development				
Write HIIPP – No Program in Place	Designated Person	40	Hours	One-Time per Establishment
Review and Modify HIIPP – Existing Program in Place	Designated Person	2.5	Hours	One-Time per Establishment
Write HIPP - Use HIIPP Template	Designated Person	6	Hours	One-Time per Establishment
HIIPP Development Involvement – Employee	Employee	1	Hours	One-Time per Employee Participant
Review and Update HIIPP				
Review and Update HIIPP	Designated Person	1	Hours	Per Establishment – Recurring[a]
HIIPP Review and Update Involvement – Employee	Employee	1	Hours	Per Employee Participant – Recurring[a]

[a] Potential options for the frequency of HIIPP updates are as follows: (1) whenever necessary to ensure its ongoing effectiveness; (2) whenever a heat-related illness or injury occurs; (3) annually; (4) whenever a heat-related illness or injury occurs, but no less than annually.

Hazard Identification and Assessment

The standard could require employers to identify if and when heat hazards exist and to monitor the hazard. For outdoor work sites, the standard could require employers to monitor weather conditions to determine when there is a heat hazard. OSHA is considering three options for monitoring weather conditions. The first option would involve a designated person for each work site tracking local forecasts of ambient temperature and humidity provided by the National Weather Service (NWS) (or others) to determine the daily maximum heat index, which the employer would then use to determine which protocols are triggered, if any, to be used throughout the entire working day. OSHA estimates it would take approximately 15 seconds per occurrence to read the daily forecast.

The second and third options would require employers to measure work area conditions. OSHA could require employers to take measurements at or as close as feasible to the work area on days when relevant forecast heat triggers are met or exceeded. The only difference between options two and three is the type of measurements the employer would need to take. The second option would require the employer to designate someone to take measurements of heat index or ambient temperature and humidity to calculate heat index (if needed, using the OSHA-NIOSH Heat Safety Tool App as a calculator or the online calculator available from the NWS). OSHA estimates it would take the designated person 5 minutes each time they measure the heat index or ambient temperature and humidity, including calculating the heat index (e.g., by consulting the OSHA-NIOSH App or NWS's online calculator). The third option would require the employer to designate someone to take measurements of wet bulb globe temperature (WBGT). This option would require the purchase of one WBGT thermometer for each

worksite. Additionally, OSHA estimates the designated person would need 30 minutes to read the WBGT thermometer user manual and 10 minutes per stabilization period and measurement.

Employers with indoor work sites may be required to conduct a hazard assessment to identify the work areas or processes where there is potential for employees to be exposed to hazardous heat, including a determination of whether and when outdoor heat affects indoor temperature/heat index at the work site. OSHA estimates that conducting the hazard assessment would require about 8 hours in total.
If the employer determines that any employee's exposure may equal or exceed relevant initial heat triggers (see Table 1), the employer could be required to develop a monitoring program to identify when employees are exposed to heat at or above the relevant triggers (as part of the HIIPP discussed above). OSHA is considering two options for monitoring conditions in indoor worker settings. These options are the same as options two and three for outdoor worksites discussed above, except that they are not tied to local weather conditions. OSHA estimates that the hours and equipment necessary to comply would be the same. Note that employers could be required to conduct additional monitoring or a new hazard assessment whenever a change in production, process, equipment, or controls has the potential to increase heat exposure.

For both outdoor and indoor work sites, the standard could require employers to consider the contributions of personal protective equipment (PPE) to heat stress.

OSHA is considering permitting an employer to forgo taking measurements if the employer assumes that a work area meets or exceeds both heat triggers. Employers that elect to do this would not incur monitoring costs. These employers would still be required to comply with relevant control measures as though they took a measurement that meets or exceeds the heat triggers.

Table 4. Compliance Estimates for Hazard Identification and Assessment

Regulatory Option	Labor Category	Value	Unit	Frequency
Outdoor – Local Weather Forecast	Designated Person	0.0042	Hours	Per Daily Measurement
Outdoor – Measure Heat Index, OR Measure Ambient Temperature and Humidity and Use Heat Safety Tool App Calculator or NWS Online Calculator	Designated Person	0.0833	Hours	Per Measurement
Outdoor – Measure WBGT	Designated Person	0.1667	Hours	Per Measurement
Indoor – Initial Hazard Assessment	Designated Person	8.0	Hours	One-Time per Establishment
Indoor – Measure Heat Index, OR Measure Ambient Temperature and Humidity and Use Heat Safety Tool App Calculator or NWS Online Calculator	Designated Person	0.0833	Hours	Per Measurement
Indoor – Measure WBGT	Designated Person	0.1667	Hours	Per Measurement
Indoor & Outdoor – Review Monitoring Equipment User Manual	Designated Person	0.5	Hours	One-Time per Employee
Indoor & Outdoor – Monitoring Equipment	N/A	1	Equipment	One-Time per Establishment

Hazard Prevention and Control Measures

OSHA could require employers to implement some combination of engineering and administrative controls.

Engineering Controls

The standard could require employers to implement engineering controls when the temperature is at or above the initial heat trigger.

For outdoor workplaces, OSHA is considering requiring employers to provide employees with a cool-down area. Options include employers providing cooling or misting fans; artificial or natural shade; air-conditioned spaces (e.g., trailers, vehicles, structures); or any combination of these measures. Cooling or misting fans might be used alone or in combination with natural or artificial shade. One example of artificial shade is a 12x12 foot tent that all employees on break can reasonably access. Combining shade with cooling or misting fans might entail one cooling or misting fan per 12x12 foot cooling station (tent or natural shade). Employers that make air-conditioned spaces available would need to provide specific AC tonnage dependent on the number of employees at the worksite.[5] Table 5 below presents the AC tonnage expected to cool a structure for the midpoint number of employees in the establishment size class listed (for the 500-plus size class, the estimate presents expected AC tonnage for 500 employees exactly). These AC tonnage estimates do not represent the potential AC tonnage needed for instances where a vehicle is used as a cool-down area. OSHA assumes employers will not purchase vehicles to use as cool-down areas given there are likely less costly options to cool more employees at once; however, if an employer does use vehicles as cool-down areas, there must be sufficient space for the number of employees present and OSHA assumes one vehicle per four employees would be needed.

For indoor workplaces, as for outdoor work sites, OSHA has identified the provision of a cool-down area (e.g., break room or trailer) as a possible engineering control. This space could be air-conditioned or have some combination of air movement and humidity control. Another option OSHA is considering for indoor work sites is the provision of work area controls. Employers could be required to provide increased air movement within a work area; some combination of increased air movement and humidity control within a work area; or, when feasible, air-conditioned work areas or control booths. For workstations, OSHA could require that employers purchase one desktop or wall mount fan per workstation. Employers could also purchase dehumidifiers or use the humidity controls built in to air-conditioning systems to address humidity levels. The number of dehumidifiers required would depend on several factors, including room volume, relative humidity, type of dehumidifier, class of water to be removed, and pints per day removal capacity.

For employer-provided vehicles, OSHA is also considering engineering control options. Options include air-conditioning or other cooling mechanisms in the passenger space of employer-provided vehicles, either in areas where temperatures regularly are above the high-heat trigger or when employees spend the majority of their shifts working in or from vehicles. OSHA estimates that, where this requirement applies, each employer who provides vehicles lacking air-conditioning or another cooling mechanism would need to install a cooling mechanism in one vehicle for every 2 employees on average.

[5] Square footage requirements are based on A-Wall Building Systems: https://a-wall.com/space-planning-sizes/, Tonnage requirements are calculated using Learn Metrics: https://learnmetrics.com/ac-tonnage-calculator/#:~:text=%E2%80%9C%E2%80%A6an%20air%20conditioner%20generally%20needs,0.0016%20tons%20per%20square%20foot.

Table 5. Compliance Estimates for Hazard Prevention and Control Measures – Engineering Controls

Regulatory Option	Labor Category	Value by Establishment Size Class						Unit	Frequency
		0-4	5-9	10-19	20-99	100-499	500+		
Outdoor – Cooling or Misting Fans	N/A	1	1	1	1	1	1	Fans	One-Time per Cooling Station (12x12ft area)
Outdoor – Artificial Shade	N/A	1	1	1	1	1	1	12x12 tent	One-Time per Establishment
Outdoor – AC Tonnage	N/A	0.15	0.20	0.28	0.75	3.25	5.33	Tonnage	One-Time per Establishment
Indoor – Cooled Workstation	N/A	1	1	1	1	1	1	Fans	One-Time per Workstation
Indoor – Cooled Break Room (AC Tonnage)	N/A	0.15	0.20	0.28	0.75	3.25	5.33	Tonnage	One-Time per Establishment
Employer Provided Vehicles – Installation of Cooling Mechanism	N/A	1	4	8	30	150	250	Vehicle Cabs	One-Time per Establishment

For radiant heat from fixed sources in indoor workplaces, OSHA is also considering requiring employers to use any of the options in the following Table 6 to reduce exposure, to the extent feasible. Each option would require staff time (e.g., engineer, maintenance/facilities) to design/redesign, install, test options, and purchase necessary technology or equipment.

Table 6: Description of Various Engineering Controls for Reducing Exposure to Radiant Heat in Indoor Workplaces

Control	Description of Control
Local exhaust ventilation (LEV) at heat-generating sources	• LEV designed and installed at points of high heat or moisture production (such as exhaust hoods in laundry rooms or steam presses, commercial kitchen exhaust hoods). • Similar to LEV used to capture air contaminants. Dampeners and hood vary depending on the moisture level of the air.
Installation of waste heat recovery technology	• Used with LEV to convert heat to energy fed back into the system. Regenerative and recuperative burners capture and use the waste heat from the hot flue gas from the combustion process. Tube heat exchangers that recover low to medium waste heat are mainly used for heating liquids.
Isolating the source of radiant heat	• Process enclosures around heat-producing components. • Containment of heat-producing equipment in rooms without workers.
Shielding or barriers that are radiant-reflecting or heat-absorbing	• Shielding to stop radiant heat from reaching workstations. Reflective Shield: Stainless steel, aluminum, or other bright metal surfaces reflect heat back toward the source. Absorbent shields: Water-cooled jackets made of black-surfaced aluminum absorb and carry away heat.
Thermal insulation on hot surfaces (e.g., steam pipes)	• Reducing the radiant heat emission from hot surfaces: Covering hot surfaces with sheets of low-emissivity material or paint reduces the heat radiating from this hot surface into the workplace. • Insulating hot surfaces: Insulation reduces the heat exchange between the heat source and the work environment.
Increasing the distance between workers and the heat source	• Moving the workstation further away from the heat source. • Repositioning controls to a cooler location.
Modifying the hot process or operation	• Would be very specific to individual workplaces but could involve such changes as re-piping or revamping existing systems.

Administrative Controls

The standard could require administrative controls including drinking water, protections for unacclimatized workers, rest breaks, and supervision/observation of workers for signs and symptoms of heat-related illness. The following are options for administrative controls that OSHA is considering.

Provision of Drinking Water

Employers could be required to provide access to one quart (32 fluid ounces) of suitably cool drinking water per employee per hour for the entire shift. To comply with this requirement at outdoor work sites, OSHA assumes employers would purchase 40-quart water coolers (with spigots) sufficient to provide the required amount of water. For indoor workplaces, OSHA assumes employers would utilize a plumbed water dispenser to comply with this requirement. Employers are assumed to purchase one reusable water bottle for both workplace types per employee. Table 7 below presents the expected number of 40-quart water coolers and water bottles for each establishment size class given the number of employees equals the midpoint of the employee range for that size class (except for the 500-plus size class, for which OSHA calculated the number of coolers and water bottles given the establishment has 500 employees).

Table 7. Compliance Estimates for Hazard Prevention and Control Measures – Administrative Controls

Regulatory Option	Labor Category	Value by Establishment Size Class						Unit	Frequency
		0-4	5-9	10-19	20-99	100-499	500+		
Outdoor – Coolers with spigot	N/A	1	1	1	2	8	13	40 qt coolers	One-Time per Establishment
Indoor – Plumbed Water Dispenser	N/A	1	1	1	1	1	1	Plumbed Water Dispensers	One-Time per Establishment
Indoor & Outdoor – Reusable Water Bottle	N/A	2	7	15	60	300	500	Reusable Water Bottles	One-Time per Employee

Protections for Unacclimatized Workers

The standard could require employers to adopt protections for new and returning employees who may not be acclimatized to working in the heat at or above the initial heat trigger, as well as all employees (new, returning, existing) during local heat waves.

OSHA is considering four options that could apply to new and returning employees, as well as all employees during local heat waves. First, OSHA could require employers to provide heat hazard awareness training before work begins and increase monitoring and communication from the supervisor/designated person for the first week. The second option OSHA is considering would require employers to develop their own acclimatization protocol based on the work tasks performed by workers, clothing/PPE worn, and environmental risk factors. The third option OSHA is considering would require employers to follow the high-heat procedures (discussed in the *High-Heat Procedures* section below) at the initial heat trigger for the first week of work.

A fourth option OSHA is considering is to require employers to implement an acclimatization schedule specified by OSHA, which would differ between new and returning employees. As with the other options, during local heat waves, employers could choose to implement the schedule for returning workers for existing employees. (The details of the acclimatization schedules OSHA is considering for this option are outlined in the regulatory framework and discussed in Section II of this Background Document.) Note that the amount of work time actually lost due to acclimatization will be tempered by the fact that workers may be able to complete other tasks during periods at or above the initial heat trigger so long as they are not working in those conditions. OSHA estimates that workers, on average, would spend 50% of their non-heat exposed time during acclimatization on tasks in non-heat exposed work conditions.

The number of hours necessary for an employer to comply with any potential acclimatization protection requirements would vary depending on the option(s) OSHA includes in any standard and, for the options requiring employers to develop a plan/protocol, the plan/protocol the employer implements. Table 8 below presents estimates for the first, second, and fourth potential options described above.

For the first option, a plan with heat hazard awareness training and a week of increased monitoring and communication, estimates for heat hazard awareness training are presented in *Training* section below. OSHA estimates that the increased monitoring and communication for the first option will require 20 minutes per 8-hour shift per employee and supervisor for the first week. For the second option, the estimate of lost hours per employee per acclimatization protocol range from 2 hours for returning workers and 4 hours for new workers. For the third option, where employers follow the high-heat procedures at the initial heat trigger for the first week of work, estimated time required per employee and supervisor are presented in *High-Heat Procedures* section below. For the fourth option, OSHA estimates that the number of lost hours per employee undergoing acclimatization ranges from 4 hours for returning workers to 8 hours for new workers, which includes an adjustment of 50% for non-heat exposed time during acclimatization.

Table 8. Compliance Estimates for Hazard Prevention and Control Measures – Acclimatization

Regulatory Option	Labor Category	Value	Unit	Frequency
Increased monitoring and communication - Supervisor per 20 Workers	Designated Person	0.3333	Hours	Per Designated Person Per 8- Hour Shift During Acclimatization
Increased monitoring and communication - Supervisor per 20 Workers	Employee	0.0167	Hours	Per Employee Per 8-Hour Shift During Acclimatization
New workers follow employer-developed protocols based on the work tasks performed by workers, clothing/PPE worn, and environmental risk factors.	Employee	4.0	Hours	Per Employee During Acclimatization Protocol
Returning workers (and existing workers during heat waves) follow employer-developed protocols based on the work tasks performed by workers, clothing/PPE worn, and environmental risk factors	Employee	2.0	Hours	Per Employee During Acclimatization Protocol
New workers exposed to heat only 20 percent of normal duration on the first day. Work duration increased by no more than 20 percent on subsequent days until the worker performed a normal schedule (5 days).	Employee	16 x 50% = 8	Hours	Per Employee During Acclimatization Schedule
Returning workers (and existing workers during heat waves) spend no more than 50% of the usual duration of work in the hot environment on day 1, 60% on day 2, 80% on day 3, and 100% on day 4.	Employee	8.8 x 50% = 4.4	Hours	Per Employee During Acclimatization Schedule

Rest Breaks

The standard could require that employers provide their workers with rest breaks once the initial heat trigger is met or exceeded. (Potential rest break requirements at or above the high-heat trigger are discussed in the *High-Heat Procedures section* below.) At or above the initial heat trigger, OSHA is considering the following options for rest breaks:

- Require employers to allow and encourage workers to take rest breaks as needed to prevent overheating. OSHA does not have an exact time estimate but estimates, for most workplaces, that the total break time per worker would average less than 10 minutes every 2 hours (for a total of 40 minutes per 8-hour shift).
- Require employers to provide 10-minute breaks for every 2 hours worked (for a total of 40 minutes per 8-hour shift).

Table 9. Compliance Estimates for Hazard Prevention and Control Measures – Rest Breaks

Regulatory Option	Labor Category	Value	Unit	Frequency
Above Initial Heat Trigger - Break Time Based on as Needed Time	Employee	<0.6667	Hours	Per Employee per 8-Hour Shift When Initial Heat Trigger is Met or Exceeded
Above Initial Heat Trigger - Break Time of 10 Minutes Every 2 Hours	Employee	0.6667	Hours	Per Employee per 8-Hour Shift When Initial Heat Trigger is Met or Exceeded

Supervision/Observation of Workers

Employers may be required to maintain effective communication with employees whenever the initial heat trigger is met or exceeded. (Potential supervision/observation requirements at or above the high-heat trigger are discussed in the *High-Heat Procedures* section below.) OSHA assumes that employers would task a designated person to stay in communication with employees. OSHA estimates this activity would require, on average, 5 minutes of the designated person's time per check-in every 2 hours (20 minutes total per 8-hour shift). In addition, each employee would spend one minute per 8-hour shift checking in with the designated person.

Table 10. Compliance Estimates for Hazard Prevention and Control Measures – Supervision/Observation of Workers

Regulatory Option	Labor Category	Value	Unit	Frequency
Effective Communication - Working in Group	Designated Person	0.3333	Hours	Per Designated Person per 8-Hour Shift When Initial Heat Trigger is Met or Exceeded
Effective Communication - Working in Group	Employee	0.0167	Hours	Per Employee per 8-Hour Shift When Initial Heat Trigger is Met or Exceeded

Other Administrative Controls

For indoor workplaces, employers could restrict access to excessively high heat areas and place warning signs near these areas. This control would require one heat surveillance flag or sign per door for each high heat area, which OSHA estimates would take a designated person 5 minutes to install. Additional administrative controls when the high-heat trigger is met or exceeded are discussed in the *High-Heat Procedures* section below.

Personal Protective Equipment

The standard could require employers to consider heat hazards and evaluate the potential use of cooling PPE. The types of cooling PPE might include, for example, durags, neck wraps, and cooling vests that can be soaked before donning. OSHA assumes that employers would need to provide one of each per employee. OSHA estimates employees could spend 30 seconds soaking/resoaking durags and neck wraps every 4 hours and 5 minutes soaking/resoaking cooling vests every 6–7 hours.

When employees are required to wear vapor barrier clothing or an additional layer (e.g., coveralls), OSHA is also considering requiring employers to take additional precautions (such as implementing high-heat procedures) when a specific trigger is met or exceeded. OSHA's estimate of the number of hours necessary to comply with potential high-heat procedures can be found in the *High-Heat Procedures* section below.

High-Heat Procedures

When high-heat triggers are met or exceeded, OSHA could require controls related to rest breaks, worker supervision/observation, and employee notice requirements. For rest breaks, OSHA is considering two options:

- Requiring employers to provide a minimum of 15 minutes of rest break at least every two hours (for one hour of total break time per worker per 8-hour shift).
- Requiring employers to design their own rest break schedule. OSHA estimates that this schedule would be equal to a minimum of 15 minutes every two hours and increasing break duration and/or frequency as temperatures increase.

For worker supervision/observation at or above the high-heat trigger, OSHA is considering two options. The first would require employers to establish buddy systems for observing through visual or verbal communication. OSHA estimates this activity would require one minute per check-in every 2 hours (4 minutes total per 8-hour shift) for all employees. The other option would require employers to use supervisors to conduct observation of employees (with one supervisor or designee responsible for observing no more than 20 employees). OSHA estimates this option would require 5 minutes of the designated person's time per check in every 2 hours (20 minutes total per 8-hour shift).

When the high-heat trigger is met or exceeded, OSHA is also considering requiring employers to hold pre-shift meetings or otherwise notify employees of the following:

- High-heat procedures are in effect
- Encouraging employees to drink plenty of water
- Reminding employees of their rights to take rest breaks as needed
- Location of shade and/or cool-down areas, breaks, and water for mobile work sites
- Designating employees to call 9-1-1 in a medical emergency

OSHA estimates this option would require 10 minutes of a designated person's time to conduct the pre-shift meeting or otherwise provide notice to employees, and require 10 minutes per employee (e.g., to attend the meeting).

Table 11. Compliance Estimates for High-Heat Procedures

Regulatory Option	Labor Category	Value	Unit	Frequency
Rest Breaks - Above High-Heat Trigger - Break Time of 15 Minutes Every 2 Hours	Employee	1.00	Hours	Per Employee per 8-Hour Shift When High Heat Trigger is Met or Exceeded
Rest Breaks - Above High-Heat Trigger - Employers Design Their Own Rest Schedule	Employee	1.00	Hours	Per Employee per 8-Hour Shift When High Heat Trigger is Met or Exceeded
Worker Supervision/Observation - Observation by Supervisor	Supervisor or Designated Person	0.3333	Hours	Per Supervisor/Designated Person per 8-Hour Shift When High Heat Trigger is Met or Exceeded
Worker Supervision/Observation - Observation by Supervisor	Employee	0.0167	Hours	Per Employee per 8-Hour Shift When High Heat Trigger is Met or Exceeded
Worker Supervision/Observation - Buddy System	Employee	0.0667	Hours	Per Employee per 8-Hour Shift When High Heat Trigger is Met or Exceeded
Pre-Shift Meeting or Other Notification	Designated Person	0.1667	Hours	Per Designated Person per 8-Hour Shift When High Heat Trigger is Met or Exceeded
Pre-Shift Meeting or Other Notification	Employee	0.1667	Hours	Per Employee per 8-Hour Shift When High Heat Trigger is Met or Exceeded

Medical Treatment and Heat-Related Emergency Response

OSHA could require employers to have written medical treatment and emergency response procedures that outline how they will prepare for and respond to emergency and non-emergency heat-related medical events. OSHA is also considering including requirements related to how employers would need to respond to reported or observed signs and symptoms of heat illness, including requiring immediate action appropriate to the severity of the illness. (Details about the options OSHA is considering are outlined in the regulatory framework and discussed in Section II of this Background Document.)

To develop written medical treatment and emergency response procedures, OSHA assumes that employers would task a designated person with writing up these procedures (as part of the HIIPP discussed in the *Heat Injury and Illness Prevention Program* section above). OSHA could also require employers to designate a person for each shift who will ensure that emergency procedures are activated and adhered to fully and appropriately in response to reported or observed signs and symptoms of heat illness (e.g., relieving any employee who is exhibiting signs of heat illness from duty and ensuring they are closely monitored). OSHA estimates that monitoring employees with signs or symptoms of heat illness would require 45 minutes of the designated person's time per incident.

When an employee is suspected of severe heat illness, the standard could require immediate action to reduce body temperature. OSHA estimates this would take 12.5 minutes per incident, accompanied by an immediate call to emergency medical services (EMS) taking an estimated 2 minutes. For any off-roadway employee that needs EMS, a designated person will spend an estimated 40 minutes transporting[6] the employee to a location where EMS can reach them. Finally, OSHA could require employers to have a way to reduce an employee's body temperature when necessary. This could be done by pouring water and ice directly on the employee, requiring a minimum of 15 pounds of ice and water assumed to be available at the work site. Alternatively, body temperature could be reduced by having one tub of sufficient size to accommodate a reclining adult and a minimum of 15 pounds of ice to fill the tub per incident.

[6] This time estimate includes time for the designated person to return to the worksite.

Table 12. Compliance Estimates for Medical Treatment and Emergency Response

Regulatory Option	Labor Category	Value	Unit	Frequency
Medical Response (Minor/Moderate) – On-Site Medical Treatment and Monitoring	Designated Person	0.75	Hours	Per Incident
Medical Response (Severe) – On-Site Medical Treatment	Designated Person	0.2083	Hours	Per Incident
Medical Response (Severe) – Tub	One-Time	1	Tubs	One-Time per Establishment
Medical Response (Severe) - Ice to Pour Over Employee or to Fill Tub	Per Employee/Incident	15	Pounds of Ice	Per Incident
Ice Cooler	One-Time	2	45 Quart Coolers[a]	One-Time per Establishment
Medical Response (Severe) – Contact Emergency Medical Services	Designated Person	0.0333	Hours	Per Incident
Transport of Worker to Location Where EMS Can Reach Them	Designated Person	0.6667	Hours	Per Incident

[a] A 45 Quart Cooler holds 37 lbs. of ice.

Worker Training

The standard could require employers to develop and implement a training program for workers and supervisors. Training could be required at certain frequencies, such as initially (e.g., upon hiring) and then refresher training annually and/or when necessary (e.g., following each heat-related incident at the work site).[7] OSHA assumes the training program would be developed and implemented by a designated person. OSHA acknowledges that some employers have existing training programs and those programs may already include heat stress related training, which would impact the amount of time the designated person would need to develop and implement the training requirements of any proposed standard. (The specific topics OSHA is considering requiring employers to cover in their training programs are outlined in the regulatory framework and discussed in Section II of this Background Document.)

For employers with no existing training program, OSHA estimates a designated person would spend 7 hours developing the initial employee training program, 1 hour preparing for the initial employee training sessions, and 2 hours administering each initial training session. OSHA estimates that a designated person would spend 1 hour preparing for the refresher employee training(s) and 1 hour conducting each refresher employee training. Finally, OSHA estimates that all employees would spend 2 hours each for the initial employee training and 1 hour each for every refresher employee training.

In addition, for training of supervisors, OSHA estimates that a designated person would spend 16 hours developing the initial supervisor training, 4 hours preparing the initial supervisor training, and 8 hours per session to deliver the initial supervisor training. OSHA estimates each supervisor would spend 8 hours attending the supervisor training. For supervisor refresher training, OSHA estimates that a designated person would spend 2 hours preparing for the refresher training, and 4 hours conducting the refresher training. Each supervisor would spend 4 hours attending the supervisor refresher training.

[7] For indoor workers, OSHA is considering requiring trainings prior to any work in hot environments or near heat-generating processes, as well as refresher trainings annually and as necessary.

For those employers with existing training programs, OSHA bases its estimate of the incremental time required to modify existing programs on burden estimates developed by the RAND Corporation (Metz et al., 2021) for the Proposed California Regulation for Heat Illness Prevention in Indoor Places of Employment. Based on those burden estimates, OSHA estimates that a designated person would spend 5.5 hours modifying the existing training program to comply with any training provisions in an OSHA standard, 15 additional minutes preparing for the first modified training session(s), and 30 additional minutes per session administering the initial training, compared to their existing program. OSHA also estimates that a designated person would spend 7.5 additional minutes preparing for the refresher training and 15 additional minutes conducting each refresher training. Finally, OSHA estimates all employees would spend 30 additional minutes each for the initial training and 15 additional minutes each for every refresher training. Note that this estimate is for training in addition to the existing training.

In addition, for those employers with existing training programs for supervisors, OSHA estimates that a designated person would spend 11 hours modifying supervisor training, 0.5 additional hours preparing for the supervisor training, and one additional hour per session to deliver the supervisor training. Any supervisor would spend an estimated one additional hour attending the supervisor training. For supervisor refresher training, OSHA estimates that a designated person would spend an additional 15 minutes preparing for the refresher training, and an additional 30 minutes conducting the refresher training. Each supervisor would spend an additional 30 minutes attending the supervisor refresher training.

OSHA also could require documentation of heat-related training attendance. OSHA assumes the designated person would record attendance and estimates that it will take five minutes per session to record attendance of each heat-related training session.

Table 13. Compliance Estimates for Worker Training

Regulatory Option	Labor Category	Value	Unit	Frequency
No Program in Place				
Initial Employee Training				
Initial Employee Training Program Development	Designated Person	7	Hours	One-Time per Establishment
Prep Time for Initial Employee Training	Designated Person	1	Hours	One-Time per Establishment
Conducting Initial Employee Training	Designated Person	2	Hours	One-Time per Session
Undergoing Initial Employee Training	Employee	2	Hours	One-Time per Employee
Initial Supervisor Training				
Initial Supervisor Training Development	Supervisor or Designated Person	16	Hours	One-Time per Establishment
Prep Time for Initial Supervisor Training	Supervisor or Designated Person	4	Hours	One-Time per Establishment
Conducting Initial Supervisor Training	Supervisor or Designated Person	8	Hours	One-Time per Session
Undergoing Initial Supervisor Training	Supervisor or Designated Person	8	Hours	One-Time per Supervisor/Designated Person
Refresher Employee Training				
Prep Time for Refresher Employee Training	Designated Person	1	Hours	Per Establishment – Recurring[a]
Conducting Refresher Employee Training	Designated Person	1	Hours	Per Session – Recurring[a]
Undergoing Refresher Employee Training	Employee	1	Hours	Per Employee – Recurring[a]
Refresher Supervisor Training				
Prep Time for Refresher Supervisor Training	Supervisor or Designated Person	2	Hours	Per Establishment – Recurring[a]
Conducting Refresher Supervisor Training	Supervisor or Designated Person	4	Hours	Per Session – Recurring[a]
Undergoing Refresher Supervisor Training	Supervisor or Designated Person	4	Hours	Per Supervisor/Designated Person – Recurring[a]
Training-Related Recordkeeping				
Record Attendance of Heat-Related Trainings	Designated Person	0.0833	Hours	Per Session
Existing Program in Place				
Initial Employee Training				
Initial Employee Training Program Development	Designated Person	5.5	Hours	One-Time per Establishment
Prep Time for Initial Employee Training	Designated Person	0.25	Hours	One-Time per Establishment
Conducting Initial Employee Training	Designated Person	0.5	Hours	One-Time per Session
Undergoing Initial Employee Training	Employee	0.5	Hours	One-Time per Employee
Initial Supervisor Training				
Initial Supervisor Training Development	Supervisor or Designated Person	11	Hours	One-Time per Establishment

Table 13. Compliance Estimates for Worker Training

Regulatory Option	Labor Category	Value	Unit	Frequency
Prep Time for Initial Supervisor Training	Supervisor or Designated Person	0.5	Hours	One-Time per Establishment
Conducting Initial Supervisor Training	Supervisor or Designated Person	1	Hours	One-Time per Session
Undergoing Initial Supervisor Training	Supervisor or Designated Person	1	Hours	One-Time per Supervisor/Designated Person
Refresher Employee Training				
Prep Time for Refresher Employee Training	Designated Person	0.125	Hours	Per Establishment – Recurring[a]
Conducting Refresher Employee Training	Designated Person	0.25	Hours	Per Session – Recurring[a]
Undergoing Refresher Employee Training	Employee	0.25	Hours	Per Employee – Recurring[a]
Refresher Supervisor Training				
Prep Time for Refresher Supervisor Training	Supervisor or Designated Person	0.25	Hours	Per Establishment – Recurring[a]
Conducting Refresher Supervisor Training	Supervisor or Designated Person	0.5	Hours	Per Session – Recurring[a]
Undergoing Refresher Supervisor Training	Supervisor or Designated Person	0.5	Hours	Per Supervisor/Designated Person – Recurring[a]
Training-Related Recordkeeping				
Record Attendance of Heat-Related Trainings	Designated Person	0.0833	Hours	Per Session

[a] Potential options for the frequency of refresher training are as follows: (1) Annually, and a refresher course as necessary (e.g., following a heat-related injury or illness at the work site); (2) Annually.

Recordkeeping

OSHA could require employers to keep records on environmental monitoring data, a record of any heat-related illness or injury, and/or an accurate record of all heat acclimatization for new and returning employees. OSHA assumes that employers would task a designated person to record environmental monitoring data and estimates that person would spend 5 minutes per measurement to take heat recordings using measurement equipment such as a heat index monitor. OSHA also assumes employers will task a designated person to record the other two employee-based recordkeeping requirements (heat-related illness or injury and heat acclimatization). OSHA estimates that person would spend 5 minutes per employee recording heat-related illness or injury and 10 seconds per employee recording acclimatization each time.

Table 14. Compliance Estimates for Recordkeeping

Regulatory Option	Labor Category	Value	Unit	Frequency
Environmental Heat Recording – Using Facility Measurement	Designated Person	0.0833	Hours	Per Measurement
Environmental Heat Recording – Using NWS	Designated Person	0	Hours	Per Daily Measurement
Recording Heat-Related Illness or Injury	Designated Person	0.0833	Hours	Per Incident
Recording Heat Acclimatization	Designated Person	0.0028	Hours	Per Employee Per Entry

Communication on Multi-Employer Sites

The standard could require employers to establish and implement procedures to effectively communicate and coordinate with other employers at the same worksite. The requirements OSHA is considering for communication on multi-employer worksites are described in the regulatory framework and in Section II of this Background Document. If OSHA were to include these requirements in any standard, OSHA assumes the host employer and other employers at a multi-employer worksite would task a designated person to develop these procedures. OSHA estimates the individual the host employer designates would need 20 minutes to develop and record (1) procedures to protect all employees on-site from heat-related hazards and (2) procedures to facilitate communication regarding the implementation of the HIIPP between the host employer and other employers on-site. OSHA estimates that other employers at the worksite would have a designated person spend 10 minutes developing a description of how their HIIPP coordinates with the host employer's.

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Appendix A: Description of Any Duplicative, Overlapping, or Conflicting Rules

The Regulatory Flexibility Act (RFA) requires that the agency's initial regulatory flexibility analysis identify, "to the extent practicable, [] all relevant Federal rules which may duplicate, overlap or conflict with the proposed rule." 5 U.S.C. § 603(b)(5). The Small Business Regulatory Enforcement Fairness Act (SBREFA) requires the agency to collect advice and recommendations from the SERs on this issue. 5 U.S.C. § 609(b)(4). Below, OSHA discusses whether the rules it has identified would duplicate, overlap, or conflict with the options for a potential standard as outlined above. While some federal rules may have overlapping requirements, OSHA did not identify any rules that would conflict with any potential standard. The agency therefore believes that no federal rules would prevent compliance with the potential standard.

Other Federal Agency Rules

The first federal rules that OSHA identified are regulations promulgated by the Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 7 U.S.C. § 136 et seq. The Worker Protection Standard (WPS) (40 CFR Part 170) is designed to protect agricultural workers from "unreasonable adverse effects of pesticides" (80 FR 67496); however, there are some provisions of the WPS addressing heat hazards associated with PPE use required by that standard. The WPS requires that employers implement "appropriate" or "sufficient" measures to prevent heat-related illness when workers must wear personal protective equipment (PPE) because of pesticide exposure (40 CFR 170.507, 170.605). The WPS also requires employers to ensure pesticide handlers are trained on how to recognize, prevent, and provide first aid treatment for heat-related illnesses (40 CFR 170.501). Although there may be some overlap between these requirements and some elements of a potential standard (e.g., training and consideration of the contributions of PPE to heat stress), OSHA is not aware of any conflicts. The potential rule would be entirely consistent with EPA's requirements around PPE considerations and training for pesticide handlers. Indeed, EPA's WPS "How to Comply" manual refers employers to OSHA's heat stress webpage for further information on what protective measures are appropriate (see Chapter 4, p. 65, available here). Additionally, the WPS, designed to protect workers from pesticide exposure, does not obviate the need for OSHA's potential standard, designed to protect workers from hazardous heat. A multitude of factors, including PPE, can contribute to heat injury and illness.

The second set of federal rules that OSHA identified are Department of Transportation (DOT) regulations. The Federal Motor Carrier Safety Administration (FMCSA) requires drivers of vehicles with gross vehicle weight ratings of 26,001 pounds or more to be instructed about extreme driving conditions, including high heat, to obtain commercial driver's licenses (49 C.F.R. Part 380). FMCSA's

regulations might overlap with OSHA's potential rule to the extent they require some training for a limited group of individuals. However, these regulations would not conflict with OSHA's potential rule, nor do they obviate the need for a comprehensive OSHA standard with provisions specifically designed to protect workers exposed to broad range of hazardous heat conditions.

OSHA Standards

OSHA does not have any standards that specifically cover workplace exposure to hazardous heat. However, OSHA has identified some current standards applicable to some issues related to hazardous heat. These standards, described below, do not conflict with the potential rule, nor do they obviate the need for an OSHA standard addressing occupational exposure to hazardous heat.

The first set of standards OSHA identified are the field sanitation standards (29 CFR 1910.141, 1926.51, 1915.88, 1917.127, 1918.95, 1928.110). Among other things, these standards require employers to provide employees with readily accessible potable drinking water and access to toilet facilities. The field sanitation standard for agriculture also requires employers to notify employees of the location of water and the importance of drinking water frequently, especially on hot days (29 CFR 1928.110(c)(4)). These existing standards and the options for a potential rule, as outlined above, do not conflict, nor do these existing standards obviate the need for a heat-specific standard. While OSHA's field sanitation standards require employers to make drinking water available to employees, their primary purpose is to ensure sanitary conditions in the workplace and they do not include the same level of specificity for provision of water as the options proposed above (e.g., specific quantity of water to be provided).

The second set of standards OSHA has identified are specific to pulp and paper and textile mills. These standards require that exposed water pipes that carry either steam or hot water and are located close to working platforms be guarded to prevent contact (29 CFR 1910.261(k)(11), 1910.262). These standards are primarily concerned with burn and scalding-related hazards to employees. However, when employers guard these pipes by using insulating material, they may also help protect their workplace from increases in temperatures that may, in some cases, induce heat-related illnesses. Thus, the existing standards and the potential standard would be complementary in nature.

The third set of standards OSHA has identified are OSHA's PPE standards (29 CFR 1910.132, 29 CFR 1915.152, 29 CFR 1917.95, and 29 CFR 1926.28). These standards require employers to conduct a hazard assessment to determine the appropriate PPE to be used to protect employees from the hazards identified in the worksite hazard assessment. Hazardous heat is not specifically identified as a hazard for which workers need PPE, though hazardous heat may be identified as a workplace hazard by an employer. These standards and the options for a potential heat standard are not conflicting or

duplicative in nature, as the proposed hazard-specific requirements would supplement any existing requirements.

The fourth set of standards that OSHA has identified are two broadly applicable standards that may apply to some heat-related hazards—the Recordkeeping standard (29 CFR 1904.7) and the Safety Training and Education standard for construction (29 CFR 1926.21). OSHA's Recordkeeping standard requires employers to record and report injuries and illnesses that meet recording criteria. However, if an injury or illness does not require medical treatment beyond the provision of first aid, it does not need to be reported. Some actions that a worker may be recommended to take when experiencing heat-related illness, such as hydration, are considered to be first aid, and therefore are not recordable. OSHA's Safety Training and Education standard requires employers in the construction industry to train employees in the recognition, avoidance, and prevention of unsafe conditions in their workplaces. However, the standard does not specifically identify hazardous heat as a hazard for which workers need training nor does it establish heat-specific training requirements.

These standards might, in some cases, overlap with some of the proposed options above. However, they do not conflict. OSHA believes that a comprehensive standard addressing heat-related illness would help ensure that all employers take all appropriate measures to protect workers from the hazards associated with exposure to hazardous heat. Where a heat standard includes specific requirements that overlap with more general requirements in other existing standards, the specific requirements would apply in lieu of the more general requirements, unless otherwise noted (see 29 CFR 1910.5(c)(1)). Where other standards, specific or general, continue to apply, OSHA will ensure that they supplement, rather than conflict with, the requirements of the heat standard. If OSHA finds, through the rulemaking process, that a standard as outlined in the regulatory framework would conflict with an existing standard's requirements or is unclear, it will take action, through the rulemaking, to correct the conflict or clarify confusing provisions. OSHA will seek comment during the SBAR process and throughout the rulemaking on any potential conflicts or confusing provisions.

Appendix B: Profile of Core Industries

OSHA broadly characterizes industries that are potentially within the scope of the regulatory framework as core industries and all other covered industries. Core industries are industries where workers are considered to have an elevated risk of exposure to heat stress. The core industries are outlined in this section with descriptions of the types of work that expose workers to heat-related hazards, such as exposure to high outdoor temperatures, exposure to radiant heat sources, or insufficient ventilation. While the risk of worker exposure to heat-related hazards is expected to be higher in the core industries, OSHA acknowledges that workers in all other industries within the Agency's jurisdiction have the potential to experience occupational heat-related hazards. For example, there are certain jobs, regardless of the industry in which they are performed, in which necessary physical exertion may increase the level of heat stress.

To identify core industries, OSHA reviewed multiple sources. The Agency reviewed its OSHA Information System (OIS) database[8] to identify industries with fatal and non-fatal heat-related injuries and illnesses. In addition, OSHA identified occupations as being potentially high risk by analyzing (1) occupational information on outdoor work settings from the Occupational Information Network (O*NET) and (2) occupation-level data from the Occupational Requirements Survey (ORS) on exposure to radiant heat sources. Occupations flagged by those two data sources were then mapped to detailed 2017 North American Industry Classification System (NAICS*)* codes using the Occupational Employment and Wage Statistics (OEWS). This mapping identifies industries that are potentially high risk in terms of their share of workers in occupations that OSHA identified as potentially high risk. Finally, OSHA evaluated industries that were included in OSHA's National Emphasis Program for Outdoor and Indoor Heat-Related Hazards, ANPRM comments, and stakeholder comments. Table C-1 in Appendix C lists the NAICS codes for each of the core industries identified by OSHA.

As noted in Section II of this Background Document, OSHA is considering exempting from the scope of the rule certain operations already covered under 29 CFR 1910.156 or 29 CFR 1910.120. Although OSHA is not considering any industry-wide exemptions, it is considering several work-related exemptions that would likely make application of the standard infrequent in industries outside those identified here as core industries.

Agriculture, Forestry, and Fishing

Agricultural workers are seasonally exposed to hazardous heat where they are at risk of adverse heat-related health outcomes. Work duties often include laboring outside at a fast pace during hot days. Workers often have limited protection from solar radiation on sunny days and access to water can be

[8] OSHA requires employers to report all severe work-related injuries, defined as amputation, fatality, in-patient hospitalization, or loss of eye. Details from the investigations of incidents reported to the Agency are entered into OIS, including NAICS code, incident narrative, occupation, and nature of injury.

limited in some work environments.[9] Indoor agricultural work may occur in greenhouses where high temperatures, and potentially high humidity levels, are maintained in an enclosed space, which may contribute to occupational heat stress throughout the year. Both outdoor and indoor agricultural workers often spray chemicals, such as pesticides, that can be harmful to worker health. To avoid the harmful effects of such chemicals, workers must don highly insulative personal protective equipment (PPE), which can increase worker exposure to heat stress.[10]

Logging and forestry predominantly take place outdoors in forested areas. During warm months, climatic conditions may result in prolonged periods of exposure to high temperatures while workers perform physically intense manual labor,[11,12] increasing workers' risk of heat-related illnesses. PPE utilized by forestry workers, such as safety trousers, can be heavy and insulative, increasing workers' exertion levels and thermal discomfort.[13]

Fishery workers regularly perform physically demanding work outdoors.[14] Workers are likely to face seasonal exposure to high temperatures, high humidity, and elevated levels of direct solar radiation. Fishery workers often don PPE, such as overalls, to protect themselves from workplace hazards,[15] which can be highly insulative and increase the physical burden to workers involved in strenuous manual labor.

Building Material and Equipment Suppliers

Building material and equipment suppliers may work in outdoor settings, such as scrap yards where they are seasonally exposed to outdoor high temperatures and solar radiation, or in poorly ventilated indoor settings that can reach high temperatures, resulting in worker exposure to hazardous heat. Additionally, workers in this core industry may operate tools and machinery that generate heat, further exposing

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[9] Spector, J. T., Krenz, J., Rauser, E., & Bonauto, D. K. (2014a). Heat-related illness in Washington State Agriculture and Forestry Sectors. *American Journal of Industrial Medicine, 57*(8), 881–895. https://doi.org/10.1002/ajim.22357

[10] Fishel, F. (2022). Personal Protective Equipment for Handling Pesticides. *EDIS, 2022*(4). https://edis.ifas.ufl.edu/publication/PI061

[11] Wästerlund, D. S. (1998). A review of heat stress research with application to forestry. *Applied Ergonomics, 29*(3), 179–183. https://doi.org/10.1016/S0003-6870(97)00063-X

[12] Bureau of Labor Statistics, U.S. Department of Labor. (2022, September 8). *Occupational outlook handbook: Logging workers.* Retrieved May 31, 2023, from https://www.bls.gov/ooh/farming-fishing-and-forestry/logging-workers.htm

[13] Bauske, E., Hutcheson, W., & Orrellana, R. (2018, December 6). *Chainsaw safety: Always use your personal protective equipment (PPE)*. University of Georgia Extension, Circular 1148. Retrieved May 31, 2023 from https://extension.uga.edu/publications/detail.html?number=C1148&title=chainsaw-safety-always-use-your-personal-protective-equipment-ppe

[14] Parsons, L. A., Shindell, D., Tigchelaar, M., Zhang, Y., & Spector, J. T. (2021). Increased labor losses and decreased adaptation potential in a warmer world. *Nature Communications, 12*(1), 7286. https://doi.org/10.1038/s41467-021-27328-y

[15] The Fishing Daily. (2020, January 9) *What apparel and safety equipment does a deckhand need?* Retrieved May 24, 2023, from https://thefishingdaily.com/business-features/what-apparel-and-safety-equipment-does-a-deckhand-need

workers to heat hazards. A review of heat-related illnesses in OSHA's OIS database in the building material and equipment supply industries found incidents often occurred while employees were in outdoor work settings. For example, one worker experienced heat-related illness while in an auto parts yard, and another suffered heat exhaustion while working as a cashier in an outdoor garden center. In addition, a worker at a recyclable materials merchant wholesaler suffered heat exhaustion while operating a sweat furnace to dismantle scrap.[16,17]

Commercial Kitchens

Workplaces with commercial kitchens, such as restaurants and bakeries, have several sources of radiant heat, such as ovens, stovetops, and grills. These create potentially dangerous heat levels for their employees. Heat exposure occurs when oven doors are opened, which releases hot air to the surrounding area, or when working in front of an underfired char broiler (700°F) or the open flames of a grill.[18] These workplaces may also require employees to move quickly in kitchens and dining areas as well as lift heavy items, such as boxes,[19,20] creating additional metabolic heat. For commercial kitchens with inadequate ventilation systems, pre-existing heat from radiant heat exposure and physical activity can be amplified by high outdoor temperatures. While most work occurs indoors, work may also be performed in outdoor settings, such as food stands or outdoor catered events.[21]

Construction

Construction sites are often located outdoors with limited access to shade. Road work, for example, is typically performed in an open area with few trees or natural cover. Workers who perform tasks in direct sunlight, such as roofing, scaffolding construction, steel fixing, and concrete pouring, are very

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[16] United States Census Bureau. (n.d.). *North American Industry Classification System: 423930 Recyclable Material Merchant Wholesalers.* Retrieved May 31, 2023, from https://www.census.gov/naics/?input=423930&year=2022&details=423930

[17] Legal Information Institute. (n.d.*). Definition: Sweat furnace from 40 CFR § 63.1503*Retrieved May 31, 2023, from https://www.law.cornell.edu/definitions/index.php?width=840&height=800&iframe=true&def_id=efbe399deff45ff22f9b92475d9f7e22&term_occur=12&term_src=Title:40:Chapter:I:Subchapter:C:Part:63:Subpart:RRR:Subjgrp:211:63.1506

[18] Lowell, C. (2020, July 22). *How does radiant heat affect your chef's and kitchen staff comfort?* Kitchen Ventilation by Halton. Retrieved April 6, 2023, from https://kitchenventilation.com/2020/07/22/how-does-radiant-heat-affect-your-chefs/

[19] Malovany, D. (2021, December 14). *If you can't stand the heat, stay out of the kitchen.* Baking Business. Retrieved April 6, 2023, from https://www.bakingbusiness.com/articles/55308-if-you-cant-stand-the-heat-stay-out-of-the-kitchen

[20] Bureau of Labor Statistics, U.S. Department of Labor. *Occupational outlook handbook: Cooks*. Retrieved May 31, 2023, from https://www.bls.gov/ooh/food-preparation-and-serving/cooks.htm

[21] Ibid.

vulnerable to heat stress.[22] Many materials used in construction, such as asphalt and concrete, attract heat from the sun, thus increasing the surface temperature to levels above the ambient air temperature.[23] Construction workers may also be exposed to additional heat sources while performing tasks such as welding or operating a cutting torch.[24]

Construction work is physically demanding, and construction workers generate metabolic heat from heavy lifting and from performing other strenuous tasks. For safety reasons, construction workers may wear PPE, such as impermeable coveralls. Such PPE can trap heat and further raise their body temperature.[25]

Drycleaning and Commercial Laundries

Employees of laundromats and dry cleaners are exposed to potentially dangerous heat and humidity levels from radiant heat and steam emitted by washers, dryers, steamers, and irons. Steaming a garment, for example, releases excess steam into the surrounding work area. Commercial dryers heat up to 176°F and produce radiant heat in an enclosed indoor environment.[26]

Fire Protection

Firefighters are primarily exposed to heat from fires they are working to suppress. In residential fires, air temperatures can climb to almost 400°F, depending on the scale of the fire.[27] Firefighters' PPE, while necessary for protection, impedes the body's ability to cool down. Under heavy layers of PPE, heat is trapped, and sweat cannot evaporate.[28] This situation is exacerbated by the physically demanding and

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[22] Yi, W., & Chan, A. P. C. (2017). Effects of heat stress on construction labor productivity in Hong Kong: A case study of rebar workers. *International Journal of Environmental Research and Public Health*, *14*(9), 1055. https://doi.org/10.3390/ijerph14091055

[23] Aletba, S. R., Abdul Hassan, N., Putra Jaya, R., Aminudin, E., Mahmud, M. Z., Mohamed, A., & Hussein, A. A. (2021). Thermal performance of cooling strategies for asphalt pavement: A state-of-the-art review. *Journal of Traffic and Transportation Engineering (English Edition)*, *8*(3), 356–373. https://doi.org/10.1016/j.jtte.2021.02.001

[24] Centers for Disease Control and Prevention. (n.d.). *Heat stress in construction*. Retrieved April 11, 2023, from https://blogs.cdc.gov/niosh-science-blog/2020/05/21/heat-stress-construction

[25] Ibid.

[26] Page, D. (n.d.) *The Maximum Temperature for a Clothes Dryer.* Hunker. Retrieved May 24, 2023, from https://www.hunker.com/12003256/the-maximum-temperature-for-a-clothes-dryer

[27] Willi, J. M., Horn, G. P., & Madrzykowski, D. (2016). Characterizing a firefighter's immediate thermal environment in live-fire training scenarios. *Fire Technology*, *52*(6), 1667–1696. https://doi.org/10.1007/s10694-015-0555-1

[28] Annaheim, S., Saiani, F., Grütter, M., Fontana, P., Camenzind, M., & Rossi, R. (2015). Internal and external heat load with fire fighter protective clothing: Data from the lab and the field. *Extreme Physiology & Medicine*, *4*(S1). https://doi.org/10.1186/2046-7648-4-s1-a100

strenuous nature of the work.[29] Additionally, wildland firefighters perform high intensity tasks, such as hiking, fireline construction, and operating chainsaws, increasing the risk of heat-related illness.[30]

Landscaping and Facilities Support

Landscapers work outdoors maintaining gardens and lawns, trimming trees and hedges, seeding and sodding lawns, planting flowers or plants, and applying fertilizer, among other tasks. The work is often conducted in direct sunlight and involves heavy lifting and carrying, digging, and operating tools or equipment.[31,32] In addition to working in potentially hot outdoor temperatures, the physical demands of the work exacerbate the potential for heat-related illnesses. Landscapers also operate machinery that generates its own heat, such as lawnmowers, leaf blowers, and chainsaws. The radiant heat emitted by these machines can increase the heat burden experienced by workers. PPE worn by landscapers, such as long sleeve shirts, pants, hats, and gloves, can trap internal heat, making it even more difficult for landscapers to cool off.[33]

Facilities support workers provide operational services, such as janitorial, grounds maintenance, trash, pest control, and guard and security services.[34,35] Certain tasks, such as grounds maintenance, are performed outdoors, putting facilities workers at risk of heat-related illness. In cemeteries, grounds maintenance workers are exposed to heat while manually digging graves and maintaining headstones and green spaces. Pest control workers sometimes perform tasks in poorly ventilated buildings, increasing the risk of exposure to hazardous heat. These workers may also apply thermal treatments that generate radiant heat, exacerbating the situation.

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[29] Serban, A. (2019, October 19) *The impact of heat stress in firefighter fatalities*. Honeywell. Retrieved April 6, 2023, from https://sps.honeywell.com/us/en/support/blog/safety/the-impact-of-heat-stress-in-firefighter-fatalities

[30] West, M. R., Costello, S., Sol, J. A., & Domitrovich, J. W. (2020). Risk for heat-related illness among wildland firefighters: job tasks and core body temperature change. *Occupational and Environmental Medicine, 77*(7), 433–438. https://doi.org/10.1136/oemed-2019-106186

[31] Bureau of Labor Statistics, U.S. Department of Labor. *Occupational outlook handbook: Grounds Maintenance Workers.* Retrieved May 31, 2023, from https://www.bls.gov/ooh/building-and-grounds-cleaning/grounds-maintenance-workers.htm

[32] *Landscaper*. (n.d.) Careers in Construction. Retrieved April 6, 2023, from https://www.careersinconstruction.ca/en/career/landscaper

[33] *Personal Protective Equipment*. (n.d.). National Association of Landscape Professionals. Retrieved April 6, 2023, from https://www.landscapeprofessionals.org/LP/Safety/PPE.aspx

[34] United States Census Bureau. (n.d.). *North American Industry Classification System: 561210 Facilities Support Services.* Retrieved May 31, 2023, from https://www.census.gov/naics/?input=561210&year=2022&details=561210

[35] United States Census Bureau. (n.d.). *North American Industry Classification System: 561710 Exterminating and Pest Control Services*. Retrieved May 31, 2023, from https://www.census.gov/naics/?input=561210&year=2022&details=561710

Maintenance and Repair

Maintenance and Repair includes automobile repair and maintenance, commercial industrial machinery and repair, and personal household goods repair. Automobile repair and maintenance employees can experience high levels of heat stress because they are routinely engaged in manual labor and work in garages that may have insufficient ventilation. Workers in garages with minimal or no insulation may experience indoor ambient temperatures up to 20°F warmer than outside temperatures.[36] Other maintenance and repair employees could be subject to high temperatures when working outdoors or when working inside a residential or commercial building with insufficient ventilation, particularly if working in small areas, such as crawl spaces or attics.[37]

Manufacturing

Certain manufacturing processes, such as glass and brick manufacturing which involve ovens, generate extreme temperatures that can adversely impact worker health.[38] In addition, not only do workers operate heavy equipment and maintain high activity levels under hot conditions,[39] they may also be required to wear heavy and insulative PPE that can increase levels of heat stress.[40]

Food processing is a type of manufacturing that involves the preparation, transformation, and packaging of food products during which raw food may be cooked and altered to create a finished product.[41] Workers are exposed to radiant heat from stoves, ovens, steam, and cookers.[42] While equipment and machines used in production lines generate heat themselves, workers are also exposed to heat from

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[36] Smith, S. (2021, June 10). *Guest blog: How does heat stress impact auto technicians?* Vehicle Services Pros. Retrieved April 6, 2023, from https://www.vehicleservicepros.com/service-repair/the-garage/blogs/blog/21226301/guest-blog-how-does-heat-stress-impact-auto-technicians

[37] *The very real dangers of heat stroke.* (2020, July 13). U.S. Boiler Company. Retrieved June 1, 2023, from https://www.usboiler.net/the-very-real-dangers-of-heat-stroke.html

[38] Meegahapola, P. A., & Prabodanie, R. A. R. (2018). Impact of environmental conditions on workers' productivity and health. *International Journal of Workplace Health Management, 11*(2), 74–84. https://doi.org/10.1108/IJWHM-10-2017-0082

[39] Marsh, J. (2022, July 21). *Heat stress often overlooked in manufacturing and industrial environments.* Industrial Safety and Hygiene News. Retrieved May 31, 2023, from https://www.ishn.com/articles/113415-heat-stress-often-overlooked-in-manufacturing-and-industrial-environments

[40] *Protective gear and PPE for the manufacturing industry.* (2021, September 28). Retrieved May 31, 2023, from https://www.themanufacturer.com/articles/protective-gear-and-ppe-for-the-manufacturing-industry

[41] Britannica, T. Editors of Encyclopedia (2023, April 21). *food processing. Encyclopedia Britannica.* https://www.britannica.com/technology/food-processing

[42] Connor, G. (2019, September 29). *Heat risks in food plants: Illinois Workers Comp Lawyer*. Retrieved April 6, 2023, from https://geraldfconnorlaw.com/food-plants-heat-risks

frying, baking, boiling, and drying food.[43,44] Radiant heat from machinery may be compounded by seasonal heat, particularly where processing plants are poorly ventilated or are not air-conditioned.

Primary metal manufacturing creates metal products by smelting and/or refining metals.[45] Foundry workers cast metal objects by melting metal into a molten liquid state, pouring it into a mold, and letting it cool.[46] Molten metals are extremely hot, often upwards of 1500°F, and are significant contributors to radiant heat at foundries.[47] In addition to the heat generated by the molten metals, working at a foundry requires intense physical activity, which generates metabolic heat. Employees must pour metal, move and position castings, and stand for long periods of time.[48,49] A 2014 study conducted at a Texan aluminum smelting facility, that collected temperature measurements in multiple work areas within the facility, found that potrooms had the highest levels of radiant heat; all but one were at or above 96°F.[50] Of the sixty workers observed within the facility, more than half exhibited at least one symptom of heat strain.

Oil and Gas

Many oil and gas workers labor outside, exposed to seasonally high temperatures and direct solar radiation.[51] Additionally, workers often perform physically demanding labor, such as handling and maintaining heavy machinery and equipment, operating pump valves, and repairing oil-hauling vehicles in poorly ventilated areas, such as inside tanks and ditches.[52,53] Workers are often required to wear PPE,

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[43] *How to keep food and beverage workers safe in Hot Workspaces*. (n.d.). Aggreko. Retrieved April 6, 2023, from https://www.aggreko.com/en-us/news/2020/nam-articles/food-and-beverage/how-to-keep-food-and-beverage-workers-safe-in-hot-workspaces

[44] Jayas, D. (2016). *Reference Module in Food Science: Food Dehydration*. Elsevier.

[45] Bureau of Labor Statistics, U.S. Department of Labor. (n.d.) *Industries at a Glance: Primary Metal Manufacturing: NAICS 331*. Retrieved June 2, 2023, from https://www.bls.gov/iag/tgs/iag331.htm

[46] Arzt, K. (2022, March 28). *Foundries 101: What is a foundry? What Foundry Workers Do?* The Crucible. Retrieved April 6, 2023, from https://www.thecrucible.org/guides/metalworking/foundry

[47] *Understanding the Melting Points of Metal*. (n.d.). Retrieved April 6, 2023, from https://www.industrialmetalsupply.com/blog/understanding-the-melting-points-of-metal

[48] National Center for O*NET Development. (n.d.). *51-4071.00: Foundry Mold and Coremakers.* Retrieved June 1, 2023, from https://www.onetonline.org/link/summary/51-4071.00

[49] Bureau of Labor Statistics, U.S. Department of Labor. (2022). Occupational Requirements Survey Database. https://www.bls.gov/ors/data.htm. Accessed 1 June 2023.

[50] Dang, B. N., & Dowell, C. H. (2014). Factors associated with heat strain among workers at an aluminum smelter in Texas. *Journal of Occupational and Environmental Medicine, 56*(3), 313–318. https://doi.org/10.1097%2FJOM.0000000000000095

[51] RPS Solutions. (2020). *Heat stress prevention in the energy industry*. Retrieved June 2, 2023, from https://rpssolutions.net/heat-stress-prevention-in-the-energy-industry

[52] Indeed Editorial Team. (2022). *14 Different types of oil rig jobs (with benefits and tips).* Retrieved June 2, 2023, from https://www.indeed.com/career-advice/finding-a-job/different-types-of-oil-rig-jobs

[53] Portacool, LLC. (2023). *Common heat stress concerns at oil rigs.* Retrieved June 2, 2023, from https://portacool.com/common-heat-stress-concerns-at-oil-rigs

which can be highly insulative and heavy, increasing physical burdens to workers and their exposure to uncomfortable thermal conditions.[54]

Postal and Delivery Services

Postal and delivery workers spend time outdoors or inside vehicles, often carrying heavy loads that increase levels of heat stress. They work outdoors in all-weather conditions, some working on foot, and some driving delivery vehicles without air-conditioning, where interior temperatures can be at least 10°F warmer than outside temperatures.[55,56] Delivery workers might be susceptible to heat stress in cases where they are unable to reschedule or alter delivery routes or vary the pace of their work even if they are experiencing heat-related symptoms.[57] Additionally, delivery truck cargo areas, where workers organize and load packages, can reach over 140°F on a hot day.[58]

Recreation and Amusement

Several jobs within the amusement and recreation industries take place outdoors and put employees at risk of heat-related illnesses. Examples include spectator sporting event jobs, amusement park jobs, lifeguards, beach and pool attendants, and recreational vehicle (RV) site jobs. These jobs are performed outdoors, and many are seasonal jobs in the summer months when temperatures are higher. Some jobs within these sectors are at an even higher risk of heat exposure. For example, amusement park employees that wear character costumes during outdoor performances are at high risk of heat-related illness, which is exacerbated by heat-trapping costumes as well as physical exertion.[59,60]

Sanitation and Waste Removal

Sanitation and waste removal services include waste collection services, landfill operations, recycling and trash sorting, cleanup of contaminated sites, septic pumping, and other waste management. Many of these jobs are performed primarily outdoors and are physically demanding. The physical labor of

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[54] Ibid.
[55] Owens, R. (2017, July 2). *Video: It's Hot Outside – Even Hotter in A Mail Truck*. Postal Employee Network. Retrieved April 6, 2023, from https://postalemployeenetwork.com/news/2017/07/02/video-its-hot-outside-even-hotter-in-a-mail-truck/#:~:text=Duran%20allowed%20CBS%20to%20take,all%20metal%20inside%20and%20out
[56] Carino, M. M. (2022, August 16). *Heat waves perilous for delivery truck drivers*. Marketplace. Retrieved April 11, 2023, from https://www.marketplace.org/2022/08/16/heat-waves-perilous-for-delivery-truck-drivers
[57] Seville, L.R. (July 18, 2019). *In the Hot Seat: UPS Delivery Drivers at Risk of Heat-Related Illnesses*. NBCNews.com. Retrieved April 6, 2023, from https://www.nbcnews.com/business/economy/hot-seat-ups-delivery-drivers-are-risk-heat-stroke-kidney-n1031321
[58] Ibid.
[59] Hosier, F. (2016). *Costumed amusement park employees suffer heat-related illness: OSHA fine.* Retrieved June 1, 2023, from https://www.safetynewsalert.com/costumed-amusement-park-employees-suffer-heat-related-illness-osha-fine
[60] Galfand Berger, LLP. (2020, July 17). *What are the hazards of working in an amusement park?* Retrieved May 24, 2023, from https://www.galfandberger.com/2020/07/17/amusement-park

lifting, pulling, and carrying garbage and recycling cans can increase body temperature, exacerbating the potential for heat-related illness or injury.[61] Workers in indoor environments, such as recycling sorters in materials recovery facilities, also report working in hot temperatures[62,63] and completing physical tasks while wearing PPE, such as gloves, coveralls, and masks.[64]

Telecommunications

Employees in the telecommunications industry, particularly line workers, may experience high levels of heat stress because they work outdoors in all-weather conditions, including direct sunlight, and typically perform physically demanding tasks.[65] These workers install and repair telecommunications equipment, dig trenches, lay underground cable, and operate power equipment. Telecommunications technicians perform installation and repair services in residential and commercial customers' property, that may have insufficient ventilation.[66]

Temporary Help Services

Temporary workers are hired through staffing agencies to work for host employers.[67] Temporary workers are found across all industries, including those that OSHA identified as the core industries at elevated risk of exposure to heat stress, such as manufacturing, transportation, and warehousing.[68] Temporary workers may face increased risk of heat illness due to lack of work-site specific safety

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[61] *Personal protective equipment for waste handlers and incinerator ... - path*. (n.d.). Retrieved April 6, 2023, from https://media.path.org/documents/TS_ppe_handouts.pdf

[62] State of Oregon. (n.d.) *Modernizing Oregon's Recycling System with Support from Oregon Consensus: Study of Material Recovery Facility Workers.* Retrieved May 24, 2023, from https://www.oregon.gov/deq/recycling/Documents/rscMRFWorkerSumD.pdf

[63] Occupational Safety and Health Administration: Region 2. (2014, January 30). *Brooklyn, NY, recycler cited by US Labor Department's OSHA for heat-related death* [Press Release]. https://www.osha.gov/news/newsreleases/region2/01302014-0

[64] Labor Occupational Health Program. (n.d.) *Worker Safety in Recycling Facilities*. Retrieved June 2, 2023, from https://lohp.berkeley.edu/wp-content/uploads/2013/12/english_recycling.pdf

[65] Bureau of Labor Statistics, U.S. Department of Labor. (2022, October 4*). Occupational outlook handbook: Line installers and repairers.* Retrieved May 31, 2023, from https://www.bls.gov/ooh/installation-maintenance-and-repair/telecommunications-equipment-installers-and-repairers-except-line-installers.htm#tab-3

[66] Bureau of Labor Statistics, U.S. Department of Labor. (2022, October 4). *Occupational outlook handbook: Line installers and repairers.* Retrieved June 2, 2023, from https://www.bls.gov/ooh/installation-maintenance-and-repair/line-installers-and-repairers.htm#tab-2

[67]Occupational Safety and Health Administration. (n.d.). *Protecting Temporary Workers*. Retrieved May 23, 2023, from https://www.osha.gov/temporaryworkers

[68] Forst, L., Chaudhry, A., Lopez, A., McCarthy, M., & Hebert-Beirne, J. (2023). Protecting workers in the temporary staffing industry. *Occupational Medicine (Oxford, England), 73*(4), 193–198. https://doi.org/10.1093/occmed/kqad045

training and experience.[69,70] Furthermore, temporary workers may not know how to report occupational hazards, including heat stress.[71,72]

Transportation

Employees in the transportation industry, such as truck drivers, airline ground workers, maritime jobs, and railyard workers, are at risk of heat-related illness from exposure to high outdoor temperatures.

Truck drivers face risks similar to those discussed for delivery workers while preparing loads for delivery and unloading.

In the air transportation industry, airline ground workers are responsible for inspecting tarmacs, loading, and unloading baggage, and ensuring that aircraft are ready for takeoff and landing.[73] These workers, therefore, spend most of the day outdoors regardless of the weather. Airline ground workers often perform physically demanding labor (e.g., baggage handling) in direct sunlight and on hot pavement. They typically have little access to shade on tarmacs, where concrete or asphalt can reach temperatures up to 150°F in the sun.[74] Furthermore, airline ground workers wear PPE, such as earmuffs, gloves, and vests, that can trap internal heat and further raise workers' body temperature.

Water transportation workers include sailors or deckhands, ship engineers, marine oilers, shipbuilders, port operators, and ship loaders, among others.[75] These jobs may require outdoor work or work in small

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[69] Virtanen, M., Kivimäki, M., Joensuu, M., Virtanen, P., Elovainio, M., & Vahtera, J. (2005). Temporary Employment and Health: A Review. *International Journal of Epidemiology*, *34*(3), 610–622. https://doi.org/10.1093/ije/dyi024

[70] Al-Tarawneh, I. S., Wurzelbacher, S. J., & Bertke, S. J. (2020). Comparative analyses of workers' compensation claims of injury among temporary and permanent employed workers in Ohio. *American Journal of Industrial Medicine, 63*(1), 3–22. https://doi.org/10.1002/ajim.23049

[71] Caban-Martinez, A. J., Santiago, K. M., Stillman, J., Moore, K. J., Sierra, D. A., Chalmers, J., Baniak, M., & Jordan, M. M. (2018). Physical exposures, work tasks, and OSHA-10 training among temporary and payroll construction workers. *Journal of Occupational & Environmental Medicine*, *60*(4). https://doi.org/10.1097/jom.0000000000001267

[72] *From the Fields to the Factories: Preventing Workplace Injury and Death from Excessive Heat: Hearing before the Subcommittee on Workforce Protections Committee on Education and Labor,* U.S. House of Representatives, 116th Cong. 12 (2019) (testimony of Javier Rodriguez). Retrieved June 2, 2023, from https://www.congress.gov/116/meeting/house/109767/witnesses/HHRG-116-ED10-Wstate-RodriguezJ-20190711.pdf

[73] *Ground Services Workers*. (n.d.). Firsthand. Retrieved May 23, 2023, from https://firsthand.co/professions/ground-services-workers

[74] Brotak, E. (2018, September 12). *Get a handle on the heat*. Aviation Pros. Retrieved May 23, 2023, from https://www.aviationpros.com/ground-handling/ground-handlers-service-providers/article/12422966/get-a-handle-on-the-heat

[75] Sawyer, R. (n.d.). *THE CASEWORKER'S GUIDE TO THE MARITIME INDUSTRY*. Retrieved April 6, 2023, from https://cool.osd.mil/usn/pubs/MaritimeCareersResourceGuide.pdf

spaces, such as engine rooms, which increases employees' heat stress.[76] Temperatures may be excessive in rooms with heat-producing machinery and in rooms with no ventilation. Sailors[77] who live and work on ships for months at a time may experience regular exposure to environmental heat. Land-based workers are involved in ship building and repair, loading and unloading cargo or passengers, and other tasks related to the maintenance and coordination of ships.[78] Many jobs in the maritime industry require physical labor while wearing PPE, such as coveralls and hard hats, which can increase body temperature.[79]

Covered railroad employees may include some conductors and train attendants who work inside trains, as well as rail maintenance workers, rail car repairers, and railroad brake, signal, and switch operators who primarily work outside in rail yards and along rail lines.[80,81] Rail maintenance workers are responsible for laying track, performing track repairs, and maintaining railroad equipment.[82] Rail car repairers perform diagnostic mechanical tests, repair, and maintenance on rail cars. Brake operators connect and disconnect trains, switch operators monitor switches and other locomotive instruments, and signal operators install and maintain signals in the rail yard. These jobs may be physically demanding. For example, rail maintenance workers performing maintenance on rail tracks engage in

[76] Palella, B. I., Quaranta, F., & Riccio, G. (2016). On the management and prevention of heat stress for crews onboard ships. *Ocean Engineering, 112,* 277–286. https://doi.org/10.1016/j.oceaneng.2015.12.030

[77] With limited exceptions, the United States Coast Guard (U.S.C.G.), rather than OSHA, promulgates and enforces regulations affecting the working conditions of seamen aboard vessels inspected and certified by the U.S.C.G. OSHA's health and safety standards generally apply to the working conditions of employees other than seamen on inspected vessels and to working conditions on uninspected vessels for which no specific U.S.C.G. regulation applies. For detailed discussion of OSHA enforcement in this area, see OSHA Authority Over Vessels and Facilities on or Adjacent to U.S. Navigable Waters and the Outer Continental Shelf (OCS). CPL 02-01-047, (February 22, 2010).

[78] Sawyer, R. (n.d.). *THE CASEWORKER'S GUIDE TO THE MARITIME INDUSTRY*.

[79] Kaushik, M. (2019, January 26). *10 Main Personal Protective Equipment (PPE) Used Onboard Ship*. Marine Insight. Retrieved June 1, 2023, from https://www.marineinsight.com/marine-safety/10-main-personal-protective-equipment-ppe-used-onboard-ship

[80] The Federal Railroad Administration (FRA) has promulgated regulations requiring the use of environmental controls to address heat hazards in three specific, limited contexts: non-steam-powered locomotives purchased or remanufactured after June 8, 2012 (49 CFR 229.119(g)), camp cars (49 CFR 228.313(c)), and certain on-track roadway maintenance machines (49 CFR 214.505(a)). OSHA's standard would apply to the working conditions of railroad employees in all other contexts, including within trains and machinery not covered by these regulations and during all outdoor work.

[81] Bureau of Labor Statistics, U.S. Department of Labor. (2022, October 4). Occupational outlook handbook: Railroad Workers. Retrieved June 2, 2023, from https://www.bls.gov/ooh/transportation-and-material-moving/railroad-occupations.htm

[82] National Center for O*NET Development. (n.d.). *47-4061.00: Rail-Track Laying and Maintenance Equipment Operators*. Retrieved June 21, 2023, from https://www.onetonline.org/link/summary/47-4061.00

heavy lifting, pulling, and operating heavy equipment.[83,84] Employees working in rail yards also wear PPE, which traps heat and can further raise their body temperature.[85,86]

Utilities

Utility workers provide services such as electric power, water supply, and sewage removal.[87] Work settings vary among utility workers. Some are involved in the maintenance and construction of outdoor infrastructure, where they are exposed to seasonally high temperatures and direct solar radiation. Electric power distributors control the flow of electricity, repair power lines and respond to emergencies as necessary.[88] Sewage and water plant workers spend time both indoors and outdoors testing water, repairing machinery, and recording meter readings.[89] Utility workers also perform tasks that are physically demanding, such as operating heavy machinery, lifting heavy objects, or climbing.[90] Some workers are primarily in indoor settings, such as nuclear power plant operators, and operate power-generating equipment that may generate heat, while wearing PPE to reduce exposure to hazardous materials.[91,92]

Warehousing

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[83] Ibid.

[84] Trac-Work, Inc. (n.d.). *TRACK LABORER – JOB DESCRIPTION*. Retrieved June 2, 2023, from http://www.trac-work.com/track-laborer/

[85] Charles Goetsch Law Offices, LLC. (2022, July 27). *Railroad workers are at high risk for heat-related illnesses*. Retrieved May 24, 2023, from https://www.gowhistleblower.com/blog/2022/07/railroad-workers-are-at-high-risk-for-heat-related-illnesses

[86] Union Pacific Railroad. (n.d.). *Safety Rules*. Retrieved June 2, 2023, from https://www.up.com/ert/safety.pdf

[87] Bureau of Labor Statistics, U.S. Department of Labor. (n.d.). *Industries at a glance: Utilities: NAICS 22*. Retrieved May 24, 2023, from https://www.bls.gov/iag/tgs/iag22.htm

[88] Bureau of Labor Statistics, U.S. Department of Labor. (2022, October 4). *Occupational outlook handbook: Power Plant Operators, distributors, and dispatchers.* Retrieved May 24, 2023, from https://www.bls.gov/ooh/production/power-plant-operators-distributors-and-dispatchers.htm#tab-2

[89] Bureau of Labor Statistics, U.S. Department of Labor. (2022, October 4). *Occupational outlook handbook: Water and wastewater treatment plant and system operators*. Retrieved May 24, 2023, from https://www.bls.gov/ooh/production/water-and-wastewater-treatment-plant-and-system-operators.htm#tab-2

[90] Bureau of Labor Statistics, U.S. Department of Labor. (2022, October 4). *Occupational outlook handbook: Line installers and repairers*. Retrieved June 2, 2023, from https://www.bls.gov/ooh/installation-maintenance-and-repair/line-installers-and-repairers.htm#tab-2

[91] Bureau of Labor Statistics, U.S. Department of Labor. (2022, October 4). *Occupational outlook handbook: Power Plant Operators, distributors, and dispatchers.* Retrieved May 24, 2023, from https://www.bls.gov/ooh/production/power-plant-operators-distributors-and-dispatchers.htm#tab-2

[92] Renaud, P. (2021, April 16). *Which PPE for working in nuclear power plants?* Retrieved June 2, 2023, from https://ouvry.com/en/which-ppe-for-working-in-nuclear-power-plants

Warehouses are typically large with uneven access to adequate air-conditioning depending on the work area within the facility.[93] When the sun shines directly on the roof of a warehouse, the indoor temperature rises dramatically, and hot air may be unable to escape. Due to poor ventilation, indoor temperatures may exceed outdoor temperatures.[94] Machinery may be running all the time, and there is constant worker activity. All of this increases the indoor temperature.[95] Production quotas that have to be met by performing strenuous labor at a fast pace can further increase warehousing workers' levels of heat stress.[96]

[93] Phillips, A. M. (2021, Oct 12). More warehouse workers toiling in extreme heat; Temperatures at facilities can hover above 90 degrees for hours; state officials have not yet finalized regulations. *Los Angeles Times* https://www.proquest.com/newspapers/more-warehouse-workers-toiling-extreme-heat/docview/2580845560/se-2

[94] Hecht Group. (n.d.). *Why warehouses are hotter than the outside temperature* Retrieved May 24, 2023, from https://www.hechtgroup.com/why-warehouses-are-hotter-than-the-outside-temperature

[95] Ibid.

[96] *From the Fields to the Factories: Preventing Workplace Injury and Death from Excessive Heat: Hearing before the Subcommittee on Workforce Protections Committee on Education and Labor,* U.S. House of Representatives, 116th Cong. 12 (2019) (testimony of Javier Rodriguez). Retrieved June 2, 2023, from https://www.congress.gov/116/meeting/house/109767/witnesses/HHRG-116-ED10-Wstate-RodriguezJ-20190711.pdf

Appendix C: Core Industry NAICS

Table C-1 lists the core industries and their associated detailed 2017 North American Industry Classification System (NAICS) codes.

Table C-1: Core Industries by NAICS Code

Core Industry	NAICS	NAICS Title
Agriculture, Fishing, and Forestry	**1111**	Oilseed and Grain Farming
	1112	Vegetable and Melon Farming
	1113	Fruit and Tree Nut Farming
	1114	Greenhouse, Nursery, and Floriculture Production
	1119	Other Crop Farming
	1121	Cattle Ranching and Farming
	1122	Hog and Pig Farming
	1123	Poultry and Egg Production
	1124	Sheep and Goat Farming
	1125	Aquaculture
	1129	Other Animal Production
	1131	Timber Tract Operations
	1132	Forest Nurseries and Gathering of Forest Products
	1133	Logging
	1141	Fishing
	1142	Hunting and Trapping
	1151	Support Activities for Crop Production
	1152	Support Activities for Animal Production
	1153	Support Activities for Forestry
Building Materials and Equipment Suppliers	**4233**	Lumber and Other Construction Materials Merchant Wholesalers
	4237	Hardware, and Plumbing and Heating Equipment and Supplies Merchant Wholesalers
	4239	Miscellaneous Durable Goods Merchant Wholesalers
	4441	Building Material and Supplies Dealers
	5324	Commercial and Industrial Machinery and Equipment Rental and Leasing

Core Industry	NAICS	NAICS Title
Commercial Kitchens	**3118**	Bakeries and Tortilla Manufacturing
	7223	Special Food Services
	7224	Drinking Places (Alcoholic Beverages)
	7225	Restaurants and Other Eating Places
Construction	**2361**	Residential Building Construction
	2362	Nonresidential Building Construction
	2371	Utility System Construction
	2372	Land Subdivision
	2373	Highway, Street, and Bridge Construction
	2379	Other Heavy and Civil Engineering Construction
	2381	Foundation, Structure, and Building Exterior Contractors
	2382	Building Equipment Contractors
	2383	Building Finishing Contractors
	2389	Other Specialty Trade Contractors
	5413	Architectural, Engineering, and Related Services
Drycleaning and Commercial Laundry	**8123**	Drycleaning and Laundry Services
Fire Protection	**92216**	Fire Protection
Landscaping and Facilities Support	**5612**	Facilities Support Services
	5617	Services to Buildings and Dwellings
	5619	Other Support Services
	8122	Death Care Services
	81293	Parking Lots and Garages
Maintenance and Repair	**8111**	Automotive Repair and Maintenance
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
	8114	Personal and Household Goods Repair and Maintenance
Manufacturing	**3111**	Animal Food Manufacturing
	3112	Grain and Oilseed Milling
	3113	Sugar and Confectionery Product Manufacturing
	3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing
	3115	Dairy Product Manufacturing
	3116	Animal Slaughtering and Processing

Core Industry	NAICS	NAICS Title
Manufacturing (continued)	**3117**	Seafood Product Preparation and Packaging
	3119	Other Food Manufacturing
	3121	Beverage Manufacturing
	3122	Tobacco Manufacturing
	3131	Fiber, Yarn, and Thread Mills
	3132	Fabric Mills
	3133	Textile and Fabric Finishing and Fabric Coating Mills
	3141	Textile Furnishings Mills
	3149	Other Textile Product Mills
	3151	Apparel Knitting Mills
	3152	Cut and Sew Apparel Manufacturing
	3159	Apparel Accessories and Other Apparel Manufacturing
	3161	Leather and Hide Tanning and Finishing
	3162	Footwear Manufacturing
	3169	Other Leather and Allied Product Manufacturing
	3211	Sawmills and Wood Preservation
	3212	Veneer, Plywood, and Engineered Wood Product Manufacturing
	3219	Other Wood Product Manufacturing
	3221	Pulp, Paper, and Paperboard Mills
	3222	Converted Paper Product Manufacturing
	3231	Printing and Related Support Activities
	3241	Petroleum and Coal Products Manufacturing
	3251	Basic Chemical Manufacturing
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
	3254	Pharmaceutical and Medicine Manufacturing
	3255	Paint, Coating, and Adhesive Manufacturing
	3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing
	3259	Other Chemical Product and Preparation Manufacturing
	3261	Plastics Product Manufacturing
	3262	Rubber Product Manufacturing

Core Industry	NAICS	NAICS Title
Manufacturing (continued)	**3271**	Clay Product and Refractory Manufacturing
	3272	Glass and Glass Product Manufacturing
	3273	Cement and Concrete Product Manufacturing
	3274	Lime and Gypsum Product Manufacturing
	3279	Other Nonmetallic Mineral Product Manufacturing
	3311	Iron and Steel Mills and Ferroalloy Manufacturing
	3312	Steel Product Manufacturing from Purchased Steel
	3313	Alumina and Aluminum Production and Processing
	3314	Nonferrous Metal (except Aluminum) Production and Processing
	3315	Foundries
	3321	Forging and Stamping
	3322	Cutlery and Handtool Manufacturing
	3323	Architectural and Structural Metals Manufacturing
	3324	Boiler, Tank, and Shipping Container Manufacturing
	3325	Hardware Manufacturing
	3326	Spring and Wire Product Manufacturing
	3327	Machine Shops Turned Product and Screw, Nut, and Bolt Manufacturing
	3328	Coating, Engraving, Heat Treating, and Allied Activities
	3329	Other Fabricated Metal Product Manufacturing
	3331	Agriculture, Construction, and Mining Machinery Manufacturing
	3332	Industrial Machinery Manufacturing
	3333	Commercial and Service Industry Machinery Manufacturing
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing
	3335	Metalworking Machinery Manufacturing
	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing
	3339	Other General Purpose Machinery Manufacturing
	3351	Electric Lighting Equipment Manufacturing
	3352	Household Appliance Manufacturing
	3353	Electrical Equipment Manufacturing

Core Industry	NAICS	NAICS Title
Manufacturing (continued)	**3359**	Other Electrical Equipment and Component Manufacturing
	3361	Motor Vehicle Manufacturing
	3362	Motor Vehicle Body and Trailer Manufacturing
	3363	Motor Vehicle Parts Manufacturing
	3364	Aerospace Product and Parts Manufacturing
	3365	Railroad Rolling Stock Manufacturing
	3366	Ship and Boat Building
	3369	Other Transportation Equipment Manufacturing
	3371	Household and Institutional Furniture and Kitchen Cabinet Manufacturing
	3372	Office Furniture (including Fixtures) Manufacturing
	3379	Other Furniture Related Product Manufacturing
	3391	Medical Equipment and Supplies Manufacturing
	3399	Other Miscellaneous Manufacturing
Oil and Gas	**2111**	Oil and Gas Extraction
	2131	Support Activities for Mining
	4861	Pipeline Transportation of Crude Oil
	4862	Pipeline Transportation of Natural Gas
	4869	Other Pipeline Transportation
Postal and Delivery Services	**4911**	Postal Services
	4921	Couriers and Express Delivery Services
	4922	Local Messengers and Local Delivery
Recreation and Amusement	**7112**	Spectator Sports
	7131	Amusement Parks and Arcades
	7139	Other Amusement and Recreation Industries
	7212	RV (Recreational Vehicle) Parks and Recreational Camps
Sanitation and Waste Removal	**5621**	Waste Collection
	5622	Waste Treatment and Disposal
	5629	Remediation and Other Waste Management Services
Telecommunications	**5173**	Wired and Wireless Telecommunications Carriers
	5174	Satellite Telecommunications
	5179	Other Telecommunications
Temporary Help Services	**5613**	Temporary Help Services

Core Industry	NAICS	NAICS Title
Transportation	**4811**	Scheduled Air Transportation
	4812	Nonscheduled Air Transportation
	4821	Rail Transportation
	4831	Deep Sea, Coastal, and Great Lakes Water Transportation
	4832	Inland Water Transportation
	4841	General Freight Trucking
	4842	Specialized Freight Trucking
	4851	Urban Transit Systems
	4859	Other Transit and Ground Passenger Transportation
	4881	Support Activities for Air Transportation
	4882	Support Activities for Rail Transportation
	4883	Support Activities for Water Transportation
	4884	Support Activities for Road Transportation
	4889	Other Support Activities for Transportation
Utilities	**2211**	Electric Power Generation, Transmission and Distribution
	2212	Natural Gas Distribution
	2213	Water, Sewage and Other Systems
Warehousing	**4931**	Warehousing and Storage