January 14, 2025

The Hon. Douglas Parker
Assistant Secretary
Occupational Safety and Health Administration
200 Constitution Ave., NW
Washington, DC 20210

Re: OSHA–2021–0009 (RIN 1218-AD39)
Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings

Dear Assistant Secretary Parker,

The International Safety Equipment Association (ISEA) is pleased to offer the following comments on the proposed heat stress rule. As you may know, ISEA members are companies that design, test, manufacture and supply a wide range of personal protective equipment (PPE) and safety equipment.

In addition, ISEA is accredited by the American National Standards Institute (ANSI) as an accredited standards developing organization (SDO). ISEA writes product performance standards for some of the most commonly used PPE, such as: Z87.1 for safety eyewear, Z89.1 for head protection, and ANSI/ISEA 107 for high visibility safety apparel.

The nation's workforce is the economy's engine. The PPE and safety equipment industry proudly protects over 125 million workers in the U.S., supports 350,000 jobs, and generates $72 B of economic activity. Our industry directly employs 130,000 workers and pays nearly $9 B in state and federal taxes.

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ISEA supports a final heat stress rule

ISEA supports a final heat stress rule. We believe cooling PPE must be included in the required heat injury and illness prevention plans. In addition, we believe electrolyte replenishment beverages must be recommended as an option equal to water, so that employers and employees can choose either.

Outline of our comments

Part I begins with a comment on the Preamble's discussion of cooling PPE, then we answer OSHA's question whether it should require cooling PPE as part of a heat stress plan, and whether employers should provide required HIIPP elements at no cost to employees. In Part II, ISEA discusses and answers OSHA's questions about electrolyte replenishment beverages. Finally, in Part III, we answer questions about shade tents and Wet Bulb Globe Temperature measuring devices.

Part I – Cooling PPE

1. Preamble Text

On pages 89 FR 70787-70788, OSHA discusses the background of its proposed text for "cooling PPE." The agency writes:

> "It is critical that employers who provide cooling PPE maintain the equipment's cooling properties; when these properties are not maintained, the defective equipment can heighten the risk of heat injury or illness with continued use."

ISEA believes OSHA is wrong to describe cooling PPE that needs to be recharged as "defective." It sets the wrong tone. This would be similar to calling a self-contained breathing apparatus as "defective" if the compressed air cylinder needs to be refilled. In both cases, the item is manifestly not defective, but being used as it should.

2. Answer to OSHA question on PPE

On page 89 FR 70788, OSHA requests **"***comments and evidence as to whether there are any scenarios in which wearing cooling PPE is warranted and feasible and OSHA should require its use."*

At 89 FR 70787 – 70788, OSHA references a *qualitative* study conducted by Roxana Chicas.[1, 2] OSHA quotes her article, stating: "reports from employees indicate that the use of cooling PPE, such as cooling vests, is burdensome and increases heat retention once the cooling properties are lost or ice packs have melted." A closer look at Chicas' two pilot studies is warranted:

> A quantitative study, "Cooling Interventions Among Agricultural Workers – A pilot study"[3] (this version has a copyright date of 2020, but a publication date of 2021. For clarity, we will refer to this as "the 2020 study" or the "quantitative study") and;
>
> A qualitative study, "Cooling Interventions Among Agricultural Workers: Qualitative Field-Base Study." (as noted above)

The test subjects in both studies included about 80 agricultural workers in central and south Florida. OSHA focuses on the second study, published in 2021, and narrowly focused on a few negative comments from a small subset of test subjects.

In the pilot study reviewed and quoted by OSHA, "Cooling Interventions Among Agricultural Workers: Qualitative Field-Base Study," Chicas et al. conducted research on agricultural workers in two locations in Florida. Her study included found groups: (1) the control group received no

[1] Chicas, R., et al., (2021). Cooling Interventions Among Agricultural Workers: Qualitative Field-Based Study. Hispanic Health Care International, 19(3), 174–181. https:// doi.org/10.1177/1540415321993429.
[2] In addition, Chicas also reports that some workers told her the vests "provided back support and alleviated muscle strain."
[3] Chicas R, et al., Cooling Interventions Among Agricultural Workers: A Pilot Study. Workplace Health Saf. 2021 (© 2020) Jul;69(7):315-322. doi: 10.1177/2165079920976524. Epub 2020 Dec 24. PMID: 33357122; PMCID: PMC8693251.

interventions, (2) the second group received cooling bandanas, (3) a third group received cooling vests, and (4) the fourth group received both cooling bandanas and cooling vests.

In both studies, Dr. Chicas provided workers with the HYPERKEWL^{tm} Evaporative Cooling Hybrid Elite Sport Vest.[4] However, this product is specially designed for cyclists for pre-race cooling and post-race cool downs. Moreover, it is generally used for short lengths of time. The HYPERKEWKL vest is designed to be soaked in water, and it requires airflow to be effective. Without airflow, it will not work as intended. This vest is not appropriate for agricultural workers in a hot, humid environment with little airflow. It is no wonder some test subjects in her study removed it[5] thus providing the comments to researchers, later referenced by OSHA.

However, in the journal article referenced in the proposed rule, workers "were all in agreement that the vest did keep them cool…" (Chicas, 2021, page 177) and when asked what practices employers should implement to protect them from heat stress, their answers included "personal cooling gear interventions." (Chicas, 2021, page 177). Furthermore, the workers in the study agreed that vests would be beneficial "during periods when the temperature is very high to help recover from heat stress and cool them down.[6]" This also suggests a new role for cooling PPE: at rest breaks, including lunch and end-of-day activities as employees doff work clothing.

In her quantitative 2020 study, Chicas found that when workers wore both a cooling bandana and the cooling vest (even though the type she provided was not appropriate for the job), "the combination group has the highest proportion of participants reporting **no** HRI [Heat Related Illness] symptoms (80%)..." followed by the bandana group (68%) and vest group (60%) and the control group (40%) has the least participants reporting no HRI symptoms[7]. (Chicas, 2020, page 317) In addition, Chicas concludes her 2020 study writing that "agricultural workers who used a bandana while working in a hot environment have the potential to be protective against exceeding a T_c [core body temperature] of 38°C." This makes sense because cooling bandanas are appropriate across a wide range of workplace environments, including the types in Chicas' study, they are

[4] https://www.techniche-intl.com/products/technicher-hybrid-cooling-vests-4531?cookieConsent=1
[5] It is not clear to ISEA how Dr. Chicas came to use this vest, when another style would have been more appropriate.
[6] This points to the vest's design and intended use.
[7] Ibid. page 317

worn directly on a part of the body that has minimal adipose tissue and have direct contact with the Internal Jugular Vein, which helps to directly reduce core body temperature. (emphasis added)

Taken together, Chicas's 2020 and 2021 studies **demonstrate the substantial benefits of wearing appropriate cooling PPE**: it was quantitatively effective, it had qualitative support and had immediate buy-in from the employees. In fact, even though the wrong vest was used, the benefits of this type of cooling PPE proved to be effective and provided core body temperature cooling.

Cooling PPE made work safer for employees. This type of PPE must be required by OSHA as a mandatory part of the final Heat Injury and Illness Prevention Programs rule.

Since OSHA used the findings in Chicas's second, qualitative study to decide cooling PPE should not be required, and the selection of cooling vests was flawed, but the overall results were positive, ISEA believes OSHA should reverse itself. Accordingly, **ISEA believes OSHA must require cooling PPE as part of an employer's heat stress program. In doing so, an employer's job hazard analysis and the assessed methods to address and prevent the hazard will lead to the proper type of cooling PPE to be selected and provided at no cost to the employee(s).**

This also answers OSHA's question: "*Whether proposed paragraph (j) mandating that requirements be implemented at no cost to employees is adequate, or whether there are other potential costs to employees that OSHA should take into consideration."*

ISEA believes OSHA's proposed mandate that all requirements be provided at no cost to the employee is adequate.

3. Types of Heat Stress PPE

Throughout the proposed rule, OSHA relies heavily on NIOSH's "Occupational Exposure to Heat and Hot Environments,"[8] also known as the "NIOSH criteria document." Last updated in 2016, **its conclusions about cooling PPE are no longer accurate**. For example, the 2016 document states "vests may contain as many as seventy-two cooling packs made of ice or phase-change materials." (page 83). We know of no vest that requires this many. More importantly, the document states "phase-change systems are cheap, but their temperature cannot be controlled and they often do not stay cool long enough to be practical.[9]" When the appropriate phase change material (PCM)-based vest is used, end-users receive 5-7 hours of cooling relief, if not more based on current technologies. Finally, the term "cheap" is derogatory, when "economically feasible" would have been a more appropriate term. We believe this shows the document's bias against the use of cooling PPE as an element of a heat injury and illness prevention plan.

Modern heat stress solutions available today include *high-tech, low-cost* items that use material science and engineered fabrics that help to make high heat working conditions safer. ISEA offers the following review of common types of personal cooling solution technologies:

These personal cooling solutions can be classified into "Passive"[10] and "Active" categories based on the mechanism of heat transfer and the energy input required. Active solutions will require an energy input while passive solutions follow natural heat transfer mechanisms without additional energy inputs[11].

Passive Cooling Solutions

Passive cooling solutions use textiles that accelerate one or more of the natural cooling mechanisms through- evaporative cooling, radiative cooling, convective and conductive cooling.

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[8] NIOSH [2016]. NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments. By Jacklitsch B, et al. Cincinnati, OH: U.S. DHHS/CDC/NIOSH. Publication 2016-106. (link)
[9] NIOSH, 2016, page 84
[10] Research at UC Berkley/Stanford-link, and China-EU Joint Lab on Nanophononics research- link
[11] Passive Cooling Mechanism

Enhanced Evaporative Technologies (Passive technology)

The most common of these are bandanas, cooling towels, vests and hard-hat inserts. These fabrics are a combination of a small percentage of hydrophilic (water loving) fibers and hydrophobic (water hating) fibers. The hydrophilic fibers absorb moisture from the body into the fabric. The hydrophobic fibers then push water and perspiration to the garment's exterior where they evaporate. These technologies are built into the fabric at the fiber level, so they do not wash or wear out.

The process works through diverting moisture rapidly and enlarging the wetted area. The evaporation ability directly affects the evaporative cooling efficiency. A higher wicking ability and evaporation rate can prevent the textile from becoming saturated and avoid excessive perspiration.[12]

Conductive Cooling Technologies (Passive technology)

Conductive Cooling materials, such as graphene, can work as "heat sink" (a component used in electronic devices to dissipate heat) to accelerate sweat transportation for personal perspiration management and its working mechanism.[13] Additional Passive Technologies, some which are currently fielded and some which are still under development, include:

Radiative cooling – in which the fabric reflects solar (near-infrared energy & visible) as well as offers high mid-IR (human body heat) emissivity (60 to 97%)[14]. Radiative Cooling materials reflects selective bandwidth (solar) using "Mie scattering" principles.

[12] Zhang X., et al., (2023) Advanced Cooling Textiles: Mechanisms, Applications, and Perspectives; https://doi.org/10.1002/advs.202305228; (See Sec. 5.2)
[13] Thermal properties of graphene: Fundamentals and applications ([Graphene has] "interesting prospects of both ultra-high thermal conductivity for heat sinking applications," p. 15) http://dx.doi.org/10.1557/mrs.2012.203
[14] Research at Stanford University (link), Radiative Cooling

Radiative cooling is also used in some types of head protection, where an aluminum shield reflects infrared heat energy back into the environment, preventing it from transferring through the shell.

Dynamic responsive cooling systems, unlike conventional cooling fabrics, which have static structures and limited functionality, smart responsive materials possess the ability to dynamically sense and respond to environmental changes in real time. This dynamic responsiveness enables them to adjust their properties and behavior based on specific stimuli, allowing for the simultaneous regulation of multiple heat dissipation pathways such as conduction, convection, radiation, and sweat evaporation.[15]

One version of Dynamic responsive cooling garments harnesses the hygroscopic and biofluorescent behaviors of genetically tractable microbial cells to design biohybrid textiles to select specific cooling mechanisms when in need.[16]

Active Cooling Solutions

Active cooling solutions include Active Moisture Management (Electro-Osmosis), air ventilation garments (AVGs),[17] liquid cooling garment (LCG),[18] and Thermoelectric cooling systems.[19]

Battery-powered, active solutions – These include high-tech fabrics that may include an "electronically controlled breathable membrane," which allows more sweat to evaporate as the wears' sweating rate increases[20]. Other technologies that are expected to come to market in the

[15] Zhang X., et al., (2023) Advanced Cooling Textiles: Mechanisms, Applications, and Perspectives; https://doi.org/10.1002/advs.202305228; (See Sec. 6)
[16] Wang et al., (2017) Harnessing the hygroscopic and biofluorescent behaviors of genetically tractable microbial cells to design biohybrid wearables; Science Advances; Vol 3., Issue 5, doi: 10.1126/sciadv.1601984
[17] Zhao et al., (2023) Development of Air Ventilation Garments with Small Fan Panels to Improve Thermal Comfort; Sustainability; May, 2023; **doi.org/10.3390/su15118452**
[18] Assessment of an active liquid cooling garment intended for use in a hot environment; Bartkowiak et al., Applied Ergonomics, Vol. 58, 2017; p. 182-189. doi.org/10.1016/j.apergo.2016.06.009
[19] Zhang, X. et al., (2023) Advanced Cooling Textiles: Mechanisms, Applications, and Perspectives
[20] Some heat management PPE use electro-osmosis to move sweat from the internal layer of garment to the external layer. See: Electro-osmosis - Wikipedia.

near future include vests with water pumps that use phase change material icepacks and circulate cool water through a vest, allowing for mobility, while keeping the wearer's core body temperature in a safe range for up to 7 hours.[21]

Cooling towels and bandanas work in conjunction with anatomy: the Internal Jugular Vein, in the neck, which can be cooled by a wetted garment going over the neck, where there is less fatty (adipose) tissue. The direct contact between this vein and cooling technology allows for more efficient core body temperature cooling.

Phase Change

Phase change vests are popular heat stress solutions among the nation's workforce. These vests have multiple pockets to hold cooling packs. The phase change packs contain substances that solidify when placed in cold water or in a freezer. Again, the packs fit into pockets in the vest to provide cooling for the wearer. The packs remain at a constant temperature, generally at about 57-60^{o} F, during the hours-long phase change. The length of time for use of these cooling devices depends on the ambient temperature and type of work being done. (Chicas used a vest that included phase-change materials, but also evaporative cooling technologies. The vest she used was designed for different types of environments than the work environments in her study.)

Other vests that are not as common, but also on the market are:

Air distributed torso cooling systems: In these vests, a microenvironment is created for the worker by providing air that can be 40-degrees Fahrenheit less than incoming air and far cooler than ambient air. While these air-cooled systems limit worker mobility, they are appropriate and effective for stationary work in high-heat environments.

Water-flow systems pump cold water through the vest using hoses. Again, these are used when the worker is stationary.

Coveralls

[21] Vests with a system that circulates chilled water through specialized channels in garments.

Right now, protective coveralls are available to employers that are designed and manufactured with impervious fabric on the front, to protect employees from hazardous exposures, with a breathable fabric on the back-half of the garment. This "zoned" design allows for air to escape more freely in areas that are not as vulnerable to the job's hazards.

Technology continues to advance in this area. Examples include garments manufactured with filter media, similar to that of an N95-reated respirator, allowing sweat to evaporate, but protective against particulate exposures. Similar advances are taking place in chemical protective garments.

OSHA must allow for flexibility in the proposed Heat Illness and Injury Prevention Plan requirement to allow employers and employees to use new protective equipment technologies and update the HIPP accordingly.

4. Effectiveness of Heat Stress Solutions

In addition to research by Chicas, many other researchers have found cooling PPE to be effective in preventing HRIs. The examples below demonstrate how cooling PPE can be protective for workers:

Research conducted by Cihuna et al.,[22] found that "most of the tested cooling vests would be beneficial for the user in terms of maintaining thermal homeostasis and mitigating heat strain." Cihuna et al. investigated phase-change vests, air-cooled vests and others.

Studies with construction workers using cooling vests during their scheduled rest breaks (A.P.C. Chan et al.) and while working (Ashtekar et al.) have shown the cooling vest to be effective at mitigating heat stress[23].

[22] Ciuha, U. (2020) Cooling efficiency of vests with different cooling concepts over 8-hour trials. *Ergonomics,* 64(5) 625-6739 https://doi.org/10.1080/00140139.2020.1853820
[23] Quoted in Chicas, 2020.

Choi et al., found that a combination of cooling PPE interventions kept workers' core body temperatures below 38-degrees C.[24]

"An Evaluation of Personal Cooling Systems for Reducing Thermal Strain Whilst Working in Chemical/Biological Protective Clothing"[25] was conducted on first responders wearing chemical/biological protective garment. The authors found use of a personal cooling garment incorporating phase-change materials "produced lower heart rate, mean skin, rectal and body temperatures in addition to improved work times compared to control" measures.

A 2024 study on healthcare workers found "that external body cooling strategies (EBCSs) manifested remarkably larger cooling benefits than internal body cooling strategies (IBCSs).[26]"

Moreover, a 2019 study looked at the physiological and psychological heat strain between exercise in participants wearing or not wearing a field-type Liquid Cooling Vests (LCV) while wearing an impermeable protective suit. The study found increases in rectal and mean skin temperatures, heart rate, heat storage, sweat rate, and cutaneous vascular conductance on the chest during 1 hour of walking were **significantly lower** with than without the LCV. Because the effectiveness of reducing heat strain was reasonable compared with other microclimate cooling systems, workers wearing protective clothing may be able to select the most suitable cooling system according to their work condition.[27] (emphasis added)

[24] Choi. J.W. (2008) Alleviation of heat strain by cooling different body areas during red pepper harvest work at WBGT 33 degrees C. *Industrial Health, 46(6).* 620-628. doi: 10.2486/indhealth.46.620. PMID: 19088415.
[25] Bach AJE, et al., (2019) An Evaluation of Personal Cooling Systems for Reducing Thermal Strain Whilst Working in Chemical/Biological Protective Clothing. *Front. Physiol.* 10:424. doi: 10.3389/fphys.2019.00424
[26] Song, W., et al., (2024) "Meta-analysis study on the effects of personal cooling strategies in reducing human heat stress: Possible application to medical workers; Journal of Building Engineering, Vol. 85, 2024. https://doi.org/10.1016/j.jobe.2024.108685.
[27] Tokizawa K, et al., (2019) Effectiveness of a field-type liquid cooling vest for reducing heat strain while wearing protective clothing. Ind Health. 2020 Feb 4;58(1):63-71. doi: 10.2486/indhealth.2018-0182. Epub 2019 Aug 9. PMID: 31406053; PMCID: PMC6997718.

In addition, other studies conclude that **cooling PPE can "significantly alleviate heat strain and improve thermal comfort,** based on the decrease in body temperature, heart rate, and subjective perceptions (including perceived exertion, thermal, wetness, and comfort sensation).[28]"

5. Cooling PPE is a key part of the hierarchy of controls for heat stress

Cooling personal protective equipment (PPE) is a key component of the hierarchy of controls for workplace safety. The hierarchy of controls prioritizes hazard elimination and reduction through substitution, but ambient heat – especially outdoor heat – cannot be eliminated. In this way, **PPE plays an outsized role in keeping workers safe**. When heat-related hazards cannot be sufficiently mitigated by higher-tier controls, cooling PPE provides an essential safeguard to protect workers from the risks of heat stress and related illnesses.

As part of a comprehensive heat hazard management strategy, cooling PPE complements other control measures and in no way replaces them. Engineering controls and administrative controls are typically employed first. However, in scenarios where these controls cannot fully mitigate heat exposure—such as outdoor work settings or industrial processes involving radiant heat—cooling PPE is a critical means to reduce the physiological burden of heat on workers. Examples of cooling PPE listed above aid in regulating core body temperature during work when temperatures are above 80-degrees F.

Like all other PPE it requires consistent use, proper maintenance, and training. Employers and employees are familiar with PPE, and adding cooling PPE to the mix of protective gear would be a minimal burden. Accordingly, **the inclusion of cooling PPE within the hierarchy of controls demonstrates its role as a vital element of a broader workplace heat illness prevention program**.

[28] Zhao Y, at al., (2017) Evaluating the Physiological and Perceptual Responses of Wearing a Newly Designed Cooling Vest for Construction Workers. Ann Work Expo Health. 2017 Aug 1;61(7):883-901. doi: 10.1093/annweh/wxx055. PMID: 28810683

Indeed, in her qualitative study, when Chicas asked workers what practices they thought employers should implement to protect workers from heat stress, the subjects recommended a complete heat stress program that includes cooling PPE along with other aspects of the proposed employer heat injury and illness prevent program.

Again, ISEA believes OSHA should require cooling PPE. The many types of cooling PPE are high-tech, low-cost ways to make working in the heat more protective for workers.

6. Indoor and Outdoor Environments

Indoor Environments

Throughout the proposed rule, OSHA discusses heat stress prevention for indoor environments. There are a number of heat stress solutions that OSHA should require employers to provide to employees at no charge. We describe these below to underscore their technological and economic feasibility.

On 89 FR 71037, OSHA says it "has provided the employer with multiple control options for compliance with the proposed rule, allowing them to tailor the controls to the individual workplaces." ISEA believes personal cooling PPE should be a required option. These align with the traditional hierarchy of controls that most employers and employees are familiar with, and as we describe below, there are a number of options that will make indoor work safer for employees.

Personal cooling devices for warehouse workers are designed to help mitigate heat stress and improve comfort, productivity, and safety. Here are some effective types of personal cooling devices commonly used for indoor environments:

Active Technologies

Phase Change Vests: These use special cooling packs that stay cool for several hours and can be "recharged" by placing them in ice or a refrigerator. They maintain a consistent, comfortable temperature (usually around 58°F), and they are agnostic of environment.

Battery-powered vests: These devices circulate cold air or liquid through channels to provide active cooling. While effective, they may require frequent recharging. New innovations have extended the usage time to up to 7 hours, eliminating the need for recharging during a single work shift.

Passive Technologies

Cooling Towels: These require air flow, such as being near a fan, and could be effective for indoor environments depending on the use of fans or other engineered airflow. Lightweight towels that can be wetted and worn around the neck or head. When the water evaporates, it provides a cooling effect. These are low-cost, portable, and convenient for heat stress relief.

Cooling Bandanas
Similar to cooling towels, these also require air flow, but as Chicas demonstrated, these effective at preventing heat stress relief.

Moisture-Wicking Clothing
Specially designed clothing made from breathable, moisture-wicking materials helps move sweat away from the body and promotes airflow. Moisture wicking clothing can enhance comfort by reducing heat retention.

Each option has different benefits and is suitable for different warehouse conditions. For continuous cooling, vests and fans tend to be the most effective, while bandanas and towels are ideal for intermittent, quick cooling.

Economic feasibility

These options are all in use now and are both economically and technologically feasible. They also help keep employees productive. Moreover, the use of these solutions would make indoor environments more protective for workers.

Outdoor Environments

Similarly, there is a wide range of cooling PPE for outdoor work. See our discussion of types of cooling PPE listed above in Part I, Sec. 2. In addition, some types of cooling solutions are activated by sweat, others are activated by applying small amounts of water. Cooling PPE solutions for outdoor work is both economical and technologically feasible. And, because a wide range of cooling PPE types are widely fielded throughout industry, the economic burden of an OSHA requirement for cooling PPE use would be minimal.

Environmental conditions may dictate which technology will perform best. A job hazard analysis will help determine the most appropriate type of cooling PPE for the job.

7. Heat Stress and Workplace Clothing

Passive cooling clothing mentioned above in Part I, Sec. 2, can be effectively used in outdoor environments to significantly reduce heat-related incidents. Specifically, radiative cooling, in combination with evaporative cooling (wicking/fast-drying fabrics), can be particularly effective in outdoor settings by reflecting most high-energy solar heat and managing human body temperature.

OSHA's proposed heat stress rule is silent on the use of clothing with wicking fabrics. ISEA recommends that this type of clothing could be categorized as personal protective equipment.

High Visibility Vests

OSHA states at 89 FR 70731 some high visibility vests are made of impermeable fabrics ("reflective vests that are made of water impermeable material that block effective heat dissipation"). We understand OSHA's point that some protective gear solves one hazard, but may create a heat hazard. PPE manufacturers understand this and have created effective solutions. Current vests are available with mesh panels that allow for airflow. In fact, there are many high visibility shirts compliant with the ANSI/ISEA 107-2020 high visibility standard made of moisture wicking fabrics. This allows for a garment that meets national standards for visibility and provides a means of heat stress relief.

Vapor Impermeable garments

Throughout the preamble, OSHA discusses and asks about how to best protect workers, who wear vapor impermeable garments. Proposed 1910.148(c)(3) would require employers that have employees who wear vapor-impermeable clothing to evaluate heat stress hazards resulting from these types of protective clothing and implement policies and procedures based on reputable sources to protect employees while wearing this clothing.

In addition to the research above, leading global garment suppliers recommend Phase Change Material cooling vests that are worn underneath these garments.

Again, **when cooling PPE is required, which proposed Sec. 1910.148(c)(3) tacitly does, employers will conduct a job hazard assessment and provide the appropriate cooling PPE at no cost to the employee.**

Finally, OSHA writes that some workers experience heat stress because of head protection (89 FR 70731). OSHA should be aware there are a number of methods to address heat build-up in hearing protection. Available right now are vented head protectors, which reduce heat build-up under the head protector, a new types of head protection with solar reflectors that reduce heat build-up; and innovative materials, as well as designs, that maximize air flow. Also, specially designed cooling

inserts that relieve heat build-up when wearing head protection are widely available. ISEA mentions this because **when cooling PPE is required, the appropriate types will be provided** to workers who need it as part of their employer's overall heat stress injury and illness prevention program.

Part II. Electrolyte Replenishment Beverages

OSHA should create a definition for drinking water that includes "electrolyte-replacing beverages that do not contain high amounts of sugar, caffeine or both." NACOSH, DOD, NIOSH, OSHA, and Washington State support electrolyte replenishment beverage hydration as part of complete heat stress management programs.

In this part we review OSHA's proposed rule and preamble text, on importance of electrolytes in hydration and OSHA's discussion of how it developed the proposed rule. Next, we review actions by states and branches of the U.S. military on electrolyte consumption. Finally, ISEA discusses why it believes electrolyte replenishment beverages should be included in the definition of water and clearly allowed under an OSHA heat stress rule.

1. OSHA's proposed text for hydration

The hydration-related text is found at proposed 1910.148(e)(2):

> (2) Drinking water. The employer must provide access to potable water for drinking that is: (i) Placed in locations readily accessible to the employee; (ii) Suitably cool; and (iii) Of sufficient quantity to provide access to 1 quart of drinking water per employee per hour.

At 89 FR 70779, OSHA asks "*Whether the agency should require the provision of electrolyte supplements/solutions in addition to water;"*
ISEA's answer is yes, for the following reasons.

2. Discussion of electrolyte replenishment in the Preamble

Reading the preamble's discussion of the importance of electrolytes, one would expect OSHA would require them to be provided. Throughout the text, OSHA cites numerous studies outlining the importance of electrolytes in preventing HRIs. OSHA also discusses the many risks to kidney damage from dehydration, and specifically, the loss of electrolytes. At 89 FR 70716, OSHA states that "sweat loss can deplete the body's stores of water and electrolytes, leading to lower blood volume, which leads to muscle cell death." In addition, in its discussion of physiological mechanisms of HRIs, OSHA says at 89 FR 70717, sweat depletes water and electrolytes as high quantities of water are consumed. "Hyponatremia" maybe developed as sodium in the blood is diluted." OSHA, at 89 FR 70718, states that heat cramps will afflict workers even if they drink water, but do not replace electrolytes. Yet in the proposed requirement for hydration OSHA is silent on electrolyte replenishment beverages.

The science strongly suggests **OSHA's heat stress rule will be more protective for workers with a requirement for electrolyte replenishment when working in environments over 80º F.**

Yet, the agency's reasons to not support employer provision of electrolyte replenishment beverages is a reference to an inset in a 2017 NIOSH two-page pamphlet on heat stress,[29] along with a comment from "an ACCOSH member."[30]

In the two-page pamphlet, an inset on the second page states offers three points. ISEA lists them and offers the following discussion.

The first point NIOSH offers is: "In general eating regular meals with adequate water intake is sufficient to maintain water and electrolyte balance." It is unclear if NIOSH's reference to meals

[29] https://stacks.cdc.gov/view/cdc/45851, cited in the proposed heat stress rule as "NIOSH 2017a; "National Institute for Occupational Safety and Health (NIOSH). (2017a). Heat Stress: Hydration. https://www.cdc.gov/niosh/mining/userfiles/works/pdfs/2017-126.pdf." (accessed Nov. 24, 2024)

[30] 89 FR 71041. "The OSHA proposed standard does not have this [electrolyte replenishment beverages] requirement, as the agency heard from **an ACCSH member** that electrolyte replenishment beverages can contain sugar that cannot be consumed by all workers." ISEA suggests this ACCSH member is incredibly out of touch with today's provision of electrolytes. Sugar-free beverages are fastest growing market for ERBs exactly because many cannot consume such beverages with high sugar content. (Emphasis added). This seems to be arbitrary and capricious.

is only to lunch and/or breakfast, or meals at rest breaks; also, NIOSH is silent on what foods are optimal for electrolyte replenishment. In addition, the NIOSH recommendation implicitly asks workers to monitor the weather and bring extra meals to work when temperatures are over 80º F. ISEA does not believe it is reasonable for OSHA to require workers to review weather patterns and pack the next day's meals accordingly, when a clear option is to require employers to provide electrolyte replenishment beverages.

A second comment in the 2017 document is: "for prolonged sweating lasting several hours, sports drinks with balanced electrolytes are another option to replace salt lost in sweat." Here, ISEA believes, the NIOSH recommendation is workable. In addition, the wording, "balanced electrolytes" is key. Balanced electrolytes refers to electrolytes that are 8% of sodium by volume[31]. Provision of this exacting balance will be protective for workers with high metabolic heat loads in ambient conditions over 80º F.

Third, the NIOSH document states: Heavy consumption of sports drinks will add unnecessary calories to your diet due to the added sugar." In fact, if OSHA fails to add electrolyte beverages to the definition of water, more workers are likely to bring to work and consume high-sugar, high-caffeine beverages. By requiring employers to offer electrolyte replenishment beverages, employers will select the best option for employees. In fact, by requiring electrolyte replenishment beverages, employers OSHA can require low-sugar, low-sodium and low-caffeine options.

The 2016 NIOSH criteria document is generally accurate about the physiological requirement for electrolyte replenishment, but is also outdated. For example, right now, there are a number of sugar-free, low-sodium electrolyte replenishment beverages on the market. In fact, sugar-free ERBs have a growing percentage of the market.

Taken together, these three points suggest OSHA should require employers to provide electrolyte replenishment beverages:

[31] NIOSH Criteria Document, 2016. Page 10

> There are a wide array of electrolytes replenishment beverages available to both consumers and employers through business-to-business distribution channels. Options include those that are sugar free, low caffeine and low in calories. Electrolyte replenishment beverages geared to the workplace also offer the NIOSH-recommended, optimal sodium levels that are designed to be maximally beneficial for workers working in high heat conditions.
>
> As noted above, if OSHA were not to require employers to provide electrolyte replenishment beverages, **it is likely workers would select beverages that are high in calories and or caffeine that would work against their health when working in high heat conditions**.

Aat 89 FR 71041, OSHA states that NIOSH, in its hydration fact sheet, recognizes that sports drinks with balanced electrolytes can replace salt lost in sweat, but similarly notes that heavy consumption will add calories due to the added sugar. This situation can be avoided with a requirement for the low-sugar options.

The final standard should equate electrolyte replenishment beverages with water in the hydration definition. Below are a number of authorities and existing state regulations that call for, equate and allow electrolyte replenishment beverages to be provided to employees along with water.

3. Washington State – Outdoor Heat Stress Regulations

Washington State's Outdoor Heat Exposure (WAC 296-62-095) regulation defines "Drinking Water" at *WAC 296-62-09520(3)*[32] as:

> "[P]otable water that is suitable to drink and suitably cool in temperature.
> Other acceptable beverages include drinking water packaged as a consumer product, and electrolyte-replacing beverages (i.e., sports drinks) that do not contain high amounts of sugar, caffeine or both, such as energy drinks."

[32] https://apps.leg.wa.gov/wac/default.aspx?cite=296-62-09520

> Identical language is found in Washington State's heat rule for agricultural work at WAC 296-307-0973.[33]

Washington State crafted this language after reviewing a study by Clapp et al. stating "[w]orkers should be provided cool drinks that appeal to them. Fluids can contain 4-8% carbohydrate and 10-30 mmol/L sodium." And "Electrolyte-carbohydrate beverages may be especially useful for rehydration between shifts.[34]"

In addition, Washington State regulators considered research by Kenefick et al., whose peer-reviewed journal article, "Hydration at the Work Site[35]," is summarized in the Concise Explanatory Statement[36] (CES)(included separately in our comments). The Washington State CES recognizes Kenefick's observation that "[i]mproved occupational guidelines for fluid and electrolyte replacement during hot weather occupational activities should be developed to include recommendations for fluid consumption before, during, and after work."

Washington State also received comments from the Local 26 Steamfitters Union, which commented that it "had a man go down because of heat stress and the company instituted a heat stress program." The program includes "plenty of liquids (including electrolytes)" among other actions[37].

The US Marine Corps tells officers to "Permit personnel to consume carbohydrate/electrolyte beverages (sports drinks) as supplemental nutrients under conditions of extreme calorie and water requirements; such as extremely vigorous activities[38]."

ISEA asks OSHA to use Washington State's definition of "water" in the final rule. The OSHA would be on firm ground to make this change. Many other organizations recognize the value and

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[33] https://app.leg.wa.gov/wac/default.aspx?cite=296-307-09720 (definitions section, including "drinking water."
[34] Outdoor Heat Exposure Concise Explanatory Statement, page 47
[35] Journal of the American College of Nutrition, Vol. 26(5): 597S-603S
[36] This document is attached to ISEA's filing to regulations.gov
[37] CES, page 186
[38] Field Hygiene and Sanitation, FM 21-10; MCRP 4-11.1D; page 3-7; Headquarters Department of the Army and Commandant, Marine Corps Washington, DC, 21 June 2000 (link)

role of electrolyte replenishment beverages in keeping workers safe when working in dangerous heat conditions.

ISEA offers the following definition of drinking water:

> "Drinking water means potable water that is suitable to drink and suitably cool in temperature. Other acceptable beverages include drinking water packaged as a consumer product, and electrolyte-replacing beverages that do not contain high amounts of sodium, sugar or caffeine."

This proposed definition is based on OSHA's own findings in the Preamble, policy results from DOD research and current safety practices, support from NACOSH's heat stress committee, and a reasoned policy decision from Washington State's Department of Labor and Industry. Furthermore, ISEA demonstrates below that OSHA and NIOSH's own recommendations, in addition to Roxana Chicas' research and the needs of those who are prediabetic and hypertensive support ISEA's recommended drinking water definition.

4. OSHA Water-Rest-Shade program says electrolyte replenishment benefits workers

OSHA's Water-Rest-Shade program[39], launched more than a decade ago, recognizes drinking electrolyte replenishment beverages can be more protective for workers than plain water. OSHA's program states:

> "Employers should provide cool water for workers to drink. Proper hydration is essential to prevent heat-related illness. For those working two hours or more, also provide access to additional fluids that contain **electrolytes.** (Emphasis added)

> "For longer jobs that last more than two hours, employers should provide electrolyte-containing beverages such as sports drinks. Workers lose salt and other **electrolytes** when they sweat. Substantial loss of electrolytes can cause muscle cramps and other dangerous

[39] www.osha.gov/heat-exposure/water-rest-shade

health problems. Water cannot replace electrolytes; other types of beverages are needed. Water or other fluids provided by the employer should not only be cool but should also be provided in a location that is familiar to the workers, near the work, easy to access, and in sufficient quantity for the duration of the work." (emphasis added)

5. NIOSH's "Occupational Exposure to Heat and Hot Environments" states that:

"During prolonged sweating lasting more than 2 hours, workers should be provided with sports drinks that contained **balanced electrolytes** to replace those lost during sweating, as long as the concentration of electrolytes/carbohydrates does not exceed 8% by volume."[40] (emphasis added)

6. Comments from OSHA SBREFA report notes that:

"In jointly submitted written comments, two SERs stated: Indeed, even though we provide our crews with coolers of water, they are always adding **electrolyte** powder to it, sometimes in less concentrated form, to make it a little less sweet. Those regularly come back empty. Accordingly, we do not think employers should be penalized for providing other, safe hydrating options in place of water, especially since these options are often healthier than water (any options that include **electrolytes** provide essential nutrients and minerals), and water is often part of the mixture or an ingredient of these options already.[41]" (emphasis added)

This was also borne out in a *Washington Post* article on heat stress mitigation of agricultural workers in Florida. Researcher Roxana Chicas "tested the effectiveness of electrolytes. She found **none of the workers who drank such liquids sustained kidney injury, whereas there was kidney injury in 23 percent of the control group, whose members drank plain water.**"[42]

[40] https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf; document page 9, Sec. 1.7.3(g)
[41] www.osha.gov/sites/default/files/Heat-SBREFA-Panel-Report-Full.pdf (quote is on doc. page 24; PDF page 30
[42] "*Heat is a mortal threat to farmworkers. A nurse may have found a way to protect them*." Washington Post, July 5, 2023 (link, accessed 3/14/25)

7. Pre-Diabetic, diabetic and hypertensive employees require balanced electrolytes.

As of 2021, approximately 97.6 million American adults—more than 1 in 3—have Prediabetes,[43] a condition where blood sugar levels are higher than normal but not yet high enough for a Type 2 Diabetes diagnosis. Individuals with Prediabetes should be cautious with their intake of added sugars that can elevate blood glucose levels. These individuals are generally advised to choose beverages with no added sugars or low-calorie options.

In addition, about 50% of the U.S. population has hypertension (aka is hypertensive)[44]. Those with hypertension must watch their sodium intake, which could cause their blood pressure to rise.

However, workers with diabetes, prediabetes or hypertension may still lose electrolytes when working in high heat conditions. Therefore, employers should provide hydration solutions formulated specifically for the needs of these workers. By providing hydrating drinks that have lower sodium concentrations and making electrolyte solutions with low sugar content available for those who need it, employers can keep their workforce properly hydrated without placing hypertensive, diabetic and pre-diabetic employees at risk.

To conclude Part II, ISEA reiterates its request for a definition of drinking water that includes electrolyte replenishment beverages. This will allow employers to supply these to employees without fear of violating OSHA regulations. In addition, provision of electrolyte replenishment beverages will be more protective for employees: they are medically necessary, as explained in Sec. M of the Preamble, necessary for those conducting heavy work in high heat conditions, they encourage employees to hydrate throughout the day, and low-sodium, low-sugar, low-caffeine options are readily available. Moreover, this recommendation is in line with DOD workplace safety policy, State-Plan state regulatory policy and even NIOSH and OSHA existing recommendations.

[43] https://diabetes.org/about-diabetes/statistics/about-diabetes
[44] Chobufo MD et al., Prevalence and control rates of hypertension in the USA: 2017-2018. Int J Cardiol Hypertens. 2020 Jul 31;6:100044. doi: 10.1016/j.ijchy.2020.100044.

Part III. Comments on Shade Tents and WBGT detectors

1. Comments on Shade Tents

The agency recognizes shade is an important aspect of safe work in outdoor high heat conditions, and OSHA asks a number of questions about how employers can provide effective shade areas. ISEA is pleased to provide the following answers.

At 89 FR 70779 OSHA discusses shade for outdoor rest breaks. The proposed requirements for shade are found at 89 FR 71070, and in proposed 1910.148(e)(3):

> (3) Break area(s) at outdoor work sites. The employer must provide one or more area(s) for employees to take breaks that can accommodate the number of employees on break, is readily accessible to the work area(s), and has at least one of the following: (i) Artificial shade (e.g., tent, pavilion) or natural shade (e.g., trees), but not shade from equipment, that provides blockage of direct sunlight and is open to the outside air; or (ii) Air-conditioning, if in an enclosed space like a trailer, vehicle, or structure

At 89 FR 70781, OSHA asks the following questions, to which ISEA provides answers.

• "*Whether OSHA appropriately defined shade; if not, how should OSHA define shade for outdoor break areas;"*

> "Blockage from direct sunlight" makes sense however, the second half of the sentence, "such that objects do not cast a shadow in the area of blocked sunlight." Coud be modified as follows: "such that objects *in the shaded area* do not cast a shadow in the area of blocked sunlight."
>
> OSHA should clarify that it means objects in the shaded area should not cast a shadow. This would help the regulated community better understand OSHA's intention.

• *Whether there are additional options for shade that are protective, but which OSHA has not included:*

ISEA urges OSHA to identify other examples of items that provide shade for outdoor workers, such as umbrellas, portable awnings and tarps.

In addition, the shade section would be more protective for workers with a statement that the "shade method" should have consistent UV blockage, flammability protection (if the source of shade is a textile), and should not introduce a secondary hazard.

Methods to assure these protective measures includes compliance with Canvass Products Association Internation (CPAI) 84,[45] "Temporary Tent Canopy, Umbrella, and Appurtenances Fabric" and/or NFPA 701-2023 ed. Standard Methods of Fire Tests for Flame Propagation of Textiles and Films for temporary "textile" shade structures. In addition, shade tents and umbrellas meeting American Association of Textile Chemists (AATC) "TM183-Transmittance or Blocking of UV Radiation through Fabric[46]" with a UPF rating of 25 or greater will make working in outdoor heat more protective for workers.

• *Whether there are situations when trees are not appropriate for use as shade and other measures should be required;*

Shaded areas must block direct sunlight completely. The use of artificial shade (e.g. slatted pergola) or natural shade (e.g. trees without "full canopies") that cast "inconsistent" blockage of direct sunlight should not be allowed. It would seem trees may be inconsistent because full foliage may not be present during the spring and fall, when temperatures could rise above 80°F, depending on location.

• *Whether there are situations when employers should be permitted to use equipment as shade; in those situations, how would employers mitigate other safety concerns such as run-over incidents;*

[45] The American Textile Association, was previously the Canvas Products Association International (CPAI). CPAI 84 is a flammability test method described here.
[46] American Association of Textile Chemists - https://members.aatcc.org/store/tm183/579/

ISEA believes using vehicles for shade creates a secondary hazard. OSHA is already prohibiting as a source of shade "equipment used in work process" (89 FR 70780). OSHA is potentially allowing as a source of shade "a large vehicle already on site, such as trucks and vans which are used to transport employees and goods" that are "not running." (89 FR 70780). The difference is unclear. Either type of vehicle could introduce a run-over or struck-by hazard to the worker.

In addition, when a vehicle is used as a source of shade, a break taken when the sun is overhead will not offer any shade.

Finally, OSHA says it expects the employer's employees will be able to comfortably fit in the shaded area. At 89 FR 70780, OSHA says employers must "ensure the break area(s) is large enough to accommodate all employees on break…" But the angle of the sun at the time of the break(s) and size of the vehicle are inconsistent, leading to a shade area that may not be large enough for the group of employees taking a break. The final rule would be more protective for workers if employers are required to carefully plan for the effective provision of shade.

• *Whether there are situations when employers should not be able to use large vehicles as shade or concerns, including those related to safety, with generally allowing the use of large vehicles for shade; and*

With the exception of employees taking breaks in the air-conditioned cab, ISEA asks OSHA to consider our comments above.

• *Whether there are situations when artificial shade should not be permitted, such as during high winds.*

If there is potential for a secondary hazard, consideration should be made and action taken to prevent or offset the secondary hazard. When installing artificial shade, care should be taken to consider factors such as obstructions, location, weather, wind exposure, access, exits, and anchoring stability. Employers should follow

manufacturer instruction and warnings to properly secure the artificial shade. ISEA agrees with OSHA these should not be used in high wind conditions.

• *Whether there are control options OSHA should require for vehicles, either when used for work activities or when used as a break area.*

Lock-out/Tag-out procedures could be put into place to prevent back-over fatalities.

2. Comments on Wet Bulb Globe Temperature (WBGT) devices

At 89 FR 70773, OSHA asks if the "*proposed definitions are appropriate, and whether any additional terms should be defined in the standard.*" We would like to focus on the Wet Bulb Globe temperature (WBGT) definition. OSHA states WBGT "means a heat metric that takes into account ambient temperature, humidity, radiant heat from sunlight or artificial heat sources, and air movement."

And at 89 FR 70777, OSHA asks "*Whether the standard should require specifications related to monitoring devices (e.g., in accordance with user manuals, properly calibrated) and whether the standard should specify a permissible accuracy level for monitoring devices*; and "*Whether the standard should further specify which sources of forecast data employers can use to comply with paragraph (d)(1)(i) and if so, what criteria should be used*."

Many environmental monitoring devices, including some that are handheld, offer WBGT data, and sometimes even more data than those in the WBGT definition (ambient temperature, humidity, radiant heat from sunlight or artificial heat sources, and air movement), such as air pressure, compass readings, evaporation rate, and wind chill. This last metric suggests that some environmental monitors can be used year-round. The

final rule should make clear any environmental monitor that can provide WBGT data can be used.

At 89 FR 70777, OSHA asks *Whether the standard should require specifications related to monitoring devices (e.g., in accordance with user manuals, properly calibrated) and whether the standard should specify a permissible accuracy level for monitoring devices;*

ISEA believes the standard should require specifications related to monitoring devices, especially that they are used in accordance with user manuals, properly calibrated, and properly maintained. For example, one monitor that offers a range of environmental data and measurements instructs users to "avoid direct sunlight on the temperature sensor and prolonged sunlight exposure to the unit in low airflow conditions."[47] Clearly, misuse of a heat stress monitor during high heat conditions could lead to negative consequences for employees and others.

Thank you for your attention to ISEA comments. I can be reached at cmackey@safetyequipment.org if you or your colleagues have questions or would like additional information.

Sincerely,

Cam Mackey
President & CEO
International Safety Equipment Association

[47] Kestrel Instruments. (link)