Heat Stress and Strain

ANSI/ASSP A10.50 Standard to Protect Construction Workers

Beat the Heat
New England Safety Roundtable
July 10, 2024

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Disclaimer

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ANSI Standards

- Consensus Standard – A10 Committee (70 members) under the auspices of ASSP (American Society of Safety Professionals)
- Consensus “when substantial agreement has been reached directly and materially affected interests”
- A subcommittee (A10.50) of ~ 30 members charged with developing the document
- A10.50 was 3 years in the making and recently affirmatively voted by the A-10 Committee
- Approved by ANSI in Jan. 2024

Why?

- To provide guidance for preventing the occurrence of heat strain
- Climate change concerns
- No OSHA standard (several states have requirements although no two are the same)
- Significant interest by members of the ASSP
- Can provide uniformity


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HEAT RECORDS ALARM SCIENTISTS IN 2024

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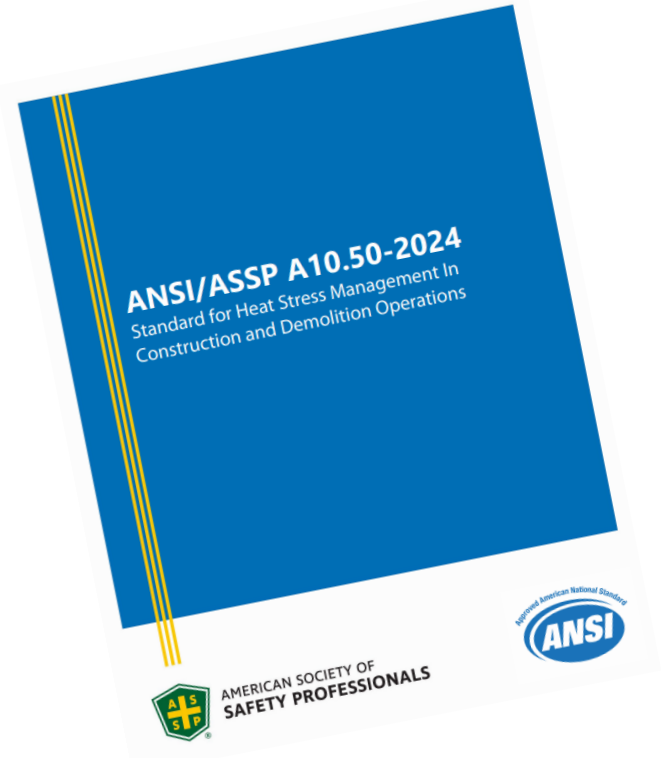


Heat stress determinants

Environmental heat

Metabolic Heat

Acclimatization status

Hydration status

Elements that affects the ability of sweat to cool

Humidity

Wind / air velocity

Clothing/PPE with high vapor resistance and/or insulation

Personal factors

Heat Stress Management Program – First Step.

- The written program should be developed in consultation with a “qualified person”

- Initiated prior to beginning work anticipated to greater than the initial trigger 70 WBGT (approximately 80°F Heat Index).

- An example of a heat stress management plan is found in the appendices

Heat Stress Management Program - should include 11 elements:

a. methods to **acclimatize workers** to heat stress environments

b. methods to **assess workers' exposure** to heat stress

c. requirements to **provide potable water** and electrolytes for employees involved with heavy work activities greater than 2 hours

d. an **emergency action plan** for heat-related medical emergencies, including on-site first aid (including rapid cooling)

e. requirements for **scheduled rest breaks**

f. requirements for **shaded areas** where the workers can rest

Heat Stress Management Program - should include

g. identification **on-site controls** (engineering, administrative controls, and personal protective equipment)

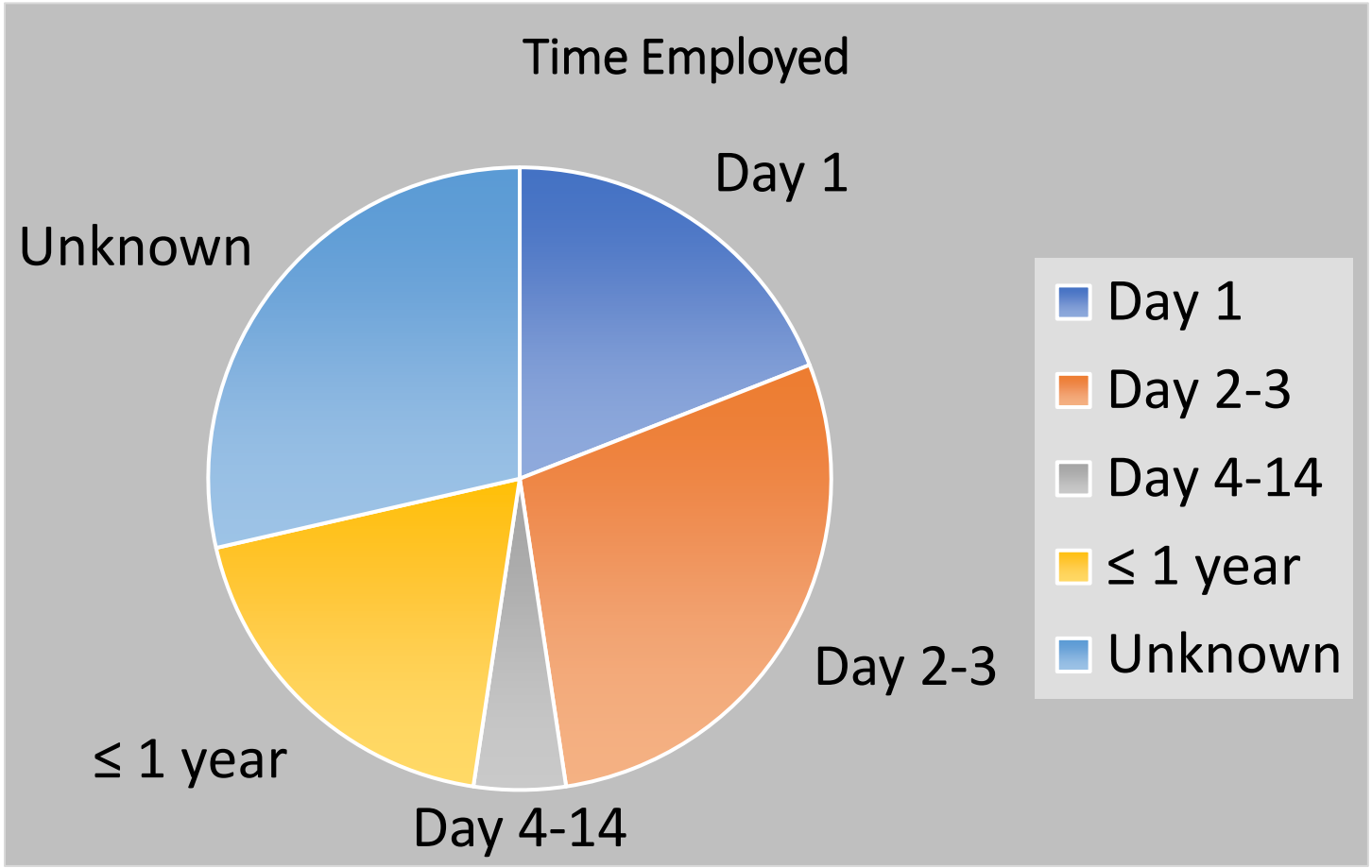
h. a method **for monitoring workers' heat strain** through means, *such as* the buddy system (and/or physiological monitoring devices)

i. identification of **employee participation and responsibilities**

j. heat stress **training**

k. an annual **program review** and revision as necessary

Heat Illness and Fatality Cases Cited by OSHA 2012-2013



Data from Morbidity and Mortality Weekly Report August 8, 2014. Vol 63.No. 31

Acclimatization

The physiological adaptations include:

1. Increased sweating efficiency
   - earlier onset of sweating
   - greater sweat production
   - reduced electrolyte concentration in sweat
2. Stabilization of blood circulation
   - lower heart rate
   - better regulated blood pressure
3. Increased skin blood flow at a given core temperature.
4. Lower core temperature
5. Enhanced cellular protection

Acclimatization

New workers or existing workers facing a sudden large change in temperature, physical intensity or a new requirement for PPE/clothing that affects sweat evaporative cooling.

Example

Day Number	Percent of the Work Shift Spent Working in the Heat
1	20%
2	40%
3	60%
4	80%
5	100%

Maintaining acclimatization

- Acclimatized workers can maintain their tolerance working 2 continuous hours in 5 of the last 7 days.

- There is noticeable loss of tolerance after 4 days of discontinued heat exposure and complete loss is apparent after 3 to 4 weeks.

- Re-acclimatization can be regained in 3 or 4 days.

Re-acclimatization example

Day #	Maximum percent of usual duration of work
Day 1	50%
Day 2	60%
Day 3	80%
Day 4	100%

Workplace Surveillance – Pre-task assessment

- *Before* beginning work on any task with potential for heat stress
- Daily, if anticipated to be greater than trigger level (*70 WBGT* or ~ Heat Index of 80°F)
- Assessment conducted by a *competent* person
- Keep written inventory of local conditions that affect or increase heat exposure
- Checklist examples can be found in the appendices

Workplace Surveillance – Environmental Assessment

Account for climatic factors including air temperature, humidity, air velocity, and radiant heat sources

- The standard recommends using Wet Bulb Globe Temperature (WBGT). This is a composite index made up of two or three temperatures.
- Allows for consideration *metabolic* heat sources and modification of heat transfer from the worker by *extra clothing* or certain PPE.

Comparison between WBGT and Heat Index

Ability to account for:	WBGT	Heat Index
Measurements taken in the shade	✓	✓
Measurements taken in the sun	✓	
Ambient temperature	✓	✓
Relative humidity	✓	✓
Wind	✓	
Effects of cloud cover	✓	
Effects of sun angle	✓	
This assessment can integrate:		
Use of additional protective PPE/clothing	✓	
Metabolic heat load (i.e., work intensity)	✓	
Differences between acclimatized and unacclimatized workers	✓	

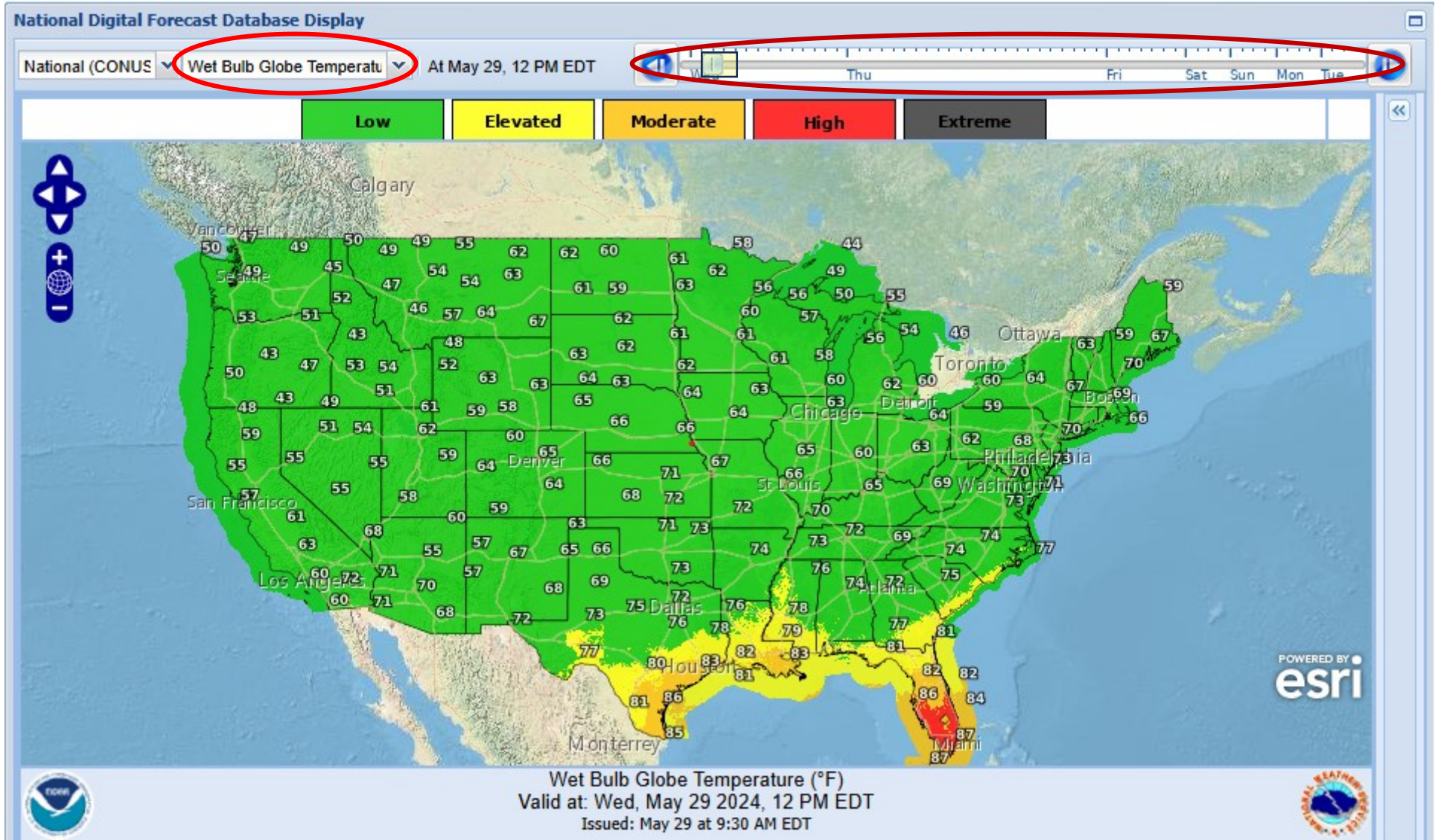
Environmental heat stress measurement

Option: 1 (Best) **Measure with an instrument**

- ***Wet-Bulb Globe Temperature*** (WBGT) is recommended to evaluate working conditions, including both environmental and “local sources”

Environmental heat information source (option 2)

- National Weather Service - Graphical Forecast (noaa.gov)



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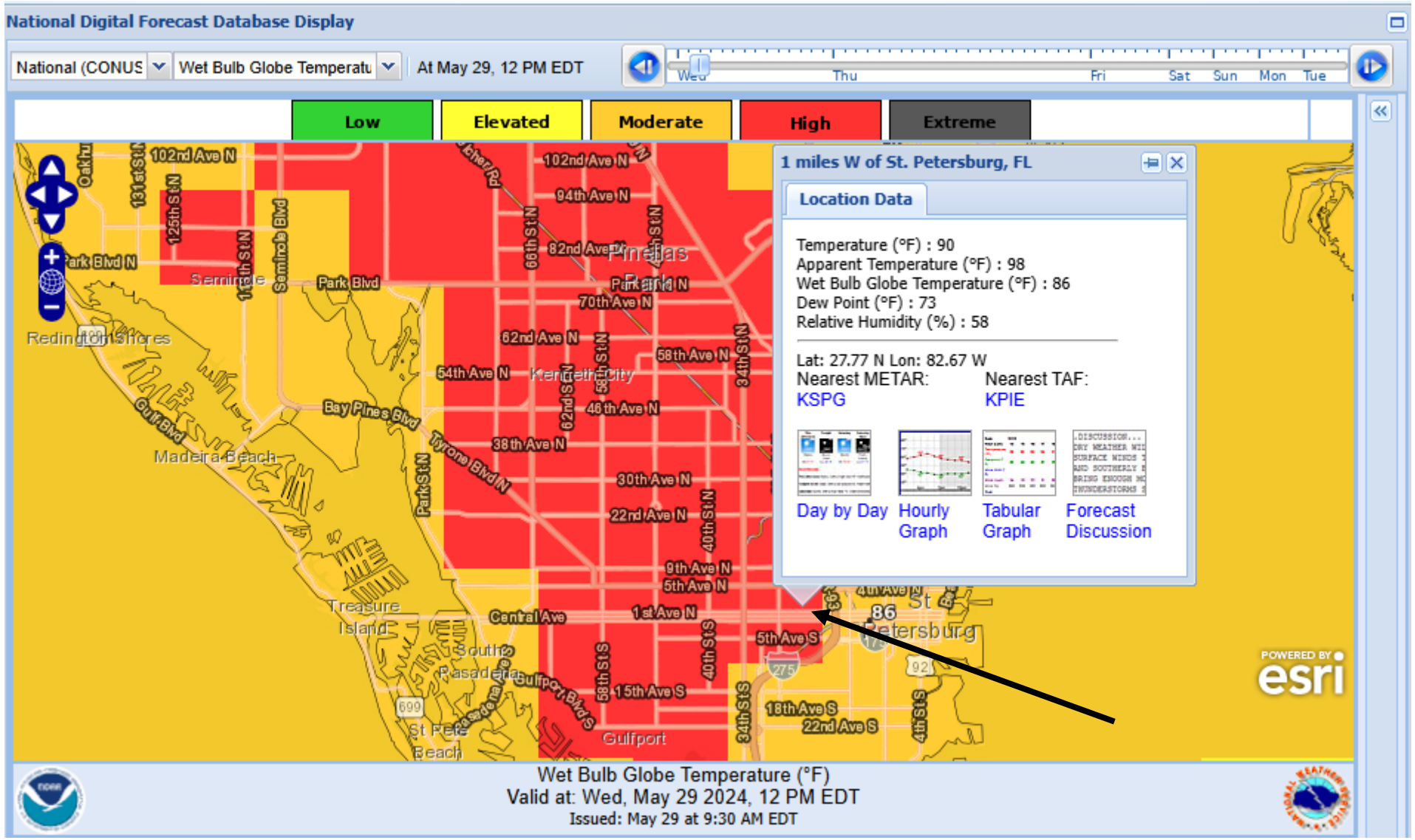


Assessment of clothing (examples)

Different ensembles are compared to a baseline of conventional work clothing typically consisting of long-sleeve shirt and pants.

Clothing Type	Addition to WBGT Index (°F)
Work clothes (long sleeve shirt and pants)	0
Woven cloth coveralls (assumes only modesty clothing underneath)	0
Non-woven SMS coveralls as a single layer	0
Hood of any fabric with any clothing ensemble	1.8
Non-woven polyolefin coveralls as a single layer	3.6
Double layer of woven clothing	5.4
Vapor-barrier apron with long sleeves and long length over cloth-coveralls	7.2
Vapor-barrier over cloth coveralls, without hood	21.6
Full-face, negative pressure respirator	0

Add the effect of clothing to the ambient WBGT to create a $WBGT_{clo}$

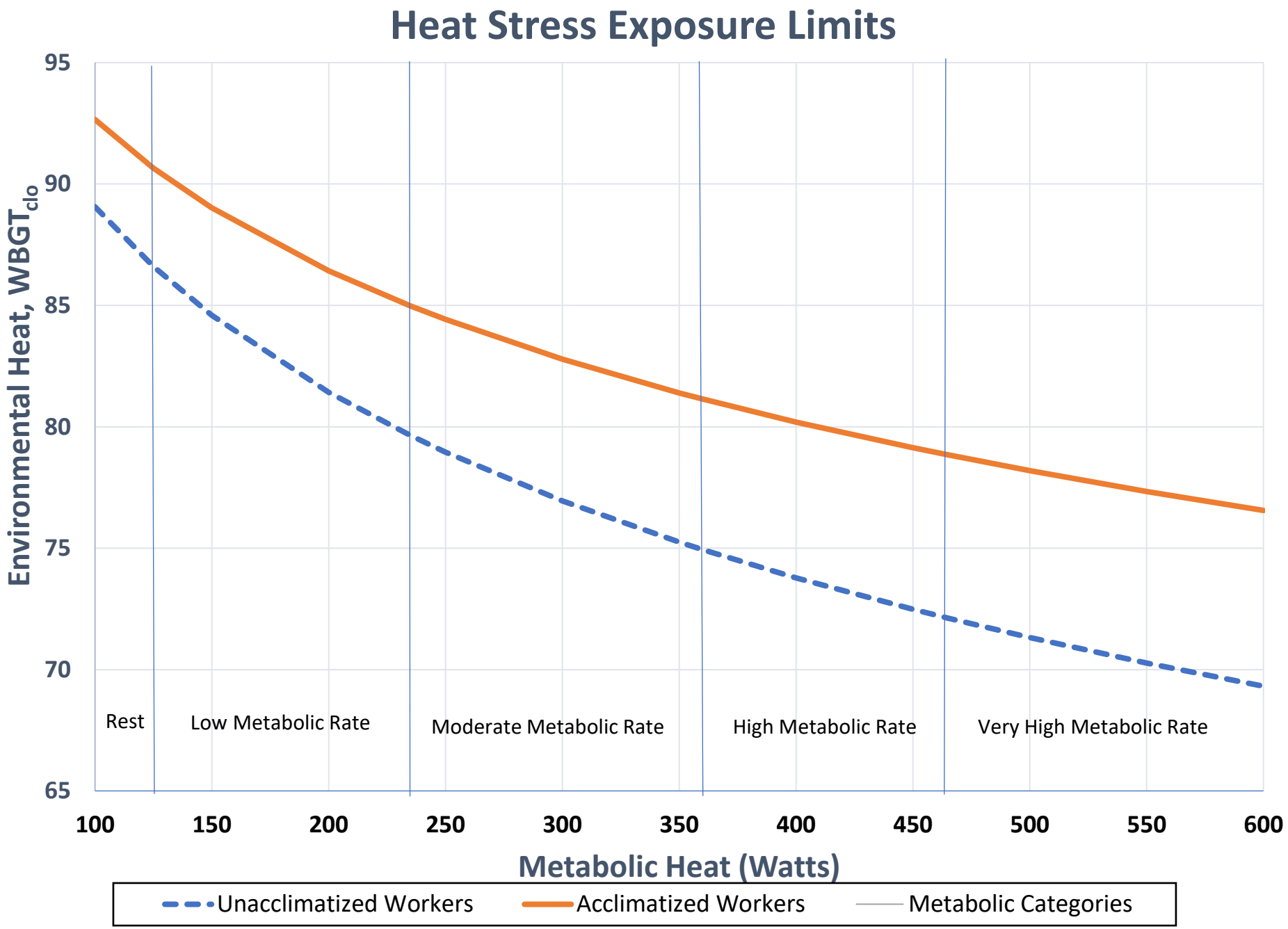
Reference: ISO 7443:2017, Fletcher et al. 2014
Additional Information at ACGIH: Heat Stress and Strain: 2022

Estimating Metabolic Heat

Examples

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

More comprehensive tables at:
Heat - Heat Hazard Recognition | Occupational Safety and Health Administration (osha.gov)


Heat Stress Exposure Limits
Environmental Heat, WBGTclo
95
90
85
80
75
70
65
Rest
Low Metabolic Rate
Moderate Metabolic Rate
High Metabolic Rate
Very High Metabolic Rate
100
150
200
250
300
350
400
450
500
550
600
Metabolic Heat (Watts)
Unacclimatized Workers
Acclimatized Workers
Metabolic Categories

Buddy System

- When workers are exposed at or above the heat stress exposure (WBGT) limits the employer should implement a buddy system for monitoring workers.

- If working alone – must use lone worker procedures such as regular communications and/or physiological monitoring devices.

Common Signs and Symptoms

<u>Included in Appendices:</u>

Heat Cramps

Heat Exhaustion

Heat Rash

Heat Stroke

Heat Syncope

Rhabdomyolysis

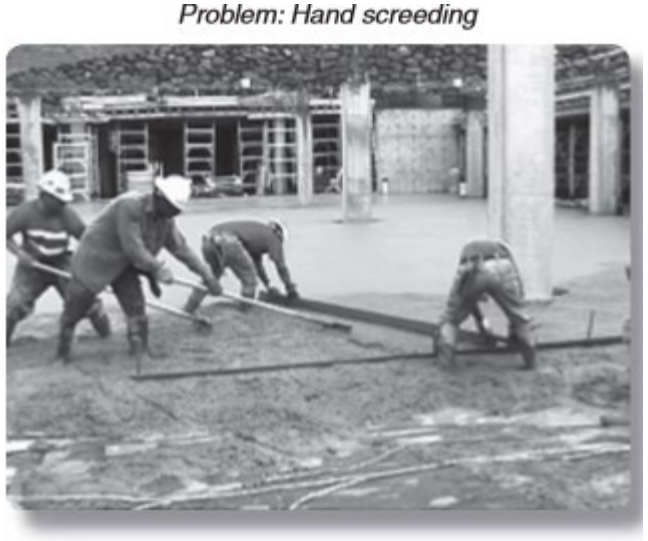
Should be included in training of all affected employes since:

1) Workers need to know when *they* are becoming heat strained and
2) Workers need to be able to play an important role in the surveillance of heat strain *in coworkers (buddy system)*.

Controls

Elimination/Substitution

Engineering controls



Metabolic engineering controls

PPE

Access to drinking water (hydration)

- Suitably cool, close proximity
- Sufficient quantity ~ 1 qt / ee / hr
- Better to drink multiple times each hour rather than once an hour;
- When employees are involved with heavy work activities for greater than 2 hours employees shall also have access to electrolyte replenishment beverages

Rest breaks and shaded break locations

- Used as an administrative control to reduce the overall heat load by providing **a temporary cool environment while reducing the metabolic heat load by resting**.

- Provide shaded rest and hydration break areas for workers **above** the program initiation **action level**.

- The length and frequency of rest **breaks should increase** as the **heat exposure increases**. (*scheduled rest breaks when above exposure limits*)

Acclimatized Workers, Selected Examples of Minutes of Work/Rest, Three Levels Metabolic Workload

Appendix 4: Work/Rest in Minutes per Hour

WBGT Index$_{clo}$	WBGT Index$_{clo}$	Metabolic Work Load	Metabolic Work Load	Metabolic Work Load
Work Exposure	Rest Exposure*	Moderate	Heavy	Very Heavy
85	85	40 / 20	25 / 35	17 / 43
85	80	47 / 13	35 / 25	29 / 31
85	75	51 / 9	42 / 18	36 / 24
85	70	53 / 7	46 / 14	41 / 19

- *"Rest Exposure" needs to be measured in the rest area

Personal Risk Factors

- Employees must be made aware that personal health conditions or risk factors may contribute to heat stress and the warning signs attributed to those risk factors.

- Medical surveillance should be established for covered workers. The assessment with an HCP should include personal risk factors.

- Employees should be encouraged to consult with their primary medical care provider

Personal Risk Factors - Examples

- age
- poor diet
- poor physical fitness
- alcohol use
- fatigue and sleep deprivation
- diabetes
- smoking and tobacco use
- pregnancy
- insufficient acclimatization
- obesity and high body mass index (BMI)
- excessive caffeine use (coffee, caffeinated soft drinks, energy drinks, etc.)
- asthma and other respiratory issues
- cardiac conditions
- high blood pressure
- prior heat illness episodes
- use of certain prescriptions or non-prescription and over the counter drugs, medications, or supplements

First Aid and Emergency Action Plan

An employee exhibiting signs or symptoms of heat illness shall be monitored and shall not be left alone or sent home without being offered on-site first aid and/or being provided with emergency medical services in accordance with the employer's procedures.

Monitoring should include measuring the heart rate. Estimated core temperature measurements (via temporal, oral, ear canal) are subject to error and biases low.

First Aid and Emergency Action Plan

- If a worker is suffering from heat stroke that include any central nervous system (CNS) impairment signs, there should be immediate, aggressive, full-body cooling, by placing the worker in a tub or tarp of cold water.
- Medical help should be contacted immediately.

Responsibilities (examples)

- **Competent Person** responsibilities include:

a. *Implementing* the site-specific *heat stress management program* and the requirements of this standard.

b. Performing *job/task hazard analyses* for heat stress.

c. *Monitoring* workers for *signs* and symptoms of heat illness.

d. *Ensuring* workers take needed *rest breaks*; encouraging workers to *drink sufficient fluids.*

e. Implementing *heat stress controls* according to the hierarchy of controls.

f. Ensuring workers are properly *acclimatized* when beginning to work in heat.

Training (to carry out their respective responsibilities)

- Broken out by:
  - Supervisors
  - Competent Persons
  - Qualified Person
  - Employees

- Retraining
  - Retraining shall occur annually and whenever there is a recognized lack of knowledge.

Want to learn more?

- A 1-day, on-line course on occupational heat stress will be held *July 19th* by the Region 1 (*Keene State College*), OSHA Training Institute Education Center.
- The course identifies key factors in occurrence and extent of work-related exertional heat stress.
- Through case studies and examples, it examines the physiological effects of heat, assessment of risk and workplace controls.
- The course will review OSHA initiatives and rulemaking and will review and refer to the new ANSI/ASSP A10.50 2024 Construction Heat Stress Standard.
  - **For more details see https://oshaedne.com/ncsh-482/**