

Using the Heat Index: A Guide for Employers

Introduction

Outdoor workers who are exposed to hot and humid conditions are at risk of heat-related illness. The risk of heat-related illness becomes greater as the weather gets hotter and more humid. This situation is particularly serious when hot weather arrives suddenly early in the season, before workers have had a chance to adapt to warm weather.

For people working outdoors in hot weather, both air temperature and humidity affect how hot they feel. The "**heat index**" is a single value that takes both temperature and humidity into account. The higher the heat index, the hotter the weather feels, since sweat does not readily evaporate and cool the skin. The heat index is a better measure than air temperature alone for estimating the risk to workers from environmental heat sources.

Heat-related illness can be prevented.

OSHA does not have a specific standard that covers working in hot environments. Nonetheless, under the OSH Act, employers have a duty to protect workers from recognized serious hazards in the workplace, including heat-related hazards. This guide helps employers and worksite supervisors prepare and implement hot weather plans. It explains how to use the

heat index to determine when extra precautions are needed at a worksite to protect workers from environmental contributions to heat-related illness. Workers performing strenuous activity, workers using heavy or non-breathable protective clothing, and workers who are new to an outdoor job need additional precautions beyond those warranted by heat index alone.

Workers new to outdoor jobs are generally most at risk for heat-related illnesses. For example, Cal/OSHA investigated 25 incidents of heat-related illness in 2005. In almost half of the cases, the worker involved was on their first day of work and in 80% of the cases the worker involved had only been on the job for four or fewer days. That's why it's important to gradually increase the workload or allow more frequent breaks to help new workers and those returning to a job after time away build up a tolerance for hot conditions. Make sure that workers understand the risks and are "acclimatized".

Heat Index	Risk Level	3URWHFWLYH 0HDVXUHV
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91° to 103°F	Moderate	Implement precautions and heighten awareness
103° to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

Two primary sources of heat for workers: Workers become overheated from two primary sources: (1) the environmental conditions in which they work and (2) the internal heat generated by physical labor. Heat-related illnesses occur when the body is not able to lose enough heat to balance the heat generated by physical work and external heat sources. Weather conditions are the primary external heat sources for outdoor workers.

Outdoor workers include any workers who spend a substantial portion of the shift outdoors. Examples include construction workers, agricultural workers, baggage handlers, electrical power transmission and control workers, and landscaping and yard maintenance workers. These workers are at risk of heat-related illness when the heat index is high. Additional risk factors are listed below. *These must be taken into consideration even when the heat index is lower.*

- Work in direct sunlight-adds up to 15 degrees to the heat index.
- Perform prolonged or strenuous work
- Wear heavy protective clothing or impermeable suits

*This guidance is advisory in nature and informational in content. It is not a standard or regulation, and it neither creates new legal obligations nor alters existing obligations created by OSHA standards or the Occupational Safety and Health Act. Pursuant to the OSH Act, employers must comply with safety and health standards and regulations issued and enforced either by OSHA or by an OSHA-approved State Plan. In addition, the Act's General Duty Clause, Section 5(a)(1), requires employers to provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm.

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About the Heat Index

The U.S. National Oceanographic and Atmospheric Administration (NOAA) developed the heat index system. The heat index combines both air temperature and relative humidity into a single value that indicates the apparent temperature in degrees Fahrenheit, or how hot the weather will feel. The higher the heat index, the hotter the weather will feel, and the greater the risk that outdoor workers will experience heat-related illness. NOAA issues heat advisories as the heat index rises. To learn more about the heat index, visit NOAA's website.

NOAA's National Weather Service

Heat Index

Temperature (°F)

	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

- Caution
- Extreme Caution
- Danger
- Extreme Danger

Why humidity matters: Relative humidity is a measure of the amount of moisture in the air. Sweat does not evaporate as quickly when the air is moist as it does in a dry climate. Since evaporation of sweat from the skin is one of the ways the human body cools itself on a hot day, high humidity reduces our natural cooling potential and we feel hotter. Low humidity can also be a problem for outdoor workers in hot, desert-like climates. Sweat evaporates very rapidly in low humidity, which can lead to severe dehydration if a person does not drink enough water throughout the day.

IMPORTANT NOTE: The heat index values were devised for shady, light wind conditions, **and exposure to full sunshine can increase heat index values by up to 15° Fahrenheit.** To account for solar load, added precautions are recommended. See Protective Measures to Take at Each Risk Level.

NOAA issues extreme heat advisories to indicate when excessive, extended heat will occur. The advisories are based mainly on predicted heat index values:

- *Excessive Heat Outlook*: issued when the potential exists for extended excessive heat (heat index of 105-110°F) **over the next 3-7 days**. This is a good time to check on supplies, such as extra water coolers, and refresh worker training.
- *Excessive Heat Watch*: issued when excessive heat could occur within the **next 24 to 72 hours**, but the timing is uncertain.
- *Excessive Heat Warning*: issued when the heat index will be high enough to be **life threatening in the next 24 hours**. This warning indicates that the **excessive heat is imminent or has a very high probability of occurring**.
- *Excessive Heat Advisory*: similar to an Excessive Heat Warning, but less serious. This is issued when the heat index could be **uncomfortable or inconvenient, but is not life threatening if precautions are taken**.

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Using the Heat Index to Protect Workers

The heat index can be used to help determine the risk of heat-related illness for outdoor workers, what actions are needed to protect workers, and when those actions are triggered. Depending on the heat index value, the risk for heat-related illness can range from lower to very high to extreme. As the heat index value goes up, more preventive measures are needed to protect workers. Heat index values are divided into four bands associated with four risk levels. These bands differ from those appearing in the NOAA Heat Index chart, which was developed for the public. The NOAA bands have been modified for use at worksites:

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

Important consideration: NOAA devised the heat index values for shaded conditions and light winds. **Full sunshine can increase heat index values by up to 15° Fahrenheit.** Strenuous work and the use of heavy or specialized protective clothing also have an additive effect. As a result, the risk at a specific heat index could be higher than that listed in the table above if the work is in direct sunlight without a light breeze, or if work involves strenuous tasks or the use of heavy or specialized protective clothing. Extra measures, including implementing precautions at the next risk level, are necessary under these circumstances.

The employer's response at the four risk levels is the subject of the remainder of this guide. The steps employers should take in response to an elevated heat index are the same type of steps that they would follow to address other hazards in the workplace:

- Develop an illness prevention plan for outdoor work based on the heat index
- Train your workers how to recognize and prevent heat-related illness
- Track the worksite heat index daily; communicate it and the required precautions to workers
- Implement your plan; review and revise it throughout the summer

STEP 1: Develop a heat-related illness prevention plan before heat index levels rise.

Use the Protective Measures to Take at Each Risk Level to inform your planning. The plan should address:

Plan Element	Heat Index Risk Level			
	Lower (Caution)	Moderate	High	Very High/Extreme
Supplies (ensuring adequate water, provisions for rest areas, and other supplies)	✓	✓	✓	✓
Emergency planning and response (preparing supervisors and crews for emergencies)	✓	✓	✓	✓
Worker acclimatization (gradually increasing workloads; allowing more frequent breaks as workers adapt to the heat)	✓	✓	✓	✓
Modified work schedules (establishing systems to enable adjustments to work schedules)		✓	✓	✓
Training (preparing workers to recognize heat-related illness and preventive measures)	✓	✓	✓	✓
Physiological, visual, and verbal monitoring (using direct observation and physiological monitoring to check for signs of heat-related illness)		✓	✓	✓

Review the pages of this guide to learn more about what you can do to protect workers from heat-related illness. Use checklists to assist in planning ahead and in daily planning.

STEP 2: Train workers before it gets hot. Train workers about safe work practices before heat index levels go up. Prepare workers so that they recognize the signs and symptoms of heat-related illness, how to prevent it, and what to do if someone has symptoms. ***Reinforce the training on hot days.***

For heat-related illness prevention training tools and resources, go to Training Resources. OSHA’s factsheets and worksite posters (in English and Spanish) can help in communicating key messages about heat safety and health.

STEP 3: Track the weather for the worksite daily and assess the risk to workers. Know how hot it will be during scheduled work activities and use this information to determine which preventive measures should be taken.

Check with the **National Weather Service** to get the current or predicted heat index values and see a map of areas under excessive heat warning across the U.S. The heat index is also announced by television and radio stations as part of the local weather. Monitor weather reports daily to remain prepared for high heat index levels. Monitor weather reports daily to remain prepared for high heat index levels. **Use OSHA's Heat Smartphone App** to check the heat index for your worksite and see reminders about the protective measures for the specified risk level.

STEP 4: Implement your plan when the heat index is at or above 80° Fahrenheit. Adjust risk level based on site conditions (direct sunlight vs. shaded, with breeze), work load, and type of protective clothing.

See **Summary of Employer Actions** at each risk level.

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Protective Measures to Take at Each Risk Level

Use the protective measures described for each risk level to help you plan ahead, and schedule and train your workers so that everyone is prepared to work safely as the heat index rises.

Actions for Low Risk Conditions: Heat Index Less Than 91°F

Actions for Moderate Risk Conditions: Heat Index is 91°F to 103°F

Actions for High Risk Conditions: Heat Index is 103°F to 115°F

Actions for Very High to Extreme Risk Conditions: Heat Index Greater Than 115°F

Summary of Risk Levels and Associated Protective Measures

The most critical actions employers should take to help prevent heat-related illness at each risk level:

Heat Index	Risk Level	Protective Measures
<91°F	Lower (Caution)	<ul style="list-style-type: none"> ▪ Provide drinking water ▪ Ensure that adequate medical services are available ▪ Plan ahead for times when heat index is higher, including worker heat safety training ▪ Encourage workers to wear sunscreen ▪ Acclimatize workers <p>If workers must wear heavy protective clothing, perform strenuous activity or work in the direct sun, additional precautions are recommended to protect</p>
91°F to 103°F	Moderate	<p>In addition to the steps listed above:</p> <ul style="list-style-type: none"> ▪ Remind workers to drink water often (about 4 cups/hour)** ▪ Review heat-related illness topics with workers: how to recognize heat-related illness, how to prevent it, and what to do if someone gets sick ▪ Schedule frequent breaks in cool, shaded area ▪ Acclimatize workers ▪ Set up buddy system/instruct supervisors to watch workers for signs of heat-related illness <p>If workers must wear heavy protective clothing, perform strenuous activity or work in the direct sun, additional precautions are recommended to protect workers from heat-related illness.*</p>

		<ul style="list-style-type: none"> ▪ Schedule activities at a time when the heat index is lower ▪ Develop work/rest schedules ▪ Monitor workers closely
103°F to 115°F	High	<p>In addition to the steps listed above:</p> <ul style="list-style-type: none"> ▪ Alert workers of high risk conditions ▪ Actively encourage workers to drink plenty of water (about 4 cups/hour)** ▪ Limit physical exertion (e.g. use mechanical lifts) ▪ Have a knowledgeable person at the worksite who is well-informed about heat-related illness and able to determine appropriate work/rest schedules ▪ Establish and enforce work/rest schedules ▪ Adjust work activities (e.g., reschedule work, pace/rotate jobs) ▪ Use cooling techniques ▪ Watch/communicate with workers at all times <p>When possible, reschedule activities to a time when heat index is lower</p>
>115°F	Very High to Extreme	<p>Reschedule non-essential activity for days with a reduced heat index or to a time when the heat index is lower</p> <p>Move essential work tasks to the coolest part of the work shift; consider earlier start times, split shifts, or evening and night shifts. Strenuous work tasks and those requiring the use of heavy or non-breathable clothing or impermeable chemical protective clothing should not be conducted when the heat index is at or above 115°F.</p> <p>If essential work must be done, in addition to the steps listed above:</p> <ul style="list-style-type: none"> ▪ Alert workers of extreme heat hazards ▪ Establish water drinking schedule (about 4 cups/hour)** ▪ Develop and enforce protective work/rest schedules ▪ Conduct physiological monitoring (e.g., pulse, temperature, etc) ▪ Stop work if essential control methods are

		inadequate or unavailable.
<p>*The heat index is a simple tool and a useful guide for employers making decisions about protecting workers in hot weather. It does not account for certain conditions that contribute additional risk, such as physical exertion. Consider taking the steps at the next highest risk level to protect workers from the added risks posed by:</p> <ul style="list-style-type: none">▪ Working in the direct sun (can add up to 15°F to the heat index value)▪ Wearing heavy clothing or protective gear <p>**Under most circumstances, fluid intake should not exceed 6 cups per hour or 12 quarts per day. This makes it particularly important to reduce work rates, reschedule work, or enforce work/rest schedules.</p>		

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Actions for Lower (Caution) Risk Conditions: Heat Index is Less Than 91°F

Most people can work safely when the heat index is <91°F with only basic measures for worker safety and health, as required by the OSH Act. As minimum measures, employers have a duty to:

- **Provide adequate amounts of drinking water** in convenient, visible locations close to the work area.
- **Ensure that adequate medical services are available.** Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.)

Additional precautions are advisable based on site conditions, work load, and protective clothing use:

- **Take actions described for Moderate Risk Conditions (91°F - 103°F) if heat index is close to 91°F OR work is being conducted in direct sunshine or without a light breeze.**
- **Follow additional precautions for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing** because they are at greater risk even when the risk to other workers is lower. Workers in heavy, non-breathable or "impermeable" protective clothing can experience heat-related illness at temperatures as low as 70°F. Monitor them closely for signs of heat-related illness and see the section on Taking Added Precautions for High Risk Conditions.
- **Acclimatize new and returning workers performing strenuous work. These individuals may be at high risk for heat-related illness, even when the heat index is low.**
- **Check the weather forecast regularly** in warm seasons to learn if more extreme hot weather conditions are predicted. Make sure your hot weather plans are in place and that workers are trained *before*

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

hot outdoor work begins. **Train workers** on how to recognize symptoms of heat-related illness, individual risk factors for heat-related illness, how to prevent it, and what to do if someone has symptoms so they are prepared when hotter, higher-risk work conditions arise.

- **Encourage workers to wear sunscreen and use other protections from direct sunlight.** Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness.

Drinking Water

Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

Sanitation standard 29 CFR 1910.141 requires that employers provide "potable water" at work sites, which is water that meets the drinking water standards of the state or local authority having jurisdiction, or water that meets the quality standards prescribed by the U.S. EPA's drinking water regulations (40 CFR Part 141).

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Actions for Moderate Risk Conditions: Heat Index is 91°F to 103°F

At the moderate risk level some precautions in addition to those already mentioned are needed to prevent heat-related illness. Review heat-related illness signs and precautions with workers. Remind workers to drink water. Provide workers opportunities to rest in cool, shaded areas. Be aware of conditions that could increase risk.

- **Alert workers to the heat index anticipated for the day and identify each precaution in place at the work site to reduce the risk of heat-related illness.**
- **Provide adequate amounts of cool water and disposable cups** in convenient, visible locations close to the work area.
- **Remind workers to drink small amounts of water often** (before they become thirsty). A good rule of thumb is to drink about 4 cups of water every hour when the heat index suggests a moderate risk level.
- **Ensure that adequate medical services are available.** Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, you must have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.)
- **Respond to heat-related illness and medical emergencies without delay. Workers who show symptoms of heat-related illness need immediate attention. Treating milder symptoms (headache, weakness) early by providing rest in a shaded area and cool water to drink can prevent a more serious medical emergency. Call 911 immediately if a worker loses consciousness or appears confused or uncoordinated. These are signs of possible heat stroke. *Heat stroke is fatal if not treated immediately.***
- **Review heat-related illness signs and symptoms and site-specific precautions during daily meetings or toolbox talks.** Be sure everyone knows procedures for responding to possible heat-related illness.
 - What steps to follow if a worker exhibits signs and symptoms of heat-related illness

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

- Who to call for medical help
- Who will provide first aid until the ambulance arrives

The resources under Educational Resources are useful training tools for daily meetings and toolbox talks.

- **Schedule frequent rest breaks in cool, shaded areas.**

Provide air conditioned or shaded areas close to the work area.

Set up temporary shade when working in open fields or areas without easy access to shade or air conditioning.

- **Acclimatize new and returning workers.** Gradually increase the workload or allow more frequent breaks to help new and returning workers build up a tolerance for hot conditions over time. **If the heat index increases suddenly, allow all workers more frequent breaks for a few days while they become accustomed to the warmer conditions.**
- **Implement actions for the High Risk Conditions (103°F - 115°F) if heat index approaches 103°F OR work is strenuous, in direct sunlight, or involves the use of heavy or non-breathable clothing or impermeable chemical protective clothing.**
- **Set up a buddy system**, if possible, to enable workers to look out for signs and symptoms of heat-related illness in each other. Often, a worker will not recognize his own signs and symptoms.
- **Instruct supervisors to watch workers for signs of heat-related illness.** Check routinely to make sure workers are making use of water and shade and not experiencing heat-related symptoms.
- **Encourage workers to wear sunscreen and use other protections from direct sunlight.** Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness. Repeated overexposure to sunlight also leads to skin cancer.

Drinking Water

Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

Other Drinks

Encourage workers to choose water over soda and other drinks containing caffeine and high sugar content. These drinks may lead to dehydration. Drinks with some flavoring added may be more palatable to workers and thereby improve hydration. Encourage workers to avoid drinking alcohol during hot weather.

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Actions for High Risk Conditions: Heat Index is 103°F to 115°F

As the heat index rises above 103°F, there is a **high risk** for heat-related illness, so additional measures to protect workers are needed. Increase rest periods and designate a knowledgeable person (well-informed on heat-related illness) at the worksite to determine appropriate work/rest schedules. Reduce work load and pace strenuous work tasks. Remind workers to drink plenty of water every 15 to 20 minutes.

- **Alert workers to the heat index anticipated for the day and identify each precaution in place at the work site to reduce the risk of heat-related illness.** Review heat-related illness signs and symptoms during daily meetings or toolbox talks.

Be sure everyone knows procedures for responding to possible heat-related illness.

- What steps to follow if a worker exhibits signs and symptoms of heat-related illness
- Who to call for medical help
- How to give clear directions to the worksite
- Who will provide first aid until the ambulance arrives

The resources under Educational Resources are useful training tools for daily meetings and toolbox talks.

- **Provide plenty of cool drinking water and disposable cups** in convenient, visible locations close to the work area.

- **Actively encourage workers to drink small amounts of water often** (before they become thirsty). They should drink about 4 cups of water every hour while the heat index is 103 to 115°F. Workers will need the greatest amount of water if they must work in direct sunshine, during peak exertion, and during the hottest part of the day.

Under most circumstances extended hourly fluid intake should not exceed 6 cups per hour or 12 quarts per day. To maintain worker hydration, it is particularly important to reduce work rates, reschedule work for a time when the heat index is lower, or enforce work/rest schedules when work must continue during periods of extreme risk for heat-related illness.

Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

- **Ensure that adequate medical services are available.** Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.)
- **Respond to heat-related illness and medical emergencies without delay. Workers who show symptoms of heat-related illness need immediate attention. Treating milder symptoms (headache, weakness) early by providing rest in a shaded area and cool water to drink can prevent a more serious medical emergency. Call 911 immediately if a worker loses consciousness or appears confused or uncoordinated. These are signs of possible heat stroke. *Heat stroke is fatal if not treated immediately.***
- **Have a knowledgeable person onsite** who is well-informed about heat-related illness and authorized to modify work activities and the work/rest schedule as needed.
- **Establish and enforce work/rest schedules** to control heat exposure and allow workers to recover. Take into account the level of physical exertion and type of protective equipment being used.
 - Advise workers of the work/rest schedule and make sure supervisors enforce rest breaks.
 - Provide air conditioned or cool, shaded areas close to the work area for breaks and recovery periods.
 - Set up temporary shade when working in open fields or areas without easy access to shade or air conditioning.
- **Adjust work activities** to help reduce worker risk:
 - **Schedule heavy tasks** earlier in the day or at a time during the day when the heat index is lower. Consider adjusting the work shift to allow for earlier start times, or evening and night shifts.
 - Where possible, **set up shade canopies** over work areas in direct sunshine or **move jobs** that can be moved to naturally shaded areas.
 - **Permit only those workers acclimatized to heat to perform the more strenuous tasks.** Rotate physically demanding job tasks among acclimatized workers.

Drinking Water

Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

Other Drinks

Encourage workers to choose water over soda and other drinks containing caffeine and high sugar content. These drinks may lead to dehydration. Drinks with some flavoring added may be more palatable to workers and thereby improve hydration. Encourage workers to avoid drinking alcohol during hot weather events.

- **Decrease the physical demands and pace of jobs.** If heavy job tasks cannot be avoided, change work/rest cycles to increase the amount of rest time.
 - **Add extra personnel to physically demanding tasks** so that the shared work load is less intense. This will lower the workers' risk of heat-related illness.
 - **Rotate workers to job tasks that are less strenuous or in cooler/air conditioned setting** for part of the work shift.
- **Acclimatize workers.** Take steps that help all workers become acclimatized to the heat, particularly if the weather turns hot suddenly. Gradually increase workloads and allow more frequent breaks during the first week of work. Closely supervise new employees for the first 14 days, until they are fully acclimatized.
- **Take actions described for the Very High to Extreme Risk Conditions (>115°F) if heat index approaches 115°F AND the work is being conducted in direct sunshine.**
- **Take added precautions** if workers are wearing heavy or non-breathable clothing or impermeable chemical protective clothing. These circumstances put workers at even greater risk of heat-related illness.
 - Reschedule activities for when the heat index is lower. Consider adjusting the work shift to allow for earlier start times, or evening and night shifts.
 - Modify the site **work/rest schedules** to make sure they are protective for workers using protective clothing.
 - Physiologically monitor workers by establishing a routine to periodically check workers for physical signs (e.g., body temperature, heart rate) of possible over exposure to heat.
 - When possible, rotate workers to job tasks that do not require this type of protective clothing for part of the work shift.
 - Encourage workers to remove protective equipment that is not needed while they are on rest breaks (e.g., if the rest area is free of hazards, remove hard hat, gloves, high visibility vest, respirator, and protective suit).
- When possible, **provide workers with personal cooling measures** (e.g., water-dampened clothing, cooling vests with pockets that hold cold packs, reflective clothing, or cool mist stations), especially for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing.
 - **Set up a buddy system** to enable workers to look out for signs and symptoms of heat-related illness in each other. Often, a worker will not recognize his own signs and symptoms.

Workers are at an increased risk of heat stress from personal protective equipment (PPE), especially from wearing semi-permeable (penetrable) or impermeable clothing (such as Tyvek or rubber), when the outside temperature exceeds 70°F, or while working at high energy levels. These types of clothing materials trap heat close to a worker's body. Workers should be monitored by establishing a routine to periodically check heart rate, temperature, and other physiological signs of overexposure.

- **Instruct supervisors to watch workers for signs of heat-related illness.** Check routinely (several times per hour) to make sure workers are making use of water and shade and not experiencing heat-related symptoms.
- **Maintain effective communication with your crew** at all times (by voice, observation, or electronic communications). Confirm that communication methods are functioning effectively.
- **Encourage workers to wear sunscreen and use other protections from direct sunlight.** Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness. Repeated overexposure to sunlight also leads to skin cancer.

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Actions for Very High to Extreme Risk Conditions: Heat Index Greater Than 115°F

Very hot and humid conditions put an extra strain on workers and greatly increase the risk of developing heat-related illness. It can develop faster and be more serious and widespread among workers. Even previously acclimatized workers are at risk for heat-related illness without protective measures. The situation is even more serious when hot weather arrives suddenly (e.g., heat wave early in the season), because the body has not had enough time to adjust to the sudden, abnormally high temperature or other extreme conditions.

In addition to the precautions already identified, extra measures are needed to protect workers under this highest risk level. Re-schedule non-essential work activities and move essential work tasks to a time during the work shift when the heat index is lower. If this is not possible, establish a water drinking schedule, enforce work/rest schedules, and be extra vigilant in monitoring workers for heat-related illness symptoms, including by using physiological monitoring and systems to enable effective communications. This requires a knowledgeable person on site who can assess heat-related safety concerns.

- **Reschedule all non-essential outdoor work for days with reduced heat index.**
- **Move essential outdoor work to the coolest part of the work shift. As able, alter the work shift to allow for earlier start times, split shifts, or evening and night shifts. Prioritize and plan essential work tasks carefully – strenuous work tasks and those requiring the use of heavy or non-breathable clothing or impermeable chemical protective clothing should not be conducted when the heat index is at or above 115°F.**

- **Stop work if essential control methods are inadequate or unavailable when the risk of heat illness is very high.**

For emergency work and essential work that cannot be rescheduled:

- **Alert workers to the heat index for the day and identify all of the precautions in place at the work site to reduce the risk of heat-related illness.** Review heat-related illness signs and symptoms during daily meetings or toolbox talks.

Be sure everyone knows procedures for responding to possible heat-related illness.

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Less than 91°F	Lower (Caution)	Basic heat safety and planning
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- What steps to follow if a worker exhibits signs and symptoms of heat-related illness
- Who to call for medical help
- How to give clear directions to the worksite
- Who will provide first aid until the ambulance arrives

The resources under Educational Resources are useful training tools for daily meetings and toolbox talks.

- **Provide plenty of cool drinking water and disposable cups** in convenient, visible locations close to the work area.
- **Establish a clear drinking schedule to ensure that workers are drinking enough water throughout the day.** Remind workers to drink small amounts of water often (before they become thirsty). A good rule of thumb at this risk level is to drink about 4 cups of water every hour during the hottest periods. Workers will need the greatest amount of water if they must work in direct sunshine, during peak exertion, and during the hottest part of the day.

Under most circumstances extended hourly fluid intake should not exceed 6 cups per hour or 12 quarts per day. To maintain worker hydration, it is particularly important to reduce work rates, reschedule work for a time when the heat index is lower, or enforce work/rest schedules when work must continue during periods of extreme risk for heat-related illness.

- **Ensure that adequate medical services are available.** Where medical services (e.g., emergency medical services, clinic, hospital) are not available within 3-4 minutes, have appropriately trained personnel and adequate medical supplies on site. The trained personnel should have a valid certificate in first aid training from the American Red Cross or equivalent training. (A first aid certificate is required at maritime and construction worksites.) Consider having medical services on site for an emergency and to conduct physiological monitoring.

Drinking Water

Water should have a palatable (pleasant and odor-free) taste and water temperature should be 50°F to 60°F, if possible.

Other Drinks

Encourage workers to choose water over soda and other drinks containing caffeine and high sugar content. These drinks may lead to dehydration. Drinks with some flavoring added may be more palatable to workers and thereby improve hydration. Encourage workers to avoid drinking alcohol during hot weather events.

- **Respond to heat-related illness and medical emergencies without delay. Workers who show symptoms of heat-related illness need immediate attention. Treating milder symptoms (headache, weakness) early by providing rest in a shaded area and cool water to drink can prevent a more serious medical emergency. Call 911 immediately if a worker loses consciousness or appears confused or uncoordinated. These are signs of possible heat stroke. Heat stroke is fatal if not treated immediately.**

- **Have a knowledgeable person onsite** who is well-informed about heat-related illness, authorized to determine appropriate work/rest schedules, and can conduct physiological monitoring.
- **Establish and enforce a work/rest schedule** to control heat exposure and allow workers to recover. Take into account the level of physical exertion and type of protective equipment being used.
 - Advise workers of the work/rest schedule and make sure supervisors enforce rest breaks.
 - Provide air conditioned or cool, shaded areas close to the work area for breaks and recovery periods.
 - Set up temporary shade when working in open fields or areas without easy access to shade or air conditioning.
 - Encourage workers to remove protective equipment that is not needed while they are on rest breaks (e.g., if the rest area is free of hazards, remove hard hat, gloves, high visibility vest, respirator, and protective suit).
- **Adjust work activities** to help reduce worker risk:
 - **Set up shade canopies** over work areas in direct sunshine or **move jobs** that can be moved to naturally shaded areas.
 - **Permit only those workers acclimatized to heat to perform the more strenuous tasks.** Rotate physically demanding job tasks among acclimatized workers.
 - **Decrease the physical demands and pace of jobs.** If heavy job tasks cannot be avoided, change work/rest cycles to increase the amount of rest time.
 - **Add extra personnel to physically demanding tasks and those requiring the use of heavy or non-breathable clothing or impermeable chemical protective clothing** so that the shared work load is less intense. This will lower the workers' risk of heat-related illness.
 - **Rotate workers to job tasks that are less strenuous or in cooler/air conditioned setting** for part of the work shift.
- **Acclimatize workers.** Take steps that help all workers become acclimatized to the heat, particularly if the weather turns hot suddenly. Gradually increase workloads and allow more frequent breaks during the first week of work. Closely supervise new employees for the first 14 days, until they are fully acclimatized.
- **Physiologically monitor all workers** by establishing a routine to periodically check heart rate, temperature, or other physiological signs that may indicate overexposure. Use monitoring results to adjust work/rest periods. This is especially critical for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing or using other personal protective equipment.
- **Provide workers with personal cooling measures** (e.g., water-dampened clothing, cooling vests with pockets that hold cold packs, reflective clothing, or cool mist stations). This is especially critical for workers wearing heavy or non-breathable clothing or impermeable chemical protective clothing.

- **Set up a buddy system** to enable workers to look out for signs and symptoms of heat-related illness in each other. Often, a worker will not recognize his own signs and symptoms.
- **Instruct supervisors to watch workers for signs of heat-related illness.** Check routinely (several times per hour) to make sure workers are making use of water and shade and not experiencing heat-related symptoms. Extra vigilance is needed when the HI reaches very high levels.
- **Maintain effective communication with your crew** at all times (by voice, observation, or electronic communications). Confirm that communication methods are functioning effectively.
- **Encourage workers to wear sunscreen and use other protections from direct sunlight.** Provide shade, hats, and sunscreen, when possible. Sunburn reduces the skin's ability to release excess heat, making the body more susceptible to heat-related illness. Repeated overexposure to sunlight also leads to skin cancer.

Using the Heat Index: A Guide for Employers

Planning Checklists

Use the following checklists to prepare for hot weather and to make sure that all appropriate precautions are in place.

Planning Ahead for Hot Weather: Employer Checklist¹

	Develop a list of hot weather supplies (e.g., water, shade devices, etc.). Estimate quantities that will be needed, and decide who will be responsible for obtaining and transporting supplies and checking that supplies are not running low.
	Create emergency action plan for heat-related illnesses (who will provide first aid and emergency services, if necessary).
	Develop acclimatization schedule for new workers or workers returning from absences longer than one week.
	Identify methods to gain real-time access to important weather forecast and advisory information from the National Weather Service and ensure the information is available at outdoor work sites (e.g., laptop computer, cell phone, other internet-ready device, weather radio).
	Determine how weather information will be used to modify work schedules, increase the number of water and rest breaks, or cease work early if necessary.
	Train workers on the risks presented by hot weather, how to identify heat-related illnesses, and the steps that will be taken to reduce the risk.
	Plan to have a knowledgeable person on the worksite who can develop and enforce work/rest schedules and conduct physiological monitoring, when necessary, at high and very high/extreme risk levels for heat-related illness.

¹This table is adapted from concepts appearing in OSHA's Heat-related Illness Prevention Training Guide.

Daily Planning for Hot Weather: Employer Daily Checklist²

Water	Is there plenty of fresh, cool drinking water located as close as possible to the workers?	
	Are water coolers refilled throughout the day? (Has someone been designated to check and make sure water is not running low?)	
Shade	Is shade or air conditioning available for breaks and if workers need to recover?	
Training	Do workers know the:	
	Common signs and symptoms of heat-related illness?	
	Proper precautions to prevent heat-related illness?	
	Importance of acclimatization?	
	Importance of drinking water frequently (even when they are not thirsty)?	
	Steps to take if someone is having symptoms?	
Emergencies	Does everyone know who to notify if there is an emergency?	
	Can workers explain their location if they need to call an ambulance?	
	Does everyone know who will provide first aid?	
Knowledgeable Person	For high and very high/extreme heat index risk levels, is there a knowledgeable person at the worksite who is well-informed about heat-related illness and able to determine appropriate work/rest schedules and can conduct physiological monitoring as necessary?	
Physiological Monitoring	Are workers in the high or very high/extreme heat index risk levels being physiologically monitored as necessary?	
Worker Reminders	Drink water often	
	Rest in shade	
	Report heat-related symptoms early	

²This table is adapted from checklist (page 18) in OSHA's Heat-related Illness Prevention Training Guide.

Using the Heat Index: A Guide for Employers

Training Workers

Train workers *before* hot outdoor work begins. Tailor the training topic outline to cover employer-specific policies and worksite-specific conditions. A single worksite may have some job tasks that are low risk for heat-related illness and others that are high risk. Training will be more effective if it is matched to job tasks and conditions, and is reviewed and reinforced throughout hot weather conditions. The following training topics may be addressed in one session or in a series of shorter sessions.

Training Topics:

- Risk factors for heat-related illness.
- Different types of heat-related illness, including how to recognize common signs and symptoms.
- Heat-related illness prevention procedures.
- Importance of drinking small quantities of water often.
- Importance of acclimatization, how it is developed, and how your worksite procedures address it.
- Importance of immediately reporting signs or symptoms of heat-related illness to the supervisor.
- Procedures for responding to possible heat-related illness.
- Procedures to follow when contacting emergency medical services.
- Procedures to ensure that clear and precise directions to the work site will be provided to emergency medical services.

Factors that May Cause Heat-related Illness	
Environmental	High temperature and humidity Direct sun exposure (with no shade) or extreme heat Limited air movement (no breeze or wind)
Job-Specific	Physical exertion Use of bulky protective clothing and equipment
Personal	Dehydration Poor physical condition or ongoing health problems Kidney disease Some medications Pregnancy Lack of previous exposure to hot workplaces

	Previous heat-related illness Obesity Alcoholism
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See Training Resources for heat-related illness prevention training tools and resources. Also see OSHA's Heat-Related Illness Prevention Training Guide for one tool to help you train your workers. The training guide includes instructions for teaching workers about heat hazards and a daily checklist to make sure all appropriate precautions are in place each workday. OSHA's factsheets and worksite posters (in English and Spanish) can help in communicating key messages about heat safety and health. Some labor and industry organizations offer industry-specific guidance for protecting workers, such as wildland firefighters, that face heat exposure under special circumstances. Inquire whether your industry offers any special guidance, or adapt information from industries with similar situations.

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Preparing for and Responding to Heat-related Emergencies

How to Prepare for Heat-related Emergencies...

Employers should confirm that worksite emergency procedures include sufficient information to address hot weather emergencies.

- Have a plan in case a worker experiences heat-related illness.
- Make sure medical services are available and that workers know what to do if a fellow worker has signs and symptoms of heat-related illness.
- Be prepared to provide first aid for any heat-related illness and call emergency services (e.g., call 911) if a worker shows signs and symptoms of heat stroke.
- Be able to provide clear and precise directions to the worksite.
- Immediately respond to symptoms of possible heat-related illness – move the worker into the shade, loosen the clothing, wet and fan the skin, place ice-packs in the armpits and on the neck. Give the worker something to drink. Call emergency services if the worker loses consciousness or appears confused or uncoordinated. Have someone stay with an ill worker.
- Ensure that emergency procedures are used whenever appropriate.
- Develop a plan to reschedule or terminate work if conditions become too risky.

How to Respond to Heat-related Emergencies...

If workers report or supervisors observe signs or symptoms of heat-related illness, stop activity immediately. Take action while waiting for help. **HEAT STROKE IS A MEDICAL EMERGENCY. CALL 911 immediately if a worker shows any signs of heat stroke.**

Illness	Symptoms	First Aid*
Heat stroke	<ul style="list-style-type: none">▪ Red, hot, dry skin or excessive sweating▪ Very high body temperature▪ Confusion▪ Seizures▪ Fainting	<ul style="list-style-type: none">▪ Call 911 <p>While waiting for help:</p> <ul style="list-style-type: none">▪ Place worker in shady, cool area▪ Loosen clothing, remove outer clothing▪ Fan air on worker; cold packs in armpits▪ Wet worker with cool water;

		<ul style="list-style-type: none"> apply ice packs, cool compresses, or ice if available Provide fluids (preferably water) as soon as possible Stay with worker until help arrives
Heat exhaustion	<ul style="list-style-type: none"> Cool, moist skin Heavy sweating Headache Nausea or vomiting Dizziness Light headedness Weakness Thirst Irritability Fast heart beat 	<ul style="list-style-type: none"> Have worker sit or lie down in a cool, shady area Give worker plenty of water or other cool beverages to drink Cool worker with cold compresses/ice packs Take to clinic or emergency room for medical evaluation or treatment if signs or symptoms worsen or do not improve within 60 minutes. Do not return to work that day
Heat cramps	<ul style="list-style-type: none"> Muscle spasms Pain Usually in abdomen, arms, or legs 	<ul style="list-style-type: none"> Have worker rest in shady, cool area Worker should drink water or other cool beverages Wait a few hours before allowing worker to return to strenuous work Have worker seek medical attention if cramps don't go away
Heat rash	<ul style="list-style-type: none"> Clusters of red bumps on skin Often appears on neck, upper chest, folds of skin 	<ul style="list-style-type: none"> Try to work in a cooler, less humid environment when possible Keep the affected area dry

* Remember, if you are not a medical professional, use this information as a guide only to help workers in need.

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About Work/Rest Schedules

Rather than being exposed to heat for extended periods of time during the course of a job, workers should, wherever possible, be permitted to distribute the workload evenly over the day and incorporate work/rest cycles. Work/rest cycles give the body an opportunity to get rid of excess heat, slow down the production of internal body heat, slow down the heart rate, and provide greater blood flow to the skin.

For the best protection from heat-related illness, workers should spend the rest periods of the cycle in a cool place, for example in a lightly air conditioned room, trailer or vehicle, or if one is not available, then in full shade.

Rest periods do not necessarily mean that the workers are on break; these can be productive times. During the rest periods, workers may continue to perform mild or light work, such as completing paperwork, sorting small parts, attending a meeting, or receiving training (e.g., instructions for upcoming work, or a tailgate safety talk).

Have a knowledgeable person at the worksite that is well-informed about heat-related illness and able to modify work activities and the work/rest schedule as needed. When evaluating an appropriate work/rest schedule:

- Shorten work periods and increase rest periods:
 - As temperature rises
 - As humidity increases
 - When sun gets stronger
 - When there is no air movement
 - When protective clothing or gear is worn
 - For heavier work
- Assign new and un-acclimatized workers lighter work and longer rest periods. Monitor these workers more closely.

When possible, more frequent shorter periods of exposure to heat are better than fewer longer exposures. This means that the work/rest schedules are often based on 1-hour cycles and might call for

Choosing Shaded Rest Areas:

When an air conditioned space is not available, choose or create rest areas with as many of the following beneficial characteristics as possible:

- In full (complete) shade .
- Where surfaces are not warm from earlier sun (e.g., north-facing wall).
- Opened to cooling breezes, but protect workers if breezes feel uncomfortably hot, which can increase risk of heat illness.
- Free of other hazards (e.g., moving traffic, excessive noise, falling objects).
- With sufficient space for the number of workers needing rest breaks at one time.
- Near a supply of cool drinking water.
- Equipped for workers to do productive light work while their bodies cool.

a rest period of 15 minutes every hour during hot weather, but 45 minutes per hour when temperature and humidity are extreme. Individual requirements may vary greatly.

Setting appropriate work rest schedules is critical for protecting workers during outdoor work. Often it requires the assistance of a trained safety and health profession. In addition to the methods provided as examples below, OSHA provides free and confidential advice to services small and medium-sized businesses in all states across the country. Contact OSHA's [On-site Consultation Program](#) for assistance in developing your heat-related illness preventions plan and work/rest schedules that appropriate for your worksite. For more information or for additional compliance assistance contact OSHA at 1-800-321-OSHA (6742).

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Estimating Work Rates or Loads

Examples of work activities that are considered light, moderate, heavy, and very heavy:

Work Rate Category	Example Motions	Example Tasks
Rest	<ul style="list-style-type: none"> ▪ Sitting 	<ul style="list-style-type: none"> ▪ Attending a meeting (seated) ▪ Reading instructions, completing paperwork ▪ Watching a training video
Light	<ul style="list-style-type: none"> ▪ Sitting with light manual work with hands and arms ▪ Driving ▪ Standing with some light arm work and occasional walking ▪ Casual walking (2 miles per hour) ▪ Lifting 10 pounds fewer than eight times per minute, or 25 pounds less than four times per minute 	<ul style="list-style-type: none"> ▪ Using small bench tools or small power tools ▪ Inspecting and sorting produce ▪ Sorting light materials ▪ Assembling small parts ▪ Driving vehicle on roads ▪ Nailing
Moderate	<ul style="list-style-type: none"> ▪ Sustained moderate hand and arm work ▪ Moderate arm and leg work ▪ Moderate arm and trunk work ▪ Moderate pushing and pulling ▪ Walking at a moderate speed ▪ Lifting 10 pounds 10 times per minute, or 25 pounds six times per minute 	<ul style="list-style-type: none"> ▪ Picking fruits and vegetables (bending, squatting) ▪ Painting with a brush ▪ Pushing or pulling lightweight carts or wheelbarrows ▪ Off road operation of trucks, tractors or construction equipment ▪ Operating an air hammer ▪ Weeding or hoeing

Heavy	<ul style="list-style-type: none"> ▪ Intense arm and trunk work ▪ Carrying, shoveling, manual sawing ▪ Pushing or pulling heavy loads ▪ Walking at a fast pace (4 miles per hour) ▪ Lifting 10 pounds 14 times per minute, or 25 pounds 10 times per minute 	<ul style="list-style-type: none"> ▪ Transferring heavy materials, shoveling ▪ Sledgehammer work ▪ Hand mowing, digging ▪ Concrete block laying ▪ Pushing or pulling loaded hand carts or wheelbarrows
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Very Heavy	<ul style="list-style-type: none"> ▪ Very intense activity at fast to maximum pace ▪ Jogging, running or walking faster than 4 miles per hour ▪ Lifting 10 pounds more than 18 times per minute, or 25 pounds more than 13 times per minute 	<ul style="list-style-type: none"> ▪ Heavy shoveling or digging ▪ Ax work ▪ Climbing stairs, ramps or ladders
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Sources:

ACGIH, 2011. Heat Stress and Strain, in TLVs and BEIs, American Conference of Industrial Hygienists, Cincinnati, OH.

Ramsey, J and Bishop, P. 2003. Hot and Cold Environments (Chapter 24), in The Occupational Environment, its Evaluation, Control, and Management (S.R. DiNardi, Editor), American Industrial Hygiene Association. [After McArdle, Katch and Katch (1996)].

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Acclimatizing Workers

Individual susceptibility to heat-related illness can vary widely between workers. Workers become gradually acclimatized when exposed to hot conditions for several weeks. Physical changes in blood vessels and in sweating occur to dissipate heat more effectively. When the **heat index** is high, special precautions are needed to protect un-acclimatized workers while they adjust, particularly on the first few days of the job.

- Develop a heat acclimatization program and plans that promote work at a steady moderate rate that can be sustained in the heat. For example, allow workers to get used to hot environments by gradually increasing exposure over at least a 5-day work period. Begin with 50% of the normal workload and time spent in the hot environment and then gradually build up to 100% by the fifth day. New workers and those returning from an absence of two weeks or more should have a 5-day minimum adjustment period. While a significant amount of acclimatization occurs rapidly in that first week, full acclimatization may take a little longer. Some workers require up to two or three weeks to fully acclimatize.
- Determine how you will lessen the intensity of workers' work during the adjustment period.
- Keep in mind that acclimatization can occur naturally for outdoor workers in a hot climate as the weather changes. However, implementing acclimatization activities is essential for new workers, workers who have been out sick or on vacation, and all workers during a heat wave. Be extra-careful with these workers and recognize immediately the symptoms of possible heat-related illness.
- During a sudden heat spike, determine how you will protect your workers from conditions resulting from sudden exposure to heat.

Why Workers Must Be Acclimatized¹

Humans are, to a large extent, capable of adjusting to the heat. Much of this adjustment to heat, under normal circumstances, usually takes about 5 to 7 days, during which time the body will undergo a series of changes that will make continued exposure to heat more endurable. However, it may take up to several weeks for the body to fully acclimatize.

On the first day of work in a hot environment, the body temperature, pulse rate, and general discomfort will be higher. With each succeeding daily exposure, all of these responses will gradually decrease, while the sweat rate will increase. When the body becomes acclimatized to the heat, the worker will find it possible to perform work with less strain and distress.

Special Caution

Some health conditions can put workers at greater risk of heat-related illness. These include diabetes, kidney and heart problems, pregnancy, and being overweight.

Source: Adapted from Page 10 in OSHA's Heat-related Illness Prevention Training Guide.

Gradual exposure to heat gives the body time to become accustomed to higher environmental temperatures. Heat disorders in general are more likely to occur among workers who have not been given time to adjust to working in the heat or among workers who have been away from hot environments and who have gotten accustomed to lower temperatures. Hot weather conditions of the summer are likely to affect the worker who is not acclimatized to heat. Likewise, workers who return to work after a leisurely vacation or extended illness may be affected by the heat in the work environment. Whenever such circumstances occur, the worker should be gradually reacclimatized to the hot environment.

People who have not worked in hot weather for a week or more need time for their bodies to adjust. They need to take more breaks and not do too much strenuous work during their first weeks on the job.

¹Information sources: NIOSH, Working in Hot Environments (NIOSH 86-112) "Preparing for the Heat" and OSHA's Heat-related Illness Prevention Training Guide (page 10).

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Monitoring Workers at Risk of Heat-related Illness

NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Chapter 8 (1985) offers guidance for performing physiological monitoring of workers at hot worksites. It describes the following options for worker monitoring to help manage the risk of heat-related illness:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.
 - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
 - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
 - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
 - If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
 - Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss, if possible. Measure the worker's weight on a scale (ideally accurate to ±0.25 lb) at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing (changes of clothing or damp clothing can cause an inaccurate reading). The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar load and the level of physical work (see table below). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers^a		
Adjusted Temperature (see notes below)	For workers with normal work clothes, conduct monitoring...	For workers wearing impermeable protective clothing conduct monitoring...
90°F or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F	After each 150 minutes of work	After each 120 minutes of work

Notes:

^a Assumes work levels of 250 kilocalories/hour (e.g., a moderate work level). Consider increasing the frequency for heavy work rates.

^b Adjusted Air Temperature: Calculate the adjusted air temperature (ta adj) by using this equation: $ta\ adj\ ^\circ F = ta\ ^\circ F + (13 \times \% \text{ sunshine})$.

Measure the air temperature (ta) with a standard thermometer, with the bulb shielded from radiant heat.

Estimate the percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow.

100 percent sunshine = no cloud cover and a sharp, distinct shadow;

0 percent sunshine = no shadows

^cFor the purpose of this chart, a normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Adapted from: NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Chapter 8 (1985).

More Advanced Methods for Monitoring Workers

Employers can choose to evaluate a range of physiological responses to heat. The example above briefly mentions heart rate (pulse), oral temperature, and body water loss, but other options are also available. New types of tools (e.g., specialized sensors and personal monitors) are becoming widely available to help employers monitor workers, but effective monitoring can still be performed using simple equipment (e.g., a wrist watch). This section provides examples of the range of options available for monitoring workers.

Examples of Monitoring Options

Physiological monitoring for workers at risk of heat illness usually focuses on vital signs, individually or in any combination:

- Heat exposure history
- Pulse rate
- Temperature (oral, tympanic [ear], or core)
- Body weight
- Blood pressure
- Respiratory rate
- Alertness

The following table lists when and how each of these monitoring methods is performed.

Examples of Physiological Monitoring Used by Some Employers to Prevent Heat Illness			
Monitoring Method	When Assessed	How Assessed	More Information
Heat Exposure History	Before work begins, physiological monitoring may start with a brief history review	Interview or questionnaire	Recent heat illness increases the risk of a repeat occurrence, so the worker should be monitored more closely. Some workers might choose to alert their employers of medical conditions, such as kidney failure, which increase the risk of heat illness.
Pulse Rate (heart rate)	Before work begins to determine the initial baseline level and then again after heat exposure (for example in the first minute and the third minute after the work period ceases)	Count the number of beats per minute (using a wristwatch), or monitor electronically using a heart rate sensor.	The pulse rate should fall rapidly and soon approach the baseline level. The pulse will remain elevated in a worker experiencing a heat illness.
Temperature			Increased temperature indicates that the body is not cooling itself as rapidly as necessary to keep temperature from rising.
	Initial baseline and again	<i>Oral temperature –</i>	Inaccurate if the worker

	after the work period	measure with an oral thermometer (available from drug stores)	drinks cool beverages frequently (as is recommended).
	Initial baseline and again after the work period	<i>Tympanic temperature</i> – measure with an infrared thermometer (available from drug stores)	A more reliable indicator of core temperature than oral readings (Beaird, Bauman, and Leeper, 1996).
	Continuous sensing devices measure temperature during both work and rest periods	<i>Core temperature</i> – measure with electronic or color-changing sensing devices (e.g., sensors that are ingestible, in-ear, or part of skin patches)	Core temperature is the most reliable measure of body temperature. Although not widely used in the workplace, modern advances in sensing technology are making core temperature measurements increasingly practical (HQI, 2007; NASA Spinoff, 2006; Mini Mitter, no date; IonX, no date; Quest, no date).
Bodyweight	Measured as baseline and again immediately after heat exposure	Step on a bathroom scale that has good precision (consistent readings). Must wear same clothes for measurements before and after work period. Account for moisture (sweat) in the clothes	Daily bodyweight loss can indicate that the worker is not drinking a sufficient amount of water. At worksites, the need to account for moisture held in clothes damp with sweat greatly complicates this otherwise simple measure.
Blood pressure	Initial baseline and again after the work period	Blood pressure cuff	Blood pressure does not recover as quickly when a worker is suffering heat illness. Posture can also affect blood pressure in workers with heat-related illness and is the basis for some physiological monitoring

			methods.
Respiratory (breathing) rate	Initial baseline and again after the work period	Count breathes per minute using a stop watch	Breathing rate does not return to baseline as quickly when a worker is suffering heat-related illness.
Alertness	During and after the work period	Converse with the worker	Assess whether the worker shows signs of confusion, a symptom of heat-related illness.
Other monitoring methods			
Perceived skin wetness zones	After the work period	Self-evaluation by the worker	An experimental method, which showed some promise for workers wearing normal clothing doing light work, but was less effective for workers wearing impermeable protective clothing doing strenuous work (Lee, Nakao, and Tochiyama, 2011).
Personal Monitors	During and after the work period	The most common include skin temperature sensors and heart rate monitors	Electronic personal monitors worn by workers can measure one or more physiological parameters and help workers judge their own condition (Buller et al, 2008; Metrosonics, no date; IonX, no date).

Sources:

NFPA, 2002. NFPA 471: Recommended Practice for Responding to Hazardous Materials Incidents, 2002 edition.

NFPA, 2008. NFPA 473: Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents, 2008 edition.

Also sources listed in "Notes Column".

Checklist for Worker Monitoring

OSHA provided two examples of vital signs monitoring checklists in Best Practices for Hospital-Based First Receivers of Victims from Mass Casualty Incidents (OSHA Document 3249), Appendix I – Vital Signs and PPE Checklists. These checklists were developed by employers to record monitoring results for workers who wear heavy protective equipment during chemical emergencies involving the Release of Hazardous Substances. The checklists have space for monitoring results before and after work periods. A comparison of the two measurements confirms that an individual worker's physiological state returns to baseline (pre-work) conditions before the worker begins the next work/rest cycle.

Monitoring Criteria

The criteria to which monitoring results are compared can vary depending on the workplace circumstances and some professional judgment is required. The individual performing the monitoring should be knowledgeable of the monitoring methods and which criteria to use in determine whether a worker is suffering from a heat-related illness or is ready to return to work under hot conditions.

The National Fire Protection Association published an extensive procedure and list of physiological monitoring criteria for evaluating workers at high risk of heat-related illness, particularly those wearing heavy protective clothing, in *Recommended Practice for Responding to Hazardous Materials Incidents (NFPA 471, 2002)*, Section 10. Although still available for inspection online, this detailed information was withdrawn as an NFPA standard and in its place NFPA incorporated an less detailed monitoring procedure (without criteria) into the more recent *Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents (NFP 473, 2008)*, section 5.4.5. Rather than providing specific criteria for each measurement, this 2008 edition of NFPA 473 relies on the professional judgment of the emergency medical personnel in assessing worker response to stressors encountered during hazardous materials response (primarily heat illness if the protective gear adequately protects the worker from chemical hazards). However, NFPA 471 remains an interesting reference for studying the monitoring methods that were historically considered important for evaluating workers wearing heavy protective clothing (i.e., at high risk of heat illness) and assessing their ability to continue work under those conditions.

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