

**TITLE: HEAT AND COLD STRESS****Document Number: *****Issue Date:**

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1 Purpose

The primary purpose of this procedure is to define temperature extreme disorders or conditions and to provide the guidance necessary for protection of **(Insert Company Name)** employees and contractors from the occurrence of temperature extreme related disorders or conditions.

2 Responsibilities

It is the responsibility of the Project Superintendent to ensure that all employees are continually aware of possible temperature extreme symptoms so that appropriate action can be taken before it becomes a medical emergency.

3 Policy Content

3.1 GENERAL INFORMATION

Disorders or conditions associated with work conducted in temperature extreme conditions can be controlled through proper planning and effective monitoring of personnel. The added burden of PPE required for hazardous waste operations in a temperature extreme condition increases the potential for worker disorders or conditions that can result in injury or illness. Factors that could affect a worker's ability to function in extreme temperatures include, but are not limited to:

- Physical fitness
- Acclimatization
- Age
- Obesity
- Alcohol consumption
- Drug use
- Infections
- Disease

The Site Specific Health and Safety Plan should contain whether extreme temperature condition exists. The use of the medical surveillance program can identify those employees with pre-existing health conditions that could be adversely effected during extreme temperatures. Workers should be pre-screened prior to beginning operations. Once baseline values are obtained, they can be used to effectively assess the health of workers during and immediately after operations (e.g., pulse, blood pressure, body temperature, body weight). Personnel who are not required to wear PPE are not immune to the potential hazards of heat-related disorders or conditions and should be included in the monitoring

program.

3.2 HEAT STRESS

Increased physical demands on workers occur as a result of increased air temperature and humidity. Wearing PPE also increases the demands on workers, due to:

- Added weight of the equipment
- Reduced visibility
- Reduced mobility
- Loss of the body's natural cooling processes
- Increased energy consumption by the body
- Lack of sufficient fluid replenishment

Other factors that influence the occurrence of heat related disorders or conditions include environmental conditions, clothing, workload, and the individual characteristics of workers.

Assessing Heat Stress Conditions

The guidance for workers wearing permeable clothing is specified in the current version of the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If actual clothing differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, changes should be made to the monitoring requirements and work rest period to account for these differences. The Table below provides the suggested frequency of physiological monitoring for fit and acclimatized workers. The ACGIH TLV guide contains a separate table for workers wearing semipermeable and impermeable encapsulating clothing. In these situations, refer to Table I.

TABLE I
Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers

Adjusted Temperature Calculation	Normal Work Clothing	Impermeable Clothing
90 F (32.2 C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5 - 90.0 F (30.8 - 32.2 C)	After each 60 minutes of work	After each 30 minutes of work
82.5 - 87.5 F (28.1 - 30.8 C)	After each 90 minutes of work	After each 60 minutes of work
77.5 - 82.5 F (25.3 - 28.1 C)	After each 120 minutes of work	After each 90 minutes of work
72.5 - 77.5 F (22.5 - 25.3 C)	After each 150 minutes of work	After each 120 minutes of work

PHYSIOLOGICAL MONITORING OF WORKERS

The following physiological readings should be taken to assess employees and to determine the work-rest cycle:

Heart rate - Count the radial pulse as early as possible in the rest period to ensure a more accurate reading. 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 at the same length. If, at the end of the following work period, the heart rate still exceeds 110 beats per minute, shorten the work period again by one-third.

Oral Temperature - The utilization of oral temperature applies to the time immediately after the worker leaves the contamination reduction zone. Using a clinical thermometer, take the temperature for three minutes. If the oral temperature exceeds 99.6 F (37.6 C), shorten the next work cycle by one-third, without a change to the rest period. If the oral temperature still exceeds 99.6 F (37.6 C) at the end of the following work period, shorten the next work cycle by one-third. **Do not permit a worker to perform duties requiring a semipermeable or impermeable garment if the oral temperature exceeds 100.6 F (38.1C).**

Ear Canal Readings - Ear canal readings are a valid method to monitor the temperature of workers who remain in the contamination reduction zone.

Body Water Loss - Measure body weight to see if enough fluids are being consumed to prevent dehydration.

TRAINING OF WORKERS

Worker training is an essential element of an effective temperature extreme program. Workers who are able to identify the symptoms of early heat stress will be able to prevent heat related disorders or conditions and possible death to themselves and their fellow workers. Workers should be trained initially and continually reminded during safety meetings to identify the following symptoms of heat stress:

Heat Rash - Caused by continuous exposure to heat or humid air. Can be recognized by the occurrence of small red pimples on the skin. Typically found in sensitive areas of the body where the potential for rubbing can occur (e.g., underarm, groin area).

Heat Cramps - Caused by heavy sweating and inadequate electrolyte replacement. Signs to look for include muscle spasms and pain in the extremities, such as hands and feet, and in the abdomen.

Heat Exhaustion - Caused by increased stress on various parts of the body, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs to look for include:

- Pale, cool, moist skin
- Heavy sweating
- Dizziness
- Nausea

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- Fainting
- Heat Stroke** - This is the most serious of all temperature related disorders or conditions since temperature regulation fails and the body temperature rises to critical levels. Immediate action should be taken to cool the body before serious injury or death occurs. Competent medical help should be obtained. Signs to look for include:

- Red, hot, usually dry skin
- Lack of or reduced perspiration
- Nausea
- Dizziness and confusion
- In extreme situations, coma

3.3 COLD STRESS

Extreme low temperatures may not be the only element necessary to create the potential for cold exposure disorders or conditions; strong wind accompanied by cold temperatures can lead to these types of disorders or conditions.

ASSESSING COLD STRESS CONDITIONS

The windchill factor is the cooling effect of any combination of temperature and wind velocity or air movement. The windchill index (Table II) should be consulted when planning for exposure to low temperatures and wind. The windchill index does not take into account the specific part of the body exposed to cold, the level of activity, which affects body heat production, or the amount of clothing being worn.

TABLE II: Windchill Index
ACTUAL THERMOMETER READING (F)

Wind Speed in mph	50	40	30	20	10	0	-10	-20	-30	-40
EQUIVALENT TEMPERATURE (F)										
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 (little added effect)	LITTLE DANGER (for properly clothed person)			INCREASING DANGER (Danger from freezing of exposed flesh)				GREAT DANGER		

The human body senses "cold" as a result of both the air temperature and the wind velocity. Cooling of exposed flesh increases rapidly as the wind velocity goes up. Frostbite can occur at relatively mild temperatures if wind penetrates the body insulation.

The generally recognized cold disorders or conditions are frostbite and hypothermia. Contributing factors to these disorders or conditions are:

- Exposure to humidity
- High winds
- Contact with wetness
- Inadequate clothing
- Poor worker health

The physical conditions that effect cold exposure disorders or conditions are the same as those associated with heat disorders or conditions, such as physical fitness, alcohol or drug use, and disease.

The presence of dead air space between the warm body and clothing and the outside air is essential. Many layers of relatively light clothing with an outer shell of windproof material maintains body temperature much better than a single heavy outer garment worn over ordinary indoor clothing. The more air cells each clothing layer has, the more efficient it insulates against body heat loss. Clothing also needs to allow some venting of perspiration. In addition to adequate clothing, whenever possible, full use should be made of windbreaks and heat tents.

Table III gives the recommended time limits for working in various low temperature ranges.

TABLE III
Maximum Daily Time Limits for Exposure at Low Temperatures

Temperature Range		Maximum Daily Exposure
Celsius	Fahrenheit	
0 to -18	30 to 0	No limit, providing that the person is properly clothed.
-18 to -34	0 to -30	Total work time: 4 hours. Alternate 1hour in and 1 hour out of the low-temperature area.
-34 to -57	-30 to -70	Two periods of 30 minutes each at least 4 hours apart. Total low temperature work time allowed is 1 hour.
-57 to -73	-70 to -100	Maximum permissible work time is 5 minutes during an 8-hour working day. At these extreme temperatures, completely enclosed headgear, equipped with a breathing tube running under the clothing and down the leg to preheat the air, is recommended.

TRAINING OF WORKERS

Early recognition of the symptoms of cold exposure stress is essential in preventing serious or permanent disorders or conditions. Workers and managers involved in cold weather operations should be adequately trained to recognize the following conditions and related symptoms:

Hypothermia - The first symptoms of this condition are uncontrollable shivering and the sensation of cold, irregular heart beat, weakened pulse, and change in blood pressure. Severe shaking of rigid muscles may be caused by a burst of body energy and changes in the body's chemistry. Vague or slow and slurred speech, memory lapses, incoherence, and drowsiness are some of the additional symptoms. Symptoms noticed before complete collapse are cool skin, slow and irregular breathing, low blood pressure, apparent exhaustion, and fatigue even after rest.

As the core body temperature drops, the victim may become listless and confused, and may make little or no attempt to keep warm. Pain in the extremities can be the first warning of dangerous exposure to cold. If the body core temperature drops to about 85° F, a significant and dangerous drop in the blood pressure, pulse rate, and respiration can occur. In extreme cases, death will occur.

Frostbite - Frostbite can occur, in absence of hypothermia, when the extremities do not receive sufficient heat from central body stores. This can occur because of inadequate circulation and/or insulation. Frostbite occurs when there is freezing of fluids around the cells of the body tissues due to extremely low temperatures. Damage may result, including loss of tissue around the areas of the nose, cheeks, ears, fingers, and toes. This damage can be serious enough to require amputation or result in permanent loss of movement.

The potential for both heat and cold related disorders or conditions can occur in many common situations. Cold early morning temperatures can give way to warm daily temperatures, resulting in heavy perspiration within protective clothing. As temperatures cool again in the evening, the potential for cold related disorders or conditions can occur. Managers should be aware of the potential for this occurrence and should monitor workers accordingly.

3.4 PREVENTION MEASURES FOR HEAT AND COLD STRESS

Preventive measures are the best approach to avoiding the types of disorders or conditions associated with temperature extreme conditions. Many of the measures are similar for both heat and cold extremes. Proper training and preventive measures are critical in temperature extreme conditions to avert illness, injury and potential loss of worker productivity.

The following steps should be followed in order to ensure workers involved in temperature extreme conditions are properly protected:

- 1) Closely monitor and modify/adjust work-rest work schedules

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- 2) Maintain proper worker body fluids in both cold and hot weather by:
 - Maintaining drinking water temperature at 50 to 60 F (10 to 15.6 C),
 - Urging workers to drink 16 ounces of fluid before beginning work, and urging workers to drink at least 4 ounces of water every 15 to 20 minutes at each monitoring break (1 to 1.6 gallons of water a day is recommended);
- 3) Weigh workers before and after each work session to determine if fluid intake and replenishment is adequate.
- 4) Encourage workers to maintain an optimal level of physical fitness
- 5) Encourage workers to maintain normal/constant weight (significant weight loss can be a strong indication of physical problems).
- 6) Advise workers that heavy alcohol intake may significantly increase their risk of heat stroke (i.e., dehydration) and drinking alcohol on (Insert Company Name) jobsites is prohibited.
- 7) Use cooling/heating devices that aid in natural body heat exchange, such as heating or cooling tents, showers or hoses, and cooling vests, jackets, or suits.

ACCLIMIZATION OF WORKERS

Site Supervisors need to be aware of the importance of acclimatizing workers before they can be added to a regular work schedule. Although the phenomenon of acclimatization is an important consideration for heat stress, it has not been recognized for cold stress. The added burden of PPE may increase the time to acclimatize workers. The worker's ability to physiologically adjust to work under temperature extreme conditions affects his/her ability to perform work. Acclimatized workers have lower heart rates and body temperatures, sweat more profusely than unacclimatized workers, and are, therefore, better able to function in these specific working conditions.

Acclimatization can occur within a few days. NIOSH recommends a progressive, 6-day acclimatization period for workers before allowing them to perform a full work load. Under this regimen, the first day of work should be conducted using only 50% of the anticipated workload and exposure time. This level should be increased 10% each day for the following 5 days.

Workers can lose their acclimatization so the work regimen will need to be adjusted to accommodate these changes

4 References

None

5 Appendices

None