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National Manual for Assets and Facilities Management Volume 10, Chapter 4

Heat and Cold Stress Management Procedure

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1.0 PURPOSE

Throughout the Kingdom of Saudi Arabia, work within different sectors of operations and maintenance will encounter different weather conditions and working environments sometimes in harsh climates.

Injuries incurred from extreme heat and cold working environments can cause immediate injury and some may result in permanent damage or even death if symptoms are not recognized and treated in a timely manner. Because of this, it is necessary for Entities, and/or their contractors, to implement a procedure to identify, assess, and control the hazards associated with heat and cold stress, and train personnel to also recognized symptoms, mitigate hazards, and implement treatment of resulting injuries.

2.0 SCOPE

The scope of this procedure is to provide means to the user to create a custom procedure outlining and detailing the requirements and responsibilities to identify, assess, and control hazards associated with working in hot and cold environments. This procedure applies throughout the Kingdom of Saudi Arabia to Operations and Maintenance functions and activities on, in, and around government owned facilities and projects. The custom procedures should also address man-made, non-weather related hot and cold working conditions (e.g., mines, foundries, solar array farms, chillers/freezers, cold storage).

3.0 DEFINITIONS

Definitions	Description
HR	Heart Rate
PPE	Personnel Protective Equipment
Tympanic	Membrane thermometer. a device that measures the temperature of the tympanic membrane by detecting infrared radiation from the tissue
WBGT	Wet Bulb Globe Temperature

4.0 REFERENCES:

- OSHA 1910.132
- Saudi Labor Law

5.0 RESPONSIBILITIES

5.1 Facility Management

Facility Managers and Supervisors are responsible for their employees. The following are guidelines as to what they shall do:

- When the potential for heat-related illness exists, monitor environmental conditions (e.g., air temperature, relative humidity), and communicate the current heat stress danger to employees.
- Scheduling works at the cooler parts of the day.
- Rotation of workers according to the heat index requirements.
- Communicating the locations to workforce the designated break/recovery areas, emergency reporting procedures and nearest medical facility.
- Monitory employees for symptoms of heat related illness and being able to recognize the symptoms.
- Not letting schedule or productivity demands supersede heat stress awareness or controls used to prevent heat-related illnesses.
- Provide areas of shade.
- Schedule training for heat stress to workers including identification and treatment.
- Provide insulated water coolers (e.g., 20-liter capacity) to employees.
- Providing suitable facilities to replenish water.
- Conducting Toolbox Topics, particularly in the summer months, relating to Heat Stress.

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6.0 PROCESS

Each work activity shall conduct a risk assessment that considers the specific work conditions and environments to be encountered during the life cycle of the work. The effects of heat and cold stress in work environments depend on factors such as:

- Air temperature and wind.
- Duration of exposure.
- Type of protective clothing and equipment.
- Type of work.
- Level of physical effort.
- Health status of the employee.
- Predominant periods in which employees may fast (i.e., Ramadan)

In addition, the use of protective clothing (full body suits for hazardous material exposure, heavy clothing/leathers, or any barrier that limits air movement), respirators, and work in confined spaces can increase or compound the risks to the worker, especially in hot environments. Pre-job briefings, (i.e., Toolbox Talks) should address the potential for heat/cold stress, where applicable. Refer to the Saudi labor law in regard to the heat/cold stress at the workplace.

6.1 Heat Stress

Employees who have symptoms or conditions of heat stress, heat stroke (i.e., hyperthermia), and/or heat exhaustion should seek immediate medical attention from a professional medical provider.

6.1.1 Causes and Symptoms

Heat stress may occur any time that work is being performed at elevated temperatures or when protective clothing is worn. Some of the most common signs of Heat stress may include:

- Dizziness
- Headache
- Muscle or abdominal cramps.
- Nausea, vomiting, or diarrhea
- Confusion.
- Collapse or pass out.
- Seizures (fits).
- May not be sweating.
- Dark-colored urine determines the dehydration level (Figure 1).
- Pale skin.
- Rapid heartbeat.
- Fatigue.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur ranging from mild to fatal. Because heat stress is one of the most common and potentially serious problems that workers encounter, regular monitoring and preventive measures are vital.

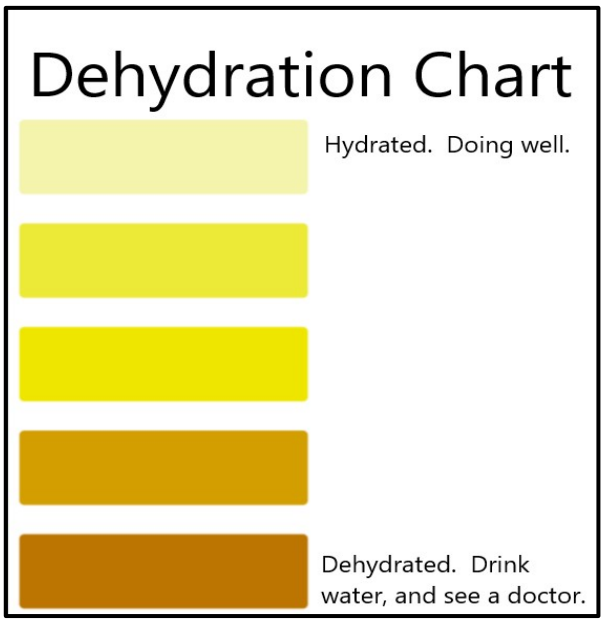

Figure 1: Urine Color Chart

Employees must learn to recognize and treat the various forms of heat stress. There are a number of factors that will determine the level at which personnel will be affected by exposure to heat stress conditions. These include:

- **Metabolic Rate:** The higher intensity (or speed) of work/activity, the higher the core body temperature becomes over time. One measure of metabolism is heat (calories) expended.

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- **Temperature:** Actual environmental temperatures will affect the temperature gradient (i.e., the change in temperature as a function of distance, especially altitude).
- **Hydration:** Personnel working in hot environments must be able to freely perspire to feel the cooling effect of evaporation. Water intake is therefore critical to ensuring proper replacement of these fluids and continued hydration - dehydration is extremely dangerous since the body will cease to perspire when not properly hydrated, resulting in heat stress disorders.
- **Humidity:** Evaporation rate (therefore, cooling rate) is reduced as the relative humidity rises. This is why relative humidity is a major element in the heat index.
- **Clothing:** Clothing must not hinder the heat-loss mechanism of radiation. It should not prevent heat from being transferred from the surface of the skin to the environment – the more protective clothing (PPE) that is worn, the more impact on the individual's ability to work during high heat conditions. Some types of protective clothing worn when performing certain tasks (i.e., radiological work, asbestos removal, etc.) do not allow heat to escape and in such cases, special consideration must be given to the cooling of personnel through some other means.
- **Fitness:** The unfit individual will not be ready or able to affect the cooling mechanism of adequate perspiration. The cooling mechanism will also be impeded in over- weight individuals, as the naturally insulating adipose tissue has the same impact as excessive clothing.
- **Medical Risks:** General effects of aging, or use of some types of medications, chronic illness (such as diabetes or blood-vessel disease), or any recent illness involving fluid loss from vomiting or diarrhea will increase the effects of heat stress on an individual.
- **Acclimatization:** Some personnel in different regions of the world are naturally more accustomed to high heat conditions and others that have been exposed to such conditions over long periods of time have adjusted to the effects of heat stress on their performance. Becoming more tolerant of heat improves the physiological heat-loss mechanisms.

6.1.2 Heat Stress Disorders

A number of disorders associated with excessive exposure to hot working conditions can pose serious, even life-threatening effects on individuals. These are described as follows:

6.1.2.1 Heat Rash

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by chafing clothes. The condition decreases a person's ability to tolerate heat.

Symptoms
The symptoms of heat rash include mild, red rash, especially on areas of the body in contact with protective gear.

Treatment:
Heat rash is treated by decreasing the amount of time workers wear protective gear and by applying powder to affected areas to help absorb moisture and decrease chafing.

6.1.2.2 Heat Cramps

Heat cramps are caused by perspiration that is not balanced by adequate fluid intake. Heat cramps are often the first sign of a heat exposure situation that can lead to the more serious condition of heatstroke.

Symptoms:
Heat cramps are painful, brief muscle cramps that occur during exercise or work in a hot environment. Muscles may spasm or jerk involuntarily. Heat cramps usually involve the muscles fatigued by heavy work such as the calves, thighs, abdominal muscles, and shoulders.

Treatment:
Move the victim to a cool area and loosen clothing. Have the victim drink 250 - 500 ml of electrolyte replacement beverage or water immediately and every 20 minutes thereafter until symptoms subside. Total water consumption should be 5 – 8 liter per day. Consult a physician.

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6.1.2.3 Heat Exhaustion

Heat exhaustion is a state of weakness or exhaustion caused by the loss of fluids from the body. This condition, although less dangerous than heatstroke, must be treated.

Symptoms:
The symptoms of heat exhaustion include pale, clammy, moist skin; profuse perspiration; and extreme weakness. The body temperature is normal, the pulse is weak and rapid, and breathing is shallow. The victim may have a headache, may vomit, and/or may be dizzy.

Treatment:
Sponge cool water on the body and/or apply cool packs to the groin, head, neck and sides of chest. Move the victim to a cool place, loosen clothing, place the victim in a head low position, and provide bed rest. The normal thirst mechanism is not sensitive enough to ensure body fluid replacement. Have the victim drink 250 ml of electrolyte replacement beverage water immediately and every 20 minutes thereafter until symptoms subside. Total water consumption should be about 5 - 8 liters per day. Consult a physician, especially in severe cases.

6.1.2.4 Heat Stroke

Heat stroke is the most serious disorder associated with heat stress. It occurs when the body's temperature regulation fails and body temperature rises to critical levels. During an episode of heatstroke, the body temperature can rise so high that brain damage and death may result if the person is not cooled quickly. It is critical that medical attention is administered and treated immediately.

Symptoms:
The symptoms of heatstroke include red, hot, dry skin (although the person may have been sweating earlier); nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rate; and unconsciousness or coma.

Treatment:
The victim of heatstroke should be cooled quickly to pre- vent permanent brain damage or death. Soak the victim in cool but not cold water, sponge the body with cool water, or pour water on the body and/or apply cool packs to the groin, head, neck and sides of chest to reduce the temperature to a safe level, 39°C. Do not give the victim coffee, tea beverages. Observe the victim and obtain medical help.

6.1.3 Heat Stress Monitoring

Work activities must institute a heat stress monitoring program that effectively evaluates employee exposure to high heat work environments. Depending upon work locations (i.e., field work in remote areas as opposed to facility/office environments) and monitoring capabilities, there are two acceptable approaches to heat stress monitoring.

6.1.3.1 Heart Rate Assessment/Monitoring

For quick assessment during strenuous fieldwork activities in hot weather, that is part of ongoing project work, the following procedure may be used to monitor the body's physiological response to heat and to manage the work cycle. This procedure may be instituted when the ambient temperature exceeds 21°C.

- The heart rate (HR) should be measured by the radial pulse (felt on the wrist, just below the thumb) for 30 seconds as early as possible in the resting period.
- The HR at the beginning of the rest period should not exceed 110 beats/minute for most individuals.
- The maximum rate is based on an individual's base rate. Base rates vary across the population.
- If the HR is higher than 110 beats/minute, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.
- If the HR still exceeds 110 beats/minute at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.
- The procedure should be continued until the HR is maintained below 110 beats/minute.

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6.1.3.2 Physiological Monitoring

Workers should be removed from duty when physiological monitoring indicates that body core temperature exceeds 38.5°C for medically fit-for- work task and acclimatized personnel, or 38°C for medically unfit for work task, un-acclimatized workers. Where the capability exists, physiological monitoring may be performed by a number of methods, including:

- Heart rate monitoring
- Core temperature surveillance
- Use of tympanic (eardrum) thermometers. by methods such as but not limited to the use of tympanic (eardrum) thermometers

These types of monitoring techniques utilize the same physiological criteria as the widely known but infrequently used Wet Bulb Globe Temperature (WBGT) index. These methods measure actual heat strain on the worker, not environmental conditions in which an acclimatized worker may or may not experience problems. For tympanic monitoring, the worker is simply removed from the hot condition when core temperature exceeds the above mentioned action levels, and when heart rate monitoring is utilized.

6.1.4 Preventive Measures

- Suggest that employees drink 500 ml of water before beginning work in the morning and after lunch.
- Provide disposable, or preferably reusable, cups and water.
- Urge employees to drink 5-8 liters of water per day.
- Consider modifying working hours to avoid extreme heat, or implement work/rest regimens to allow cool-off periods during extreme heat (e.g., 10-minute rest period after every 30-minute work period).
- Provide a cool (preferably air-conditioned) area for rest breaks.
- Monitor employees for signs of heat stress.
- An employee with high blood pressure must be monitored often, and extra precautions should be taken (e.g., drink more water).
- Acclimate employees to work conditions by slowly increasing their workloads (i.e., do not begin work activities with extremely demanding tasks).
- Where appropriate, provide cooling devices to aid natural body ventilation. An example of a cooling aid is long cotton underwear that acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing. Because these devices add weight, their use should be carefully considered and properly balanced against worker efficiency.
- Ensure that shelter is available to protect personnel from heat.
- Maintain good hygienic standards by frequent changes of clothing and showering.
- Clothing should be permitted to dry during rest periods.
- Employees should immediately report any skin problems to their supervisor.
- Provide initial and on-going training regarding heat stress recognition and prevention.

6.2 Cold Stress

6.2.1 Hypothermia

Hypothermia is when the body loses heat faster than it can produce it. This causes the blood vessels in the skin to constrict in order to conserve important vital heat. Hands and feet are usually affected first. As the body tries to produce more heat, involuntary shivering begins.

Symptoms:
Uncontrollable shivering and inability to warm-up, confusion, forgetfulness, irritation, clumsiness, slurred speech, blurred vision, loss of manual dexterity and lack of co-ordination, despair and disinterest, ashen white face and hands, shivering replaced by muscle rigidity, paradoxical stripping of clothes as cold impairs thermo-regulation center of brain, incoherence and collapse; unconsciousness.

Treatment:

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Encourage physical activities to generate muscle heat. Replace wet clothing with dry layers, covering the head and neck. Apply hot packs, water bottles, or warm campfire rocks wrapped in hot, wet towels to the groin, head, neck and sides of the chest. Supply hot decaffeinated drinks.

6.2.2 Other Common Cold Injuries

- **Trench foot** an injury to the foot/feet caused by prolonged exposure to wet and cold temperatures, even up to 16° C.,
- **Frost Bite** is a skin injury caused by freezing of the skin and underlying tissues.
    - Do not try to rewarm the frostbitten area before getting medical help.

The symptoms for each disorder are similar and include tingling, itching, swelling, pain in some cases or numbness in others, lack of sweating, and blisters.

6.2.3 Preventive Measures

- Train personnel in the recognition and treatment of cold related injuries
- Personnel working in cold environments should dress in warm layers.
    - The inner layer should be wicking material to keep moisture away from the body.
    - The middle layer should provide insulation even when wet.
    - The outer layer should give a protective layer from wind and rain that allows some ventilation to prevent overheating.
- Stay dry in the cold because moisture or dampness, e.g. from sweating, can increase the rate of heat loss from the body.
- Drink fluids to prevent dehydration.
    - Preferably drink warm sweetened fluids.
- Utilize space heaters and warming tents when possible.

7.0 TRAINING

It is important that training is conducted to all personnel regarding Heat Stress Prevention. Responsible entities shall train their personnel on applicable elements of their heat-stress prevention procedure and specifically on self- monitoring such as:

- Understanding signs and symptoms of heat stress.
- Using their urine color to check for early signs of dehydration.
- Understanding the need to avoid, caffeinated drinks and large, heavy meals.
- Applying sunscreen regularly for outdoor activities.
- Taking breaks in cool down areas, pacing their work, knowing their limits.
- Immediately reporting any suspected heat related disorder to their supervisor.
- Understanding signs and symptoms of cold stress.
- Understanding the need to dress in layers.
- Understanding the need to continue to hydrate even in cold environments.
- Taking breaks in warm-up areas/tents, and knowing their limits.
- Immediately reporting any suspected cold related disorder to their supervisor.

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