



# **JO SHEERS Procedure 535 – Management of Heat Stress**

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## 1.0 Purpose and Scope

Working outdoors in the summer and working near local sources of heat, exposes workers to heat and humidity (termed heat stress). The human body tries to cope with heat stress to maintain its core (internal) temperature but when heat load (environmental heat plus metabolic heat) exceeds the body's physiological limit of coping, it can potentially give rise to adverse health effects, unless the risk is effectively managed.

### **Purpose:**

The purpose of this Joint Operations (JO) SHEERS procedure is to provide the requirements and guidance to manage risk of heat stress at work and prevent heat related illnesses among employees and contractors. The JO SHEERS procedure complies with Kuwait Environmental Public Authority (KEPA) and Kuwait Government's requirements pertaining to Heat Stress.

### **Scope:**

This JO SHEERS procedure applies both to JO and contractors employees working at sites within the operational control of JO.

## 2.0 Definitions

**Acclimatization:** The physiological ability of a person to develop tolerance to repeated heat exposure. Acclimatization results in changes within the body that increase the tolerance to working in hot environments. Acclimatization usually develops within 5 to 7 days from the start of the heat exposure with full acclimatization being achieved generally within 14 days.

**Conduction:** The transfer of heat energy from materials that are in direct contact with one another. The direction of transfer is from a region of higher temperature to one of lower temperature.

**Convection:** The transfer of heat energy through the movement of matter through a material from a hot region to a cool region.

**Dry Bulb Temperature:** The temperature of air measured by a thermometer freely exposed to the air but shielded from radiation.

**Evaporation:** The process by which a liquid substance like water is converted into a gas.

**Heat related illness:** An illness that results from heat strain. There is a range of heat illnesses and include heat exhaustion, heat syncope, heat cramps, heat rash, and potentially fatal heat stroke.

**Heat strain:** The overall response of the body that occurs when the net load of heat in the body exceeds the body's physiological limit of coping, resulting in a heat imbalance.

**Heat stress:** The net load of heat on the body from the ambient environment, clothing, PPE and metabolic demands of work. It must be dissipated if the body is to remain in thermal equilibrium.

**Hydration:** The state of the body in relation to normal fluid–electrolyte balance.

**Radiant heat:** The heat from a hot object travelling in the form of electromagnetic waves falling on to a cooler object. Sources of radiant heat include the sun, furnaces, flares, fire, or radiant heat reflected or emanating from heated surfaces.

**Relative Humidity:** A measure of percentage of water vapor in air. Zero percent is full dry and 100% is full humid.

**Specific gravity:** The ratio of the density of a substance to the density of water.

**Wet Bulb Temperature:** The lowest thermometer temperature that can be reached by the evaporation of water. It is measured by exposing a wet sensor, such as a wet cotton wick fitted over the bulb of a thermometer.

**Wind Speed:** Average wind speed as measured by an Anemometer.

### 3.0 Requirements

The following requirements must be followed at JO sites where employees or contractors are likely to be exposed to heat stress exposure situations such as work outdoor in the sun in the summer, work in hot and humid environment, work performed in the vicinity of furnaces, heaters and ovens, moderate to heavy physical work in hot and humid conditions, work in confined spaces without adequate ventilation, work situations where heavy protective clothing has to be worn, and any situation where the worker has previously shown signs of heat related illness (e.g., fainting, dizziness, heat cramps).

#### 3.1 Assessment of risk of Heat Stress

Risk assessment for Heat Stress should be done in Planning Phase Hazard Analysis (PPHA) of job as part of Managing Safe Work and also on-site before the start of work to ensure measures are in place to control the risk. Industrial Hygienist/ Safety Officer will offer subject matter expertise, and carry out detailed risk assessment to heat stress for employee groups that have been determined to be at moderate and high risk by employees' supervisors.

##### 3.1.1 Basic Heat Stress Risk Assessment

Supervisors of employees/contractors at work must carry out on-site Basic Heat Stress Risk Assessment of their employees before the commencement of work/ tasks that exposes them to Heat Stress, as an integral part of Job Safety Analysis. The supervisor should assess Heat Stress of the employee group likely to be exposed to heat stress, using "Practical Heat Stress Calculator" tool in Excel spread sheet given as Appendix-B, and made available below "weather" on [JOPWEB intranet page](#). The supervisor (task identifier) should enter the following information in the excel spread sheet tool to calculate Heat Stress Index:

- (a) Actual or forecast Dry bulb (standard temperature) for the work place in Celsius or Fahrenheit from weather site for Wafra available on a link on the JOPWEB intranet page.
- (b) Actual or forecast Relative humidity (%) for the work place in Celsius or Fahrenheit from weather site for Wafra available on a link on the JOPWEB intranet page.
- (c) Acclimatization: Worker/s acclimatized/ not acclimatized.
- (d) Impact of clothing/PPE: Enter one appropriate option: (a) Normal coverall or Light FRC, or no thick garment or no insulated PPE, (b) Full body Chemical suit (c) Full face SCBA, (d) Thick inner or outer garments.

- (e) Level of physical workload: Enter either (a) Light, or (b) Moderate Normal, or (c) Heavy physical work
- (f) Solar load: Enter either (a) No exposure to direct sun light, or (b) Exposed to sunlight with no or few clouds.

**Interpretation of Heat Stress Index:** On completion of entry of data, the excel spread sheet tool will calculate Heat Stress Index and it will appear as a number in degree Fahrenheit or Celsius, and the number can be interpreted as follows:

Heat Stress Index		Interpretation	Work zone
<sup>0</sup> C	<sup>0</sup> F		
Up to 32 <sup>0</sup> C	Up to 90 <sup>0</sup> F	No risk (No adverse effect expected)	Unrestricted Work Zone
32.1 <sup>0</sup> C to 40 <sup>0</sup> C	91.1 <sup>0</sup> F to 104 <sup>0</sup> F	Low Risk (Heat exhaustion and heat cramps possible)	Controlled Work Zone
40.1 <sup>0</sup> C to 54 <sup>0</sup> C	104.1 <sup>0</sup> F to 130 <sup>0</sup> F	Medium (Moderate) Risk (Heat exhaustion and heat cramps likely)	Controlled Work Zone
More than 54 <sup>0</sup> C	More than 130 <sup>0</sup> F	High risk. (Heat Stroke likely)	Restricted Work Zone

### 3.1.2 Detailed Heat Stress Risk Assessment:

Detailed Risk Assessment will be carried by Industrial Hygienist/ Safety Officer having expertise on the subject, for groups that have been determined to be at moderate or high risk during Basic Heat Stress Assessment. Industrial Hygienist/ Safety Officer having expertise on subject will select the group/s, review findings of Basic Heat Stress and carry out a detailed risk assessment described below, record findings on a form “Detailed Heat Stress Assessment Form”, given in Appendix-C.

- (a) **Determination of Wet bulb globe Temperature (WBGT) Index:** The WBGT is an index of the environmental contribution to heat stress. It is influenced by air temperature, radiant heat, humidity and air movement. Use the WBGT instrument to measure dry bulb temperature, wet bulb temperature, globe temperature and wind speed at location representative of environmental conditions to which employees are exposed. The instrument is suspended at a height of 4 feet above the ground and a period of 20 minutes should elapse before readings are taken. WBGT is computed separately for outdoor and indoor environment, as follows:

WBGT Index with direct exposure to the sun = 0.7 wet bulb reading + 0.2 globe temperature reading + 0.1 dry bulb reading.

WBGT Index without direct exposure to the sun = 0.7 wet bulb reading + 0.3 globe temperature reading

- (b) **WBGT Correction factor for clothing:** WBGT index should be adjusted for the contribution clothing makes to the net heat load to which worker is exposed. Additions that should be made to WBGT for clothing are as follows:

**Clothing type**

**Clothing adjustment factor  
(Add to WBGT in °C)**

Cotton coverall (or light FRC)	0
Work clothes (shirt and pants)	0
Polypropylene coveralls	0.5
Polyolefin coveralls	1
Double-layer woven clothes	3
Vapor barrier coveralls	11

- (c) **Physical Work Load:** Physical work load also contributes to the net heat load to which worker is exposed as increase in intensity of physical work increases metabolic rate of body. “WBGT” index, “Physical Work Load” and “Clothing” together contribute to the net heat load to which worker is exposed. Physical work activity can be categorized into rest, light, moderate and heavy based on metabolic rate and examples of the same are given below:

<b>Category of Physical Work</b>	<b>Metabolic Rate in W</b>	<b>Description and examples of activity under each category of Physical Work</b>
<b>Rest</b>	<b>115</b>	Sitting
<b>Light</b>	<b>180</b>	Sitting with light manual work with hands and arms. Standing with some light arm work and occasional walking. Driving a vehicle and Welding/ filling metal.
<b>Moderate</b>	<b>300</b>	Sustained walking. Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work or light pulling and pushing. Laying bricks. Hammering nails. Raking asphalt. Cleaning a floor. Beating a carpet.
<b>Heavy</b>	<b>415</b>	Intense arm and trunk work, carrying, shoveling, manual sawing; pushing and pulling heavy loads and walking at fast pace. Carpenter sawing by hand. Shoveling dry sand. Hammering nails.
<b>Very Heavy</b>	<b>520</b>	Very intense activity at fast to maximum pace. Examples: Lifting heavy objects. Digging. Shoveling sand.

Kuwait EPA has set maximum limits for adjusted WBGT according to degree of work load and recommended work rest cycles for each zone of WBGT and degree of work load and these are reproduced in Appendix-D. This appendix should be used as a screening tool to evaluate whether a heat stress situation exists and degree of heat stress situation. Work rest periods mentioned in the appendix should be used as a guide to protect the workers against heat stress. If required, employees can be assigned work in an environment with WBGT value and/ or work-rest period exceeding the limit mentioned in the Appendix-D, provided direct supervisor is able to ensure that employees are able to work safely without causing harm to their health, by ensuring that:

- (a) The General Control measures described in this procedure are in place.
- (b) The employees at risk of heat stress are monitored for symptoms of early effects of heat strain. If heat strain is detected in a single employee, his/ her further exposure to heat should be discontinued. If heat strain is detected in 2 or more employees among a group at risk, the direct supervisor must discontinue work for the entire group and review general and specific control measures to prevent recurrence of the incident. Heat stress is considered to be under control if heat strain is not detected among the employees at risk.

### 3.2 Assessment of Heat Strain:

Heat Strain occurs when net heat load placed by heat stress on the body exceeds the body's physiological capacity to lose heat. Monitoring for heat strain is required when employees are exposed to heat stress above the adjusted WBGT limit value and/ or work-rest period exceed the limit mentioned in the Appendix-D. Heat strain is indicated if one or more of the following occur:

- (a) **Symptoms of heat Strain:** If symptoms of heat related illness such as malaise, inexplicable irritability, flue like symptoms, sudden and severe fatigue, nausea, dizziness, lightheadedness, disorientation or confusion occur.
- (b) **Internal (core) temperature:** Body core temperature can be measured using an ear thermometer or Personal Heat Strain Monitor. Heat strain is indicated if temperature exceeds 38<sup>0</sup> C. If the work is intermittent, then transient increase to 39<sup>0</sup> C is acceptable provided core temperature recovers to 37<sup>0</sup> C. Core temperature can be estimated from oral temperature. Core temperature = Oral temperature + 0.5 degree C. The employee whose oral temperature is to be measured should breathe through nose and not open mouth and should not eat or drink for 15 minutes prior to taking reading.
- (c) **Sustained (several minutes) heart rate** exceeds 180 beats per minute minus the individual's age in year (i.e., 180 – age in years). It can be measured using Personal Heat Strain Monitor.
- (d) **Recovery Heart rate at one minute** after a peak work effort is another indicator of heat strain. Heat strain is considered to be present if heart rate at one minute after stoppage of work effort exceeds 110 beats per minute. It can be measured using Personal Heat Strain Monitor.

Heat strain should be monitored in one or more workers representative of moderate to high risk of heat stress and over a period of time that it represents the worst case scenario or exposure. Assessment of Heat Strain should be recorded in Appendix-E "Heat Strain Assessment Form".

### 3.3 Measures to control Heat Stress:

Measures to control heat stress can be categorized into General control measures and Specific control measures (refer to Appendix-A Flow Chart for Heat Stress Management):

**3.3.1 General measures to control Heat Stress:** General measures to control heat should be applied uniformly all across to all work zones (unrestricted, controlled and restricted), work places, and jobs at risk of heat stress. General control measures include training, personal control measures, and scheduling work.

**3.3.1.1 Awareness Training:** Employees should receive training every year before the start of the summer season or before the employee is assigned heat related job. The content should include what is heat stress, how it is caused, how to recognize heat stress and its harmful effects, and how to control the risk.

**3.3.1.2 Personal Control measures:** These actions must be taken by the employee to protect self and reduce the risk of heat related illness. These measures are:

**Protective clothing:** Wear light colored and loose fitting coverall to reflect heat and facilitate evaporation of sweat.

**Acclimatization:** Physiological changes occur in an individual during the first week of exposure to heat. Acclimatization improves the efficiency of body's response to heat. Both new employees and employees returning to work after minimum three weeks leave should work gradually in the

heat to full capacity. New employee can do 100% of manual work from 5<sup>th</sup> day and the existing employee can do full manual work from 4<sup>th</sup> day of joining duty, as shown in table below:

**Table: Acclimatization schedule**

Day	% of Full Work Assignment	
	New Employee	Experience worker returning to work after 3 weeks of break
Day 1	20%	50%
Day 2	40%	60%
Day 3	60%	80%
Day 4	80%	100%
Day 5 onwards	100%	

**Fluid Replacement:** Cool potable water should be made available to workers in nearby shade or room. It should meet the requirements mentioned in Appendix – B of JO SHEERS Procedure 530 – Potable Water. These requirements are summarized here: Cool potable water should be made available either as (a) bubble top branded potable water bottles mounted on plumbed-in water coolers, or (b) potable water tap with filter and chiller, or (c) in a thermo cool container with a tap or dispenser. The container should be cleaned, washed and sanitized each time prior to filling potable water, and potable water should be filled without touch or contamination, and lid should be closed tightly. The container should carry label “Drinking water” and “Date of last filling”.

Drinking minimum 1 cup (150 ml) every 20 minutes is recommended. Color and volume of urine is a good indicator fluid replacement. The person drinking adequate quantity of water will pass sufficient urine and it will be light yellow in color. An employee can drink part of water requirement in the form of flavored drink like lemonade or commercially available normal tonic drink. Employees should not take “salt tablets” or “sports drink” unless specifically advised by their physician. Employees working in the sun/ heat should avoid tea, coffee and caffeinated drink as these dehydrate body.

**Personal Hygiene:** Employees should wipe sweat with individual towels from time to time to keep the skin dry. They should change wet clothes and wear clean and dry clothes. Employees who sweat profusely should take bath at the end of the shift.

**Diet:** Employees should not eat large meals at work as it increases circulatory load and metabolic heat.

**Health and life style:** Encourage healthy life style and ideal body weight. Employees, who are obese, above 50 years of age, with a long term illness of heart, lungs, kidneys, or liver, and employees with fever and diarrhea have lower tolerance for heat. Employee suffering from long term illnesses mentioned above or on long term medication should inform their physician of exposure to heat stress and seek advice. Employees having fever and diarrhea should inform their direct supervisor. Employees should not abuse drug or alcohol.

**3.3.1.3 Scheduling work:** Manual work in outdoors during peak hot hours (12:00 hour to 16:00 hours) in the summer months of June, July and August is prohibited in Kuwait vide Ministerial Decision number 157 of 5 June 2005, issued by the Ministry of Social and Labor affairs. Accordingly JO and Contractors responsible persons must ensure compliance while preparing shift roster/ work schedule.



**3.3.2. Specific measures to control Heat Stress:** Specific measures to control heat stress should be reviewed and appropriate control measures should be selected and implemented in work zones determined to be “controlled” or “restricted” on basic heat stress assessment, and whenever employees carry out medium or heavy manual work while exposed to heat stress. It is recommended to have short term solutions while long term solutions are planned and executed.

**Engineering controls:** These reduce or contain hazard. (a) Lower air temperature, radiant heat and humidity by improving ventilation, shield source of heat, or bring in cooler air in the work area, as appropriate. (b) Shade should be provided in “controlled work zones” and air-conditioned rooms should be provided in “restricted work zones” near work areas, to let employees rest during breaks and when not working. (c) Reduce physical work by mechanizing tasks and use of powered tools.

**Training:** Site specific training should be provided to employees working in restricted work zones, emphasizing hydration, pacing of work, work-rest cycles, taking break in a shade or a cool room, and identifying symptoms and signs of heat stress in self and fellow employees.

**Fitness for Duty:** Employees direct supervisor should identify workers that have lower tolerance for heat due to health reasons and refer them to physician and seek opinion if they can work on heat-related jobs.

**Scheduling and pacing of work, and work – rest cycles:** Self pace work or pace work over longer period to reduce the rate of metabolism, with adequate work breaks in a cool room or a shade. Schedule heavy work during cooler part of the shift/ day. Follow work breaks in a cool room or a shade, as mentioned in Appendix-D. Any idle time inherent in the work should be spent in a cool room or a shade.

**Fluid replacement:** Cool potable water should be made available to workers in nearby shade or room as mentioned under “General measures to control Heat Stress”. Employees working in controlled zones should be encouraged to drink 0.5 to 1 liter cool potable water per hour and employees working in restricted zones should be encouraged to drink 1 liter or more of cool potable water per hour. An employee can drink part of water requirement in the form of flavored drink like lemonade or commercially available normal tonic drink. Employees should not take “salt tablets” or “sports drink” unless specifically advised by their physician. Employees working in the sun/ heat should avoid tea, coffee and caffeinated drink as these dehydrate body.

**Self-monitoring and “buddy – monitoring”:** Encourage employees to observe self and co-workers for symptoms and signs heat strain and heat related illness. Use stop work authority if indicated. If an employee shows any indication of heat strain or heat related illness, the employee should stop work, rest in cool place and seek immediate medical help. The incident should also be reported to employee’s supervisor. Working alone should be avoided and employees must not work alone in restricted zones.

Control measures are briefly summarized in a table below. For details refer to General Measures to Control Heat Stress (Section 3.3.1) and Specific Control Measures to Control Heat Stress (Section 3.3.2).

Basic Heat Stress Index	Work Zones	Control Measures
Up to 32 <sup>0</sup> C	Unrestricted	General Measures to Control Heat Stress (Section 3.3.1).
32.1 <sup>0</sup> C to 54 <sup>0</sup> C	Controlled	General Measures to Control Heat Stress (Section 3.3.1). Engineering controls. Fitness for duty. Pace work, schedule work at cooler time of day, Work-rest cycles. Breaks under shade. Self and buddy monitoring. Hydration: Drink 0.5 to 1 liter of cool potable water.
More than 54 <sup>0</sup> C	Restricted	General Measures to Control Heat Stress (Section 3.3.1). Site specific Training. Engineering controls. Fitness for duty. Pace work, schedule work at cooler time of day, Work-rest cycles. Breaks in air-conditioned room. Self and buddy monitoring. Working alone is prohibited. Hydration: Drink 1 liter or more of cool potable water.

### 3.3.3 First aid and Medical measures

A brief description of Heat related illnesses is given in Appendix-F. Employees should contact JO Dispatcher and report any person suspected of heat related disorder. The person attending the victim should do the following till medical help/ ambulance arrives at the site. (a) Move victim to a cool room or shade. (b) Make victim lie down flat and loosen clothes and shoes. (c) Elevate victim's legs if victim is suspected of heat syncope or heat exhaustion. (d) Make victim drink cold potable water if conscious and responding. (e) Apply ice packs or wet towel to cool body if victim is suspected of heat stroke.

## 4.0 Roles and Responsibilities

### 4.1 EHS Division

JO-Environment, Health and Safety (EHS) Superintendent is designated as Process Sponsor, owner and competent person to administer, coordinate, and maintain elements of this SOP. JO-Industrial Hygienist shall assist the competent person in coordinating implementation of the requirements given in this SOP and provide subject matter expertise.

### 4.2 Contract Owners

Ensure contractors have a written Heat Stress Management procedure, abide by Ministerial Decision number 157 of 5 June 2005 issued by the Ministry of Social and Labor affairs, review control measures ahead of heat stress condition, e.g. summer season, and ensure Basic Heat Stress Assessment is carried out each time workers are likely to be exposed to heat, and training, potable water supply, and other control measures are in place.

### 4.3 Line Managers and Supervisors

Ensure that persons under their control are aware and comply with the requirements in this procedure. Identify all potential heat stress exposure situations. Assess the potential health risk with consideration of both the likelihood and severity of consequence and ensure Basic Heat Stress Assessment is done and Work zones are communicated to personnel. Ensure that applicable work schedules comply with this procedure. Select and implement exposure control measures based on

the hierarchy of controls. Ensure employees, who work in controlled and restricted work zones are monitored for early effects of heat. Implement additional controls as needed for managing heat stress. Conduct a review of any heat related incident and the effectiveness of the existing control measures as required.

#### **4.4 Employees**

Employees should attend training, manage personal control measures, monitor self and co-workers for early effects of heat, and comply with controls. They should report heat stress issues to their supervisor. They should present fitness for duty when asked by supervisor. If not fit to work in heat stress condition, notify to supervisor to ensure that an appropriate risk mitigation process is implemented.

### **5.0 References**

- American Conference of Government Industrial Hygienist (ACGIH). Heat Stress and Heat Strain.
- ANSI - Hot environments - Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature)
- K-EPA Appendix 6-1 Maximum Limits Allowed for Heat Stress. Regulations Implemented under Law No. 21. Environmental Public Authority Kuwait, 2001.
- National Institute for Occupational Safety and Health (NIOSH). Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments.
- Occupational Safety and Health Administration (OSHA) Safety and Health Topics: Heat Stress.
- Mario Guzman. United States Mines Rescue Association. Practical Heat Stress Calculator.

### **6.0 Management Systems**

#### **6.1 Support resources**

JO EHS is available to assist with implementation of this JO SHEERS procedure. Support resources include Practical Heat Stress Calculator by Mario Guzman of United States Mines Rescue Association, K-EPA Appendix 6-1 Maximum Limits Allowed for Heat Stress and Work Rest periods, ACGIH Heat Stress and Heat Strain, and Chevron GUG COP for Occupational Hygiene.

#### **6.2 Document control and record keeping**

Divisions and Contractors shall maintain auditable records to document their compliance with applicable clauses of this document.

#### **6.3 Audit Requirements**

This JO SHEERS procedure must be audited as part of JO first party HSE audit to ensure compliance. Audit findings must be documented and a system established to ensure that findings are appropriately addressed.

#### **6.4 Standard renewal process**

- This procedure shall be reviewed and approved by JO SHEERS Leadership Team.
- The latest approved version of this procedure shall be maintained on JO Intranet.
- This document will be reviewed and revised every 3 years from the date of issue, or earlier if work conditions or regulatory requirements change.

- Validity of this JO SHEERS procedure can be extended for another term if work conditions or regulatory requirements have not changed within the validity period. Extension of validity shall be endorsed on the cover page of the procedure.

### 6.5 Deviation process

Deviation from this document requirement must be authorized by the SHEERS Leadership Team. Deviations must be documented, and the documentation must include the relevant facts supporting the deviation decision. Deviation authorization must be renewed every 3 years.

### 6.6 Document Control Information

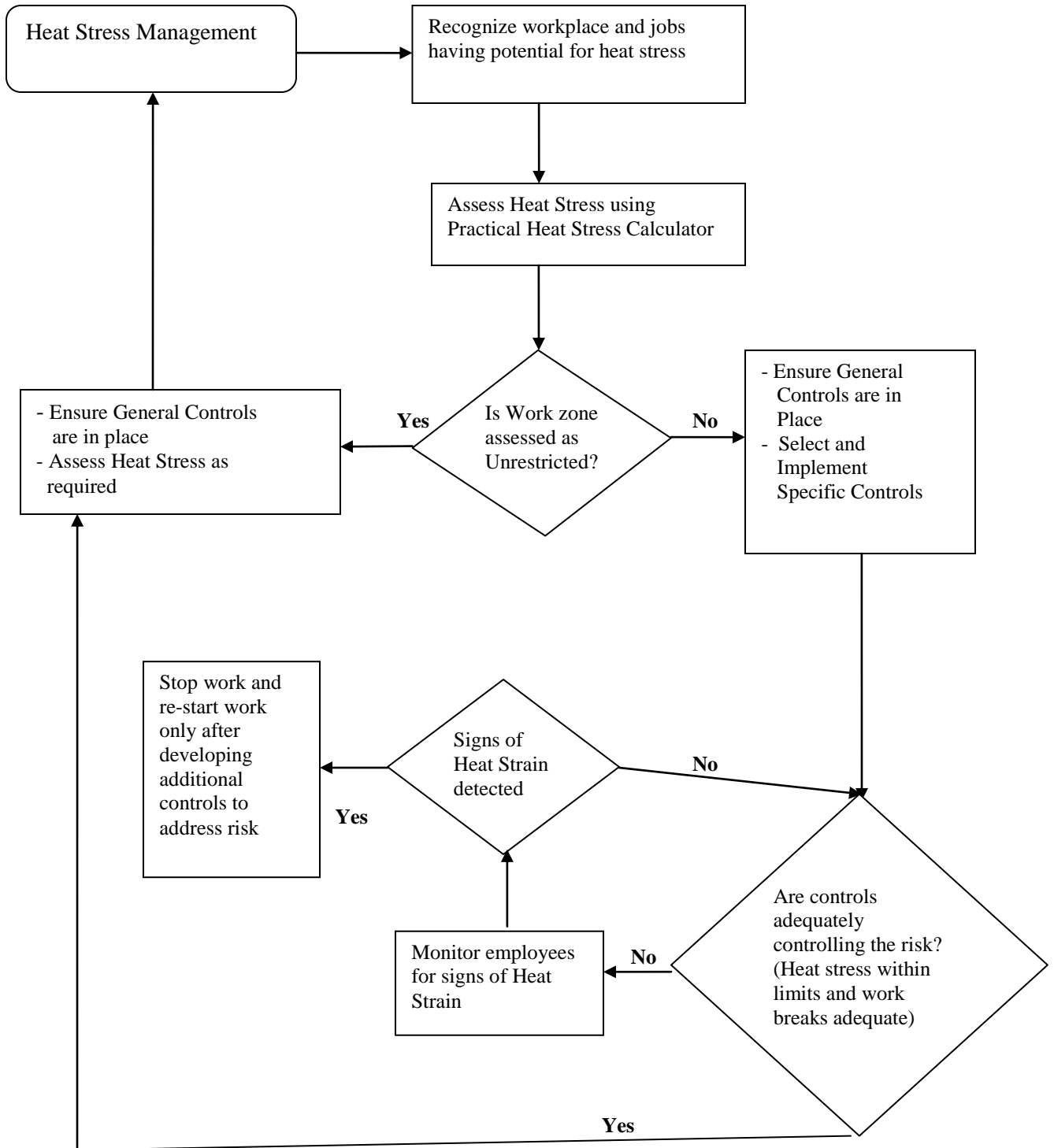
Description	JO-Common	JO-Owner
Approval Date	21 April 2015	EH&S
Next Revision Due	21 April 2018	
Control Number	1.0	

**Table 1: Document History**

Version Number	Date	Notes
1.0	21 April 2015	Initial Release

# Appendix – A

## Flow chart for Heat Stress Management



## Appendix – B

### Practical Heat Stress Calculator for Assessment of Basic Heat Stress

Practical Heat Stress Calculator		
Task Identifier		
<b>Physical Parameters of the Task and Environment (Actual or Simulated)</b>		
	<b>°C</b>	<b>°F</b>
Dry bulb (standard) temperature [enter as Celsius or Fahrenheit]		
Relative Humidity (%)		
Evaluate workforce acclimatization	Workforce is acclimated	▼
Evaluate impact of clothing, FRCs and certain PPE	Light FRCs or no thick garments or no insulating PPE	▼
Evaluate the level of the physical workload	Work could be classified as normal physical exertion	▼
Evaluate the solar load	Exposure to direct sunlight with few or no clouds	▼
<b>Calculated Parameters of the Heat Stress Model</b>		
Heat Index (°F)		
Heat Index adjustment due to workforce acclimatization	0	
Heat Index adjustment due to impact of PPE or other clothing	0	
Heat Index adjustment due to the physical workload	0	
Heat Index adjustment due to the solar load	15	
<b>Heat Stress Interpretation</b>		
Adjusted Heat Index (°F)		
<b>NONE</b> - Adjusted Heat Index less than 90°F (32°C). No adverse impact expected		
<b>LOW RISK</b> - Adjusted Heat Index more than 90°F (32°C) and less than 104°F (40°C). Heat exhaustion or cramps possible.		
<b>MEDIUM RISK</b> - Adjusted Heat Index more than 104°F (40°C) and less than 130°F (54°C). Heat cramps or exhaustion likely. Heat stroke possible.		
<b>HIGH RISK</b> - Adjusted Heat Index more than 130°F (54°C). Heat stroke very likely		
<b>Severe Heat Illness Risk Level</b>		
<b>Recommended Actions</b>		
<b>Reduce the level of physical effort involved in the task</b>		
<b>Shade the employees while working and resting</b>		
<b>Notes on the Use of this Tool</b>		
When measuring Dry Bulb Temperature, be sure to measure the temperature at the point work is being performed in case a heat source greater than ambient temperature is collocated to the work area and impacting the crew.		
Individual reactions to heat will vary. Risk levels are determined based upon the responses to heat stress of average males of average fitness level. Individual differences may increase the risk levels and should be considered when evaluating the heat stress risk level.		
Chart provides guidelines for assessing the potential severity of heat stress. This chart is not meant to replace heat stress assessments using Wet Bulb Globe Temperature Index or Required Sweat Rate. If the appropriate psychometric measuring capabilities are available, then they should be considered for use and the results considered more accurate than those obtained from the above methodology		
<b>References</b>		
U.S. National Weather Service		
U.S. NIOSH Publication 86-113 "Occupational Exposure to Hot Environments"		
HSE RESEARCH REPORT 008 – "The development of a practical heat stress assessment methodology for use in UK industry", Damian Bethea & Ken Parsons, Department of Human Sciences, Loughborough University		
U.S. Army CHPMM – Heat Stress Assessment		

## Appendix – C

### Detailed Heat Stress Assessment Form

(To be filled by Industrial Hygienist at the time of Detailed Heat Stress Assessment)

**Location:** \_\_\_\_\_ **Date** \_\_\_\_\_ **Time** \_\_\_\_\_

**WBGT instrument used:**

**Make/Model** \_\_\_\_\_ **Serial No.** \_\_\_\_\_ **Calibration date:** \_\_\_\_\_

#### Details of Person/Job Monitored:

Name of Employee:

Employer: SAC/KGOC/ Other (Write):

Badge/ ID:

Job Position:

Tasks:

#### Clothing:

Clothing Adjustment Factor =

Work Load Type: Light/Medium/ Heavy

#### **Measurements using WBGT:**

Dry Bulb Temperature:

Wet Bulb Temperature

Globe Temperature:

Wind Speed:

#### **Computation of WBGT Index:**

WBGT Index with direct exposure to the sun = 0.7 wet bulb reading + 0.2 globe temperature reading + 0.1 dry bulb reading.

#### WBGT Index adjusted for clothing:

WBGT Index without direct exposure to the sun = 0.7 wet bulb reading + 0.3 globe temperature reading.

## Appendix – D

### Maximum Limits Allowed for Heat Stress Exposure by Kuwait EPA in Industrial Environment, based on WBGT Index and Type of Physical Work

Applicable Work-Rest System	Work Plan (Physical Work Category)					
	Light		Medium		Heavy	
	WBGT value in Centigrade	WBGT value in Fahrenheit	WBGT value in Centigrade	WBGT value in Fahrenheit	WBGT value in Centigrade	WBGT value in Fahrenheit
Continuous work	30	86	26.7	80	25	77
75% work, 25% rest every hour	30.6	87	28	82	25.9	78
50% work, 50% rest every hour	31.4	89	29.4	85	27.9	82
25% work, 75% rest every hour	32.2	90	31.1	88	30	86

Note: WBGT value should be calculated for the work environment (either exposure to direct sunlight or no exposure to direct sunlight) using equation given under item 3.1.2 (a) on page 5 of this document, and as a next step WBGT value should be corrected for clothing as mentioned under item 3.1.2 (b) on page 5 of this document.



**Appendix – E**  
**Heat Strain Assessment Form**

**Location:** \_\_\_\_\_ **Date** \_\_\_\_\_ **Time** \_\_\_\_\_  
**Monitored by: Name:** \_\_\_\_\_ **Signature:** \_\_\_\_\_

**Details of Person/Job Monitored:**

Name of Employee:

Employer: SAC/KGOC/ Other (Write):

Badge/ ID:

Job Position:

Tasks:

**WBGT Index:**

**Assessment of Heat Strain:**

**1. Symptoms of Heat Strain:**

None/ Malaise/ Nausea/ Dizziness/ Hot and dry skin/ Confusion/ Disorientation/Fatigue/ Other  
(Write):

**2. Body Temperature:** Ear temperature: ..... degree centigrade  
Oral temperature: ..... degree centigrade

**3. Recovery Heart Rate:** Heart rate at one minute of rest after a peak effort: ..... Beats/ minute

## Appendix - F

### Harmful Effects of exposure to Heat stress

Over exposure to heat stress can cause heat related disorders, discomfort, reduce concentration, and impair performance. Heat related disorders are manifestations of over-exposure to heat stress. A brief description of common or important heat related disorders is given below:

Disorder	Symptoms	Signs	Cause
Heat exhaustion	Mostly commonly occurring Heat related disorder. Victim complains: nausea, weakness, dizziness, fatigue, and blurred vision.	<ul style="list-style-type: none"> <li>- Profuse sweating. Skin cold and moist</li> <li>- Dehydration.</li> <li>- Increase in Pulse rate</li> <li>- Decrease in Blood pressure</li> </ul>	Excessive fluid loss from body due to profuse sweating.
Heat stroke	It is a severe and often fatal form of Heat related disorder. Victim complains: restless, irritable, confused, erratic behavior, unconsciousness.	<ul style="list-style-type: none"> <li>- Skin hot and dry.</li> <li>- Internal Body temperature above 40°C.</li> <li>- Unconscious</li> <li>- Convulsions</li> </ul>	Severe and long term exposure to heat. Heat regulating center in the brain is affected and as a result body loses its ability to regulate its response to heat.
Heat syncope	Fainting (brief black out) and blurred vision	<ul style="list-style-type: none"> <li>- Fainting</li> <li>- Decrease in Blood Pressure</li> </ul>	Pooling of blood in the legs from prolonged standing, heat exposure, and lack of acclimatization or poor health.
Heat cramps	It occurs rarely. Victim complains: Painful muscle cramps in fatigued muscles of legs and abdomen	Painful spasm of muscles in leg and abdomen	Decrease in salt content due to sweating over long period of time (many days or months).
Heat rash (Prickly heat)	Skin eruptions and irritation and redness at the site of eruptions	Skin eruptions in skin folds (axillae, groin), and areas subject to friction from clothes (back of the chest and abdomen)	Blocking of pores of sweat glands due to sweating over long period of time (many days or months) and inadequate hygiene practices.