

BP OIL -- TOLEDO REFINERY

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| SCOPE | This document will help guide supervisors who manage jobs that involve work in elevated air temperatures, radiant heat, high humidity, physical contact with hot objects, or strenuous physical activities in hot environments. |
| HEALTH Special PPE & Special Hazards | Several heat disorders can result if the body core temperature rises over 100.4 ^o F. Normal body core temperature is 98.6 ^o F. |
| SAFETY | Mental and physical performance can be altered as a result of heat stress which could lead to an injury or an accident. |
| REFERENCE DOCUMENTS | <ul style="list-style-type: none"> • OSHA Technical Manual, US DOL, 1995. • ACGIH TLV Handbook, 1999. • Principles of Industrial Hygiene, National Safety Council Third Edition, 1993. • National Oceanic and Atmospheric Administration • OSHA's Campaign to Prevent Heat Illness in Outdoor Workers |
| SPECIAL MATERIALS & EQUIPMENT | Wet Bulb Globe Thermometer (WBGT), Heat Index Thermometer, Cooling Vests, Fire Blankets, Air Movers |
| QUALITY | Improved health and productivity will result in workers who are not exposed to excess heat stress. |
| ENVIRONMENTAL | Ambient air temperatures, air movement, water vapor pressure (humidity), and radiant heat are environmental factors to be considered for heat stress assessments. |

- 1.0 Workplace Description
- Almost all petroleum refinery processes occur outdoors. As the outside air temperature and humidity rises in warm weather months, the risk of a heat stress situation to workers can become evident.
 - Radiant heat from equipment such as hot process pipes, furnaces, heat exchangers, vessels, reactors, or air coolers (fin fans) can contribute to the heat stress environment.
 - Confined space entry into hot work environments can create additional heat hazards, due, in part, to limited air movement.
 - Semi-permeable or impermeable clothing such as flame-retardant suits and tyvek will minimize the worker's ability to remove body heat and needs to be considered.
- 2.0 Definitions
1. **Acclimatization:** the process of becoming accustomed to the heat. Acclimatized workers will have a lower heart rate, lower body temperature, higher sweat rate, and a more dilute sweat (less salt-containing).
 2. **Apparent Temperature (Heat Index):** a measure of the contribution humidity makes, with a high air temperature, to reduce the body's ability to cool itself.
 3. **Evaporative Cooling (Heat Loss):** when sweat evaporates from the skin. High humidity reduces the rate of evaporation and the effectiveness of this very essential body cooling system.
 4. **Heat Cramps:** painful muscle spasms as a result of exposure to excess heat. Too much or too little water replacement is involved.
 5. **Heat Exhaustion:** a condition usually caused by loss of body water because of exposure to excess heat. Symptoms include: headache, tiredness, nausea, and sometimes fainting.
 6. **Heat Stress:** the combined effect of environmental and physical work factors that create the total heat load onto the body.
 7. **Heat Stroke:** a medical emergency that includes a rise in body core temperature. Symptoms include: mental confusion, convulsions, hot, dry, red skin, loss of consciousness.
 8. **Wet-Bulb Globe Thermometer (WBGT):** an instrument that can simultaneously measure dry air temperature, radiant heat transfer, and humidity. It cannot reflect the effects of air movement, evaporative heat loss, nor the excess body heat build-up due to physical activity.
- 3.0 Engineering Controls
- Increase evaporative heat loss by: 1) ventilation with cooler air, or, 2) decrease the humidity with an air cooler.
 - Shield or insulate radiant heat sources from the worker. Fire blankets, insulation, or reflective shielding is recommended.

4.0 Work Practices

- If air temperature is above 95° F, attempt to reduce the air temperature, and reduce air speed across the skin. At 95° F, moving hot air across the skin will not provide evaporative cooling because the air is too hot.
- Provide heat stress training for workers and supervisors.
- Consider a Work/Rest Schedule and a cool area for rest when physical activity and high temperatures are present.

The following chart can be used as a guideline in order to help determine the schedule. Temperatures listed are determined using a WBGT (Safety Dept).

| Work/Rest Regimen | Work Load | | |
|--------------------------------------|--------------------|-----------------------|--------------------|
| | Light ^a | Moderate ^b | Heavy ^c |
| Continuous work* | 88° F | 82° F | - |
| 75% Work---- 25% Rest, each hour | 88° F | 84.2° F | 81.5° F |
| 50% Work ---- 50% Rest, each hour | 89.6° F | 86° F | 84.2° F |
| 25% Work---- 75% Rest, each hour | 90.5° F | 88.7° F | 86.9° F |

*Continuous work implies an 8-hour workday with a 15 minute morning and afternoon break and a 30 minute lunch break. If additional breaks or rest are provided, these temperatures could be adjusted upward based on a time-weighted average calculation. This estimation can be done by the Safety Department.

Workload Examples

| Light ^a | Moderate ^b | Heavy ^c |
|---|---------------------------|------------------------------------|
| Adjusting equipment (light arm/hand work) | Using a hand wrench | Shoveling |
| Using table saw | Prying | Firefighting |
| Painting | Loosening | Manually chipping |
| Occasional walking | Using a broom | Consistently lifting heavy objects |
| Driving | Wire brushing | Digging |
| | Removing insulation | Sawing by hand |
| | Light pushing and pulling | Impact Wrenching |
| | Welding | Erect a scaffold |

- Liquid replacement must be encouraged and be available. It is recommended to drink small amounts frequently, i.e., 8 ounces every 20 minutes, preferably water (must not be distilled water).
- Reduce the physical demands of work; automate (mechanize) components of the work task. Reduce work time, rotate more workers into the job.

Alternately, the **Heat Index Banding Chart** can be used as a guideline to help evaluate occupational exposures to heat stress. The heat index temperature is an index of the air temperature (dry globe) and the % relative humidity. The below heat index banding may be used as a resource for assessing employee heat exposure.

OSHA’s NOAA Modified Heat Index Banding

| 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 |

Follow the below table for actions associated with the modified NOAA Heat Index Banding.

| Plan Element | Heat Index Risk Level | | | |
|--|-----------------------|----------|------|-------------------|
| | Lower (Caution) | Moderate | High | Very High/Extreme |
| Ensure adequate water is available, and provisions for rest areas have been made. | ✓ | ✓ | ✓ | ✓ |
| Prepare workers to recognize heat-related illness and preventive measures. | ✓ | ✓ | ✓ | ✓ |
| Supervisors should have a heightened awareness of workers activities, and should monitor work crews for signs of heat-related illness. | | ✓ | ✓ | ✓ |
| Modified Work Schedules (contact the safety department to take a WBGT reading to accurately determine a work rest regimen) | | ✓ | ✓ | ✓ |

- 5.0 PPE
 - When temperatures reach extremely high levels, additional plans for heat stress control need to be addressed. For entry into enclosed, or permit, confined spaces, such as fin fan cowlings, reactors, or furnaces, where temperatures exceed 100° F, supplied air respiratory protection should be used to protect lung tissue from hot temperatures.
 - If extremely long periods of work time are necessary in a hot working environment (>95° F and >75% relative humidity), PPE will need to be considered along with a worker rotation plan. Ice vests are available from the Safety Department or the Tool Room.

- 6.0 Other Factors
 - Age, gender, and obesity influence the body’s ability to sweat. Older workers and women cannot sweat as efficiently. The larger surface area of the obese worker is less favorable for heat dissipation. Be mindful to these factors when planning jobs.
 - Alcohol reduces heat tolerance and increases the risk of heat illnesses. Also, certain heart medications and diuretics (water pills) can alter the body’s ability to control heat. Inform workers of these additional effects on the body.

Revision history

The following information documents at least the last 3 changes to this document, with all the changes listed for the last 6 months.

| Date | Revised By | Changes |
|----------|------------------|--|
| 04/05/12 | Michael Chambers | Changed revision number, changed owner, changed responsible authorizer, changed effective date, added OSHA's campaign to prevent heat illness in outdoor workers to references, added heat index thermometer to equipment section, deleted NOAA heat index chart, Added OSHA's NOAA modified banding chart, changed work load temperatures to coincide with 2011 ACGIH recommendations, added work load examples, added actions chart relevant to the heat index banding chart. MOC# M20121845-001 |

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