

NASA CR-1205-1,

"A Compendium of Human Responses to the Aerospace Environment".*

The report shows that when in-plant temperatures rise over 85°, output drops by 18% and accuracy suffers from a 40% increase in errors. Productivity losses from high temperatures may be documented by your own production records.

<u>Effective Temp.</u>	<u>Loss in Output</u>	<u>Loss in Accuracy</u>
75°	3%	Negligible
80°	8%	5%
85°	18%	40%
90°	29%	300%
95°	45%	700%
100°	62%	>>
105°	79%	->> ---

***Effective Temperature** is the combined effect of temperature, humidity, and air motion on the body.

*Study for **NASA**. "Comfort Conditioning the Plant with Evaporative Cooling" *Plant Engineering* July 8, 1976 Pg 76 Joseph Marg

"**Evaporative Air Conditioning Handbook**" John Watt, PE and Will Brown PE 3rd Edition Pg 201

U.S. Department of Labor Program Highlights

Fact Sheet No. OSHA 95-16

PROTECTING WORKERS IN HOT ENVIRONMENTS

Many workers spend some part of their working day in a hot environment. Workers in foundries, laundries, construction projects, and bakeries - to name a few industries - often face hot conditions which pose special hazards to safety and health.

HEAT STRESS CAUSES BODY REACTIONS

Four environmental factors affect the amount of stress a worker faces in a hot work area: temperature, humidity, radiant heat (such as from the sun or a furnace) and air velocity. Perhaps most important to the level of stress an individual faces are personal characteristics such as age, weight, fitness, medical condition and acclimatization to the heat.

The body reacts to high external temperature by circulating blood to the skin which increases skin temperature and allows the body to give off its excess heat through the skin. However, if the muscles are being used for physical labor, less blood is available to flow to the skin and release the heat.

Sweating is another means the body uses to maintain a stable internal body temperature in the face of heat. However, sweating is effective only if the humidity level is low enough to permit evaporation and if the fluids and salts lost are adequately replaced.

Of course there are many steps a person might choose to take to reduce the risk of heat stress, such as moving to a cooler place, reducing the work pace or load, or removing or loosening some clothing.

But if the body cannot dispose of excess heat, it will store it. When this happens, the body's core temperature rises and the heart rate increases. As the body continues to store heat, the individual begins to lose concentration and has difficulty focusing on a task, may become irritable or sick and often loses the desire to drink. *The next stage is most often fainting* and death is possible if the person is not removed from the heat stress.

HEAT DISORDERS

Heat stroke, the most serious health problem for workers in hot environments, is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. Signs include (1) mental confusion, delirium, loss of consciousness, convulsions or coma; (2) a body temperature of 106 degrees F or higher; and (3) hot dry skin which may be red, mottled, or bluish. Victims of heat stroke will die unless treated promptly. While awaiting medical help, the victim must be removed to a cool area and his or her clothing soaked with cool water. He or she should be fanned vigorously to increase cooling. Prompt first aid can prevent permanent injury to the brain and other vital organs.

Heat exhaustion results from loss of fluid through sweating when a worker has failed to drink enough fluids or take in enough salt or both. The worker with heat exhaustion still sweats but experiences extreme weakness or fatigue, giddiness, nausea, or headache. The skin is clammy and moist, the complexion pale or flushed, and the body temperature normal or slightly higher. Treatment is usually simple: the victim should rest in a cool place and drink water or an electrolyte solution (a beverage used by athletes to quickly restore potassium, calcium, and magnesium salts). Severe cases involving victims who vomit or lose consciousness may require longer treatment under medical supervision.

Heat cramps, painful spasms of the muscles, are caused when workers drink large quantities of water but fail to replace their bodies' salt loss. Tired muscles - those used for performing the work - are usually the ones most susceptible to cramps. Cramps may occur during or after working hours and may be relieved by taking liquids by mouth or saline solutions intravenously for quicker relief, if medically determined to be required.

Fainting (heat syncope) may be a problem for the worker unacclimatized to a hot environment who simply stands still in the heat. Victims usually recover quickly after a brief period of lying down. Moving around, rather than standing still, will usually reduce the possibility of fainting.

Heat rash, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep, impedes a worker's performance, or even results in temporary total disability. It can be prevented by resting in a cool place and allowing the skin to dry.

PREVENTING HEAT STRESS

Most heat-related health problems can be prevented or the risk of developing them reduced. Following a few basic precautions should lessen heat stress.

1. A variety of **engineering** controls including general ventilation and spot cooling by local exhaust ventilation at points of high heat production may be helpful. Shielding is required as protection from radiant heat sources. Evaporative cooling and mechanical refrigeration are other ways to reduce heat. Cooling fans can also reduce heat in hot conditions. Eliminating steam leaks will also help. Equipment modifications, the use of power tools to reduce manual labor and personal cooling devices or protective clothing are other ways to reduce the hazards of heat exposure for workers.

2. **Work practices** such as providing plenty of , drinking water - as much as a quart per worker per hour - at the workplace can help reduce the risk of heat disorders. Training first aid workers to recognize and treat heat stress disorders and making the names of trained staff known to all workers is essential. Employers should also consider an individual worker's physical condition when determining his or her fitness for working In hot environments. Older workers, obese workers and personnel on some types of medication are at greater risk.

3. **Alternating work and rest** periods with longer rest periods in a cool area *can help workers* avoid heat stress. If possible, heavy work should be scheduled during the cooler parts of the day and appropriate protective clothing provided. *Supervisors should be trained to detect early signs of heat stress* and should permit workers to interrupt their work if they are extremely uncomfortable.

4. **Acclimatization** to the heat through short exposures followed by longer periods of work in the hot environment can reduce heat stress. New employees and workers returning from an absence of two weeks or more should have a 5-day period of acclimatization. This period should begin with 50 percent of the normal workload and time exposure the first day and gradually building up to 100 percent on the fifth day.

5. **Employee education** is vital so that workers are aware of the need to replace fluids and salt lost through sweat and can recognize dehydration, exhaustion, fainting, heat cramps, salt deficiency, heat exhaustion, and heat stroke as heat disorders. Workers should also be informed of the importance of daily weighing before and after work to avoid dehydration.

Safety is a major economic consideration in all working areas. Safe working conditions are important in keeping insurance costs down and avoiding employee disruptions. The hot, uncomfortable worker is more liable to ignore good safety practice and allow accident causing situations to occur.

Heat Stress related productivity losses due to high temperatures in your plant are probably documented by your own records. Accuracy is similarly affected as temperatures above 85 degrees cause a 300% increase in errors.

Low Morale caused by an uncomfortable work environment results in tardiness, absenteeism, and turnover. The summer increase in negative employee reactions due to heat stress is also documented through production records. Vacant work stations result in lowered efficiency, in overtime paid to meet schedules, and in hiring and training costs for replacements.

Health Factors relating to heat stress in the working environment is an increasing concern of regulatory agencies. The National Institute of Occupational Safety & Health (NIOSH) has developed a preliminary standard for allowable heat stress levels. The standard defines environmental temperature requirements and work-time / rest-time percentages tolerable for employees.

Payback is an important factor in determining the purchase of equipment. As wages inflate, it becomes increasingly important to get the full productivity you are paying for from your employees by keeping their working conditions comfortable.

MORE INFORMATION

A 15-page booklet, Working in Hot Environments, is available free from National Institute for Occupational Safety and Health Publications, 4676 Columbia Parkway, Cincinnati, Ohio 45226; telephone (513) 533-8287.

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