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Subject:
Working in Hot Environments

1. Introduction:

The Environmental Health and Safety standard operating procedure for Working in Hot Environments was developed by the Department of Environmental Health & Safety in accordance with the University's Policy Statement on Health and Safety and to ensure compliance with the Ontario Occupational Health & Safety Act and Regulations. This document is a general guide to working in hot environments. **Due to the decentralized nature of Queen's University, specific procedures for working in hot environments must be developed by individual departments or faculties based on their specific needs and work environments.**

2. Definitions:

Acclimatization

Acclimatization refers to the physiological changes taking place after prolonged exposure to heat, which partly involves increased sweat production. Core body temperature can be controlled within acceptable limits and the body then becomes accustomed to a hot environment. Acclimatization takes place over several days, with the greatest benefit occurring during the first four to five days. However, acclimatization is reversible following cessation of exposure.

Convection

Convection is the process of heat exchange between the body and the surrounding air as a result of air moving over the skin.

Core body temperature

The core body temperature is generally considered to be the temperature of the vital organs. These organs are maintained within a narrow range of temperatures by thermoregulatory mechanisms.

Dehydration

Dehydration is the loss or deficiency of water in body tissues, which may be caused by perspiration, vomiting or diarrhea. Symptoms include excessive thirst, nausea and exhaustion.

Heat stress

Heat stress can be defined as the sum of heat generated in the body (metabolic heat) plus the heat gained from the environment minus the heat lost from the body to the environment. The risk of heat related disorders and accidents increases substantially with increasing heat stress.



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Heat Strain

Heat strain is a series of physiological responses to heat stress. These responses reflect the degree of heat stress. When the strain is excessive for the exposed individual, a feeling of discomfort or distress may result, and, finally, a heat disorder may ensue. The severity of strain will depend not only on the magnitude of the prevailing stress, but also on the age, physical fitness, degree of acclimatization, and dehydration of the worker.

Metabolism

Metabolism is the transformation in the body of chemical energy into energy that is used for performing work. Metabolism results in heat production and varies with the level of activity.

Radiation (Heat)

Radiation is the transfer of heat to or from surrounding objects that are not in direct contact with the body.

Humidity (Relative)

Relative humidity is the ratio of the water vapour content of air to the maximum possible water vapour content of air at the same temperature and air pressure.

Wet Bulb Globe Temperature (WBGT) Index

The WBGT index is used to measure occupational heat exposure, which combines several environmental factors that contribute to heat load. Environmental factors include air temperature and movement, radiant heat and evaporation.

3. Responsibilities:

This section outlines the responsibilities within the University for the implementation of this SOP.

3.1 Directors, Department Heads & Managers:

Each has the following responsibilities under this SOP:

- Ensure that pertinent supervisors and employees are notified of their responsibilities for work in hot environments;
- Ensure that procedures, equipment and materials appropriate for the specific work locations under their authority are provided to protect the health and safety of all employees;



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- Ensure that all employees are given adequate supervision and instruction on the hazards of hot environments, the symptoms of heat-related disorders and the standard operating procedures;
- To ensure that the components of this SOP and the Ministry of Labour, Immigration, Training and Skills Development (MLITSD) Guidelines ([Appendix A](#)) are implemented in all facilities under his/her authority.

3.2 Supervisors

Supervisors must be knowledgeable about the hazards and standard approaches to work associated with the specific hot environments under their authority, the education and training requirements for safety while working in these environments, the appropriate standard operating procedures for all such locations under his/her authority, as well as the other requirements of this program. They have the following responsibilities:

- To identify all hot work environments under his/her authority;
- To ensure that employees are familiar with the hazards, symptoms of heat related disorders and the standard operating procedures for working in hot environments;
- To ensure that all employees act in accordance with the standard operating procedures for hot work environments;
- To ensure that appropriate equipment and materials for working in hot environments are used by all employees;
- To promptly report known or suspected heat related incidents to the Department of Environmental Health & Safety.

3.3 Employees

Employees have the following responsibilities:

- To be familiar with the hazards associated with working in hot environments, the symptoms of heat related disorders and the pertinent standard operating procedures for the environment;
- To work in accordance with written standard operating procedures for work in hot environments;
- To use the appropriate equipment and materials provided for work in hot environments;
- To consult a physician of choice regarding personal risk factors that may affect heat tolerance. Physician recommended accommodation should be discussed with the supervisor;
- To promptly report any known or suspected accidents, unsafe conditions or unsafe procedures to his/her supervisor.

4. Risks & Hazards:

The human body maintains a fairly constant core body temperature, even though it may be exposed to varying environmental temperatures. To keep the core body temperature within safe limits, the body dissipates excess heat in two ways:

- convective heat exchange (the heart rate increases to pump more blood through outer body parts and skin so that the body loses heat to cooler air which is in contact with the skin) and
- evaporative cooling (evaporation of sweat from the skin cools the body).

If the skin is warmer than the air, simple heat exchange helps to cool the body; convective heat exchange increases with increasing air speed and increased differences between air and skin temperature. Cooling by the evaporation of sweat lets the body reduce its temperature; evaporation proceeds more quickly, and the cooling effect is more pronounced with increasing air speed and low relative humidity.

When working in an environment that is hotter than normal skin temperature or when near a heat source, the body will actually gain heat from the air. In this case, evaporation is the only way the body can cool itself.

Working in hot environments will subject the body to heat stress; it (heat stress) is the aggregate of physical work and environmental factors that constitute the total heat load imposed on the body. Physical work contributes to the total heat stress of the job by producing metabolic heat in proportion to the intensity of the work. The environmental factors of heat stress include air temperature, radiant temperature, humidity and air velocity. Clothing also affects heat stress.

When the body's cooling system has to work too hard to reduce heat stress, it can strain itself. When the strain is excessive for the exposed individual (possibly combined with other stresses such as moderate/heavy work, loss of fluids and/or fatigue), a feeling of discomfort or distress may result, and, finally, a heat disorder may ensue. The severity of strain will depend not only on the magnitude of the prevailing stress, but also on the age, physical fitness, degree of acclimatization, and dehydration of the worker.

Excessive exposure to a hot work environment can lead to a variety of heat-induced disorders and safety problems.

Heat-Induced Disorders

The risk of heat-related illness varies from person to person. Older and obese people are generally at high risk. Heat exposure can cause the following illnesses:

Heat rashes

Heat rashes may develop during unrelieved exposure to humid heat with continuously wet skin. Heat rashes are characterized by tiny, blister-like red vesicles on the skin accompanied by prickling sensations during heat exposure.

Heat cramps

Heat cramps are painful spasms of muscles used during work, which occur either during or after work. The cause is heavy perspiration during hot work and subsequent consumption of large volumes of water without replacing salt loss.

Heat exhaustion

Heat exhaustion results from sustained exertion in hot environments, lack of acclimatization and failure to replace water lost in perspiration. Heat exhaustion is characterized by fatigue, nausea, headache, and clammy and moist skin.

Heat syncope

Heat syncope is heat-induced giddiness and fainting that occurs while a person is immobile and standing erect. It results from pooling of blood in the legs and occurs mostly among unacclimatized people.

Heat stroke

Heat stroke is the most serious heat stress disorder. It results from sustained exertion in hot environments by unacclimatized employees. Its cause is partial or complete failure of perspiration following sweat gland fatigue, which leads to a loss of evaporative cooling and a rapid rise in core body temperature. Heat stroke is characterized by hot, dry skin, confusion, loss of consciousness, convulsions and continually rising core body temperature. Heat stroke may be fatal if medical treatment is delayed.

Safety Problems

In addition to heat-induced disorders, certain safety problems are also common to hot environments. There is a higher frequency of accidents in hot environments.

Direct causes of accidents include:

- slippery hands from perspiration
- skin contact with hot surfaces
- fogging of eyeglasses
- dizziness or fainting

Indirect causes of accidents include:



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- physical discomfort
- irritability and anger
- poor judgment
- diverted attention from the task
- slower mental and physical reactions

5. Control Measures:

In order to minimize and mitigate heat related disorders and safety issues, The MLITSD Guidelines for Heat Stress ([Appendix A](#)) are to be followed. The MLITSD guidelines outline preventative measures for various heat related disorders, as well as engineering and administrative controls for working in hot environments. The preventative measures and controls implemented will be based on the specific environment and tasks associated with each individual department.

Under the MLITSD guidelines, resting in air-conditioned locations is a recommended engineering control method. On campus the following common locations could be used:

- MacKintosh-Corry Hall
- Stauffer Library
- Douglas Library
- Botterell Hall
- Biosciences Complex
- Mitchell Hall
- Duncan MacArthur Hall
- Queen's Centre
- Stirling Hall
- Chernoff Hall
- Beamish-Monro Hall
- Humphrey Hall
- Jefferey Hall
- Goodes Hall
- Gordon Hall
- School of Medicine Building
- Dunning Hall
- Kinesiology and Health Building

In the event that excessive heat requires a departmental shutdown, the Queen's University Inclement Weather Policy must be followed. The policy states "When weather conditions are severe, Department Heads may choose to permit employees of his/her area to leave early, without loss of pay. Departments are not to close without prior consultation with the respective Dean or Vice-Principal."

Departments must also develop and document a contingency plan for the treatment of affected individuals. Information regarding the first aid treatment of heat related disorders is available in the MLITSD Heat Stress Guidelines ([Appendix A](#)). For information regarding employee absences due to heat-related disorders, contact Employee and Labour Relations in Human Resources.



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6. Training & Education:

The key to preventing excessive heat stress is educating supervisors and employees on the hazards of working in hot environments and the benefits of implementing proper engineering and administrative controls and work practices.

The content of a departmental education session will depend on the specific characteristics of the department but must include a discussion of the hazards of hot work environments, standard approaches to working in hot environments and the standard operating procedures for the prevention of the associated hazards.

7. Revision History:

Revision 1.0 – August 2002 - Initial Release

Revision 2.0 – June 2004

Revision 3.0 – May 2010

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