

**(your logo here)**

Heat Stress

Original: March 2020

Amended: July 2022

Heat Stress

Table of Contents

REFERENCES 1

PURPOSE 1

POLICY 1

SCOPE 1

DEFINITIONS 1

Regulations for Firefighters 3

RESPONSIBILITIES 3

Employer 3

Managers 3

Supervisors 3

Workers 4

Joint Health and Safety Committee or OHS Representative 4

PROGRAM DETAILS 5

Program Overview and Application 5

Heat Stress Assessment and Exposure Control Plan 5

Risk Controls 8

Investigation Procedures for Heat Related Illness 13

Record Keeping 13

Program Review 13

TRAINING REQUIREMENTS 14

Goal 14

Objectives 14

Summary of Training 14

PROGRAM MAINTENANCE 16

DOCUMENTATION 16

APPENDICES 16

Appendix A – SAMPLE Operational Guidelines for Fire Departments 18

Appendix B – Rehabilitation Guidelines for Fire Departments 20

Appendix C – BC Ambulance First Responder Guidelines 22

Appendix D – Heat Stress Hazard Identification 25

Appendix E – Heat Stress Risk Assessment Worksheet 27

Appendix F – Instructions for Calculation of WBGT°C for Intermittent Work 32

Appendix G – Heat Stress Exposure Control Plan 35

Appendix H – Summary Table of Heat-Related Disorders and Indicators 37

Appendix I – Formula for Work-Work Cycles 39

Appendix J – Guidelines for Fluid Replacement 40

Appendix K – Record of Worker Training 41

 Appendix L – Risk Assessment Auto Calculator ..………………………………….……42

# REFERENCES

WorkSafeBC Regulations Part 7, Sections 7.27 to 7.32

# PURPOSE

This program is designed to reduce heat stress whenever practicable and to eliminate the risk of the effects of heat stress to workers when performing tasks in the workplace.

# POLICY

[Organization]will maintain a Heat Stress Program to prevent or reduce the effects of heat stress in the workplace whenever a worker may be exposed to heat in excess of the WorkSafeBC action limits.

# SCOPE

This program applies to all workers, supervisors, contractors, and other personnel who may be exposed to heat stress in the workplace.

# DEFINITIONS

|  |  |
| --- | --- |
| **Acclimatization** | A process by which the body modifies its own functions to cope more effectively and efficiently with heat stress. |
| **Administrative Controls** | Methods of changing the way that work in a job is assigned or scheduled to reduce exposure to heat stress. |
| **Calorie (=kilocalorie / kcal)** | The amount of heat required to raise 1 gram of water 1°C (based on a standard temperature of 16.5 to 17.5°C). This measure is used to categorize the workload of activities into light, moderate and heavy. |
| **Conduction** | The transfer of heat between materials that contact each other. Heat passes from the warmer material to the cooler material. |
| **Convection** | The transfer of heat from the skin to the surrounding air when the air is cooler than the skin. Conversely, air that exceeds 35°C (95°F) can increase the heat load on the body. |
| **Dry Bulb Temperature**  | Temperature measured by a thermal sensor, such as an ordinary mercury-in-glass thermometer, shielded from direct radiant energy sources. |
| **Engineering Controls**  | The physical arrangements, designs or alterations of a workplace, equipment, materials, production facilities or other aspects of physical work environment to reduce the risk to workers. |
| **Evaporative Cooling** | Takes place when sweat evaporates from the skin. High humidity reduces the rate of evaporation and thus reduces the effectiveness of the body’s primary cooling mechanism. |
| **Globe Temperature** | Temperature measured by a thermometer with its sensor inside a matte black globe, exposed to radiant heat. |
| **Heat Cramp** | A condition usually caused by performing hard physical labour in a hot environment. Cramps may be attributed to an electrolyte imbalance caused by sweating. |
| **Heat Exhaustion** | A condition preceding heat stroke that may include headache, nausea, vertigo, weakness, thirst and giddiness. Although not as serious as heat stroke, it is treated as a medical emergency. |
| **Heat Stress** | The process in which a person’s body gains heat faster than it can get rid of it resulting in a rise in body temperature. Health problems resulting from heat stress are known as heat disorders including heat cramps, heat exhaustion and heat stroke. |
| **Heat Stroke** | This occurs when the body’s system of temperature regulation fails and body temperature rises to critical levels (over 41°C). This is the final stage of heat stress and may be fatal if signs and symptoms are not recognized early enough and medical aid is delayed. |
| **Natural Wet Bulb Temperature**  | Temperature measured by a thermometer that has its sensor covered by a wetted cotton wick for measurement of the effects of evaporation and convection. The term “natural” refers to the movement of air around the sensor. |
| **Radiant Heat** | The transfer of heat energy through space. A worker whose body temperature is greater than the temperature of the surrounding surfaces radiates heat to these surfaces. Hot surfaces and infrared light sources radiate heat that can increase the body’s heat load. |
| **Reflective Clothing** | A type of clothing that protects workers from radiant heat, also known as Anti-Radiant Heat Clothing. |
| **Unacclimatized** **Worker**  | A worker who is not accustomed to working in a hot environment or who has been out of a hot environment for seven consecutive days. |
| WBGT°C  | Combines air temperature, humidity, airflow and radiant heat to measure the risk of heat stress disorders. |

# Regulations for Firefighters

The WorkSafeBC OHS Regulation regarding heat stress does not apply to firefighting if special provisions satisfactory to the Board are in place to ensure that the firefighter’s core body temperature is maintained below 38°C.

Special provisions related to firefighting that fulfill the intent of this section include:

* Instruction and training
* Work procedures that address both the hazards and necessary controls
* Specialized personal protective equipment

# RESPONSIBILITIES

## Employer

* Identify and assess areas, tasks, and occupations where there is the potential for heat stress.
* Implement and/or provide controls (engineering, administrative, or personal protective equipment) to minimize heat stress.
* Provide training and education regarding heat stress, including early signs and symptoms of heat-related disorders.
* Maintain records of the heat stress assessments and worker training.
* Ensure that there is adequate first aid coverage and establish emergency procedures to deal with serious conditions such as heat exhaustion and heat stroke.
* Ensure that special provisions are made to ensure that a firefighter’s core body temperature is maintained below 38°C.

## Managers

* Post heat stress hazard warning signs in indoor work areas where the heat exposure limits could be exceeded if a worker was continuously exposed to heat.
* Ensure workers who are at risk of heat-related disorders are adequately educated and trained in the recognition of signs and symptoms of heat-related disorders and the responsibility to leave the hot environment if signs and symptoms of a heat-related disorder occur.

## Supervisors

* Ensure that workers are made aware if there is a risk of heat stress in the area in which they are working.
* Ensure that workers maintain their exposure to heat within the permissible exposure limits.
* Provide and maintain personal protective equipment for workers where engineering and administrative controls are not possible to implement, provided the PPE provides equally effective protection against heat exposure.
* If personal protective equipment is provided ensure that it is worn, and that it is properly cleaned, inspected, maintained and stored.
* Provide and maintain an adequate supply of cool potable water close to the work area for use by heat-exposed workers.
* Remove the worker from the hot environment and provide treatment by a first aid attendant or a physician if a worker shows signs or reports symptoms of heat stress or strain.

## Workers

* Participate in environmental monitoring program to assess worker exposure to conditions that could cause heat stress.
* Adhere to all control measures or work procedures that have been designed and implemented to reduce exposure to conditions that could cause heat stress.
* Leave hot environments if signs or symptoms of a heat-related disorder appear.
* Follow safe work procedures.
* Use or wear personal protective equipment that is provided.
* Report unsafe acts and conditions to the supervisor.

## Joint Health and Safety Committee or OHS Representative

* Advise the employeron procedures and effective systems to deal with hot environments.
* Address worker issues regarding heat stress.
* Attend and cooperate in incident investigations and worksite inspections regarding hot environments and heat stress.

# PROGRAM DETAILS

## Program Overview and Application

The Heat Stress Program will incorporate the requirements of the WorkSafeBC OHS Regulations Sections 7.27 to 7.32.

If firefighters are to be exempt from compliance with the Heat Stress Program and Regulation, [Organization]will ensure that special provisions are made to ensure that the firefighter’s core body temperature is maintained below 38°C. These provisions will include:

* Instruction and training
* Work procedures that address both the hazards and necessary controls
* Specialized personal protective equipment

A sample of Operational Guidelines for firefighters is located in Appendix A (Operational Guidelines for Fire Departments). A sample of Guidelines for Rehabilitation is located in Appendix B (Rehabilitation Guidelines for Fire Departments).

An additional sample of guidelines for first responders is located in Appendix C (BC Ambulance First Responder Guidelines).

## Heat Stress Assessment and Exposure Control Plan

An assessment and exposure control plan will be conducted, based on WorkSafeBC Regulation 5.54(2) and will include the following elements:

1. a statement of purpose and responsibilities;
2. risk identification, assessment and control;
3. education and training;
4. written work procedures, when required;
5. hygiene facilities and decontamination procedures, when required;
6. health monitoring, when required;
7. documentation, when required.

### Heat Stress Hazard Identification

[Organization]will conduct a heat stress hazard identification process to identify hazards associated with the environment, type of task being performed, and clothing/equipment required for the task that may expose the worker to a risk of heat stress.

The Heat Stress Hazard Identification form located in Appendix D will be used to record the results of the hazard identification process.

Conditions, work areas and jobs/tasks will be identified that may put workers at risk. These will include:

* Environmental temperature conditions: areas with temperatures above 23°C.
* Areas with high humidity such as aquatics facilities.
* Areas or occupations that have been identified through accident investigation reports, first aid treatment books, and records of injury and disease.
* Jobs or tasks that require medium to high exertion or strength.
* Areas, tasks, or occupations that have been identified through accident investigation reports, first aid treatment records, and records of injury and disease.
* Areas or occupations about which workers have expressed concern.

### Heat Stress Risk Assessment

Once it is determined which occupations, tasks, or areas should be monitored, the risk of developing a heat-related disorder will be evaluated using a risk assessment. The risk will be assessed using the following methods:

* Determining the Workload (Metabolic Rating) of the tasks being performed.
* Measuring environmental parameters such as air temperature, air velocity, air humidity and infrared radiation. WBGT°C measurements will be used to assess the risk of developing a heat-related disorder. There are various assessment instruments available for measuring WBGT°C. The type of instrumentation to be used will depend on its availability, worksite conditions and the expertise of the assessor. The WBGT°C measurements obtained from component 2 will be adjusted using clothing correction values to take into account the effect of types of clothing being worn by workers.
* Measurement of other physiological responses such as heart rate, and the type of clothing being worn by workers.

[Insert name or job position here]will be responsible for conducting or facilitating heat stress risk assessments. The form located in Appendix E (Heat Stress Risk Assessment Worksheet) will be used to document results of the risk assessment. The formulae located in Appendix F (Instructions for Calculation of WBGT°C for Intermittent Work)should be used if calculating WBGT°C mathematically.

### Interpretation of Results

Results of the risk assessment will determine whether heat exposure limits are being exceeded. [Organization]will implement appropriate risk controls to ensure that workers perform their tasks within WorkSafeBC acceptable limits.

The Action Levels and Exposure Limits Table (Table 1 below) provides an overview of the exposure limits for workers. If the results of the risk assessment show that a worker is or may be regularly exposed to an environment in excess of the heat action levels/exposure limits, [Organization] will implement a heat stress exposure control plan. Refer to Appendix G (Heat Stress Exposure Control Plan) for the form to be completed.

Exposure Limits listed in Table 1 determine the exposure limits for healthy, acclimatized workers.

|  |
| --- |
| **Table 1 – Action Levels and Exposure Limits** |
| **Workload** | **Action Level for** **Unacclimatized Workers****(2-hour time weighted average)** | **Exposure Limit for Acclimatized Workers (2-hour TWA)** |
| **Light** | 28WBGT°C | 30WBGT°C |
| **Moderate** | 24.7WBGT°C | 26.7WBGT°C |
| **Heavy** | 23WBGT°C | 25WBGT°C |

### Supplementary Measurements

In occupations where workers are required to wear semi-impervious or impervious clothing i.e. rain gear or chemical-resistant suits, WBGT°C may not provide sufficient information to determine appropriate protection for workers against exposure to heat stress. However, the requirement to perform supplementary measurements is rare. If additional measures are required, use the following guidelines for conducting physiological measurements to ensure that safe body temperatures are not exceeded:

1. Heart Rate

Recording heart rate is the most common and practicable physiological measurement that may be used in the field environment. Count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

1. Temperature

If heart rate measurements are insufficient for monitoring worker’s exposure to heat stress (for instance in very heavy work), record his/her oral temperature. Using a clinical thermometer, record temperature after work but before the worker drinks water. If the oral temperature taken under the tongue exceeds 37.6°C, the next work cycle will be shortened by one third.

1. Fluid Balance

Recording fluid balance should only be performed if heart rate and temperature measurements are insufficient markers for worker’s exposure to heat stress. Body water loss will be measured by weighing the worker on a scale at the beginning and end of each workday. The worker’s weight loss should not exceed 1½ % of total body weight in a workday. If a weight loss exceeding this amount is observed, fluid intake must be increased.

## Risk Controls

[Organization] will reduce workers’ exposure below the heat exposure limits by implementing risk controls.When it is not practicable to eliminate the task or substitute it with another to achieve the same goal, engineering controls will be developed and implemented. If it is not practicable to reduce exposure below the heat exposure limits by engineering controls, then [Organization] will provide administrative controls and/or personal protective equipment.

Combinations of various control measures may provide the most effective protection from heat stress.

### Engineering Controls

**Reduction in metabolic heat production through reduction in workload**

Redesign and/or mechanization of the task to reduce the work time and/or physical effort will reduce the metabolic heat load. For example, power tools, hoists, lift tables or other mechanized devices can be used to reduce manual labour.

**Reduction in temperature and humidity**

Reductions of air temperature and humidity may be achieved through local or general ventilation. The ventilation systems can be temporary or permanent and may include air conditioning.

Where possible hot air and steam produced by specific operations should be exhausted away from the working environment.

**Increase in air motion**

At temperatures less than 35°C, increasing air speed can help workers stay cooler by increasing both the convective heat exchange (the exchange between the skin surface and the surrounding air) and the rate of evaporation. In order to be effective, increased air speed, i.e. a fan, must be positioned to directly impact the worker.

When the air temperature is greater than 35°C, increasing air motion may actually increase heat stress.

**Control of radiant heat**

Radiant heat from the sun or any heat source can be reduced through shielding or insulating exterior surfaces.

Whenever possible, canopies should be provided over the work area to provide shading, e.g. ride-on vehicles, lifeguard stations, large unprotected windows. Whenever possible, heat-producing equipment such as a furnace or boiler should be shielded.

### Administrative Controls

Administrative controls attempt to minimize risks through work practices. They are relatively easy to implement, although they may not be the most cost effective. Administrative controls include the following:

**Training**

Training is a fundamental health and safety practice for those who may be exposed to a hazard such as heat stress. The Heat Stress Hazards information sheet in Appendix H should be posted in workplaces where workers are exposed to heat stress.

A training and information program should include the following components and be reviewed annually:

* Knowledge of the hazards and potential health effects of heat stress
* Recognition of predisposing factors, danger signs and symptoms
* Awareness of first-aid procedures for heat-related disorders
* Employee responsibilities in minimizing heat stress
* Possible side effects of certain medications when taken in a hot environment
* Use of protective clothing and equipment

**Determine Appropriate Work-Rest Cycles**

A work rest cycle refers to the period a worker spends working in a hot or strenuous environment and the time spent in a rest or recovery area. Appropriate work-rest cycles should be determined and scheduled to allow adequate time for workers’ bodies to cool. Workers cannot rely on their bodies to indicate wen a rest period is needed. By the time a worker feels ill, it may be too late.

It is important to have cool areas, such as shaded or well-ventilated area, for breaks and rests. Showering or soaking in cool water, when possible, can cool the body very quickly.

An example of a work-rest cycle is provided in Table 1 below. ACGIH Screening Criteria for Heat Stress Exposure (WBGT values in °C):

|  |  |  |
| --- | --- | --- |
| **Allocation of Work in a Work/Rest Cycle** | **Acclimatized**  | **Action Limit (Unacclimatized)**  |
| Light | Moderate | Heavy | Very Heavy | Light | Moderate | Heavy | Very Heavy |
| 75-100% | 31.0 | 28.0 | -- | -- | 28.0 | 25.0 | -- | -- |
| 50-75% | 31.0 | 29.0 | 27.5 | 28.0 | 28.5 | 26.0 | 24.0 | -- |
| 25-50% | 32.0 | 30.0 | 29.0 | 29.0 | 29.5 | 27.0 | 25.5 | 24.5 |
| 0-25% | 32.5 | 31.5 | 30.5 | 30.0 | 30.0 | 29.0 | 28.0 | 27.0 |

**Notes:**

Assumes 8-hour workdays in a 5-day workweek with conventional breaks.

TLVs assume that workers exposed to these conditions are adequately hydrated, are not taking medication, are wearing lightweight clothing (long-sleeve shirts and pants) and are in generally good health.

**Examples of workloads:**

**Rest** - sitting (quietly or with moderate arm movements)

**Light work** - sitting or standing to control machines; performing light hand or arm work (e.g. using a table saw); occasional walking; driving

**Moderate work** - walking about with moderate lifting and pushing or pulling; walking at moderate pace; e.g. scrubbing in a standing position

**Heavy work** - pick and shovel work, digging, carrying, pushing/pulling heavy loads; walking at fast pace; e.g. carpenter sawing by hand

**Very Heavy** - very intense activity at fast to maximum pace; e.g. shovelling wet sand

If your worksite criteria match the above assumptions, use Table 1 as the work-rest cycle of choice. [Insert name or job position]is responsible for scheduling and organizing appropriate work-rest/work-work cycles.

If workers are required to continue working with no rest period, calculations for work-work cycles must be used. Refer to Appendix I (Formula for Calculation of Work-Work Cycles)for further information on how to calculate work-work cycles.

**Schedule work to minimize heat exposure**

The following methods of minimizing worker exposure to heat will be used whenever possible:

* Hot tasks will be scheduled for the cooler part of the day (early morning, late afternoon or night shift) whenever possible.
* The path of sun movement will be determined and work will be performed in its shadows whenever possible.
* Where a crew of workers are performing tasks, job rotation will be implemented to allow workers to work in both hot and cool areas.
* Routine maintenance and repair work in hot areas will be scheduled for cooler seasons of the year whenever practicable.
* Schedules will be adjusted where practicable, so that hot operations are not performed at the same time and place as other operations that require the presence of workers (e.g. maintenance cleanup while tapping a furnace).
* Extra personnel will be provided, when practicable, to reduce exposure time for each member of the crew.
* Workers will be permitted to set their own pace of work when practicable.
* If weather forecasts predict very hot conditions, non-urgent tasks will be postponed until the hot spell is over.

**Allowance for recovery time**

It is important to provide adequate recovery from heat stress exposures. Appropriate rest breaks should be determined based on the humidex level and type of work performed.

**Initiation of a "Buddy" System**

Individuals are less likely to notice their own symptoms; a buddy system approach reduces the risk of signs and symptoms going unnoticed. Workers should also buddy-up when travelling to remote locations or when entering extremely hot environments.

**Decrease in metabolic heat production through reduction in workload**

Metabolic heat may be decreased by reducing the work pace, work duration or the physical exertion required to perform the task. This can be achieved by increasing the frequency and duration of rest breaks, alternating or substituting heavy tasks with light tasks, increasing assigned staff so that more workers share the loads, and so forth.

**Acclimatization**

A gradual period of acclimatization to work in hot weather is recommended for new and other non-acclimatized workers. It generally takes 1 to 2 weeks to become accustomed to working in hot environments. This may happen gradually as spring temperatures warm into summer, however, sudden exposure to work in hot temperatures does not allow for adequate acclimatization and increases an individual's risk of heat-related disorders. There are two ways to acclimatize; one can either gradually increase exposures to work in hot environments, or one can reduce the physical demands of the job for one to two weeks. If a worker has health problems or is not in good physical condition, longer periods of acclimatization may be required.

**Reduce use of heat generating devices**

Where possible, eliminate the use of heat or steam generating devices.

**Fluid Replacement and Work Practices**

Cool water (10 to 15°C) will be made available to workers and they will be encouraged to drink small amounts frequently. See Appendix J (Guidelines for Fluid Replacement) regarding proper fluid replacement.

**Supervision of Workers**

Regular supervision of workers will reduce the possibility of a heat-related disorder going unnoticed in a worker. Supervisors should be aware of the signs and symptoms of heat-related disorders and should encourage workers to drink plenty of fluids.

### Personal Protective Equipment

Preventative measures are focused on engineering and administrative controls. Personal protective equipment may be made available where engineering administrative controls are ineffective or where personal protective equipment is available that provides equally effective protection. Examples of personal protective equipment for heat stress include anti-radiant heat or reflective clothing and temperature-controlled suits.

## Investigation Procedures for Heat Related Illness

[Organization]will conduct an investigation in response to a worker reporting or suffering a heat-related disorder. The following elements will be included in the investigation:

* Description of heat stress problems that have been experienced
* Possible hazards that caused the condition to occur
* Sources of heat stress in the location
* Determine whether the incident occurred on a day that was typical of previous recent weather conditions
* Description of clothing worn by the affected worker
* Confirm whether the worker had been instructed on heat stress, signs and symptoms and preventive action
* Description of risk controls that had been implemented on the worksite to prevent heat-related disorders
* Evidence of heat exposure measurements/risk assessments being conducted
* Review site documentation, and where appropriate, look for indications of prior heat stress problems

## Record Keeping

[Organization]will maintain records of the following:

* Heat Stress Assessments
* Heat Stress Exposure Control Plans
* Worker Education and Training
* Health Monitoring
* Heat Stress Program Review

## Program Review

The Heat Stress Program will be reviewed at least annually and updated as necessary, in consultation with the JHS Committee or the worker health and safety representative, as applicable. The following elements will be included in the review:

* Hazard identification, risk assessment and controls
* Education and training
* Written work procedures
* Health monitoring
* Documentation

# TRAINING REQUIREMENTS

## Goal

To ensure that all workers are aware of the dangers of heat related illnesses and the Heat Stress Program.

## Objectives

As a result of this training workers will:

* Understand the effects of too much heat exposure.
* Be knowledgeable of heat exposure limits and understand the hazards of working in a hot environment.
* Know the requirements for heat exposure measurements and the procedures to be followed.
* Understand the process of acclimatization.
* Understand the importance of fluid replacement.
* Recognize the signs and symptoms of heat-related disorders and know the first aid procedures for workers exhibiting signs of heat-related disorders.
* Understand the risk control procedures that are implemented to reduce exposure to heat stress.
* Know when to remove workers from hot environments.
* Understand their responsibility to leave a hot environment when signs and symptoms of a heat-related disorder occur.
* Understand the significance of heat stress warning signs and know the procedures that are to be followed if warning signs are posted.
* Understand the implications of wearing personal protective equipment and various types of clothing in hot environments.

## Summary of Training

Workers who have not previously worked in a heat stress environment will receive training. A form is available in Appendix K (Record of Worker Training). Training will include the following:

* Heat-related disorders such as heat cramps, heat exhaustion, and heat stroke.
* Relevant signs and symptoms of heat-related disorders.
* Predisposing factors for heat-related disorders including:
	+ lack of acclimatization
	+ poor physical fitness
	+ obesity
	+ increased age
	+ dehydration
	+ pre-existing medical conditions and treatment (for example, diabetes or hyperthyroidism)
	+ short-term disorders and minor illnesses (for example, cold, flu, or diarrhea)
	+ chronic skin disorders (for example, rashes or dermatitis)
	+ use of medication that may inhibit sweating, reduce blood flow or cause dehydration (for example antihistamines)
	+ alcohol abuse and recreational drugs
	+ previous heat illness
* Potential health effects of excessive heat stress.
* First aid procedures.
* Safe work procedures and proper precautions for work in heat stress areas, including the importance of fluid replacement and of immediately reporting the development of signs or symptoms of heat-related disorders to the employer.
* Purpose and description of the environmental monitoring program, as well as the benefits to the worker of participating in these programs.
* Proper use of protective clothing and equipment, if required.
* Fluid replacement - Adequate hydration is critical in preventing heat-related disorders. Workers will be educated on the importance of fluid replacement to prevent dehydration causing heat-related disorders. The information found in Appendix J (Guidelines on Fluid Replacement) will be taught to workers.

Refresher training will be provided annually to all workers exposed to environments that could cause heat stress.

# PROGRAM MAINTENANCE

This program requires:

* Inspection and maintenance of heat stress measuring instruments.
* Heat stress measurements.
* Implementation of exposure control plans.
* Education of workers on the recognition of heat-related disorders.

# DOCUMENTATION

Documentation for this program includes:

* Records of Heat Stress Assessments
* Records of Exposure Control Plans
* Heat Stress Hazard Warning Signs (if required)
* Worker Education and Training
* Records of Heat Stress Investigations

# APPENDICES

Appendix A – Sample Operational Guidelines for Fire Departments

Appendix B – Rehabilitation Guidelines for Fire Departments

Appendix C – BC Ambulance First Responder Guidelines

Appendix D – Heat Stress Hazard Identification

Appendix E – Heat Stress Risk Assessment Worksheet

Appendix F – Instructions for Calculation of WBGT°C for Intermittent Work

Appendix G – Heat Stress Exposure Control Plan

Appendix H – Summary Table of Heat-Related Disorders

Appendix I – Formula Work-Work Cycles

Appendix J – Guidelines for Fluid Replacement

Appendix K – Record of Worker Training

**Appendices**

## Appendix A – SAMPLE Operational Guidelines for Fire Departments

### Purpose

To inform firefighters of the operational guidelines utilized by EHS (Emergency Health Services or BC ambulance) crews involved in the assessment and rehydration treatment of firefighters.

### Scope

All fire department personnel.

### Procedure

1. Upon request by the Incident Commander to have EHS attend an incident:
* To standby will be an immediate routine response
* For a specific patient will be a code “3” response
1. EHS should be positioned adjacent to the firefighters staging and rehabilitation area.
2. EHS will generally utilize an ambulance for their H.S.R.U. (Heat Stress / Rehydration Unit).

### Firefighter Assessments

Assessments will be done each time SCBA (self contained breathing apparatus) bottles are exchanged by individual firefighters. If abnormal findings are noted at the time of the assessment, the individual will be immediately pulled from duty and treatment begun in the EHS.

### Assessment Protocol Evaluations

1. Mental status
2. Temperature
3. Pulse
4. Blood pressure
5. Cerebellar exam
6. Romberg – feet together standing erect
7. Finger to nose
8. Tandem gait – heel to toe walking

### Medical Treatment Protocol

1. Prehydration
2. Rehydration
3. Cooling

### Medical Treatment in Instances of Abnormal Medical Examination

1. Elevated temperature
2. Elevated pulse
3. Altered blood pressure
4. Altered mental status

All fire department personnel will follow both the findings and recommendations of EHS personnel.

## Appendix B – Rehabilitation Guidelines for Fire Departments

### General

It is understood the desire the firefighter has to accomplish his/her goal. “Bring the fire to a safe and quick conclusion.” For most related department incidents, this goal is achieved. Unfortunately, some require more manpower and for longer periods of time. The Incident Commander must be able to recognize the time and needs to implement rehabilitation, rotation of firefighters at a working scene (i.e. RE-HAB DESIGNATION).

### Rehabilitation Implementation

The Command Officer shall establish a rehabilitation area, the fire base area in the following situations:

* During working fires of extended duration
* Whenever encapsulating suits are used
* Anytime, when in the judgement of the Command Officer, the workload and/or temperature indicates the probability of heat related illness

### Rehabilitation Function

In the absence of EHS, a firefighter with a First Responder Level 3 or higher endorsement will conduct and record an initial examination that includes the following:

* General appearance
* Temperature
* Heart rate
* Mental status

A comprehensive examination will be conducted when indicated by the initial check and if a comprehensive examination is indicated that EHS personnel will immediately transport the individual to hospital.

EHS or the firefighter assigned to the Re-Hab area shall have the authority to detain firefighters for medical treatment. He/she will also record names, times and stats as required.

### Personal Ventilation

Removal of bunker gear is required in order to allow the body’s temperature regulating mechanism to function properly. The duration of the ventilation process will depend upon workload and air temperature and will be determined by the Re-Hab Firefighter or Officer.

The use of tarps for shade and electric fans to provide airflow may be necessary during hot weather. Firefighters are also encouraged to **“Get Wet”,** especially the head and upper torso, so that individual cool down is more efficient.

### Fluid Replacement

Fluid replacement is necessary in order to maintain the high metabolic demand placed on firefighters during emergency operations.

It is highly recommended that members drink one litre of water or more per hour in order to replace fluids lost due to dehydration.

Caffeinated beverages should be avoided during the emergency incident due to their diuretic effect. It is recognized that, at the conclusion of the incident, some members may wish to consume caffeinated beverages.

**Note:** Fire department personnel may not consume water being utilized by engines. This water is impure due to additives used by the department. Drinking water is supplied by other means, e.g. water jugs or individual bottled water.

## Appendix C – BC Ambulance First Responder Guidelines

### Heat Stress / Rehydration Unit (HSRU) Procedures

### Purpose

To establish standard procedures for EHS crews involved in the assessment and rehydration treatment of firefighters.

### Application

All EHS crews

### Procedures

**The HSRU**

1. The decision to activate the HSRA will rest with the Fire Department Commanding Officer. Guidelines for establishment of the Unit include industrial fires, long working fires, high ambient temperature and Hazmat encapsulation.
2. If the Fire Department involved does not have a HSRU, an ambulance will be utilized for this function.
3. The HSRU should be located adjacent to the Fire Department’s staging area.
4. EHS will supply personnel to man the Unit. This will normally be the Unit Chief’s partner. If he/she requires additional manpower, this request will be forwarded to the Unit Chief in charge of the scene. The Unit Chief may assign additional EHS personnel or request trained personnel from the Fire Department.

**Firefighter Assessments**

1. Assessments will be done each time SCBA bottles are exchanged by individual Firefighters. If abnormal findings are noted at the time of the assessment, the individual will be immediately pulled from duty and treatment begun in the HSRU.
2. The Fire Department will provide the HSRU with a copy of the duty roster to identify all personnel involved in the incident. The personnel manning the HHSRU will keep records of assessments.
3. When dealing with Hazmat incidents, blood pressure and pulse determinations will be done prior to encapsulation to identify individuals who are at risk due to pre-existing hypertension or tachycardia.

### Assessment Protocol[[1]](#footnote-2)

1. The following protocol will provide guidelines for the assessment of Firefighters returning from tactical operations:
2. Mental Status – The following questions will be asked:
* Name
* Platoon assignment
* Firefighter partner name
* Current date
1. Temperature – Temperature will be obtained by use of an oral thermometer. A temperature of greater than 38.5°C mandates additional assessment and treatment.
2. Pulse – A pulse greater than 130bts/min. mandates additional assessment and treatment.
3. Blood Pressure – A systolic B.P. of less than 100 or greater than 160 and/or a diastolic B.P. greater than 100 mandates additional assessment and treatment.
4. Cerebellar Exam – The following tests will be conducted:
* Romberg – feet together, standing erect
* Finger to nose
* Tandem gait – heel to toe walking

Incoordination or clumsiness mandates additional assessment and treatment.

### Medical Treatment Protocol[[2]](#footnote-3)

1. The following protocol will provide guidelines for the treatment of Firefighters involved in tactical operations:
2. Pre-hydration – Firefighters should drink 400-500cc of electrolyte solution prior to beginning “at risk” activities.
3. Rehydration – Firefighters should drink 1000cc per hour of electrolyte solution to replenish lost body fluid. This should be ongoing during the incident, but especially during times of assessment in the H.S.R.U. The drink should be as cold as possible to speed gastric emptying and to provide a small amount of body cooling.
4. Cooling- Cooling of firefighters is best accomplished in the H.S.R.U. Removal of turn out gear will allow cooling to proceed more rapidly and facilitate assessment. Fans and spray bottles can be used to increase evaporative cooling.
5. Medical Treatment in Instances of Abnormal Medical Examination
6. Elevated temperature – Any individual with a temperature greater than 38°C should be cooled and rehydrated as above until the temperature drops below 38°C. If the temperature is greater than 40°C cooling and rehydration should begin and the individual should be transferred to hospital.
7. Elevated Pulse – If the pulse is greater than 130 bts/min. the individual should be allowed to rest during the cooling and rehydration phase until the pulse rate drops below 100 bts/min.
8. Altered Blood Pressure – If the systolic blood pressure is greater than 160mmHg or less than 100mmHg. and/or the diastolic B.P. is greater than 100mmHg. the individual should be allowed to rest during the cooling and rehydration phase until the systolic pressure is between 100 and 160mmHg. and the diastolic pressure is less than 100mmHg.
9. Altered Mental Status and Cerebellar Signs – Any change in mental status (confusion, disorientation, etc.) and/or alteration of cerebellar testing (lack of co-ordination, clumsiness) will mandate transfer of the individual to hospital for further assessment and treatment. Immediate treatment will consist of removing turnout gear, active cooling (as these individuals will usually have elevated temperatures) and rehydration with oral electrolyte solution as tolerated or intravenous fluid.

## Appendix D – Heat Stress Hazard Identification

### Instructions

* Complete Section A. This section includes general information about the worksite and affected workers.
* Complete Section B. This section involves identifying hazards associated with the environment, type of tasks being performed and clothing/equipment required for the task.

|  |
| --- |
| **SECTION A – WORKSITE INFORMATION** |
| Location of Work Site: |
| Date: | Time: |
| Activities of Workers at Risk: | Job Titles/Occupations of Workers at Risk: |
| Weather Conditions (description only) | First Aid Attendant On-Site? Yes No |
| Other Remarks: |
| Name of Surveyor: | Signature of Surveyor: |
| Others in Attendance: | Signatures of Others in Attendance: |

|  |
| --- |
| **SECTION B: HAZARD IDENTIFICATION** |
| **Workload of Activities:** Check boxes that are relevant to the type of work activity being undertaken by workers |
| **Hazard** | Present in Work Area | Absent in Work Area | Details of Hazard |
| Jobs/tasks requiring medium exertion/strength | ☐ | ☐ |  |
| Jobs/tasks requiring heavy exertion/strength | ☐ | ☐ |  |
| **Environmental Conditions:** Check boxes if conditions are present. Provide brief details of the hazard if appropriate |
| Areas with temperatures above 23°C (summer or winter) | ☐ | ☐ |  |
| Outdoor job site | ☐ | ☐ |  |
| Workers exposed to radiant heat e.g. sunlight | ☐ | ☐ |  |
| Indoor job site | ☐ | ☐ |  |
| Heat is a problem for the entire work shift | ☐ | ☐ |  |
| Areas with high humidity i.e. relative humidity greater than 50% | ☐ | ☐ |  |
| **Clothing Requirements:** Check boxes that are relevant to the type of clothing required for the job/task. |
| Jobs/tasks require winter work clothing | ☐ | ☐ |  |
| Jobs/tasks require semi-impervious clothing | ☐ | ☐ |  |
| Jobs/tasks require impervious clothing | ☐ | ☐ |  |
| **Review of Records/Statistics:** Check boxes as appropriate |
| Work area and/or occupation have been previously identified as being hazardous | ☐ | ☐ |  |
| Workers have previously expressed concern regarding the work area/work activity | ☐ | ☐ |  |

Determine whether you need to conduct a Heat Stress Risk Assessment based on the information you have just gathered:

☐ Yes, risk factor(s) identified: continue with a risk assessment.

☐ No risk factor identified. Repeat the hazard identification procedure if/when conditions (environmental or worker) change that may present a new risk of heat stress.

## Appendix E – Heat Stress Risk Assessment Worksheet

All 4 sections must be completed in the Risk Assessment. Read through the entire risk assessment worksheet before proceeding with the risk assessment measurements / calculations.

### Instructions

* Section 1: Determine the metabolic rate of activities being performed by workers. Check the appropriate box in Table E1.
* Section 2: Determine the thermal environment by measuring the WBGT°C. Complete Steps 1, 2 and 3.
* Section 3: Determine the effect of clothing and/or protective equipment
* Section 4: Determine whether workers are acclimatized to heat
* Section 5: Interpreting results

|  |
| --- |
| **Section 1 – Determine Workload of Work Activities** |
| **Table E1- Workload of Work Activities** |
| **Classification of Workload** | **Types of Activity** | **Examples of Activity** | **Check Appropriate Box** |
| LightWork that generates a metabolic rate of less than 200 kcal/hr | Sitting, with moderate movement of arms and legsStanding doing light work, with mostly arm movementCasual walking | Desk work; typing; Driving in trafficTraffic ControlSupervising a worksite, bylaw inspections | ☐ |
| **Moderate**Work that generates a metabolic rate of between 200 and 350 kcal/hr | Brisk walkingSitting, with vigorous arm and leg movementsStanding, doing light to moderate work, including some walkingModerate lifting or pushing | Meter readingDriving heavy machineryTending shrub bedsWarehouse work; loading and unloading of trucks | ☐ |
| **Heavy**Work that generates a metabolic rate of greater than 350 kcal/hr | Construction tasksIntermittent heavy lifting, pushing or pullingClimbing stairs with heavy gear | Sawing; planing; digging; shoveling; sledgehammer work; roofingAsphalt crewFirefighting | ☐ |

|  |
| --- |
| **Section 2 – Determine Thermal Environmental: Record of WBGT°C Measurements** |
| **Step 1**: Record WBGT°C of the thermal environment. Ensure that the WBGT°C measurements are recorded and averaged over the hottest 2-hour period of the workday. Write the result below |
| WB: |  |
| GT: |  |
| DB: |  |
| Where:WBGT = Wet Bulb Globe TemperatureWB = Natural Wet Bulb TemperatureDB = Dry-Bulb TemperatureGT = Globe Thermometer Temperature |
| **Step 2**: Adjust WBGT°C to factor effects of solar or no solar-loading using the following equations: |
| OUTSIDE ENVIRONMENTS* Solar Loading Equation: WBGT°C = 0.7WB + 0.2GT + 0.1DB

INSIDE ENVIRONMENTS* No Solar Loading Equation: WBGT°C = 0.7WB + 0.3GT
 |
| Adjusted WBGT°C for solar loading or no solar loading: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |
| --- |
| **Step 3**: Determine whether the exposure is continuous or intermittent. Complete either Step 3A or Step 3B |
| **Step 3A:** Continuous Exposure |
| * Exposure is continuous i.e. work involves a continuous task with no variation in workload or thermal environment

Proceed to Section 3 (Clothing/Equipment). |

**OR**

|  |
| --- |
| **Step 3B:** Intermittent Exposure |
| * Exposure is intermittent i.e. the work involves a variety of tasks, is intermittent or is performed in various thermal environments.

Go to Appendix Fto calculate bothTWA (time weighted average)-workload and TWA- WBGT°C. Write your results below. TWA-WBGT°C: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (actual)TWA-WBGT°C: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (permitted)TWA-Workload: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Now proceed to Section 3 (Clothing/Equipment) |

|  |
| --- |
| **Section 3 - Clothing/Equipment** |
| If a worker is required to wear clothing over and above a single layer of light summer clothing, then a clothing correction value will be required. Refer to the values in Table E1 for the appropriate correction value and insert into formula below. |
| **Table E1- Clothing Correction Values** |
| **Clothing Type** | **Correction Value (WBGT°C)** | **Check the appropriate box** |
| Single layer of light summer clothing | 0 | ☐ |
| Cotton coveralls worn over light summer clothing | -2 | ☐ |
| Winter work clothing | -4 | ☐ |
| Impervious coveralls | -6 | ☐ |
| **Formula for Clothing Correction Values** |
| WBGT°C (from step 3) minus clothing correction value = Adjusted WBGT°C for clothing |
| Adjusted WBGT°C for clothing: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |
| --- |
| **Section 4 - Acclimatization to Heat** |
| Check the appropriate box: |
| Acclimatized Workers☐ | Worker has satisfied the criteria for acclimatization. Refer to main text pp14 & 15 for criteria. | The “Exposure Limits” listed in Table E2 should be used as permissible heat exposure limits |
| **Unacclimatized Workers**☐ | Worker is not used to working in hot environments or has been removed from a hot environment for at least seven consecutive days | The “Action Levels” listed in Table E1 should be used as permissible heat exposure limits |

|  |
| --- |
| **Section 5 - Interpreting the Results** |
| Record the final WBGT°C reading: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(from Section 3: clothing corrections) |
| **Table E2: Action Levels and Exposure Limits** |
| **Work Load** | **Action Level for Unacclimatized Workers****(2-hr TWA)** | **Exposure Limit for Acclimatized Workers****(2-hr TWA)** |
| **Light:** (less than 200kcal/hr) | 28 WBGT°C | 30 WBGT°C |
| **Moderate:** (between 200 and 350 kcal/hr) | 24.7 WBGT°C | 26.7 WBGT°C |
| **Heavy:** (greater than 350kcal/hr) | 23 WBGT°C | 25 WBGT°C |

Using the WBGT°C above compare the result to the WBGT°C listed in Table E2. Determine whether the Action Level or Exposure Level, as applicable, is being exceeded on your worksite.

If yes, you must implement risk control measures to reduce exposure to heat stress.

**(Note:** if you are going to implement work/rest recovery cycles, refer to Appendix Hfor guidance on calculations.**)**

|  |  |
| --- | --- |
| **Description of Risk Controls to be Implemented:** |  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |

## Appendix F – Instructions for Calculation of WBGT°C for Intermittent Work

Complete both Steps 1 and 2. An example is included at the end of this appendix.

### Step 1: Calculation of WBGT°C for Intermittent Work

For intermittent tasks, the 2-hr time-weighted average WBGT°C should be determined by measuring the WBGT°C for each task performed in the hottest 2-hr period and multiplying it by the duration of each task. The product of WBGT°C and duration for each task is then added up and the sum is divided by the total duration of all tasks performed during the 2-hr period.

Use the following formula to calculate this:

|  |  |
| --- | --- |
| Av. WBGT°C = | (WBGT1) x (T1) + (WBGT2) x (T2) +… +( WBGTn) x (Tn) |
| (T1) + (T2) + … + (Tn) |

WBGT1 = WBGT measured during task #1 (°C)

T1 = Duration of task #1 (minutes)

WBGT2 = WBGT measured during task #2 (°C)

T2 = Duration of task #2 (minutes)

**Step 2: Calculation of TWA (time weighted average) -Workload for Intermittent Work**

For intermittent tasks, it is necessary to determine a time-weighted average workload (=Workload (TWA)). To do this, the Workload (TWA) shall be determined by the equation:

|  |  |
| --- | --- |
| Workload (TWA) = | (M1) x (T1) + (M2) x (T2) +… +(Mn) x (Tn) |
| (T1) + (T2) + … + (Tn) |

M1 = Estimated or measured workload (metabolic rate) of task #1 (kcal/hr) during the total time period. Use the WCB estimates for activity workloads (Table F1 of this Appendix).

T1 = Duration of task #1 (minutes)

Tn = “n” represents the number of time measurements that you record

**Note:** The averaging period should be the same as that used to calculate the time-weighted average WBGT°C (i.e. the hottest 2-hr period of work).

### Completed Example

**1. Actual Worksite Time-weighted average WBGT°C**

|  |  |  |  |
| --- | --- | --- | --- |
| **Job** | **Time** | **Type of Job** | **Permitted WBGT** |
| Setting forms | 75 min | Light | 28 |
| Smoothing dumped concrete | 15 min | Moderate | 29 |
| Trowelling concrete by hand | 30 min | Heavy | 28 |

Use the hottest 2-hour period for this calculation

**2. Assume the last 3 jobs were used:**

|  |  |
| --- | --- |
| Av. WBGT = | (WBGT1) x (T1) + (WBGT2) x (T2) +… +( WBGTn) x (Tn) |
| (T1) + (T2) + … + (Tn) |

Calculation of Worksite WBGT°C

|  |  |
| --- | --- |
| Av. WBGT= | (28°C) x (75min) + (29) x (15) +( 28) x (30) |
| (75) + (15) + (30) |

|  |  |
| --- | --- |
| Av. WBGT= | 2100+435+840 |
| 120 |

⇒ Actual Av. WBGT=28.1°C

**3. Time weighted average permitted WBGT°C**

|  |  |  |  |
| --- | --- | --- | --- |
| **Job** | **Time** | **Type of Job** | **Permitted WBGT** |
| Setting forms | 75 min | Light | 28 |
| Smoothing dumped concrete | 15 min | Moderate | 29 |
| Trowelling concrete by hand | 30 min | Heavy | 28 |

|  |  |
| --- | --- |
| Av. WBGT°C = | (WBGT1) x (t1) + (WBGT2) x (t2) +… +( WBGTn) x (tn) |
| (t1) + (t2) + … + (tn) |

|  |  |
| --- | --- |
| Av. WBGT°C = | (28°C) x (75min) + (27) x (15) +( 25) x (30) |
| (75) + (15) + (30) |

|  |  |
| --- | --- |
| Av. WBGT°C = | 2100+405+750 |
| 120 |

### ⇒ Permitted Av. WBGT=27.1°C

**4. Calculation of time-weighted average workload**

|  |  |
| --- | --- |
| Av. Workload = | (M1) x (t1) + (M2) x (t2) + (M3) x (t3) |
| (t1) + (t2) + (t3) |

Determine the workload of the task using the table below:

|  |
| --- |
| Table F1 – Workloads of Task |
| Light WorkloadWork that generates a metabolic rate of less than 200 kcal/hr such as: performing light hand work while seated or standing, casual walking. |
| Moderate WorkloadWork that generates a metabolic rate of between 200 and 350 kcal/hr such as: hand and arm work, arm and legwork, picking fruits and vegetables, brisk walking. |
| Heavy WorkloadWork that generates a metabolic rate greater than 350 kcal/hr such as: shoveling, sledgehammer work, sawing, planing, digging, axe work, pushing or pulling heavy loads angle grinding, restocking cans on shelves. |

Use equation to calculate workload

|  |  |
| --- | --- |
| Av. Workload = | (200) x (75) + (300) x (15) + (350) x (30) |
| (75) + (15) + (30) |

|  |  |
| --- | --- |
| Av. Workload = | (200) x (75) + (300) x (15) + (350) x (30) |
| (75) + (15) + (30) |

|  |  |
| --- | --- |
| Av. Workload = | 1500 + 4500 + 10500 |
| (75) + (15) + (30) |

|  |  |
| --- | --- |
| Av. Workload = | 16500 |
| 120 |

|  |  |
| --- | --- |
| Av. Workload = | 137.5 k/cal per hour |

At this point, return to the risk assessment worksheet and continue with 3B. You will need the actual and permitted – Av. WBGT°C measurements for the worksheet.

## Appendix G – Heat Stress Exposure Control Plan

|  |  |  |
| --- | --- | --- |
| Department: | Job Classification: | Procedure/Task: |
| Statement of Purpose: |
| Policy: [Insert name or job position]will ensure that the Heat Stress Exposure Plan has been fully developed if workers are or may be at risk to conditions that may expose them to heat stress. Work will be prohibited until such time that the Heat Stress Exposure Plan is ready for implementation. |
| Responsibilities:* Departmental Manager
* Supervisor
* Worker
* Others
 |
| Heat Stress Hazard Identification and Risk Assessment: Attach separate completed forms |
| List risk controls to be implemented: |
| Is semi-impervious or impervious clothing i.e. rain gear or chemical-resistant suits worn while performing this task(s)?  Yes ☐ No ☐ |
| Is additional health monitoring required to monitor workers for heat stress? (Check appropriate boxes.)☐ Heart rate☐ Temperature☐ Fluid Balance |

|  |
| --- |
| Additional Comments: |
| Name of Person Completing Heat Stress Exposure Control Plan: | Signature: |
| Date of Completion of Heat Stress Exposure Control Plan: | Time of Completion: |
| Proposed Date/Time of Next Exposure Control Plan Review (if applicable): |

## Appendix H – Summary Table of Heat-Related Disorders and Indicators

|  |
| --- |
| After just three hours of moderate work on a warm-to-hot job site, performance can be drastically affected by the symptoms of heat stress. The U.S. National institute for Occupational Safety & Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend drinking five to seven ounces of cool fluid every 15 - 20 minutes to replenish the necessary fluids in the body. |
| **Heat Stress Indicators** |
| **Dehydration Levels** | **Percentage of Body Weight Loss** | **Fluid Loss in Pounds and Litres** | **Effects and Symptoms** | **How Soon This Can Happen Without Drinking\*** |
| Minor | 1% | 1.5 lbs0.75 litres | Unnoticed | 1 hour |
| Initial stage | 2% | 3.0 lbs1.5 litres | Loss of endurance, thirsty, feel hot, less comfortable | 2 - 3 hours |
| Performance loss | 3% | 4.5 lbs2.25 litres | Loss of strength, loss of energy, moderate discomfort | 3 - 4 hours |
| Heat cramps | 4% | 6.0 lbs3.0 litres | Cramps, headaches, extreme discomfort | 4 - 5 hours |
| Heat exhaustion | 5 - 6% | 7.5 - 9 lbs3.5 - 4 litres | Heat exhaustion; nausea, faint | 5 - 6 hours |
| Heat stroke | 7%+ | 11+ lbs5+ litres | Heat stroke, collapse, unconsciousness | 7+ hours |
| Source: CamelBak© Products | Rough guidelines only. Depends on rate of water loss. |

|  |
| --- |
| **Heat Stress Hazards** |
| **CONDITION** | **CAUSE** | **SYMPTOMS** | **TREATMENT** | **PREVENTION** |
| Heat Rash | Hot, humid environment; plugged sweat glands | Red bumpy rash with severe itching | Change into dry clothes and avoid hot environments. Rinse skin with cool water. | Wash regularly to keep skin clean and dry. |
| Sunburn | Too much exposure to the sun | Red, painful or blistering and peeling skin. | If the skin blisters, seek medical aid. Use skin lotions (avoid topical anesthetics) and work in the shade. | Work in the shade; cover skin with clothing; wear sunscreen lotions with a sun protection factor of a least 15. People with fair skin should be especially cautious. |
| Heat Cramps | Heavy sweating drains a person body of salt, which cannot be replaced just by drinking water. | Painful cramps in arms, legs or stomach which occur suddenly at work or later at home. Cramps are serious because they can be a warning of other more dangerous heat-induced illnesses. | Move to a cool area, loosen clothing and drink cool, salted water (1 Tbsp salt per gallon of water) or commercial fluid replacement beverage. If the cramps are severe or don't go away, seek medical aid. | When working in the heat, workers should put salt on their food (if on a low salt diet, this should be discussed with a Doctor). This will give the body all the salt it needs. Do not take salt tablets. |
| Fainting | Not enough blood flowing to the head, causing loss of consciousness. | Sudden fainting after at least two hours of work, cool moist skin, weak pulse. | Fainting may be due to a heart attack or other illness. GET MEDICAL ATTENTION. Assess need for CPR. Move to a cool area; loosen clothing; make person lie down and if the person is conscious, offer sips of cool water. | Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms which often precede heat stroke. |
| Heat Exhaustion | Inadequate salt and water intake causes a person's body's cooling system to start to break down. | Heavy sweating; cool, moist skin; body temperature over 38C; weak pulse; normal or low blood pressure; person is tired, weak, clumsy, upset or confused; is very thirsty or is panting or breathing rapidly; vision may be blurred. | GET MEDICAL AID. This condition can lead to heat stroke, which can kill. Move the person to a cool shaded area; loosen or remove excess clothing; provide cool water to drink (salted if possible); fan and spray with cool water. | Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms which often precede heat stroke. |
| Heat Stroke | If a person's body has used up all it's water and salt, it will stop sweating. This can cause body temperature to rise. | High body temperature (over 40C) and any one of the following: the person is weak, confused, upset or acting strangely; has hot, dry, red skin; a faint pulse; a headache or dizziness; in later stages, a person may pass out and have convulsions. | CALL AMBULANCE. This condition can kill a person quickly; remove excess clothing; fan and spray the person with cool water; offer sips of cool water if the person is conscious. | Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms which often precede heat stroke. |

## Appendix I – Formula for Work-Work Cycles

If the work-rest cycle given on page 14 of the program is not appropriate for the worksite, alternative calculations must be performed to determine the work regime for workers operating in a hot environment. The formula given in this appendix allows you to calculate work cycles that involve working in a hot environment then switching to working in a cooler environment i.e. there is no rest period.

The formula factors in variable thermal environments and variable workloads.

TH - Thermal index as measured in hotter environment

TC - Thermal index as measured in cooler environment

TAH - Allowable thermal index for hotter environment depending on level of work activity

TAC - Allowable thermal index for cooler environment depending on level of work activity

 - The time required in cooler environment

**Formula for Work-Work Cycles**

|  |  |
| --- | --- |
| t = | 120(TH-TAH) |
| (TH-TC) + (TAC-TAH) |

## Appendix J – Guidelines for Fluid Replacement

Use the following guidelines when working in a hot environment:

* Thirst is not an adequate indicator. Relying on thirst will result in dehydration.
* Once the body becomes dehydrated, it is more difficult to rehydrate because the intestines do not absorb water so well. Adequate fluid intake throughout the work shift is critical.
* Workers should drink one cup (150ml) of cool water every 15-20 minutes
* Under conditions of profuse sweating, a commercial electrolyte replacement drink may be appropriate. Some drinks are too concentrated and need to be diluted or consumed with water.
* Avoid salt tablets as they can irritate the stomach and lead to vomiting, resulting in further dehydration.

## Appendix K – Record of Worker Training

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date of Training** | **Name of Worker** | **Job Title/Position** | **Work Location** | **Supervisor’s Signature** |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

## Appendix L – Risk Assessment Auto Calculator

<https://www.bcmsa.ca/resources/risk-assessments/#toggle-id-5>

1. Buchanan, K.D. 1991. Heat Stress and Hydration Management – A Victoria Fire Dept./B.C. Ambulance Service Project [↑](#footnote-ref-2)
2. [↑](#footnote-ref-3)