



BC Wildfire
Service

BC Wildfire Service

Standard Operating Procedures for Heat Response Plan

BCWS Humidex Based Heat Response Plan

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Program Area: Safety and Well-Being

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BCWS Humidex Based Heat Response Plan

The BC Wildfire Service (BCWS) recognizes the potential problems caused by elevated temperatures in the wildland fire work environment. To reduce the potential for heat-related illness, BCWS has developed the following heat stress prevention plan. This plan requires the full cooperation of all members of the BCWS team: Senior Management, the Joint Health and Safety Committee, supervisors, and workers.

To monitor and evaluate the potential for heat-related problems in the workplace, a guide called the Heat Stress Awareness Guide will be the reference used by BCWS personnel. By linking temperature and humidity, a colour code on the heat stress awareness chart provides the appropriate work-site response. All BCWS employees will be trained to recognize the signs and symptoms of heat stress — in themselves, as well as in other employees.

Employees experiencing symptoms of heat stress must report to first aid immediately to obtain proper medical attention. During days when heat stress procedures are in place, all employees will follow the awareness and prevention plan.

The heating and cooling balance in the body depends on the following factors:

1. air temperature humidity (moisture in the air)
2. radiant heat load (sun, fire)
3. physical activity (how hard you are working)
4. cooling (by the evaporation of sweat)
5. body adjustments (acclimatization)

There are two sources of heat exposure, the outside environment and internal muscle activity. (80% of muscle energy is turned into body heat.) Elevated temperatures and high levels of physical work create heat stress. The body cools itself by evaporating sweat. High humidity hinders sweat from evaporating.

The body will get used to working in a hot environment over time. This process of the body becoming more efficient at cooling itself down is known as “acclimatization.” The body redirects blood to the skin’s surface, the heart becomes more efficient, sweating starts sooner, and there is more sweat produced by the body. Sweat contains less salt during this adjustment period, and symptoms of fatigue, dizziness, heat rash, and stomach discomfort are common. **Workers can assume they have acclimatized after they have worked the last five of seven days with temperatures in the heat stress range without incident.** It should be noted, however, that dehydration can cancel the benefits of acclimatization. Acclimatized workers will be able to work longer in a hot environment than unacclimatized workers.

Heat stress symptoms are a set of natural signals telling you that something needs to be done to balance your body’s heating and cooling. As your body heats up, it tries to rid itself of excess heat through the evaporation of sweat. If it is unable to cool itself this way, your body temperature will increase. When body temperatures get above 38-39°C, the brain starts to overheat, leading to a shutdown of your body’s cooling system (sweating stops). Your temperature now rises even faster, leading to heat stroke and dire consequences.

This is a simplified Heat stress prevention program and should establish implementation criteria, or “triggers” to put the plan into effect. Criteria may include:

- Humidex reaching or exceeding 35°C.
- Environment Canada Humidex advisory (air temperature exceeding 30°C and Humidex exceeding 40)
- Heat waves (three or more days of temperatures of 32°C or more)

5 Steps to Reduce Heat Stress

Step 1 Training:

Measurements by themselves cannot guarantee worker protection from heat stress. It is essential that workers learn to recognize the early signs and symptoms of heat stress and know how to prevent them. If possible, workers need to be able to alter their pace of work, take rest breaks, and drink in response to early symptoms (a cup of water every 20 minutes). The ideal heat stress response plan would let workers regulate their own pace by “listening” to their bodies.

Step 2 Clothing:

The heat stress action chart assumes workers are wearing regular clothes (shirt and pants, underwear, socks, and boots). If workers are wearing falling gear/ hi-vis, add 5° of Humidex to the workplace measurement (using the heat stress reference chart on the next page). Estimate the correction factor for other kinds of clothing/protective equipment by comparing them with falling gear/hi-vis (e.g., gloves, hard hat, chest pack, and hi-vis might be equivalent to a little less than half the evaporation resistance of falling gear/hi-vis, so add 1° or 2° of Humidex).

Step 3 Select a measurement location:

Divide the workplace into zones that have similar heat exposures. i.e., fire line or fire camp.

Step 4 Measure workplace temperature and humidity:

Using a thermal hygrometer (Kestrel Weather Meter or Sling Psychrometer) measure the temperature and relative humidity at your *actual* worksite hourly (fire line or at camp). Weather forecasts, operational briefings, or Fire Behaviour briefing values can only be used for planning purposes. Once you have the temperature and humidity, be sure to adjust for clothing (Step 2), and radiant heat (Step 5). Then use the heat stress awareness table to determine the appropriate heat stress prevention response.

Step 5 Adjust for radiant heat:

For outdoor work in direct sunlight between the hours of 10 a.m. and 5 p.m., add 1°-2° (pro-rate according to percentage cloud cover) to your Humidex measurement.

Shut Down Criteria

At Humidex values greater than 45 (before adjusting for clothing), supervisors should consider shutting down work activities that are not critical to the protection of life, property, and critical infrastructure. Where work must continue, strict work/rest procedures will be established including the provision of enhanced cooling and recovery facilities. Humidex values will be regularly re-assessed until it is safe to resume work. Where extreme humidex values are forecasted, supervisors may consider running split shifts with work planned early in the morning and in the evening when ambient temperatures are more reasonable.

Humidex 1 Moderate unacclimatized & Heavy acclimatized	Response	Humidex 2 Moderate acclimatized & Light unacclimatized
25 - 29	Supply water to workers on an "as needed" basis	32 - 35
30 - 33	Post Heat Stress Alert notice: encourage workers to drink extra water; start recording hourly temperature and relative humidity	36 - 39
34 - 37	Post Heat Stress Warning notice. Alert workers that they need to drink extra water; ensure workers are trained to recognize symptoms.	40 - 42
38 - 39	Work with 15 minutes relief per hour can continue; provide adequate cool (10-15°C) water; at least 1 cup (240 mL) of water every 20 minutes. Worker with symptoms should seek medical attention	43 - 44
40 - 41	Work with 30 minutes relief per hour can continue in addition to the provisions listed previously	45 - 46*
42 - 44	If feasible, work with 45 minutes relief per hour can continue in addition to the provisions listed above	47 - 49*
45 or over	Only medically supervised work can continue	50 or over

This chart is based on a person wearing normal Nomex clothing and boots. When heavier clothing or additional PPE is worn, extra values must be added to the chart value to obtain the correct Humidex temperature.

Using the chart above, a person would add the identified quantity for any additional PPE being worn.

- Cotton Coveralls over clothes add 5 degrees.
- Hardhat add 1 degree.
- Gloves add 1 degree.
- Chest pack add 1 degree.
- Falling gear/hi-vis add 5 degrees.

An example, from the “Guidelines - Part 7 – Division 4 – Thermal Exposure:

The Humidex value from Table above is 34°C and the worker performing roadway repairs in the B.C. Interior, in July. As the worker is wearing coveralls and gloves (as well as other safety equipment, e.g., work boots and hard hat), a value of 5°C (for the coveralls) and 1°C (for the gloves and/or hardhat) will have to be added. Another 3°C are added to adjust for radiant heat in direct sunlight (the worker is exposed to direct sun on the roadway). The final calculation for Humidex becomes: $34 + 5 + 1 + 3 = 43$ degrees Celsius. The Humidex value must then be compared to the ranges in Table below (Humidex 1 or Humidex 2) depending on whether the worker is acclimatized.

Humidex 1 or Humidex 2

There are two Humidex guidelines to determine the appropriate actions required:

Humidex 1 refers to **unacclimatized** workers doing “moderate” work, and ranges indicate the need for general heat stress controls. These include providing annual heat stress training, encouraging adequate fluid replacement, permitting self-limitation of exposure, encouraging the watching out for symptoms in co-workers, and adjusting expectations for workers coming back to work after an absence.

Humidex 2 refers to **acclimatized** workers doing “moderate” work, and ranges indicate the need for job-specific controls. These include (in addition to general controls) engineering controls to reduce physical job demands, shielding of radiant heat, increased air movement, adjusting exposure times to allow sufficient recovery.

The chart below specifies an action limit to prevent workers’ body temperatures from exceeding 38°C (38.5°C for acclimatized workers). Below the action limit (which corresponds to Humidex 1 for work of moderate physical activity), most workers will not experience heat stress. Most healthy, well-hydrated, acclimatized workers not on medication will be able to tolerate heat stress up to the threshold limit value (Humidex 2 for moderate physical activity).

NEVER IGNORE ANYONE’S SYMPTOMS, REGARDLESS OF YOUR MEASUREMENTS!

Note: Clothing and radiant heat must also be considered when using this guideline (See Steps 1 to 5 outlined on page 3).

Hot conditions, workload or personal monitoring may indicate that additional rest breaks are needed in the work rest cycle. Rest periods do not necessarily mean that the workers are on break; these can be productive times. Rest periods do not always require a change in location from the work environment. Rest periods *do* require that workers move away from direct sunlight or other sources of radiant heat and that they change to less strenuous tasks to reduce the build-up of body heat.

Manual work with hands or hands/arms, driving and standing with some light arm work and occasional walking are examples of light work demands. The recovery period does not necessarily mean a complete break from work but could include "resting" or light tasks such as Danger Tree Assessments, hosing hot spots or pump maintenance.

Managing heat stress

No system can address all situations. Once in heat stress season, workers and supervisors eventually learn to anticipate when heat stress controls “kick in.” In such situations, the system becomes less formal. The baseline we recommend is that when forecasted temperatures exceed 32 degrees, supervisors will apply these procedures. Prescribed responses to the measurements alone will not protect every worker. Workers must also learn to listen to what their bodies are telling them and know how to respond appropriately.

Supervision should allow for individual responses and accommodations, realizing that a person’s tolerance of heat will change from day to day with the person’s state of health and nutrition. A strategy must be in place to trigger the monitoring process (typically weather). The plan needs to be communicated to all personnel and implemented. Workers suffering from heat exhaustion should be transported to medical aid. It is important to remember that one must notify WorkSafeBC if a worker is transported to hospital with symptoms of exhaustion or heat stroke (heat stroke is considered a medical emergency).

Control Measures

General control measures

- Develop, communicate, and implement the heat stress plan for all workers.
- Worker education and training to recognize the signs and symptoms of heat stress and how to avoid them. (IAP (Incident Action Plan) messages, message boards in camp, safety bulletins, 24-hour reports, briefings, conversations with crews, BCWS internal training video-link included at end of this document).
- Provide water nearby on the job site and ensure everyone drinks about one cup of water every 20 to 30 minutes, even if they are not thirsty (Supplement water with electrolyte or sport drinks if it is available) Warehouses may be able to supply crews with bagged ice and coolers.
- Establish a first-aid response system with trained first-aid providers and a means to record and report heat stress incidents.
- Employers must notify WorkSafeBC of serious heat stress incidents which are likely to result in a life-threatening condition or cause permanent injury or significant physical impairment.
- Allow time for workers to acclimatize to the heat and the work. This typically takes about 5-7 days and in some rare cases can take up to two weeks.
- Measure Humidex levels and allow for self-limitation of exposure. (If this is not possible, adjust the work/rest cycles accordingly.) Encourage workers to use a buddy system — each buddy looks out for early signs and symptoms of heat stress in the other.

Job-specific control measures

- Provide barriers to shield workers from radiant heat exposure (work in shade or under tree canopy where possible and safe to do so)
- Organize the work to reduce the pace of activity. If possible, postpone strenuous work until a cooler time of the day.
- If work is done outside, ensure that shaded areas are available. Provide pop-up canopies for camp and stand-alone settings (First Aid, Security, Warehouse).
- Rotate workers in and out of hot work areas whenever possible.

Personal control measures

- Avoid eating large meals before working in hot environments.
- Avoid alcohol and limit beverages with caffeine. The diuretic effect of caffeine has been disputed but there are clear health advantages to reducing consumption. *
- Wear light clothing that permits the evaporation of sweat (e.g., cotton clothing). Use sunscreen and cover your head if working outside.
- Advise workers to check with their doctor if their medication may affect their heat tolerance.
- Make healthy lifestyle choices (i.e., body weight, fitness, diet, rest, etc.)

Risk identification, assessment, and control

Prior to forecasted heat events, heat stress protocols as provided in this plan, will be discussed during provincial and regional prep calls as well as at zone and incident level briefings. It will be assumed that all workers are at risk of heat-related disorders until suitably acclimatized or conditions change. Incident Management and/or site supervisors will conduct heat stress assessments and identify controls to eliminate or minimize worker exposure to conditions that could cause heat stress, as well as when and how the controls will be implemented.

Education and training

All workers who work in areas where there is a reasonable likelihood of heat stress will be provided training and education. The training and education material provided to workers who have not previously worked in a heat stress environment will include the following information:

- Heat-related disorders (heat cramps, heat exhaustion, and heat stroke),
- Relevant signs and symptoms of heat-related disorders,
- Predisposing factors for heat-related disorders include the following:
 - 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.

Administrative controls for reducing exposure to heat stress.

Typical engineering controls are not practicable in a wildland firefighting environment. Section 7.30(2)(a) permits the use of administrative controls, such as an acceptable work-rest cycle, to reduce the exposure of workers to below the screening criteria levels.

Several administrative controls that are commonly used to reduce a worker's exposure to heat stress are described below:

- **Fluid replacement and work practices.** Section 7.31 of the *Regulation* requires employers to provide and maintain an adequate supply of cool potable water (10-15°C) close to the work area for the use of a heat exposed worker who is or may be exposed to the conditions specified in section 7.27.
- **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.
- **Acclimatization.** The body will adapt to working in hot conditions if it is allowed sufficient time. This physiological process is referred to as acclimatization and can usually be induced in 4 to 7 days of exposure to a hot environment.
- **Scheduling and organization of work.** There are several ways to organize and to schedule tasks to minimize the length of time and temperatures to which workers may be exposed. For example:
 - When possible, schedule hot tasks for the cooler part of the day (early morning, late afternoon, or night shift).
 - Add extra personnel to reduce exposure time for each member of the crew.
 - Where practical, allow workers to set their own pace of work.
 - If weather forecasts predict very hot conditions, postpone tasks that are not urgent until the hot spell is over.

Additional measures Incident Management personnel may take in addition to but not limited to include having dedicated air-conditioned cooling rooms at camp, MTC's and work trucks typically at worksite or within 10 min surface travel time when on the fire line, access to community cooling shelters, dedicated helicopter for medivac purposes, pre-organized access to local gymnasiums or community centres for crews to relocate tents if night-time temperatures remained elevated.

Shut Down Criteria

At Humidex values greater than 45 (before adjusting for clothing), supervisors should consider shutting down work activities that are not critical to the protection of life, property, and critical infrastructure. Where work must continue, strict work/rest procedures will be established including the provision of enhanced cooling and recovery facilities. Humidex values will be regularly re-assessed until it is safe to resume work. Where extreme humidex values are forecasted, supervisors may consider running split shifts with work planned early in the morning and in the evening when ambient temperatures are more reasonable.

References and useful links...

OHS Guidelines Part 7 Division 4 – THERMAL EXPOSURE References 7.28(1) Heat Exposure, 7.28(1) Exposure Limits, 7.28(2) Clothing correction values, 7.29(1) (a)(b) Heat stress assessment-acceptable measures and methods, 7.29-4 Heat stress assessment using Humidex index, 7.29-5 Exposure control plan, 7.30-2 Administrative controls: [Found Here](#)

WorkSafe BC has a [booklet](#) that provides a basic overview of job-related heat stress, how to recognize and treat heat stress, and how to prevent heat stress.

- BCWS has the following internal training video:
https://www.for.gov.bc.ca/ftp/HPR/gov_internal!/publish/BCWS%20Intranet/Staff%20Development/Heat%20Stress%20PSA%202021.mp4
- Quick reference card from OHSA
<https://www.osha.gov/sites/default/files/publications/osha3154.pdf>
- 2021 Extreme Heat Warning Safety Bulletin:
https://intranet.gov.bc.ca/assets/intranet/bcws-intranet/provincial-programs/organizational-development/safety/safety-communication/07-safety-bulletins/safety_bulletin_-_extreme_heat_warning.pdf
- *Diuretic effect of caffeinated beverages <https://pubmed.ncbi.nlm.nih.gov/19774754/>

Document History

Version	Change Made	Effective Date
1.0	New SOG	January 2023

Approvals



Kyle Young, Manager of Org Development

May 16th, 2023

Date



Ian Meier, ADM

June 12, 2023

Date

Appendix A: Heat Stress Plan – Poster

Humidex Table

°C	Relative Humidity (in percent)																		
	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10
49																			50
48																			49
47																		50	47
46																		49	46
45																	50	47	45
44																	49	46	43
43																49	47	45	42
42															50	48	46	43	41
41															48	46	44	42	40
40														49	47	45	43	41	39
39													49	47	45	43	41	39	37
38												49	47	45	43	42	40	38	36
37											49	47	45	44	42	40	38	37	35
36									50	49	47	45	44	42	40	39	37	35	34
35								50	48	47	45	43	42	40	39	37	36	34	33
34							49	48	46	45	43	42	40	39	37	36	34	33	31
33					50	48	47	46	44	43	41	40	39	37	36	34	33	32	30
32			50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29
31	50	49	48	47	45	44	43	42	40	39	38	37	35	34	33	32	30	29	28
30	48	47	46	44	43	42	41	40	39	37	36	35	34	33	31	30	29	28	27
29	46	45	43	42	41	40	39	38	37	36	35	33	32	31	30	29	28	27	26
28	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
27	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25		
26	39	38	37	36	35	34	33	33	32	31	30	29	28	27	26	25			
25	37	36	35	34	33	33	32	31	30	29	28	27	26	26	25				
24	35	34	33	33	32	31	30	29	28	28	27	26	25						
23	33	32	31	31	30	29	28	28	27	26	25								
22	31	30	30	29	28	27	27	26	25	25									
21	29	29	28	27	26	26	25												

Using the chart above, a person would add the identified quantity for any additional PPE being worn:

Coveralls over clothes + 5 | Hardhat +1 | Gloves +1 | Chest pack +1 | Falling gear/hi-vis + 5

Humidex Based Heat Response Plan

UNACCLIMATIZED WORKER

Humidex 1 general controls

30 – 37
38 – 39
40 – 41
42 – 44
45+

ACTION RECOMMENDED

Warn for symptoms and extra water
Work with 15 minutes/hour relief
Work with 30 minutes/hour relief
Work with 45 minutes/hour relief
Hazardous to continue physical activity

ACCLIMATIZED WORKER

Humidex 2 specific controls

36 – 42
43 – 44
45 – 46*
47 – 49*
50+*