Policy Name:	**Archery Australia Heat Stress Policy**
Responsibility	Archery Australia Inc Board
Effective	January 2017
Policy Number	1020
Edition	3

Archery Australia
HEAT STRESS POLICY

In Australia heat kills more people than any other weather related hazard. Archery is practiced all year round, but generally in the warmest months of the year.

On hotter days all participants will be affected by the heat to some degree.

What is heat stress?

Heat stress is the overall heat burden on the body from the combination of body heat, environmental sources and clothing.

In Australia shooting in hot conditions and direct sunlight is common, especially in summer.

Archery Australia has a duty of care to alert individuals, RGBs, clubs and organising committees to the hazard and associated risks when shooting in extreme heat conditions.

What factors contribute to heat stress?

Factors that contribute to heat stress and affect the body's ability to disperse excess heat and maintain normal body temperature are:

- The work rate - the heavier the work, the greater the amount of metabolic heat produced.
- Ambient air temperature - the higher the ambient air temperature, the harder it is for the body to disperse metabolic heat and maintain body temperature by sweating.
- Humidity - the higher the humidity the lower the sweat evaporation rate.
- Air flow - the lower the rate of air flow (or wind speed) the lower the rate of sweat evaporation.
- Clothing - heavy or protective clothing reduces heat dispersion by trapping the heat within the clothing. This reduces the airflow, preventing evaporation of sweat and therefore dispersal of body heat.
- Radiant heat - e.g. standing in the sun or in the vicinity to heat sources such as ovens, furnaces, stage lighting, boilers etc

What are the Risks?

These vary from mild to severe:

Mild heat illness

Those affected feel weak or dizzy. Symptoms respond well to rest in a cool place, frequent drinks of non-alcoholic fluid and removal of any heavy clothing.

Heat exhaustion

This results in the collapse of the affected person due to dehydration and an overloaded cardiovascular system. Symptoms include fainting, lethargy, headache, low blood pressure, nausea, clammy, pale or flushed skin and a normal to slightly elevated body temperature (>39°C).

Treatment includes removal of any heavy clothing, rest in a cool place and frequent drinks to replace fluid.

Heat stroke

This is a very serious condition that can result in death or permanent injury from brain damage.

Signs of heat stroke include:

- Irritability;
- Confusion, disorientation;
- Incoherent speech;
- Hot, dry flushed skin;
- Convulsions;
- Loss of consciousness;
- Body temperature > 40°C;
- Cardiac arrest.

Immediate first aid must be given, while awaiting transfer to hospital. It is essential to cool the person affected by removing heavy clothing, moving to a cool place, sponging with water and vigorous fanning.

Heat Cramp

Heat cramp is characterised by painful spasms in one or more skeletal muscles. Heat cramp primarily occurs in persons who sweat profusely in heat without restoring their body's salt balance. Resting in a cool place and drinking saline solution normally alleviates cramp.

Who is Responsible for preventing Heat Stress?

The chance of a person being exposed to excessive heat is potentially high due to the nature of how the sport of Archery is practised i.e. it is principally an outdoor activity.

Apart from a general lack of enjoyment and poor performances, playing sport in extreme weather conditions can result in heat cramps, heat exhaustion and ultimately heat stroke and death.

Archery Australia, RGBs, clubs and the organising committee of the archery events have a duty of care to ensure all members and competitors are aware of the risks and hazards associated with competing outdoors. Ideally, events should be programmed to avoid periods of extreme heat.

Archers should be fully aware of the risks associated with outdoor archery.

It is the competitor's responsibility to take all the necessary precautions to protect themselves against heat stress and ensure their own welfare and safety.

How Does the Body Manage the Heat?

A healthy person has a remarkable capacity for regulating body temperature. When air temperature is below skin temperature (~34ºC) the body's principal cooling mechanism is to radiate heat into the atmosphere.

When the air temperature is above skin temperature, the body absorbs radiant heat from the atmosphere, so the principal cooling mechanism is via the evaporation of sweat. However, there are a number of personal factors that inhibit the body's ability to manage the heat.

These factors include:

Clothing

Wearing dark clothing may increase the absorption of heat from the environment as well as form barriers to evaporation. Always wear light weight, loose fitting and light coloured clothing.

Physical Condition

Individuals who are unfit and/or obese will produce far more metabolic heat during exercise and are much less efficient at dissipating that heat.

Dehydration

Sweating, inadequate fluid intake, consumption of alcohol, caffeine (coffee and tea), soft rinks and drinks containing caffeine and certain medications can lead to fluid deficits.

Without sufficient fluid the body cannot sweat.

Medical Condition

There are a range of medical conditions that interfere with the body's ability to manage heat.

Probably the most common condition is cardio-vascular disease.

Age

Children (pre-pubescent) and older participants (>50 years age) are at an additional risk.

Repeated Exposure

Exposure to hot conditions on a previous day increases the risk of suffering heat stress for the current day.

The effects of heat stress are cumulative.

Previous Heat Related Illnesses

Individuals who have a history of heat related illnesses are at risk of repeat occurrences.

Environmental Factors

Air temperature is a significant factor in how body temperature is managed. Other environmental factors, which affect the body's ability to manage heat, include:

Relative Humidity (RH)

RH, expressed as a percentage, is a measure of the actual amount of water vapour in the atmosphere compared against the maximum possible water vapour for a given air temperature.

The higher the Relative Humidity, the more saturated the atmosphere is with water vapour resulting in sweat increasingly pooling on the skin rather than evaporating.

Radiant Heat

Direct sunlight adds to the body's heat load.

Wind

Wind blowing in hot dry (low humidity) conditions adds to the body's heat load, with the reverse occurring in higher humidity conditions.

Heat Stress Models

Tools used for determining whether conditions which are safe for outdoor activities must make some attempt to measure the heat stress being placed on the participants and not simply measuring air temperature.

There is a general belief that events should not continue when the air temperature reaches a certain level, usually 38^{o}C or 40^{o}C.

This policy although it appears to be simple ignores the comprehensive physiological data that is available regarding heat stress guidelines.

The commonly accepted method of determining potential heat stress is the 'Wet Bulb Globe Temperature' (WBGT).

The **Wet Bulb Globe Temperature** (**WBGT**) is a composite method used to estimate the effect of temperature, humidity, wind speed and solar radiation on humans.

Why are the indices useful?

We often use the air temperature as an indicator of how comfortable we will feel when involved in sports or other physical activities. However, the air temperature is only one factor in the assessment of thermal stress. In climates where other important factors, principally humidity, can vary widely from day to day, we need more than just the temperature for a more realistic assessment of comfort.

However, it is useful to be able to condense all the extra effects into a single number and use it in a similar way to the way we used the air temperature. The Wet Bulb Globe Temperature (WBGT) and the Apparent Temperature are indices which attempt to do this.

What causes thermal stress?

Human thermal comfort depends on environmental and personal factors. The four environmental factors are airflow (wind), air temperature, air humidity, and radiation from the sun and nearby hot surfaces.

The personal factors are the clothing being worn and the person's level of physical activity.

Thermal sensation is also significantly affected by acclimatisation/adaptation: people living in hot climates have been shown to be comfortable at higher temperatures than those living in cooler climates.

In hotter conditions the body must shed heat to maintain thermal equilibrium. The cooling effect of evaporation of sweat from the skin becomes an important factor. The efficiency of this cooling depends on the humidity of the air.

A high humidity reduces the effectiveness of evaporative cooling significantly. The amount of clothing will also affect this cooling efficiency due to its restriction of the air flow over the skin.

Fabrics with low vapour permeability (those that don't "breathe") will increase the humidity of air near the skin.

In colder conditions, the body must either reduce heat loss (e.g. by taking shelter from the wind) or increase heat production, for example, by greater physical activity. In these conditions evaporation and air humidity are relatively unimportant factors. The cooling of the exposed parts of the body by the wind now becomes the most important external factor affecting thermal balance.

The effect of radiation is important under all temperature conditions. Excess radiation always acts to increase the heat load on a person. This can be of assistance under cold conditions, but under hot conditions it's an extra heat load that must be shed.

Of the four environmental factors, wind and radiation are very much influenced by the immediate surroundings. For example, wind speed is reduced by the sheltering effect of belts of trees and solar radiation is affected by short term localised phenomena such as cloudiness.

If these factors are to be used as inputs, they are best measured on location, as values can vary significantly over relatively short distances. The remaining two factors (temperature and humidity) are less spatially variable and can be used to give an indication of the general comfort level of a region.

In order to make comparisons between areas, it is convenient to combine the effect of temperature and humidity into one index. This does not mean we can ignore the other environmental and non-environmental factors, but adjustments to the index value, either up or down, can be made to take them into account.

Most people use the temperature alone to provide some guide to the level of comfort.

Generally this is quite reasonable because humidity doesn't often vary a lot, particularly in the tropics. However people moving from a less humid to more humid environment will immediately notice the effect of the greater humidity. In many sub-tropical regions of Australia the humidity is usually quite low, but occasionally can become quite high, again reducing comfort to those people not acclimatised.

The Wet Bulb Globe Temperature (WBGT)

The **WBGT** was developed in the late 1950s for the US Marine Corps Recruit Depot on Parris Island in South Carolina. Humidity in this region can be quite high and Marines have to undergo vigorous training exercise in military clothing, under full sun. There is a significant risk of heat injury if precautions are not taken.

The **WBGT** was later used by researchers as an easily measured general heat-stress index. In time its use widened. Because its use is recommended in the Standard, ISO 7243, it is often used in Occupational Health and Safety guidelines for working in hot environments. It has been advocated for use in sports requiring continuous exertion, such as the marathon. It is also used for horses in equestrian events.

The **WBGT** is measured by a simple three-temperature element device similar to the picture on the right.

Photo: Courtesy of Richard de Dear, Macquarie University.

The first temperature, (**Tg**), is measured by the *black globe thermometer*, which usually consists of a 150 mm (6 inch) black globe with a thermometer located at the centre. The black globe temperature represents the integrated effects of radiation and wind.

The second thermometer measures the *natural wet-bulb temperature* (**Tnwb**). It consists of a thermometer with its bulb covered with a wettened cotton wick supplied with distilled water from a reservoir. Evaporation from the wettened bulb cools the thermometer. The *natural wet-bulb* thermometer, like the *black globe* thermometer is not shielded from wind or radiation. This thermometer represents the integrated effect of humidity, wind and radiation.

The final temperature element is the *air temperature* (**Ta**). It is measured by a thermometer shielded from radiation - generally by being placed in a weather screen. It is the standard temperature normally quoted in weather observations and forecasts.

The three elements **Tg**, **Tnwb**, and **Ta** are combined by into a weighted average to produce the **WBGT**.

WBGT = 0.7 × Tnwb + 0.2 × Tg + 0.1 × Ta

For active contact sports the generic' recommendations WGBT temperatures are:

Temperature > 28^{o}C

Extreme risk of heat risk and sporting events requiring *moderate to intense* exercise should be cancelled.

WBGT between 23-28^{o}C – *High* risk of heat injury

WBGT between 18-22^{o}C – *Moderate* risk of heat injury

WBGT < 18^{o}C – *Minimal* risk of heat injury.

Most sporting authorities recommend that for sport involving children and adolescents, regardless of the WBGT, activities should be cancelled when the air temperature (using a standard thermometer placed in a shaded area in direct air flow) reaches 34^{o}C.

The Apparent Temperature (AT) - Heat Index

The *apparent temperature* (**AT**), invented in the late 1970s, was designed to measure thermal sensation in indoor conditions. It was extended in the early 1980s to include the effect of sun and wind. Only the modification due to wind is taken into account on the BoM website. The **AT** index used here is based on a mathematical model of an adult, walking *outdoors*, in the shade (Steadman 1994). The **AT** is defined as; the temperature, at the reference humidity level, producing the same amount of discomfort as that experienced under the current ambient temperature and humidity.

Basically the **AT** is an adjustment to the *ambient temperature* (**T**) based on the level of humidity. An absolute humidity with a dewpoint of 14°C is chosen as a reference (this reference is adjusted a little with temperature). If the humidity is higher than the reference then the **AT** will be higher than the **T**; and, if the humidity is lower than the reference, then **AT** will be lower than **T**. The amount of deviation is controlled by the assumptions of the Steadman human model. In practice the **AT** is more intuitive to use than the **WBGT**, as it is an adjustment to the actual air temperature based on the perceived effect of the extra elements such as humidity and wind. **AT** is valid over a wide range of temperature, and it includes the chilling effect of the wind at lower temperatures.

The hot weather version of the **AT** (1984) is used by the National Weather Service in the United States. In the United States this simple version of the **AT** is known as the **Heat Index**.

The **AT** used here does not include the effect of the sun, but this can be factored in. Under Australian conditions the effect of full sun produces a maximum increase in the **AT** of about 8°C when the sun is at its highest elevation in the sky.

The Apparent Temperature (AT) - Wind Chill

The apparent temperature (**AT**), described in the previous section, can also be used as a measure of wind chill. There are a number of Wind Chill Indices in use around the world, generally for colder temperatures than usually experienced in Australia. Nevertheless, conditions in parts of Australia can be cold enough, under windy conditions, to cause significant chilling. Below is a conversion table with a temperature range suitable for Australian conditions.

When using the **AT** as a wind chill the Steadman model assumes an appropriately dressed adult for those conditions. However if clothing were to get wet, the cooling effect would be greater than that predicted by this model, and the chance of hypothermia would be greater than indicated by the **AT**. In wet, windy conditions, someone wearing inadequate clothing can become hypothermic in quite mild temperatures.

Using the Indices

The heat indices are only a guide to help you make decisions relating to your activity. Your decision process would need to include a number of factors of which temperature and humidity only form part.

By using the conversion tables below and your own measurements it is possible to determine the value of the heat index at your venue. Electronic thermometers containing relative humidity are available from electronic, and other suppliers. These instruments produce fairly

accurate values of relative humidity. Care must be taken to correctly expose the temperature sensor. It should be about a metre above ground level, shaded and away from extraneous radiation sources (for example brick wall) so as to produce an accurate shade temperature. Compare your maximum temperature with a nearby reference weather station. If your value is consistently high, for a reason you can't explain, try another location.

You can estimate the average WBGT conditions in a given area by using the historical information provided by the Bureau of Meteorology on their website at www.bom.gov.au/climate/averages/.

Looking at the website the lower part of the Climate Averages page, choose your state, lookup the nearest observation site to your location, click on the station number. For afternoon conditions you should use the **Mean Daily Maximum Temperature** and **Mean 3pm Relative Humidity**. Do not use this relative humidity for other times because relative humidity changes quite a bit during the day.

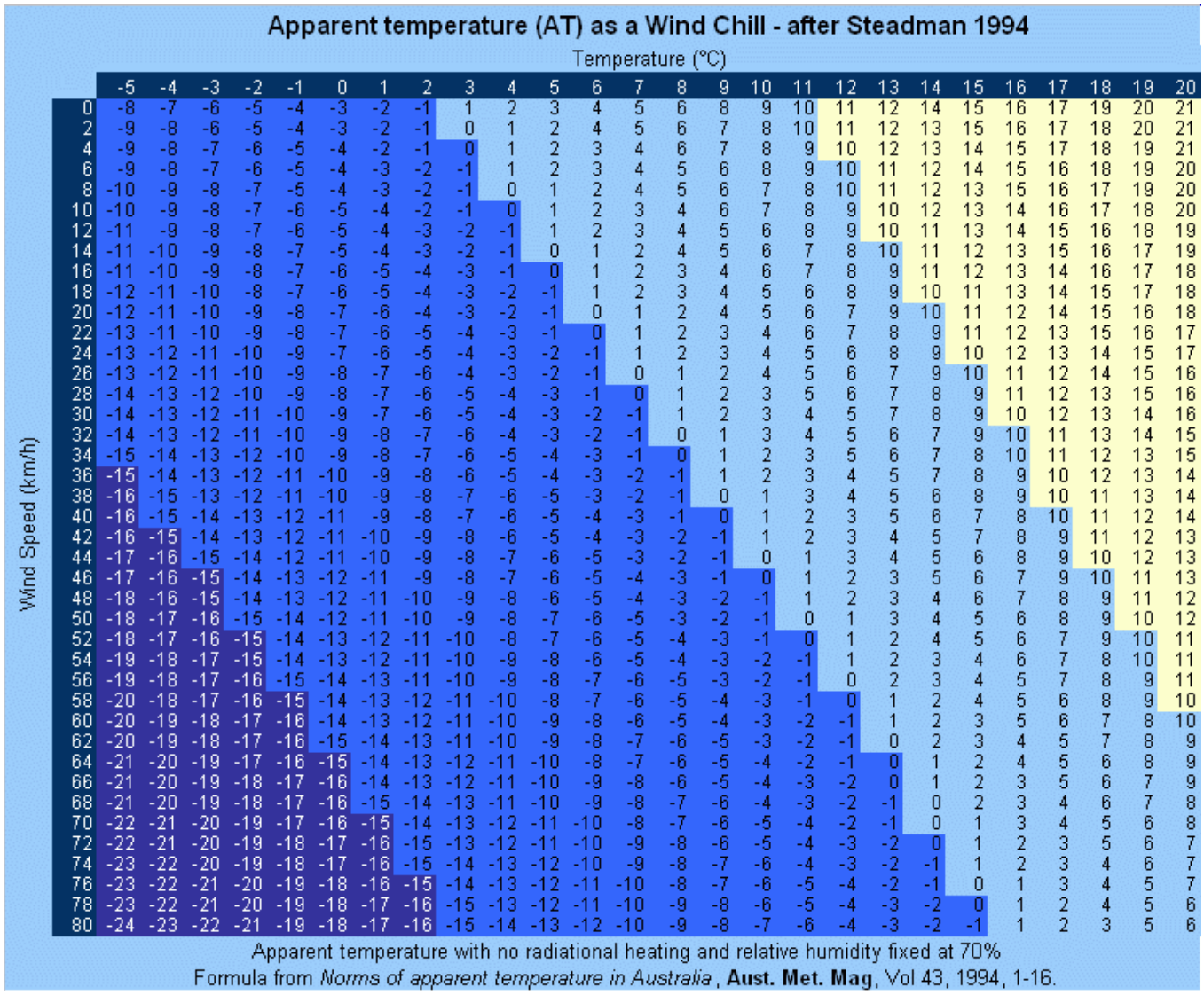
For example if we choose BRISBANE REGIONAL OFFICE, in January we have a temperature of 29.4°C and relative humidity of 59%. From the tables below this gives an apparent temperature of about 32°C and a **WBGT** of about 30°C.

Steadman Apparent Temperature

Legend: Red values, apparent temperature above air temperature; blue values, apparent temperature below air temperature.

Apparent temperature (AT) from temperature and relative humidity - after Steadman 1994

Relative Humidity (%) \ Temperature (°C)	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
5	16	17	18	19	20	21	22	23	24	25	26	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	47	48
10	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	33	34	35	36	37	38	39	41	42	43	44	45	46	48	49	50
15	17	18	19	20	21	22	24	25	26	27	28	29	30	31	33	34	35	36	37	38	40	41	42	43	45	46	47	48	50		
20	17	18	20	21	22	23	24	25	26	28	29	30	31	32	33	35	36	37	38	40	41	42	43	45	46	47	49	50			
25	18	19	20	21	22	24	25	26	27	28	29	31	32	33	34	36	37	38	40	41	42	44	45	46	48	49					
30	18	19	21	22	23	24	25	26	28	29	30	31	33	34	35	37	38	39	41	42	43	45	46	48	49						
35	19	20	21	22	23	25	26	27	28	30	31	32	34	35	36	38	39	40	42	43	45	46	48	49							
40	19	20	21	23	24	25	26	28	29	30	32	33	34	36	37	39	40	41	43	44	46	48	49								
45	19	21	22	23	24	26	27	28	30	31	32	34	35	37	38	40	41	43	44	46	47	49									
50	20	21	22	24	25	26	28	29	30	32	33	35	36	38	39	41	42	44	45	47	49	50									
55	20	22	23	24	25	27	28	30	31	32	34	35	37	38	40	42	43	45	46	48	50										
60	21	22	23	25	26	27	29	30	32	33	35	36	38	39	41	42	44	46	48	49											
65	21	22	24	25	27	28	29	31	32	34	35	37	39	40	42	43	45	47	49				AT above 50°C								
70	21	23	24	26	27	28	30	31	33	35	36	38	39	41	43	44	46	48	50												
75	22	23	25	26	28	29	31	32	34	35	37	38	40	42	44	45	47	49													
80	22	24	25	27	28	30	31	33	34	36	38	39	41	43	45	46	48	50													
85	23	24	26	27	29	30	32	33	35	37	38	40	42	44	45	47	49														
90	23	25	26	28	29	31	32	34	36	37	39	41	43	45	46	48	50														
95	23	25	26	28	30	31	33	35	36	38	40	42	43	45	47	49															
100	24	25	27	29	30	32	33	35	37	39	41	42	44	46	48	50															



Wind Speed (km/h)	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	-8	-7	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6	8	9	10	11	12	14	15	16	17	19	20	21
2	-9	-8	-6	-5	-4	-3	-2	-1	0	1	2	4	5	6	7	8	10	11	12	13	15	16	17	18	20	21
4	-9	-8	-7	-6	-5	-4	-2	-1	0	1	2	3	4	6	7	8	9	10	12	13	14	15	17	18	19	21
6	-9	-8	-7	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6	8	9	10	11	12	14	15	16	18	19	20
8	-10	-9	-8	-7	-5	-4	-3	-2	-1	0	1	2	4	5	6	7	8	10	11	12	13	15	16	17	19	20
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12	-11	-9	-8	-7	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6	8	9	10	11	13	14	15	16	18	19
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22	-13	-11	-10	-9	-8	-7	-6	-5	-4	-3	-1	0	1	2	3	4	6	7	8	9	11	12	13	15	16	17
24	-13	-12	-11	-10	-9	-7	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6	8	9	10	12	13	14	15	17
26	-13	-12	-11	-10	-9	-8	-7	-6	-4	-3	-2	-1	0	1	2	4	5	6	7	9	10	11	12	14	15	16
28	-14	-13	-12	-10	-9	-8	-7	-6	-5	-4	-3	-1	0	1	2	3	5	6	7	8	9	11	12	13	15	16
30	-14	-13	-12	-11	-10	-9	-7	-6	-5	-4	-3	-2	-1	1	2	3	4	5	7	8	9	10	12	13	14	16
32	-14	-13	-12	-11	-10	-9	-8	-7	-6	-4	-3	-2	-1	0	1	3	4	5	6	7	9	10	11	13	14	15
34	-15	-14	-13	-12	-10	-9	-8	-7	-6	-5	-4	-3	-1	0	1	2	3	5	6	7	8	10	11	12	13	15
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44	-17	-16	-15	-14	-12	-11	-10	-9	-8	-7	-6	-5	-3	-2	-1	0	1	3	4	5	6	8	9	10	12	13
46	-17	-16	-15	-14	-13	-12	-11	-9	-8	-7	-6	-5	-4	-3	-1	0	1	2	3	5	6	7	9	10	11	13
48	-18	-16	-15	-14	-13	-12	-11	-10	-9	-8	-6	-5	-4	-3	-2	-1	1	2	3	4	6	7	8	9	11	12
50	-18	-17	-16	-15	-14	-12	-11	-10	-9	-8	-7	-6	-5	-3	-2	-1	0	1	3	4	5	6	8	9	10	12
52	-18	-17	-16	-15	-14	-13	-12	-11	-10	-8	-7	-6	-5	-4	-3	-1	0	1	2	4	5	6	7	9	10	11
54	-19	-18	-17	-15	-14	-13	-12	-11	-10	-9	-8	-6	-5	-4	-3	-2	-1	1	2	3	4	6	7	8	10	11
56	-19	-18	-17	-16	-15	-14	-13	-11	-10	-9	-8	-7	-6	-5	-3	-2	-1	0	2	3	4	5	7	8	9	11
58	-20	-18	-17	-16	-15	-14	-13	-12	-11	-10	-8	-7	-6	-5	-4	-3	-1	0	1	2	4	5	6	8	9	10
60	-20	-19	-18	-17	-16	-14	-13	-12	-11	-10	-9	-8	-6	-5	-4	-3	-2	-1	1	2	3	5	6	7	8	10
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68	-21	-20	-19	-18	-17	-16	-15	-14	-13	-11	-10	-9	-8	-7	-6	-4	-3	-2	-1	0	2	3	4	6	7	8
70	-22	-21	-20	-19	-17	-16	-15	-14	-13	-12	-11	-10	-8	-7	-6	-5	-4	-2	-1	0	1	3	4	5	6	8
72	-22	-21	-20	-19	-18	-17	-16	-15	-13	-12	-11	-10	-9	-8	-6	-5	-4	-3	-2	0	1	2	3	5	6	7
74	-23	-22	-20	-19	-18	-17	-16	-15	-14	-13	-12	-10	-9	-8	-7	-6	-4	-3	-2	-1	1	2	3	4	6	7
76	-23	-22	-21	-20	-19	-18	-16	-15	-14	-13	-12	-11	-10	-8	-7	-6	-5	-4	-2	-1	0	1	3	4	5	7
78	-23	-22	-21	-20	-19	-18	-17	-16	-15	-13	-12	-11	-10	-9	-8	-6	-5	-4	-3	-2	0	1	2	4	5	6
80	-24	-23	-22	-21	-19	-18	-17	-16	-15	-14	-13	-12	-10	-9	-8	-7	-6	-4	-3	-2	-1	1	2	3	5	6

Apparent Temperature as a Wind Chill

Legend: Colours added to visually delineate increasingly colder values.

Wet Bulb Globe Temperature Approximation

Wet Bulb Globe Temperature (WBGT) from Temperature and Relative Humidity

Relative Humidity (%) \ Temperature (°C)	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0	15	16	16	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	25	26	27	27	28	28	29	29	30	31	31	32	32
5	16	16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32	33	33	34	35
10	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	30	30	31	32	32	33	34	35	36	36	37
15	17	17	18	19	19	20	21	21	22	23	23	24	25	26	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38	39	
20	17	18	18	19	20	21	21	22	23	24	24	25	26	27	27	28	29	30	31	32	32	33	34	35	36	37	38	39			
25	18	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39					
30	18	19	20	20	21	22	23	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	39							
35	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39								
40	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39									
45	19	20	21	22	23	24	25	26	27	27	28	29	30	32	33	34	35	36	37	38											
50	20	21	22	23	23	24	25	26	27	28	29	30	31	33	34	35	36	37	39												
55	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	38													
60	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	38														
65	21	22	23	24	25	26	27	28	29	31	32	33	34	36	37	38															
70	22	23	24	25	26	27	28	29	30	31	33	34	35	36	38	39							WBGT > 40								
75	22	23	24	25	26	27	29	30	31	32	33	35	36	37	39																
80	23	24	25	26	27	28	29	30	32	33	34	36	37	38																	
85	23	24	25	26	28	29	30	31	32	34	35	37	38	39																	
90	24	25	26	27	28	29	31	32	33	35	36	37	39																		
95	24	25	26	27	29	30	31	33	34	35	37	38																			
100	24	26	27	28	29	31	32	33	35	36	38	39																			

Note: This table is compiled from an approximate formula which only depends on temperature and humidity. The formula is valid for full sunshine and a light wind

About the approximation to the WBGT used by the Bureau of Meteorology

The approximation used by the Bureau of Meteorology does not take into account variations in the intensity of solar radiation or of windspeed, and assumes a moderately high radiation level in light wind conditions.

Use of this approximation may lead to incorrect estimates of thermal stress, particularly in cloudy and windy conditions. Under these conditions the approximation is likely to lead to an overestimate of the stress. The approximation will also overestimate night-time and early morning conditions when the sun is low or below the horizon.

Implications for Archery

As mentioned the Bureau of Meteorology maintains records of Air Temperature and Relative Humidity and wind speeds for a number of areas around Australia, you can use these to estimate the WBGT for your area for a given period. When organising events and looking at possible dates to conduct events this should be taken into account.

Assuming that a WBGT of 28ºC or greater is the trigger for suspending/cancelling sporting events, it is an interesting exercise to examine the records of the Bureau of Meteorology.

How does WGBT relate to standard air temperatures?

The short answer is there is no relationship. For example;

Two sporting events are worth comparing, an event held in Berri, SA during February 2004.

For example temperatures in Berri SA over a 2 day event were extreme (40.9ºC and RH up to 18%) indicating WBGT heat stress levels of just over 32ºC. This tournament was ultimately cancelled early on the second day of competition although the air temperature was very high the WBGT was only just above the danger level.

Another event which was not cancelled was in Brisbane where the air temperatures were much lower (28ºC -33ºC), however the RH was between (59-75%) resulting in WBGT heat

stress levels of between 31°C and 34°C. This event was not cancelled as the air temperatures were considered acceptable although participants were exposed to high WGBT levels over a number of days in succession.

What to Do?

Archers are responsible for their own safety and well being and as such should consider all possible control measures, examples include:

- Always wear a hat
- Wear appropriate light weight clothing.
- Wear shirts with long sleeves
- Always use appropriately rated sun screen
- Consume large amounts of water, avoid soft drinks as they usually encourage dehydration
- Competitors concerned about possible heat risk should review weather forecasts and consider withdrawing from events

Event organisers should take every possible measure to provide a safe environment by:

- Providing access where possible to cool, easily accessible rest areas
- Providing shade in the waiting Area
- Providing access to water
- Programming events outside of known high extreme weather times of the year
- Reviewing Bureau of Meteorology weather history to avoid excessive hot periods of the year
- Follow the Archery Australia 1026 Tournament Management Policy available on the Archery Australia website.

It should be stressed it is the responsibly of the archers to ensure they are appropriately supplied with necessary refreshments.

The organising committee where possible should provide access to water to the competitors.

Heat Policy

Archery Australia has a Heat Policy which can be found in 1026 Tournament Management Policy. Extract from policy -

Heat - An event may be delayed, suspended, postponed or abandoned in extreme heat conditions, in such weather conditions the Heat Index level must be checked every 15 minutes.
In weather conditions with high temperatures and high relative humidity the Director of Shooting and the Organising Committee should be determining the latest Heat Index by using either a Heat Stress Testing device or by using Chart 1.

a. When weather conditions force the Heat Index to rise into the Caution Zone as a duty of care competitors must be alerted to the conditions and advised to wear appropriate protection such as a hat or long sleeve top and to use sunscreen and keep hydrated.

b. The tournament may be cancelled when the Heat Index enters the Extreme Caution Zone if shade and adequate water is not available.

c. In extreme heat conditions when the Heat Index enters the Danger Zone the tournament must be cancelled or postponed.

Archery being an “outdoor” sport the risk of heat exposure is ever present. Archers are responsible for their own safety and should take appropriate precautions such as wearing appropriate clothing, hats and long sleeve shirts, use sunscreen and drink water on a regular basis.

It is the responsibility of the parent/carer of a junior archer to safely manage the junior archers health and well being during an event where extreme heat conditions may occur.

Tournament organisers should, where practical, provide shade behind the “Waiting Line” at tournaments and provide access to potable water.

For club activities, clubs should consider setting up a shade shelter along the Shooting Line.

During tournaments archers spend the majority of the time on the field of play moving to and from the targets, retrieving arrows and scoring. Extra care should be considered in the use of personal umbrellas.

Organisers of tournaments should also consider the tournament program and an earlier starting time of events to avoid the “heat of the day” or program the tournament outside of times of the year subjected to extreme weather conditions.

Monitoring

It is essential to have some form of on-site heat stress measurement tool or consult the Bureau of Meteorology on-line.

Devices for measuring heat stress are available and information on a popular device used by many sports can be found below.

Implementation

Clubs and RGBs and Organising Committees should comply with the Archery Australia Heat Stress Policy and 1026 Tournament Management Policy when conducting events outdoors

In extreme heat conditions conduct regular air temperature and humidity readings referring to Table 1 in this document or the Bureau of Meteorology website or use a Heat Stress testing device.

Clubs, RGBs and Organising Committees should regularly advise competitors of the Heat Index during the course of a day’s competition.

When the Heat Index rises into Caution and Extreme levels consideration must be given to postponing or cancelling the event.

Organisers should keep the DOS and officials advised of heat stress levels during competition. The DOS should advise the competitors of conditions; this will enable competitors to make their own decision about continuing.

Authority

Event organisers should appoint someone to monitor environmental conditions. The DOS and Organising Committee have the sole authority for continuing, suspending or recommencing activities.

Emergency Response

When organising events in possible extreme weather periods ensure that appropriately trained and qualified people are available to respond to heat stress victims.

Remember, for potential heat stroke sufferers, immediate treatment is the key to survival.

HEAT INDEX from TEMPERATURE & RELATIVE HUMIDITY READINGS

RELATIVE HUMIDITY (%)	TEMPERATURE (Degrees Celsius)																																	
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
10	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	49	50	51
15	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40	41	42	43	45	46	47	49	50	52	53	55
20	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	36	37	38	40	41	43	44	45	47	48	50	52	53	55	56	58
25	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	36	37	39	40	42	43	45	46	48	49	51	53	54	56	58	60	61
30	18	19	20	21	22	23	24	25	26	27	29	30	31	33	34	36	37	39	40	42	43	45	47	48	50	52	53	55	57	59	61	63	65
35	18	19	20	21	22	23	24	26	27	28	29	31	33	34	36	37	39	40	42	44	45	47	49	50	52	54	56	58	60	62	64	66	68
40	18	19	20	21	22	24	25	26	28	29	31	32	34	35	37	39	41	42	44	45	47	49	51	53	54	56	58	61	63	65	67	69	72
45	18	19	20	22	23	24	26	27	29	30	32	33	35	37	38	40	42	43	45	47	49	51	53	55	57	59	61	63	65	68	70	72	75
50	18	19	21	22	24	25	27	28	30	31	33	34	36	38	40	41	43	45	47	49	51	53	55	57	59	61	63	66	68	71	73	76	78
55	19	20	22	23	24	26	27	29	31	32	34	36	37	39	41	43	45	46	48	50	52	55	57	59	61	64	66	68	71	74	76	79	82
60	19	21	22	24	25	27	28	30	32	33	35	37	38	40	42	44	46	48	50	52	54	57	59	61	64	66	68	71	74	76	79	82	85
65	20	21	23	24	26	27	29	31	32	34	36	38	40	42	43	45	47	50	52	54	56	58	61	63	66	68	71	74	77	79	82	85	89
70	20	22	23	25	27	28	30	32	33	35	37	39	41	43	45	47	49	51	53	56	58	60	63	65	68	71	73	76	79	82	85	89	92
75	21	23	24	26	27	29	31	33	34	36	38	40	42	44	46	48	50	53	55	57	60	62	65	68	70	73	76	79	82	85	89	92	95
80	22	23	25	26	28	30	32	33	35	37	39	41	43	45	47	50	52	54	57	59	62	64	67	70	73	75	79	82	85	88	92	95	99
85	22	24	25	27	29	31	32	34	36	38	40	42	44	46	49	51	53	56	58	61	63	66	69	72	75	78	81	84	88	91	95	98	102
90	23	24	26	28	30	31	33	35	37	39	41	43	45	48	50	52	55	57	60	63	65	68	71	74	77	80	84	87	90	94	98	102	106
95	23	25	27	28	30	32	34	36	38	40	42	44	47	49	51	54	56	59	62	64	67	70	73	76	79	83	86	90	93	97	101	105	109
100	24	26	27	29	31	33	35	37	39	41	43	45	48	50	53	55	58	60	63	66	69	72	75	78	82	85	89	92	96	100	104	108	112
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

LEGEND

SAFE	MILD CAUTION	CAUTION	EXTREME CAUTION	DANGER	EXTREME DANGER	DEATH IMMINENT
No serious issues.	Frail Aged and children may exhibit discomfort	Discomfort Evident Fatigue Possible	Fatigue Likely Muscle Cramps & Heat Exhaustion Possible	Muscle Cramps & Heat Exhaustion Likely Heatstroke Possible	Heatstroke Likely Death Possible	Reduce exposure to under 2 minutes

Sources: Australian Bureau of Meteorology 2009 and the Environment Canada Website 2009

*Heat Index refers to Apparent or Felt Temperature which minimises the body's capacity to cool itself.

Kestrel 3000 Pocket Weather Meter

Website Link

www.kestrelweather.com.au/store5/agora.cgi?p_id=00027

The New kestrel 3000 (heavy duty) has been redesigned for even better performance and functionality! A popular meter with fire fighting and outdoors organisations.

Measures

- Current Wind Speed
- Maximum Wind Gust
- Average Wind Speed
- Air, Water & Snow Temperature
- Wind Chill
- Relative Humidity
- Heat Stress Index
- Dewpoint

Know Your Conditions

- Measure environmental conditions quickly and accurately
- Reliable, portable and easy to use

Quality by Design

- All instruments and accessories are completely assembled in the USA
- Innovative design for stability and accuracy in abrupt condition changes

- Patented user-replaceable impeller
- Quick response, external thermistor
- Thermally adjusted humidity sensor

Features

- Protective cover with sure-grip over moulding
- Data hold function
- Large easy-to-read display with backlight
- Waterproof and floats
- Lanyard and battery included
- Two-year warranty

Specifications

Measurement	Units of Measure	Accuracy	Range
Current, Max and Avg Wind Speed	m/s, km/hr, mph, fpm, kts, Beaufort Force	±3% of reading or ±0.1 m/s	0.3 to 40 m/s (0.7 to 89 mph)
Temperature, Wind Chill, Heat Stress, Dewpoint	°C, °F	±1°C (±2°F)	-29 to 70°C (-20 to 158°F)
Relative Humidity	%	± 3% or scale	5 to 95%

Display Update	1 second
Display Size	Reflective 3 1/2 digit LCD, 9 mm (0.36 in.) digit height
Off-Axis Wind Speed Accuracy	-1% @ 5º off-axis; -2% @ 10º; -3% @ 15º
Calibration Drift	< 2% after 100 hours use at 7 M/S (~14 KT, 25 KM/H, 16 MPH or 1,400 FPM)
Environmental Sealing	Electronics enclosure IP67 - water resistant to 1 m. (3 ft.)
Shock Resistance	Drop tested to 2 m. (6 ft.)
Auto Shutdown	45 minutes after last key press
Battery	User-replaceable CR2032 coin cell; typical life, 400 hrs
Impeller	25 mm (1 in.) diameter, sapphire bearings, light weight; user-replaceable without tools
Temperature Sensor	Hermetically sealed precision thermistor
Humidity Sensor	Silicon based capacitive sensor
Dimensions	unit: 122 x 42 x 20 mm (4.8 x 1.7 x 0.8 in.) cover: 122 x 46 x 26 mm (4.6 x 1.8 x 1.1 in.)
Weight	unit: 2.3oz (65gr) cover: 1.3oz (37gr)
Operating Temperature	LCD readability is lost above 50ºC (122ºF) and below -15ºC (5ºF). Accurate readings may be taken beyond these temperature limits by exposing the unit for the minimum time necessary to take and record measurement.
Storage Temperature	Recommended -20ºC to 80ºC (-4ºF to 176ºF)

Temperature Limitations	The Kestrel temperature sensor is able to measure temperatures as low as -30C (-22F) and as high as 70C (158F). The Kestrel is able to display wind chill measurements lower than -30C, depending on wind conditions. It is also able to display heat index measurements above 70C, depending on humidity conditions. The Kestrel display will not function if the display itself gets below -15C. However, if the unit is kept in a pack or pocket or other warm area, the display itself should not get this cold.
Certification	Wind speed, temperature and humidity measurements are tested at the factory before packaging. Factory certification is available for additional fee.
Warranty	Standard 5-year warranty covers parts and labour.