Making Your Own Wet Bulb Thermometer

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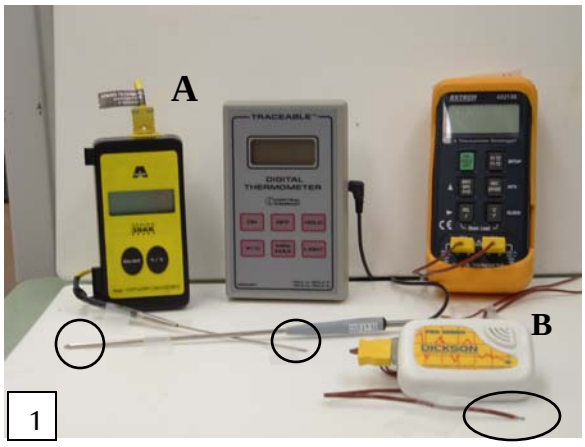
If you are smoking or drying meat, there are several parameters to monitor which will help you control your process: **dry bulb temperature**, **wet bulb temperature**, and **relative humidity**. Research at the University of Wisconsin Center for Meat Process Validation has shown that **monitoring wet bulb temperature is even more important (and much easier!) than monitoring product temperature** during your process. Since wet bulb temperature is critical to process monitoring, this document describes how to easily, and perhaps inexpensively, construct a wet bulb thermometer.

Dry bulb temperature, usually referred to as air temperature, is the smokehouse/oven property that is most commonly measured by jerky-makers. When people refer to the temperature (heat content) of the air, they are normally referring to the dry bulb temperature. It is called "dry bulb" because the air temperature is indicated by a thermometer that is not moistened and will not be affected by evaporative cooling.

Wet bulb temperature is the temperature indicated by a moistened thermometer bulb exposed to air. A wet bulb thermometer measures the extent of cooling that happens as moisture dries from a surface (evaporative cooling). The wet bulb temperature is always lower than the dry bulb temperature except when there is 100% relative humidity. **Because evaporative cooling occurs on the surface of thin jerky strips, the wet bulb temperature is more accurate measurement of product temperature**.

We developed a **wet bulb thermometer (WBT)** which is easy to assemble and economical for a meat processor to use.

To begin assembling a wet bulb thermometer, you will need to determine what type of **temperature measuring device** you will use. You will need to use a temperature recorder with a “tip reading” probe/wire/stem. Either an **instant read** or a **data-logging temperature measuring device** will work; both are pictured in image 1.

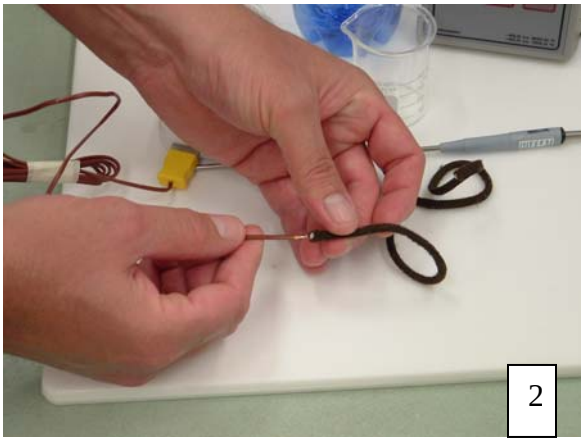


1

A – 3 styles of ‘instant read’ temperature measuring device
B – a data logger-style of temperature measuring device
In each case, the ‘tip reading’ probe/wire is circled.

Instant read temperature recorders. (A) An instant read temperature recorder will offer immediate feedback, with the temperature displayed on the front of the unit. However, data may not be recorded with this type of unit; the processor must record the data periodically. See page 3 for information on ordering instant-read temperature recorders.

A data logger-style temperature recorder. (B) This type of device keeps track of, or 'logs' temperature over a period of time. An inexpensive data logger usually does not offer immediate readout of data. A processor must connect the data logger to a computer to view the temperature data. A data logger does, however, offer a continuous record of temperature history which can be important for HACCP documentation. See page 3 for information on ordering a standard data logger.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Once you have your temperature recorder, you will need to choose material to serve as the **"wick"** to cover the tip probe. Water evaporating from the wick will reduce the temperature recorded, giving an indication of evaporative cooling. The wick should be made from an absorbent material, preferably cotton. It should also be constructed of **two phases**: a loose, absorbent interior, and an exterior that is of an absorbent tighter meshing material. The exterior keeps the inner absorbent material around the sensing portion of the temperature probe and prevents the sensing portion of the recorder from being exposed to direct ambient conditions. You may wish to purchase wicks commercially, such as from an online supplier (http://www.wickstore.com/wetbulbwick.html), or a good substitute is a round cotton bootlace (image 2). See page 3 for more information on supplies for a wet bulb thermometer.

There are several simple steps to setting up a **wet bulb thermometer**.

1. **Gather materials.** You will need a **vessel for holding water** which must either be refilled during processing, or must be sufficiently large to hold enough water (allowing for evaporation) to keep the water level close to the temperature probe. Choosing a vessel with a small diameter opening will reduce evaporation. Once a water vessel has been chosen, simply fill it with water. You will also need a **temperature measuring device** and material to serve as a **wick**. In image 3, the bottom of a soda bottle and a glass beaker are pictured as vessels. Both an instant read and a data logger are shown for measuring temperature and pieces of brown cotton shoelace serve as the wick.


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2. **Assemble the wet bulb thermometer. Cut** a portion of the wicking material (it should be long enough to reach the bottom of the water vessel and than some). **Connect** the sensing portion of your temperature recorder to the wick by inserting the probe/wire/stem into the center of the wick (image 2). **Secure the end** of the wick to the probe/wire/stem using tape. **Place the wick** in the water-containing vessel. **Make sure** the wick is completely

saturated with water, then position the wick-covered sensing portion of your temperature recorder so that it is completely exposed to ambient conditions, yet as close as possible to the water source (image 4). This will ensure adequate wicking of the water to the sensing portion of the temperature recorder. If exposure to ambient conditions is too great, such as when the wick is too long or the recorder too far from the water surface, the wick may dry out, and evaporative cooling will not be recorded.

3. **Place the wet bulb thermometer inside the chamber.** If you are using an instant reading temperature measuring device to make process adjustments, place the wet bulb thermometer for easy access and readability, such as near a door or window (image 5). If immediate feedback is not a consideration (image 6), place the device where the ambient conditions of your process are least likely to give you optimum conditions – hence a "worst case" reading. Position the wet bulb thermometer in a flow of air (such as in a stream of incoming air), but away from fans which will cause excessive evaporation and drying of the wick.

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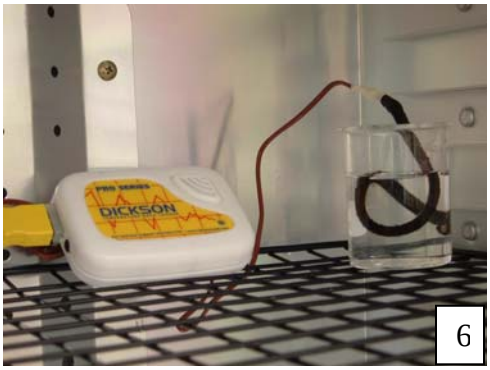

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4. **Record wet bulb temperature.** Establish a regular schedule of recording or down-loading wet bulb temperature. Check water level in the vessel periodically, and also check the position of the wick. The portion of the wick above the water must remain moist for accurate temperature measurement. The wet bulb temperature can be used to adjust your process conditions, as needed.

Supplies for Making a Wet Bulb Thermometer*

Instant Read Temperature Recorders
Fisher Scientific (800-766-7000)
- Part 15-078-38; price $131.49 plus shipping
- Part 15-077-14; price $111.15 plus shipping

Data Logger-Type Temperature Recorders
Dickson Company (800-323-2448)
- Part SM325 (LCD Display Temperature Data Logger w/ 2 K-thermocouple probes); price $399 plus shipping
- Also order software to download information to computer ($79)

Wick Material
- Round cotton bootlace (pictured in this document) – available at many general stores
- Wet-bulb wick ($50-$60 per spool http://www.wickstore.com/wetbulbwick.html)

- Wet-bulb sock: Alkar, part #50040; price $127.00 for bundle of 100 (608-592-4865)

**The items and suppliers listed here are suggestions only, based on price and availability. The mention of particular suppliers is not meant to exclude others from consideration.*

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The University of Wisconsin-Madison Center for Meat Process Validation provides science-based HACCP support to small meat processors in meeting state and federal mandates for safe food processing and handling. For more information on the Center contact Dr. Steve Ingham, 1605 Linden Drive, UW-Madison, Madison, WI 53706 (608) 265-4801 Email: scingham@wisc.edu