Field-Expedient Wet Bulb Thermometer (FEWBT)

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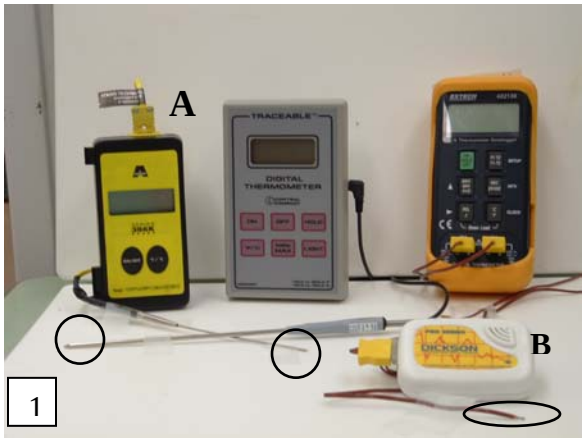
If you are smoking or drying meat, there are several parameters which will help you monitor your process: **dry bulb temperature**, **wet bulb temperature**, and **relative humidity**.

Dry bulb temperature, usually referred to as air temperature, is the air property that is most commonly measured. 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 not affected by the moisture of the air. The temperature is usually given in degrees Celsius (°C) or degrees Fahrenheit (°F).

Wet bulb temperature is the temperature indicated by a moistened thermometer bulb exposed to the air flow. A wet bulb thermometer measures the extent of cooling 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, making the wet bulb temperature a more accurate measurement of product temperature. We developed a **field-expedient wet bulb thermometer** (FEWBT) which is easy to assemble and economical for a meat processor to use.

To begin assembling a FEWBT, you will need to determine what type of **temperature measuring device** (TMD) you will use. You will need to use a TMD with a 'tip reading' probe/wire/stem to construct your FEWBT. Either an **instant read** or a **data-logging TMD** will work; both are pictured in image 1.



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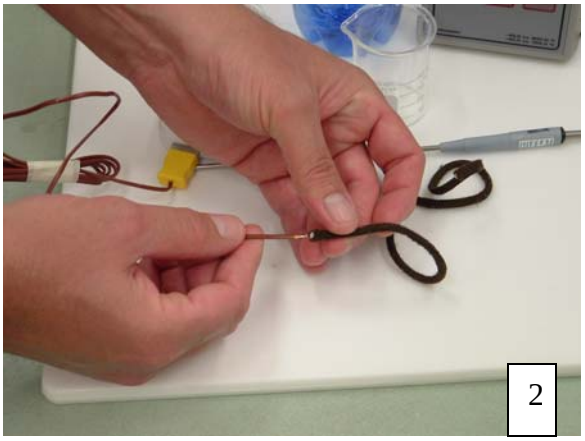
A – 3 styles of 'instant read' TMD
B – a data logger-style of TMD
In each case, the 'tip reading' probe/wire is circled.

Instant read TMDs. (A) An instant read TMD will offer immediate feedback, with the temperature displayed on the front of the unit. However, no data is usually recorded with this type of unit; the processor must record the data periodically.

A data logger-style TMD. (B) 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.

You will also need to choose material to serve as the **"wick"** to cover the tip of the TMD. 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 TMD and prevents the sensing portion of the TMD 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 field-expedient substitute is a round cotton bootlace (image 2).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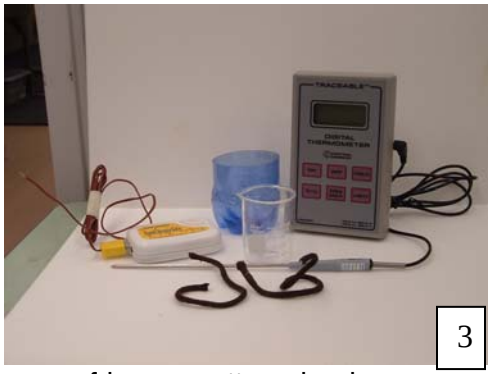
There are several simple steps to setting up a FEWBT.

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 sensing portion of the TMD. 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 **TMD** 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 pictured as TMDs and pieces of brown cotton shoelace serve as the wick.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2. **Assemble the WBT. 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 TMD 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 TMD 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 TMD. If exposure to ambient conditions is too great, such as when the wick is too long or the TMD too far from the water surface, the wick may dry out before reaching the sensing portion of the TMD, and evaporative cooling will not be recorded.

3. **Place the FEWBT inside the chamber.** If you are using an instant reading TMD to make process adjustments, place the FEWBT 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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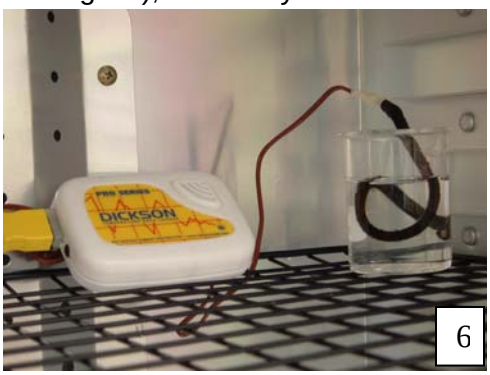

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4. **Record wet bulb temperature.** Establish a regular schedule of recording wet bulb temperature. Check water level in the vessel periodically, and also check the position of the wick. The portion of the wick above the water must remain moist for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

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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