Occasionally, Welch Allyn receives phone calls from SureTemp® and SureTemp® Plus customers questioning the proper method for verifying calibration of their thermometers. Of these customers, many have indicated that they are trying to or would like to use a water bath test. It is IMPERATIVE to note that the SureTemp and SureTemp Plus thermometers can only be tested in monitor mode, when being tested in a water bath.

There are a couple of reasons why the SureTemp and SureTemp Plus thermometers (as well as any other electronic thermometer that gives a reading in under 3-5 minutes) cannot be tested in their normal fast mode in a water bath.

1. The thermometers are electronic predictive thermometers that utilize a software algorithm to “predict” what the patient’s temperature would have been after 3-5 minutes. Most electronic predictive thermometers also have a monitor mode, which allows the thermometer to be used in a fashion similar to traditional glass mercury thermometers, where the thermometer can be left in place for 3-5 minutes to allow it to come to thermal equilibrium (or for the probe and the mouth to come to the same temperature) and give the patient’s “true” temperature.

2. A water bath test does not have the same rate of heat transfer to the probe as does a human mouth and the thermal recovery times for water versus human tissue are different.

3. Probe contact with the heat source is more constant when fully submerged and surrounded by water than when placed in a mouth that has various anatomical structures that have different levels of blood perfusion and biological activity and, therefore different levels of heat emissions. As a person breathes and as blood is pumped through the body, the heat transfer is more pulsatile than in a water bath.

To understand the differences between the human subject and a water bath, let’s look at the following example.

Assumptions:
- Probe cover = room temperature (approximately 70 °F)
- Human mouth = 98 °F
- Water bath = 98 °F

Human subject:
Heat energy moves from the tissue of the mouth that is touching the probe cover (MT) into the probe cover to bring thermal equilibrium between the probe cover and the mouth tissue. The tissue temperature begins to go down while the probe cover temperature begins to rise. The body restores the tissue with heat energy at some rate (R1). The ability of the tissue to heat up the probe cover depends on (R1) the rate that the body can restore heat energy into the tissue.

Water bath:
Heat energy moves from the water that is touching the probe cover (WT) into the probe cover to bring thermal equilibrium between the probe cover and the water. The water temperature (WT) begins to go down while the probe cover temperature begins to rise. The water bath restores the water (WT) with heat energy at some rate (R2). The ability of the water (WT) to heat up the probe cover depends on (R2) the rate that the bath can restore heat energy into water (WT).

Summary:
(R1) does not equal (R2) therefore the rate of thermal change, or the time to reach thermal equilibrium with the probe, is different for the bath and the mouth. This is the fundamental reason why Welch Allyn does not design their software by “training” thermometers in water baths. It is also why testing the thermometers in a water bath can only be done in monitor mode. In monitor mode, you are essentially allowing the thermometer the full time required (3-5 minutes) for the water bath and the probe to come to the same temperature. This is also why one should be suspicious of any predictive thermometer that gives good readings in the predictive mode in a water bath. Thermometers that perform well in water baths do not usually perform well in human subjects. Water baths basically don’t reflect what actually occurs in the mouth.
Proper method for testing calibration of the SureTemp and SureTemp Plus thermometers

1. Verify electronic calibration by using a Welch Allyn Calibration Verification Key. The part number for the appropriate Calibration Verification Key is 06137-000 for the SureTemp M679/678 and 06138-000 for the SureTemp Plus M690/692.

2. Verify the calibration of the probe by using a Welch Allyn Calibration Verification Test Device Model 9600 OR a stirred water bath. With both devices, the calibration of the probe must be tested in MONITOR mode. This will verify that the thermistor in the probe has not fallen out of calibration. If using the Model 9600, refer to the Model 9600 Operator's Manual for instructions on how to use. If using a stirred water bath, refer to the test protocol that follows.

M678/679 SureTemp and M690/692 SureTemp Plus Thermometer - Water Bath Test Protocol

TEST OBJECTIVE:
This test protocol is to help the customer to determine if M678/679 (SureTemp) and M690/692 thermometers have maintained their accuracy performance requirements by using the water bath technique.

TEST EQUIPMENT:
* A Precision Thermometer (which is used to monitor water bath temperature).
* Hart Scientific water bath (or equivalent) to be set at specified temperature (to be determined by customer).
* Welch Allyn SureTemp Thermometer(s).
* Welch Allyn Probe covers.
* Stop Watch.

TEST PROCEDURE:
The following table details the different parameters to be utilized to determine the accuracy performance of the M678/679 in MONITOR MODE within the operating environment and the water bath temperature range.

<table>
<thead>
<tr>
<th>Environmental Temp.</th>
<th>Water Bath Temp.</th>
<th>Number of units</th>
<th>Number of Temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>62 °F to 102 °F</td>
<td>94 °F to 108 °F</td>
<td>TBD by customer</td>
<td>TBD by customer</td>
</tr>
</tbody>
</table>

(Suggested temp: 70-75 °F)

Note: Water bath temperature to be monitored by a precision thermometer. Allow water bath to stabilize for at least 30 minutes prior to testing.
M678/679 SureTemp and M690/692 SureTemp Plus Thermometer - Water Bath Test

1. Record the serial number of each thermometer.
2. Pull the probe out of the storage well and wait until an audible tone is heard (symbol Orl to be displayed).
3. Place a probe cover onto the probe.
4. Place the probe with cover into the water bath.
5. After predict temperature is taken, press the MODE button for about two (2) seconds to change to MONITOR mode, shown by a letter “M” in the bottom right hand corner of the LCD on the M678/679 or by a symbol of a SNAIL in the upper right corner of the M690/692.
6. It is important to time the Monitor temperature, in step #5, for three minutes and record the temperature off the LCD before you remove the probe from the water bath.
7. Remove the probe from the water bath. Discard the probe cover.
8. Place the probe into the probe well.
9. Compare the MONITOR temperature to water bath temperature.