# THE DANGEROUS BIMETALLIC COIL THERMOMETER

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## Introduction

Is the cook really responsible when someone becomes ill with *E. coli* O157:H7 from an under-cooked hamburger, or is it the government? In this report, I will point out that it is our government, which tells us that the bimetallic coil thermometer can accurately measure the temperature of the thin, mixed foods such as hamburger and sausage, which are contaminated with pathogens in the center, when, in fact, it is scientifically false to believe that the bimetallic coil thermometer is an accurate measuring device for these foods.

## Background

The government-required food label (Figure 1) warns us that meat and poultry are contaminated and must be cooked thoroughly to make them safe to eat; the cook is identified, then, as the hazard controller. Then, it shows the image of a bimetallic coil thermometer to measure the food temperature. Obviously, this is the government-recommended thermometer for checking foods, including thin foods such as hamburgers, to be sure that they are adequately pasteurized. The fact is that this bimetallic coil thermometer is a highly inaccurate food temperature measuring devise. It also must be calibrated every time it is used, and calibration must be at 120ºF, not the government's 32ºF, because the inaccuracies in the coil must be equally divided between the top and bottom of the measurement range. (LeGault, 1999)

Figure 2 shows a cut-away image of the common bimetallic coil thermometer. It shows that the bimetallic coil, which measures temperature (colored red in the figure), stretches from a bit above the tip to 2 inches up the stem in this thermometer. To use this thermometer, the stem and coil must be inserted into the thin food (e.g., hamburger) so that the 2-inch measuring zone straddles the center cold spot in the food. With most thin foods, this is a very awkward temperature measuring process and beyond the capability of any home food preparer or cook in a foodservice operation. To use this thermometer, one needs advanced technical training. One must remove the hot food from the pan, hold it in a hot pad or mitt, and then, determine how to insert the tip through the edge into the middle of the food so that the 2-inch coil ends up fully contained in the cold middle of the food.

## Demonstration of the Problem

Figure 3 shows a 4-oz. hamburger from a local fast-food hamburger chain. This burger has been flattened in manufacturing to fill the bun, but that also makes it very thin. The stem of the bimetallic coil thermometer is $^{1}/_{8}$ inch in diameter. The burger is between ¼ and $^{3}/_{8}$ inch thick. The figure shows that, if a cook were to use this thermometer, he/she would have to hold the hamburger in the fingers and try to thread the thermometer in from the edge of the hamburger so that the coil would span the center of the hamburger (i.e., the cold spot). This is simply impossible when the stem is about the same thickness as the food.

Figure 4 shows a cooked hamburger made of ¼ lb. raw ground beef formed a little over 3 inches in diameter so that it would be thicker after cooking, simulating a home-cooked hamburger. When formed by hand, it was about ½ inch thick. After cooking, it was possible to put the thermometer into the hamburger from the edge. However, there are no marks on the stem of the thermometer, so there is no way to know where the sensing coil is in the hamburger. With a

bimetallic coil thermometer, it is impossible to know the correct center temperature, because one does not know the exact location of the bimetallic coil.

## Discussion and Conclusions

Over the years, I have done research on the bimetallic coil thermometer to show that the bimetallic coil in the thermometer can only measure average temperature for the length of the coil (Snyder, 1996; Snyder, 1999). Therefore, if the temperature is 100ºF at one end of the coil and 200ºF at the other end, the temperature reading would be 150ºF. This device cannot measure cold spots, which are about ½ inch in diameter, in thin foods such as hamburgers, chicken, fish, steaks, chops, casseroles, meatballs, shrimp, shish kabob, etc.

Another critical problem is that this device needs to be calibrated every time it is used, because the stem is easily twisted, and the thermometer is then out of calibration.

Finally, measuring thin foods with a bimetallic coil thermometer cannot be done with the food on a cooking surface. One needs to pick up the food, using a hot pad or some kind of heat protection, and hold it so that the thermometer can be threaded through the edge of the food and into the center. It takes at least a minute to measure the temperature of a thin food this way.

While the bimetallic coil thermometer is inexpensive—less than $2.00 when purchased wholesale—it is worthless if it does not give an accurate temperature measurement or is impractical to use. There are tip-sensitive, electronic thermistors and thermocouple thermometers that accurately measure thin food temperatures. I do not know why the government will not ban the use of the bimetallic coil thermometer, but perhaps it has provided misinformation for so many years about thermometers, it is afraid to give out the correct information. The industry has been put in the position to find out the truth on its own.

## Summary

The FDA- and USDA-recommended bimetallic coil thermometer is an inaccurate, awkward, and complicated device for measuring the temperature of the highly contaminated, government-inspected and approved, raw foods that cooks must pasteurize.

Over the last ten years, I have shown many FDA and USDA officials and Minnesota regulators how inaccurate the bimetallic coil thermometer is, yet, it is still identified by the government as an accurate thermometer to measure pasteurization of thin foods. It is unfair to blame cooks in the U.S. who fail to kill the pathogens in the food, if the government-recommended measuring devices are inaccurate and impractical. The government not only allows the food to be contaminated, it also fails to give correct temperature measurement information. Adequate thermometers are shown on the HITM website at: 1) http://www.hi-tm.com/Documents/Thermoms.html (a consumer paper about various types of thermometers) and 2) http://www.hi-tm.com (click side bar, Products and Equipment, then, Safe Food Temperature Measurement).

We will know that the government has done its "homework" when it changes the picture on the consumer warning label on contaminated food to a digital thermistor or, preferably, a thermocouple thermometer. Then, regulators must learn how to cook so that they can demonstrate to the home food preparer how to cook hamburgers to 150ºF for 1 minute / 155ºF for 15 seconds / 160ºF instant pasteurization. The correct thermometer will also prevent overcooking, because, if the food is overcooked, hazardous, carcinogenic products are formed.

Finally, all inspectors must be issued and taught thin-food pasteurization using micro-tipped thermocouple probes.

The government claims that it costs too much to change the picture of the bimetallic coil thermometer on the hazard warning label. The government needs to answer the question, "What of the cost and heartbreak when a child dies or needs a kidney transplant, due to the inability of food preparers to use the government-promoted bimetallic coil thermometer to check pasteurization temperatures of thin foods?"

References:
LeGault, S. 1999. Cooper Instrument Corporation. Personal communication.
Snyder, O.P. 1996. Limitations of bimetallic-coil thermometers in monitoring food safety in retail food operations. Dairy Food Environ. Sanit. 16(5):300-304.
Snyder, O.P. 1999. Food temperature variations along the stem of the bimetallic-coil thermometer. Dairy Food Environ. Sanit. 19(7):477-483.

**Figure 1. Ground beef label**

**Figure 2. Cut-away of bimetallic coil thermometer and ¼-pounder from fast-food chain**
**Hamburger dimensions:**
**4½-inch average diameter, ¼ inch thick**

**Figure 3. Trying to insert a bimetallic coil thermometer into the edge of a ¼-pounder from fast-food chain**
**Hamburger dimensions:**
**4½-inch average diameter, ¼ inch thick**

**Figure 4. Measuring temperature of a ¼-lb. hamburger, hand-molded with ground beef purchased at grocery store, with bimetallic coil thermometer**
**Hamburger dimensions:**
**3-inch diameter**
**½ to $^{5}/_{8}$ inch thick**