

# Use Air Circulation Fan to Reduce Temperature Distribution in Electric Smokers

## Part 3: A case study of temperature distribution when smoking salmon in a Bradley Smoker

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### Introduction

This is the Part 3 of a series temperature profile studies that we have performed in a Bradley electric smoker. The purpose of these studies is to find out the effectiveness of Auber's Air Circulation Fan kit in reducing the temperature distribution in electric smokers. In Part 1, we have demonstrated that there is a significant reduction on the temperature variation in a smoker when our circulation fan is running, either in an empty smoker or a smoker loaded with cardboard sheets or boxes. In Part 2, we have shown that how does the voltage supplied to the motor affect the fan speed and the temperature distribution in the smoker. In this part of study, real food was loaded in the smoker. We examined the effect of our CIRFAN kit on temperature distribution when salmon meat was smoked at 150°F.

### Equipment and Method

The details of the equipment and the method we used have been described in the Part 1 of our report. Only the differences in the equipment and methods is described here.

#### Equipment

In this study, totally 17 probes were used to monitor the temperature profile in the smoker. Comparing to the Part 1 of the study, only a wall-mount probe that was mounted in the center of the backwall right below the top rack (i.e., "3\_Wall\_Center") was removed from this study, all other probes were located and mounted the same way as before.

#### Method

The temperature profiles were recorded while two batches of salmon filet were smoked. Salmon meat was prepared as described in Part 2 of the study. In the first batch (test #1), two pieces of skinless salmon filet, weighed 4.35 pounds in total, were cut into 8 smaller pieces of similar size. Two pieces of salmon meat were arranged on each rack. In the second batch (test #2), one piece of skinless salmon filet, weighed 2.12 pounds, was cut into 4 smaller pieces of similar size. They were arranged as one piece on each rack. The pictures in Figure 1 shows how the salmon meat were arranged in the smoker. The smoker cabinet temperature was set at 150°F for each test.

In each smoking test, the smoker was first preheated to 120°F. Then salmon meat was loaded into the smoker. A Bradley Cold Smoke Adapter was used. The salmon was considered as done when the

internal food temperature reached 125°F. The picture in Figure 2 shows the smoked salmon from the Test #1.

During each cooking test, the voltage supplied to the fan motor was varied from 0 V to 12 V, and then to 24V to observe the effect of circulation fan on temperature distribution. Probe readings were only recorded after the voltage had been changed for at least 20 minutes and the smoker temperature had been stable on the set temperature (i.e., SV is 150°F).

In each test, the readings from all 17 probes were recorded. The average of all readings, standard deviation (SD), and the range of the data (i.e., the difference between the highest temperature and the lowest temperature) from all 17 probes were calculated to describe the temperature distribution in the smoker.



*Figure 1. In test #1 (left), 2 pieces of salmon meat were arranged on each rack. In test #2 (right), one piece of salmon meat was arranged on each rack.*



Figure 2. Finished smoked salmon.

## Results

The average temperature, standard deviation, and the range of the data of two cooking tests were summarized in the Table 1. In both tests, there is a big decrease in the standard deviation and the range of data as the voltage to the motor was increased from 0 V to 12 V. As the voltage to the motor increased from 12 V to 24 V, the standard deviation and the range of data decreased but not much. This trend can be seen in the plots in Figure 3.

Table 1. Temperature data from two cooking tests.

	Test #1 (8 pcs. salmon meat)			Test #2 (4 pcs. salmon meat)		
<b>Set Temperature (°F)</b>	150					
<b>Fan Voltage (V DC)</b>	0	12	24	0	12	24
<b>Average Temperature (°F)</b>	156.6	150.6	152.5	155.0	150.8	151.1
<b>Standard Deviation</b>	10.5	2.8	2.6	7.1	3.6	2.8
<b>Range of Data (°F)</b>	39	11	9	24	13	10

## Discussions

1) The effect of the circulation fan.

In both cooking tests we performed with salmon meat, as the circulation fan was turned on (equivalent to changing the power to the circulation fan was from 0 V to 12 V), there is a huge decrease in the standard deviation (SD) and the range of the data of temperature readings. Smaller standard deviation and smaller range of data means that the data set becomes a tighter group, and in our case, the

temperature in the smoker becomes more even. This is an indicator that our Air Circulation Fan is very effective at improving the temperature uniformity in a smoker. In contrast, when the voltage to the fan was changed from 12 V to 24 V, there is a small improvement on the SD and range of data. However, the result could be affected by factors such as the size of the smoker, the amount of food being loaded, or the smoking temperature, and etc. We speculate that in a bigger smoker, user can see more improvement on the temperature uniformity if the fan voltage was increased from 12 V to a higher voltage.

2) The Effect of load (simulated load vs real food).

The data from these two real cooking tests are compared with the data from Part 1 of the study, where temperature profile in empty smoker or a smoker loaded with cardboard sheets or boxes. The Table 2 shows the data from tests when the circulation fan was turn off (i.e., supplied 0 V to the fan), and the Table 3 shows the temperature distribution data when the circulation fan was turn on at 12 V.

Table 2. Comparing temperature profile data between a smoker loaded with real food and a smoker loaded with simulated load when the circulation fan was turned off.

	Test #1 (8 pcs salmon)	Test #2 (4 pcs salmon)	Empty Smoker	Evenly Loaded Cardboard Sheets	Random Loaded Cardboard Boxes
<b>Set Temperature (°F)</b>	150				
<b>Fan Voltage (V DC)</b>	0	0	0	0	0
<b>Average Temperature (°F)</b>	156.59	155.00	149.30	144.3	146.40
<b>Standard Deviation</b>	10.47	7.05	2.80	4.1	4.40
<b>Range of Data (°F)</b>	39	24	11	13	17

Table 3. Comparing temperature profile data between a smoker loaded with real food and a smoker loaded with simulated load when the circulation fan was turned on.

	Test #1 (8 pcs)	Test #2 (4 pcs)	Empty	Evenly Loaded Cardboard Sheets	Random Loaded Cardboard Boxes
<b>Set Temperature (°F)</b>	150				
<b>Fan Voltage (V DC)</b>	12	12	12	12	12
<b>Average Temperature (°F)</b>	150.59	150.82	150.90	149.9	150.60
<b>Standard Deviation</b>	2.76	3.57	3.30	2.2	1.80
<b>Range of Data (°F)</b>	11	13	14	8	6

We noticed two interesting facts:

A) When smoking real food without forced air circulation, there can be a big temperature variation in different spots in a smoker. The more food is loaded, the bigger the temperature variation.

Without circulation fan, the SD and the range of data from Test #1 (8 pcs salmon) are higher than Test #2 (4 pcs salmon), and they are both much higher than the results from an empty smoker. Similarly, the data from test with cardboard boxes are higher than the data from test with cardboard sheets, and they are both higher than the data from empty smoker. So, it appears that the temperature variation in the smoker becomes bigger as more load (either salmon meat or cardboard boxes) occupies more space in the smoker.

B) With the Air Circulation Fan running, not only the temperature uniformity is greatly improved, but also it further improves as more food is loaded in a smoker.

The temperature profile in a smoker loaded with more food (Test #1, 8 pcs salmon) was more uniform than the temperature profile in a less loaded smoker (Test #2, 4 pcs salmon). This observation is consistent with what we have seen in cardboard load simulations: the temperature profile from a smoker with more volume occupied by the load (cardboard boxes) was more uniform than the smoker with less load (cardboard sheets). These data suggest that if you use our Air Circulation Fan running, you can confidently load more food to your smoker knowing they will be cooked evenly.

## Conclusions

In summary, temperature at different spots of an electric smoke can have a huge variation, from 24°F to 39°F difference have been recorded when cooking salmon at 150°F. When forced air circulation is introduced, the maximum temperature difference is reduced to 13°F to 11°F. And with more food loaded in the smoker, the temperature become more uniform. Adding Auber's Air Circulation Fan (CIRFAN) to an electric smoker can make a big difference to the cooking process.

(END)

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