

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

## Part 1: The temperature distribution with circulation fan in a Bradley Smoker

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### Abstract

An air circulation fan kit (CIRFAN) was installed in a 4-rack Bradley Original Smoker, and 18 probes were installed in the smoker to monitor the 3-D temperature profile in the smoker. The effect of the circulation fan on the temperature distribution was studied under different conditions by varying the set temperature, adding or not adding objects to block the air flow, turning on or off the smoker generator, and opening or closing the top vent. The average temperature of all probes and the standard deviation were calculated. The temperature profile with and without Auber's circulation fan are compared. The circulation fan significantly improved the uniformity of the heat distribution in the smoker under all conditions.

### Introduction

This is the Part 1 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.

Most of home-use electric smokers depend on natural convection (i.e., gravity convection) to distribute heat inside a smoker. A common issue with these smokers is that heat is not evenly distributed inside a smoker and the problem gets worse when food is loaded in the smoker. Food loaded in a smoker not only block the radiant heat from the heater but also restrict the air flow inside a smoker. When food is cooked at a relative low temperature, for example, smoking salmon at 150°F, the temperature of the top rack can be more than 20°F lower than that of the bottom rack. A 20°F difference could be a big problem because the cooking time needed for cooking at 140°F is much longer than the time needed at 160°F. To deal with this issue, people either have to re-arrange the salmon pieces in the middle of the cooking, or have to take out salmon pieces from different shelf at different time.

Introducing forced air convection inside the smoker can help reduce the temperature distribution. However, forced air convection is not readily available on smokers for home-use yet. Many enthusiastic owners of electric smokers had tried to add circulation fans to their smokers. But effectiveness of this kind of modifications have not been carefully studied. After we explored and tested nearly all the available options, we developed our Air Circulation Fan Kit (part number: CIRFAN) to address this issue.

In this study, we performed a series of tests to demonstrate how much improvement can be achieved by adding our circulation fan to a traditional gravity-convection smoker.

## Equipment and Method

### Equipment

A 4-rack Bradley Original Smoker was used in this study. As the smoker had been used before, all walls inside were in dark brown color, which represented the typical heat reflection condition in home smokers.

All probes used in this study had Platinum (PT1000, Class A) sensing elements. Probes were calibrated with the controller/thermometers together on a Fluke 9100 dry-well calibrator. The reading accuracy was within  $\pm 1^\circ\text{F}$  accuracy in the testing temperature range.

Totally 18 probes were used in this study. On the second rack (rack #2) from the bottom, a free-hanging probe (part number: WS-SENSOR17) was clipped to the center by a probe-clip (part number: Pclip). It was used for controlling the temperature of the smoker cabin.

On rack #1, #2, and #4, five probes were mounted on each rack: one probe was clipped at the center and four probes at the corners. The picture and the 3-D image in Figure 1 show probes' locations. The probes mounted at corners were Auber's miniature probes (part number: WS-SENSOR22), which were 2 mm in diameter and 20 mm long. They were mounted vertically at the intersection of the second wires from their nearest two sides, i.e., they were 2.75" (70 mm) from the side wall and 2" (50 mm) from the front wall or the back wall. This is to ensure probes installed at the corners were vertically aligned. At the center of each rack, Auber's free-hanging probe (part number: WS-SENSOR17) were mounted horizontally by a probe-clip (part number: Pclip).

On rack #3, only a free-hanging probe (part number: WS-SENSOR17) were clipped at its center by a probe-clip. No probes were mounted at the corners.

Each probe is named by its rack number and its relative location in the smoker. For example, "1\_Center" is the probe on the center of the #1 rack, and "2\_Back\_Left" is the probe at the back-left corner of the #2 rack. The left side or the right side of the smoker is defined as the same way we are facing the smoker and looking into it.

In the space between rack #3 and rack #4, two wall-mount probes were installed. A wall-mount probe (part number: WS-SENSOR11) was installed on the centerline of the back-wall of the smoker, just underneath the rack #4 (i.e., the top rack from the top). Another wall-mount probe was mounted on the right half of the backwall, just underneath the rack #4, and about 4" from the side-wall on the right. The temperature readings from these two probes were also monitored and recorded to see if their readings were close to the readings from the probes on the center. These two probes were named as "3\_Wall\_Center" and "3\_Wall\_Right".

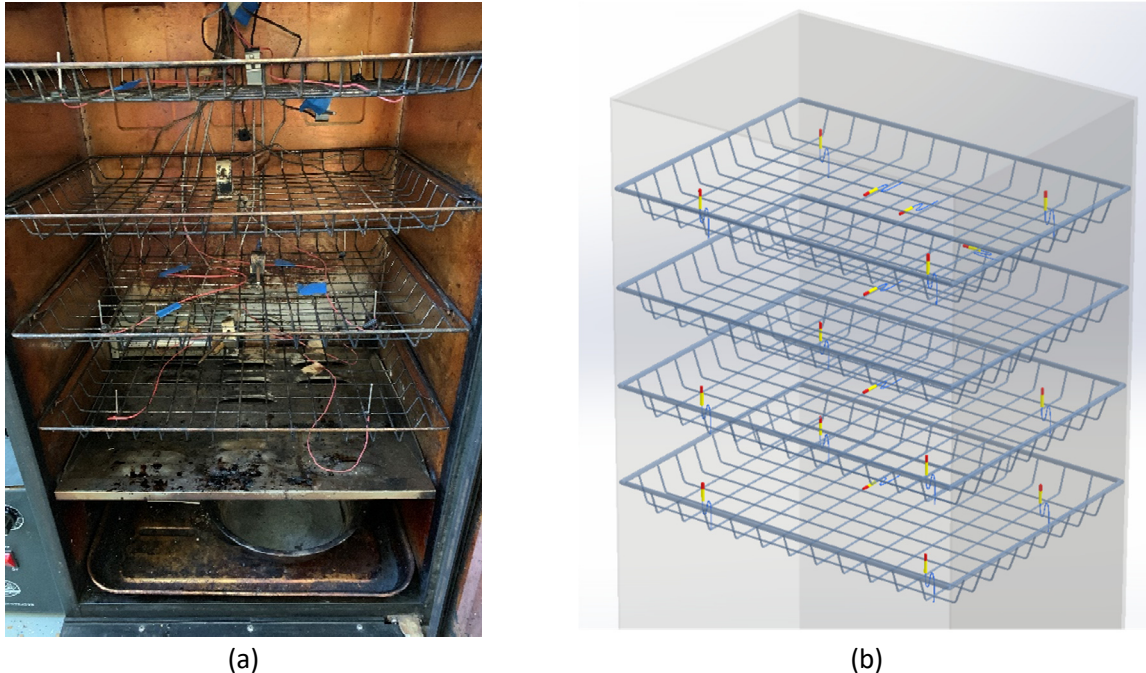


Figure 1. (a), totally 18 temperature probes were installed on a 4-rack Bradley Original Smoker. (b), the locations of installed probes are marked in a 3-D drawing, where each probe is represented by a yellow rod and the red tip indicates where the probe tip is.

An Auber WSD-1500H controller was used with the center probe on the second rack (i.e., probe 2\_Center) to control the smoker cabin temperature. The rest of the probes were read either by Auber's WSD-1500H or by SYL-2615, both of which were PID controllers with Wi-Fi capability. These controllers were used as thermometers to record temperature readings from these probes. All temperature readings were taken at least 30 minutes after both the reading of the control probe and the power output of the controller were stabilized at the set point.

## Method

The temperature profile in a smoker oven with or without the circulation fan was tested under various conditions: 1) at setpoint of 150°F or at 225°F; 2) with the smoke-generator turned on or turned off; 3) with the top venting hole completely open or completely closed, 4) in an empty smoker or in a smoker with blocks of cardboard sheets or cardboard boxes to block the airflow.

The temperature profile in an empty smoker can give us a general idea of whether a circulation fan would help reduce the temperature variance in a smoker, but it doesn't necessarily represent the situation under a real cooking process. The cardboard sheets and cardboard boxes were used to simulate food chunks in two different real cooking situations: A) we used 28 pieces of cardboard sheets that were cut to the same size (6" x 1.5") to simulate the salmon strips. 7 pieces of cardboard were placed in each rack. They are evenly distributed on the rack with gaps of similar width in between. In order to avoid leaving a big gap around the corner sensor, a half inch hole is punched to the cardboard

that was placed at the corner. B) In another simulation, we used a few cardboard boxes (randomly selected and arranged on each shelf) to simulate food chunks of different size.

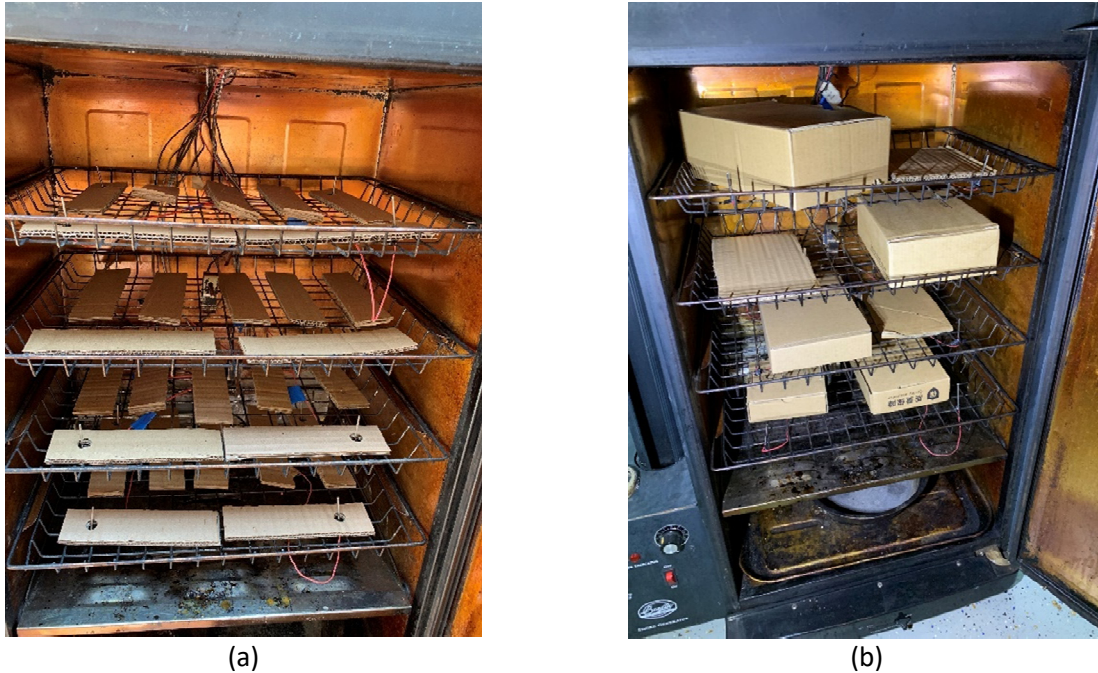


Figure 2. (a), 28 pieces of cardboard sheet were arranged evenly in all racks in the smoker. (b), cardboard boxes and cardboard sheet of different size that were selected and randomly placed in the smoker to simulate different food chunks.

## Results

Temperature profiles in the smoker in varies conditions were tested extensively and the tests were grouped into four sections. Data are summarized in a table in each section. In each table, the testing conditions are given in the first a few rows, temperature readings are listed in the middle, and the statistics of the data are given in the bottom rows. The probe “2\_Center” is denoted by an asterisk sign, indicating it is the temperature control probe.

Under each testing condition, we did one test with the circulation fan turned off and one test with the circulation fan turned on. Data from these two tests are listed side-by-side in for easier comparison.

The data from each test is listed in a column. In each column, the highest reading is marked in red color, and the lowest reading is mark in blue color. The data average, standard deviation, and the range of the data (i.e., the span between the minimum reading and the maximum reading) are calculated and listed at the bottom of each table. The average, standard deviation, and range of the center probes are also calculated.

### 1) Empty Smoker

In this group of tests, no cardboard sheets or boxes were used to simulate food chunks in a smoker. The top vent is closed down to leave ¼” gap so all the sensor wires can go through. Temperature profile of an empty smoker were recorded at two different Set Values (150°F and 225°F), with the smoke generator turn on or off, and with the circulation fan turn on or turn off.

Table 1. Temperature profile recorded in tests performed in an empty smoker.

Empty smoker									
Conditions	Set Temperature (°F)	150				225			
	Circulation Fan	off	on	off	on	off	on	off	on
	Smoke Generator	off	off	on	on	off	off	on	on
Probe Readings (°F)	1_Center	148	150	149	150	225	225	228	225
	2_Center *	150	150	150	150	225	225	225	225
	3_Center	151	151	151	151	226	226	228	225
	4_Center	154	151	151	149	234	226	234	225
	1_Back-Left	151	155	153	152	242	228	234	228
	1_Back-Right	152	148	148	145	240	223	242	222
	1_Front-Left	144	146	161	152	219	218	221	219
	1_Front-Right	144	149	147	147	220	222	221	222
	2_Back-Left	153	160	153	153	235	239	228	238
	2_Back-Right	148	148	148	145	229	220	231	220
	2_Front-Left	147	149	159	151	223	223	224	222
	2_Front-Right	147	151	149	149	224	225	225	224
	4_Back-Left	150	154	154	154	232	231	230	232
	4_Back-Right	150	150	150	148	229	227	237	226
	4_Front-Left	149	151	153	150	227	228	227	223
	4_Front-Right	150	151	150	148	227	224	230	224
	3_Wall_Center	155	148	148	146	240	221	236	221
	3_Wall_Right	151	151	149	149	228	225	234	225
	Statistics (overall)	Average	149.3	150.9	151.6	149.6	228.6	225.6	229.1
Standard Deviation		2.8	3.3	3.9	2.6	6.6	4.8	5.7	4.6
Range		11	14	14	9	23	21	21	19
Statistics (center)	Average	150.8	150.5	150.3	150	227.5	225.5	228.8	225
	Standard Deviation	2.5	0.6	1	0.8	4.4	0.6	3.8	0
	Range	6	1	2	2	9	1	9	0



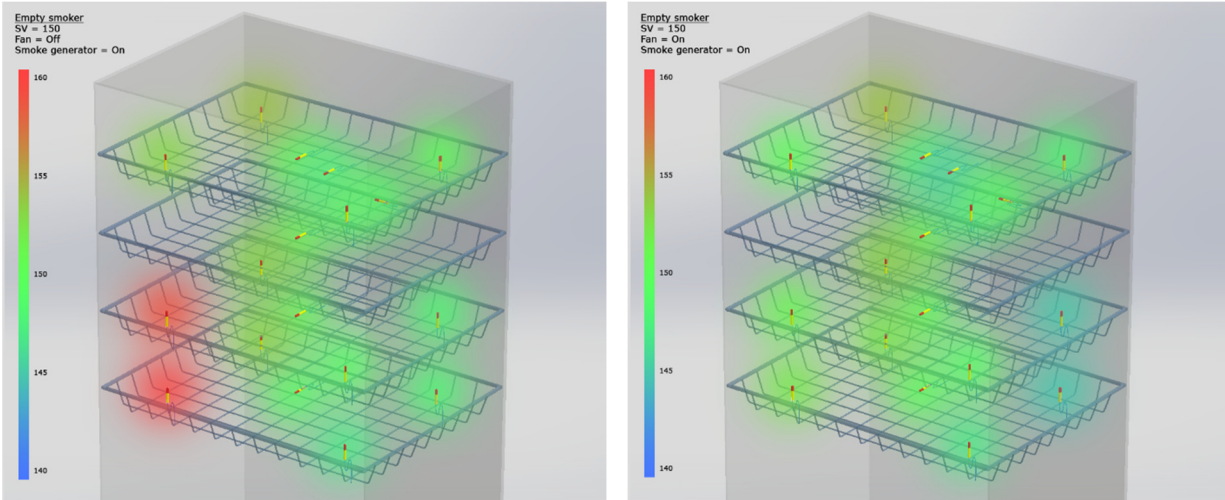


Figure 3. Animated image of the temperature distribution in an empty smoker where the SV is set at 150°F and with the smoke generator turned on. The color map indicates how much the probe readings deviates from the SV. Hotter area is in red color, and cooler area is in blue color. The data is from the 3rd and the 4th columns in Table 1. Left: the circulation fan was turned off. Right: the circulation fan was turned on.

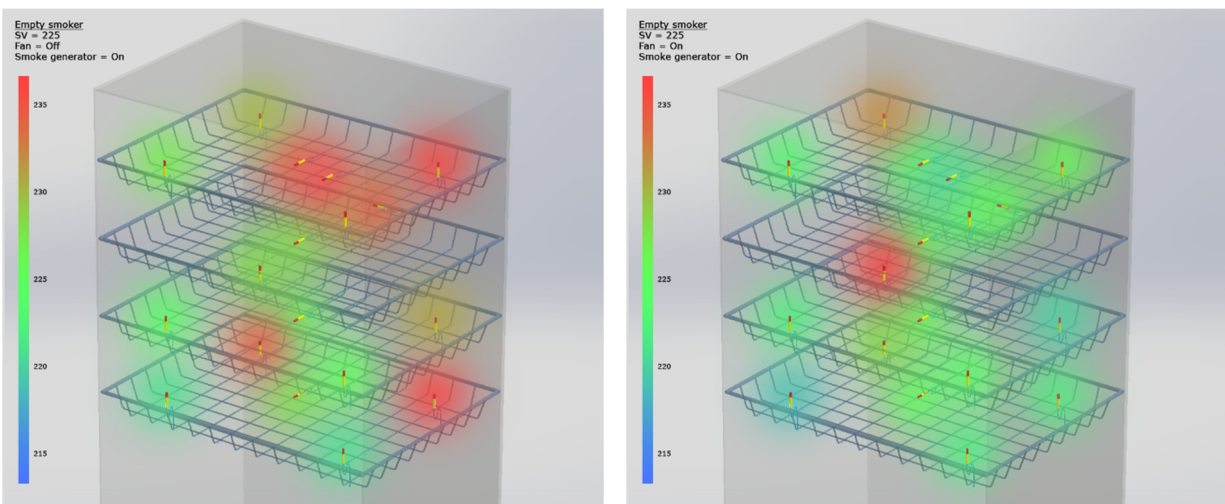


Figure 4. Animated image of the temperature distribution in an empty smoker where the SV is set at 225°F and with the smoke generator turned on. The color map indicates how much the probe readings deviates from the SV. Hotter area is in red color, and cooler area is in blue color. The data is from the last two columns in Table 1. Left: the circulation fan was turned off. Right: the circulation fan was turned on.

## 2) Smoker with evenly arranged load

In this group of tests, cardboard sheets of the same size were placed on all racks in to simulate salmon strips in a smoker. The top vent is closed down to leave ¼” gap so all the sensor wires can go through.

Temperature profile of the smoker were recorded at two different Set Values (150°F and 225°F), with the smoke generator turn on or off, and with the circulation fan turn on or turn off.

Table 2. Temperature profile of the smoker with evenly arrange load.

Smoker loaded with 28 pcs of cardboard sheets									
Conditions	Set Temperature (°F)	150				225			
	Circulation Fan	off	on	off	on	off	on	off	on
	Smoke Generator	off	off	on	on	off	off	on	on
Probe Readings (°F)	1_Center	150	150	154	153	227	226	232	227
	2_Center *	150	150	150	150	225	225	225	225
	3_Center	151	153	153	153	226	228	226	228
	4_Center	148	151	148	150	223	228	225	226
	1_Back-Left	145	150	165	155	224	228	242	229
	1_Back-Right	149	146	145	145	224	224	230	220
	1_Front-Left	138	149	156	152	207	225	218	227
	1_Front-Right	141	149	145	150	211	224	213	224
	2_Back-Left	142	152	159	154	215	231	234	231
	2_Back-Right	142	145	146	144	216	219	217	218
	2_Front-Left	141	151	151	152	210	227	218	226
	2_Front-Right	141	150	146	151	213	226	216	226
	4_Back-Left	144	154	156	156	217	235	223	235
	4_Back-Right	143	150	145	149	215	227	216	225
	4_Front-Left	141	149	146	151	210	225	216	225
	4_Front-Right	142	150	144	149	211	225	215	224
	3_Wall_Center	151	153	152	151	232	231	237	233
	3_Wall_Right	146	149	148	149	222	227	220	225
Statistics (overall)	Average	144.3	149.9	150.6	150.9	217.1	226.4	222.9	226
	Standard Deviation	4.1	2.2	6.1	3.2	6.7	3.4	8.3	3.9
	Range	13	8	21	11	25	16	29	17
Statistics (center)	Average	149.8	151	151.3	151.5	225.3	226.8	227	226.5
	Standard Deviation	1.3	1.4	2.8	1.7	1.7	1.5	3.4	1.3
	Range	3	3	6	3	4	3	7	3

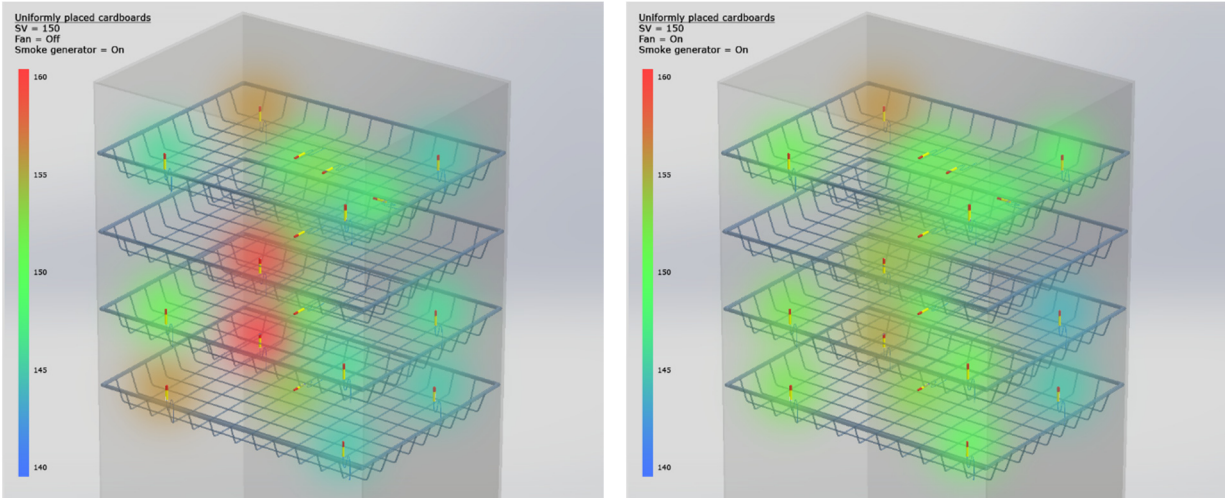


Figure 5. Animated image of the temperature distribution in a smoker loaded with equal-sized cardboard sheets. The SV was set at 150°F and the smoke generator was turned on. The color map indicates how much the probe readings deviates from the SV. Hotter area is in red color, and cooler area is in blue color. The data is from the 3rd and the 4th columns in Table 2. Left: circulation fan was turned off. Right: circulation fan was turned on.

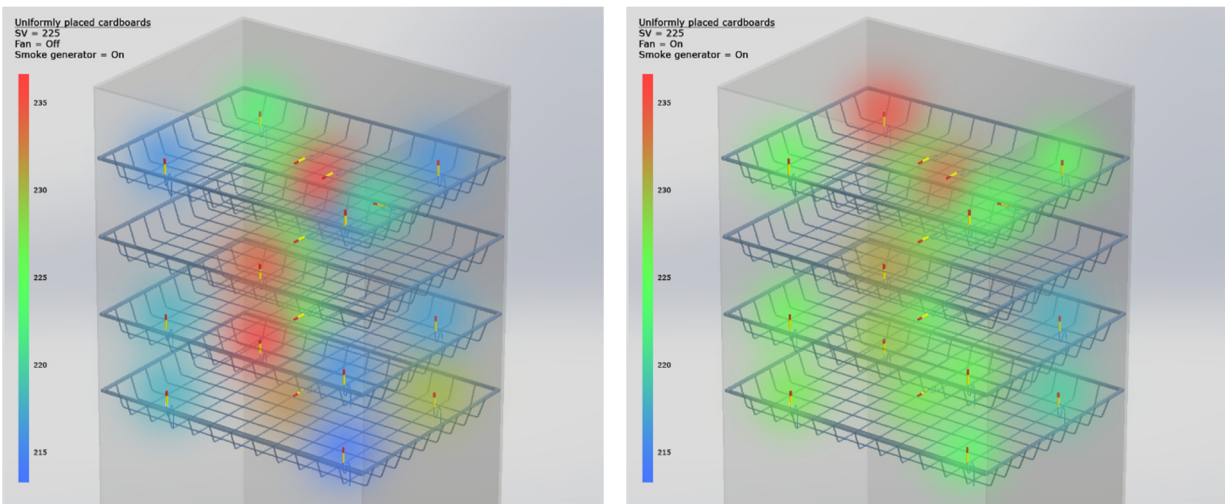


Figure 6. Animated image of the temperature distribution in a smoker loaded with equal-sized cardboard sheets. The SV was set at 225°F and the smoke generator was turned on. The color map indicates how much the probe readings deviates from the SV. Hotter area is in red color, and cooler area is in blue color. The data is from the last two columns in Table 2. Left: circulation fan was turned off. Right: circulation fan was turned on.

### 3) Randomly placed load

In this group of tests, we used different shaped and different size cardboard sheets and boxes to simulating a situation where different size and type of food is cooked together in a smoker. Cardboard sheets and boxes were randomly placed on racks in the smoker. The top vent is closed down to leave ¼"



gap so all the sensor wires can go through. Temperature profile of the smoker were recorded at two different Set Values (150°F and 225°F), with the circulation fan turn on or turn off, and with the smoke generator turn on or off.

Table 3. Temperature profile of the randomly loaded smoker.

Smoker loaded with randomly placed cardboard boxes										
Conditions	Set Temperature (°F)	150				225				
	Circulation Fan	off	on	off	on	off	on	off	on	
	Smoke Generator	off	off	on	on	off	off	on	on	
Probe Readings (°F)	1_Center	148	150	151	152	218	228	231	229	
	2_Center *	150	150	150	150	225	225	225	225	
	3_Center	145	153	149	151	216	230	228	228	
	4_Center	149	151	147	150	224	227	226	226	
	1_Back-Left	150	149	144	153	215	227	260	229	
	1_Back-Right	152	151	154	153	238	231	233	229	
	1_Front-Left	142	148	144	149	209	223	220	224	
	1_Front-Right	140	147	151	155	212	222	215	223	
	2_Back-Left	153	151	144	153	222	232	254	231	
	2_Back-Right	146	147	153	146	226	223	216	223	
	2_Front-Left	141	150	144	151	206	228	220	227	
	2_Front-Right	143	149	149	149	215	224	218	224	
	4_Back-Left	147	153	141	155	215	235	246	225	
	4_Back-Right	144	151	146	150	223	231	222	229	
	4_Front-Left	141	150	137	150	208	226	218	227	
	4_Front-Right	144	150	141	149	216	226	217	225	
	3_Wall_Center	149	149	144	148	219	226	229	225	
	3_Wall_Right	145	149	148	148	226	225	220	224	
	Statistics (overall)	Average	145.9	150	146.6	151	218	227.4	228.1	227
		Standard Deviation	4.1	1.8	4.8	2.4	8.1	3.7	13.8	2.5
Range		13	6	17	9	30	13	45	8	
Statistics (center)	Average	148	151	149.3	150.8	220.8	227.5	227.5	227	
	Standard Deviation	2.2	1.4	1.7	1	4.4	2.1	2.6	1.8	
	Range	5	3	4	2	9	5	6	4	

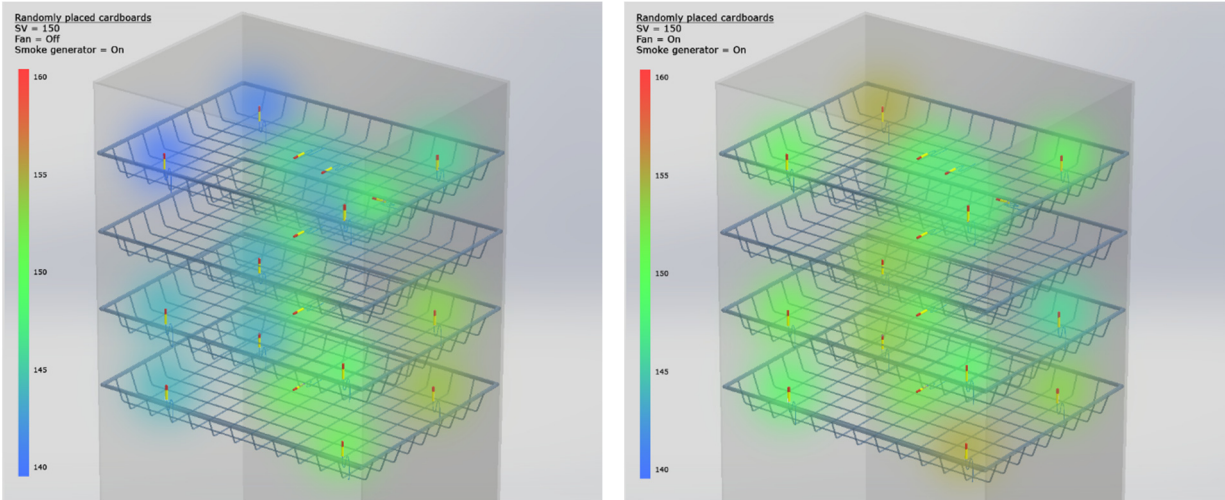


Figure 5. Animated image of the temperature distribution in a smoker loaded with cardboard boxes and sheets of various size. The SV was set at 150°F and the smoke generator was turned on. The color map indicates how much the probe readings deviates from the SV. Hotter area is in red color, and cooler area is in blue color. The data is from the 3rd and the 4th columns in Table 3. Left: circulation fan was turned off. Right: circulation fan was turned on.

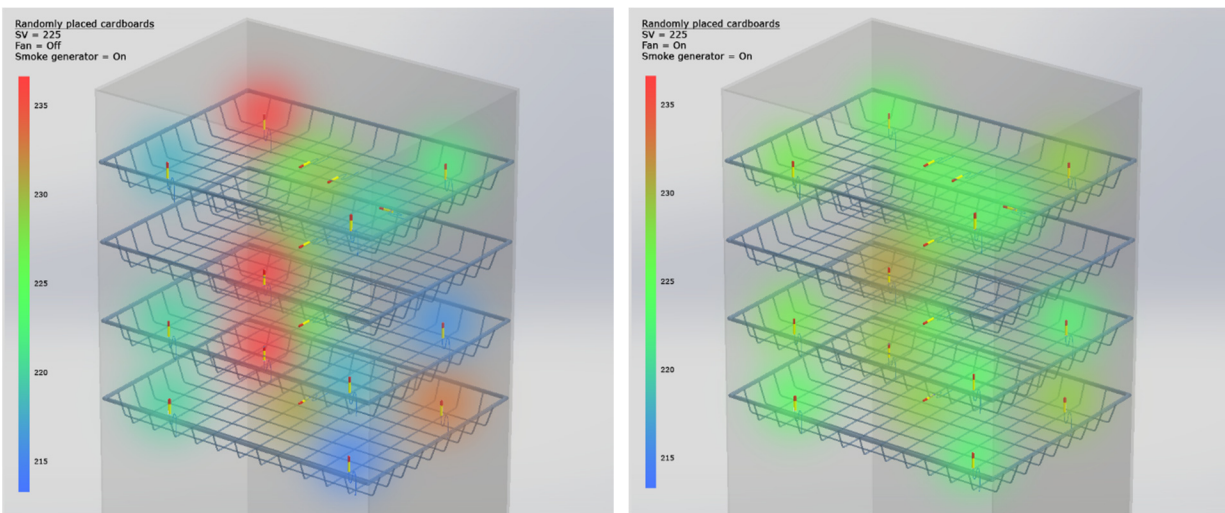


Figure 6. Animated image of the temperature distribution in a smoker loaded with cardboard boxes and sheets of various size. The SV was set at 225°F and the smoke generator was turned on. The color map indicates how much the probe readings deviates from the SV. Hotter area is in red color, and cooler area is in blue color. The data is from the last two columns in Table 3. Left: circulation fan was turned off. Right: circulation fan was turned on.

#### 4) Top vent open

This group of tests was performed to see if opening the top vent would affect the temperature profile in the smoker. The top vent was either fully open or closed down to leave only a ¼” wide gap, which is to

let sensor wires to run through. We kept the load at the same position as in the group 3. Tests were performed at two different Set Values (150°F and 225°F) and the circulation fan was turned on or turned off. The smoke generator was kept on in all tests run at 225°F, but it turned off in all tests run at 150°F to reduce its effect on temperature-control at low temperature range.

Table 4. Temperature profile when the top vent was changed.

Randomly placed cardboard boxes									
Conditions	Set Temperature (°F)	150				225			
	Circulation Fan	off	on	off	on	off	on	off	on
	Smoke Generator	off	off	off	off	on	on	on	on
	Vent	1/4"	1/4"	open	open	1/4"	1/4"	open	open
Probe Readings (°F)	1_Center	146	151	148	150	229	225	228	224
	2_Center *	150	150	150	150	225	225	225	225
	3_Center	144	153	145	153	225	225	226	225
	4_Center	149	151	149	151	230	225	231	225
	1_Back-Left	148	150	150	149	238	226	237	224
	1_Back-Right	157	151	152	151	223	221	224	221
	1_Front-Left	143	148	142	148	221	220	220	218
	1_Front-Right	143	148	140	147	220	221	219	220
	2_Back-Left	151	153	153	151	243	230	243	229
	2_Back-Right	150	148	146	147	223	218	223	218
	2_Front-Left	140	151	141	150	222	222	223	222
	2_Front-Right	144	149	143	149	224	224	224	224
	4_Back-Left	144	154	147	153	240	233	241	232
	4_Back-Right	148	152	144	151	225	226	225	226
	4_Front-Left	141	150	141	150	229	227	231	227
	4_Front-Right	145	151	144	150	224	222	224	222
	3_Wall_Center	146	149	149	149	233	221	237	221
	3_Wall_Right	149	150	145	149	226	224	225	225
Statistics (overall)	Average	146.4	150.6	145.9	150	227.6	224.4	227.8	223.9
	Standard Deviation	4.4	1.8	4.1	1.8	7	3.8	7.1	3.7
	Range	17	6	13	6	22	15	24	14
Statistics (center)	Average	147.3	151.3	148.0	151.0	227.3	225.0	227.5	224.8
	Standard Deviation	2.8	1.3	2.2	1.4	2.6	0.0	2.6	0.5
	Range	6	3	5	3	5	0	6	1

## Discussions

### The Effect of the Air Circulation Fan

The results shown in Table 1 indicates that the temperature in an empty smoker was fairly uniform even without a circulation fan. Turning on the circulation fan can improve the evenness of the temperature distribution.

The data in Table 2 shows that temperature profile became less uniform when the smoker was loaded with evenly arranged cardboard sheets on all racks while the circulation fan was turned off. The standard deviation increased by 30% to 50% compare to the standard deviations in an empty smoker. After the circulation fan was turned on, the standard deviation was greatly reduced by nearly 50%. The range of the temperature data also decreased by 30% to 50%.

The data in Table 3 shows that when the smoker that was loaded with randomly placed cardboard sheets and cardboard boxes of various size, the temperature distribution became even higher with no circulation fan. With the circulation fan turned on, the temperature distribution is significantly reduced. The standard deviations were reduced by 50% or even more of what it was without the circulation fan. The temperature range was also reduced by 50% or 66%.

### The Effect of Loads in a smoker

We have an interesting observation in the standard deviations (SD) and the range of the data. In situations where circulation fan was turned off, SD and the range of the data in an empty smoker are usually the lowest among all three loading conditions (i.e., empty, loaded with cardboard sheets, and loaded with cardboard boxes), and the SD and range of data in a smoker loaded with cardboard boxes of different size are usually the highest among all three conditions. In contrast, in the situations where the circulation fan was turned on, the SD and data range of an empty smoker are usually the highest among all three loading conditions, and the SD and data range of a smoker loaded with cardboard boxes are usually the lowest.

In a smoker without forced air circulation, randomly arrange cardboard boxes restrain the natural air flow and therefore increase the temperature distribution. Whereas in a smoker with force-air circulation, the restraint on the air-flow by the cardboard boxes is counter-acted by the circulation fan. In the meantime, we speculate that because of a significant portion of the volume in the smoker is occupied by the boxes, there is much less air that needs to be heated and circulated, making it easier to reach an even temperature distribution.

### The Effect of the Top Vent

During our tests, opening or closing the top vent didn't show obvious effect on the temperature profile in the smoker. The average and the standard deviation remain about the same between open or closed top vent. It is worth pointing out that our tests were done in balmy summer days. In cold windy days, the effect of opening the top vent could be different.

### The Location of The Wall-Mount Sensor

Traditionally we mount a wall-mount probe, on the center line of the backwall and just underneath the top rack, as the control probe. In this study, two "wall-mount" probes are installed, "3\_Wall\_Center" and "3\_Wall\_Right". The readings from these two probes were compared to the Set Value (SV). The



relative difference (RD) between the wall-mount probe (T) and the average reading ( $M_a$ ) was calculated using the formula below:

$$RD = (T - M_a).$$

This value indicates how much the probe reading deviates from the average temperature of the smoker.

The Table 5 summarized the difference of the wall-mount probe on the backwall and the wall-mount probe on the sidewall. In the majority of tests, the wall-mount probe on the right side of the wall is closer to the smoker’s average temperature. However, the air flow pattern in the smoker does affect the heat distribution in the smoker. As we can see in the data from group #3 in the Table 4, the wall-mount sensor on the back appear to be closer to the average. But in general, the wall-mount sensor on the right is closer to the smoker average. Therefore, instead of mount the wall-mount probe to the backwall of the smoker, we suggest the wall mount sensor to be mounted on the sidewall on the right just under the top rack (rack #4).

Table 5. The temperature reading difference between wall-mount probes and the average temperature in the smoker.

Difference					
Conditions	Set Temperature (°F)	150		225	
		Circulation Fan	on	on	on
	Smoke Generator	off	on	off	on
#1, Empty	3_Wall_Center	-2.9	-3.6	-4.6	-4
	3_Wall_Right	0.1	-0.6	-0.6	0
#2, Sheets	3_Wall_Center	3.1	0.1	4.6	7
	3_Wall_Right	-0.9	-1.9	0.6	-1
#3, Boxes	3_Wall_Center	-1	-3	-1.4	-1.5
	3_Wall_Right	-1	-3	-2.4	-2.5

### Heat Produced by the Smoker Generator

To find out the effect of the smoke generator on the temperature profile in the smoker, we looked at the data from section #1, #2, and #3, and we compared the data between tests when the smoke generator was turned off and when it was turned on. Without the circulation fan, in most of the cases when the smoke generator was turned on (no smoking bisquettes was used), the average temperature increased, and the standard deviation as well as the range of the data increased comparing to the conditions where smoke generator was turned off. This indicates that turning on the smoke generator can bring up the average temperature and reduce the temperature uniformity in the smoker. However, when the circulation fan was turned on under each testing condition, the SD and the range of the data were greatly reduced.

In warm days (70°F or higher), smoking at 150°F can be difficult because turning on the smoke generator alone can contribute 125 watts power, that is approximately ¼ of the 500 watts element comes with the Bradley Smoker. And this part of power is not regulated by our PID controller. The heater in the smoke generator alone can raise the temperature by almost 70°F. The heat from burning bisquettes can increase the temperature by another 20°F. When smoking at a temperature that is relatively close to the ambient temperature, the heat contributed by the smoke generator is significant. In addition, because the heater of the smoke generator is located at the bottom-center, turning it on or off can change the temperature profile in the smoker. In this situation, the Bradley's cold smoking adaptor should be used. The other solution is to run it in the night when temperature is lower, keep the top vent at the maximum opening. Run the smoker generator at very beginning for 1 hour and then turn it off.

## Conclusion

The temperature profile in a Bradley Original 4-rack electric smoker was tested extensively under varies conditions. This study demonstrates that a smoker that relies on natural convection (gravity convection) can achieve a reasonable even temperature distribution when it is empty. But once the smoker is loaded with food, the temperature profile becomes uneven.

By adding a circulation fan to the smoker, forced-air-convection was introduced to the smoker. With the circulation fan turned on, the standard deviation and the range of the temperature data are significantly reduced, which means the temperature profile in the smoker has become more uniform. An interesting fact is that, with the circulation fan running, the air temperature in the smoker becomes more even when more food in loaded to the smoker.

If a wall-mount probe is going to be used as the temperature control probe, it is suggested to avoid the hot air stream from the circulation fan, and mount it to the other side of the backwall.

The heat from the burner of smoker generator is not regulated by Auber's PID controller. It can increase the average temperature inside the smoker and change the temperature profile. When smoking at low temperature (e.g., 150°F for salmon), we suggest you use a "cold smoking adapter" when the ambient temperature is above 70°F.

Our data shows that leaving the top vent open or close doesn't have a significant effect on the temperature profile in the smoker in warm days that we performed tests.

The result of circulation fan in this report could be applied to other brand of smokers when the size of the smoker and mounting location are similar. This study did not include the fan speed and fan size effect to the temperature profile. That will be presented on separate report.

(END)

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