# TEMPERATURE ACCURACY OF AN ELECTRIC BELT GRILL, A FORCED-AIR CONVECTION OVEN, AND AN ELECTRIC BROILER

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## Summary

We evaluated the temperature variation of an electric belt grill set at four temperatures, a forced-air convection oven set at three temperatures, and an electric broiler that has no temperature control. After finding that the actual temperatures of the electric belt grill and the forced-air convection oven were higher than the targeted temperature, we used regression techniques to correct for the temperature biases of both cooking methods. The forced-air convection oven was very precise when the doors were kept closed, as was the electric belt grill after adjustments were made. Temperature of the electric broiler was not consistent across surface positions or among replications. We suggest that when used for cooking experiments, each meat-cooking instrument be validated for temperature and corrected when necessary. This will improve cooking consistency and related results among various instruments and research institutions.

(Key Words: Cooking, Temperature, Methods, Meat.)

## Introduction

Many researchers consider actual oven temperatures to be constant with the thermostat settings, with little or no variation. Cooking methods used for research should achieve the desired target temperature and maintain that temperature for the duration of the cooking process so that measures such as cooking loss and shear force values will be reliable and repeatable. Cooking methods for research have often utilized electric broilers, forced-air convection ovens, or more recently, electric belt grills. We evaluated the temperature variation and accuracy of a single example of each of these instruments.

## Experimental Procedures

We monitored the temperature at 18 locations (9 for each platen) on an electric belt grill (TBG-60 Magigrill, MagiKitch'n Inc., Quakertown, PA) set at 160, 242, 325, and 408°F; 18 locations in a forced-air convection oven (Blodgett, model DFG-102 CH3, G.S. Blodgett Co., Burlington, VT) set at 225, 325, and 425°F; and 12 locations on an electric broiler (Open Hearth electric broiler, Farberware, Yonkers, NY). The electric belt grill cooks by moving a product between two heated platens using conveyor belts. In this conduction type of heating, a product is heated from the top and bottom simultaneously. Unloaded temperature of each oven was monitored using copper-constantan thermocouples (Omega Engineering, Stamford, CT) connected to a Doric temperature recorder (Vas Engineering, San Francisco, CA). The electric belt grill and forced-air convection oven were monitored for two replications, and the electric broiler was monitored for three. Linear regression analysis was used to correct for temperature bias in the electric belt grill and forced-air convection oven.

## Results and Discussion

The electric belt grill was 8, 13, 20, and 26°F high when set at 160, 242, 325 and 408°F, respectively. The forced-air convection oven produced temperatures 5, 4.5, and 1.4°F higher than it was supposed to at settings of 225, 325, and 425°F. Linear regression equations developed to correct for the temperature bias of the electric belt grill and forced-air convection cooking methods are reported in Table 1. Based on the regression equations, the set points of the electric belt grill and forced-air convection oven were adjusted to obtain the desired temperatures. Results before and after adjustment are shown in Table 2 for the electric belt grill and Table 3 for the forced-air convection oven. Temperature variation from point to point was relatively high for the electric belt grill (Table 2) but was small for the forced-air convection oven (Table 3). The electric broiler had a mean operating temperature of 245.1°F; but varied from 194.4°F to 292.8°F depending upon location. These data emphasize that temperature for each cooking instrument used for research should be validated and corrected when necessary. These quality control measures will assure accurate reporting of procedures and reduce variation in cooking and related results (cooking loss, shear force value) among instruments and research institutions.

**Table 1. Linear Regression Equations to Correct for Temperature Bias of Cooking Methods**

| Cooking Method | Intercept | Slope | $R^2$ | P > F |
|---|---|---|---|---|
| Electric belt grill (top platen) | 4.523 | .932 | .99 | .001 |
| Electric belt grill (bottom platen) | 6.050 | .921 | .99 | .001 |
| Forced-air convection oven | 10.342 | .979 | .99 | .001 |

**Table 2. Mean Top and Bottom Electric Belt Grill Platen Temperatures Before and After Temperature Adjustment (°F)**

| Targeted Temperature | Top Platen Unadjusted | Bottom Platen Unadjusted | Range Unadjusted | Top Platen Adjusted | Bottom Platen Adjusted | Range Adjusted |
|---|---|---|---|---|---|---|
| 160°F | 168.3 | 168.3 | 164.4-171.1 | 160.0 | 160.5 | 156.3-163.9 |
| 242°F | 254.3 | 256.5 | 247.1-263.5 | 243.9 | 245.5 | 236.3-252.2 |
| 325°F | 343.4 | 346.1 | 332.0-356.9 | 325.9 | 326.7 | 312.1-334.7 |
| 408°F | 432.7 | 435.7 | 419.2-451.8 | 410.2 | 410.5 | 396.1-425.1 |

**Table 3. Mean Temperature Before and After Temperature Adjustment for the Forced-Air Convection Oven (°F)**

| Targeted temperature | Unadjusted | Range | Adjusted | Range |
|---|---|---|---|---|
| 225°F | 219.9 | 219.3-220.7 | 225.0 | 222.9-225.8 |
| 325°F | 320.4 | 320.2-323.0 | 324.9 | 323.3-326.3 |
| 425°F | 423.9 | 422.2-426.3 | 425.3 | 423.6-427.2 |