



Challenges of Lateral Heat

By Ed Baldwin and Jim Glidden

In the commercial baking industry, tunnel and tray ovens fired by ribbon burners are very common. These ovens consist of a conveyor which carries the product along the length of the baking chamber, passing over a series of burners throughout the oven. The burners are grouped into zones, with each zone individually controlled to a specific temperature set-point.

While a standard oven control system is designed to control the heat along the *length* of the oven, there is another consideration, and that is the heat distribution across the *width* of the oven. This reference to heat distribution across the width of the oven is commonly referred to as **lateral heat**.

While ovens are manufactured in a variety of sizes and capacities, typical widths are 10' – 13'. While these widths are an excellent combination of size and capacity, they are large enough that the lateral heat distribution can actually vary from one side of the oven to the other. These variations can be caused by a number of factors. Due to their straight-through design, tunnel ovens can be especially prone to air currents travelling their length, causing a cooling effect on one side. In addition, environmental factors, such as being located adjacent to a cold outer wall, can impact the lateral heat distribution. Also, improper pan loading can give the appearance of lateral heat problems due to uneven air circulation around the pans.

Poor or missing insulation on the side of the oven can change the way heat is distributed. While this would, at first glance, seem to cause cold spots in the oven, it can also cause hot spots. Many ovens have air recirculation systems that pull air from the top of the oven and distribute it through a set of tubes back into the baking chamber. The air is transferred from the recirculation fans at the top of the oven to the distribution tubes via ductwork located on the side of the oven. If there is poor or missing insulation between the ductwork and the side of the oven, excessive heat can be transferred from the ductwork to the baking chamber along that side, raising the temperature and creating hot spots.

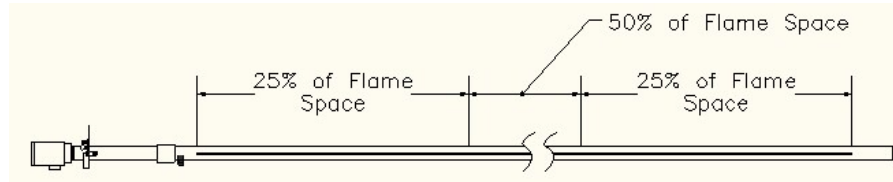
Early in the history of oven manufacturing, it became very evident that it was desirable to have a method to adjust the lateral heat distribution inside the oven. To that end, the multi-zone ribbon burner was invented. A typical multi-zone ribbon burner has three separate sections that can each be individually adjusted for proportional firing rate. The typical set-up is: a **N**ear section (25% of the total burner), an **I**ntermediate section (50% of the total burner) and an **O**pposite (far) section (the remaining 25% of the total burner). Each section can be independently adjusted via a metering device typically located in the burner head.

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Typical lateral heat adjuster head and burner divided into three zones



These laterally adjustable burners have proven to be very effective in compensating for various factors that cause the “normal” lateral heat distribution in an oven to be uneven. However, there are a number of factors that should be considered when utilizing multi-zone adjustable burners. First, is the ignition system – in some cases the “hot spot” in the oven is on the near side (where the ignitor is located). At first glance, the obvious solution would seem to be to turn down the near side adjustment. A bakery should be **EXTREMELY** cautious in doing this. A modern DSI ignition system works by first igniting the gas, and then sensing the flame to continue operation of the burner. If the near side is turned down too far, the burner will have extreme difficulty lighting, especially at low fire. There is also a significant chance that, even if the burner lights, the burner control module will fail to sense the flame due to insufficient flame strength.

A common problem with lateral heat distribution occurs when burners are turned down below 8”-10” w.c. as the control system reduces the heat in the zone to control the temperature. At low firing rates, any lateral heat definition set up by the baker to produce an even product bake is completely lost. This is a result of the burner construction. The three sections within the burner are defined by a set of internal tubes, one for each section. With this construction design, there is **NO** baffling or other divider between the burner sections. The lateral heat definition is strictly a function of local pressure differential at or near that section’s inner tube. Consequently, when a burner is turned down to a low firing rate, the back pressure of the fuel flowing out through the ribbon overcomes the local pressure differential and causes the burner to be completely equal across its entire length – essentially negating any lateral heat definition that was set up by the baker.

The proper solution for this issue is to implement a control system that enables the burners to function at a higher firing rate which maintains lateral heat definition, while still controlling the heat in the zone. This is typically accomplished via burner cutback – turning individual burners off, allowing the remaining burners to carry the heat load while operating at a higher firing rate. However, care should be taken choosing the cutback control system, as not all are created equal. Many systems that implement burner cutback do so based strictly on temperature deviation. The result is that the burners still modulate down to extremely low firing rates before turning burners off. An ideal control system, such as that designed by Banner-Day, utilizes a strategy that maintains higher firing rates while still controlling zone temperatures typically within +/- 2 deg. F.

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One last, and frequently overlooked, problem affecting lateral heat is the viewports on the burner headplates. When these are left open, they provide a path for unintended air flow creating undesired heat movement inside the oven. Burner viewport covers should always be closed.

In summary, lateral heat is a critical issue in proper oven operation and quality control. Care should be taken to eliminate and/or control as many sources of influence on lateral heat distribution as possible. This includes plant ventilation systems that create a draft in the oven, negative building pressure differentials and oven insulation. The choice of a proper control system is also critically important in maintaining any lateral heat definition that has been set up.

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