

Section 6: Heating Systems

The 3 Types of Heating Sources for Industrial Ovens

There are primarily 3 different types of heating sources used in industrial heating systems. These are most often referred to as direct gas fired, indirect gas fired and electric coil heaters. Direct fired heaters are generally more efficient and less expensive as there are fewer components in these systems. Although this is true, there are instances when an indirect gas fired heater or an electric heater is a better choice. Understanding the advantages of each system will aid you in understanding which system to use.

Top 3 Heating Sources for Industrial Ovens

Direct Gas Fired Heaters

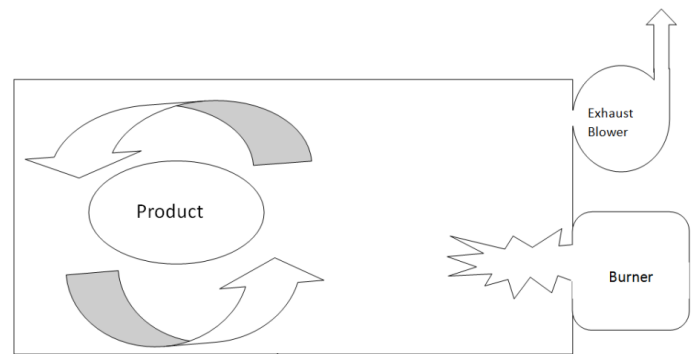
A direct fired heater uses natural gas, propane, butane or other gas mixtures to create an open flame for heating. The gas burners are designed to operate in a fresh flowing airstream. Gas is fed directly to the burner and the fresh airstream provides the needed oxygen for combustion.

Direct Gas Fired Heater Advantages

- **Efficient** - since it is firing an open flame; almost all of the fuel is converted to heat in the chamber. These types of burners are rated at 92% efficiency.
- **Smaller footprint** – since these burners do not use heat exchangers, they are able to produce more heat in a smaller footprint.
- **Flexibility** – Direct fire burners have a higher turn down ratio. This allows for better temperature control and a larger temperature range than indirect burners.

Direct Gas Fired Heater Disadvantages

- **Combustion** – combustion byproducts are introduced into the air stream. In certain applications, these byproducts could affect the users product.
- **Explosion Panels** – since the byproducts are introduced into the work stream of the oven/furnace, extra cost and design input is needed to design explosion relief into the product equipment or specific explosion relief panels in the equipment.
- **Exhaust** – a powered exhaust is needed in the oven/furnace to remove byproducts and water from the combustion process.
- **Purge time** – Before starting or re-firing a direct gas burner, there is a wait time (purge time) where a specific volume of air in the system needs to be purged



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Indirect Gas Fired Heaters

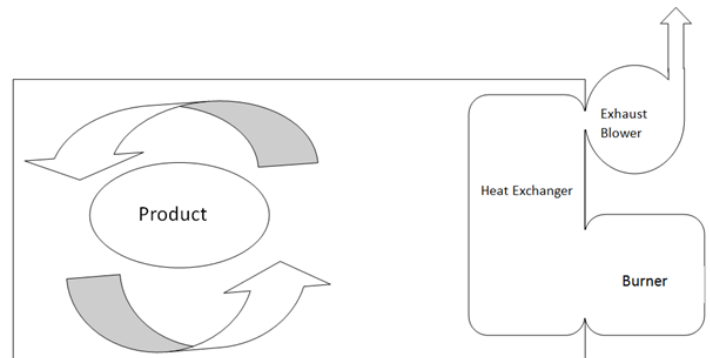
An indirect heater used in industrial ovens and furnaces is a gas burner that fires directly into a heat exchanger. When using indirect heaters, the process air is heated by passing over the heat exchanger. For gas burners, the combustion byproducts remain in the heat exchanger and are expelled out the flue which eliminates them from the process air stream.

Indirect Gas Fired Heater Benefits

- **Product of Combustion** – Products of combustion are eliminated from the process air stream
- **Exhaust** – Powered exhausts are no longer needed required to expel combustion byproducts
- **Explosion Proof** – as the combustion is not happening inside the oven or furnace, there is not a need to design the system with explosion panels, the tube or exchanger would typically be built of an explosion proof construction.

Indirect Gas Burner Disadvantages

- **Low Efficiency** – The heat loss from the flue and inefficiencies in the heat exchanger result in efficiencies of 65% to 80% depending on the type of burner and heat exchanger.
- **Higher Cost** – Utilizing heat exchangers increases the cost over direct fired burners as the build materials can get costly at higher temperatures.
- **Space** – Indirect systems are physically larger as a result of packaging a heat exchanger into the equipment.
- **Temperature control** – The heat exchanger tends to make holding a tight temperature range harder as it tends to overshoot or undershoot a couple of degrees, due the lag of heat transfer in the heat exchanger.



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Electric Heaters

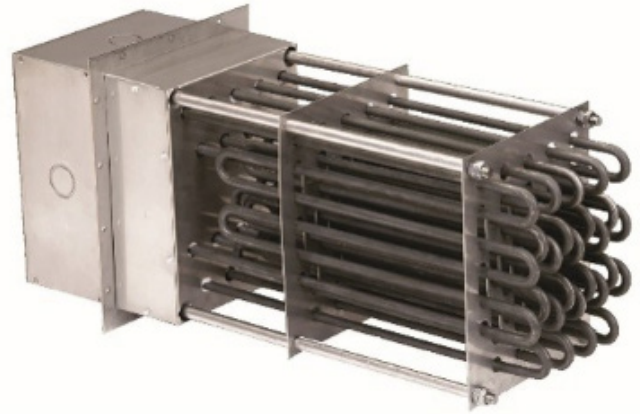
An electric heater converts electrical energy into heat through resistance. This heat spreads out in every direction. Electric heaters are typically placed in the ductwork so that the air moving over them can be controlled. The air can either be recirculated or fresh. Recirculated air is more commonly used to reduce power consumption and the heater size. Fresh air is used when ventilation of the process is necessary.

Electric Heater Benefits

- **Simple** - Electric heaters are simple to install, control and have the least number of components.
- **No Exhaust** - Powered exhaust and introduction of fresh air are eliminated. Other than what may be required to remove process gasses or to balance the equipment.
- **Product of Combustion** - Eliminates the worry of products of combustion affecting the end user's product.
- **Turn Down** - Can turn to zero percent out, allows running at very low temperatures.

Electric Coil Disadvantages

- **Operating cost** - Electricity costs in most parts of the world are higher than that of propane or natural gas heating
- **Large heaters** - Larger heating requirements increase the upfront costs to the end user as a result of providing a larger electrical service to the machine as well as the increased costs of the electrical cable and circuit costs.
- **Footprint** - Packaging heaters throughout the oven and furnace can increase its size compared to gas fired. Watt density of the coils can also drive a larger physical size.



We look forward to partnering with you.
Contact ITS for a product proposal
sales@itsllcusa.com · 414.672.7700

Visit our website at internationalthermalsystems.com

