The purpose of radiant tube combustion is to apply fuel-fired heating, with the products of combustion isolated and separated from the furnace atmosphere. This will allow control of the furnace atmosphere to protect or modify the surface of the material being heated. When utilizing radiant tube combustion, attention must be paid to the following factors:

- Thermal efficiency of the combustion process
- Environmental emissions from the combustion process
- Effect of the combustion process on the life of the radiant tube
- Reliability of the combustion equipment itself

APPLICATIONS
- Continuous Annealing Lines (CAL)
- Continuous Galvanizing Line (CGL)
- Continuous Silicon Lines
- Heat Treating Systems
- Roller Hearth Systems
- Aluminium Process Furnaces

FEATURES
- Flexible “Retention Nozzle” burner design
- Engineered NOx Emissions
- Custom Engineered design
- Laboratory verification of designs
- Maximum combustion efficiency
- Tube temperature uniformity
- Rugged experience-based construction
- 15,000 burners in operation
- 55 years applications experience
- Family of burner types available to suit application
- World-wide manufacturing and service network
Bloom has been building radiant tube burners for over 55 years, with more than 15,000 radiant tube burners in operation. We were instrumental in the application of the design incorporating an internal recuperator inserted within the radiant tube. This long experience coupled with our R&D capabilities and engineering programs of continuous design improvement, puts us in a position to be the burner supplier of choice for radiant tube combustion applications.

**EFFICIENCY**

Burner combustion efficiency is achieved, first, by transferring as much of the heat, from the combustion process, directly into the process as possible. Tube configuration is a large factor in this heat transfer with the longer W and recirculating (double P) tubes allowing a greater heat transfer vs the shorter U and straight thru tubes. Burner efficiency is further enhanced by recovering the waste sensible heat from the products of combustion and preheating the incoming combustion air. Recuperation and regeneration are the two primary techniques for recovering the sensible heat. Regenerative heat recovery offers a greater efficiency but at a greater capital cost than recuperation. Overall system efficiency is further enhanced by utilizing the remaining sensible heat, in the products of combustion, in accompanying system processes, such as heating rinse water. Bloom has the capability to engineer temperature of the products of combustion to optimize the integration with the rest of the system.

**EMISSIONS**

Within the restricted combustion environment of a radiant tube, NOx emissions can be relatively high. The paradox of NOx relative to combustion efficiency is that the higher the combustion air temperature preheat (ie better efficiency) the disproportionately higher is the emissions of NOx. Bloom uses its “Retention Nozzle” design, air-staged combustion and exclusive type “F” exhaust gas recirculation technique to reduce NOx. Recirculating tubes (such as P and double P) can be inherently low in NOx. Bloom’s “retention Nozzle” and air-staged combustion techniques further reduce these emissions. With these multiple techniques, NOx emissions do not need to be predicted from guesswork. The emissions can be engineered to create the proper levels to meet a given requirement.

**TYPE “F” ULTRA LOW NOx**

U.S. Patent No. 5,775,317

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**REGENERATIVE BURNER**

**RECUPERATIVE BURNER**

**COLD AIR BURNER**
A unique and fundamental feature of a typical Bloom radiant tube burner design is the “Retention Nozzle” fuel nozzle. Quiet stable operation and uniform tube temperatures are obtained by utilizing this patented nozzle design. The nozzle distributes the air uniformly around the (center) gas stream while creating a partial vacuum between the two streams. This allows for a controlled mixing of the fuel and air, promoting flame stability and safe, reliable burner operation.

For proper radiant tube life, the maximum operating temperature at any point along the tube must not exceed the design working temperature for the tube material. Tube life can thus be predicted, to a large extent, by its temperature uniformity. A measure of temperature uniformity is expressed as the Hot Spot Over Average (HOSA) temperature. The HSOA is the difference between the peak high (or low) tube temperature and the average tube operating temperature within the operating range of the burner. A low HSOA is an indication of low peak tube temperature. A low HSOA will cause the tube to have minimal thermal stresses, enhancing tube life. A low HSOA will also create a better heating quality within the furnace. Due to the design flexibility of Bloom’s “Retention Nozzle”, the burner flame can be engineered to a customer’s specific radiant tube, achieving minimal HSOA.
In the application of the burners, a variety of control techniques can be employed. The final choice would depend on such considerations as: system configuration, fuels utilized, environmental considerations and product mix. Typical alternative considerations include:
- Suction, Forced Draft or Push/Pull
- High/Low, On/Off or Modulating
- Mass Flow, Pressure Balance or Pulse Firing

**RELIABILITY**

Bloom burners are designed for continuous operation in demanding environments. The burners are manufactured from heavy alloy castings. Bloom burner designs are based on 50 years experience and backed up by the latest design techniques including computational fluid dynamics (CFD). Laboratory testing ensures the optimization of the specific application. Additionally, customer feedback and laboratory-based research provides a source of continuous improvement of the fundamental designs. All of these characteristics are what to expect from an engineering based company. As such, reliability is not an unknown but an engineered process to achieve the maximum service life. Service lives in-excess of twenty-five years have been documented.

**LABORATORY CAPABILITIES**

Bloom operates one of the largest and most advanced private, applied combustion labs in North America. The lab occupies 20,000 ft\(^2\) (2,000 M\(^2\)). It has twenty fully instrumented furnaces of varying configurations to suit the range of industrial combustion applications. Additionally, the lab has a dedicated staff of engineers and technicians. Lab activities include: new burner development, burner upgrades, production performance testing and emissions verification. Bloom’s computational fluid dynamics (CFD) capabilities are fully integrated into the laboratory activities.
### Radiant Tube Types
- **A** U tube
- **B** W tube
- **C** Straight thru
- **C** Single ended
- **D** P tube
- **E** Double P tube

### Piping Configuration
- **A** Suction (pull)
- **B** Forced draft (push)
- **C** Push/pull

### Control
- **A** Modulating high/low
- **B** Modulating high/off
- **C** Pulse high/low
- **D** Pulse on/off
- **E** Tempered flame

### Burner Ignition
- **A** Glow pilot
- **B** Lance pilot
- **C** Direct spark ignition

### Fuels
- **A** Natural gas
- **B** Coke oven gas
- **C** Propane
- **D** Butane
- **F** Any mixed gas above 176 Btu/Ft³ (HHV), (6.9 Mj/nM³) (HHV)
- **E** #2 fuel oil (nominally 20% excess air is required)

### Tube Diameter
- 3in (76mm) to 10in (254MM) ID

### Operating Temperature Range
- 400°F (200°C) to 1950°F (1065°C)

### Flame Monitoring
- **A** U/V detector
- **B** Flame rod

### RADIANT TUBE BURNER MODELS
Today our customers can choose from the following burner types as best fits their applications:

- **2300** Cold air, forced draft
- **2310** Type “R” Cold air, suction
- **2320** Recuperated, suction and push-pull *
- **2350** Recuperated, forced draft *
- **2370** Type “F” Ultra low NOx *
- **2301** Single ended tube, recuperated
- **2390** Regenerative
- **2450** Recuperative P
- **2460** Recuperative double P
- **2470** Regenerative double P

*Type “L”
Improved recuperated enhancement available as option

#Air Staged – Available as low NOx option

**CAPABILITIES**

- Quiet, stable operation across a wide range of parameters
- Exclusive “Retention Nozzle”
- Easy conversion of older designs to low NOx operation
- Easy conversion of existing design to multi-fuel operation
- 3” ID tubes and larger Rugged cast/machined alloy construction
- Operating temperatures up to 1950°F (1065°C)
- Operating efficiencies up to 80% (LHV)
# BURNER SELECTION TABLE TYPICAL (Natural Gas Fuel)

<table>
<thead>
<tr>
<th>Burner Model</th>
<th>Type</th>
<th>Available Heat (LHV)</th>
<th>NOx</th>
<th>Piping Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2301</td>
<td>Recuperated</td>
<td>55-60</td>
<td>Low</td>
<td>Push/Pull</td>
</tr>
<tr>
<td>2300</td>
<td>Cold Air</td>
<td>39-46</td>
<td>Low</td>
<td>Forced Draft</td>
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<tr>
<td>2310</td>
<td>Cold Air</td>
<td>39-46</td>
<td>Low</td>
<td>Suction</td>
</tr>
<tr>
<td>2320</td>
<td>Recuperated</td>
<td>61-66</td>
<td>Low</td>
<td>Suction, Push/Pull</td>
</tr>
<tr>
<td>2320-Air Staged</td>
<td>Recuperated</td>
<td>61-66</td>
<td>Very Low</td>
<td>Suction, Push/Pull</td>
</tr>
<tr>
<td>2320-L</td>
<td>Recuperated</td>
<td>68-77</td>
<td>Low</td>
<td>Suction, Push/Pull</td>
</tr>
<tr>
<td>2320-L, Air Staged</td>
<td>Recuperated</td>
<td>68-77</td>
<td>Very Low</td>
<td>Suction, Push/Pull</td>
</tr>
<tr>
<td>2350</td>
<td>Recuperated</td>
<td>61-66</td>
<td>Low</td>
<td>Forced Draft</td>
</tr>
<tr>
<td>2350-Air Staged</td>
<td>Recuperated</td>
<td>61-66</td>
<td>Very Low</td>
<td>Forced Draft</td>
</tr>
<tr>
<td>2350-L</td>
<td>Recuperated</td>
<td>68-77</td>
<td>Low</td>
<td>Forced Draft</td>
</tr>
<tr>
<td>2350-L, Air Staged</td>
<td>Recuperated</td>
<td>68-77</td>
<td>Very Low</td>
<td>Forced Draft</td>
</tr>
<tr>
<td>2370</td>
<td>Recuperated</td>
<td>61-66</td>
<td>Ultra-Low</td>
<td>Push/Pull or F-D</td>
</tr>
<tr>
<td>2370-L</td>
<td>Recuperated</td>
<td>68-77</td>
<td>Ultra-Low</td>
<td>Push/Pull or F-D</td>
</tr>
<tr>
<td>2390</td>
<td>Regenerative</td>
<td>77-83</td>
<td>Ultra-Low</td>
<td>Push/Pull</td>
</tr>
<tr>
<td>2450-P</td>
<td>Recuperated</td>
<td>61-66</td>
<td>Ultra-Low</td>
<td>Push/Pull or F-D</td>
</tr>
<tr>
<td>2460-PP</td>
<td>Recuperated</td>
<td>63-73</td>
<td>Ultra-Low</td>
<td>Push/Pull or F-D</td>
</tr>
<tr>
<td>2470-PP</td>
<td>Regenerative</td>
<td>77-82</td>
<td>Ultra-Low</td>
<td>Push/Pull</td>
</tr>
</tbody>
</table>

For your specific application, a Bloom engineer can assist with the selection process.