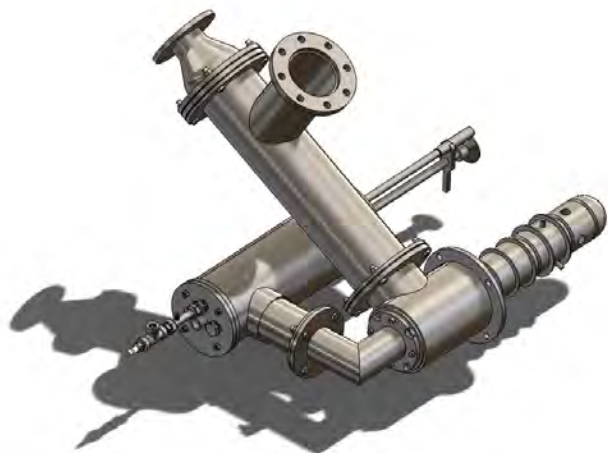


# 2370 Series

2370 <sup>1</sup>Type 'F' & Type 'FL' Ultra Low NOx Recuperative Radiant Tube Burner

**Bloomengineering**



## APPLICATIONS

- Annealing Furnaces
- Galvanizing Furnaces
- Silicon Lines
- Heat Treating

## FEATURES

- Rugged construction
- Standard material suitable for exhaust gas temperatures up to 760°C (1400°F)
- Low NOx air staged design available

## CAPABILITIES

- Quiet stable operation
- Very high efficiency
- Uniform tube temperature
- Dual fuel (gas and oil) operation available
- Suitable for 127 mm (5") through 203 mm (8") and larger I.D. 'U' Tubes and 'W' tubes

<sup>1</sup>U.S. Patent Number 5,775,317 Recuperative Radiant Tube with Hot Side Vitiation

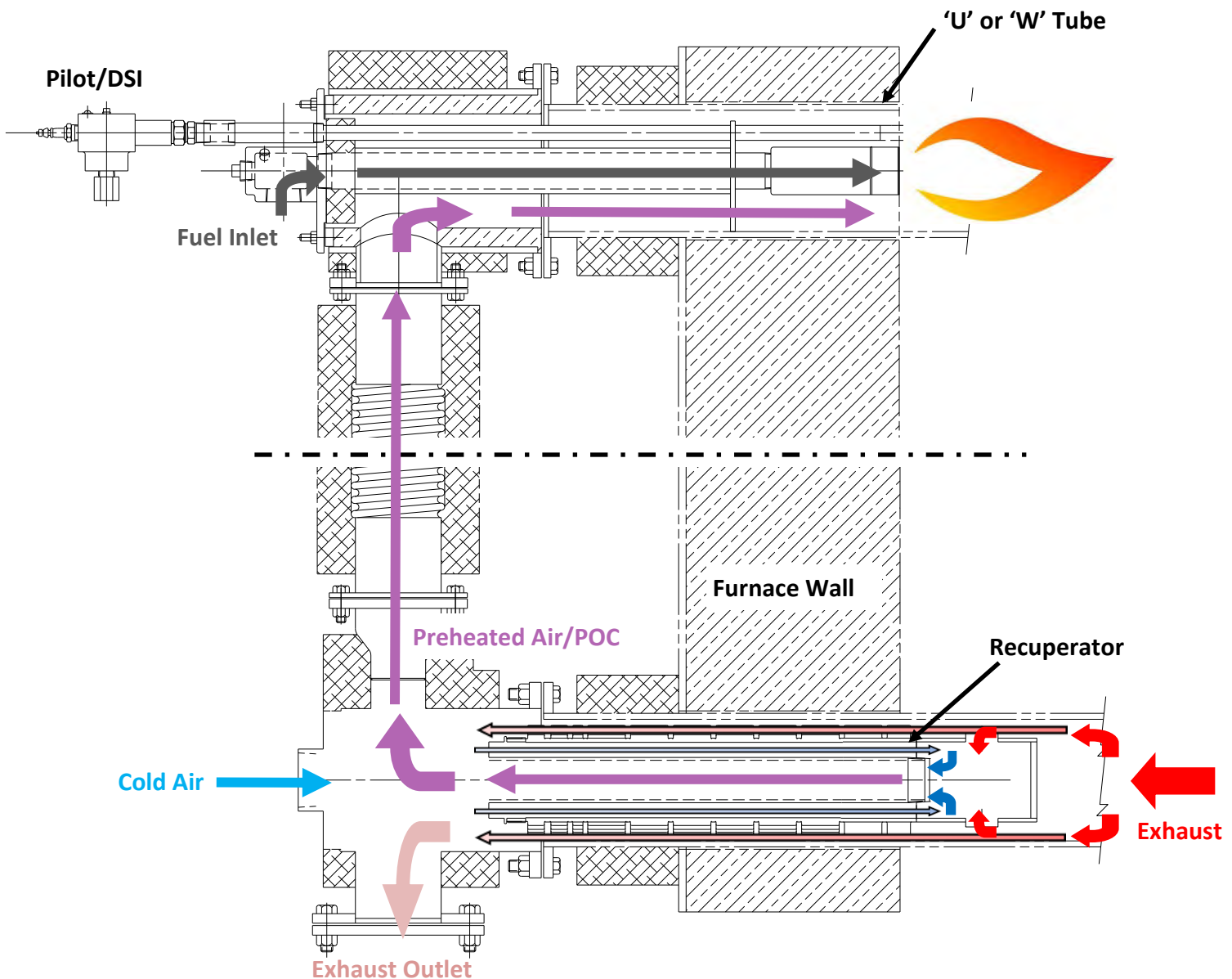
[www.bloomeng.com](http://www.bloomeng.com)

**CAUTION:** The improper use of combustion equipment can result in a condition hazardous to people and property. Users are urged to comply with National Safety Standards and/or Insurance Underwriters recommendations

## Design Concept

The purpose of radiant tube combustion is to apply fuel fired heating, with the products of combustion isolated and separated from the furnace atmosphere. The 2370 Series RRT burner is a forced draft burner (cold combustion air is supplied by a fan/blower).

The Bloom patented<sup>1</sup> 'Hot End' FGR recirculation technology mixes the combustion air and flue gas earlier than other standard designs. Cold combustion air is fed into a tube which is immediately preheated via counterflow recuperation. The preheated air reverses direction at the end of the recuperator and induces hot exhaust gases to mix with the combustion air stream. The flue gases combine with the air before giving up heat in the recuperator, resulting in more efficient preheating of the combustion air. The combustion air/POC mixture is then fed to the burner nozzle for firing through a W or U tube.



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## Advantages

- Flame Retention Nozzle design for flame stability, reliable burner operation and reduced NOx emissions
- Uniform tube temperatures
- Burner flame engineered to a customer's specific radiant tube, achieving minimal HSOA (Hot Spot Over Average) - leading to better heating quality and longer tube life
- Designs backed by (Computational Fluid Dynamics) CFD and laboratory testing
- Designs available for a variety of low calorific mixed gases
- Ultra low NOx performance

## Performance

\*Burner capacities range from approximately:

**58.6 kW (200,000 Btu/hr) to 293.1 kW (1 MMBtu/hr)**

\*Available Heat (LHV) ranges from:

**61—77%**

\*NOx values as low as:

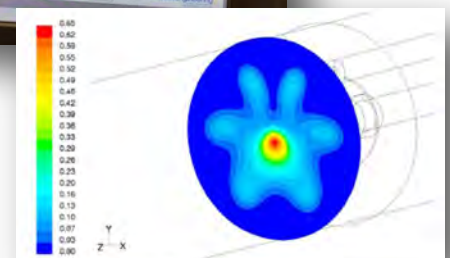
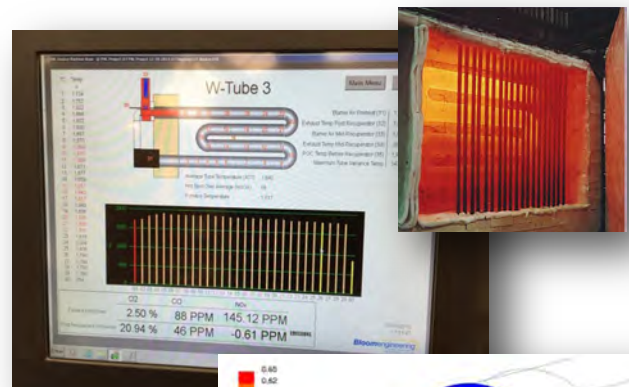
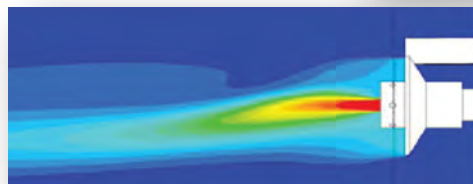
**0.06 #/MMBtu** (based on 2% O<sub>2</sub> in the exhaust with Average Tube Temperature = 1900 °F (1038 °C))

*\*These values are dependent on a variety of factors including the tube size, configuration, average tube temperature, and recuperator length/type.*

## Design Verified with Laboratory Testing

Because of unique operating requirements, radiant tube burner design parameters and emissions are verified by physical laboratory testing. Customers will have the confidence that field results will very closely reflect design conditions specified by Bloom.

Bloom operates one of the largest and most advanced private, applied combustion labs in North America. The lab occupies 20,000 ft<sup>2</sup> (1,850 m<sup>2</sup>). It has twenty fully instrumented furnaces of varying configurations to suit the range of industrial combustion applications.



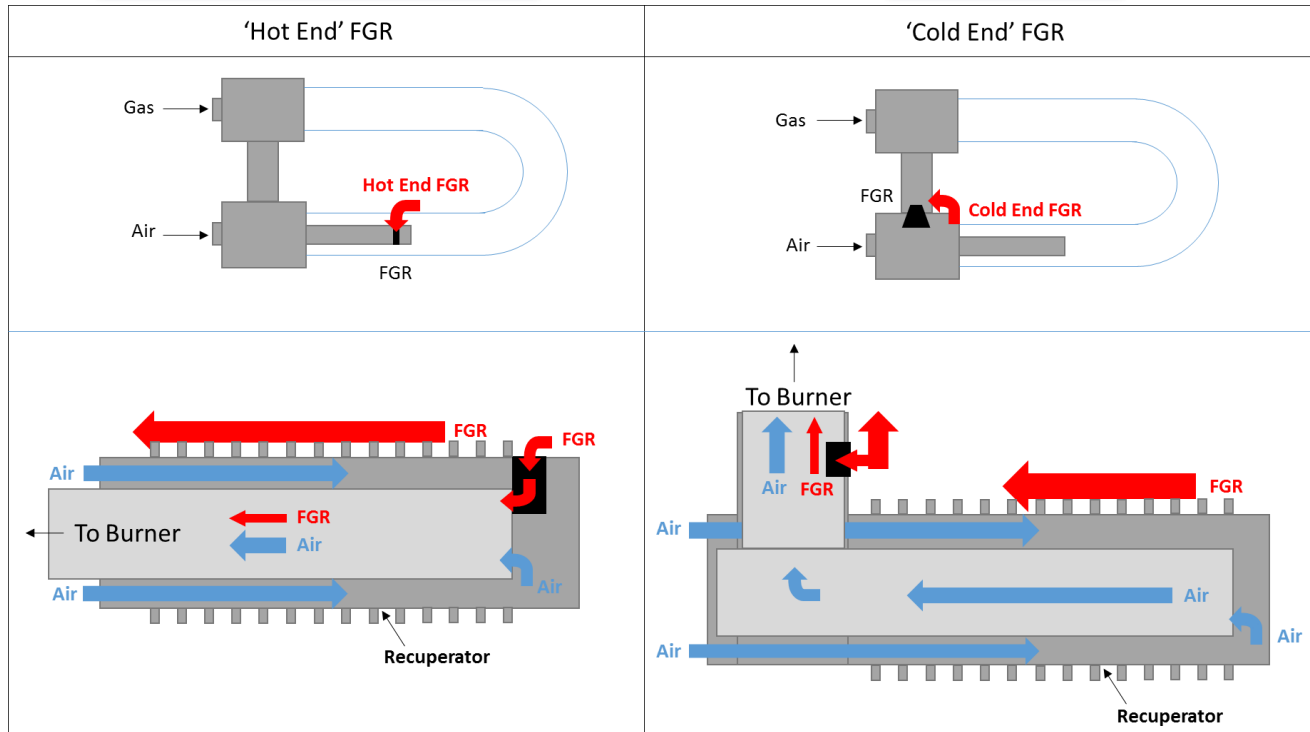
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## 'Hot End' versus 'Cold End' Flue Gas Recirculation (FGR)

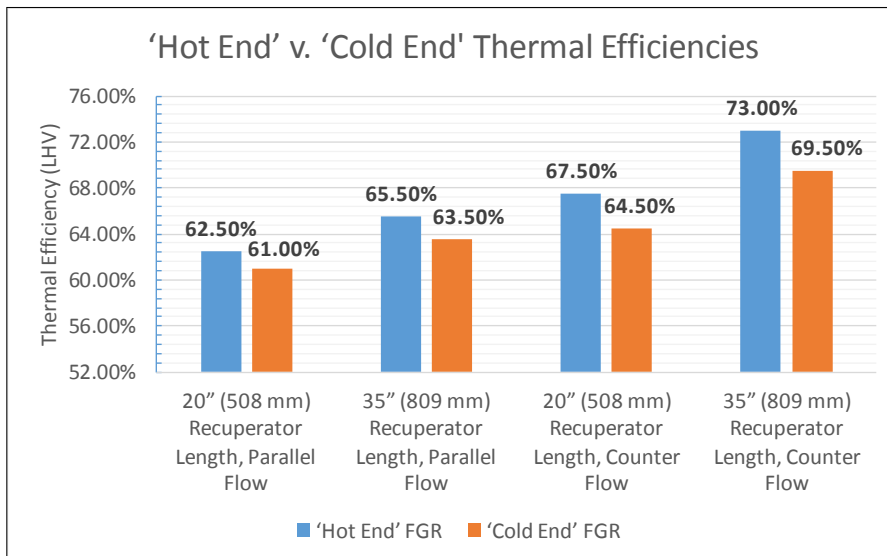
Mixing flue gas with the combustion air stream can have a dramatic effect on NO<sub>x</sub> reduction. Hot End' FGR is illustrated on the left, and 'Cold End' FGR is shown on the right. Both technologies shown below utilize counterflow recuperation, although are also adaptable for parallel flow. The top pictures show a complete conceptual illustration of the burner, exhaust tee, and radiant tube. The bottom pictures show flow patterns of the exhaust leg with the recuperator and combustion air tubes.

### Bloom 2370 Radiant Tube Burner

### Other Technology



The hot FGR is mixed with the combustion air before the energy is lost. The longer mixing path utilized by 'hot end' recirculation also leads to evenly mixed flue gas and air mixture without pockets of high or low oxygen. This brings several advantages over the 'cold end' FGR recirculation including: better flame stability and tube temperature uniformity. Thermal efficiencies sample calculations are shown below comparing the two technologies.



- ⇒ **Recuperator (heat exchanger) type:** parallel and counter flow
- ⇒ **Recuperator Length:** (20" (508 mm) and 35" (809mm))
- ⇒ **FGR Recirculation Type:** 'hot end' and 'cold end'

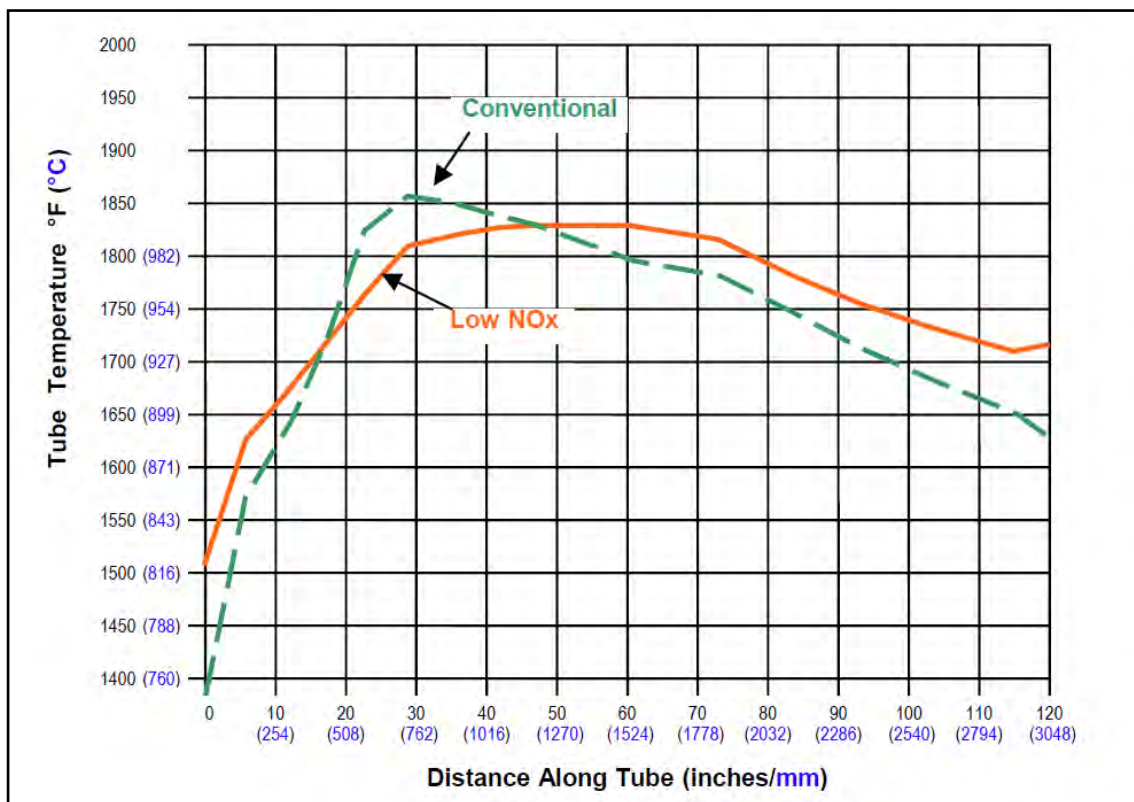
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## Tube Temperature Uniformity

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. FIGURE 1 below shows uniform temperature distribution with the 2370 radiant tube burner.

The Bloom Type F RRTB produces a substantially more uniform tube temperature profile than the conventional RRTB. This allows operation at higher inputs while maintain good tube life and producing NO<sub>x</sub> emission levels equal to or lower than a conventional burner, thereby allowing increased productivity without increased NO<sub>x</sub> emissions.

**FIGURE 1: Tube Temperature Profile**



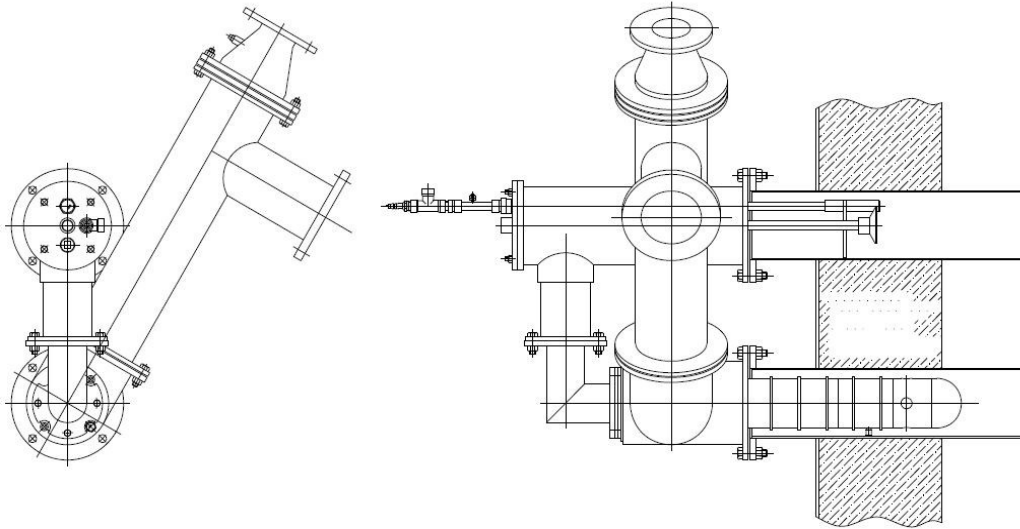
Fuel efficiency can be improved through the use of longer recuperator lengths and improved recuperator designs and materials. The burners can be retrofitted on existing tubes at very reasonable costs. More uniform tube temperature profiles can also be obtained with new technology resulting in better product quality and radiant tube life. The vitiated combustion air stream (combustion air + FGR) results in a higher volume of exhaust gases in the tube leading to more uniform temperatures. Finally, lower NO<sub>x</sub> emissions can be obtained using the FGR recirculation technology.

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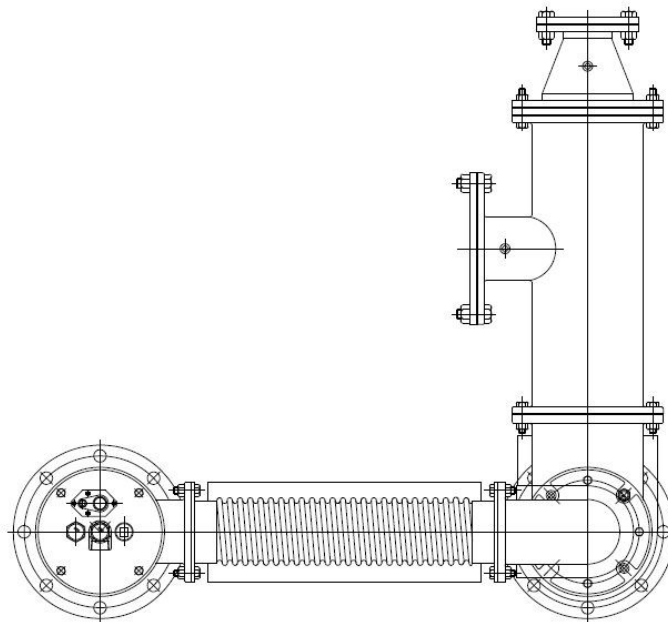
## Arrangements— Additional Recuperator Lengths for Type ‘FL’ Burner

The ‘F’ in Type “FL” refers to the use/addition of the eductor. The eductor is designed to draw POC (Products of Combustion) into the combustion air which creates a vitiated stream with an oxygen content lower than standard air.

The ‘L’ in Type “FL” refers to the shape of the recuperator. In order to increase the temperature of the preheated air and the corresponding efficiency, an extra length of recuperator is included in the design of this burner.



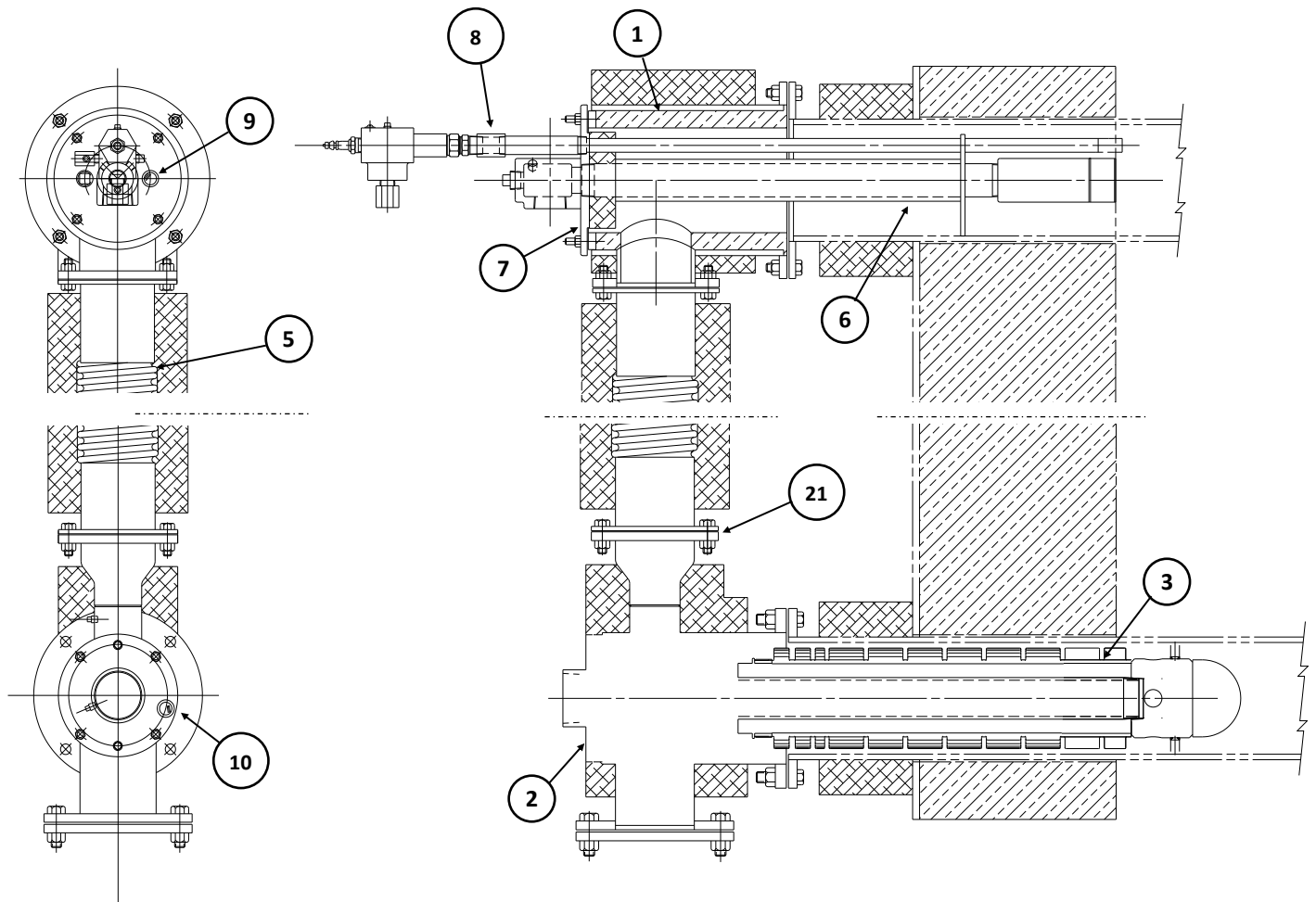
**Figure 2: Shape position (V shape) for external recuperator (Type ‘FL’)**



**Figure 3: Alternate Shape position (L shape) for external recuperator (Type ‘FL’)**

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# Parts List



Part Number	Description
01	Burner Body
*02	Exhaust Gas Tee
03	Recuperator Assembly
05	Hot Air Tube
06	Gas Nozzle Assembly
07	End Plate
08	Pilot Assembly
09	Observation Port
10	Observation Port
21	Hot Air Flex Gasket

Part Number must be preceded by catalog number.

**EXAMPLE:**

To order Part 03—Gas Nozzle Assembly for 2370-060 burner, specify:

**2370-070-03**

\*Specify 'right' or 'left' hand exhaust gas tee (right hand shown)

## Application Guidelines \*

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### FUEL CAPABILITIES \*\*::

- Natural Gas
- #2 Fuel Oil
- Propane
- LPG
- Coke Oven Gas (COG)

\*\*Please Consult a Bloom Representative for availability of other fuel types

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### BURNER IGNITION:

- Direct Spark Ignition (*Recommended*)
  - Pilot
  - Manual
- 

### CONTROL:

- Volumetric Fuel/Air Ratio
- On-Off (Pulse-Fired)\*
- High/Low

\*Oil fired burner require on-off control system

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### FLAME MONITORING:

- UV Detector
  - Flame rod
- 

### OPTIONS:

- External insulation
  - Internal insulation for higher air preheat temperatures
  - Right, left, or straight exhaust connections
  - Lower NOx designs
  - Custom designs with lab development capabilities
  - Air staged nozzle
  - 'L' shaped or additional recuperator length for increased efficiency
  - 'Cold End' FGR
  - Advanced recuperator types
- 

\* NOTE: Due to continual developments in the Bloom Laboratory and results from field research, the applicability of different fuels and other options listed above are constantly being updated. Please consult a Bloom Representative to inquire about the availability of any guidelines/options that are not shown above.

## SPARE OR REPLACEMENT PARTS

Spare Parts and Replacement parts are available for virtually all industrial burners and combustion systems supplied by Bloom Engineering in the past 50 years. Spare and replacement parts are manufactured to original dimensions and tolerances to ensure performance is maintained. For more information, please visit our website at [www.bloomeng.com/burner-spare-parts](http://www.bloomeng.com/burner-spare-parts).

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## Product Details

**\*The following information is required to specify an order:**

1. Fuel type and pressure
2. Maximum heating capacity required
3. Turndown required
4. Proposed method of control
5. Inside and outside diameter of tube
6. Tube length, configuration and distance between center of tube
7. Distance from burner flange to inside face of furnace wall
8. Proposed method of ignition (Manual or spark ignited pilot)
9. Furnace operating temperatures
10. Any restrictions or special requirements such as:
  - a) Total pressure drop (not to exceed)
  - b) NO<sub>x</sub>
  - c) CO
  - d) Direct Spark Ignition

### Burner Designation: 237X-XXX Type X

*(Example: 2370-074; gas burner with 7.5" (191mm) I.D. tube)*

Fourth digit:

XXX0 — Gas Only  
 XXX2 — Air staged  
 XXX5 — LP oil only  
 XXX6 — Combination gas and LP oil  
 XXX9 — Special

Last Three Digits:

-ABC—A and B are for inches; C is to the nearest 1/8"  
*i.e. -074 = 7.5" (191mm) I.D. radiant tube (firing leg)*

Type:

F—Type F Eductor  
 FL—Type F Eductor with 'L' or 'V' shaped additional recuperator length

<b>*Tube Sizes (I.D.)</b>		
<b>Burner Designation</b>	<b>mm</b>	<b>inches</b>
<b>2370 - ____</b>		
-040	102	4
-050	127	5
-054	140	5 1/2
-060	152	6
-063	162	6 3/8
-070	178	7
-074	191	7 1/2
-080	203	8

\*Designs available for other tube sizes.  
 Please contact your Bloom representative

\* **NOTE:** Information required to process a quote includes, but may not be limited to, the information specified above.  
 Additional details may **also** be required to quote a combustion control system.

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 please visit our website at:  
[www.bloomeng.com/industrial-burners](http://www.bloomeng.com/industrial-burners)