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Todd Ellerton, Jessica Irons,
Al Benz, Jim Roberts, Brian Kelly

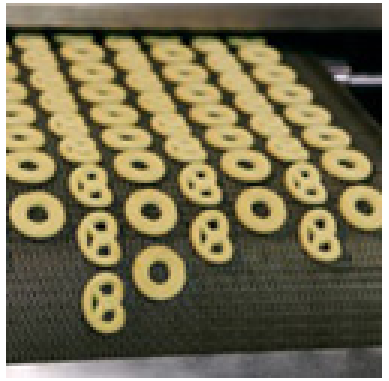
THERMAL TRANSFER OVERVIEW

April 20, 2017

Honeywell
THE POWER OF CONNECTED

Markets/Applications

- Automotive Finishing
- Food and Beverage
- Building Materials
- Thermal Oxidizers
- Thermal Fluid Heaters
- Combined Heat & Power / Cogeneration
- Metals

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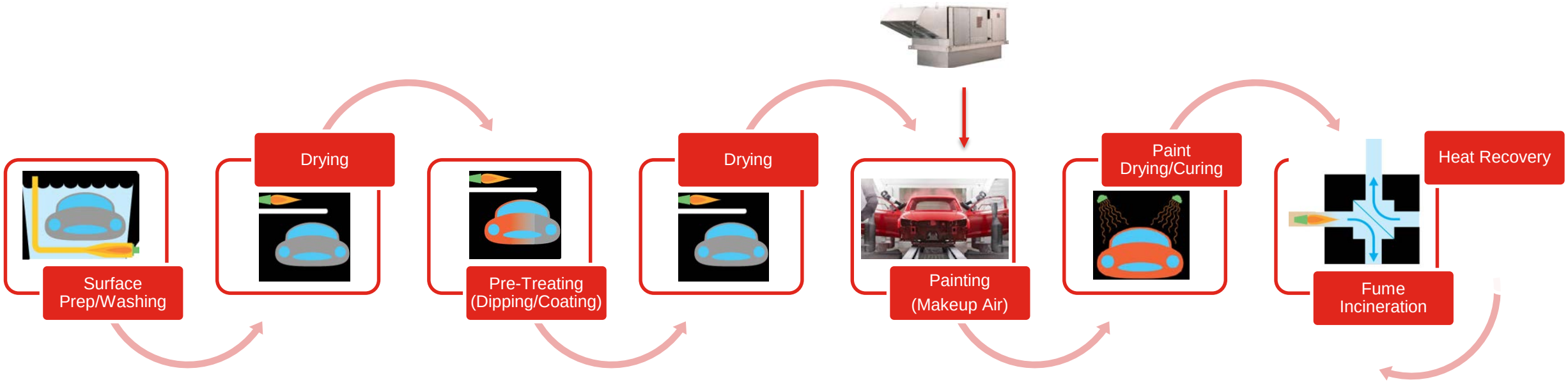
Automotive Finishing

Automotive Finishing

- Process Overview



Automotive Finishing

- Surface Preparation/Washing – Immersion Burners on a Wash Tank

Automotive Finishing

- Surface Preparation/Washing – Immersion Tube Burners

	Tube-O-Flame	ImmersoPak	Tube-O-Therm	ImmersoJet
				
Key Differentiators	Easy Installation, Simple Start Up, Low Horsepower Requirements, Low Noise	Simple and Durable, Low Maintenance, Multiple Fuel Capability, Low Noise, High Turndown	Burner To Tube Direct Firing, Economical Efficient Package, Easy Maintenance, No Powered Exhaust	Quiet Operation, Highest heat capacities and efficiencies, Easy Installation
Choose When	Simple, Clean, Low NOx Tube Firing, Lower Operating Costs	Multiple Fuels Required, Simple Setup is Desired, High Turndown Required	Uniform Heat Transfer, Higher Efficiency, Faster Heat-Up Times, Economical Tube Sizes	A High Heat Transfer rate is desirable, Small Diameter Tube Application, Fast Heat-up Time is Required

Automotive Finishing

- Part Drying

Automotive Finishing

- Part Drying – Direct Fired, Gun Style, Standard Emissions

	RatioMatic	OvenPak	ThermAir	RatioAir
				
Key Differentiators	Alloy, SiC, and Refractory Tube Options, Nozzle Depth Options	Gas or Gas/Oil Combo, Linked valve control	ThermJet Nozzle, Fixed-Air Control, Alloy or SiC/Refractory Tube Options	Straight/Medium/High Velocity and Alloy/SiC Refractory Tube Options, ThermJet Nozzle
Choose When	Ratio Regulator Control Desired, Larger Capacities Needed	Linked Valve Control Desired, Combination Gas/Oil Needed	Gaseous Fuel Flexibility Needed, Fixed-Air Control Desired	Gaseous Fuel Flexibility, Velocity Tubes Needed, Ratio Regulator Control Desired, Higher Temps

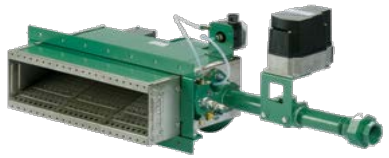
Automotive Finishing

- Part Drying – Direct Fired, Gun Style, Low Emissions

	 **Winnox**	 **OvenPak LE**
Key Differentiators	Multi-Fuel Capability, Simple Ratio Regulator Control, Very Short Flame Length	Compact, Unique Nozzle, Visible Action Speeds, Balanced Pressure Design
Choose When	Variety of Fuels, Reliable Performance, Low NOx and CO, Convenient and Easy to Setup Ratio Regulator Control are Desired	Clean Combustion, High Turndown, Added Flexibility, Low NOx, Linked Valves or Parallel Positioning Control are Desired

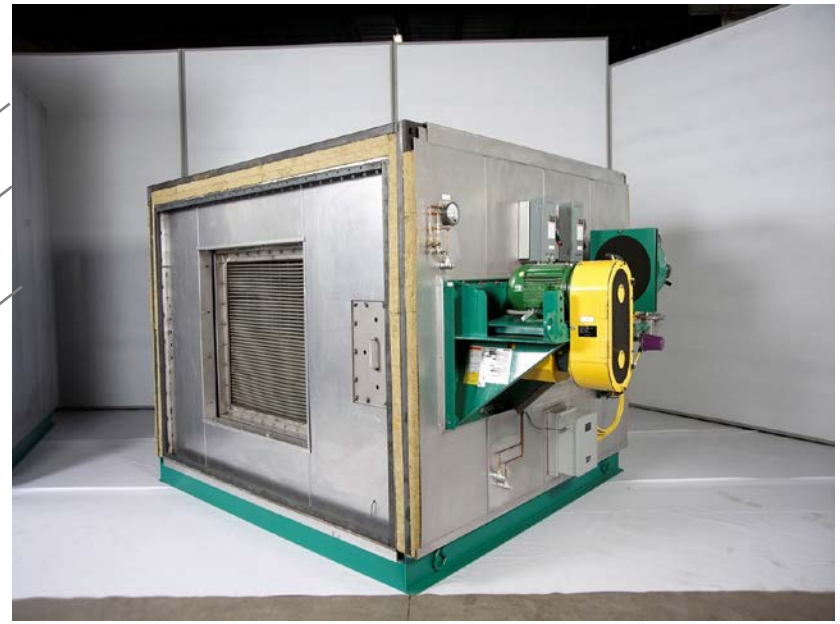
Automotive Finishing

- Part Drying – Direct Fired, Line Style, Standard Emissions

	AirHeat v1	AirHeat v2	APX
			
Key Differentiators	Industry Standard, Lower Pressure & Lower hp Blowers, Tees & Crosses, Choice of Inputs per Foot	Low CO Emissions, Designed Around TA-Luft CO Requirements, Multiple Gas Manifold Materials	Packaged Blower, High Cross Velocities, Aluminum Body, Short Flame, Lengths up to 15ft, “H” Styles
Choose When	Uniform Duct Heating, Stable Operation/Many Velocities, Large Volume of Hot Air	Lower CO Emissions	Packaged Blower, High Cross Velocities

Automotive Finishing

Paint Curing Oven

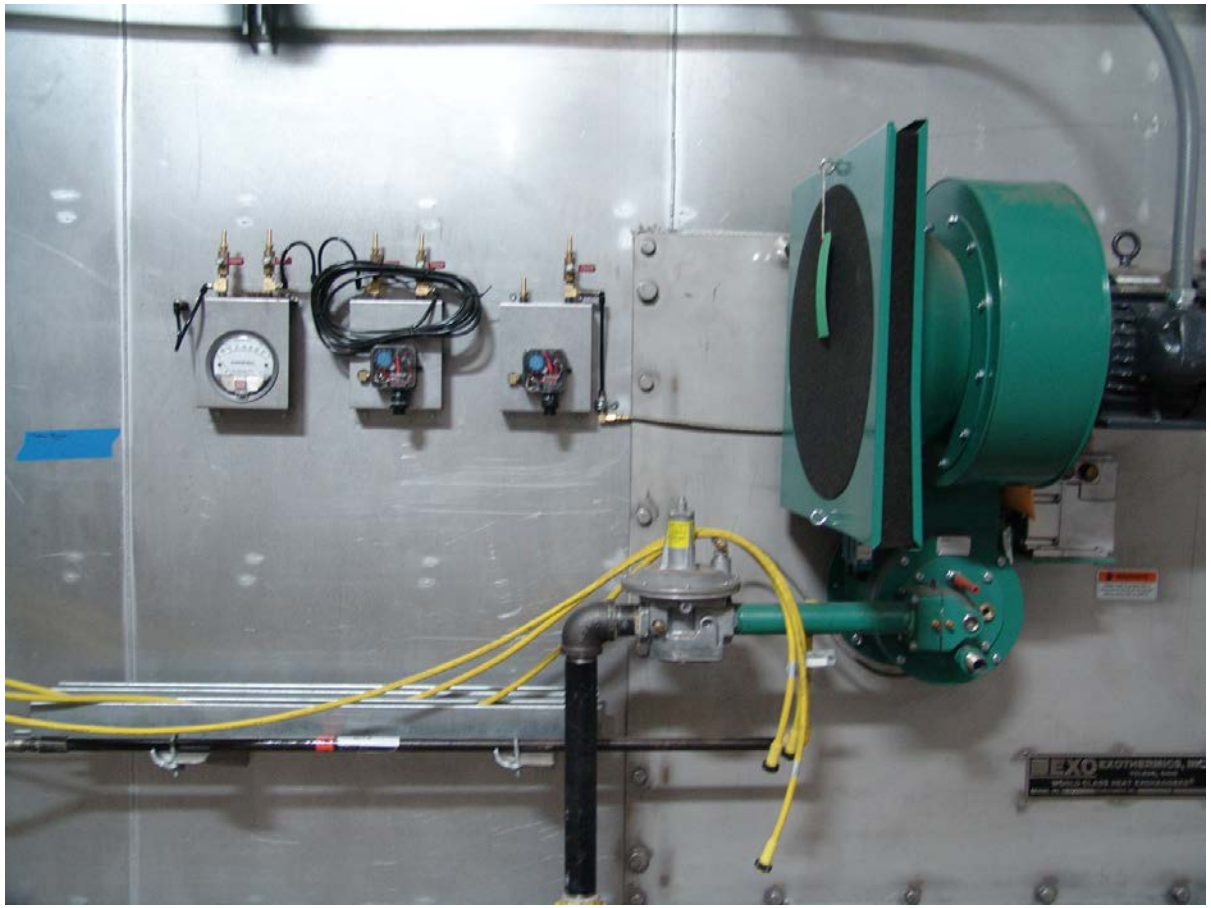


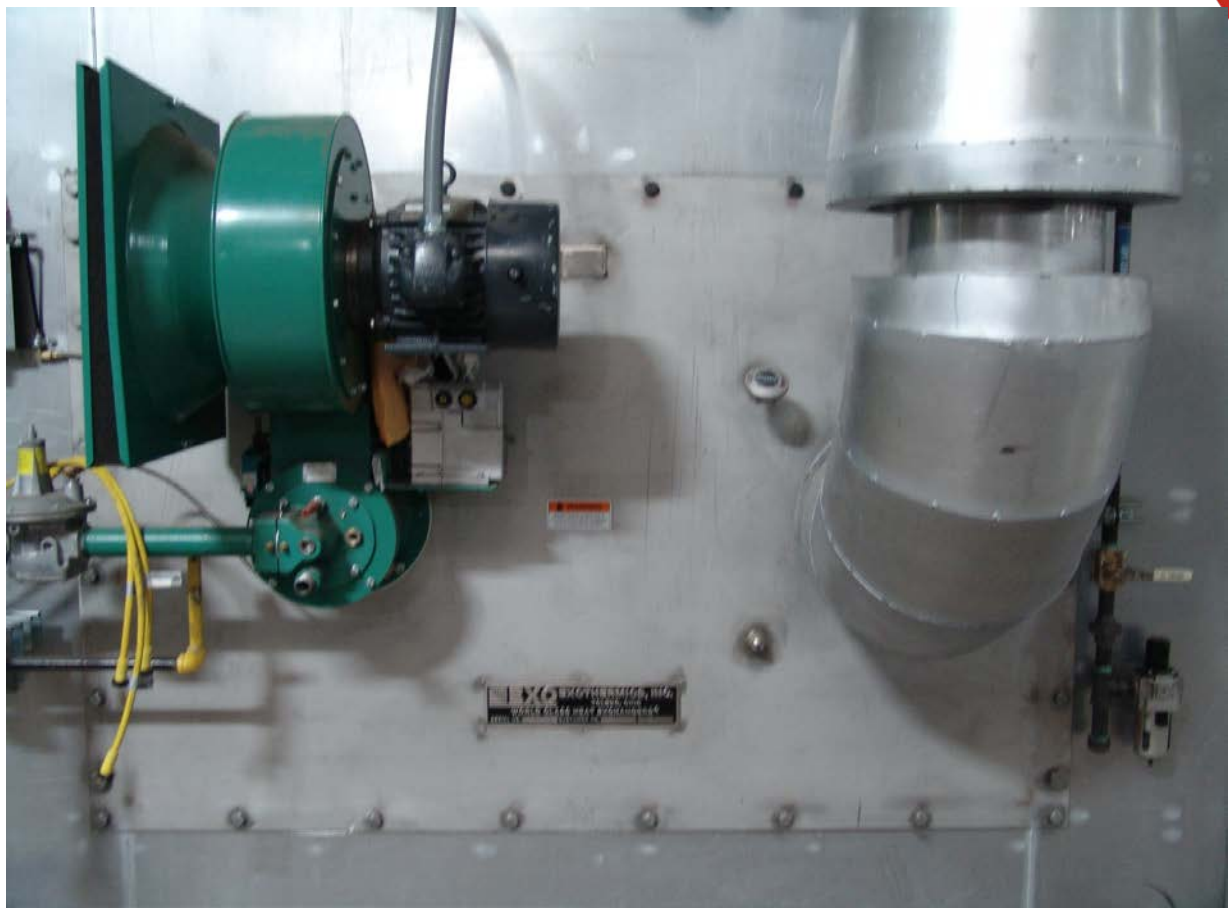
Indirect Air Heater

Automotive Finishing

RatioMatic on an RHT-Indirect Oven Heater

Automotive Finishing





RatioMatic on an RHT-Indirect Oven Heater

Automotive Finishing

- Paint Drying/Curing – Indirect Fired

	 **RHT**	 **ER Heater**
Key Differentiators	Choice of Burner (RatioMatic, RatioAir, ThermAir), Clean Industrial Heat, Compact Package, Indirect, Designed to allow thermal expansion, low air pressure drops	Choice of Burners (Linnox, Minnox, Winnox), Low NOx, High Efficiency, Free of Products of Combustion, Heat Exchanger Included, Multiple Configurations, 90% gross efficiency
Choose When	Complete package design is needed, Indirect Fired drying is required, high efficiency is desired, in NFPA 86 applications	Process Air must be free of contaminants, low NOx requirements, high efficiency requirements, complete package desired

Automotive Finishing

- Paint Booth and Makeup Air

Air Supply Houses used for Makeup Air (On Roof of Paint Booth)

Burners Installed Inside Air Supply House

Paint Booth

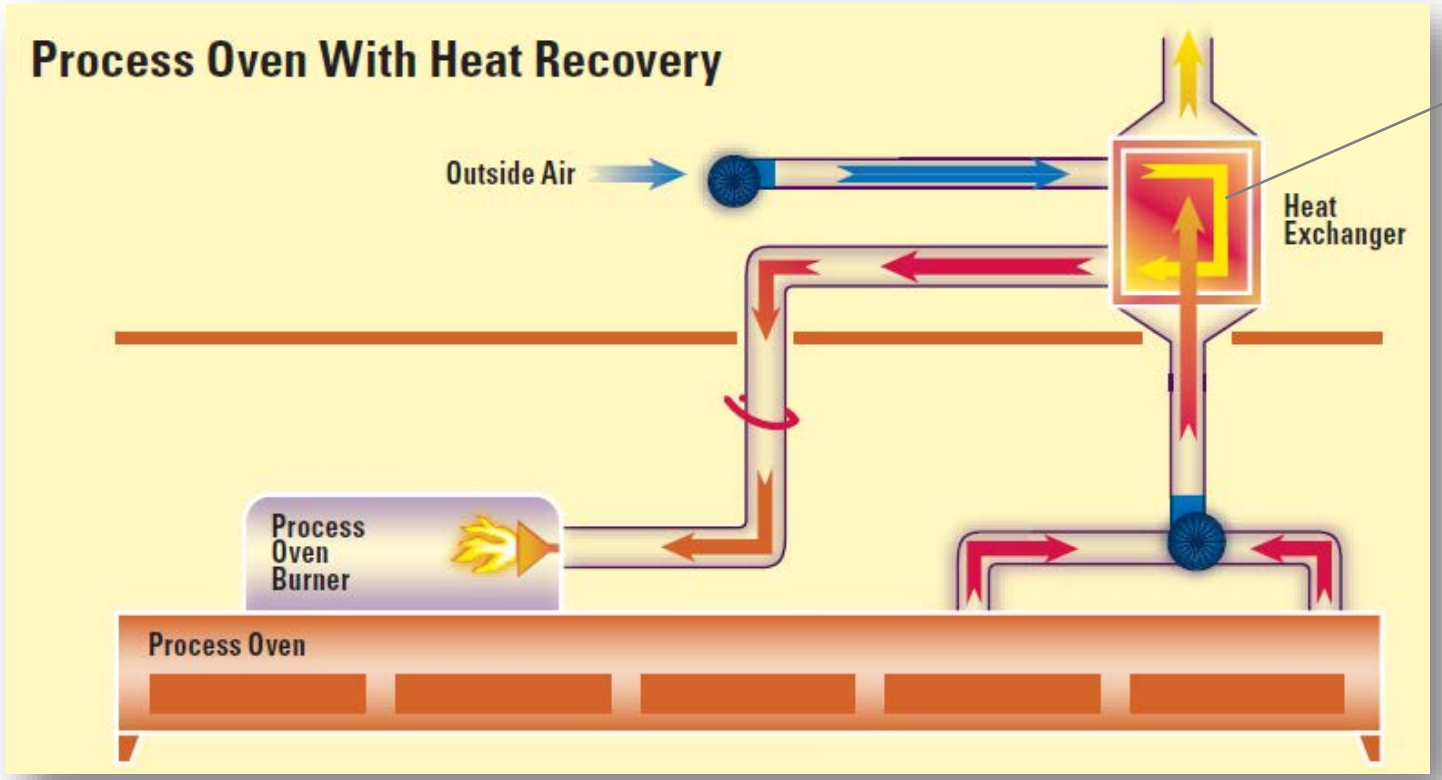
Automotive Finishing

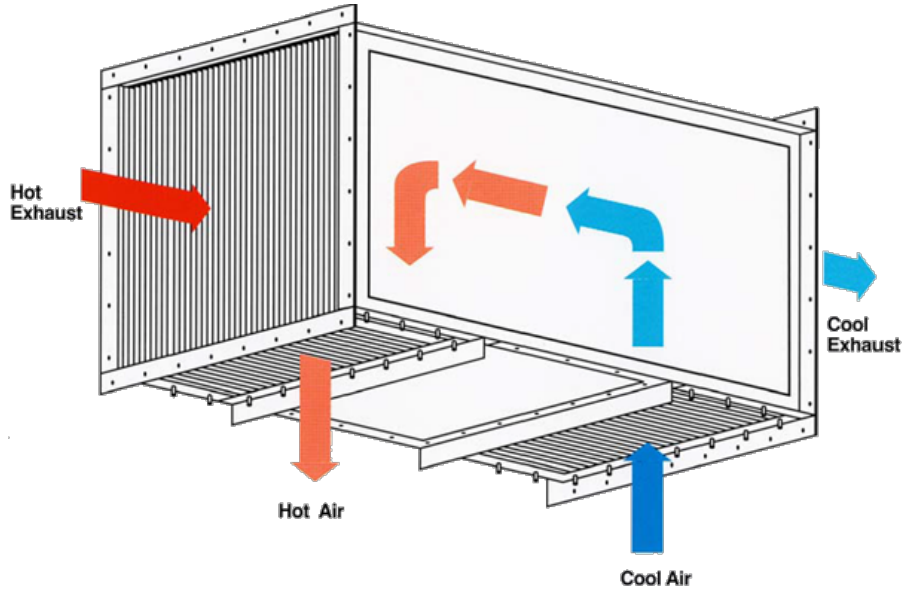
- Makeup Air (Paint Booth)

	NG/RP	NPLE	AHMA
			
Key Differentiators	Use for Any Duct Heating, Choice of Inputs per Foot, Stainless Steel Mixing Plates	Aluminum Body, Modular/Flexible Design, Low Emissions, Holds Turndown at High Velocity	Available with Tee's and Crosses, Modular/Flexible Design, High Turndown, Multi-fuel capability
Choose When	Basic Raw Gas Duct Burner is Needed	Low Emissions, Variety of Airflows & Velocities	Design/Fuel flexibility and high turndown is needed

Automotive Finishing

- Air-to-Air Heat Exchanger
- Can apply to more than just automotive – any process with heat exhaust!





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Automotive Finishing

- Process Heat Recovery – Heat Exchangers

	Tubular Heat Exchanger 	**Sinusoidal Plate Heat Exchanger** 	**Dimple Plate Heat Exchanger** 
Key Differentiators	Preferred choice for high temperature heat recovery, Customizable flow configurations	Compact, High Heat Transfer Effectiveness, Lighter Weight	Thick Plates for abrasive/corrosive applications, In-Line dimples accommodate dirtier streams
Choose When	Robust heat recovery is needed in high temperature applications	High efficiency required	Process air is dirty, abrasive, corrosive

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Food and Beverage

Food and Beverage

- Commercial Baking – Continuous Ovens

Food and Beverage

- Commercial Baking – Continuous Ovens

Food and Beverage

- Commercial Baking – Batch Oven

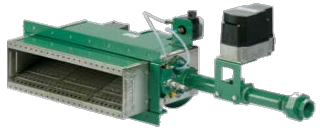
Food and Beverage

- Baking/Commercial Ovens – Gun Style

	RatioMatic	OvenPak	Winnox	OvenPak LE	RatioAir/ThermAir
					
Key Differentiators	Alloy, SiC, and Refractory Tube Options, Nozzle Depth Options	Gas or Gas/Oil Combo; Fixed Air Version Available, Larger Capacities	Multi-Fuel Capability, Simple Ratio Regulator Control, Very Short Flame Length	Compact, Unique Nozzle, Visible Action Speeds, Balanced Pressure Design	Straight/Medium/High Velocity and Alloy/SiC Refractory Tube Options on Ratio Air, ThermJet Nozzle; Fixed Air via ThermAir
Choose When	Ratio Regulator Control Desired, Larger Capacities Needed	Linked Valve Control Desired (or Fixed Air), Combination Gas/Oil Needed, Large Capacity Needed	Variety of Fuels, Reliable Performance, Low NOx and CO, Convenient and Easy to Setup Ratio Regulator Control are Desired	Clean Combustion, High Turndown, Added Flexibility, Low NOx, Linked Valves or Parallel Positioning Control are Desired	Gaseous Fuel Flexibility, Velocity Tubes Needed (or Fixed Air for ThermAir), Ratio Regulator (for RatioAir) Control Desired, Higher Temps

Food and Beverage

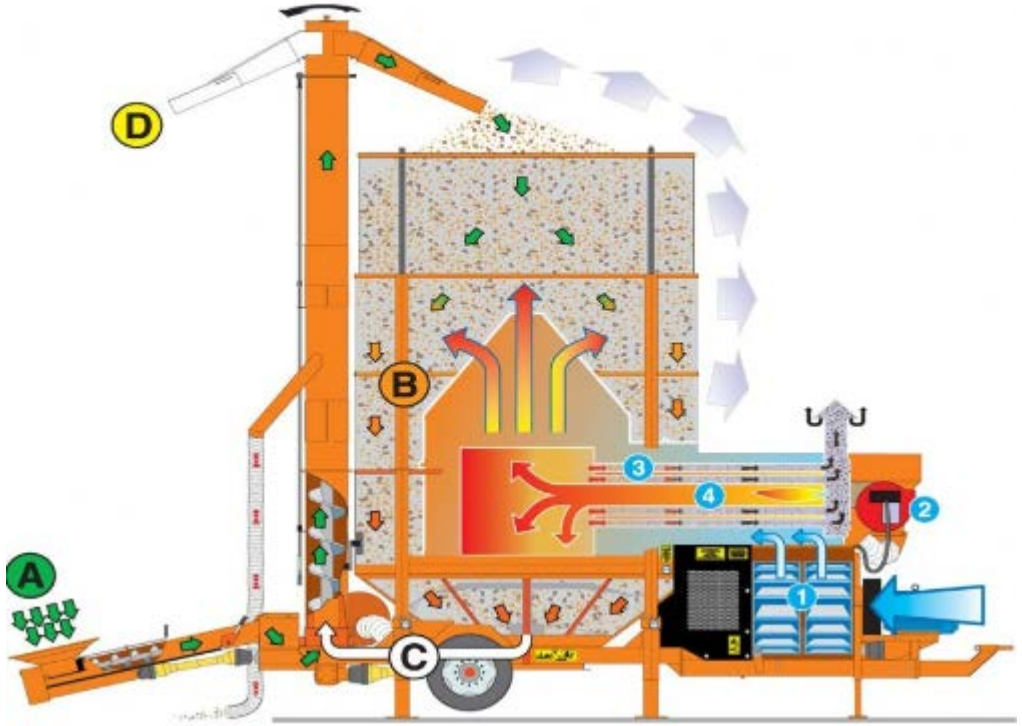
- Baking/Commercial Ovens – Line Style

	AirHeat v1	AirHeat v2	APX
			
Key Differentiators	Industry Standard, Lower Pressure & Lower hp Blowers, Tees & Crosses, Choice of Inputs per Foot	Low CO Emissions, Designed Around TA-Luft CO Requirements, Multiple Gas Manifold Materials	Packaged Blower, High Cross Velocities, Aluminum Body, Short Flame, Lengths up to 15ft, “H” Styles
Choose When	Uniform Duct Heating, Stable Operation/Many Velocities, Large Volume of Hot Air	Lower CO Emissions	Packaged Blower, High Cross Velocities

Food and Beverage

- Agricultural Grain Dryers

Column Dryer



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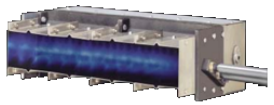
Food and Beverage

- Agricultural Grain Drying – Line Style

	AirHeat v1	NP-RG	NP-LE	Crossfire	APX
					
Key Differentiators	Industry Standard, Lower Pressure & Lower hp Blowers, Tees & Crosses, Choice of Inputs per Foot	Use for Any Duct Heating, Choice of Inputs per Foot, Stainless Steel Mixing Plates	Aluminum Body, Modular/Flexible Design, Low Emissions, Holds Turndown at High Velocity	Low emissions, excellent turndown, available in a variety of configurations, High energy release per foot	Packaged Blower, High Cross Velocities, Aluminum Body, Short Flame, Lengths up to 15ft, “H” Styles
Choose When	Uniform Duct Heating, Stable Operation/Many Velocities, Large Volume of Hot Air	Basic Raw Gas Duct Burner is Needed	Low Emissions, Variety of Airflows & Velocities	Low Nox requirements, flexibility required, Parallel positioning control desired	Packaged Blower, High Cross Velocities

Food and Beverage

- Agricultural Grain Drying – Gun Style

	OvenPak	OvenPak LE	M-Pakt	Vortometric	RatioMatic
					
Key Differentiators	Gas or Gas/Oil Combo	Compact, Unique Nozzle, Visible Action Speeds, Balanced Pressure Design	Low NOx and CO, Flame Contained in Sleeve, Compact Design, Durable Construction	Low Air Pressure Requirements, High Capacity, Variety of “exotic” fuels, High Turndown	Alloy, SiC, and Refractory Tube Options, Nozzle Depth Options
Choose When	Linked Valve Control Desired, Combination Gas/Oil Needed	Clean Combustion, High Turndown, Added Flexibility, Low NOx, Linked Valves or Parallel Positioning Control	Ultra Low Emissions, Reliability and Durability	Large capacities up to 230MM Btu/h, Ratio regulator Control, low air pressures are required and multiple fuel capability needed	Ratio Regulator Control Desired, Larger Capacities Needed

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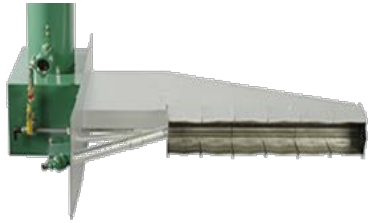
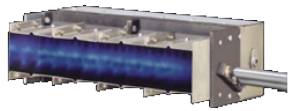
Food and Beverage

- Pet Food Dryers

Food and Beverage

- Pet Food Drying – Line Style

	Linnox	Minnox	Crossfire	AirHeat v2
				
Key Differentiators	Ultra Low NOx, Flexible Design for a Wide Range of board sizes, choice of inputs per module/foot.	Extremely low NOx and CO, can be direct or indirectly fired, Can be paired with ER Heater	Low emissions, excellent turndown, available in a variety of configurations, High energy release per foot	Low CO Emissions, Designed Around TA-Luft CO Requirements, Multiple Gas Manifold Materials
Choose When	Ultra Low NOx required, large drying area, flexible layout required, Ratio Regulator control preferred	Ultra Low emissions required, Flexible Design is needed	Low Nox requirements, flexibility required, Parallel positioning control desired	Lower CO Emissions than AH v1

Food and Beverage

- Pet Food Drying – Gun Style

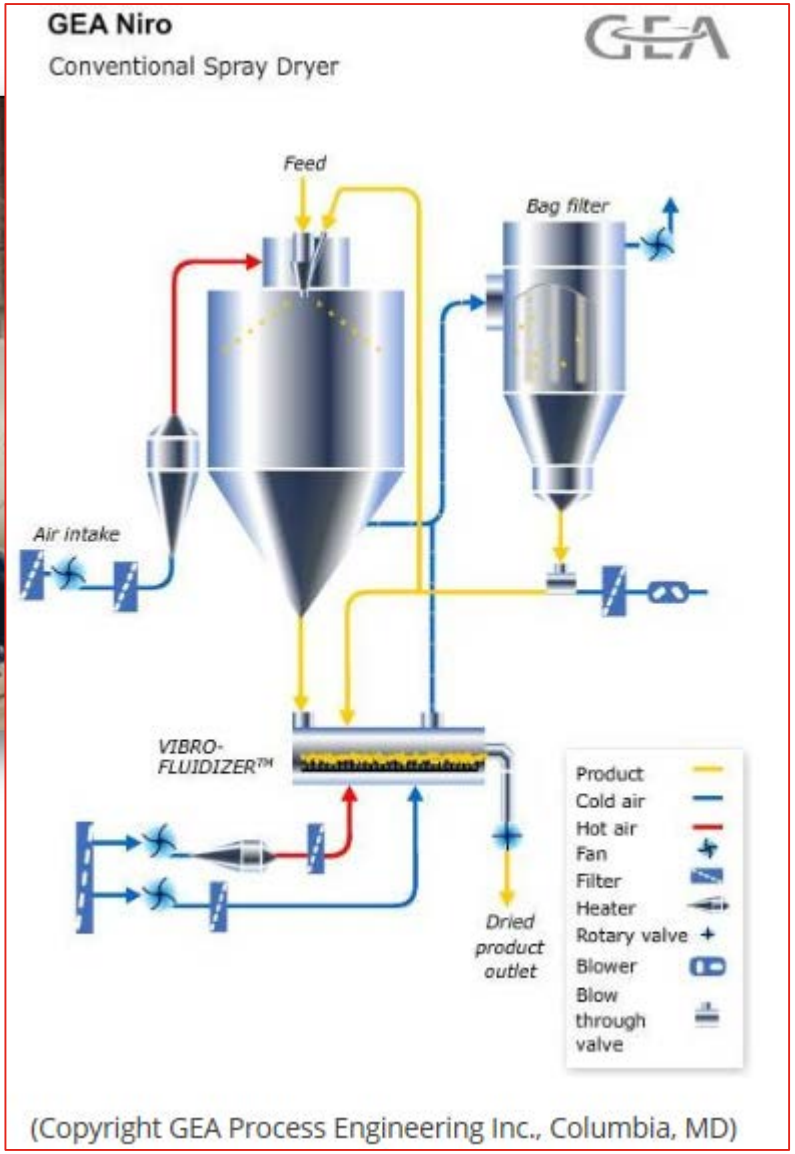
	RatioMatic	OvenPak	Winnox	OvenPak LE
				
Key Differentiators	Alloy, SiC, and Refractory Tube Options, Nozzle Depth Options	Gas or Gas/Oil Combo; Fixed Air Version Available, Larger Capacities	Multi-Fuel Capability, Simple Ratio Regulator Control, Very Short Flame Length	Compact, Unique Nozzle, Visible Action Speeds, Balanced Pressure Design
Choose When	Ratio Regulator Control Desired, Larger Capacities Needed	Linked Valve Control Desired (or Fixed Air), Combination Gas/Oil Needed, Large Capacity Needed	Variety of Fuels, Reliable Performance, Low NOx and CO, Convenient and Easy to Setup Ratio Regulator Control are Desired	Clean Combustion, High Turndown, Added Flexibility, Low NOx, Linked Valves or Parallel Positioning Control are Desired

Food and Beverage

- Spray Drying

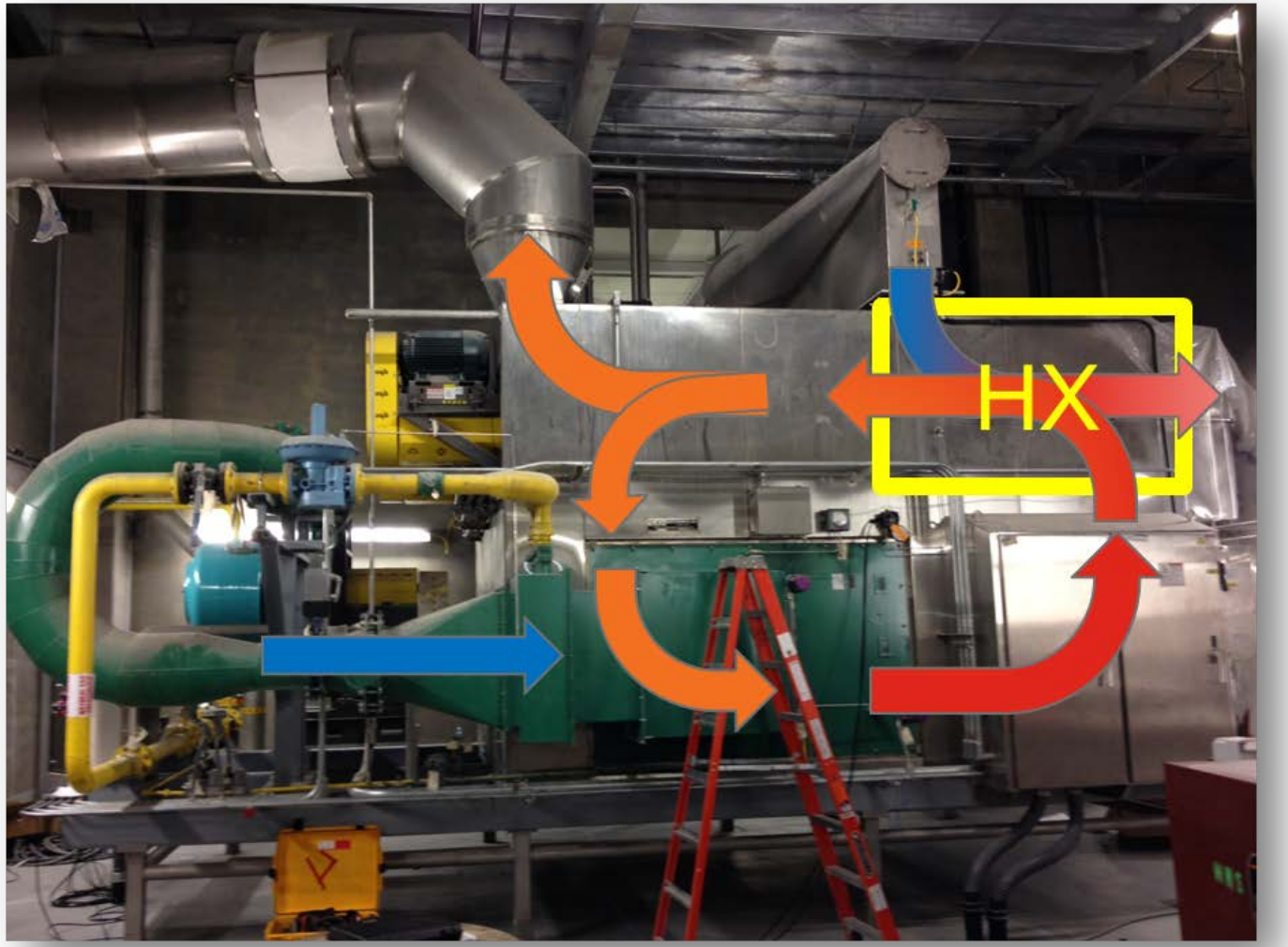
ER Heater Installation at Spray Drying Facility

Standard Spray Drying Layout



Food and Beverage

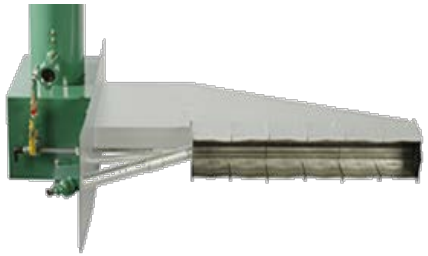
- Spray Drying



ER Heater Air Flow Configuration

Food and Beverage

- Spray Drying

	Linnox	Minnox	ER Heater
			
Key Differentiators	Ultra Low NOx, Flexible Design for a Wide Range of board sizes, choice of inputs per module/foot.	Extremely low NOx and CO, can be direct or indirectly fired, Can be paired with ER Heater	Choice of Burners (Linnox, Minnox, Winnox), Low NOx, High Efficiency, Free of Products of Combustion, Heat Exchanger Included, Multiple Configurations, 90% gross efficiency
Choose When	Ultra Low NOx required, large drying area, flexible layout required, Ratio Regulator control preferred	Ultra Low emissions required, Flexible Design is needed	Process Air must be free of contaminants, low NOx requirements, high efficiency requirements, complete package desired

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Building Materials

Building Materials

- Gypsum Board Dryers – Longitudinal (air flow parallel with board)
  - 2 - 4 drying zones
  - Fewer, Larger Capacity Burners
  - Burner located inside upper duct in a recirculating air flow with high humidity

Building Materials

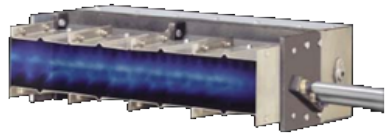
- Gypsum Board Dryers – Cross Fired (air flow perpendicular with board)
  - 12 - 20 drying zones
  - Several, Smaller Capacity Burners
  - Burners located on top of dryer

Building Materials

- Gypsum Board Dryers – Vortometric at USG

Building Materials

- Gypsum Board Drying, Lumber/Wood Drying, Veneer Drying, Ceiling Tiles – Line Style

	Air Heat v1	Linnox	Crossfire
			
Key Differentiators	Industry Standard, Lower Pressure & Lower hp Blowers, Tees & Crosses, Choice of Inputs per Foot	Ultra Low NOx, Flexible Design for a Wide Range of board sizes, choice of inputs per module/foot.	Low emissions, excellent turndown, available in a variety of configurations, High energy release per foot
Choose When	Uniform Duct Heating, Stable Operation/Many Velocities, Large Volume of Hot Air	Ultra Low NOx required, large drying area, flexible layout required, Ratio Regulator control preferred	Low Nox requirements, flexibility required, Parallel positioning is desired control method

Building Materials

- Gypsum Board Drying, Lumber/Wood Drying, Veneer Drying, Ceiling Tiles – Gun Style

	Vorotmetric	Megafire	Beta BBC/BBG
			
Key Differentiators	Low Air Pressure Requirements, High Capacity, Variety of “exotic” fuels, High Turndown	Low Air Pressure, Natural Gas or Propane and No. 2 Oil,	Alloy or Refractory Baffles and Tiles, Fuel Gases Greater than 500 Btu/ft3 and No. 2 to No. 6 Oil, Low Pressure Atomization with No. 2 Oil
Choose When	Large capacities up to 230MM Btu/h, Ratio regulator Control, low air pressures are required and multiple fuel capability needed	Low Combustion Air Pressure Desired, Gas or Combination No. 2 Oil, 3 Sizes up to 12MW (45 MMBtu/h)	Large Capacities up to 32.5MW (123 MMBtu/h), Need Low Pressure Oil Atomization, Fuel Flexibility, Higher Temperatures and/or PCA

Thermal Oxidizers

Thermal Oxidizers

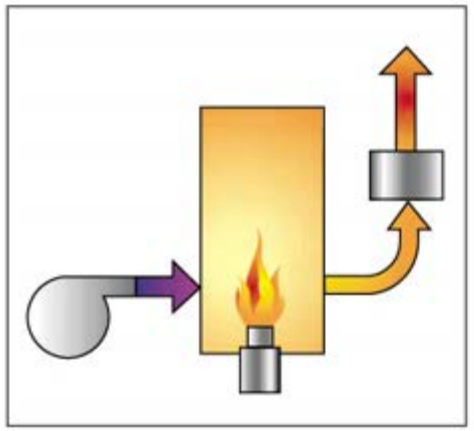
- **Thermal** oxidation is the effective employment of a process that provides thorough mixing of an organic substance with sufficient oxygen, at a high enough temperature, for a sufficient time, to cause the organics to oxidize to the desired degree of completion.

- A **thermal oxidizer** (also known as a **thermal** incinerator) is a process unit for air pollution control in many chemical plants that decomposes hazardous gases at a high temperature and releases them into the atmosphere.

Thermal Oxidizers

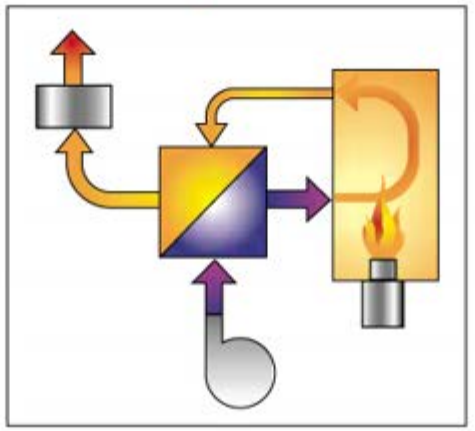
- Process Details/Pictures

Direct-Fired



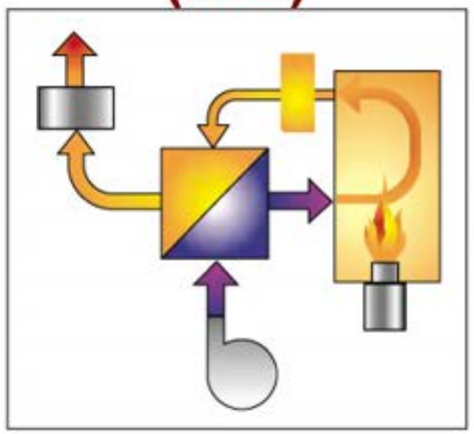
- **Kinedizer LE**
- **ThermJet**
- **Winnox**
- **InciniCone**
- **IncinoPak**
- **Combustifume**

Recuperative



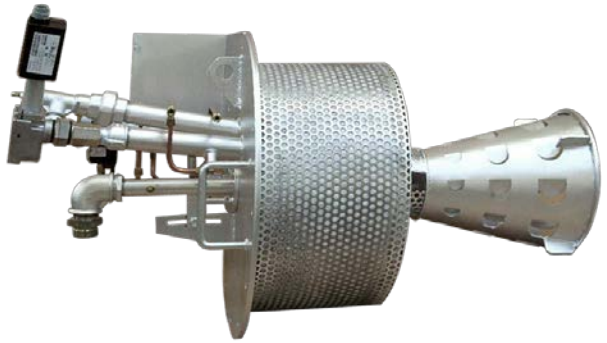
- **Kinedizer LE**
- **ThermJet**
- **Winnox**
- **InciniCone**
- **IncinoPak**
- **Combustifume**
- **Plate Heat Exchanger**
- **Tubular Heat Exchanger**

Regenerative (RTO)

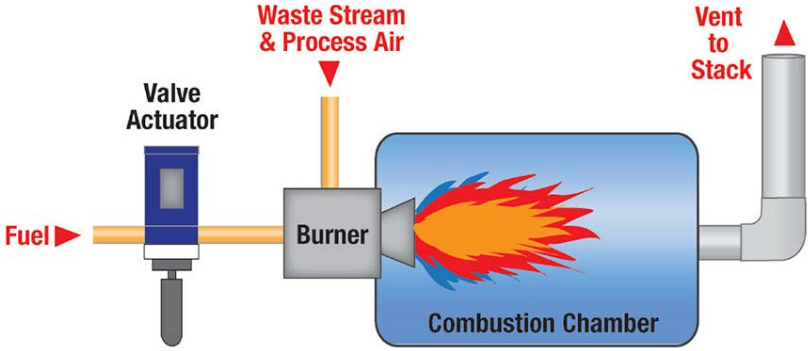


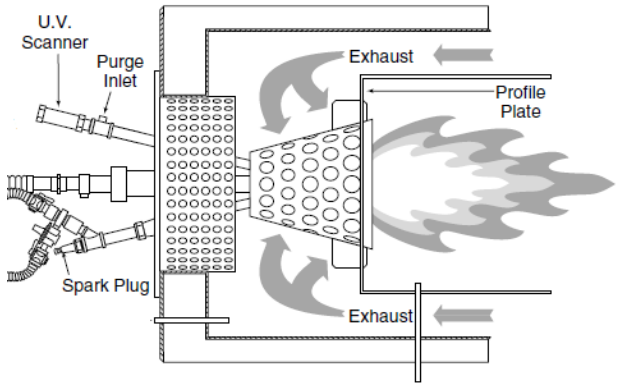
- **Kinedizer LE**
- **ThermJet**
- **Winnox**

Direct Fired Thermal Oxidizers

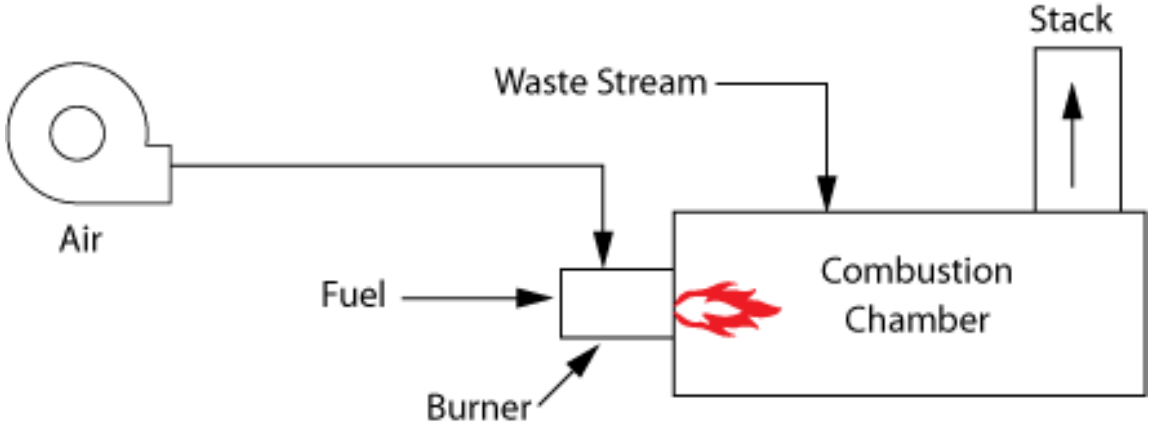


Direct-Fired, Raw-Gas-Airflow Thermal Oxidizer Burner

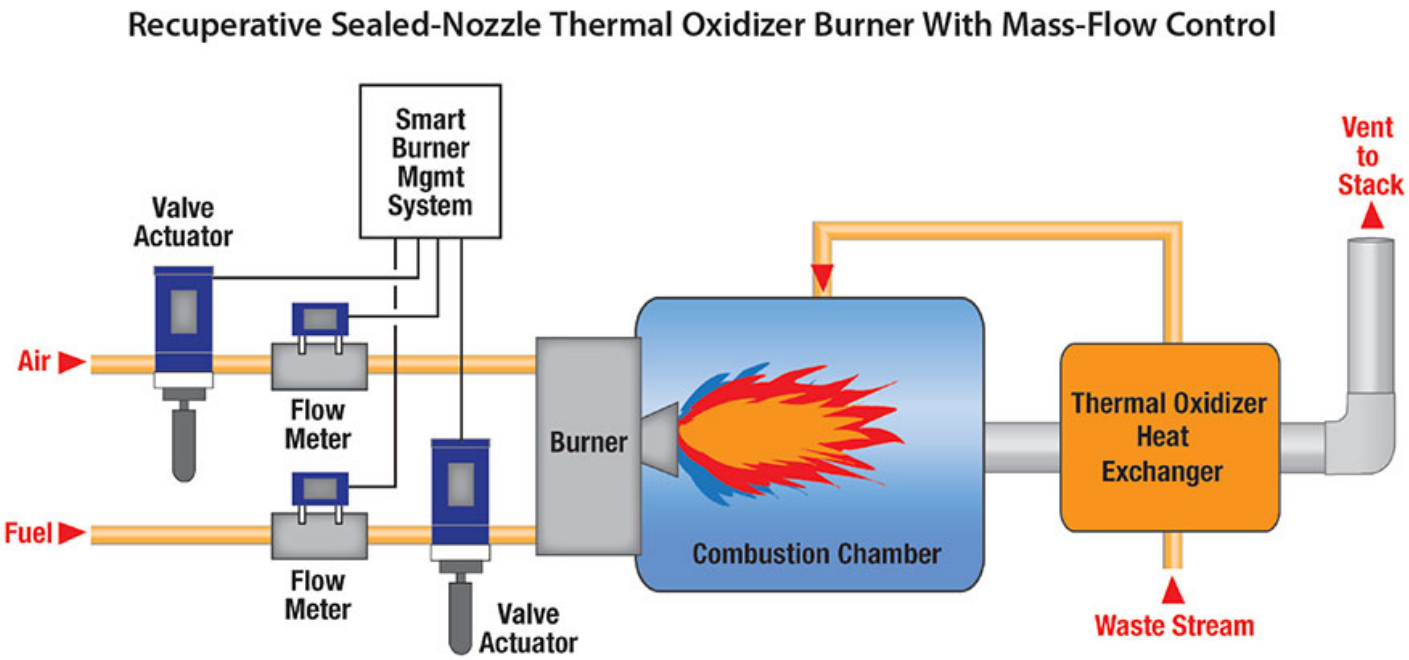




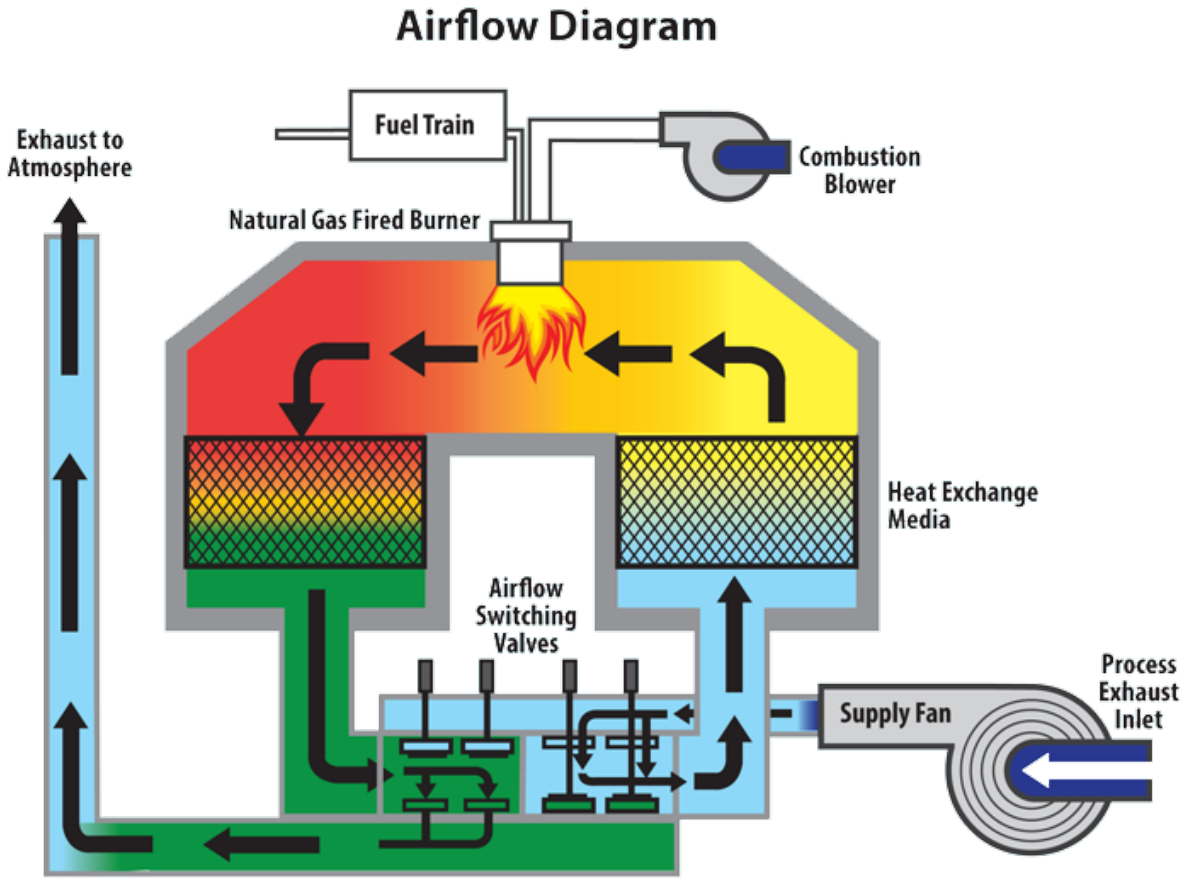
Direct-Fired, Forced Draft Thermal Oxidizer Burner



Recuperative Thermal Oxidizers



Regenerative Thermal Oxidizers (RTO)



Oxidizers

	Kinedizer LE	ThermJet	Winnox	Incini-Cone	Circular Incino-Pak	Combustifume
						
Key Differentiators	Field Proven Low Emissions, Low NOx and Excess Air, Rugged Design, Wide Capacity Range	Alloy combustor, Excess air capability and thermal turn down	Multi-Fuel Capability, Simple Ratio Regulator Control, Very Short Flame Length	Minimal Maintenance, Compact Design, Gas or Oil Fired, High Turndown	Easy cone replacement, High Turndown	Modular, Multiple Configurations and Materials, Clean Heat, Raw Gas or Pre-Mix
Choose When	Low to Ultra Low Emissions, Low Excess Air, Robust	Very large turn down, Fuel flexibility, High excess air capability	Packaged Blower, Low NOx and CO, Ratio Regulator Control Desired	Multi-Fuel, Wide range of capacities	Customer preference is Incino-Pak	Duct uniformity in Low O2 environments, flexible configurations

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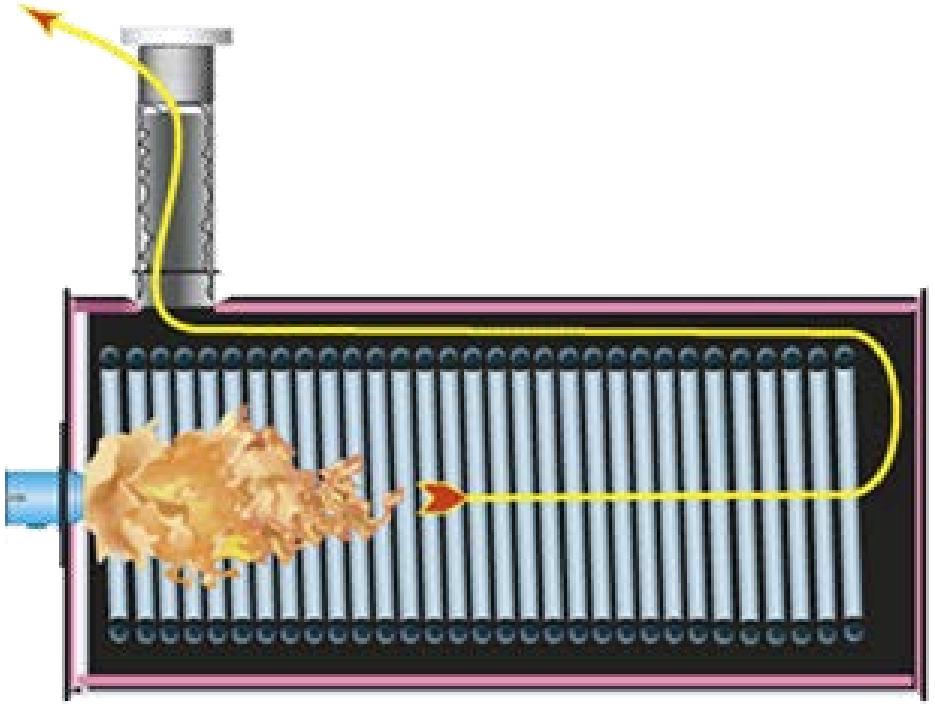
Thermal Fluid Heaters

Thermal Fluid Heaters

- Application/Process Diagrams



Thermal Fluid Heaters

- Application

Thermal Fluid Heaters

- Standard Emissions

	 **RatioMatic**	 **RatioAir**	 **BBC/BBG**	 **Vortometric**
Key Differentiators	Alloy, SiC, and Refractory Tube Options, Nozzle Depth Options	Straight/Medium/High Velocity and Alloy/SiC Refractory Tube Options, ThermJet Nozzle	Alloy or Refractory Baffles and Tiles, Fuel Gases Greater than 500 Btu/ft3 and No. 2 to No. 6 Oil, Low Pressure Atomization with No. 2 Oil	Alloy or refractory combustors, Fuel flexibility including oil, low air pressure,
Choose When	Ratio Regulator Control Desired, Larger Packaged Capacities Needed	Gaseous Fuel Flexibility, Velocity Tubes Needed, Ratio Regulator Control Desired, Higher Temps	Large Capacities up to 32.5MW (123 MMBtu/h), Need Low Pressure Oil Atomization, Fuel flexibility, Higher temperatures and/or PCA	Low air pressure desired, Fuel flexibility

- Low Emissions

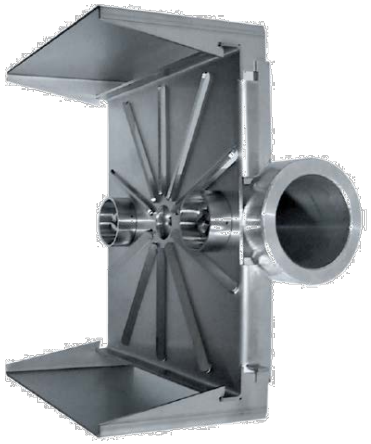
	 **Kinedizer LE**	 **OPLE**	 **Winnox**
Key Differentiators	Field Proven Low Emissions, Low NOx and Excess Air, Rugged Design, Wide Capacity Range	Compact, Unique Nozzle, Balanced Pressure Design	Multi-Fuel Capability, Simple Ratio Regulator Control, Very Short Flame Length
Choose When	Low to Ultra Low Emissions with high capacity, Lower Excess Air	Low NOx, High Turndown, Linked Valves or Parallel Positioning Control are Desired	Variety of Fuels, Low NOx and CO, Ratio Regulator Control desired, Packaged to 8.5MM Btu/h

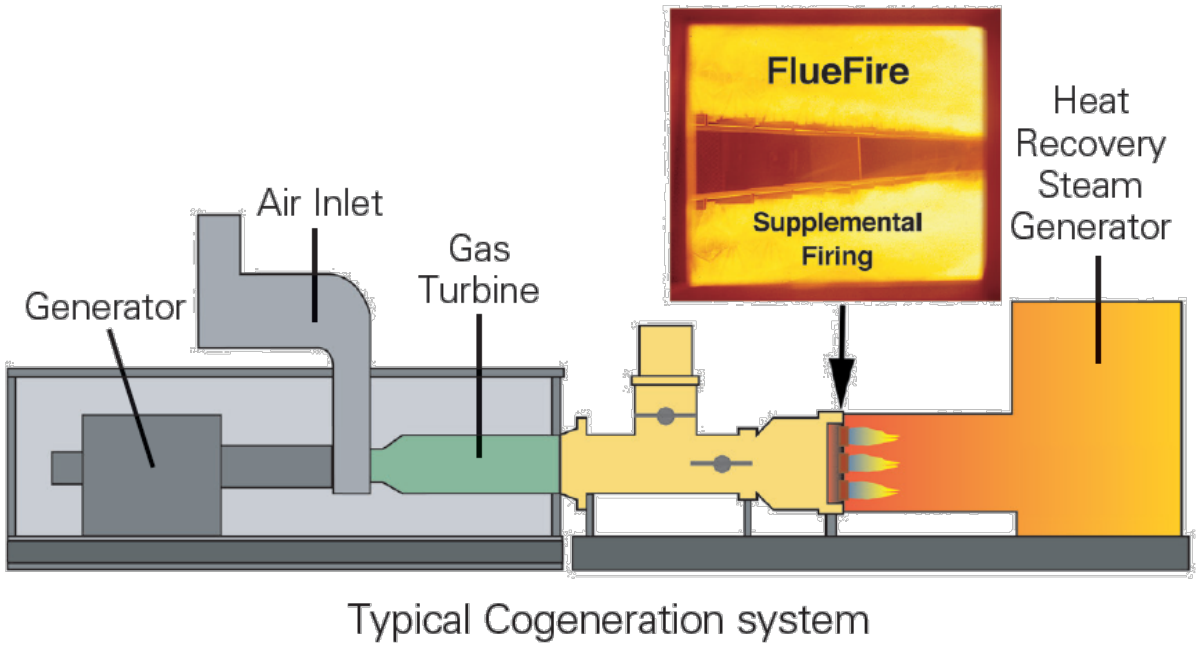
INFORM. PREPARE. ENABLE.

Power Generation

Power Generation

- Process Details

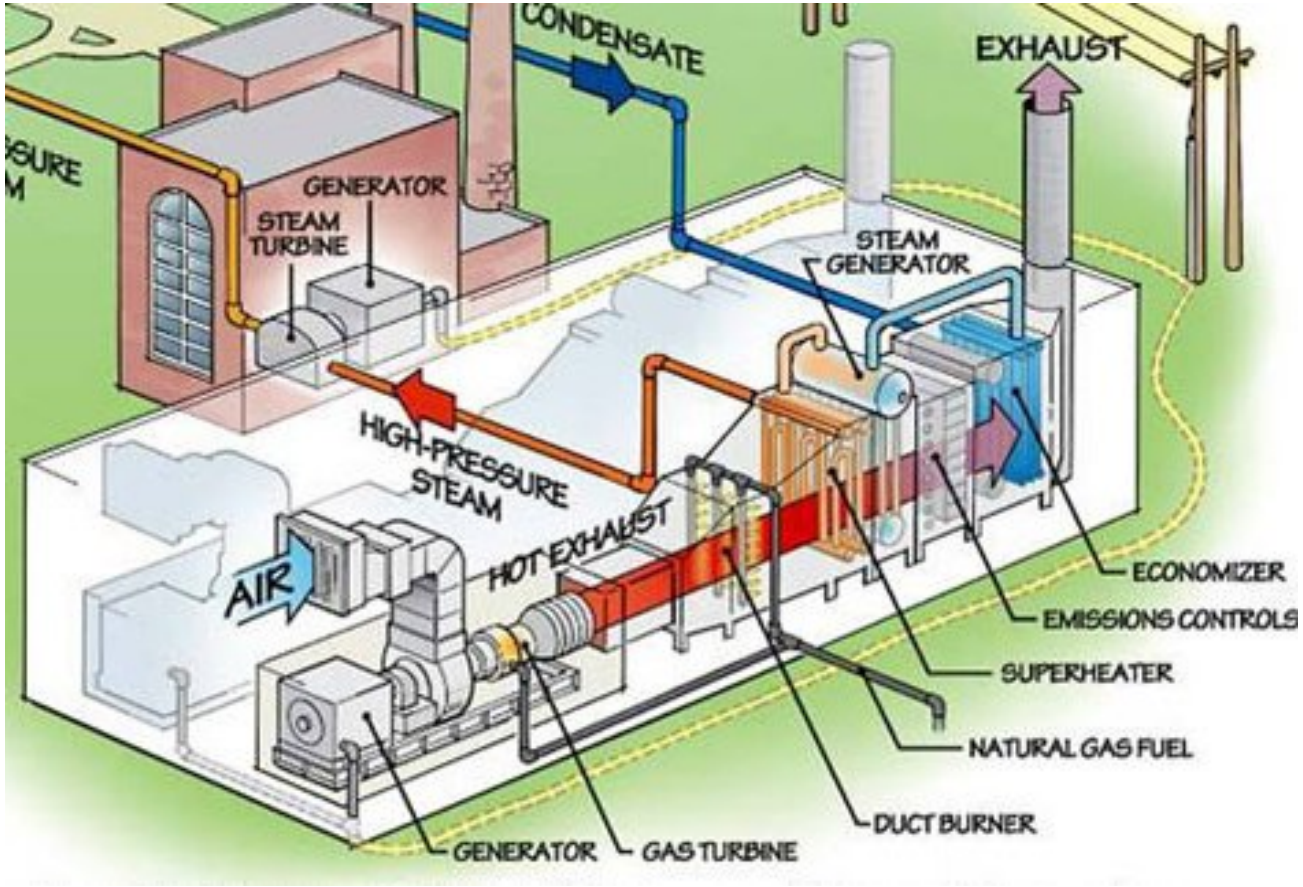




Typical Cogeneration system

Power Generation

- Application



Power Generation

- Application

Power Generation

- Turbine Exhaust Gas Reheating

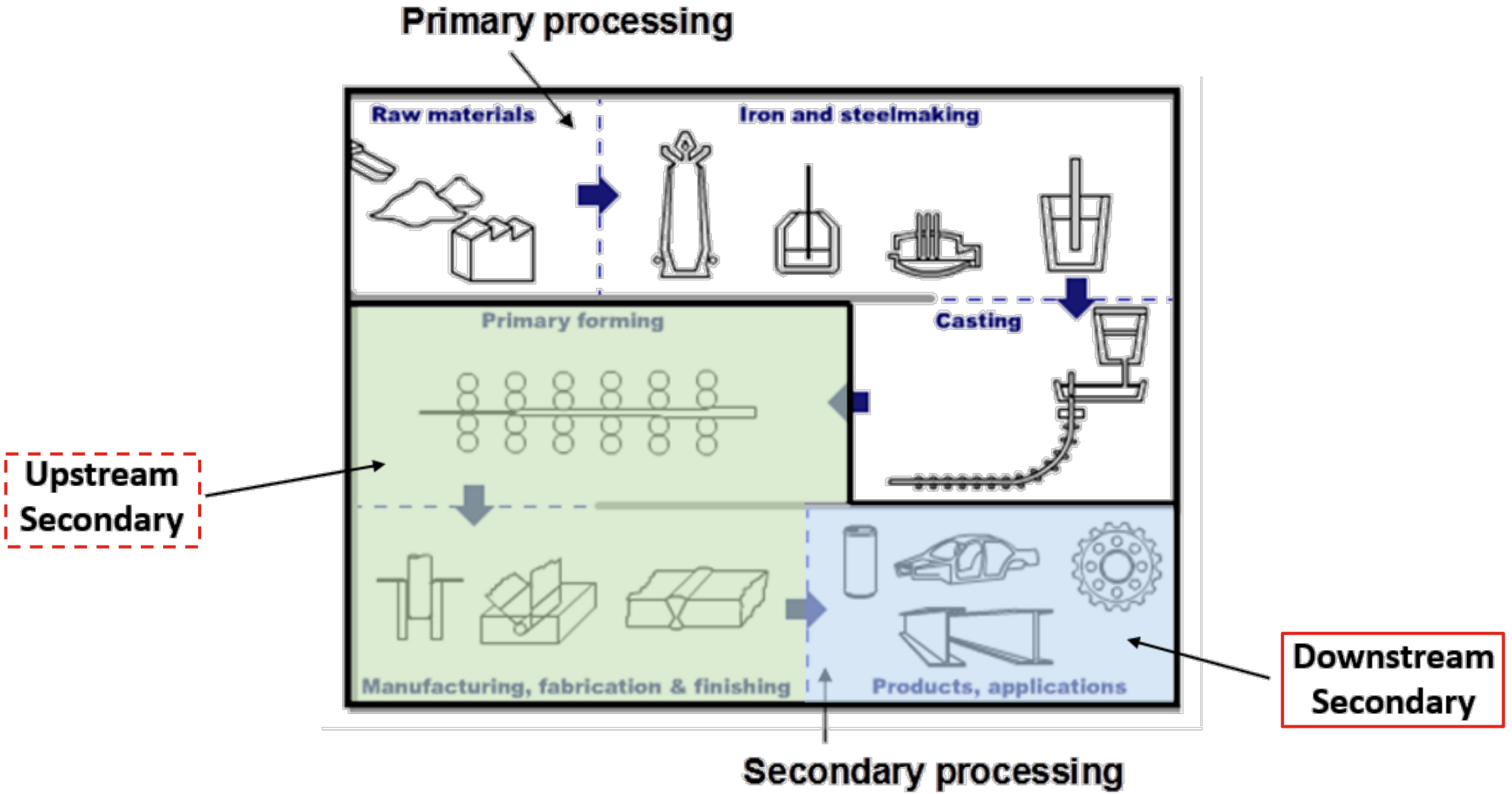
	FlueFire	HC AirFlo	Combustifume
			
Key Differentiators	Operates with fresh air down to 11% O2 in process stream, Flame propagation across rows possible, 6” modules, 1.5MM Btu/h per foot at 15% O2	Large capacity per length, Low NOx, Operates with fresh air down to 12% O2 or less in process stream, low pressure drop over burner, 5.1MM Btu/h per foot at 15% O2	Modular construction with a variety of construction materials, Operates with fresh air down to 12% O2 process stream, 1MM Btu/h per foot at 15% O2
Choose When	Flame propogation for improved ignition, Air assist possible for extremely low O2 streams	Large capacities or high combustion density required, Low NOx	Flexible modular construction needed

INFORM. PREPARE. ENABLE.

Metals

Metals

- Ferrous Process Details



Metals

- Non-Ferrous

- Similar to our involvement in Ferrous
  - Not involved with Primary Operations / Smelting
  - We are involved in Secondary Operations / Processing

- Secondary Non-Ferrous Applications
  - Aluminum Furnaces
    - Scrap Melting
    - Reverb / Melt Down
    - Holding
  - Aluminum Transport Ladles (Die-Casting)
  - Aluminum Aging/Homogenizing Ovens
  - Zinc Melting
    - Galvanizing Kettles
  - Copper Annealing Furnaces

Metals

- Direct Fired Furnaces and Applications

Batch:

- Car Bottom
- Tip Up
- Box
- Lift Off
- Drop Bottom
- Beehive (Brick)
- Ladle Heating

Continuous:

- Roller Hearth
- Rotary Hearth
- Continuous Strip Annealing
- Mesh/Cast Belt
- Reheat (Walking Beam / Pusher)
- Tunnel Kiln
- Galvanizing Kettle

Applications:

- Metals: Annealing, Normalizing, Stress Relief, Tempering, Austenitizing, Homogenizing, Galvanizing, Reheating, Forging, Melting, Holding

Metals

- Velocity Burners - Direct

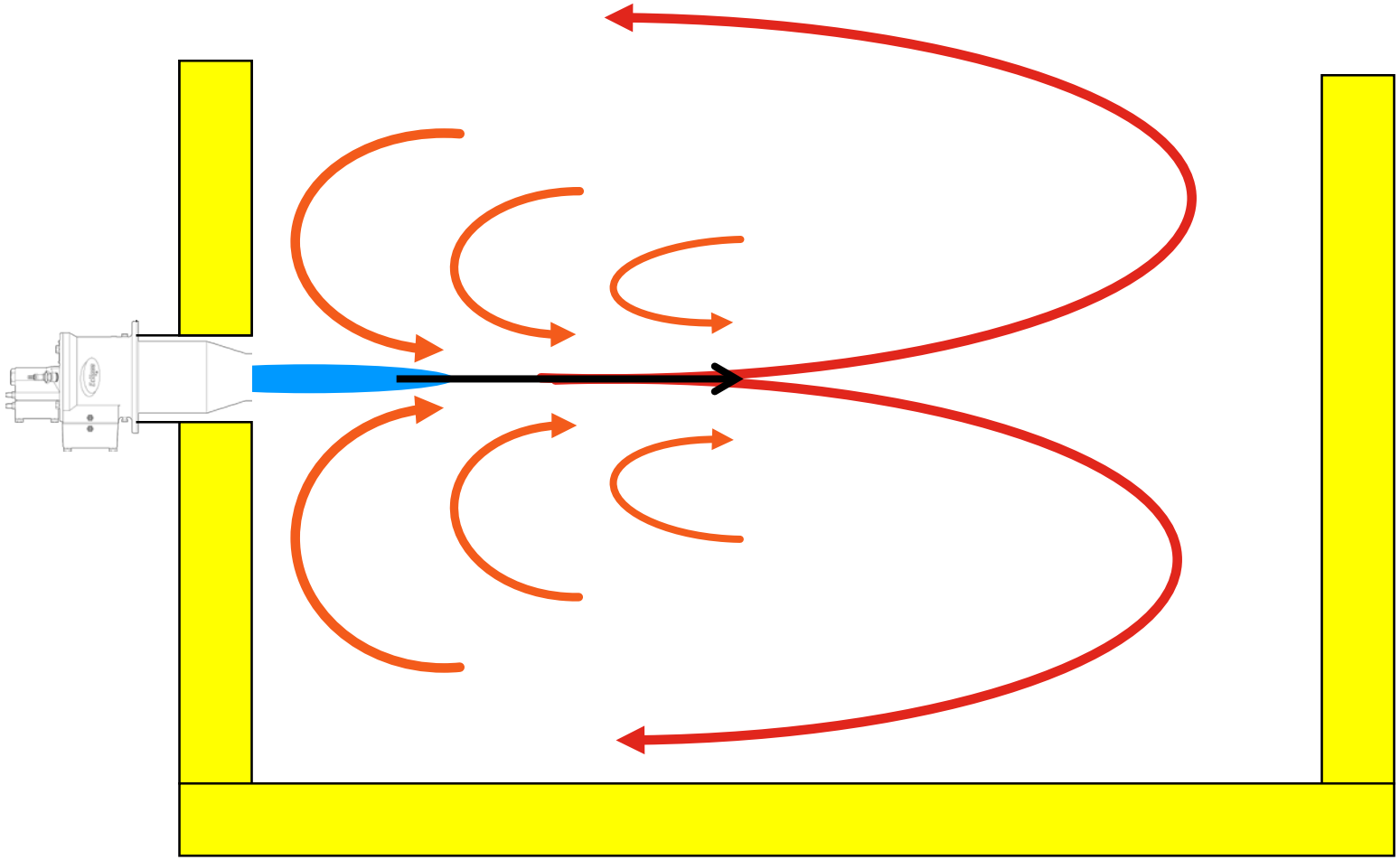
ThermJet

BIC/BIO

Metals

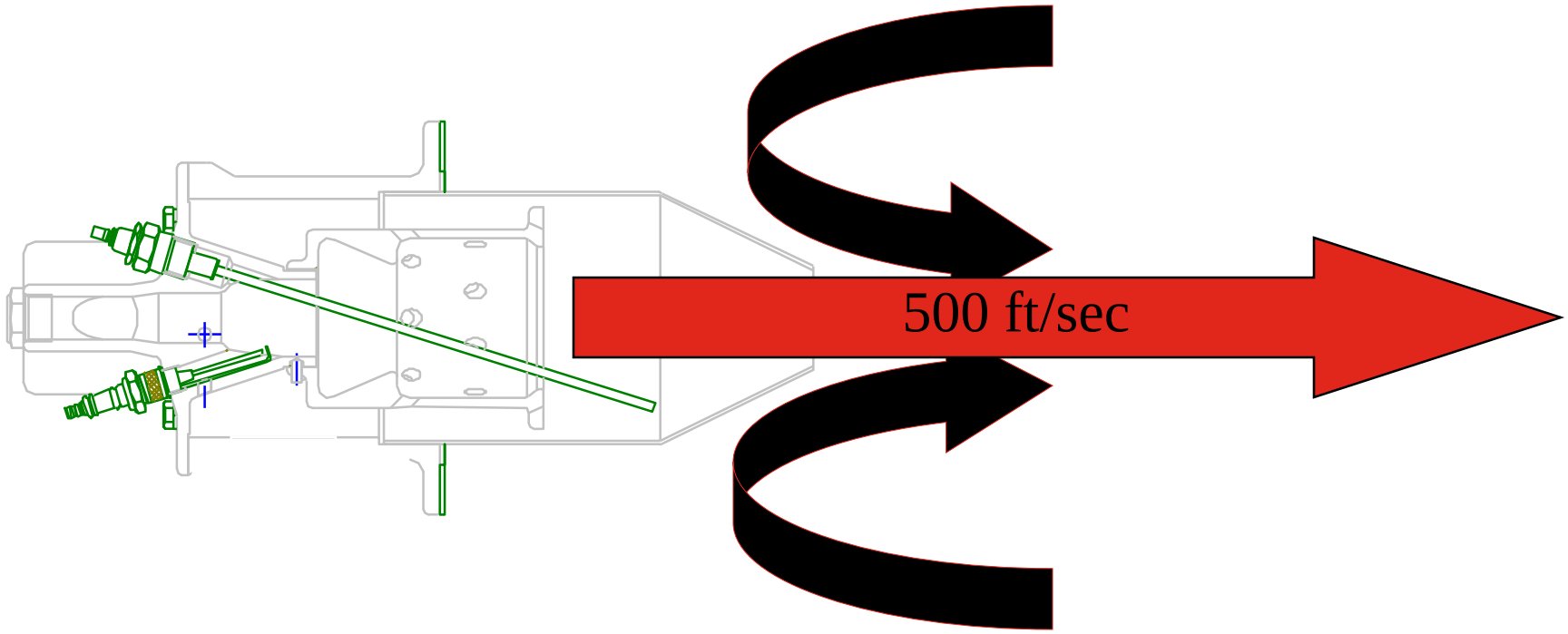
- Direct Fired Velocity Burners

High Velocity = Improved Temperature Uniformity



Metals

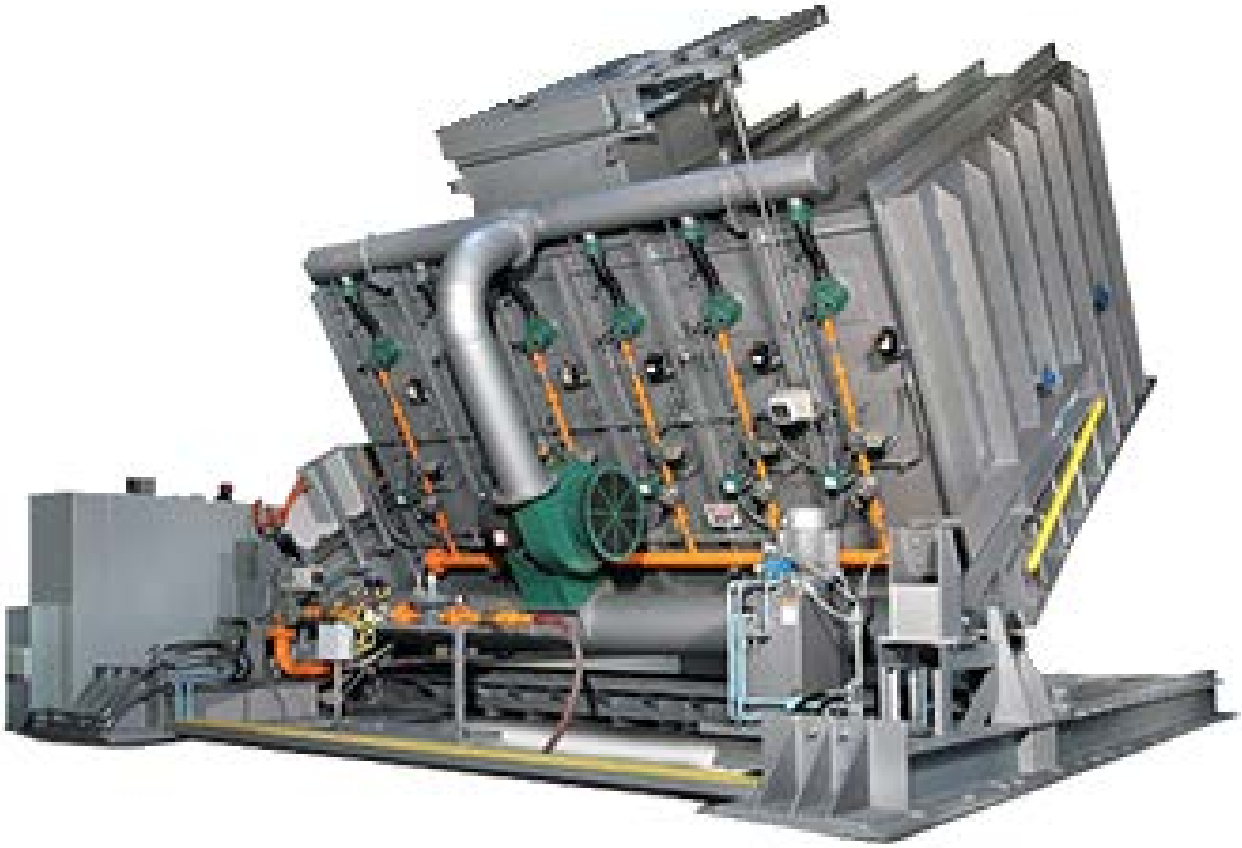
- Direct Fired Velocity Burners
- Low NOx
  - Nozzle Design
  - Exhaust gas recirculation



Metals

- Direct Fired Batch Type: Tempering, Normalizing, Annealing and Stress Relief Furnaces

Box Furnace



Tip Up Furnace

Metals

- Direct Fired Batch Type: Tempering, Normalizing, Annealing and Stress Relief Furnaces

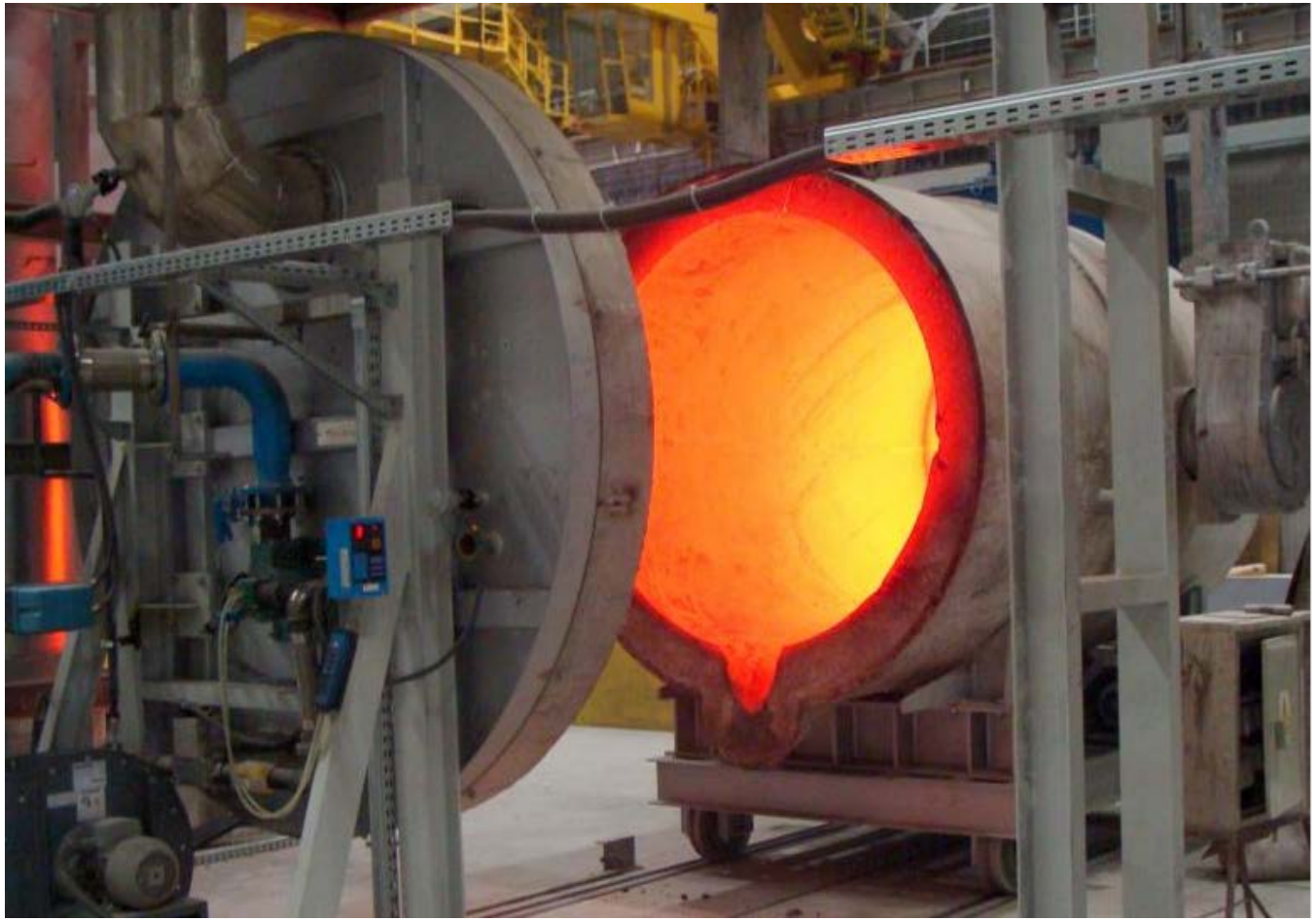
Car Bottom Furnace

Bell Furnaces

Honeywell
THE POWER OF CONNECTED

Metals

- Direct Fired - Ladle Preheating



Metals

- Velocity Burners

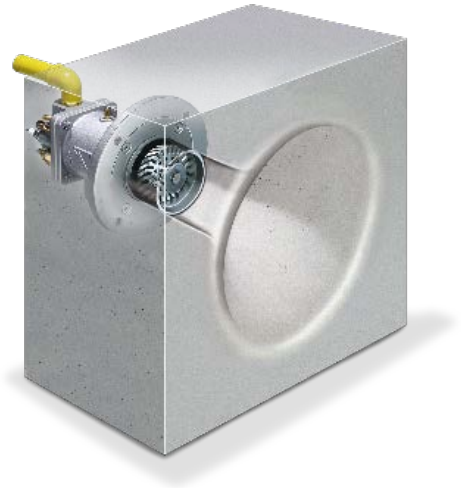
	ThermJet 	BIC/BIO 
Key Differentiators	Alloy combustor, Excess air capability and thermal turn down, PCA options, Multiple combustor options	Adaptable length, Multiple tile design options, Safe and reliable ignition control, PCA options with internal insulation
Choose When	Very large turn down, Modulating and Fuel-only control, HIGH-LOW impulse control, High excess air capability	ON-OFF impulse control, Short flame length, Thick furnace walls, Insulated version for PCA

Metals

- Other Direct-Fired Burners

Furnnox

TriOx

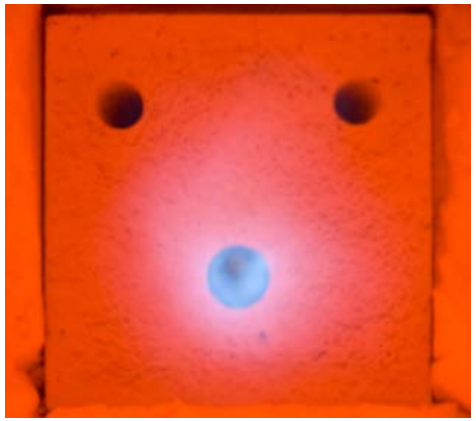


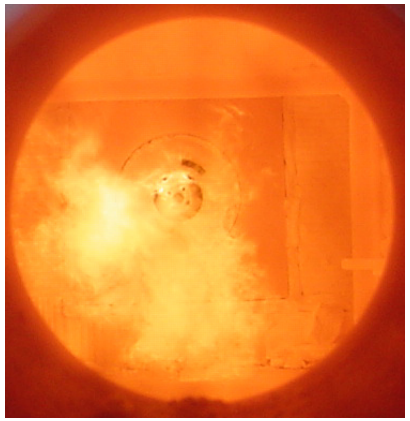
BIO..K

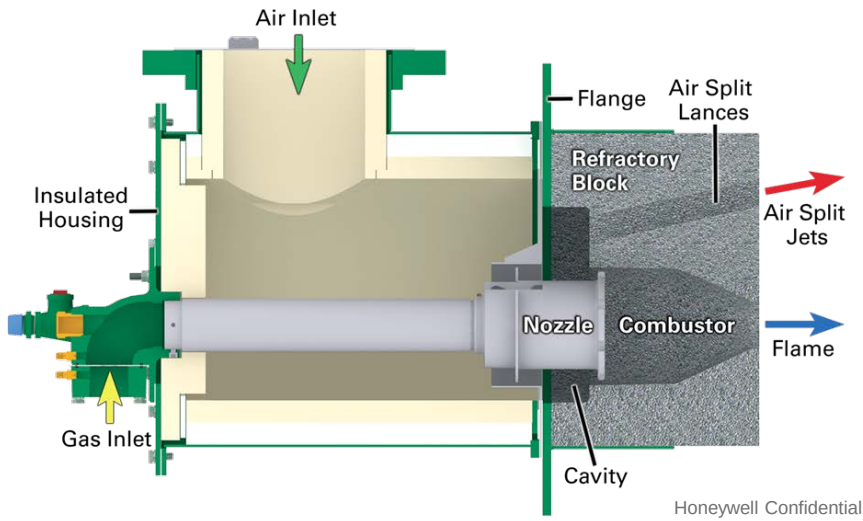
Wall Hugger

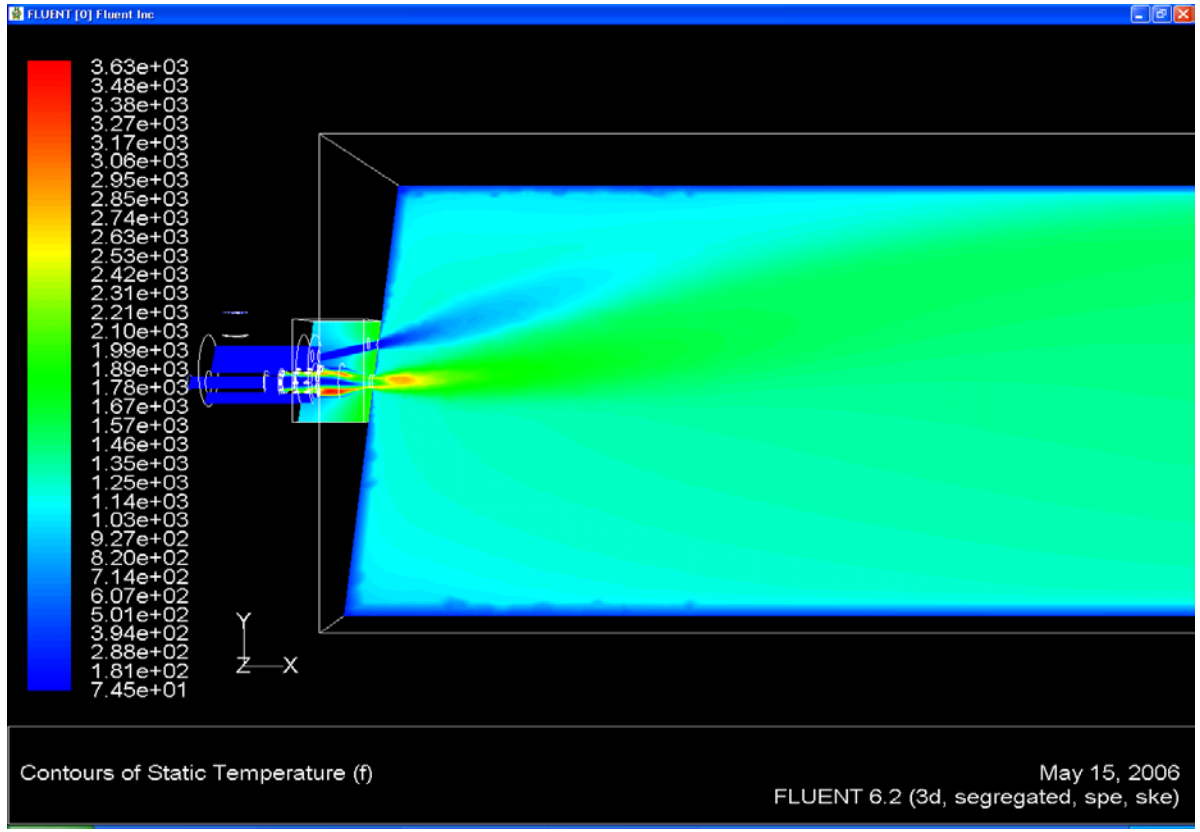
Metals

- Deep Air Staging for Low NOx
  - Furnnox
  - TriOx (Invisiflame®)



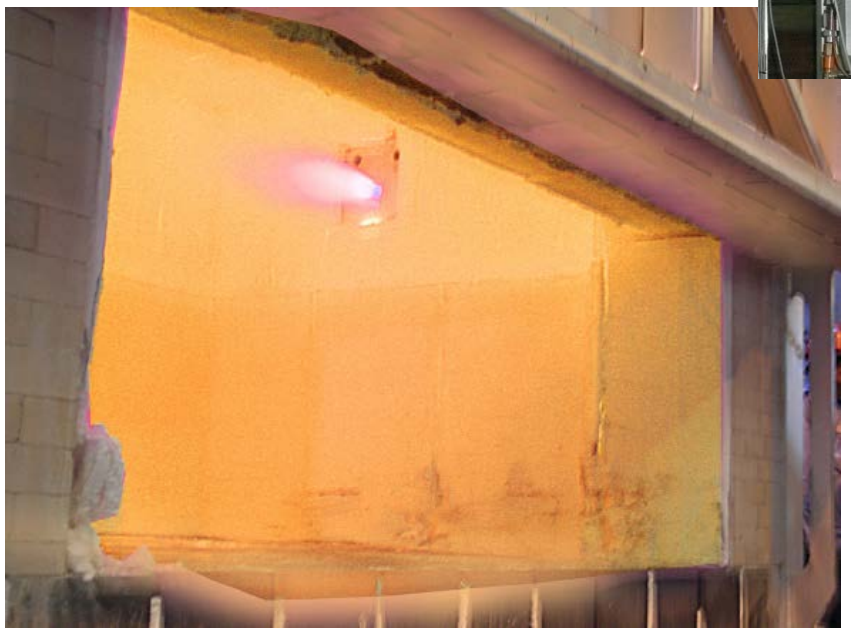






Metals

- Batch Type: Forge Furnaces



Metals

- Direct Fired - Aluminum Melting

Metals

- Direct Fired – Reheat Furnaces

Metals

- Low NOx Direct Fired

	 **Furnnox**	 **TriOx**
Key Differentiators	Ultra Low NOx emissions in high temp applications, with or without preheated combustion air, optional insulated body for PCA	Ultra Low NOx Invisiflame Mode, Several firing modes options, Large capacities
Choose When	Ultra Low NOx emissions required, Smaller capacities	Ultra Low NOx emissions are required with larger capacities

- Flat Flame

	 **BIO..K**	 **WHG**	 **RKG**	 **WHI**
Key Differentiators	Adaptable length, safe and reliable ignition control	Flat flame throughout entire firing range	Short ball-shaped flame	Flat Flame, Ultra Low NOx Invisiflame Mode available, Short Flame Length, Low Excess Air Requirement
Choose When	ON-OFF Impulse control, thick furnace walls	Modulating control, impulse control HIGH-LOW, large area roof or wall, flat flame required	Modulating control, impulse control HIGH-LOW, small area roof or wall with adjacent walls nearby, round-ball flame shape is needed	Applications where heat must be applied close to the load (flat flame), Ultra Low NOx, Even Heat Distribution is needed.

Metals

- Percent Fuel Savings at Various Furnace and Preheated Combustion Air Temperatures

Furnace Exhaust Temp °F	Preheated Combustion Air Temperature °F					
	600	800	1000	1200	1400	1600
2400	26%	32%	38%	43%	47%	51%
2200	23%	29%	34%	39%	43%	47%
2000	20%	26%	31%	35%	39%	43%
1800	18%	24%	28%	33%	37%	40%
1600	17%	22%	26%	30%	34%	
1400	15%	20%	24%	28%		
1200	14%	19%	23%			
1000	13%	18%				

Fuel – Natural Gas @ 10% Excess Air

Honeywell
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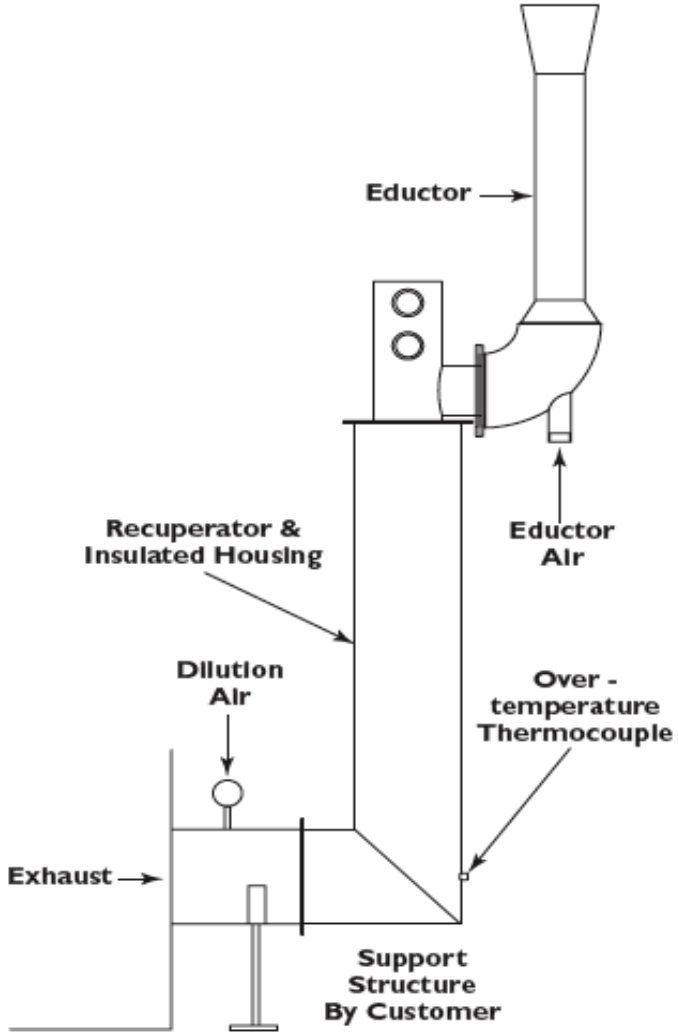
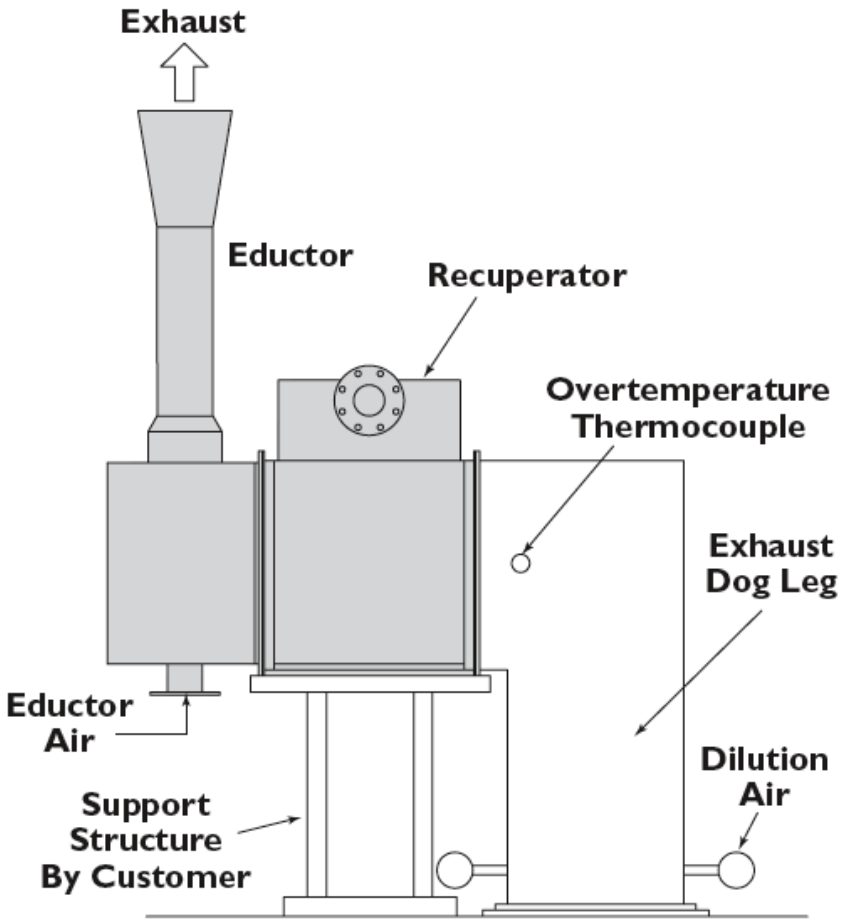
Metals Extern-a-Therm

- Extern-A-Therm



Metals

- Crossflow



Metals

- Heat Recovery

	 **Cross-Flow Recuperator**	 **Extern-a-Therm Recuperator**	 **Dimple Plate Heat Exchanger**
Key Differentiators	Robust, Fixed only on one end to prevent damage/stress, system efficiency improvement up to 70%	Unique “Plug-In” style recuperator designed to improve system efficiency up to 70%	Thick Plates for abrasive/corrosive applications, In-Line dimples accommodate dirtier streams
Choose When	Efficient, Robust, Larger Size heat recovery is required	Efficiency, Smaller Size heat recovery is required	Process air is dirty, abrasive, corrosive

Metals

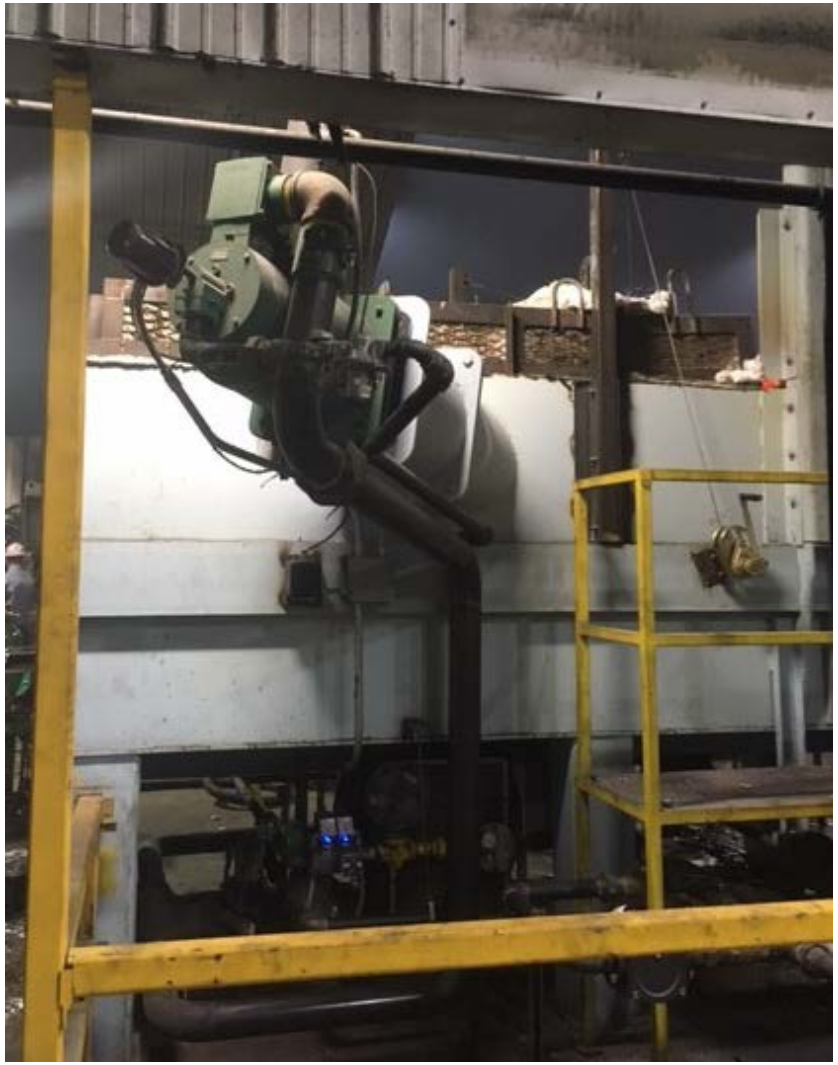
- Self-Recuperative - Direct

TJSR

ECOMAX

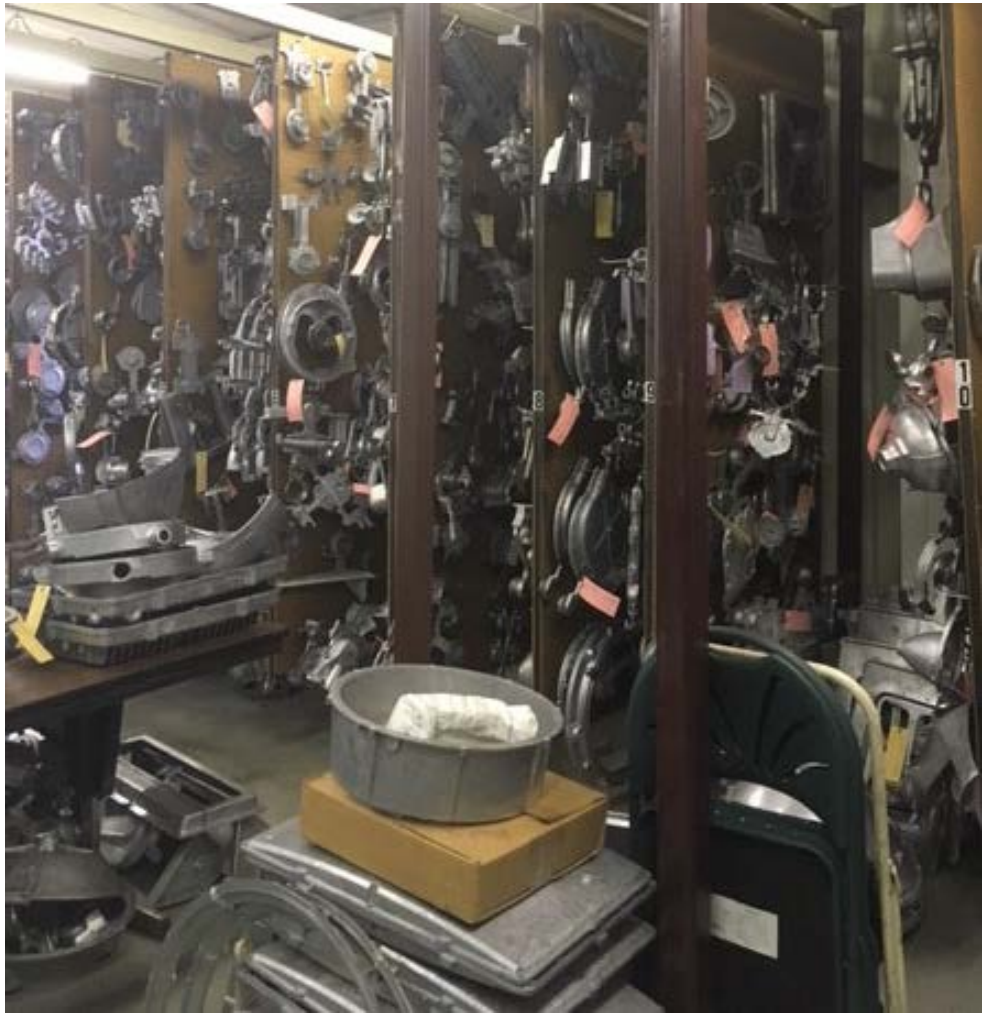
Metals

- Direct Fired – Aluminum Die-Casting



Metals

- Direct Fired – Aluminum Die-Casting



Metals

- Direct Fired Batch Type – Tip-up Furnace

Metals

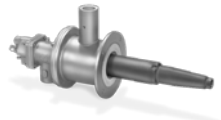
- Direct Fired Conversion to Self-Recuperative Burners – Stainless Steel Annealing Furnace

Metals

- Direct Fired Conversion to Self-Recuperative Burners – Stainless Steel Annealing Furnace

Metals

- Direct Self-Recuperative

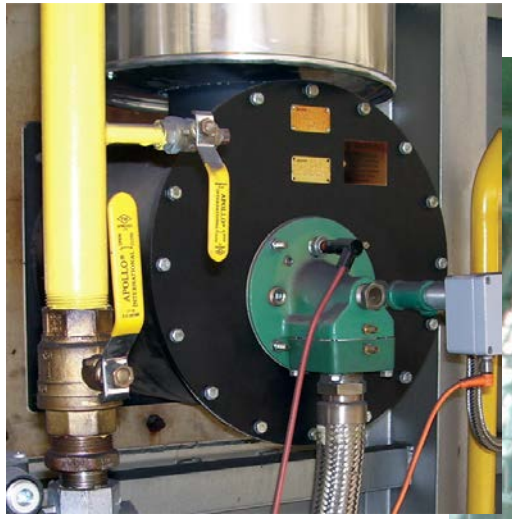
	 **TJSR**	 **Ecomax**	 **BICR**
Key Differentiators	Direct fired, self recuperative burner, single air inlet for combustion + eductor	Ceramic or metallic recuperators, broad range of capacities	Ceramic flat recuperator, simple design
Choose When	HIGH-LOW pulse firing, Modulating control, simple air piping	ON-OFF pulse firing, Flame rod, Larger capacities required	Small capacities

Metals High Temperature Applications - Direct

- Direct Fired Continuous Line – Continuous Annealing Line, Non-Oxidizing Furnace (NOF)

Metals

- Direct Fired Continuous Line – Stainless Steel Annealing and Pickling



Metals

- Indirect Fired Furnaces and Applications

Batch:

- Tip Up
- Box
- Bell

Continuous:

- Roller Hearth
- Continuous Strip Annealing
- Mesh/Cast Belt
- Tunnel Kiln
- Galvanizing Kettle

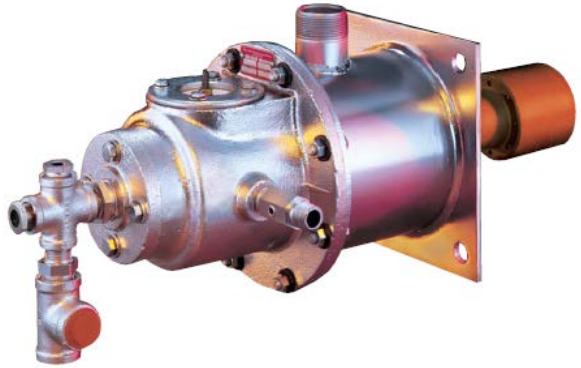
Applications:

- Metals: Annealing, Normalizing, Stress Relief, Tempering, Austenitizing, Carburizing, Homogenizing, Holding, Sintering

Metals

- Indirect Fired - Burner/Plug-in Recuperator Systems

TFB

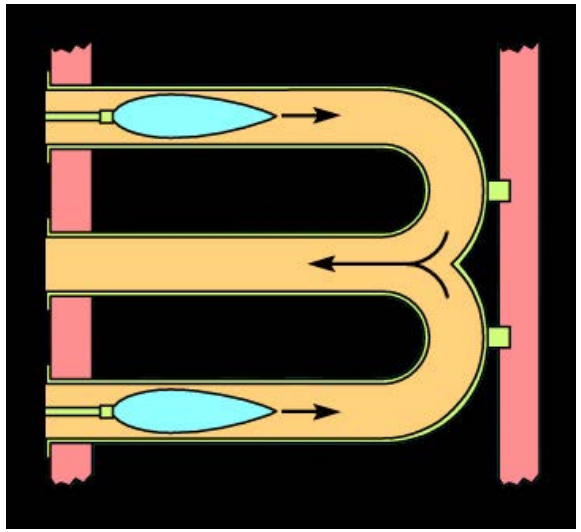


Uni-Rad

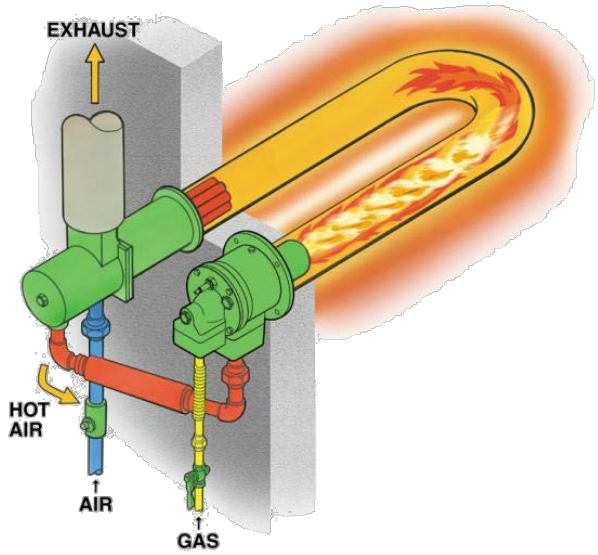
Bayonet Ultra Recuperator

Metals

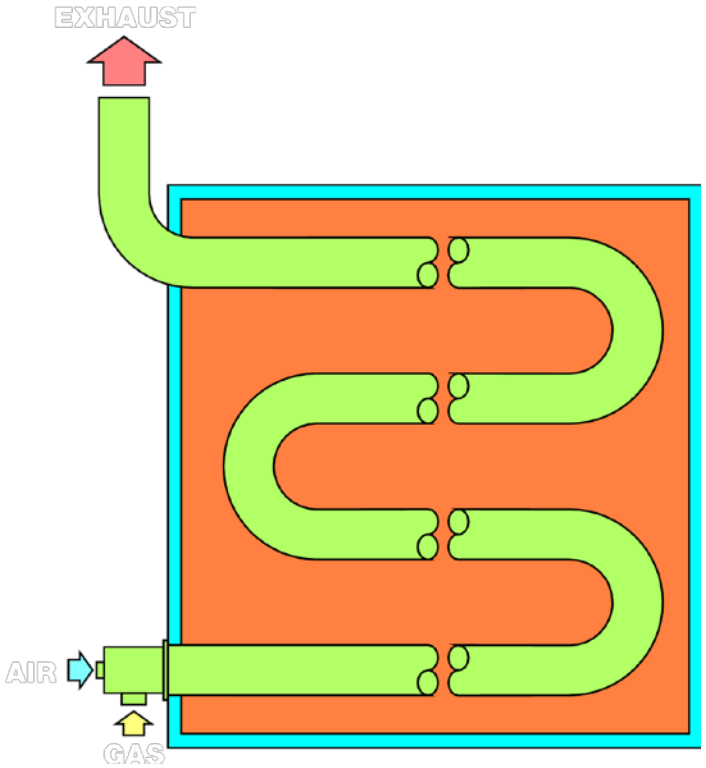
- Indirect Fired – Tube Configurations



Trident Tube



U-tube



W-Tube

Metals

- Indirect – Radiant Tube Material Selection
  - Alloy Benefits – Outer Tubes
    - ☑ Cost issues – Initial outlay
    - ☑ Repairable items – Stocking repair programs
    - ☑ Historical field life
    - ☑ Maintenance handling
    - ☑ Crash scenario not present
  - Maintenance Considerations

Metals

- Indirect – Radiant Tube Material Selection
  - SiC benefits-outer tubes
    - ☑ Extremely high temperature capabilities
    - ☑ Impervious to carbon rot
    - ☑ Potential for extremely high heat flux rates
  - Maintenance Considerations
    - ☑ Not repairable if damaged
    - ☑ Higher initial capital cost
    - ☑ Additional seal required
    - ☑ According to NFPA code-should be outfitted with flame safety

Metals

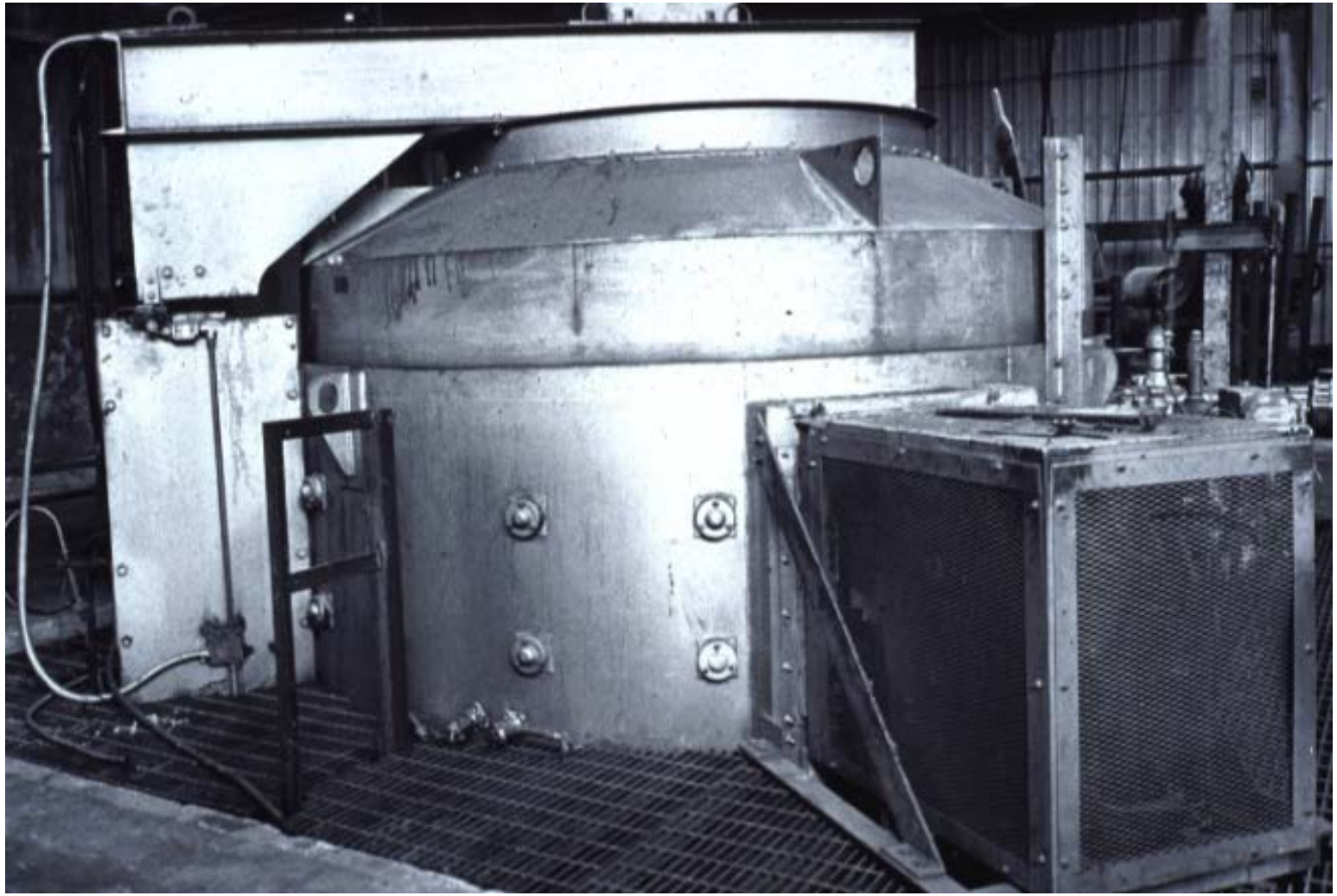
- Indirect Fired – U-Tubes

Metals

- Indirect Fired – Non-Self Recuperative Applications

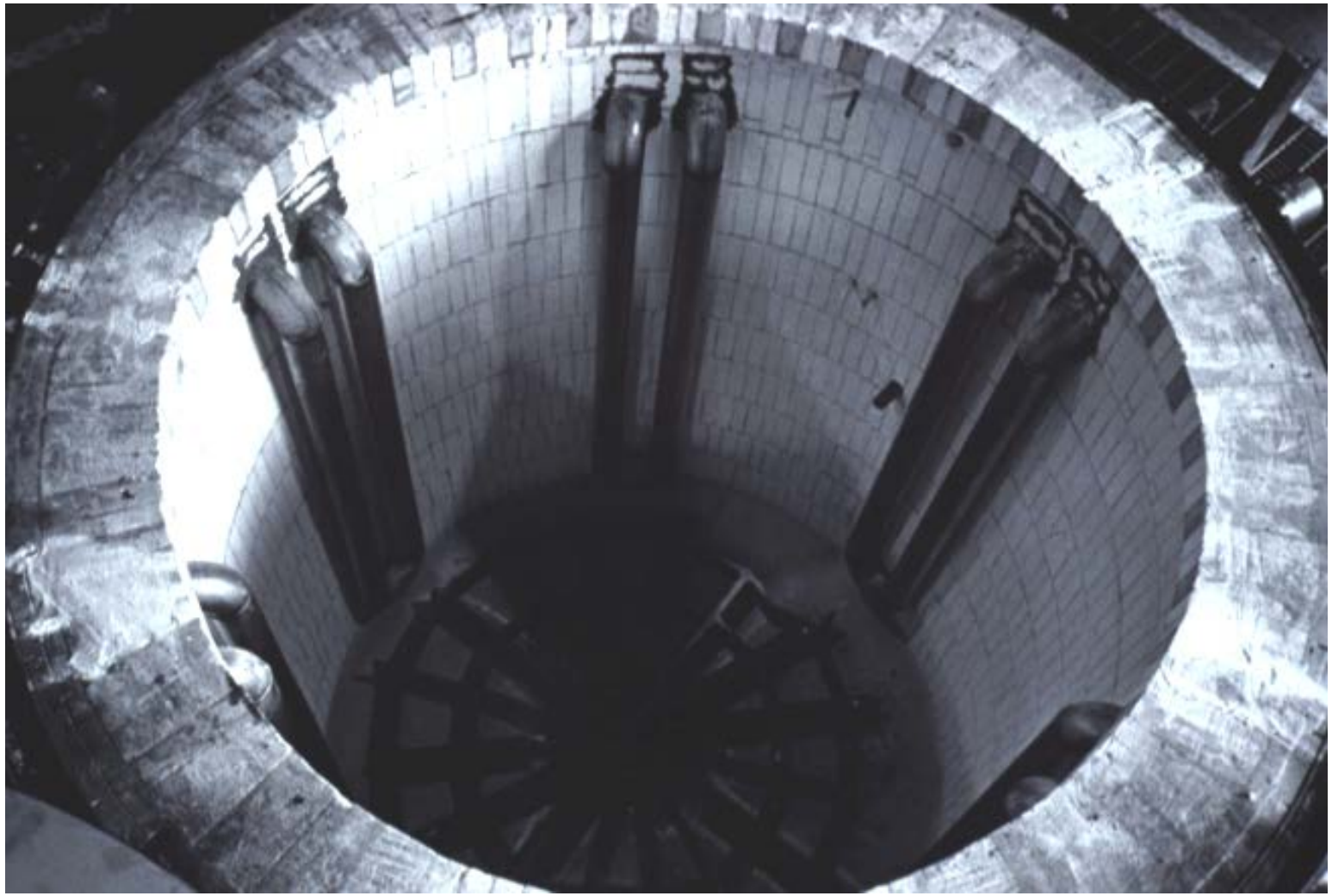
Metals

- Indirect Fired – Pit Furnace



Metals

- Indirect Fired – Pit Furnace with TFBs and BUs

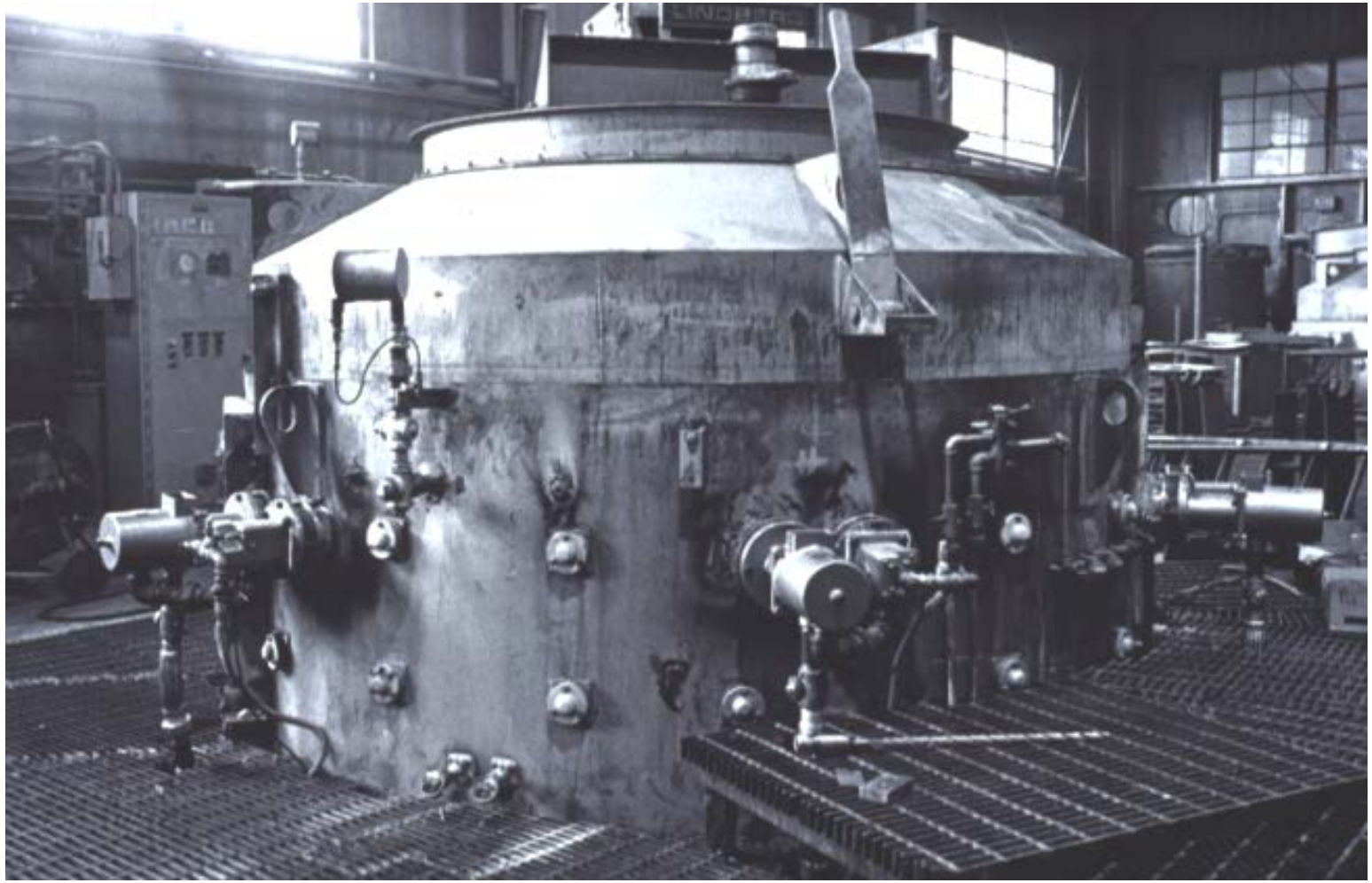


Metals

- Indirect Fired – Non-Self Recuperative Applications

Metals

- Indirect Fired – Pit Furnace with TFBs and BUs



Metals

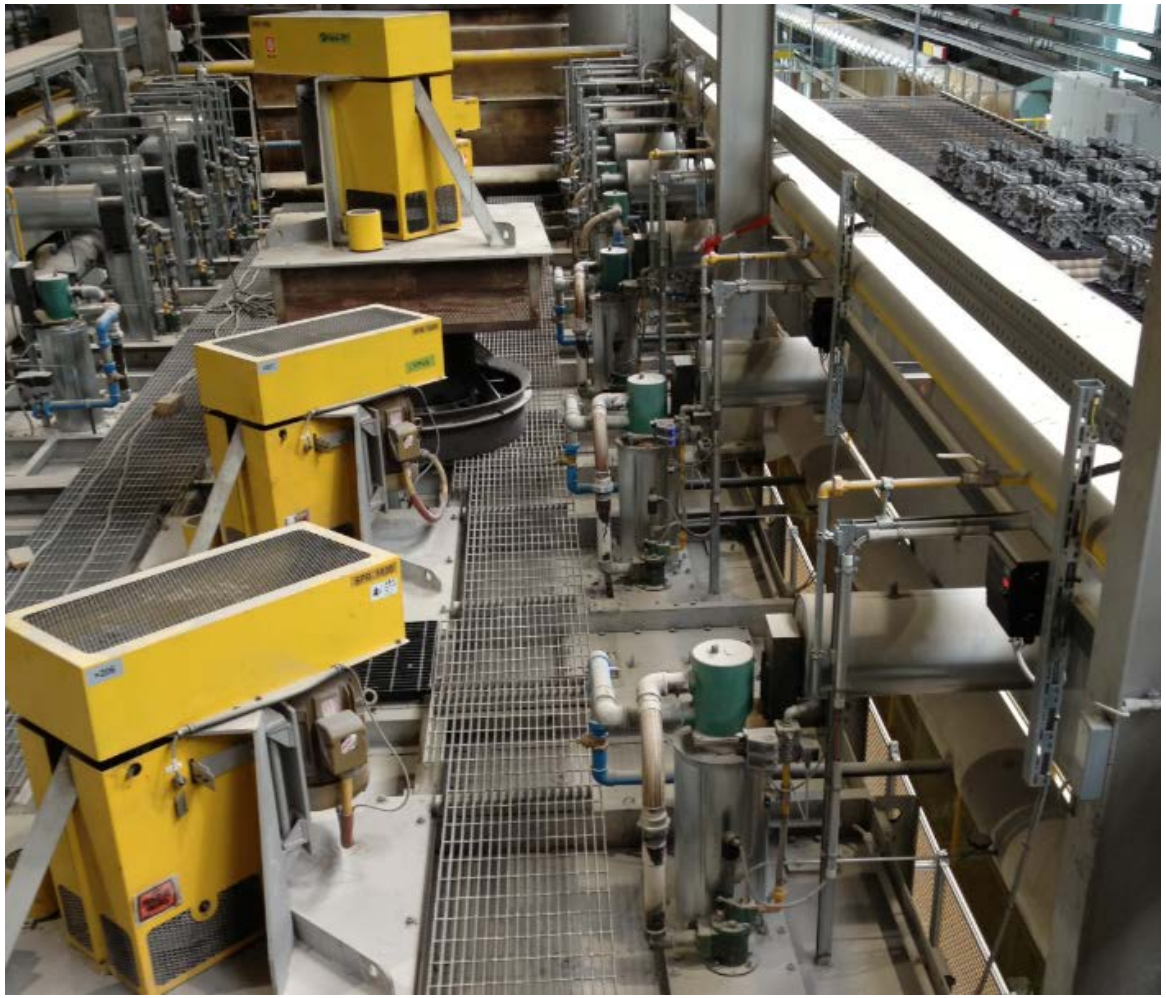
- Indirect Fired – Pit Furnace

Metals

- Indirect Fired – Mesh-belt Furnace with TFBs/BUs on U-Tubes

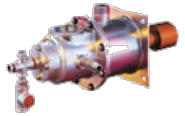
Metals

- Indirect Fired Continuous Type – Aging/Homogenizing Aluminum Engine Blocks



Metals

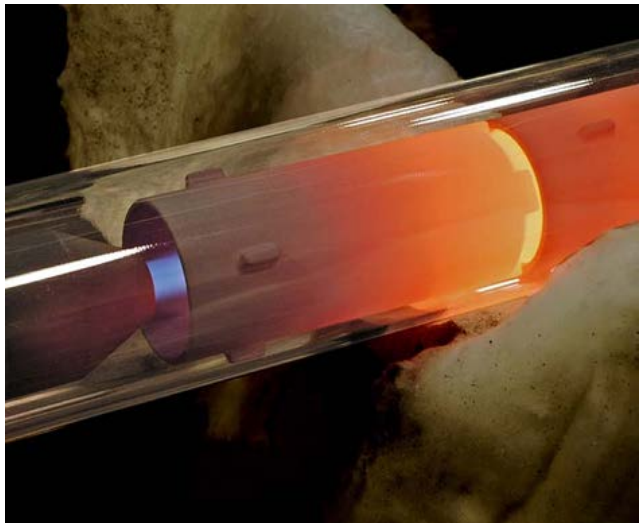
- Indirect Fired Burners – Non-Self Recuperative

	 **TFB**	 **Uni-Rad**	 **Bayonet Ultra Recuperator**
Key Differentiators	3 capacities and many length options, integral air and fuel orifice, adjustable flame length	6 capacities and many length options	Many diameter and length options available to suit the application
Choose When	HIGH-LOW pulse firing or Modulating control, Larger capacity needed	ON-OFF firing, long flame length for long tube	Additional efficiency required

Metals

- Indirect Fired – Self-Recuperative

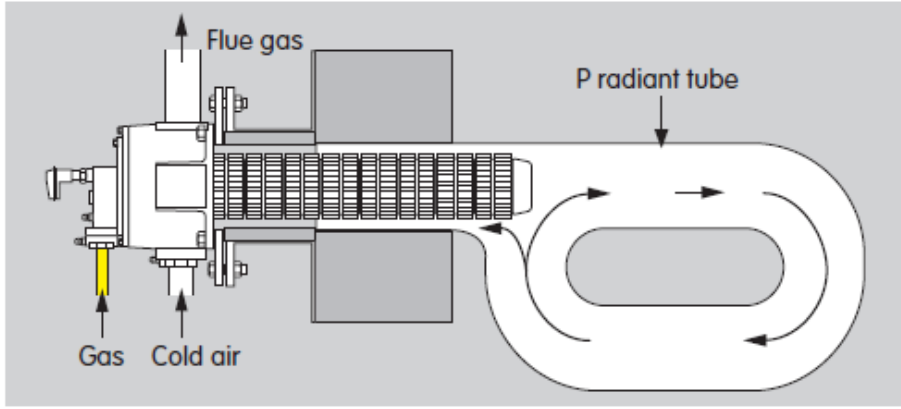
SER



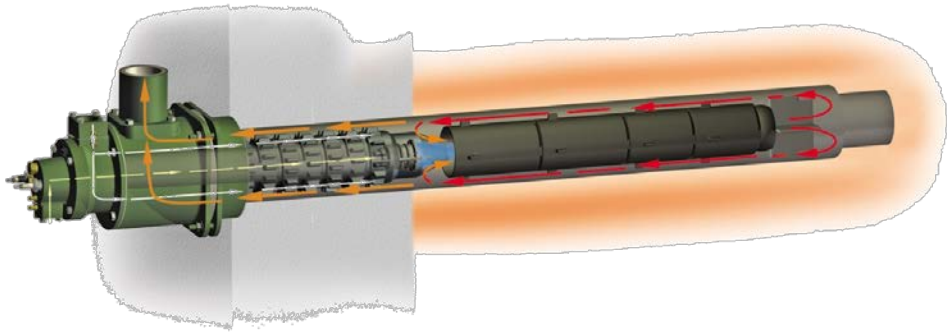
ECOMAX

Metals

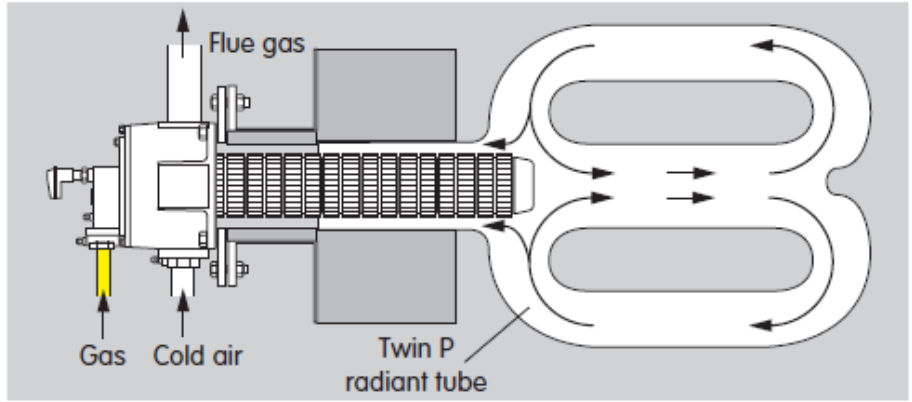
- Indirect Fired – Tube Configurations for Self-Recuperative Burners



P-tube



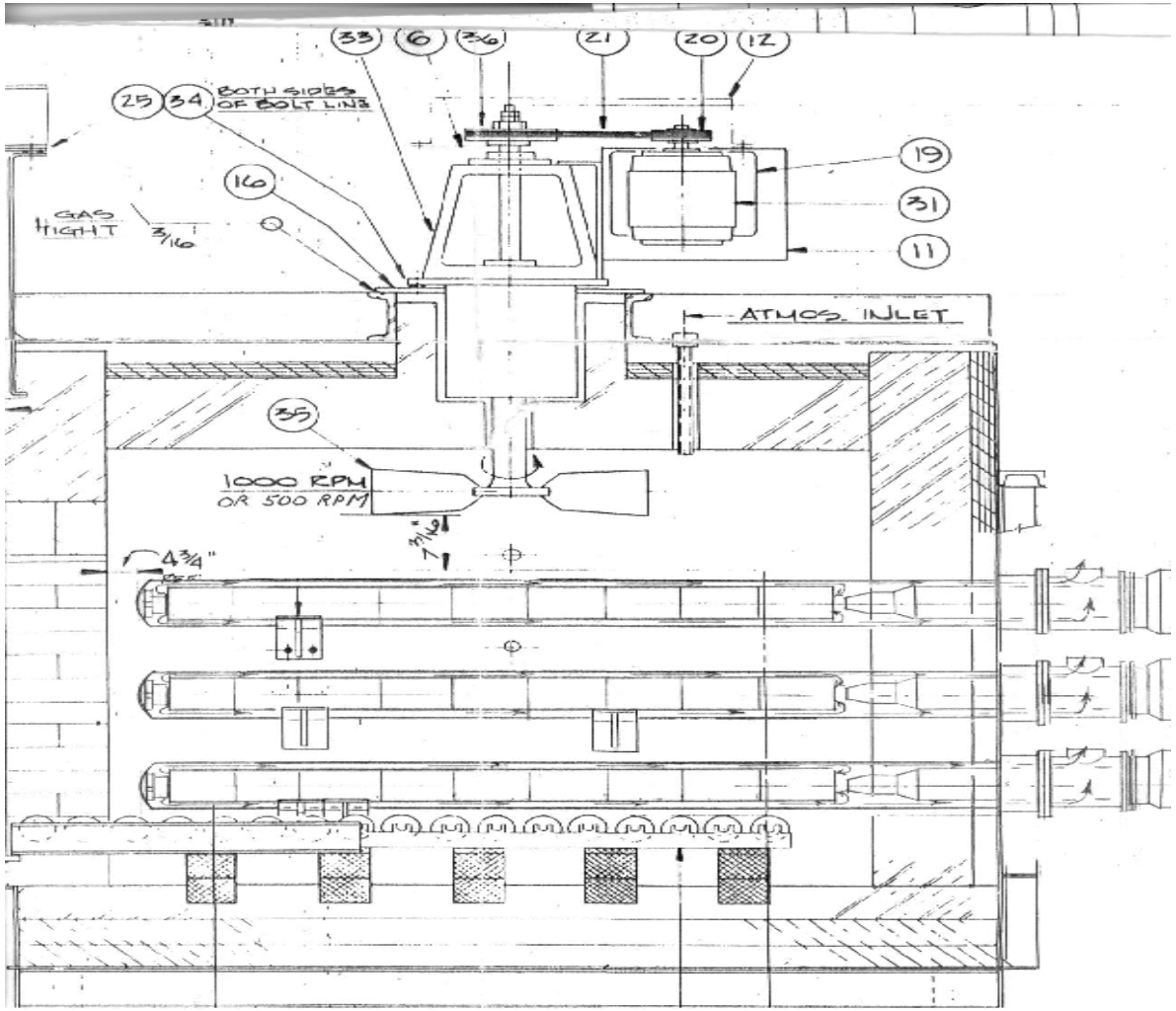
Single Ended Tube



Double P Tube

Metals

- Batch Type - Indirect Fired



Metals

- Batch Type - Indirect Fired

Metals

- Batch Type - Indirect Fired

Metals

- Indirect Fired – Aluminum Holding Furnace

Metals

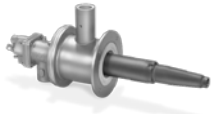
- Continuous Type – Indirect Fired Continuous Annealing/Galvanizing Lines (U-Tubes)

Metals

- Indirect Fired – Continuous Lines (Single Ended)

Metals

- Indirect Self-Recuperative

	SER 	Ecomax 	BICR 
Key Differentiators	High efficiency,	Direct or indirect fired, ceramic or metallic recuperator	Ceramic flat recuperator, simple design, fit into smaller tubes
Choose When	HIGH-LOW pulse firing or Modulating control	ON-OFF pulse firing, Flame rod sensing, Higher furnace temperatures	Radiant tubes where ECOMAX and SER don't fit

Questions?

Todd Ellerton – Product Line Director, Thermal Transfer (todd.ellerton@Honeywell.com)

Jessica Irons – Product Marketing Manager (jessica.irons@Honeywell.com)

Al Benz – Applications Engineer (alan.benz@Honeywell.com)

Brian Kelly – Applications Manager (brian.kelly2@Honeywell.com)

Jim Roberts – Applications Engineer (james.roberts2@Honeywell.com