POWER SOLUTIONS

Products and Capabilities

COMBUSTION | BURNERS | CONTROLS | IGNITION SYSTEMS

ZEECO®

Work with the World Leader.

Zeeco is the global leader in combustion and environmental solutions for the refining, gas processing, production, petrochemical, LNG, power, pharmaceutical, pulp and paper, food processing, marine and offshore, and biogas industries. An ISO 9001:2015 certified company with more than 40 years of industry experience and a worldwide footprint of built-for-purpose manufacturing facilities, Zeeco's reputation for excellence in engineering, reliability, and integrity sets the industry standard. ZEECO® product lines include ultra-low emission burners, gas and liquid flaring systems, hazardous and non-hazardous waste incinerators; vapor control, vapor recovery, and flare gas recovery units.

ZEECO®

CELEBRATING 40 YEARS | EST. 1979

We Work Where You Work.

The world continues to demand cleaner, greener processes, and Zeeco continues to engineer the lowest emissions power equipment available. Zeeco has over 1,000 employees in more than 20 global locations, with eight manufacturing facilities around the world to ensure we are always available for our customers. Put our global engineering, manufacturing, aftermarket parts and service, rental, and project management capabilities to work for your next project.

Located at our global headquarters near Tulsa, Oklahoma, Zeeco's 10-acre (4-hectare) Research and Test Facility is the largest in the world and the first of its kind to become ISO 9001 certified.

*Visit **zeeco.com/contact** for additional Global Location contact information*

Talented. Experienced. Dedicated.

Headquartered in Plainville, CT, USA, Zeeco's Power Group is comprised of industry experts who combine decades of combustion experience with cutting edge technology to provide innovative solutions and seamless project execution. With an average industry experience of 20+ years and an ever-growing installation list of more than 1,000 burners, our team is a cohesive working unit small enough to answer the phone yet large enough to execute global projects.

Customers can put our industry experience and worldwide manufacturing to work on power projects around the globe. Zeeco's reputation for delivering on our promises is unparalleled in the industry. And, Zeeco's ISO 9001 accredited quality management system ensures an interactive, responsive process of review and leads to lean manufacturing processes.

570+ years of combined experience

Zeeco Power Equipment:

New and retrofit, low and ultra-low NOx, round and duct burners for power applications

Typical Applications

- Packaged water tube boilers
- Field erected boilers
- Circulating/bubbling fluidized bed boilers
- Stoker boilers
- CO boilers
- Recovery boilers
- Marine boilers
- Heat Recovery Steam Generation (HRSG)
- Once Through Steam Generation (OTSG)
- Hot Water Generators (HWG)

Ancillary Equipment & Services

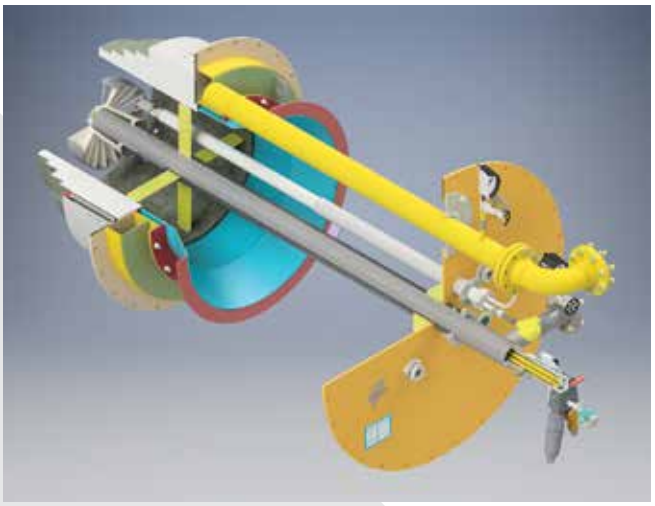
- Ignition systems
- Pilots
- Flame scanners
- Dampers, actuators, positioners
- Cooling air blower skids; simplex/duplex
- Oil pump skids; simplex/duplex
- Combustion electronics
- Burner Management Systems (BMS)
- Boiler Control Systems (BCS)
- Fuel delivery skids
- Physical air flow modeling
- Computational Fluid Dynamics (CFD) modeling
- Engineering/feasibility studies
- Boiler impact studies
- Forced draft and FGR fan assemblies
- Combustion air inlet weather hoods, inlet boxes, FGR mixing boxes and silencers

FREE-JET® Burner: Proven Ultra-Low NOx Performance.

The ZEECO® FREE-JET Burner has delivered ultra-low NOx performance for more than two decades, utilizing advanced fuel staging techniques and patented technology to reduce emissions. The FREE-JET uses a center-fired gas burner with an air swirler to provide a stable core flame while our gas ring directs fuel around the periphery of the burner throat. The FREE-JET design incorporates enhanced fuel staging and aspirates flue gas internal to the furnace, resulting in superior ultra-low NOx performance. The FREE-JET design reduces – and in many cases eliminates – the need for Flue Gas Recirculation (FGR).

Additional FREE-JET Advantages

- Multiple fuel firing capability
- Can meet same or lower emissions with less or no FGR compared to other burner manufacturers
- Pre-cast, pre-cured burner throat – no front wall refractory pouring
- Flexible burner design for single/multi-burner applications
- Center-fired gas gun may be used for low-load / hot standby – no need for dedicated Class I pilot or lower drum heater
- Exceptional turndown capability on both gaseous and oil fuels
- Typical start up and commissioning time of less than two weeks
- Enhanced stability at low loads and during commissioning



FREE-JET® Burner Technical Info

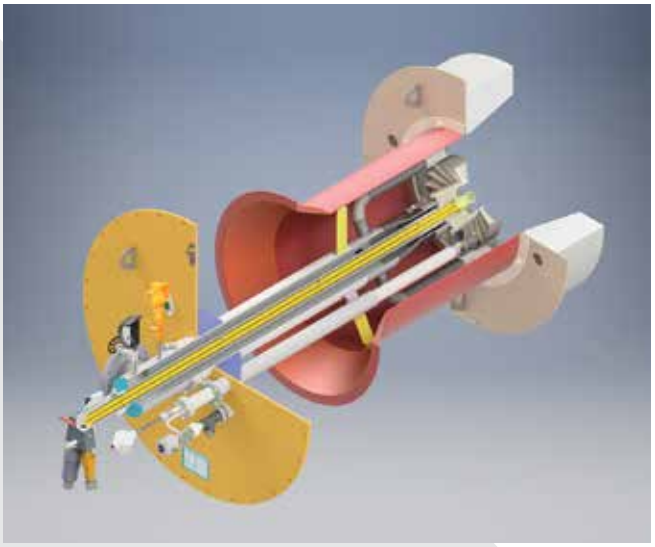
Item	Gas Firing	#2 Oil Firing	#6 Oil Firing
Maximum Design Heat Input, MMBtu/hr (HHV)	430+	420	420
Minimum Design Heat Input, MMBtu/hr (HHV)	10	10	10
Burner Draft Loss, In. W.C.	5 - 12	5 - 12	5 - 12
Excess Air, %	15 - 17	15	15
Burner Operational Turndown	20:1	8:1	8:1
Burner Emissions Turndown	4:1	4:1	4:1
NOx Emissions w/ FGR, ppm at 3.0% O_2, dry	7 - 9	30 - 50	195
NOx Emissions w/o FGR, ppm at 3.0% O_2, dry	15 - 30	100	220
CO Emissions, ppm at 3.0% O_2, dry	50 - 100	50 - 100	100
VOC Emissions, lb/MMBtu	0.004	0.005	0.006
PM Emissions, lb/MMBtu	0.005	0.018	0.10

GB Burner: Simple Solutions. Exceptional Results.

The ZEECO® GB Burner is engineered to solve complex issues, simply. This axial, parallel-flow, register-type burner, is based on a design proven in the combustion industry for more than 40 years. By employing advanced fuel and air staging techniques and incorporating the Z-Jet™ staged gas manifold, it can reliably achieve emissions as low as 18 ppm with Flue Gas Recirculation (FGR), while eliminating flameout or flash back. Flexible and dependable, the GB design can be fired with or without FGR, with multiple fuels, and across both single and multi-burner applications. With no moving parts, the GB burner is engineered for quick startups – typically completed in a week with little to no field adjustment.

Additional GB Burner Advantages

- More compact flame pattern than competition
- Can meet same or lower emissions with less FGR than other burner manufacturers
- Scroll design available for low-Btu fuels
- Suitable for low fuel gas pressure applications



GB Burner Technical Info

Item	Gas Firing	#2 Oil Firing	#6 Oil Firing
Maximum Design Heat Input, MMBtu/hr (HHV)	430+	420	420
Minimum Design Heat Input, MMBtu/hr (HHV)	10	10	10
Burner Draft Loss, In. W.C.	5 - 12	5 - 12	5 - 12
Excess Air, %	10	15	15
Burner Operational Turndown	10:1	8:1	8:1
Burner Emissions Turndown	4:1	4:1	4:1
NOx Emissions w/ FGR, ppm at 3.0% O_2, dry	18 - 30	30 - 50	195
NOx Emissions w/o FGR, ppm at 3.0% O_2, dry	50 - 80	100	220
CO Emissions, ppm at 3.0% O_2, dry	50 - 100	50 - 100	100
VOC Emissions, lb/MMBtu	0.004	0.005	0.006
PM Emissions, lb/MMBtu	0.005	0.018	0.10

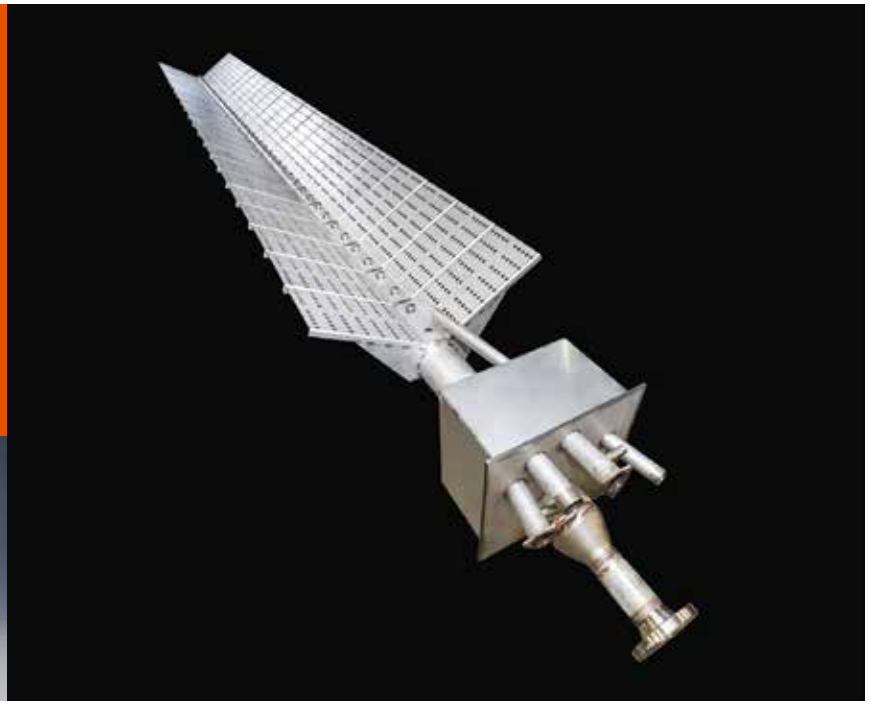
TEG+™ Duct Burner: Lower Cost. Better Stability.

The next generation ZEECO® TEG+ Duct Burner provides the most reliable supplementary firing system available for today's demanding HRSG and Turbine Exhaust Gas (TEG) applications. Our self-supporting burners eliminate the need for internal fixed structural support, which can cause binding and overall deformation – dramatically reducing installation time and material costs.

TEG+ burners use flame stabilizers featuring an optimized drilled wing orifice pattern to create a short, compact flame. The nozzle design features pilot flame propagation drilling and varying orifice sizes throughout the runner to ensure highly reliable ignition, even temperature distribution, and consistent flame pattern.

Additional TEG+ Duct Burner Advantages

- Rapid light-off and enhanced load-following capabilities
- Can fire multiple gaseous fuels for various applications
- Ability to remove/replace individual gas nozzles
- Lowest installation/retrofit cost in the industry



Grid-Style Duct Burner

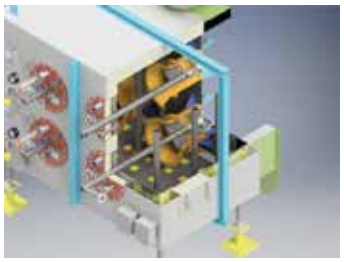
Item	Gas Firing
Maximum Total Design Heat Input, MMBtu/hr (HHV)	980+
Minimum Total Design Heat Input, MMBtu/hr (HHV)	30
Heat Release Range, MMBtu/hr (HHV) per linear foot	2 – 5
Burner Draft Loss, In. W.C.	0.25 – 0.5
Flame Length, ft	6 - 8
Burner Operational Turndown	≥ 12:1
Temperature Distribution, °F	± 100
NOx Emissions, lb/MMBtu	0.05 – 0.08
CO Emissions, ppm at 3.0% O_2, dry	50 - 100
VOC Emissions, lb/MMBtu	0.004
PM Emissions, lb/MMBtu	0.005

Register-Style Duct Burner: Meet Emission Targets.

ZEECO® register-style duct burners may be the ideal choice when lower emissions or lower operating O_2 levels are a project requirement. Our register-style duct burner delivers high efficiency and excellent reliability across a wide range of both gaseous and liquid fuels, suitable for a variety of TEG firing applications.

Register-Style Duct Burner

Item	Gas Firing	#2 Oil Firing
Maximum Total Design Heat Input, MMBtu/hr (HHV)	340+	340+
Minimum Total Design Heat Input, MMBtu/hr (HHV)	10	10
Burner Draft Loss, In. W.C.	2.0	2.0
Burner Operational turndown	10:1	8:1
NOx Emissions, lb/MMbtu	0.04 – 0.05	0.06 – 0.08
CO Emissions, ppm at 3.0% O_2, dry	50 - 100	50 - 100
VOC Emissions, lb/MMBtu	0.004	0.005
PM Emissions, lb/MMBtu	0.005	0.018

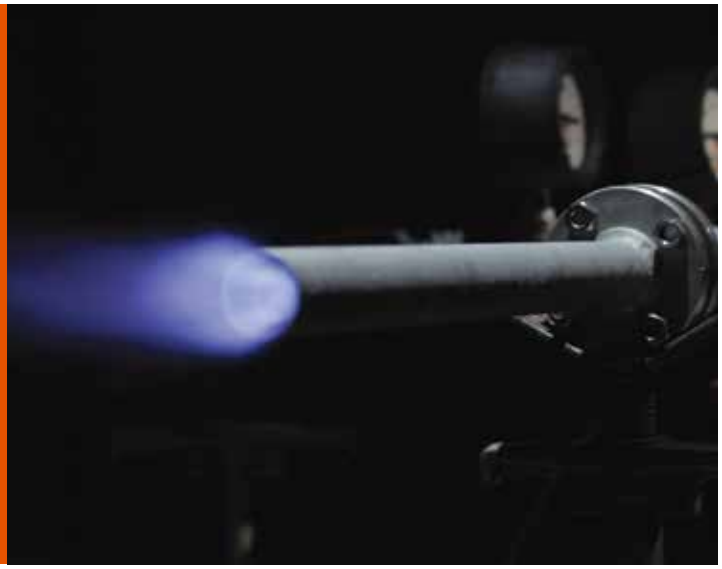


Ignition Systems: Reliable. Flexible. Proven.

Trust our full line of high-quality and ultra-reliable ZEECO® ignition systems. Ranging from simple flame rods to retractable NFPA Class 3 special high-energy direct spark rods, through Class 3 intermittent igniters, up to Class 1 continuous duty pilots, Zeeco offers solutions for any application.

Additional Igniter and Pilot Advantages

- Fast, reliable light-off of pilot and/or main fuel
- Can fire a variety of fuels including natural gas, propane, and #2 oil
- Class 3 special direct spark system eliminates pilot fuel valve train
- Space saving remote transformer enclosure
- Optional high-energy or high-tension ignition
- Optional pneumatic retraction with ancillary equipment
- Quick-disconnect wiring harnesses for easy installation/adjustment



Igniter

Item	AR/GS-1	AR/GS-2	ZHENG	Direct Spark	ZA2	FFG
NFPA Class	Class 3	Class 1/2/3	Class 1/2	Class 3s	Class 3	Class 1/2/3
Heat Input, kBtu/hr	150	1,500 – 5,000	1,000 – 15,000	N/A	300	150 – 5,000
Fuel Designation	NG / Propane	NG / #2 OIL	NG / Propane	N/A	NG / Propane	NG / Propane
Fuel Flow, pph	10	65 - 215	45 - 385	N/A	15	10 – 215
Fuel Pressure, psig	10	10	10	N/A	5	5 – 15
Air Flow, scfh	1,609	1,609	N/A	N/A	N/A	1,609
Air Pressure, psig	10	10	N/A	N/A	N/A	10 – 15
Carrier Tube	1-7/8"	2-7/8"	2-7/8"	N/A	2"	2-7/8"
Retractable?	Option Only			Yes	Option Only	No
Ignition Method	High-Energy (HE)				High-Energy (HE) / High-Tension (HT)	
Power Discharge, J	7				N/A	
Discharge Frequency, S	<0.6 to 8 (preset to 5)				N/A	
Nom. Operating Voltage, V	2000				6000	
Power Supply	120 VAC / 1-PH / 60 Hz				120 VAC / 1-PH / 60 Hz	
Consumption, A	<1.6				<1.2	
Ignition Start Command, V	12-24				12-24	
Enclosure Rating	NEMA 1 / IP20				NEMA 4 / IP66	
Operating Temperature, °F	-40 to 185				-40 to 131	
Certifications	UL, CE, CSA				UL	

Solid Fuel Boiler and Burner Capabilities.

ZEECO® solid fuel burner ignition systems are designed for the fast retrofit of pulverized coal burners. The reduced diameter of the igniter carrier tube makes installation quick and easy. The tube can be placed in the annulus or through the center with little or no internal modifications.

Additional Solid Fuel Ignition Systems Advantages

- Highly reliable operation for both new and retrofit projects
- Firing rates up to 30 MMBtu/hr
- Applicable in light-off, warm-up, or low-load conditions
- Pneumatic retraction included to protect offline burners
- Retractable high-energy ignition source

ZEECO Start-Up Burners (SUB) are designed for the reliable start-up of recirculating bed boilers. Utilizing high-energy direct spark ignition, ZEECO SUBs do not require a separate igniter train, increasing the overall system reliability. Featuring a dual cylinder retraction mechanism, the system safely and reliably retracts firing end components away from the harsh recirculating bed environment when not in operation. An optional throat damper can be included to completely isolate the SUB from the bed when not in operation.

Additional Start-Up Burner Advantages

- Reliable light off of recirculating and bubbling bed furnaces
- Reliable source of supplemental heat for recirculating and bubbling bed furnaces
- Features high-energy direct spark ignition
- Heat input up to 170 MMBtu/hr per SUB
- Suitable for gas or oil firing

Flame Scanners: Integrated. Reliable. Responsive.

Zeeco offers a complete line of integrated flame scanners that provide reliable flame detection, and superior background flame signal suppression for single and multiple burner applications. Each ZEECO® ProFlame™ and ProFlame+™ model is easy to configure, simple to set up, and uniquely designed for safer operation in hazardous or nonhazardous areas.

The ProFlame is designed for smaller applications and offers an adjustable flame relay pull-in time, service dipswitch, adjust dipswitch, and raw flame signal measuring pins for advanced troubleshooting and signal analysis.

The ProFlame+ is designed for larger applications and has similar features to the ProFlame, with more intricate tuning to discriminate a target flame from a background flame, additional flame relay dropout time, separate flame-on and flame-off threshold settings for the frequency components of the flame signal, and a PC software interface.

ZPF-130/230

ZPF-120/220

ZPF-110/210

Additional Flame Scanner Advantages

- Compact, integrated, and reliable; no external flame amplifier needed
- LED flame status indicators
- Quick-connect adapters allow retrofit of any other major manufacturer's scanner
- Vortex cooling jackets available for high-temperature environments

ZPF-1200

ZPF-1100

Item	ProFlame™			ProFlame+™		
Flame Scanner Model	**ZPF-130/230**	**ZPF-120/220**	**ZPF-110/210**	**ZPF-1200**	**ZPF-1100**	**Fiber Optic**
Sensor Type	UV/IR	UV/IR	UV	UV/IR/Dual	UV/IR/Dual	UV/IR/Dual
Hazardous Area Rating	Safe Area	Zone 2 Class 1, Div 2	Zone 1 Class 1, Div 1	Zone 2 Class 1, Div 2	Zone 1 Class 1, Div 1	Zone 2 Class 1, Div 2
Environmental Protection	IP67 NEMA 4X	IP67 NEMA 4X	IP66 NEMA 4X	IP66 NEMA 4X	IP66 NEMA 4X	IP66 NEMA 4X
Relative Humidity (Noncondensing), %	99.50	99.50	99.50	95.00	95.00	95.00
Vibration Fatigue Limit, G	5	5	5	N/A	N/A	N/A
Fuel Application	Gaseous, Liquid, Solid	Gaseous, Liquid, Solid	Gaseous, Liquid	Gaseous, Liquid, Solid	Gaseous, Liquid, Solid	Gaseous, Liquid, Solid
Purge Air Pressure, In. W.C. (mbar)	5 (12.5)	5 (12.5)	5 (12.5)	5 (12.5)	5 (12.5)	10 (25)
Purge Air Flow, scfm (L/min)	5 (142)	5 (142)	5 (142)	5 (142)	5 (142)	10 (284)
Operating temperature, °F (°C)	-40 to 167 (-40 to 75)	-40 to 167 (-40 to 75)	-4 to 149 (-20 to 65)	-4 to 158 (-20 to 70)	-4 to 158 (-20 to 70)	-4 to 158 (-20 to 70)
Cable	Quick Disconnect	Quick Disconnect	Fixed	Quick Disconnect	Fixed	Quick Disconnect
Mounting	1" NPT M	1" NPT M	1" NPT M	1" NPT F	1" NPT F	N/A
Integral Sealing Window	Yes	Yes	Yes	No	No	N/A
Operating Voltage, VDC	24	24	24	24	24	24
Relay Output, Flame	N.O./N.C.	N.O./N.C.	N.O./N.C.	N.O./N.C.	N.O./N.C.	N.O./N.C.
Analog Output	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA
Power Consumption, W	4	4	4	4	4	4
Certifications	UL, FM, CSA, CE	UL, FM, CSA, CE, INMETRO, IECEX, ATEX	UL, FM, CSA, CE, IECEX, ATEX	UL, FM, CSA, CE, IECEX, ATEX	UL, FM, CSA, CE, IECEX, ATEX	UL, FM, CSA, CE, IECEX, ATEX
SIL Rating	3	3	3	3	3	3
Weight, lbs (kg)	1.3 (0.6)	1.3 (0.6)	4.2 (2.0)	3.3 (1.5)	8.8 (4.0)	3.0 (1.4)

Burner Management and Boiler Control Systems: Better By Design.

ZEECO® Burner Management Systems (BMS) and Boiler Control Systems (BCS) are engineered with thorough knowledge of industry standards and environmental regulations to ensure plant operations remain in compliance. Each system is crafted by experienced engineers and qualified electrical and instrument technicians in Zeeco's ISO 9001-2015 certified manufacturing and test facility. We also offer Factory Acceptance Testing (FAT) with hardwire simulation to reduce the commissioning process from weeks to days.

While other systems exclude critical control and multi-layer diagnostic safety and alarm features, ZEECO BMS and BCS include these loops and First-Out annunciation points as standard. The ZEECO controls package includes fully-metered firing rate, 3-element feedwater, and draft control with O_2 trim. Depending on the application, additional loops may be included for steam coil air preheaters, lower drum heaters, oil pumps, VFD, and deaerator controls.

Additional BMS and BCS Advantages

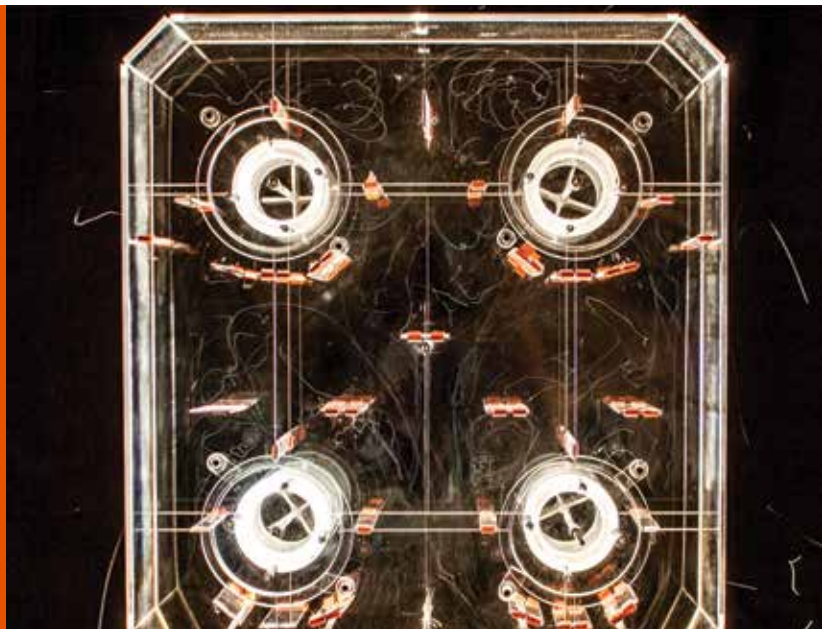
- Engineered and supplied with globally-approved processors
- Applicable for all package, utility, industrial, CFB, stoker boilers, and HRSGs
- Designed for process applications, air heaters, and startup burners
- Multi-burner and multi-fuel designs with optional simultaneous firing or low-fire changeover
- Available panel-mounted touchscreen Human Machine Interface (HMI)
- Seamless communications integration into existing plant-wide DCS through Ethernet or Modbus TCP/IP
- Optional Fault Redundant or SIL-2/3 functionality for PLC hardware
- Turnkey installation, commissioning, and startup services available
- Enclosure and mounting location options range from NEMA 12 through SS NEMA 4X, and up to hazardous area NEMA 7
- Full compliance with NFPA 85, NFPA 70, API RP 556, EN 61508, EN 61511, OLFO70 & ISA S84, EN 746-2 EN 0156, EN 12952-8, EN 298, IEC 61131, and more

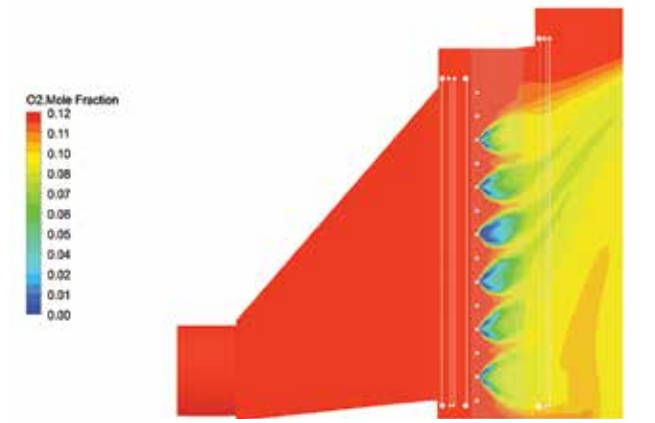
Physical Airflow Modeling and CFD: Design Right From the Start.

Physical airflow modeling and Computational Fluid Dynamics (CFD) optimize combustion air systems and streamline solution development. Zeeco is the only major combustion company that offers physical airflow modeling and our Z-Flow™ Technology provides clients with real time performance feedback through testing simulations to help assess, analyze, modify, correct, and design airflow systems – taking the guesswork out of the optimization process. Our multi-disciplined engineers put the latest in CFD to work to demonstrate product integrity for customer solutions.

Physical Airflow Modeling and CFD

- Eliminate boiler vibration
- Lower O_2, CO, NOx
- Reduce system pressure drop
- Increase efficiency
- Increase turndown capabilities
- Optimize burners for:
  - ±2% air mass flow balance between burners
  - Flame fit
  - Eliminate unwanted air swirl through burner
  - Ensure proper air and fuel distribution





Aftermarket Capabilities: Better Choices Every Day.

Zeeco is the world leader in aftermarket combustion products. We offer replacement components for ZEECO® equipment, as well as other manufacturers – all at economical prices. While Zeeco's normal response and ship times are some of the fastest in the industry, expedited deliveries are our specialty. Our products are only part of the equation. It is the people behind the products – engineers with extensive combustion experience – that elevate our Aftermarket group from the role of a mere supplier to that of a true partner in your long-term success.

Aftermarket Products Include:

- Burner parts
- Gas tips
- Ignition systems
- Pilot parts
- Emission systems
- Control systems
- Oil nozzles / Sprayer plates
- Oil guns and components
- Swirlers / Air diffusers
- Flame scanners and components
- Instruments, valves, and switches

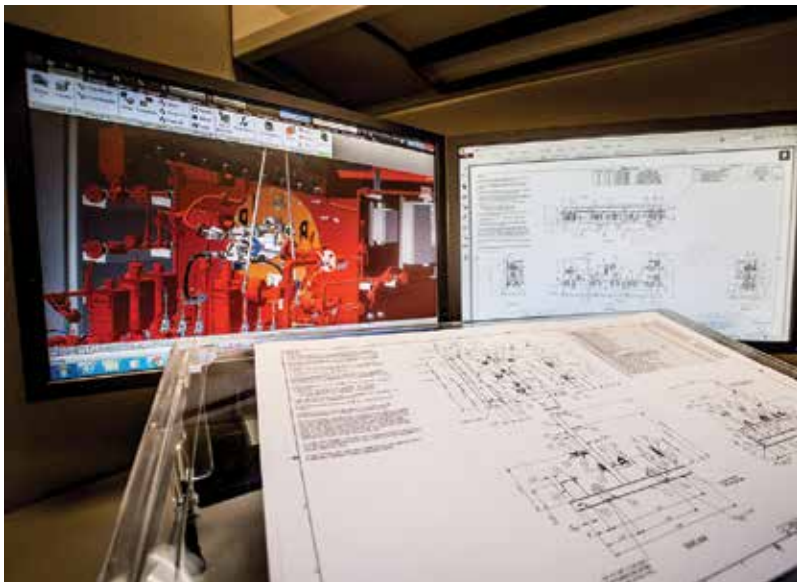
Turnkey Solutions: Avoid Burning Time (and Money).

With a ZEECO® turnkey solution, you will gain access to a single point of contact throughout the entire project and the full support of Zeeco, 24/7. There are no contractual layers between the customer, the OEM burner equipment supplier, and the contractors.

Because all project phases are handled by one team, with a single vision, there are no shortcuts, compromises, or disconnects. With Zeeco "handling the details," your own resources – engineers, time, and dollars – are available for other operational needs.

Turnkey Boiler Burner Solutions Include:

- Design
- Engineering
- Safety analysis and assurance
- Equipment purchasing
- Fabrication
- Site supervision
- Contractor management
- Installation
- Checkout
- Commissioning
- Operator training



The Zeeco Difference

Our only business is the combustion business. By concentrating on what we do best, Zeeco has grown into a worldwide leader in combustion solutions. We are a privately held company whose ownership stays highly involved in daily operations, with upper management comprised of the world's leading combustion experts.

When you call Zeeco, we answer. When you make a request, you get a quick, efficient response. We are lean and efficient, able to make decisions quickly, without bureaucracy and red tape. Our sales, engineering, and purchasing groups work hand-in-hand to deliver highly competitive quotes and heroic turnaround times. We stand ready and willing to travel anywhere in the world to discuss upcoming projects firsthand, and to ensure that every existing project runs seamlessly.

*Visit **zeeco.com/contact** for additional Global Location contact information*

GO ZEECO

Choose to work with our dedicated, flexible, and innovative team, and you won't be disappointed. Call or email us today to request a quote or to learn more about our proprietary combustion systems.

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Certifications apply to Zeeco Headquarters.

CERTIFIED NBBI · CERTIFIED ASME · CERTIFIED ASME · REGISTERED ISO 9001: 2015

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