

Enclosed Ground Flares

Zero Smoke, Low Noise
and No Visible Flame

Our enclosed ground flare systems combust waste gases cleanly and efficiently by eliminating smoke and minimizing noise and visible flame from conventional flaring. Enclosed flares are customized to client specifications to achieve excellence in overall system performance.

FEATURES AND BENEFITS

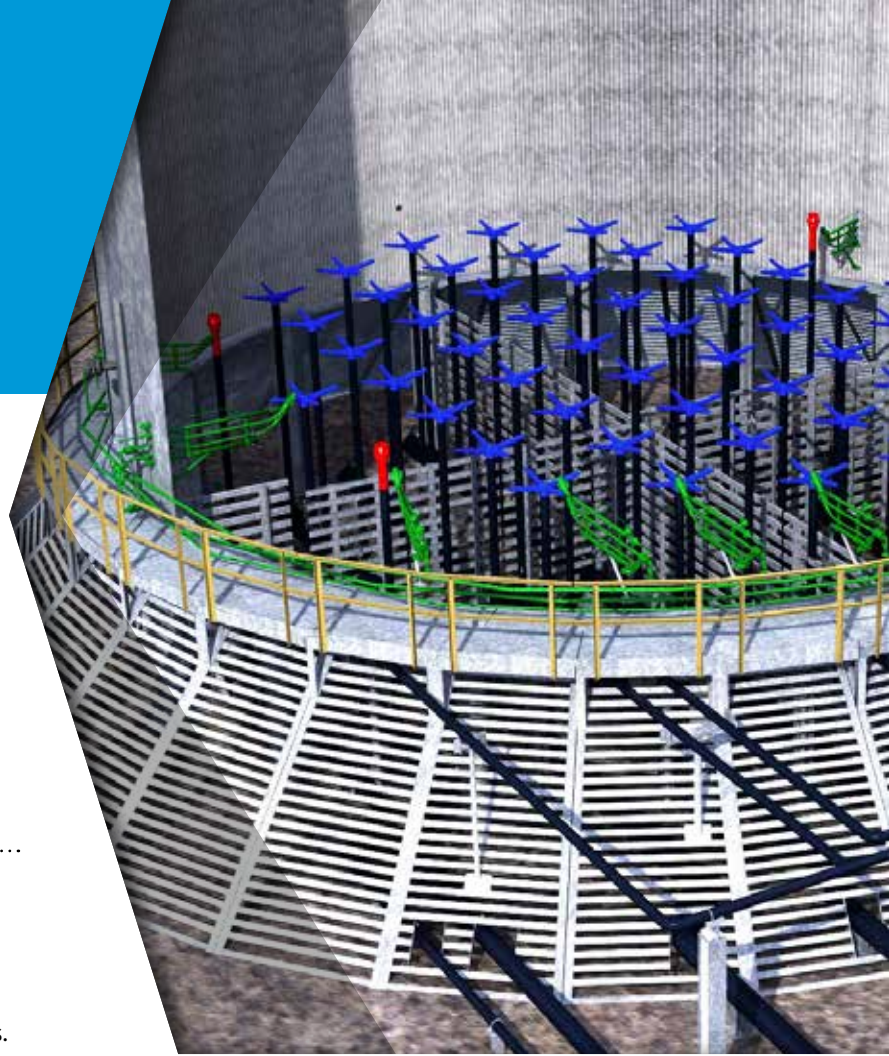
John Zink Hamworthy Combustion enclosed ground flares incorporate a variety of technological features developed through years of experience in a wide array of applications. Features are customized to provide optimal performance for every application.

FEATURES

- + Refractory-lined combustion chamber
- + Proprietary burner designs
- + Staged flare gas controls
- + Proprietary wind fence designs

BENEFITS

- + Minimizes environmental impact
- + Safe flaring in tight locations
- + Minimizes or eliminates the need for assist air or steam
- + High-destruction efficiencies
- + 100% smokeless performance
- + Minimizes utility consumption
- + Maximizes system performance



Decades of research and development are incorporated into every flare design to provide unsurpassed reliability, safety, efficiency and cost effectiveness.



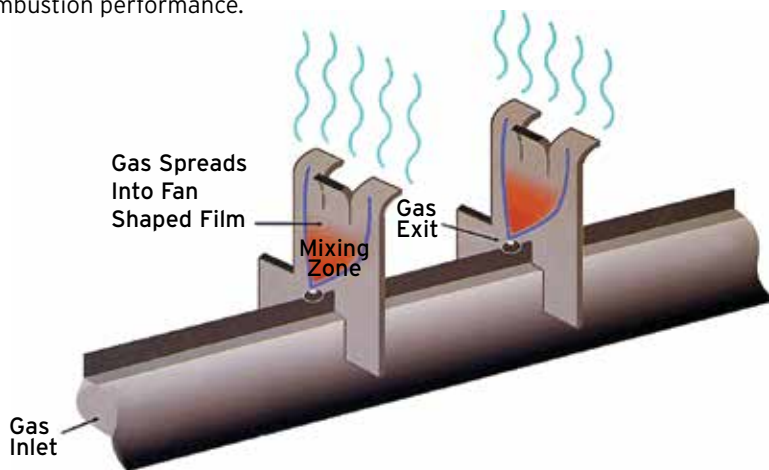
Burner Technologies

JZHC burner technologies utilize proven methods to deliver:

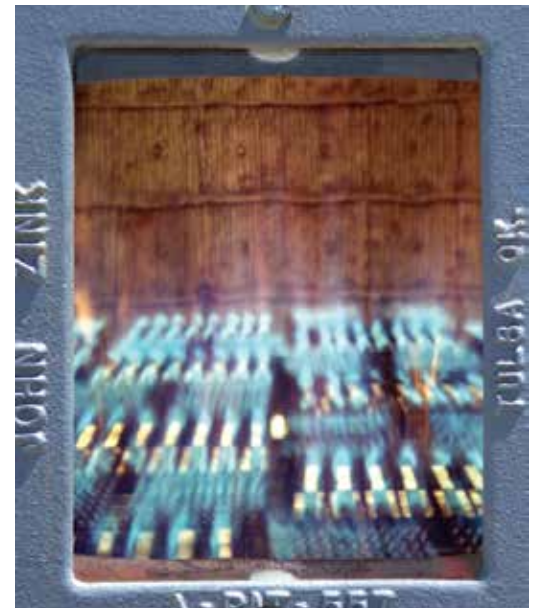
- + Short flame lengths
- + Efficient air entrainment
- + Long operating life
- + Reduced maintenance costs
- + Reliable cross-lighting
- + Simple operation
- + Smokeless operation
- + 99.5% + DRE

Unassisted Fin Plate Burners

Our fin plate burner provides smokeless flaring without steam or air assist. The proprietary design offers superior mixing performance over a wide range of operating conditions. The burner design utilizes proprietary fin technology to provide highly effective air/gas mixing zones that optimize combustion performance.



Each fin plate burner contains many individual fins to spread the flare gas into a thin film and optimize the gas/air mixing area.



FIN PLATE BURNERS

The fin plate burner provides unassisted, highly efficient, smokeless flaring of highly unsaturated hydrocarbons such as ethylene and propylene.

Pressure-Assisted Burners

For high-pressure applications, up-fired, pressure-assisted burners provide optimum flame stability, high hydrocarbon destruction efficiency, and many additional benefits. The pressure-assisted burner designs utilize proprietary methods to promote high efficiency mixing.

Low-Pressure Assisted Burners

For low-pressure applications that require assistance to control smoke or flame stability, JZHC offers a variety of steam-assisted, air-assisted, and gas-assisted burners that are used in enclosed ground flares. These assisted burners are commonly used as first-stage burners in applications that need smoke control at turndown.



Low-pressure, steam-assisted burners staged with pressure-assisted burners.

LOW-PRESSURE, STEAM-ASSISTED BURNERS

Combustion Air Dynamics

A wind fence is a proprietary aerodynamic structure at grade used to modify the effect of crosswinds on the combustion process and hide the visible radiation. These fences are also used as an important safety control, preventing unauthorized access into the combustion zone. Locked access ways are provided for maintenance operations.

JZHC provides two types of wind fences:

- + Solid-wall fences consist of one or two walls typically made of concrete that surrounds the enclosure at grade. This wall provides a blockage from the crosswinds and allows air to flow over the wall and into the combustion zone aerodynamically.
- + A fluidic wind fence consists of a structure at the base of the flare enclosure with angled slats. These slats are designed to modify the effect of crosswinds on the combustion process and evenly distribute drafted air toward the burners.



SOLID-WALL FENCE



FLUIDIC WIND FENCE

Burner Orientation

JZHC provides two burner configurations for enclosed ground flares. Both configurations can be high-pressure or low-pressure designs.

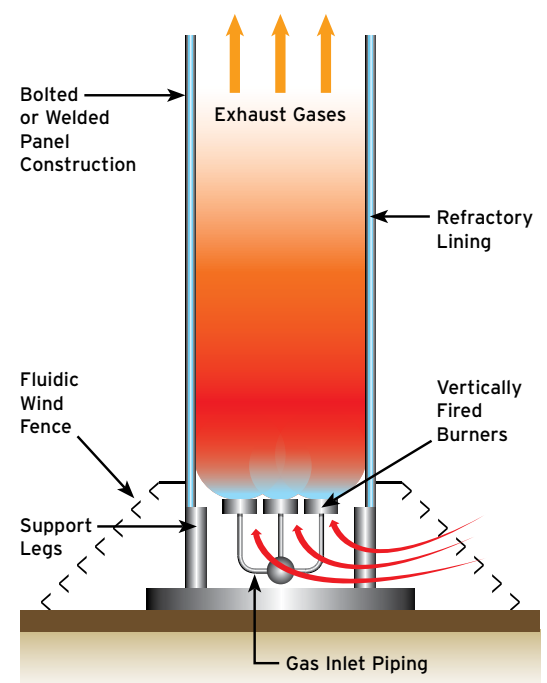
- + Vertically fired burners are located at an elevation above the wind fence at the base of the flare enclosure. These systems utilize an array of multiple burners for smokeless combustion spread out like a floor, creating even access to the drafted air.
- + Horizontally fired burners are located near grade of the flare enclosure and fire through windows that control the amount of air that passes through the burners. These systems are typically steam-assisted or air-assisted.



VERTICAL ORIENTATION

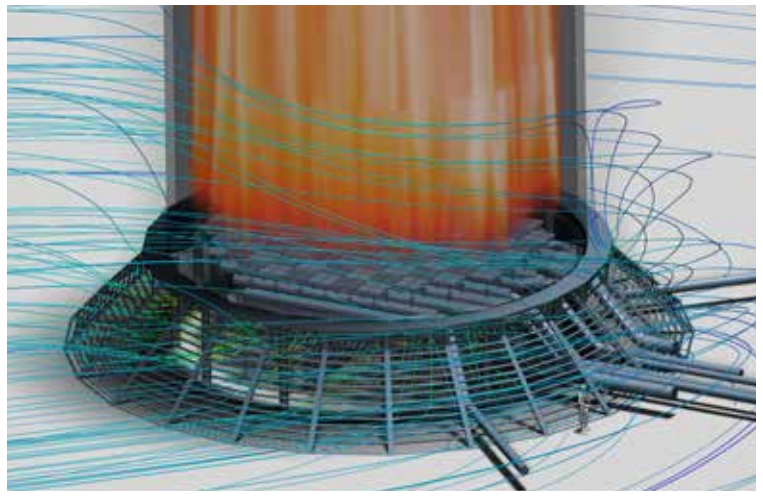


HORIZONTAL ORIENTATION



Computational Fluid Dynamics (CFD)

At John Zink Hamworthy Combustion, CFD simulation is an integral part of the research and development of industry-leading flare technologies. CFD modeling is a simulation methodology that can provide a prediction of flow, mixing, and combustion in flare flames. Our engineers routinely perform CFD analysis on our enclosed ground flare technologies to optimize flare performance. CFD is also used extensively to assess exhaust gas dispersion and environmental impact at customer sites.



COMPUTATIONAL FLUID DYNAMICS (CFD)

CFD is used by JZHC to simulate the air flow characteristic into and hot plume flow out of ground flares.



FLARE INSTALLATION

Modular design simplifies the installation of our ground flares.

Ease of Installation and Modularization

We offer enclosed ground flares in a variety of configurations designed for ease of installation. The modular ground flare combustion chamber is designed with all bolted panels for simple site erection. The sections can be designed to allow multiple levels to be pre-assembled at grade to minimize lifting requirements and save installation time.

We utilize ceramic fiber refractory modules for the combustion chamber walls, which allow simple bolt-on assembly. The burners and staging valves can be provided as pre-assembled skidded modules to minimize field work.

Experience/Range of Applications

We've provided enclosed ground flare systems for decades in a wide range of industries including refining, petrochemical, LNG production, and oil and gas production and distribution. Applications include cryogenic LNG gas, paraffins, olefins and polyolefins, low BTU gases, and many other challenging applications. Our proprietary Fin Plate designs provide unassisted, high-turnaround smokeless flaring below 1 psig (70 mbar), even with difficult compounds such as ethylene/propylene. Our range of pressure-assisted burners can provide optimum operation at higher operating pressures.



Global Headquarters

johnzinkhamworthy.com
+1 918 234 1800

Tulsa, Oklahoma | United States

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