



An Ovivo Company

## BURNERS/ FLARES

### VAREC BIOGAS 249 Series ENCLOSED FLARE

The Varec Biogas 249 Series Enclosed Flare is specifically designed for biogas application where flare stack emissions are controlled and regulated.

#### Introduction

The Varec Biogas 249 Series Enclosed Flare is a flare specifically designed for biogas applications. It is primarily used in areas where the flare stack emissions are controlled and regulated.

The sophisticated design of the 249 Series is a top-of-the-line, full-featured, drop-ship product, where all eventualities have been carefully considered at the design phase. After the product is shipped, our qualified Varec Biogas Field Service Engineers are present for commissioning, start-up and personnel training, and will work in conjunction with the Contractor or the Maintenance/ Operation Personnel at the plant.



#### Design Features

The 249 Series consists of three combustion related components: combustion air inlet, burner zone, and combustion chamber.

The three parameters required for combustion are turbulence, temperature and time. Turbulence is created by the burners, the flame speed and flame pattern. Temperature is generated by the combustion process, and controlled by the proper mixing of air. The time is provided in the combustion chamber located above the burners and below the exit of the flare to atmosphere.

In this application, the combustion of gas releases energy in the form of heat and light. In order to achieve combustion, air is required.

The ratio of air to gas for 60% methane is approximately 6 parts air to 1 part gas. This theoretical, perfect fuel gas ratio is referred to as the stoichiometric mixture. The heat released under these ratios develops a flame temperature of 3500°F (1927°C).

The combustion chamber is not capable of withstanding temperatures of 3500°F (1927°C), therefore, excess cooling or quench air is brought into the chamber past the burners and mixed with the products of combustion. One or more dampers, which modulate (open or closed) to maintain the exit temperature at its set point, control the total air flow through the chamber. Typically, exit temperature is between 1400 - 1600°F (760° to 871°C).

The excess air maintains the temperature within the chamber at its specified minimum and maximum temperature range.

As biogas flows to the 249 Series Enclosed Flare and is burned, the temperature increases and a thermocouple installed near the stack exit, senses the change. The temperature process controller modulates the air damper motor to open or close. The natural draft established in the enclosed flare allows more air through the chamber, and cools the products of combustion to the temperature set-point of the flare. If the reverse takes place and the gas volume drops, then less heat is generated and the temperature decreases.

## Design Features (Cont'd)

The dampers are signaled to close, restricting the air flow through the chambers in order to maintain the temperature set-point. The surface area of the combustion chamber determines the length of time all the products of combustion (POC) remain in the combustion zone. This time is referred to as residence time or retention time. Typically, this time frame is designed to be between 0.6 to 1.0 seconds, at maximum gas flows through the flare and at the process design (control) temperature.

The residence time is inversely proportional to the gas flow. In other words, as the gas flow decreases, the residence time increases. The total volume of the POC's created at the maximum design flow rate and

temperature, determines the required volume of the combustion chamber.

The total heat value released at peak design on a per hour basis, determines the total cross-sectional surface area of the base of the combustion chamber.

The combustion stack and windbox are internally insulated with ceramic silica fiber modules and refractory blanket, respectively. The insulation protects the carbon steel from excessively high temperatures. The modular, ceramic fiber module, is thermal-shock tolerant and is superior to castable refractory for standby applications. In the unlikely event of refractory failure, individual modules can be easily and inexpensively replaced.

The controlled combustion condition described results in high Destruction Removal Efficiency (DRE). DRE is expressed as a percentage of unburned hydrocarbons exiting the flare in comparison to the total hydrocarbon content of the biogas input. High DRE ratios are accomplished through excellent burner flame characteristics and the residence time and temperature at which the products of combustion remain in the combustion chamber.

The DRE for our 249 Enclosed Flare is typically above 99.95% regardless of retention time.

The 249 Series can handle high turndown ratios because it utilizes a burner manifold system. Back pressure regulators or isolation valves are used to isolate specific burner zones of the flare. The regulators open and close based on the increase or decrease of waste gas flow. The use of burner zones keeps the individual burners within their normal operating design parameters to assure proper combustion characteristics.

Each burner manifold is equipped with a burner assembly complete with multiple fixed orifices. The orifice velocity generates the energy required to control individual burner flame speed, primary air mixing, flame pattern, and flame length. These flame characteristics are fundamental in achieving the desired combustion process.

In normal operation, the flare utilizes biogas for the standing pilot with a backup natural gas or propane fuel source.

The unit comes equipped with a sophisticated controller system, which include an externally serviceable and adjustable high voltage ignition assembly.

The Control Panel is designed for flexible integration with diversified plant process requirements. All control functions are protected by an Uninterrupted Power Supply (UPS).

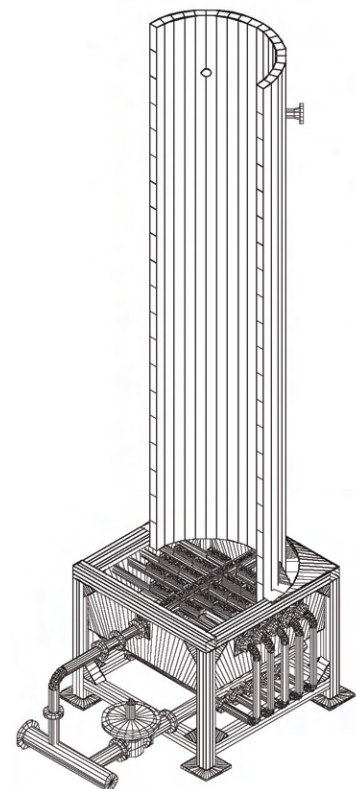
The 249 Series utilizes flame shoot technology as its ignition system. During the ignition cycle, pilot gas is directed to the flame shoot nozzle via a dedicated pilot fuel line where pilot gas is diverted and consumed during ignition or re-ignition sequence.

Air is introduced via an inspirating venturi installed on this dedicated pilot fuel line, and upstream of the flame shoot nozzle. This air/gas mixture is then ignited at the venturi outlet where the spark plug is located. All components are located outside the chamber and far from the heat of combustion.

Once ignition occurs at the venturi outlet, this generates a flame front that travels through the flame shoot nozzle and shoots a ball of flame across and lights the pilot burner installed inside the flare combustion chamber. The pilot burner then lights the main burners on the main burner zone.

The pilot burner is situated inside the chamber to ensure that it maintains a pilot when digester gas is diverted to the flare for combustion.

The unit includes four individual test ports for EPA emissions testing and an integrated ground level sample tube for spot waste stream analysis by plant personnel.



- No visible flame
- Destruction Removal Efficiencies (DRE) of 99.95%
- Low NOx and CO emissions
- High turn down ratios available
- Handles low operating pressure

## Operation

The 249 Series Flare is started by a control signal (pressure switch or DCS signal) transmitted to the local control panel located adjacent the flare. The pilot ignition commences and is verified by an ultra-violet certified flame safeguard (FSG) system. A permissive is then transmitted to the normally-closed motor, actuated main shut-off valve (Emergency Shutdown Tricentric Butterfly Valve) installed in the main biogas line. The shut-off valve is installed downstream of a thermal bypass shutoff valve and flame arrester assembly (Varec Biogas Model 450 Flame Trap Assembly).

A dedicated Uninterruptible Power Supply (UPS) system for the emergency shutoff valve is provided as standard on the 249 Series flare. The UPS system will drive the valve closed in the event of a power failure. Once the enclosed flare is started and the flame is proven, this shut-off valve is then permitted open, and the flow of biogas is delivered to the burner manifold system.

The biogas is routed to the main burner zone. At the same time, a signal from the control panel opens the pilot gas solenoid valves for ignition. In the 249 Series, regulators or electrically-actuated valves are used to isolate specific burner zones on the flare.

The valves control the zones and will open and close based on the waste gas flow.

### CONTROLS

The control panel will be configured based on customer operating requirements and provided with a Programmable Logic Controller (PLC), necessary temperature controls and input/ outputs to communicate with the plants' DCS system.

## Option

The 249 Series was designed to handle high turndown ratios accomplished through staged combustion. In instances when the maximum turndown ratio required is 4:1, the 249LC can be specified.

The 249LC is limited to handle a 4:1 turndown ratio because it does not utilize the staged or zoned combustion concept. The burner manifolds are welded directly to the stack. The unit includes two 4" threaded and plugged test ports for sampling.

The 249LC comes equipped with one UV scanner for pilot and flame monitoring. It also comes with one thermocouple which modulates the air dampers open or closed depending on the temperature setpoint inside the chamber.

The unit comes with a sophisticated controller system, which include an externally serviceable and adjustable high voltage ignition assembly. The Control Panel is designed for flexible integration with diversified plant process requirements.

Like the 249, the 249LC uses ceramic silica fiber modules for stack insulation. It also exhibits high DRE values. It permits flow to the flare through the use of an Emergency Shutdown Tricentric Butterfly Valve installed downstream of the 450 flame trap assembly. In normal operation, the 249LC flare utilizes biogas for the standing pilot with a backup natural gas or propane fuel source.

## Specification

The 249 Series Flare was designed with environmental safety in mind. Varec Biogas ensured that the flare meets the most stringent air quality requirements while keeping in mind the importance of occupational health and safety along with operation and maintenance cost effectiveness.

The control panel provides flame failure response along with high & low temperature alarms among important functions.

The combustion chamber is internally insulated and designed to limit maximum external surface or skin temperatures, eliminating the need for heat shields or barriers.

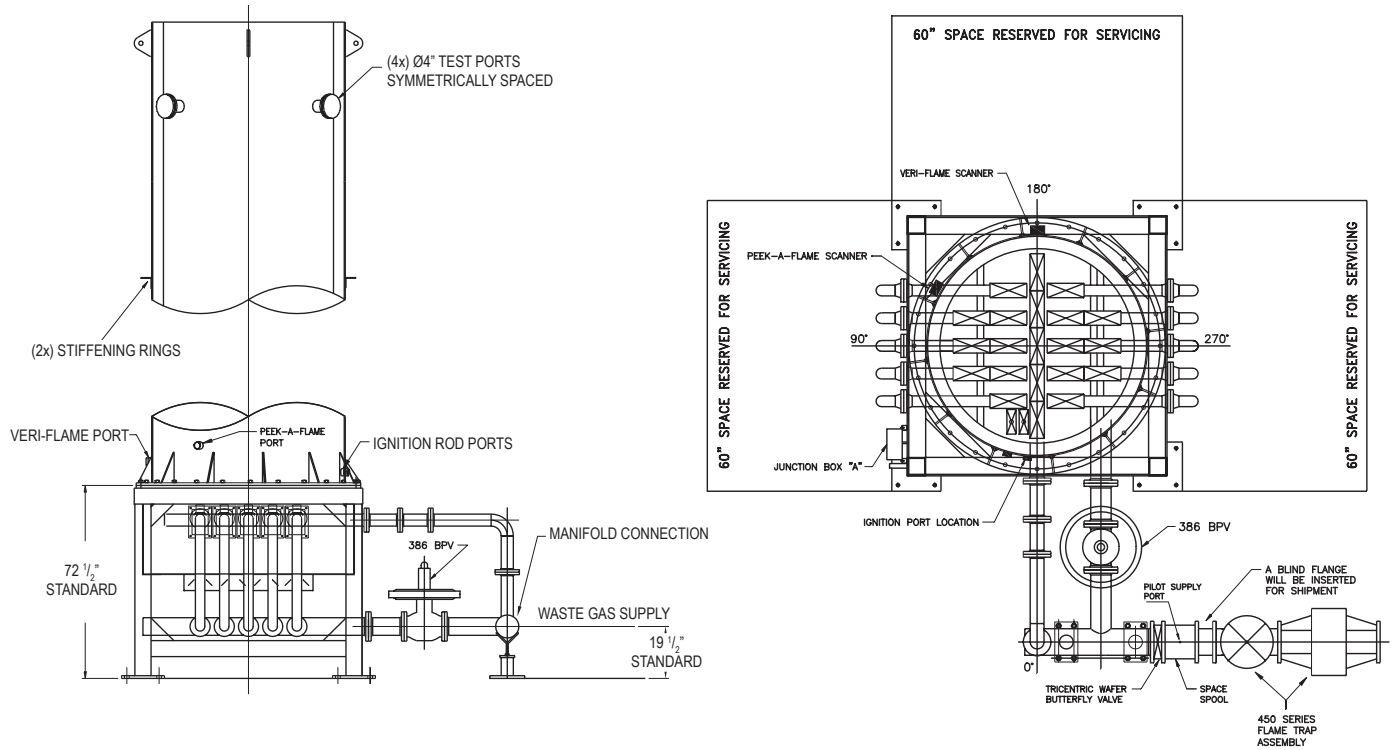
The unique design of the flare air dampers, permit a natural draft of air inside the chamber. This eliminates the need for air purge blowers.

When selecting an installation site, 5 feet (1.52 meters) on either side of the flare substructure is required for easy maintenance of the burner manifolds.

The complete burner manifolds can slide out for easy burner maintenance or replacement. The air dampers can be easily disassembled to allow internal flare access without the need for access doors.

Varec Biogas can accommodate special requirements of process control logic. This is important in ensuring the smooth operation of the flare especially when larger flow capacities and high turndown ratios are expected.

## Specification



## Ordering Information

Consult factory or your authorized sales representative for ordering information.