METHANE FROM FLARING TOOLKIT

# Flare Design: Steam-assisted flares

How is the flare designed to minimise methane? > Flare Design: Steam-assisted flares



## Summary

Steam-assisted flare design utilizes steam for efficient air/waste gas mixing and turbulence which provides smokeless flaring while maintaining the desired combustion efficiency.

## How it works

- Steam is injected into the flare gas stream via nozzles on an external ring around the top of the flare tip (upper steam) and/or by steam tube(s) (center or lower) located concentrically within the tip. Center steam is introduced into the stack of a flare to reduce burn back. Lower steam is piped to an exterior annular ring near the lower part of a flare tip, which then flows through tubes to the flare tip, and ultimately exits the tubes at the flare tip.
- Steam assisted tip design vary by manufacturers and can be a single or multiple steam addition locations.

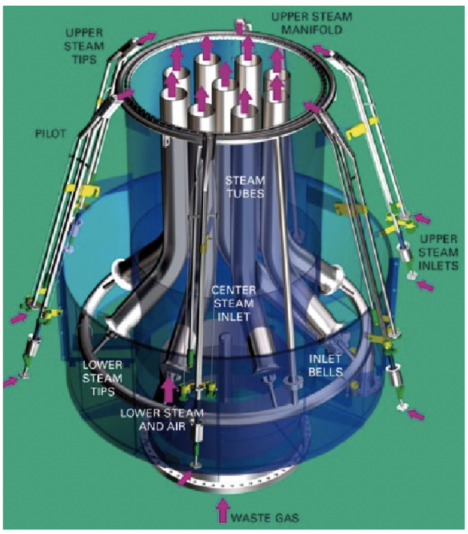


Figure 1: Schematic of an internal tube steam -assisted flare (Courtesy from John Zink)

## Advantages

- Widely used in the industry where steam is available
- Provides smokeless flaring with 98% destruction efficiency provided that the amount of steam is monitored and controlled to maintain the desired combustion efficiency

## Limitations

- If too much steam is applied, the  could be diluted which would reduce the combustion efficiency. As such, optimization of steam injection can be achieved by monitoring hydrocarbon emissions such as using cameras, to determine process parameters to improve flare efficiency measurements
- It could be a costly option if the local water cost is high
- Steam- assisted flares generally produce loud noises that might disturb operators and nearby residential areas

Go Deeper

- Vendor Website: John Zink Hamworthy
- Vendor website: Zeeco

Case study

An industrial flare performance was done on steam-assisted flares organized by the Texas Commission on Environmental Quality, working through the University of Texas.

The steam-assisted flare operated with a 36” diameter flare tip. This flare tip has an upper ring for injecting steam around the perimeter of the tip as showed in Figure 2.

Figure 2: Steam-assisted flare tip with upper ring steam injectors

A series of tests was performed on the above steam-assisted flare to explore the destruction and removal efficiency (DRE) for different **Combustion Zone Gas Net Heating Values** (CZG NHVs) and flaring rates.

Figure 3 shows observed DRE as a function of CZG NHVs. DRE was high (typically > 95%) for CZG NHVs above 250 BTU/scf. Below this value, DRE and combustion efficiency fell off rapidly. The scatter in the DRE values reported in Figure 3 is due to variety of factors such as inherent variability in the flare operation, uncertainty in measurements, and differences in ambient conditions.

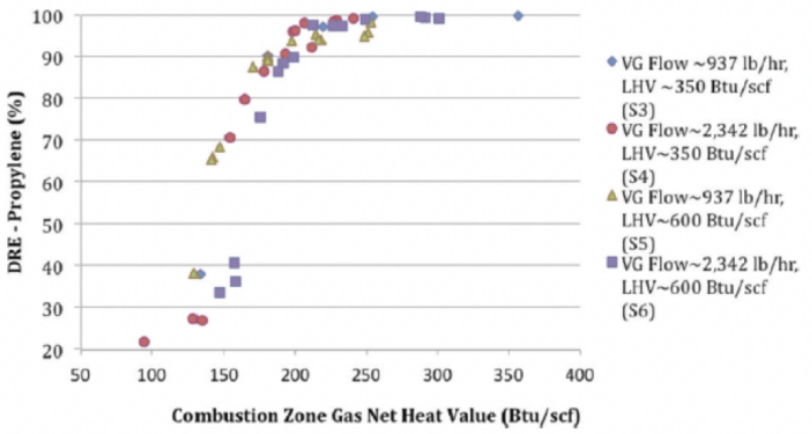


Figure 3: Propylene DRE vs Combustion Zone Gas Net Heating Value for steam-assisted flare

*Source: Industrial Flare Performance at Low Flow Conditions. 1. Study Overview, Industrial & Engineering Chemistry Research*

## How is the flare designed to minimise methane?

Flare Design: Pilots

Flare Design: Air-assisted flare

Flare Design: Nitrogen Purge

Flare Design: Sonic tips with fixed exit slot

Flare Design: Sonic tips with variable exit area