

From Diffusion to Premix, Variable Geometry K-ONE Combustion System for GE10, PGT10 and PGT5

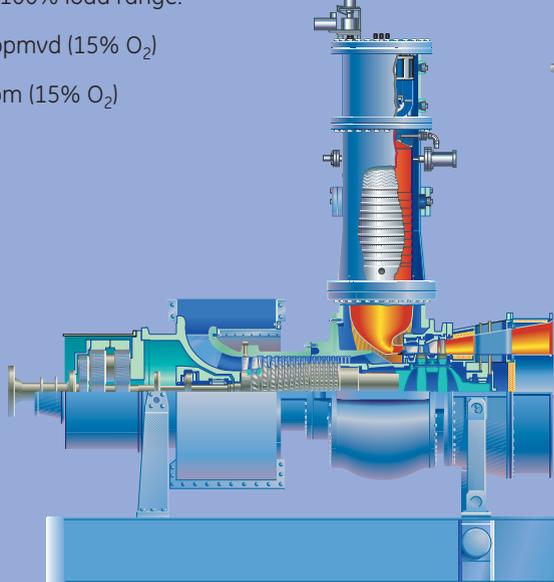
Benefits

- Increased production
- Higher efficiency
- Compliance with environmental regulations**
- Availability and Reliability
- Life extension**

GE Oil & Gas's vast amount of experience in R&D has resulted in a state-of-the-art product with performance and reliability ratings which have been widely confirmed by machines with the K-ONE system as standard. In addition to **excellent flexibility** and **reliability**, these machines **limit NOx emissions** to 25 ppmvd compared to 250-300 ppmvd with a conventional combustor, and CO from 25 to 80 ppmvd (15% O₂) over the entire operating range (100-50% of power). These results comply with the current emissions requirements.

Further improvements have been extended to the K-ONE System, enabling it to reach the outstanding emission levels of the GE10, in the 50-100% load range:

- NOx reduced to 15 ppmvd (15% O₂)
- CO reduced to 25 ppm (15% O₂)



What it is

GE Oil & Gas has designed and developed a combustion system that combines the advantages of both systems without compromises, including emissions abatement. The result is a configuration that employs a pre-mix lean combustion, integrated with a pilot diffusion combustion system, termed K-ONE (Figure 1). The K-ONE system is an exclusive combustion air control system with a rotating cylinder assembly (6) built into the burner. The improved burner performance is supported by a new, specially developed liner. The extra air needed for the lean combustion process reduces the amount available for cooling. Therefore the liner has been made completely of Hastelloy (7), with a double welded hat, turbulence promoters on the exterior, internal film cooling and a complete Thermal Barrier Coating (TBC). This makes it possible to obtain a

transverse distribution of uniformly low temperatures and an optimum distribution of temperatures on the first stage nozzles with a pattern factor of 6-8% across the whole operating range, greatly benefitting long-term reliability. The final K-ONE development updated the pilot burners by changing the design from diffusion to pre-mix flame.

Turbine Control Panel

The MarkVI control panel is preset for use with the K-ONE system; only minor operations are required to establish the connection.

PERFORMANCE

with 50-100% Thermal load

	Conventional	GE10	PGT10 - PGT5
NOx	>250ppmvd	<15ppmvd	<25ppmvd(*)
CO	>2ppmvd	<25ppmvd	20-80ppmvd

(*) 15 ppmvd can be achieved for PGT-10

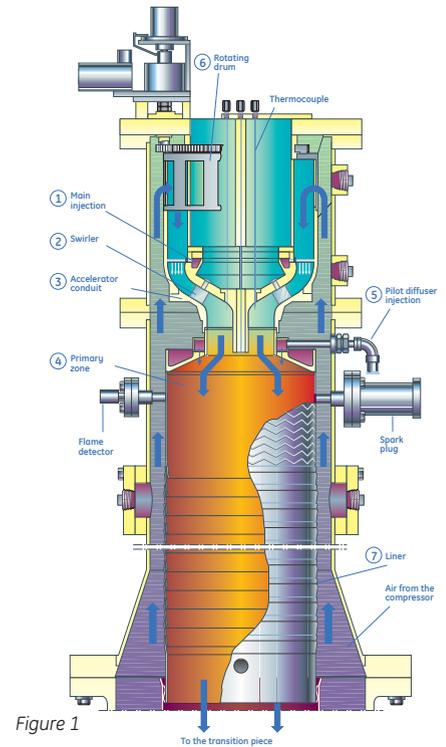


Figure 1

How it works

Diffusion burners are characterized by fuel injection in the combustion airstream inside the primary zone, generally preceded by a swirler which is necessary to limit excessive variability in the local air/fuel ratio and to reduce the high dwell time necessary for diffusion. For stability reasons, a lean mix is not suitable in such a configuration so combustion is marked by a transverse distribution of temperatures with steep gradients and peaks concentrated in the primary zone, working practically in stoichiometric conditions. According to the Zeldovich mechanism, this leads to the creation of unacceptable quantities of NOx (hundreds of

ppmvd) at high loads, a condition which is exaggerated by the long dwell time.

In pre-mix burners fuel is injected and mixed with the combustion air before it enters the liner. This achieves a very homogeneous diffusion thus allowing a lean mix. In addition, the mixing and combustion processes are separate, which substantially reduces dwell time and optimizes temperature distribution eliminating zones with steep temperature gradients. All these features combined slash NOx emissions to just a few ppmvd.

Application

Natural gas fired PGT5, PGT10 and GE10 gas turbines.



GE imagination at work

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