

Gas-air-ratio control technologies for high efficiency gas fired appliances

Tom Costello

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The engineer's choice

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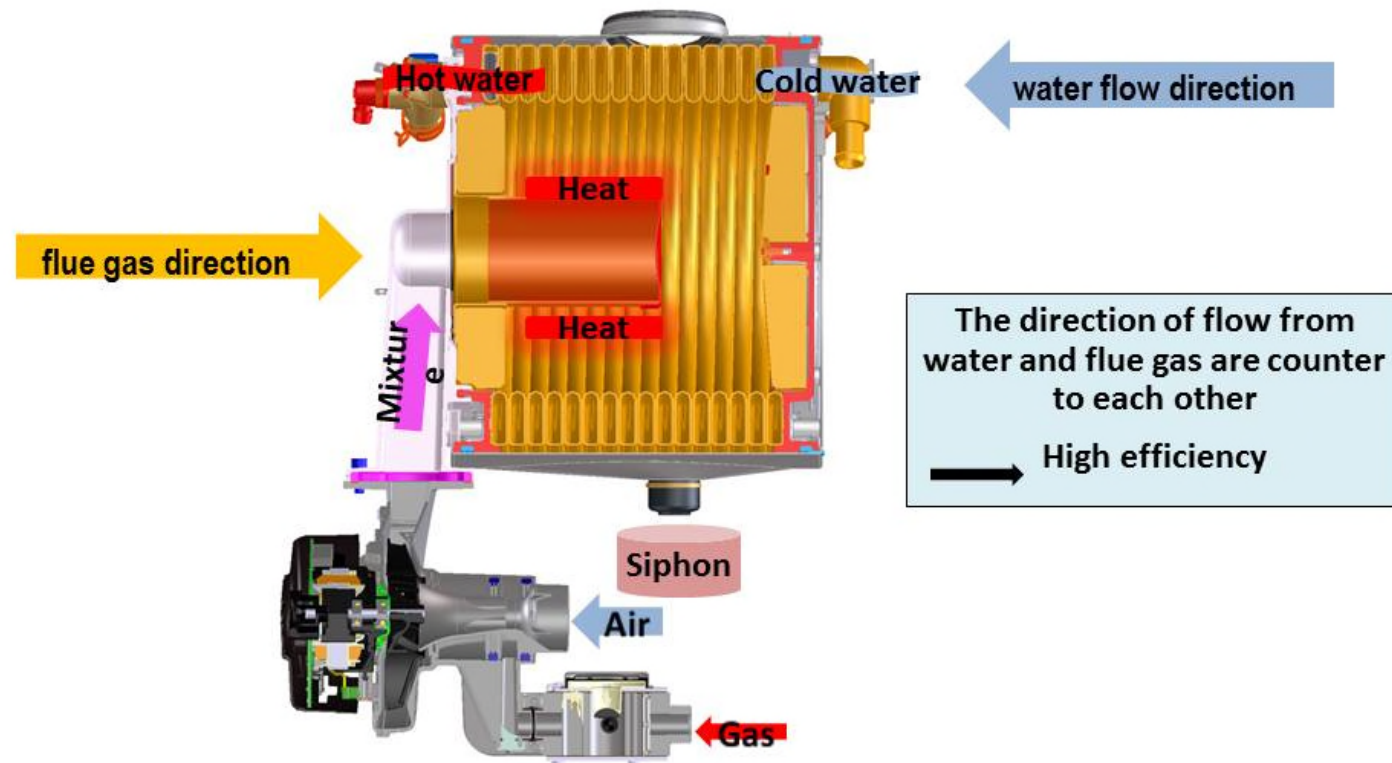
Gas-air-ratio control technologies

Overview

- Combustion system components
- Pneumatic gas-air-ratio control
- Electronic gas-air-ratio control (gas adaptive)
- Features and benefits
- Computer simulation

Gas-air-ratio control technologies

Combustion system components

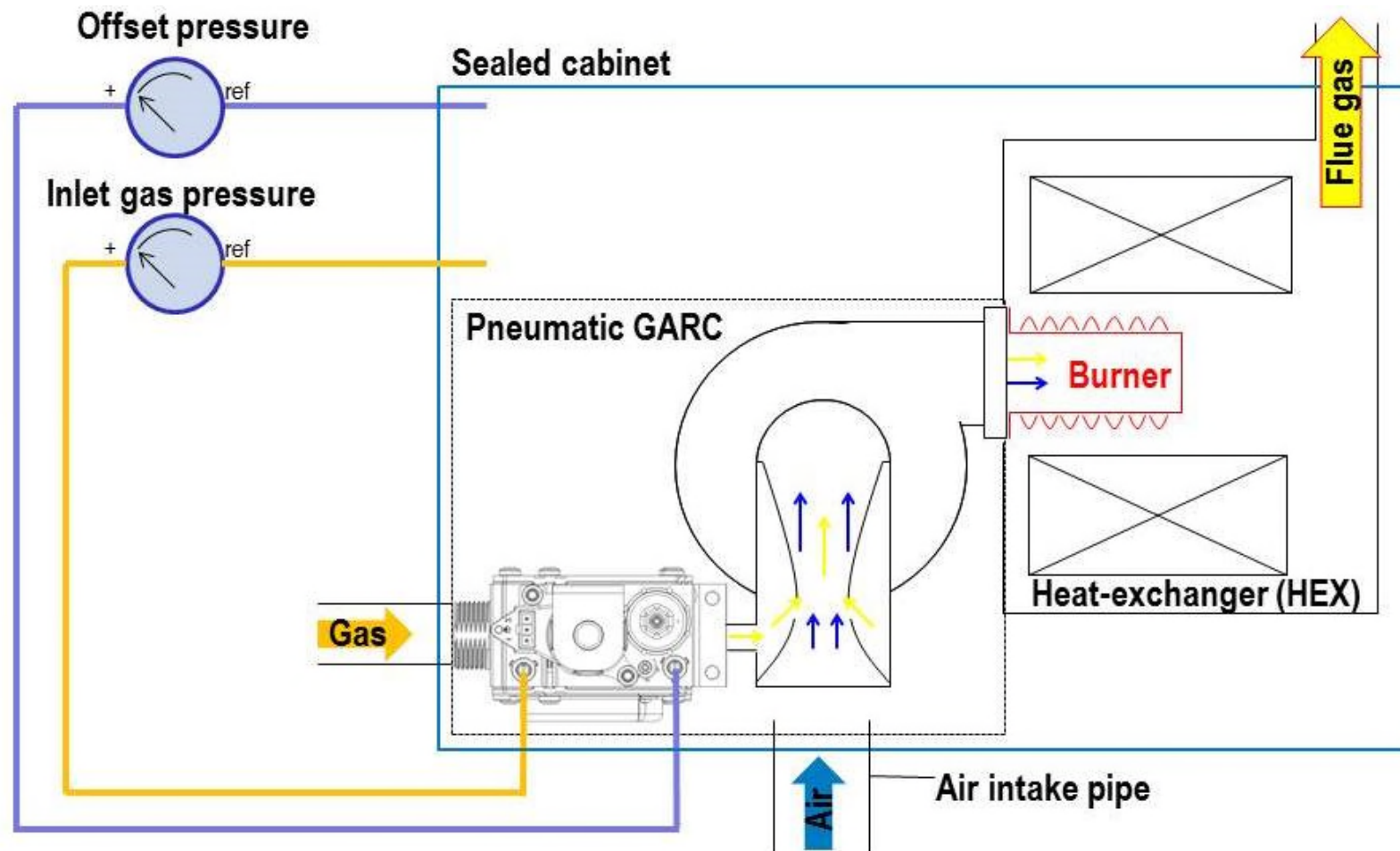


Pneumatic gas-air-ratio control

Gas-air-ratio control technologies

Pneumatic GARC system

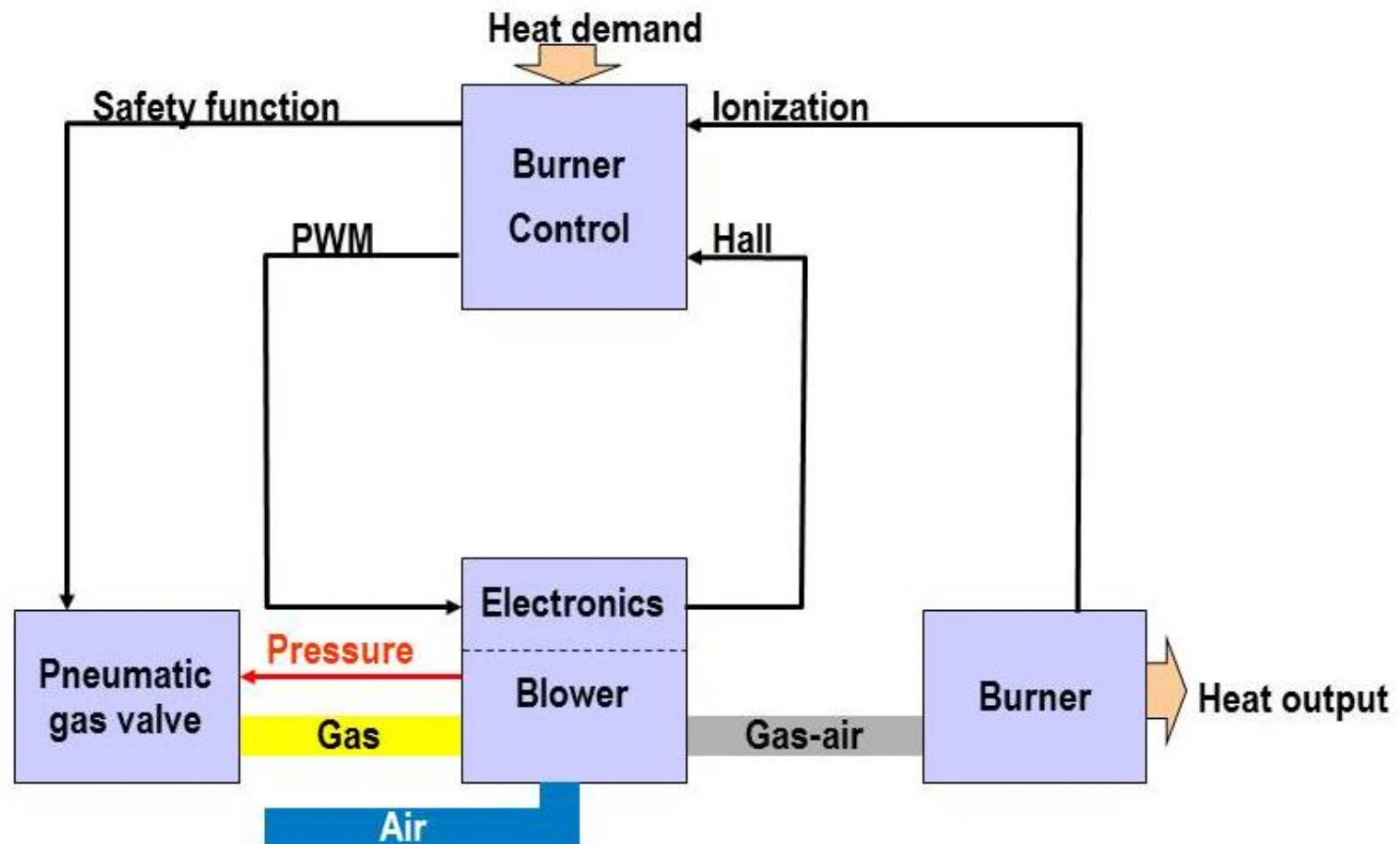
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Pneumatic GARC diagram

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Components – Pneumatic GARC Assembly

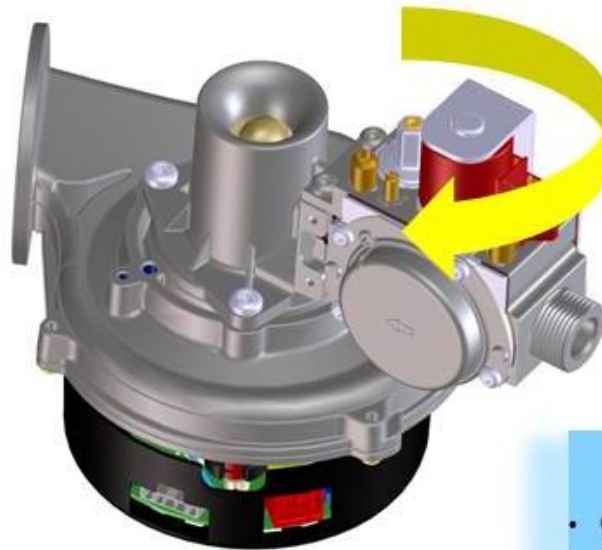
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Blower

- Mixes Gas and Air
- Provides air-gas mixture to burner

Venturi

- Generates low pressure signal
- Injects the gas into air



Gas Valve

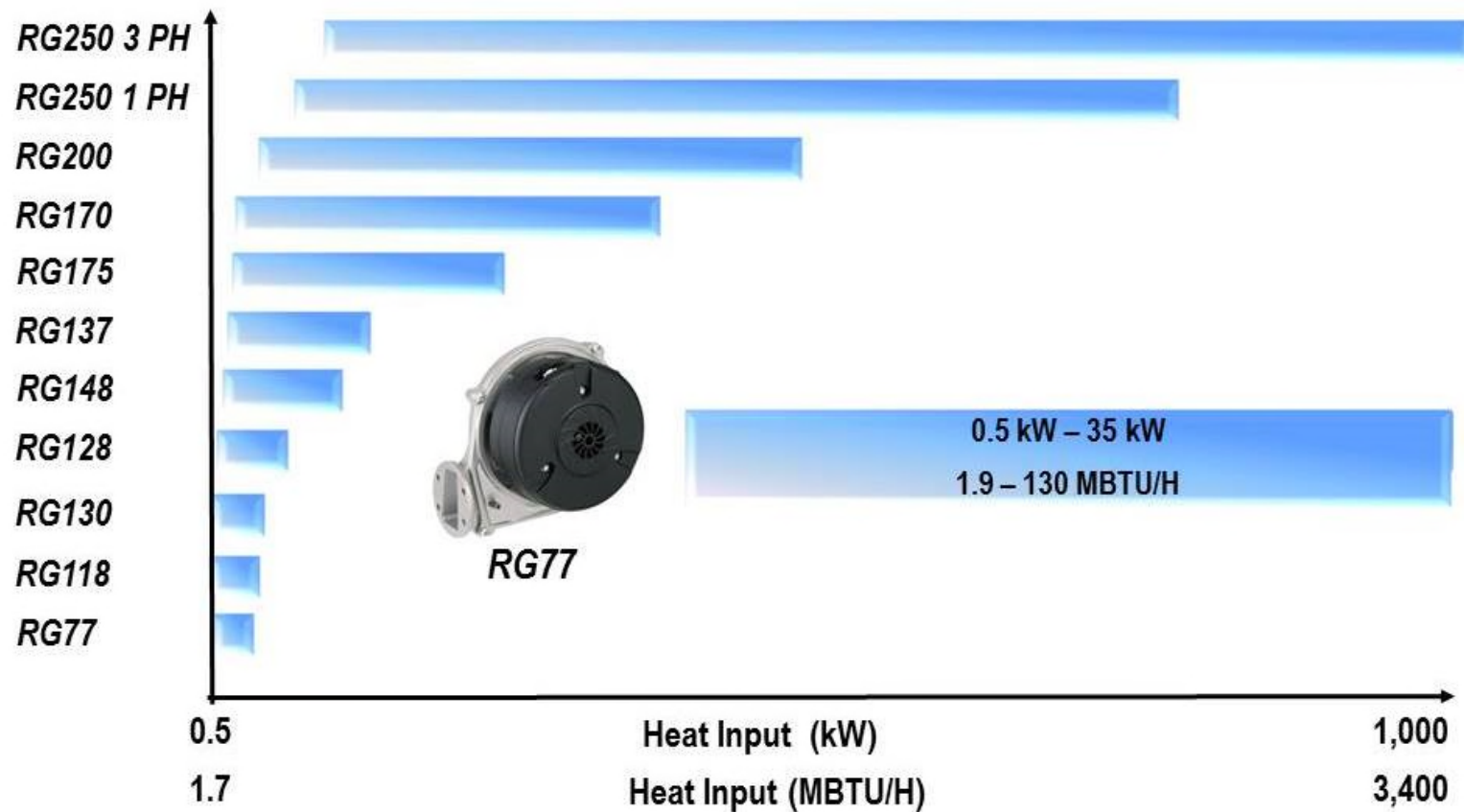
- Closes the gas supply
- Controls the amount of gas supplied



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Components – Premix ready gas blower

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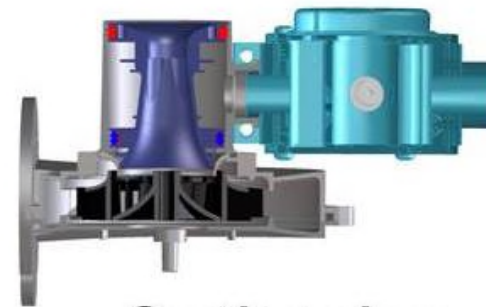


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Components – Venturi

Venturi for air-gas mixing control

- Venturi integrated into the blower housing
- Specific design for the operating points



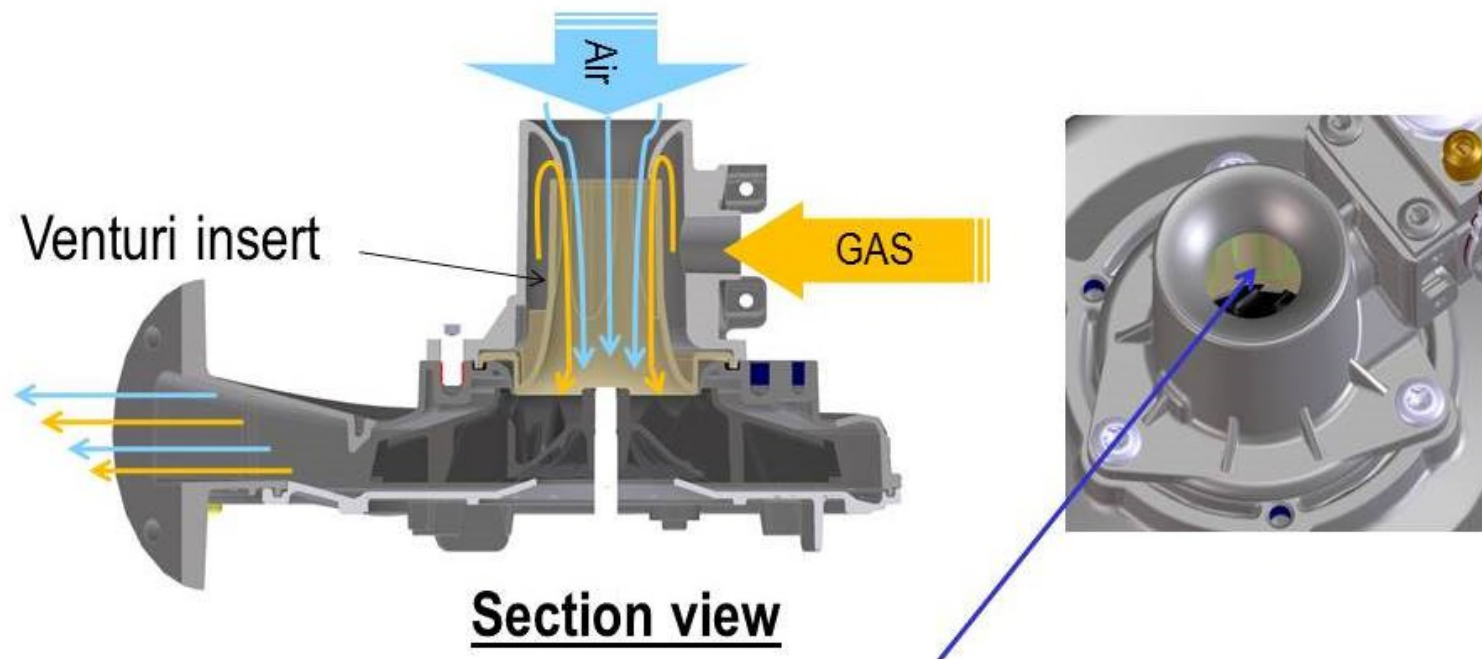
Section view

Custom or universal



Gas-air-ratio control technologies

Components – Venturi

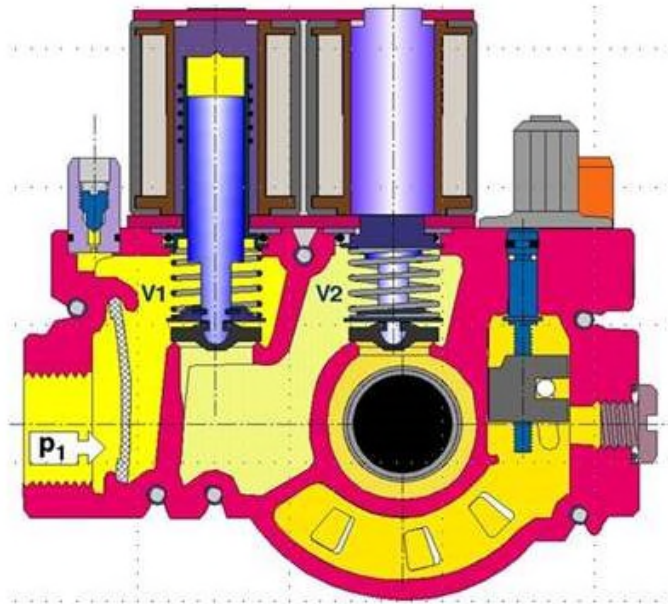


Multiple venturi inserts are possible to vary heat load

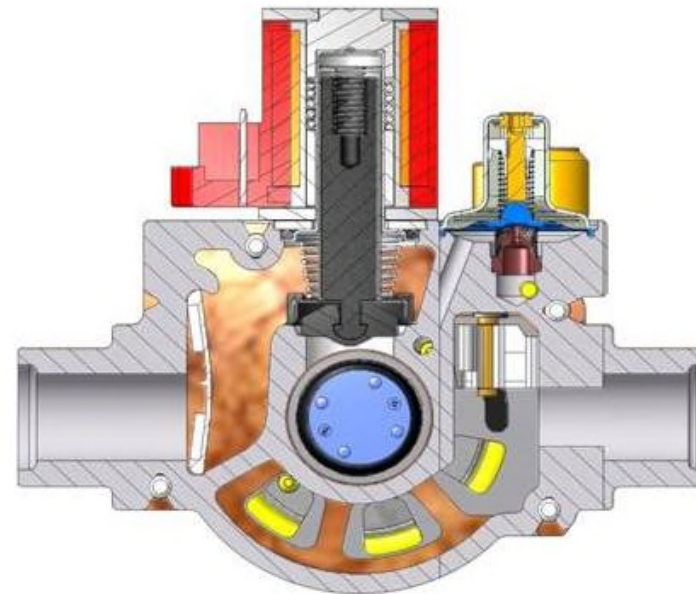
Gas-air-ratio control technologies

Components – Zero pressure gas valve

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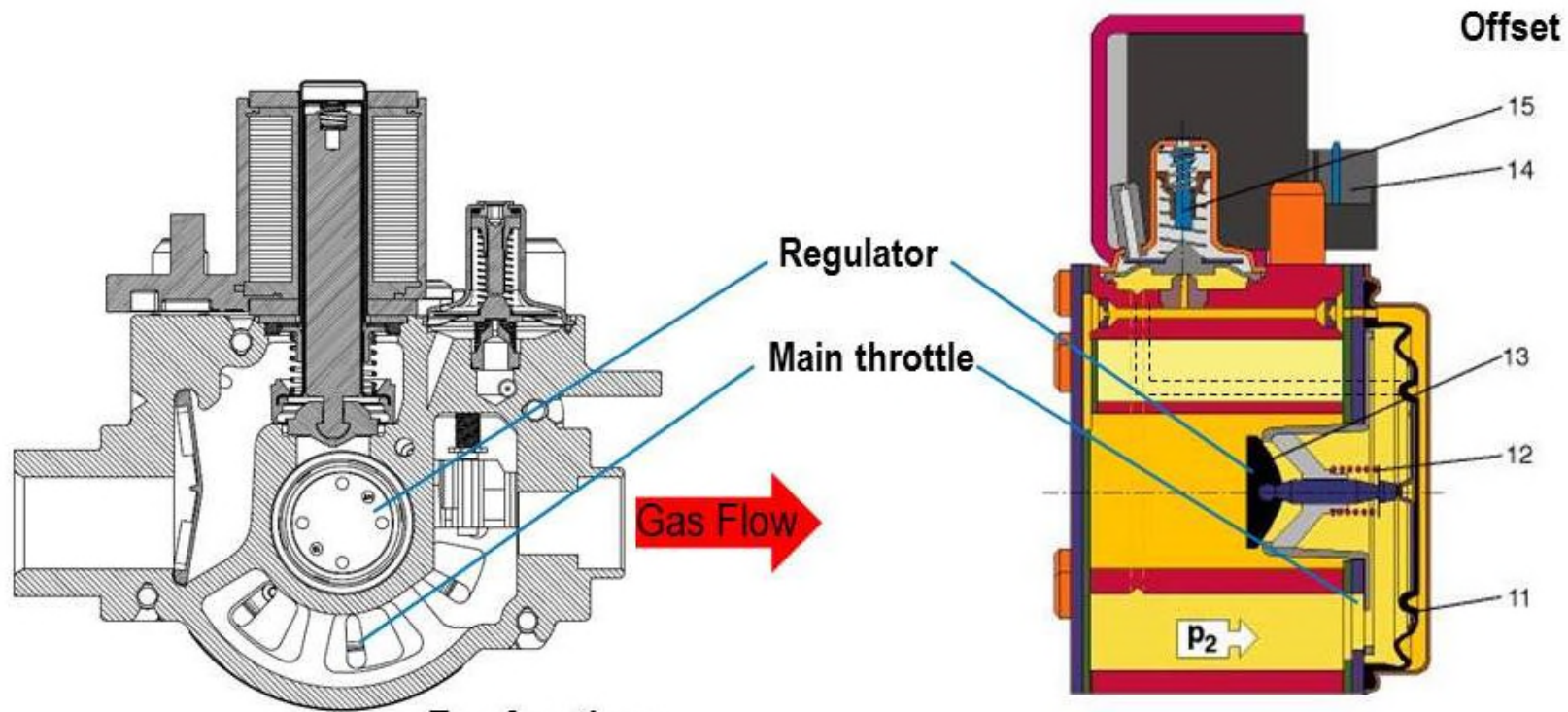
Dual valve



Co-axial valve

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Components – Zero pressure gas valve

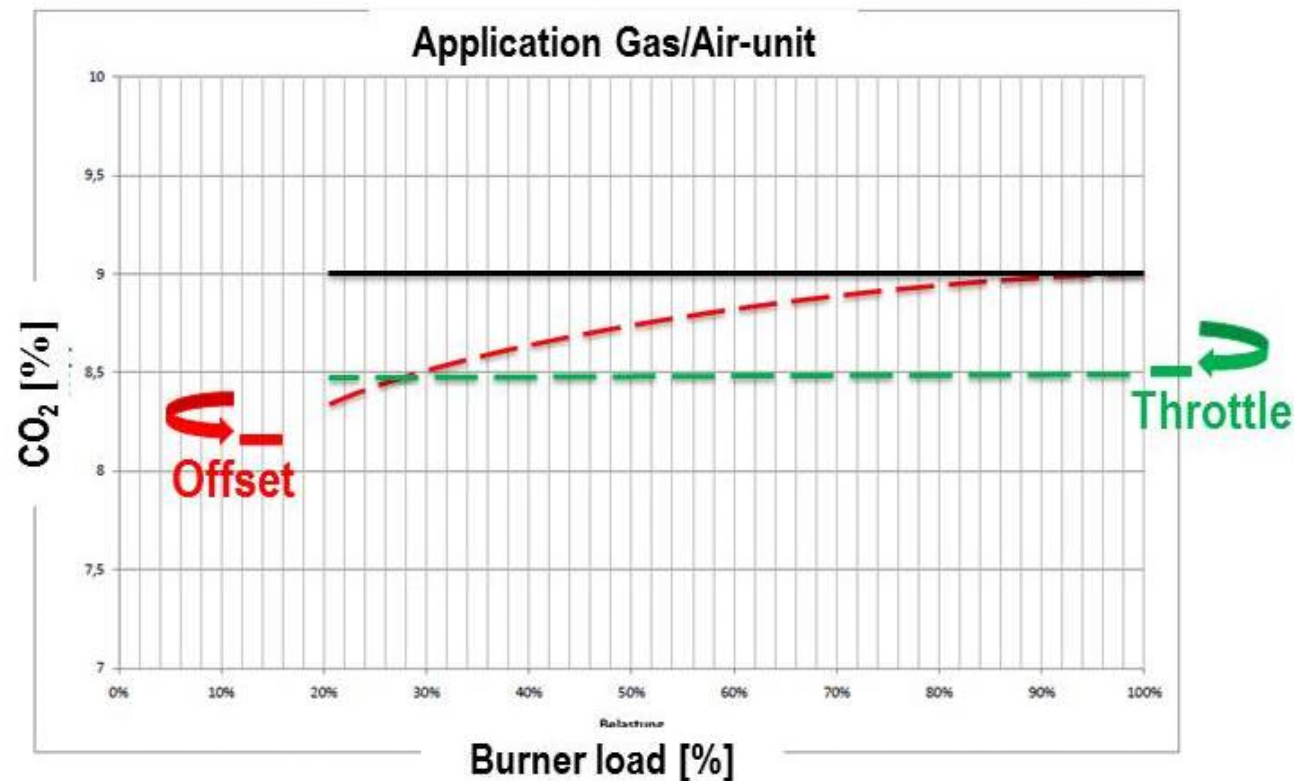


Two functions:

1. regulation of the gas flow
2. adjustment of the gas flow over range of load

Gas-air-ratio control technologies

Throttle and offset adjustment characteristics



Electronic gas-air-ratio control [gas adaptive]

Gas-air-ratio control technologies

Principle of electronic GARC operation

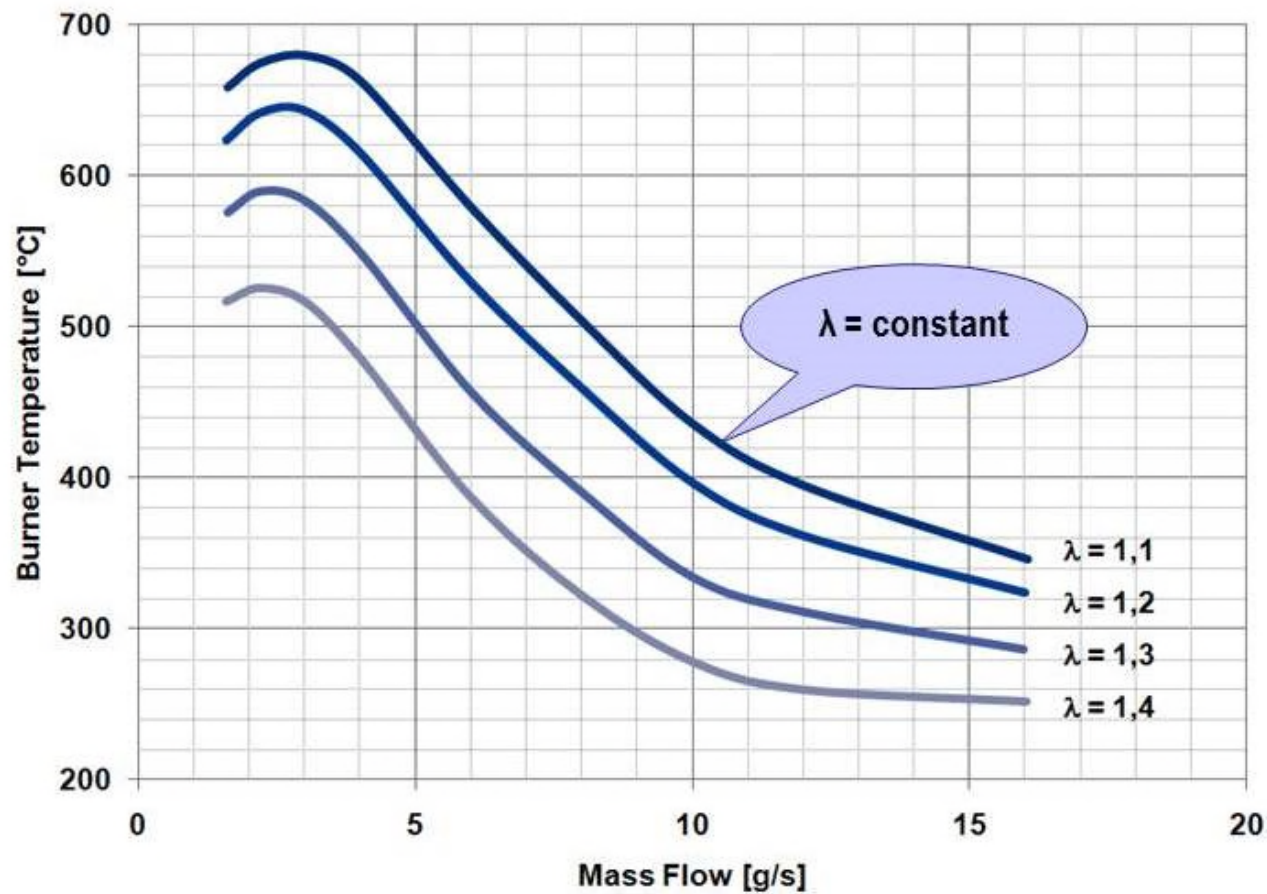


- Well-defined characteristic curve for burner temperature vs. mass flow air (thermal load of burner) within a gas family for given λ
 - $T_{\text{Burner}} = F(\text{mass flow air})$
- Ratio between mass flow air and thermal load of the burner is nearly constant within a gas family (NG) but different between gas families (NG vs. LPG)
- Mass flow air corresponding to heat demand is directly adjusted by a blower with an integrated mass flow sensor
- Gas flow is adjusted with an actuator valve so that T_{Burner} assumes proper value; increase gas flow when burner temperature is too low or decrease gas flow when burner temperature is too high
- During start-up a known characteristic curve (stored) is used for opening of gas valve vs. mass flow of air at ignition.

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Burner temperature vs. mass air flow

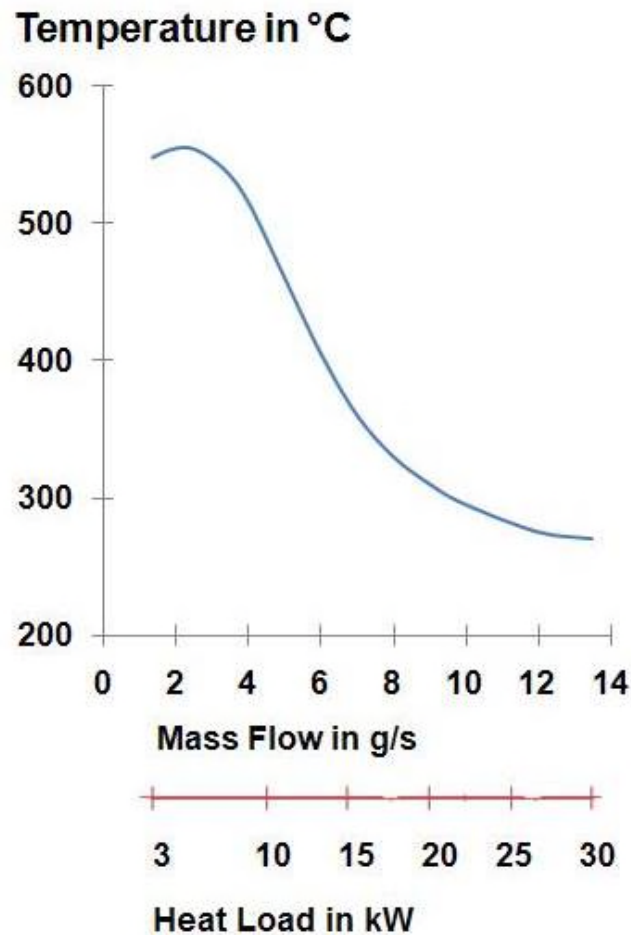
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Components – Burner with K-type thermocouples

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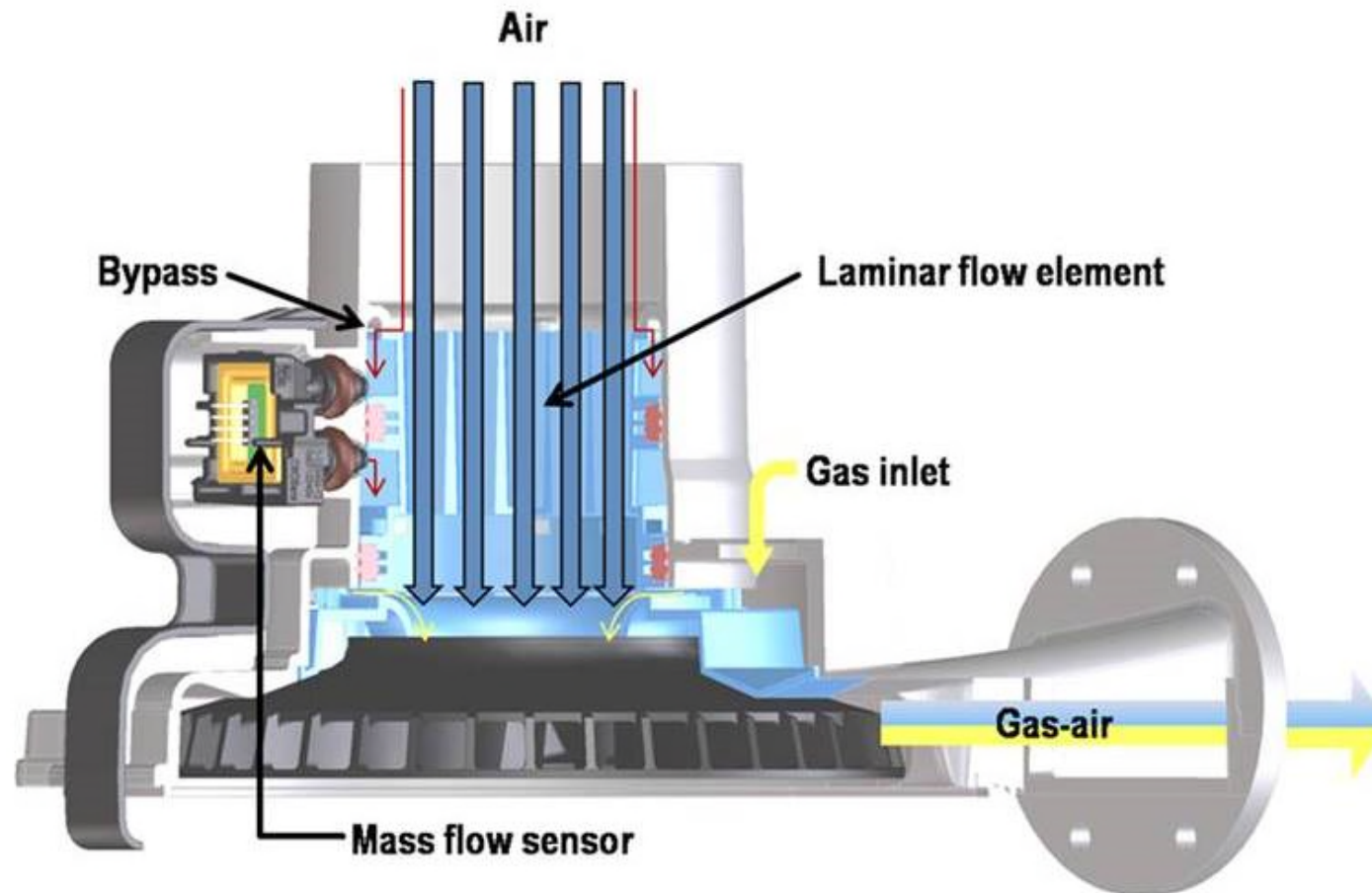
Components – Electronic GARC Assembly

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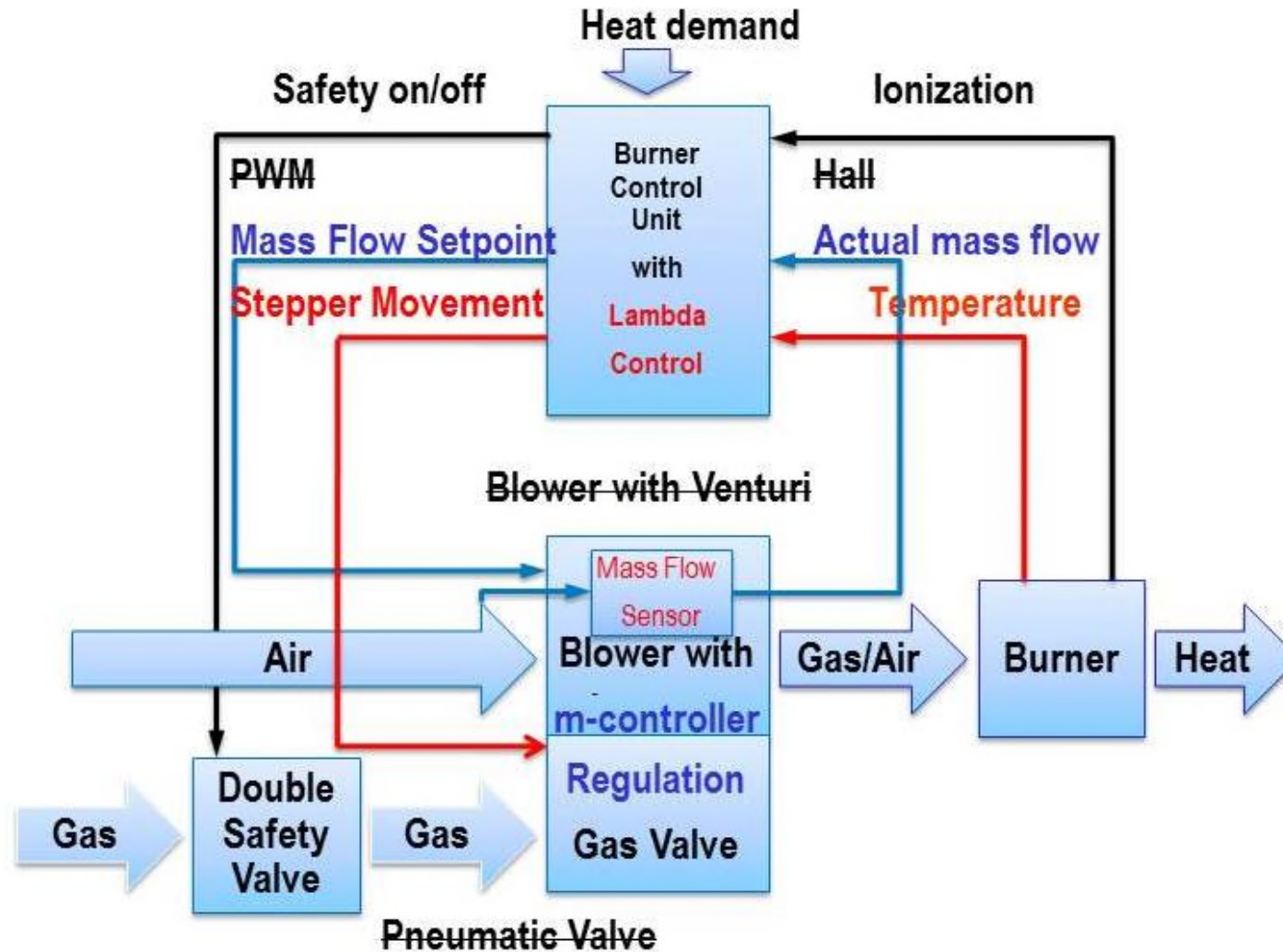
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Components – LFE with mass air flow sensor



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Electronic GARC diagram



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Features and benefits

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	Electronic GARC (gas adaptive)	Pneumatic GARC
Heat Demand	Modulation range of 1:10	Modulation range of 1:5
Altitude	Heat output remains the same	Heat output is reduced
Flue Pipe Length	Heat output remains the same	Heat output is reduced
Gas pressure	Constant Lambda value	Lambda value changes
Gas Quality	Only one appliance type is necessary for NG and LPG.	Change of gas orifice and appliance adjustments may be necessary.

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Pneumatic vs. Electronic

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**Computer
Simulation**

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QUESTIONS?

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THANK YOU!

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