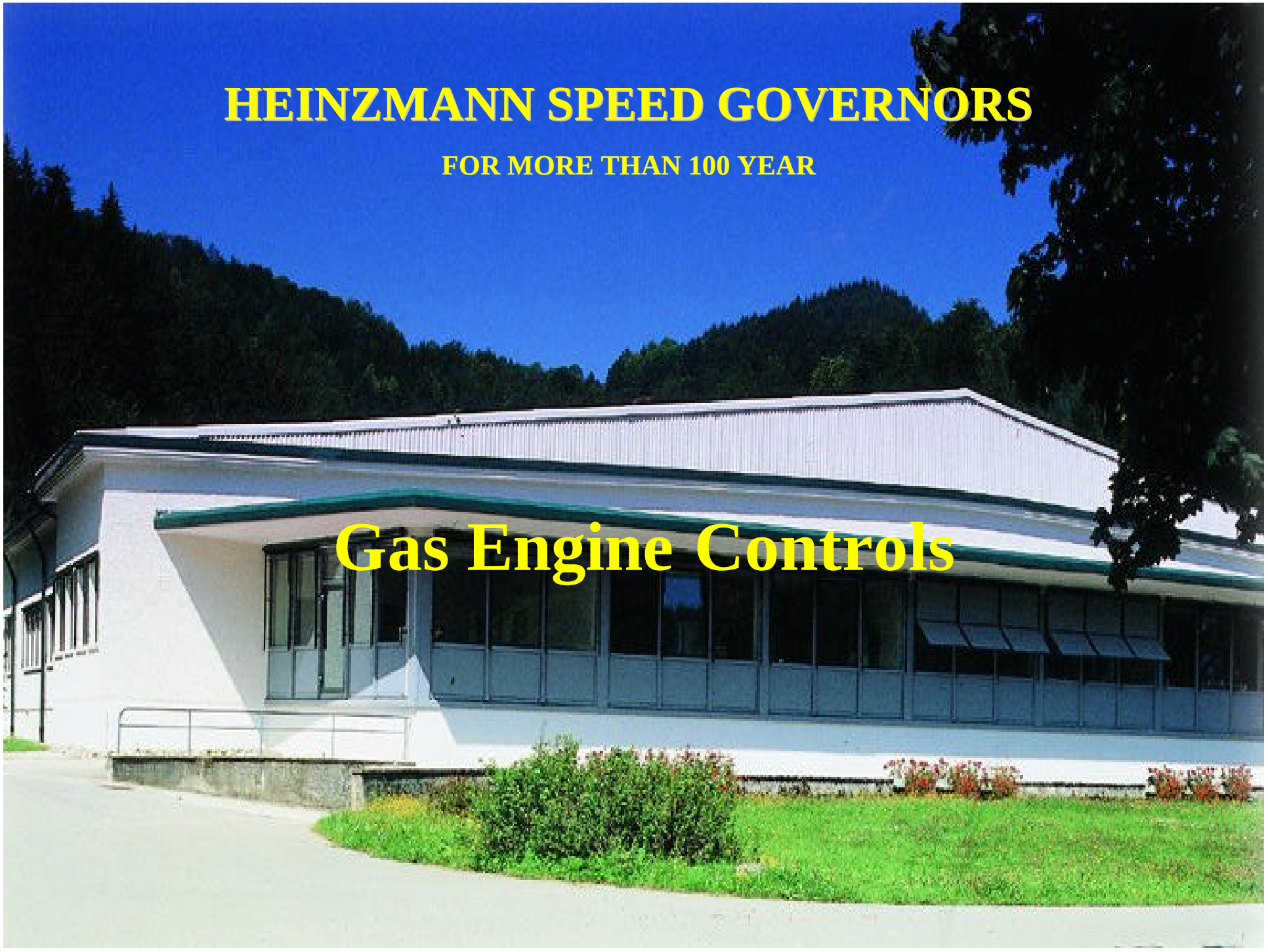
HEINZMANN SPEED GOVERNORS
FOR MORE THAN 100 YEAR
Gas Engine Controls

HEINZMANN®

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Gas engine equipment

ARTEMIS

- **Dual fuel gas engine control system**

KRONOS 10 – 20 – 30

- **Gas-air mixer**
- **Electronic AFR system**
- **Full authority AFR system with integrated engine speed governor**

ARTHEMIS system

For <u>DUAL FUEL</u> gas engine control system

- **For engines up to 2000 KW**
- **Gas and Air mixing Units**
- **Control unit for 2 or 3 actuators**
- **Actuators up to 64 nM**
- **Transfer from gas to diesel and back under load**
- **Full speed and load control**

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KRONOS system

For <u>SPARK IGNITED</u> gas engine control system

- **Venturi based gas and air mixing units**
- **Throttle Valves**
- **Gas Metering Valves**
- **Electronic adjustable Main Adjustment Screw**
- **AFR control systems**
- **Integrated speed control**
- **Misfire Detection**

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KRONOS 10 basic

$$Mmix = \frac{n \; x \; displ \; x \; MAP \; x \; 273K \; x \; Ve}{2 \; x \; 60 \; x \; 101.3 \; kPA \; x \; MAT} \; x \; 3.6 \; nM^3 / h$$

Where:

Mmix	*Total mix (gas +air)*
n	*Engine speed (rpm/min)*
displ	*Engine displacement (L)*
MAP	*Manifold Abs. Pres. (kPA)*
Ve	*Volumetric Efficiency (%)*
MAT	*Mixture Abs. Temp. (K)*

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KRONOS 10 basic

$$Mmix = Mair + Mgas$$

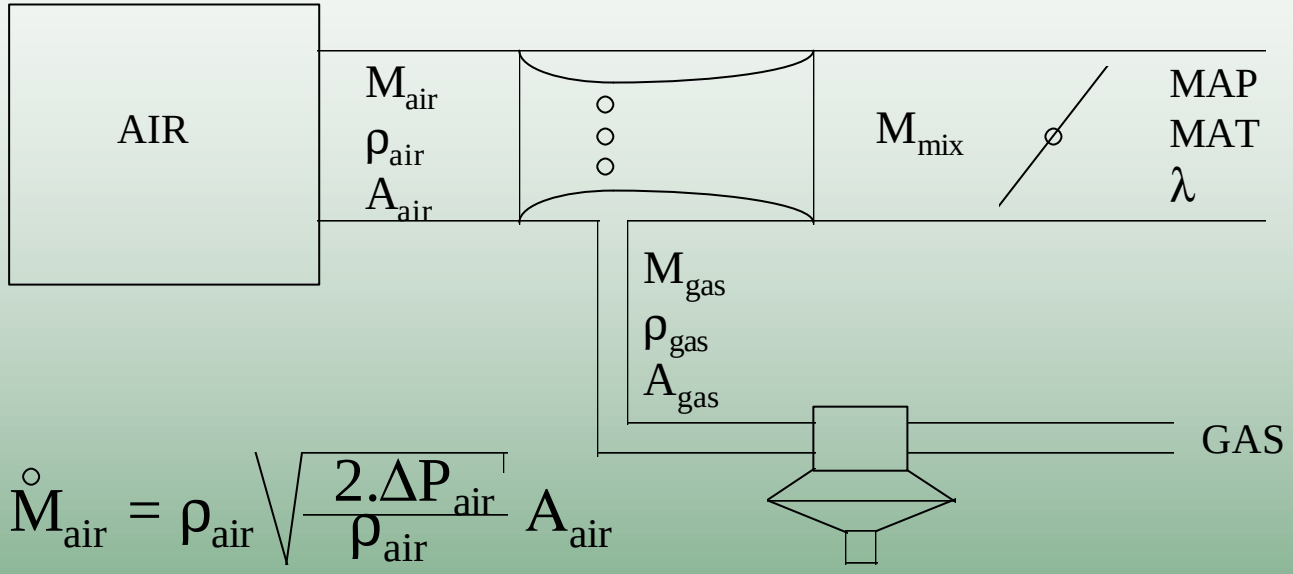
$$Mair = Mgas \, x \, l\,st \, x \, l\,des$$

$$Mgas = \frac{Mmix}{1 + l\,st \, x \, l\,des}$$

Where:

Mmix	*Total mix (gas +air)*
Mgas	*Total gas flow*
Mair	*Total air flow*
$l\,st$	*Lambda stoichimetric*
$l\,des$	*Lambda desired*

Kronos 10 Venturi-basic



$$\dot{M}_{air} = \rho_{air}\sqrt{\frac{2.\Delta P_{air}}{\rho_{air}}}\,A_{air}$$

$$\dot{M}_{gas} = \rho_{gas}\sqrt{\frac{2.\Delta P_{gas}}{\rho_{gas}}}\,A_{gas}$$

$$\frac{\dot{M}_{air}}{\dot{M}_{gas}} = \frac{A_{air}}{A_{gas}}\sqrt{\frac{\rho_{air}}{\rho_{gas}}}$$

Where:

Aair Size insert

Agas Size meterings holes

r Density

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KRONOS 10

Advantages of just a zero pressure regulator, a Heinzmann carburetor and a MAS.

- **It is a very simple and reliable system with just one moving component (the membrane inside the zero pressure regulator).**
- **High MTBF**
- **Under medium and higher load conditions A/F ratio near to desired.**
- **Venturi carburation is ideal for *l* 1 engines with closed loop 3-way catalyst control, because it provides a constant A/F ratio.**

KRONOS 10 Gas and Air Mixing Units

KRONOS 140 Gas/Air mixer

- **Venturi principle according to Bernoulli's Law**
- **No moving parts**
- **Very homogeneous mixture**
- **Low pressure drop**
- **Can be located upstream or downstream turbo**
- **In sizes from 50 to 300 mm**
- **For engines up to 2000 KW**

KRONOS 10 Throttle Valves

KRONOS 140 Throttle valve

- **75° Rotation angle**
- **For NA and TC engines**
- **Low friction**
- **Low torque at flow**
- **In sizes from 43 to 116 mm**

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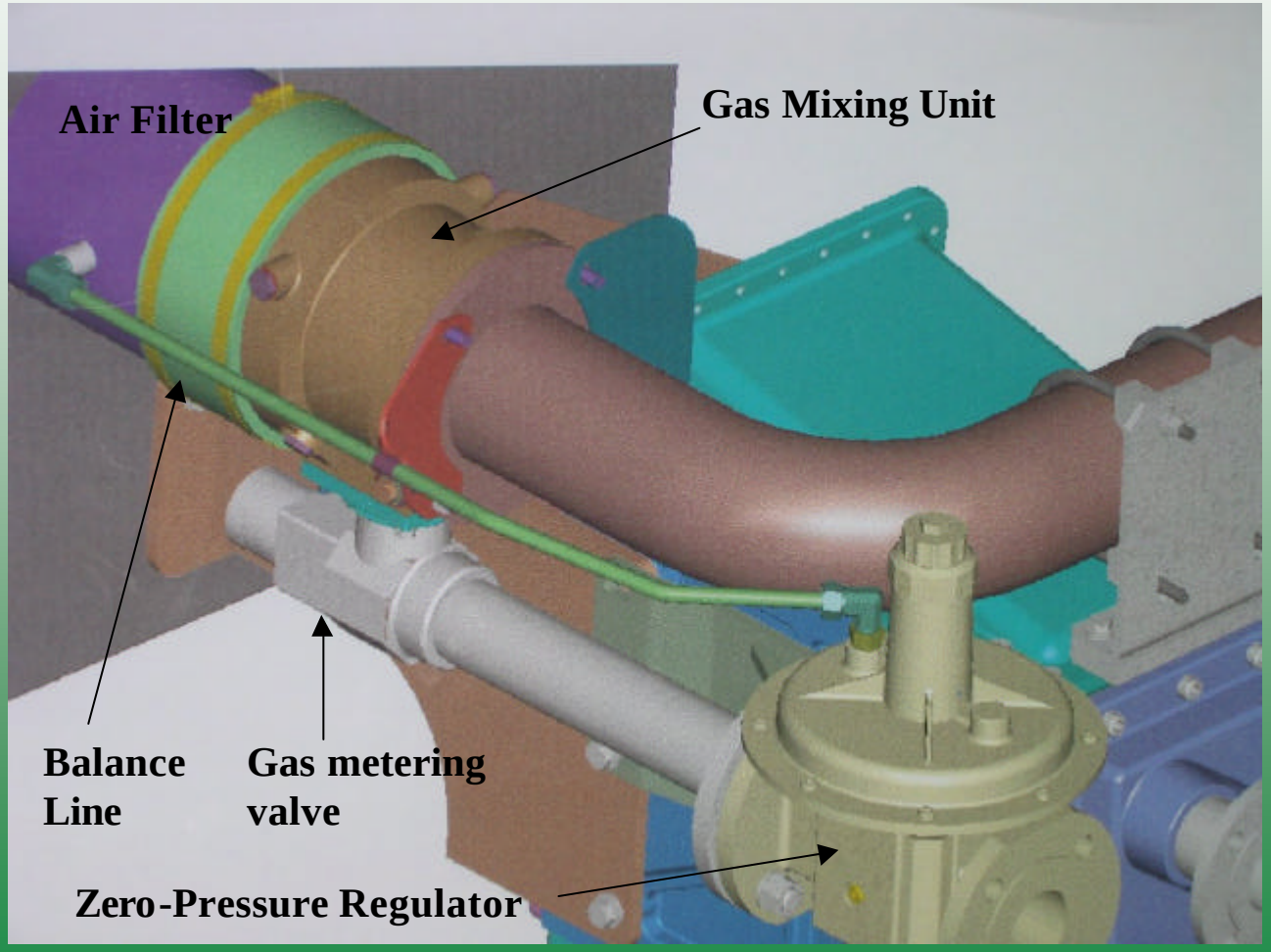
KRONOS 10

Typical Lay-out of a low pressure system



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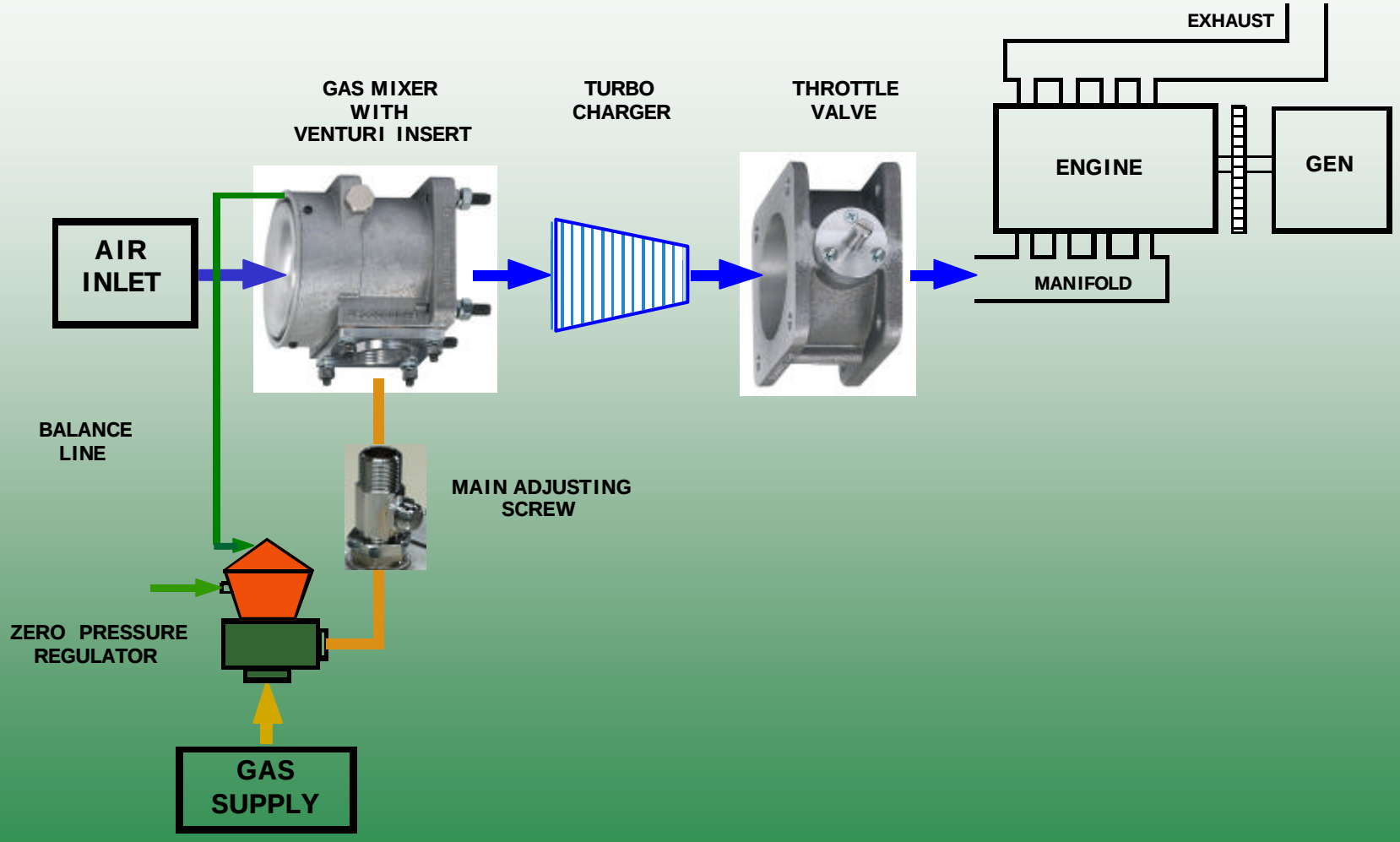
KRONOS 10



KRONOS 10

Commissioning:

- **Air / fuel ratio curve can be manual adjusted at full load by means of the main adjusting screw.**
- **At cranking speed the adjustment can be made with the offset of the ZPR (for instance 1/4” H^2O).**
- **Further adjustments not possible**

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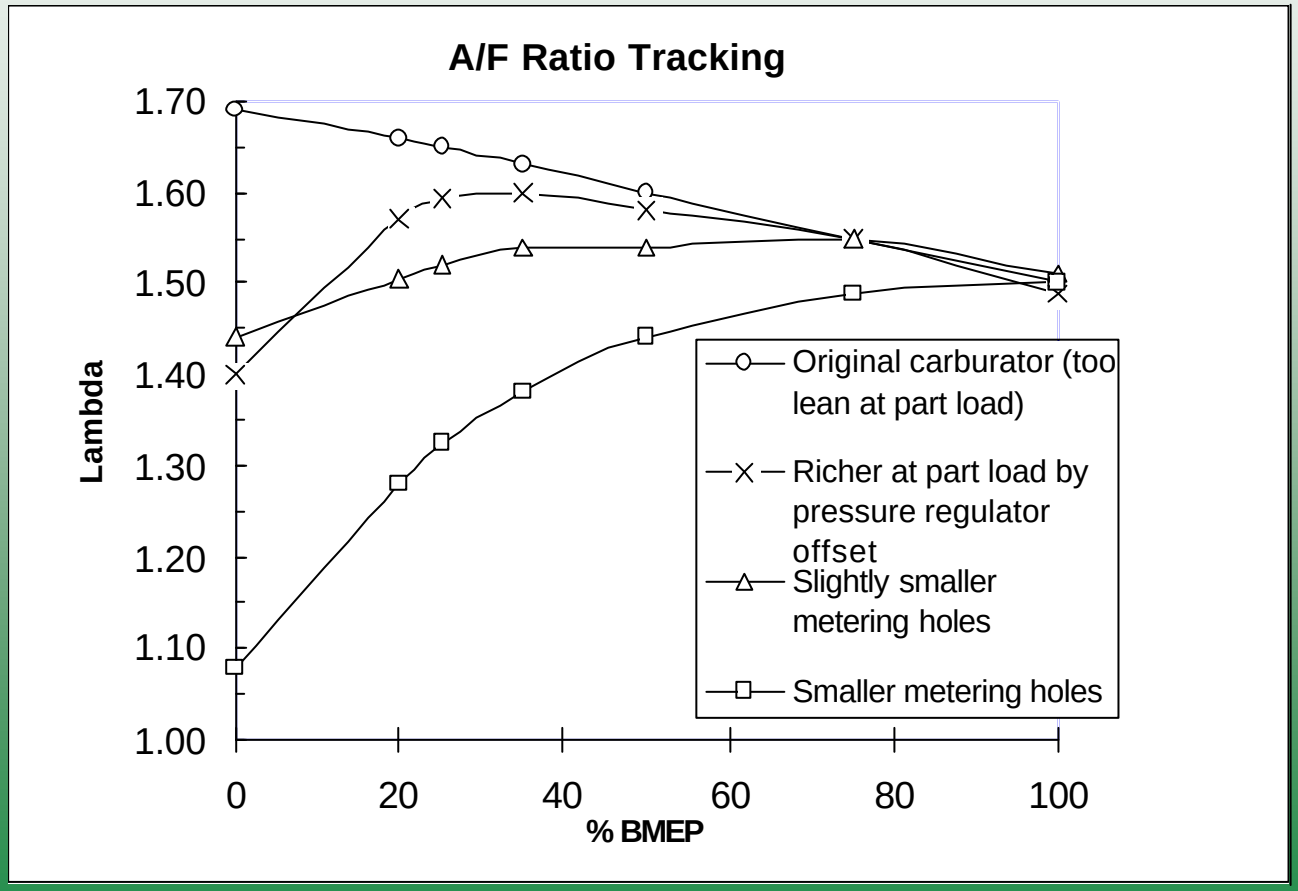
KRONOS 10

Trial and Error Method to solve Tracking Problem



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KRONOS 20

The problem:

- **The (cold) start behavior, the engine speed stability at synchronizing and the A/F ratio tracking for lean burn engines is not good enough with just a zero pressure regulator, a venturi carburetor and MAS.**
- **For Lean-burn the A/F ratio has to be load- dependent. At part load the the engine requires a richer mixture to avoid misfiring.**
- **There are systems that solve these problems, but they are too expensive and require an additional control**

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KRONOS 20

KRONOS Basic idea:

- **We do not want to create a full gas engine fuel management system with all kinds of sensors to achieve optimum engine performance. We want a solution that is simple and just eliminates the few disadvantages of the venturi system.**
- **We do want to combine this with a reliable over all closed loop system that gives the other applied sensors a secondary role.**
- **Better control over the NOx emission.**

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KRONOS 20

The answer:

- **Combine the advantages of the proven venturi principle and trim the gas flow for the other situations by adding an Intelligent Main Adjusting Screw.**
- **Can work with all kind of engine speed governor systems.**
- **For constant and variable speed engines.**
- **Closed loop with lambda sensor or CH4 signal or load signal.**
- **Misfire detection to protect the engine**

KRONOS 20

Gas Flow Actuator (E-LES)

E-LES 50

- **Available in size 50 and 80 mm**
- **For engines up to 2000kW**
- **Manual adjustment**

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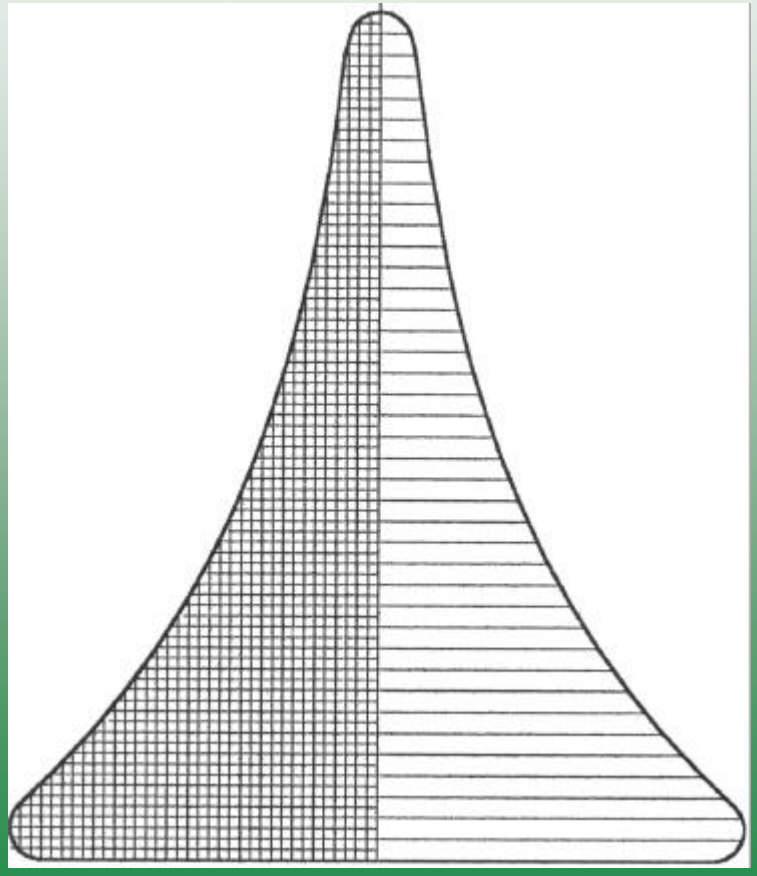
KRONOS 20

Exponential shaped slots



- **The shape is important to get a constant flow change per step of the stepper motor.**

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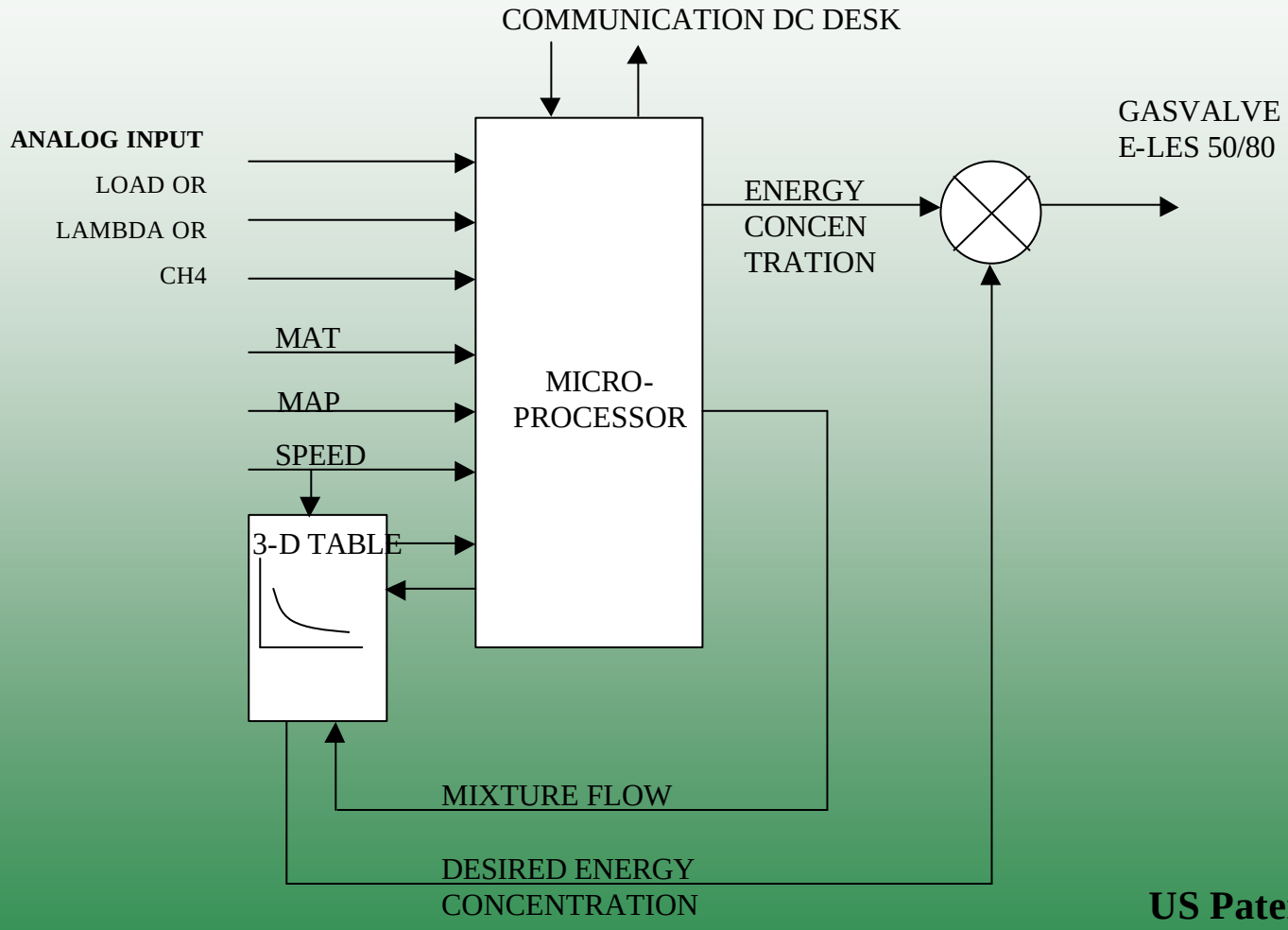
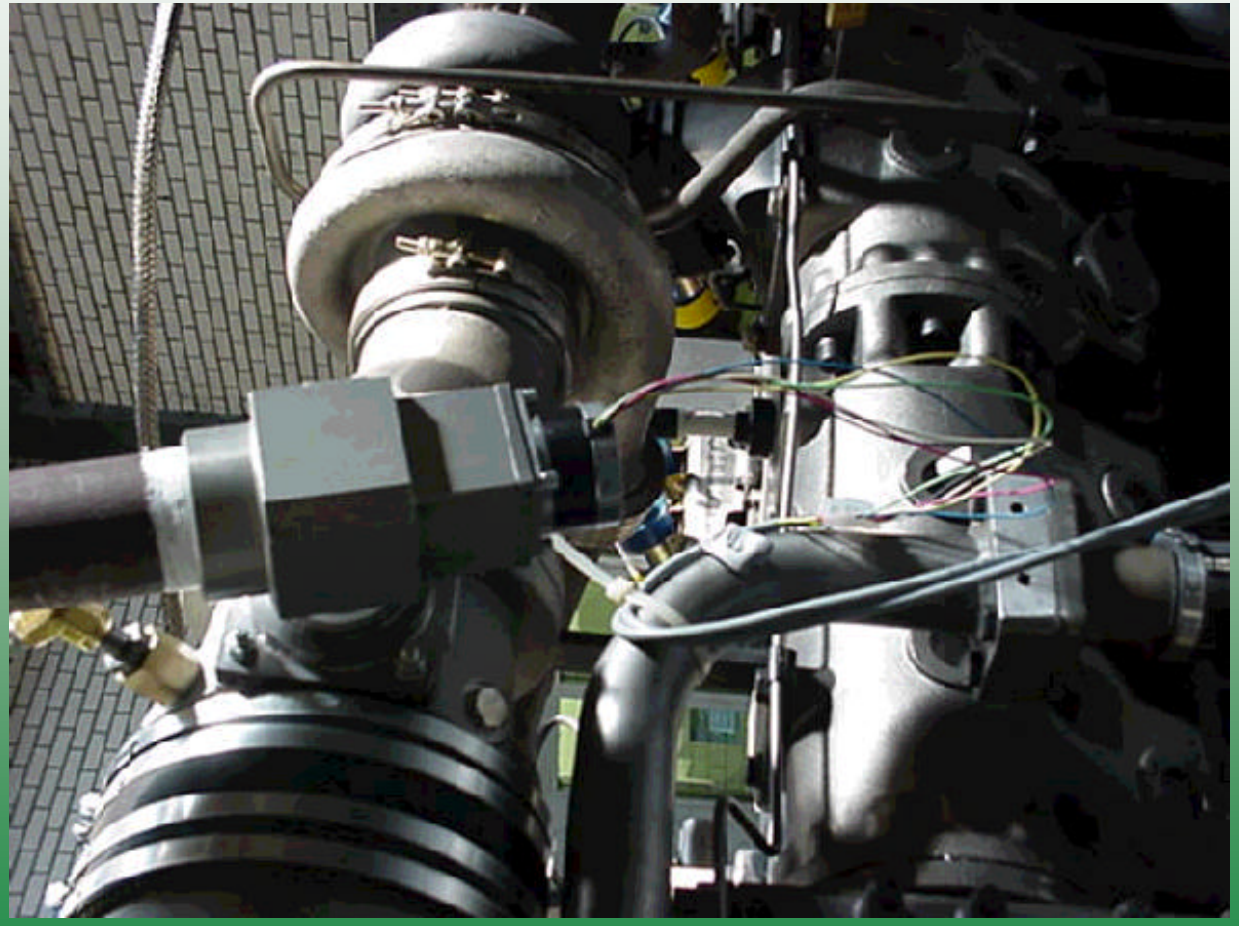
KRONOS 20



US Patent 09/500,785

KRONOS 20

Lab-testing of KRONOS 20



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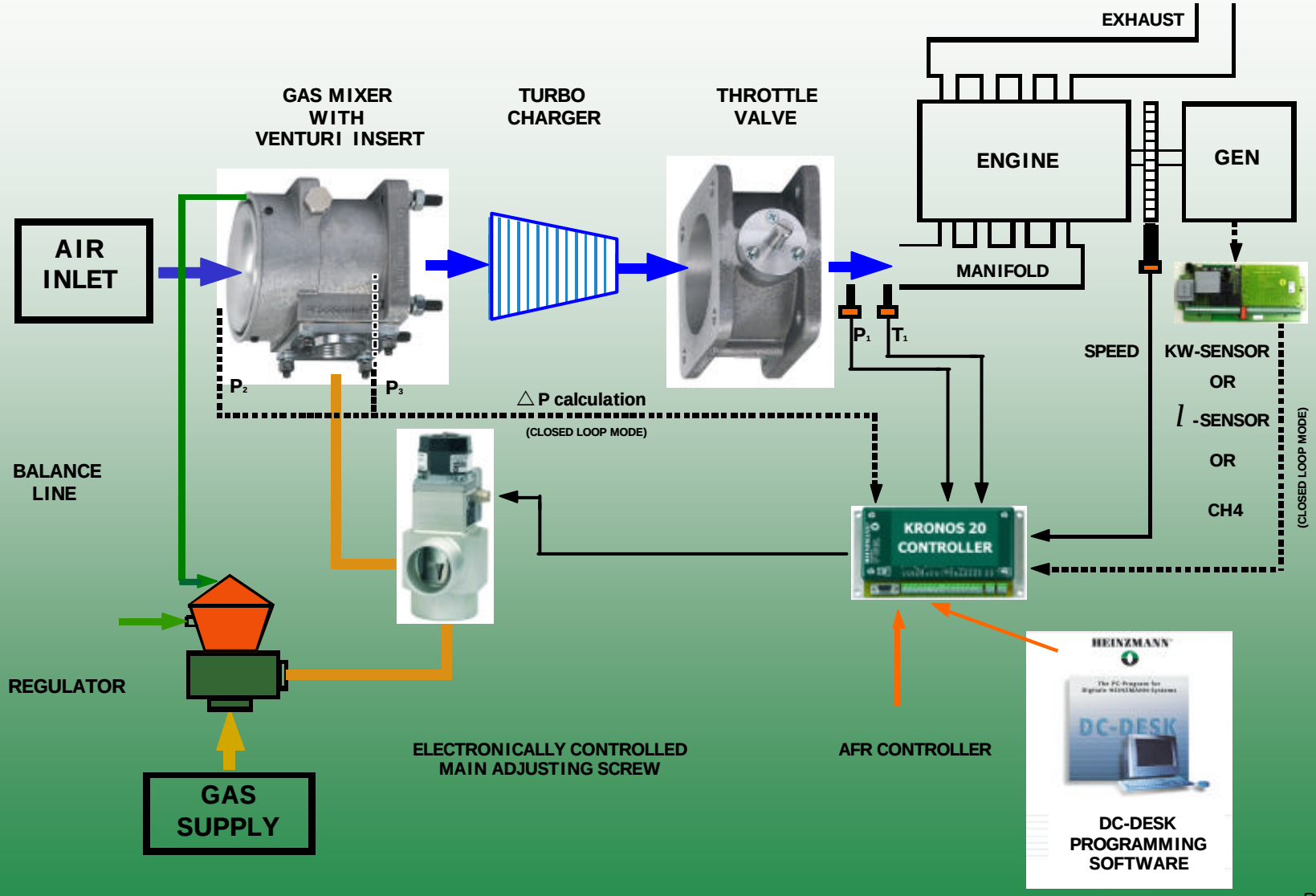
KRONOS 20



KRONOS 20

Commissioning:

- **Adjust the pressure regulator with a pressure gauge on the required pressure (for instance 1/4” H^2O).**
- **The lack of venturi suction at starting will be eliminated by this small regulator off set.**
- **Program the adjustment in the control module and the valve position will be compensated for this pressure.**
- **Communication program HEINZMANN DC-DESK for setup and monitoring of parameters.**

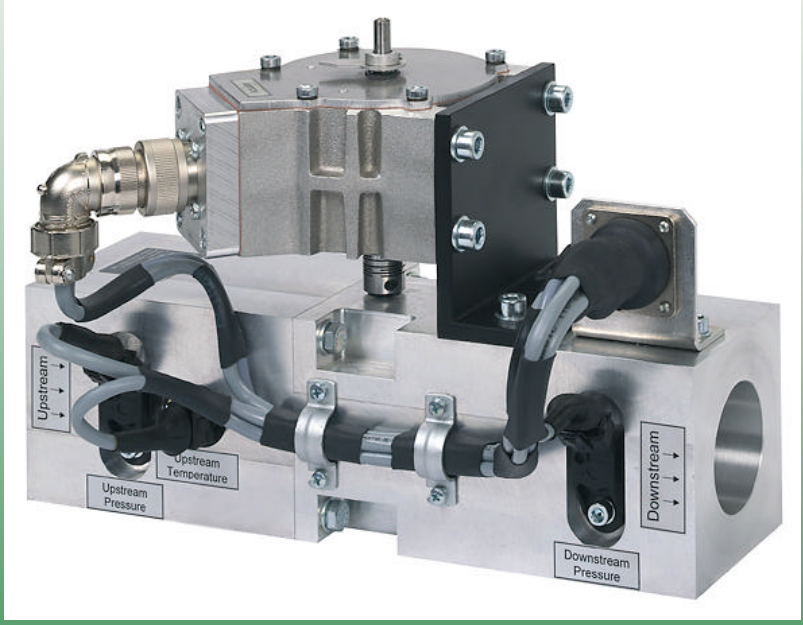
KRONOS 30

Full authority AIR FUEL ratio system

- **Electronic Gas Metering Valves**
- **Trottle valve and actuator in one unit**
- **Air Fuel Ratio Controls**
- **Integrated speed governor**
- **Misfire detection**
- **Ideal for retrofit**

KRONOS 30

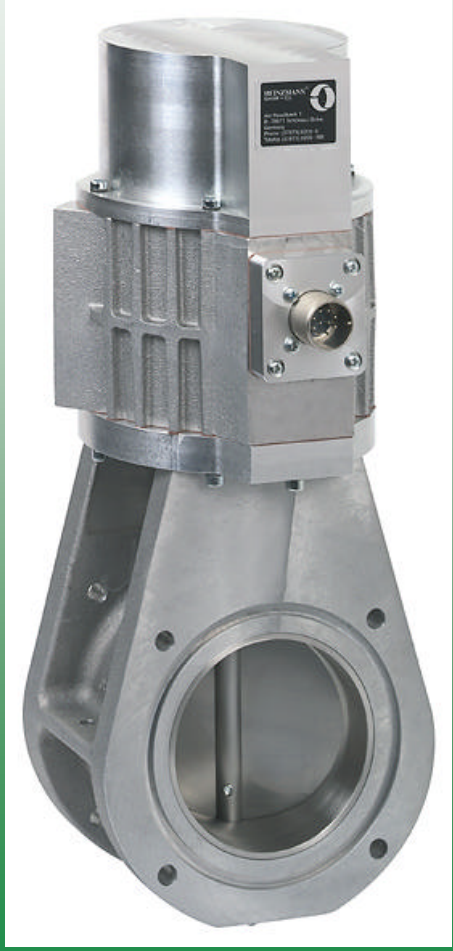
Gas metering unit



- **Gasflow up to 600 nM³/h.**
- **Gasflow measurement with pressure and temperature.**
- **Can be used for all type of gases.**
- **Precise actuator feedback system.**

KRONOS 30

Throttle valve with actuator



- **Available in different sizes.**
- **Integrated electronic as positioner.**
- **Precise actuator feedback system.**

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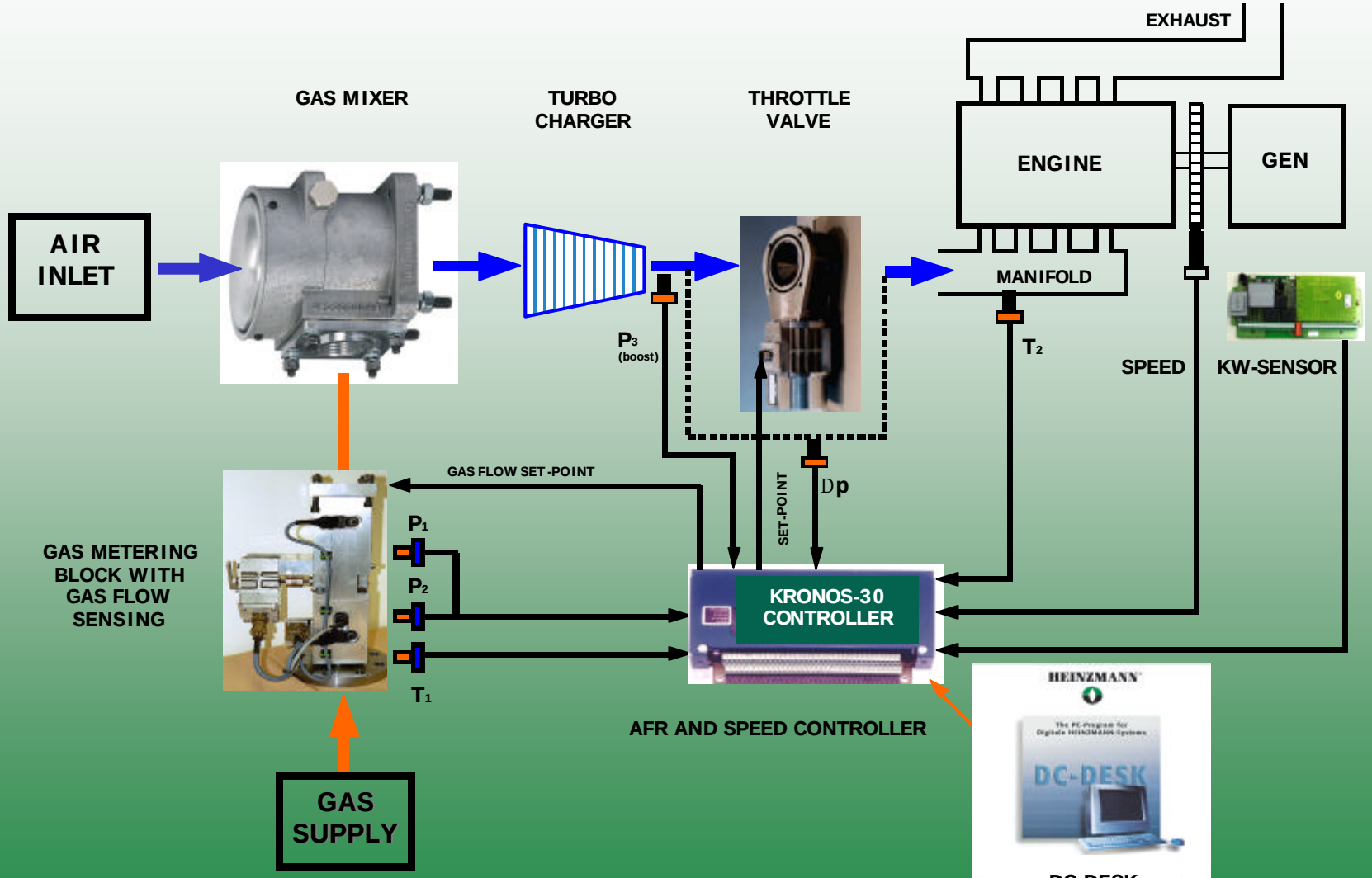
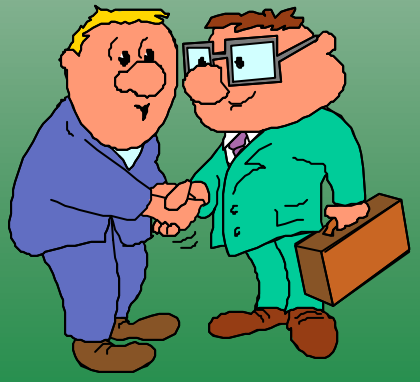
KRONOS 30



Our customers – Gas engine equipment

- ABC
- AGT (EGT)
- Caterpillar (Geveke)
- Deutz (KHD)
- Guascor
- Isotta Fraschini
- Jenbacher
- Perkins
- And many set builders



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End of presentation