

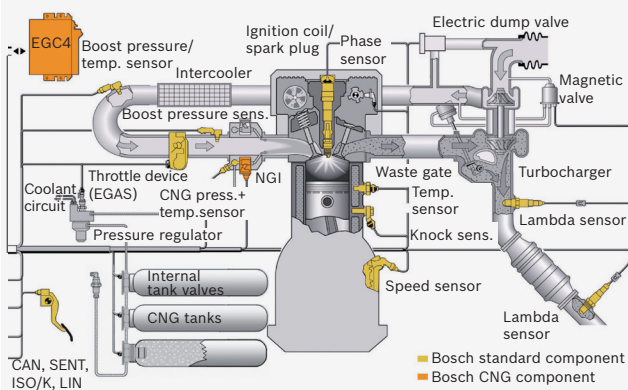
Diesel Systems

CNG system for natural gas and combined gas-diesel drivetrains



BOSCH
Invented for life

CNG system for commercial vehicle engines



Customer benefits

- ▶ Robust and tried components
- ▶ High system quality and reliability
- ▶ Solutions with the competence of a global engine management supplier
- ▶ Service spectrum to fit customer demand: from consulting on the purchase of special CNG components to turn-key projects
- ▶ Experience in function development, large pool of field-proven software modules

Customer benefits CNG

- ▶ Sustainable energy source with a secured long-term perspective
- ▶ Potential for CO₂ neutral transport
- ▶ Technology immediately available
- ▶ Low total cost of ownership due to low fuel costs (up to 50% savings)
- ▶ Emission targets up to Euro VI can be achieved with low effort: compliance with NO_x threshold values, no soot particles
- ▶ Clearance for environmental zones
- ▶ Lower combustion noise level

Global relevance of mobility will keep growing.

Therefore it is very important to have fuels which will be available on a long-term basis. Compressed natural gas (CNG) offers this security. The reserves known today are twice as large as those of crude oil. And biogas adds even more potential.

Technology for CNG engines is fully developed and field-tested. Since CO₂ output and emissions are very low, more and more countries promote CNG vehicles.

Expenses for engine management and exhaust gas treatment are about the same as with classical drivetrains, while fuel costs less. This makes CNG drivetrains a cost-effective contribution to cleaner mobility, which will become ever more important in the growing number of mega-cities.

Possible applications

Bosch supplies comprehensive system know-how with consulting services and field-proven components for monovalent medium- and heavy-duty CV engines and for dual-fuel applications. Monovalent vehicles, which run exclusively on CNG, are mainly used for inner-city applications. Dual-fuel systems allow engine change-over for combined diesel and CNG operation.

Functional principle

Compressed natural gas (CNG) is a gaseous fuel. It is stored at about 200 bar and injected with about 6 bar into the manifold. An electronic ignition system is required to ignite the air-CNG mixture. Because of its low energy density a given tank volume of CNG offers less range than other fuels.

In dual-fuel systems diesel is used as pilot fuel, which ignites the air-CNG mixture, making external ignition dispensable. Dual-fuel vehicles can also be operated on diesel only. This makes them fit for operation in regions with limited CNG infrastructure.

	EGC4	EGC10
Technical features		
Classification	High-end	Base-line
Emission targets monovalent (CNG) dual-fuel (diesel/CNG)	Euro VI Euro V	Euro VI Euro V
Engine mounting	Yes	Yes, mounting with absorber
Air-fuel mixture monovalent dual-fuel	$\lambda=1$ /lean mix Lean mix	$\lambda=1$ /lean mix Lean mix
Ignition monovalent dual-fuel	Spark plug Diesel jet	Spark plug Diesel jet
Substitution of diesel monovalent dual-fuel	100% $\leq 70\%$	100% $\leq 70\%$
Valve output stage booster capable	Controlled	Switched
Cold start reliability monovalent dual-fuel	-30°C As diesel	-20°C As diesel
Lifetime [million km]	1.5	0.5
Gas-tank pressure [bar]	~200	~200
Injection pressure (absolute) [bar]	7...10	7...10

System design

The Natural Gas Injector NGI2 from Bosch has been developed specifically for the requirements of natural gas injection into the air intake. It sets standards for dosing precision, gas leakage and costs. The injector is very compact and can be controlled by a standard output stage. It is applied in monovalent and dual-fuel systems.

The electronic control units EGC4 and EGC10 can be used for monovalent and dual-fuel operation. Dual-fuel operation requires two control units, one for diesel, and one for CNG. In monovalent operation with $\lambda=1$ and three-way catalytic converter, vehicles can already comply with Euro VI emission thresholds.

The throttle device regulates the air intake mass into which the natural gas is injected. Monovalent systems require a spark plug and an ignition coil for each engine cylinder to ignite the air-fuel mixture.

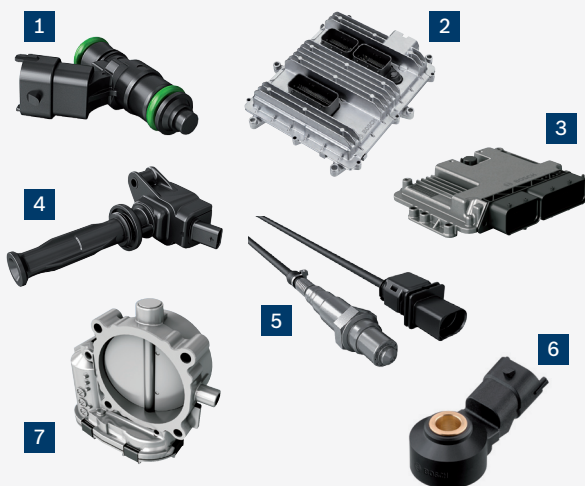
From the knock sensor signal, engine control can recognize combustion quality and adjust ignition timing accordingly. This protects the engine when using varying fuel qualities and allows full usage of the engine power.

A lambda oxygen sensor measures the oxygen content of the exhaust gas. In monovalent systems the air-fuel mixture is controlled within a narrow spectrum, the so called lambda window. This ensures optimal conversion inside the three-way catalytic converter. In dual-fuel systems the lambda sensor serves to achieve optimal combustion quality and exhaust-gas return rate.

Outlook

An optimized infrastructure of filling stations for natural gas vehicles will make CNG a serious primary-fuel alternative.

System components



- 1 Natural Gas Injector NGI2
- 2 Control unit EGC4 (Electronic Gas Control)
- 3 Control unit EGC10 (Electronic Gas Control)
- 4 Ignition coil (Single-spark coil)
- 5 Lambda oxygen sensor
- 6 Knock sensor
- 7 Throttle device

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Printed in Germany
29200P0KU-C/CCA-201009-En