



Company group



Worldwide



Products

- Mixer systems
- Gas injection systems
- Dieselblend systems
- Liquid gas injection systems
- ValveCare (additive)

Eindhoven

The Netherlands



Fuels

- LPG
- CNG , LNG
- Hythane
- Hydrogen
- Bio fuels



Part 1

Dieselblend Principal



Diesel blending principle

- Diesel blend is based on the vapor injection of LPG / CNG in an existing diesel engine.
- The VSI computer calculates the amount of injected LPG / CNG depending on engine load and speed.
- LPG / CNG gas is sequentially injected into the intake manifold.
- Sequential means that the injected gas is calculated and timed per cylinder
- The amount of injected gas mixes with the intake air.
- The diesel will ignite because of the high compression end pressure in the cylinder and will ignite the gas/air mixture.



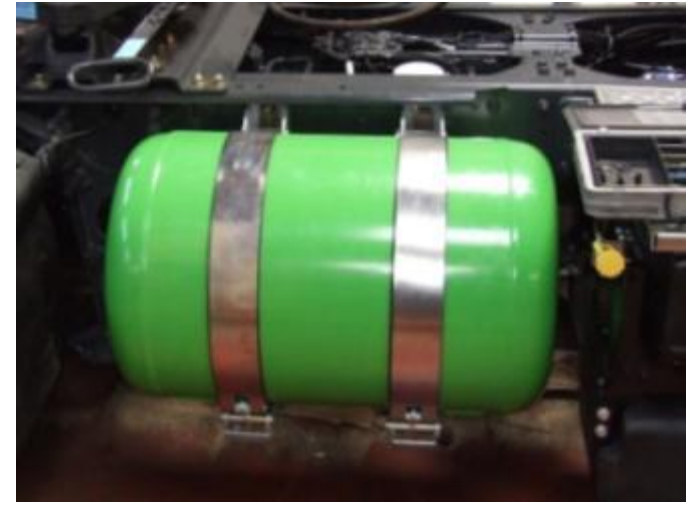
Central versus Sequential injection

- Central injection=>LPG/CNG injected before or after turbo charger.
- Sequential injection=> LPG/CNG injected per cylinder into the intake manifold just before the inlet valve.
- Disadvantages central gas injection before/after turbocharger:
- Large volume explosive air/fuel mixture in intercooler and intake;
- High risk of LPG/CNG leakage in the intercooler and intake system;
 - Diesel engines have no gas-tight seals in the turbocharger;
- Slow response of engine fueling;
- During valve overlap a portion of the air fuel mixture will be wasted directly into the exhaust [higher HC emissions].





CNG



LPG



LNG



Dieselblend fuels LPG/CNG/LNG

- **LPG (Liquefied Petroleum Gas)**
 - Propane : C_3H_8 Boiling point 231 °K (-42 °C)
 - Butane : C_4H_{10} Boiling point 273 °K (0 °C)*
 - Several mixtures; summer- & winter fuel
 - Storage pressure 100-1500 KPa
 - Heat value 24,89 MJ/Ltr
- **CNG (Compressed Natural Gas)**
 - L-Gas : Low caloric Gas
 - H-Gas : High caloric Gas
 - Storage pressure up to 25000 KPa
- **LNG (Liquefied Natural Gas)**
 - Storage pressure 200-700 KPa at ca. -140 degrees
 - Heat value 21,00 MJ/Ltr



Calorific value/density

	MJ/l	MJ/kg	MJ/m ³	Density [kg/l]
Petrol	32,0	43,5		0,73
Diesel	36	42,5		0,83
Propane	23,6	46,5		0,51
Butane	26,6	45,5		0,58
CNG (NL)	----	38.0	31,7	0,83 [kg/m ³]
CNG (Japan)	----	49.4	41,4	0,83 [kg/m ³]

- 1 liter diesel => 1.4 liter LPG
- 1 liter diesel => 0.95 kg L-CNG
- 1 liter diesel => 0.75 kg H-CNG



Part 2

Why Dieselblend ?



Why Diesel blending?



- Costs reduction.
 - Up to 15 % fuel savings
- Significant reduction of emissions by using alternative fuels.
 - contributes to “green” image of your company
 - meets demand for environmentally conscious ECO-transport
- Low system costs.
 - Not necessary to rebuild a diesel engine into an otto-engine [mono fuel LPG/CNG]
- Truck maintenance interval stays the same.
- No downtime when system fails.
 - Able to switch back to full diesel operation



Savings depending on:

- ◆ Vehicle /engine type
- ◆ Vehicle use
- ◆ Type of load
- ◆ Type of fuel blending LPG-CNG
- ◆ Local fuel prices



- ◆ Savings are achieved because a percentage of the diesel is replaced with LPG/CNG which is far cheaper
- ◆ The more miles covered the greater the savings!!



Prins Calculator for LPG or CNG

It is only possible / necessary to change the variables in the yellow marked cells!!

Data used for calculation:

LPG composition

Percentage propane: 50 %

Percentage butane: 50 %

Kilometers/year: 120.000 kilometers

Fuel consumption diesel: 30 l/100 km

Fuel price diesel: 1,15 Euro/liter

Fuel price LPG: 0,69 Euro/liter

Average blend percentage: 25 %

Fuel tank capacity Diesel: 400 liter

Nett Fuel tank capacity LPG: 200 liter

Calculation results:

1 liter diesel is equivalent to: 1,44 liter LPG

100% Diesel mode:

Liters diesel used: 36.000 l/year

Driving range: 1.200 km assumes 90% usable tank volume

Total fuel cost per year: 41.400 Euro

CO2 emissions per year: 97,2 ton

Dieselblend-LPG mode:

Liters diesel used: 27.000 l/year

Liters LPG used: 12.940 l/year

Fuel consumption diesel: 22,5 l/100 km

Fuel consumption LPG: 10,8 l/100 km

Driving range diesel: 1.600 km assumes 90% usable tank volume

Driving range LPG: 1.855 km

Fuel cost diesel: 31.050 Euro

Fuel cost LPG: 8.928 Euro

Total fuel cost per year: 39.978 Euro

CO2 emissions per year diesel: 72,9 ton

CO2 emissions per year LPG: 20,1 ton

Total CO2 emissions per year: 93,0 ton

Fuel cost saving: 1.422 Euro/year

CO2 emission reduction: 4,2 ton



Part 3

Applications



Dedicated motor sets

- Dedicated motor kit
- Dedicated software
- Engine specific parts
- Instruction manual



Universal tank sets



Developments for Europe



DAF : MX & PR engine



Iveco : F3A engine



MAN : D20/26 engine



Mercedes : OM501



Renault : DXi 11 / DXi 13



Applications heavy duty LPG



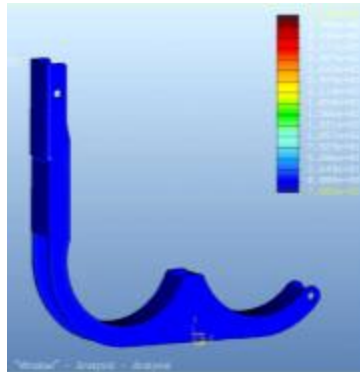
- ◆ Different tank situations 250 / 376 liter
- ◆ Steel cylindrical tanks are available in different sizes / diameters
- ◆ 1 liter diesel => 1.4 liter LPG
- ◆ 250 Liter tank LPG x 80%= 200 Liter LPG
- ◆ 200 Liter LPG $\approx$ 142 Liter Diesel
- ◆ Blendrate 25% (142L)
- ◆ 75% diesel $\approx$ 426 liter diesel



Applications heavy duty CNG



Applications heavy duty CNG



4 x 100 / 120 / 140 Liter LPG

2 x 100 / 120 / 140 Liter LPG



1 x 100 / 120 / 140 Liter LPG



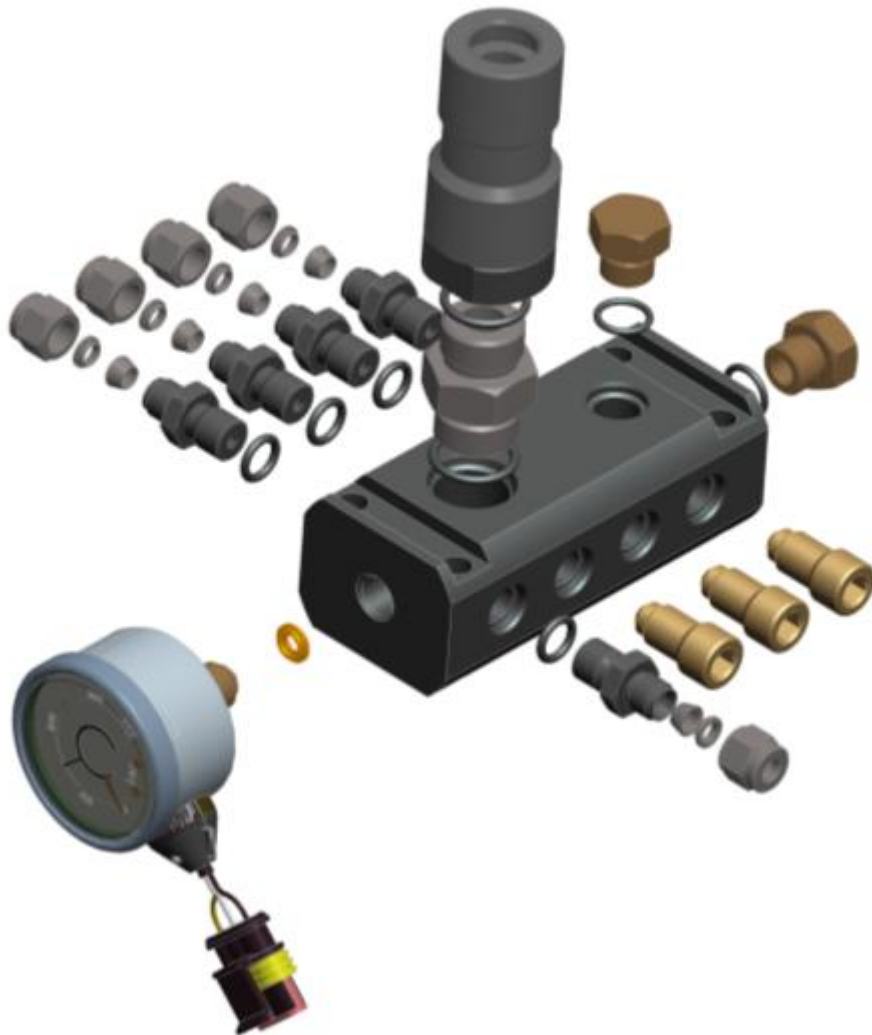
Applications heavy duty CNG

4 x 120 /140 Liter CNG

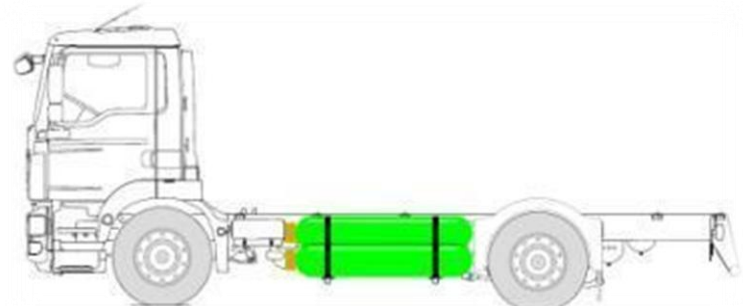
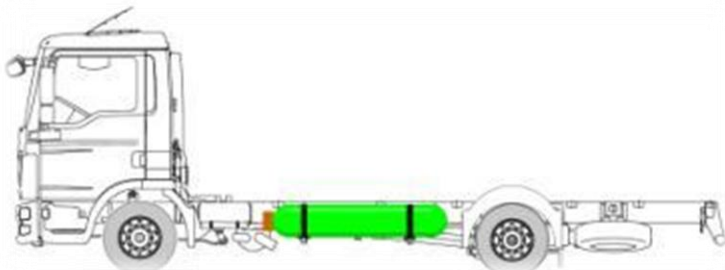
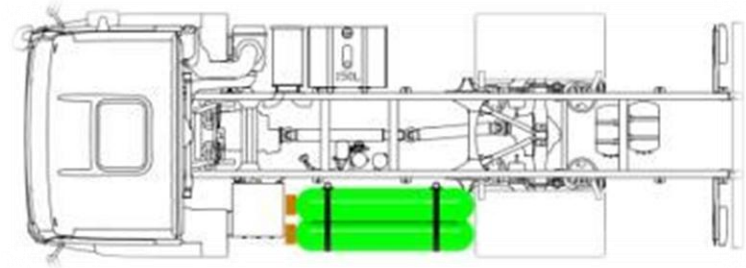
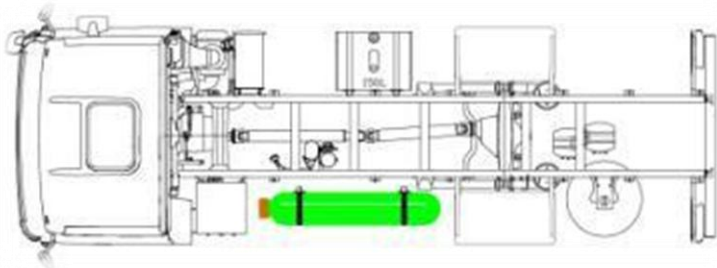
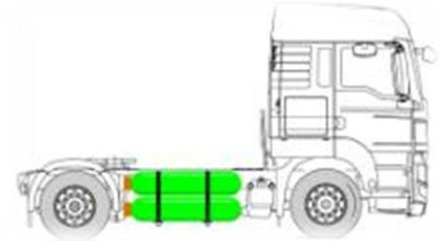
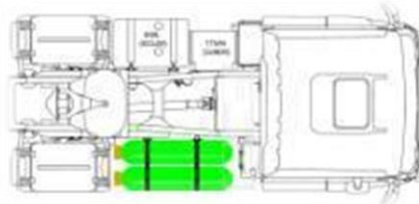
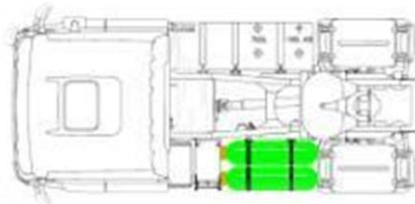
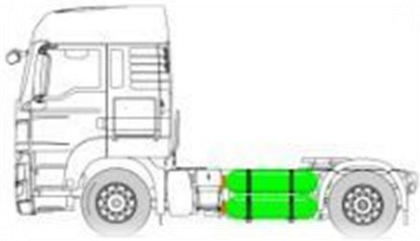




NGV 1 and 2 coupling block



Tank configuraties



Conversion shop Lagos Nigeria



Sino truck



Applications light duty LPG/CNG

Peugeot Boxer



Volkswagen Crafter



Ford Transit



Mitsubishi Canter



**4 cylinder
Diesel engines**

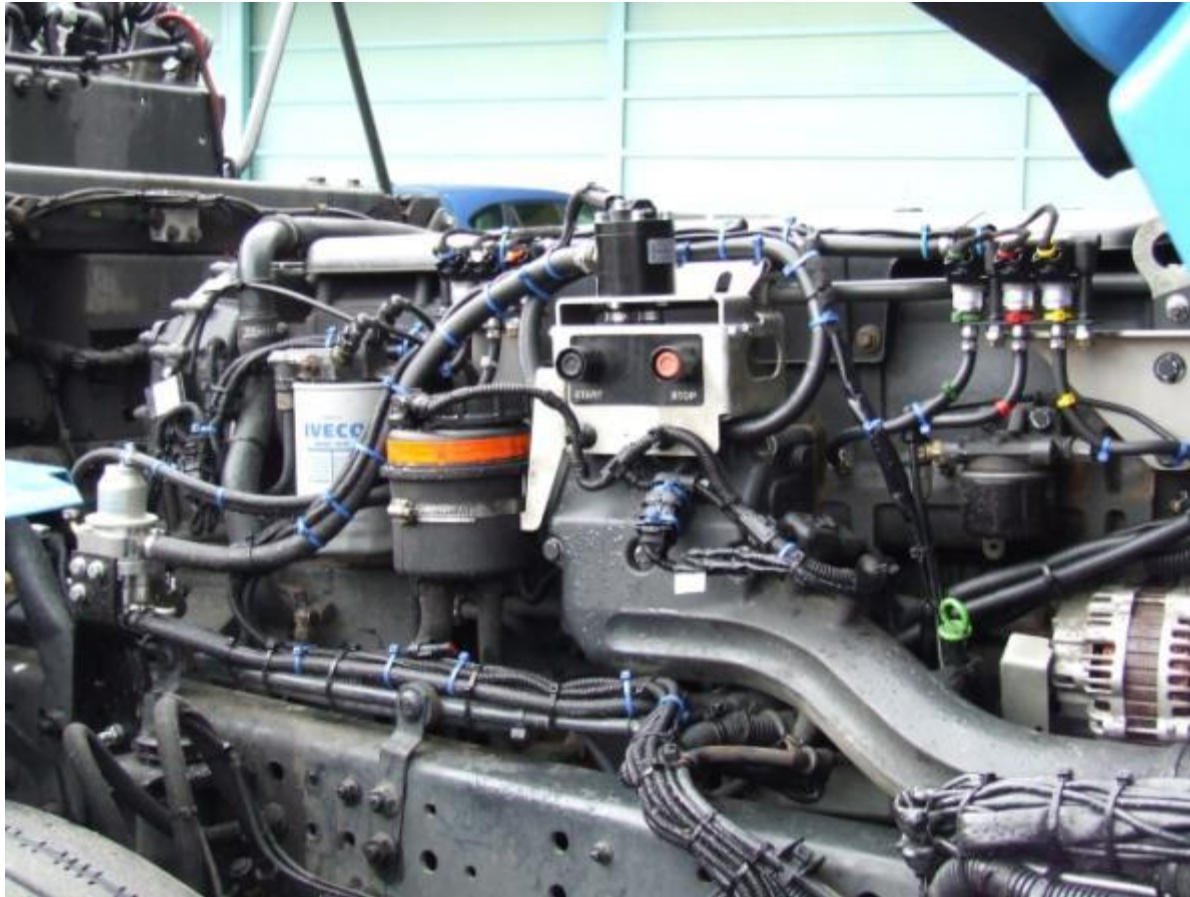






Iveco Stralis





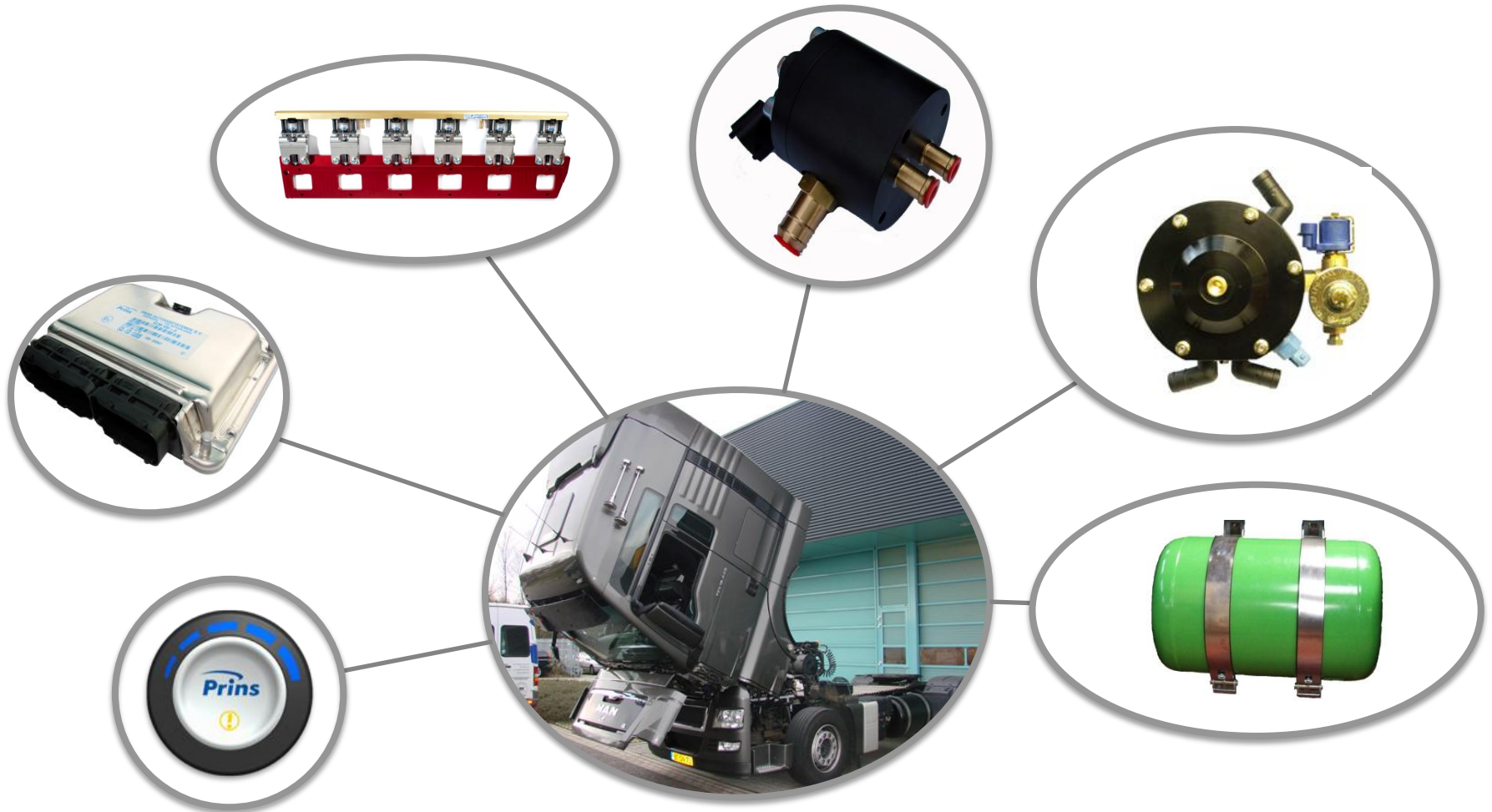
Iveco Stralis



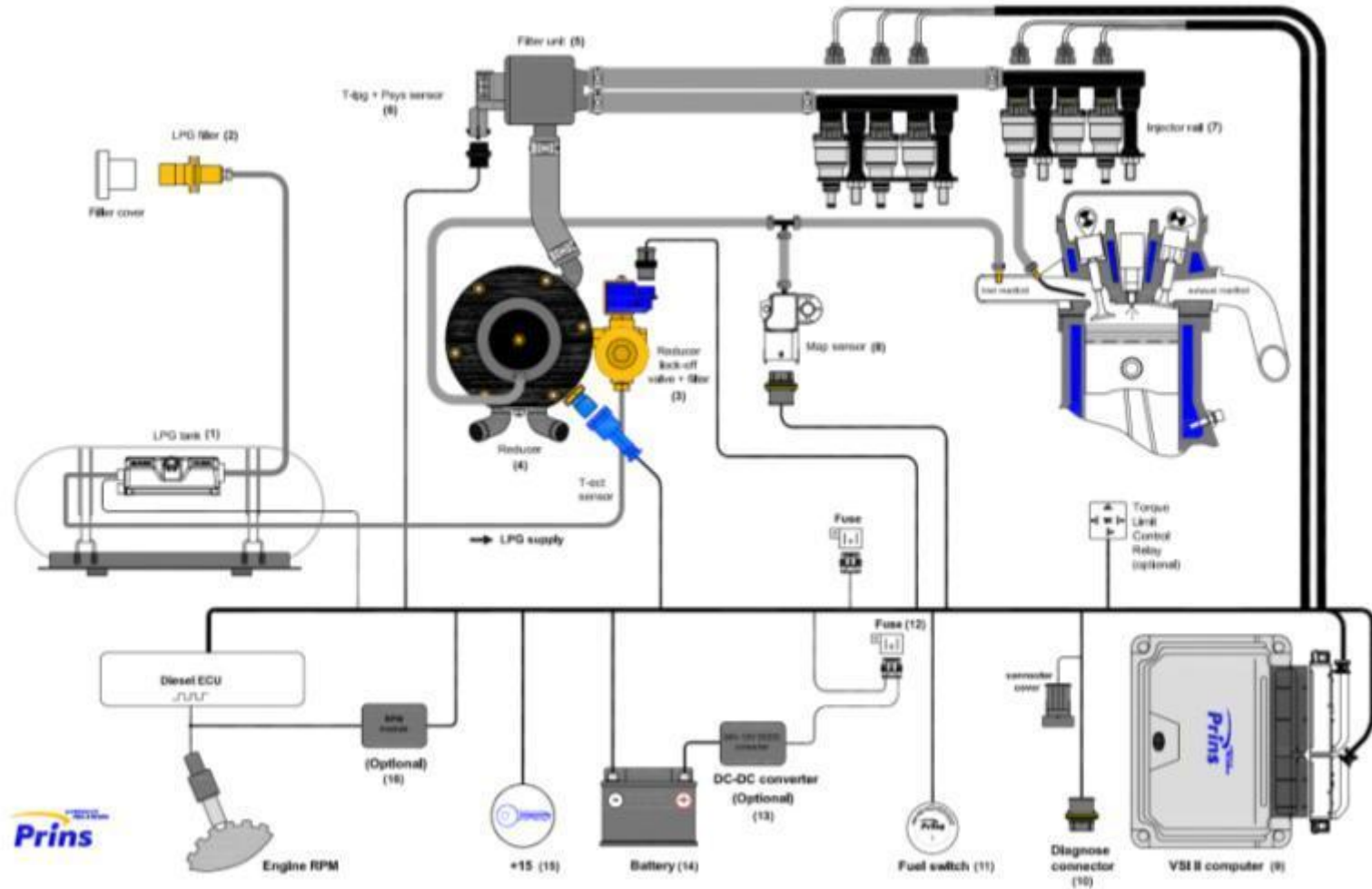
Part 4

Dieselblend-2.0 LPG





System overview (LPG blend)



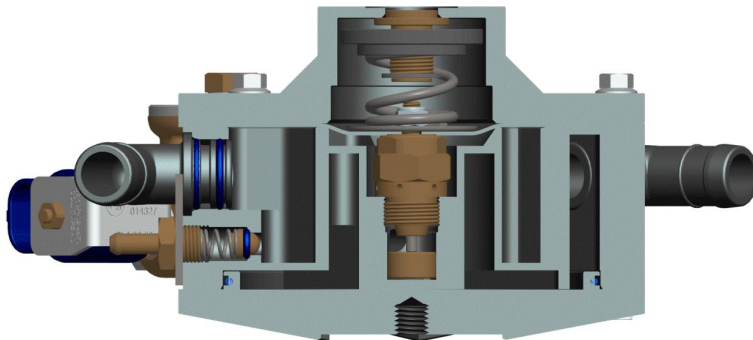
LPG Reducer



With ECT-sensor



With shut of valve



Part 5

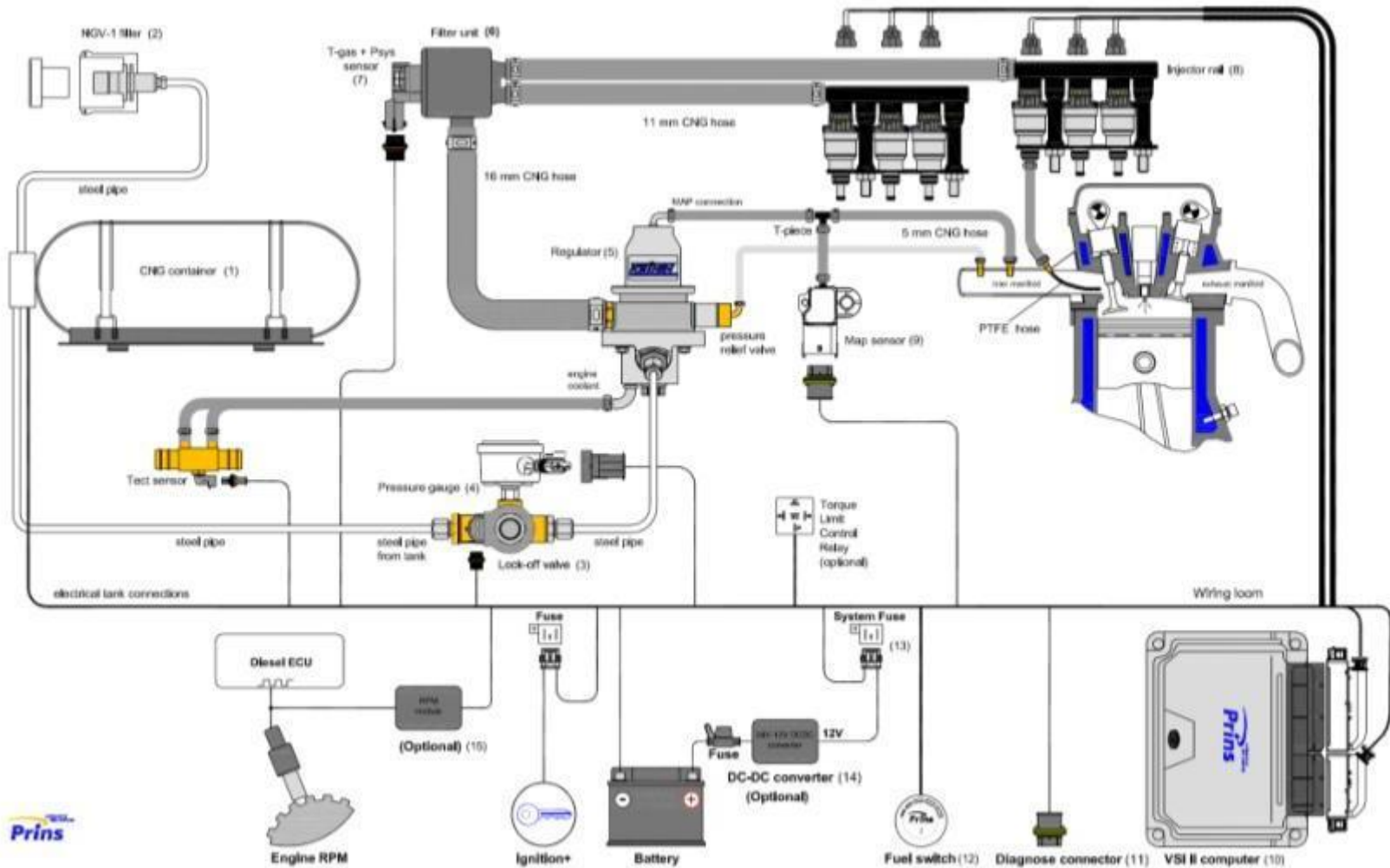
Dieselblend-2.0 CNG



Dieselblend-2.0 CNG



System overview CNG



CNG Pressure regulator



With lock off valve



Manometer



Corresponding components LPG / CNG



Filter Unit (LPG/CNG)



Temperature – pressure sensor
0.5 – 10 BAR
- 40 - 130 C.





Type Prins	Bosch type	Pressure range (abs)
180/80350	0 281 002 576	0.5 tot 4bar

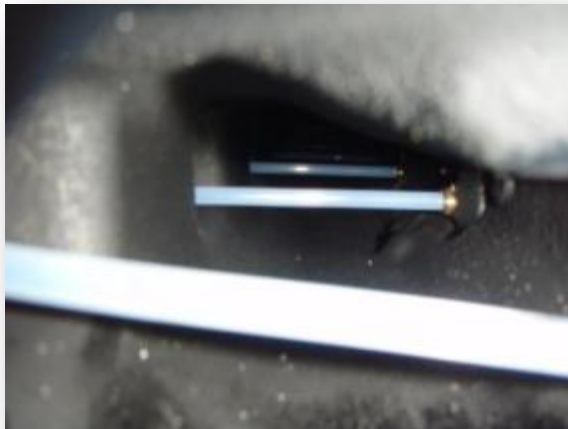
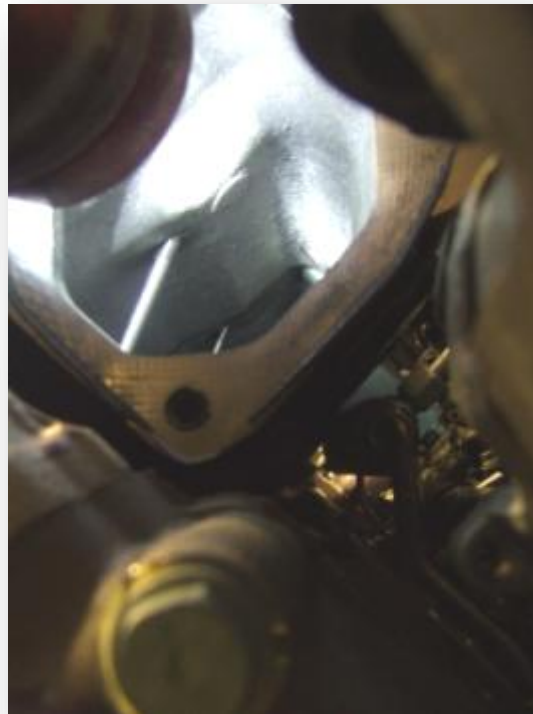
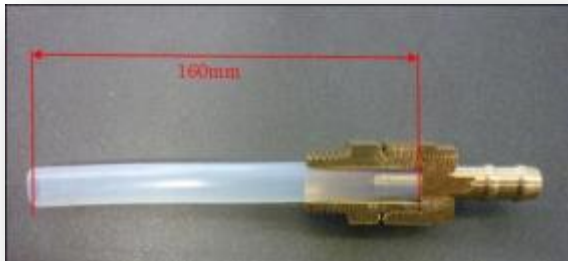


LPG/CNG injectors



Injector inserts

Fuel must be injected as near to the inlet valve as possible.



Injector manifold plate Renault/Volvo

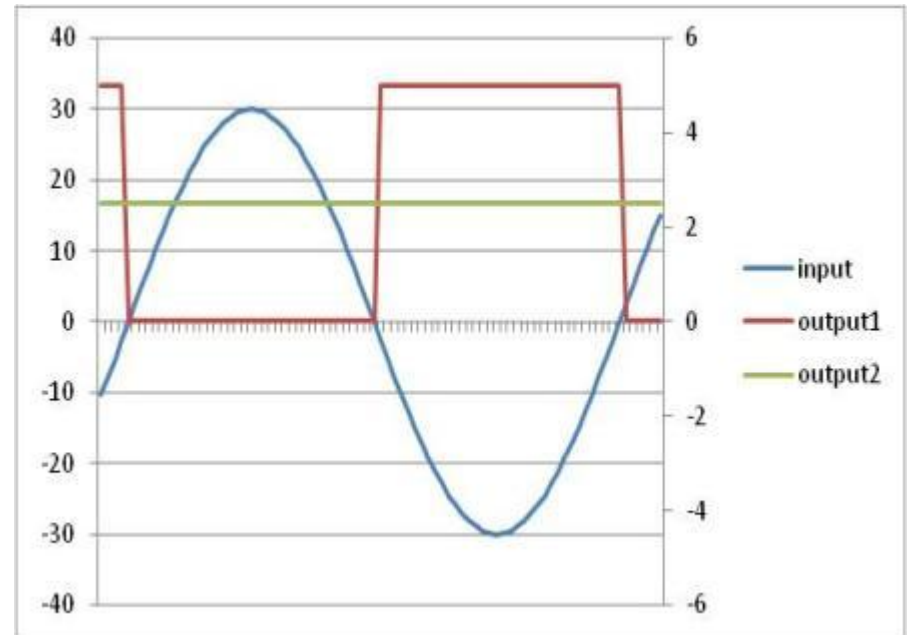
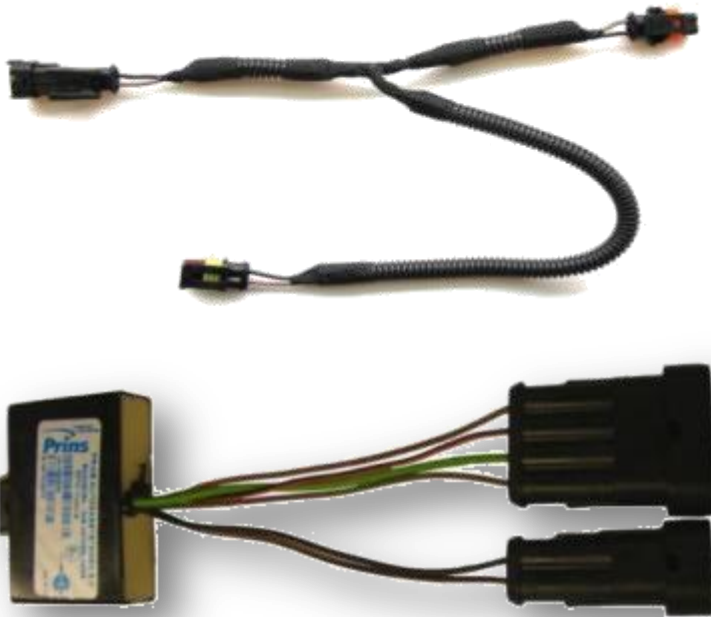


AFC-2.0 computer



Communication through CAN controller





RPM module converts the inductively cam signal to a 0-5 volt square wave signal.



Prins multi colour switch



Part 6

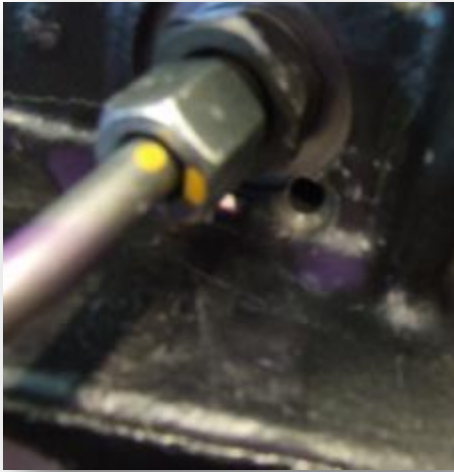
Tooling



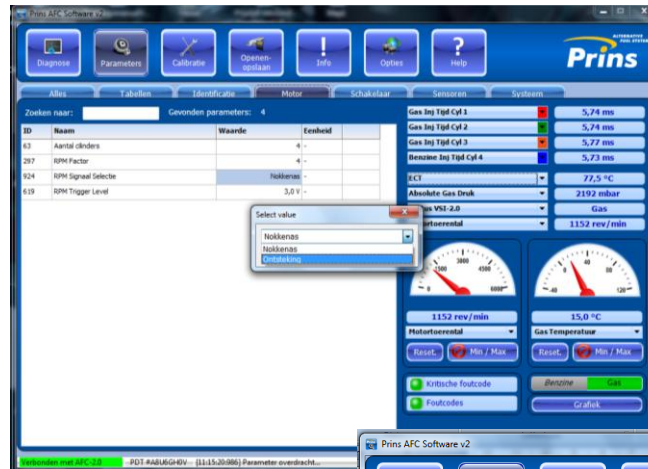




Injector inserts tooling



Prins Diagnostic Tool + diagnostic software



Part 7

Conversions





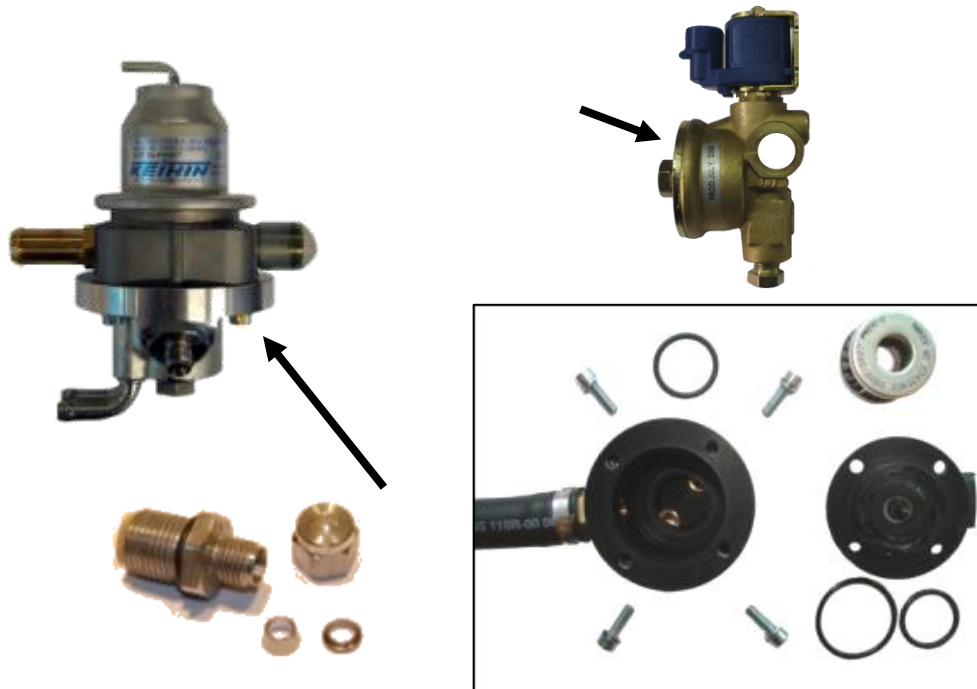
Part 8

Service and maintenance

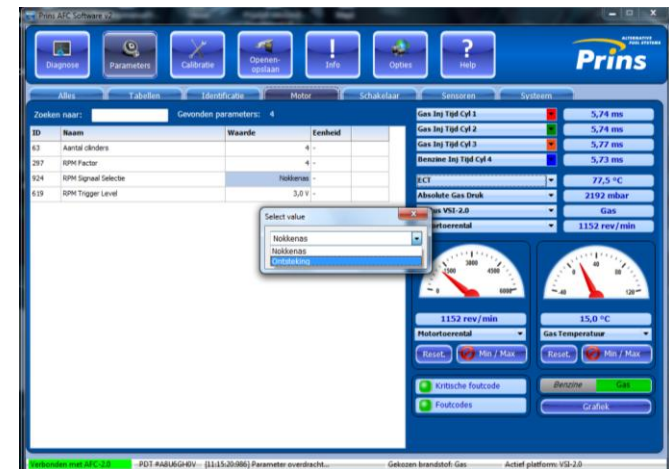


Filter change:

- ◆ Filter unit (LPG + CNG)
- ◆ Inlet filter regulator (CNG)
- ◆ Filter lock off valve (LPG)



	25.000 km	1 ^e jaar of na 100.000 km	2 ^e jaar of na 100.000 km	3 ^e jaar of na 100.000 km
Uitgevoerd is:				
Keihin inlaatfilter vervangen	☐	☐	☐	☐
Filterunit vervangen	☐	☐	☐	☐
Slangen + leidingen controleren	☐	☐	☐	☐
Bevestiging componenten controleren	☐	☐	☐	☐
Elektrische aansluitingen + bedradingen controleren	☐	☐	☐	☐
Op gaslekage controleren	☐	☐	☐	☐
Controleren op foutcodes (diesel en gas) + systeemdruk	☐	☐	☐	☐
	Km-stand: Datum:	Km-stand: Datum:	Km-stand: Datum:	Km-stand: Datum:



Hour counter



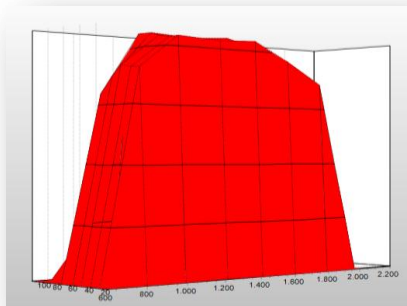
Part 9

Calibration & Software

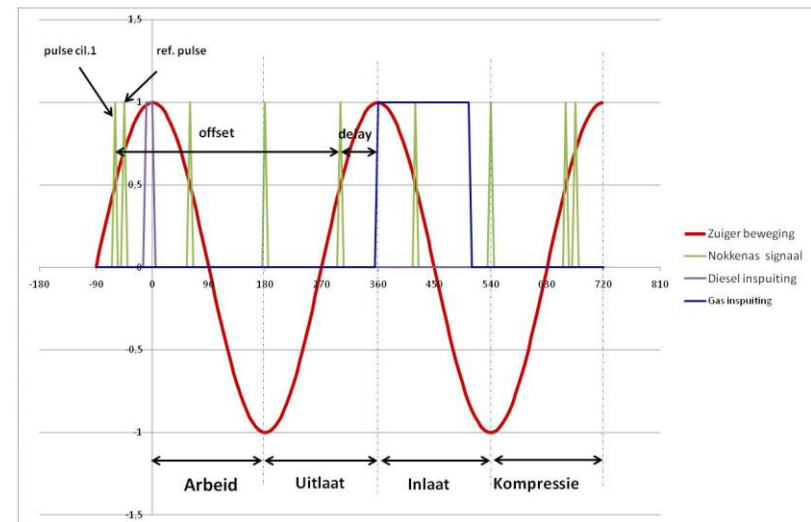


Calculation injection times using following parameters:

- Look up table (RPM and engine load related)
- Injection times correction depends on:
 - System pressure (P_{sys})
 - Gas temperature (T_{gas})
- Timing delay adjustable:
 - To give in crankshaft degrees



Engine speed [rev/min]		608	800	992	1216	1408	1600	1792	2016
J1939 Engine Actual Torque [%]	8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	17	0,00	71,50	82,80	82,00	82,80	76,10	68,30	0,00
	28	0,00	71,70	82,80	82,00	82,80	76,30	68,60	0,00
	40	0,00	72,70	83,30	82,50	83,30	77,10	69,80	0,00
	50	0,00	69,10	84,60	83,70	84,60	75,40	68,00	0,00
	65	0,00	63,20	84,40	83,60	84,40	71,80	66,00	0,00
	80	0,00	17,70	69,70	69,00	69,70	45,00	20,00	0,00
	100	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

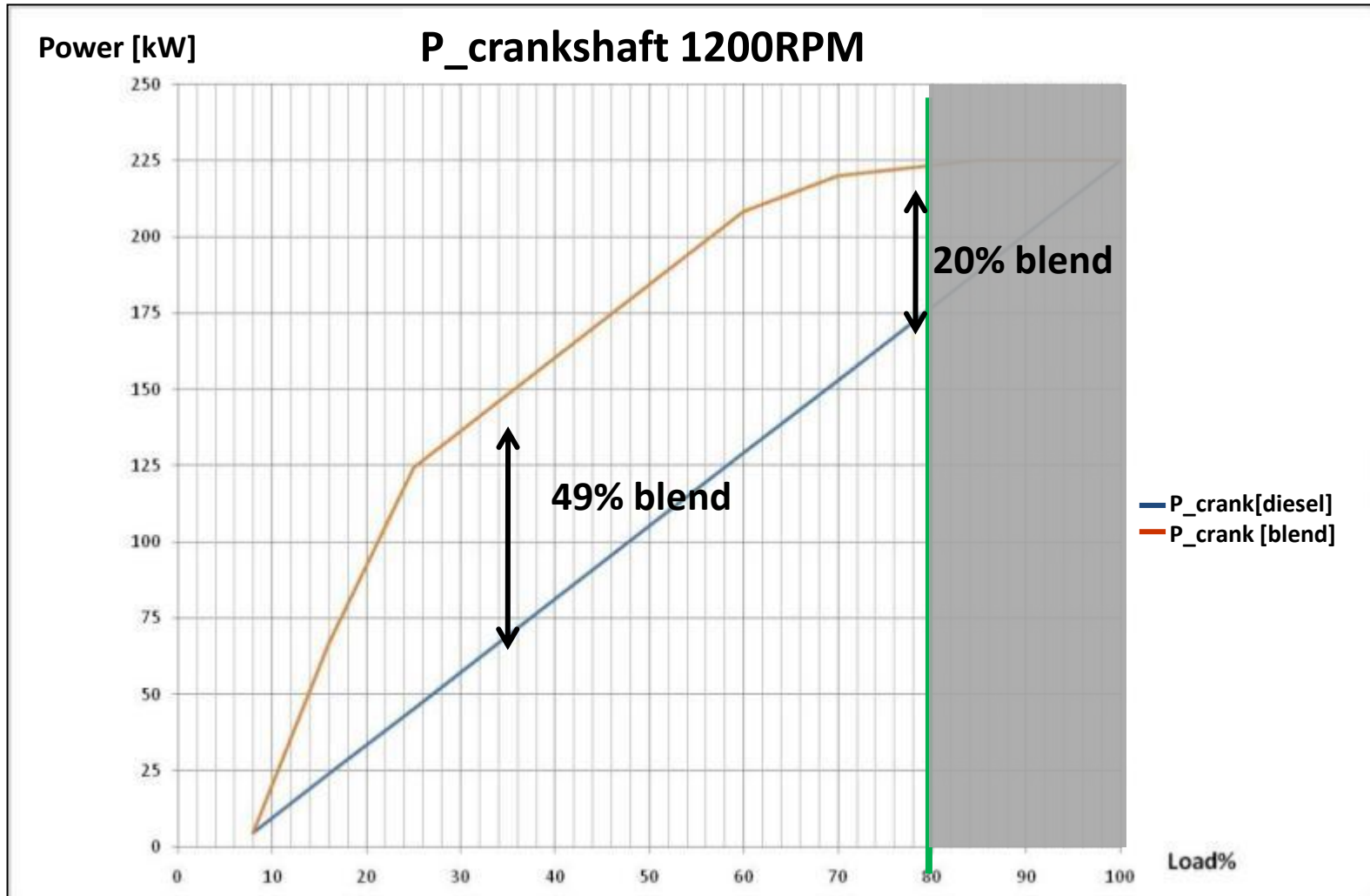


CNG Blend rate (%)

Load	Engine RPM							
	600	800	1000	1200	1400	1600	1800	2000
10	0	0	0	0	0	0	0	0
25	0	29	37	35	35	38	32	0
40	0	38	46	49	47	47	45	0
55	0	41	47	47	43	45	44	0
70	0	32	41	41	39	40	39	0
85	0	27	35	38	32	32	27	0
100	0	10	20	20	20	17	8	0



Torque limiter



Part 10

Emissions



TGX 18.440 CNG TNO



MAN TGX 18.400 CNG European Transient Cycle

	Diesel	Dual fuel	Euro 5 limit	
CO	0,16	1,26	1,50	g/kWh
NOx	2,25	1,88	2,00	g/kWh
THC	0,02	1,5	0,46	g/kWh
PM	0,033	0,033	0,02	g/kWh
CO2	684	650		g/kWh

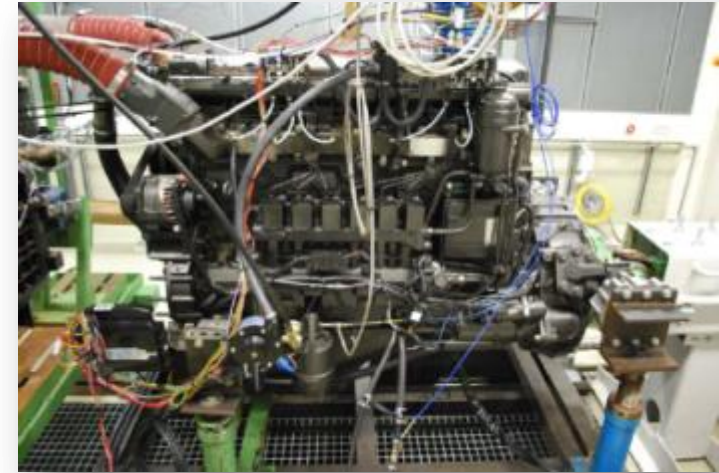
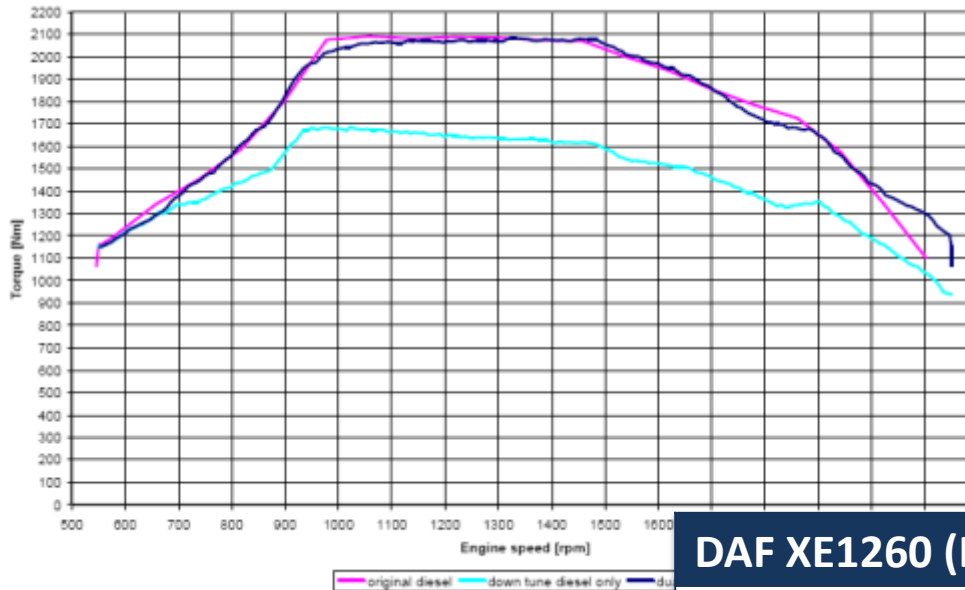
Emission test TNO

Average advantage :

- CO₂ reduction 5 %
- NO_x reduction 16,4 %



DAF XE 1260 (Euro 3) LPG TNO



DAF XE1260 (European Transient Cycle)

	Diesel	Dual fuel	Euro 3 limit	
CO	1,72	6,8	5,45	g/kWh
NOx	5,41	4,93	5,00	g/kWh
NMHC	0,13	2,75	0,78	g/kWh
PM	0,087	0,094	0,16	g/kWh
CO2	628	601		g/kWh

- Same torque output
- CO₂ reduction 4,3 %
- NO_x reduction 8,9 %



Portable Emission Measurement system (PEMS test)



Part 11

Training



Training Dieselblend

1 day theoretical



Together building the
first conversion



Part 12

Points of attention



Points of attention?

- Too much fuel injection:
 - Too high power output, thermal and mechanical overload, detonation.
- Incorrect injection timing/injector connection order:
- Too little fuel capacity
- Refueling infrastructure



- Savings on fuel costs
- “Green” image
- Filling station/skid on premises (when allowed)
- Enlargement of driving range
- No major changes on diesel engine / low cost conversion
- Telematics possible
- 100% diesel fall back / no downtime



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