ALTERNATIVE FUEL SYSTEMS

Prins

VOLVO

Installation manual

PART 2/2

MANUFACTURER	Volvo
TYPE	Based on S60/V60/V90
ENGINE DISPLACEMENT	2000cc
NUMBER OF VALVES	16
ENGINE CODE / NUMBER - OUTPUT	B4204T23 (187kW)
ENGINE CODE / NUMBER - OUTPUT	B4204T37 (112kW) / B4204T38 (90kW)
FIRING ORDER	1-3-4-2
VEHICLE CATEGORIES	M
TRANSMISSION	MT / AT
VERSION	AFC-2.1 DI-LPG
TYPE VSI INJECTOR	KN9 - 73cc
TYPE INJECTION MODULE	Type 1 – Gen2
PETROL ECU MANUFACTURER / CODE	Volvo / Denso **31**459244 & **31**471837
PETROL ECU MANUFACTURER / CODE	Volvo / Denso **32**203480 & **32**242004
MODEL YEAR:	2015-
SYSTEM APPROVAL NUMBER (R115)	Denso **31**… : E4-115R-000048 / VSI-LPG 54 Denso **32**… : N.A. (not for WLTP vehicles)
LOCATION R115 SYSTEM STICKER	right side, centre door post
ENGINE SET NUMBER	367/121004/A
MANUAL NUMBER	076/2707600-1
DATE	2020-07-23

Revision: 1

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FOR EXPLANATION AND CIRCUIT DIAGRAMS SEE : INSTALLATION MANUAL GENERAL PART 1 / 2

Manual updates / revision

Rev. nr	Rev. Date	Subject update
-	2019-06-05	Release / start update revision management
1	2020-07-23	Manuals petrol ECU Volvo / Denso 31x & 32x combined

General instructions

- The installation of the system shall be done in accordance with the installation manual provided by Prins Autogassystemen.
- This manual is based on Dutch regulations; always install the system in accordance to the local regulations.
- Always download the “general manual 1/2“ from our website for basic instructions and diagrams.
- Always disconnect the battery when installing the LPG system. Make sure the ignition key is outside the car. Be aware of central door locking, radio / telephone memory code and alarm system.
- Do not place the main fuse into the fuse holder before having completed the installation of the VSI system.
- The VSI computer has to be activated by means of the diagnosis software.
- In the unlikely event the AFC fails, it will automatically switch over to petrol.
  Never disconnect the AFC connector, unless you have removed the main fuse.
- When installing the VSI wiring harness, ensure that it does not run near any of the ignition components.
- Solder and insulate all electrical connections.
  The wires in the loom are provided with numbers and text.
  The text on the wire explains the function of the wire.
  The wire harness is not model specific, therefore it may be necessary to adjust the length of the wires.
  Ensure maximum care is taken when connecting the wiring.
  Make professional joints using solder and shrink sleeve. Do not stretch the wiring harness.
- No component of the LPG-system shall be located within 100mm of the exhaust or similar heat source, unless such components are adequately shielded against heat.
- Remove any internal burrs after having shortened the LPG pipe.
  (This guarantees the maximum flow through the pipe without pollution.)
- If holes have to be drilled (wear safety glasses) for installing brackets, etc., the drilled holes must always be treated with an anti-corrosion agent after the chips have been removed (especially when mounting an exterior filler into the body work).
- After having completed the installation, check the whole system for gas leakage; use a gas leak detection device. Also check for any leak of engine coolant, petrol and air.
- Fitting and maintenance is only allowed by Prins Autogassystemen selected LPG engineers.
- Failure to follow the instructions in this manual can result in a poor or non-working LPG-installation or a dangerous situation.
- For maintenance instructions and filter registration see owner’s manual.
- Prins Autogassystemen is not responsible for any damages to people or objects as a result of changes to Prins products.
- Check our website regularly for diagrams, certificates, updates, info-bulletins and product information.

Please fill in the warranty portal completely within 14 days after installation.

Required equipment / tools / materials for installing a complete system

- Complete workshop toolbox (wrenches, screwdrivers, cutters, pliers, ratchet, sockets)
- Car lift
- Portable computer
- Vehicle fuel system scan tool or OBD scan tool Prins (part nr. 099/99928)
- Exhaust gas analyser
- Multimeter
- Oscilloscope
- Prins diagnostic software
- Prins diagnostic tool
- Torque wrench (5-50Nm)
- Torque wrench (200-250Nm)
- Portable light
- Assortment drill bits 4 to 12 mm
- Assortment cutters (Ø20, 30, 50, 70 mm)
- Portable drill or pneumatic drill
- Thread cutting device (male M6x1, M8x1, M10x1)
- Air gun
- Vacuum cleaner
- Safety goggles
- Hot air gun
- Soldering iron, soldering tin
- Wire-stripping pliers
- Adhesive tape
- Adhesive sealant
- Thread locking compound
- Anti-corrosion agent / black body coating
- Gas leak detection device or foam leak spray
- Shrink sleeves

Vehicle check

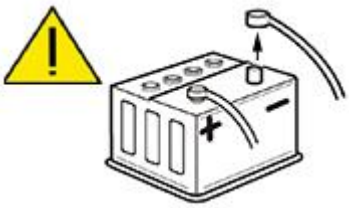
- Check the vehicle drivability on petrol
- Check the fuel system for error codes (scan tool)
- Check if the catalytic converter is in good condition (exhaust gas analyser)
- Check the condition of the ignition system (spark plugs, cables, coil)

Tightening moments

	Nm	Spanner mm
M 4 x 0,7	3.3	7
M 5 x 0,8	6.5	8
M 6 x 1,0	11.3	10
M 7 x 1,0	14.5	11
M 8 x 1	24.5	13
M 8 x 1,25	27.3	13
M 10 x 1	52	15-16-17
M 10 x 1,5	54	15-16-17

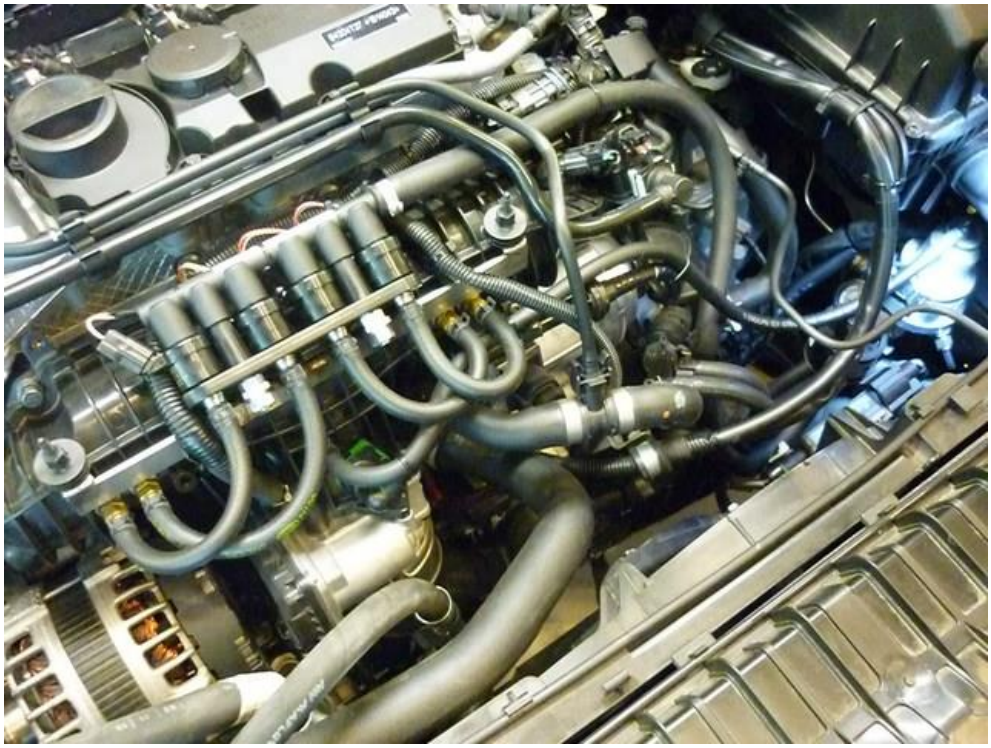
EXPLANATION OF SYMBOLS :

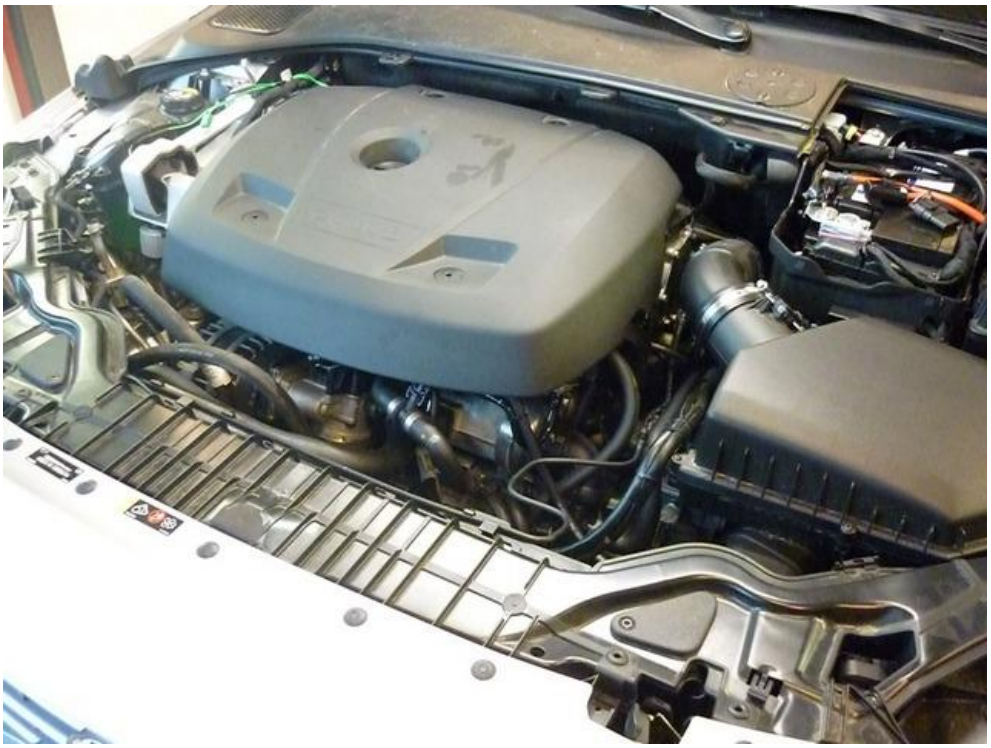
= IMPORTANT, CAUTION



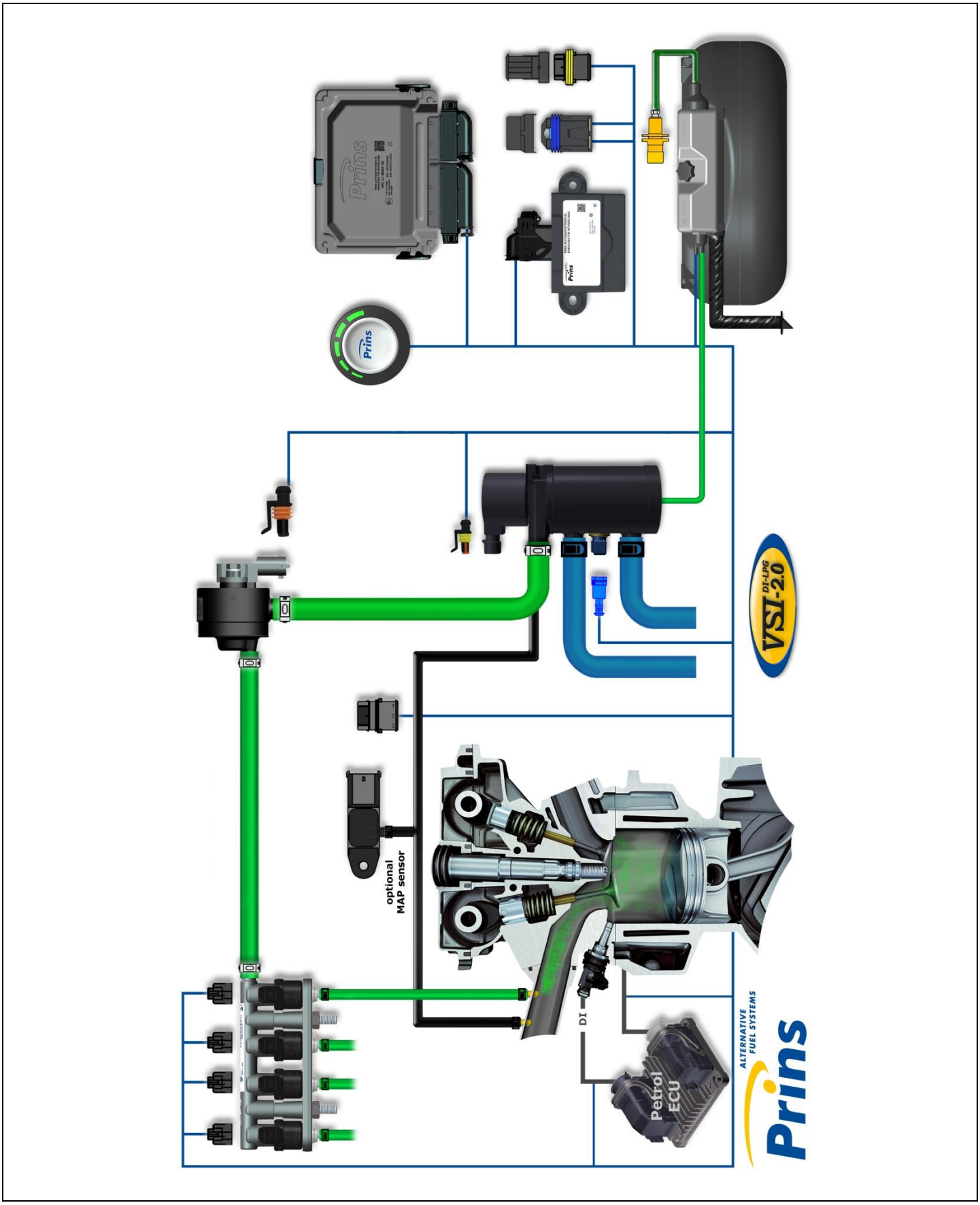
= WEAR SAFETY GOGGLES

Engine overview
(Example S60 / V60)





Base diagram



VSI approval numbers

	
Reducer VSI LPG Prins : E4-67R-010358	Injector rail Prins : LPG E4-67R-010093
 	
Filter unit T1 / T2 Prins : LPG E4-67R-010096 Filter unit Keihin: LPG E4-67R-010177	Injector Keihin KN9 : LPG E4-67R-010310
 	
Prins AFC : E4-67R-010098 E4-10R-030507	Tubithor : LPG E13-67R-010145 Rubia : LPG E4-67R-010068 Winlas: LPG E37-67R-010140 Thunderflex LPG E24-67R-010018

VSI component location overview
(Example S60/V60)

Petrol ECU

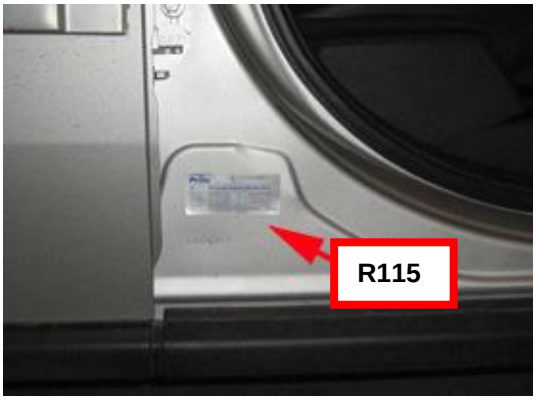
AFC

Fuse

Rail(s)

Filter

eVP-500



R115 approval sticker (if applicable) :
Right side centre door post

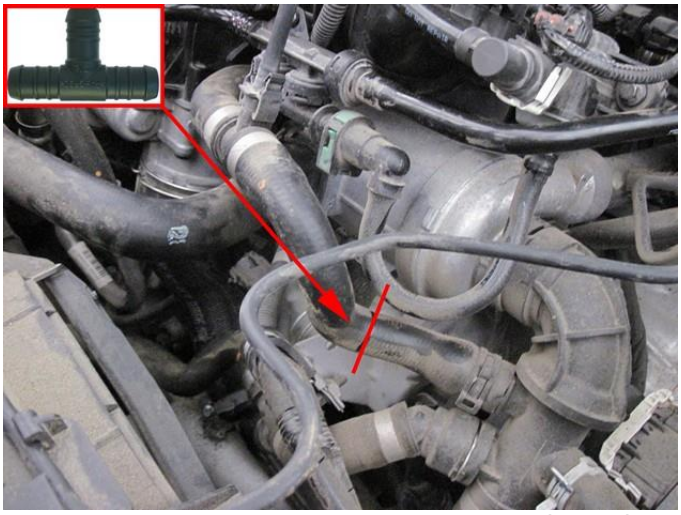
Examples
(based on Volvo V40/S60)

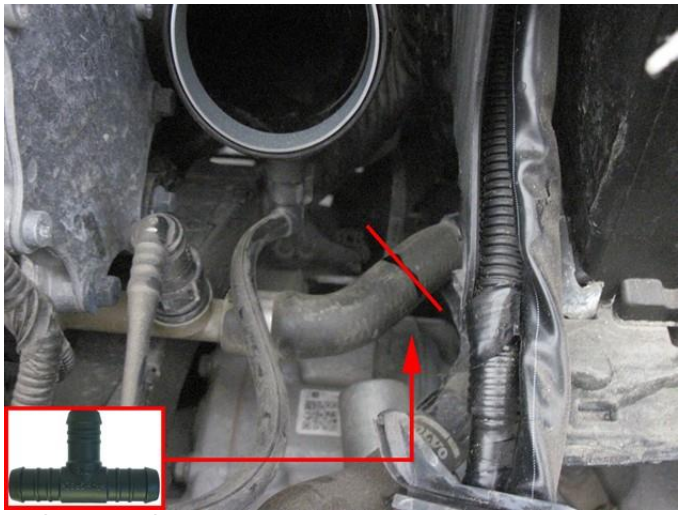
Overview with filter mounted directly to the eVP-500

AFC & Injection Module

Water connections

(based on Volvo S60)



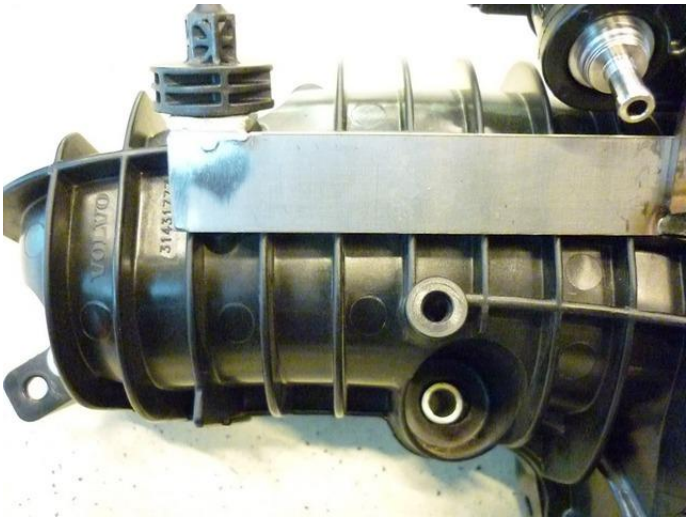
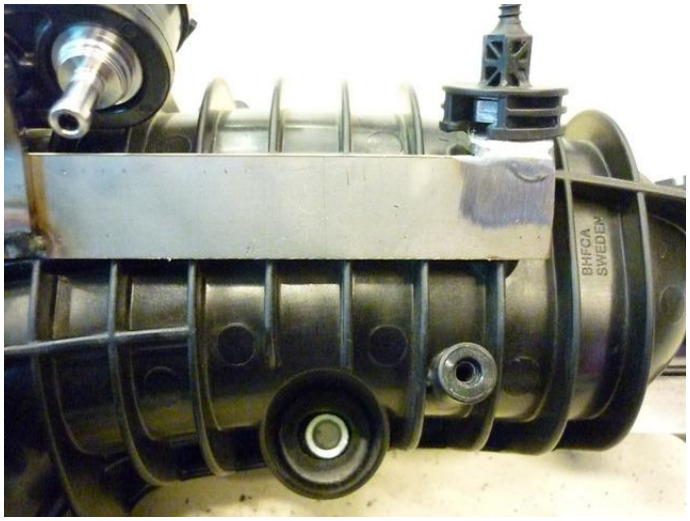
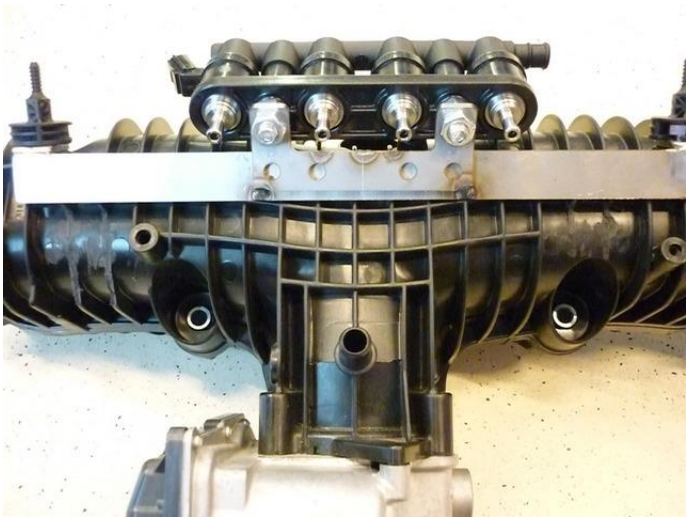
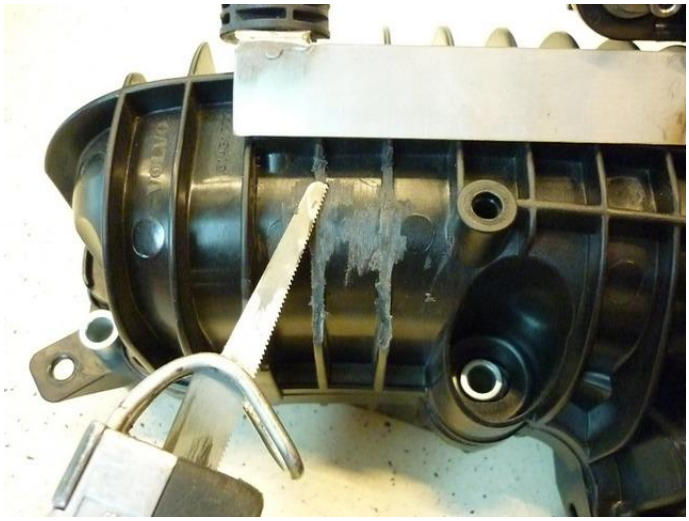


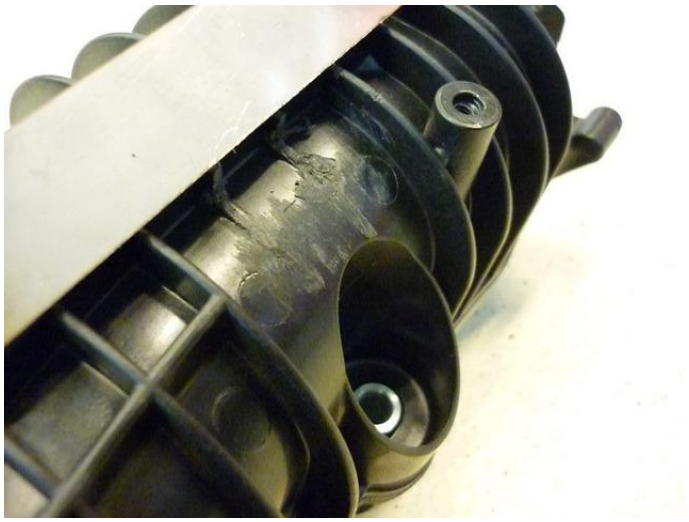
Mount the T-pieces to the water hoses

Routing (based on Volvo S60)

Mounting the inlet manifold couplings

Remove the inlet manifold. Install the rail bracket.

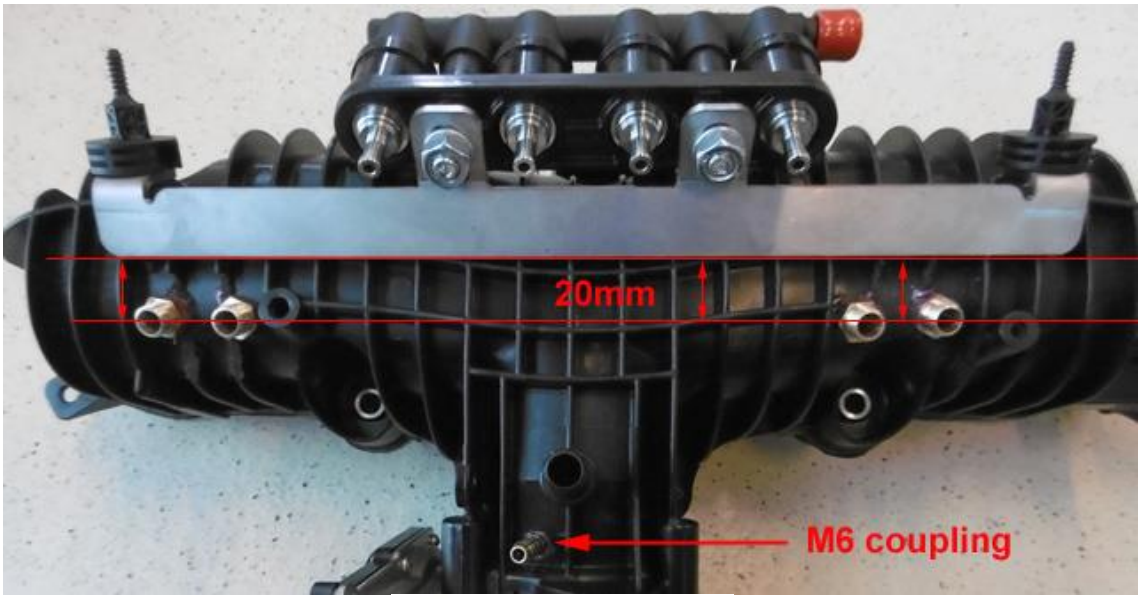







CAREFULLY remove the edges

Mounting the inlet manifold couplings / MAP

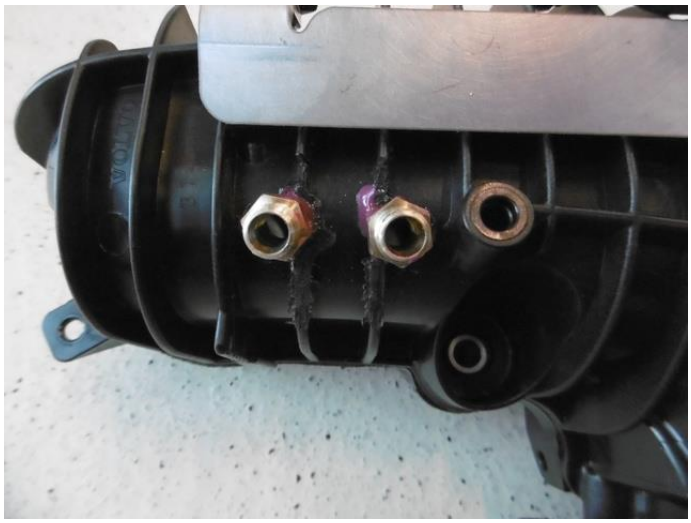
Drill **4** holes of **5mm** in the inlet manifold. Drill up to **8.5mm**. Cut **M10x1** thread in these holes.

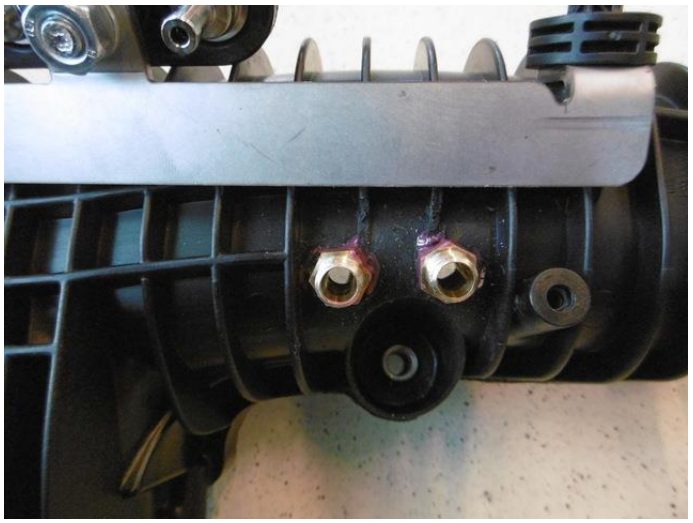


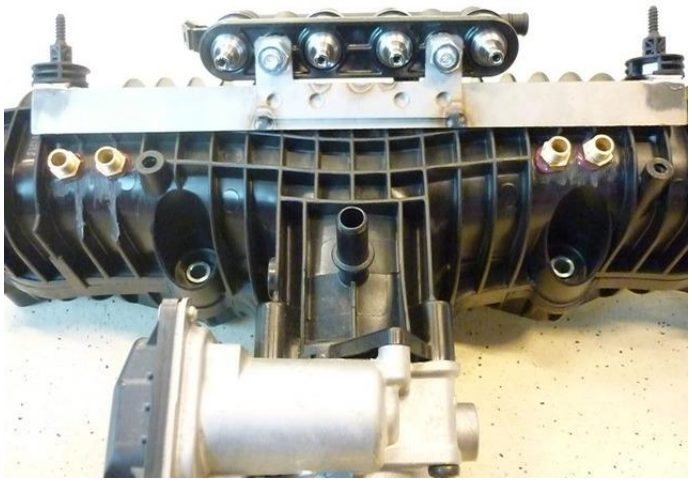
MAP: drill Ø5mm and cut M6x1

Mounting the inlet manifold couplings

Place the VSI couplings with a lock compound in the inlet manifold.
Watch out that the lock compound doesn't come inside the VSI couplings.







LPG hoses

(based on Volvo S60)

Hose (Ø..mm)	*From component*	*To component*	*Hose length (cm)*
5	VSI injector 1	Inlet manifold coupling cyl.1	± 20
5	VSI injector 2	Inlet manifold coupling cyl.2	± 20
5	VSI injector 3	Inlet manifold coupling cyl.3	± 20
5	VSI injector 4	Inlet manifold coupling cyl.4	± 20
6	VSI injector 1	PTFE hose cyl.1	9 out of manifold
6	VSI injector 2	PTFE hose cyl.2	9 out of manifold
6	VSI injector 3	PTFE hose cyl.3	9 out of manifold
6	VSI injector 4	PTFE hose cyl.4	9 out of manifold

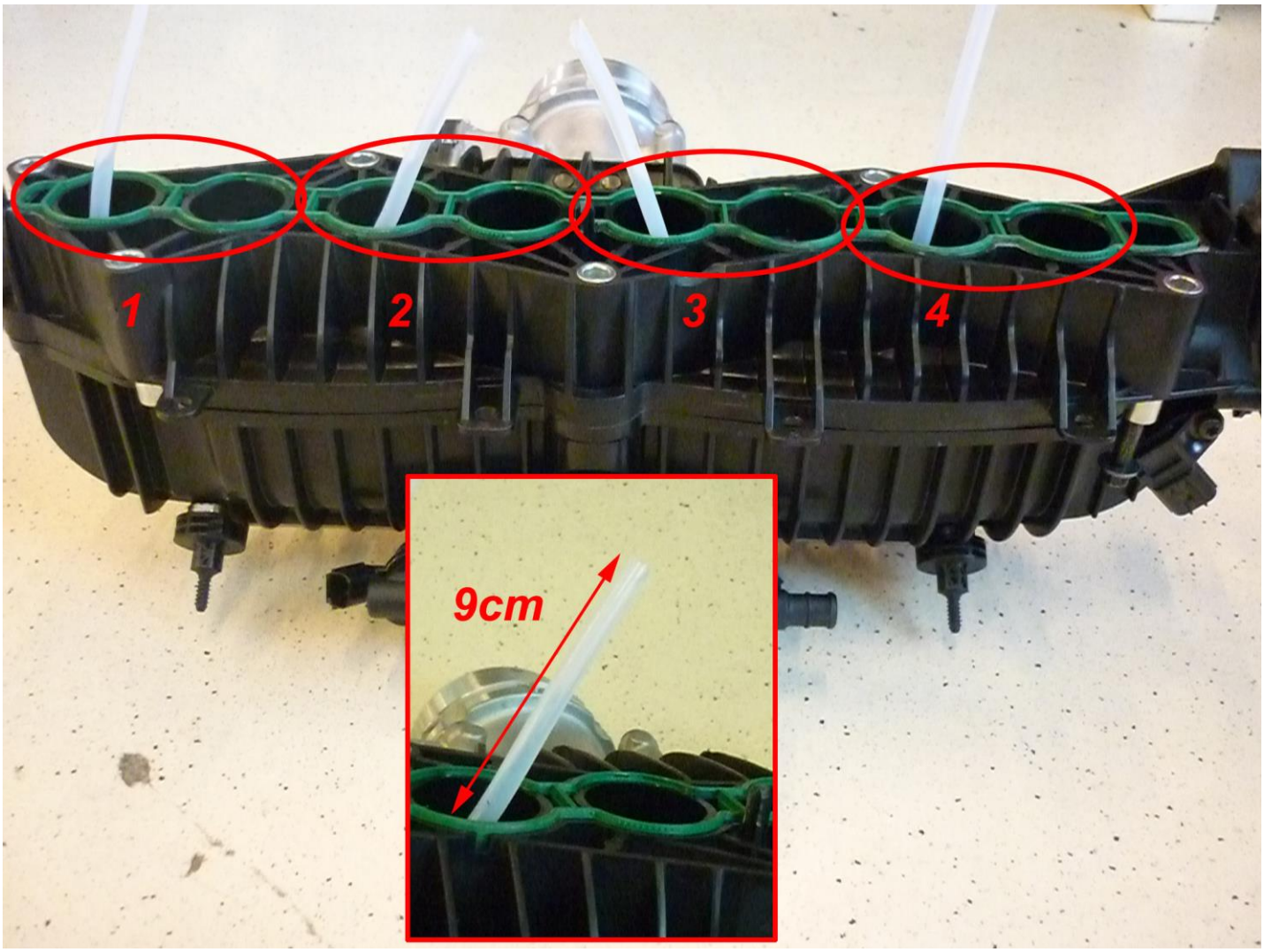
General info.

Cut the LPG hoses on length.
Cut the PTFE hoses on length.

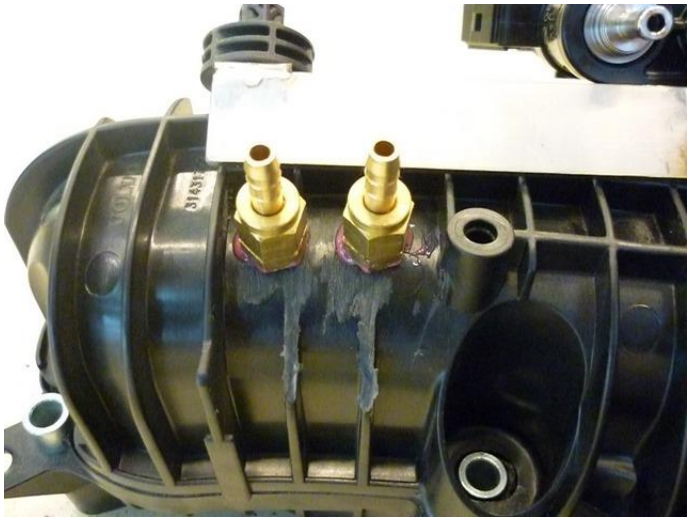
Please observe that there is no damage or fouling to the hoses.

Mounting the PTFE hoses

Cut on length, sticking out 9cm

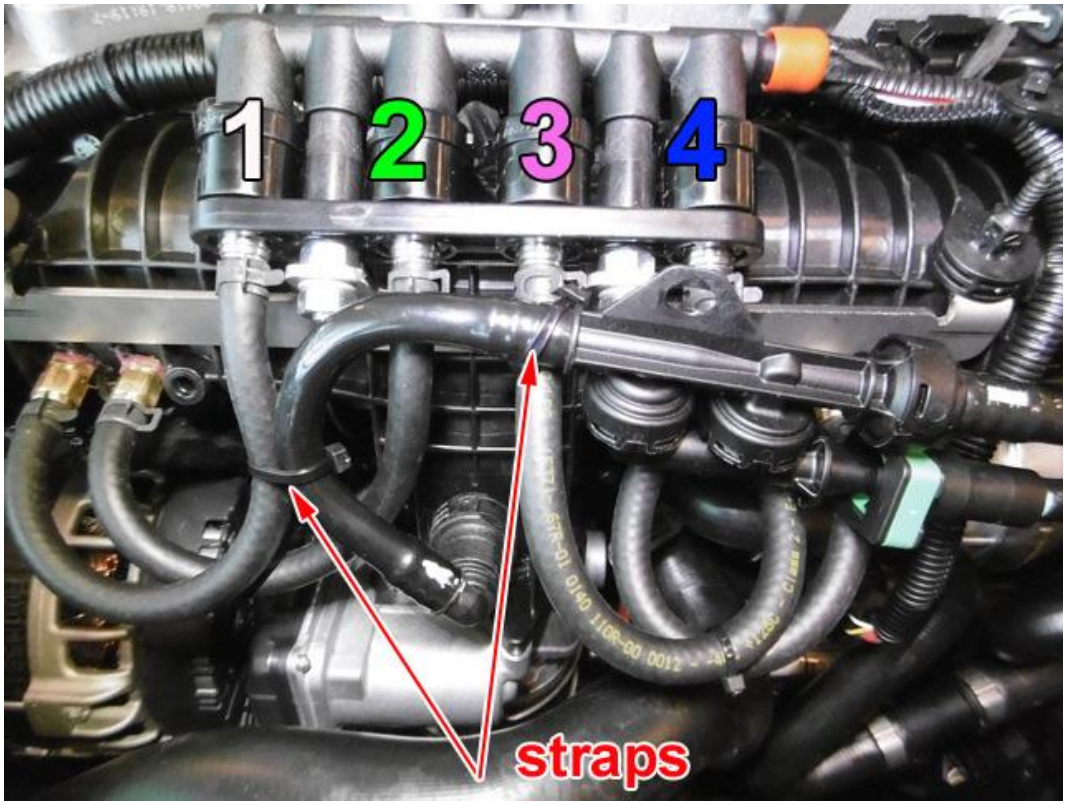


Mounting the injector hoses



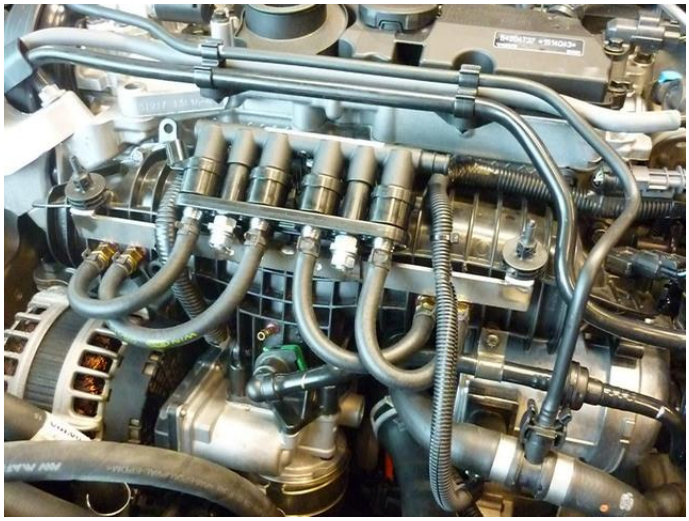
Ø5mm hose: 20 - 20 - 20 - 20 cm

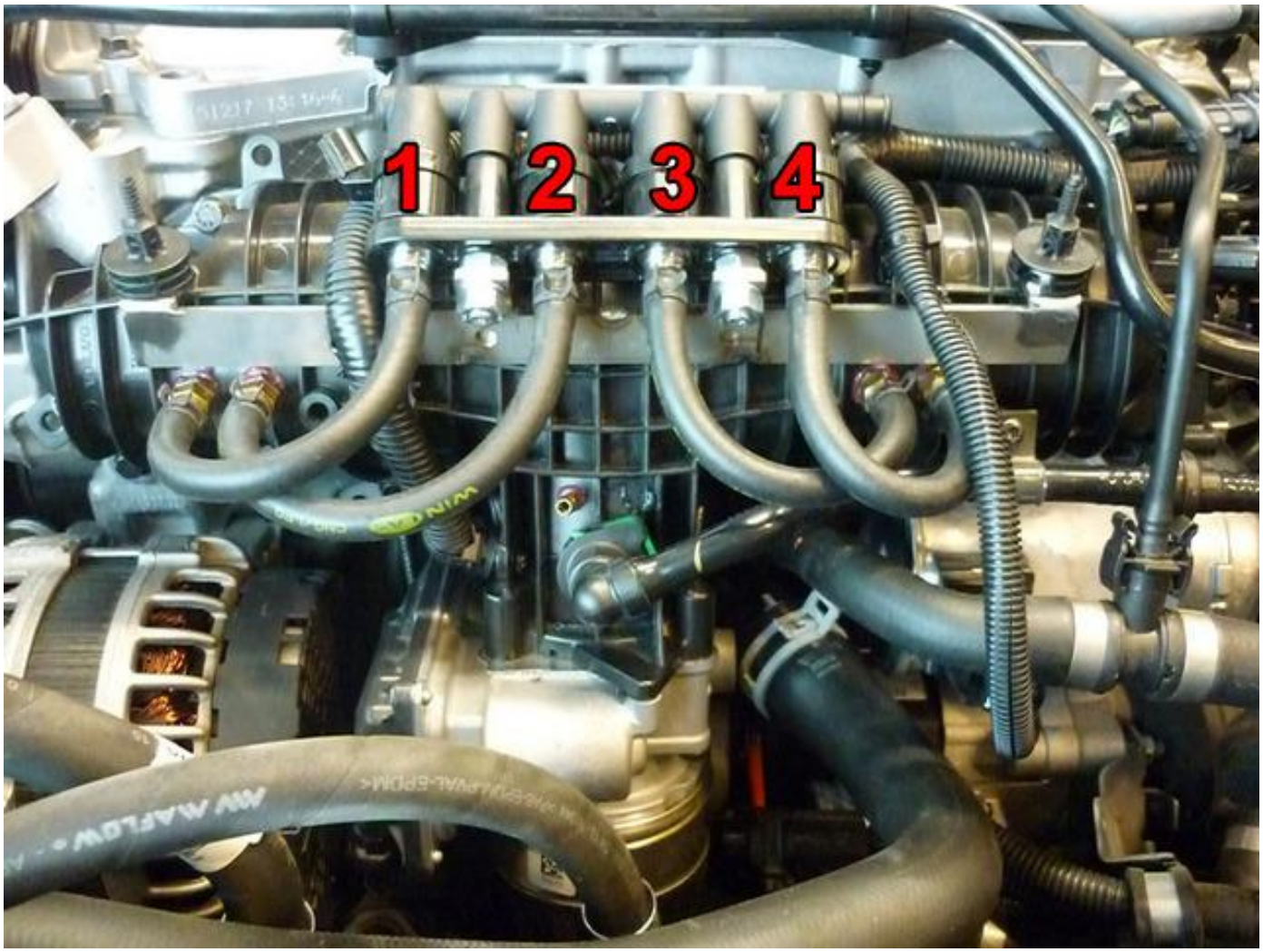
Mounting injector rail



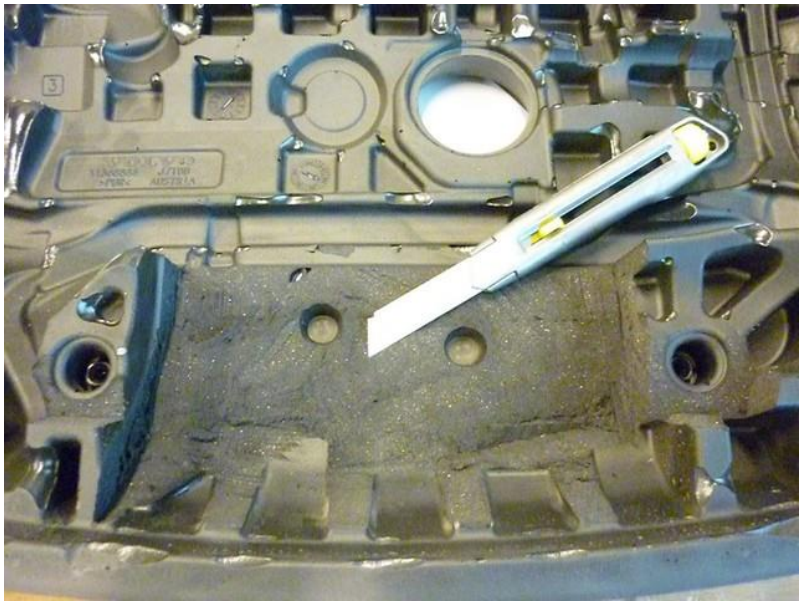
Place the VSI coupling with a lock compound in the inlet manifold.
Watch out that the lock compound doesn't come inside the VSI coupling.

Mounting injector rail



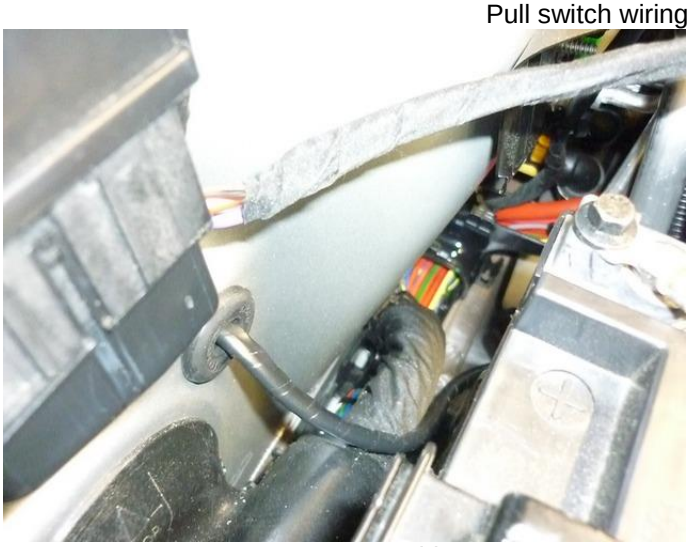


Adapt engine cover



Switch wiring
(example Volvo S60)

Pull switch wiring through grommet



Grommet on Passenger side

Remove glove compartment

!! OBD WIRING connected to petrol ecu, NOT at OBD connector !!

Mounting the fuel selection switch

(Examples)

When mounting the switch, only push on its sides.
Pushing the switch hard in the centre may result in damage to the switch.

Drill hole Ø8.3mm and mount switch.

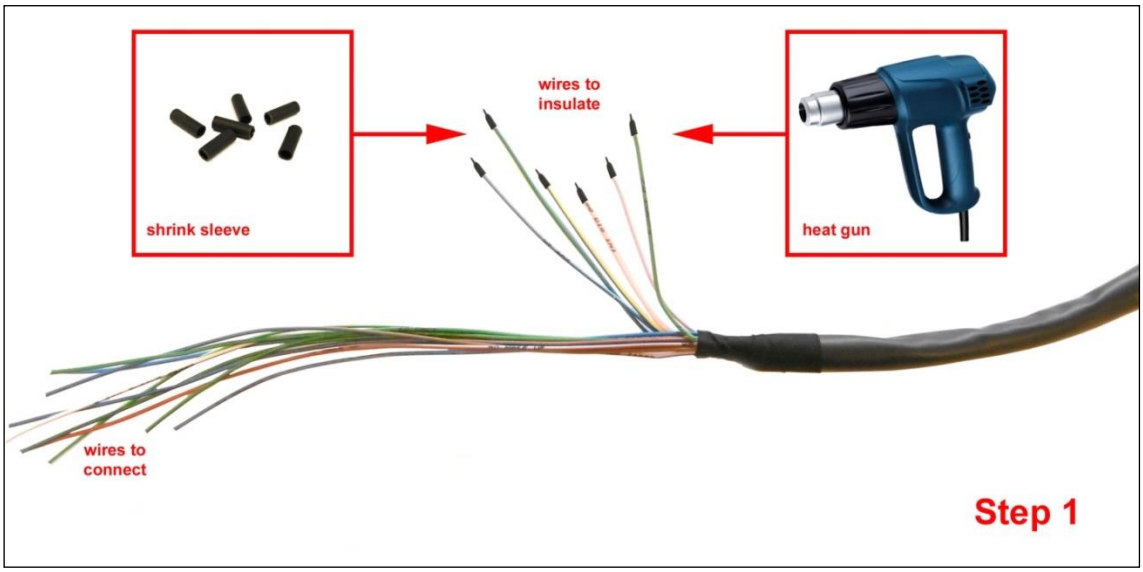
S60 / V60

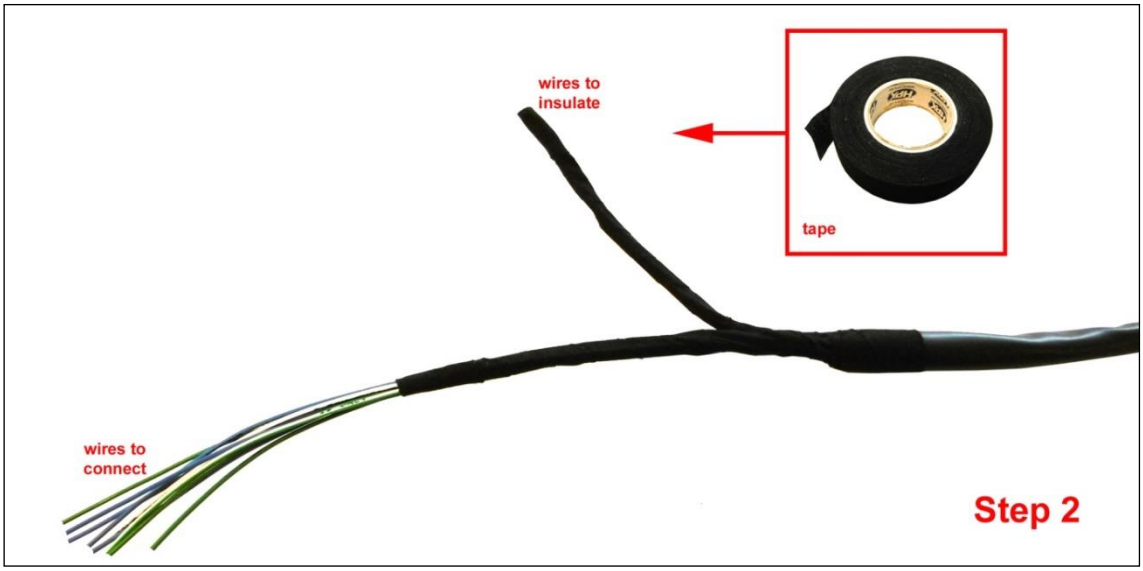
V90

Electrical connections

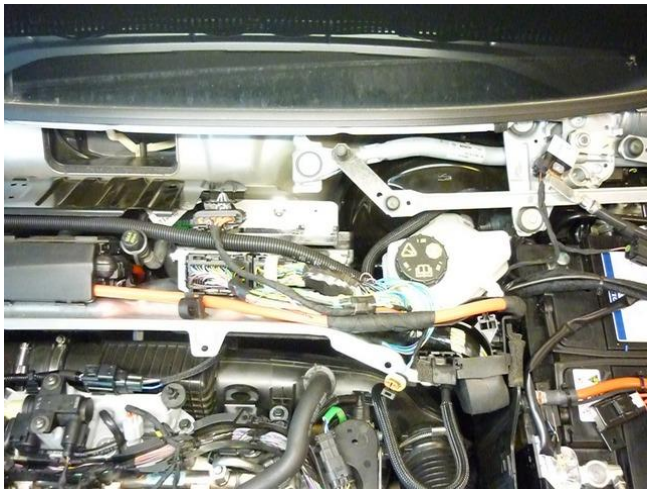
19	AD4	Blue	***Insulate***
20	AD3	Blue-pink	***Insulate***
22	LSS1	Purple	***Insulate***
23	LSS2	Purple-green	***Insulate***
39	AD8	Blue-red	***Insulate***
43	+12 Valve 2	Red-white	***Insulate***
50	DAC4	Green-blue	***Insulate***
60	DIG IN3	Yellow-pink	***Insulate***
61	DIG IN4	Yellow-blue	***Insulate***
62	C Ground	Brown-black	***Insulate***
74	DAC3	Green-pink	***Insulate***
Insulate additional not used wires			

Insulating



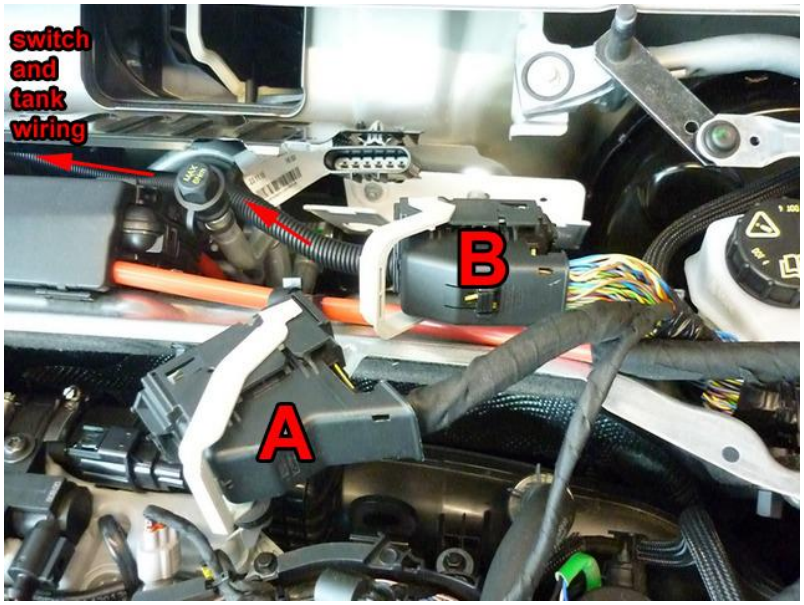


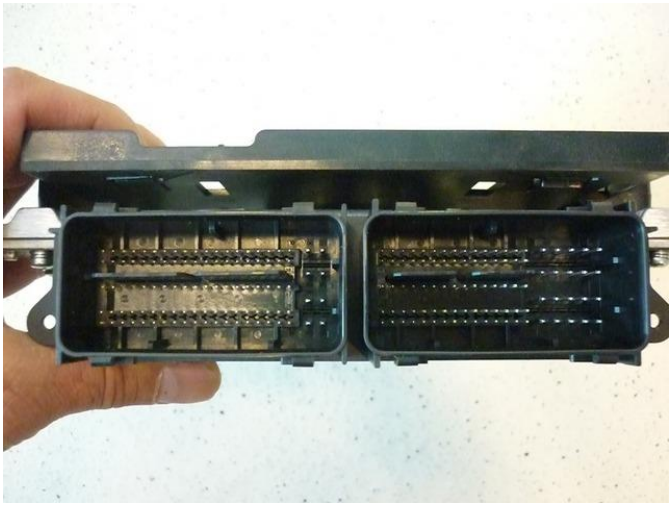
Petrol ECU



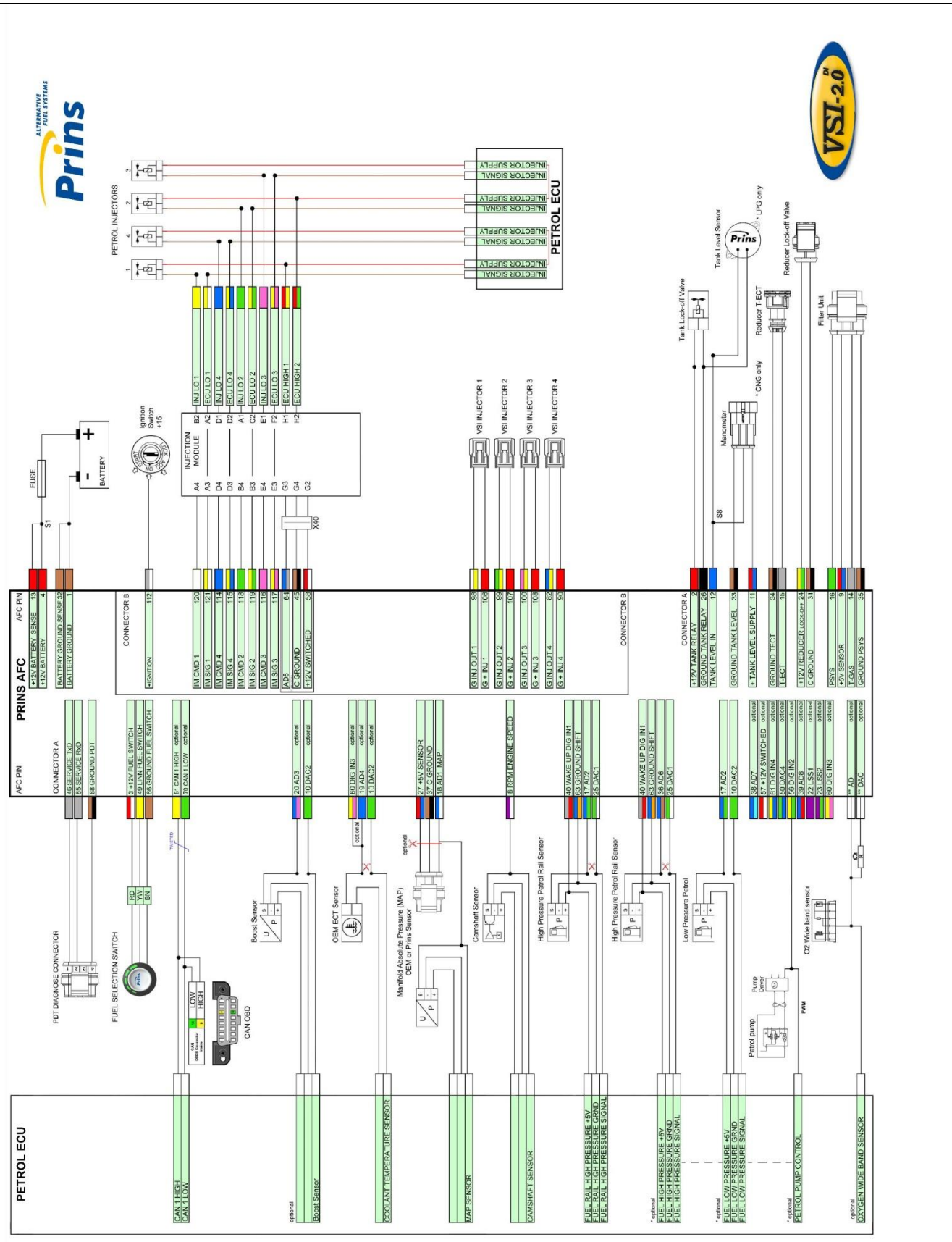
S60 / V60

V40 / V90





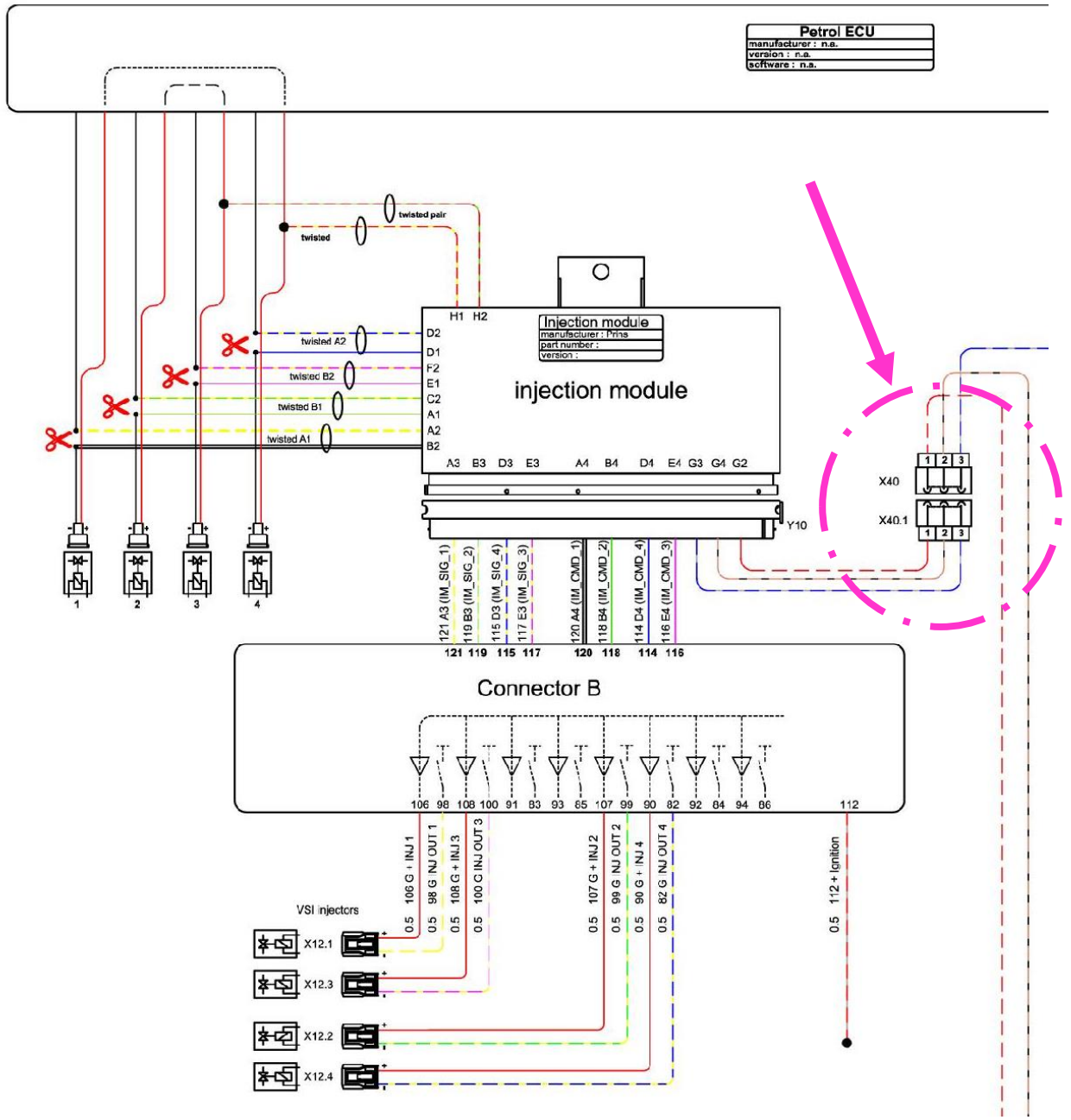
Basic Wiring Diagram



Electrical connections

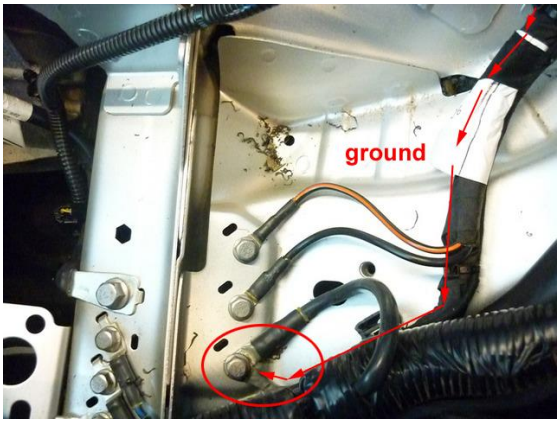
Check and measure the wiring in case of changes in the cars wiring colours.

Connector Injection Module



Electrical connections

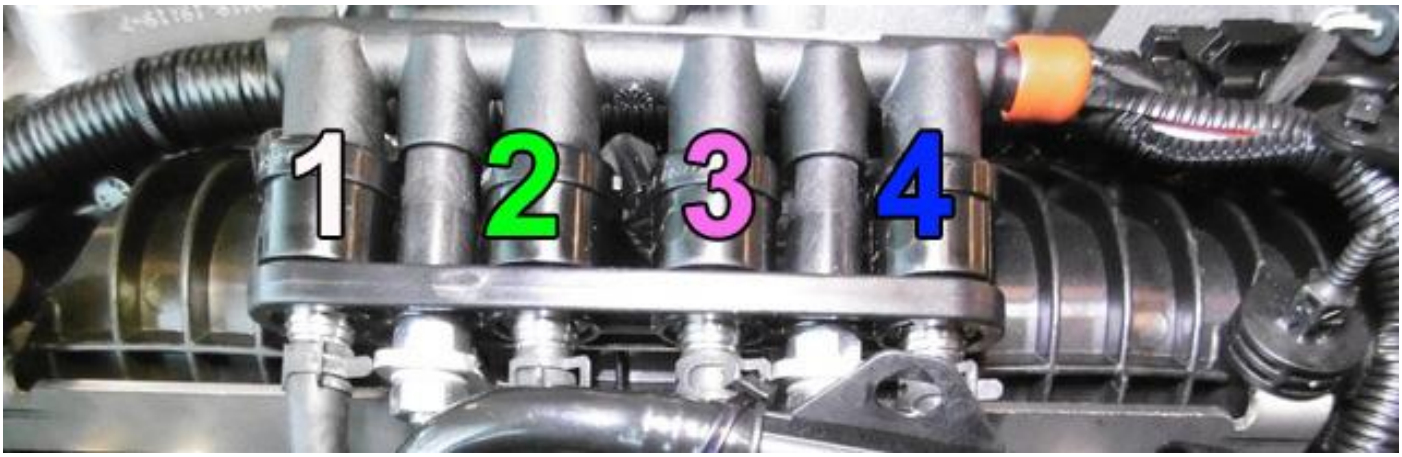
Check and measure the wiring in case of changes in the cars wiring colours.

Wire number / code	Wire colour	Connection
32 Ground sense 1 Ground battery	Brown Brown	*Connect to the '–' of the battery; use a ring terminal:*  (example S60, original ground point)
4 +12V Battery	Red	*Do not place the fuse in the holder before having completed the installation of the LPG system. use a ring terminal:*  (example S60)

Electrical connections

Check and measure the wiring in case of changes in the cars wiring colours.

Wire number / code	Wire colour	Connection
98 98 G INJ OUT **1** 106 106 G + INJ 1	**White-yellow** red	Connector VSI-injector to cylinder **1**. Timing belt side
99 99 G INJ OUT **2** 107 107 G + INJ 2	**Green-yellow** red	Connector VSI-injector to cylinder **2**.
100 100 G INJ OUT **3** 108 108 G + INJ 3	**Pink-yellow** red	Connector VSI-injector to cylinder **3**.
82 82 G INJ OUT **4** 90 90 G + INJ 4	**Blue-yellow** red	Connector VSI-injector to cylinder **4**.



Electrical connections

B-CONNECTOR

⚠ For measuring the petrol injectors :

Interrupt each petrol injector control wire (injector min)
Each VSI wire has a petrol injector / cylinder number printed on the wire, connect this wire to the corresponding petrol injector / cylinder.
Connect the **bicoloured** VSI measuring wire to the **ecu side**, (wire code: ecu-lo).
Connect the **corresponding full coloured** VSI wire to the **petrol injector side** (wire code: inj-lo).
See diagrams: Installation manual general part 1 / 2.

Attention:
Each bicoloured measuring wire corresponds to a specific LPG injector and petrol injector / cylinder number.
Do not interchange the wires.

Petrol injector **cyl. 1**			
INJ LO 1	**White**	Injector side	
ECU LO 1	**White-yellow**	ECU side	
B2 / A2		Colour: Y**ellow-blue** Location: petrol ecu, **B90**	

Petrol injector **cyl. 4**			
INJ LO 4	**Blue**	Injector side	
ECU LO 4	**Blue-yellow**	ECU side	
D1 / D2		Colour: **Blue** Location: petrol ecu, **B95**	

ECU HIGH A	**Red-yellow**	Injector supply	
H1		Colour: **Green-blue** Location: petrol ecu, **B89**	

Petrol injector **cyl. 2**			
INJ LO 2	**Green**	Injector side	
ECU LO 2	**Green-yellow**	ECU side	
A1 / C2		Colour: **Blue-orange** Location: petrol ecu, **B79**	

Petrol injector **cyl. 3**			
INJ LO 3	**Pink**	Injector side	
ECU LO 3	**Pink-yellow**	ECU side	
E1 / F2		Colour: **Green-purple** Location: petrol ecu, **B84**	

ECU HIGH B	**Red-green**	Injector supply	
H2		Colour: **Grey-yellow** Location: petrol ecu, **B80**	

Electrical connections – VOLVO / DENSO 31x

Check and measure the wiring in case of changes in the cars wiring colours.

B-CONNECTOR

3-pole connector 27 +5V Sensor 37 C ground 18 AD1	**Cut-off connector** *Red-blue* *Brown-black* Blue-white	*For measuring the inlet manifold pressure (MAP).* ***insulate*** ***insulate*** Wire colour: **Green-brown** Wire location: petrol ecu, **B30**
36 AD6 25 DAC1	Blue-brown Green-white	*High pressure petrol sensor signal interruption.* Sensor side. ECU side. Wire colour: **Blue-brown** Wire location: petrol ecu, **B7**
63 Ground shift	Blue-orange	*High pressure petrol sensor signal ground.* Wire colour: **Blue-black** Wire location: petrol ecu, **B22**
40 Wake-up	Grey-red	*High pressure petrol sensor 5Volt supply / car wake-up.* Wire colour: **Grey** Wire location: petrol ecu, **B37**
8 RPM engine speed	Purple-white	*Engine speed signal.* Wire colour: **Twisted green-purple** Wire location: petrol ecu, **B8**

A-CONNECTOR

		Low pressure petrol sensor signal interruption. Sensor side ECU side Wire colour : brown-blue Wire location : **A15**
17 AD2	Blue-green	Sensor side
10 DAC2	Green	Petrol ecu side
51 CAN1 High	Yellow	Wire colour :white-green Wire location : **A95**
70 CAN1 Low	Green	Wire colour : green-yellow Wire location : **A76**
56 DI2	Yellow–green	*PWM* Wire colour: **Yellow-orange** Wire location: petrol ecu, **A12**

Electrical connections – VOLVO / DENSO 32x

Check and measure the wiring in case of changes in the cars wiring colours.

B-CONNECTOR

3-pole connector 27 +5V Sensor 37 C ground 18 AD1	**Cut-off connector** *Red-blue* *Brown-black* Blue-white	*For measuring the inlet manifold pressure (MAP).* ***insulate*** ***insulate*** Wire colour: **Orange-green** Wire location: petrol ecu, **B27**
36 AD6 25 DAC1	Blue-brown Green-white	*High pressure petrol sensor signal interruption.* Sensor side. ECU side. Wire colour: **Orange-purple** Wire location: petrol ecu, **B22**
63 Ground shift	Blue-orange	*High pressure petrol sensor signal ground.* Wire colour: **Grey-purple** Wire location: petrol ecu, **B7**
40 Wake-up	Grey-red	*High pressure petrol sensor 5Volt supply / car wake-up.* Wire colour: **Grey** Wire location: petrol ecu, **B37**
8 RPM engine speed	Purple-white	*Engine speed signal.* Wire colour: **Twisted green-purple** Wire location: petrol ecu, **B8**

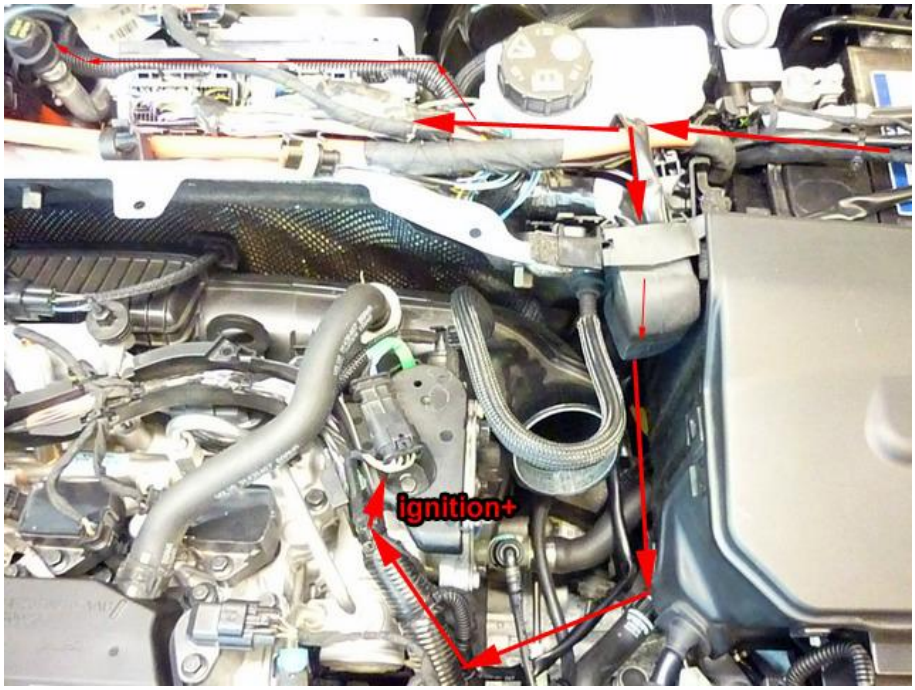
A-CONNECTOR

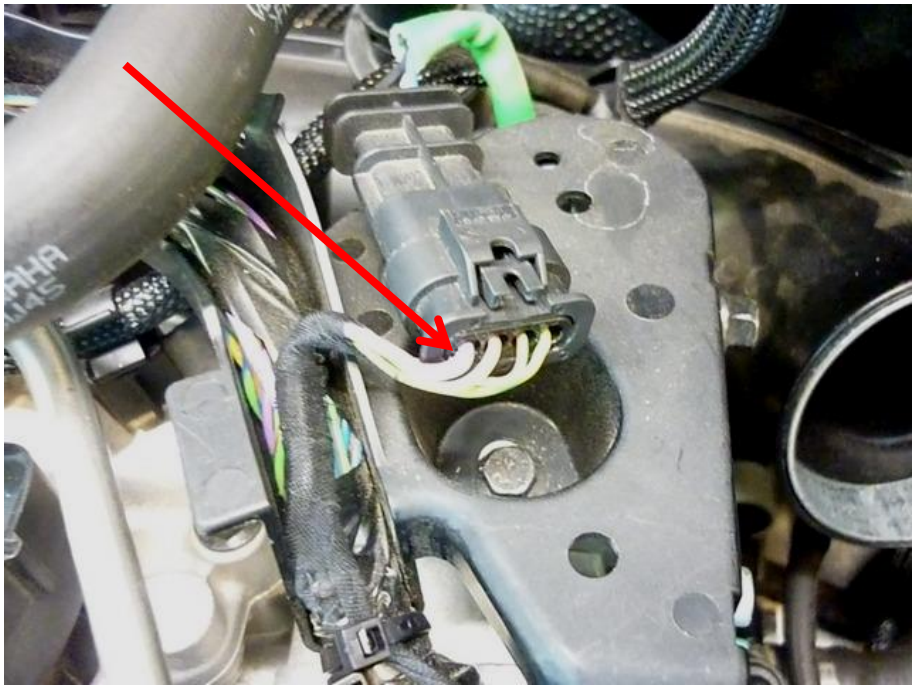
		Low pressure petrol sensor signal interruption. Sensor side ECU side Wire colour : brown-grey Wire location : **A16**
17 AD2	Blue-green	Sensor side
10 DAC2	Green	Petrol ecu side
51 CAN1 High	Yellow	Wire colour :white-green Wire location : **A95**
70 CAN1 Low	Green	Wire colour : green-yellow Wire location : **A76**
56 DI2	Yellow–green	*PWM* Wire colour: **Grey-orange** Wire location: petrol ecu, **A12**

Electrical connections +ignition - Option 1

Check and measure the wiring in case of changes in the cars wiring colours.

112 + Ignition	Red-grey	*Make a connection to ignition +.* Do not place the fuse in the holder before having completed the installation of the LPG system. Wire colour: **Purple-white** Wire location: **Oxygen sensor connector**

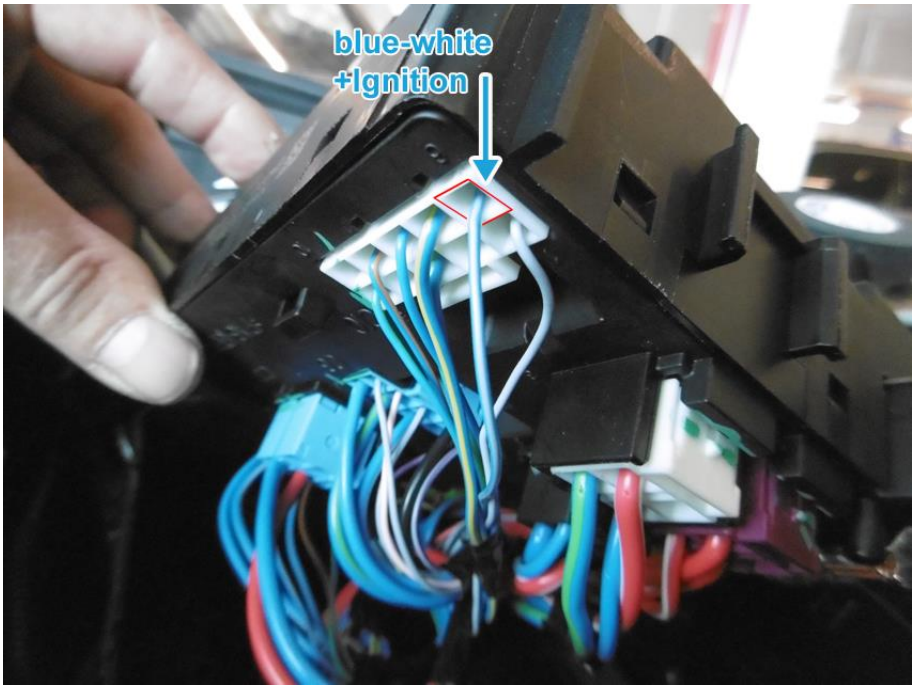


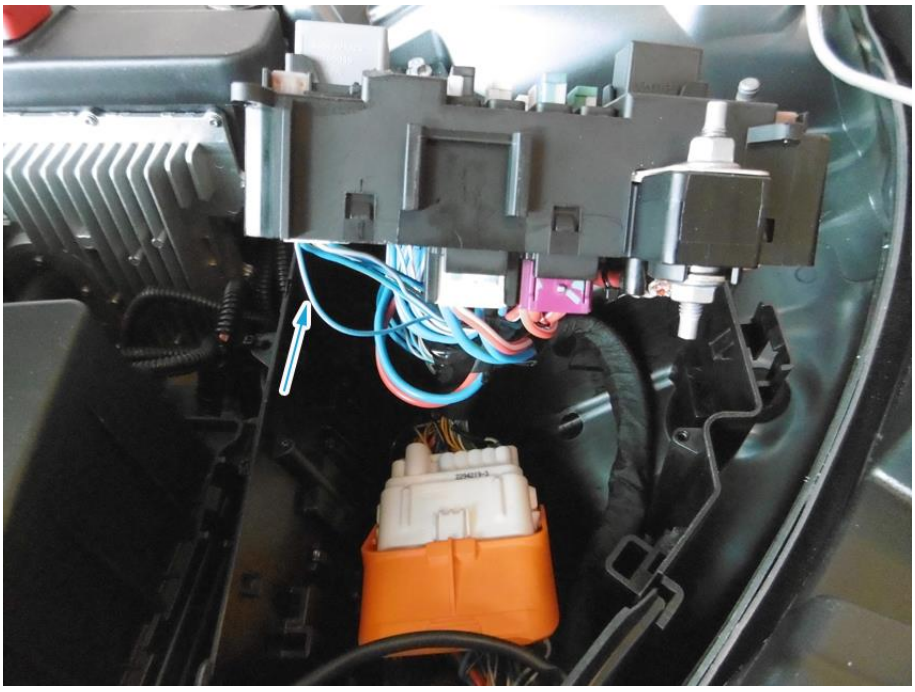


Electrical connections +ignition - Option 2

Check and measure the wiring in case of changes in the cars wiring colours.

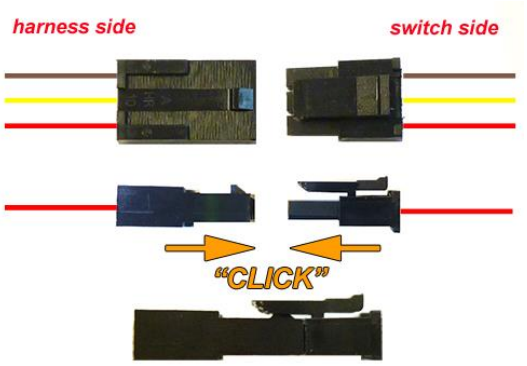
112			*Connect to +ignition / contact+ (+15).* *Do not place the fuses in the holder before having completed the installation of the LPG system.* Wire colour: **Blue-white** Wire location: under relay/fuse box (remove 4 small torx screws)
112 + Ignition		Red-grey	





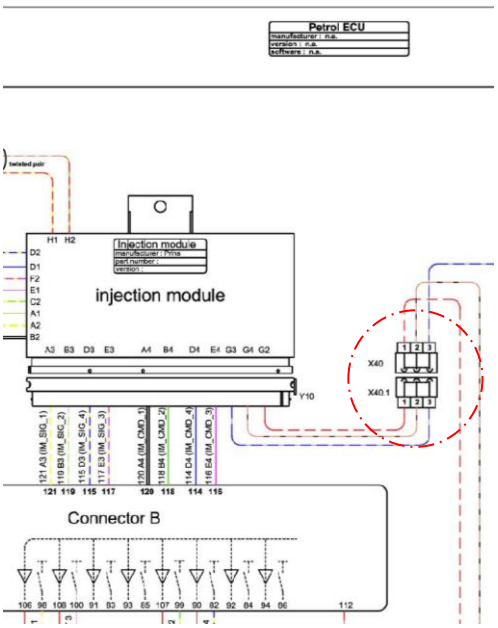
Electrical connections inside

Driver room

3-pole micro connector 66 Ground fuel switch 3 +12V fuel switch 49 LIN fuel switch	 Brown-black Red-white Yellow	*Connect to switch.* Connect the 3-pole connector to the Prins fuel selection switch
		

Electrical connections

Connectors in wiring loom

4-pole connector 35 Ground Psys 14 T-Gas 9 +5 Volt sensor 16 Psys	 Brown-black Grey Red-blue Green	*For measuring gas pressure and temperature.* Connect the connector to the filter unit sensor.
2-pole black connector 24 +12V regulator lock-off 31 C Ground	 Yellow-green Brown-black	Connect the connector to the regulator lock-off valve.
2-pole blue connector 15 T-ECT 34 Ground T-ECT	 Grey Brown-black	*For measuring the engine coolant temperature (Tect).*
4-pole connector 46 Service TxD 65 Service RxD 68 Ground PDT	 Grey Grey Brown-black	Diagnose connector.
Wiring loom link 45 C ground 58 +12V switched 64 AD5	 Brown–black Red–white Blue-grey	Connection from AFC connector A to connector B. 
3-pole connector 11 + manometer 12 tank level in 33 ground manometer	 red blue brown	Connect the connector to the manometer

Tank wiring loom 6meter 2 +12V Tank relay 26 Ground tank relay	 red black	Connect to the tank lock-off relay, trunk. Connect to the tank lock-off relay, trunk.

Checklist after installation

1. Connect the Prins Diagnostic Tool and run the VSI diagnostic program.
   Install the VSI fuse, turn the ignition key in the accessory position.
   When working on the car, beware of moving and rotating parts in the engine compartment.

2. When commissioning the LPG system, you must activate the AFC with the diagnostic software.
   When the AFC has not been activated, the switch will keep blinking.
   To activate the AFC, select function *activate ECM* in the diagnostic software.

3. Check whether the program in the AFC matches with the car (dedicated engine set):
   Refer the car description in the diagnostic software (Basic → Identification) and compare these with the set number.

4. The system will switch over to LPG as soon as the temperature of the coolant becomes higher than parameter 70 - Switch over ECT.

5. Check all components and connections for any gas leakage (use a LPG leak detector device or a fluid detection like soap). Caution for moving and rotating parts in the engine compartment!

6. Let the engine run warm on petrol >80°C.
   Check if the reducer heats up.
   Check the engine signals, petrol injection time, RPM, ECT, lambda, MAP signal and petrol pressure signal.
   Let the engine run idle on LPG.
   Adjust the reducer pressure.
   Refer to *Basic → System* in the diagnostic software for the idle level value set.
   Adjust the reducer pressure in such a way that the pressure measured (P-sys) equals the idle level value.
   Turn the socket-head screw at the front of the reducer to adjust the pressure.
   An error code will be generated whenever the pressure variation is too high.

7. Use the diagnostic software to check again all input and output signals.

8. Check the system for error codes and solve these, if required.
   Check the petrol ECM for EOBD error codes.
   Place the protection connector on the VSI communication connector.

9. Take a test drive and check the drivability on LPG and petrol.

ALTERNATIVE FUEL SYSTEMS
Prins