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Regulation 115 handbook CNG Sequent systems

Part Ia (Installer's handbook)

90AV99001049 of Dec 12 2011	**M.T.M. srl** **TECHNICAL MANAGER** Danilo CERATTO, Eng.

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PART I - (I)

1. DESCRIPTION OF CNG SEQUENT SYSTEMS

Sequent is a family of control systems for sequential injection carburation in gaseous phase, divided into many different conversion kits satisfying the more and more technological requirements of today's and tomorrow's car generations.

Sequent is a real Common Rail. In fact, it introduces in the field of gas supply the winning evolution for modern Diesel engines: a "rail-line" under pressure (Rail) that supplies fuel to every injector.

Sequent introduces the concept of harness modularity. This allows installing SEQUENT equipment on a vehicle by only connecting three electrical cables (obviously besides the supply and ground connections) and adding further electrical connections just in case of particularly sophisticated vehicles.

SEQUENT Plug&Drive MY10 (P&D MY10) for 3- and 4-cylinder vehicles with integrated timing advance processor

The transformation system with new engine control software. Dedicated to 3- and 4-cylinder vehicles.

SEQUENT Plug&Drive (P&D) for 5-, 6- and 8-cylinder vehicles

The transformation system with new engine control software. Dedicated to 5-, 6- and 8-cylinder vehicles.

SEQUENT 24.11 for 3- and 4-cylinder vehicles

Dedicated to 3- and 4-cylinder vehicles converted to CNG.

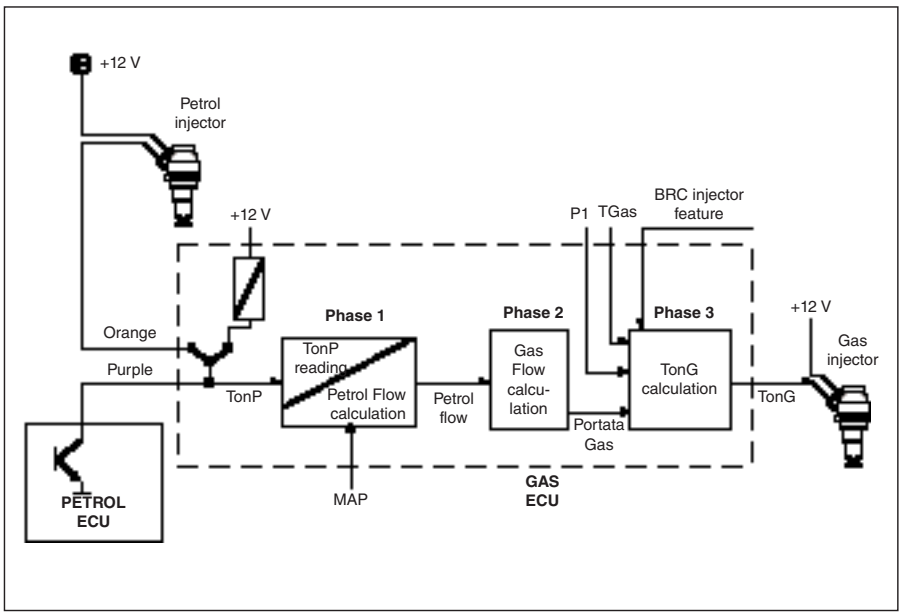
2. WORKING PRINCIPLE OF CNG SEQUENT SYSTEMS

SEQUENT is a system put “in series” with the petrol system, that’s to say that it allows petrol ECU, during gas mode too, deciding fuel quantity to provide to the engine. We can also say that SEQUENT is a “passive system”, or “slave”, or that SEQUENT acts as a “translator” between petrol system and gas fuel management. SEQUENT system is based on the fact that Fly SF ECU is connected to the petrol ECU terminal/s driving injectors (pict. 1).

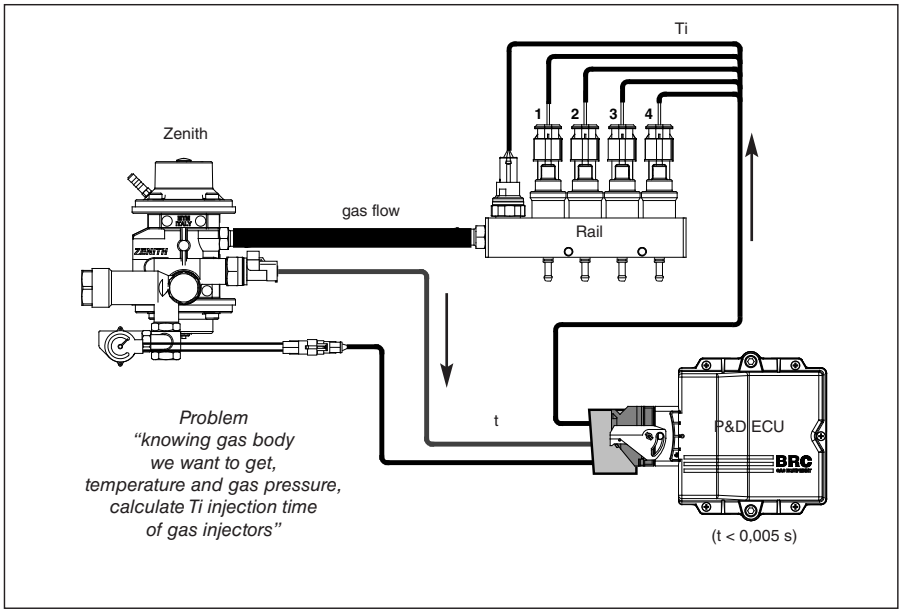
In this way, it recognizes petrol injection time (Ti). (During gas mode, injectors signal will be recognized thanks to the presence of injectors emulation integrated in the system itself). Thanks to Ti and RPM signal, Fly SF ECU calculates petrol flow that original ECU wants to supply to the engine, converts it in gas flow and realizes it by suitably piloting gas injectors.

This choice is very important, because as petrol ECU is always operating and pilots gas dosage from itself, system can carry out, in a clear and transparent way, functions such as stoichiometric control, enrichment in full load and cutting during tip-out (cut-off) according to the criteria expected by the manufacturer, RPM maximum limitation, coherent control of petrol vapours bleeding, right communication with air conditioner equipment, and so on. And this with no possibility of false error codes. For what concerns petrol system, nothing changes, so if an error message appears during petrol or gas mode, this has to be considered as true. Moreover, if vehicle has some problems during petrol mode, those will be present in gas mode too.

This is very important if you want to respect OBD anti-polluting



Pict. 1



Pict. 2

laws, also in gas mode.

Low impedance injectors are piloted in peak & hold mode, considering gas physical parameters (temperature and absolute pressure) read by Fly SF ECU in real time (pict. 2).

We want to underline that Ti is a precise and precious parameter, because it grows out of sophisticated calculations made by the petrol ECU according to complete and specific sensors.

As gas pressure and temperature conditions may change according to vehicle use conditions, system is equipped with temperature sensors and suitable absolute pressure sensors placed on the injectors gas supply and on the intake manifold. So, Fly SF ECU can adapt in real time its calculations and, above all, can work rightly in presence of big changes of parameters too.

Reducers used in the different configurations tend to keep a practically constant pressure differential between gas outlet pressure and intake manifold, exactly as it happens in most of petrol equipments. This helps to optimize system working, but it isn’t indispensable, as control electronic is faster than

pressures steady condition.

For example, after a sudden acceleration, pressure in the reducer increases in a fraction of second. During this lapse of time, ECU makes many calculation cycles and obviously compensates any mechanic delay.

As you can imagine, ECU, in addition to the system working general program, has to contain specific data of vehicle where we install it (it's a rather complex kit of maps and other setting – mapping parameters).

Computer has also the task to make diagnostic to verify system right working or to detect possible anomalies.

3. DESCRIPTION OF CNG SEQUENT SYSTEMS COMPONENTS FRONT SIDE

COMPONENTS DESCRIPTION	HOMOLOGATION
"VMA3/E" WP CNG electro-assisted valve	E13*110R-00*0039 E3*10R03*1139*
ZENITH reducer	E13*110R-00*0090
BRC Rail	E13*110R-00*0005
PTS sensor (Gas pressure and temperature)	E13*110R-00*0084 E4*110R-00*0096 E3*10R03*1138
MAP sensor	E13*110R-00*0044
BRC injectors	E13*110R-00*41 E3*10R03*1140*
Fly SF ECU	E3*110R-00*1001 E3*10R03*1131*
Changeover switch and level gauge	----------
Parker pipe 5-10,5 and 10-17	E13*110R-000008
Polimer pipe 5-10,5	E13*110R-000128
Polimer pipe 10-17	E13*110R-000127
Tubithor pipe	E13*110R-000017

3.1 CNG ZENITH REDUCER

It is the reducer dedicated to CNG equipments.

This reducer consists of two reduction stages with the task of:

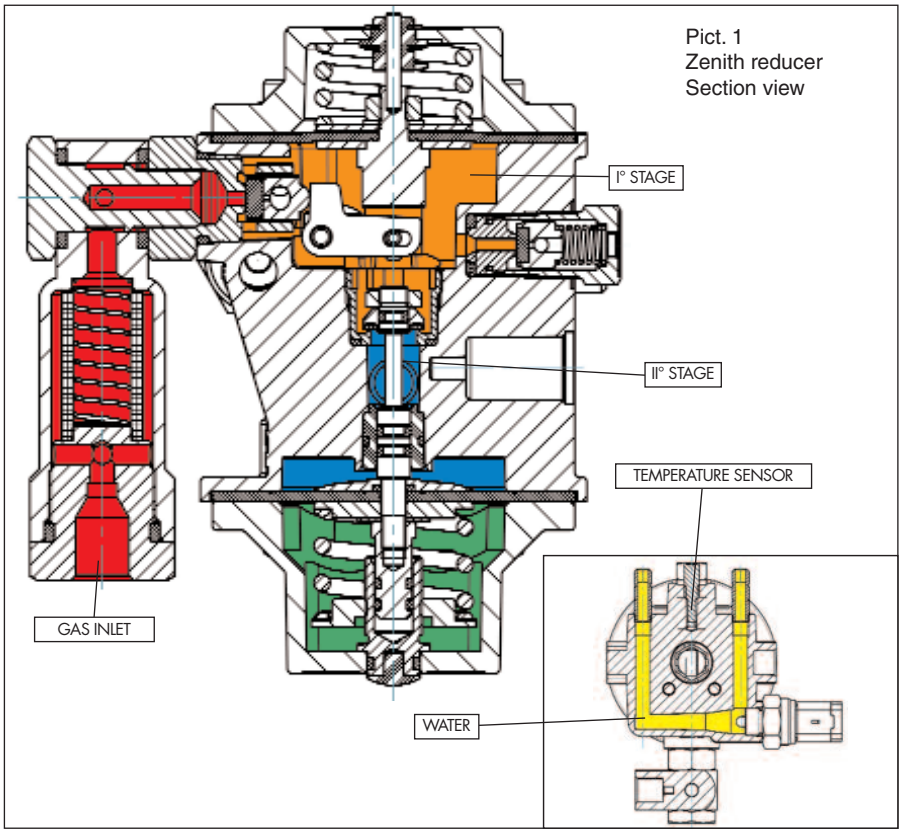
- face pressure level of CNG coming from the tank (load pressure roughly 22 MPa corresponding to 220 bar);
- spread CNG at an intermediate pressure, roughly 500 - 600 kPa (5 - 6 bar), in a first stage;
- bring some heat suitable to avoid a fuel cooling too high because of its sudden expansion;
- further spread CNG to the wished final pressure, roughly 200 kPa (2 bar), useful to supply injection system. This outlet pressure value depends on intake manifold pressure signal: practically, differential pressure between CNG pipe at the outlet of the reducer and intake manifold stays the same.

In spite of its compact dimensions, reducer can guarantee high gas flows, so that it can satisfy powers up to 230 kW.

Zenith pressure reducer is provided with a Delta p (**Δp**) setting of roughly 2000 mbar.

Installer can modify this value if necessary, between 1600 and 2500 mbar, operating on suitable screw.

Zenith reducer is different from the other ones thanks to some peculiarities as:



Pict. 1
Zenith reducer
Section view

- adjustable fitting with integrated high efficiency filter;
- first stage of lever reduction;
- security valve on the first stage;
- second stage of reduction with direct and desmodromic connection;
- water circuit obtained from the

aluminium body (with no gasket);
- water temperature sensor installed on the reducer (no need of setting);
- fixation by means of two M6 holes;
- compensation system for adjusted pressure according to the flow;
- connection at outlet with pipe-holder for 12x19.

The advantages are more precise and stable setting, quicker reply times, possibility to supply more powerful vehicles (with the same number of injectors and the same delta-p default calibration).

We suggest to replace inner cartridge of the adjustable fitting with integrated filter every 40.000 km.

3.2 WATER TEMPERATURE SENSOR (BLACK)

Temperature sensor shown in picture 3 is a resistive sensor with three cables, based on NTC thermistor. All gas changeover strategies of the system are based on water temperature measured by this sensor.

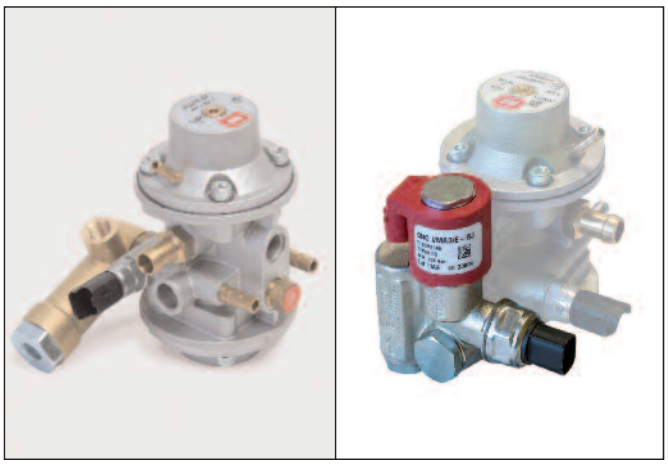
This sensor is different from the previous ones for its new mechanical structure; in fact, it is more compact and integrates sensor and connector parts in itself.

3.3 "RAIL" WITH BRC MY09 INJECTOR

This is the element on which injectors are installed; it allows distributing gas in a suitable way to each injector at the wished pressure.

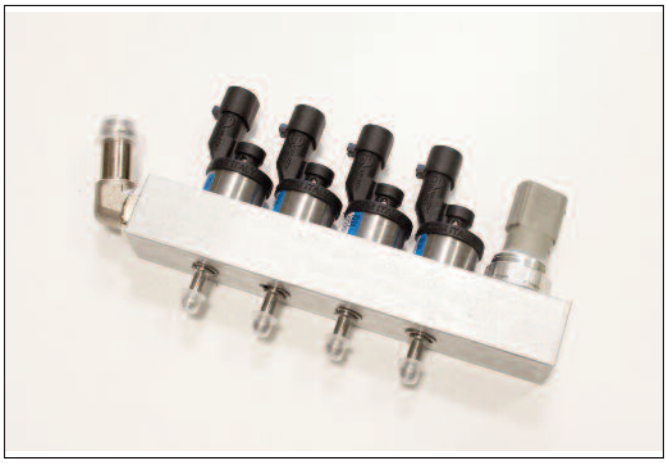
A patent covers BRC injectors protecting its details of construction.

It's a "bottom feed" injector (supplied from the bottom). Gas contained in the rail comes into the injector low side and it's injected into the intake manifold when shutter, moved by the electromagnet, free the passage section.



Pict. 2
Zenith reducer and Zenith reducer with integrated Solenoid Valve (Banjo) and Level Sensor HP

a. 3
Water temperature sensor (black)



Pict. 4a
Version with BRC MY09, injectors, gas pressure and temperature sensor

Pict. 4b
Version with pressure die-casting rail

Tightness is assured by the rubber final part of the shutter that pushes on a frustum-of-cone-shaped component (volcano).

Pressure differential that operates on shutter allows this latter staying closed when coil is not excited, avoiding that gas conveys into the intake manifold.

Injector has been especially planned to have a long length of time in extreme working conditions:

• diaphragms insulate the delicate area of megnetic circuit, avoiding that all kind of gas deposits modify its geometry;.

• operating temperatures: from –40 °C up to +120 °C;

• 15 g accelerations;

• strong electromagnetic forces assure opening also if there are oils or waxes in the dirty gas that, not retained by the filter tend to paste shutter to its seat.

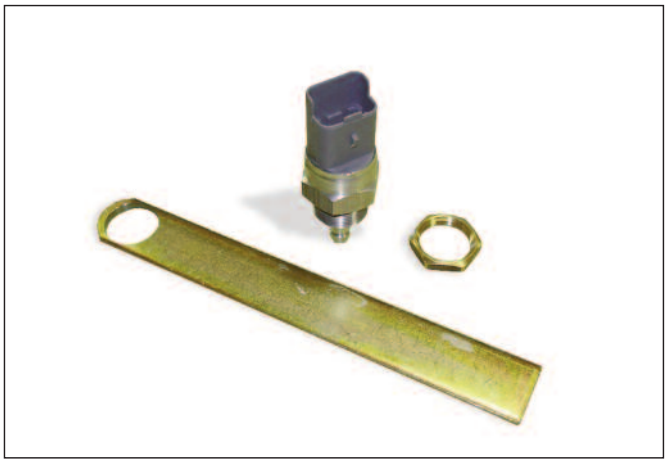
It's a low impedance injector (2,04 ohm / 2,35 mH at 20 °C) and so it requires a peak & hold piloting.

Shutter opens by applying all battery tension during peak phase; then tension with which injector is supplied becomes the keeping one (hold), enough to keep it open for the wished time. Shutter opens in brief time, and this allows having a good control of gas, injected in small doses too, as at idle conditions. Gas passage sections, then, allow a right supply also for the most powerful vehicles into the current market.

In order to better satisfy need of good idle control and good supply in high speed, there are many kinds of injectors with different passage sections.

Pict. 5
"Normal", "Max" e "Super Max" BRC injectors

Pict. 6
Gas pressure and temperature sensor, inserted in the body rail (PTS)



Pict. 7
MAP sensor

3.4 GAS PRESSURE AND TEMPERATURE SENSOR (PTS)

This sensor (pict. 6) has a compact body and is already integrated with the connector; it's available in version with P1 pressure sensor and gas temperature sensor.

This sensor allows obtaining a more precise measure of gas pressure and temperature, and making faster gas carburetion corrections if needed.

3.5 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)

This sensor (pict. 7) is light, small and easy-to-fix to the car body.

It has a compact body already integrated with the connector. Inside, it has a pressure sensor suitable for both intake and turbo-CNG engines, allowing an accurate setting on every kind of vehicle.

3.6 "SQ P&D" ECU

ECU is the operating unit that

controls the whole system. It's completely made by automotive components, being therefore suitable to face high temperatures inside the engine compartment, event though precautions must be taken to not assembly it near white-hot devices such as the exhaust manifold. It incorporates components of the latest conception with a data processing speed higher than most of the original petrol ECUs.

Memory where program and setting data are contained is not volatile, so, once programmed, ECU (pict. 8) can even be disconnected from the battery with no loss of data. It can be programmed many times without any problem, for instance it can be moved from a vehicle to another and re-programmed. Some data acquisition channels have been planned in order to be connected to various signals, very different according to the kind of vehicle (e.g. MAP, etc.). Task of the ECU is collect and process full information and so verify all different system functions.

So, Sequent system is able to assure the best integration at electronic and communication level (through serial K-line and CAN BUS) keeping the same petrol control strategies and "translating" petrol ECU injection times into the corresponding gas ones, precisely and fast, adapting itself to gas pressure and temperature variations.
It satisfies OBD regulations thanks to an efficient diagnostic system on each sensor and actuator.

ECU is contained in a strong aluminium case totally watertight, able to face high temperatures and to protect its electronic components, both from external atmospheric agents, and from mechanical stresses it is subjected to, and from electromagnetic radiations irradiated by the engine electrical components or by other sources (transmitters, repeaters, mobile phones, etc.). We wish to remember that ECU has been planned to withstand prolonged short-circuits, both towards ground and battery positive, on each of its inlet/outlet cables (naturally except for grounds and supplies). This allows not ruining ECU even in presence of the most common wiring errors (polarity inversion, wrong connection of one or more cables, etc.).

Pict. 8
SQ Plug&Drive ECU for 5-, 6- and 8-cylinder vehicles

Wiring connection passes through a single 56-way connector, which contains all the necessary signals for its different functions.

ECU incorporates the following functions, previously obtained by installing many external components:

- "**modular**" function for injectors cutting and emulation;
- **crankshaft sensor adapter** function, even more useful on new vehicle models;
- possibility to connect **two Lambda oxygen sensors** with no need of adapters;
- ECU contains the main **adapters for "current" and "supplied" lambda oxygen sensors**, that on other systems must be assembled externally;
- timing advance processor function, useful especially for CNG installations

(this function is only for special vehicles, and only after Technical assistance indication).

GENERAL FEATURES

- Microprocessor 16 bit 40 MHz
- Operating temperature: -40 °C + 105 °C
- Watertight through immersion
- According to automotive norms for protections and inlet/outlet signals
- Operating voltage: 8 V ÷ 16 V
- Sensors and actuators diagnostic compatible with EOBD
- Communication and reprogramming with PC through K-line
- It supports KWP2000 communication protocol
- It supports CAN 2.0 communication
- EMC compliant
- It pilots up to 8 injectors
- Integrated injectors cut and emulation
- Approval: R67-01 - R110 - 2004/104/CE

Note: *please make reference to chapter 13 for wiring connections.*

3.7 "SQ P&D MY10" ECU ARIES/ACRUX OR SCORPIO

Please see Chapter 12 for choosing P&D MY10 Aries/Acrux or Scorpio ECU.

Wiring connection passes through a single 64-way connector, which contains all the necessary signals for its different functions. Follow the same installation instructions valid for all Sequent ECUs.

GENERAL FEATURES

- Microprocessor 16bit – 38 MHz
- Operating temperature: -40 °C +105 °C
- Voltage: from 7 V to 17 V
- Max voltage: 24 V
- According to automotive norms for protections and inlet/outlet signals
- Sensors and actuators diagnostic compatible with OBD
- Communication Protocol KWP2000 through K-line CAN 2.0
- Aluminium case with plastic cover, totally watertight (IP67)
- Watertight 64-pin connection (IP67)
- Compliant to 2004/104/CE EMC
- Approval R67-01 and R110
- Integrated timing advance processor Aries/Acrux or Scorpio

Note: *please make reference to chapter 13 for wiring connections.*

Pict. 9
SQ Plug&Drive MY10 ECU Aries/Acrux or Scoprio

Pict. 10
SQ 24 MY10 ECU

3.8 "SQ 24 MY10" ECU

Wiring connection passes through a single 24-way connector. Follow the same installation instructions valid for all Sequent ECUs.

GENERAL FEATURES

- Automotive microprocessor 16 bit - 32 MHz
- Operating temperature: -40 °C + 100 °C
- Watertight through immersion
- According to automotive norms for protections and inlet/outlet signals
- Operating voltage: 7 V ÷ 17 V
- It pilots up to 4 injectors
- Integrated injectors cut and emulation
- Approval: R67-01 - R110 - 2004/104/CE

Note: *please make reference to chapter 13 for wiring connections.*

3.9 ONE-TOUCH CHANGEOVER SWITCH WITH LEVEL GAUGE AND ACOUSTIC INDICATOR (BUZZER)

It is a push-button changeover switch with a separate acoustic indicator (Buzzer) and with a level indicator consisting of 4 green LEDs for gas level indication and possible errors indications, and of a bicolour LED (green-red) which indicates the gas or petrol mode.

Unlike the changeover switches provided until now, the One-Touch is a one-position changeover switch. Fuel change is recognised every time the push-button is pressed.

When you switch the vehicle off, ECU recognises and records the fuel state (gas or petrol), in order to re-propose the same state at the next switching on. Therefore, if during the switching off vehicle is in gas mode, the gas mode will be the one recorded at the switching on (idem for petrol mode).

3.9.A PETROL MODE

The red round LED turned on informs the user of this state; gas level information disappears, that's to say that the four green level LEDs are turned off.

3.9.B CNG MODE

In this state, vehicle starts in petrol mode (so level LED are turned off), and it changes automatically over gas mode when program changeover settings are reached. The round LED, by becoming first orange and then green (gas mode), informs the user that changeover has been done.

Changeover switch works also as level gauge thanks to the four green LEDs.

In order to know how much gas there is in the cylinder, it is enough

to control how many LEDs are turned on. If four LEDs are turned on, tank is completely full (80% of tank total capacity), if three led – 3/4 of the tank, if two led – half tank, if one led – 1/4 of the tank.

Fuel reserve indication is given by the first LED blinking and it is purely indicative.

You can have correct indication with vehicle in plain and after few minutes since the starting, also if indication is immediately present.

We suggest to use the partial speedometer in order to control vehicle autonomy.

If the four green LEDs are blinking at the same time, it means that it could be a gas exceeding quantity inside the tank or the cylinder. In this case, we suggest to cover some kilometres until the blinking is over.

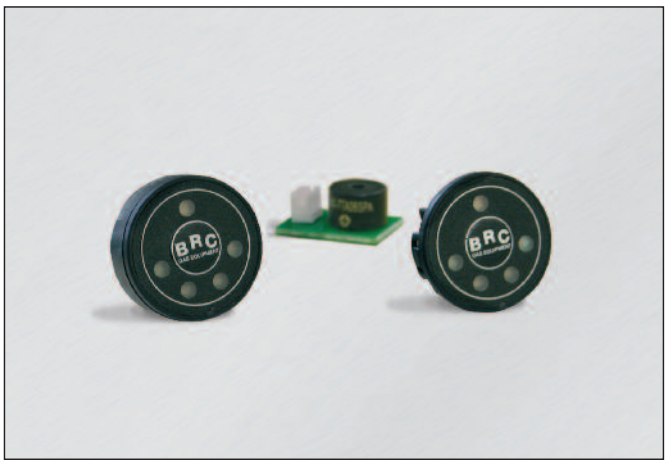
Just in CNG mode, gas level of the cylinder is displayed on the four green LEDs.

Avoid that petrol tank is completely empty.
It is necessary to keep always petrol level at 1/4 or 1/2 of the tank and periodically refill it.

3.9.C ERROR INDICATION (ONLY WITH DIAGNOSTIC ENABLED)

When communication fails, system informs the user by turning on the two blinking green level LEDs in the middle, and by the round orange LED blinking too. In this situation the changeover switch doesn't work anymore, and the ECU records the fuel mode that you had before the error indication. If vehicle was in gas mode, the mode remains the same (idem for petrol mode).

If ECU recorded the gas mode, but meanwhile the fuel ends, passage to the petrol mode will happen automatically and without any acoustic indication.



Pict. 11
One-Touch changeover switch (version with and without body and with separate buzzer

3.10 RESISTIVE LEVEL SENSOR

SEQUENT ECUs control gas level indication by means of a signal on the GREEN LEDs of the changeover switch. To do that, ECU is able to elaborate the signal coming from the BRC resistive pressure sensor (pict. 12) of the CNG equipment. LEDs lighting thresholds can be freely set up with the PC (see Software Handbook code 90AV99001046) to allow a precise indication.

3.11 HP LEVEL SENSOR

Level sensor of picture 13 is combined with Zenith reducer with Banjo integrated solenoid valve. This sensor sends values to the gas ECU that elaborates them and shows gas level thtough the GREEN LEDs of One-Touch changeover switch.

LEDs lighting thresholds can be freely set up with the PC (see Software Handbook code 90AV99001046) to allow a precise indication.

3.12 FUSES

CNG Sequent system is supplied with fuses at the correct amperage, fitted into the right seat.

We suggest not inverting their position or replacing them with fuses with different amperage.

- SQ P&D MY10 and SQ 24.11 up to 4 cylinders: 5A fuse and 15A fuse.
- SQ P&D 5-, 6- and 8-cylinder: 5A fuse and 15A fuse.

The 5A fuse must be inserted in the fuse-holder with the smaller section cables, while the 15A/25A fuse in the fuse-holder with the larger section cables.

3.13 RELAY

Sequent system uses relay to interrupt battery positive coming from the actuators (just for SQ P&D 5-, 6- and 8-cylinder).

3.14 DIAGNOSTIC SOCKET

The PC connection to the FLY SF ECU is based on a diagnostic socket, directly coming out from the wiring. It is the 3-way connector diagnostic socket (female-holder on the harness), equipped with a protection cap.

For PC connection, it is necessary to use the USB cable code DE512522.

3.15 SEQUENT SYSTEMS INJECTORS EMULATION

Sequent ECU carries out the whole injectors cutting and emulation function.

With the word "cutting", we mean the function that, by interrupting

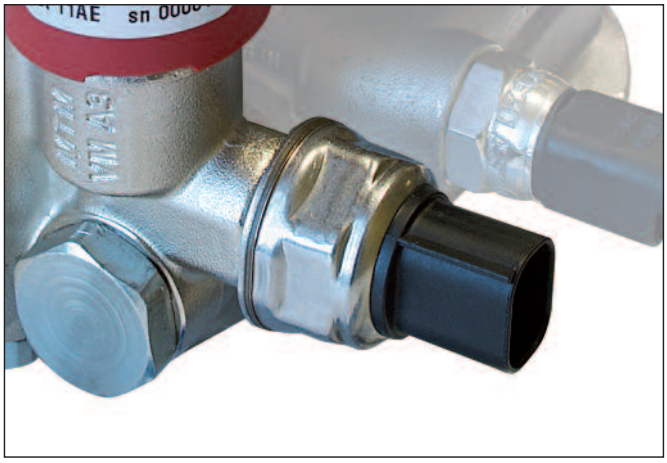
electrical connection between petrol ECU and injectors, avoid that injectors could introduce petrol into the cylinders during gas mode.

Actually, in this phase engine supply of gas fuel must be carried out by the SEQUENT system, and the contemporaneous petrol injection must be absolutely avoided because it should be dangerous for both engine and catalyst. Obviously, the petrol ECU diagnostic has especially been studied to detect possible interruption in actuators connection, especially for injectors.

This is the reason that make necessary to "emulate" the load that was before represented by the petrol injectors, that's to say to replace for an electrical point of view the petrol injectors disconnected with "fake" injectors that ECU cannot distinguish from the true ones.

This function happens directly inside the ECU without external components to its harness.

Pict. 12
Resistive pressure sensor for BRC CNG reducers



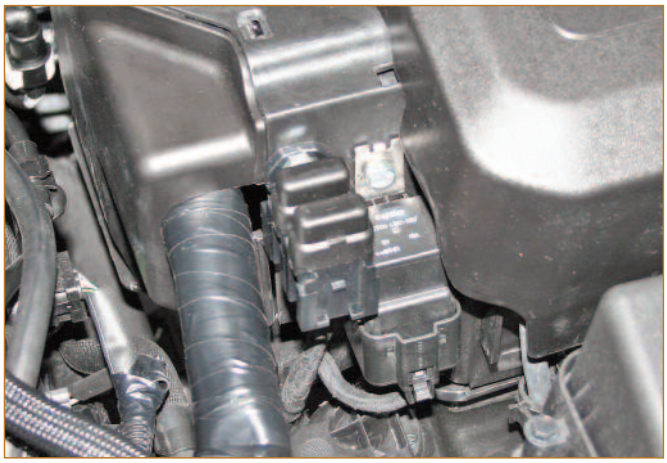
Pict. 13
HP level sensor

3.16 "VM A3/E" CNG ELECTRO-ASSISTED VALVE

"VM A3/E" electro-assisted valve (pict. 16) is Water Proof (with watertight connectors) and it is an evolution of the well-known CNG VMA3 solenoid valve.

This valve, usually installed inside the engine compartment along the pipes connecting the CNG cylinder/s to the reducer, if combined to the IM series CNG filling point allows refuelling and, at the same time, the free passage of the supply flow.

Using this kind of refuelling solenoid valve, in the CNG SEQUENT systems context, has a very important role as the solenoid valve is controlled and managed by the electronic control system. It opens when the starting begins and closes in case of engine stop, even if the driver doesn't turn the ignition



Pict. 14
Fuses and Relay

Pict. 15
Diagnostic socket

key off (for instance in case of accident).

3.17 SEQUENT SYSTEMS HARNESS

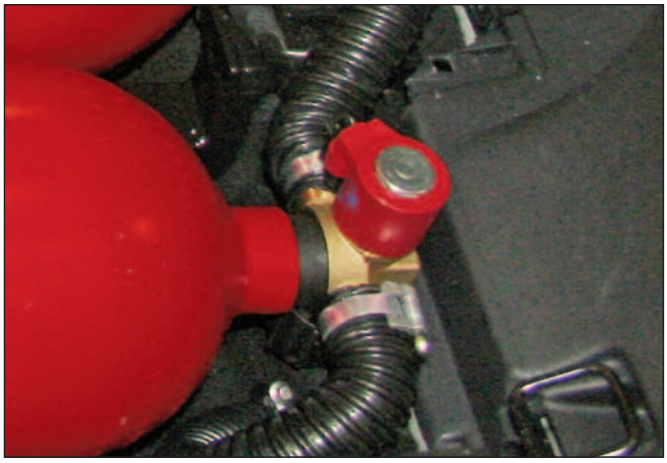
Please make reference to paragraph 13, “Wiring connections”.

Pict. 16
“VMA3/E” WP CNG electro-assisted valve

4. DESCRIPTION OF CNG SEQUENT SYSTEMS COMPONENTS REAR SIDE

COMPONENTS DESCRIPTION	HOMOLOGATION
1 - VBS1 MY07 cylinder valve	E13*110R00*110R00*0042*02
2 - CNG cylinders	See section about alternative components rear side PART I- (II), Chap. 3

4.1 VBS1 MY07 CYLINDER VALVE



Pict. 1
VBS1 MY07 cylinder valve

Pict. 2
CNG cylinders

"VBS1 MY07" cylinder valve was planned and produced by BRC to combined cylinder valve traditional functions with safety functions internationally required for this kind of device.

BRC, on the basis of its experience in national and foreign markets, realizes many versions of "VBS1 MY07" cylinder valve, according to the laws in force in each country.

Especially, the following functions stay the same in each model:

- Cylinder refuelling,
- Cylinder supply,
- Cylinder insulation by means of a manual tap,
- Ventilation for gas-tight housing.

The following safety devices can be added to the standard model:

- Excess flow valve,
- Safety device for over pressure with bursting disk,
- Safety device with thermic fuse.

"VBS1 MY07" cylinder valve is made up of a main body with a threaded fitting for connecting it to the cylinder, and two threaded fittings for connecting it to the high-pressure pipes. Normally, we use one of these fittings for the connection to the refuelling point and to the engine supply, and the other one for the connection to other cylinders. Last valve fitting is used for the connection to the steel pipe in case of wall leadthrough couplings. With couplings not needing a wall leadthrough installation (applied on the "VM A3" CNG valve), we apply a blank-off plug on the last valve fitting not used.

"VBS1 MY07" has a shut-off solenoid valve directly inserted on its body, suitably piloted by BRC ECUs, stopping so the gas flow towards the engine in case of accident or accidental shutdown.

However, you can close the gas outlet thanks to the manual tap situated on the valve in case of emergency or maintenance.

4.2 CNG CYLINDERS

CNG cylinders are the biggest

additional element of the equipment and they are normally installed inside the luggage compartment, and sometimes under the bodywork, under the flatcar, or on the sunroof.

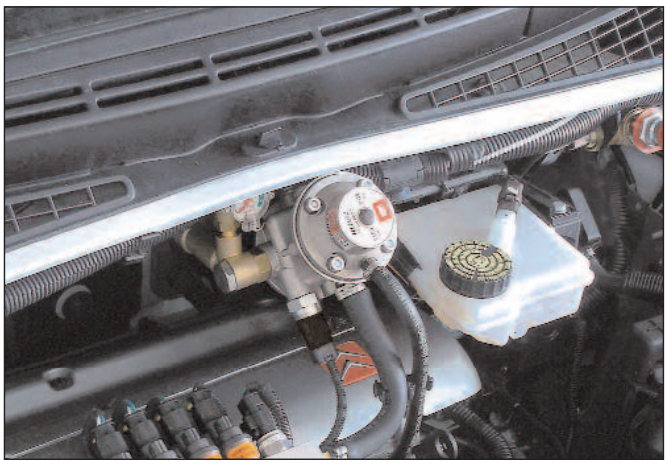
Of course, cylinders have to comply with prescriptions of European Regulation n. 110, or with any laws in force in the destination country.

According to needs and spaces, one or more cylinders can be installed on the vehicle.

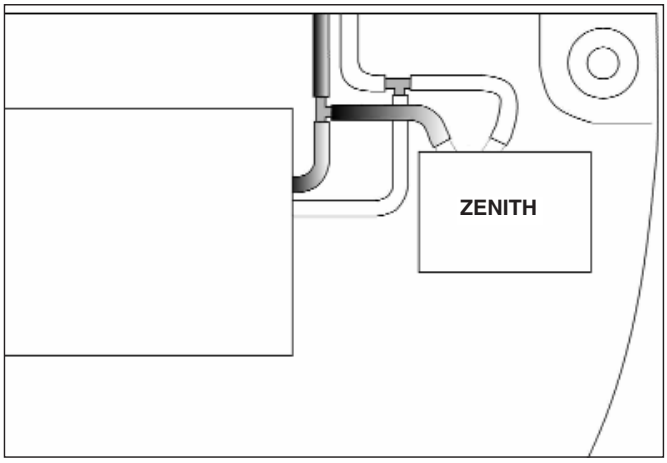
We can easily say that cylinders are one of the safest components of the whole vehicle.

Real experience, in fact, shows that, even in case of serious hard crashes, CNG cylinders are one of the few parts of the vehicle remaining complete. Even in case of pileup collision, cylinders don't change its shape; so, it's completely untrue the diffused preconception about cylinders danger.

5. MECHANICAL INSTALLATION



Pict. 1
CNG Zenith Reducer: example of assembly position



Pict. 2
Reducer "parallel" heating circuit

The following installation rules have to be considered as general.

Before installing the various components of Sequent system, it is recommended to check the vehicle petrol good working. Especially, it is necessary to carefully check the electronic ignition equipment, the air-filter, the catalyst and the Lambda Oxygen sensor.

5.1 CNG ZENITH REDUCER

Reducer must be firmly fastened to the bodywork so that it is not subjected to vibrations during its working. With the engine under stress, the reducer must not hit any other device. It can be installed with any orientation; it's not important that diaphragm be parallel to the running direction.

Pipe that connects reducer to the rail should not be longer than 200-300 mm. For connection, see paragraph 5.5.

If you need to tighten or loosen the gas inlet fitting or any other fitting, we recommend to always using two wrenches, in order to not move the component screwed on the reducer body.

Temperature sensor cable should not be too tight or twisted, and it should not make sudden folds at the outlet of the sensor.

Steel pipe going from the solenoid valve to the reducer mustn't go through too hot areas of the engine compartment.

As no adjustment is expected on the reducer, it's not essential to assemble it in an easily accessible area. Anyway, the installer should avoid too uneasy positions, in order to realize maintenance operations without too many difficulties. Water connection can be made in parallel compared with the passenger compartment heating circuit. During the functional inspection of the equipment installed, it's important to check that gas temperature doesn't reach low values particularly after a long use in power.

Zenith reducer has pipe-holder fittings at outlet. So, pipes must be tightened with the suitable click clamps supplied.

5.2 RAIL AND INJECTORS GROUP

5.2.1 BRC MY09 INJECTORS ASSEMBLY ON RAIL WITH GAS PRESSURE AND TEMPERATURE SENSOR

On the rail body, besides the injectors, the gas pressure and temperature sensor is also directly inserted.

BRC injectors has to be installed as follow:

- Insert injector (1) on the rail seat (2).
- Fix injector to the rail and lock it with Seeger (3) provided. During tightening, hold firmly the injector with a hand in the wished position, avoiding its rotation. Do not use pliers or spanners to hold injector as they can damage the steel body or the plastic covering.
- Insert sensor (4) in the rail seat

(2).

• Install fixing bracket on the vehicle using the two screws and washers.

Please pay attention to the cleaning during assembly to avoid dirtiness could damage injector.

Injector ends with a threaded part, where you have to connect the pipe on which fitting ought to be installed, as indicated in paragraph 5.4.

5.2.2 Installation of injectors rail on vehicle

The rail with the injectors can be fixed both to the vehicle and to the engine; the orientation is not important (pict. 4).

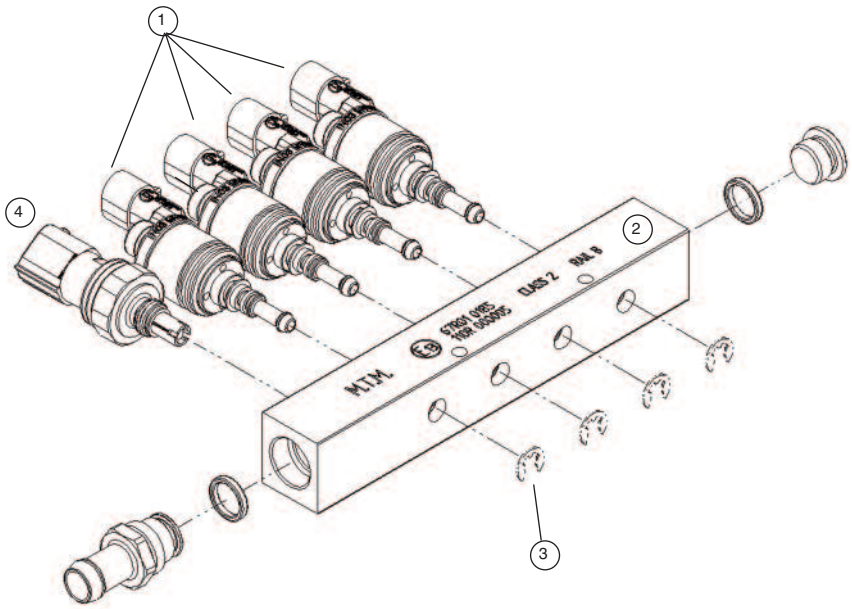
Fixing must be stable; it is necessary to place injectors as close as possible to the engine head so that air-intake manifold connection pipes are as short as possible. They should not be longer than 150 mm.

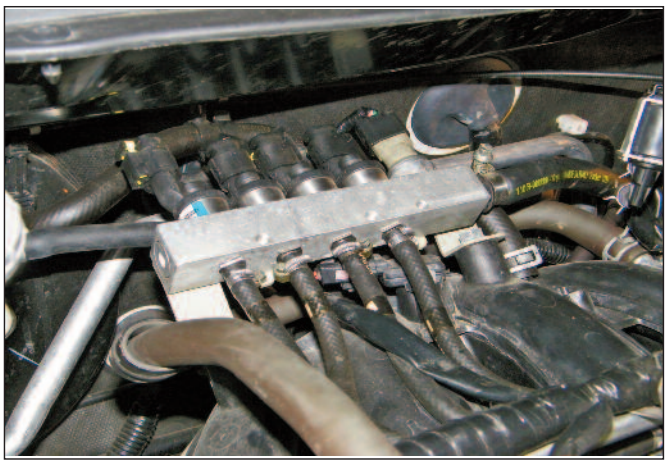
In case of BRC injectors, the suitable connection nut has to be assembled on one end of the pipe as indicated in paragraph 5.4. Pipes should have the same length and don't create any narrowing.

Injectors must not be situated near the exhaust manifold. Always follow good installation criteria for pipes and electric wires indicated in paragraph 5.4 and in chapter 13.

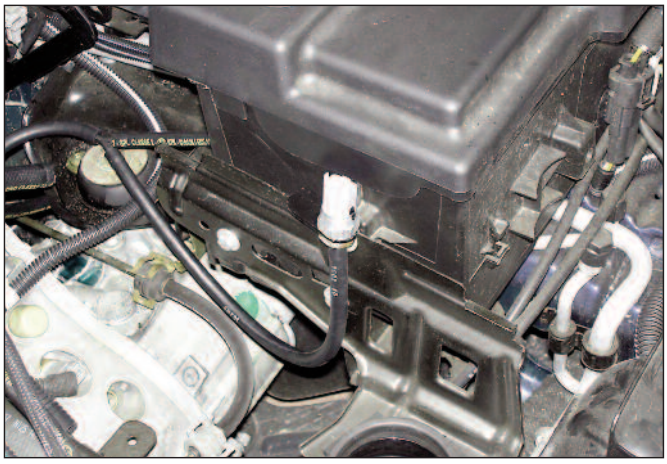
As the injectors are not totally noiseless, it is better to not fix them to the bulkhead that divides the engine from the passenger compartment, because it may become a resonance box and amplify the noise. In case you cannot choose any other position, it is necessary to equip the fixing bracket with suitable damping systems (silent-block).

Pict. 3





Pict. 4
Example of installation of Rail with BRC injectors and gas pressure and temperature sensor



Pict. 5
MAP sensor - example of installation

5.3 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)

Sensor has to be fixed to the vehicle bodywork (pict. 5) avoiding high heat irradiation areas. It is better that pipes are as short as possible and anyway no longer than 400 mm. For connection see paragraphs 5.4.
Electrical cables should not be too stretched or twisted, and they should not make sudden folds at the sensor outlet.

5.4 PIPES

Pipes belonging to the Sequent system are realised by BRC. According to the Sequent kit used, we provide pipes ø 10x17 or ø 12x19 mm, or pipes ø 5x10,5 mm with fitting on one end only (pict. 6).

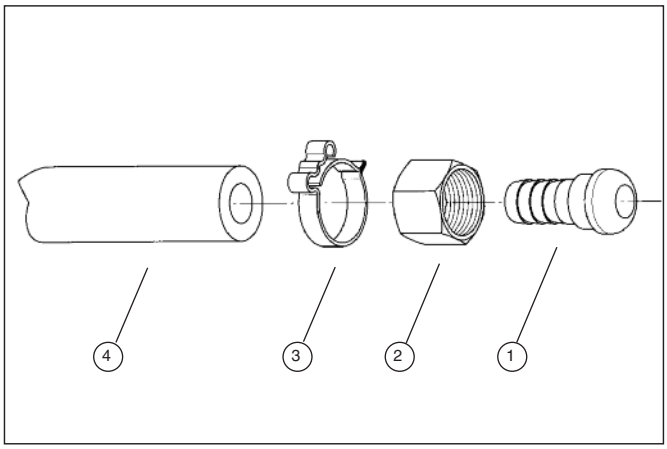
Before connecting pipes ø 10x17 or ø 12x19 mm, pipe-holders should be installed on each end as shown by picture 7.

For connecting BRC MY09 injectors, we use pipe ø 5x10,5, that must be cut at the length desired to allow installing on it a pipe-holder with a fitting-nut. In such cases, installation will be as follows (pict. 7):

- Install pipe-holder fitting (1) on the suitable nut (2).
- Fit the click clamp (3) on the pipe (4).
- Fit deeply the pipe on the previously assembled pipe-holder.
- Tighten pipe on the pipe-holder with the click clamp using suitable pliers.

Be careful with not leaving any rubber residuals while cutting pipe or fitting pipe-holder, because they could obstruct the pipes or other components of the equipment, prejudicing its working. Before installing pipe, it's better to blow it with compressed air, in order to expel any impurities or residuals. Verify that clamp assures tightness.

Pict. 6
Pipe ø 5x10,5 mm



Pict. 7
Assembly of pipe-holder on pipe

We recommend not using pipes different from the supplied ones and always installing them using high-quality wrenches in order to avoid damage to the nuts.

Every time you need to remove a fitting, use two wrenches, in order to firmly hold the component not to be unscrewed. Fittings are watertight and they seal on conical-spherical surfaces. Do not apply excessive torque wrenches to avoid damaging the fittings.

Do not use any sealing product. The usual criteria related to the correct installation of pipes should always be respected, avoiding any relative movements during running in order to not creating frictions and wears, contacts against sharp corners or drive belts, and so on.

Once installed, pipes should not be too stretched, they should not make any folds or be positioned in such a way to have the tendency to make folds in the future.

5.5 NOZZLES

Nozzles installation is one of the most important operations of the whole installation.
We suggest to clearly indicating on the manifold all the points that will be drilled, before beginning.
Use specific tools included in the tool-case Injection Systems code 90AV99004048.
Drill should be quite near the cylinder head, but preserving the same distance on all manifold branches and the same nozzle orientation.
Each nozzle has to be perpendicular to the intake-pipe axis, or at least, create an angle such to convey flow towards the engine and not towards the throttle-body (picture 8 and 9).

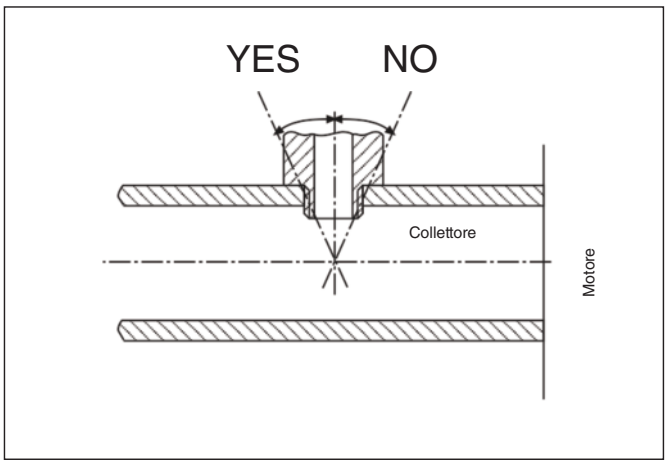
On the plastic manifolds, find areas whose walls are as less thin as possible. After having marked properly the drilling points with a pencil, before starting to drill, verify with the drilling-machine equipped with a helical bit, that there are not overall dimensions such to avoid the correct drilling of all branches following the direction wanted. Make an engraving and now drill (pict.10). Use a correctly sharpened 5 mm helical bit, and then make an M6 threading (pict. 11). While drilling and threading, take all necessary measures to prevent the chips from going into the manifold.

In particular, we suggest to frequently remove chips while drilling and grease the bit during the breaking last phase of the wall, in order to stick the chips to the bit. The last part of wall should be broken slowly so that the chips could be very thin: in this way, chips stick better to the bit and, if any of them falls inside, it would cause no damages. Even during the M6 threading, it is necessary to often grease, extract and clean the screw tap.

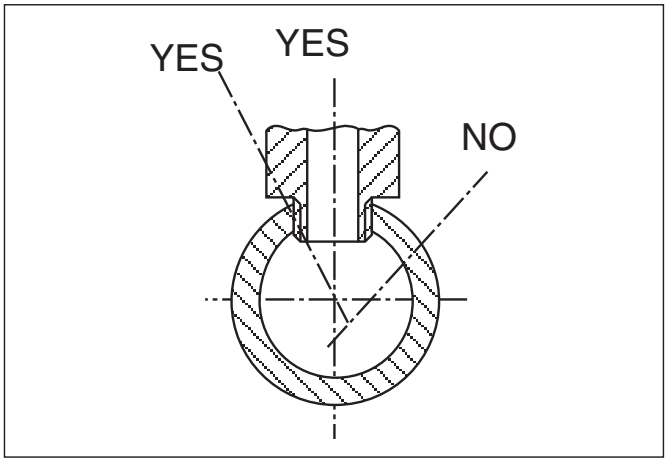
By using two 10 mm wrenches (pict. 12) screw each nozzle to the used ø 5x10,5 mm pipe connection. Using some sealing product, as Loctite 83-21 (pict. 13) screw nozzle and pipe on the manifold hole (pict. 14). Fit the nozzles correctly in order to avoid tightening them excessively and stripping them. During the wrenching, we suggest to always use a proper wrench, as the one contained in the tool-case code 90AV99004028.

Never change either the inside diameter of the nozzles or their outside shape.

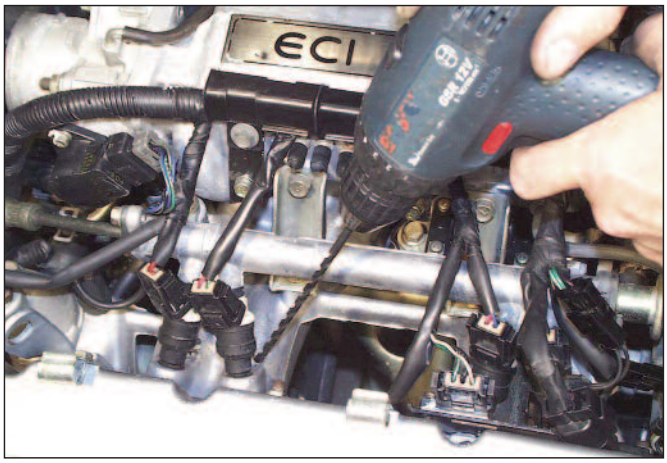
NOTE! In presence of small diameter intake manifolds, it can be necessary to install some special nozzles, shorter than the standard ones.



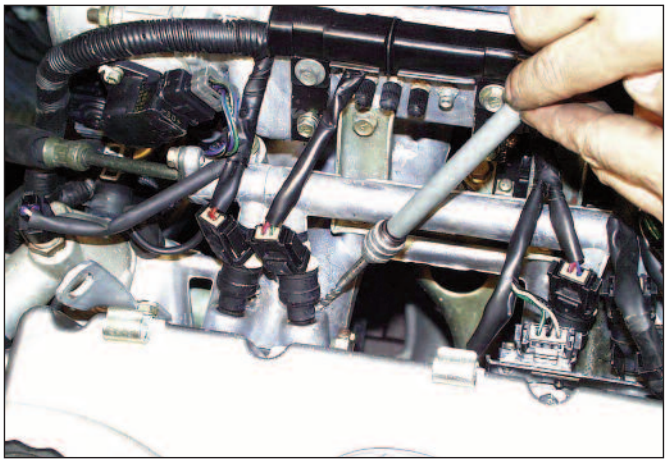
Pict. 8
Inclination of manifold drilling



Pict. 9
Holes orientation on manifolds



Pict. 10
Manifold drilling



Pict. 11
Manifold threading

5.6 LPG ECU

It can be fixed both inside the passenger and in the engine compartment.

Use the fixing holes on the aluminium body avoiding subjecting structure to excessive stresses (e.g.: do not fix the ECU on a convex surface, thinking you can tighten the bolts thoroughly, level so everything).

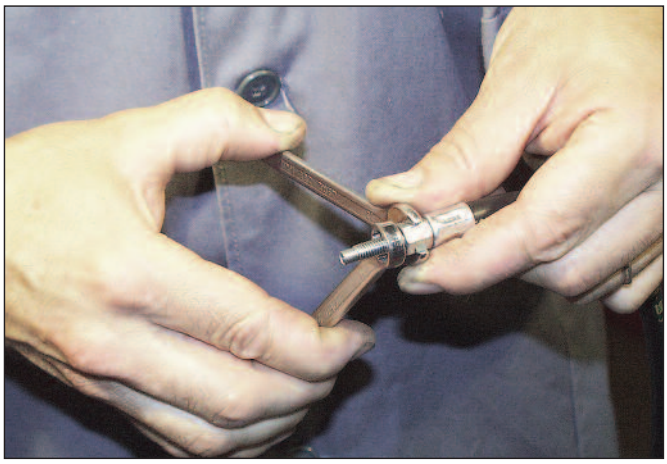
If available, always use the suitable fixing bracket.

Avoid too hot areas, or areas subjected to high thermal radiations.

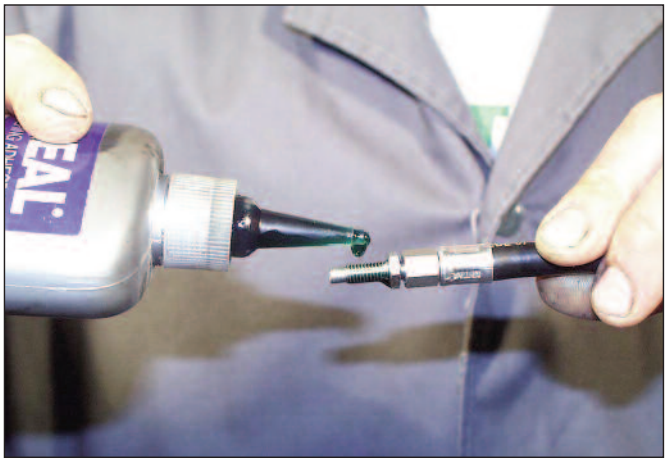
Even though ECU is watertight, avoid installing it in areas subjected to continuous dripping in case of rain, so that the water doesn't penetrate and stagnate in the harness or sheaths.

No adjustment is programmed on the ECU; it is therefore not important it's easily accessible.

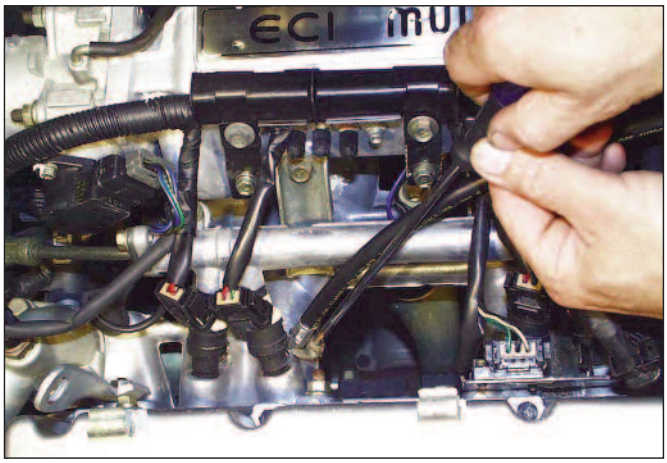
It's more important, instead, that cable going from the ECU with the computer connection is placed in a very accessible area and protected by the cap from possible water infiltration.



Pict. 12
Nozzle wrenching on pipe fitting. Just for BRC injectors



Pict. 13
Threads-blocker product. Just for BRC injectors



Pict. 14
Nozzle wrenching with pipe on manifold

5.7 ONE-TOUCH CHANGEOVER SWITCH

One-Touch changeover switch is available in two versions, with or without the round frame. So, installation must be carried out as following:

- *built-in fixing*: making a 23 mm hole and introducing changeover switch without its frame (pict. 17).
- *external fixing:* making a 14 mm hole that allows the cable passage, and pasting changeover switch with its round frame (pict. 18).

5.8 SEQUENT SYSTEMS HARNESS

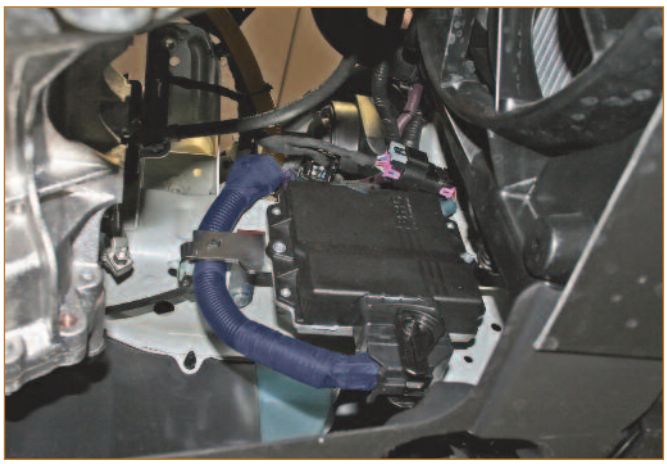
From a "mechanical" point of view, we suggest placing wiring

Pict. 15
ECU assembly into the engine compartment

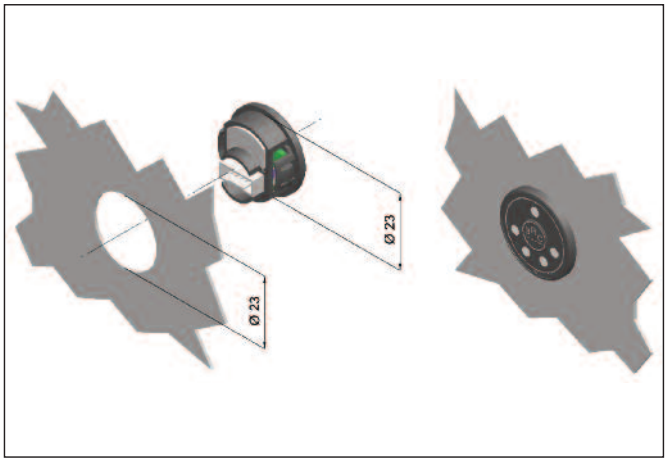
very carefully and avoiding forcing on the connections (never pull on wires to let a connector passing through a hole or to disconnect it!!!). Avoid making too remarked folds, too strong clamping, sliding against moving parts, etc. Avoid that some pieces of cables are too stretched when the engine is under stress. Fix opportunely the pieces of cable near connectors, to prevent that, by dangling, they could wear them out in the future. Avoid any contact with sharp corners (burr the hole rims and install some wire-leads). Avoid placing Sequent system cables too close to the spark plugs cables or to other parts subjected to high voltage.

Each connector is polarised, and this is the reason why you can install it without stress only in the right direction.

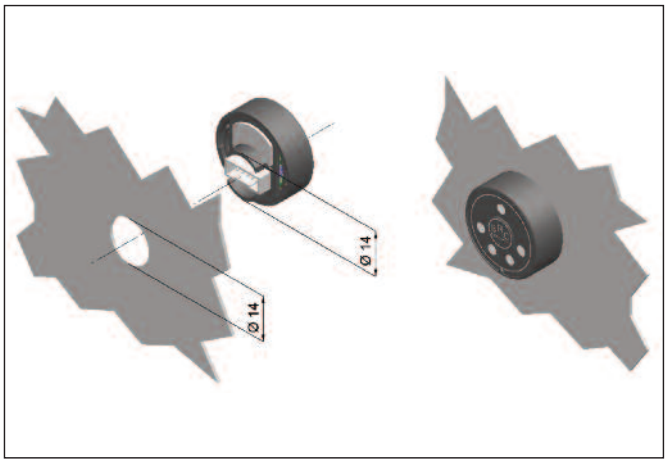
Warning: all not pre-cabled connections should be carried out through sweet brazing (soft soldering) and opportunely insulated. Be careful that soldering is not "cold" and without risk of detachment in the future. Any unused wiring cables should be shortened and separately insulated. Never use welders that are connected to the battery of the same vehicle, or quick type welders.



Pict. 16
ECU assembly into the engine compartment



Pict. 17
One-Touch changeover switch - example of built-in fixing



Pict. 18
One-Touch changeover switch - example of external fixing

6. RULES FOR A RIGHT INSTALLATION OF CNG SEQUENT SYSTEMS REAR SIDE

6.1 CNG CYLINDERS ASSEMBLY RULES

Before going on with fixing cylinders, it's necessary to install on them respective cylinder valves.

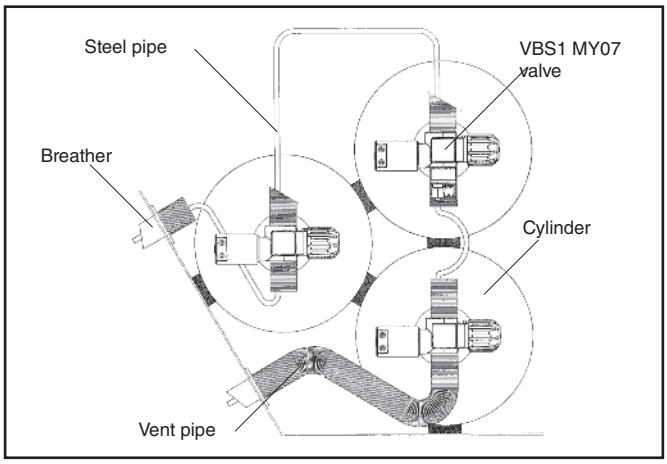
Carry out these operations following wrenching instructions of VBS1 MY07 CNG Cylinder Valve code FM900015-1, that you'll find inside the valve package. If cylinder valves are not made by BRC, please make reference to their respective assembly instructions.

6.1.1. General rules

Cylinders must be installed inside the vehicle template, included the vehicle rear side, and so that they result protected enough from crashes. Near the cylinders, sharp edges must be absent. Cylinders position in the template is not submitted to special orientation bonds. We can install on the same vehicle one or more cylinders equipped with one or more refuelling lines. For fixing cylinders to the vehicle, we have to use measured anchors resisting to stresses due to a vehicle accelerations with full tank.

Cylinders position has to not provoke friction while vehicle is running; so, it can be useful to insert some anti-sparkling and not hygroscopic material among cylinders, and between them and the fixing system.

Cylinder valve/s must be placed in a position easy to reach. Petrol tank and CNG cylinders don't have to touch, but rather be well separated.



Pict. 1

Installation of CNG cylinders into the luggage compartment: insulation and ventilation

6.1.2. Installation into the rear luggage compartment

If cylinders have been placed inside the rear luggage compartment, it's necessary to realize a suitable ventilation assuring that, in case of leakages or other anomalies, CNG could flow towards the outside, avoiding so its accumulation in dangerous and not suitable areas. This ventilation can be realized as shown in picture 1 and 2, by making two holes connecting the luggage compartment with the outside, and inserting here breathers and vent hoses. The passing hole on the valves body assures ventilation on each valve. Breather minimum inside diameter must measure 30 mm. Breathers and vent hoses are normally used for steel high-pressure pipes passage (pictures 1 and 2).

If, eventually, installation inside the luggage compartment creates closed spaces, it's necessary to create two further air intakes, with a inside diameter not lower than 25 mm. They must be done on one side of the compartment, as high as possible. It's necessary to protect the two air intakes in order to avoid that luggage compartment could obstruct them, and being careful with always keep a good air circulation.

6.1.3. Assembly general warnings

Before realizing holes or breaks in the bodywork, be careful with no damage pipes, cables, tanks and other elements. Before fully refuel tanks, check the presence of leakages with soap water with a pressure of roughly 20 bar inside the cylinders.

6.1.4. High-pressure pipe and Fittings

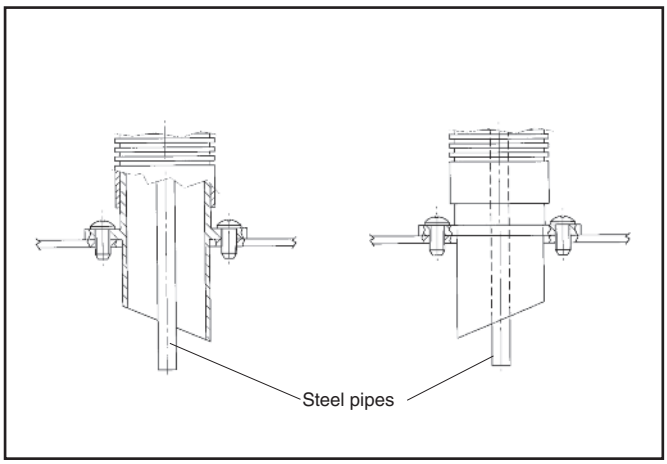
With the words "high-pressure pipes", we mean pipes connecting valves with possible refuelling couplings, cylinder valves among themselves, cylinder valve to the shut-off valve of engine compartment, and shut-off valve to the reducer.

This pipe, normally made of seamless steel, is suitable for a working pressure of 330 bar, and it can be bended with suitable tools if needed.

Pipe is connected to the different devices (cylinder valves, refuelling couplings, shut-off valve, reducer) by means of suitable pipe-fittings (pictures 4 and 5, detail of steel pipe fitting).

For fixing pipe to the car bodywork is better to respect prescriptions in force in the different Countries, considering that it must be fixed at the bottom of the vehicle, far away from the exhaust pipe and from vehicle strengthening

points, at a regular distance by using suitable clamps with self-tapping screws. Connections, where subjected to vibrations, must be made by coil or elastic spirals (pict. 5).

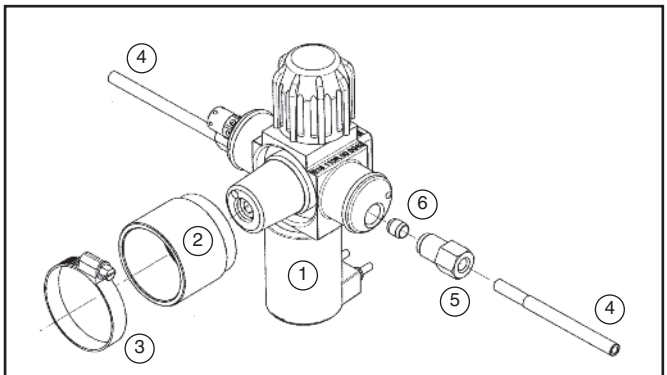


Pict. 2

Installation of CNG cylinders into the luggage compartment: installation of breathers

Pict. 3

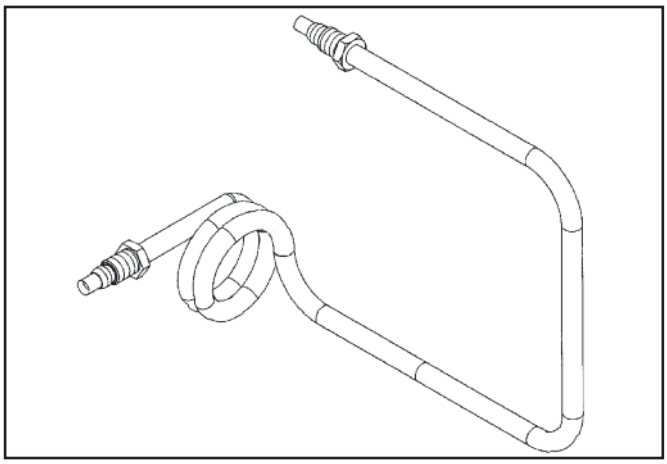
Example of CNG cylinders installation into the luggage compartment



KEY
1 = "VBS1 MY07" cylinder valve; 2 = gasket sleeve; 3 = clamp;
4 = gas pipe; 5 = fitting; 6 = locking ring.

Pict.4

High-pressure pipes



Pict. 5

High-pressure pipes: elastic spiral

7. CHECK PROCEDURES FOR A RIGHT INSTALLATION

In the engine compartment, verify that all tightness clamps have been inserted, that fittings are closed and that every component has been installed.

With the engine switched on, check that components and pipes in the engine compartment don't touch any moving mechanical part or any heat source.

Verify fittings tightening to avoid possible gas leakages and check that pipes don't create any narrowing.

Control liquids level, and be sure with the right reducer heating.

Check right changeover, and LEDs and level sensor working.
Control tank fixation.

Start vehicle up and refill it with 5 litres of CNG in the refuelling area.

Check the right working of VBS1 MY07 cylinder valve and VMA3 refuelling valve. Verify that opening and closing of supply solenoid valve situated on the Cylinder Valve are clear and precise.

With the engine switched on, connect yourself to the PC and, by means of the suitable software, verify vehicle working parameters (download software as shown in paragraph 9).

CHECK LIST		
	GAS	PETROL
Components fixing		
Pipes narrowing		
Water clamps		
Fittings of high-pressure gas pipes		
Fittings of low-pressure gas pipes		
Gas leakages		
Liquids		
Components slidings		
Reducer heating		
Changeover switch LED working		
Level sensor working		
Right changeover		
Check of software last vers. with PC		
Parameters check with PC		
Petrol mode		

8. START UP PROCEDURES (RANGE-VALUES)

You'll find Start Up procedures and all information about diagnostic into the handbook Part Ib.

9 SEQUENT SYSTEMS SOFTWARE INSTALLATION

Installation can be made both using CD-ROM, and downloading files from our website www.brc.it.

Moreover, you can update software on PC and ECU programming files (software, loader, mappings and setting up) both using CD-ROM, and downloading files from our website www.brc.it.

In order to program an ECU, you need SEQUENT program, which allows controlling and programming ECU, and files to be transferred on the ECU itself, especially:

- program allowing the ECU working;
- loader allowing the passage from a program already installed in the ECU to a new one;
- files containing setting up of vehicles already developed (the ones called .FPD for SQ P&D).

10. COMPONENTS MAINTENANCE SCHEDULE

The following rules for components maintenance have to be considered as general.

10.1. SECURING THE EQUIPMENT

THESE OPERATIONS ARE NOT NECESSARY IF YOU REALIZE INTERVENTIONS ON FLY SF ECU, ON RELAY AND FUSES (PARAGRAPHS 10.2.5 AND 10.2.6).

Open the bonnet, lift cylinder cover up, close all cylinder valves taps (pict. 1).

NOTE: while closing tap don't apply too much strength, to avoid damaging its inside (Max 2,5 Nm).

Start vehicle up with changeover switch on automatic mode (pict. 2, red LED on and LEDs on; changeover switch button has a red LED that reports vehicle working mode: Red=petrol mode, Green=Gas mode).

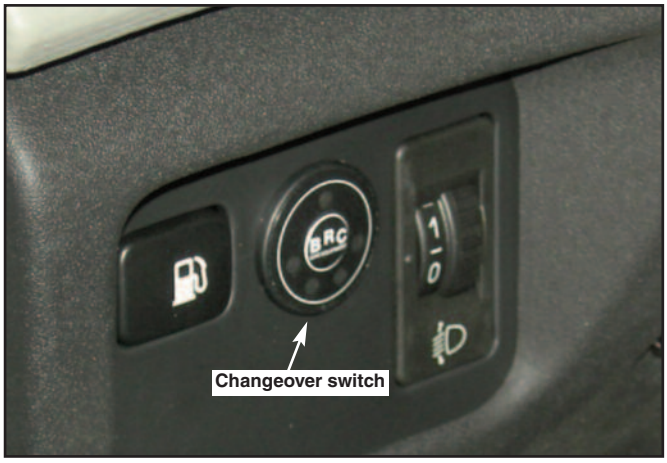
Bring vehicle to 3000 RPM and wait for gas exhaustion in the pipes.

When gas is over, an intermittent sound informs that vehicle has automatically changed over to petrol. Push changeover button. Button should turn on (red LED on) and sound should stop.

Switch vehicle off.

NOTE: sometimes, during the automatic changeover from forced gas to petrol, vehicle could switch off. In these cases, change over to petrol (Red LED on) and turn dashboard off.

Pict. 1



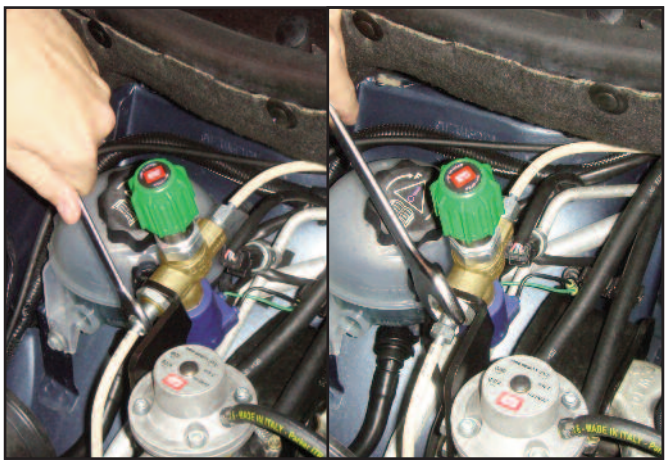
Pict. 2
Changeover switch

Scheduled maintenance coupons	1000 km	20.000 km	40.000 km	60.000 km	80.000 km	100.000 km	120.000 km	
Inspection of CNG system mechanical components		X	X	X	X	X	X	X
Air filter cleaning	X	X	X	X	X	X	X	
Check of spark plugs cables, spark plugs, ignition system	X	X	X	X	X	X	X	
Inspection of connections clamping	X	X	X	X	X	X	X	
Inspection of water-gas clamps tightening	X	X	X	X	X	X	X	
Inspection of carburation with BRC special instrument	X	X	X	X	X	X	X	
Replacement of Zenith filter cartridge			X		X		X	
Inspection and adjustment of valves gap		X	X	X	X	X	X	

Key:
X= to carry out

10.2. CNG COMPONENTS OVERHAULING AND/OR REPLACEMENT

Open the bonnet and proceed to overhauling and/or replacement where necessary.
In this section we described procedures necessary to overhaul and/or replace CNG system components. Choose paragraphs concerning component and operations you are interested in.



Pict 3
VMA3 refuelling valve

10.2.1 Overhauling and/or replacement of VMA3-E CNG refuelling valve

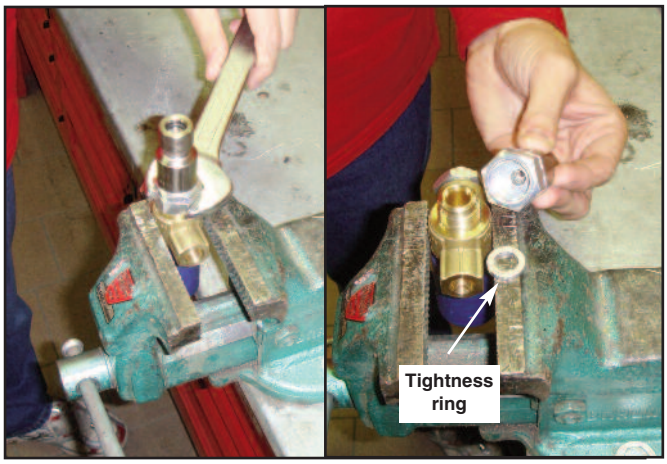
10.2.1.1 Disassembly

After realizing preliminary operations described in paragraph 10.1, disconnect Coil connector. Unscrew inlet and outlet fittings of CNG refuelling valve using a 14 mm wrench (*during this operation, the CNG still present in pipes will go out*). Unscrew valve fixation using a 26 mm wrench (pict. 3).

Pict. 4

10.2.1.2 Coil replacement and reassembly

Close valve brass body in a vice placing coil upwards in order to let it turn.
Remove black cap and unscrew coil fixation screw using a 10 mm wrench (pict. 4).
Take out the old coil and replace it with the new one.
Fix coil using the screw removed before (applying a 8 Nm torque wrench) and put cover-coil cap again.
Fix valve to the bracket, screw gas inlet and outlet fitting again, applying a 30 Nm torque wrench.
Join coil connector again.
Once overhauling/replacement ended, carry out operations described in paragraph 10.3.



Pict. 5

10.2.1.3 Replacement of refuelling fitting

Close solenoid valve brass body in a vice placing coil downwards. Unscrew refuelling fitting using a 27 mm wrench. Remove the tightness ring too. Screw new refuelling fitting with its tightness ring again, applying a 40 Nm torque wrench.
Fix valve to the bracket, screw gas inlet and outlet fitting again, applying a 30 Nm torque wrench.
Join coil connector again.
Once overhauling/replacement ended, carry out operations described in paragraph 10.3.

10.2.2 Zenith Reducer replacement

Realize preliminary operations described in paragraph 10.1.

NOTE: Unscrew cap of engine cooling water basin to decrease water circuit pressure.

By using a 22 mm wrench, unscrew fixation screw of Zenith reducer filter (pict. 7). Disconnect vacuum pipe 4x10 mm and gas pipe 10x17 mm.

Close water pipes with suitable pliers. Loosen clamps fixing water pipes on the reducer and remove pipes.

By using a 13 mm wrench, unscrew Genius reducer fixation screw, and replace reducer.

Connect water pipes to the elbows of the new reducer, then fix them with clamps. Remove pliers from water pipes.

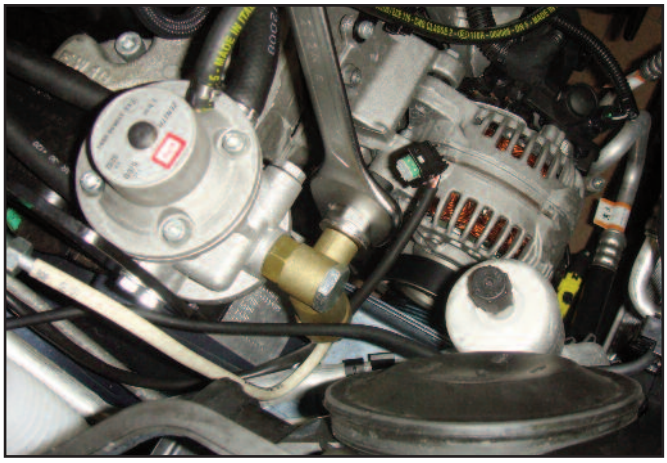
Place reducer on the bracket again and connect vacuum and gas pipes.

Screw on the reducer gas level sensor filter group again, applying a 30 Nm torque wrench.

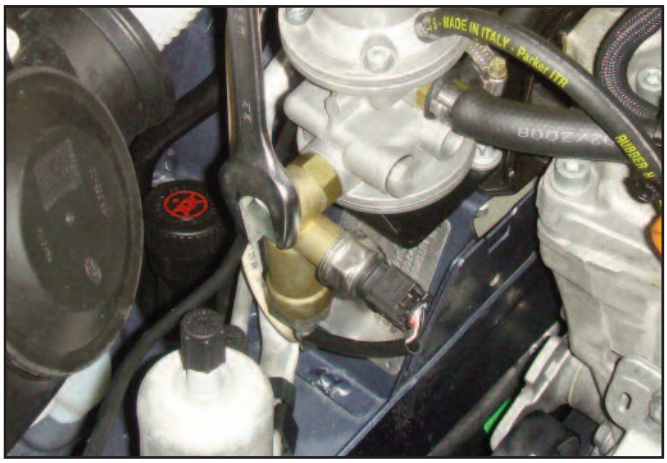
Refill the engine cooling liquid.

Once overhauling/replacement ended, carry out operations described in paragraph 10.3.

Pict. 6



Pict. 7



Pict. 8

10.2.2.1 Gas level sensor replacement

Disconnect connector and unscrew sensor with a 24 mm wrench.

Screw new sensor again, applying a 40 Nm torque wrench and join connector again.

ATTENTION! Screw sensor holding the nut. Never screw sensor holding the connector.

Once overhauling/replacement ended, carry out operations described in paragraph 10.3.

10.2.2.2 Replacement of Zenith filter fitting

Realize preliminary operations described in paragraph 10.1.

Remove gas level sensor following paragraph 2.2.1.

Unscrew gas pipe using a 14 mm wrench, then fixation screw of filter fitting with a 22 mm wrench.

As you can see in picture 9, unscrew filter fitting nut with a 27 mm wrench.

Replace components following instructions included in the *"Overhauling kit for CNG inlet fitting with filter integrated (Zenith reducer)"* code 02BM03990001.

Assemble filter fitting and gas level sensor again.

10.2.3 BRC MY09 INJECTORS REPLACEMENT

REALIZE PRELIMINARY OPERATIONS DESCRIBED IN PARAGRAPH 1.

Note: we'll show here how to replace one only BRC injector, because procedure is the same for all injectors.

Unhook connector from the injector, by first bringing yellow tongue towards the outside, and pressing then the black tongue.

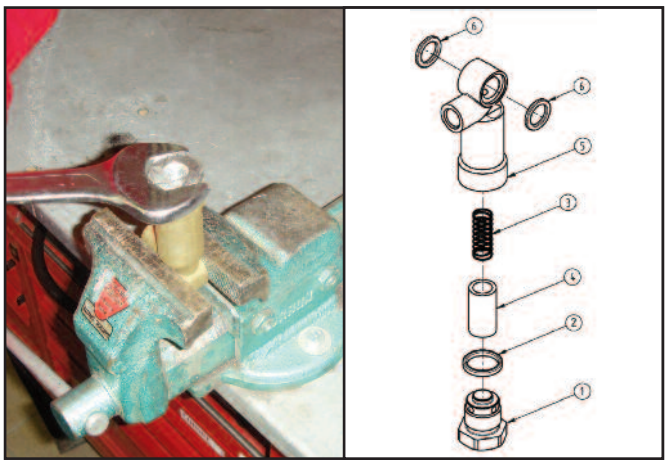
Unhook click clamp of gas pipe and take it from the injector.

Remove seeger blocking injector using a screwdriver.

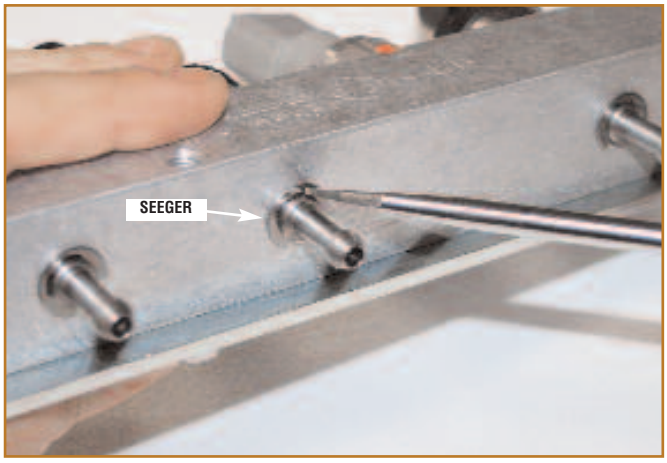
Move the injector away being careful to not let small parts falling into the engine. Remove possible ORs left inside the injector housing on the Rail. Introduce new injector on the Rail, being careful with using every OR and seeger provided.

Fix new injector to the Rail with seeger. Install connector again. Fix gas pipe with click clamp previously removed.

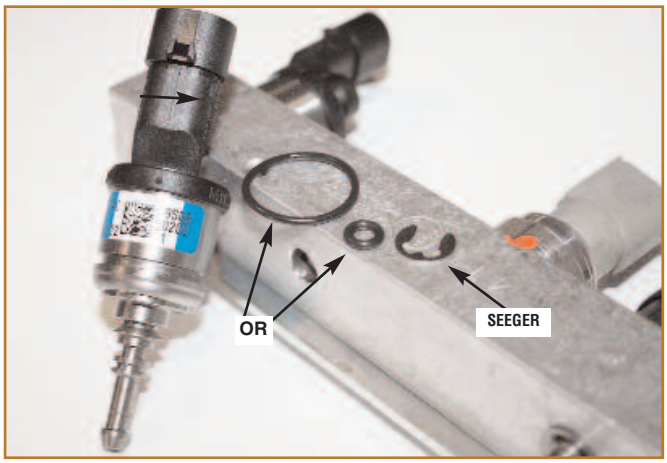
Once overhauling/replacement ended, carry out operations described in paragraph 10.3



Pict. 9



Pict. 10



Pict. 11

10.2.4 REPLACEMENT OF GAS PRESSURE AND TEMPERATURE SENSOR

AFTER REALIZING PRELIMINARY OPERATIONS DESCRIBED IN PARAGRAPH 10,1. replace sensor as follows.

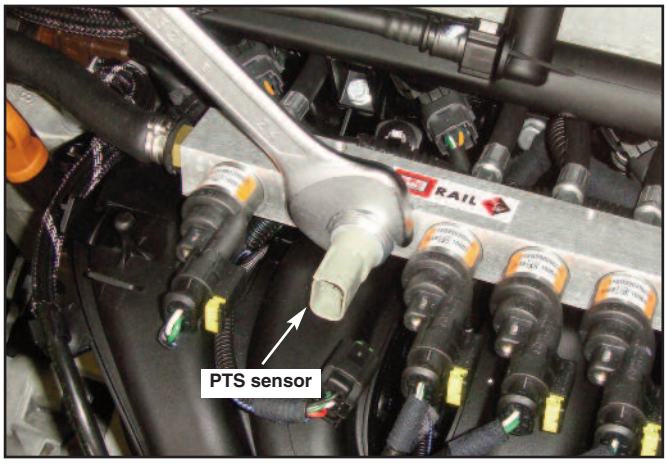
Unhook connector and unscrew it, removing the aluminium tightness washer too.

Introduce now the new sensor complete with tightness ring (pict. 12) and screw it using a 24 mm wrench and applying a 8 Nm torque wrench.

WARNING! Screw sensor on the Rail holding the nut. Never screw sensor on the Rail holding the connector.

Join connector again.

ONCE OVERHAULING/REPLACEMENT

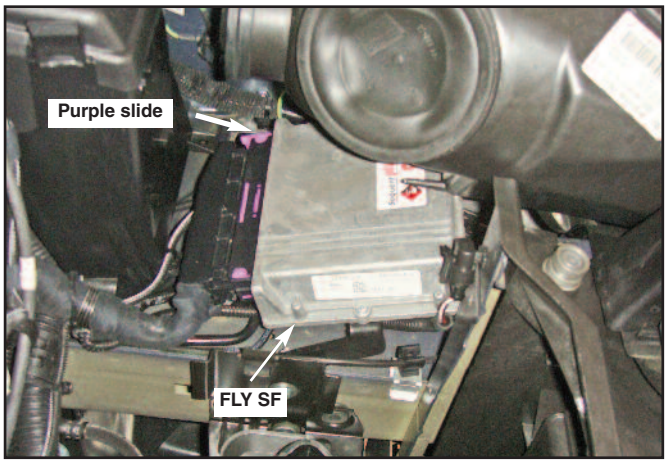


Pict. 12

ENDED, CARRY OUT OPERATIONS DESCRIBED IN PARAGRAPH 10.3.

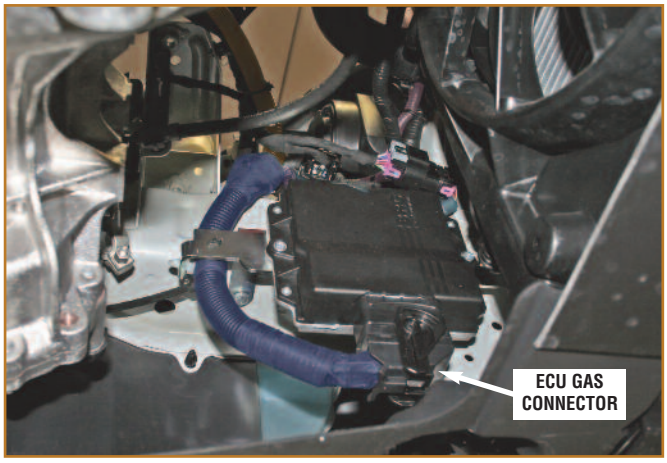
10.2.5 GAS ECU REPLACEMENT

Version A pict. 13:
Unhook connector pulling purple slide towards the outside of the connector.
Unscrew the two fixing screws.
Replace gas ECU and fix it with screws. Hook connector again.



Pict. 13

Version B pict. 14:
Unhook connector tongue and remove connector.
Unscrew the two fixing screws.
Replace gas ECU and fix it with screws. Hook connector again.



Pict. 14

Version C pict. 15:
Unhook connector pulling purple slide towards the outside of the connector.
Unscrew the two fixing screws.
Replace gas ECU and fix it with screws. Hook connector again.
ONCE OVERHAULING/REPLACEMENT ENDED, CARRY OUT OPERATIONS DESCRIBED IN PARAGRAPH 10.3.

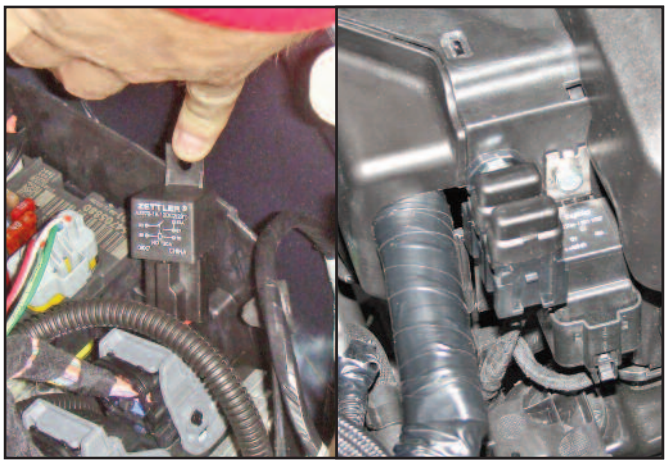

Pict. 15

10.2.6 FUSES AND RELAY REPLACEMENT

Fuses must be replaced only with fuses with the same characteristics.
ONCE OVERHAULING/REPLACEMENT ENDED, CARRY OUT OPERATIONS DESCRIBED IN PARAGRAPH 10.3

10.2.7 CHANGEOVER SWITCH REPLACEMENT

Dismounting changeover switch from its own housing. Unhook connector and replace changeover switch with a new one.


Pict. 16

10.2.8 VBS1 MY07 CYLINDER VALVE OVERHAULING/REPLACEMENT

Before realizing any overhauling operation on cylinder valves, it is <u>compulsory</u> to secure the equipment carrying out preliminary operations described in paragraph 10.1.

10.2.8.1 COIL REPLACEMENT

BEFORE REALIZING ANY OPERATION, CARRY OUT INDICATIONS OF PAR. 10.1.

Unhook coil connector and unscrew fixing screw using a 22 mm dynamometric wrench. Replace coil and assemble the new one applying a 10 Nm torque wrench.

10.2.8.2 COIL CYLINDER REPLACEMENT

BEFORE REALIZING ANY OPERATION, CARRY OUT INDICATIONS OF PAR. 10.1.

Disassemble coil as for par. 10.2.8.1.

Remove tightness OR and washer, but not use them again.

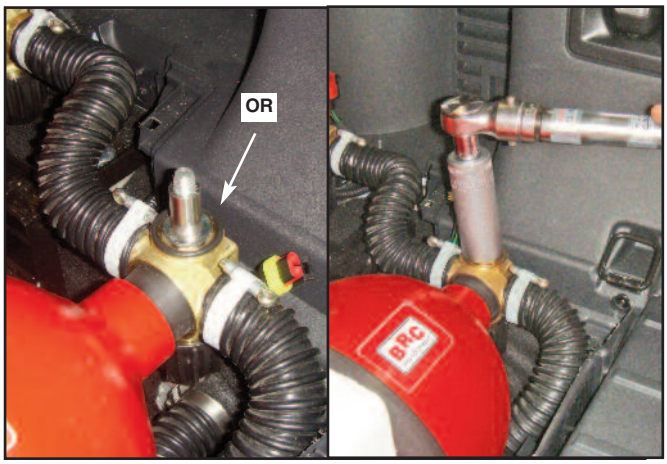
Unscrew coil cylinder using a 22 mm dynamometric spanner. Replace all components as indicated by the *"Overhauling kit for VBS1 MY07 valve cylinder"* code E161M0001. Screw cylinder applying a 40 Nm torque wrench.

ONCE OVERHAULING/REPLACEMENT ENDED, CARRY OUT OPERATIONS DESCRIBED IN PARAGRAPH 10.3.

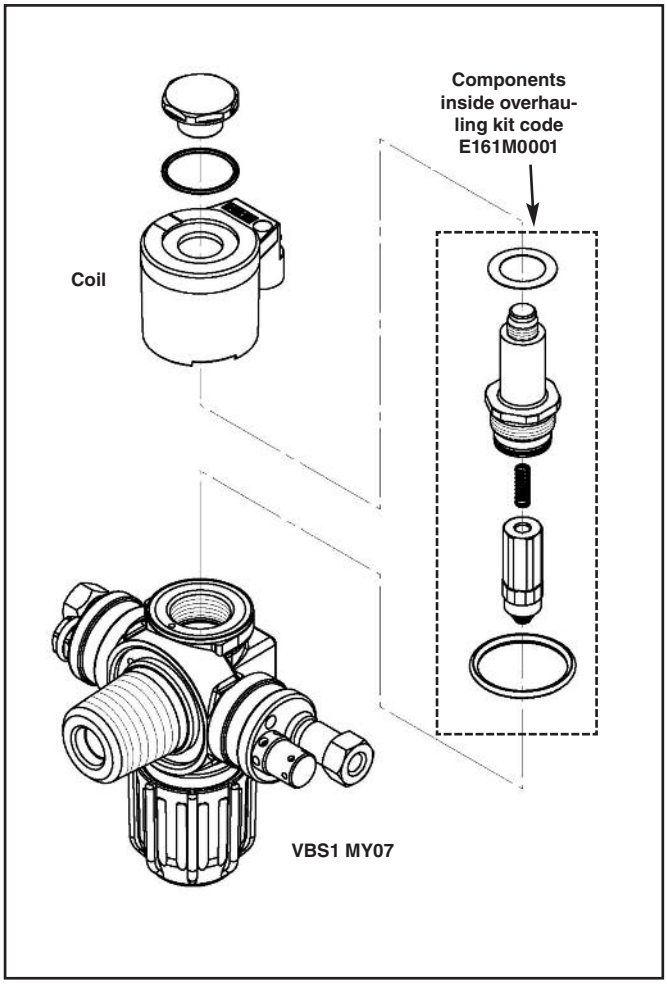
10.2.8.3 VBS1 MY07 CYLINDER VALVE REPLACEMENT

BEFORE REALIZING ANY OPERATION, CARRY OUT INDICATIONS OF PAR. 10.1.

The following instructions are valid for every cylinder valve installed on a vehicle.



Pict. 17



Pict. 18

Remove wrinkled pipes, unscrew steel pipes and unhook Coil connector. Disassemble cylinder, unhooking it form its support.

Fix cylinder in order to unscrew VBS1 MY07. Use a 27 mm wrench or a 1/2" ⍁ ratchet spanner.

Clean and check thread.

Using a new VBS1 MY07, follow the hereunder instructions.

10.2.8.4 Valve tightening on cylinder

To assure gastight between valve and cylinder:

- Visual check the thread completeness
- Apply 3-5 layers of teflon on the thread
- In case of valve with ventilation, put tightness gasket
- Clamp valve on cylinder using the

suitable "A" spanner, applying a controlled 250Nm (0+30Nm) torque wrench

10.2.8.5 Clamping of stiff steel pipes

To assure gastight between valve and pipe:
• Visual check the integrity of valve tightness surfaces
• Check and burr with care the extremity of stiff pipe
• Clamp by only using BRC fittings, pipes and locking rings applying a 30 (0/+10) N·m torque wrench

10.2.8.6 Breather installation

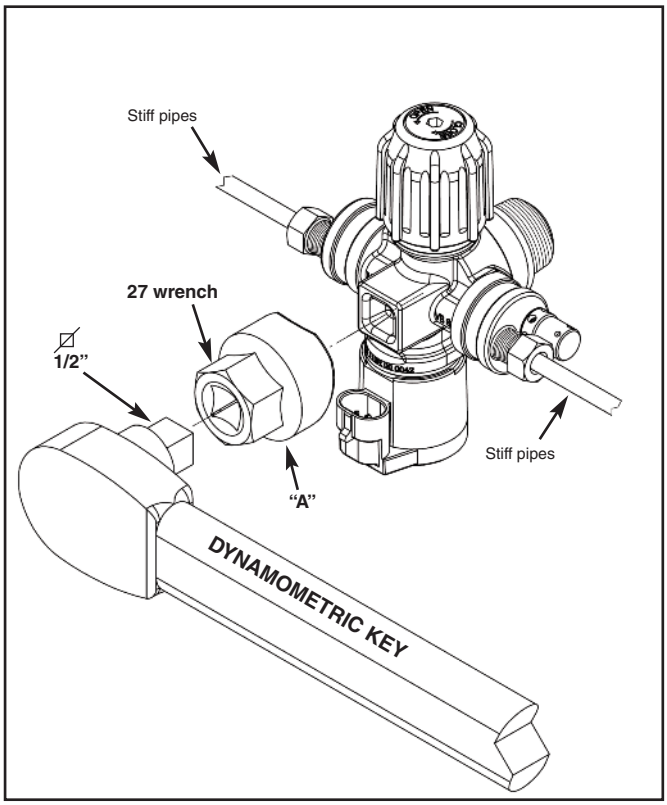
• Connect wrinkled pipe to the valve with suitable clamps
• Fix breather pipe to the vehicle in order to convey any possible gas leakage to the outside

10.3. FINAL OPERATIONS

Once components overhauling and/or replacement ended, reassemble engine guard.
Then, open taps of the 5 rear cylinder valves.
Start vehicle up.
Bring changeover switch in automatic gas position (red LED on and level LED on).
Bring vehicle at 3000 RPM.
Wait for changeover to gas.
Open the bonnet and check the absence of leakages on gas fittings touched by the overhauling and/or replacement of gas components.
Realize the same operations on CNG cylinder valves too.

11. INSTALLER'S LEVEL OF COMPETENCE

Workshop must possess suitable certifications that law makes compulsory to realize gas system conversions.



Pict. 19

Moreover, it has to possess the certificate of participation issued during the installer's technical courses made in MTM-BRC seat (or in the BRC dealer seat).

12. SEQUENT PLUG&DRIVE MY10 ARIES/ACRUX OR SCORPIO: CHOICE PROCEDURE

This chapter will show you how to choose suitable system through some screenpages of Sotware handbook 90AV99001046.

NOTE: make reference to the Flow-Chart of pict. 1 for the correct choice procedure between Sequent Plug&Drive MY10 Aries, Acrux, Scorpio.

12.1 SEQUENT PLUG&DRIVE MY10 ARIES/ACRUX

NOTE: this system can only be installed on vehicles with inductive Top Dead Center (TDC) sensor with Crankshaft signal 36-1, 36-2, 60-2 (Aries) or Effect Hall with Crankshaft signal 18-2, 30-2, 60-2 (Acrux) following diagrams on the next pages for realizing connections.
Use one of the BRC Gas Equipment **INTERFACE CABLES** on vehicles with inductive Top Dead Center sensor (Aries), choosing it according to what indicated by the "Manual for choosing Timing Advance Processor" code TA010986-3.

SOFTWARE CONFIGURATION:
Basic setting of this system is similar to the Plug&Drive one.

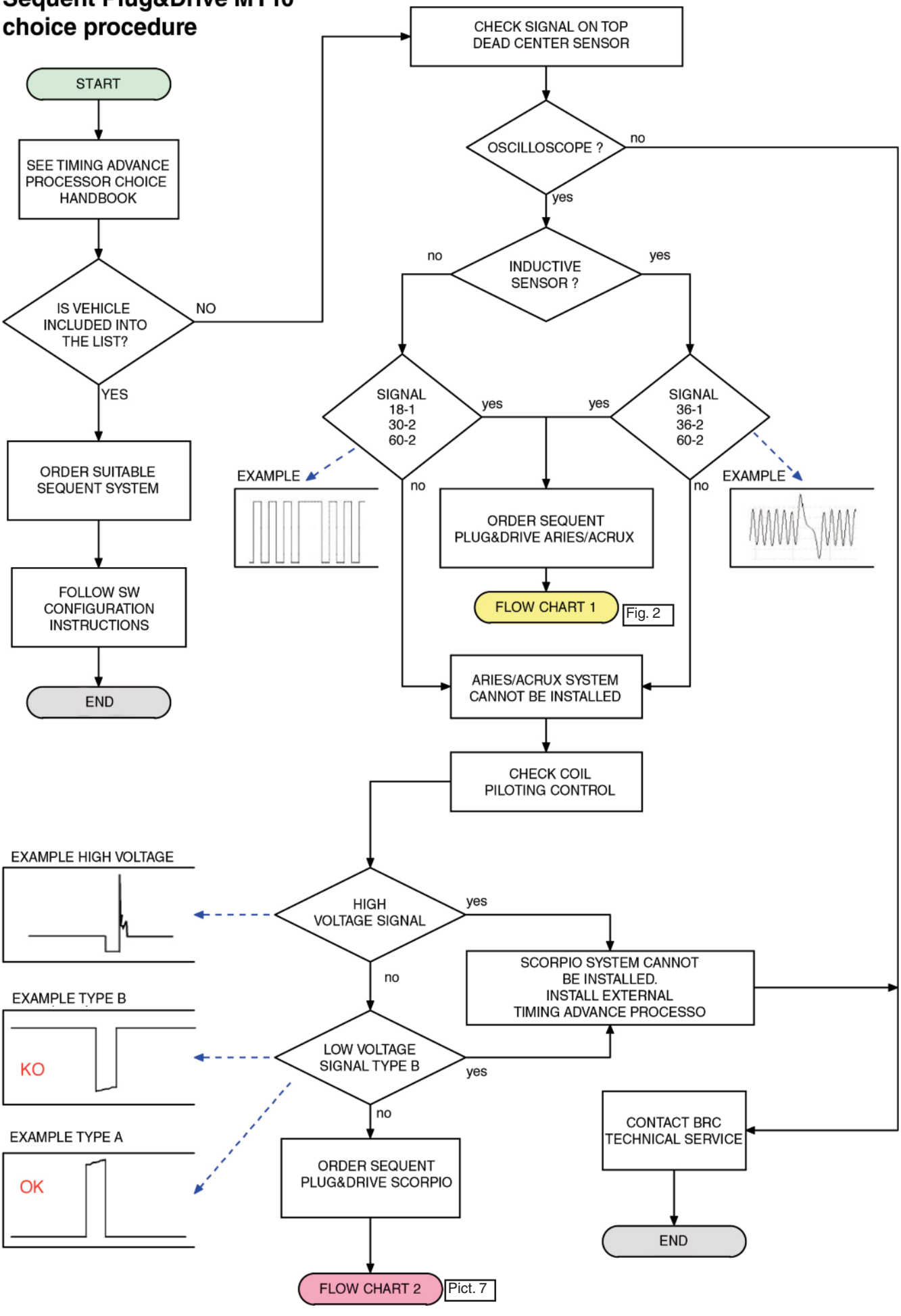
WARNING: BEFORE ORDERING SEQUENT PLUG&DRIVE ARIES OR ACRUX*, check by means of an oscilloscope (If you don't possess an oscilloscope do not proceed with inspection, but rather contact BRC Technical Assistance) the kind of Top Dead Center sensor .*

Crankshaft recognition procedure
There are two kinds of Crankshaft:
a) With Inductive sensor (Aries)
b) With Effect Hall sensor (Acrux)

• **Inductive sensor:** this sensor has

pict. 1

Sequent Plug&Drive MY10 choice procedure



two wires on connector (Positive and Negative signal).
Oscilloscope diagram could be the one of pictures 3a and 3b. In this case you need to use Aries Timing Advance setting.
After connecting the 5-pole connector to the interface cables provided by BRC you need to set **INDUCTIVE HIGH VOLTAGE in CRANKSHAFT Configuration (pict. 5).**
INDUCTIVE LOW VOLTAGE configuration is only used for special applications.

- **Effect Hall sensor:** this sensor has three wires on connector (Positive, Negative and Signal). Oscilloscope diagram could be the one of pictures 4a and 4b. In this case you need to use Acrux Timing Advance setting.
After realizing connections, Pink - Pink/Black on signal (see Installer's Handbook code 90AV99001039 you need to set **HALL in CRANKSHAFT Configuration (pict. 5).**

NOTE: if Timing Advance inside Plug&Drive ECU is not necessary, select ONLY RPM in CRANKSHAFT configuration to identify the reading connection of RPM of BRC harness Grey cable.

WARNING: if you are using Aries/Acrux ECU, it is very IMPORTANT *to enable/set RPM in* ***RPM configuration*** *as* ***RPM OR CRANKSHAFT SIGNAL*** *(pict. 5).*

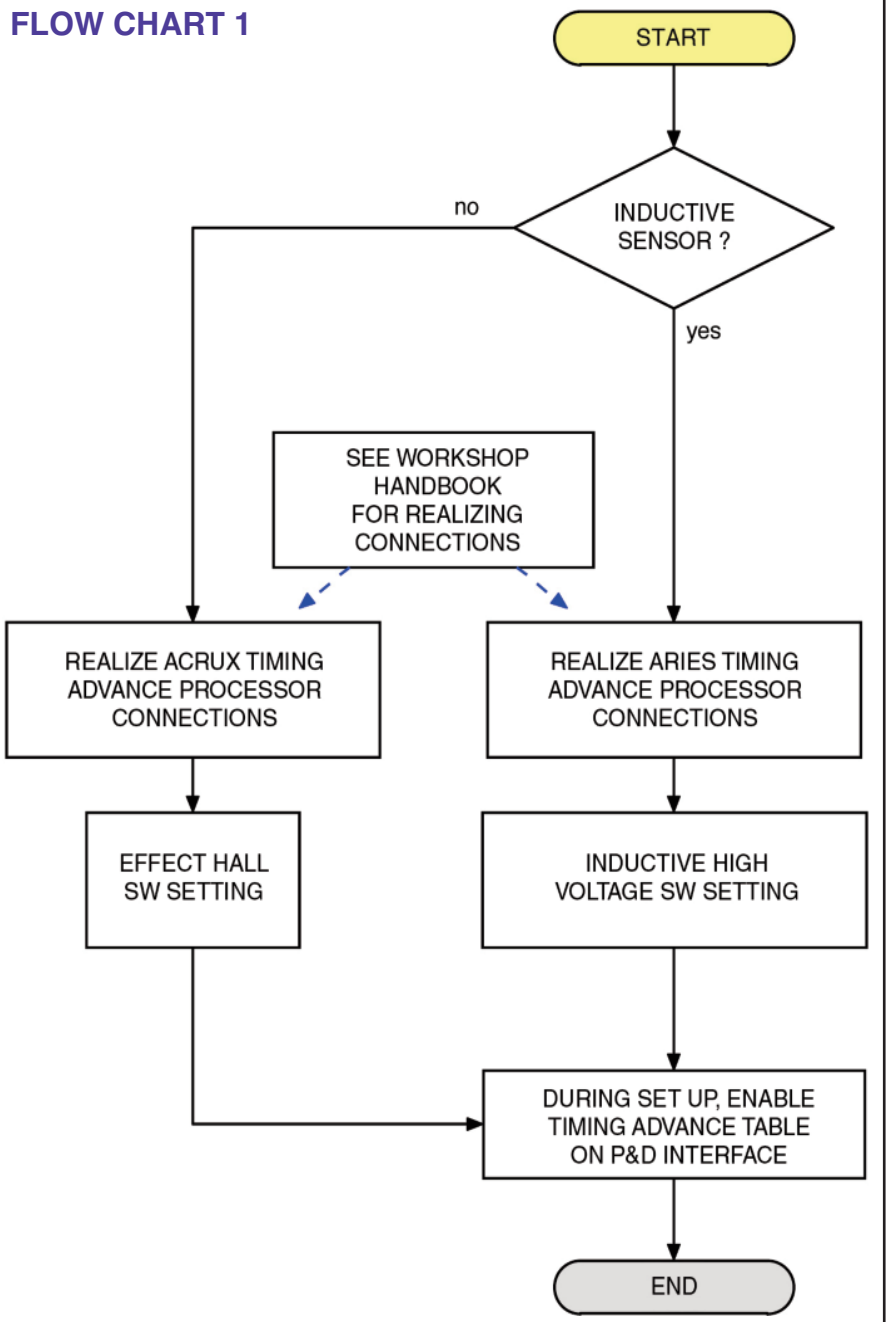
12.2 SEQUENT PLUG&DRIVE MY10 SCORPIO

NOTE: Sequent Plug&Drive SCORPIO can only be installed on vehicles having a low voltage ignition system with piloting module outside the engine control ECU.

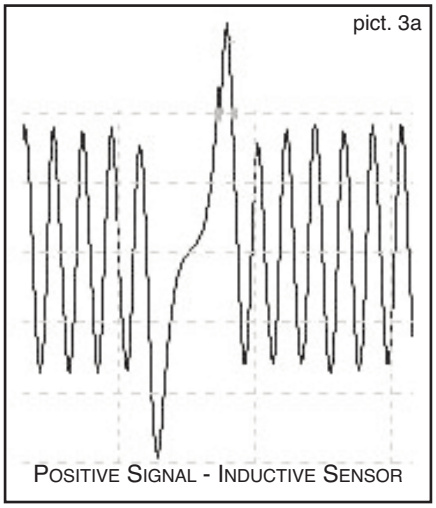
WARNING: BEFORE ORDERING SEQUENT PLUG&DRIVE SCORPIO*, check by means of an oscilloscope what kind of signal corre-*

Configuration Procedure ofSequent Plug&Drive Aries/Acrux pict. 2

FLOW CHART 1

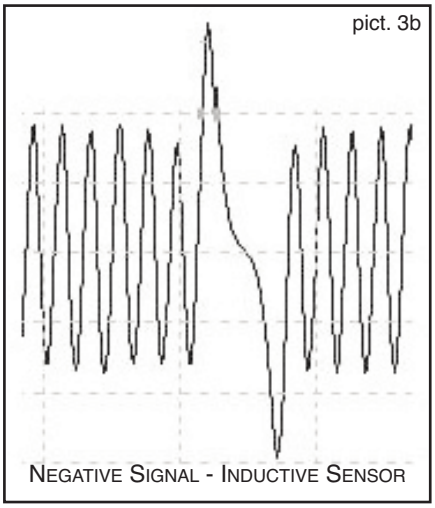


pict. 3a



POSITIVE SIGNAL - INDUCTIVE SENSOR

pict. 3b



NEGATIVE SIGNAL - INDUCTIVE SENSOR

sponds to the coil piloting cable: ***CASE A****,* ***B*** *or* ***C*** *of pict. 6.*
(If you don't possess an oscilloscope do not proceed with inspection, but rather contact BRC Technical Assistance).

CASE A (low voltage)

if you see the square wave of **CASE A,** vehicle can be converted with Sequent Plug&Drive Scorpio. You can go on with reading instructions.

CASE B (low voltage)

if you see the square wave of **CASE B** vehicle **CAN NOT** be converted with Sequent Plug&Drive Scorpio.
Please contact BRC Technical Assistance.

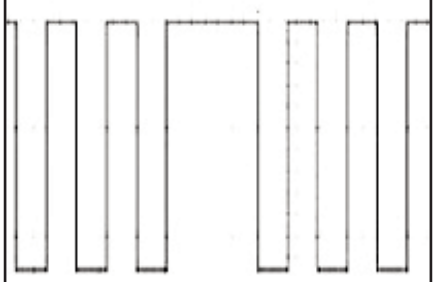
CASE C (high voltage)

if you see the square wave of **CASE C**, vehicle **CAN NOT** be converted with Sequent Plug&Drive SCORPIO.
Please contact BRC Technical Assistance.

WARNING: *Sequent Plug&Drive SCORPIO ECU software setting parameters should be chosen only after reading carefully instructions below. In case of wrong choices, petrol coils could be* ***DAMAGED****.*

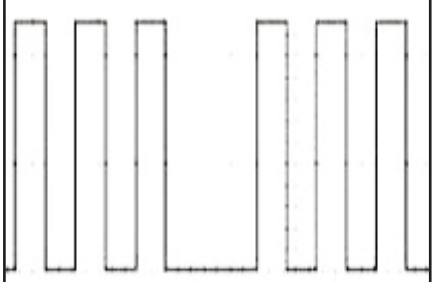
WARNING: if you are using Scorpio ECU, it is very IMPORTANT *to enable/set RPM in* ***RPM configuration*** *as* ***RPM OR CRANKSHAFT SIGNAL*** *(pict. 8).*
In picture 8 with Scorpio ECU, you can see the presence of 2 new configurations.

pict. 4a

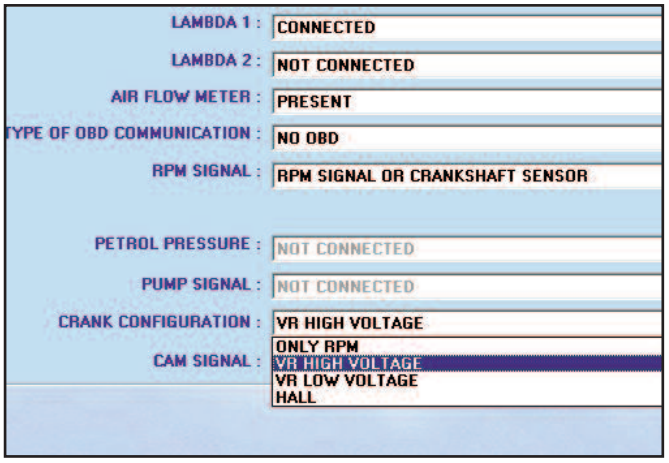


POSITIVE SIGNAL - EFFECT HALL SENSOR

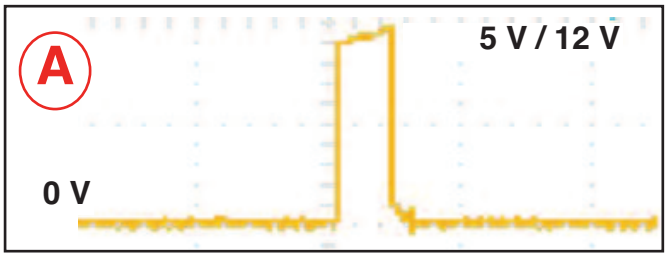
pict. 4b



NEGATIVE SIGNAL - EFFECT HALL SENSOR

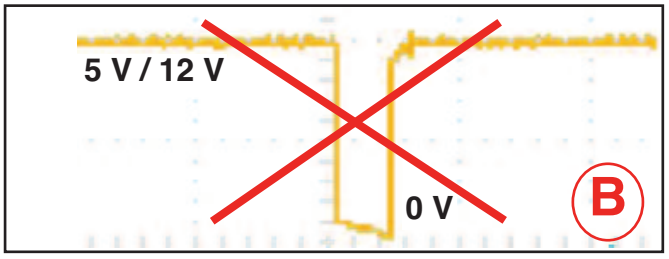


pict. 5
Aided procedure - equipment calibration Plug&Drive MY10 Aries/Acrux

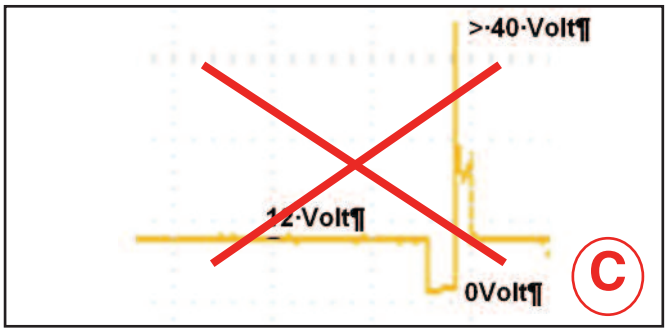


pict. 6

CASE A
Low voltage coil signal.
Vehicle can be converted with P&D SCORPIO



CASE B
Low voltage coil signal.
Vehicle **CAN NOT** be converted with P&D SCORPIO

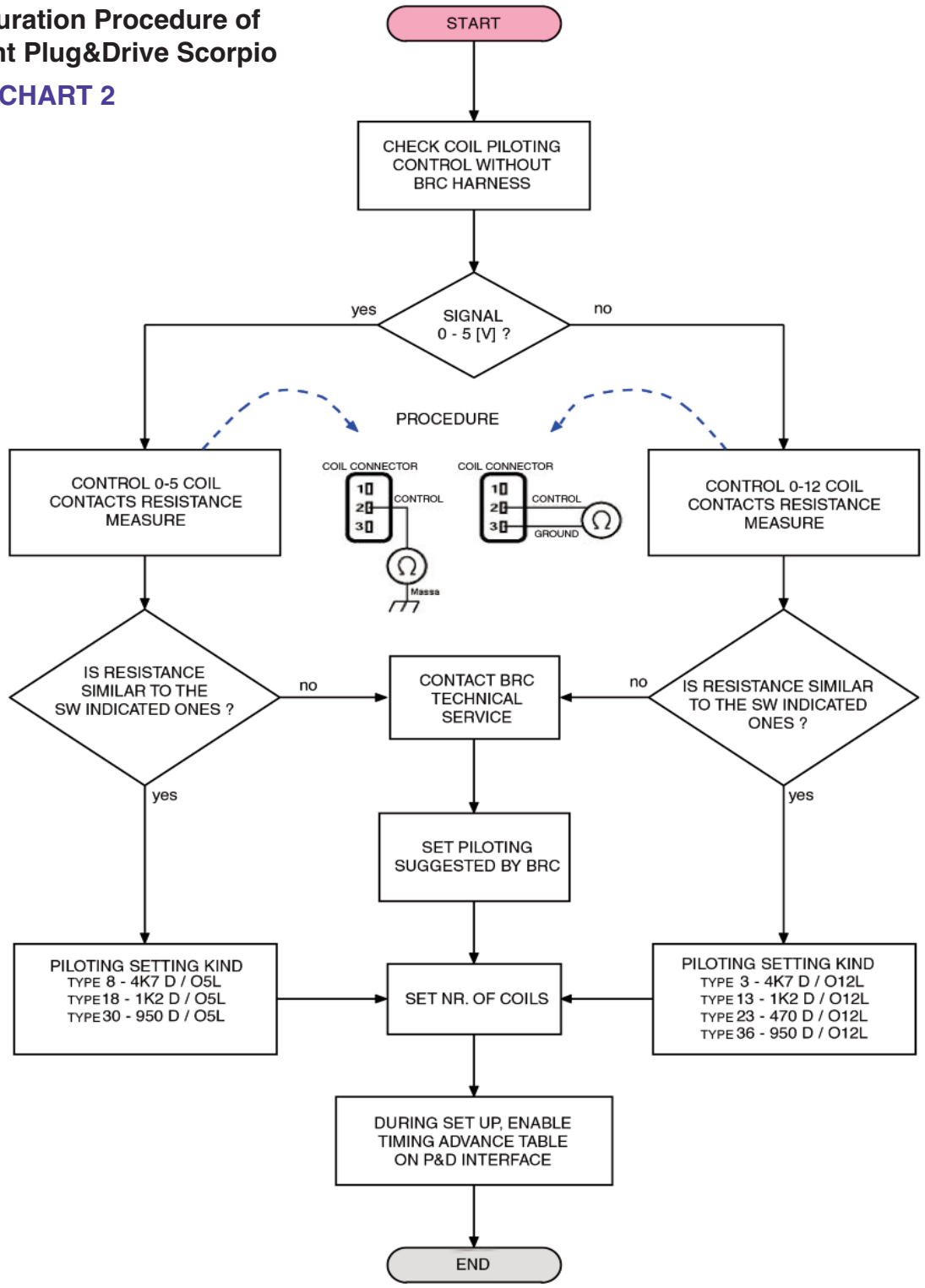


CASE C
High voltage coil signal. Vehicle **CAN NOT** be converted with P&D SCORPIO

Configuration Procedure of Sequent Plug&Drive Scorpio

pict. 7

FLOW CHART 2



1- Coils Configuration

You have to indicate what kind of piloting signal, in low voltage, have the coils of the vehicle.

2 - Nr. of Coils

It shows the number of coils on vehicle.

1- COILS CONFIGURATION

WARNING: *coil piloting signal inspection must carried out with vehicle in petrol mode, so* ***BRC harness MUST NOT to be connected****.*

In case of a low voltage control signal, piloting driver is integrated into the coil. Low voltage control comes from the ECU.

This kind of coil has regularly three wires (+12 V, Ground and Coil control).

In order to detect control wire, start the engine and analyze oscilloscope signals, with BRC harness disconnected.

The control is a square wave included between 0 V and 5 V or 0 V and 12 V as shown in picture 6a **CASE A**.

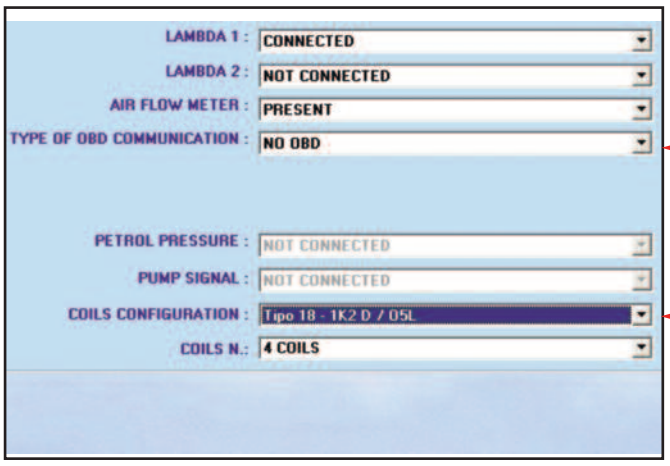
Voltage amplitude identifies the kind of signal that system should create and you should choose in the list present in **Coil configuration** (pict. 9).

In **COIL configuration** (pict. 9) indication 012L and 05L identifies the signal amplitude to be recreated to advance vehicle ignition. If using oscilloscope you detected a low voltage signal between 0 V and 5 V, you'll only use the 05L piloting. On the contrary, if signal is included between 0 V and 12 V, you'll use 012L piloting.

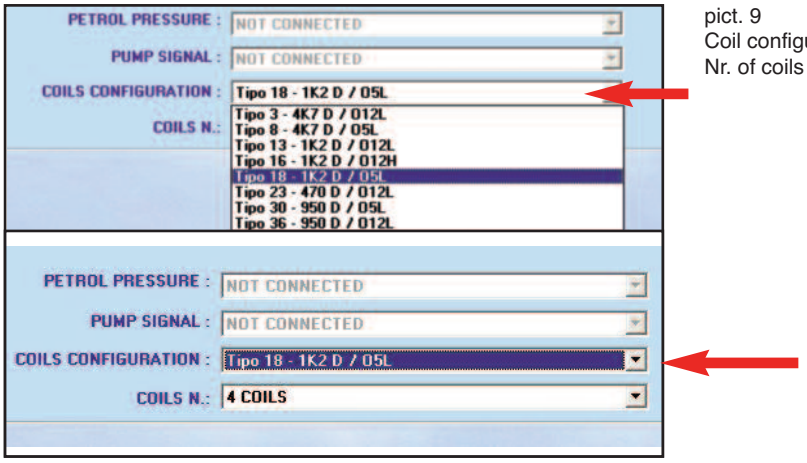
Once the amplitude defined, proceed with wiring connections on coil signal/s (make reference to Chap. 13 pict. 5).

Interrupting the signal wire, the system needs to give petrol ECU a coil load emulation (pict. 10). You have to select resistance value (4K7, 1K2, 470, 950) to be supplied as emulation in order to not create diagnostic or failure problems to the petrol equipment.

So it is necessary to check the right emulation through a Multimeter by measuring resistance between ground pin and control pin on coil connector (pict. 11). Select now in **COIL configuration** the resistance value nearest to the measured one.



pict. 8
Aided procedure - equipment calibration Plug&Drive MY10 Scorpio



pict. 9
Coil configuration Nr. of coils

2- NR. OF COILS

In **Nr. of Coils** you have to indicate what kind of starting Coils the vehicle possesses.

N° 4 COILS

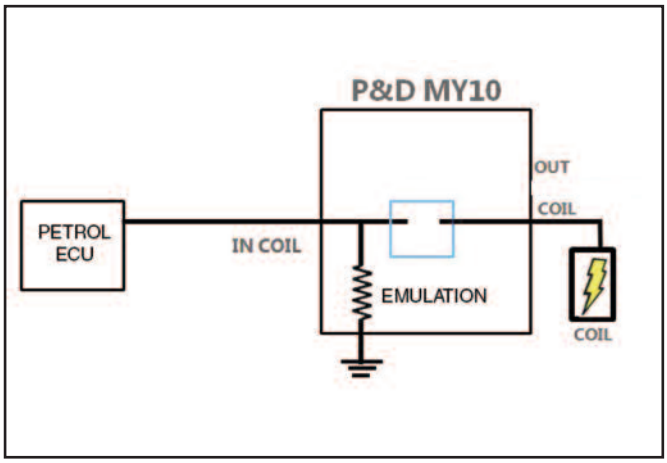
Vehicle has single coils for each cylinder. On every connector we can see positive and negative supply and a signal. (Cables layout in picture 12 is purely indicative).

DOUBLE-COIL

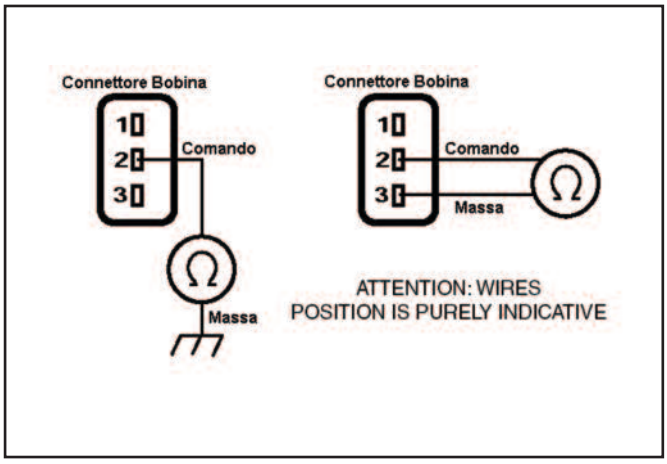
Vehicle has a double coil showing on connector the two supply cables and two piloting controls, one for every pair of cylinders. (Cables layout in picture 13, b is purely indicative).

SINGLE COIL

Vehicle has a single coil for all cylinders. On connector we can see the two supply cables and only one piloting control (pict. 14).

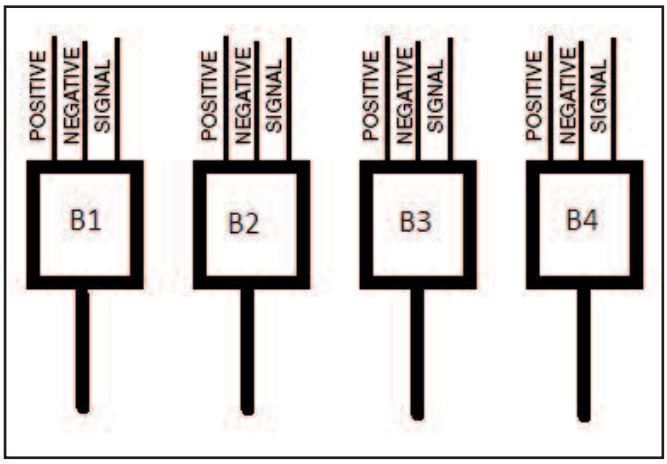


pict. 10

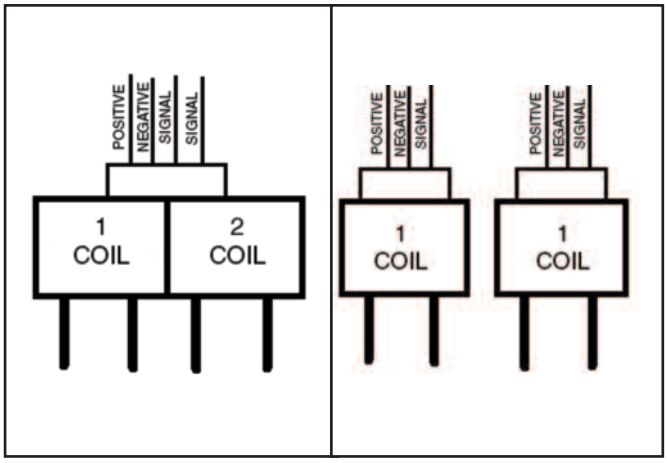


pict. 11

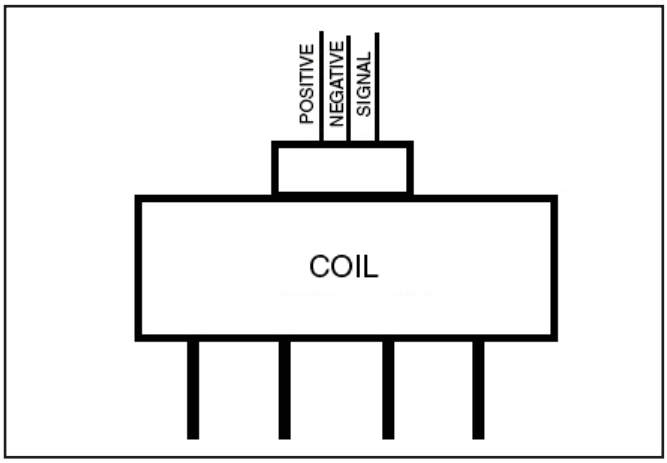
For any problem with recognizing the kind of Coil, please contact BRC Technical Service.



Pict. 12
n° 4 coils



pict. 13
n° 2 coils



pict. 14
Single Double coil

13. SEQUENT WIRING CONNECTIONS

The following general installation rules have to be considered as indispensable for a good understanding of the system.

SEQUENT ECUs are connected to the SEQUENT electric equipment (supplies, grounds, signals, sensors, actuators, etc.) through a 56-, 64- or 24-pole connector (according to the system used) containing all the signals necessaries for the various functions.

Most of the wiring cables ends on pre-cabled connectors, therefore it becomes very easy to connect the system components to the ECU; furthermore, conductors are divided into many sheaths, in order to simplify the installation and the identification of the different cables.

All the connections of cables not ending on a connector should be carried out by a well-done and duly insulated soft soldering. Avoid any connections by simply twisting the wires or using other scarcely reliable systems. For the mechanical assembly and the wiring location, make reference to the chapter 5 of the present handbook. In the following paragraphs we'll analyse wiring connections of CNG Sequent Plug&Drive MY10 Aries/Acrux or Scorpio for 3- and 4-cylinder vehicles, CNG Sequent Plug&Drive for 5-, 6- and 8-cylinder vehicles and CNG Sequent 24.11 for 3- and 4-cylinder vehicles.

For the right choice between P&D MY10 Aries/Acrux or Scorpio please make reference to chapter 12 *"Sequent Plug&Drive MY10 Aries/Acrux or Scorpio: choice procedure"*.

13.1 CNG SEQUENT PLUG&DRIVE MY10 ARIES/ACRUX MAIN HARNESS (3- AND 4-CYLINDER)

13.1.1 SUPPLY AND BATTERY GROUND

Sheath "A" in picture 1 contains two red and three black cables to be connected to the car battery: the red wires to the positive and the black ones to the negative. It is important to connect the cables as they are, allowing that they reach separately the terminals of the battery, without joining wires of same colour in one only or joining them along the harness.

Grounds must be always connected to the battery negative and not to the car body, to the engine ground or to other grounds presents on the vehicle.

13.1.2 ONE-TOUCH CHANGEOVER SWITCH AND BUZZER

The 5-poles multi-polar cable "B1" of the wiring, ending on a 5-way connector, is the cable for connection between ECU and One-Touch changeover switch situated inside the passenger compartment.

The 2-poles multi-polar cable "B2" of the wiring, ending on a 2-ways connector, is the cable for connection between ECU and the acoustic indicator (buzzer), which in this kind of changeover switch is separated, because of its small dimensions (pict. 1).

13.1.3 BRC DIAGNOSTIC SOCKET

The PC connection to the gas ECU is based on a diagnostic socket, directly coming from the wiring "C". It is the 3-way connector diagnostic point (female-holder on the harness), equipped with a protection cap. Diagnostic socket is usually placed near the 56-poles connector of the ECU.

For the PC connection, it is necessary to use the suitable USB cable code DE512522.

13.1.4 SOLENOID VALVES CONNECTIONS

No solenoid valve terminal is permanently connected to the ground, but a cable comes from +12V battery (through fuse and relay), while Gas ECU controls the other one.

Do not directly connect solenoid valve terminals to the ground: this may cause a short-circuit and will burn fuses on harness and/or prejudice the equipment right working.

Separated piloting cables have been planned for front and back solenoid valve. This separation allows gas ECU understanding whether and, in case, which of the two solenoid valves is burnt or in short-circuit. It is therefore necessary to avoid connecting the two solenoid valves in parallel: this may prejudice the ECU diagnostic function (pict. 1).

Solenoid valves are connected to the harness through precabled connectors, joined to the cables in sheaths "D" and "E".

Front solenoid valve ought to be connected to the connector of sheath "E", while the rear one ought to be connected to the connector of sheath "D" through suitable extension cable code 06LB50010062 (pict. 1).

13.1.5 FUSES

At the outlet of the sheath "F" (see picture 1) there are the two 15A and 5A fuses of the SEQUENT equipment. The harness is supplied with the two fuses at the correct amperage, fitted in the right seat. We suggest not inverting their position. The 5A fuse ought to be inser-

General wiring diagram
CNG SEQUENT PLUG&DRIVE MY10
with ARIES/ACRUX Internal Spark Timing Advancer

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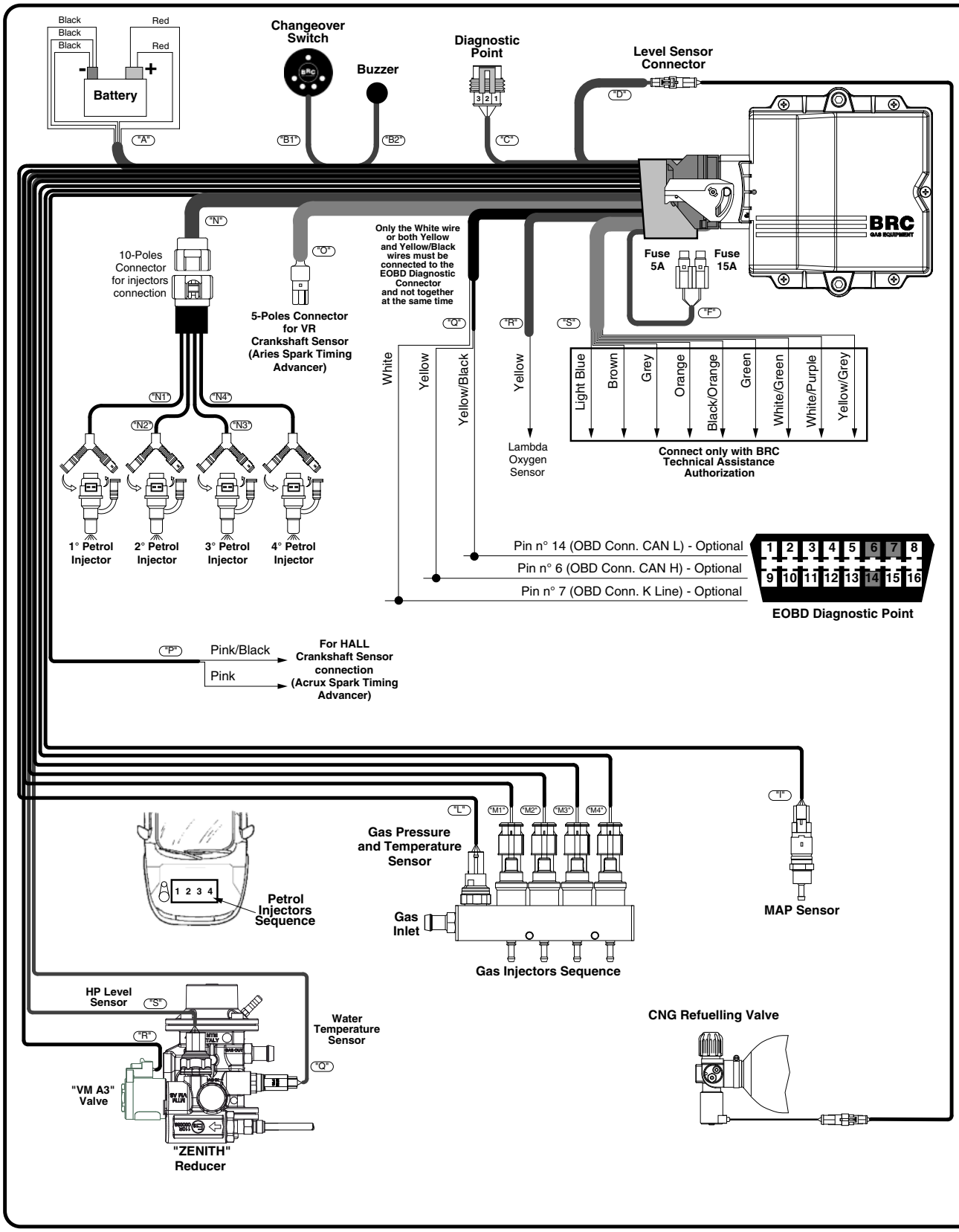


CAUTION:
Be careful with the cars for which the manufacturer prohibits or advises against disconnecting the battery, not to alter the antitheft devices or automatic adaptivity - Never use welders connected to the battery of the same car - Connect with suitably insulated soft solderings - Position the BRC electrical devices in a well ventilated area, protected from water seepages and heat sources - We recommend to insulate the BRC electronic control unit wires which are not connected - BRC reserves the right to modify this diagram without notice - We also recommend you to be sure to have the last revision of the diagram drawn up by BRC.

Pict. 1

ted in the fuse-holder with the smaller section cables, while the 15A fuse in the one with the larger section cables. After ending connections, we suggest to properly fix and protect both fuses and relay.

13.1.6 HP LEVEL SENSOR

HP level sensor is connected directly to the harness through the pre-cabled 3-pole connector (sheath "G").

13.1.7 TH_2O SENSOR

It's connected to the harness through the suitable 4-way connector (male-holder on harness) on which 3 cables of sheath "H" end.

13.1.8 MAP ABSOLUTE PRESSURE SENSOR

The new MAP pressure sensor is connected to the harness through suitable pre-cabled connector, at cables contained in sheath "I".

13.1.9 (PTS) GAS PRESSURE AND TEMPERATURE SENSOR

Gas pressure and temperature sensor is directly situated on the rail (dedicated to BRC injector). It's connected to the harness through suitable 4-way connector (male-holder on harness) where the 4 cables of sheath "L" end.

13.1.10 GAS INJECTORS

Gas injectors are connected to the wiring through the cables with pre-cabled connectors contained in the sheaths "M1", "M2", "M3", "M4" (pict. 1).

Gas injectors connectors are numbered from 1 to 4; the same is for sheaths whose cables will be connected to the petrol injectors.

It is very important to maintain correspondence between gas and petrol injectors.

Actually, gas injector to which connector M1 has to be connected, must correspond to the cylinder containing the petrol injector to which we will connect the plug of Injectors Connection Sequent Harness (or the Orange and Violet wires of the Universal Injector Connection Sequent Harness) marked with M1 and so on. If corrispondence fails, you could note a performance worsening, such as: worse driving conditions, higher unsteadiness of lambda control, less "clean" petrol/gas changeover, etc.

Remember that number distinguishing gas injectors connectors is printed on wiring cables arriving to the connector itself.

13.1.11 10-POLE CONNECTOR, PETROL INJECTORS HARNESS CONNECTION

Sheath "N" ending with a 10-poles connector, makes possible petrol injectors cutting. Now, it's enough to connect one of the specific injectors cutting wirings according to the kind of connector present on the vehicle (Bosch or Sumitomo).

List of harness codes with connector **Bosch** not supplied into the kit but sold apart:

- code 06LB50010102 RIGHT Sequent Connection Harness 4 Petrol Injectors,
  - code 06LB50010103 LEFT Sequent Connection Harness 4 Petrol Injectors,
  - code 06LB50010105 RIGHT Sequent Connection Harness 2 Petrol Injectors,
  - code 06LB50010106 LEFT Sequent Connection Harness 2 Petrol Injectors,
  - code 06LB50010101 Universal Sequent Connection Harness 4 Petrol Injectors,
  - code 06LB50010104 Universal Sequent Connection Harness 2 Petrol Injectors;

to choose according to the petrol injectors polarity.

List of harness codes with connector **Sumitomo** not supplied into the kit but sold apart:

- code 06LB50010113 RIGHT Sequent Connection Harness 4 Petrol Injectors,
  - code 06LB50010114 LEFT Sequent Connection Harness 4 Petrol Injectors,
  - code 06LB50010115 RIGHT Sequent Connection Harness 2 Petrol Injectors,
  - code 06LB50010116 LEFT Sequent Connection Harness 2 Petrol Injectors,

  to choose according to the petrol injectors polarity.

Connection is very easy, and philosophy of injectors cutting is the same followed by BRC during all these years. To select the right wiring you only have to follow the instructions inside the single packages.

During gas mode, it's important to keep the same injection sequence you had during the petrol mode. Therefore, it's necessary to interrupt petrol injectors signals in the same order you will follow to connect gas injectors.

To do this, you can pair a consecutive number to each cylinder, for instance from 1 to 4 in case of a 4-cylinder engine (note that this order only help to carry out the SEQUENT installation so that it could be different from the one assigned by the car manufacturer). Generally, in case of engine positioned in a transversal way, you will indicate as number 1 the cylinder placed on the timing belt side (see picture 1).

Petrol injector sprinkling in the cylinder n. 1 will be stopped with the group 1 of the Sequent Petrol Injectors Connection Harness (or with the Orange and Purple wires identified with n. 1 of the Sequent Universal Petrol Injectors Connection Harness) and so on.

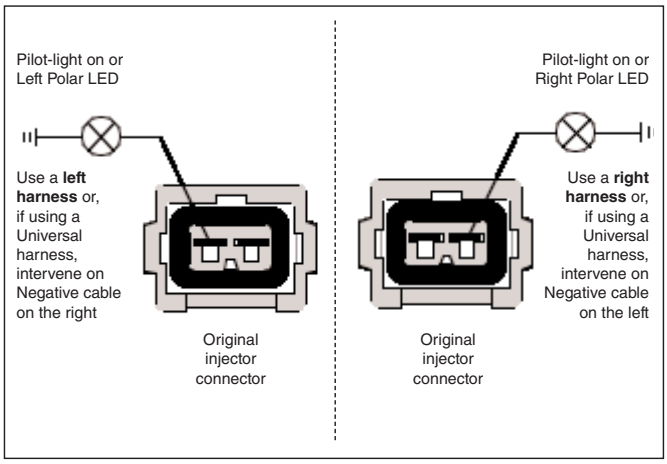
The numbers identifying both gas and petrol injectors connections are printed directly on the wiring connection cables.

13.1.12 Injectors polarity

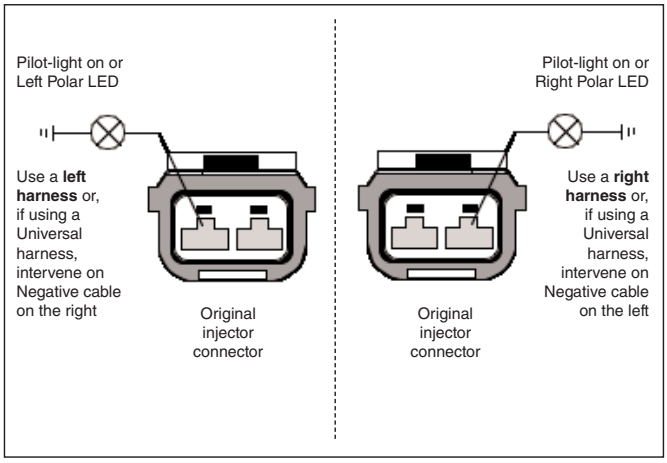
In order to choose the right injectors cutting wiring (**Right or Left**) or to precisely know which is the negative wire (in case you preferred to use a **Universal harness**), it's important to know the injector polarity, that's to say where positive wire is placed to safely intervene on the Negative one.

Therefore, referring to picture 2 it is necessary to:

- Disconnect all injectors connectors and, if necessary, all other connectors eventually installed upstream (only after contacting BRC Technical Service);
- Switch the dashboard on
  - Detect which pin of each female connector just disconnected has a +12 V voltage (use the POLAR device code 06LB00001093 or a pilot-light). **[Check all of them!!];**
- If watching the connector as indicated in picture 7 (pay attention to the reference teeth orientation) the +12V cable is on the right, you have to use a RIGHT Wiring. If instead you are installing a Universal wiring you will have to cut the negative cable (on the left).
  - If supply is on the left, use a LEFT Wiring. If instead you are installing a Universal wiring you will have to cut the negative wire (on the right).



Pict. 2a
Bosch connector



Pict. 2b
Sumitomo connector

13.1.13 Crankshaft connector with INDUCTIVE sensor (Aries timing advance processor)

In case of Aries timing advance processor inside the gas ECU, connector of sheath "O" should be connected to *BRC interface cables (make reference to the Guide to choosing BRC Timing Advance Processors for the right choice)*.

In this case you need to insulate the 2 cables to connect coming out from sheath "P".

Please make reference to paragraph 12.1 *"Sequent Plug&Drive MY10 Aries/Acrux or Scorpio: choice procedure"* to decide the use of sheath "O".

13.1.14 Crankshaft connector with Effect HALL sensor (Acrux timing advance processor)

In case of Acrux timing advance processor inside the gas ECU, Pink and Pink/Black cables of sheath "P" should be connected (pict. 3).

Please make reference to paragraph 12.1 *"Sequent Plug&Drive MY10 Aries/Acrux or Scorpio: choice procedure"* to decide the use of sheath "P" .

13.1.15 Connection of EOBD diagnostic socket

Through cables of sheath "Q" you can take signals from EOBD diagnostic socket to obtain a better integration of the system with petrol injection strategies.

White cable or Yellow and Yellow/Black cables should be connected to EOBD diagnostic socket one by one, and not the three ones at the same time (pict. 1).

13.1.16 Lambda Oxygen Sensor signal

In sheath "R", there is the Yellow cable to be connected, **if necessary**, to the Lambda Oxygen sensor signal wire, placed before the catalyst. You don't have to cut this cable but rather only strip it, weld it with gas harness cable and insulate it.

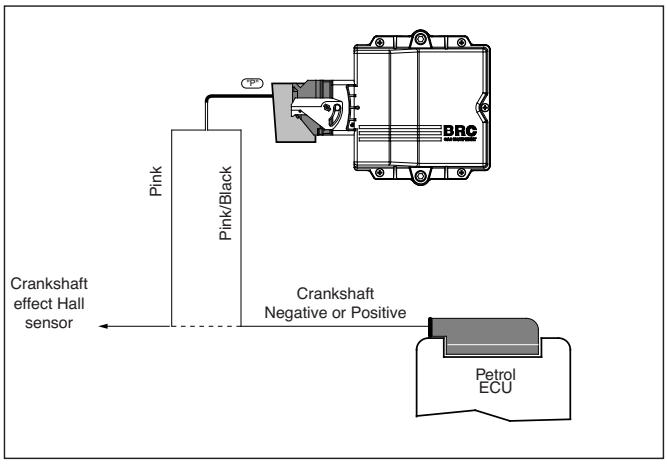
Yellow cable connection allows a

quicker self-adapting of the gas ECU and is therefore very useful if the self-mapping phase needs a further map refinement.

13.1.17 Additional Connections

At the outlet of sheath “T” there are the following cables: Brown (+12 V key contact), Light Blue (to use in case of Lambda Ox Sensor cut-off), Grey (RPM connection), Orange and Black/Orange (CAM Sensor), Green (External actuators control) White Purple (Air Temperature Input), White/Green (pump cut-off relay control) and Yellow/Grey (for petrol system sensors ground connection).

These connections can be made only under indication of BRC technical assistance.



Pict. 4
Example of Pink and Pink/Black cables connection

13.2 CNG SEQUENT PLUG&DRIVE MY10 SCORPIO MAIN HARNESS (3- AND 4-CYLINDER)

13.2.1 Supply and battery ground

See paragraph 13.1.1.

13.2.2 One-Touch changeover switch and Buzzer

See paragraph 13.1.2.

13.2.3 BRC Diagnostic socket

See paragraph 13.1.3.

13.2.4 Solenoid valves connections

See paragraph 13.1.4.

13.2.5 Fuses

See paragraph 13.1.5.

13.2.6 HP Level sensor

See paragraph 13.1.6.

13.2.7 TH_2O sensor

See paragraph 13.1.7.

13.2.8 MAP Absolute Pressure sensor

See paragraph 13.1.8.

13.2.9 Gas pressure and temperature sensor (PTS)

See paragraph 13.1.9.

13.2.10 Gas injectors

See paragraph 13.1.10.

13.2.11 10-pole connector, petrol injectors harness connection

See paragraph 13.1.11.

13.2.12 Injectors polarity

See paragraph 13.1.12.

13.2.13 Crankshaft connector with Effect HALL sensor (Scorpio timing advance processor)

Sheath “O” contains:
- White and White/Black: coil 1 - cables marked with n° 1
- Grey and Grey/Black: coil 2 - cables marked with n° 2
- Yellow and Yellow/Black: coil 3 - cables marked with n° 3
- Blue and Blue/Black: coil 4 - cables marked with n° 4

See picture 5 to realize cables connection.

13.2.14 Connection of EOBD diagnostic socket

See paragraph 13.1.15.

13.2.15 Lambda Oxygen Sensor and RPM signal

In sheath “R”, there is the Yellow cable to be connected, **if necessary**, to the Lambda Oxygen sensor signal wire, placed before the catalyst. You don’t have to cut this cable but rather only strip it, weld it with gas harness cable and insulate it.

Yellow cable connection allows a quicker self-adapting of the gas ECU and is therefore very useful if the self-mapping phase needs a further map refinement.

Sheath “R” also contains Grey cable taking Revolutions Per Minute signal (RPM) by directly connect with RPM counter.

You don’t have to cut RPM cable but rather only strip it, weld it with grey gas harness cable and insulate it.

13.2.16 Additional Connections

At the outlet of sheath “T” there are the following cables: Brown (+12 V key contact), Light Blue (to use in case of Lambda Ox Sensor cut-off), Green (External actuators control) White Purple (Air Temperature Input), White/Green (pump cut-off relay control) and Yellow/Grey (for petrol system sensors ground connection).

These connections can be made only under indication of BRC technical assistance.

General wiring diagram
CNG SEQUENT PLUG&DRIVE MY10
with SCORPIO Internal Spark Timing Advancer

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Diagram N°:	1
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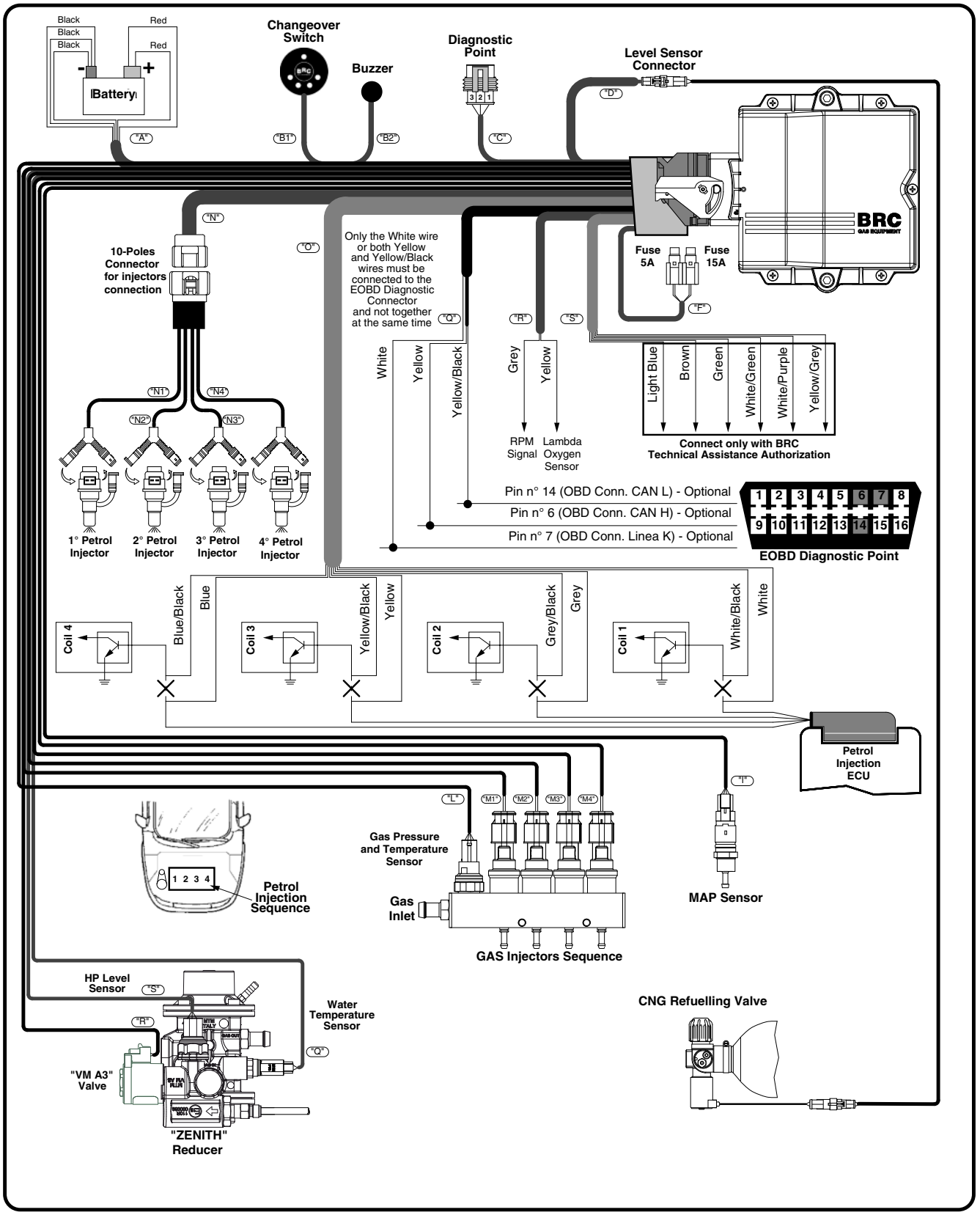

CAUTION:
Be careful with the cars for which the manufacturer prohibits or advises against disconnecting the battery, not to alter the antitheft devices or automatic adaptivity - Never use welders connected to the battery of the same car - Connect with suitably insulated soft solderings - Position the BRC electrical devices in a well ventilated area, protected from water seepages and heat sources - We recommend to insulate the BRC electronic control unit wires which are not connected - BRC reserves the right to modify this diagram without notice - We also recommend you to be sure to have the last revision of the diagram drawn up by BRC.

Pict. 5

13.3 CNG SEQUENT 24.11 MAIN HARNESS CODE DE531033

13.3.1 Supply (fuses) and battery ground

Sheath "A" in picture 6 contains a red cable connected to the 15A fuse and 2 black cables to be connected to the vehicle battery: the red one to the positive and the black ones to the negative. It is important to connect the cables as they are, allowing that they reach separately the terminals of the battery, without joining wires of same colour in one only or joining them along the harness.

Grounds must be always connected to the battery negative and not to the car body, to the engine ground or to other grounds presents on the vehicle.

13.3.2 One-Touch changeover switch and Buzzer

See paragraph 13.1.2.

13.3.3 BRC Diagnostic socket

See paragraph 13.1.3.

13.3.4 Solenoid valves connections

See paragraph 13.1.4.

13.3.5 TA pressure gauge with optical level sensor

Pressure gauge sensor is directly connected to the harness through the pre-cabled 3-pole connector (sheath "S").

13.3.6 TH_2O Sensor

See paragraph 13.1.7.

13.3.7 MAP Absolute Pressure Sensor

See paragraph 13.1.8.

13.3.8 Gas pressure sensor (PTS)

Gas pressure sensor is directly situated on the rail (dedicated for BRC injectors). It's connected to the harness through suitable 4-way connector (male-holder on harness) where the 3 cables of sheath "L" endo.

13.3.9 Gas injectors

See paragraph 13.1.10.

13.3.10 Petrol injectors connection

In sheath "F" there are the following cables:

- Orange n° 1 (petrol injector n° 1)
- Purple n° 1 (petrol injector n° 1)
- Orange n° 2 (petrol injector n° 2)
- Purple n° 2 (petrol injector n° 2)
- Orange n° 3 (petrol injector n° 3)
- Purple n° 3 (petrol injector n° 3)
- Orange n° 4 (petrol injector n° 4)
- Purple n° 4 (petrol injector n° 4).

Connect cables as indicated by picture 6.

During gas mode, it's important to keep the same injection sequence you had during the petrol mode. Therefore, it's necessary to interrupt petrol injectors signals in the same order you will follow to connect gas injectors.

To do this, you can pair a consecutive number to each cylinder cilindro, for instance from 1 to 4 in case of a 4-cylinder engine (note that this order only help to carry out the SEQUENT 24.11 installation so that it could be different from the one assigned by the car manufacturer). Generally, in case of engine positioned in a transversal way, you will indicate as number 1 the cylinder placed on the timing belt side (see picture).

Petrol injector negative sprinkling in the cylinder n. 1 will be stopped sprinkling in the cylinder n. 1 will be stopped.

The numbers identifying both gas and petrol injectors connections are printed directly on the wiring connection cables.

13.3.11 Lambda Oxygen Sensor, RPM e Positive Key Contact

In sheath "O" there is the Yellow cable to be connected, **if necessary**, to the Lambda Oxygen sensor signal wire, placed before the catalyst. You don't have to cut this cable but rather only strip it, weld it with SEQUENT harness cable and insulate it.

Yellow cable connection allows a quicker self-adapting of the gas ECU and is therefore very useful if the self-mapping phase needs a further map refinement.

Sheath "O" also contains Grey cable taking Revolutions Per Minute signal (RPM) by directly connect with RPM counter.

You don't have to cut RPM cable but rather only strip it, weld it with grey gas harness cable and insulate it.

Moreover sheath "O" also contains the Brown cable to be connected to the under key positive signal of the original equipment.

You don't have to cut this cable but rather only strip it, weld it with SEQUENT harness cable and insulate it.

We want to remind you that it's very important to connect our +12V with key contact (brown cables) on a safe and clean supply, with no voltage peaks that could cause temporary problems or, in worst case, a serious damage to BRC ECU.

Safe connections:

General wiring diagram
CNG Sequent 24.11
Harness cod. DE531033

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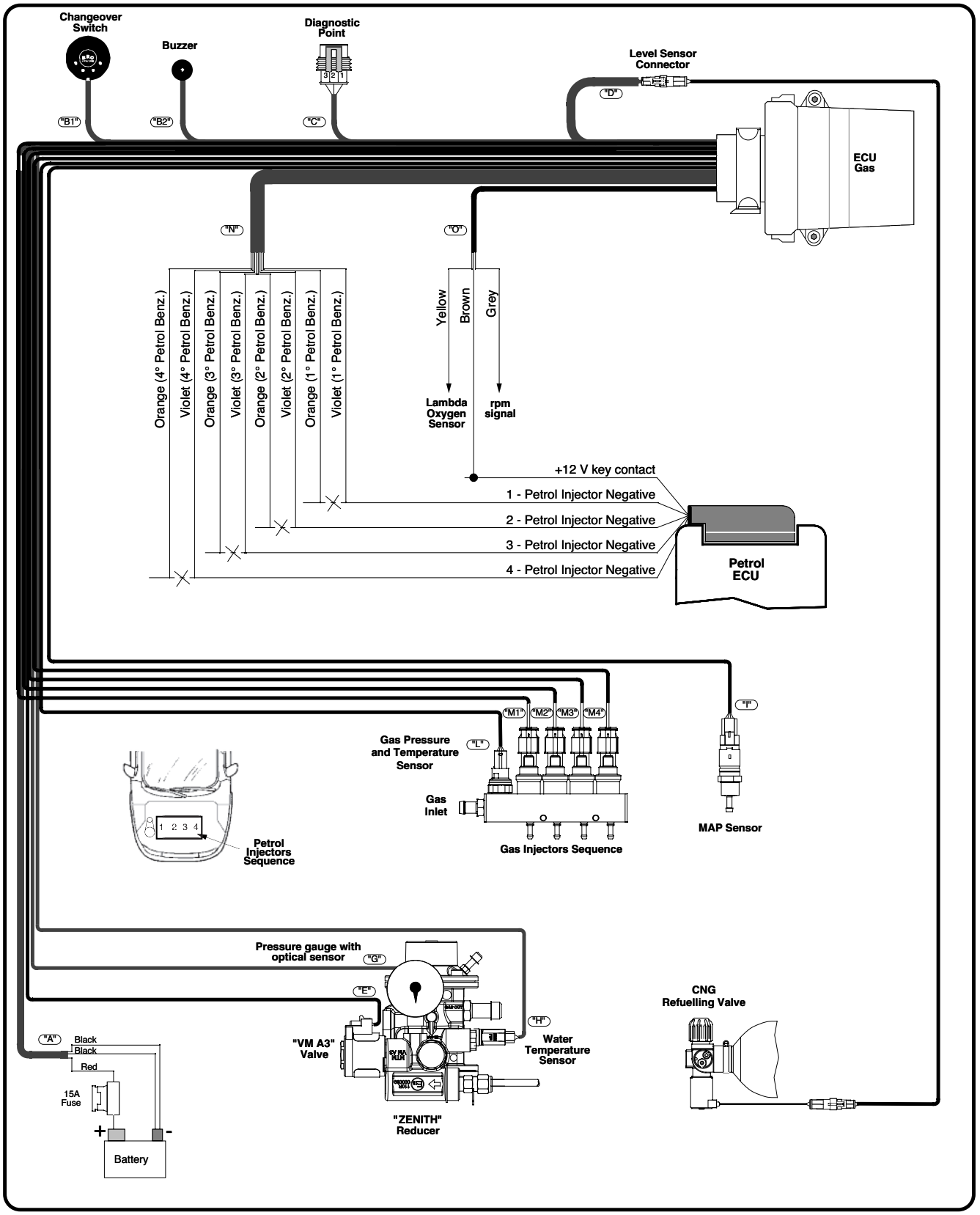

CAUTION:
Be careful with the cars for which the manufacturer prohibits or advises against disconnecting the battery, not to alter the antitheft devices or automatic adaptivity - Never use welders connected to the battery of the same car - Connect with suitably insulated soft solderings - Position the BRC electrical devices in a well ventilated area, protected from water seepages and heat sources - We recommend to insulate the BRC electronic control unit wires which are not connected - BRC reserves the right to modify this diagram without notice - We also recommend you to be sure to have the last revision of the diagram drawn up by BRC.

Pict. 6

We suggest to take this signal from a good +12V with key contact or at most from petrol injectors positive.

13.4 CNG SEQUENT PLUG&DRIVE MAIN HARNESS
5-, 6- AND 8-CYLINDER VERSION

13.4.1 56-POLE CONNECTOR

Being the 56-pole connector used by the system SEQUENT the same **already used in the other Sequent family systems**, also considering the similitude of ECUs outside structure, it could happen you install the wrong ECU in the wrong system.

It's very important to avoid this error, because it could damage ECUs and/or vehicle original supply system. If, after installing the system and inserting ECU, vehicle doesn't start up, we suggest not insisting, rather checking that ECU is the right one.

13.4.2 SUPPLY AND BATTERY GROUND

See paragraph 13.1.1.

13.4.3 ONE-TOUCH CHANGEOVER SWITCH AND BUZZER

See paragraph 13.1.2.

13.4.4 BRC DIAGNOSTIC SOCKET

See paragraph 13.1.3.

13.4.5 SOLENOID VALVES CONNECTIONS

See paragraph 13.1.4.

13.4.6 LEVEL SENSOR

Level sensor is connected directly to the harness through the precabled 2-poles connector (sheath "D" in picture 7). The connection between ECU and sensor can be made through the special extension cable (06LB50010062).

13.4.7 TH_2O SENSOR

See paragraph 13.1.7.

13.4.8 MAP ABSOLUTE PRESSURE SENSOR

See paragraph 13.1.8.

13.4.9 GAS PRESSURE AND TEMPERATURE SENSOR (PTS)

See paragraph 13.1.9.

13.4.10 FUSES AND RELAY

Remember that for 5-, 6- and 8 cylinder version 15A fuse is replaced with a 25A one.

Follow instructions of paragraph 13.1.5 concerning fuses.

In picture 1 is also represented the relay used by SEQUENT system to interrupt battery positive coming from actuators.

After ending connections, we suggest to properly fix and protect both fuses and relay.

13.4.11 GAS INJECTORS

Gas injectors are connected to the wiring through the cables with pre-cabled connectors contained in the sheaths "M1", "M2", "M3", "M4", "M5", "M6", "M7" and "M8" (pict. 5).

Gas injectors connectors are numbered from 1 to 8; the same is for sheaths whose cables will be connected to the petrol injectors.

It is very important to maintain correspondence between gas and petrol injectors.

Actually, gas injector to which connector n° M1 has to be connected, must correspond to the cylinder containing the petrol injector to which we will connect the plug of Injectors Connection Sequent Harness (or the Orange and Violet wires of the Universal Injector Connection Sequent Harness) marked with N1 and so on.

If corrispondence fails, you

CNG Sequent Plug&Drive General Wiring Diagram

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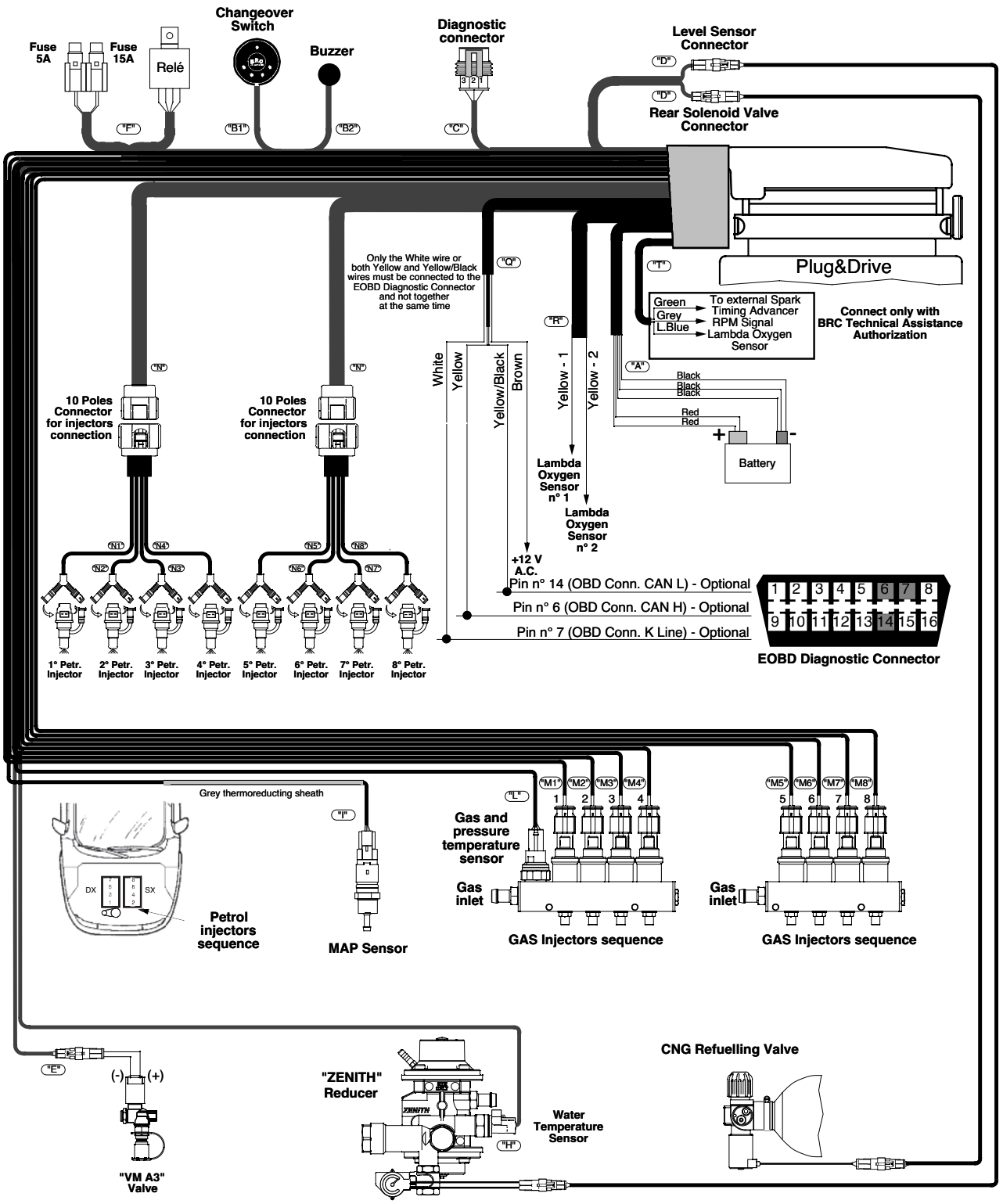
Draftsman:	M.P.
Signature:	



CAUTION:
Be careful with the cars for which the manufacturer prohibits or advises against disconnecting the battery, not to alter the antitheft devices or automatic adaptivity - Never use welders connected to the battery of the same car - Connect with suitably insulated soft solderings - Position the BRC electrical devices in a well ventilated area, protected from water seepages and heat sources - We recommend to insulate the BRC electronic control unit wires which are not connected - BRC reserves the right to modify this diagram without notice - We also recommend you to be sure to have the last revision of the diagram drawn up by BRC.

Pict. 7

could note a performance worsening, such as: worse driving conditions, higher unsteadiness of lambda control, less “clean” petrol/gas changeover, etc.

Remember that number distinguishing gas injectors connectors is printed on wiring cables arriving to the connector itself.

13.4.12 10-POLE CONNECTOR, PETROL INJECTORS HARNESS CONNECTION

See paragraph 13.1.11.

13.4.13 INJECTORS POLARITY

See paragraph 13.1.12.

13.4.14 LAMBDA OXYGEN SENSOR SIGNAL

In sheath “R”, there are 2 Yellow cables to be connected, **if necessary**, to the Lambda Oxygen sensor signal wire, placed before the catalyst. You don’t have to cut these cables but rather only strip it, weld it with gas harness cable and insulate it.

Yellow cable connection allows a quicker self-adapting of the gas Fly SF ECU and is therefore very useful if the self-mapping phase needs a further map refinement

13.4.15 CONNECTION OF EOBD DIAGNOSTIC SOCKET AND POSITIVE KEY CONTACT

Through cables of sheath “Q” you can take signals from diagnostic socket to obtain a better integration of the system with petrol injection strategies.

White cable or Yellow and Yellow/Black cables should be connected to EOBD diagnostic socket one by one, and not the three ones at the same time (pict. 7).

Moreover sheath “Q” also contains the Brown cable to be connected to the under key positive signal of the original equipment.

You don’t have to cut this cable but rather only strip it, weld it with SEQUENT harness cable and insulate it.

13.4.16 ADDITIONAL CONNECTIONS

At the outlet of sheath “T” there are the following cables: Green (to the Outer timing advance processor), Grey (RPM) and Light Blue (Lambda Oxygen Sensor).

These connections can be made only on special vehicles, under indication of BRC technical assistance.

PART I - (II)

1. DESCRIPTION OF ALTERNATIVE COMPONENTS OF CNG SEQUENT SYSTEM FRONT SIDE

DESCRIPTION OF ALTERNATIVE COMPONENTS FRONT SIDE	APPROVAL
Gas pressure and temperature sensor (PTS)	E4*110R-000095*
PAN-EVO Injector	E13*110R-000119*
TA reducer	E13 110R-000157*
TA pressure gauge with MGN 5 optical level sensor	E13 110R-000224*
Parker pipe 5-10,5 and 10-17	E13*110R-000008*
Polimer pipe 5-10,5	E13*110R-000128*
Polimer pipe 10-17	E13*110R-000127*
Tubithor pipe	E13*110R-000017*
Flex pipe	E13*110R-001107*

1.1 GAS PRESSURE AND TEMPERATURE SENSOR (PTS)

This sensor (pict. 1) has a compact body and is already integrated with connector, and allows detecting P1 pressure and gas temperature on the rail.

It also allows obtaining a more precise measure of gas pressure and temperature, and making faster gas carburetion corrections if needed.

Pict. 1
Gas pressure and temperature sensor (PTS

1.2 PAN-EVO INJECTOR

PAN-EVO injector has the task to open and close gas passage coming from reducer. When injector opens, gas is sent to the engine through a pipe fixed at the end of intake manifold, engine side. Main feature of PAN-EVO injector is its versatility in installation: being a modular component, it can be

Pict. 2
Pan EVO

assembled two injectors by two according to the kind of engine.

Single connectors of main harness provide wiring supply to the injectors. Connectors are watertight with IP protection degree 54. All components are homologated according to the European Regulation 2006-28-EC (Electromagnetic compatibility) 67R-01, 110R-00.

1.3 TA PRESSURE GAUGE WITH MGN 5 OPTICAL LEVEL SENSOR

As CNG is stocked into the tank at its gaseous state, fuel level indication is given according to the outlet pressure thanks to a pressure gauge inserted on reducer inlet fitting (pict. 3).

It gives information about pressure coming out from tank and consequentely about residual autonomy.

Information given by pressure gauge is sent to BRC ECUs so that fuel level can be shown through the changeover switch LEDs inside the vehicle.

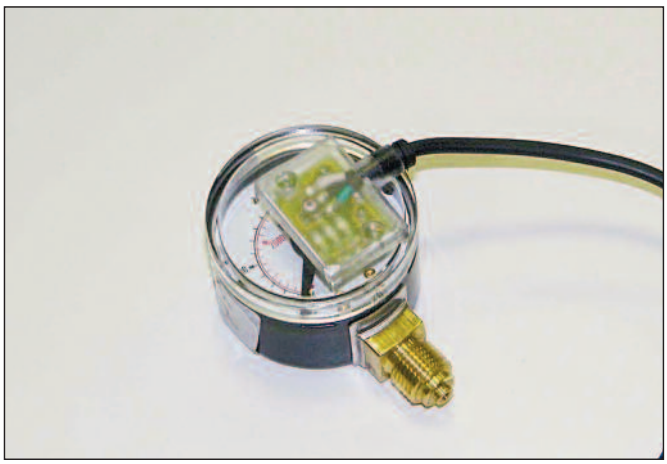
1.4 "VM A3/E" CNG ELECTRO-ASSISTED VALVE

"VM A3/E" CNG electro-assisted valve is Water Proof type (with watertight connectors) and it is an evolution of the well-known CNG VMA3 solenoid valve.

This valve, usually installed inside the engine compartment along the pipes connecting CNG cylinder/s to the reducer, if combined to the IM series CNG filling point allows refuelling and, at the same time, the free passage of the supply flow.

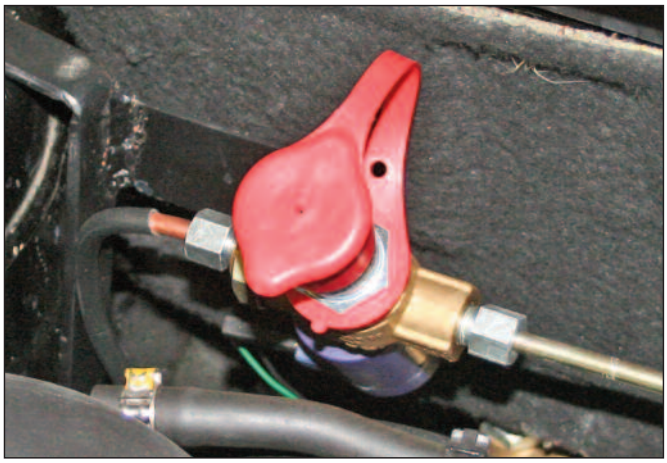
Use of this kind of refuelling solenoid valve, in the CNG SEQUENT context, has a very important role as the solenoid valve is controlled and managed by the electronic control system. It opens when the starting up begins and closes in case of engine stop, even if the driver doesn't turn the ignition key off (for instance in case of accident).

Valve is available both in Red Cap and in Green Screw Cap version.



Pict. 3

Pict. 4
"VMA3/E" WP. electro-assisted valve
Green Cap Version



Pict. 5
"VMA3/E" WP. CNG electro-assisted valve
Red Cap Version

1.5 CNG TA REDUCER

2-stage reducer with aluminium body and a 200 bar pressure.

Pict. 6
CNG TA reducer

3. DESCRIPTION OF ALTERNATIVE COMPONENTS OF CNG SEQUENT SYSTEM REAR SIDE

3.1 LIST OF CNG CYLINDERS

	LENGTH [mm]											
	1200		1300		1400		1500		1600		1700	
	T [kg]	C [l]	T [kg]	C [l]	T [kg]	C [l]	T [kg]	C [l]	T [kg]	C [l]	T [kg]	C [l]
Diam. [mm]												
168,3	21,8	24,3	23,8	26,1	25,8	28,0	27,7	29,8	29,8	31,6	31,7	33,5
203	32,6	31,6	35,1	34,5	37,6	37,5	40,0	40,4	42,5	43,3	45,0	46,2
229	40,7	39,8	43,8	43,5	46,9	47,2	50,0	50,9	52,1	54,8	56,1	58,4
244,5	49,3	44,7	53,0	49,0	56,7	53,2	60,4	57,4	64,1	61,6	67,8	65,9
273	57,8	55,6	62,1	60,9	66,4	66,2	70,6	71,6	74,9	76,9	79,2	82,2

T [kg]: Tare in kilograms
C [l]: Capacity in litres

	LENGTH [mm]									
	800		900		955		1000		1100	
	T [kg]	C [l]	T [kg]	C [l]	T [kg]	C [l]	T [kg]	C [l]	T [kg]	C [l]
Diam. [mm]										
168,3	13,9	16,9	15,9	18,7	16,9	19,8	17,8	20,6	19,8	22,5
203	22,6	19,9	25,1	22,9	26,5	24,5	27,6	25,8	30,1	28,7
229	28,4	24,9	31,5	28,6	33,2	30,6	34,5	32,3	37,6	36,0
244,5	34,5	27,8	38,2	32,1	40,2	34,4	41,9	36,3	45,6	40,5
273	40,7	34,4	45,0	39,7	47,4	42,6	49,3	45	53,6	50,3

T [kg]: Tare in kilograms
C [l]: Capacity in litres

Description of alternative components rear side		Homologation
CNG Cylinder (All Dimension)	Dalmine	E6-110R-000018
	Kioshi	E7-110R 6674-01
	Kioshi	E7-110R 6674-02
	Kioshi	E7-110R 6674-10
	Kioshi	E7-110R 9122-03
	Kioshi	E7-110R 9122-04
	Kioshi	E7-110R 9122-05
	Kioshi	E7-110R 9122-06
	Faber	E6-110R-000002
	Faber	E6-110R-000005
	Faber	E6-110R-000013
	Dalmine	E6-110R-000018
	Faber	E6-110R-000034
	Faber	E6-110R-000042
CNG Cylinder (All Dimension)	Dalmine	E6-110R-000050
	Worthington (267x995 mm 45 liter)	E1-110R-000111

	Worthington (229x1070 mm 36 liter)	E1-110R-000113
	Worthington (267x920 mm 40 liter)	E1-110R-000055
	Worthington (267x1085 mm 50 liter)	E1-110R-000121
Cylinder valve BRC VBS1 in configuration VBS1, VB S1 MY 07		E13-110R-000042
OMB	Tipo A5	E13-110R-000143
EMER	Tipo MARK	E4-110R-000052
EMER	Tipo VBE	E3-110R-003003
EMER	Tipo PFTI-594	E3-110R-003001
EMER	Tipo MCR	E3-110R-003019
EMER	Tipo PRD	E4-110R-000054
EMER	Tipo PFTI-600	E3-110R-003002

WARNING: Before converting a vehicle to CNG, the installer should check the existing coupling between cylinders/CNG valves by verifying homologation certificates in his possession. In case of failed verification BRC-MTM will not be responsible for any inconvenience occurred during the final inspection.

NOTES : CNG SYSTEMS COMPONENTS, EXCEPT FOR TANKS AND STIFF PIPES, COMPLY WITH INSTRUCTIONS OF REGULATION UN-ECE 110. BESIDES REGULATION 110, TANK CONFORMITY IS ALSO ALLOWED TO NATIONAL REGULATIONS IN LAW (SEE PAGE 4 OF MEMORANDUM NR. 12816/23.36.14 OF FEB 9TH, 2009)

3.2 VBA1 MY07 CYLINDER VALVE

"VBA1 MY07" cylinder valve was planned and produced by BRC to combined cylinder valve traditional functions with safety functions internationally required for this kind of device.

BRC, on the basis of its experience in national and foreign markets, realizes many versions of "VBA1 MY07" cylinder valve, according to the laws in force in each country.

Especially, the following functions stay the same in each model:

- Cylinder refuelling,
- Cylinder supply,
- Cylinder insulation by means of a manual tap,
- Ventilation for gas-tight housing.

The following safety devices can be added to the standard model:

- Excess flow valve,
- Safety device for over pressure with bursting disk,
- Safety device with thermic fuse.

"VBA1 MY07" cylinder valve is made up of a main body with a threaded fitting for connecting it to the cylinder, and two threaded fittings for connecting it to the high-pressure pipes. Normally, we use one of these fittings for the connection to the refuelling point and to the engine supply, and the other one for the connection to other cylinders. Last valve fitting is used for the connection to the steel pipe in case of wall leadthrough couplings. With couplings not needing a wall leadthrough installation (applied on the "VM A3" CNG valve), we apply a blank-off plug on the last valve fitting not used.

Pict. 1
VBA1 MY07

GLOSSARY OF TERMS AND ACRONYMS USED IN THE HANDBOOK

Term or acronym	Meaning
Absolute pressure	Pressure measured with reference (value=0) to the perfect vacuum.
Bottom Feed	Literally Supplied from the bottom. Compare with "top Feed". Particular type of injector, in which path fuel only involves the injector low part.
CAN Bus	Communication system between ECUs and devices installed on a vehicle.
Catalyst	Device installed on the exhaust pipe in order to reduce the polluting emissions.
3-way catalyst	Catalyst that reduces the HC, CO and NOx values.
Changeover switch	It is the device situated in the passenger compartment which allows driver choosing the wished fuel type (gas or petrol). See also paragraph 4.9.
Connector	Device which connects wirings parts with other wiring parts or with electric devices.
Crankshaft (sensor)	Sensor installed near a gearwheel supportive with the drive shaft; it produces an electric signal that represents the drive shaft position.
Cut-Off	Particular engine working condition where injectors don't supply fuel to the cylinders, so that they intake pure air. Normally, you are in cut-off during a tip-out, with possible vehicle deceleration (engine brake), starting from rpm not too low.
Diagnostic	Identification process of cause or nature of a problem, a failure, or of a particular condition/situation to detect and indicate as bad working.
Differential pressure	Pressure difference between two zones, for instance between the intake manifold and the atmospheric pressure.
Duty Cycle	In a rectangular wave-shape is the proportion between the high level duration and the wave-shape period. In formulas, if Ton is the high level duration and Toff is the low level duration, then Tp = Ton + Toff is the period and DC = Ton / Tp = Ton / (Ton+Toff) is the Duty Cycle.
Electro-injector	See Injector.
EOBD	See "OBD". European On Board Diagnostics. European implementation of OBD systems, regulated from institutions as ISO.
ECU	In this context, it's the Electronic Control Unit of the engine or of the gas carburetion.

Flow	Physical measure that defines the fluid quantity passing through a specific section in a time unit. Mass flow defines, for instance, how many grams of a fluid pass through a specific section in a second.
Ground	Reference electric potential (relative tension amounting to zero Volt). It is also the mass of wires and electric conductor connected to this potential. Ground potential is on the negative pole of the vehicle battery, so that it's called battery ground too.
Harness	In this handbook, it is the whole of wires coming from the ECU connector and going to all the other system wiring points.
Injector	Device that supplies accurate measured quantities of fuel in pressure, injecting them in the intake manifold.
K line	Communication line of engine ECU towards the external diagnostic instrument.
Lambda Oxygen Sensor	Sensor measuring the oxygen concentration in the exhaust gas. Thanks to this sensor ECU determines if air/fuel mix is too rich or too poor in fuel, allowing the system closed loop working.
LED	Light Emitting Diode. Semiconductor electronic devices that can glow if crossed by electric current.
LPG	Liquefied Petroleum Gas. It is a fuel coming from petroleum distillation, essentially made up of Butane and Propane in variable proportions. You can find it in gaseous state at ambient temperature and pressure, whereas it is liquid inside the tank.
MAP (Manifold Absolute Pressure)	Absolute pressure of the engine intake manifold (see Absolute pressure). It indicates the relative sensor too.
Map	See Mapping
Mapping/Map	It is the mass of data that defines fuel quantity to dose in accordance with the engine working conditions.
Multivalve	Device situated on the tank that performs different functions, controlling tank filling, fuel level, security protection, and so on.
Magnetic circuit	Path where magnetic flow conveys, usually made of iron or other iron-magnetic material. It is part of an electromagnetic device (solenoid valve, injector, electric engine, and so on).
OBD (On Board Diagnostics)	See also "Diagnostic". Monitoring system of all or some inlet and ECU signal control. If it finds one or more signals out of the predefined threshold, it informs of the system/systems bad working and records it.
OR (O Ring)	Gasket made up of a rubber ring.
PC	Personal Computer
Peak & Hold (piloting)	Literal. See also "Piloting". Particular injectors piloting that supplies to the coil early a bigger current in the opening phase, so that it can reduce the injector opening time (peak); then current decrease at a lower value, enough to maintain the injector open (hold).

Piloting	In this handbook, it indicates action and way with which electric actuators are controlled by the ECU or by other electric device, through power electric signals.
Positive battery	The pole with the higher electric potential of the vehicle battery. Normally it has a voltage between 8 and 16V compared to the ground.
Positive under key	Tension or electric knot situated upstream the switch activated by the vehicle ignition key. Normally it has a low potential; it reaches the battery positive potential when you turn the key off.
Rail	It is the element on which injectors are installed; thanks to it, gas at the required pressure can be opportunely supplied at every injector inlet.
Relative pressure	Pressure measured with reference (value=0) to the atmospheric pressure.
Relay	Electro-mechanical device that can open or close one or more electric contacts after appropriate electric piloting.
RPM (Revolutions per minute)	Acronym for Revolutions Per Minute. It usually indicates drive shaft rotation speed.
Self-diagnostic	See Diagnostic.
Sensor	Device measuring a physical quantity value as temperature, pressure, speed, and converting it in electric signal useful to the ECU or to another electric device.
Sequential injection	Injection management system of a modern vehicle with fuel electronic injection; here the injection phase of each cylinder starts and ends according to independent times for everyone of them. The engine ECU verifies these times and correlates them with the cylinder phase and position.
Solenoid valve	Electro-mechanical device that stops a fluid flow. In this handbook, this device stops gas flow when it's not supplied, otherwise it lets the gas flow.
Throttle Valve	Valve that regulates the air flow intaken from the engine. Normally is controlled by the accelerator pedal but nowadays it is controlled directly from the petrol ECU more and more.
Top Feed	Literally Supplied from the top. See "Bottom Feed". Particular type of injector, in which path fuel passes through the whole injector length in an axial way, arriving from the top and being injected in the low part of the device.
TPS (Throttle Position Sensor)	Throttle Valve Position Sensor. It supplies an electric signal that shows the throttle valve opening (see "Throttle Valve").