

GENERAL INSTALLATION MANUAL

ELECTRONIC GASEOUS FUEL INJECTION SYSTEM (LPG) WITH "MASTER/SLAVE"FUNCTION

Retrofit System

TYPE:

Alisei-ZETA

GENERAL MANUAL

Part I

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Valued Customer,

ZAVOLI srl congratulates you on your choice. We would like to draw your attention to some of the features of ***Alisei-ZETA'***s **LPG** or **Methane Gas** sequential gaseous fuel injection. This state of the art injection system is the result of **ZAVOLI**'s long experience and ongoing research in the field of LPG and Methane kits for vehicles. Our kits can be installed in any multipoint fuel injection motor vehicles.
Thanks to its superior integration features, ***Alisei-ZETA*** guarantees high performances as well as an easy, user-friendly installation process.

The following manual is designed to guide you through the installation process and provide clear, complete information about the installation of our system. It will help you learn how the system works while guiding you through the details of its installation and configuration process.

ZAVOLI srl would also like to remind you that our **Technical Support Center** is always available for any question or problem you might encounter during the installation of our system.

Alisei-ZETA RETROFIT KIT

INSTALLATION MANUAL

PART ONE

The ***Alisei-ZETA*** retrofit kit installation manual is divided into two sections. The first one includes general information about the kit, while the second contains a selection of installation charts designed for different types of vehicles.

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(PART ONE)

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1. THE *Alisei-ZETA* RETROFIT KIT – INTRODUCTION

1.1. The *Alisei-ZETA* Retrofit System

This brand new system was created by *Zavoli srl* for the sequential electronic injection of gaseous fuel. Its “Master/Slave” function makes it ideal for manual start-up engines The Retrofit Kit is available in a number of configurations, so as to meet the specific needs of every single customer. The main components of the Retrofit Kit are included in the following list, and can be ordered through our company:

- Control unit 2001N for 3-4 cylinder vehicles – 2568 for 5-6-8 cylinder vehicles
- Main Wiring
- Petrol/Gas Switch
- *ZETA* Regulator/Evaporator
- *PAN* Gas Injectors
- Gas Pressure Sensors
- Gas Temperature Sensors
- Filters
- LPG Solenoid valve
- Tubing for the Pneumatic-Hydraulic Connection of the System
- Small tools for the installation of the system.
- Use, Maintenance and Warranty Manual for the Final User of Our System



Fig.1.1-1

1.2. Main features of the *Alisei-ZETA* Retrofit Kit

The ***Alisei-ZETA*** system is the product of some of the most advanced design techniques available today, combined with a detailed study of the materials involved in the making. The result is a production line which guarantees total quality control, and a state-of-the-art GAS system which can be easily installed on a wide range of vehicles. The exclusive design of our system complies with the latest E.U. technical standards, and is homologated according to regulations UNECE R67-01 and UNECE R115-00. Thanks to its ECU Gas advanced electronic function, the system is conveniently unobtrusive, as it does not require users to change the original air/petrol settings of the engine. According to its operating principles, the ***Alisei-ZETA*** Retrofit System is defined as a "Master/Slave" type of system, as its ECU Gas electronic console (slave) can convert the control strategy of the ECU petrol console (master) into a GAS one.

1.2.1 The *Alisei-ZETA*

Over the years, gas injection systems have undergone many changes. These changes have been caused by a revolutionary wave in the field of engine injection devices, which in the last few years has prompted the progressive elimination of old carburetor injection systems and favored the use of more modern electric injection ones. The latter have proven to be not only more reliable, but also safer and less polluting – a very important feature in today's world.
The old-fashioned systems - commonly referred to as "traditional types" - featured a fuel dispensing device based on a mixer whose function was to ensure a continuous supply of gas. The amount of gas dispensed by the mixer was determined exclusively by the depressurization level of the intake manifold in the engine, as well as by the position of a regulation valve (or step-by-step motor). At this point, a traditional system would be inappropriate for contemporary cars, as they usually feature the most sophisticated electronic solutions for carburetion control. For this reason, electronic injection has become essential even in the case of gas fueled engines. The very first few systems of this kind did not actually represent a real solution to the problem, as they were based on a concept which was very similar to traditional devices. As a matter of fact, the injection of fuel was continuous (in a "non-master/slave" type of system), which is very different from the kind of phased sequential injection that the original control unit used to run the engine.
The new ***Alisei-ZETA*** Kit, which uses a sequential "Master/slave" injection system, guarantees:

- Reliability.
- Optimal performance
- An environmentally-friendly system

1.2.2 Reliability

This is one of the most important points to take into consideration when converting a vehicle to a LPG gas system. The use of this gaseous type of fuel is in fact associated to a potential danger of combustion, due to the natural tendency of these gas fumes to spread. The risk of combustion increases when fumes collect in the intake manifold. In this case – and under specific operating conditions – ignition may be triggered, which may result in damages to the intake manifold.
However, with the new ***Alisei-ZETA*** system, all of the above may be considered a "prehistoric" fact, since our product is based on a *sequential* type of ignition. Specifically, the amount of gas injected during each engine cycle is the bare minimum required for ignition. Gas is released into the intake manifold through a *sequence* of impulses which are perfectly synchronized with each engine *phase.* This feature – combined with the fact that injection nozzles are located above the inlet valves – helps prevent gas fumes from collecting in the intake manifold.

1.2.3 Performance

With the old fashioned systems – or, in other words, traditional ones – a decrease in performance quality was an unpleasant, yet unavoidable, drawback. These systems used to feature a mixer installed right above the intake manifold. Its purpose was to reduce air flow. However, this would often cause a reduction in the fluid-dynamic charge – which would lead, in turn, to a considerable decrease in performance quality for the engine, both while using petrol and LPG.
The Zavoli ***Alisei-ZETA*** retrofit kit will not alter the original fuel dispensing pathway of the engine in any way – nor your vehicle's performance when using petrol. For the same reason, your vehicle is guaranteed to maintain optimal performance levels also when running on gas, and to achieve much better results than when using a traditional system. On the whole, we can describe our retrofit kit as an "unobtrusive" system for the original fuel dispensing pathway of your vehicle. In addition, the "Master/Slave" function in our ***Alisei-ZETA*** retrofit kit will make your engine more flexible and receptive. Unlike traditional systems, ***Alisei-ZETA*** will dramatically improve your vehicle's acceleration times.

1.2.4 An Environmentally-friendly System

Zavoli srl prides itself on its attention and respect for anti-pollution regulations. The anti-pollution law enforced by the European Union has set restraining conditions about tail pipe emission levels. In detail, the recent EURO 4 law requires all new vehicles registered in E.U.-member countries to ensure compliance with the current anti-pollution regulations. Vehicles fueled by environmentally-friendly substances, or alternatively by LPG and Methane gas, are required to comply with this law too.
Incidentally, LPG and Methane contain smaller amounts of polluting substances, and are therefore a lot less dangerous than regular petrol. Moreover, toxic additives are usually added to the latter to increase its octane number – a practice which, on the other hand, does not concern environmentally-friendly fuels. Therefore, a vehicle using a gas-injection system will always be less dangerous for our environment.

The ***Alisei-ZETA*** retrofit kit carefully controls the amount of gas being dispensed to the engine allowing it to use the most advantageous air-fuel mixture possible. A good mixture is a key element in the performance of every vehicle, as it allows the catalyst to perform at its best. As a consequence, the amount of polluting substances released by the vehicle (CO, HC, NOx) will be drastically reduced.

1.3. NOTES

1.3.1 What to Do in Case of Maintenance Checks or Repairs

Your LPG tank will have to be removed before your car is taken in for a professional oven paint job. Should your vehicle experience any issues with its mechanical, electrical or body parts and need to be taken in for repairs, your mechanic or body shop personnel will determine whether parts of your gas system must be removed or temporarily repositioned.
Caution: For security reasons, the repositioning and/or removal of the system or of any of its parts must be performed exclusively by an authorized Zavoli installer.

1.3.2 Environmental Operating Conditions

Our system is designed to operate at a temperature range of **–30 °C** and **+60 °C**.

1.3.3 After an Accident

Your ***Alisei-ZETA*** system will have to be inspected by an authorized professional ZAVOLI installer after an accident.

1.4. Operating Strategies of the Retrofit System

The ***Alisei-ZETA*** Retrofit Kit is a system which "complements" your vehicle's petrol system. In other words, even when your vehicle is using gas, the petrol control unit will still determine the amount of fuel to be supplied to the engine. ***Alisei-ZETA*** is in fact a "slave" device, a sort of "intermediary" which connects the "master" petrol system to the gaseous fuel control unit. The way ***Alisei-ZETA*** operates is based on a connection between the electronic C.U. (2001N for 3-4 cylinder vehicles and 2568 for 5-8 cylinder vehicles) and the petrol control unit, established through of a series of charging terminals controlling the injectors. The electronic control unit is therefore able to read each individual petrol injection time (PIT). When the vehicle uses gas, the injection signal is sent by a series of injector emulator devices located in the control unit itself (see Fig. 1.4-1). By means of the PIT and an engine RPM signal sensor, the control unit determines the amount of petrol that the original control unit is going to supply to the engine. This amount is converted into gas injection times (GIT) which are implemented by the gas injectors.
The ***Alisei-ZETA*** retrofit system can be turned on/off by pressing the button on the Petrol/Gas switch. The ignition phase usually uses petrol, while the best time to switch to gas mode is determined by the temperature of the gas stored in the tank. (Optimal gas temperature levels can be easily programmed by means of the system software during the installation phase). Once fuel has reached its ideal temperature, the system will automatically switch to gas.

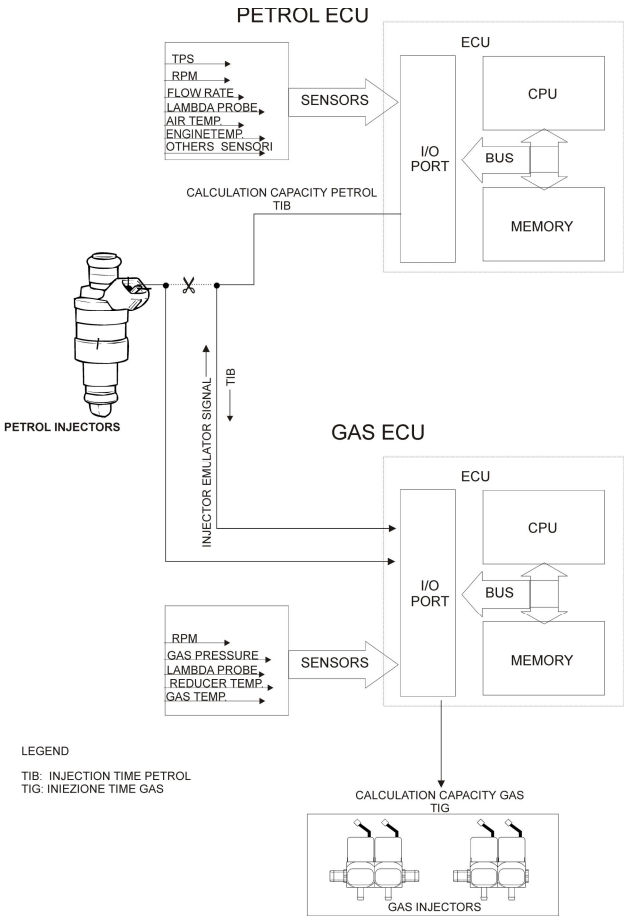


Fig. 1.4-1 – "Master/Slave" system operating chart

Electromechanical Operation Cycle

When switching to gas, the solenoid valves regulating gas flow open up, thus allowing liquid gas to flow out of the tank and into the pressure regulator. Here gas is vaporized, and pressure levels are decreased by reducing the temperature of the water stored in the engine cooling system. A compensation device ensures that the difference between the pressure of the outgoing flow in the pressure regulator and the MAP (*Manifold Absolute Pressure*) is constantly maintained throughout the different phases of engine load. The fuel (in its gaseous form) is then channeled to the injectors, whose opening is synchronized with each intake phase. The synchronized opening times of the injectors determine the amount of gas being supplied to the engine.
All of the above is part of a procedure which has become virtually necessary if vehicles are to meet the restrictive EOBD anti-pollution regulations – even in the case of gas-fueled systems. As a matter of fact, the vehicle's original EOBD (European On Board Diagnostic system, a device which checks tail pipe emission levels) will remain active even when you are using gas. If any of the components of the gas system fails to work correctly, the safety of the anti-polluting system is compromised. But in this case, the ECU immediately proceeds to identify the malfunctioning part and automatically switches back to petrol. Afterward, your ***Alisei-ZETA*** system installer will be able to identify the malfunctioning part by checking the ECU memory, and to perform a more precise diagnosis of the failure. In cases like these, the automatic switch back to petrol will be indicated on the switch display (see the "Petrol/Gas Switch" paragraph).



Make sure that the petrol tank is *never* empty. Both LPG and Methane versions of the system require that at least ¼ or ½ of the tank be filled with petrol at all times.
It is extremely important to have a sufficient amount of petrol in the tank, because your vehicle will have to run on petrol regularly in order to maintain its efficiency. Should your vehicle not be in the condition to start with petrol (ex: in case of problems with the petrol pump, etc.), ignition can be performed with GAS. See the "Petrol/Gas Switch" paragraph.

1.5 General Description of the Components

The ***Alisei-ZETA*** retrofit kit is composed of a number of components which will be installed in the vehicle. See fig. 1.5-1 for reference.

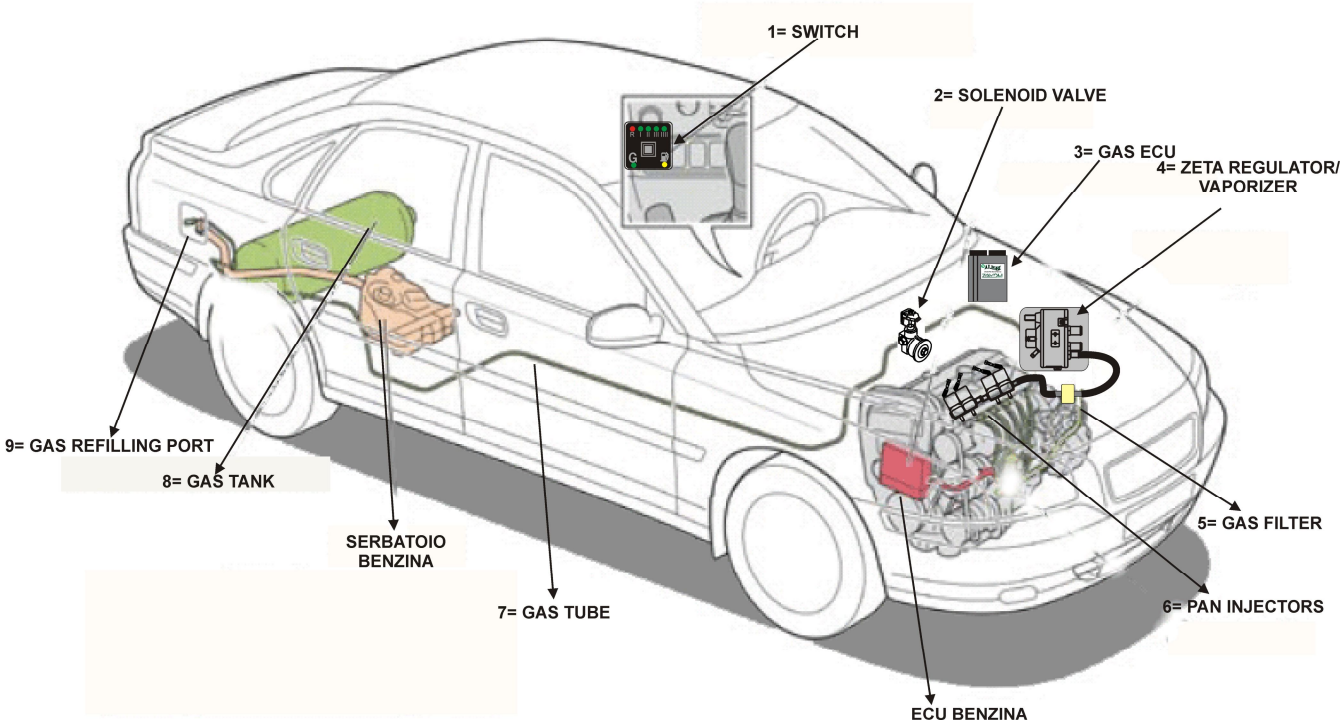
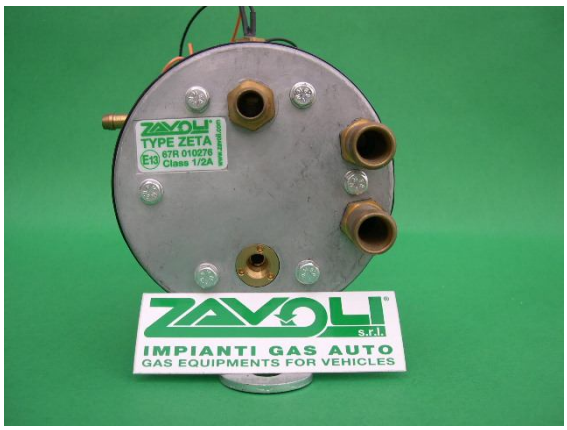


Fig.1.5-1

Alisei-ZETA RETROFIT KIT MAIN COMPONENTS - LEGEND	
POSITION	**DESCRIPTION**
1	SWITCH
2	SOLENOID VALVE
3	GAS ECU
4	*ZETA* REGULATOR/ VAPORIZER
5	GAS FILTER
6	PAN INJECTORS
7	GAS TUBE
8	GAS TANK
9	GAS REFILLING PORT

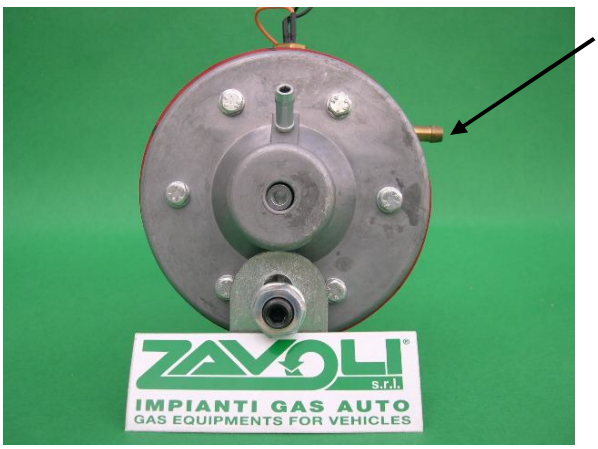
1.5.1 ZETA Regulator/Vaporizer

The kit is equipped with a regulator/vaporizer, called **ZETA**, which is designed to control pressure levels. The regulator/vaporizer is available in two models: **ZETA N** (regular) and **ZETA S** (super). The regulator, illustrated in fig. 1.5.1-1, comes in a conveniently compact size.



1.5.1-1

The regulator/vaporizer is the area where gas turns from a liquid to a gaseous state – a transformation which causes a reduction in pressure. From the tank, gas enters theregulator in a liquid form. Here, following a lamination process, its pressure is decreased and the liquid gas takes on a gaseous form. In order for the process to be completed, heat is taken from the engine cooling system. The regulator is also equipped with a pressure release valve and an integrated water temperature sensor.
The single-stage **ZETA** regulator provides, in other words, a surface for thermal exchange which allows for a complete gasification process even under the most extreme circumstances (ex: low room temperature, heavy engine loads and long-distance driving). In order for the kit to work properly, the difference between the pressure of the outgoing flow in the pressure regulator and the intake manifold must be maintained at stable levels. The reason for it is that as the engine load increases, so does the intake manifold absolute pressure (or MAP). If the pressure of the outgoing flow in the pressure regulator/vaporizer were stable, the difference in pressure between the two parts would decrease – resulting in a reduction of the amount of gas supplied to the engine. A “compensation” system and a small rubber tube, however, connect the chamber containing the contrast spring with the intake manifold in the engine.
As shown in fig. 1.5.1-1, all the connections branching off of the regulator are located in front of the device: gas intake, gas outtake and water circulation pipe. The fixing screw and depressurization chamber socket, instead, are located in the rear (fig. 1.5.1-2), while the pressure regulation valve can be found at the center of the regulator (use a 4mm allen wrench).



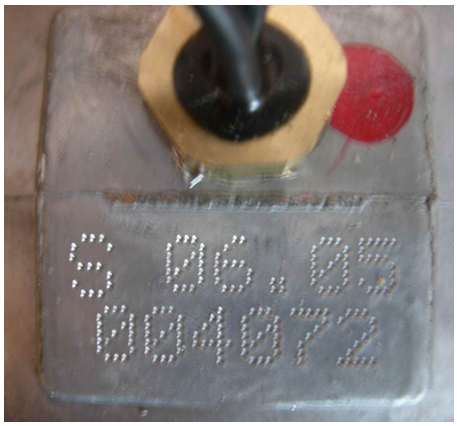
1.5.1-2

Fig. 1.5.1-2 shows the pressure release valve, which following directions in chapter 2, must be connected to the intake manifold.

In order to tell a ZETA N regulator (fig. 1.5.1-3) from a ZETA S regulator (fig. 1.5.1-4), check the identification number near the water temperature sensor. An N identifies a simple regulator, while an S identifies a “super” regulator. A “super” regulator is also identified by a red stamp.



1.5.1-3



1.5.1-4

WARNING:

The pressure of the **ZETA N** regulator must be at **1.2** atm, while the **ZETA S** must be maintained at **1.5** atm. Please remember to specify what regulator your vehicle is using when working with the system software.

1.5.2 GAS ECU



1.5.2-1



1.5.2-2

The Gas ECU (Electronic Control Unit) is available in two models (2001N for 3-4 cylinder vehicles, fig. 1.5.2-1, and 2568 for 5-8 cylinder vehicles, fig. 1.5.2.-2). The ECU is the operative device which controls the whole system. The entire unit is made up of automotive components, which allow it to withstand high engine temperatures. We recommend, however, that you do not install it in close proximity to heat sources, like the exhaust manifold, for example. The control unit is watertight, and its electro-magnetic features comply with regulations UNECE R67-01 and R10-02. The main wiring for the Gas ECU uses watertight connectors designed to protect the system - IP 54 (IEC EN 60529).
The Gas ECU software is installed in a non-volatile memory support unit, which allows you to save your personal settings even in case of power outage.

Here are some of the main tasks performed by the Gas ECU software:

I. It controls gas injectors. Thanks to the PIT and the engine RPM signal, the unit determines the amount of petrol that the original control unit is going to supply to the engine. This amount is converted into gas injection times (GIT) which are implemented by the gas injectors (see fig. 1.4-1).

II. It deactivates the original petrol injectors whenever the vehicle is using gas. It also “emulates” the way petrol injectors work in relation to the Petrol ECU. Both operations are made possible by connecting the emulation circuit wiring (see fig 1.4-1) to the negative wires of the petrol injectors. Deactivating petrol injectors prevents petrol from being injected into the engine when your car is running on gas. The emulation process, on the other hand, ensures that the petrol ECU does not translate the temporary cutting-off of the other injectors as a system failure.

III. It performs regular self-diagnoses of the system and identifies potential failures of each retrofit kit component. All component breakdowns – which could cause the emission of toxic substances and trigger a switch-back to petrol mode – are memorized. We would like to remind you that when using gas, the vehicle’s original EOBD will remain active for all the original components (with the exception of emulated parts, like petrol electro-injectors, for example).

IV. It implements Safety Car measures by switching off gas solenoid valves in case of engine breakdown – even when the key is inserted and the dashboard controls are on.

1.5.3 Gas Injectors

The ***Alisei-ZETA*** retrofit kit supports two different kinds of injectors.

One is the **Matrix MJ** Rail (fig. 1.5.3-1), the other are the Zavoli srl **PAN** injectors (fig. 1.5.3-2). Injectors dispense the gas coming from the pressure regulator into the individual cylinders, controlled by the Gas ECU. These electro-magnetic devices are based on one or more coils, whose task is to control the shutter. The latter, in turn, controls fuel flow.
By means of a connector, each injector input is attached to the pressure regulator tube, while outputs use calibrated nozzles (or jet nozzles) to connect to the intake manifold (located near the intake valve). Injector output nozzles are selected according to the specific engine power. Injectors must be installed as close as possible to the intake manifold by means of rubber tubes of identical length. We suggest you to keep the distance between the injectors and the injector nozzle as short as possible.



1.5.3-1

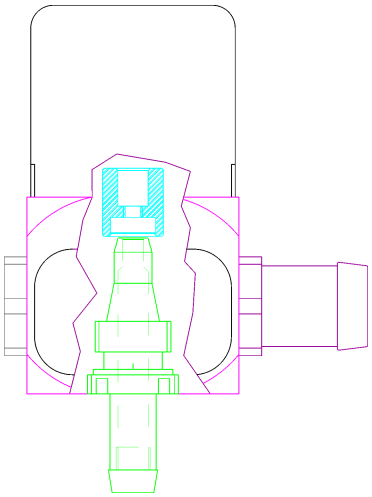


1.5.3-2

1.5.3.1 Matrix MJ Rail

The Matrix MJ Rail (fig. 1.5.3-1), features a single gas input, attached to the main body by means of a connector. Thanks to the connector, gas is channeled to each individual output nozzle. Power supply for the injectors is provided by a single connector attached to the main wiring. The connector is watertight, and designed to guarantee an IP 54 (IEC EN 60529) protection level.

1.5.3.2 Pan Injectors



1.5.3.2-1

PAN injectors (fig. 1.5.3.2-1) are designed to induce (or cut off) gas flow to the Regulator. When the injector opens up, gas is supplied to the engine by means of a tube attached to the side of the intake manifold on the engine head. Closing and opening times for the injectors are determined by the Gas ECU, which shoots the injector coil with a 12-volt power jolt. A magnetic field is then created around the coil, and when the coil spring resistance is overpowered, the piston raises up. The latter is attached to an actuator, which prompts gas flow. As soon as power is shut off by the ECU, the magnetic field disappears, and the piston, pushed by the coil spring, brings the actuator back into its original position. Under these conditions, both the gas pressure and the coil spring thrust ensure a watertight seal by forcing the actuator back into its position. Power is supplied to the injectors by individual connectors attached to the main wiring. The connectors are watertight and designed to guarantee an IP 54 (IEC EN 60529) protection level.

1.5.4 Pressure Sensors



1.5.4-2

The device shown in fig. 1.5.4-2 contains two sensors. The first one measures the absolute pressure of the **Matrix** injector rail (or **PAN** injector group), while the second measures the absolute pressure of the manifold (MAP). The second sensor supplies the Gas ECU with important information about the absolute pressure of the intake manifold. This helps the Gas ECU to determine gas injection times. The device's pre-wired connection allows for a convenient, easy installation.

1.5.5 Gas Temperature Sensor



.5.5-1

The gas temperature sensor (shown in fig. 1.5.5-1) is thermo-resistant, and is designed to measure the temperature of gas in the tube connecting the injectors to the regulator. The information provided by this component helps the Gas ECU to determine gas injection times.

1.5.6 Pneumatic-Hydraulic Tubing Harness and Connectors

The tubing harness is the final part of the retrofit kit fueling system. Thanks to it, gas flows to the intake valve, where it is channeled into each individual cylinder. Therefore, it is extremely important that this part be installed correctly (see following directions). The connection between the injectors' output tubes and the intake manifold is ensured by a series of brass connectors, to be fixed to the intake manifold.

The retrofit kit comes with a series of tubes of different diameter, which varies according to their use:

- Ø 15 water tube, with corresponding joints and metal bands. Always make sure that water flow is steady.
- Ø 4 tube, to connect the injectors to the pressure sensor (fig. 1.5.4-2). It is used to measure the pressure of the injectors and the level of depressurization of the intake manifold.
- Ø 5 tube, to connect the depressurization chamber with the regulator.
- Ø 6 tube, to connect the injectors with the injection joints located on the intake manifold.
- Ø10 tube, to connect the regulator to the injectors.

1.5.7 Main Wiring



1.5.7-1



1.5.7-2

The kit's main wiring varies depending on the type of Gas ECU in use. For the 3-4 cylinder model (fig. 1.5.7-1) the wiring consists of two connectors: a "**BLACK**" one, incorporating all the main connections to sensors, signals, power supply, etc., and a "**GREY**" one, which integrates pre-cabled connections for the gas injectors, the injector cut-out cable and the pressure sensor. Both "**BLACK"** and "**GREY**" connectors must be installed in the corresponding Gas ECU ports. The wiring harness connecting to the Gas ECU is compact and conveniently protected against potential damaging events which might occur in the system. The connectors used in pre-cabled connections are watertight. Connections created without a pre-cabled connector must be put into place with the utmost care, as described in the following paragraphs.

1.5.8 Petrol/Gas Switch

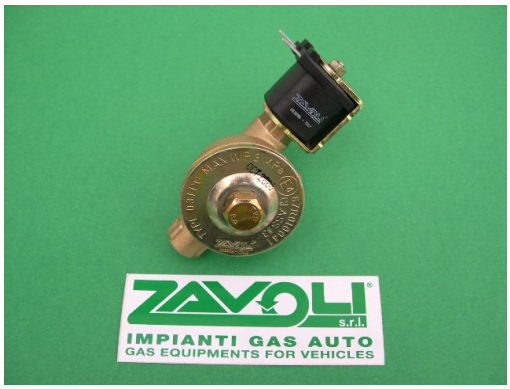


1.5.8-1

The Petrol/Gas switch (fig. 1.5.8-1) is the electronic device used to switch from petrol mode to gas mode. It is also used to check the amount of gas left in the tank; perform self-diagnoses and identify potential failures or malfunctions in the system (gas shortage, breakdowns, automatic switch to petrol, etc). All of the above functions are indicated by a series of LED's, or by an acoustic signal (buzzer). The device features modern, essential design and a compact size which makes for easy installation on the dashboard.

1.5.9 LPG Solenoid valve

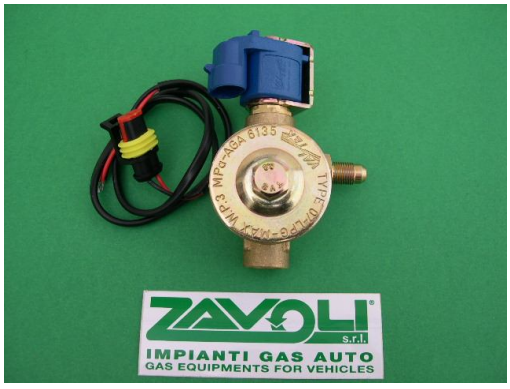
The solenoid valve controls the flow of LPG from the tank to the regulator. It comes in a conveniently compact size, and must be installed right above the regulator. The "regular" model (shown in fig. 1.5.9-1) is connected to the regulator by means of a Ø 6 copper pipe, while the 5-8 cylinder "regular" model is connected directly to the regulator by means of a specifically designed valve (see fig. 1.5.9-2). With all "super" models, the type of connection used is similar to the 5-8 cylinder model, with the exception of the tube, which in this case is a Ø 8 (see fig. 1.5.9-3). The valve is designed in compliance with regulation UNECE R67-01, and it features an electro-magnetic part which opens the valve by activating a shutter. This allows LPG to flow freely. It is, in other words, a device which is generally closed up to prevent LPG flow unless power-operated. It is not necessary to disconnect feed pipes when replacing and/or cleaning filters.



1.5.9-1



1.5.9-2



1.5.9-3

1.5.10 Gaseous Phase Gas Filter

The gaseous phase gas filter is a very important part of the system, as it removes soot and particulate matter from gas, thus ensuring the correct functioning of the injectors. The system supports two different kinds of filters: F779 (fig. 1.5.10-1) and MJ (fig. 1.5.10-2).



1.5.10-1



1.5.10-2

1.5.11 Tanks and Accessories

The retrofit kit is designed to work with an LPG tank and to use gas in a gaseous form. The tank must be equipped with all the accessories listed in the corresponding homologation certificate, in compliance with regulation UNECE R67-01. Some of the accessories in the following list may be combined in one single multi-functional component called the “multi-valve”, which is to be installed in the corresponding ring nut on the tank.

- Watertight chamber (only when the accessories are located inside the vehicle)
- Interception solenoid valve
- LPG tank inlet (connection for fuel supply)
- Fuel Supply Control Cut-Off Valve. It cuts off fuel intake when the gas inside the tank has reached the maximum capacity of 80%
- Overflow valve.
- Pressure release valve
- Thermo-fusible (whenever included in the tank homologation certificate)
- Level-indicator sensor (a device used to read the level of LPG in the tank).

1.5.12 High Safety Standards

Modern gas systems are designed to guarantee high safety standards – much like petrol-based systems – both during everyday use and after an accident. In order to maintain such high safety standards – prescribed by European Homologation Regulations UNECE R67-01 and R115-00 – the system must be equipped with the following devices.

1.5.12.1 Watertight Chamber

This is a watertight container which is used whenever the fuel tank is installed inside the vehicle. It acts as a “conveyor” for any potential excess LPG coming from the pressure release valve, or leaking from connections between the system components. The watertight chamber must be directly connected with the outside by means of flexible tubes and inlet valves.

1.5.12.2 Interception Solenoid Valve

The system is equipped with two LPG interception solenoid valves:

- One valve is located on the multi-valve (or valve group) of the tank.
- The other valve is located above the regulator.

Both valves are designed to automatically isolate the tank from the rest of the system. The valves are automatically shut in the following cases:

- When the engine is off.
- When the vehicle is using petrol.
- When the “Safety car” function is activated.

1.5.12.3 Fuel Supply Cut-Off Valve

The valve group (or multi-valve) is equipped with a specific valve which, when putting gas in the car, automatically cuts off fuel intake when the gas inside the tank has reached the maximum level of 80%. In higher temperatures, the volume of liquid LPG tends to increase considerably, since this gas has a high thermal dilation coefficient. Cutting off fuel intake to 80% of the maximum tank capacity ensures that there is enough room left for the gas to expand when the temperature rises. If the tank were completely filled, the pressure inside would rise alongside the temperature, which, in turn, would set off the pressure release valve.

1.5.12.4 Overflow Valve

It is a mechanical valve which, in case of an accident or breakdown of the gas outlet pipes in the tank, will automatically set off and interrupt gas flow.

1.5.12.5 Pressure Release Valve

It is a valve located in the valve group – or in the multi-valve. It sets off when the pressure in the tank reaches the ‘alarm threshold’ of 27 bar ±1 bar, as a result of high internal temperature. The pressure release valve is a spring-loaded mechanical valve connected with the gaseous phase of the tank. It can release pressure both directly - in the atmosphere outside of the vehicle – and indirectly – through the watertight chamber. The valve will release pressure only for a short period of time, until pressure in the tank has

dropped below the ‘‘alarm threshold’. Once pressure is back to a safe level, the valve shuts off until the next ‘‘alarm threshold’ is reached.

1.5.12.6 Thermo-fuse

It is a safety device located in the valve group – or in the multi-valve – which sets off whenever the temperature in the vehicle reaches unsafe levels (in case of fire, for example). The fuse discharges the remaining gas in the tank, thus preventing the tank from exploding. When the ‘alarm threshold’ of 120 ± 10°C is reached, the fuse melts, thus allowing for a complete discharge of gas from the tank. The fuse is an irreversible “one-shot” type of device.

2. INSTALLATION INSTRUCTIONS

The following are general installation instructions. For more detailed instructions about specific vehicles, please refer to the installation guides provided in Part II of this Manual.

2.1 Getting Ready to Install

Before installing any ***Alisei-ZETA*** RETROFIT KIT, authorized installers are required to attend a training course exclusively offered or authorized by ZAVOLI srl.

2.2 Check-ups and Suggestions

Before installing the system, please refer to the specific installation guides provided in Part II of this Manual. We also recommend that you make sure that the vehicle is in proper working conditions when using petrol. In particular, carefully check the efficiency of the following parts:

- Air filter.
- Start-up system (cables, spark plugs, coils).
- Lambda sensor.
- Catalyst.
- With the help of proper diagnosis tools, verify that there are no malfunctions associated with the emission of toxic substances or with the petrol engine.

Change or adjust parts as necessary and replace defective items before proceeding with the installation.

2.3 Equipment and Materials Required for the Installation

⇒ Exhaust gas analyzer
⇒ Lifting platform
⇒ Bench vice
⇒ Tube cutter for the copper pipe
⇒ Tube cutter for the rubber tube
⇒ A series of assorted wrenches
⇒ M6x1 Screw taps
⇒ Screwdriver
⇒ Twist drill bits of different sizes (Ø 1.5 - Ø 12 mm)
⇒ Pillar drill
⇒ Portable hand drill
⇒ Ø 75mm, Ø 32mm cylindrical milling cutter
⇒ Multimetre
⇒ Personal computer
⇒ Software for the configuration/management of the ***Alisei-ZETA*** Retrofit Kit and corresponding communication interface device.
⇒ Diagnosis tools for vehicles

⇒ Soldering iron
⇒ Grease
⇒ Thermoshrinking sheath
⇒ Electric tape
⇒ Thread sealant
⇒ Alloy for soft brazing
⇒ Liquid leak detector
⇒ Anti-corrosion products

2.4 INSTALLATION - MECHANICAL PART

This Manual contains important information about the installation of the ***Alisei-ZETA*** Retrofit kit components, according to regulations UNECE R67-01 and UNECE R115-00. The installation of each component of the Retrofit Kit must guarantee the best possible level of protection against potential damages. Potential damages include those caused by the vehicle's moving parts, collisions with any type of goods stored in the vehicle, damage caused while the vehicle is being loaded/unloaded, or collisions with rocks, etc.
After drilling a hole in the body of the vehicle (when installing the regulator or to insert a cable, for example), please make sure to treat surrounding metallic surfaces with an anti-corrosion product.
Fix all the flexible tubes in place using the complementary metal bands, and make sure that the latter are not touching or rubbing against other mechanical parts.
Never position any of the kit components at a distance of less than 100mm from the engine exhaust pipes or any other heat source. While regulations allow for a shorter distance, we recommend that you carefully read point 1I, attachment 1 and paragraphs 17.1 - 17.2 of the ONU ECE R67-01 guideline before doing so.
When installed underneath the bed of the car, the tank must be at a safe distance of 200mm from the road surface while the vehicle is running, and must in any case be shielded by a chassis sheet in the front and on the sides.

2.4.1 ZETA Regulator/Vaporizer

The following general installation criteria are valid for both LPG and the CNG versions. The **ZETA** regulator must be securely fixed to the body, to prevent it from shaking while the vehicle is running. When the engine is under stress, the regulator should not hit against any other device. The regulator must be installed so that the temperature sensor faces upwards. We recommend that the tube connecting the regulator with the injectors be kept at a maximum length of 700mm, and that the regulator be installed in a way so that it is easy accessible in case any intervention or repair is necessary. Connections with the tank tubes must be established by means of a copper pipe in case of a **ZETA "N"** regulator (fig. 2.4.1 -1A). When installing a **ZETA "S"** regulator, on the other hand, connections are established by screwing the solenoid valve into the gas intake joint of the regulator (fig. 2.4.1-1B).

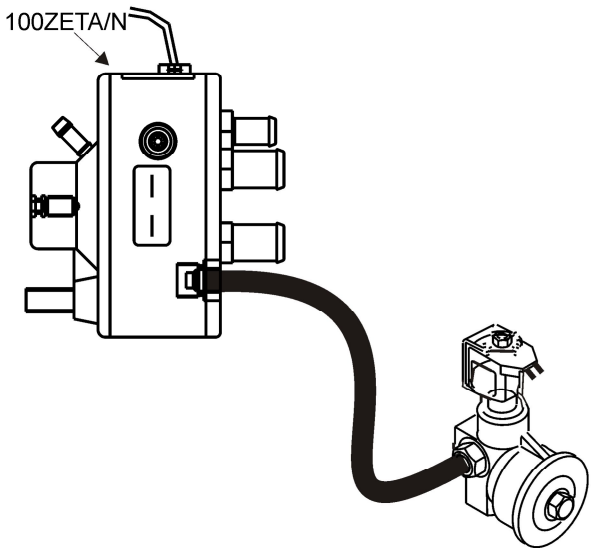


Fig. 2.4.1.-1A

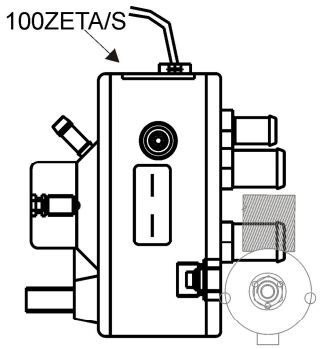


Fig. 2.4.1.-1B

The copper pipe connecting the solenoid valve with the ZETA regulator must not be installed near the hottest parts of the engine. Installers will also have to make sure to avoid awkward equipment configurations, in case future repairs or maintenance operations are needed.

In order to allow LPG to complete its gasification process, heat must be taken from the engine cooling liquid. The connection to the water tube will have to run parallel to the vehicle's heating system (fig. 2.4.1-2). The connection is established by cutting off the inbound and outbound tubing of the heating system. We recommend installers to use of two T's – one to be positioned in the inbound tube of the switch, and the other on the outbound tube.

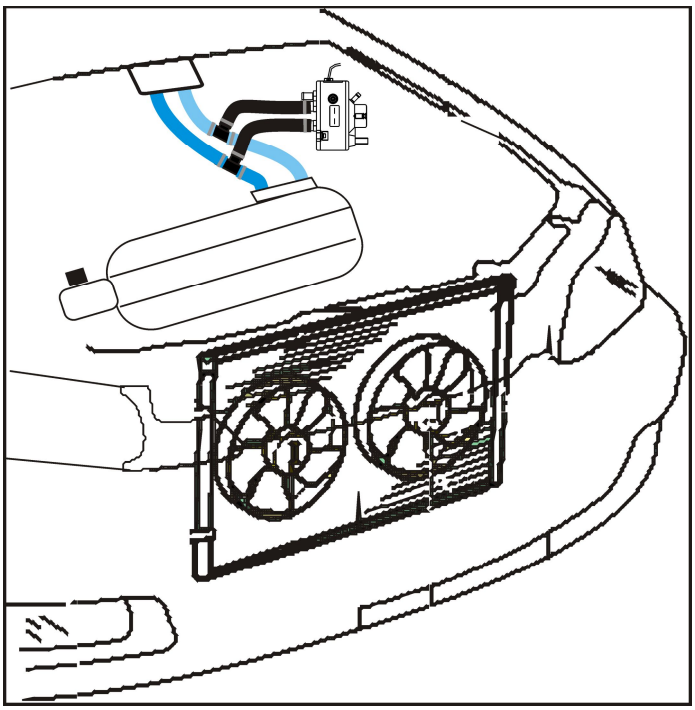


Fig. 2.4.1 -2

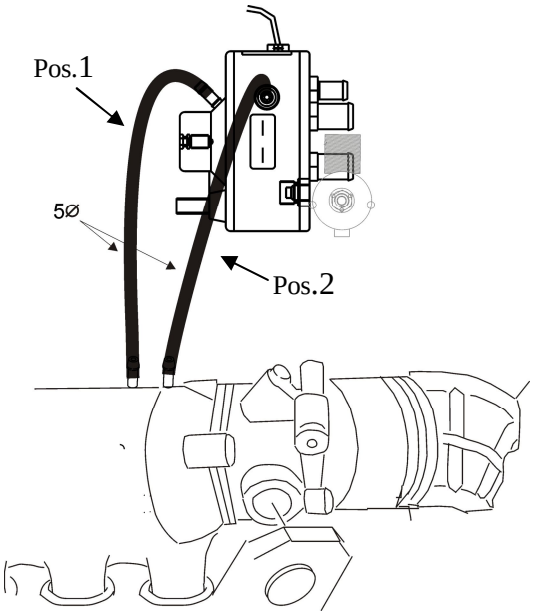


Fig. 2.4.1-3

As indicated in the previous paragraph, in order for the **ZETA** regulator to work correctly, pressure compensation must be ensured in the connection between the regulator (fig. 2.4.1-3, pos. 1) and the intake manifold. A connection between the two can be created by means of a Ø 5mm rubber tube. One of the tube ends is attached to the joint on the regulator, while the other is attached to the corresponding joint supplied with the kit. The joint must be perforated, cut, and then installed on the intake manifold. To be more precise, the hole must be drilled below the throttle valve and above the tubes branching off of the intake manifold and connecting to each individual cylinder. The tube should not be any longer than 700mm (fig. 2.4.1-3). In addition to the compensation joint, the regulator also features a pressure release valve (fig. 2.4.1-3, pos. 2), which must be connected to the intake manifold through a Ø 5mm rubber tube. Please refer to the directions given above to establish this connection. In order for this connection to be securely sealed, thread sealant must be applied on the stem of the joint before the latter is installed. While screwing down the joint, make sure that the thread sealant does not drip onto the nozzles and clog them. We recommend that you spray the nozzles with compressed air once the operation is completed.

We recommend that you remove the intake manifold before performing these operations (drilling holes, tapping, screwing the connector into place and cleaning the manifold). If, for any reason, the intake manifold cannot be removed, take all the necessary measures to minimize the risk of damages to the engine (ex: smear tools with grease before using them, sweep away shavings while working).

2.4.2 Tubing Connections

Tubing must be connected by means of the joints supplied with this kit. Tubing cannot be soldered, brazed or stapled into place. Whether flexible or stiff, tubing inside the vehicle (or the trunk) should not exceed the bare minimum length, as indicated.
Connections among tubes must be secured inside the “watertight chamber” (or in a similar protective case) to prevent potential gas fumes from being released inside the vehicle. Connections cannot be placed inside the vehicle or the trunk.
Whenever holes are drilled in the body of the vehicle to allow for the passage of flexible or stiff tubing, protective material must be applied along the edges of the holes.
In order for tubing to be installed correctly, make sure that it does not rub against any sharp edges, or blunt and movable parts of the main body of the vehicle or of the engine (ex: driving belts, shock absorbers, outtake manifold, etc.). Protracted rubbing may in fact cause the tubing to wear out. We also recommend that tubes be not too taut, nor bent, and that their cross-section is not in any way reduced. Once installation of the kit has been completed, please check that all the joints in the liquid/gaseous LPG circuit are safe by means of some liquid leak detector. Perform this operation while the vehicle is using gas.

Your retrofit kit features both rubber tubes and copper pipes. Copper pipes must be cut by the installer with the help of a pipe cutter. After cutting, make sure to trim and clean the inside rim of the pipe, to prevent any residue from obstructing it. Connect the copper pipes with pressure-screw joints and a double-cone ogive. Screw down the pressure screw by hand for at least one turn, so as to prevent the thread of the screw from getting damaged during the operation. Tighten the pressure screw enough to ensure a safe seal.
The rubber tubing supplied with the kit must be cut by the installer with the help of a tube cutter. After cutting, make sure that the inside of the tube is clean of any shavings, as they may affect the efficiency of all components connected to the tube. We recommend that the inside of the tube be sprayed with compressed air before being installed. Connect the tubes with their corresponding joints using the metal bands supplied with the kit.

2.4.3 LPG Solenoid Valve

The liquid LPG solenoid valve registers the amount of gas flowing from the tank into the regulator. It is small in size and conveniently compact. When installing a “regular” system, the valve must be fixed directly above the regulator (fig. 1.5.9-1) and connected to it by means of a Ø 6 copper pipe. With the 5-8 cylinder version, the solenoid valve is attached right onto the regulator (fig. 1.5.9-2), while with all “super” models, the connection will be the same as the 5-8 cylinder version, with the exception of the pipe, which is a Ø 8 instead of a Ø 6 (fig. 1.5.9-3).

2.4.4 Filter Units for the Gaseous Phase

Use F779 filters if you are working with **PAN** injectors, and MJ filters if you are working with Matrix **MJ** injectors. Filters must be installed between the regulator and the injectors, so as to allow for an easy replacement. Make sure to connect the regulator tube with the regulator inlet joint, and the injector tube with the filter outlet joint. Gas flow inside the filter should be following the direction of the arrows printed on the filter label. The tubing connecting the regulator to the filter is made of linen rubber, and must be connected to the corresponding joints by means of the metallic rings supplied with the kit.

2.4.5 Injectors

The injectors must be securely fixed into place, and installed as close as possible to the intake manifold. It is very important that the tubing connecting the injectors to the intake manifold does not exceed the maximum length of 150mm. The type of injectors to be used (as well as the corresponding “Calibrated Jets”) should be determined by the specific power of the engine (power per cylinder, kw/cylinder). We recommend that you refer to the specific vehicle installation guides to determine what type of nozzle is most suitable for each individual vehicle. Matrix **MJ** injectors come in single blocks of two, three or four injectors, while **PAN** injectors are modular – they are, in other words, assembled according to the specific type of engine installed in the vehicle.

2.4.5 PAN 4-Cylinder Rail Injectors Assembly Kit (2+2)
"Kit Code – 491MKI2+2v1"

Fig. 2.4.5-1 lists all the operations to be performed to assemble the kit correctly.

Description

1. Insert the O-rings (590001) in the corresponding sockets, as shown in fig. 2.4.5-1, step 1.
2. Connect the two **PAN** injectors together by using the 491003 connecting joint. Make sure that the two injectors are well connected. Repeat the operation for the next couple of injectors, step 2.
3. Tighten screw 491053 at an inclined angle, as described in fig. 2.4.5-1, step 3.
4. Screw down the two gas inlet joints (gas inlet joint of the injector, 491002) on the **PAN** injector couple. On another couple, fix the 491051 joint into place on one side and the inlet gas joint (gas inlet joint of the injector, 491002) on the other, as shown in fig. 2.4.5-1, step 4.

Step 5 shows the injector couples, properly assembled and ready to be installed.

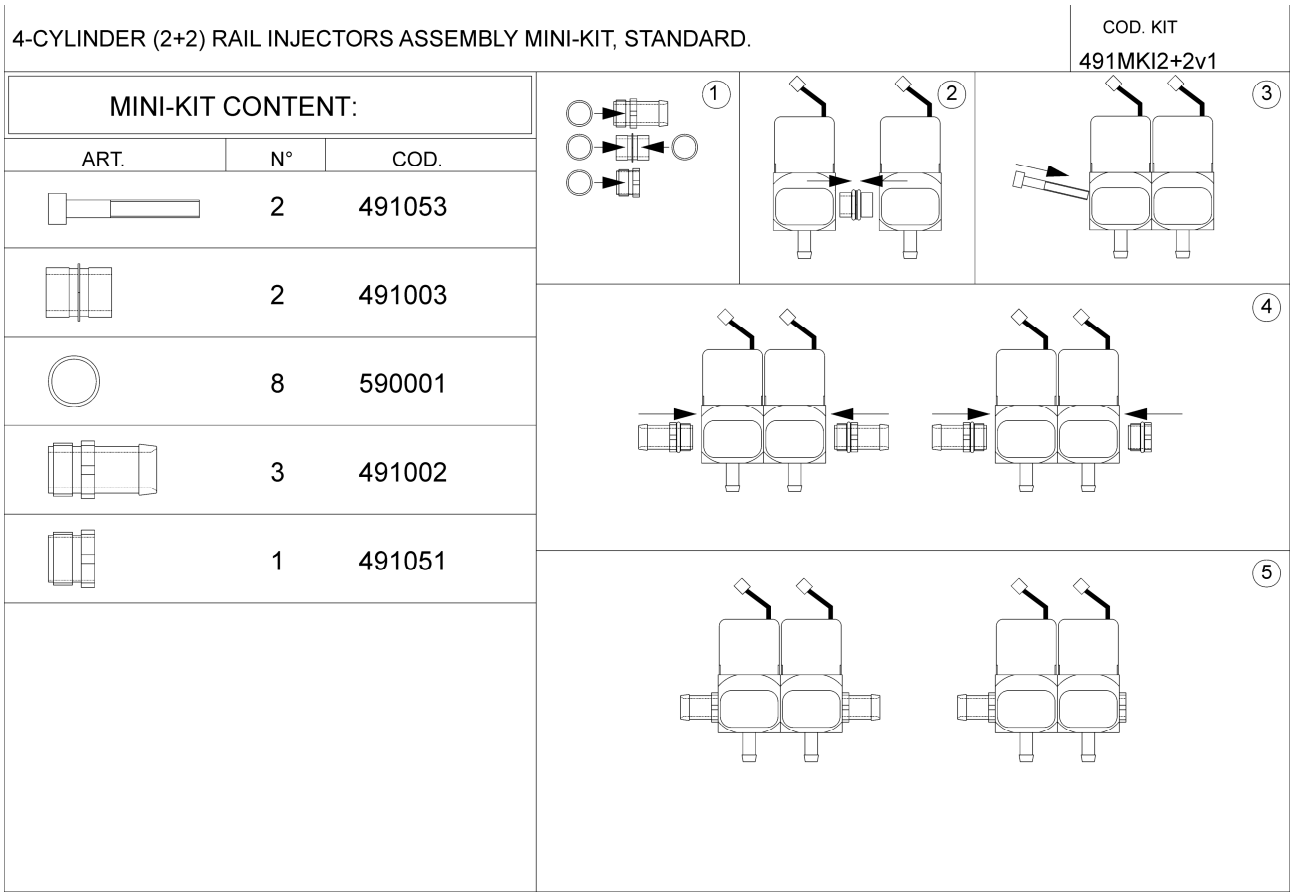


Fig. 2.4.5.1-1

2.4.5.2 PAN Rail Injectors Assembly Kit (3x1)

"Kit Code – 491MKI3x1v1"

Fig. 2.4.5.2-1 lists all the operations to be performed to assemble the kit correctly.

Description

1. Insert the O-rings (590001) in the corresponding sockets, as shown in fig. 2.4.5.2-1, step 1
2. Connect the two **PAN** injectors together by using the 491003 connecting joint. Make sure that the two injectors are well connected, as shown in step 2.
3. Tighten screw 491053 at an inclined angle, as described in fig. 2.4.5.2-1, step 3.
4. Join a third **PAN** injector to the pair obtained in fig. 2.4.5.2-1, step 4, by using a 491003 connecting joint.
5. Tighten screw 491053 at an inclined angle, as described in fig. 2.4.5.2-1, step 5.
6. Screw the 491051 joint into place on one side, and on the other side, install the gas inlet joint (gas inlet joint of the injector, 491002), as in step 6.

Fig. 2.4.5.2-1, step 7, shows the injectors, properly assembled and ready to be installed.

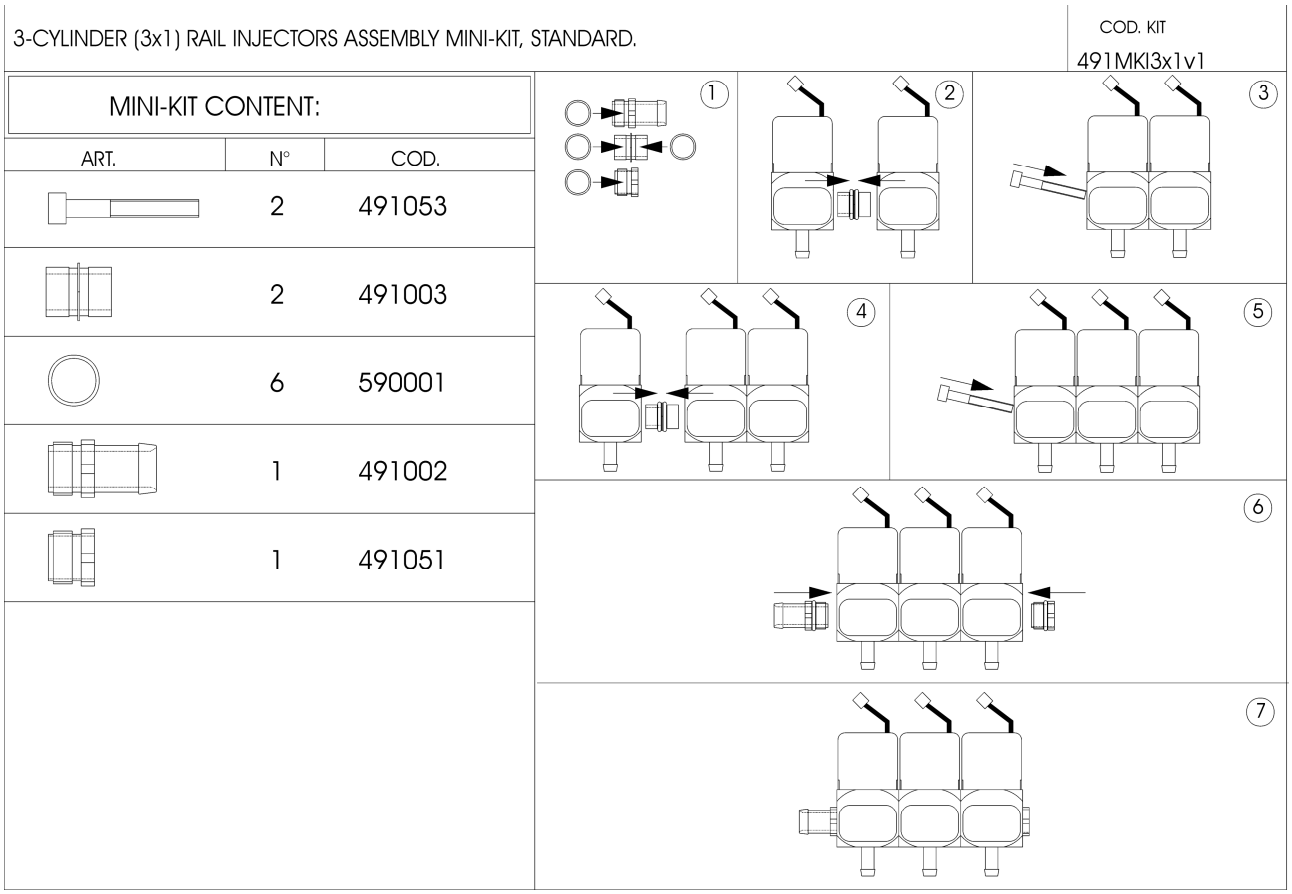


Fig. 2.4.5.2-1

2.4.5.3 PAN Rail Injectors Assembly Kit (3+2v1)

To assembly the injector kit for 5-cylinder vehicles, follow these directions **"Kit Code 491MKI3+2v1"***:*

1. Follow directions given in steps 1, 2 and 3 for the **PAN 4-Cylinder Rail Injectors Assembly Kit (2+2).** You will obtain a rail, composed by two injectors assembled together (fig. 2.4.5.1-1).
2. Follow directions given in steps 1, 2, 3, 4, 5 and 6 for the **PAN Rail Injectors Assembly Kit (3x1).** You will obtain a rail, composed by three injectors assembled together (fig. 2.4.5.2-1).

Fig. 2.4.5.3-1 shows the injectors, properly assembled and ready to be installed.

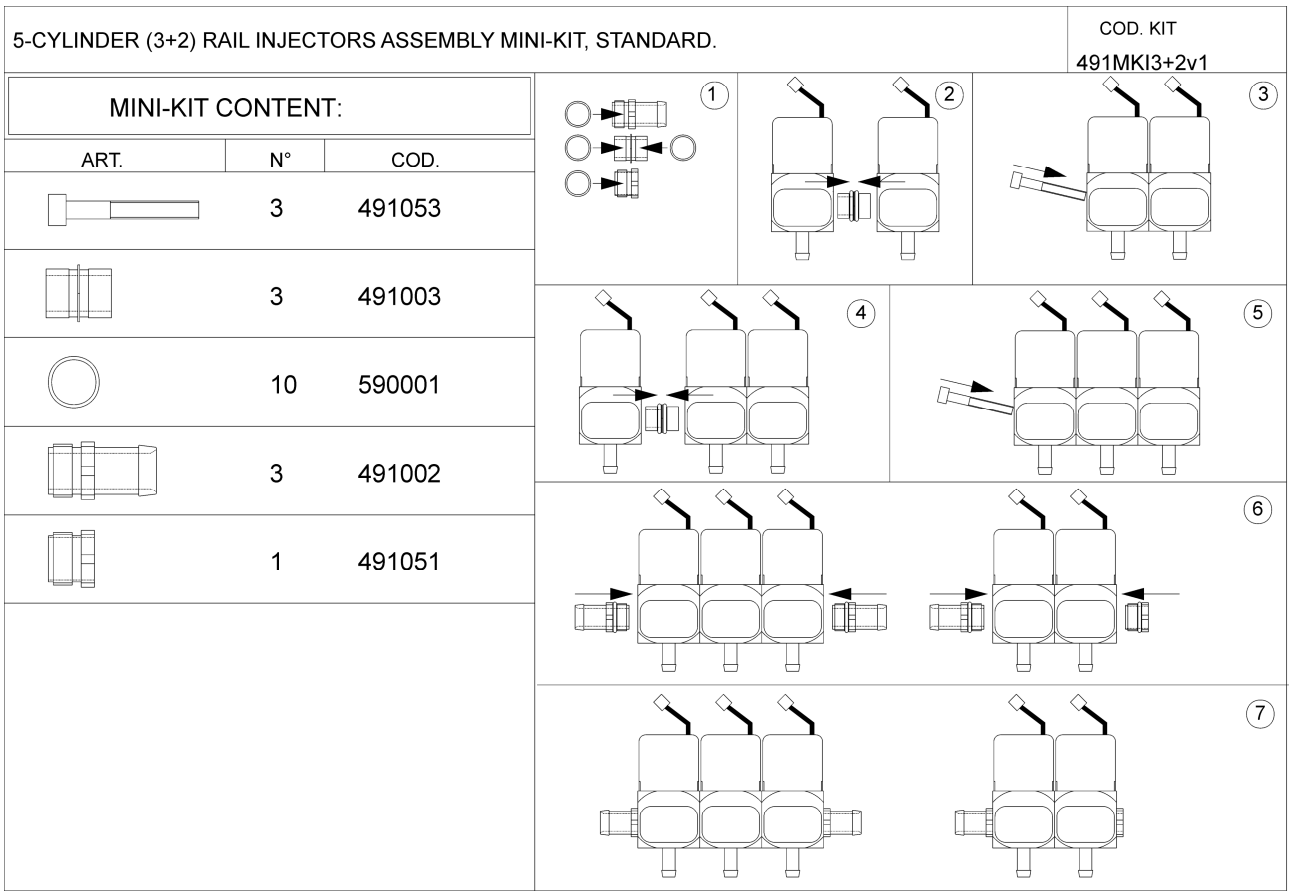


Fig. 2.4.5.3-1

2.4.5.4 PAN Rail Injectors Assembly Kit (3+3v1)

To assembly the injector kit for 6-cylinder vehicles, follow these directions **"Kit Code 491MKI3+3v1"**

1. Follow directions given in steps 1, 2, 3, 4, 5 and 6 for the **PAN Rail Injectors Assembly Kit (3x1)** (fig. 2.4.5.2-1)**.** Perform the operation twice. You will obtain 2 rails, composed by three injectors assembled together.

Fig. 2.4.5.4-1 shows the injectors, properly assembled and ready to be installed.

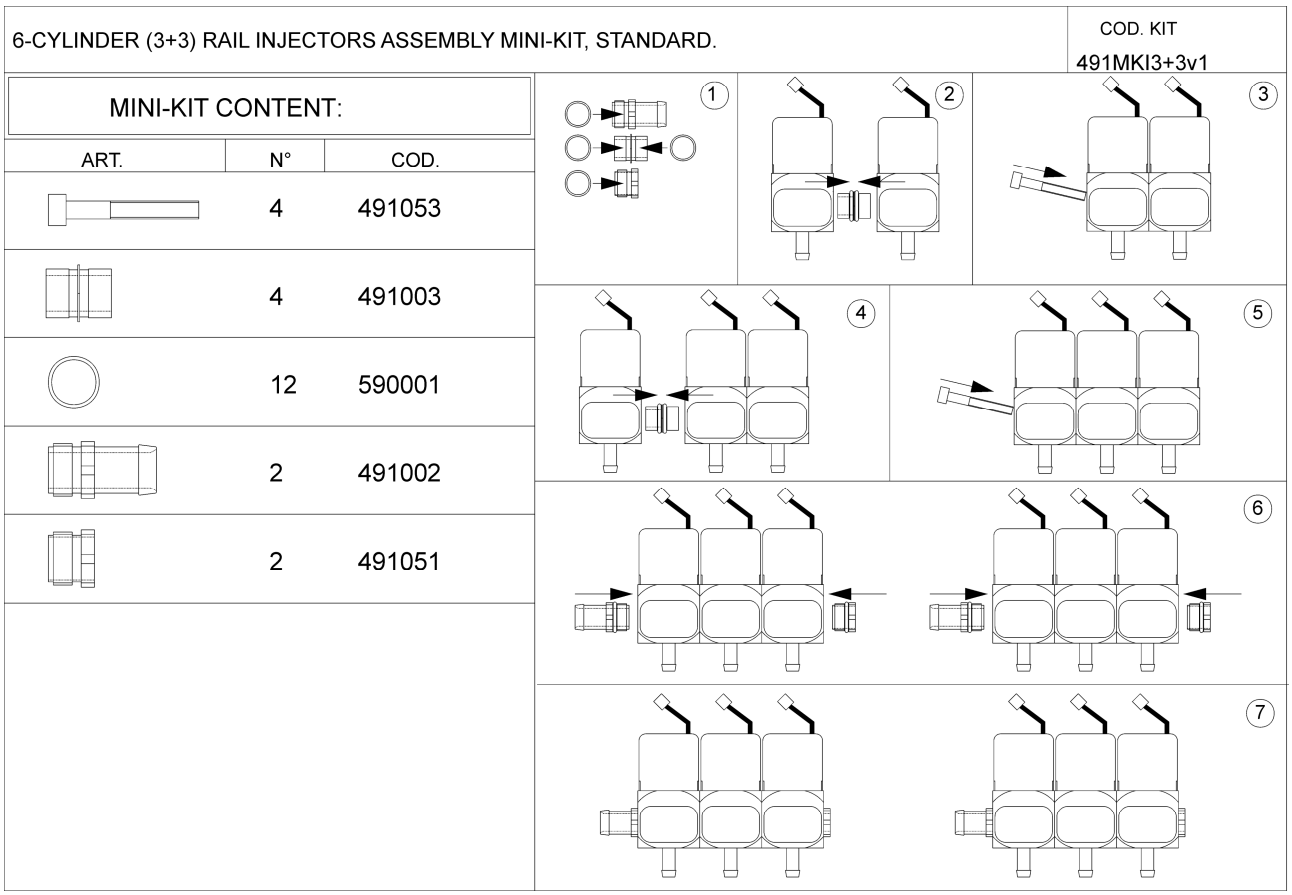


Fig. 2.4.5.4-1

2.4.5.5 PAN Rail Injectors Assembly Kit (2x4v2)

To assembly the injector kit for 8-cylinder vehicles, follow these directions **"Kit Code– 491MKI2X4v2"**

1. Follow directions given in steps 1, 2, 3 and 4 for the **PAN 4-Cylinder Rail Injectors Assembly Kit (2+2).** Perform the operation twice. You will obtain 4 rails, composed by two injectors assembled together (fig. 2.4.5.1-1)

Fig. 2.4.5.5-1 shows the injectors, properly assembled and ready to be installed.

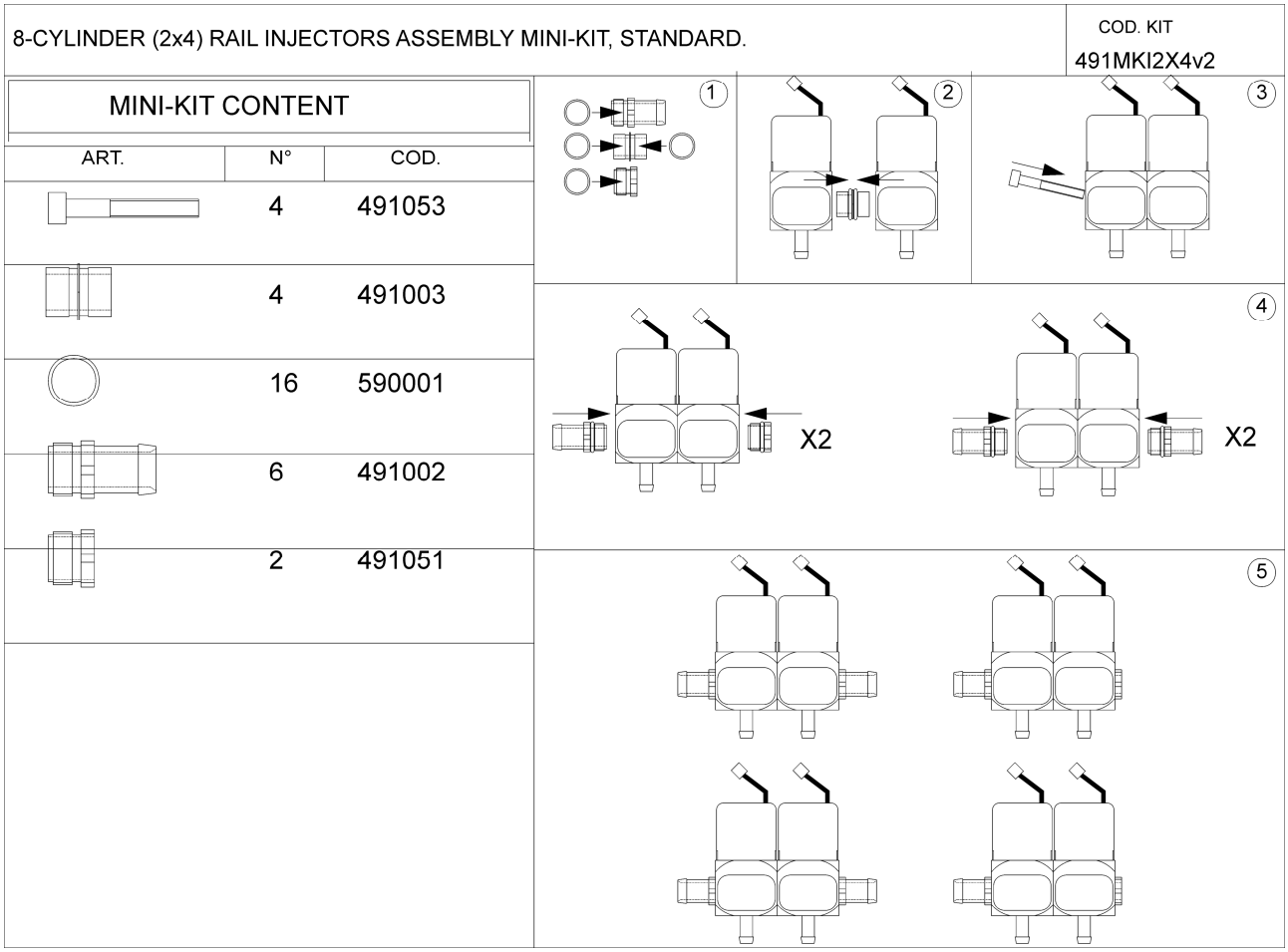


Fig. 2.4.5.5-1

2.4.5.6 Optional Assembly Kit for Pan Rail Injectors (1x4)

To assembly this kit of single injectors (one per cylinder), follow these directions **"Kit Code *491MKI1x4v1*"**

1. Insert the O-rings (590001) in the corresponding sockets, as shown in figure 2.4.5.6-1.
2. Screw down the inlet gas joints (gas inlet joint of the injector, 491002), as shown.
3. Repeat the same operation for the next 3 injectors.
4. Screw down the 491051 joint into place on one side, and the gas inlet joint on the other side (gas inlet joint of the injector, 491002), as shown in fig. 2.4.5.6-1

Fig. 2.4.5.6-1 shows the injectors, properly assembled and ready to be installed.

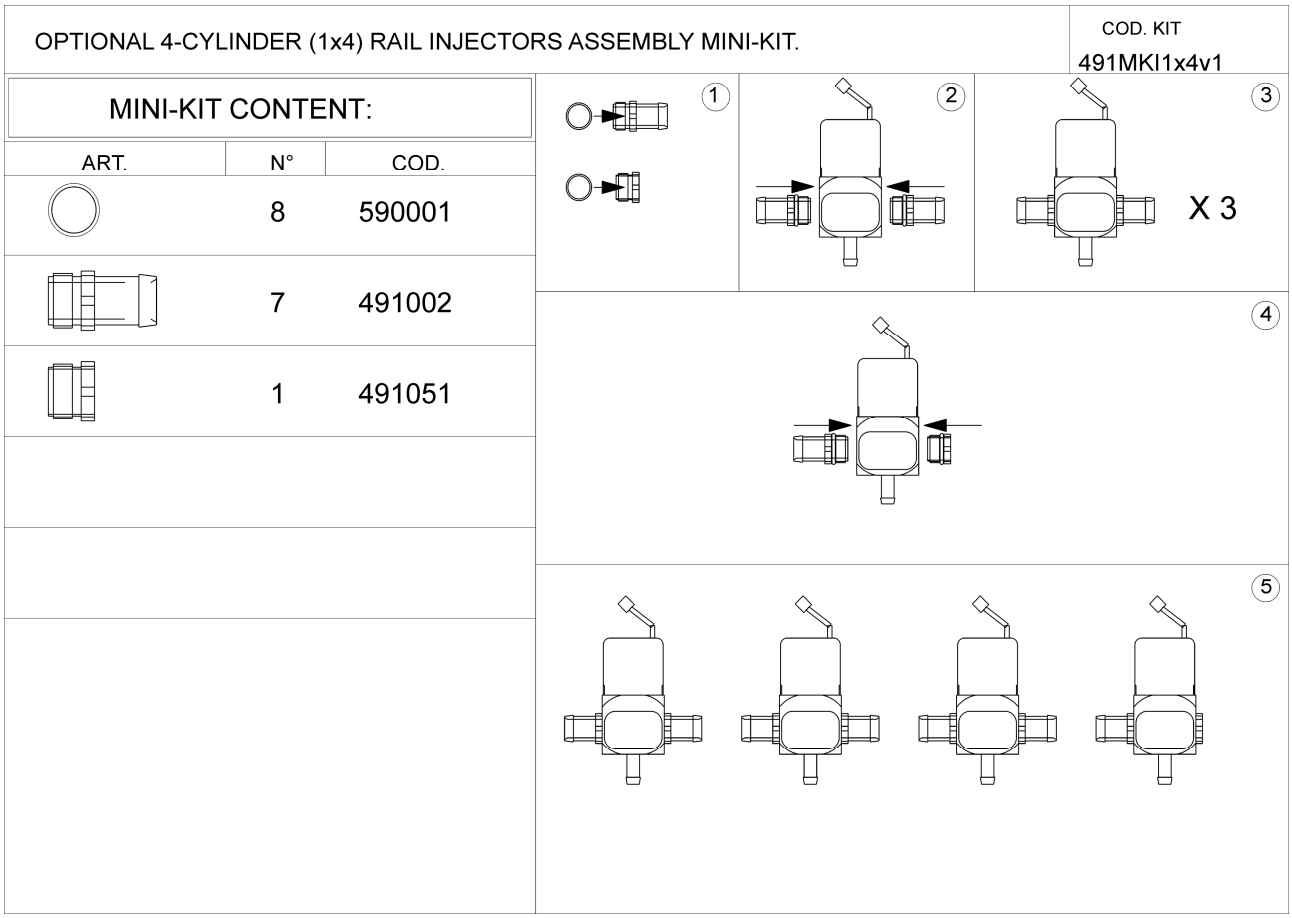


Fig. 2.4.5.6-1

We recommend installers to pay careful attention to any existing bends in the connecting tubing installed between the injectors and the intake manifold. Please make sure that bends are "soft" and flexible, and that enough room is allowed for the tubing. Make sure that the tubing does not get "crushed", as this may prevent the system from working correctly.

2.4.6 Installing the Injection Nozzles

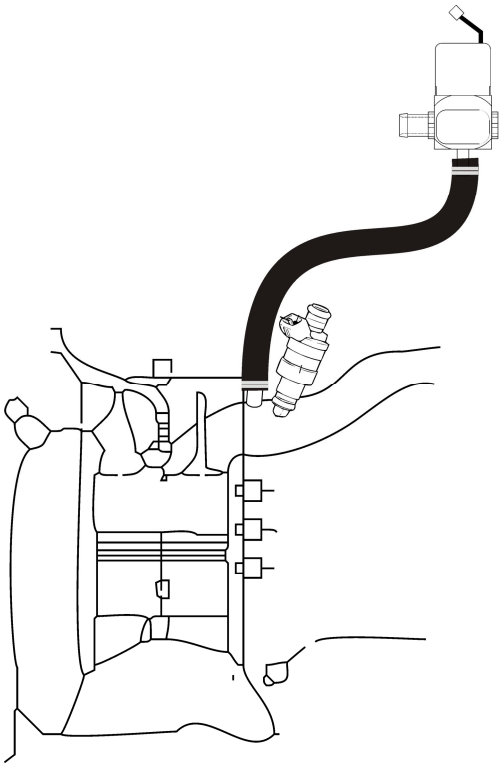


Fig 2.4.6-1

This section of the Manual will guide you through one of the most crucial phases of your work. Before you start installing the nozzles, we recommend that you clearly identify all the parts of the intake manifold that will have to be perforated. Perforations must be made near the engine head (fig. 2.4.6-1). Maintain the same distance on all the branches of the intake manifold, and also make sure to install all nozzles in the same direction. Each nozzle should be at a 90 degree angle with the intake manifold – or at least at such an angle that jets are directed toward the engine rather than the throttle valve. Carefully mark the exact perforation areas with a marker. Insert the drill bitsin the drill and make sure that each branch can be easily perforated in the proper direction. Before drilling any holes in the intake manifold, make sure that nozzles are positioned in a way that allows the connecting tubes not to exceed the maximum length of 150mm. Start by lightly scratching the manifold with the drill bit, and then drill your hole. Perforations must be made with a Ø 5mm twist drill bit, while trimming should be performed with an M6 screw tap. This is an extremely delicate part of the installation: as a matter of fact, shavings might collect inside the intake manifold and get sucked in by the engine when the vehicle is on. We therefore recommend that the drill bit be coated with grease before perforating and trimming the manifold. That way, shavings will stick to it rather than fall inside the manifold. Make sure to drill the last part of each hole slowly, so as to get very small shavings. This will allow shavings to stick better to the drill – and reduce the risk of future damage in case they fall into the manifold. While using the M6 screw tap, coat the tap with grease frequently, and clean it several times.
Screw the nozzles in very carefully taking care not to strip the threads, and secure them into place. Always take care to use the proper wrench to perform these operations. Do not alter the inner diameter of the nozzles in any way, nor their outer shape. To ensure a watertight seal in the connection, apply thread sealant at the base of the joint before installing it. While tightening the joint, make sure that the thread sealant does not drip into the nozzles, as this may clog them. We strongly recommend that nozzles are sprayed with compressed air when all installing procedures have been completed.



We recommend that the intake manifold be removed before the above-mentioned operations are performed (drilling holes, tapping, screwing the connector into place and cleaning the manifold). If, for any reason, the intake manifold cannot be removed, take all the necessary measures to minimize the risk of damages to the engine (i.e.: smear tools with grease before using them, sweep away shavings while working).

2.4.7 Pressure Sensors

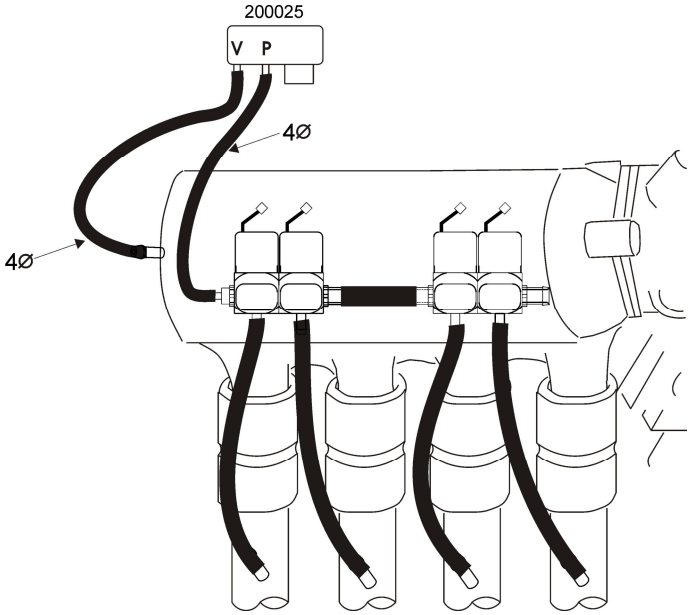


Fig. 2.4.7-1

Sensors must be installed on the body of the vehicle. Please make sure to avoid potentially hot areas. Tubing should be kept as short as possible, as shown in fig. 2.4.7-1. A connection with the depressurization chamber must be established by means of a Ø 4mm rubber tube. One end of the tube should be connected to the joint on the sensor marked by a "V", and the other to the corresponding joint supplied with the kit. The joint must be perforated and trimmed before being installed on the intake manifold. A second connection – which allows sensors to read the pressure of the injector rail – is created by means of a Ø 4mm rubber tube. One end of the tube should be connected to the joint on the sensor marked by a "P", and the other to a corresponding joint provided with the kit and installed on the injector rail.

2.4.8 Directions for the Installation of Tanks and Accessories

The tank must be installed inside the vehicle, in accordance with the installation requirements prescribed by UNECE regulations R67-01 and R115-00.
The main requirements for the installation are:
1. Installation of the tank must be carried out in accordance with the directions provided in the installation guide of each specific vehicle.
2. The installation of the tank in the vehicle is a permanent alteration, and must never be performed in the engine compartment.

A layer of protective material – felt, leather or plastic - will have to be inserted between the fuel tank and the metal bands.

1. When installed underneath the chassis, the tank must be at a safe distance of 200mm from the road surface when the vehicle is running. Nevertheless, the law provides for a shorter distance from the road surface, on condition that a protective system, specifically designed for this use, is installed over the tank.
2. The tank must be fixed to the body of the vehicle by means of the corresponding installation system. The law requires compliance with the following installation requirements:

    - The tank must be secured to the installation system by means of at least two metal bands;
    - The bands must prevent the tank from sliding, turning and moving around;
    - The installation system must be equipped with at least 4 bolts;
    - Should the joints of the installation system be located on single-layer metal sheets, a spacing washer of proper size should be used to support the system.

The size of metal bands, bolts and spacing washers is determined by the following chart. The chart is based on the use of stainless steel EN 10025-S235 metal bands and spacing washers, and on stainless steel 8.8 bolts.

Tank Capacity (liters)	Minimum size of the spacing washers, or plates (mm)	Minimum size of the metal bands (mm)	Minimum size of the bolts (mm)
Up to 85	Ø 30 × 1.5 Ø 25 × 2.5	20 x 3 30 x 1.5	8
85 – 100	Ø 30 × 1.5 Ø 25 × 2.5	30 x 3 20 x 3 *	10 8 *
100-150	Ø 50 × 2 Ø 30 × 3	50 x 6 50 x 3 **	12 10 **
Over 150	For LPG tanks, compliance with the requirements set forth by Regulation n. 67 is expected. For CNG tanks, see Regulation n.110.		

* In this case, the tank will have to be fixed with at least three metal bands.
** In this case, the tank will have to be fixed with at least four metal bands.

1. Should the tank be installed behind a seat, a minimum overall distance of 100mm between the tank and the seat must be allowed for. Such distance can be split between the tank and the rear panel on one side, and the seat and the tank on the other.
2. When using cylindrical tanks (installed along the length of the vehicle), the installation support system must be equipped with a crossbar. The crossbar should be fixed in front of the tank and follow the length of the tank. The expression 'tank installed along the length of the vehicle' indicates that the longitudinal axis of the tank should be at a 0° - 30° angle on the axis of the vehicle.

The crossbar should meet the following requirements:

- Its thickness should be the same as (or bigger than) the rest of the installation system.
- It must be installed as close as possible to the bottom of the tank.
- It must be at least 30mm tall, and at least 30mm taller than the lowest point of the tank mantel.

2.4.9 Watertight Chamber

The watertight chamber must communicate with the outside through one or more openings. The latter should provide an overall opening of 450 mm^2 - minus the tubing and the wiring harness (see point 3i, attachment 1). Vents should be pointing downward – never toward the wheels or heat sources (see ece/onu Regulation n.67/01, point 3i, attachment 1, paragraphs 17.7 – 17.8 – 17.9 – 17.10 – 17.11 – 17.12)

2.4.10 Gas Tank Fuel Supply Port

The gas tank fuel supply port must be installed on the outside of the vehicle, and secured tightly so that it does not move around. It must be shielded from dirt and water.

2.5 Electrical Wiring

The following are general directions, valid for any type of vehicle. It is important to be fully aware of these directions, as they represent a key factor in understanding how the entire system works. Your Retrofit Kit's electrical wiring must be installed in accordance with the indications given in UNECE Regulations R67-01 and R115-00.
Here are some of the most important points to remember for a correct installation:

- All connections involving wires that are not joined to a connector must be soldered. Connections must be watertight and properly insulated. Never connect wires by simply twisting them together. Always make sure that all connections are safe and secure.
- When installing electrical wiring for your Retrofit kit, please follow the original wiring system of your vehicle.
- Securely fix the wires into place by means of metal bands to prevent loose wires from rubbing together (or against moving/fixed parts of the vehicle or the engine) and getting damaged. Please make sure that wires are not too taut, as this may damage the connections.
- The gas tube should *never* be used as a support for electrical wires or any other kit component.

2.5.1 Gas ECU

The gas ECU must be fixed to the vehicle frame. Use the existing holes on the aluminum parts of the body of the vehicle, so as not to put the frame under too much stress (ex: do not install the ECU on a convex surface and try to tighten the bolts as much as possible. This may cause the supporting surface to flatten out).

Fig. 2.5.1-1 shows the correct position of a gas ECU. Please avoid hot surfaces, or surfaces which might become hot when the vehicle is running. Although the ECU is watertight, do not install it in areas which may get wet in case of rain. Water might get into the ECU, or into its wiring and sheaths. It is important to make sure that the ECU cable connected to the on-board computer is positioned in an easily accessible area, and that its cap is on to protect it from potential water leaks.

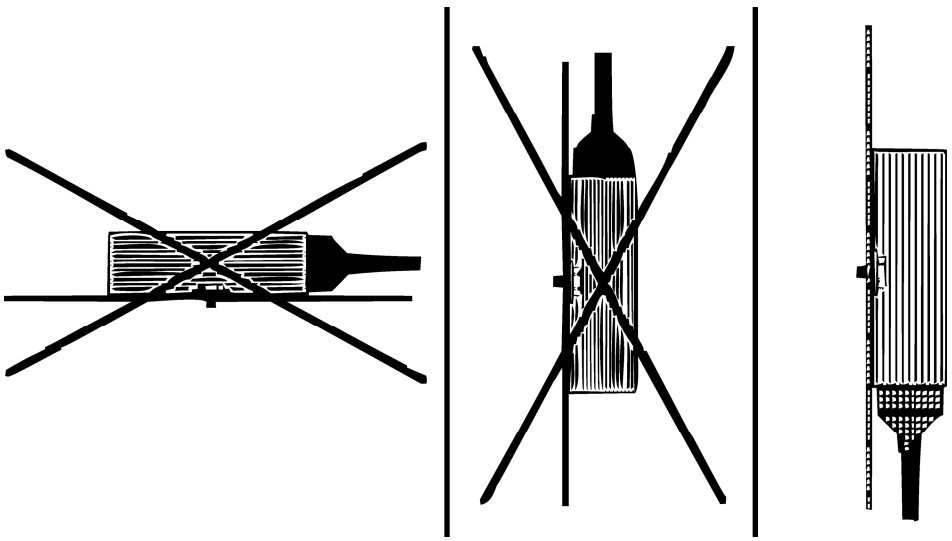


Fig. 2.5.1-1



Never open the Gas ECU box, especially when the engine and/or the dashboard commands are on. This may cause irreversible damages to the system.

ZAVOLI srl disclaims all responsibility for damages to people or things caused by tampering with its system by unauthorized personnel. Illegal tampering with the system will cause its warranty to become null and void.

2.5.2 Main Cables

The main cables represent a complex electrical component of the system, which includes a number of thin wires connected to stiff connectors. It is therefore recommended to handle this part of the system with great care during all phases of the installation process.

In particular, pay careful attention to the following:

- All cables must be installed at a safe distance from the fuses and their corresponding wires.
- When wires are inserted through holes in the main body of the car, the edges of the holes must be trimmed, and cable stoppers must be installed.
- Connect all the ground wires at a point which ensures good electrical contact (battery negative pole).
- The positive wire under the key ignition slot must be connected to a power source which guarantees a stable current of 12V.
- Do not force the connectors into their sockets. Connectors are of a “polarized” kind – in other words, they will only fit into their socket if inserted the proper way. Connections without a proper connector (lambda signals, connection under the key ignition slot, battery positive and negative poles) require soft brazing (watertight soldering) and proper insulation, in compliance with the general installation directions provided with the kit.
- Install the fuse in a position which is easily accessible.
- Inform your customers that if the gas fuse breaks down, the system will revert to the devices it is currently connected to. We strongly recommend that the fuse be not replaced with a higher-amperage fuse, as this may cause irreversible damages to the system.

Fig. 2.5.2-1 shows the main wiring and its connections to the various kit components. Connections with some of the vehicle’s main components are included in the picture, too. Fig. 2.5.2-1 refers to 3-cylinder vehicles, while fig. 2.5.2-2 and the corresponding legend refer to 4-cylinder versions. Similarly, fig. 2.5.2-3 refers to 5-cylinder vehicles and fig. 2.5.2-4 to 6-cylinder versions. Finally, fig. 2.5.2-5 and its legend apply to 8-cylinder vehicles.

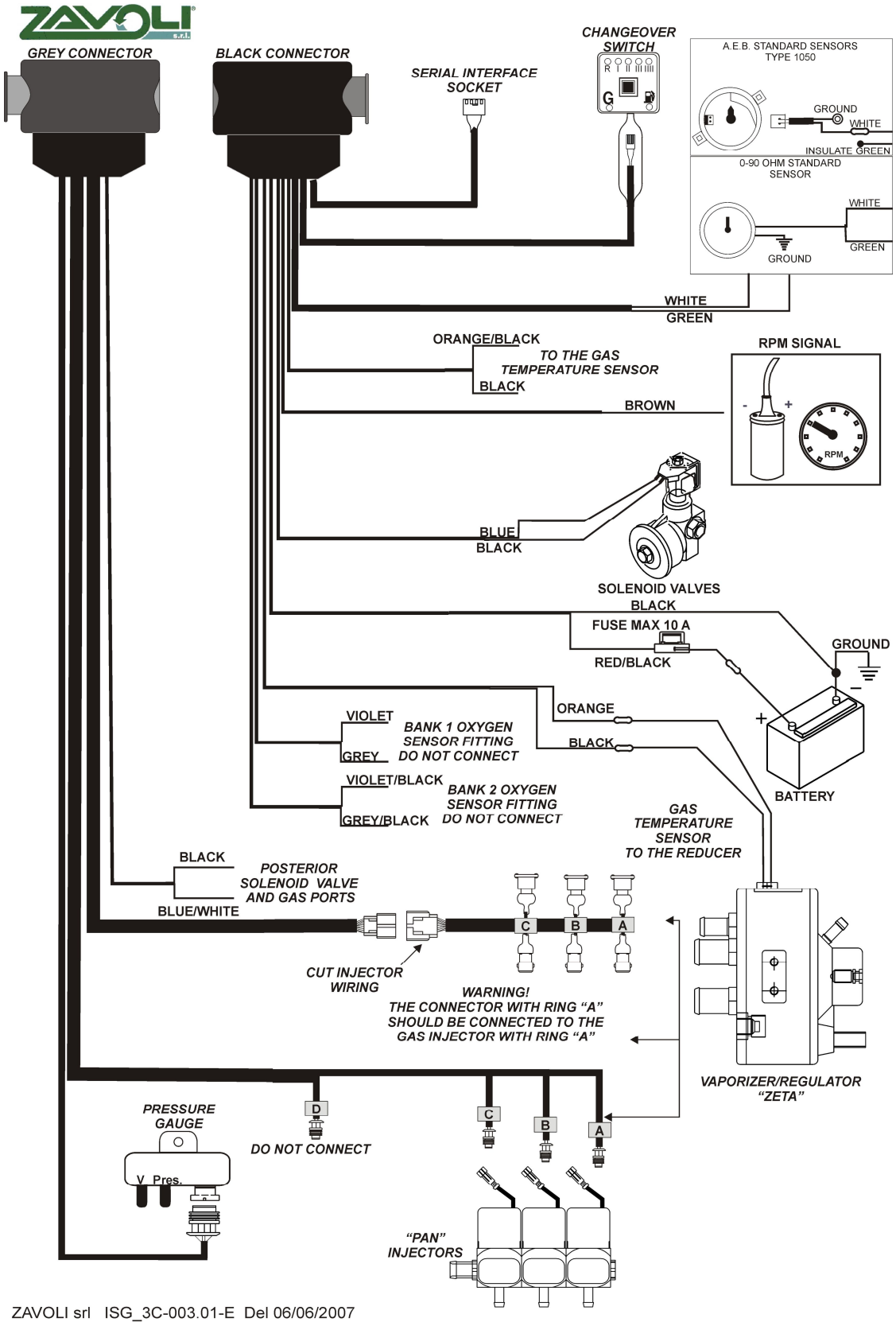

GREY CONNECTOR
BLACK CONNECTOR
SERIAL INTERFACE SOCKET
CHANGEOVER SWITCH
A.E.B. STANDARD SENSORS TYPE 1050
GROUND
WHITE
INSULATE GREEN
0-90 OHM STANDARD SENSOR
WHITE
GREEN
GROUND
WHITE
GREEN
ORANGE/BLACK
TO THE GAS TEMPERATURE SENSOR
BLACK
RPM SIGNAL
BROWN
BLUE
BLACK
SOLENOID VALVES
BLACK
FUSE MAX 10 A
RED/BLACK
GROUND
VIOLET
GREY
BANK 1 OXYGEN SENSOR FITTING DO NOT CONNECT
ORANGE
BLACK
VIOLET/BLACK
GREY/BLACK
BANK 2 OXYGEN SENSOR FITTING DO NOT CONNECT
BATTERY
GAS TEMPERATURE SENSOR TO THE REDUCER
BLACK
POSTERIOR SOLENOID VALVE AND GAS PORTS
BLUE/WHITE
C
B
A
CUT INJECTOR WIRING
WARNING!
THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "A"
VAPORIZER/REGULATOR "ZETA"
PRESSURE GAUGE
V Pres.
D
DO NOT CONNECT
C
B
A
"PAN" INJECTORS
ZAVOLI srl ISG_3C-003.01-E Del 06/06/2007

Fig. 2.5.2-1

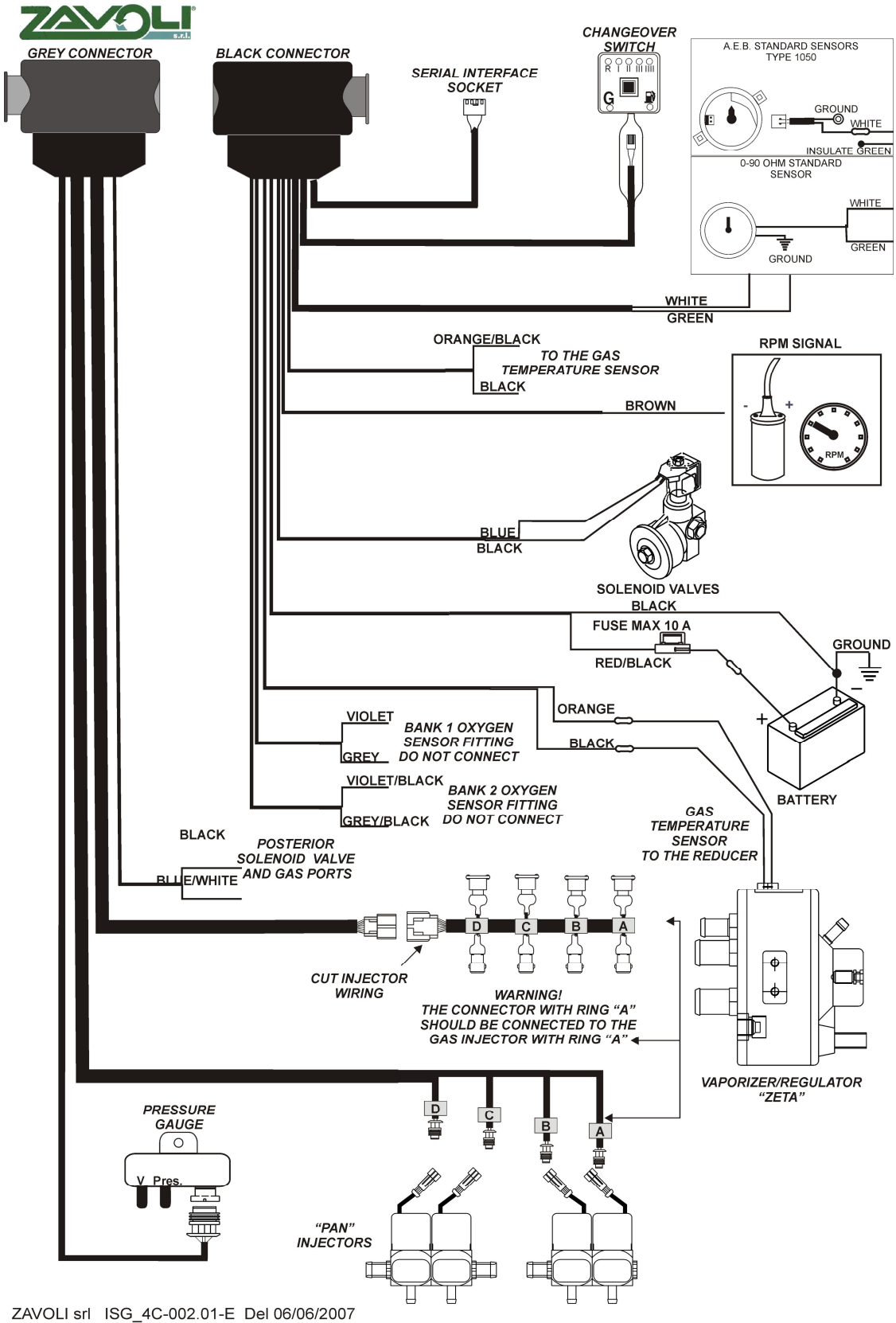

GREY CONNECTOR
BLACK CONNECTOR
SERIAL INTERFACE SOCKET
CHANGEOVER SWITCH
A.E.B. STANDARD SENSORS TYPE 1050
GROUND
WHITE
INSULATE GREEN
0-90 OHM STANDARD SENSOR
WHITE
GREEN
GROUND
WHITE
GREEN
ORANGE/BLACK
TO THE GAS TEMPERATURE SENSOR
BLACK
RPM SIGNAL
BROWN
BLUE
BLACK
SOLENOID VALVES
BLACK
FUSE MAX 10 A
RED/BLACK
GROUND
VIOLET
GREY
BANK 1 OXYGEN SENSOR FITTING DO NOT CONNECT
ORANGE
BLACK
VIOLET/BLACK
GREY/BLACK
BANK 2 OXYGEN SENSOR FITTING DO NOT CONNECT
BATTERY
BLACK
POSTERIOR SOLENOID VALVE AND GAS PORTS
BLUE/WHITE
GAS TEMPERATURE SENSOR TO THE REDUCER
D C B A
CUT INJECTOR WIRING
WARNING!
THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "A"
VAPORIZER/REGULATOR "ZETA"
PRESSURE GAUGE
V Pres.
D C B A
"PAN" INJECTORS
ZAVOLI srl ISG_4C-002.01-E Del 06/06/2007

Fig. 2.5.2-2

Main wiring for 3-4 cylinder vehicles - Description		
Grey 24-way Connector		
Description	**Signal Type**	
Pressure Sensor (Wiring)	1 4-way Connector	In
Gas Injector Commands (Wiring)	4 2-way Connectors	Out
Petrol Injector Emulator (Wiring)	1 10-way Connector	In/Out
2-wire Cable	Black Wire Negative Rear Solenoid Valve and Gas Use Blue/White Wire Positive Rear Solenoid Valve and Gas Use	Out
Black 24-way Connector		
Description	**Signal Type**	
Diagnosis System (Wiring)	1 8-way Connector	In/Out
Switch/Indicator (Wiring)	1 4-way Connector	In/Out
1-wire Cable	Brown Wire Tachometer Interceptor (Engine Rounds Signal)	In
2-wire Cable	Ground Connection Black Wire (Battery - Negative Pole) Red/Black Wire - 12V Connection (Battery - Positive Pole)	In
2-wire Cable	Black Wire Negative – Gas Use (Gas Solenoid Valve) Blue Wire Positive – Gas Use (Gas Solenoid Valve)	Out
2-wire Cable	Green Wire White Wire Connection to the Gas Level Sensor	In/Out
2-wire Cable	Purple Wire Grey Wire Connection to Lambda Sensor (if included)	In/Out
2-wire Cable	Purple/Black Wire Grey/Black Wire Connection to Lambda Sensor (if included)	In/Out
2-wire Cable	Black Wire Orange Wire Connection to Temperature Sensor on the Regulator	In
2-wire Cable	Black Cable Orange/Black Wire Connection to Gas Temperature Sensor	In

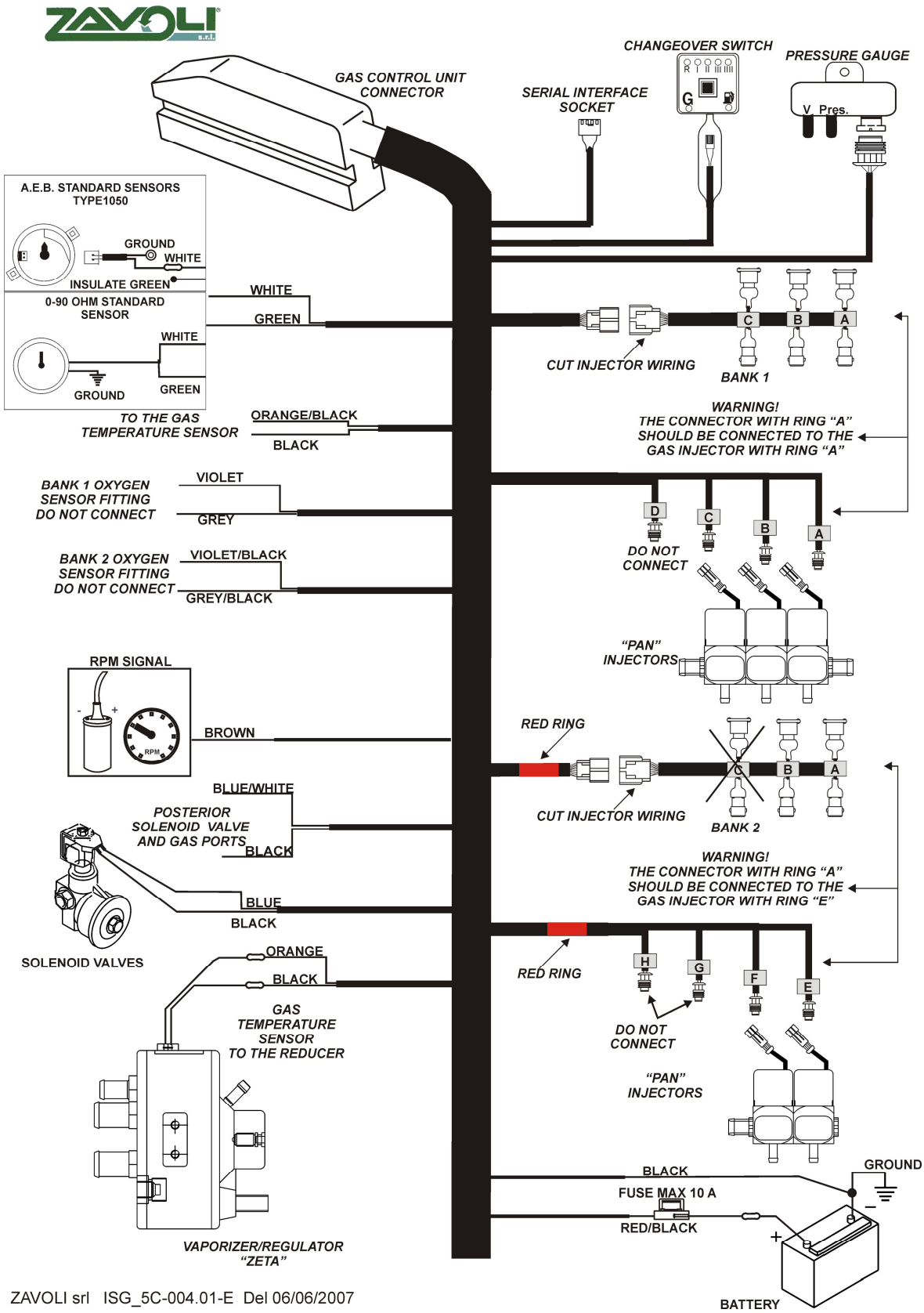

GAS CONTROL UNIT CONNECTOR
SERIAL INTERFACE SOCKET
CHANGEOVER SWITCH
PRESSURE GAUGE
V Pres.
A.E.B. STANDARD SENSORS TYPE1050
GROUND
WHITE
INSULATE GREEN
0-90 OHM STANDARD SENSOR
WHITE
GREEN
GROUND
WHITE
GREEN
TO THE GAS TEMPERATURE SENSOR
ORANGE/BLACK
BLACK
CUT INJECTOR WIRING
BANK 1
WARNING! THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "A"
BANK 1 OXYGEN SENSOR FITTING DO NOT CONNECT
VIOLET
GREY
BANK 2 OXYGEN SENSOR FITTING DO NOT CONNECT
VIOLET/BLACK
GREY/BLACK
DO NOT CONNECT
"PAN" INJECTORS
RPM SIGNAL
BROWN
RED RING
CUT INJECTOR WIRING
BANK 2
BLUE/WHITE
POSTERIOR SOLENOID VALVE AND GAS PORTS
BLACK
BLUE
BLACK
WARNING! THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "E"
SOLENOID VALVES
ORANGE
BLACK
GAS TEMPERATURE SENSOR TO THE REDUCER
RED RING
DO NOT CONNECT
"PAN" INJECTORS
BLACK
FUSE MAX 10 A
RED/BLACK
GROUND
VAPORIZER/REGULATOR "ZETA"
BATTERY
ZAVOLI srl ISG_5C-004.01-E Del 06/06/2007

Fig. 2.5.2-3

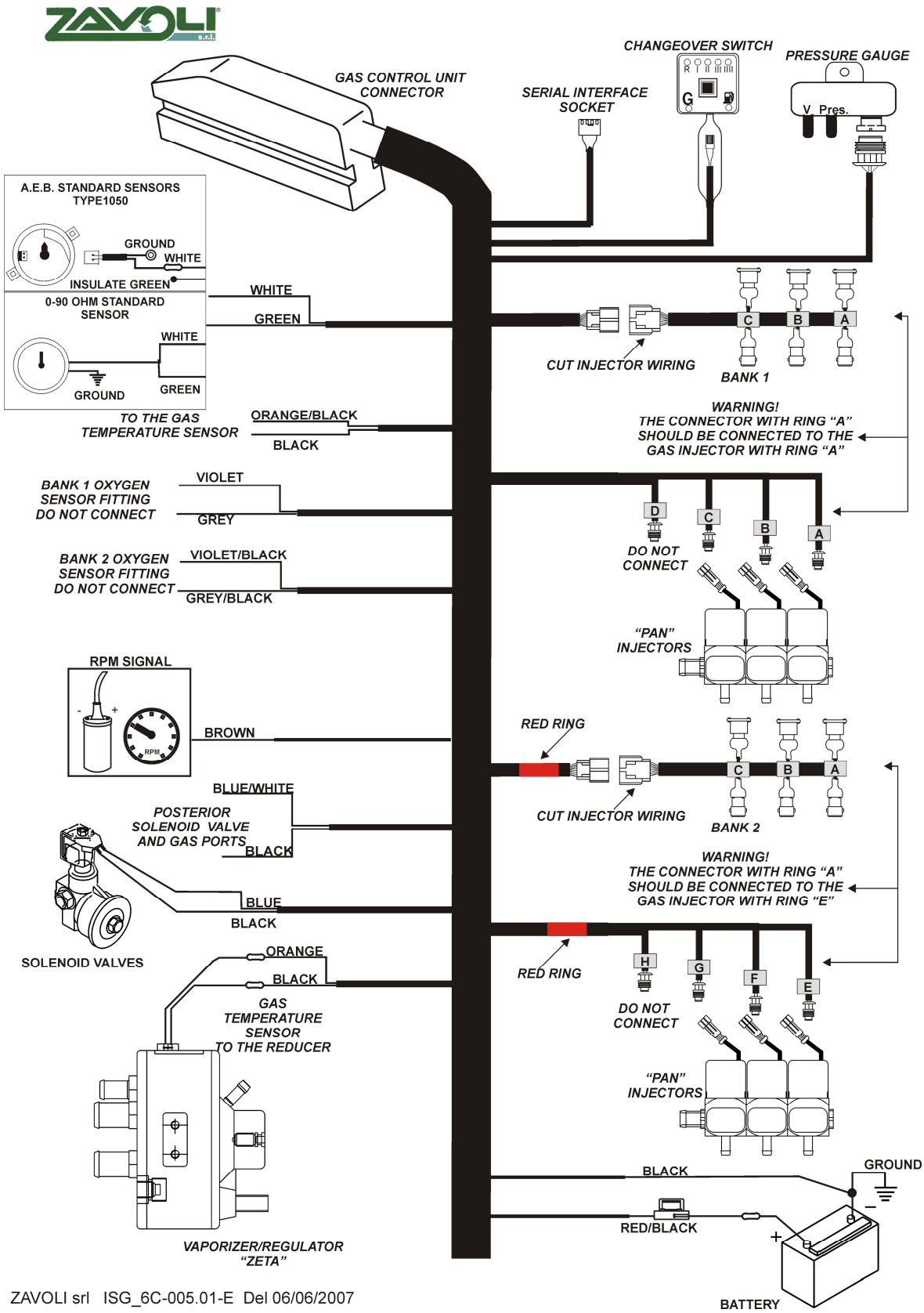

GAS CONTROL UNIT CONNECTOR
SERIAL INTERFACE SOCKET
CHANGEOVER SWITCH
PRESSURE GAUGE
V Pres.
A.E.B. STANDARD SENSORS TYPE1050
GROUND
WHITE
INSULATE GREEN
0-90 OHM STANDARD SENSOR
WHITE
GREEN
GROUND
WHITE
GREEN
TO THE GAS TEMPERATURE SENSOR
ORANGE/BLACK
BLACK
CUT INJECTOR WIRING
BANK 1
WARNING! THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "A"
BANK 1 OXYGEN SENSOR FITTING DO NOT CONNECT
VIOLET
GREY
BANK 2 OXYGEN SENSOR FITTING DO NOT CONNECT
VIOLET/BLACK
GREY/BLACK
DO NOT CONNECT
"PAN" INJECTORS
RPM SIGNAL
BROWN
RED RING
CUT INJECTOR WIRING
BANK 2
BLUE/WHITE
POSTERIOR SOLENOID VALVE AND GAS PORTS
BLACK
BLUE
BLACK
WARNING! THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "E"
SOLENOID VALVES
ORANGE
BLACK
GAS TEMPERATURE SENSOR TO THE REDUCER
RED RING
DO NOT CONNECT
"PAN" INJECTORS
VAPORIZER/REGULATOR "ZETA"
BLACK
GROUND
RED/BLACK
BATTERY
ZAVOLI srl ISG_6C-005.01-E Del 06/06/2007

Fig. 2.5.2-4

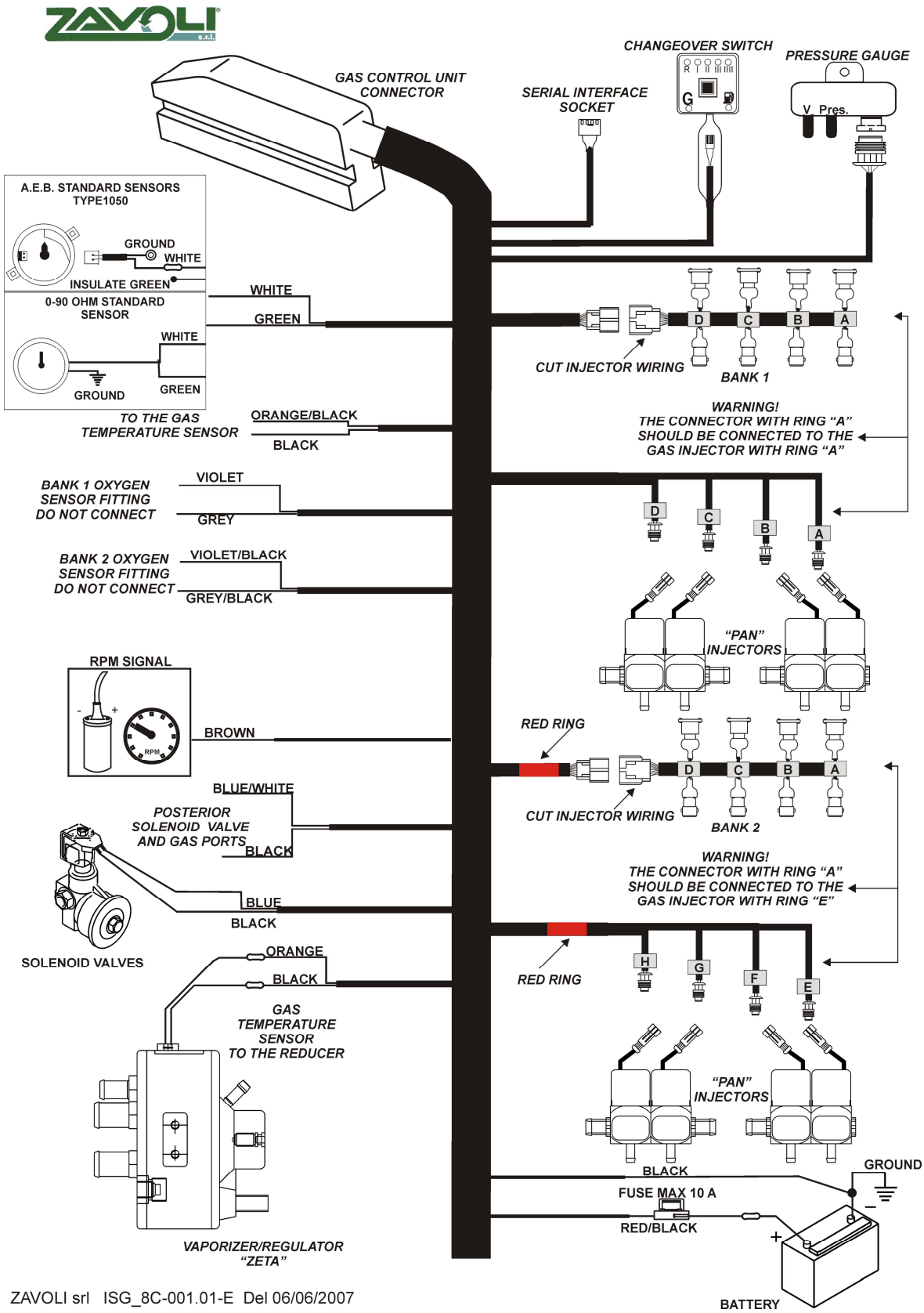

ZAVOLI
GAS CONTROL UNIT CONNECTOR
CHANGEOVER SWITCH
SERIAL INTERFACE SOCKET
PRESSURE GAUGE
V Pres.
A.E.B. STANDARD SENSORS TYPE1050
GROUND
WHITE
INSULATE GREEN
0-90 OHM STANDARD SENSOR
WHITE
GREEN
GROUND
WHITE
GREEN
TO THE GAS TEMPERATURE SENSOR
ORANGE/BLACK
BLACK
CUT INJECTOR WIRING
BANK 1
WARNING!
THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "A"
BANK 1 OXYGEN SENSOR FITTING DO NOT CONNECT
VIOLET
GREY
BANK 2 OXYGEN SENSOR FITTING DO NOT CONNECT
VIOLET/BLACK
GREY/BLACK
"PAN" INJECTORS
RPM SIGNAL
BROWN
RED RING
CUT INJECTOR WIRING
BANK 2
BLUE/WHITE
POSTERIOR SOLENOID VALVE AND GAS PORTS
BLACK
BLUE
BLACK
WARNING!
THE CONNECTOR WITH RING "A" SHOULD BE CONNECTED TO THE GAS INJECTOR WITH RING "E"
SOLENOID VALVES
ORANGE
BLACK
RED RING
GAS TEMPERATURE SENSOR TO THE REDUCER
"PAN" INJECTORS
BLACK
GROUND
FUSE MAX 10 A
RED/BLACK
VAPORIZER/REGULATOR "ZETA"
BATTERY
ZAVOLI srl ISG_8C-001.01-E Del 06/06/2007

Fig. 2.5.2-5

Main wiring for 5-6-8 cylinder vehicles - Description		
56-way Connector		
Description	**Signal Type**	
Diagnosis System (Wiring)	1 8-way Connector	In/Out
Switch/Indicator (Wiring)	1 4-way Connector	In/Out
Pressure Sensor (Wiring)	1 4-way Connector	In
Gas Injector Commands (Wiring)	4 2-way Connectors	Out
Red-Band Gas Injector Commands (Wiring)	4 2-way Connectors	Out
Petrol Injectors Emulator (Wiring)	1 10-way Connector	In/Out
Red-Band Petrol Injectors Emulator (Wiring)	1 10-way Connector	In/Out
1-wire Cable	Brown Wire - Tachometer Interceptor (Engine Rounds Signal)	In
1-wire Cable	Ground Connection Black Wire (Battery - Negative Pole)	In
1-wire Cable	Red/Black Wire - 12V Connection (Battery - Positive Pole)	In
2-wire Cable	Black Wire Negative – Gas Use (Gas Solenoid Valve) Blue Wire Positive – Gas Use (Gas Solenoid Valve)	Out
2-wire Cable	Black Wire Negative Rear Solenoid Valve and Gas Use Blue/White Wire Positive Rear Solenoid Valve and Gas Use	Out
2-wire Cable	Green Wire White Wire Connection to the Gas Level Sensor	In/Out
2-wire Cable	Purple Wire Grey Wire Connection to Lambda Sensor Bench 1 (if included)	In/Out
2-wire Cable	Purple/Black Wire Grey/Black Wire Connection to Lambda Sensor Bench 2 (if included)	In/Out
2-wire Cable	Black Wire Orange Wire Connection to Gas Temperature Sensor on Regulator	In
2-wire Cable	Black Wire Orange/Black Wire Connection to Gas Temperature Sensor	In

2.5.3 Injector Cut-off Cables

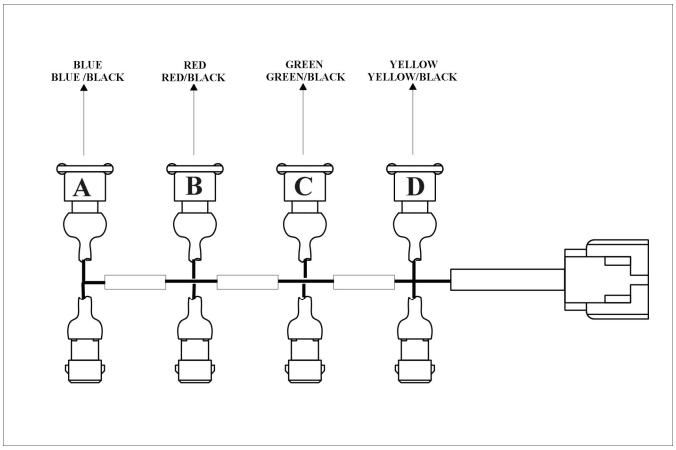


Fig. 2.5.3-1

As shown in fig. 2.5.3-1, there are two different kinds of injector cut-off cables which can be connected to the injection control unit. To determine the type of cable to be used for each specific vehicle, check which PIN the injector positive wire is connected to (on the petrol injector connector). In order to identify your positive wire, please follow these directions:

- Disconnect all connectors from the injectors;
- Take your multimeter and select the “continuous current” reading function;
- Select the ‘ground’ setting for the negative pointer;
- Set the positive pointer in one of the two contact points of the injector cables;
- Turn the dashboard controls on and using your multimeter, check if current is at +12V.
- If this is the case, the selected wire is the positive one.

Cables feature either “BOSCH” or “JAPAN” connectors, which can be attached directly to the petrol injectors. To determine what kind of connector to use, check the polarization of the petrol injector cables.

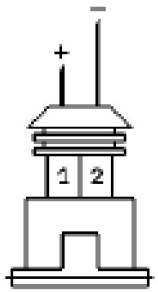


Fig. 2.5.3-2

200SA144 (“Bosch” connectors), 200SA144J (“Japan” connectors), 200SA143 (used for 3 – 5 – 6-cylinder vehicles), to be used when the petrol injector positive pole is on PIN n.1 and the negative is on PIN n.2. Please refer to fig. 2.5.3-2.

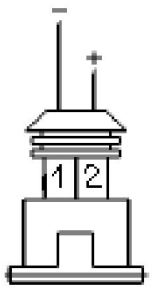


Fig. 2.5.3-3

200SA144INV (“Bosch” connectors), 200SA144JINV (“Japan” connectors), 200SA143INV (used for 3 – 5 – 6-cylinder vehicles), to be used when the petrol injector positive pole is on PIN n.2 and the negative is on PIN n.1. Please refer to fig. 2.5.3-3.

WARNING: +12V continuous current may only occur temporarily in some vehicles. In this case, the power may go out just a few seconds after the dashboard controls have been turned on. We suggest that you verify the polarization of all injector cable connections, so as to make sure that all connectors are equally polarized.

In some cases, when installing the injector cut-off cables, it may not be possible to use the connectors provided with this kit. The petrol injector connectors may in fact not be compatible with the ones supplied in our cable emulators. In that case, connect the wires directly to the 200SA144U universal cables.

Follow the examples in fig. 2.5.3-3 and fig. 2.5.3-4.
For a correct installation, please refer to your vehicle's specific installation guide.

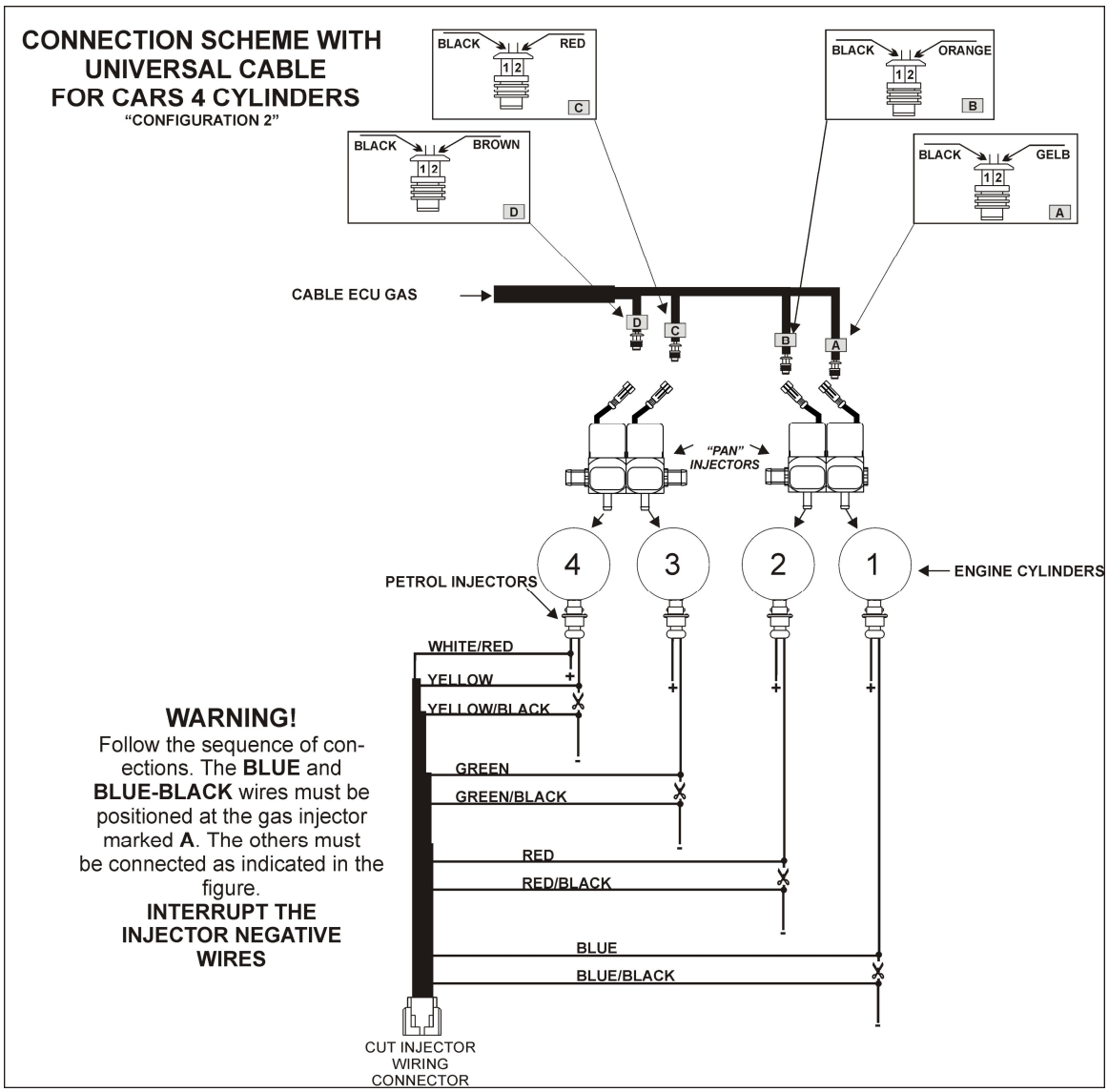


Fig. 2.5.3-3

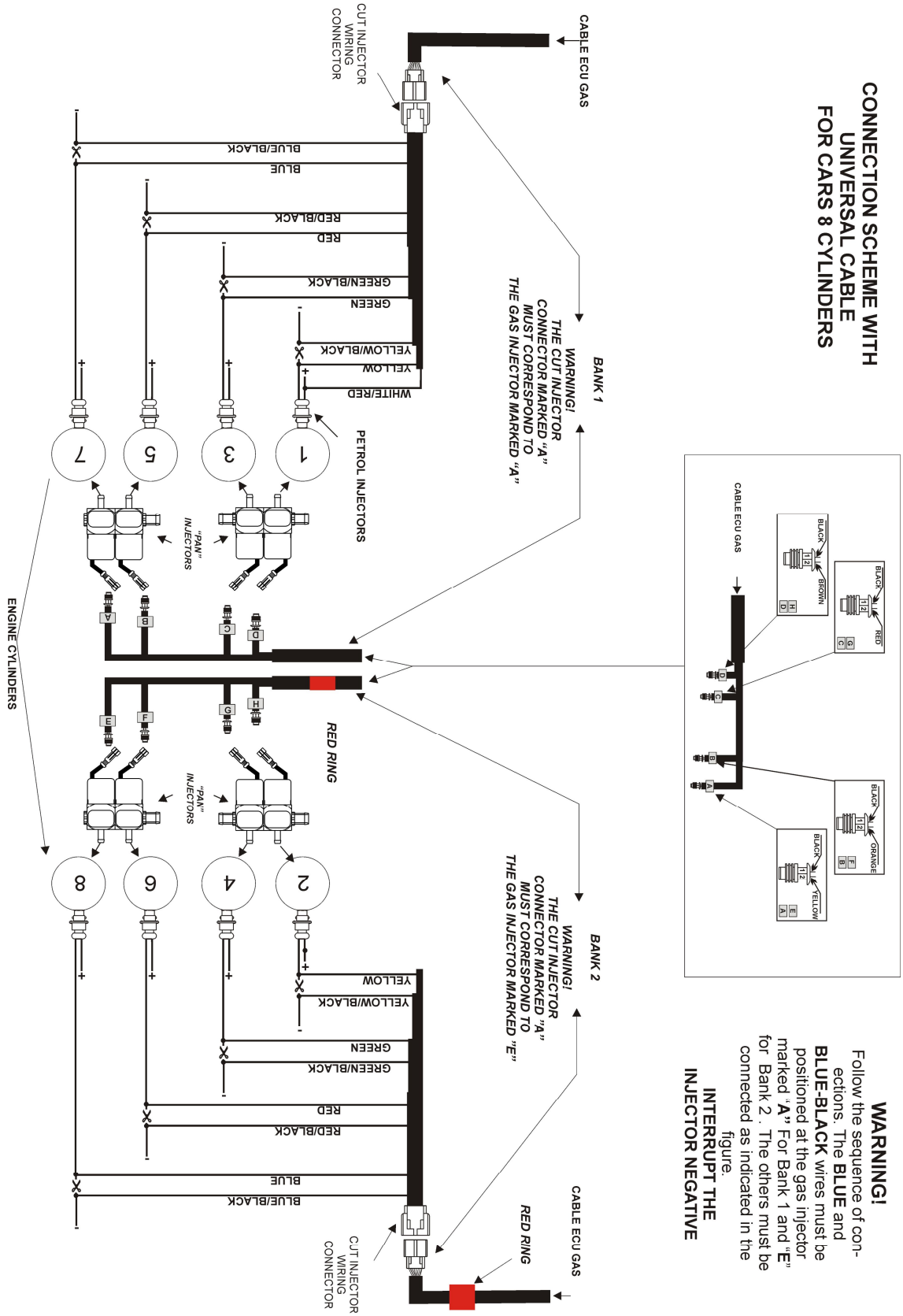


Fig. 2.5.3-4

In order to install these cables, the negative wires of the petrol injectors must be cut off first. Follow directions given in fig. 2.5.3-3 and 2.5.3-4.

The direction of your connections is very important. BLACK wires should be heading toward the petrol injection control unit, while the other wires should be pointing toward the injectors.

2.5.4 Connection of the Gas Injectors

In order to install the gas injector cables correctly, please follow the order of the emulator cables very carefully. Gas injector outlets and cables are individually identified by letters (A, B, C, D). For 5-6-8-cylinder vehicles, cables include two extra connectors and two extra sheaths (marked by two red bands) to allow for the second bench to be connected. The sheaths of the gas injector cables are identified by letters E, F, G and H. In the above charts, the individual connectors of the emulator cables for the petrol injectors are identified in the same way (fig. 2.5.3-1). Remember to always identify each individual connector exactly – refer to the color of the wires connected to it.

- *A-band sheath:* it must be connected to the gas injector on the petrol injector (disconnected) through the BLUE and BLUE/BLACK wires of the injector cut-off device.

- *B-band sheath:* it must be connected to the gas injector on the petrol injector (disconnected) through the RED and RED/BLACK wires of the injector cut-off device.

- ***C-band sheath:* it must be connected to the gas injector on the petrol injector (disconnected) through the GREEN and GREEN/BLACK wires of the injector cut-off device.**
- ***D-band sheath:* it must be connected to the gas injector on the petrol injector (disconnected) through the YELLOW and YELLOW/BLACK wires of the injector cut-off device.**

The main wiring system for 5-6-8-cylinder vehicles includes two Red bands (see fig. 2.5.2-5), which should be connected to Bench n.2. Connect the first one to the connector for the injector cut-off cables, and the other to the connector sheath. For the connection of other gas injectors, these cables must always be connected to their corresponding connectors.

2.5.5 Installation of the Petrol/Gas Switch

The Petrol/Gas switch must be installed inside the vehicle, near the dashboard. Make sure that the switch is in a visible position, and that it can be easily used when driving. As shown in fig. 2.5.5-1, the switch can be installed directly on the dashboard. Just remember to drill a Ø 12.5mm hole to insert the connector. Make sure that the edges of the hole are trimmed and cleaned, to allow for the sticker located in the back of the switch to adhere to the surface. The switch must be connected to the main wiring system by means of the corresponding polarized connector.

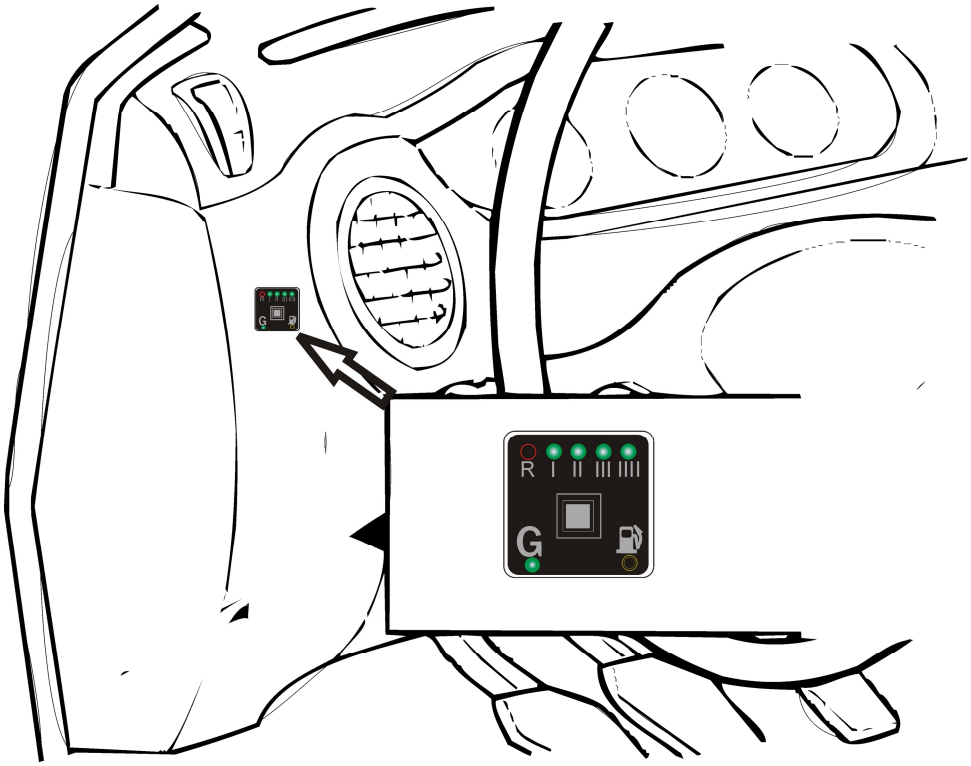


Fig. 2.5.5-1

2.5.6 Homologation Stamp

Once the installation of your Retrofit Kit is complete, a stamp (fig. 2.5.6-1) will have to be permanently applied to the vehicle. The stamp includes the kit's homologation data (legible and indelible), as well as its main components. The stamp must be applied in compliance with the specific installation norms of the vehicle (to be found in the installation guide).

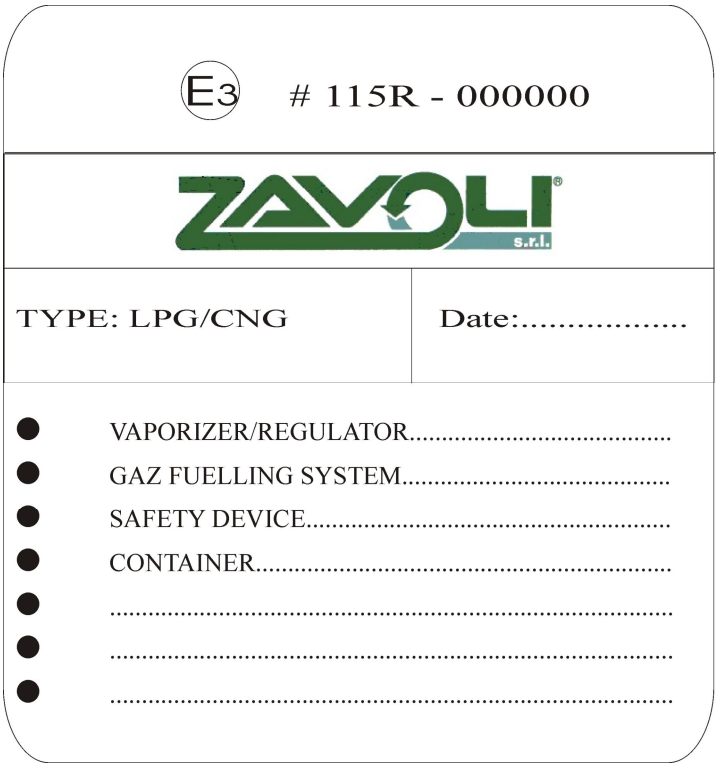


Fig. 2.5.6-1

3 STARTING PROCEDURE

3.1 Operating the Switch

The Petrol/Gas switch allows you to select the type of fuel you want to use (GAS or PETROL). The switch supplied with your ***Alisei-ZETA*** Retrofit Kit features one button, 7 LED's and a buzzer.

3.2 Switch Display

The switch display can supply useful information about the system, depending on the configuration of the different LED's (fig. 3.2-1).

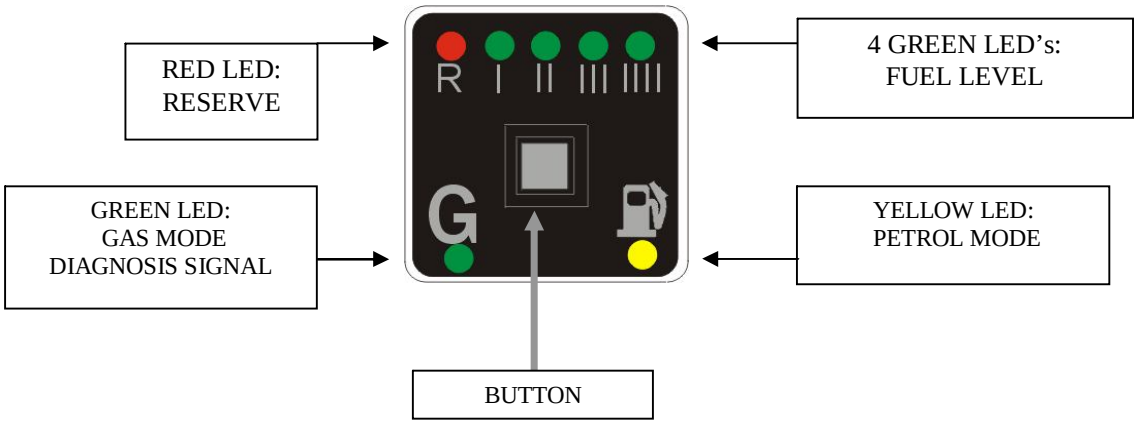
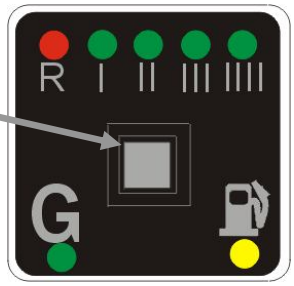


Fig. 3.2-1

3.3 Operating Details

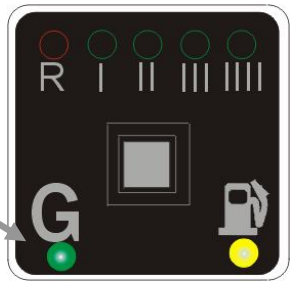
BUTTON

It is used to select the type of fuel (Petrol or Gas). You can switch from one type to the other by simply pressing this button.

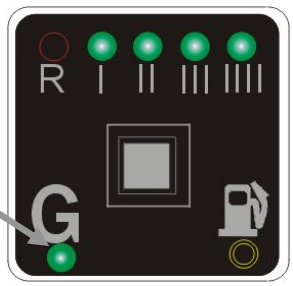


GREEN LED: FUNCTIONS

GREEN led flashing and YELLOW led on: the control unit is programmed to use petrol for ignition and automatically switch to GAS.

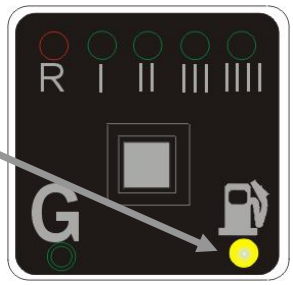


GREEN LED: FUNCTIONS



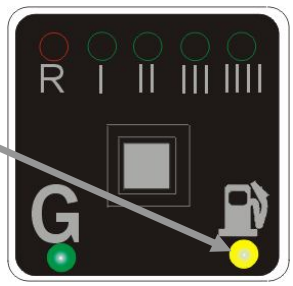
GREEN led on and YELLOW led off: GAS mode.

YELLOW LED: FUNCTIONS



YELLOW led on and GREEN led off: PETROL mode.

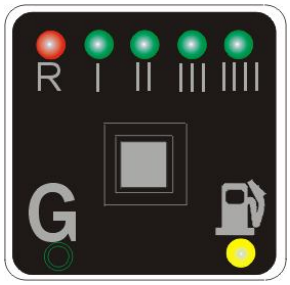
YELLOW LED: FUNCTIONS



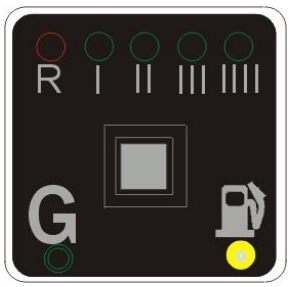
YELLOW led on and GREEN led flashing: the control unit is programmed to use petrol at ignition and then automatically switch to GAS.

3.4 Switch to Petrol Caused by GAS Low Pressure

When the switch indicates **reserve (RED level led on)** and the gas pressure drops below the desired threshold, the Gas ECU automatically switches to petrol mode. This prevents the engine from working with insufficient levels of fuel – a condition which may damage the catalyst. Before switching to GAS again, please make sure to fill up the tank. **A switch to petrol caused by GAS low pressure** is signaled by the YELLOW led turning on. **PETROL mode:** signaled by the level RED LED turning on alternatively with the 4 GREEN LED's. The switch to petrol mode is also conveniently signaled by the buzzer.



In order to reset the switch, press the **BUTTON** once. The YELLOW LED will turn on, to indicate that your vehicle is running on PETROL. The buzzer will stop buzzing.



3.5 Emergency Gas Ignition

EMERGENCY

If you are not in the condition to start your car in petrol mode (ex: in case of issues with the petrol pump), you can perform an emergency GAS ignition. To do so, please follow these procedures:

1. ***Turn the dashboard controls on and then press the button to switch to GAS mode;***
2. ***Turn the dashboard controls off;***
3. ***Turn the dashboard controls on while at the same time pressing the button for about 5 seconds, until the GREEN LED stops flashing;***
4. ***Start up the engine without turning the dashboard controls off. Your vehicle will automatically start in GAS mode;***
5. ***In order to perform another EMERGENCY start, the procedure will have to be repeated each time you turn the engine off.***



The Emergency function is active only when the switch turns on together with the dashboard controls.

3.6 Configuration of the *Alisei-ZETA* Retrofit Kit

After installing your retrofit kit, you will have to set up your system using the interface software. This phase ensures the correct functioning of your gas system. Please refer to the software manual for a correct use of the interface. The configuration of the system must be reviewed after each maintenance operation is performed.

3.7 Important Information for the Final Users of the System

Upon returning the vehicle to its owner, the installer must:

- Instruct the owner about the basic procedures to be followed when using the system.
- Give the owner the User Manual, supplied with our Retrofit kit.

4. MAINTENANCE PROGRAM AND TROUBLESHOOTING

A correct maintenance of the ***AliseN*** retrofit kit main devices – as well as of other components of the vehicle – is fundamental to preserve the efficiency and safety standards of this gas system. Regular maintenance helps extend the life and efficiency of all devices connected to this system, while at the same time reducing all expenses related to your vehicle's upkeep. Maintenance costs for the gas system are generally low, especially when compared to the amount of money that can be saved by using gas instead of petrol.



In order for the owner of the vehicle to take advantage of the warranty included in the kit, maintenance receipts should be saved in the User Manual. The installer of the system will have to record any maintenance operation performed on the system in the User Manual – see Maintenance Operation Record (at the end of the book).

4.1 System Maintenance

Regular maintenance of the kit ensures the system's efficiency. It should be performed by an authorized **ZAVOLI s.r.l.** car shop at scheduled intervals. The first maintenance check-up is free, and should be performed after the first 1,000 Km.
Other check-ups will have to be performed every 20,000 Km, and will entail ordinary maintenance operations. Failing to perform scheduled maintenance on the kit will result in the cancellation of its warranty. Please make sure to perform maintenance check-ups regularly as indicated in the User Manual.

SCHEDULED MAINTENANCE						
Description of Maintenance Operations/Inspections	**Kilometers (x 1,000)**					
	1	**20**	**40**	**60**	**80**	**100**
Visual inspection of the system	√	√	√	√	√	√
Joints	√	√	√	√	√	√
Water and gas tubing	√	√	√	√	√	√
Electrical connections	√	√	√	√	√	√
Regulator pressure	√	√	√	√	√	√
Tank installation seals		√		√		√
Parameters of the gas fueling system (including auto-diagnosis plug)	√	√	√	√	√	√
Replacement of the Gas Filters		√	√	√	√	√
Regulator check-up					√ (*)	
Gas injectors check-up			√ (*)		√ (*)	

(*) **Suggested** mileage.



Some maintenance operations may be scheduled at earlier times than indicated in the chart above. Some operations (like replacing the gas filters, or checking-up the injectors/regulator, for example) may have to be scheduled sooner than indicated, due to the use of impure gas (known to cause premature clogging of the system components).

Fig. 4.1-1 shows facsimiles of the first two maintenance receipts.

1° Maintenance Receipt (Free) ***1,000 Km** after Installation*		
Operations/Inspections Performed:	***YES***	***NO***
Visual inspection of the system	☐	☐
Joints	☐	☐
Water and gas tubing	☐	☐
Electrical connections	☐	☐
Regulator pressure	☐	☐
Tank installation seals	☐	☐
Parameters of the gas fueling system (including auto-diagnosis plug)	☐	☐

Other Operations:	
DATE:_____-	Stamp and Signature:
Km:_____-	

2° Maintenance Receipt ***20,000 Km** after Installation*		
Operations/Inspections Performed:	***YES***	***NO***
Visual inspection of the system	☐	☐
Joints	☐	☐
Water and gas tubing	☐	☐
Electrical connections	☐	☐
Regulator pressure	☐	☐
Tank installation seals	☐	☐
Parameters of the gas fueling system (including auto-diagnosis plug)	☐	☐
Replacement of Gas Filters	☐	☐

Other Operations:	
DATE:_____-	Stamp and Signature:
Km:_____-	

fac-simile

Fig. 4.1-1

4.2 Contacting the Zavoli Technical Support Center

Should the installer need support from the ZAVOLI Support Network, an "**Assistance Request Form"** (filled in all its fields) must be sent to the Support Center. Data requested in the form are necessary to find the best possible solution to your problems.

4.3 Troubleshooting

Problem	Cause	Solution
The switch will turn off about 10 seconds after ignition.	The RPM signal (brown wire) is not properly connected.	Check the connection
The switch will not turn on.	The fuse on the Red/Black wire has burned out.	Replace the fuse with a fuse of equal capacity.
	Cables have not been installed correctly. The petrol injectors have not been connected.	Install cables correctly.
	The switch cable is damaged.	Repair/replace the cable.
	The switch is damaged.	Replace the switch.
The RPM displayed on the PC does not correspond to the actual RPM.	Parameters in the configuration of the type of ignition (or RPM signal) have not been set up correctly.	Check parameters. Options are available in the Alisei software (see the **"Change"** menu). "All parameters highlighted in YELLOW will be changed as soon as the dashboard controls and the switch are turned off"
When switching from Petrol to Gas, the engine turns off.	The gas tank is empty.	Check that there is gas in the tank.
	Gas is not supplied to the gas injectors.	Check that the gas solenoid valve is open.
	Lack of power.	Check for 12V current in the cables located under the key ignition slot.
The software will not display the petrol injection time.	The injector cut-off cables have not been installed correctly.	Make sure that all colored wires (blue, blue/black, red, red/black, green, green/black, yellow, yellow / black) have been properly connected to the injector negative pole.
The engine will not work when cylinders are in gas mode.	Connection of the gas injector connectors.	Make sure that the gas injector connectors are not cut-off/detached from the gas ECU or the gas injectors.
	The joint of the injection nozzle is clogged.	Make sure that the joint of the injection nozzle is not clogged, or that the connection tube is not clogged or constricted.
	Calibrated joint in the injectors.	Make sure that all calibrated joints in the injectors are the same size (diameter).

	Issue with the gas ECU injectors.	Make sure that the gas ECU is sending the right signal to the injectors.
The MI LED is on (EOBD) When the MI LED is on, the system is not working correctly. This may cause the emission of polluting substances. Each irregularity is memorized in the EOBD and can be traced back later by means of a specific diagnosis device (connected to the petrol ECU "diagnosis plug"). Irregularities in the system affect emissions when the vehicle is using gas, and cause the system to switch back to petrol. However, malfunctions are memorized in the gas ECU and can be traced back by means of the Alisei software connected to the gas ECU. Identifying malfunctions helps users find solutions for these issues. Some of the most common malfunctions of the system (which may also occur when the vehicle is using gas) are listed in the next column.	"Failed Ignition" or codes P0300, P0301, P0302, etc. The most likely causes for a "Failed Ignition" in the cylinders are the following:	The injectors and their corresponding connectors in the injector emulator are not properly connected.
		For 5-6-8-cylinder vehicles, the connectors marked by a red band are not connected in the proper order.
		Insufficient supply of gas to the engine, which is also known to cause the so-called "poor mixture" malfunction.
	"Carburetion Error" or code (P0170); "poor mixture" or codes (P0171; P0173); "rich mixture" or codes (P0172-P0174). In general, these malfunctions (and in particular the "poor mixture" and "rich mixture") occur at the same time. They are usually caused by to differences in some "parameters" used to compare the efficiency of the petrol mode and the gas mode. Some of the most common parameters are the "injection times" and the "lambda control" (*), which can be identified by means of diagnosis devices. In general, under regular operating conditions, parameters for the gas mode should be very similar to the ones registered for petrol mode. Some of the most	Excessive length of the tubing between the injectors and the injection nozzles. The tubing should be kept as short as possible. **The maximum length is 150mm.**
		Clogging, due to bends in the injection tubing.
		The holes for the connection of the injection nozzles (located on the intake manifold) have been drilled in the wrong position. Whenever possible, holes must be drilled as close as possible to the intake valves of the engine, slightly leaning toward the valves.

	common causes for these irregularities are:	Both gas filters - liquid and gaseous phase - are in poor conditions.
		The calibrated nozzles of the injectors are not the proper size. In general, in case of a "poor mixture", the nozzles are undersized (too small), while in case of a "rich mixture" they are oversized (too big) for the vehicle in use. The problem can be easily identified by connecting to the gas ECU through the Alisei software (check the correction coefficients in the "Map" menu). In general, if the correction coefficients are too high, the calibrated nozzles are too small, and vice versa – if the coefficients are too low, it means that the calibrated nozzles are too big.
(1)WARNING: depending on the diagnosis device in use, the "lambda control" may be indicated by a different name, like "instant mixture adaptors", "instant mixture regulators", etc.		
The emergency gas ignition will not work.	In case the vehicle cannot be started in petrol mode (ex: due to problems with the gas pump), you can start it up in GAS mode.	See paragraph 3.5 "Emergency Gas Ignition"

5. Glossary of Terms and Acronyms used in the Manual

Terms	Definition
Cables	It indicates the set of cables branching off of the connector. They are connected to the control unit, and through the unit to all the major components of the electrical system.
Catalyst	It is a device which is installed on the exhaust pipe. It reduces toxic emissions.
CO, HC, NOx	CO (carbon monoxide), HC (unburned hydrocarbons) and NOx (Nitrogen Oxide) are the gaseous polluting substances whose emission has been restricted by the current anti-pollution regulations.
Switch	It is the device (located inside the vehicle) which allows the driver to select the desired type of fuel (petrol or gas).
Cut-off	It is an electronic device which controls the amount of fuel supplied to the engine. It automatically cuts off petrol supplies whenever the acceleration pedal is all the way up and the engine is running at a specific rate.
Diagnosis	It identifies the causes of dysfunctions in the system, based both on the type of irregularities that have occurred and on a series of technical and instrumental check-ups.
Display	It is a monitor which displays the data supplied or processed by an electronic device.
ECU (Control Unit)	Electronic Control Unit, an electronic piece of equipment which controls the operating parameters of the system and a series of mechanic devices.
Solenoid valve (electro-valve)	It is an electro-mechanic device which cuts off fuel supply.
EOBD	European On Board Diagnostic: a system which monitors all – or some – inputs and signals coming from the Control Unit. When one or more signals are out of range, the device registers and memorizes a malfunction in the system – or in the interconnected systems.
LPG	Liquid Petroleum Gas. It is a fuel composed of a mix of hydrocarbons. Its recipe is mostly based on variable amounts of butane and propane. At room temperature, and under conditions of moderate pressure, the mixture is liquid.
Sequential injection	It is a multipoint injection system where injectors work independently of each other. The injectors are synchronized with the opening of the intake valve in the corresponding cylinder.
Injector	It is a device which supplies accurately dispensed amounts of pressurized fuel. The fuel is injected into the intake manifold.
ISO	International Organization for Standardization. It is composed by representatives of various national institutions, and it defines industrial and commercial standards worldwide.

Retrofit Kit	In compliance with UNECE regulations, it indicates the set of components on which this gas system is based. Each component is manufactured in compliance with UNECE regulation R67-01.
Led	It is an acronym which indicates the individual Light Emitting Diodes.
MAP	Mainfold Absolute Pressure. The absolute pressure of the intake manifold of the engine.
Master/slave	It indicates whether the gas ECU is able to control the petrol ECU to switch and operate the system in gas mode.
MI	Malfunction Indicator. It is a led which informs the driver that one of the system components related to the emission of toxic substances – or the OBD system itself – is not working properly.
One-shot	Mono-use. One-shot devices can be used one time only, and need to be replaced after that.
Positive under the key ignition slot	It is a positive electrical wire coming from the battery. It is intercepted inside the vehicle, below the key ignition slot.
Battery positive	It indicates the pole with the highest electrical power in the battery. In general, it is at a current between 8 and 16V.
Absolute pressure	Pressure calculated on the basis of the absolute void pressure (zero).
RPM	Revolutions Per Minute. It is generally used to indicate the rotational speed of the motor's spindle.
Lambda Sensor	Also called Oxygen Sensor. It provides the control unit (which controls the amount of fuel being supplied to the engine) with information about the amount of oxygen contained in the exhaust gas. That way, the electronic unit can create the most balanced blend for the air-petrol mixture.
Diagnosis device	In compliance with law SAE J 1978, this device is connected to the original diagnosis plug of the vehicle. It identifies the malfunction codes memorized by the OBD. It is also known as OBD II SCAN TOOL or DIAGNOSTIC TESTER.
Switch-back	It indicates the automatic switch from gas to petrol mode in the system, operated by the gas ECU. It takes place whenever a gas system component is missing, and the emission of toxic substances is no longer guaranteed.
UNECE	United Nation's Economic Commission for Europe. It is an international organization, which supports the sustainable economic development of its member countries. It provides them with the most appropriate legal international tools in the field of trade, transportation and environment.
THROTTLE VALVE	This valve controls the amount of air drawn in by the engine. It is generally operated through the accelerator pedal. However, in many vehicles today is it often operated by the petrol ECU.