LOVATO

FAST

Installation Manual

CERTIFIED QUALITY SYSTEM
UNI EN ISO 9001/2000

SINCERT DNV

Revision 01 - April 2005

Contents

1.0 General recommendations

- Before installing the gas system, disconnect the battery earth cable (unless specified to the contrary by the car maker).

  Attention: this may delete the car radio and telephone memories and jam the centralised door locking and anti-theft systems. In this case, you may connect the battery temporarily.
- Always smooth holes after drilling and apply anti-rust to the edges.
- Apply silicon to each cable through-hole to prevent water from entering the interior.
- Always soft solder connections without connectors to prevent the future formation of false contacts.
- Always observe the current laws and/or regulations in the State where the LPG system is mounted.
- Remember that, as per the relative standards, all the assembly instructions refer to the driving position.
- Before assembling the “FAST” control unit, make sure the relative fuses are disconnected.
- Do not wash the engine after installation.

CAUTION

FAILURE TO OBSERVE THE INSTRUCTIONS CONTAINED IN THIS MANUAL MAY CAUSE THE FAST SYSTEM TO WORK INCORRECTLY OR NOT WORK AT ALL. THIS MAY CAUSE DAMAGE TO LOVATO COMPONENTS AND INVALIDATE THE WARRANTY.

2.0 "FAST" gas injection system features

2.1 System description

The system comprises:
- Tank
- Multivalve
- Safety lock-off valve
- Reducer / vaporiser
- Injector assembly
- Electronic control unit
- Compressed air connections
- Gas temperature and pressure sensor
- Wiring harnesses
- Smart injector-cutter control unit
- Switch
- Buzzer.

2.2 Operating principle

The liquid LPG is stored in equilibrium with the vapour phase in a tank fitted with a multivalve. Storage pressure depends on the composition and temperature of the fuel. The LPG is collected in its liquid phase and delivered to the reducer/vaporiser along the pressurised piping to which the LPG lock-off valve is fitted. The reducer/vaporiser is heated by the engine cooling water, vaporises the fuel and adjusts its pressure, known as injection pressure, to a value that is proportional to the pressure in the inlet manifold downline from the engine butterfly valve (M.A.P.). The gaseous LPG then reaches the injector assembly controlled by the electronic control unit. The LPG is batched by the injection time and phasing signal. This is determined by the electronic control unit according to the signals from the engine and petrol supply system.

2.3 Precautions for fitters

- The vehicle must be fitted with a three, four, five or six cylinder engine with a capacity ranging between 900 and 3470 cm^3 and a maximum power of 150kW.

CAUTION

MAKE SURE THE ELECTRONIC PETROL INJECTION MANAGEMENT SYSTEM, ESPECIALLY THE LAMBDA PROBE, IS IN PERFECT WORKING ORDER; ANY IRREGULARITIES OR FAULTS MAY BE TRANSFERRED TO THE GAS INJECTION SYSTEM AND CAUSE IT TO WORK INCORRECTLY.

- Check the general condition of the car.
- Check the signals required for conversion, especially the Lambda probe.
- Follow the instructions in this manual with care.

3.0 FAST system components

3.1 FAST kit components

The LPG FAST kits comprise the following components:

DESCRIPTION	QUANTITY			
	FAST 3 Cylinders	FAST 4 Cylinders	FAST 5 Cylinders	FAST 6 Cylinders
LPG lock.off valve E67R01	1	1	1	1
FAST reducer complete with guarantee certificate	1	1	1	1
Galvanized reducer support	1	1	1	1
Galvanised bracket for injector assembly	1	1	2	2
Aluminium bracket for control unit	1	1	1	1
Injector assembly	1	1	2	2
LPG filter	1	1	1	1
FAST accessory kit	1	1	1	1
Length of rubber hosing 15x23	1	1	1	1
Length of rubber hosing 7x13	2	2	2	2
Length of rubber hosing 12x19 E67R01	1	1	1	1
Length of rubber hosing 6.3x13 E67R01	3	4	5	6
Length of copper piping 4x6 wound	1	1	-	-
Length of copper piping 6x8 wound	-	-	1	1
FAST electronic control unit	1	1	1	1
EMU FAST injector-cutter control unit	1	1	2	2
Gas pressure sensor	1	1	1	1
FAST wiring harness	1	1	1	1
EMU FAST emulator wiring harness	1	1	2	2
Microswitch	1	1	1	1
Acoustic signal	1	1	1	1
Use and maintenance manual	1	1	1	1

3.2 Description of parts

LPG lock-off valve

This electromagnetic device interrupts the flow of LPG when the engine is stopped or when the fuel supply is switched to the petrol mode.

Reducer / vaporiser

The reducer / vaporiser provides the heat required to vaporise the liquid LPG from the tank and reduces and adjusts the pressure of the LPG in its gaseous phase according to the pressure in the engine intake system downline from the butterfly valve (MAP, short for Manifold Absolute Pressure). This component is fitted with a temperature sensor for the petrol / LPG switching procedure, an overpressure valve and an adjustment screw for modifying the gas reduction pressure.

"FAST" injector assembly

This component delivers the quantity of gaseous LPG determined for each cycle by the electronic control unit to each cylinder. The fuel supply is sequenced and phased by the lock-off valves controlled by the electronic control unit.

LPG filter

This device is installed upline from the injector assembly and protects it from the impurities in the LPG.

FAST service bag

The service bag contains the nozzles to install on the inlet manifold next to the combustion chamber, fuse holders with relative fuses, screws, supports and the hardware required to install the KIT. In particular, the aluminium or galvanised steel supports can easily be cut and/or bent to size in order to properly secure the reducer and injector assembly to the car.

Rubber hosing

There are four types of rubber hosing in the Kit:

- water circuit hosing for heating the reducer/vaporiser with the fluid in the engine cooling circuit.

- "only air" hosing connects the pressure tap downline from the butterfly valve to the MAP sensor and the reducer/vaporiser. It also connects the overpressure valve of the reducer to the air filter of the engine intake system.

- the various sizes of LPG E67R1 hoses are class 2 approved according to European Regulations E67- R01 and connect the reducer to the injector assembly and the lock-off valve outputs to the corresponding ducts on the inlet manifold.

- coil of copper piping for compressed air connections between the multivalve of the tank and the LPG lock-off valve in the engine compartment and between the lock-off valve and the reducer.

Electronic control unit

This microprocessor-controlled electronic system processes the signals from the sensors in real time and calculates optimum gaseous LPG injection times on the basis of the operating conditions of the engine. It is fitted with a hose connecter for reading the absolute pressure signal of the inlet manifold (M.A.P.).

EMU FAST injector cutter control unit

This control unit prevents the petrol injection system from working while the engine is running in the gas mode. The control unit also checks the polarity of the petrol injector and selects the negative injector sending the signal to the control unit for processing.

Gas pressure sensor

Reads gas pressure in real time near the injector assembly. The control unit uses this information to calculate gas density and corrects the opening time of the injectors.

FAST wiring harness

The universal wiring harness supplied with the FAST Kit connects the electronic LPG sensor to the sensors required to determine the operating conditions of the engine and the FAST system components. In particular, it connects the electronic control unit to the EMU FAST injector emulator control unit.

EMU FAST emulator wiring harness

This wiring harness connects the EMU FAST control unit to each petrol injector in order to interrupt petrol operation and transmit the injection signal for correct engine supply. Dedicated Bosch and Japan wiring harnesses are available.

Switch

This electronic device allows the driver to switch the fuel supply from petrol to gas (and vice-versa) and to view the operating status and gas level in the tank.

Buzzer

This device is directly controlled by the FAST control unit. It sounds when switching from petrol to LPG, when the LPG level in the tank reaches reserve and when automatically switching to petrol if the LPG runs out. For further information on the buzzer please consult chapter 8.0 User information and the use and maintenance manual.

4.0 Installation sequence

The sequence of operations for installing the system is shown below.

1 Installing the tank, multivalve and high pressure line to the engine compartment (Consult the specific manual for each product)
2 Locating the installation area for the FAST Injector Assembly
3 Locating the installation area for the FAST Reducer/Vaporiser Assembly
4 Locating the installation area for the LPG lock-off valve
5 Installing the nozzles
6 Installing the FAST Injector Assembly
7 Installing the LPG lock-off valve
8 Installing the FAST Reducer/Vaporiser
9 Installing the FAST control unit
10 Installing the EMU FAST electronic control unit
11 Installing the switch and buzzer
12 Electrical connections
13 Connection between PC and control unit
14 Checking and configuring sensors
15 Calibration
16 Diagnostics
17 Road test

Before starting to mount the components, the areas where the FAST devices can be installed inside the engine compartment must be located according to the following instructions.

4.1 Locating the installation area for the FAST Injector Assembly

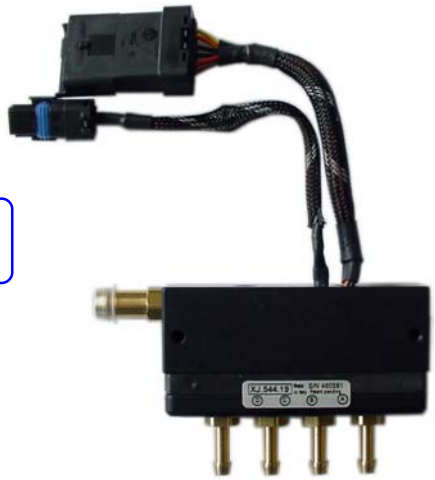
Secure the FAST injector assembly to the car using the two steel supports supplied in the kit. Locate fixing points for the supports bearing in mind that:

- the injector assembly must be positioned as near as possible to the ducts on the engine inlet manifold in order to minimise the length of the connecting hoses,
- the hoses connecting the outlet nozzles of the assembly to the nozzles mounted on the manifold ducts must all have the same length and have no sharp bends.

CAUTION

THERE ARE NO CONSTRAINTS TO THE INSTALLATION POSITION OF THE INJECTOR ASSEMBLY. WE RECOMMEND INSTALLING THE ASSEMBLY WITH THE NOZZLES POINTING DOWNWARDS IN ORDER TO PREVENT POSSIBLE DEPOSITS OF OIL AND DIRT THAT MAY COMPROMISE LONG-TERM SYSTEM PERFORMANCE.

High



Standard injector assembly

Low

High

Oversize injector assembly

Low

fig. 1

4.2 Locating the installation area for the FAST Reducer/Vaporiser

Secure the FAST reducer/vaporiser to the car using the relative steel support, making sure to observe the following conditions:

- the reducer must be mounted in the position indicated in figure 2.
- the hose connecting the MAP tap on the reducer cover to the pressure tap on the inlet manifold downline from the butterfly valve must be as short as possible. Considering that the MAP tap must also be connected to the electronic control unit, these components must all be installed near to each other;
- the high pressure LPG is supplied from underneath
- the gaseous LPG outlet at injection pressure must point towards the FAST injector assemblies at a fairly close distance
- the reducer must be fed with engine cooling fluid through the relative adjustable pipes
- the overpressure valve must be connected to the engine intake circuit.
- the reducer must be positioned so that it can be easily accessed from above after assembly; it must also be easy to reach the adjustment screw located on the top of the cover and read its serial

number during its MOT test

- after making all compressed air, hydraulic and electrical connections, the reducer must not touch or lie dangerously close to moving or hot parts of the car.

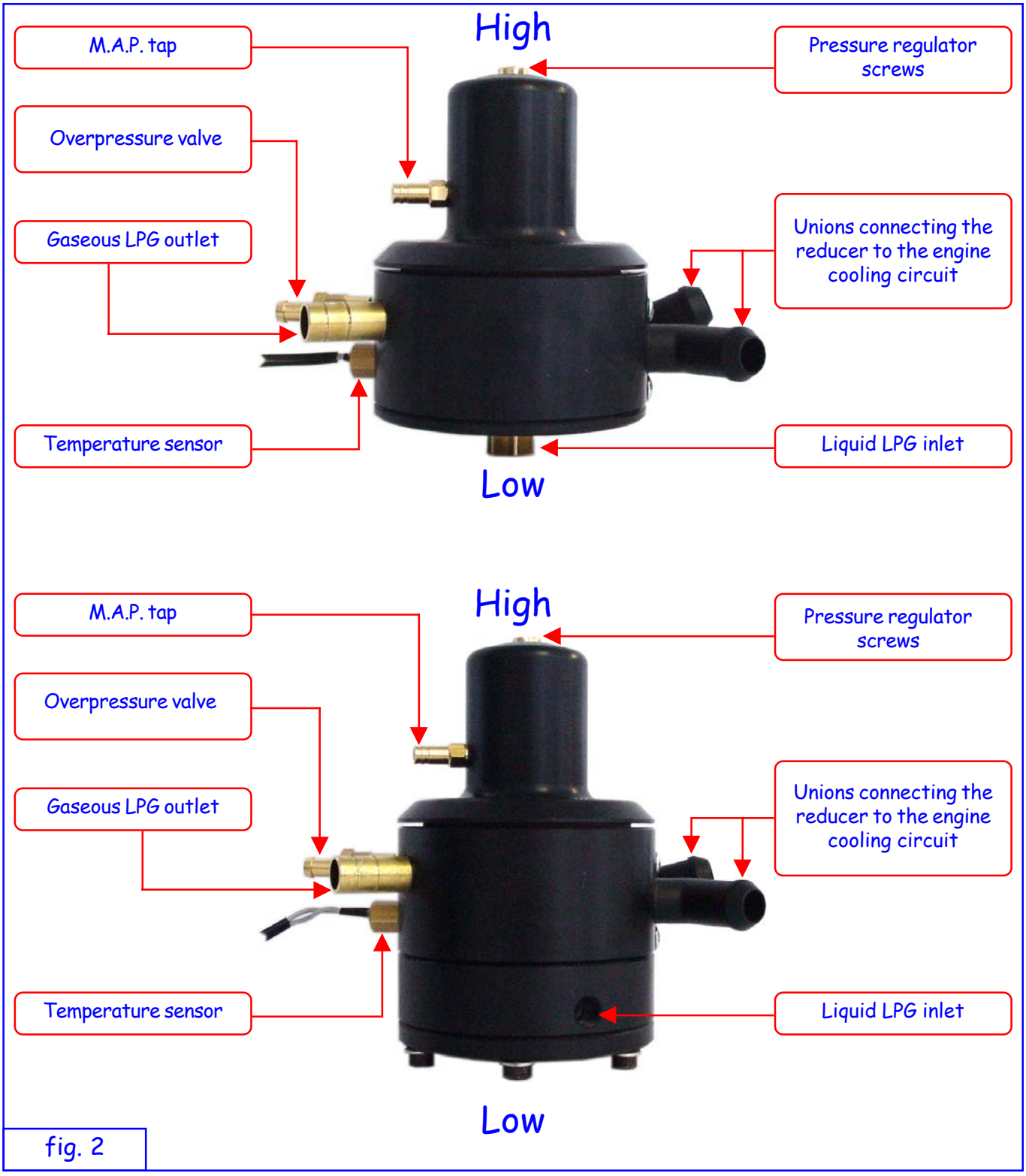


fig. 2

4.3 Locating the installation area for the LPG Lock-off valve

After deciding on the assembly area for the reducer, locate the position for mounting the on-off lock-off valve on the high pressure LPG line; place the valve as close as possible to the reducer but far away from accident impact zones. Mount the lock-off valve vertically with the coil at the top.

4.4 Mounting the nozzles

Mount the nozzles by dismounting the inlet manifold and the air filter box of the car. This will allow you to make sure the manifold is perfectly clean.

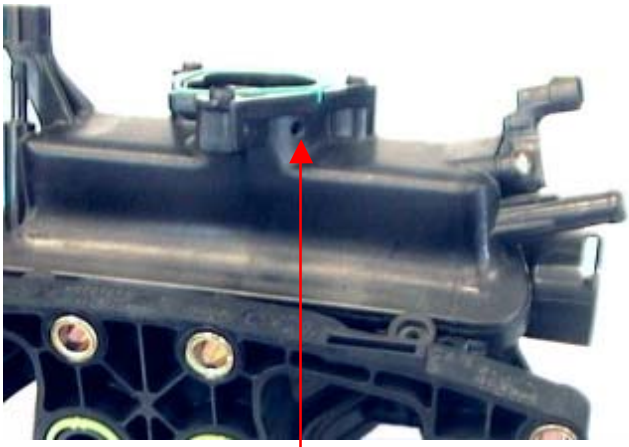
Gas injection nozzles
(contained in service bag)

fig. 3

To install the nozzles, proceed as follows:

1. drill a 4.7 mm hole in each of the four ducts of the inlet manifold taking care to centre the hole in the width of the manifold and as near as possible to the engine intake valve
2. drill a 4.7 mm hole in the stretch of the inlet manifold just downline from the butterfly valve in the point previously located for the pressure tap on the manifold.

Ø 4.7 mm threaded M6 holes for installing the LPG injection nozzles

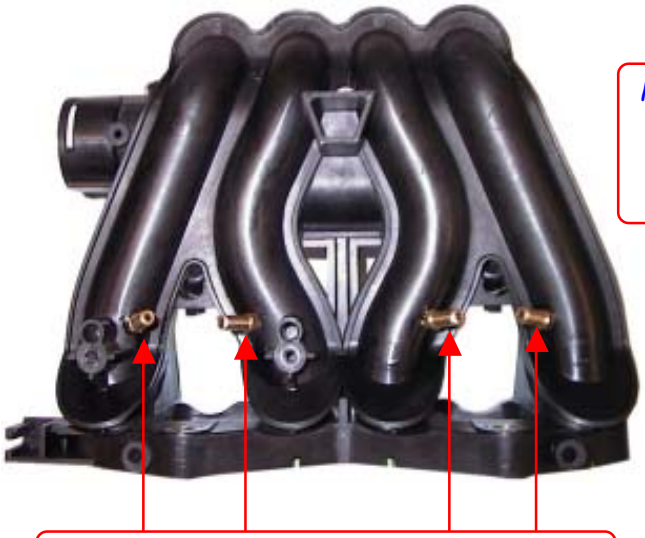


Ø 4.7 mm threaded M6 hole for installing the M.A.P. pressure delivery nozzle

fig. 4

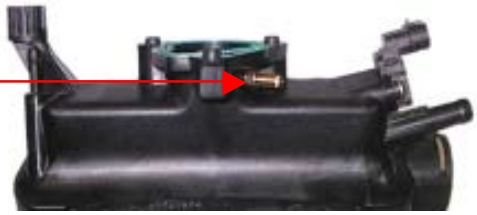
3. drill a 4.7 mm hole in the air filter box or, if the car is fitted with a hot wire air flow meter (debimeter), immediately downline from it

4. thread each hole with a male M6 tapper
5. fit the six nozzles into the relative holes after applying a drop of thread retainer (Loctite 638) to each thread
6. clean the inside of the inlet manifold before remounting it.

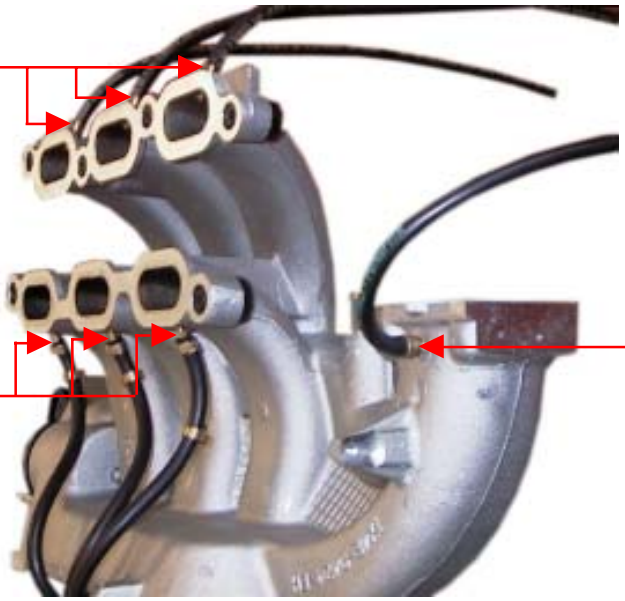


LPG injection nozzles

M.A.P. signal delivery nozzle



Overpressure discharge nozzle



LPG injection nozzles and hoses

M.A.P. signal delivery nozzle and hose

fig. 5

4.5 Mounting the FAST electric injector assembly

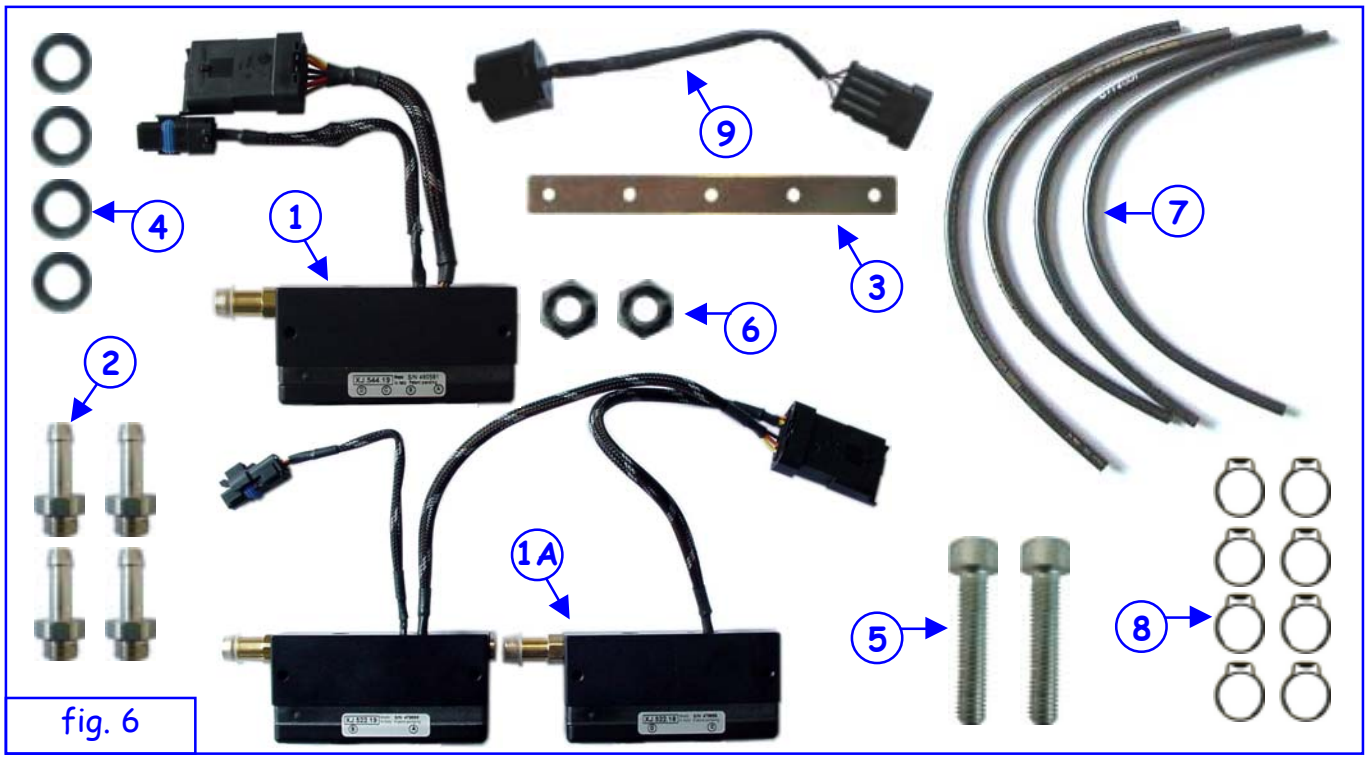


fig. 6

1. Injector assembly
   - 1 = Standard injector assembly (FAST kit 3 cylinders, 4 cylinders 90kW, 4 cylinders 120kW, 5 cylinders and 6 cylinders)
   - 1A = Oversize injector assembly (FAST kit 4 cylinders 150kW),
2. Nozzles for injector assembly; these must be sized according to the specific power of the car being converted to LPG
3. Injector assembly support,
4. Ø 6 washer
5. M5 x 25 screws for fixing the supports to the injector assembly,
6. Nuts for creating a gap between the injector assembly and the support,
7. Approved E67-R01 4x10 hose for connecting the nozzles of the injector assembly to the nozzles fixed to the inlet manifold.
8. Ø10.3 ÷ 12.3 hose clamps for securing the hosing to the nozzles.
9. Pressure sensor.

Install the pressure sensor on the injector assembly as follows:

1 Unscrew the cap of the injector assembly using a “5” hex wrench,

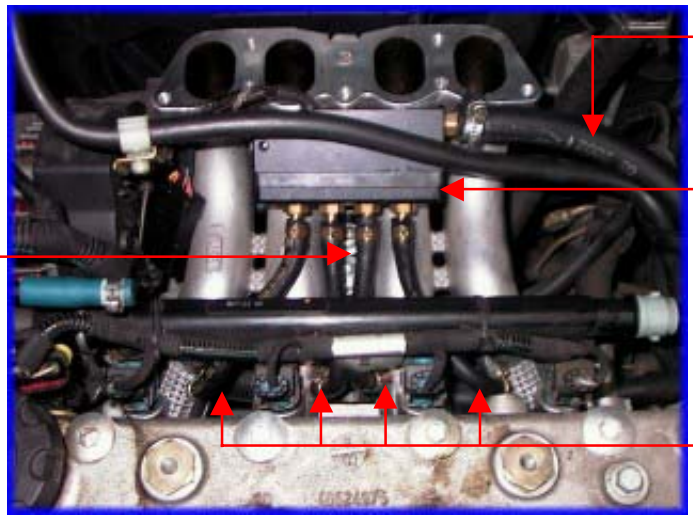
2 Apply the pressure sensor to the hole in the cap and tighten with a “34” box wrench

Select the nozzles to install on the injector assembly according to the power of the car. There are various sizes of nozzles: Ø 2.4, Ø 2.7, Ø 3.2 and Ø 3.5. To determine the type of nozzle, consult the following table.

Power of vehicle	Nozzle diameter (mm)					
	FAST 3 cylinders	FAST 4 cylinders 90kW	FAST 4 cylinders 120kW	FAST 4 cylinders 150kW	FAST 5 cylinders	FAST 6 cylinders
up to 65 kW	Ø 2.7	Ø 2.4				
65 to 90 kW		Ø 2.7				
90 to 120 kW			Ø 2.7		Ø 2.7	Ø 2.7
120 to 135 kW				Ø 3.2	Ø 2.7	Ø 2.7
135 to 150 kW				Ø 3.5	Ø 2.7	Ø 2.7

To install the Injector Assembly, proceed as follows:

1. Fix the nozzles (2), chosen according to the kind of car being converted, to the Injector assembly (1).
2. Bend and shape the support (3) as required.
3. Fix the support (3) to the engine.
4. Fix the Injector Assembly (1) to the support (3) with the washers (4), the two M5 screws (5) and the nuts (6), if required.
5. Make sure that the Injector Assembly (1) with the wiring harness mounted does not prevent the bonnet from being closed.
6. Cut one of the lengths of hose (7) to size in order to connect one of the lateral nozzles on the manifold to the corresponding outlet on the injector assembly (1). The hose must be cut so that the connection is as short as possible and to avoid sharp bends.
7. Cut the other lengths of hose (7) to the same length
8. Attach the four cut lengths of hose (7) to the nozzles on the ducts of the inlet manifold and to the outlets of the injector assembly (1) using the supplied clamps (8) and secure them with the relative tool.



LPG hose from reducer.

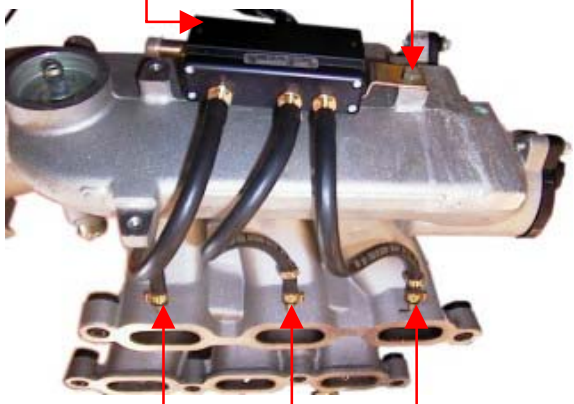
Injector assembly

Suitably shaped bolt and bracket for fixing the injector assembly

E67-R01 hosing for connecting the nozzles mounted on the inlet manifold with the injection assembly nozzles.

Injector assembly

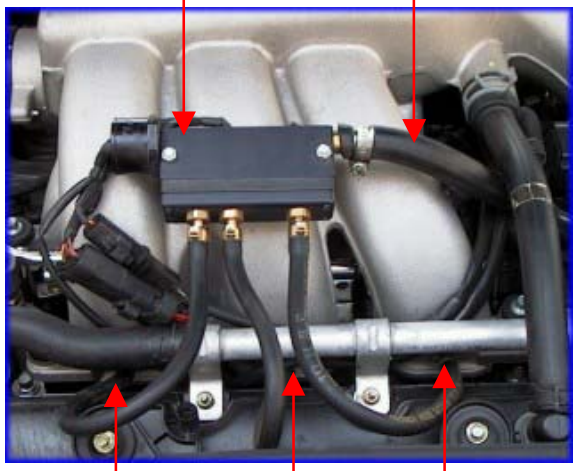
Suitably shaped bolt and bracket for fixing the injector assembly



Nozzles and hoses connecting the Injector assembly to the inlet manifold

Injector assembly

LPG hose from reducer.



Nozzles and hoses connecting the Injector assembly to the inlet manifold

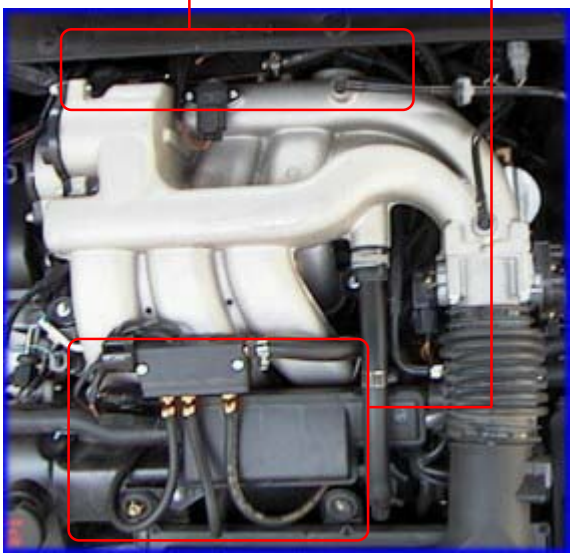


fig. 7

4.6 Installing the LPG lock-off valve

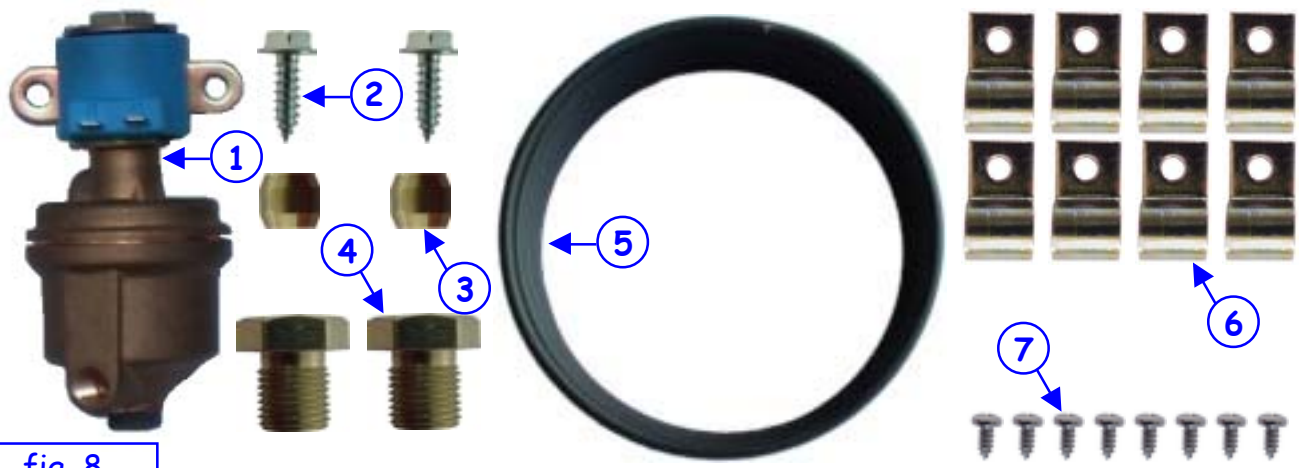


fig. 8

1. LPG lock-off valve
2. 4.8x16 self-tapping screws for fixing the LPG lock-off valve to the chassis or bodywork of the car,
3. Ø 6 double cone,
4. M10x1 galvanised connector,
5. Coil of 4x6 copper piping,
6. Ø 8 car hose clamp,
7. 3.9x9.5 self-tapping screw

Fit the LPG lock-off valve (1) before installing the reducer; to do this, use the bracket built into the valve and the two self-tapping screws.

Connect the multivalve mounted on the tank to the LPG lock-off valve (1) with a suitable length of copper piping (5).

Fix the pipe to the multivalve with the double cone (3) and the galvanised connector (4) supplied with the multivalve.

Fix the pipe to the bottom of the car in as protected a position as possible from heat sources and/or accidental impact as this may cause it to deteriorate or break, using the car hose clamp (6) and the self-tapping screws (7), until it reaches the engine compartment.

Fix the pipe to the gas inlet of the LPG lock-off valve using the double cone (3) and the galvanised connector (4).

Also prepare a section of copper piping that will connect the lock-off valve to the reducer, fixing it to the lock-off valve and then to the reducer with the double cone and the relative galvanised connector.

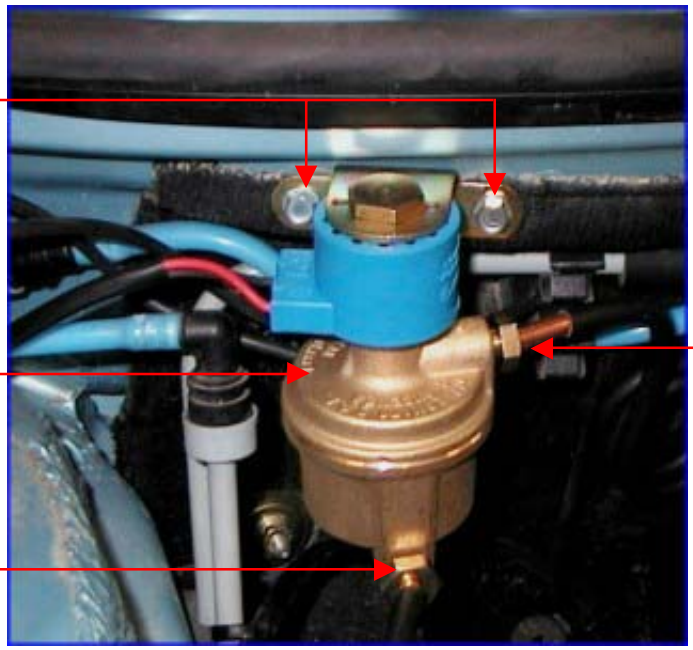

Screws for fixing the LPG lock-out valve to the vehicle body
LPG lock-off valve
Gas inlet connector
Gas outlet connector

fig. 9

4.7 Installing the FAST Reducer/vaporiser

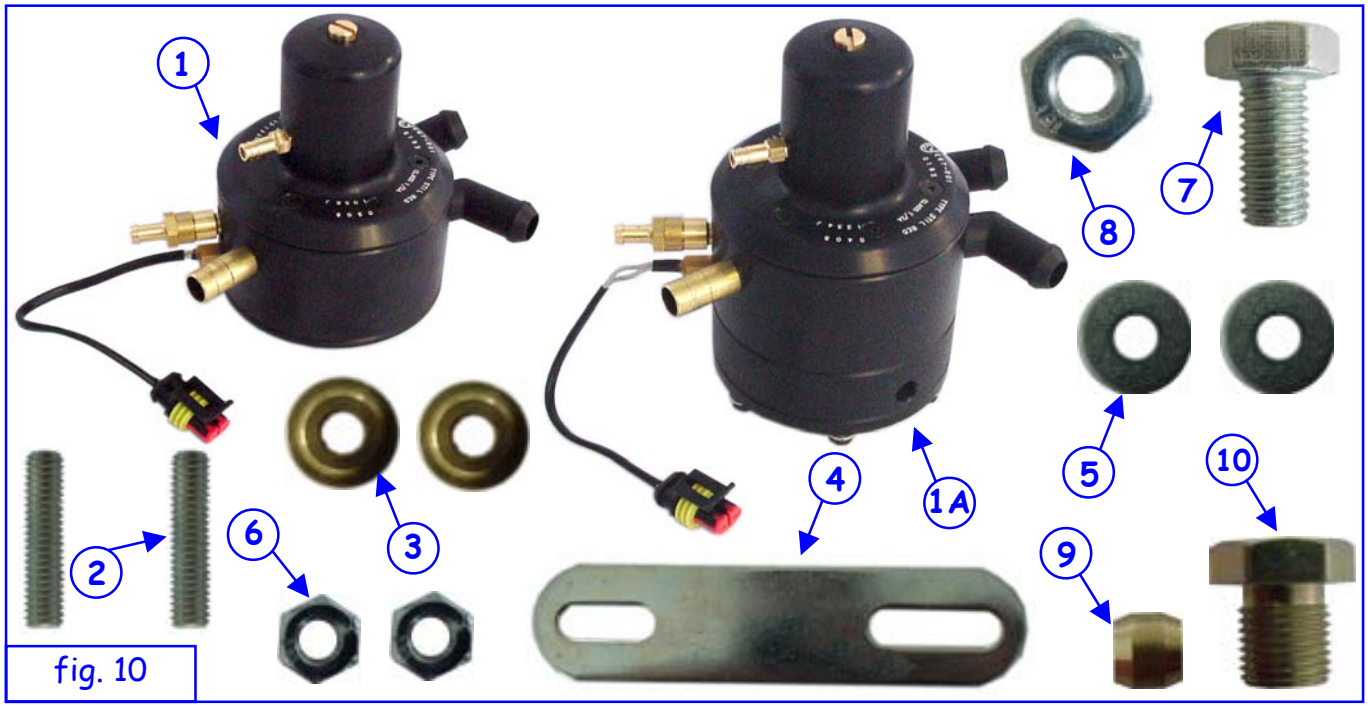


fig. 10

1. Reducer - 1 = Reducer 90kW - 1A = Reducer 150kW,
2. Reducer fixing stud,
3. Reducer fixing bush,
4. Reducer fixing bracket,
5. Wide M6 washer,
6. Hex nut M6,
7. Screw M10 x 20,
8. Hex nut M10
9. Double cone
10. Galvanised connector M10x1

To fix the reducer, proceed as follows.

- Mount the two studs (2) in the relative holes on the reducer body (1) and fix them with an M3 Allen key.

- Insert the brass bushes (3) i nto the studs with the widest part lying on the reducer body (1).

- Bend the steel bracket (4) to size and insert the shorter slot into the two studs (2).

- Position the wide M6 washers (5).

- Fix the bracket to the reducer using the M6 nuts (6).

- Before fixing the reducer-bracket assembly to the car, connect the gas inlet tube from the lock-off valve using the double cone (9) and M10 connector (10).

Fit the reducer-bracket assembly to the bodywork of the car in the chosen position using the M10x20 (7) screw and the M10 hex nut (8) (see figure 11).

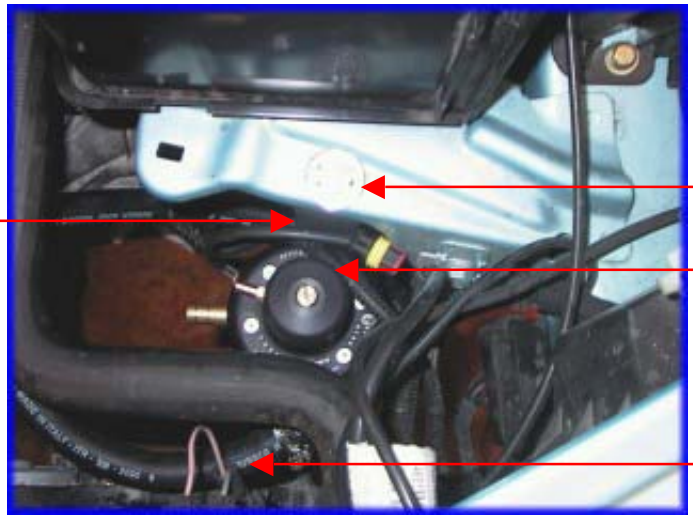
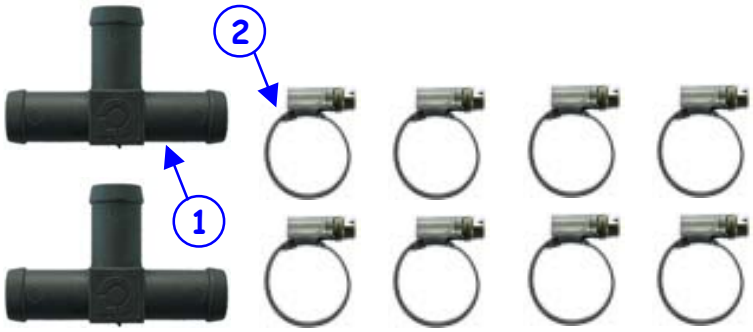


fig. 11

Mount the reducer vertically (see paragraph 4.2) so that the pressure adjustment screw is easy to reach and the LPG outlet connector, the MAP nozzle, the overpressure valve and the water pipes are roughly directed towards the relative components. Take care to prevent it from touching moving or hot parts.

Make compressed air connections from the reducer to the injector assembly, from the overpressure valve to the nozzle upline from the butterfly valve and from the upper cover of the reducer to the MAP tap downline from the butterfly valve.

Connecting the reducer to the cooling circuit of the car

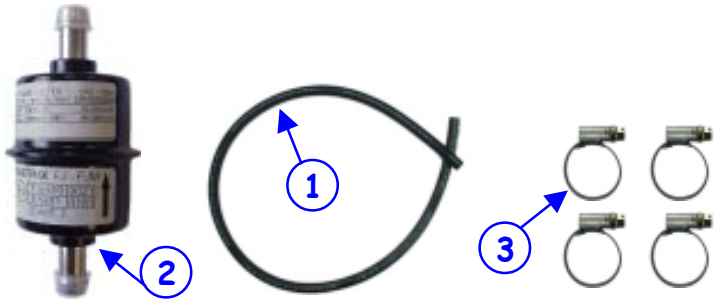


(1) T-shaped water union
(2) Hose clamp Ø 16 ÷ 27

Install the reducer heating circuit as shown below, taking care to reduce the loss of liquid coolant to a minimum:

1. cut the two engine coolant hoses at the bulkhead between the engine compartment and the interior, and insert the two T-shaped unions (1).
2. attach the hoses for heating the reducer to the other ends of the unions.
3. attach the hoses to the relative pipes on the reducer.
4. tighten the entire hydraulic circuit installed with the hose clamps D. 16 – 27 (2).
5. vent the cooling system.

Connecting the reducer to the injector assembly on 3 and 4 cylinder vehicles



1. Gas hose E67-R01 Ø 12x19
2. LPG filter
3. Hose clamp Ø 12 ÷ 22

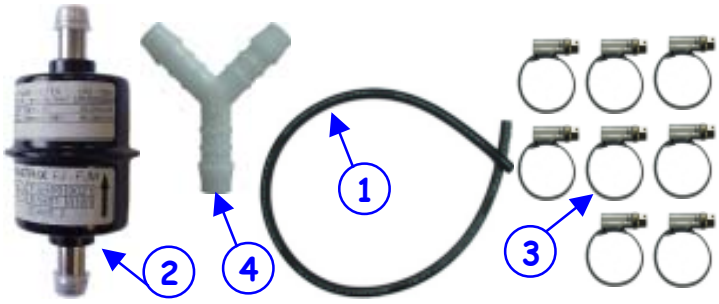
Supply the LPG to the FAST injector assembly as shown below (fig.12):

1. Mount the LPG filter (2) in series between the reducer and the injector assembly.
2. cut the 12x19 E67-R01-approved hose (1) into two sections.
3. install and tighten the compressed air circuit using the four hose clamps D. 12 – 22 (3).

CAUTION

MOUNT THE LPG FILTER HORIZONTALLY

Connecting the reducer to the injector assembly on 5 and 6 cylinder vehicles



1. Gas hose E67-R01 Ø 12x19
2. LPG filter
3. Hose clamp Ø 12 ÷ 22
4. Y-shaped union

Supply the LPG to the FAST injector assembly as shown below (fig.12):

1. Mount the LPG filter (2) in series between the reducer and the injector assembly.
2. Use a length of E67-R01-approved 12x19 hose (1) and two clamps (3) to connect the LPG filter (2) to the reducer gas outlet, respecting the direction of the gas flow indicated by the arrow,
3 Use another length of hose (1) and another two clamps (3) to connect the LPG filter (2) outlet to the Y-shaped union (4),
4. Use two equal lengths of hose (1) and the four remaining clamps (3) to connect the free ends of the Y-shaped union (4) to the two injector assemblies.

CAUTION

MOUNT THE LPG FILTER HORIZONTALLY

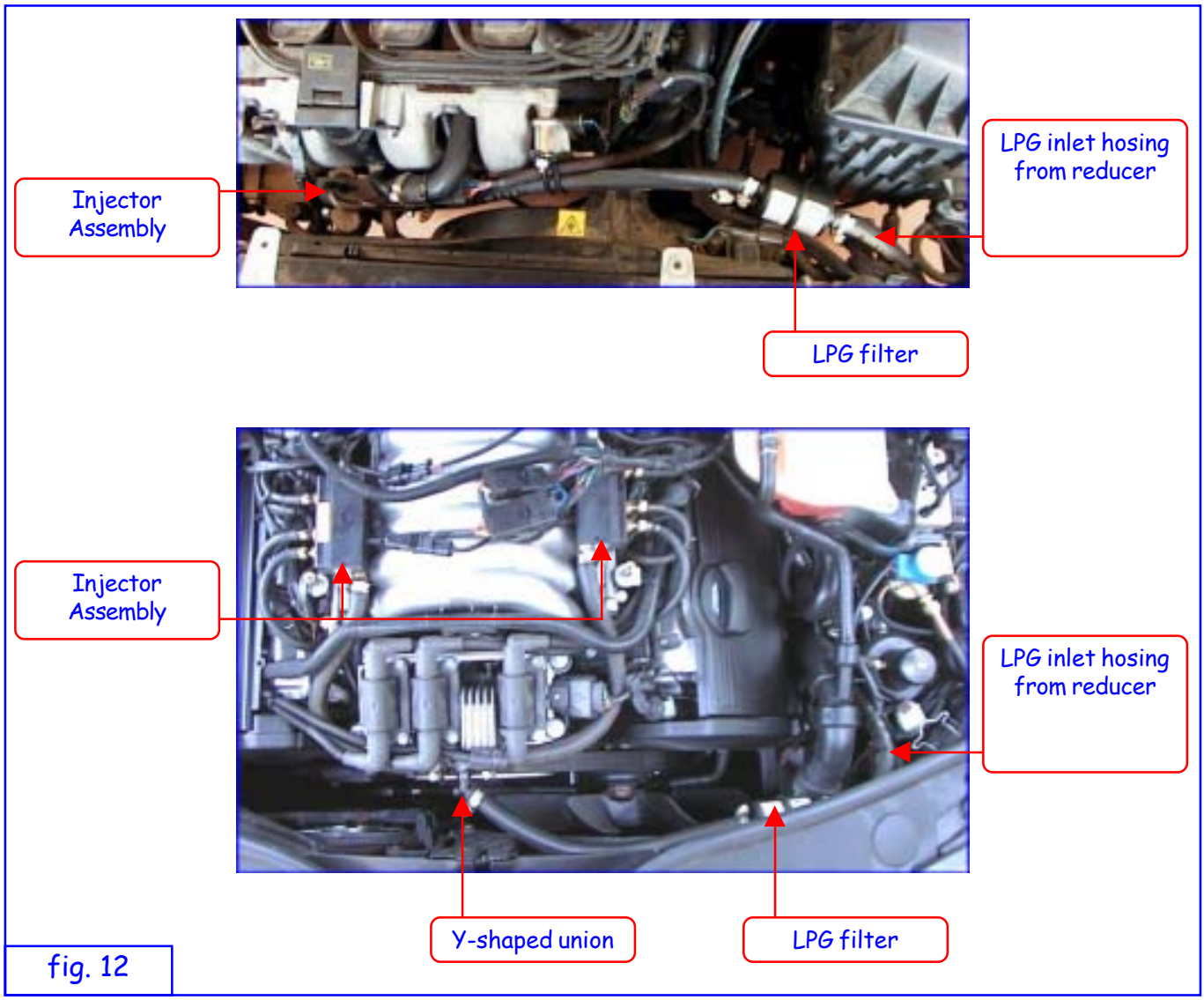
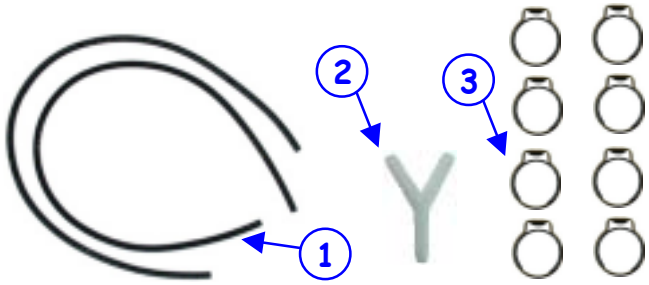


fig. 12

Connecting the reducer to the M.A.P. sensor and discharging overpressure



1. "Only air" hose
2. Y-shaped union
3. Hose clamp

Install the overpressure discharge circuit as follows (fig. 13):

1. fix a section of "only air" hose to the reducer overpressure valve hose connector using the hose clamp.
2. cut the hose to length and attach it to the nozzle fixed to the air filter or downline from the airflow meter, if fitted.
3. fix the hose with the hose clamp.

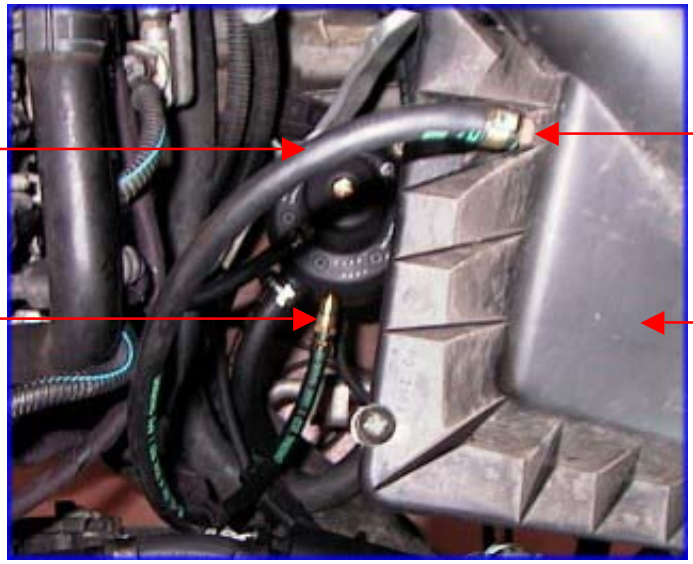
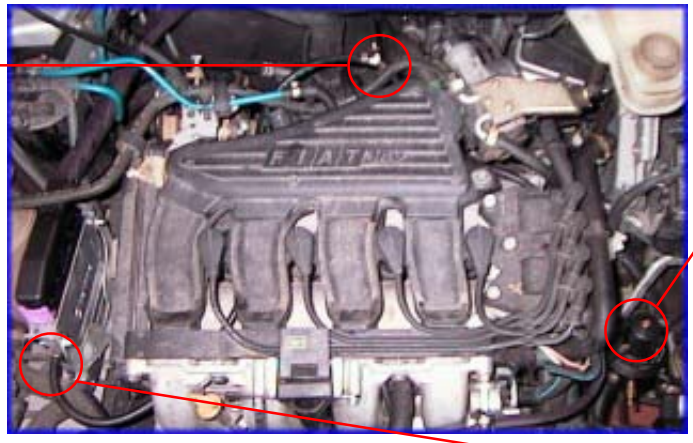


fig. 13

Install the inlet manifold pressure measurement circuit as follows (fig. 14):

1. mount a length of "only air" hosing to the manifold pressure delivery nozzle fitted downline from the butterfly valve and secure it with a hose clamp,
2. cut the hose so that it can reach the immediate vicinities of the reducer and the FAST control unit and then attach the free end to the Y union,
3. connect two lengths of "only air" hose and fix them with two hose clamps to the free ends of the union. Taking care to keep them as short as possible, connect one to the M.A.P tap on the FAST control unit and the other to the reducer pressure delivery nozzle.

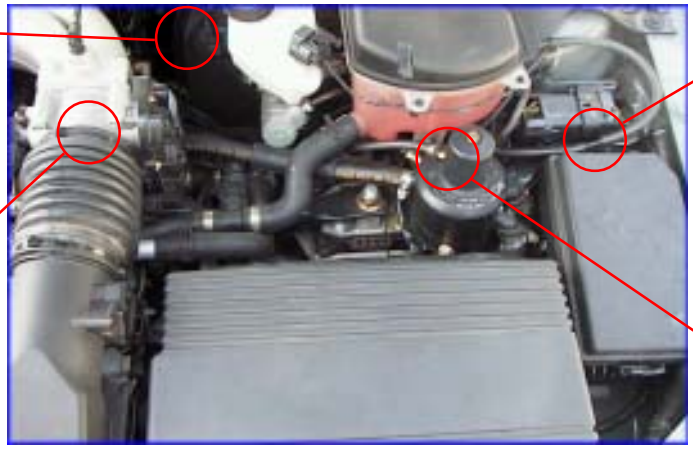
M.A.P. signal delivery nozzle from the inlet manifold and the Y-shaped union



M.A.P. signal delivery nozzle from the reducer

M.A.P. signal delivery nozzle from the control unit

M.A.P. signal delivery nozzle from the control unit



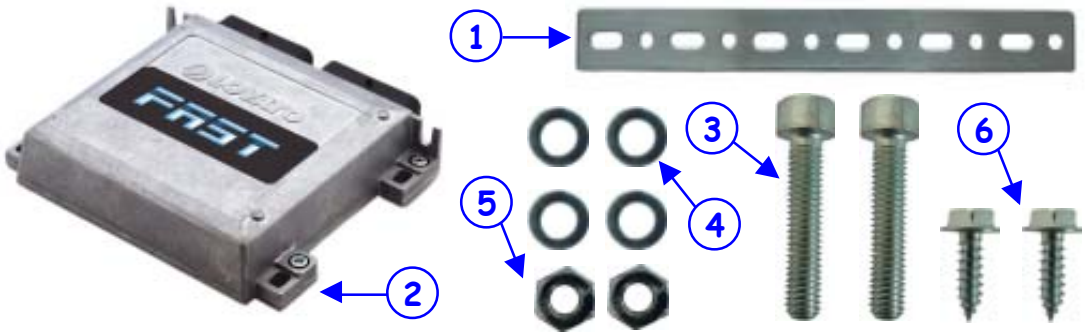
Y-shaped union

M.A.P. signal delivery nozzle from the inlet manifold

M.A.P. signal delivery nozzle from the reducer

fig. 14

4.8 Installing the Electronic control unit



1. Bracket for fixing the electronic control unit,
2. Electronic control unit,
3. M6 x 30 screw for fixing the bracket to the control unit,
4. M6 washer,
5. M6 nut,
6. 4.8x16 self-tapping screws for fixing the control unit supports to the chassis or bodywork of the car.

Cut two pieces from the fixing bracket (1) and shape them so as to be able to fix the control unit (2) in the required position. Fix the two brackets to the control unit using the screws (3), washers (4) and nuts (5). Fit the control unit to the bodywork of the car using the self-tapping screws (6).
Position the electronic control unit in the engine compartment. Make sure to respect the following requirements:

- mount the control unit as far away as possible from the spark plug wires and the high-voltage ignition circuit
- mount the control unit in an area where the temperature is not normally very high; do not position it near the engine exhaust manifold
- do not fix it to the engine assembly
- even though the control unit is airtight, do not fix it in a position where it can be directly sprayed by water
- to ensure the MAP tap connection is not too long, install the FAST control unit as near as possible to the reducer and butterfly valve body.

Generally speaking, it should be positioned near the engine battery.

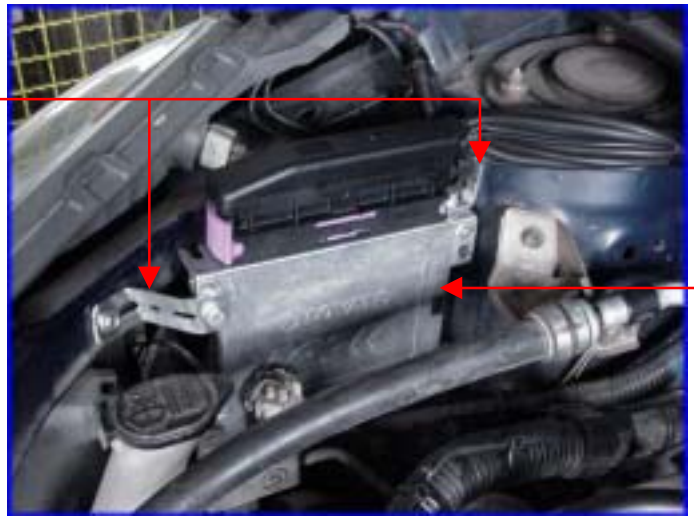
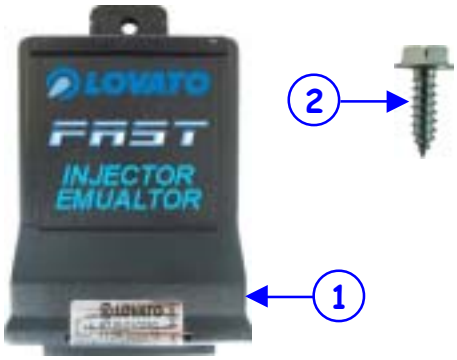

Bracket for fixing the electronic control unit
Control unit

fig. 15

4.9 Installing the EMU FAST electronic control unit



1. EMU FAST control unit,
2. 4.8x16 self-tapping screw for fixing the EMU FAST control unit to the chassis or bodywork of the car.

Position the control unit (1) in the chosen point and fix it with the self-tapping screw (2) supplied with the kit.

Position the control unit in the engine compartment taking care to respect the following requirements:
- mount the control unit as far away as possible from the spark plug wires and the high-voltage ignition circuit
- mount the control unit in an area where the temperature is not normally very high; do not position it near the engine exhaust manifold
- do not fix it to the engine assembly
- do not fix it in a position where it can be directly sprayed by water

Generally speaking, it should be positioned near the engine battery.
Connect the control unit to the injectors with the relative cable harness. Choose the type of harness depending on the injector:
1) Bosch-type injectors, with normal or inverted polarity
2) Japan -type injectors, with normal or inverted polarity

fig. 16

5.0 Electrical connections

5.1 RPM signal

FAST is a phased Sequential Injection system and, as such, the revs input is used to synchronise the whole system.
In order to optimise conversion, assess the capture method with care.
The selection criteria is the following:

- Always prefer the RPM signal from the petrol control unit; locate its position on the connector with the wiring diagram of the car or by directly visualising the signals with an oscilloscope
- In some recent models of car, the RPM counter signal is conveyed on the Can Bus and contains no phase information.

  In this case, choose the negative signal on the ignition coil.

  When capturing this signal, remember that if the grounds of the ignition coil are not in good condition, discharge may be incorrect and generate impulses on the low voltage side that may disturb system operation: in these cases, if it is not possible to eliminate the cause, use a rev amplifier to decouple the circuits.

Make the electrical connection to the rev counter signal or the ignition coil negative signal by stripping the signal wire for a sufficient length to allow the BLACK wire from the FAST control unit to be soft soldered; insulate the connection with insulating tape.
If the FAST control unit does not detect a correct RPM signal, the system will not allow the car to shift from the petrol mode to the LPG mode. The red status LED will shine and the green status LED will flash on the switch.

5.2 Lambda probe signal (before catalyser)

The Lambda probe signal is not required for the FAST system but it may be useful when calibrating the system. Check the Lambda probe works properly in the petrol mode before connecting it to the FAST system. To prevent electromagnetic disturbance, do not lay the sheath with the WHITE wire near the ignition coil.
The Lambda probe signal is captured by pinning the WHITE wire of the FAST cable harness to the Lambda probe signal wire (the BLACK wire of the probe is generally the signal wire).

CAUTION

THE COLOURS OF THE LAMBDA PROBE WIRES IN THE EXPLANATIONS AND THE ELECTRICAL DIAGRAM REFER TO THE SECTION FROM THE PROBE TO THE CONNECTOR. AS THE SIGNALS ARE ALWAYS CAPTURED AFTER THE PROBE CONNECTOR AND THE COLOURS OF THE WIRES OFTEN CHANGE, MAKE SURE TO REFER TO THE CORRESPONDING WIRE BEFORE THE CONNECTOR.

5.3 Connecting the reducer temperature sensor

The FAST system uses the reducer temperature signal for various purposes. The temperature of the reducer is one of the variables that govern switching from the petrol mode to the LPG mode. Switching from petrol to LPG is only allowed when the reducer reaches the set switching temperature.
Connect the temperature sensor by attaching the 2-way female AMP connector of the cable harness to the corresponding male connector of the sensor mounted on the reducer.
If the temperature sensor does not work correctly or is not connected, the system will not allow you to switch from petrol to LPG. The red status LED will shine and the green status LED will flash on the switch.

5.4 Connecting the level indicator

The FAST system includes a digital fuel level indicator located in the MICRO switch. The wiring harness of the FAST system is fitted with a level sensor connecting wire. Install the Lovato level sensor by connecting the green wire of the level sensor mounted on the multivalve to the green wire of the FAST cable harness and the purple wire of the sensor to the red wire of the FAST cable harness (12 V key on).
Specific connections for other kinds of sensor are shown in the following table:

Sensor	Sensor		FAST harness
	Purple wire	Green wire	Green wire
Lovato	Harness red	Harness green wire	Sensor green
0 ÷ 90 Ω	To earth	Harness green wire	Sensor green
0 ÷ 95 Ω	To earth	Harness green wire	Sensor green
90 ÷ 0 Ω	To earth	Harness green wire	Sensor green
AEB	To earth	Harness green wire	Sensor green
Reserve	To earth	Harness green wire	Sensor green
No sensor	- - - - -	- - - - -	Insulate

5.5 Connecting the LPG multivalve and lock-off valve

Connect the sheath with the BLUE and BROWN wires to the multivalve coil power wires. Connect the BLUE wire to the RED wire from the multivalve, and the BROWN wire to the BLACK wire.
Connect the two-way male connector to the corresponding female connector located on the coil of the LPG lock-off valve.

5.6 Connecting the Injector Assembly

• 3 and 4 cylinder kit

Connect the injector command connector and the temperature and pressure sensor connectors on the FAST wiring harness to the corresponding connectors on the FAST injector assembly.

• 5 and 6 cylinder kit

Connect the injector command connectors and the temperature and pressure sensor connectors on the FAST wiring harness to the corresponding connectors on the FAST injector assemblies.

5.7 Connecting the power lines

• 3 and 4 cylinder kit

Connect the RED / BLACK wire to the positive battery terminal, interposing a 7.5 A fuse, and the BROWN wire to the negative battery terminal.
Connect the RED wire to the 12V key on circuit (not timed) interposing a 5 A fuse.

• 4 cylinder kit 150 kW

Connect the RED / BLACK wire to the positive battery terminal, interposing a 15 A fuse, and the BROWN wire to the negative battery terminal.
Connect the RED wire to the 12V key on circuit (not timed) interposing a 5 A fuse.

• 5 - 6 cylinder kit 150 kW

Connect the RED / BLACK wires to the positive battery terminal, interposing a 7.5 A fuse (on both), and the BROWN wire to the negative battery terminal.
Connect the RED wire to the 12V key on circuit (not timed) interposing a 5 A fuse.

5.8 Connecting the switch and the buzzer

Run the sheath with the switch power connector and the sheath with the RED and BLACK wires into

the interior. Connect the male connector powering the switch to the corresponding connector on the switch. Connect the RED wire of the buzzer to the RED wire of the FAST wiring harness and the BLACK wire of the buzzer to the BLACK wire of the FAST wiring harness.

5.9 Connecting the injector emulator

• 3 - 4 cylinder kit

After connecting the injector cutter wiring harness to the injectors, connect it to the EMU FAST control unit.
Fit the sheath of the FAST wiring harness with the AMP MODU male connector into the protective hood of the injector cutter wiring harness and connect it to the corresponding female connector located on the EMU FAST control unit next to the injector cutter connector.

• 5 - 6 cylinder kit

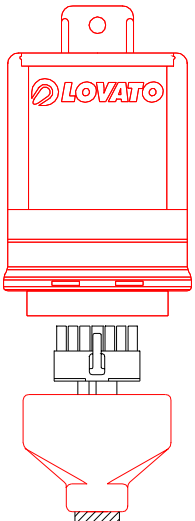
After connecting the injector cutter wiring harnesses to the injector connectors, connect them to the EMU FAST control units.
Fit the sheaths of the FAST wiring harness with the AMP MODU male connector into the protective hoods of the injector cutter wiring harnesses and connect them to the corresponding female connectors located on the EMU FAST control units next to the injector cutter connector.

If you do not have the injector emulator wiring harness with the right connectors, cut the injector commands from the original injector control unit (injector negative). See the next page for the relative instructions.

CAUTION

ALL CONNECTIONS WITHOUT CONNECTORS MUST BE SOFT SOLDERED IN ORDER TO PREVENT RUSTING AND FALSE CONTACTS.

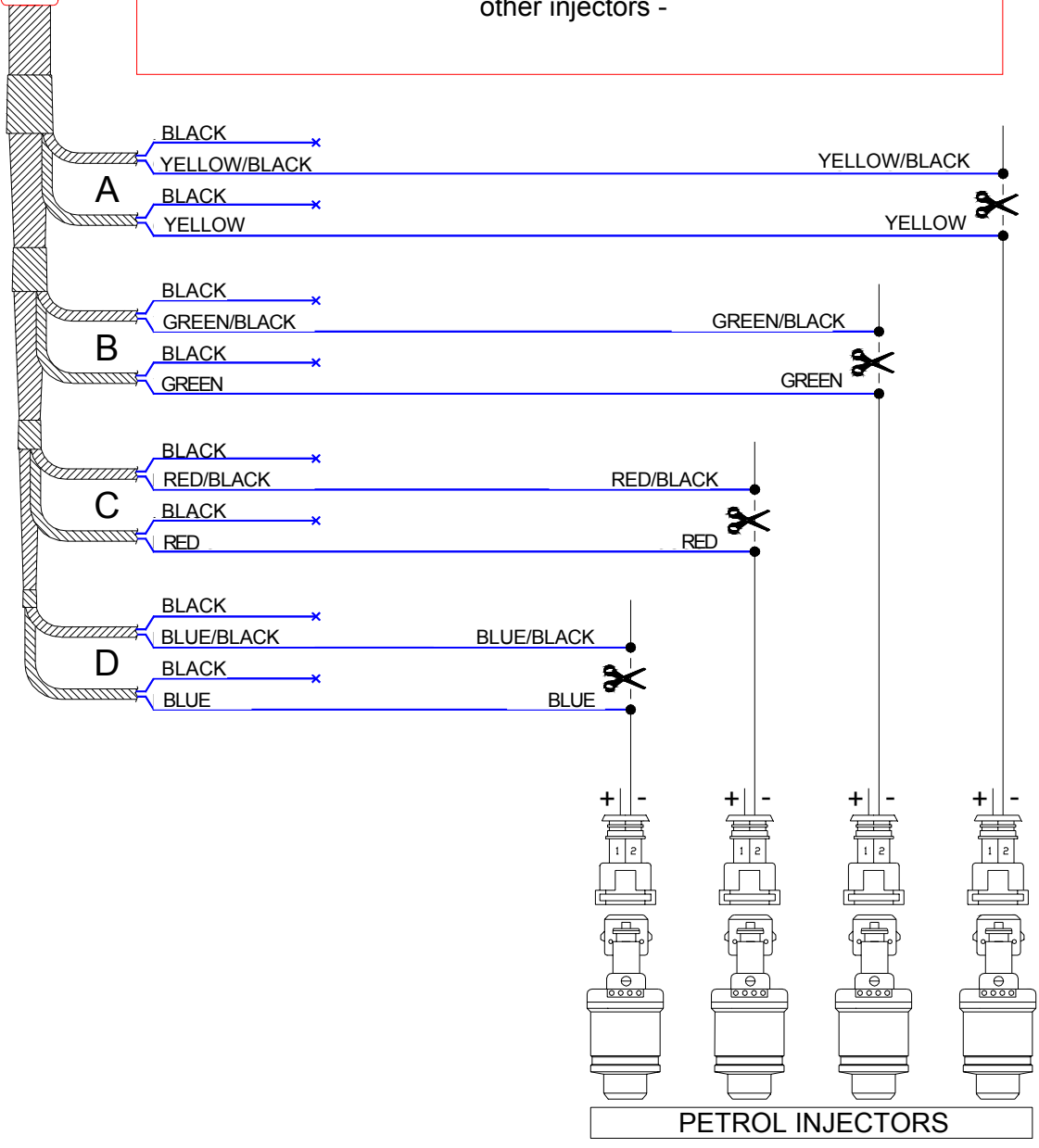
last revision date	file name	DIAGRAM SHOWING INJECTOR EMULATOR DIRECTLY CONNECTED TO VEHICLE HARNESS		revision 000
24 - 03 - 05	F__ - ___			Pag. 1/1



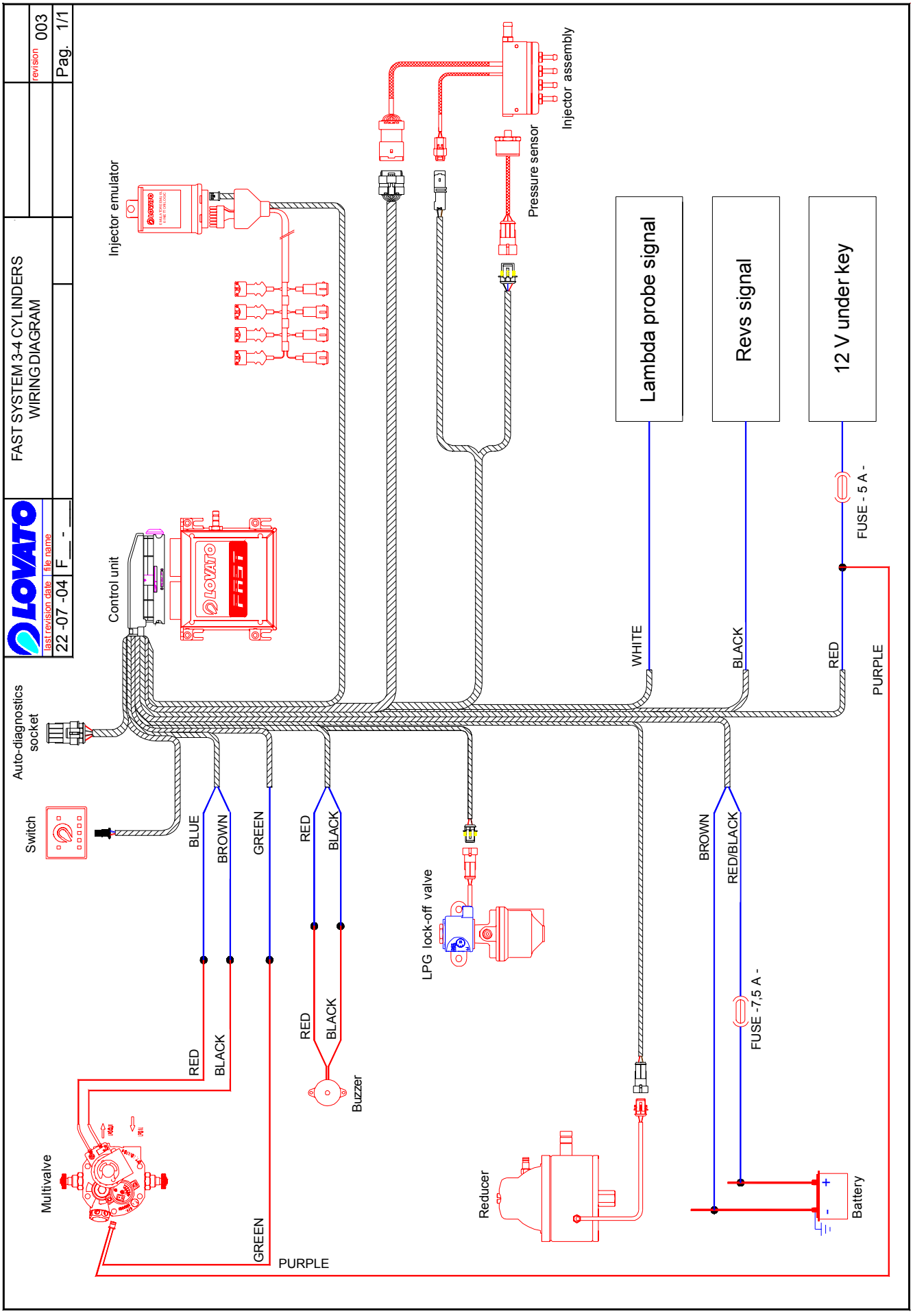
CAUTION

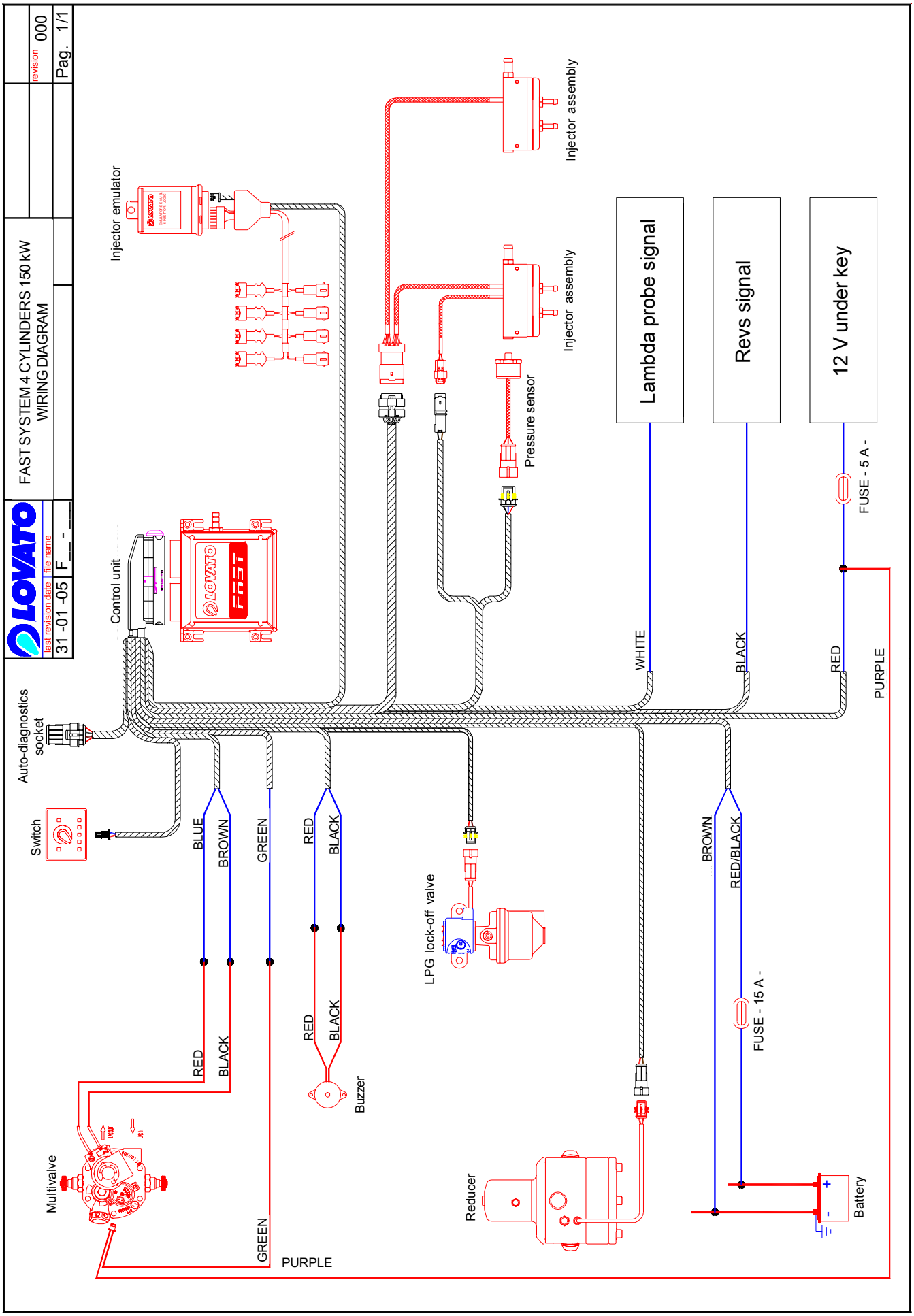
Connect the one-colour wires to the injectors and the corresponding black wires to the petrol injector control unit.

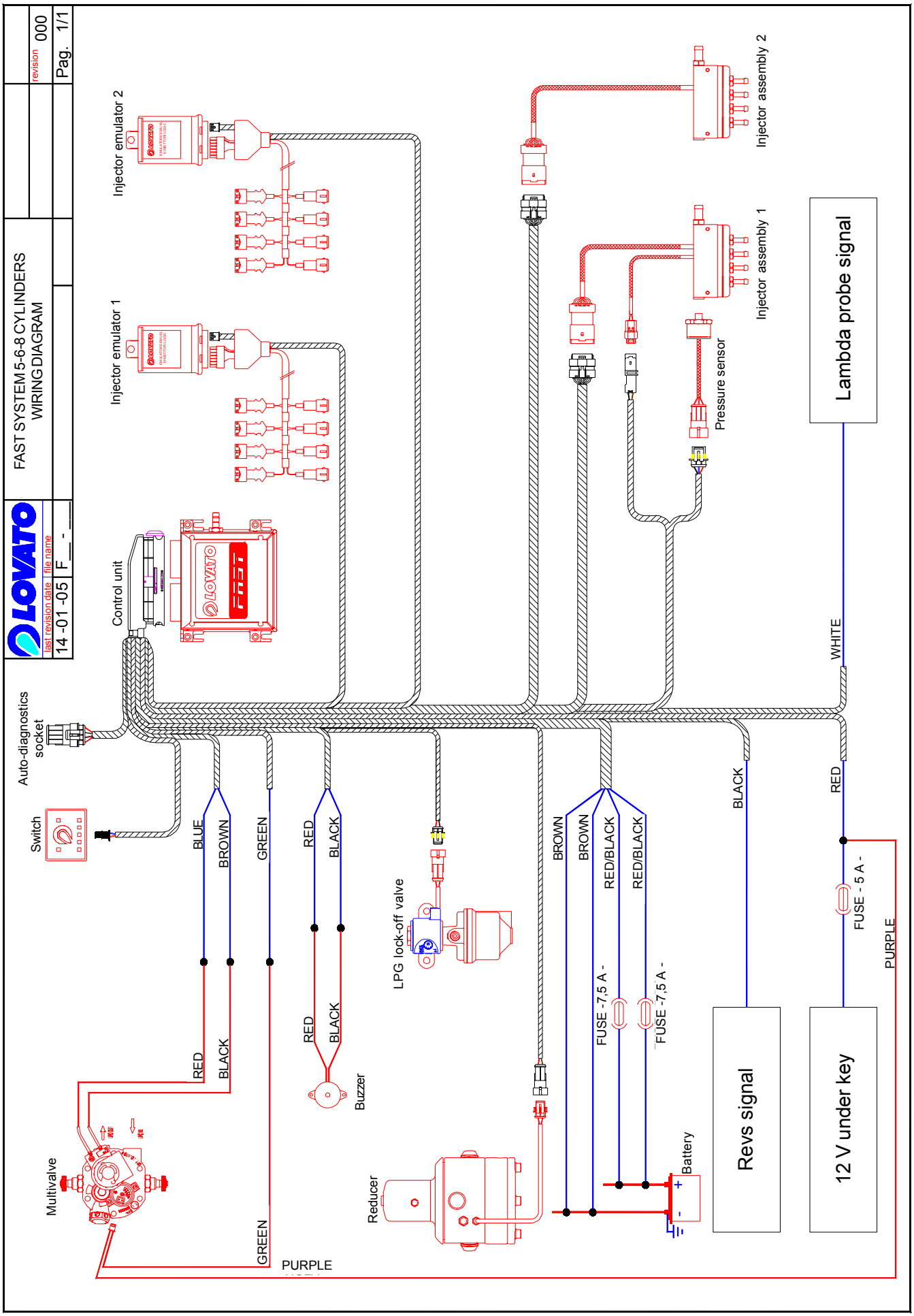
Make sure the sheath of the injector emulator harness and the gas injector match
-Connect the sheath A wires of the injector emulator harness to the injector control unit where the gas injector A is pneumatically connected. The same applied for the other injectors -



6.0 Wiring diagram

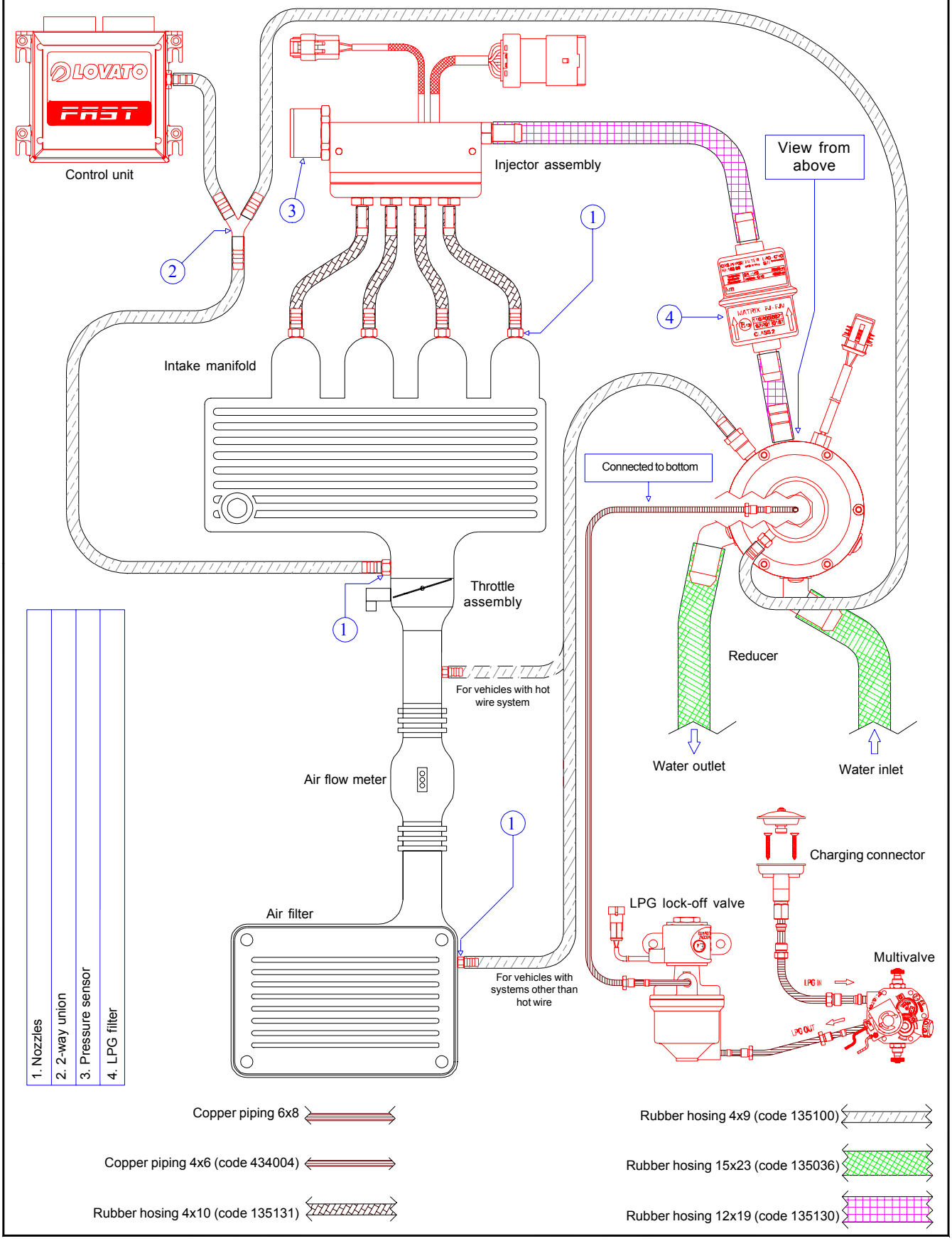



LOVATO
last revision date
31 -01 -05
file name
F__ -___
FAST SYSTEM 4 CYLINDERS 150 kW
WIRING DIAGRAM
revision
000
Pag. 1/1
Injector emulator
Injector assembly
Injector assembly
Pressure sensor
Lambda probe signal
Revs signal
12 V under key
Control unit
Auto-diagnostics socket
Switch
FUSE - 5 A -
WHITE
BLACK
RED
PURPLE
BLUE
BROWN
GREEN
RED
BLACK
LPG lock-off valve
BROWN
RED/BLACK
FUSE - 15 A -
RED
BLACK
Buzzer
Multivalve
Reducer
Battery
GREEN
PURPLE

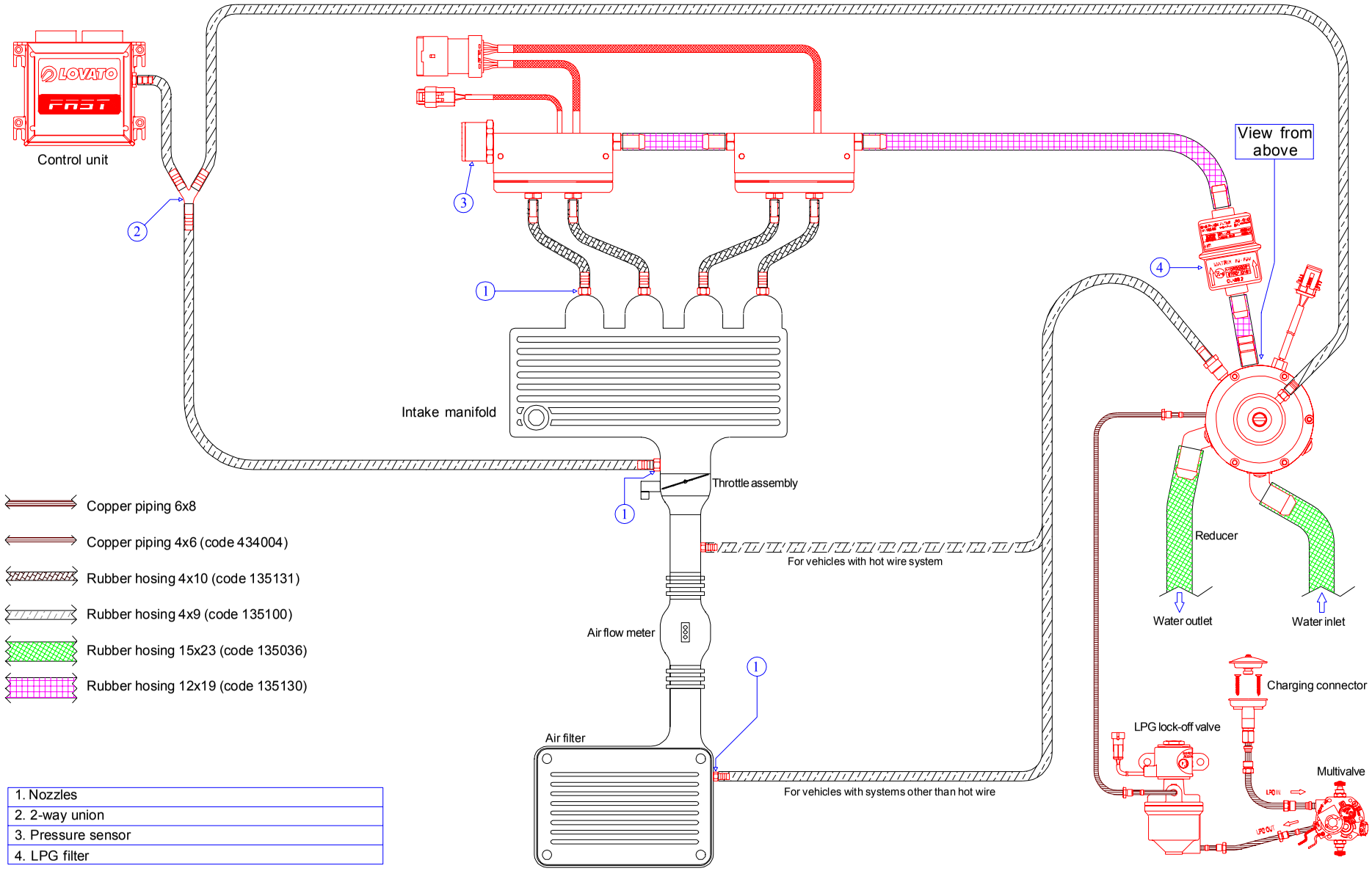

FAST SYSTEM 5-6-8 CYLINDERS
WIRING DIAGRAM
LOVATO
last revision date
14 -01 -05
file name
F__ -
revision
000
Pag. 1/1
Injector emulator 2
Injector emulator 1
Injector assembly 2
Injector assembly 1
Pressure sensor
Lambda probe signal
Control unit
Auto-diagnostics socket
Switch
WHITE
BLUE
BROWN
GREEN
RED
BLACK
BROWN
BROWN
RED/BLACK
RED/BLACK
BLACK
RED
FUSE - 5 A -
PURPLE
LPG lock-off valve
Buzzer
Multivalve
Reducer
FUSE -7,5 A -
FUSE -7,5 A -
Battery
Revs signal
12 V under key
GREEN
PURPLE

7.0 Compressed air diagram

LOVATO	FAST SYSTEM - COMPRESSED AIR DIAGRAM		
last revision date: 23 - 07 - 04	file name: F__ - ___		revision 002
			Pag. 1/1

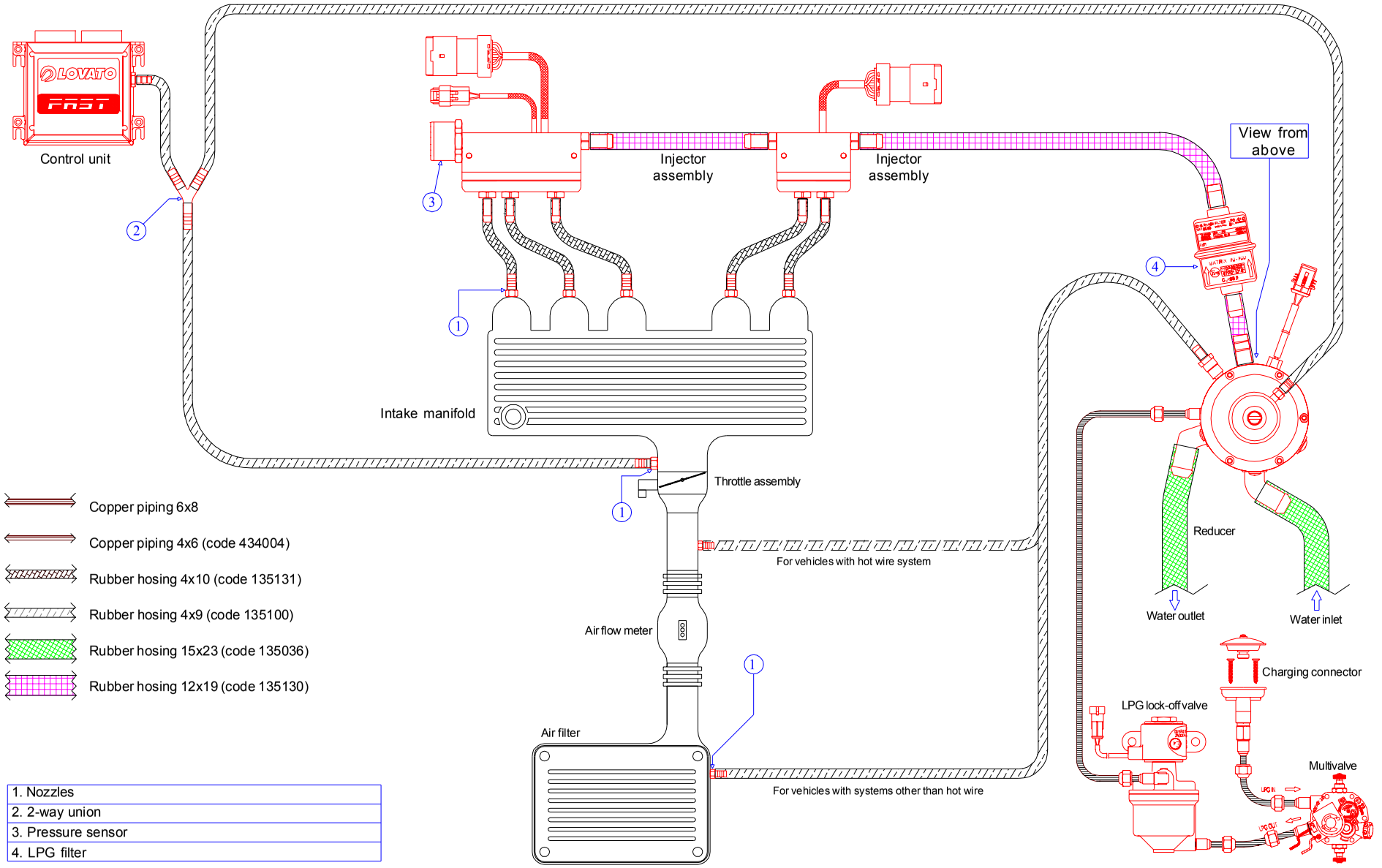


LOVATO	FAST SYSTEM 4 CYLINDERS 150 kW COMPRESSED AIR DIAGRAM		
last revision date: 14 -01 -05 / file name: F__ - ___			revision 000 Pag. 1/1

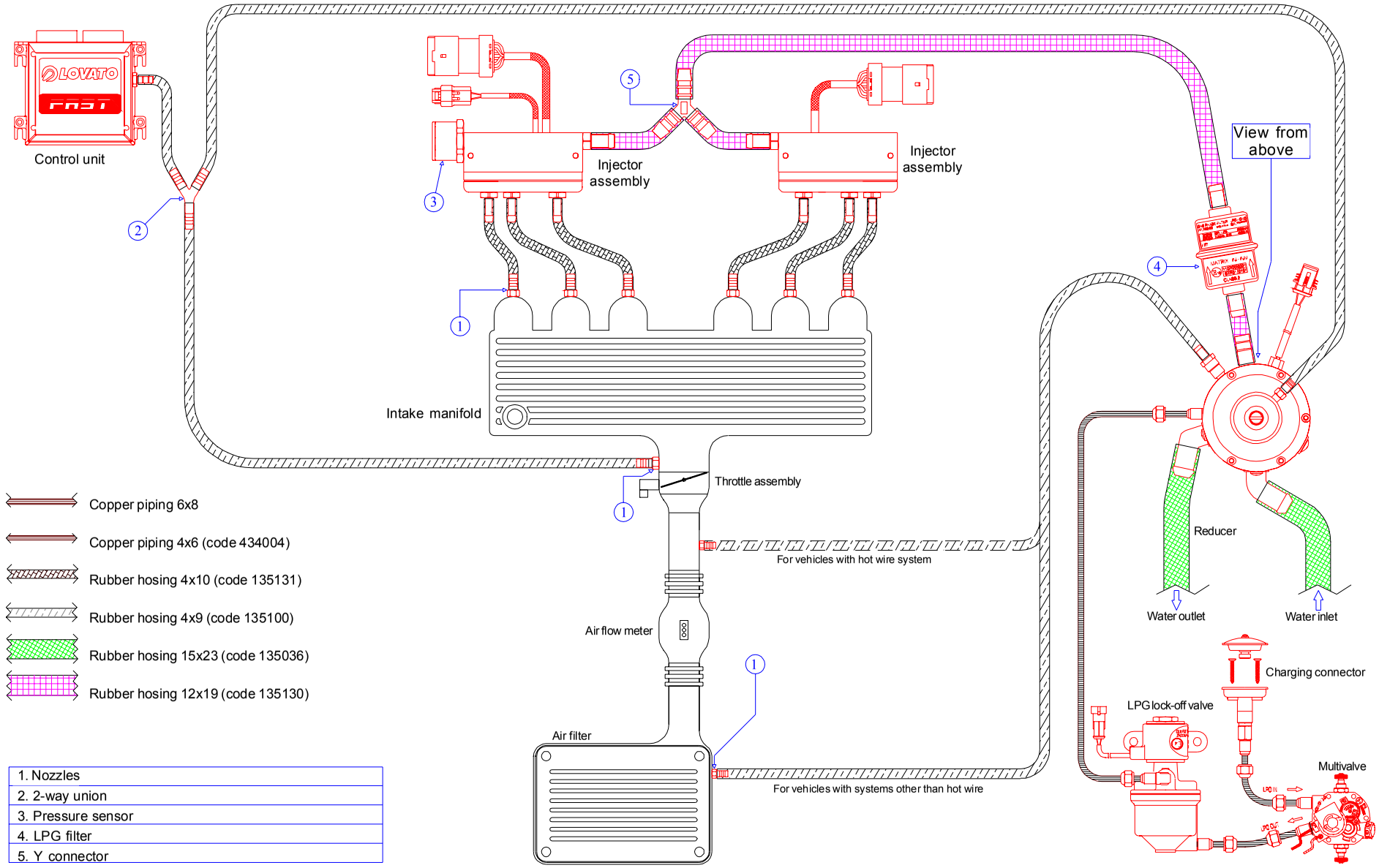


1. Nozzles
2. 2-way union
3. Pressure sensor
4. LPG filter

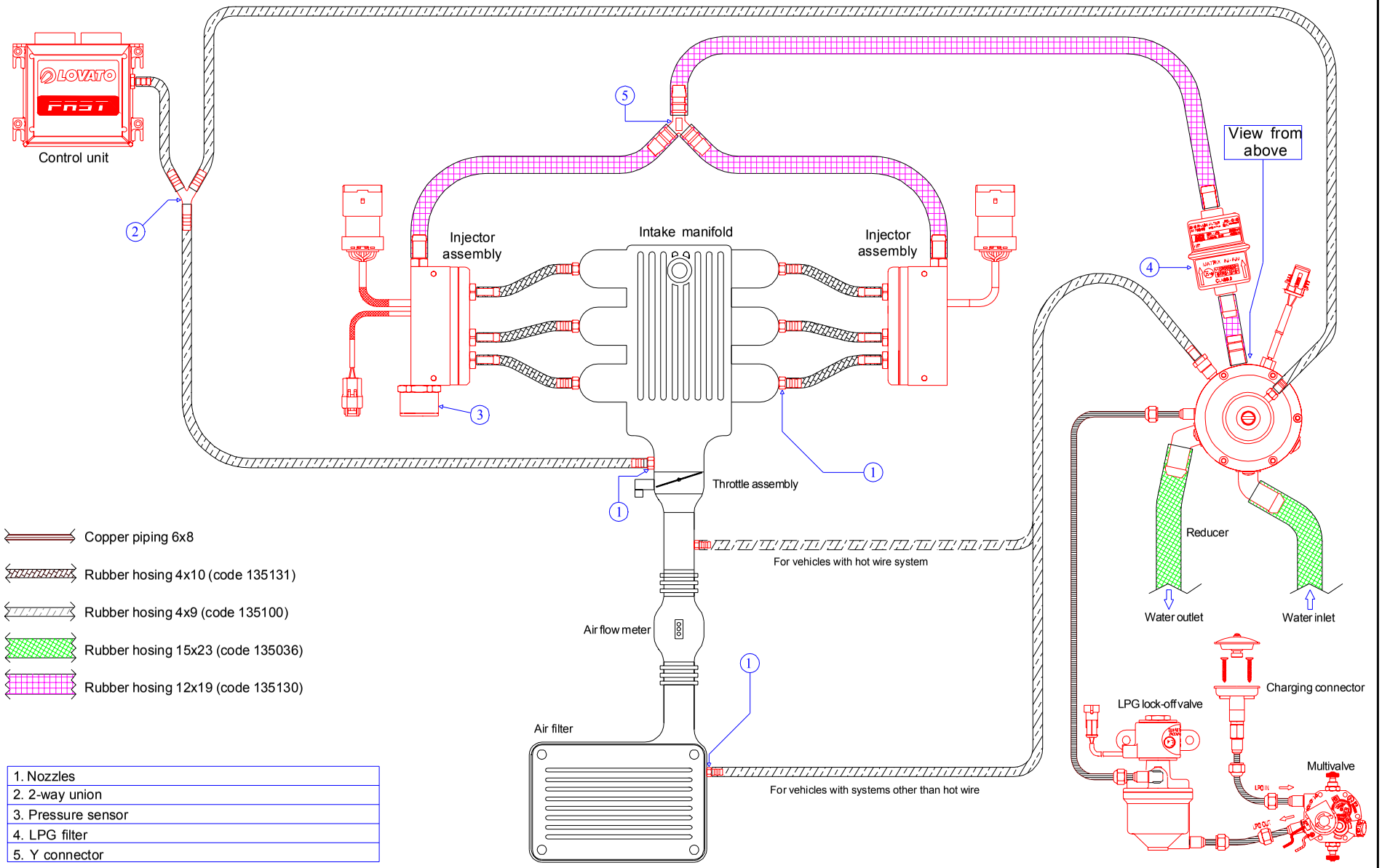
LOVATO	FAST SYSTEM 5 CYLINDERS COMPRESSED AIR DIAGRAM		
last revision date: 14 -01 -05	file name: F__ -___	revision 000	Pag. 1/1



LOVATO	FAST SYSTEM 6 IN-LINE CYLINDERS COMPRESSED AIR DIAGRAM		
last revision date: 14 -01 -05	file name: F__ - ___		revision 000
			Pag. 1/1



LOVATO	FAST SYSTEM 6 CYLINDERS COMPRESSED AIR DIAGRAM		
last revision date: 14 -01 -05	file name: F__ - ___	revision: 000	Pag. 1/1



8.0 User information

The MICRO switch is the interface between the end user and the FAST system. This component displays the operating status of the car, the gas level in the tank and allows various operations to be performed, such as setting the gas or petrol modes, and, in case of emergency, starting the car directly in the gas mode.

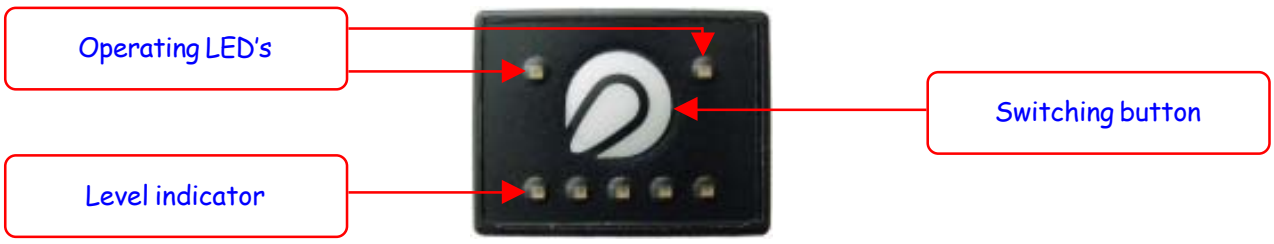


fig. 17

The operating LED's display the power status of the car: the green LED at the top left refers to gas, the red LED at the top right refers to petrol. The button with the Lovato logo is used to manually switch from petrol to gas and vice-versa and to force engine ignition in the gas mode. Lastly, there are five level indicator LED's at the bottom.

Indicating the quantity of gas in the tank

The amount of fuel in the tank is measured by the relative indicator LED's as shown below:

- 1 **red** LED on = reserve
- 1 **green** LED on = tank ¼ full
- 2 **green** LED's on = tank ½ full
- 3 **green** LED's on = tank ¾ full
- 4 **green** LED's on = tank full

Operation

Initial switching to LPG

To switch from the petrol mode (RED LED on) press the button. The GREEN LED starts flashing (gas enabled). In this condition, the car is still working in the petrol mode. When all the conditions required for switching have been satisfied, the control unit switches from the petrol mode to the LPG mode. The RED LED switches off, the GREEN LED switches on and the buzzer confirms the shift from the petrol mode to the LPG mode with two short sounds.

Subsequent switching

- If the car was turned off in the petrol mode, when the dashboard is turned on the switch shows the amount of gas in the tank, the gas LED is off and the petrol LED is on. When the engine is turned on, the switch remains unchanged and the car works on petrol. To switch to gas, press the switching button; the green gas mode LED flashes: the car still works on petrol and the FAST system waits to be enabled by the FAST electronic control unit to switch to gas. As soon as it receives the enable, switching takes place: the green gas mode LED turns on and the petrol mode LED turns off. The buzzer sounds.
- If the car was turned off in the gas mode, when the dashboard is turned on the switch shows the amount of gas in the tank, the gas LED is off as is the petrol LED. When the engine is turned on, the green gas mode LED flashes: the car works on petrol and the FAST system waits to be enabled by the FAST electronic control unit to switch to gas. As soon as it receives the enable, switching takes place: the green gas mode LED turns on and the petrol mode LED turns off.

The engine, therefore, is normally turned on in the petrol mode in order to keep the petrol injection system efficient; the system automatically switches to the gas mode when the engine reaches the set temperature.

Switching from LPG to petrol

To switch to the petrol mode, simply press the switching button: the green gas LED turns off and the red petrol LED turns on.

Emergency operation

In case of emergency, the engine can be started in the gas mode as shown below:
- press the switching button with the engine off
- turn the key and release the button after 3 seconds

The switch will show the RED LED on and the GREEN LED flashing.
Now you can start the engine.

Automatic switching to petrol

The system automatically switches from the LPG mode to the petrol mode when the amount of LPG inside the tank is no longer able to maintain the pressure required to power the car correctly. When the car is switched to petrol due to the lack of LPG, the buzzer emits long, repeated sounds which only stop after pressing the switching button. Switching to LPG will only be permitted again after filling up the tank.

“Car safety” condition

The “car safety” condition occurs when the number of revs measured by the electronic gas control unit falls under a set safety threshold. In this condition, all the gas delivery valves are closed and the car reverts to the petrol mode. This feature is required by current legislation in order to keep the system safe in case of an accident. The “car safety” condition can also occur, for example, when the engine stalls or breaks down. **The gas and petrol LED’s both flash and the level LED’s turn off**. To reset the system, simply restart the engine. In the event of a fault or an accident, contact an Authorised Lovato Fitter.

A table summarising the various signals given by the buzzer is shown below.

ACTION	BUZZER
Pressing the switching button	1 short sound
Switching to gas	2 short sounds
Entering fuel reserve	1 long sound
No fuel detected	Long repeated sounds
Starting in gas mode	2 long sounds
Problems with pressure and temperature sensors, or reducer is cold	3 long sounds
Faulty system component	Repeated sounds

CAUTION

DO NOT TRAVEL IN THE GAS MODE WITH THE PETROL TANK EMPTY: PREVENT THE PETROL PUMP FROM RUNNING DRY BY KEEPING THE PETROL TANK AT LEAST A QUARTER FULL.

9.0 FASTCOM calibration and diagnostics software

To install FASTCOM you must first obtain the FAST installation CD code 1570000.

9.1 Programme installation guide.

To install FASTCOM, insert the installation CD and wait for the window shown in figure 19 to open.

fig. 19

Click on FASTCOM and follow the instructions on the screen.

9.2 Connection between PC and control unit

The PC and the control unit are linked with the Code 540013 serial connection. Connect the RS232 serial connector on the interface harness to the relative socket on the computer. If you have a last-generation computer without a serial port, fit a standard USB-to-serial port adaptor. Connect the 4-pin female AMP connector on the interface harness to the corresponding 4-pin AMP male connector on the FAST harness. The following figure shows an example of a connection between the computer and the FAST system.

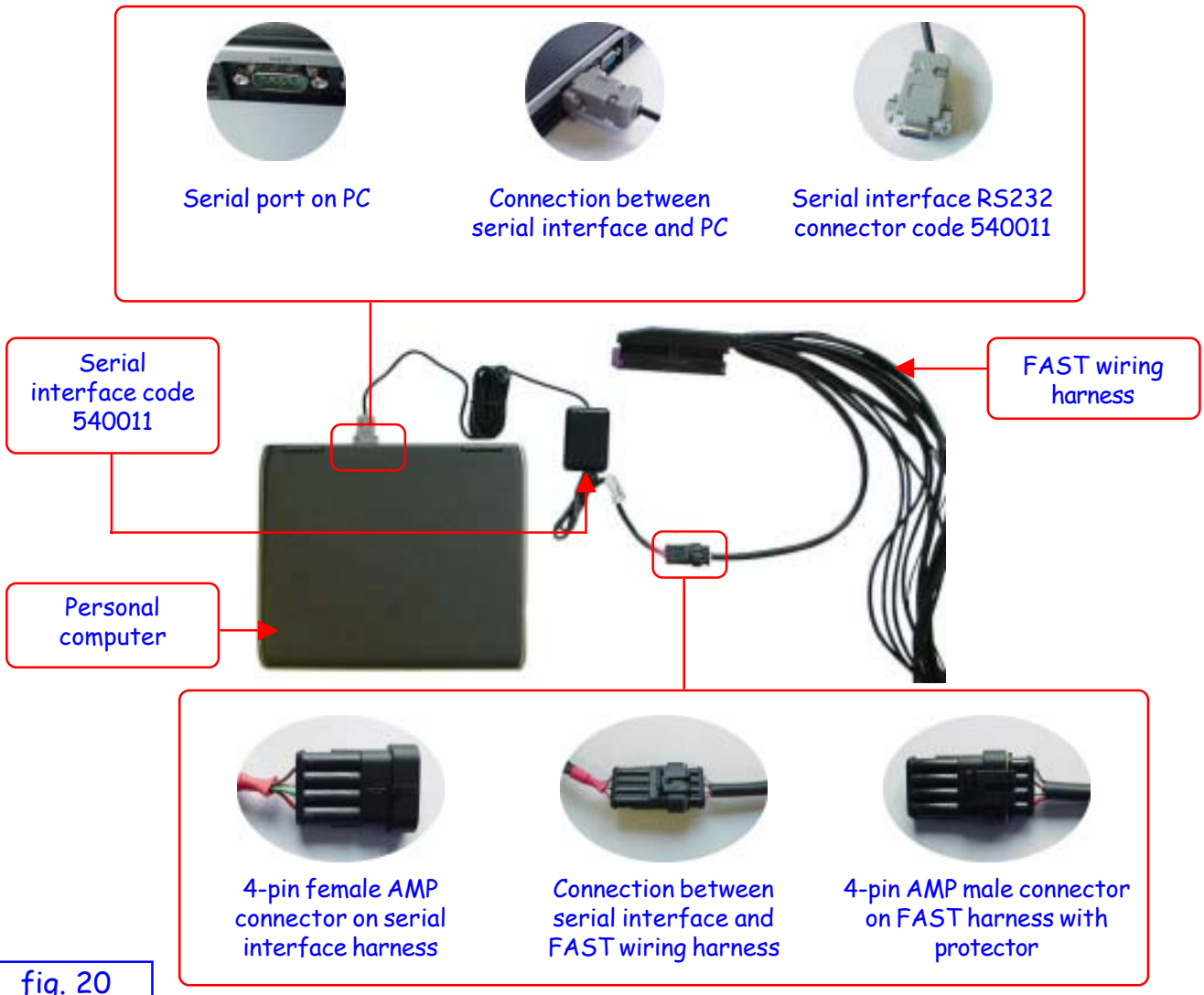


fig. 20

9.3 Start window

The start window shows the version of Fastcom and contains a language selection option.

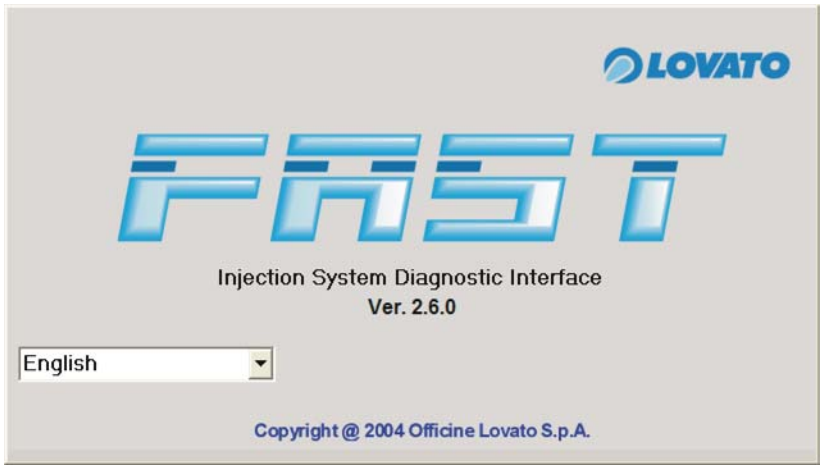


fig. 21

When the programme is run, the serial connection with the FAST control unit is checked. Communication status is shown by the symbol in the bottom left-hand corner. A red cross over the symbol means that communication is inactive.

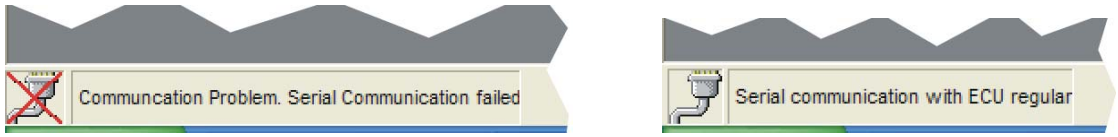


fig. 22

Compatibility between the software version (programme open on the computer) and the firmware (programme loaded on the control unit) is also checked. If the two versions are incompatible the error message shown in figure 23 is displayed. Click on SI to close the incompatible version and open the version that is compatible with the programme residing in the control unit.

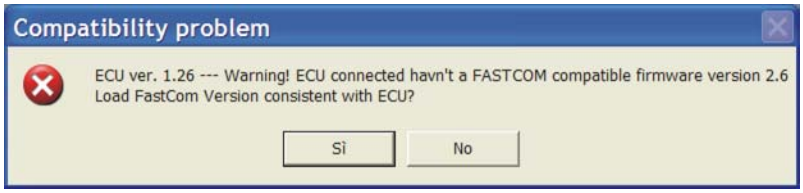


fig. 23

9.4 Programming the FAST control unit

To update the firmware, proceed as follows.

Select the BootLoader command from the Tools menu. The window shown in figure 24 appears.

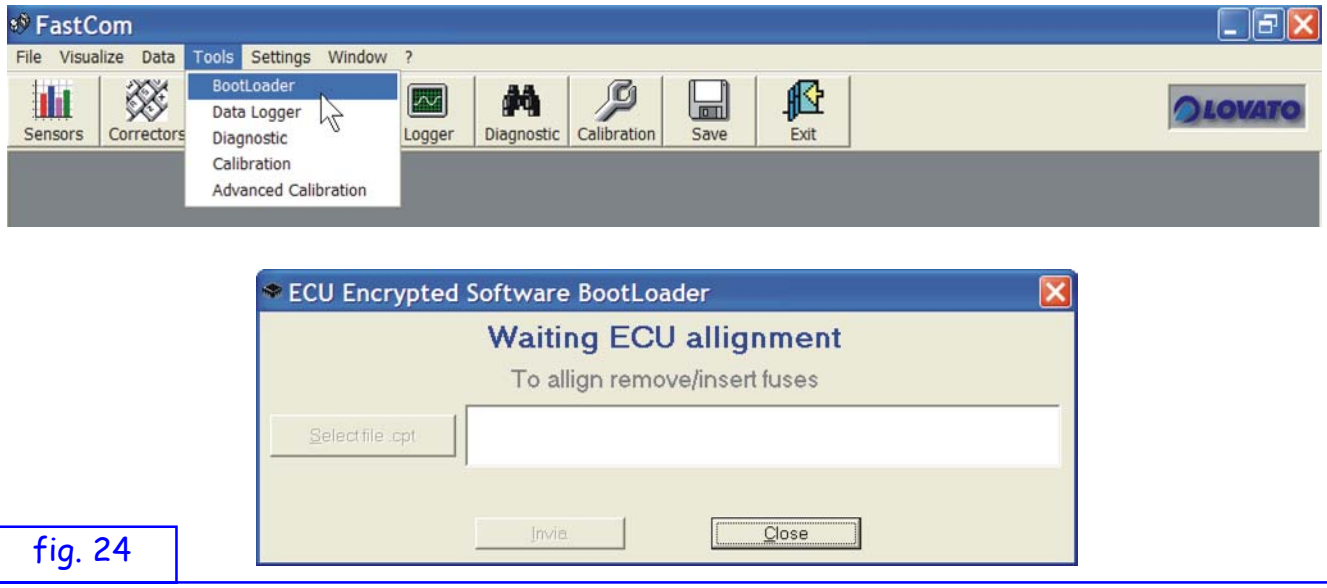


fig. 24

The programme will show a "connection with control unit failed" message. Remove the fuses and put them back again. After restoring power, reactivate the buttons on the "ECU Encrypted Software BootLoader" window that were deactivated (see figure 24). Click on Select File .cpt to open the window shown in figure 25.

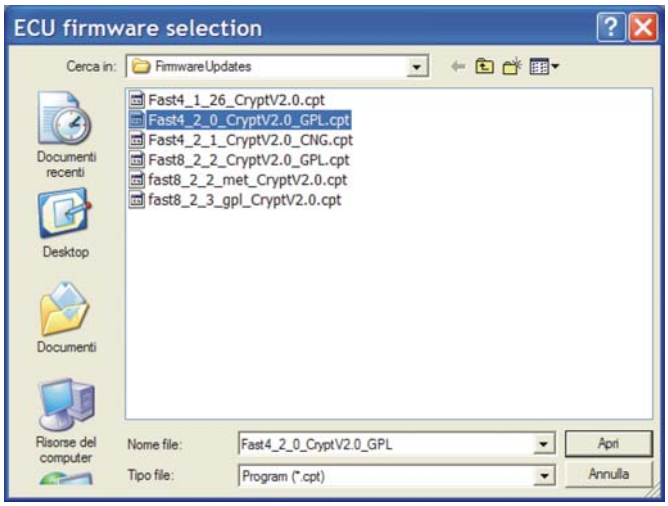


fig. 25

Select the encrypted control unit programming file (*.cpt) and click on Open. The window shown in figure 26 appears.

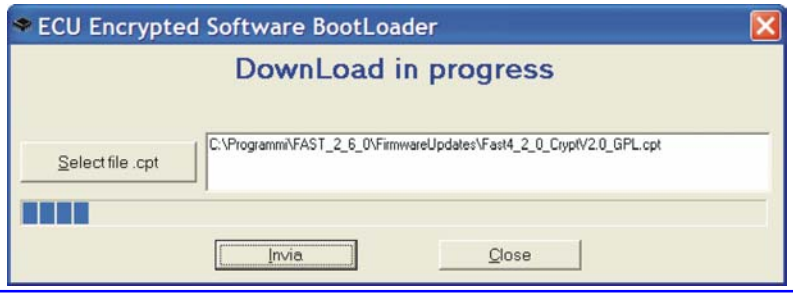


fig. 26

Click on Enter. The programme begins to transfer the data from the computer to the FAST control unit. Download progress is displayed on the status bar under the file selection window. After downloading has finished, remove the fuses, put them back again and reset the control unit from the file menu to implement the modifications.

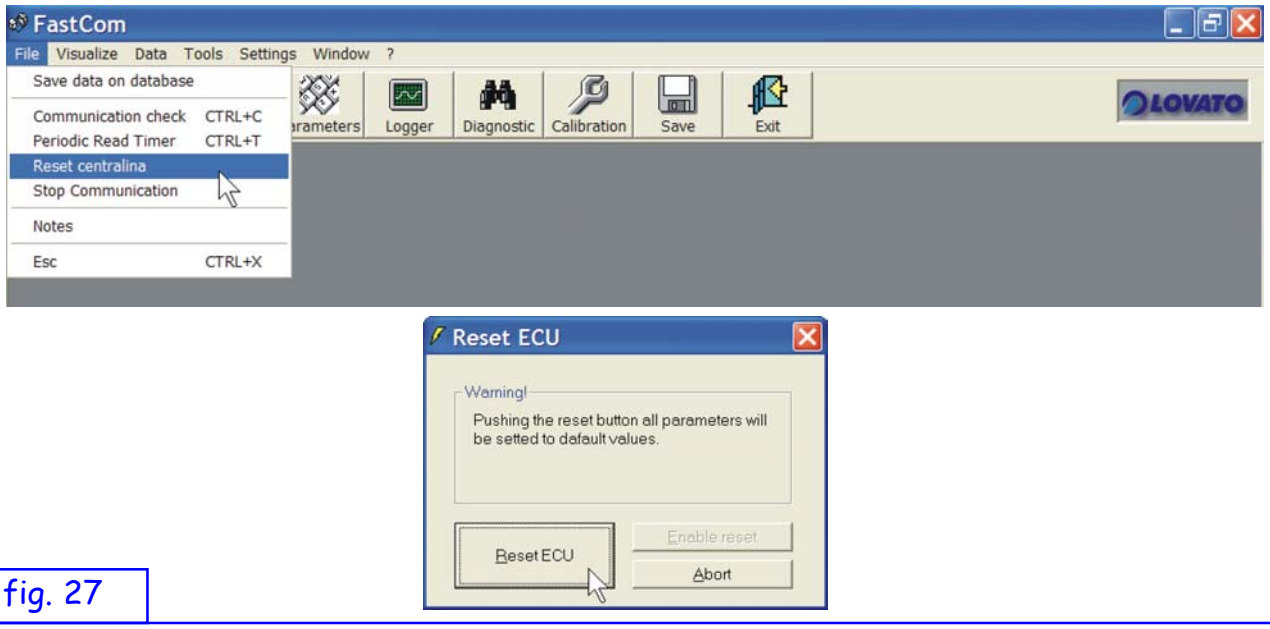


fig. 27

CAUTION

BEFORE UPDATING THE SOFTWARE OF THE FAST CONTROL UNIT, SAVE A COPY OF THE RESIDENT DATA WITH THE FOLLOWING COMMANDS (SEE EXPLANATIONS OF THE DATA AND FILE MENUS).

9.5 Data management in the FASTCOM programme

Two types of data are contained in the mappings: permanent data, which is saved to a permanent memory on both the computer (mapping file) and the FAST control unit (flash memory), and volatile data, which is saved to RAM memory on both the computer and the FAST control unit. All the mapping modifications made when calibrating the car are temporarily saved in the RAM memory and are then transferred to the permanent memory when the file is saved on the computer and 10 seconds after disconnecting the 12 V key on power supply in the FAST control unit.

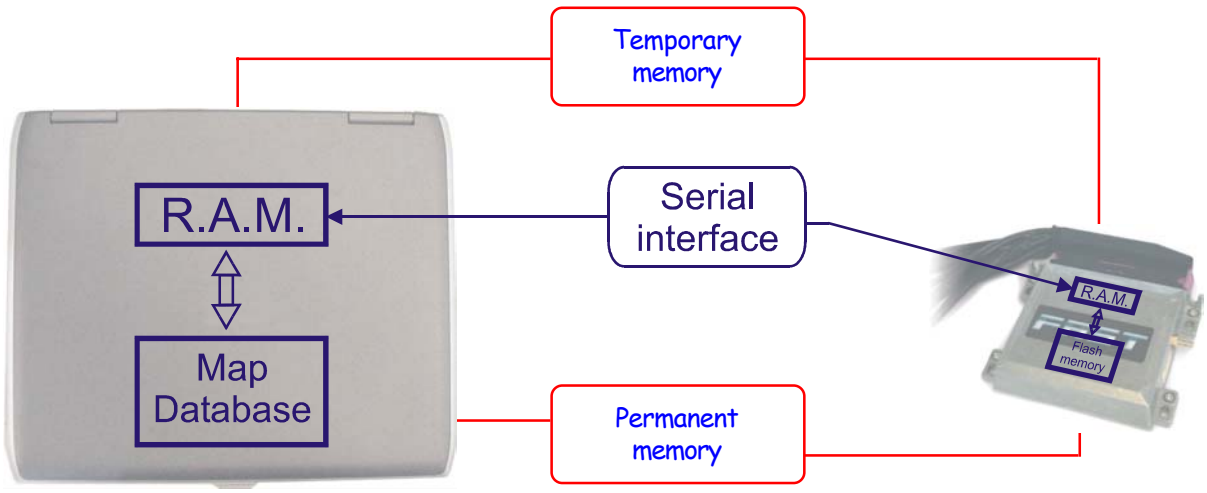


fig. 28

9.6 Explanation of the drop-down menus in the FASTCOM programme

File menu

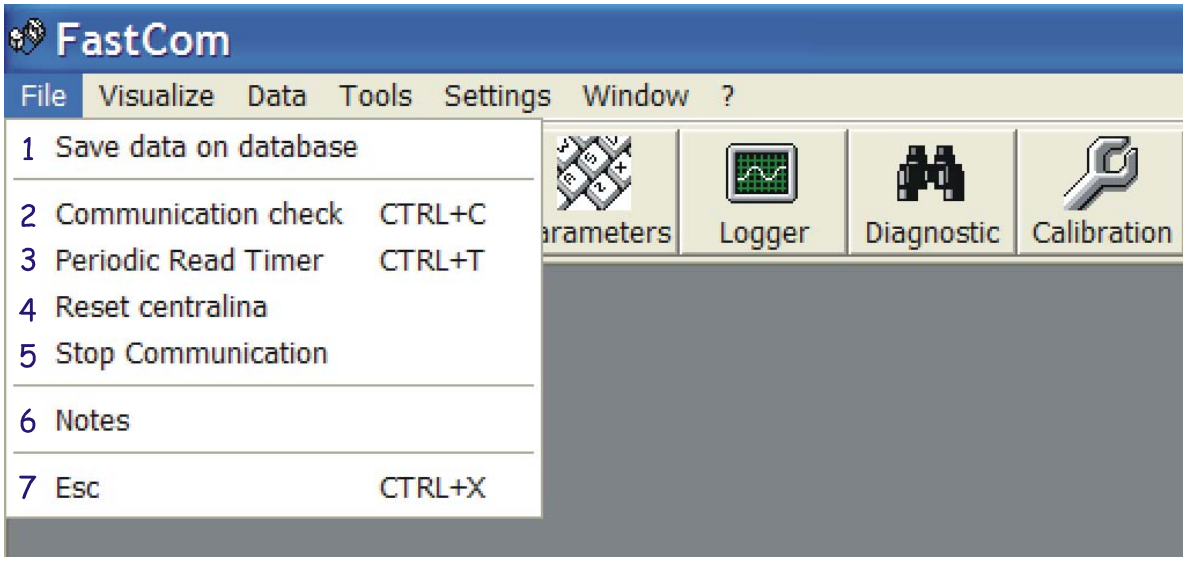


fig. 29

The items in the "File" menu are used to:

1 Save data (mappings) to a mass memory unit
2 Check communications
3 Reactivate periodic reading of sensors in the event of problems

4 Reset the FAST control unit
5 Force the interruption of serial communication (in order to work only locally)
6 Open the integrated block notes for writing, saving, loading and printing notes
7 Exit the programme.

View menu

The items in the "View" menu are used to:

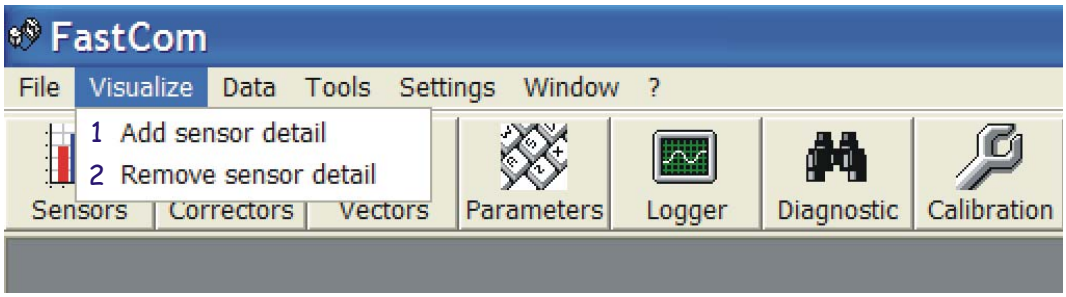


fig. 30

1 Add graphics to the sensors window
2 Remove graphics from the sensors window

Data Menu

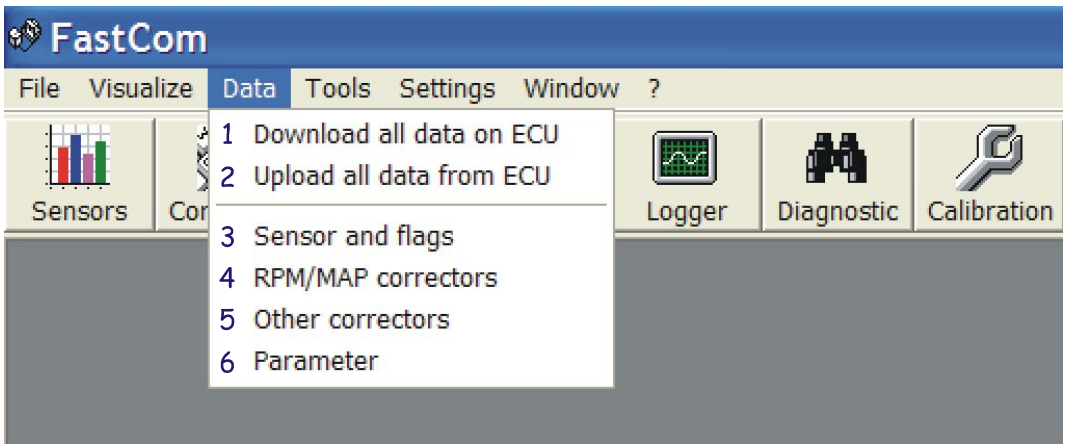


fig. 31

The items in the "Data" menu are used to:

1 Download all screen data to the FAST control unit
2 Upload all the data from the FAST control unit (overwriting the data on the computer screen)
3 Open the sensors and flags view window
4 Open the map of the multipliers and petrol times
5 Open the corrective factor vector window
6 Open the operating setting parameters window

Tools menu

The items in the "Tools" menu are used to access:

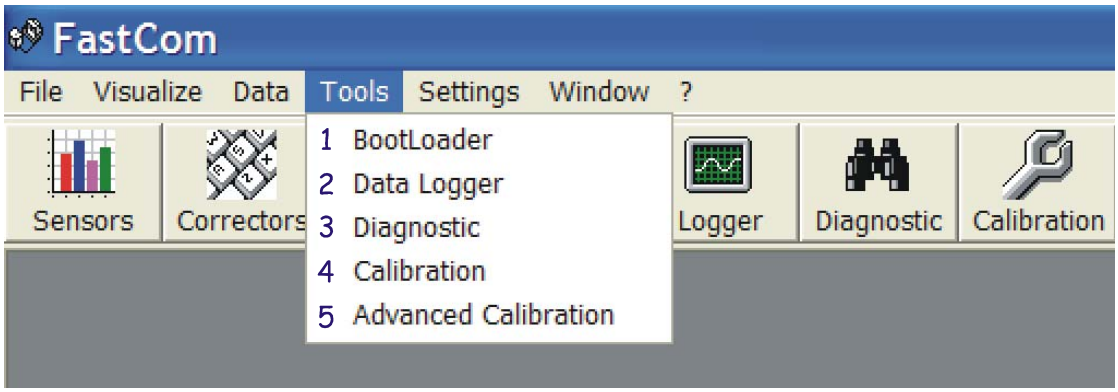


fig. 32

1 BootLoader for programming the FAST control units if they require reprogramming
2 Data Logger for tracing and memorising the values transmitted by the sensors
3 Diagnostics window
4 Basic calibration procedure
5 Optional advanced calibration procedure

Settings Menu

The "Settings" menu accesses the Fastcom parameters.

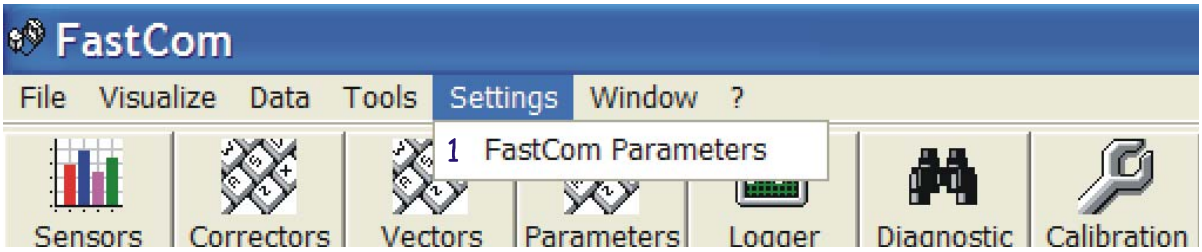


fig. 33

Window menu

The items in the "Window" menu allow the various open windows to be arranged on the screen in various ways.

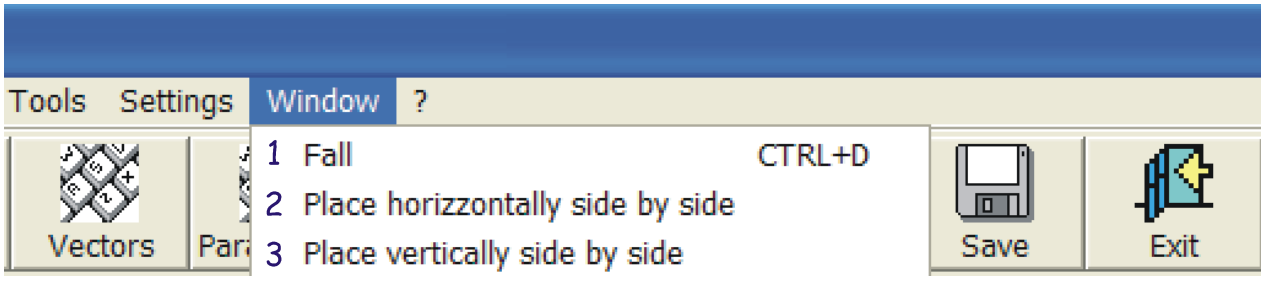


fig. 34

"?" menu

The items in the "?" menu are used to access:

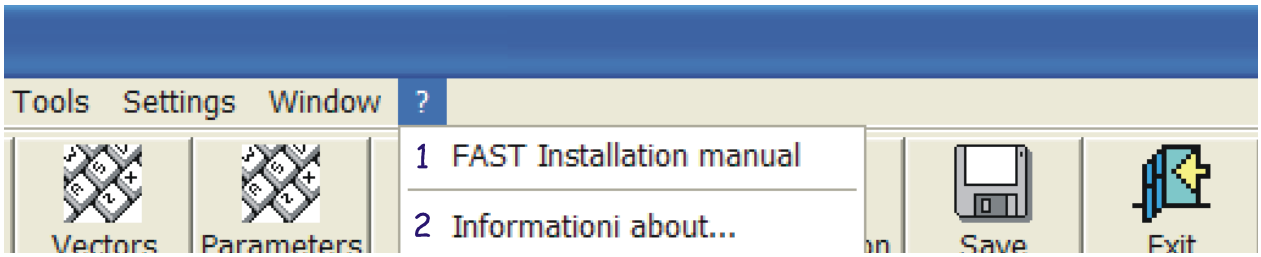


fig. 35

1 Visualisation of the FAST system installation manual
2 Fastcom programme information

9.7 Sensor and status control

From the "View" menu, you can expand the sensors window to obtain a graphic display of system values and statuses.

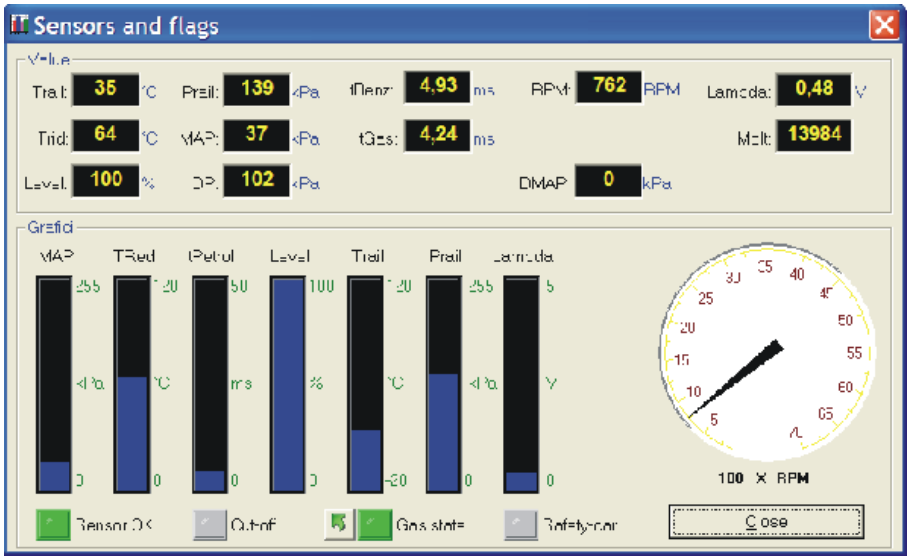


fig. 36

Values displayed:

Trail	-	gas temperature in Rail
Trid	-	temperature of reducer
Level	-	quantity of fuel in tank
Prail	-	gas pressure in Rail
MAP	-	pressure in intake duct
DP	-	delta P (pressure difference from MAP to Prail)
Tbenz	-	petrol injector open time
Tgas	-	gas injector open time
RPM	-	engine RPM
Lambda	-	lambda probe value
Molt	-	multiplier applied
DMAP	-	NOT SIGNIFICANT

Statuses displayed:

Sensors OK	-	LED on if sensor data is significant
Cut-off	-	LED on if in cut-off mode
Gas status	-	LED on if in gas mode
Safety-car	-	LED ON if in safety-car mode (gas injectors closed if car stalls)

The "Switch" button changes the display to gas or petrol.

The indicative values of a car at minimum heat regime are shown below.

Trail	-	30° C
Trid	-	75 ÷ 90° C
Level	-	Depends on the quantity of LPG in the tank
Prail	-	110 ÷ 120 kPa (± 100 + M.A.P. value at minimum)
MAP	-	30 ÷ 40 kPa
DP	-	~ 100 kPa
Tbenz	-	4 ÷ 5 ms
Tgas	-	4.5 ÷ 5.5 ms
RPM	-	600 ÷ 800
Lambda	-	0.2 ÷ 0.9 V oscillating (for 0÷1V probe)
Molt	-	15000 ÷ 18000

9.8 Parameters

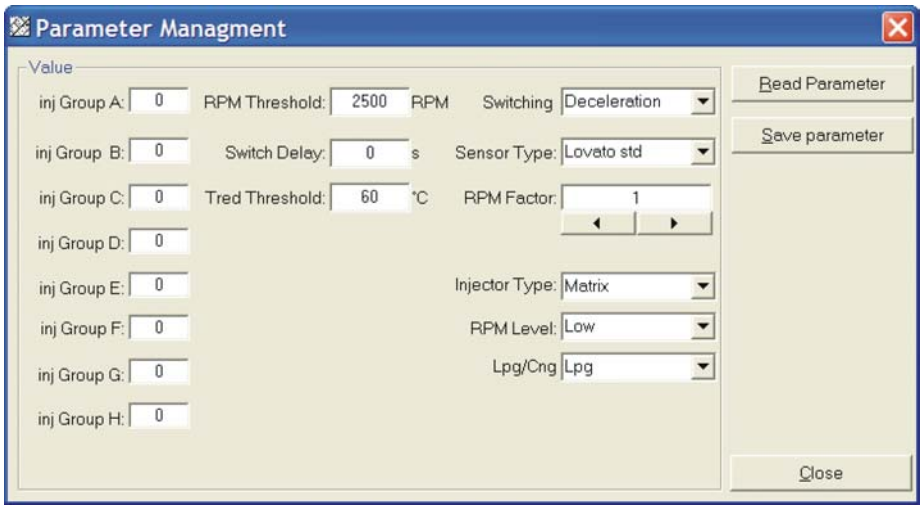


fig. 37

After clicking on "Parameters" you are asked whether to load the data from the control unit or view those already present in the memory of the PC.

The system operating parameters are displayed.

Some parameters can be modified to change the way the system works

Values displayed:

- Inj Group A-H: indicates the injector group the single injectors belong to. The same number on more than one injector indicates that these injectors belong to the same group . For example, injectors A,B,C,D marked 1,2,3,4 describe a phased 4-cylinder injection system, 1,1,1,1 instead describes 4-cylinder full-group injection as all the injectors belong to group 1.

Values displayed (modifiable):

- RPM threshold: this is the threshold over which switching may take place if the other conditions

(temperature of reducer, change delay, RPM<4,000 and MAP pressure<60KPa) are satisfied.
- Switch delay: this is the minimum delay (in sec.) between starting the engine and switching.
- Trid threshold: this is the temperature threshold for switching.
- Switching: this is the window for selecting the type of switching.
- Sensor type: this is the window for selecting the installed type of Level sensor.
- RPM factor: this is the window for selecting the type of RPM input.
- Injector type: chooses between Lovato and Matrix injector piloting
- RPM level: sets the parameter for reading the RPM input stage depending on whether the input signal is low (0-5V or 0-12V), high (6-12V) or average. The set thresholds are:
  or lowest = <2.5V
  or low = 2.5V
  or average = 6.0V
  or high= 8.0V
- Lpg/Cng:this is the window for selecting the type of fuel (only applies to FAST control units with firmware 2.5 or higher)

9.9 Calibration

Do not open other windows in the programme during the calibration procedure. The sensors window can be used.

To run the calibration procedure click on the Calibration button. The window shown in figure 38 opens.

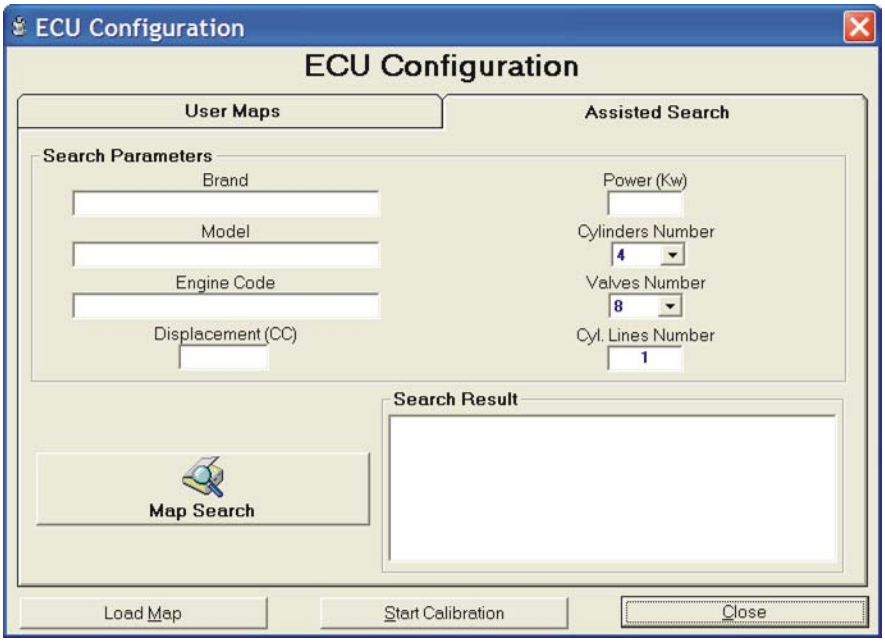


fig. 38

This window is used to programme the control unit. A previously saved user map can be opened by licking on the "User Maps" menu. The window shown in figure 39 opens.

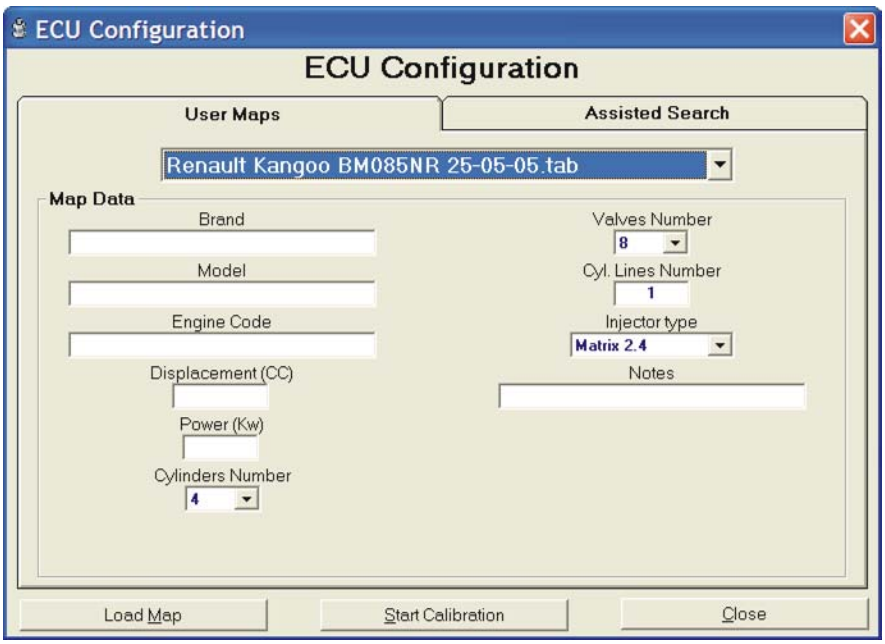


fig. 39

If there are no valid maps for the vehicle being converted to LPG, click on the "Assisted Search" menu. The window shown in figure 40 opens.

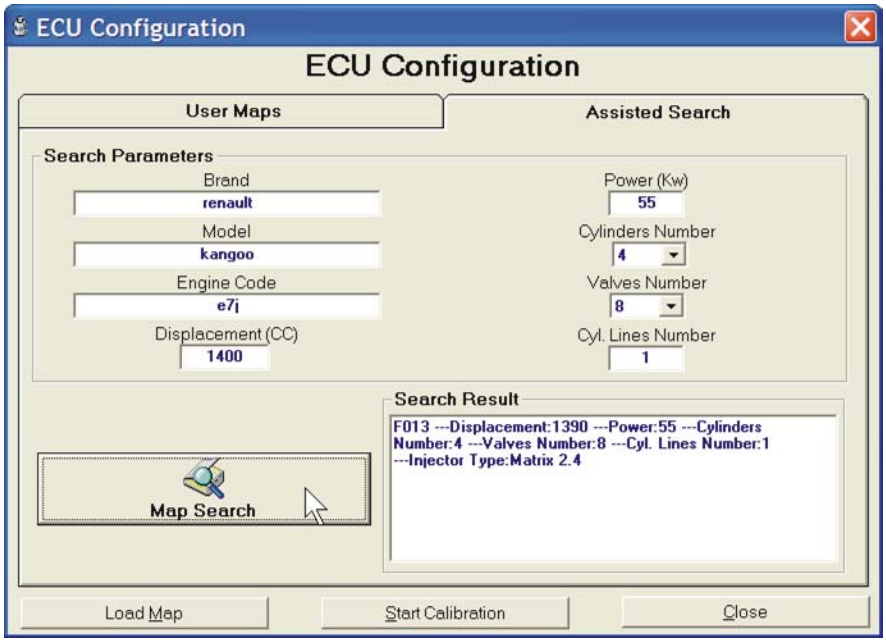


fig. 40

Enter the vehicle data and click on "Search Map". The system looks for the basic map in the internal data bank that most resembles the characteristics of the vehicle and proposes it as a starting file for vehicle auto-calibration.

After identifying the most suitable map, start configuring the control unit by clicking on "Load Map". The screens shown in figure 41 appear in sequence.

After loading the map to the control unit, start the auto-calibration procedure by clicking on "Start Calibration".

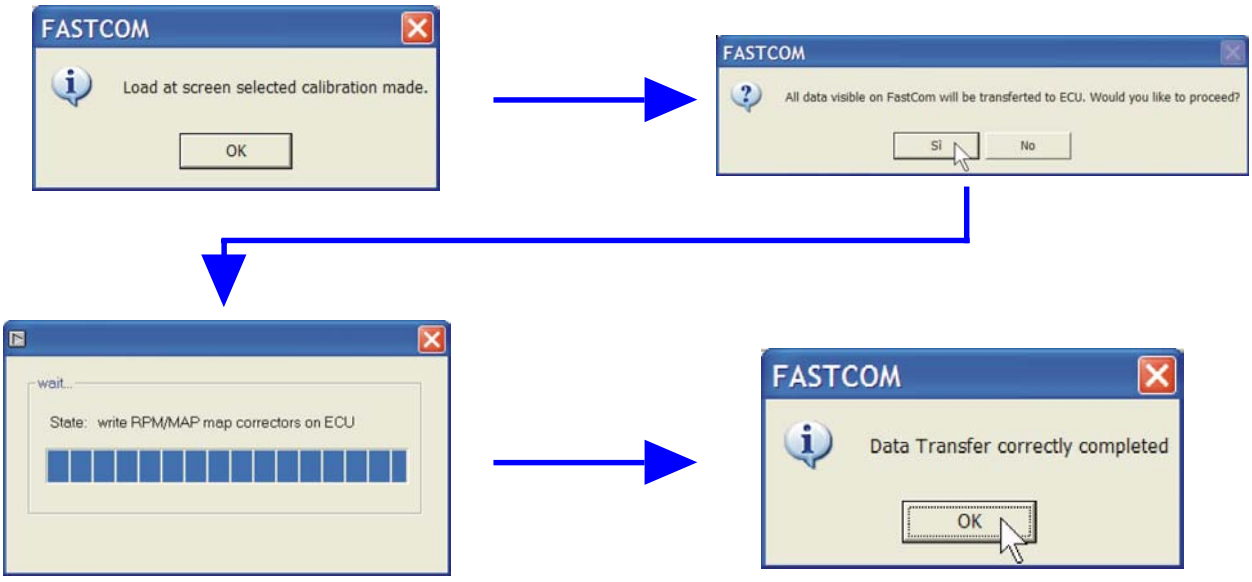


fig. 41

After running the calibration procedure with the relative button, various boxes showing calibration progress are automatically displayed in sequence.

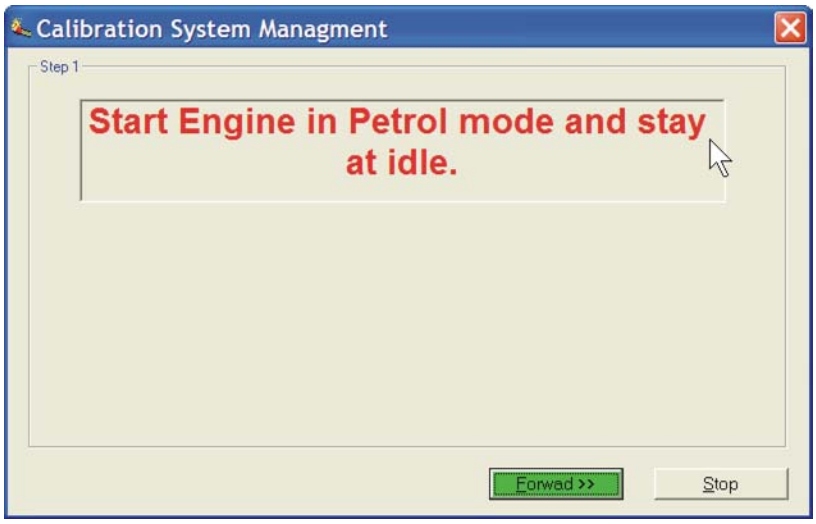


fig. 42

When the "Forward>>" button shines green, you can move on to the next step. In any case, you are automatically moved on to the next step after a few seconds.

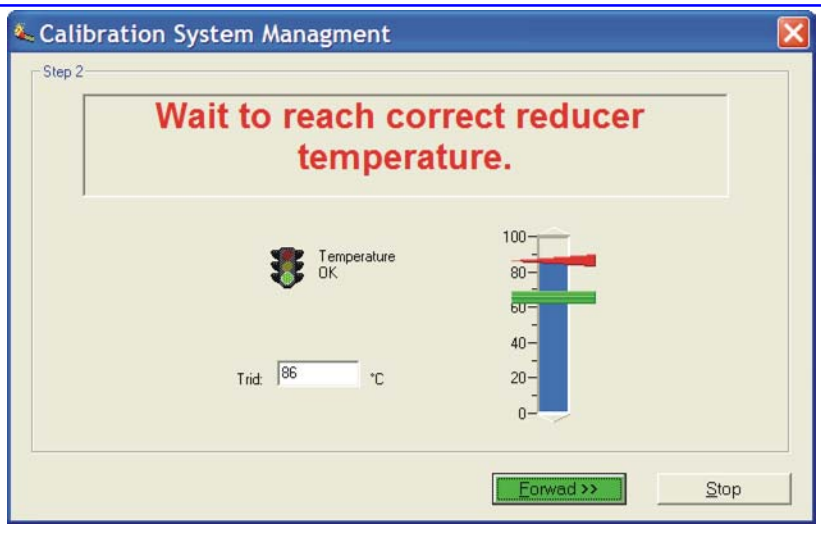


fig. 43

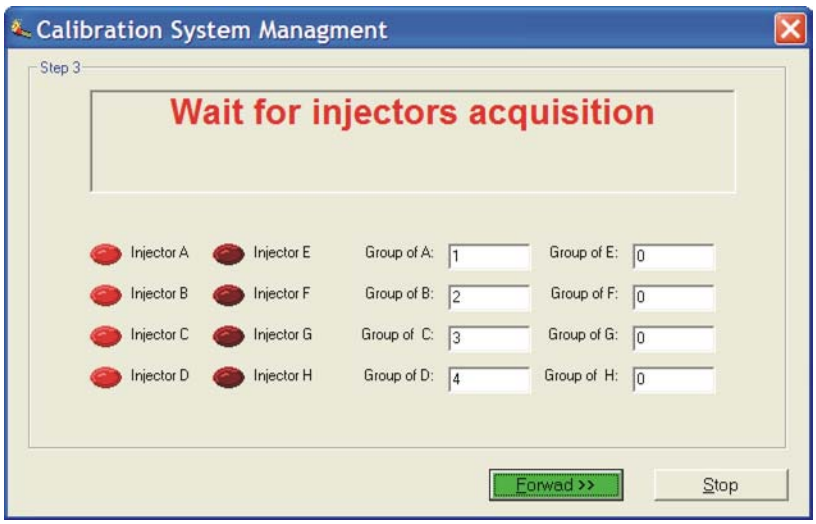


fig. 44

During calibration, the number of petrol injectors connected is established (LED ON) and the type of grouping is checked (full-group, semi full-group or sequential injection).

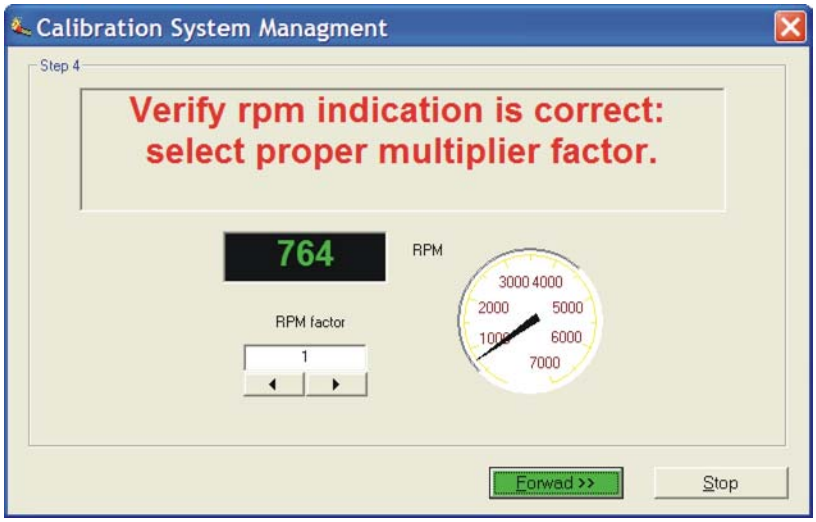


fig. 45

Adjust the RPM factor to synchronise RPM visualisation with the RPM counter of the car. Press "Forward" to continue.

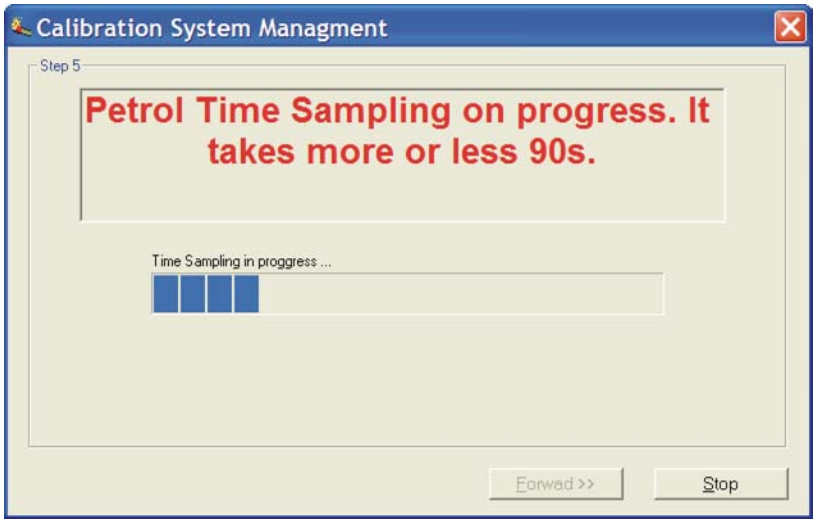


fig. 46

The petrol injection time is acquired as it is used to calculate the multipliers after switching the car to the gas mode.

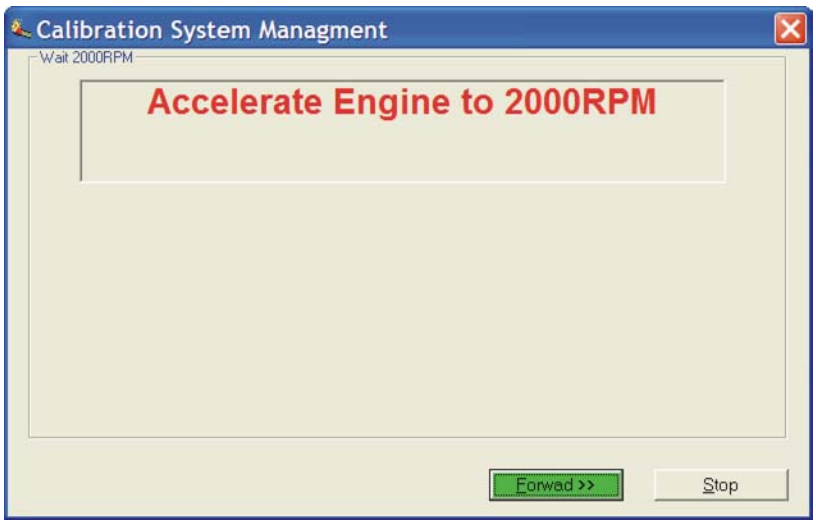


fig. 47

After acquiring petrol injection times, the system asks to take engine revs to about 2000 rpm for switching from petrol to LPG.

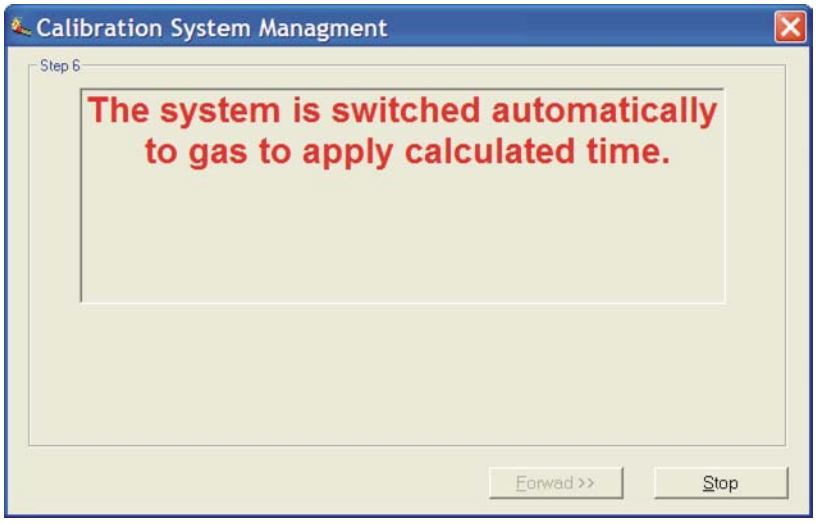


fig. 48

When the system detects 2000 rpm, it enables switching.

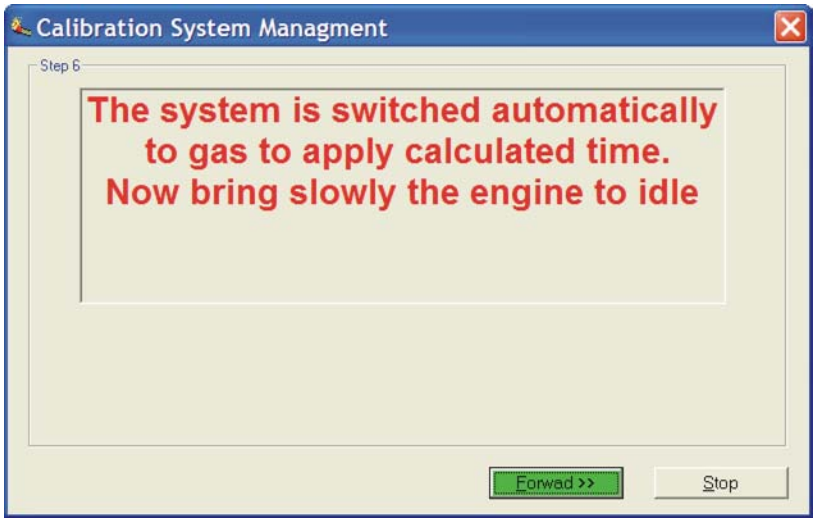


fig. 49

After switching, the system asks you to slowly release the accelerator until the vehicle idles again.

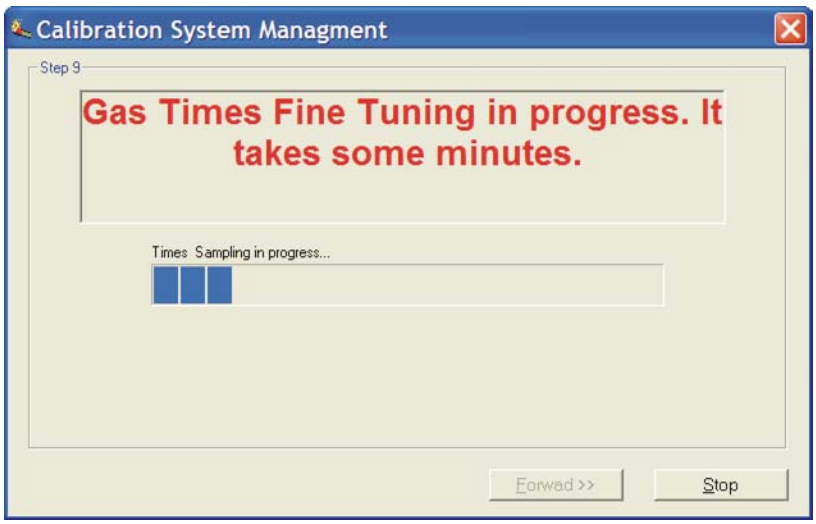


fig. 50

After identifying a more or less correct work point, the procedure continues with a detailed control.

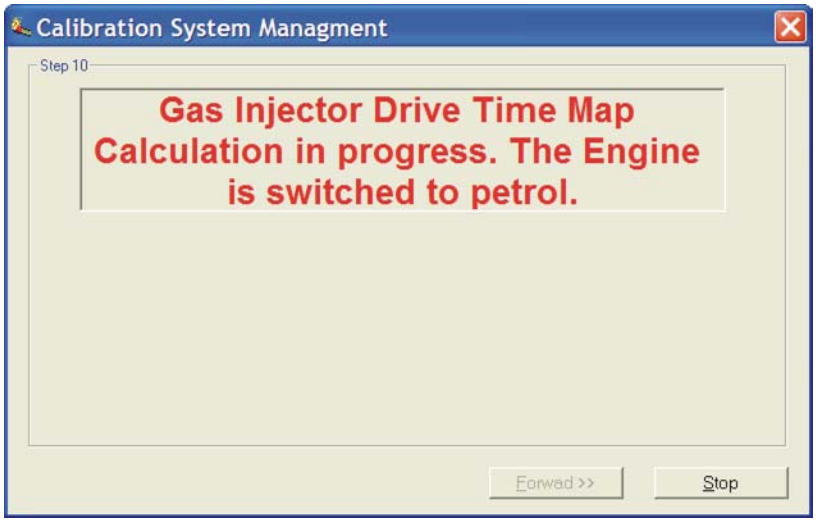


fig. 51

After this detailed control, the multipliers map is updated and the car is switched to the petrol mode.

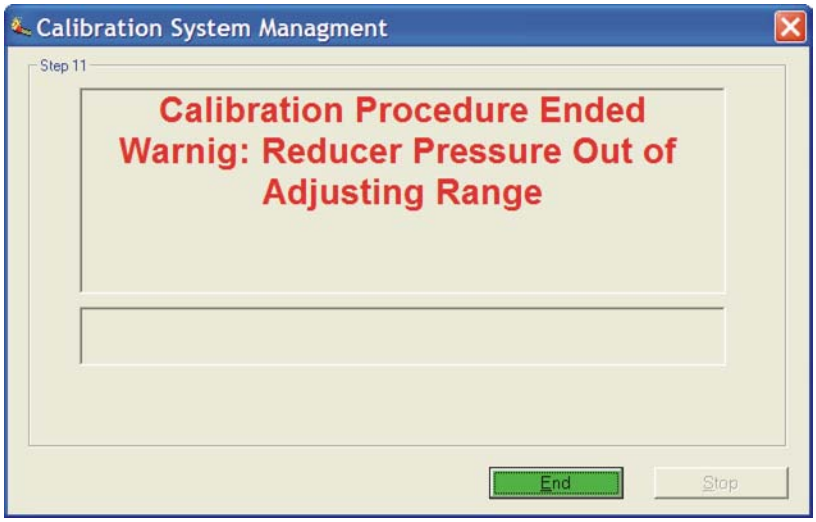


fig. 52

During this initial calibration phase, if the gas pressure is too high or too low, a warning window will be displayed at the end. Adjust the pressure within the range (85+ map pressure at minimum) and recalibrate.

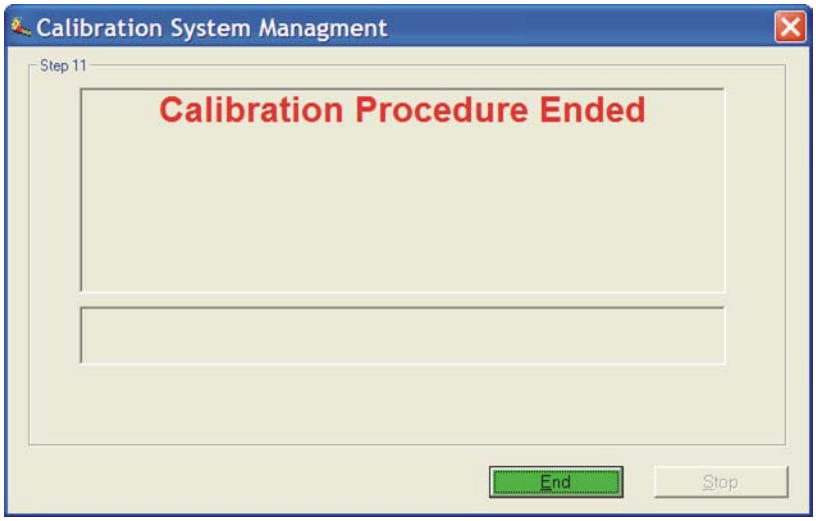


fig. 53

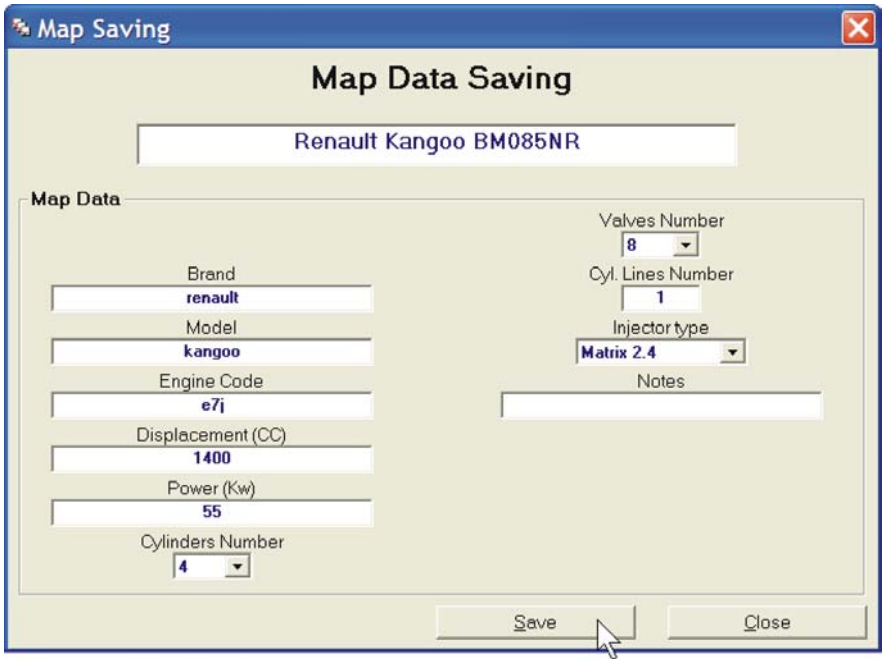


fig. 54

After terminating the calibration procedure, the programme opens the window for saving the new map. Enter a file name and the vehicle data.

After calibration, the maps and parameters are saved to the RAM memory on the control unit. The data may be deleted if the battery positive is disconnected.

To memorise it permanently, simply switch off the panel and wait about 30 secs. until the window signalling that the permanent memory (EEPROM) is being updated appears. This permanent memorisation procedure is also valid for modifications made manually by modifying other interface data.

CAUTION

ALWAYS WAIT 30 SECONDS AFTER TURNING OFF THE CAR BEFORE DISCONNECTING THE POSITIVE BATTERY. AS WELL AS LOSING ALL THE DATA MODIFIED AFTER THE LAST TIME THE CAR WAS TURNED OFF, ALL THE MEMORISED DATA MAY ALSO BE LOST. IN THIS CASE, THE CONTROL UNIT WILL START WITH FACTORY-SET DATA.

9.9.1 Advanced calibration

This procedure can improve, if required, the mapping obtained from the auto-calibration process

To activate the advanced calibration procedure, click on the "Tools" menu and then on "Advanced calibration". The window shown in figure 38 opens. To perform the advanced calibration procedure to modify the map obtained with auto-calibration click on "Run Calibration", the programme reads the data saved to the FAST control unit after which the window shown in figure 55 opens.

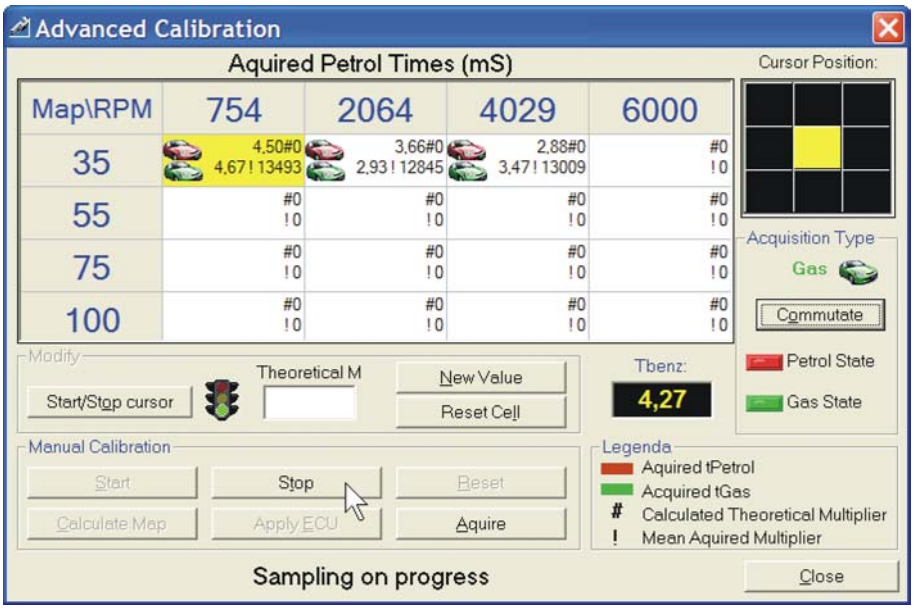


fig. 55

Press Start to begin the Advanced Calibration procedure and terminate it with the Stop button.

During calibration, each cell displays the average Petrol Time acquired during an 8 second interval in which the position of the cursor remains in the centre of the 9X9 grid (red symbol). The Gas Time (green symbol) is also shown if the car is running on gas, as well as the mean acquired Multiplier (indicated with the symbol "!").

If you exit the cell centre during acquisition (padlock active), the samples memorised up to that point are maintained. Acquisition is automatically started for each operating status (Gas/petrol) when the cell centre is maintained for over 2 seconds.
If the reducer temperature is too low, the whole window is disabled.
The "Commutate" button changes to gas or petrol. The current status is shown by the symbol above the button.
In the "Modify" box, you may block the update status and edit the previously calculated Theoretical Multiplier.
The "Reset" button resets all the boxes in the Map.
With the car in the petrol mode, the "Acquire" button forces the acquisition of the Petrol Time while in the gas mode it forces the acquisition of the current time and calculated multiplier.
After terminating Advanced Calibration by completely acquiring (Gas and Petrol mode) a sufficient number of cells, press the "Calculate Map" button to find the Theoretical Multipliers of each cell and interpolate the results on the main 8X10 Multipliers Map.
Press "Apply ECU" to transfer the 8X10 Map to the control unit.

9.10 Diagnostics

After clicking on "Diagnostics" you are asked whether to load the data from the control unit or view those already present in the memory of the PC.

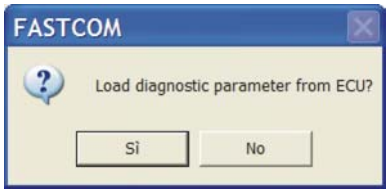


fig. 56

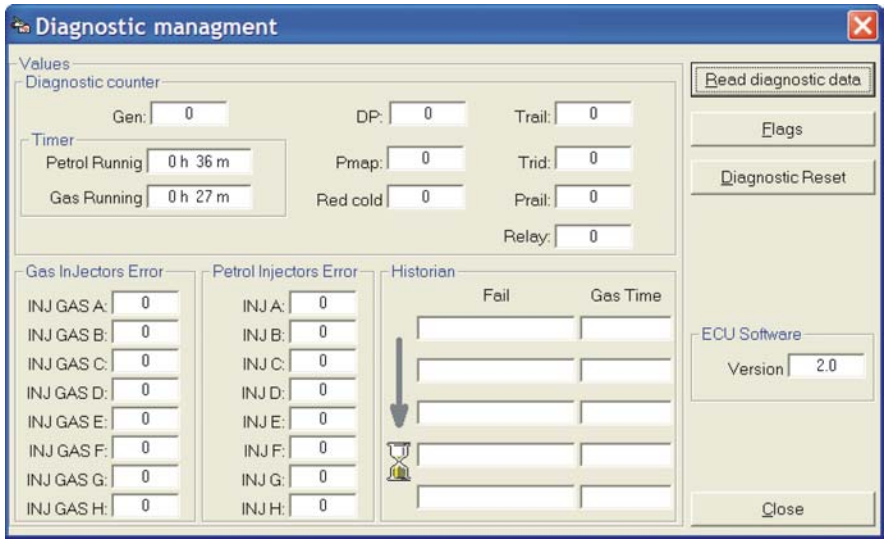


fig. 57

The counters relative to internal system diagnostics are displayed.

Values displayed:

- Gen - = 1 if a fault is found.
- Timer - gas and petrol operating time counters (in hours).
- DP - signals when reducer pressure is too low (and for too long) compared with the pressure measured during calibration. This happens when the gas runs out and the car is automatically switched to petrol.
- Pmap - this is the MAP sensor fault counter.
- Redcold - reducer temperature sensor fault counter.
- Trail - gas temperature sensor fault counter.
- Trid - reducer temperature sensor fault counter.
- Prail - gas pressure sensor fault counter.
- Gas injectors error - series of fault counters on each gas injector.
- Petrol injectors error - series of fault counters on each petrol injector.
- Historian - memorises the typologies of the last five faults.
- ECU software - shows the version of the software installed in the FAST electronic control unit.

Press "Reset Diagnostic Data" to reset the counters (apart from the Timers).

9.10.1 "Diagnostics flag" window

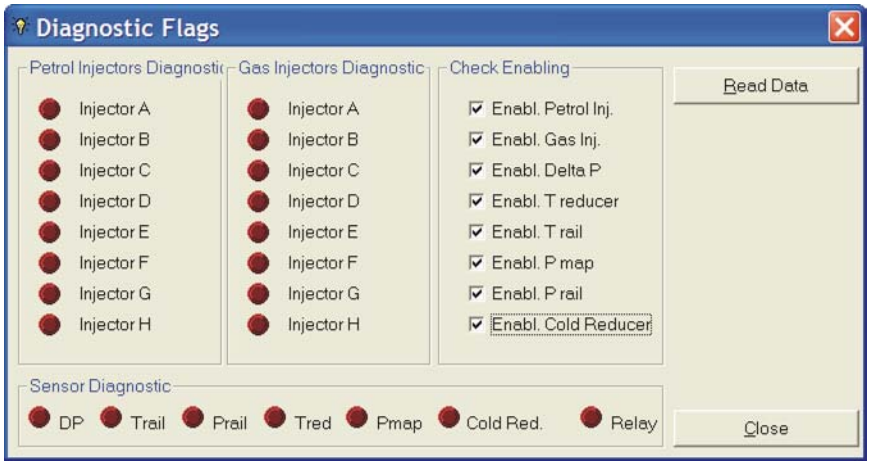


fig. 58

The red LED's signal faults on injectors and sensors in real time. LED ON means that a fault is present.
Use the selection boxes in the "Enable controls" section to enable or disable individual controls.
When the car is stopped, the faults are reset but the relative counters are memorised (cf. Diagnostics on previous page). The LED's can also be commanded with the "Reset flags" button.

9.11 Logger

The Data Logger window shows the progress of the parameters selected in the bottom left-hand box.

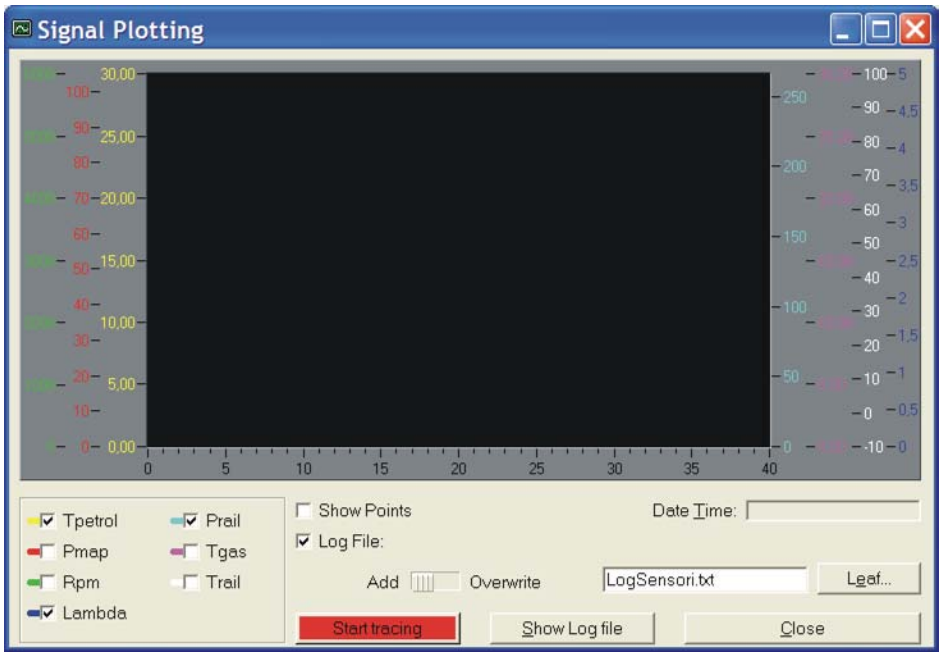


fig. 59

It is possible to save the graph to a file, choosing whether to reset the file before writing the data ("Overwrite") or add the data to that already existing in the file ("Add").

The "Show points" shows the exact points sampled in the graph (the continuous trace is constructed by interpolation between these points).

The "Show Log File" button shows the associated values in tabular format at the moment they are sampled (text file).

9.12 Maps

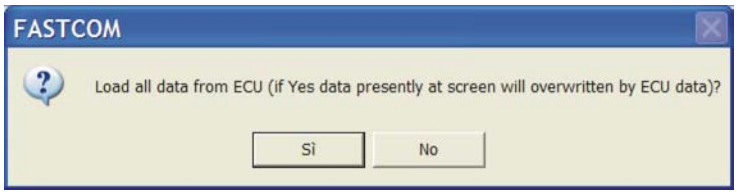


fig. 60

After clicking on "Maps" you are asked whether to load the data from the control unit or view those already present in the memory of the PC. The map is established during auto-calibration.

9.12.1 Map management: "Multipliers" directory

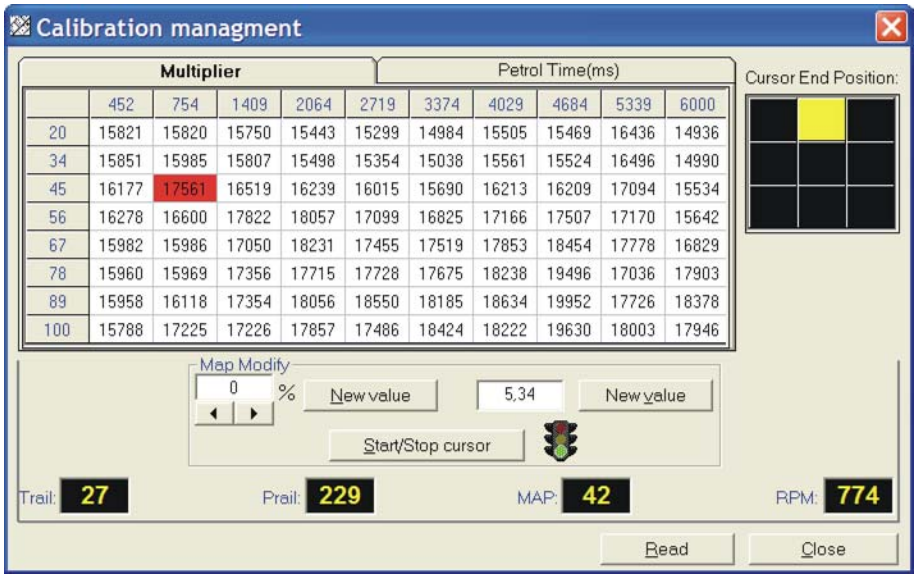


fig. 61

The values of the MAP/RPM multipliers are displayed. These parameters are used by the control unit to calculate Tgas.
The RPM/MAP work area of the car is displayed by the red cell inside the map. For a precise indication of the position inside the red cell refer to the fine position box: the cell is divided into nine boxes in which a mobile yellow cursor indicates the area of the cell on the map currently identified by MAP and RPM. When the yellow cursor is positioned in the central box of the nine-element matrix, it means that the values of MAP and RPM correspond to the centre of the cell illuminated in red on the map.
To modify a cell or group of cells

1 block the cursor by clicking on "Start/stop cursor"
2 select the cell or group of cells (by dragging the mouse)
3 enter the new value and press "New value"

To work on an individual cell, you can also use the suggested value and attempt to reach the displayed Tbenz target value. To activate the hints mechanism the "Suggestions" box must be selected. For the suggestion to work correctly, the Petrol Times map must already be present.
The most important sensors are also displayed in this window.
The "Calibration constant" shows the value obtained during the calibration phase to which the map refers. Change its value by setting a variation percentage and pressing "Read". All map values are modified by the set percentage.

9.12.2 Map management: "Petrol times" directory

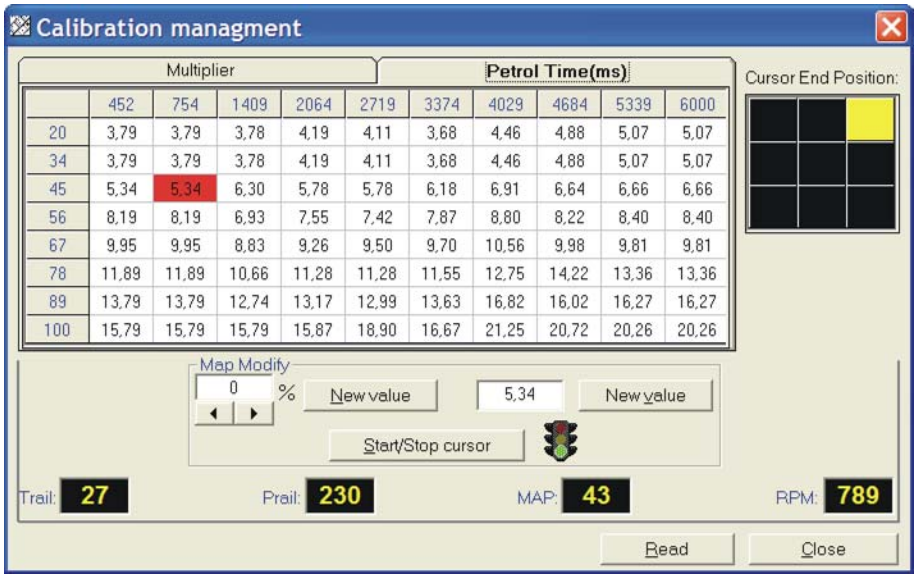


fig. 62

Access the "Petrol times" directory from the maps management window
To modify a cell or group of cells

1 block the cursor by clicking on "Start/stop cursor"
2 select the cell or group of cells (by dragging the mouse)
3 enter the new value and press "New value"

Use the enter command to work on an individual cell during operation and capture the displayed petrol time.

9.13 Vectors

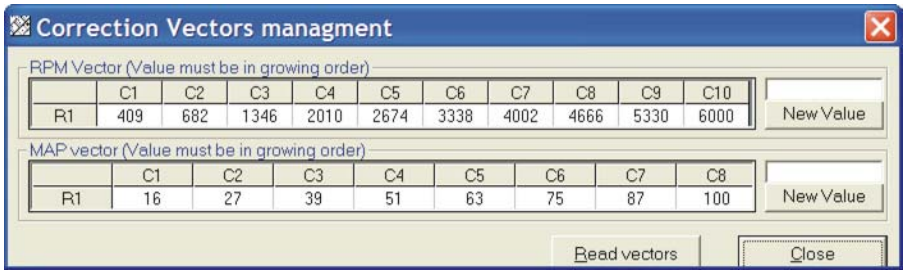


fig. 63

After clicking on "Vectors" you are asked whether to load the data from the control unit or view those already present in the memory of the PC.
Ranges RPM and MAP are displayed.
The RPM and MAP vectors establish the reference points of the multipliers map. These values are also shown in the first row and the first column of the maps window respectively. To modify one or more cells:

1 select the cell or group of cells (by dragging the mouse)
2 enter the new value and press "New Value"

MAINTENANCE OF INJECTORS XJ5XX

The injectors rail is a high precision device that in normal operating conditions needs no maintenance. Particular conditions of use (non-compliant fuel, exhausted or absent filter) may require skilled technicians to disassemble and clean the rail. Make sure the workbench is perfectly clean as foreign bodies, even very small ones, accidentally introduced inside the rail may generate functional faults.

The use of solvents or chemical products to clean the inside or outside of the rail is expressly forbidden.

Tools: setscrew wrench 2.5 - setscrew wrench 5 - Allen wrench 13 - small tweezers or screwdriver.
Cleaning material: absorbent paper or equivalent, small brush.
Equipment: compressed air supply

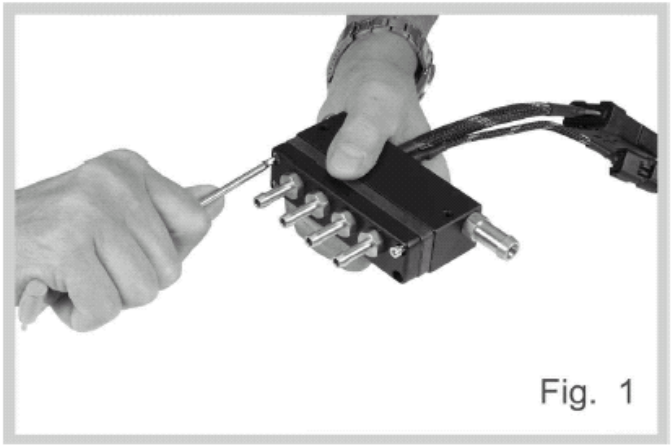


Fig. 1

Remove the front flange by loosening the 4 screws with the setscrew wrench 2.5.

Clean the part, particularly the inlet side, and make sure the hose connectors are not obstructed.

Remove the 4 o-ring seals on the flaps support using the tweezers.

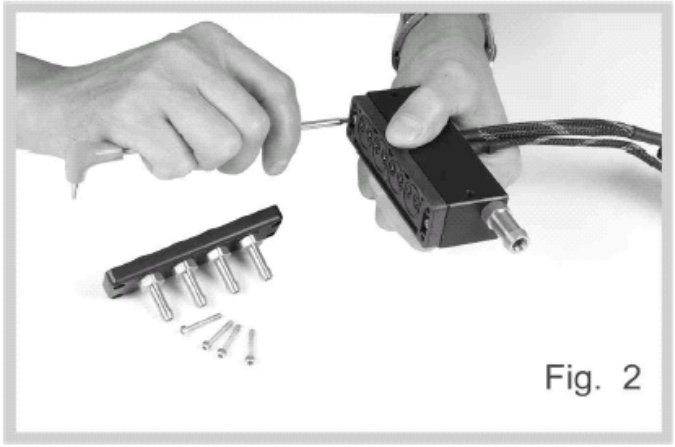


Fig. 2

Remove the two lock screws on the flaps support using the setscrew wrench 2.5 keeping the support in place on the rail.

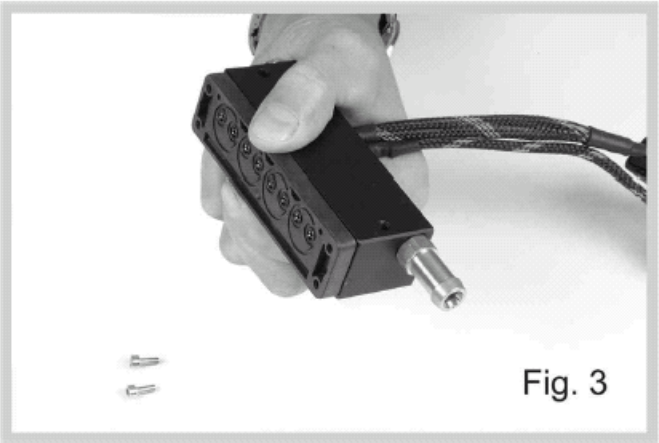


Fig. 3

Turn the rail over, keeping the flaps support in position and place it on the workbench making sure the internal components do not fall out (Figs. 3-4).

Fig. 4

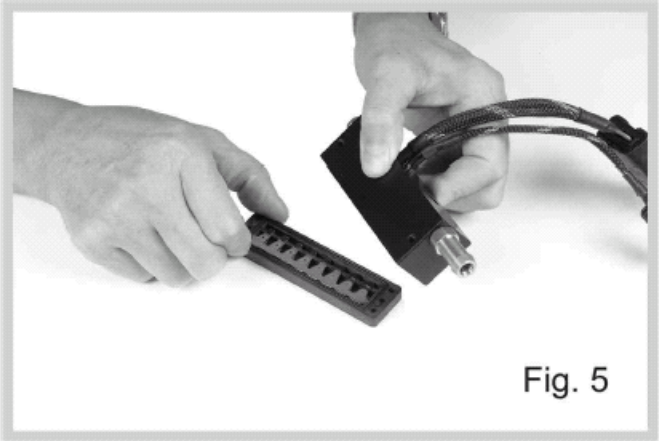


Fig. 5

Remove the rail and the cover with the Allen wrench 5, or the pressure tap with the setscrew wrench 13.

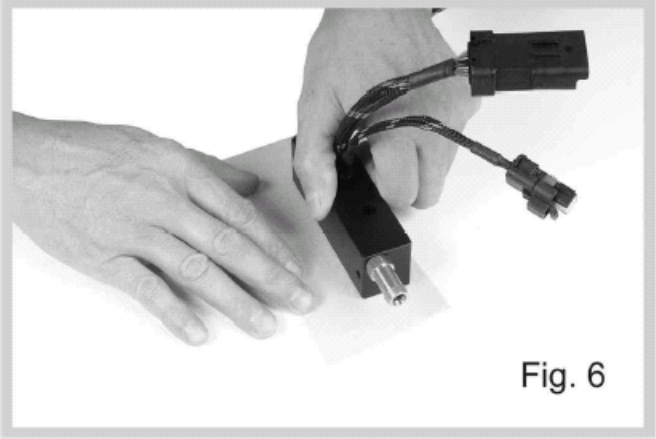


Fig. 6

Clean the inside of the rail and pipelines with compressed air and eliminate any oily deposits or foreign bodies.

Carefully clean the contact surfaces with absorbent, non-abrasive material, and then with compressed air.

Clean and carefully tighten the sealing cover or pressure tap.

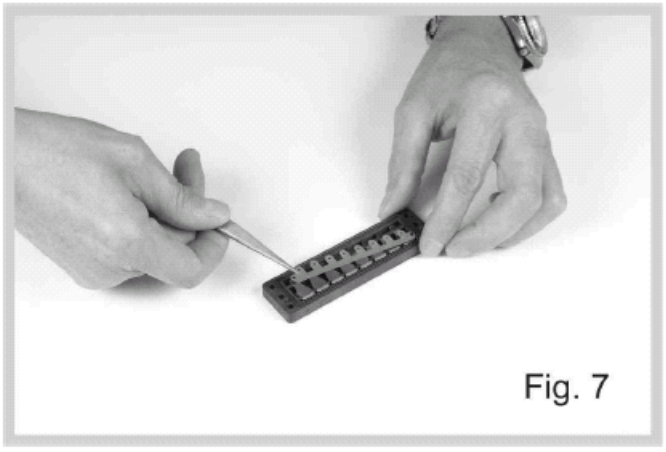


Fig. 7

Delicately remove the magnetic gap from the flap support using tweezers or a small screwdriver, making sure not to bend or deform the component (Figs. 7-8).

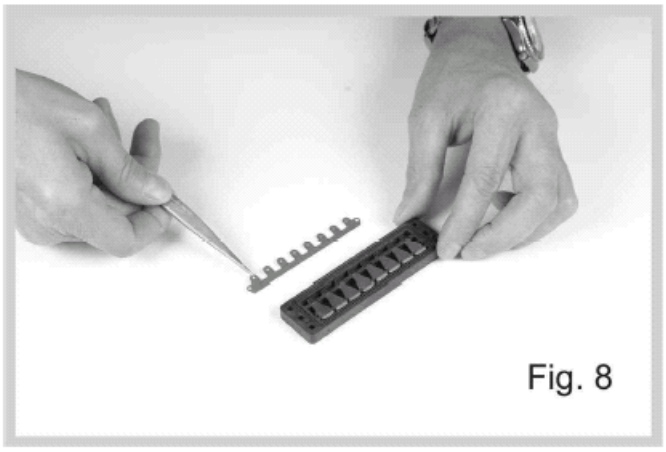


Fig. 8

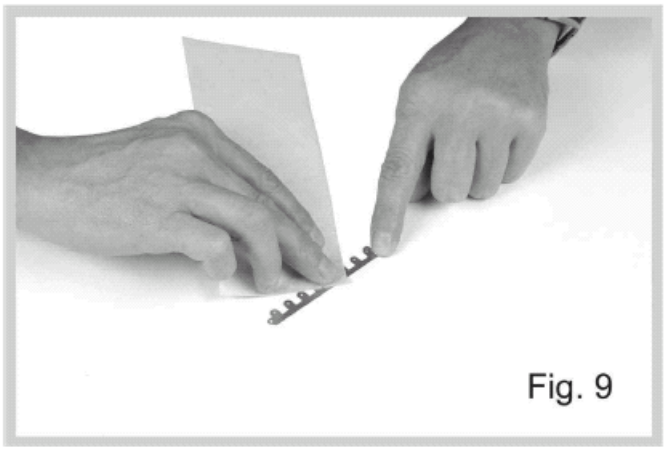


Fig. 9

Clean the surfaces with absorbent material.

Take great care not to bend or deform the magnetic gap.

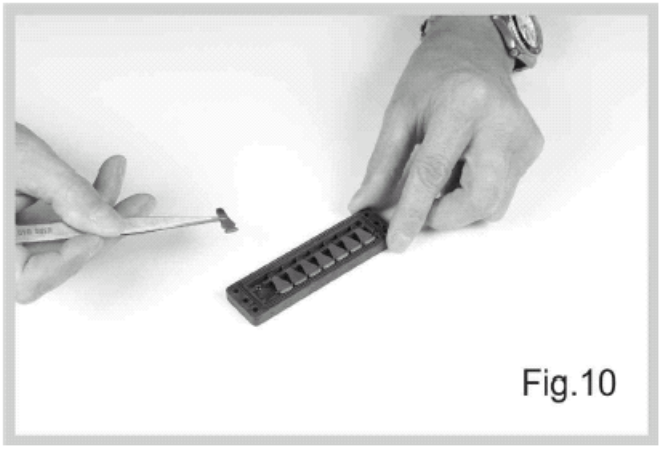


Fig.10

Remove the flaps using tweezers or a small screwdriver and place them on the workbench in their original sequence (Figs. 10-11).

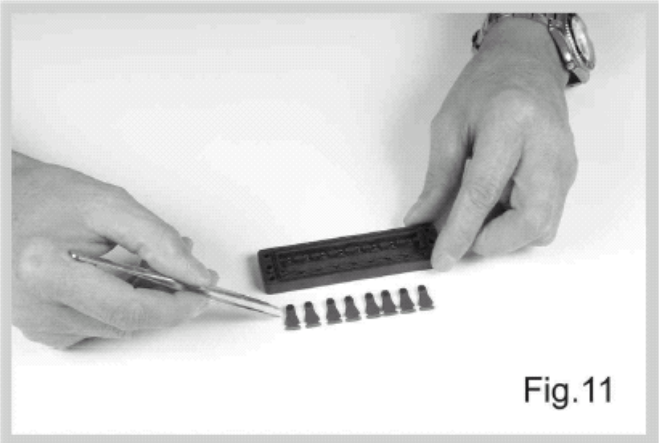


Fig.11

Clean the flaps with absorbent material.

Make sure no foreign bodies have deposited on the rubber surfaces.

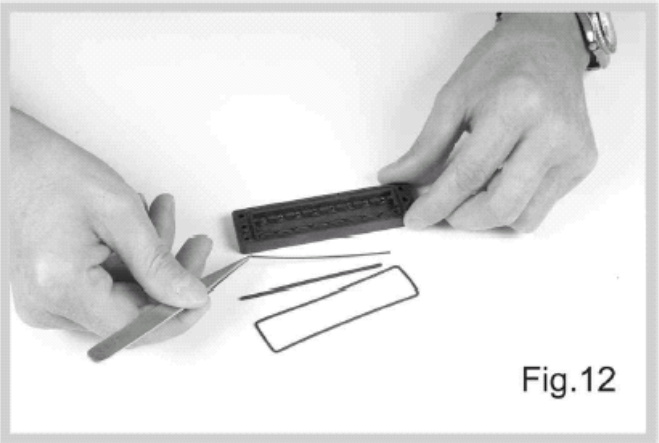


Fig.12

Remove the outer seal, the linear o-ring and the metal lamina underneath with tweezers or a small screwdriver.

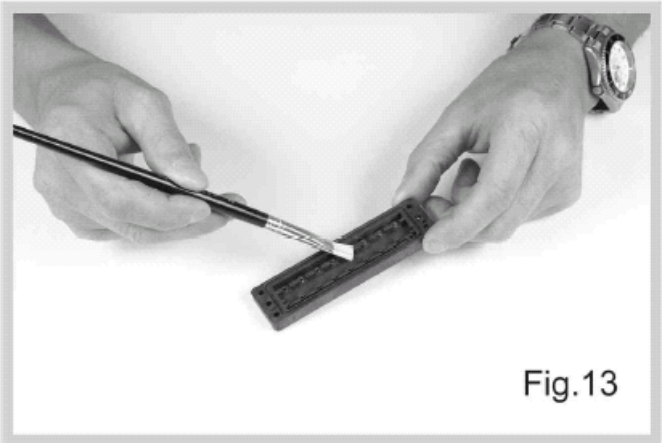


Fig.13

Carefully clean the flaps support using a small brush and compressed air. Make sure the outlet nozzles are not obstructed.

Make sure the parts in metal do not come into contact with the nozzles.

Fig.14

Carefully put back the external seal, the lamina and the linear o-ring in that order.

Put back the flaps in their original sequence with the rack facing upwards.

Make sure that all the flaps are correctly fitted into their respective seats.

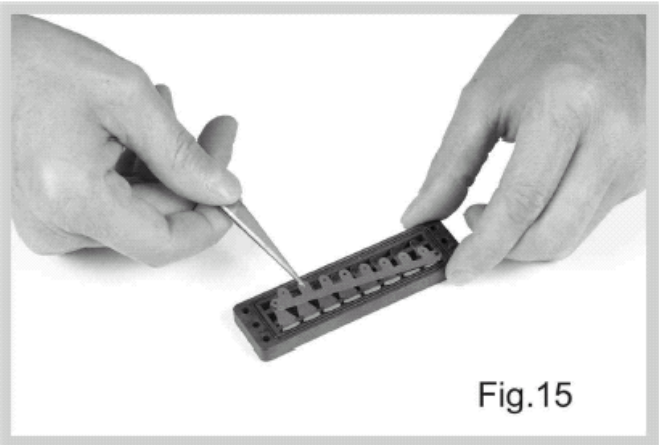


Fig.15

Put back the magnetic gap on the two reference pins on the flaps support, taking care not to bend or deform it.


Fig.16

Place the rail on the flaps support making reference to the lateral pins.

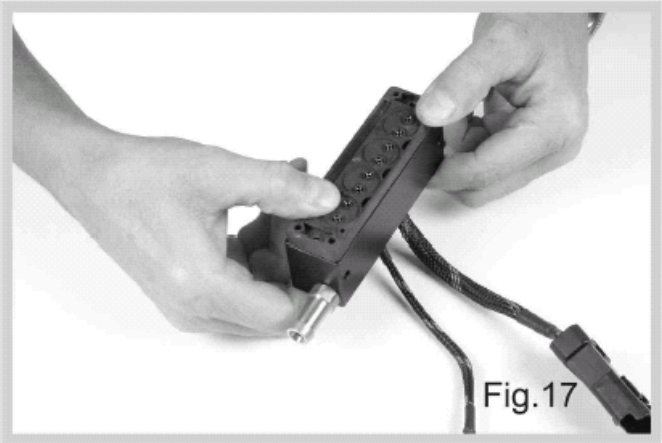


Fig.17

Keep the rail in close contact with the flaps support and turn by 180°.

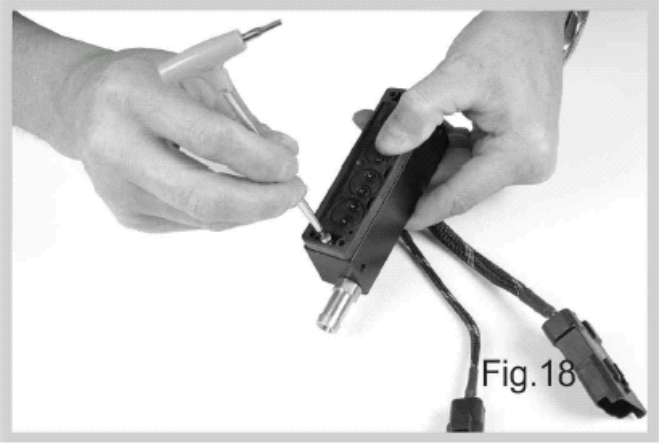
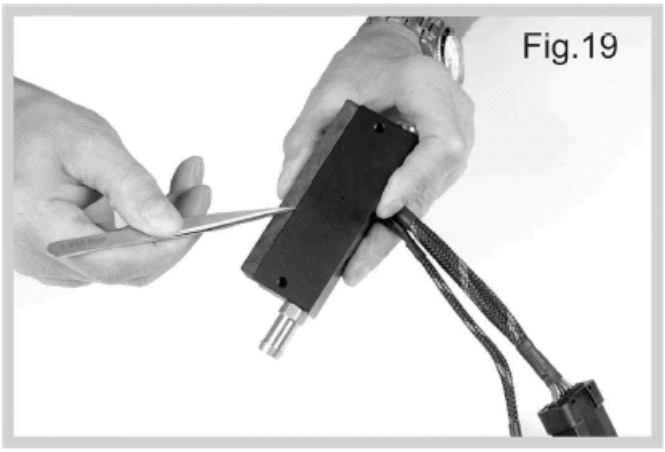


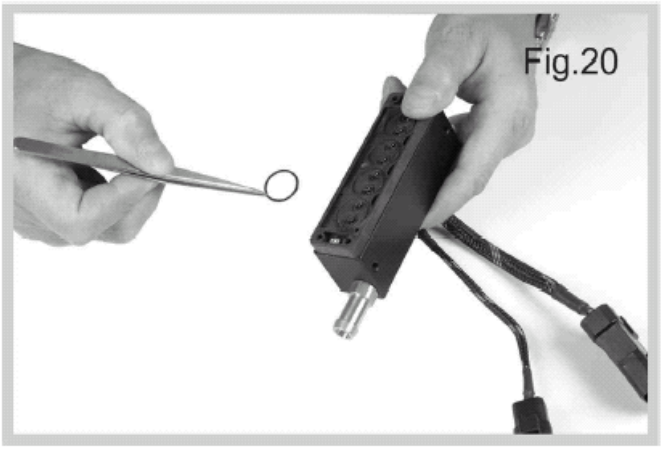
Fig.18

Tighten the flaps support to the rail with the two short screws without forcing them (the screws do not act as rigid seals).



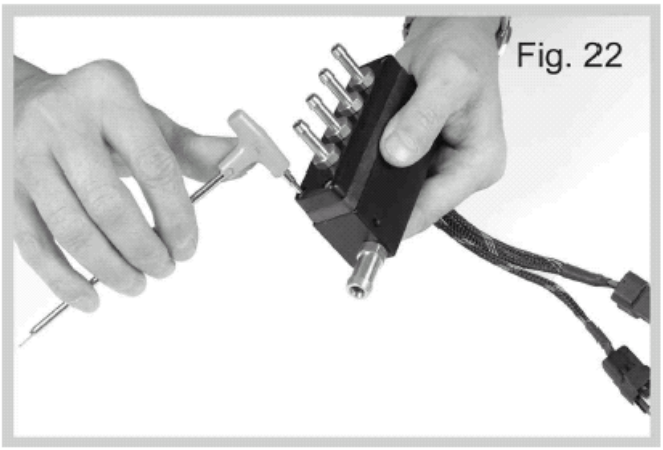
Make sure that the surfaces of the rail and flaps support make perfect contact.

If not, the flaps or the seal are not correctly positioned.



Put back the 4 o-ring seals on the flaps support and make sure there are no foreign bodies in the relative seats.

Put back the front flange making sure that the axial position of the hose connectors matches that of the nozzles on the flaps support.



Fix the whole rail with the 4 screws applying a tightening torque of 12 Kg cm.

N.B.: before installing the rail, and in case of inadequate equipment, connect it to the compressed air inlet hose connector at 4-6 bar and make sure that there are no perceivable leaks from the rail body and the outlet hose connector.

Routine maintenance

Similarly to any other vehicle parts, maintenance of Lovato equipment is vital for guaranteeing system efficiency and safety. Use of the maintenance vouchers extends the lifetime of all the equipment, thereby helping to reduce operating costs.

Inspection vouchers

Inspections are programmed every 15,000 km and allow the system to be kept in perfect working order. These vouchers do not replace the maintenance vouchers issued by car makers, of course, which must be performed at the established intervals. In this regard, the gas delivery system should be controlled immediately after the maintenance operations required by the car makers in order to prevent the repetition of certain operations.

km	15.000	30.000	45.000	60.000	75.000	90.000	105.000	120.000	135.000	150.000	165.000	180.000	195.000	210.000	225.000
Date and stamp															
General system inspection	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Replace reducer gaskets			☐			☐			☐			☐			☐
Replace LPG lock-of valve filter		☐		☐		☐		☐		☐		☐		☐	
Replace LPG low pressure filter	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Replace CNG low pressure filter		☐		☐		☐		☐		☐		☐		☐	
Check air filter	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Check spark plugs and ignition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Check reducer pressure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Check carburation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Annex 3

MODULARIO 290UN990001

Imposta di bollo assolta mediante versamento in c/ postale ai sensi dell'art. 7 L. 18.10.70 n. e succ. mod.

99/01

Ministero delle Infrastrutture e dei Trasporti

DIPARTIMENTO PER I TRASPORTI TERRESTRI E PER I SISTEMI INFORMATIVI E STATISTICI
Direzione Generale della Motorizzazione e della Sicurezza del Trasporto Terrestre

CERTIFICATO DI OMOLOGAZIONE N.DGM 59534 GPL

Visto il Codice della Strada, emanato con Decreto Legislativo 30 aprile 1992 n.285;

Visto il Decreto Legislativo 10 settembre 1993, n. 360 (art.128 comma 1 lettera c);

Visto il Regolamento di esecuzione e di attuazione del Codice della Strada, emanato con Decreto del Presidente della Repubblica 16 dicembre 1992 n.495(art.407);

Visto il Decreto del Ministro dei Trasporti e della Navigazione n.277 in data 2 maggio 2001, recante norme sulle procedure amministrative di omologazione;

Viste le domande presentate dalla **Officine LOVATO S.p.A.-Vicenza** in data **06.11.2003** e successiva in data **10.12.2003**, intese ad ottenere l'omologazione del:
Complessivo di trasformazione a G.P.L. ai sensi della circolare U.di G. MOT n.B54 del 27.07.2000, rispondente alle Direttive 98/69/CE, 1999/102/CE , 2001/1/CE , 2001/100/CE, 2002/80/CE (Fase B), tipo **STIL SLAVE** ;
Fascia di cilindrata : **900÷2250** cm^3;
Vista la documentazione allegata;
Visto il verbale n. **1006/I/03/RM** in data **17.02.2004**, redatto dal **C.S.R.P.A.D.** di **ROMA**.

SI DICHIARA OMOLOGATO

Il Complessivo di trasformazione a G.P.L. ai sensi della circolare U.di G. MOT n.B54 del 27.07.2000, rispondente alle Direttive 98/69/CE, 1999/102/CE , 2001/1/CE , 2001/100/CE, 2002/80/CE (Fase B), tipo **STIL SLAVE** ;
Fascia di cilindrata : **900÷2250** cm^3;
marchio di fabbrica **LOVATO.**

Gli esemplari prodotti dovranno essere conformi al tipo omologato le cui caratteristiche sono riportate nel prospetto-mod.DGM 405- munito del timbro a secco del Dipartimento dei Trasporti Terrestri, che costituisce parte integrante del presente certificato.

Ciascun esemplare dovrà portare impresso il marchio di fabbrica **LOVATO** e la dicitura:**DGM 59534 GPL**.

Roma, 10 marzo 2004

IL DIRETTORE
(dott. ing. Alessandro DE GRAZIA)

VC

VC-04-STIL SLAVE-GPL

MODULARIO 299/N000699

MOD. 99/09

Ministero delle Infrastrutture e dei Trasporti

DIPARTIMENTO PER I TRASPORTI TERRESTRI
E PER I SISTEMI INFORMATIVI E STATISTICI
Direzione Generale della Motorizzazione e della Sicurezza del Trasporto Terrestre
ex MOT 2
Prot. n° 668-MOT2/P/213

Roma, 10 MAR. 2004

Allegati vari

Alla Officine LOVATO S.p.A.
Strada Casale, 175
36100 Vicenza

Al C.S.R.P.A.D. di ROMA
(Rif. n. 6508-7266/03 in data 18.02.2004)

Oggetto: Ditta **Officine LOVATO S.p.A.- Vicenza.**
Omologazione complessivo di trasformazione a GPL ai sensi della circolare U.di G.–B54 del 27.07.2000, rispondente alle Direttive 98/69/CE, 1999/102/CE,2001/1/CE,2001/100/CE, 2002/80/CE (Fase B).Fascia di cilindrata: **900÷2250** cm^3.

Per il complessivo in oggetto si è dato corso al seguente provvedimento di omologazione:

DISPOSITIVO/TIPO	PROVVEDIMENTO	DATA
STIL SLAVE	**DGM 59534 GPL**	**10.03.2004**

IL DIRETTORE
(dott. ing. Alessandro DI GRAZIA)

VC

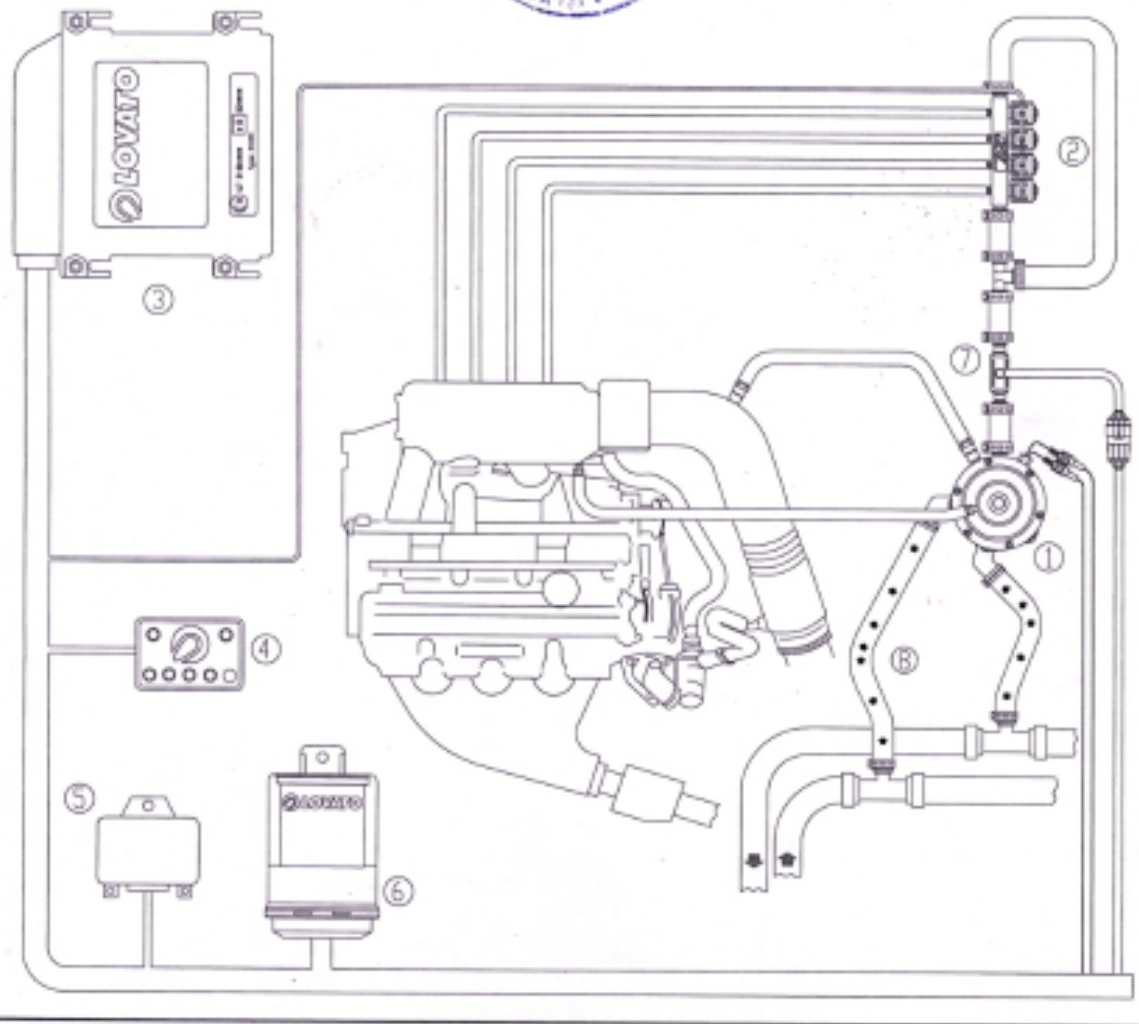
VC-04-STIL SLAVE-GPL

- DGM 59534 GPL -

LOVATO Officine Lovato S.p.A. Strada Casale, 175 36100 Vicenza	**SISTEMA GPL TIPO " STIL SLAVE"** Per veicoli catalizzati rispondenti alle direttive: 91/441/CE, 93/59/CE, 94/12 CE, 96/44 CE, 96/69 CE, 98/69 CE fase A-B, 1999/102/CE, 2001/1/CE, 2001/100/CE e 2002/80/CE Omologato dal Ministero delle Infrastrutture e dei Trasporti Dipartimento per i Trasporti Terrestri e per i sistemi informativi e statistici Certificato DGM 59534 GPL del 10 marzo 2004	ANNO 2004

Componenti del sistema di alimentazione a GPL tipo " STIL SLAVE" (Variante A)

Riduttore:	LOVATO "STIL RED"	- E13*67R00*67R01*0195*02
Centralina:	LOVATO "SECU"	- E13*67R00*67R01*0249
		- E13*72/245*95/54*2094*00
Emulatore iniettori	LOVATO "SEMU"	- E13*67R00*67R01*0250
		- E13*72/245*95/54*2098*00
Gruppo di elettroiniezione	LOVATO "STIL INJ"	- E13*67R00*67R01*0194*01
Tubazione GPL		- E13*67R00*67R01*0145*01



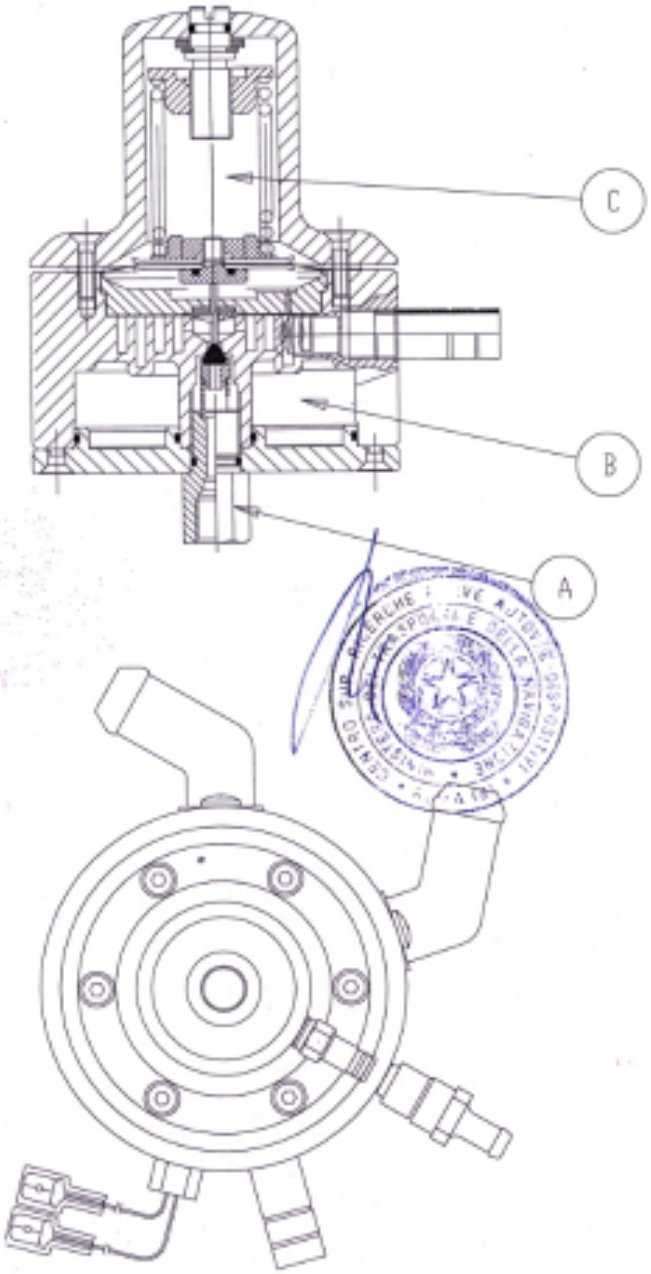
LEGENDA

1	Riduttore	5	Centralina elettronica benzina	8	Tubazioni acqua refrigerazione motore
2	Gruppo di elettroiniezione	6	Emulatore iniettori		
3	Centralina elettronica	7	Sensore temperatura e pressione		
4	Commutatore				

1

- DGM 59534 GPL -

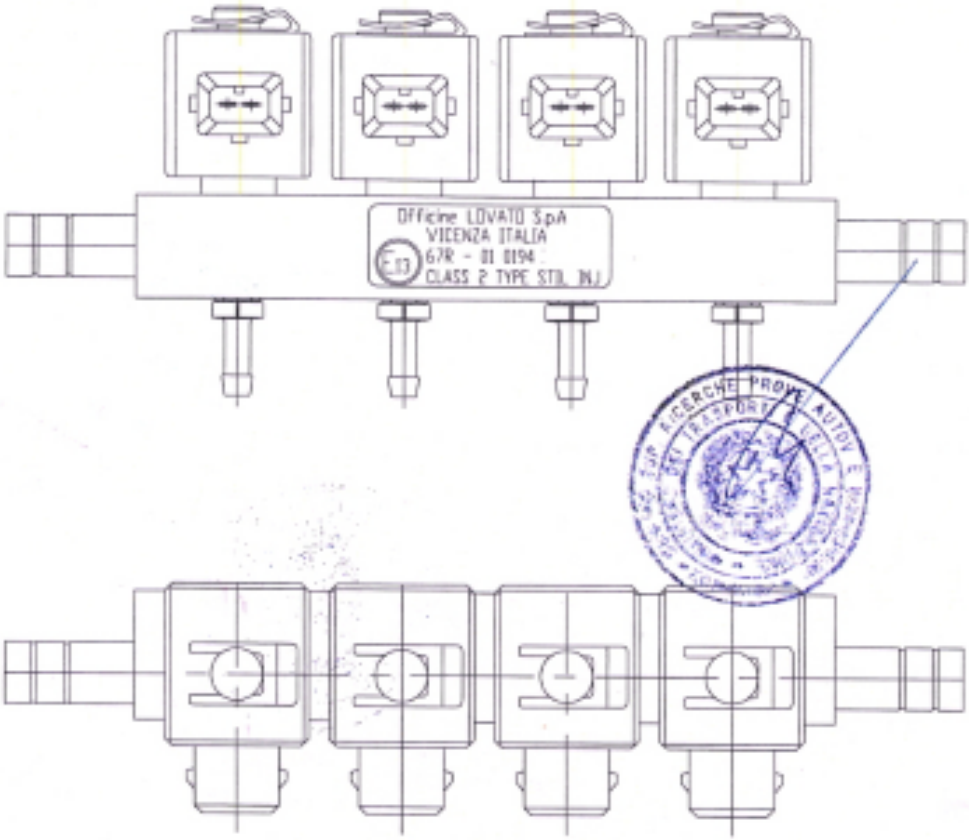
RIDUTTORE DI PRESSIONE

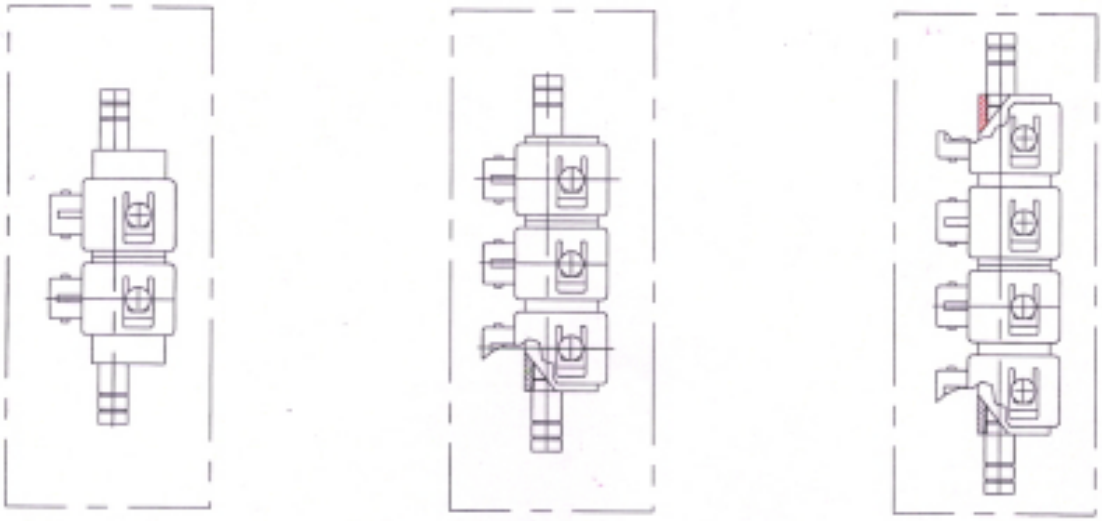


CARATTERISTICHE COSTRUTTIVE RIDUTTORE "STIL RED"	
- Uno stadio di riduzione a membrana e molla	- Capacità di erogazione di circa 30kg/ora di GPL commerciale (70% butano + 30% propano) con una circolazione di circa 6 litri/min di acqua a 80°C.
- Camera di vaporizzazione	- Dimensione di ingombro 130x88
- Riscaldamento del vaporizzatore con circolazione forzata di liquido di raffreddamento del motore	- Spessore 130 mm
	- Massa 1,1 kg circa

2

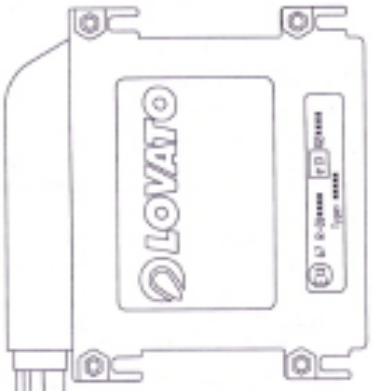
GRUPPO ELETTROINIEZIONE LOVATO
TIPO "STIL INJ"





3

CENTRALINA ELETTRONICA LOVATO TIPO "SECU"



STACCA INIETTORI

CONNETTORE DIAGNOSI

ELETTROINIETTORI

- ALIMENTAZIONE
- SEGNALE GIRI
- SEGNALE SONDA LAMBDA
- SENSORE NTC
- INIETTORI
- MAP

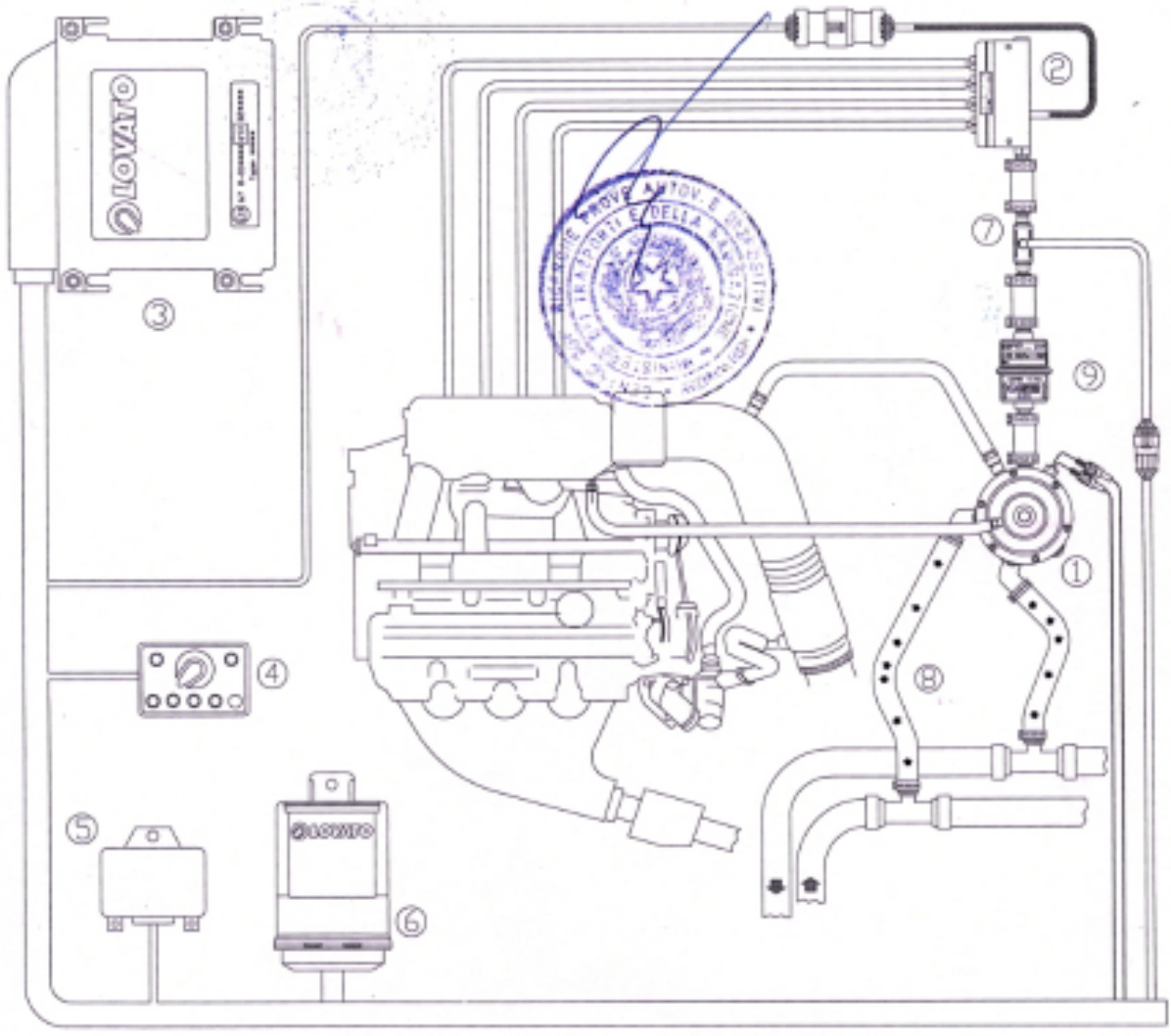
EMULATORE INIETTORI LOVATO TIPO "SEMU"

4

- DGM 59534 GPL -

Componenti del sistema di alimentazione a GPL tipo "STIL SLAVE" (Variante B)

Riduttore:	LOVATO "STIL RED"	- E13*67R00*67R01*0195*02
Centralina:	LOVATO "SECU"	- E13*67R00*67R01*0249*00
		- E13*72/245*95/54*2094*00
Emulatore iniettori	LOVATO "SEMU"	- E13*67R00*67R01*0250*00
		- E13*72/245*95/54*2098*00
Gruppo di elettroiniezione	MATRIX "MJ"	- E13*67R00*67R01*0167*03
		- E13*10R00*10R02*1763*00
Filtro GPL	MATRIX "FJ"	- E13*67R00*67R01*0181*01
Tubazione GPL		- E13*67R00*67R01*0145*01



LEGENDA

1	Riduttore	5	Centralina elettronica benzina	8	Tubazioni acqua refrigerazione motore
2	Gruppo di elettroiniezione Matrix	6	Emulatore iniettori		
3	Centralina elettronica	7	Sensore temperatura e pressione	9	Filtro GPL
4	Commutatore				

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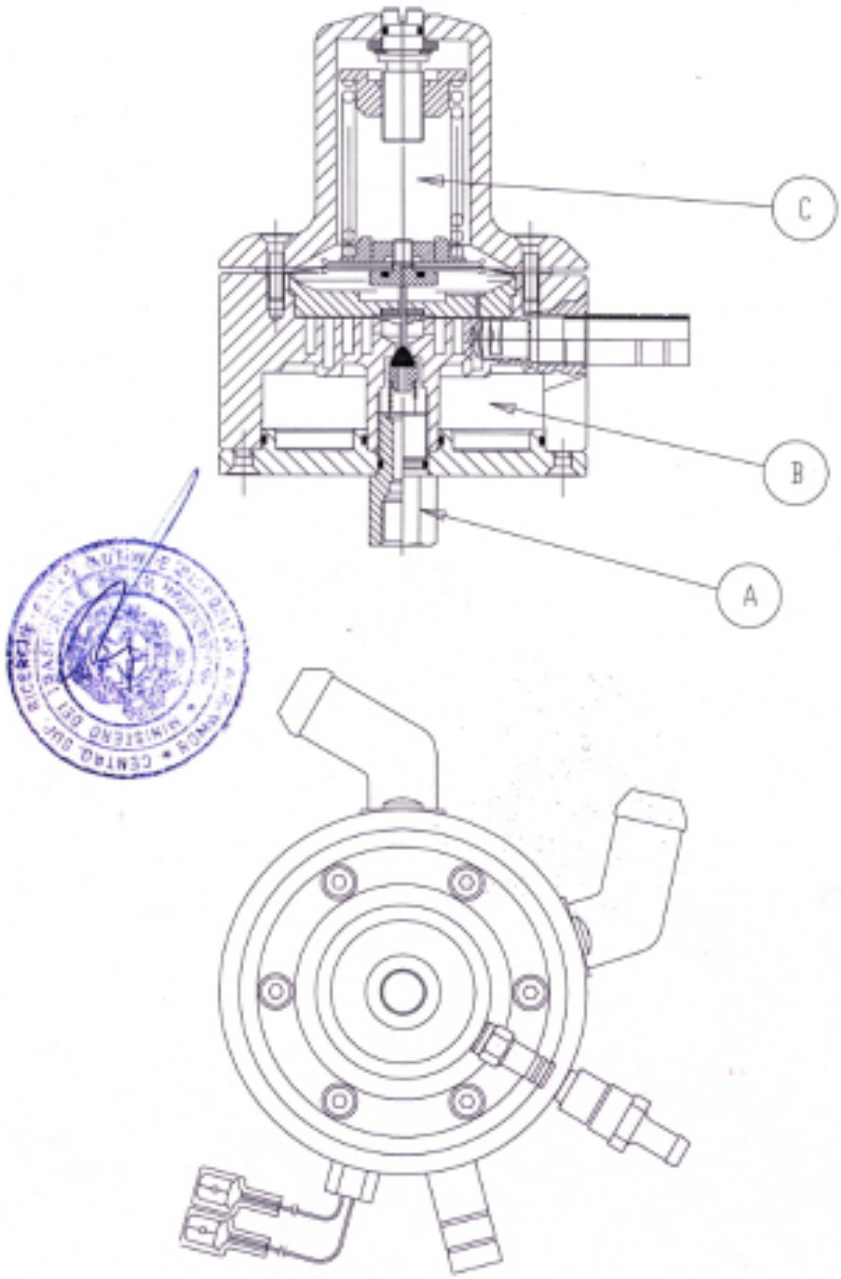
RIDUTTORE DI PRESSIONE



CARATTERISTICHE COSTRUTTIVE RIDUTTORE "STIL RED"	
- Uno stadio di riduzione a membrana e molla - Camera di vaporizzazione - Riscaldamento del vaporizzatore con circolazione forzata di liquido di raffreddamento del motore	- Capacità di erogazione di circa 30kg/ora di GPL commerciale (70% butano + 30% propano) con una circolazione di circa 6 litri/min di acqua a 80°C. - Dimensione di ingombro 130x88 - Spessore 130 mm - Massa 1,1 kg circa

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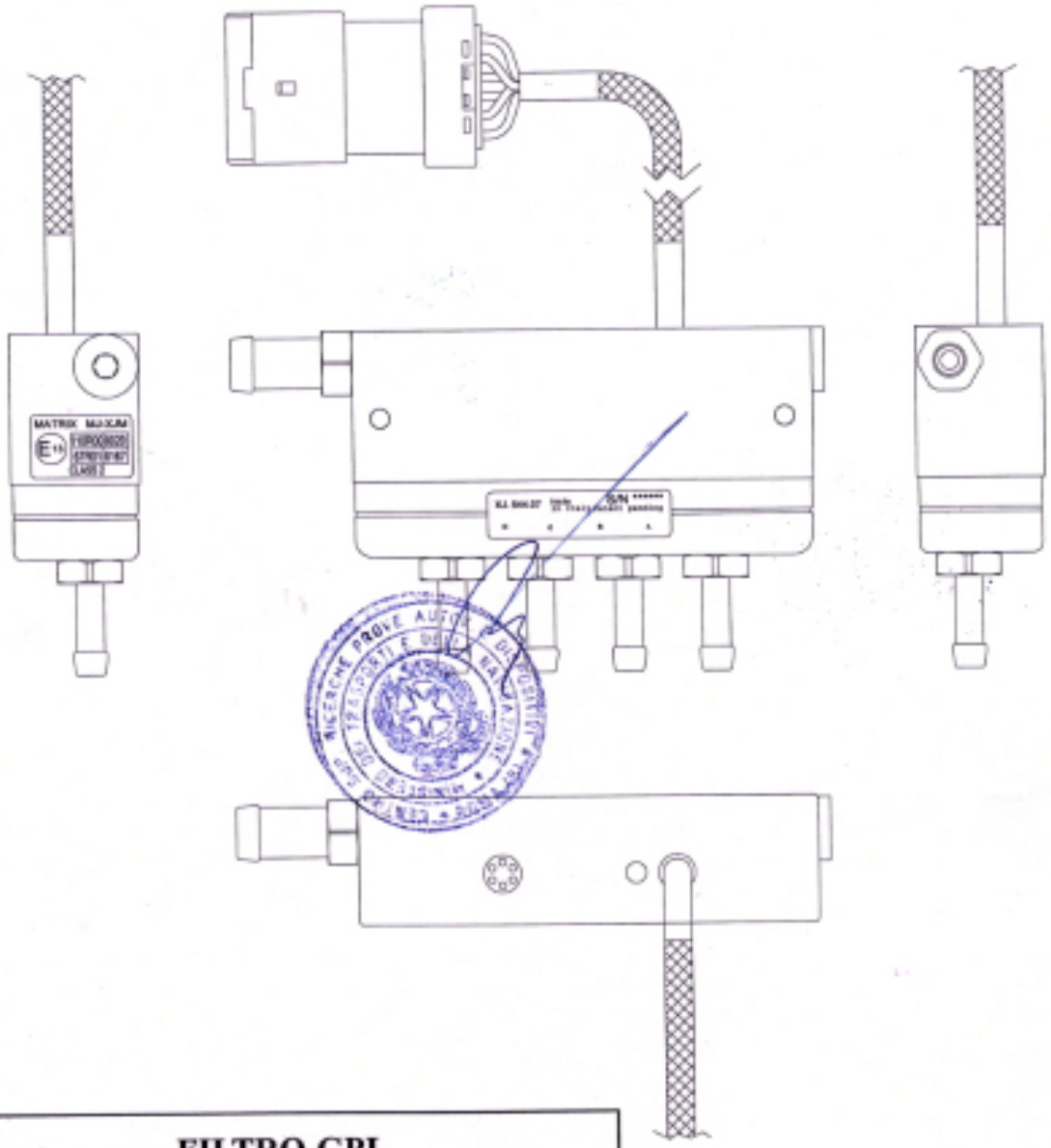
GRUPPO ELETTROINIEZIONE MATRIX TIPO "MJ"



FILTRO GPL TIPO "FJ"

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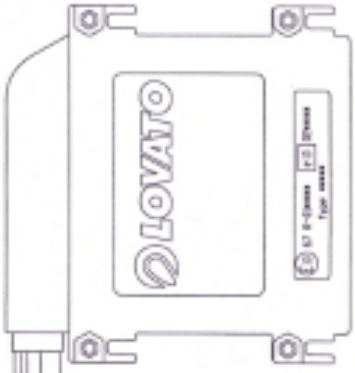
CENTRALINA ELETTRONICA LOVATO TIPO "SECU"



STACCA INIETTORI

CONNETTORE DIAGNOSI

ELETTROINIETTORI

- ALIMENTAZIONE
- SEGNALE GIRI
- SEGNALE SONDA LAMBDA
- SENSORE NTC
- INIETTORI
- MAP

EMULATORE INIETTORI LOVATO TIPO "SEMU"

Il sistema "STIL-SLAVE" può essere montato su veicoli che rispondano alla direttiva 2002/80/CE (fase A-B), 2001/100/CE (fase A-B), 2001/1/CE (fase A-B) 1999/102 (fase A-B), 98/69 CE (fase A-B), 96/69/CE, 96/44/CE, 94/12/CE con motore aspirato ad iniezione compreso nella fascia di cilindrata 900 ÷ 2250. Senza limitazione di cilindrata può essere montato su veicoli che rispondano alla direttiva 93/59/CEE, 91/441/CEE e precedenti

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- DGM 59534 GPL Agg. 01 -

LOVATO Officine Lovato S.p.A. Strada Casale, 175 36100 Vicenza	**SISTEMA GPL TIPO " STIL SLAVE"** Per veicoli catalizzati rispondenti alle direttive: 91/441/CE, 93/59/CE, 94/12 CE, 96/44 CE, 96/69 CE, 98/69 CE fase A-B, 1999/102/CE, 2001/1/CE, 2001/100/CE, 2002/80/CE e 2003/76/CE Omologato dal Ministero delle Infrastrutture e dei Trasporti Dipartimento per i Trasporti Terrestri e per i sistemi informativi e statistici Certificato DGM 59534 GPL del 10 marzo 2004	ANNO 2004

Aggiornamento 01 del 20 ottobre 2004

Aggiornamento per introduzione di ulteriore fascia di cilindrata 2080 ÷ 3470 cc

Componenti del sistema di alimentazione a GPL tipo "STIL SLAVE"

DISPOSITIVO	COSTRUTTORE E TIPO	OMOLOGAZIONE	MARCHIO
Riduttore:	LOVATO "STIL RED"	- E13*67R00*67R01*0195*03	LOVATO
Centralina:	LOVATO "SECU"	- E13*67R00*67R01*0249*01 - E13*72/245*95/54*2094*01	LOVATO
Emulatore iniettori	LOVATO "SEMU"	- E13*67R00*67R01*0250*00 - E13*72/245*95/54*2098*00	LOVATO
Sensore di pressione e temperatura	LOVATO "PTSENSOR"	- E13*67R00*67R01*0263*00 - E13*72/245*95/54*2557*00	LOVATO
Gruppo di elettroiniezione	MATRIX "MJ"	- E13*67R00*67R01*0167*03 - E13*10R00*10R02*1763*00	MATRIX
Filtro GPL	MATRIX "FJ"	- E13*67R00*67R01*0181*01	MATRIX
Tubazione GPL	ITR	- E13*67R00*67R01*0128*01	ITR

Le tubazioni non metalliche in bassa pressione (a valle del riduttore) possono essere qualsiasi, purché omologate secondo il regolamento ECE 67-01 e nel rispetto delle prescrizioni dimensionali fornite da Officine Lovato SpA.

Il sistema "STIL-SLAVE" può essere montato su veicoli che rispondano alla direttiva 2003/76/CE (fase A-B), 2002/80/CE (fase A-B), 2001/100/CE (fase A-B), 2001/1/CE (fase A-B) 1999/102 (fase A-B), 98/69 CE (fase A-B), 96/69/CE, 96/44/CE, 94/12/CE con motore aspirato ad iniezione compreso nella fascia di cilindrata 2080 ÷ 3470 cc. Senza limitazione di cilindrata può essere montato su veicoli che rispondano alla direttiva 93/59/CEE, 91/441/CEE e precedenti

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