Injection System

INSTALLATION AND ADJUSTMENT MANUAL

AUTO GAS EQUIPMENT
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1. DESCRIPTION

1.1 Operational principles

LIS allows the conversion of gasoline injection engines, provided with lambda sensor (oxygen sensor) and three-way catalytic converter, by means of a continuous gaseous LPG injection. The gas coming from the tank passes through the **Regulator-Vaporizer**, which controls its pressure and temperature, enters the **Proportioner,** which sets the gas output to the **Distributor** according to the information from the **Electronic Control Unit (ECU)**, and goes to the **Distributor** which provides for proportioning the gas output to each single duct of the intake manifold, maintaining at the same time a constant pressure downstream of the **Proportioner**.

Since the system is compensated, and being the pressure constant downstream of the **Proportioner**, it follows that the **Proportioner** gas supply pressure increases with the engine load, with important advantages in terms of injection system speed reaction during transients.

LIS has been designed and developed for being suitable to the most recent petrol injection systems.

The mapping is bi-dimensional, while the information pertinent to Manifold Absolute Pressure (MAP) and RPM is used to establish the amount of fuel that must be injected for the best performance and emissions results. The microprocessor modulates the amount of gas in function of driving conditions so that performance and emissions are constant even in different environmental conditions and with fuel composition changes.

The microprocessor takes into account the engine's deterioration and automatically corrects the fuel's reference parameters.

The fuel management is further refined by other functions: such as oxygen sensor management strategies, fuel enrichment in acceleration transients, and fuel cut-off in deceleration.

The **ECU** controls also other corollary functions of the system, such as fuel level indicator, fuel change-over, maximum RPM governor, and ignition system-triggered fuel solenoid valves' safety shut-off.

Interaction with the ECU can be achieved by means of a serial interface with a portable PC or a tester . This is possible for diagnostic purposes, as well as during the first start-up after the completion of the conversion, when the data files pertinent to the vehicle that is being converted are uploaded from the PC into the ECU. For diagnostic a check can be made for proper operation of the sensors and of the **Regulator-Vaporizer (RV)** , while assessing the quality of carburetion.

1.2 Programming the ECU

To properly operate, the **ECU** must be configured for the vehicle on which **LIS** is installed.

The programming of the **ECU** is achieved by means of an IBM-compatible personal computer and the proper interface.

In Chapter 6 please find information on how to perform this operation.

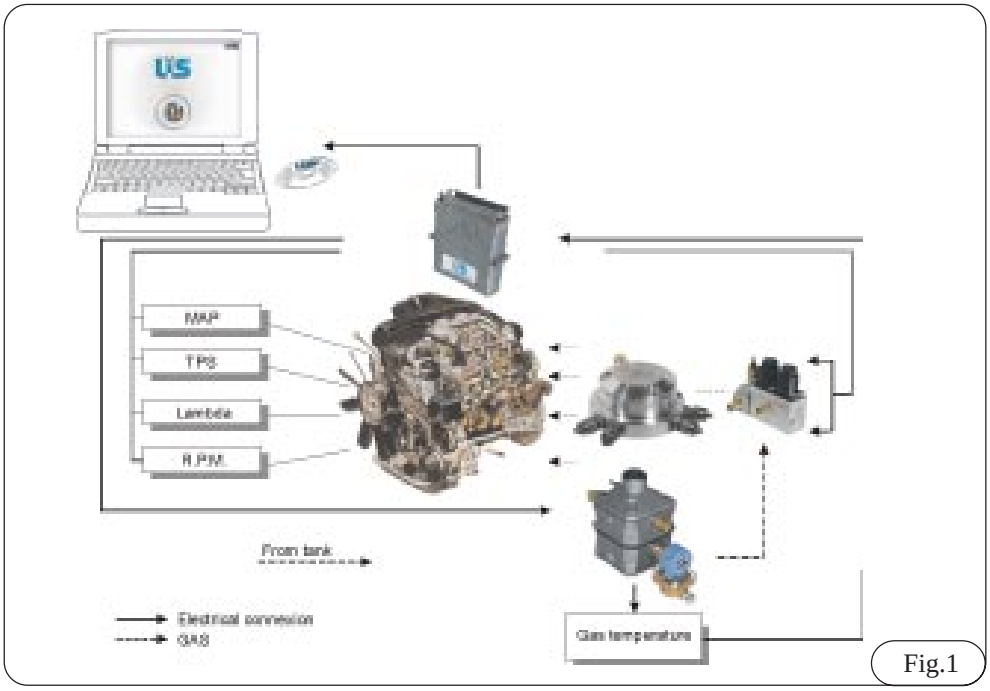

Fig.1

2. INPUT SIGNALS

2.1 MAP (Manifold Absolute Pressure)

The MAP input signal is used as a reference for :

- managing the mapping in combination with the RPM input. The mapping determines the position of the step- motors in the **Proportioner**.
- managing the fuel working pressure from the **Regulator-Vaporizer** as a function of the engine load.

2.2 Engine RPM

The RPM signal is read by the **ECU** for managing the mapping, which in turn determines the correct position of the step-motors in the **Proportioner** and handles the fuel cut-off.

2.3 TPS (Throttle Position Sensor)

The TPS signal informs the **ECU** on the throttle position and is mainly used for fuel enrichment during transients.

During acceleration phases the **ECU** uses appropriate opening strategies for the step-motors of the **Proportioner**, in order to get the injection system to promptly react to the engine's greater fuel demand.

During the deceleration phases the **ECU** operates the cut-off electrovalve in order to reduce the amount of fuel delivered to the engine, this way optimizing emissions and engine braking effect.

2.4 Lambda sensor (Oxygen Sensor)

The Lambda signal informs the **ECU** on engine combustion. To achieve the correct air-fuel ratio, it is necessary that the air volume taken in by the engine corresponds to the theoretical fuel volume required to completely burn the fuel.

A value of Lambda > 1 indicates lean mixture.

A value of Lambda < 1 indicates rich mixture.

The Lambda signal is used by the **ECU** for setting the proper gas output to the engine.

2.5 Regulator-vaporizer temperature

The **Regulator-Vaporizer** temperature signal is used for setting the automatic change-over from petrol to gas . Once the programmed temperature is reached by the **Regulator-Vaporizer**, the **ECU** performs the fuel change-over .

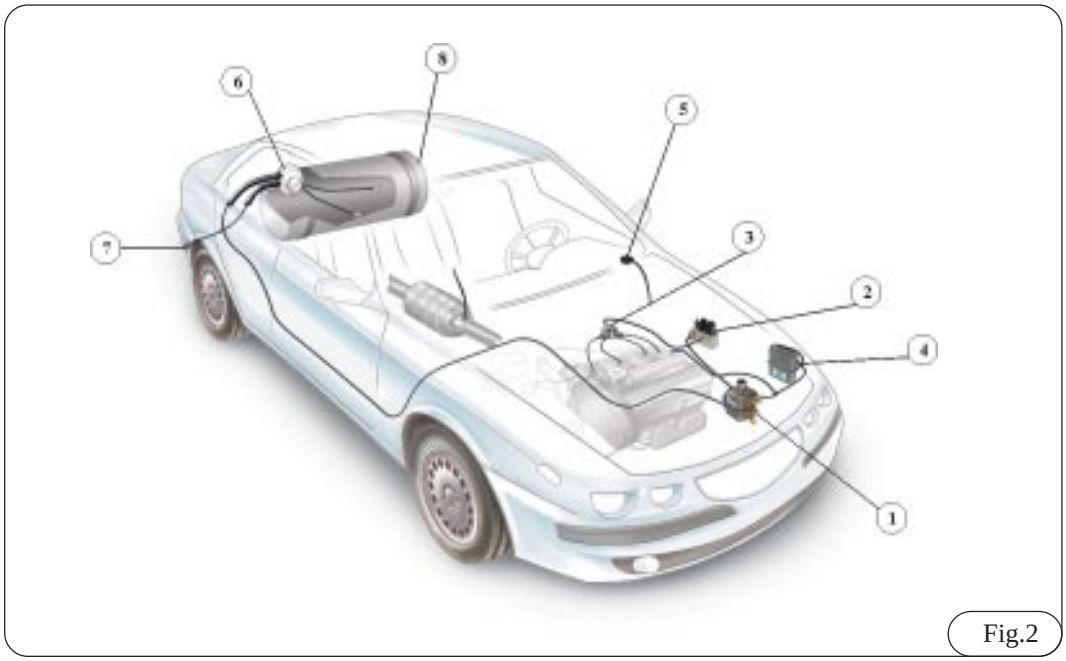

Fig.2

3. COMPONENTS

In the figure 2 all the components of the conversion are visualized:

1) Regulator-Vaporizer
2) Proportioner
3) Distributor
4) ECU
5) Gas/petrol switch and fuel level indicator
6) Multivalve
7) Filling point
8) LPG tank

3.1 Regulator-vaporizer

The **Regulator-vaporizer (RV)** (Fig. 3.1) has two stages for pressure reduction and control and is provided with water-gas heat exchanger, filter, fuel lock-off, gas temperature sensor, and safety valve.

The output pressure is 0.95 bar (95 kPa) higher than the pressure existing in the intake manifold.

Legenda:

A) Fuel inlet
B) Fuel lock-off
C) Fuel outlet
D) Bracket mounting points (M6)
E) Compensation inlet
F) Water outlet
G) Water inlet
H) Temperature sensor
I) Safety valve
L) Second stage pressure setting screw
M) Drain taps

Main data :

First stage working pressure ..... 1.6 bar (160 kPa)
Second stage-working pressure ..... 0.95 bar (95 kPa)
Nominal operating output 40 Nm3/h
Operational temperature ..... -20/+120 C
Setting of safety valve pressure ..... 3.5 bars (350 kPa)

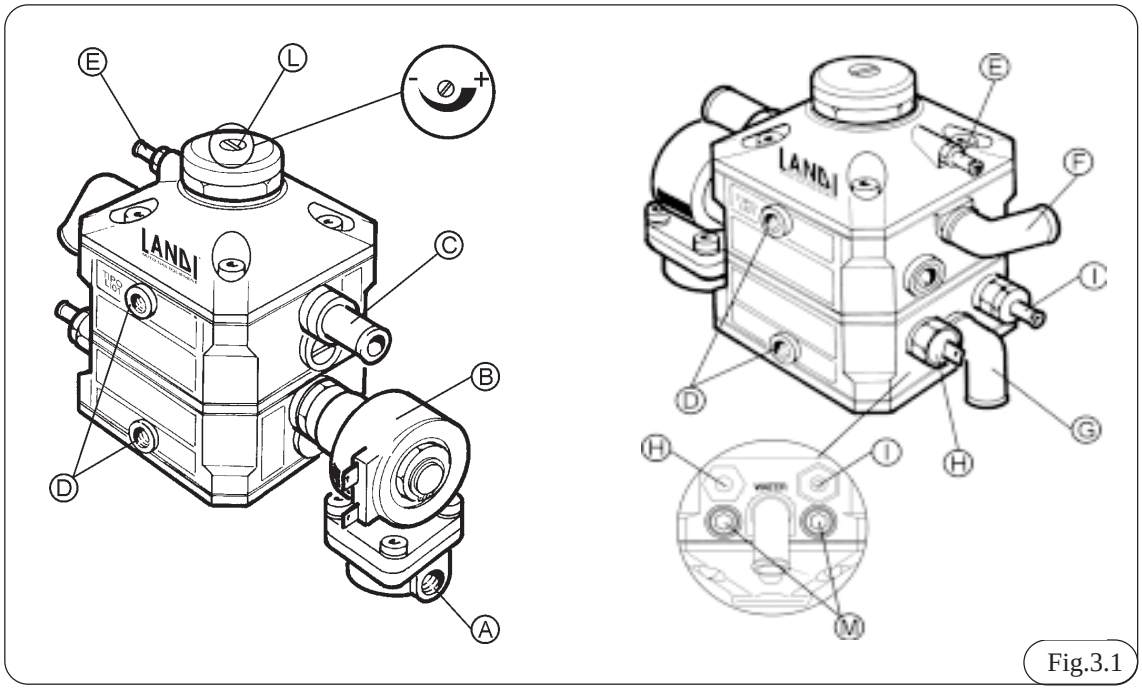

Fig.3.1

3.2 Proportioner

The **Proportioner (P)** (Fig. 3.2) includes two step- motors which sequentially drive two valves. The first step- operates at idle and low RPM conditions, the second handles the gas output at medium-high engine power output and during acceleration.

An electrovalve is positioned at the inlet of the **Proportioner** to perform the fuel cut-off function during deceleration. The diagnostic plug to read the system's working pressure is present on the cut-off valve.

Legenda

A) Fuel inlet
B) Fuel outlet
C) Solenoid valve
D) Cut-off electrovalve
E) Idle/low power step-motor
F) Medium/high power step- motor
G) Diagnostic plug to read the system's working pressure
H) Bracket holes (M6)
I) Drain tap
L) Water inlet
M) Water outlet

Main data

Test Pressure ..... 1.6 bar (160kPa)
Working Pressure ..... 0.95 bar (95 kPa)

Step motor data

Operating Voltage 12V
Power Absorption ..... 150 mA
Nominal Power 2W
Operational Temperature ..... -20/+120 C
Protection against Dust and Water IP54

Solenoid valve data

Operating Voltage 12V
Internal Resistance ..... 26-30 Ohm
Operational Temperature ..... -20/+120 C

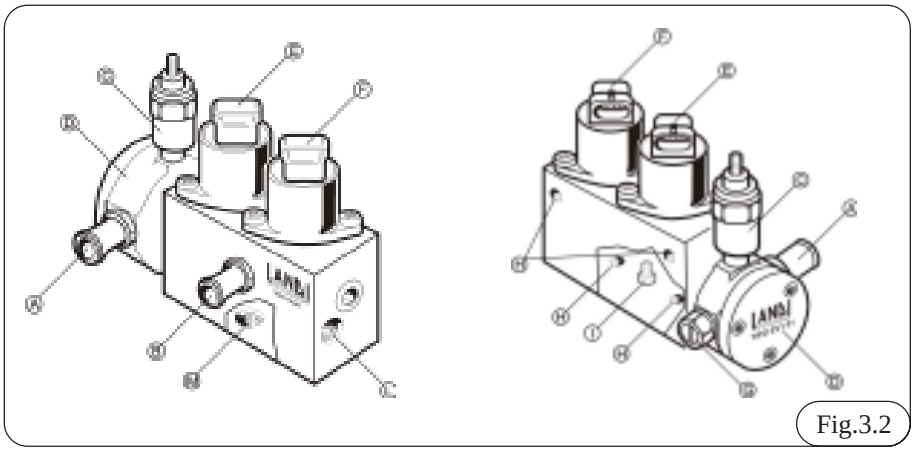

Fig.3.2

3.3 Distributor

The **Distributor** (Fig 3.3) is designed in order to maintain at the inlet a constant pressure slightly higher than the atmospheric one, and at the outlet a pressure close to the one of the intake manifold.

It has the task of supplies the proper quantity of gas to each cylinder.

Legenda

A) Gas inlet
B) Gas outlet
C) Alternative gas inlet

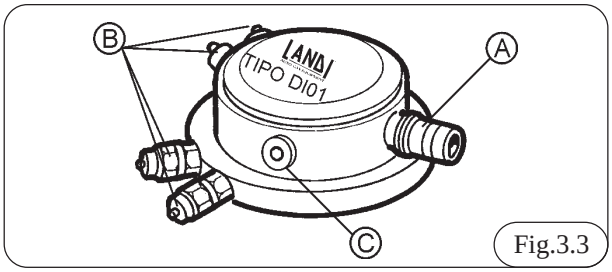

Fig.3.3

3.4 Injector

One injector is positioned on each duct of the air intake manifold. It injects the gas through an orifice that is calibrated according to the engine displacement (Fig 3.4).

Fig.3.4

3.5 Electronic Control Unit (ECU)

The strategy of the electronic handling is memorised in a step-motors opening map which is defined depending on the engine RPM and on the MAP mesured in the air intake manifold in reference conditions.

These data are fine-tuned by means of the proportional-integral correction in function of the Lambda sensor signal, and further fine-tuned in function of the TPS signal, for acceleration and cut-off conditions.

The MAP sensor is an integral part of the **LIS**, as is the temperature sensor on the regulator-vaporizer.

The signal of the temperature sensor is utilized to establish the petrol-gas automatic change-over after the engine start-up. The change-over is also a function of other parameters like the time elapsed from start-up, status of the oxygen sensor, RPM.

The **LIS** includes strategies that prevent over-revving, and there is an automatic switching to petrol in case of extensive malfunction (Fig 3.5).

Legenda:

A) Electronic Control Unit (ECU)
B) MAP signal inlet
C) Electric cable connector
D) Bracket mounting points

Main data

Operational voltage ..... 12V (-20%/+30%)
Maximum current absorption during operation ... 0.6A
Maximum current applicable to the relay for cutting the petrol injection (yellow wires) 6.5A
Maximum output current available for gas control devices (Blue Wires) 6.5A
Protection against dust and water IP54

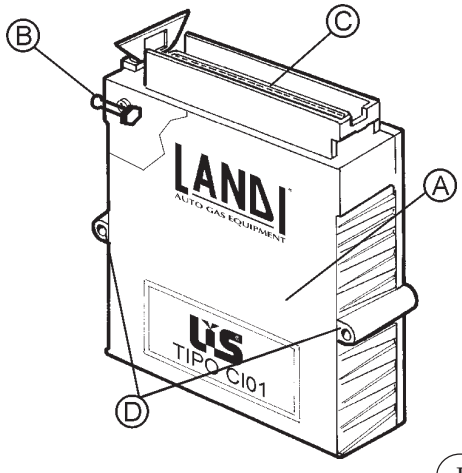

Fig.3.5

3.6 Wiring

LIS requires only one wiring harness.

The harness includes

- an automotive type, weatherproof, 55-pin connector for the connection to the ECU (Fig 3.7)
- a connector for the connection to the PC
- a connector for the working pressure tester
- a connector for the connection to the switch
- two connectors for the connection to the step-motors of the proportioner.

Harness Description Table in the Figure 3.6:

Pin	Signal	Color
1.	Ground	Black
2.	Petrol injection disabling	Yellow
3.	Cut-off solenoid valve	Green/Black
4.	12V accessories	Red
5.	RPM counter	Brown
6.	Temperature	Orange
7.	N.C.	N.C.
8.	N.C.	N.C.
9.	Serial port +5V supply	Red/White
10.	Serial port ground	Black
11.	Serial port Data IN	Pink/Black
12.	Serial port Data OUT	Pink
13.	Pressure conn. supply	Red/White
14.	Pressure conn. signal	Orange/Black
15.	Pressure conn. ground	Nero
16.	N.C.	N.C.
17	N.C.	N.C.
18.	N.C.	N.C.
19.	N.C.	N.C.
20.	N.C.	N.C.
21.	N.C.	N.C.
22.	N.C.	N.C.
23.	N.C.	N.C.
24.	N.C.	N.C.
25.	N.C.	N.C.
26.	N.C.	N.C.
27.	Proportioner Ground	Black
28.	+12 Battery	Red/Black
29.	Petrol injection disabling	Yellow
30.	N.C.	N.C.
31.	Gas out	Blue
32.	Oxigen sensor emulation	Gris
33.	Oxigen sensor	Purple
34.	Alternative fuel level sensor	White
35.	Power supply sensor	Green
36.	N.C.	N.C.
37.	N.C.	N.C.
38.	TPS	Yellow/Blue
39.	TPS/2	Blue/Black
40.	Switch	Brown
41.	Switch shunter	Blue
42.	DC Switch supply	Red
43.	Switch Ground	Black
44.	Step motor signal	White
45.	Step motor signal	Orange
46.	Step motor signal	Light blue
47.	Step motor signal	Purple
48.	N.C.	N.C.
49.	N.C.	N.C.
50.	N.C.	N.C.
51.	N.C.	N.C.
52.	Step motor signal	White
53.	Step motor signal	Orange
54.	Step motor signal	Light blue
55.	Step motor signal	Violette

Fig.3.6

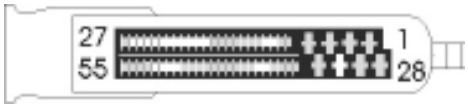

Fig.3.7

3.7 Switch

In the Figure 3.8 is reported the switch sketch.

3.7.1 Switch with fuel level indicator specifications

A) Gas-petrol switch, two positions

- switch in left, petrol position

- switch in right, gas position

B) Green L.E.D.s display bar readout interpretation:

- during the functioning of the vehicle in petrol, all LEDs are OFF

- fast flashing, the system is waiting for automatic change-over to gas after start-up. (please note that the start-up is always on petrol);

- constantly on, the vehicle is operating on gas, the L.E.D.s bar indicates the level of gas in the tank with a 1/4 tank resolution;

- last L.E.D.(1/4) slow flashing, indicates reserve condition.

C) Red L.E.D.

- the red L.E.D. slow flashing indicates gas system malfunction.

D) Connector

- Connects the switch to the harness from the **ECU**.

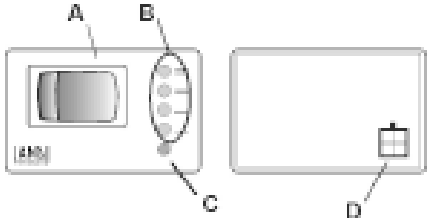

Fig.3.8

3.7.2 Emergency alternative fuel start-up by using the switch/fuel level indicator

In case of petrol system malfunction that prevents a petrol start-up (i.e. petrol pump breakdown), it is possible to start the engine directly on gas . Proceed as follows:

- Turn the ignition key on (without cranking the engine);
- Put the switch (A) in petrol position, then put it in gas position without cranking the engine;
- The green L.E.D.s bar (B) is steadily on;
- Crank the engine (without bringing the key back to off position before starting!), this achieves direct gas start-up.

3.8 The LIS kit content *

Description	Quantity
Electronic Control Unit	1 pcs.
Switch with level Indicator	1 pcs.
Distributor DI01-4 for 4 cylinders engine	1 pcs.
Proportioner	1 pcs.
LIS01 LPG regulator-vaporizer electrovalve	1 pcs.
Water hose 15x23	1.5 m
Low pressure gas hose 10x18	1 m
Low pressure gas hose 14x22	1 m
MAP hose 5x10.5	1 m
Low pressure gas hose 4x6	1 m
High pressure gas pipe 4x6	6 m
Injector	4 pcs.
Fixing set for distributor and proportioner	1 pcs.
Fixing set for regulator-vaporizer	1 pcs.
LIS accessories	1 pcs.

(*) Example kit for a 4-cylinder engine.

4. Installation

4.1 Required equipment

- Exhaust gas analyzer as per D.M. 628/96 (approved) HC, CO, CO_2, LAMBDA (Italy only)
- Chisel
- Electrician's scissors
- Milling machine (diam.75mm and 32mm)
- Tap wrench
- Goniometer to correctly position LPG tank
- Male Tap M8x1, M6X1
- Tape measure
- Bench vise
- Multimeter
- Personal Computer. Minimum requirement: 486, 8 MB Ram, 10 MB available HD space, SVGA 800x600 resolution.
- CLIC manual pliers for locking clamps
- Wire crimping tool
- Wire strippers
- Hoist
- Drill bits, diameter 7 mm, 6.75 mm and 4,75mm
- Solderer
- Welder machine
- Assorted wrenches
- LIS programming and diagnosis devices
- Instrumentation for the diagnosis of the vehicle's fuel and ignition systems
- Colum Drill
- Portable electric drill

The above-mentioned equipment must be properly maintained and, when necessary, calibrated according to the specifications and time charts of the manufacturer.

4.2 Assorted shop materials

- Grease
- Heat-shrink tubing
- Radiator coolant
- Soapy water solution to check for gas leaks or gas leakage detector
- Adhesive fabric tape
- Thread sealant
- Stannum

4.3 Before starting the conversion

Before proceeding with the conversion it is necessary to retrieve the file pertinent to the vehicle to be converted. This file is available in the **LIS** software archive and/or on paper.

Check the vehicle for the following:

- Air filter
- By using the oscilloscope check that high voltage wires, spark plugs, and coil(s) are within OEM specifications.
- Intake and exhaust valves, when mechanical, must have the clearance specified by the OEM.
- The Lambda sensor must be in good operating condition and have the appropriate voltage span.
- The catalytic converter must be in good operating condition.

Perform the adjustments and/or modifications that are required by the above-mentioned diagnostic procedure, and when necessary replace deficient components, with particular emphasis on the Lambda sensor.

4.4 LIS components installation

4.4.1 Regulator-vaporizer

The regulator can be installed by observing the following procedure :

- Install the regulator in the engine compartment in the position indicated in the relevant "vehicle file." Mount the unit directly or indirectly onto the vehicle's body or on the frame by means of the provided fixing set
- Do not mount the regulator on the engine or other components that are in turn mounted on the engine.
- Do not install the regulator in the area of the passenger compartment ventilation system; also ensure that the regulator is not installed close to the air intake for the passenger compartment ventilation system.
- Install the regulator not closer than 150 mm from the exhaust system, or mufflers. If this is not possible, a heat shield in metal or equivalent with a minimum thickness of 1 mm must be installed. In any case, do not install the regulator closer than 75 mm away from the exhaust system.
- Mount the regulator in such a way to allow easy access for adjustment and maintenance.
- Mount the regulator below the engine's water table in order to avoid airlocks in the cooling system.
- Make sure that the regulator's drain plug is not positioned on top of the ignition distributor, or ignition coil(s).
- Thoroughly clean the LPG tank and tubing before installation in order to prevent dirt from accumulating inside the regulator.
- When the installation is complete, start the engine and allow it to reach normal operating temperature, then make sure that there are no water leaks and that the regulator warms up quickly.
- Each time the cooling system is drained, it is necessary to restore the coolant level to the recommended OEM specifications, taking care to eliminate possible airlocks that could prevent heating of the pressure regulator.

When connecting the regulator's fuel outlet to the proportioner, take care not to create sharp bends or tight curves in the connecting hose.

4.4.1.1 Connecting the regulator-vaporizer to the cooling system

- By using the clamps supplied, secure the heater hoses to the water fittings of the regulator as in Fig. 4.1.

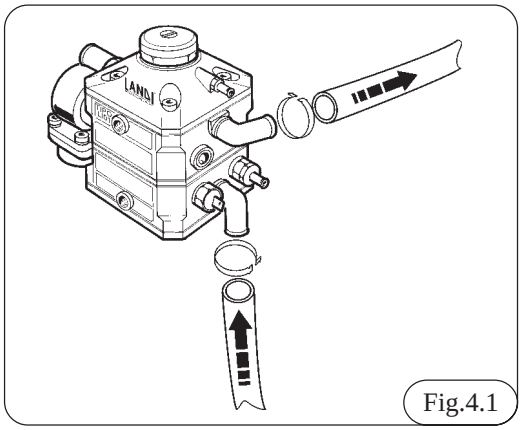

Fig.4.1

4.4.2 Proportioner

To install the proportioner the following procedure is to be observed:

- Install the proportioner in the engine compartment in the position indicated in the appropriate "vehicle file." Mount the unit on the vehicle body by means of the provided fitting set.
- Do not install the proportioner in the area of the cockpit ventilation system.
- Mount the proportioner in such a way as to allow easy access for adjustment and maintenance, as well as for the connection of the pressure tester.
- Make sure that the proportioner's drain plug is not positioned on top of the ignition distributor, or coil(s).
- Install away from the exhaust system.
- Install the proportioner with the stepper motors positioned as in Fig. 4.2.
- This unit can be connected to the engine's cooling system. Follow the instructions in the "vehicle file."

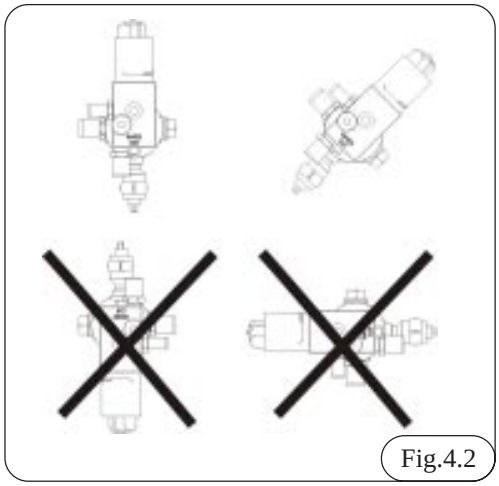

Fig.4.2

4.4.3 Distributor

To install the distributor the following procedure is to be observed:

- Install the distributor in the engine compartment in the position described in the "vehicle file", and mount it solidly to the engine using the supplied fitting set. This unit is not affected by the engine's vibrations.
- The distributor has two fuel inlets to facilitate its connection to the proportioner. After one of the two fuel inlets has been selected, seal the unused inlet with the plug provided, as indicated in the "vehicle file".
- A 120-degree (A) fitting (Fig 4.3) is supplied with the kit. This fitting can be installed either in the fuel inlet of the distributor or in the fuel outlet of the proportioner to facilitate the connection in special circumstances. Information on the circumstances for the use of this fitting is indicated in the "vehicle file". Once the fitting has been mounted, it is no longer usable for other applications.

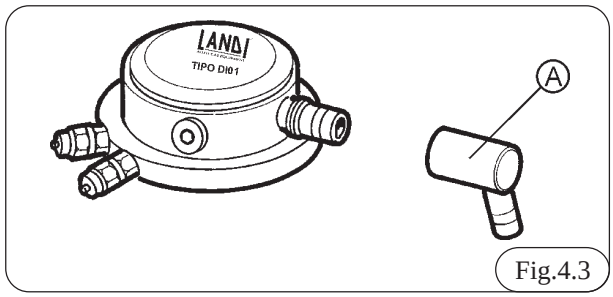

Fig.4.3

4.4.4 Injectors

The correct installation of the injectors is very important for good engine operation. These devices can be installed directly on the intake manifold of the engine, or by removing the manifold first. Carefully follow the instructions supplied in the "vehicle file", and observe the following:

- Carefully select the position of the injectors on the intake manifold.
- Maintain the same distance (X) on all the conduits of the manifold (See Fig. 4.4).
- The position of the injectors cannot exceed +/- 5 degrees tolerance from the vertical of the intake manifold drilling point (See Fig. 4.5)
- Do not alter the internal diameter of the injectors under any circumstances.
- Lock the units in place by using thread sealant.

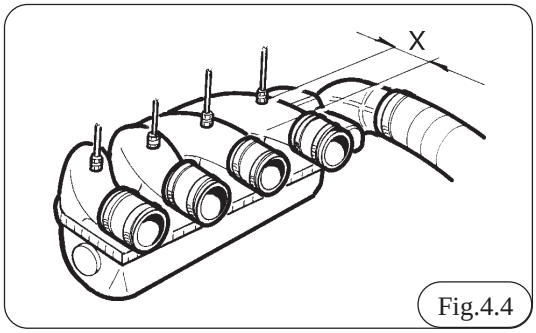

Fig.4.4

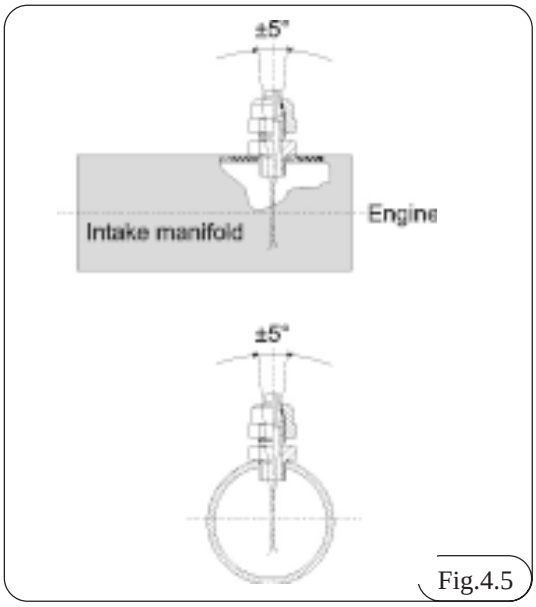

Fig.4.5

4.4.4.1 Procedure to install the injectors by disassembling the engine's intake manifold

1) Disassemble the intake manifold, taking care not to damage the gasket. Carefully take note of connection and assembly of all components installed on the manifold.
2) By following the indications in the "vehicle file", establish the location on the manifold where the holes to install the injectors are to be drilled. Mark the drilling points.
3) Before drilling, punch the exact locations where the holes for the injector jets will be created.
4) Apply grease on the drill bit in order to prevent the spreading of shavings, then drill by using a 7-mm bit if the intake manifold is made of aluminum alloy. Use a 6.75-mm drill bit if the intake manifold is made of plastic. During drilling it is important that the drill bit is maintained perpendicular to the surface to be drilled.
5) Thread with M 8x1 tap.
6) Carefully clean the intake manifold and remove any shavings that result from the drilling.
7) Screw in the injector fittings by using thread sealant. Pay attention not to damage the threads while tightening the fittings.
8) Reassemble the intake manifold, and use new manifold gaskets if necessary. Remount all components previously removed during the disassembly operation.

4.4.4.2 Procedure to install the injector jets without disassembling the engine's intake manifold

1) By following the indications in the "vehicle file", establish the location on the manifold where the holes to install the injector jets are to be drilled. Mark the drilling points.
2) Before drilling, punch the exact locations where the holes for the injector jets will be created.
3) While drilling, extract the drill bit several times in order to remove shavings, and apply grease each time after cleaning. During the breakthrough phase of the drilling operation, pay particular attention to prevent the drill bit from carrying shavings inside the intake manifold. Drill by using a 7-mm bit if the intake manifold is made of aluminum alloy. Use a 6.75-mm drill bit if the intake manifold is made of plastic. During drilling, it is important that the drill bit is maintained perpendicular to the surface to be drilled.
4) Thread with M 8x1 tap.
5) Screw in the injector fittings by using thread sealant. Be careful not to damage the threads while tightening the fittings.

4.4.5 Gaseous LPG connection hoses and MAP connection

Fig 4.6

A) Hose between regulator-vaporizer and proportioner
B) Hose between proportioner and distributor
C) Tube between distributor and injectors
D) MAP hose between ECU, regulator-vaporizer, and intake manifold
E) Venting tube from safety relief valve's fitting to the outside of the engine compartment

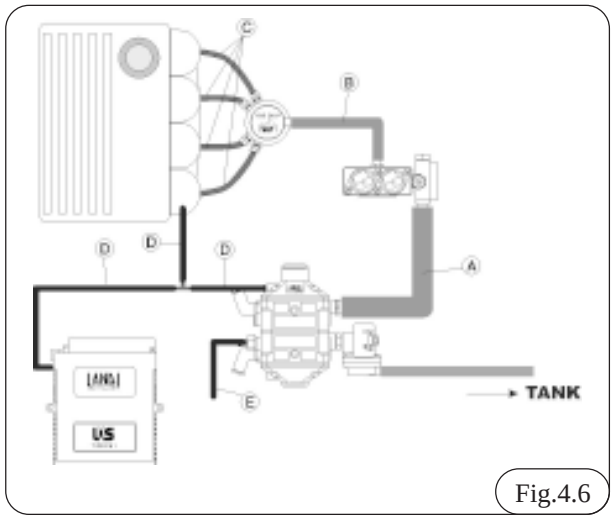

Fig.4.6

4.4.5.1 Hose between regulator-vaporizer and proportioner (diameters: I.D. 14mm; O.D. 22mm)

- The length must be the one indicated by the "vehicle file"
- Make sure that the inner part of the hose is clean.
- When routing the hose, avoid paths that require sharp bending which can deform the tube and reduce the flow.
- Once the hose is connected, secure it with the clamps provided.

4.4.5.2 Hose between proportioner and distributor (diameters: I.D. 10mm; O.D 18mm)

- The length must be the one indicated by the "vehicle file."
- Make sure that the inside of the hose is clean.

- When routing the hose, avoid paths that require sharp bending which can deform the tube and reduce the flow.
- Once the hose is connected, secure it with the clamps provided

4.4.5.3 Tube between distributor and injector jets (diameters: I.D. 4mm; O.D. 6mm)

- The length must be the one indicated by the "vehicle file."
- The tubes must all be of the same length.
- After cutting the tubes, remove shavings and burrs from the ends and make sure that the inside is clean.
- Route the tubing in such a way as to avoid sharp bends.
- Once the tubes are connected, secure them with the clamps provided (Fig.4.7).

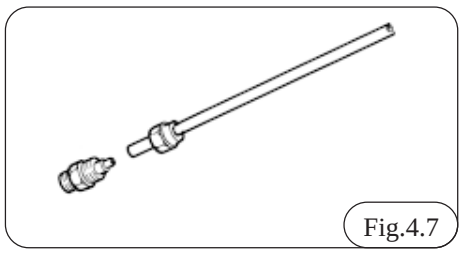

Fig.4.7

4.4.5.4 MAP hose (diameters: I.D. 5mm; O.D. 10.5mm)

- The routing of the hose and the length of each segment must be as specified in the "vehicle file."
- Utilize the connecting "Tee" provided; avoid routing such as to sharply bend the hose.
- Once the hose is connected, secure it with the clamps provided.

4.4.5.5 Venting tube from safety relief valve (diameters: I.D. 5mm; O.D. 10.5mm)

Connect to the safety relief valve an adequate tube length in order to pipe the possible discharge of the safety relief valve to the outside of the engine compartment. The outlet of the piping must be in a ventilated area away from heat sources and electrical devices.

Also, the outlet of the piping must point towards the road, and be free from impingement.

4.4.6 Installation of the LIS ECU

- Fill in the label on the ECU unit. The label carries the vehicle's make and model, to which the ECU's software is referred.
- Position the ECU away from heat sources such as exhaust manifold, radiator, etc., and protect against water infiltration.
- Mount the ECU on the vehicle's body inside the engine compartment in such a way as to allow easy access to connect and disconnect the harness' connector, following the instructions in the "vehicle file".

4.4.7 Installation of the switch

- Install the switch on the vehicle's dashboard in one of the following ways:
- Mount the switch in a non-utilized cavity of the dashboard.
- Mount the switch in the dashboard after cutting a rectangular hole of appropriate dimensions (about 25x38mm) with the special cutting tool.
- Set the switch externally to the dashboard by using the bracket provided.

4.4.8 Installation of injector's simulator

- The "vehicle file" indicates if and which type of simulator must be utilized. To install, follow the specific instructions enclosed with the product.

4.4.9 Electrical connections

Part of the electrical connection is achieved through pre-assembled harnesses and connectors. The electrical connections must:

- Follow the wiring diagram of the "vehicle file."
- Be kept away from heat sources such as exhaust manifolds, radiator etc.
- Be kept away from moving parts such as fans, belts, etc.
- Be kept away from high tension wires such as spark plug wires.
- Follow the routing of the original vehicle wiring and secure the LIS wiring by means of straps when necessary. In this way the installation is protected from accidental tearing during engine service.
- Solder each connection and seal it with heat-shrink tubing.
- To find the +12V power source for the LIS, see the wiring diagram of the "vehicle file."
- Connect the ground wires to a reliable ground.

In the proportioner unit, the idle/low power stepper motor is marked in red; make sure that only the harness connector marked in the same way is connected to it.

Legenda:

A) ECU
B) Proportioner with cut-off electrovalve
C) Switch
D) Harness
E) Connector for programming & diagnosis unit
F) Connector for pressure tester
G) Pressure diagnosis device
H) Throttle Position Sensor
I) Simulator
L) Lambda sensor (oxygen sensor)
M) Ignition coil
N) Battery
O) Regulator-vaporizer
P) Electrovalve
Q) Fuel level sensor
R) Temperature sensor

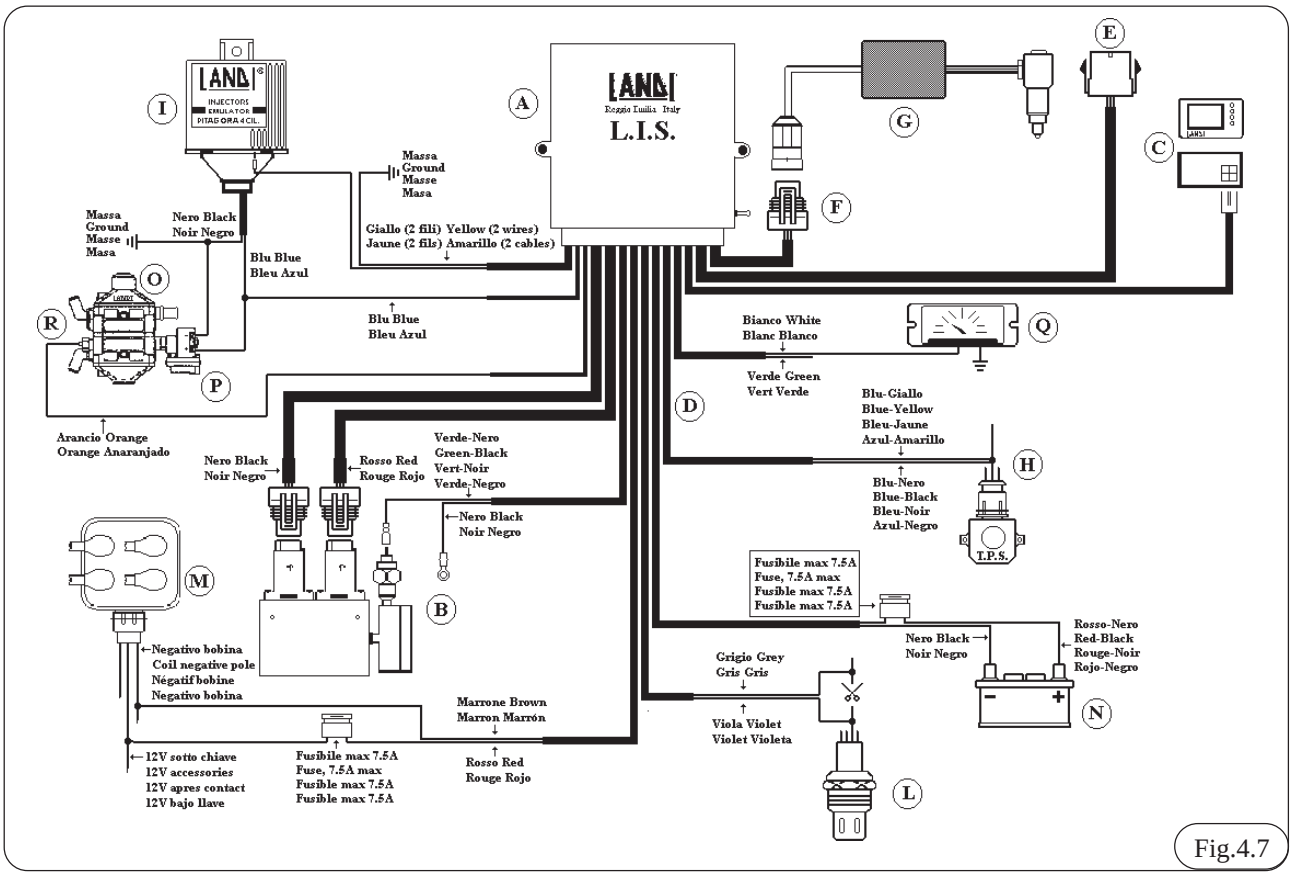

Fig.4.7

4.4.10 Installation of LPG tank and tubing for liquid LPG

The installation of these components is not different from the installation of a conventional aspirated system using the Venturi mixer.

4.4.10.1 LPG tank - General information

The installation of the LPG tank must comply with the following criteria. For more detailed information on regulations, check local regulations.

5. Programming of the electronic control unit (ECU)

The LIS computer software program enables Landi installers to interact with the LIS injection system. Normaly it is possible to program the ECUs with "vehicle files" from the archive, to maintain a customer archive, and to view and modify some of the parameters used by the ECU.

The program can be used without the need for in-depth knowledge of the operation of a personal computer, except the course for the basics of the Windows interface.

The program works with the following operating systems: Windows95, and Windows98.

Minimum PC requirements: 486 processor, 8 Mb RAM, SVGA 800x600, 256 colour video card, CD ROM drive or internet connection, at least 10 Mb available on the hard disk. The space taken on the hard drive is a function of the number of "vehicle files" in the archive. Each "vehicle file" occupies 600 Kb of hard disk space. For the best performance, we recommend a Pentium 133 processor or better, 16 Mb RAM.

5.1 How to begin

The installation the LIS software program required the execution the file "setup.exe" that is in the "setupLIS" file of the Landi CD, as follows:

1) Select Start ⟹ Run.
2) Type D:\setup.exe (where the "D" indicates the CD ROM drive; on your computer the drive may be identified by another letter).
3) The installation is totally automatic and it allows the user to view its progress. The only input required is the selection of the directory in which the program must be installed. If nothing is specified, then the default directory is <PROGRAM FILES>\Landi\LIS Installer, where <PROGRAM FILES> is the program's files as in Fig. 5.1.

Fig.5.1

Once the installation is completed, start the program by double clicking on the "LISLandi" icon on the desktop, or click on Start ⟹ Programs ⟹Landi ⟹ LIS Injection System.

4) Before using the LIS software, make sure that ACROBAT READER 4.0 or higher version is installed. This is necessary in order to read the "vehicle files". A copy of this software is in the Landi CD ROM.
5) To install ACROBAT READER, proceed as follows:
6) Select Start ⟹ Run
7) Type D:\ar405eng.exe (where the "D" indicates the CD ROM drive; on your computer the drive may be identified by another letter).
   This starts an automatic installation procedure to install Acrobat Reader on your computer.

The Landi installation program installs the LIS software only. To program the ECU, the mapping file for the vehicle to be converted must be in the archive. To update the archive, follow the procedure described in 6.9.1.

Fig.5.2

5.2 Select language

The first time the program is started, the screen as in Fig. 5.2 is displayed. You must select the desired language clicking on the flag. Next time when you start again the programm, the first screen will be similar to the one shown in Fig.5.3, because the language selected before is store.

The language selection can be achieved also in the window in Fig. 5.3, by right-clicking the mouse, a brief menu appear, containing the same language selection options as the window in Fig. 5.2.

5.3 Main screen

Each time the program is started, the main screen is displayed. The main screen is similar to the one shown in Fig. 5.3 below.

The main headings are:

1. ICON Main Menu
2. ICON Function Buttons
3. ICON Status Bar

5.3.1 Main menu

The main menu contains all the commands and set-ups of the programs. Particularly:

FILE menu: contains SELECT THE LANGUAGE command that allow to change the language (Fig.5.2) and EXIT command that allows the termination of the software LIS program.

ECU menu: includes the CONNECT and DISCONNECT commands to connect and disconnect respectively the personal computer from the ECU. This menu also contains the SERIAL PORT command that allows the selection of the port to be used for the connection.

GO TO... menu: includes the INSTALLATION, ECU MANAGEMENT, CAR ARCHIVE and CUSTOMER ARCHIVE that allows to execute the program function (as described in 5.3.3 paragraph)

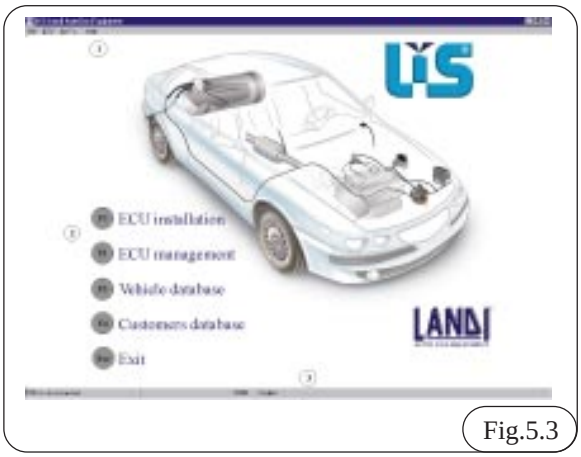

Fig.5.3

HELP menu: contains the ON-LINE HELP, and ABOUT a window with the program's identification data and copyright information.

5.3.2 Status bar

The bar is in the lower part of the window, and contains information on the program's status. It is divided into four fields. From left to right:

- The ECU connection
- If the ECU is connected, the file name stored in the ECU.
- The communication port
- The selected language

The status bar cannot be modified directly.

5.3.3 Function buttons

The buttons on the left of the screen are for the execution of the program's functions. They can be called up either with the mouse, or with the keyboard's function key described in the button.

The functions are:

- F1 INSTALLATION: This starts a guided procedure that allows the user to program a new ECU, and to record the customer's data in a computer archive.

- F2 ECU MANAGEMENT: A sub-menu is activated. This sub-menu contains all the commands pertinent to the management of the ECU, from the display of certain parameters to the modification of other parameters.

- F3 VEHICLES ARCHIVE: allows access to the vehicles archive in the computer.

- F4 CUSTOMER ARCHIVE: allows access to the customer archive in the computer.

- ESC: terminates the program.

5.4 LIS software configuration

When using the LIS program for the first time, it is necessary to configure certain parameters required for the correct operation of the program.

These parameters are:

Serial communication port through which communication is achieved with the ECU.

Connection for internet interface (ONLY if an internet connection is available).

The first set-up can be performed directly from within the LIS program:

1) Select the ECU menu either with the mouse, or by pressing ALT-C.
2) Select the Serial Port command with the mouse, or by pressing ALT-P. A submenu appears, where it is possible to select COM1, or COM2. The default selection is COM1, since this is the one available on all laptops, which are provided with just one serial port in the first place. If the use of the second serial port is desired, option COM2 must be chosen.

To choose the internet connection, proceed as follows:

3) Choose SETTINGS ⇒ CONTROL PANEL ⇒INTERNET in the start-up menu of Windows.
4) Choose the CONNECTION screen. Enable CONNECT TO THE INTERNET USING A MODEM if necessary. Next to it, a check-mark will appear. In the square UTILIZE REMOTE ACCESS CONNECTION, choose the connection that is normally utilized to connect to your internet Provider. Confirm by pressing OK. PLEASE NOTE: if this set-up pre-exists, nothing is to be done.

These settings, as well as the size of the dialogue windows, are kept in memory after the computer has been turned off. Each time the program is started, the last saved data will be called up. The data are:

- Serial port to communicate with the ECU
- Language
- Position and dimension of the main dialogue window

5.5 Programming the ECU

To perform a new installation, it is necessary to:

- Program the ECU with the program for the specific

vehicle to be converted
- Record the customer data in the CUSTOMERS archive.

1) The automatic installation procedure guides the operator through the following simple but important steps:
   First, a window appears in the VEHICLE archive (Fig. 5.4).
   From this window it is possible:
   1. To program the ECU with the programming selected in the vehicle archive

Fig.5.4

   2. To consult the general installation instructions
   3. To consult the specific instructions for the conversion in progress
   4. To register the customer data, once the programming of the ECU has taken place.
2) Once the vehicle model has been chosen, click on GENERAL INSTRUCTIONS (or ALT-G) in order to see the general installation instructions.
   The specific instruction file is accessible by clicking on VEHICLE-SPECIFIC INSTRUCTIONS (or ALT-V). Please note: these buttons are enabled only if the data files for the vehicle to be converted are available.
3) **Before proceeding with the ECU programming, remove the ECU's fuse on the power supply cable, for just a few seconds.** This sets the ECU in programming reception mode.
4) The programming operation is started by clicking on the PROGRAM ECU button (ALT-P). Notice that this button is enabled only if car model has been previously selected from the vehicle archive.
5) During the programming operation a small communication window appears, to indicate the progress of the programming. At the end of the programming, if all data have been uploaded properly, the message OPERATION SUCCESSFUL appears. In case of error, the computer displays the message, and provides the opportunity to attempt uploading again. In addition to the data pertinent to the fuel mapping strategy, data pertinent to the fuel deceleration switch-over and Landi fuel level sensor are uploaded.
6) Once the uploading is complete, the second phase is initiated. The PC connects to the ECU, and, for future reference, acquires from it the specific identification data pertinent to the ECU's characteristics. After this operation is complete the computer displays the CUSTOMER ARCHIVE window, so that the operator can enter the customer data. This is an important operation and requires attention, since the data entered, combined with the ECU data, make up the CUSTOMER FILE, which makes the data pertinent to that specific installation available for the installer.
7) To terminate this operation sequence, it is necessary to click on the EXIT button (ALT-E). Please note: the computer accepts this command only if all the key data have been entered. In the case of missing data, the computer warns the operator.
8) The installation procedure terminates with the ECU connected to the computer. This can be confirmed by looking at the status bar in the main window. It must display the CONNECTION WITH ECU ESTABLISHED verbiage, and the file name stored in the ECU.

5.5.1 ECU management

The ECU Management button F2 allows the user to enter into a sub-menu containing the following items:
- Display and Verifications (F1)
- Operational Diagnosis (F2)
- Parameter Modification (F3)
- Main Menu (ESC)

All the operations of this menu are possible only if the ECU is CONNECTED and powered up. If the user has performed the LIS installation the ECU is ready. Otherwise, it is necessary to choose the command CONNECT in the ECU menu of the main screen display before entering this page.

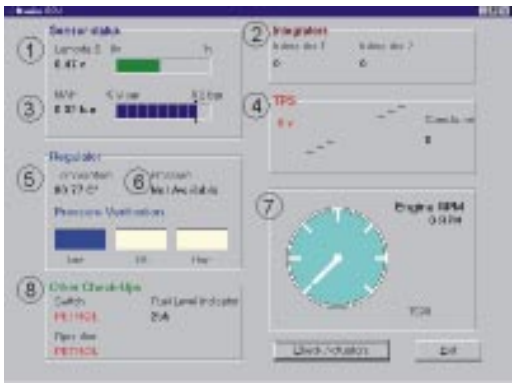

Fig.5.5

5.5.2 Display and verification

This command makes it possible to see all the significant signals used by the ECU in a single screen display (see Fig. 5.5).

The two buttons at the lower right-hand of the screen allow the user to go, respectively, to the CHECK ACTUATORS (ALT-C) or back to the ECU MANAGEMENT (ALT-E) menu.

Following is a short description of the information displayed:

1 LAMBDA: This is the value, expressed in volts, that is output by the Lambda sensor. If the background is green, this means that the ECU interprets the input value as a "lean" signal, thus the ECU increases the flow of fuel. The red background indicates that the ECU interprets the input value as a "rich" signal, thus the flow of fuel is decreased.

2 INTEGRATOR: This value, expressed in steps, is algebraically summed to the value stored in the map in order to correct the carburetion. The value of the corrector is calculated by processing the Lambda sensor signal in real time.

3 MAP: This is the value, expressed in bar, of the pressure sensor inside the ECU. This sensor measures the absolute pressure inside the intake manifold, which in turn indicates engine load.

4 TPS: This is the value, expressed in volts, of the throttle position sensor. When the display turns red, it indicates that the TPS is in idle position.

5 REGULATOR TEMPERATURE: Celsius degree value of the temperature of the regulator-vaporizer.

6 REGULATOR PRESSURE: This value, expressed in bar, indicates the system's operating pressure. This value is available only if the pressure measuring device is connected. The pressure verification bar indicates whether the pressure is high, low, or correct.

7 ENGINE RPM: Indicates the actual engine RPM.

8 OTHER CHECK-UPS: Indicates the fuel level and the type of fuel used (LPG or petrol).

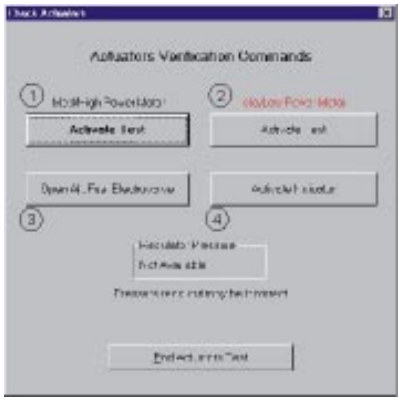

Fig.5.6

5.5.3 Actuators verification

The actuators verification screen (Fig. 5.6) works only when the ECU is connected to the Personal Computer. Specifically, the engine is to be OFF with the KEY TURNED TO THE ON POSITION.

In this screen, four buttons are displayed; the buttons allow the activation or deactivation of as many TESTS:

1 Idle Stepper Motor Sequence: The idle/low power stepper motor performs an open/closed sequence.
2 Power Stepper Motor Sequence: The medium/high power stepper motor performs an open/closed sequence.
3 Fuel Indicator Sequence: The switch/fuel level indicator performs a sequence during which all the LEDs are lit, thus verifiying their correct operation.
4 Open/closed LPG Electovalve Sequence: At each pushing of the button, the LPG electrovalve switches from OPEN to CLOSED, and vice-versa.

To access this screen, the program must have established a link with the ECU. Moreover, it is necessary to turn the ignition key OFF, then key ON engine OFF again after a few seconds. In this way, it is possible to access the "Actuator Verification" screen. To exit the "Actuator Verification" screen, it is necessary to turn the ignition key off.

5.5.3.1 How to verify the operation of the actuators

To verify for the correct operation of the actuators, proceed as follows:

1 Disassemble the actuator(s), being careful not to damage the O-Rings.
2 Start the test of the pertinent actuator by clicking on the ACTIVATE TEST button. This test drives the actuator to perform a sequence of alternate motions for the duration of one minute. The sequence can be interrupted by clicking on the same button that has started it.
3 Once the testing is complete, turn the ignition key off and reassemble the actuator(s), being careful to correctly position the O-Rings.

Please Note: the correct positioning of the O-RIngs is of special importance. If the O-Rings are not correctly positioned, fuel will leak from the actuators' seats.

5.5.3.2 How to verify for the correct operation of the LPG electrovalve

To verify for the correct operation of the LPG electrovalve, it is necessary to connect the pressure measuring device to the pressure regulator. Then, by clicking on the OPEN ALT. FUEL ELECTROVALVE, the electrovalve is opened, the fuel reaches the regulator-vaporizer, and from there the fuel reaches the proportioner. Since the "cut-off" electrovalve is not energized, the fuel is not allowed to reach the distributor. In the area marked REGULATOR PRESSURE in Fig. 5.6, a pressure value between 0.6 and

0.95 bar is displayed, indicating the correct operation of the electrovalve.

5.6 Operation diagnoses

The operation diagnoses screen (Fig 5.7) allows the operator to see possible component and system malfunctions that can occur during alternative fuel operations.

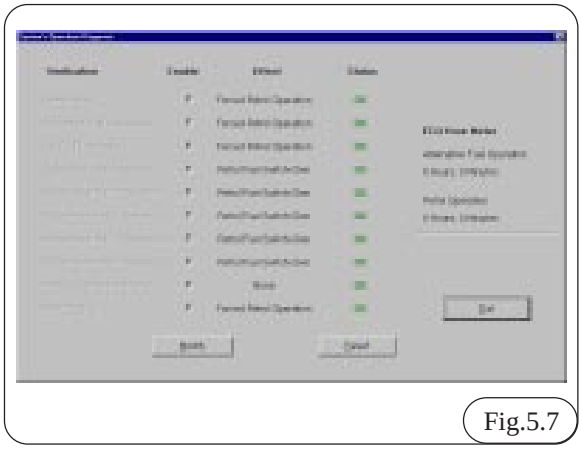

Fig.5.7

The malfunctions that can be shown are:

Safety Relay: this device is engaged if there is power to the LPG electrovalves as well as the cut-off electrovalve, notwithstanding that the ignition key is turned off.

LPG Electrovalve: short-circuit or power interruption on LPG electrovalve.

Cut-off Electrovalve: short-circuit or power interruption on LPG electrovalve.

Excessively low temperature: after the switch-over to LPG, the regulator-vaporizer's temperature has become excessively cold.

Mixture too rich for Integrator 1: stepper motor 1 has stayed at its minimum cross-section for too long.

Mixture too lean for Integrator 1: stepper motor 1 has stayed at its maximum cross-section for too long.

Mixture too rich for Integrator 2: stepper motor 2 has stayed at its minimum cross-section for too long.

Mixture too lean for Integrator 2: stepper motor 2 has stayed at its maximum cross-section for too long.

Lambda Sensor Inoperative: the sensor has reduced its efficiency beneath an acceptable level, or the electrical circuit is interrupted.

MAP troubles: malfunctioning or disconnected sensor.

See Fig. 5.7. The following is displayed beside each check-up point: an enabling box, an "effect" column, and the current status of the checkup.

The enabling box shows the activation of the selected check-up if a check-mark is shown. The inactive enabling boxes (in grey), indicate that those check-ups cannot be either enabled or disabled by the operator. Conversely, the active enabling boxes allow activation or deactivation of the pertinent check-up simply by clicking on the box.

Each check-up corresponds to a certain strategy that the ECU performs when the malfunction occurs. The strategy cannot be modified, but it can be viewed in the EFFECT column.

The possible effects are:

No Effect: when the malfunction occurs, the ECU only signals the error for as long as the engine is on, in the following manner:
- the red L.E.D. flashes slowly.

Petrol Fuel change-over: when the malfunction occurs, the ECU only signals the error for as long as the engine is on, in the following manner:
- the red L.E.D. flashes slowly
- the green L.E.D.s bar of the switch is turned off
- the system switches to petrol mode

Forced Petrol Operation: the ECU defaults to petrol operation, while indicating malfunction by slowly flashing the red L.E.D. and turning off the green L.E.D.s bar for as long as the problem is not corrected.

Finally, the check-up status is displayed in the STATUS column with one of the following displays:

OK: no error

ERROR: the check-up indicates an error and the ECU has behaved as displayed in the EFFECT column.

Only the check-ups that are enabled (check-mark in the enabling box) can display an error. To reset the status of the checkups, click on the RESET button. This button is at the bottom of the STATUS column. The MODIFY button makes it possible for the operator to send a new configuration of enabled controls to the ECU.

In the diagnosis screen it is possible to see the hours of operation during both LPG and petrol mode, expressed in hours and minutes.

5.7 ECU parameter modifications

The screen ECU PARAMETER CHANGES (Fig 5.8) allows the operator to modify the data in the ECU. To this purpose, it is necessary to click on the MODIFY button. Click on the EXIT button to go back to the ECU MANAGEMENT menu.

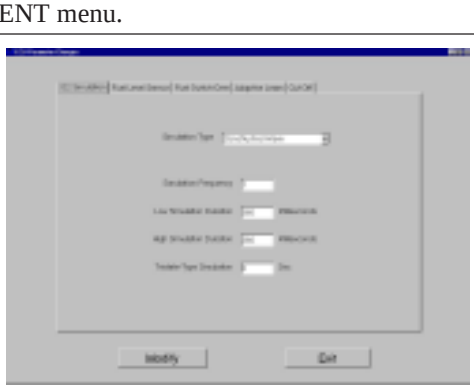

Fig.5.8

The data that can be modified are arranged in four screens, which can be viewed by clicking the mouse on the appropriate tab or by pressing the keys F1, F2, F3, F4 and F5.

The screens containing modifiable data are:
- **Simulation**: contains the necessary data to completely configure the type of Lambda sensor simulation.
- **Fuel Level Sensor**: contains the necessary data to set up the fuel level sensor.
- **Fuel Switch-Over**: contains the parameters that establish the necessary condition for the ECU to perform the petrol to LPG switch-over.
- **Adaptive Learn:** contains the parameters for the Adaptive Learn strategy.
- **CutOff:** contains the parameters and datas to select the gas cutoff during the deceleration.

Each data field only allows a certain value range to be entered. This range changes from data field to data field. In case of input error:
- the computer warns the operator.
- the computer shows the range of acceptable values.

5.7.1 Simulation

In this screen it is possible to enter the parameters pertinent to the type of Lambda sensor signal simulation that is going to be fed to the OEM petrol ECU during LPG operation. This signal pattern must mimic the one that the Lambda sensor inputs in the ECU during petrol operation. The appropriate simulation is available in the data file, which is uploaded in the ECU during the programming phase. **Therefore do not modify the Lambda sensor signal simulation unless directly advised to do so by the LANDI technical support centre.**

SIMULATION TYPES:

1) O2-disconnected Simulation: simulates a disconnected lambda sensor for the OEM petrol computer. When sensing a disconnected lambda sensor, some older OEM computers are programmed to ignore the input and proceed according to a pre-programmed mode.

2) Ground Simulation: sends a constantly “lean” signal to the OEM computer. This simulation works for MONO-BOSCH systems and other new vehicles.

3) Constructed Wave: sends to the OEM computer a simulation constructed with the following parameters:

- **Frequency:** number of waves sent to the OEM computer after simulating disconnection of the lambda sensor.

- **High Simulation Duration:** time during which the signal simulates rich mixture.

- **Low Simulation Duration:** time during which the signal simulates lean mixture.

- **O2-disconnected Duration:** time elapsed between two pulsation sequences.

5.7.2 Fuel Level Sensor

This screen allows the set-up of the type of LPG level sensor that has been installed. The default set-up is the one for the Landi Sensor.

By clicking on the option NOT STANDARD or NOT STANDARD - INVERTED it is possible to customize the set-up for the type of LPG level sensor that has been installed.

5.7.3 Fuel switch-over

This screen allows the set-up of the parameters for the petrol to LPG switch-over. The appropriate parameter values for the specific vehicle are already entered in the ECU at the time of the program upload. In most cases the fuel switch-over is programmed to occur during deceleration.

5.7.4 Adaptive Learn

The adaptive learn screen (Fig 5.9) makes possible to:

- set-up some parameters for mapping modification;
- enable or disable Adaptive Learn;
- modify the degree of enrichment;
- verify the changes performed by the Adaptive Learn.

Fig.5.9

A) MAXIMUM NUMBER OF CORRECTIVE STEPS: This is the maximum number of steps that both the installer and the Adaptive Learn System can perform; this is the maximum value that can be entered in the area CORRECTIVE STEPS PERFORMED (B).

B) CORRECTIVE STEPS PERFORMED: these cells show the steps that the LIS strategy (“Automatic” line) and the installer (“Installer” line) sum to the number of steps programmed in the map.

C) AVERAGE DRIFT: The value shown in this cell is an average of the drift of the integrator. This average is calculated during alternative fuel operation. If the abbreviation NDA is shown, this means that the engine has not worked in this specific range for a sufficient time.

D) ENRICHMENT RANGE: this parameter allows modification of the fuel enrichment during acceleration, and it can be modified by +/- 5 steps

maximum.

E) IDLE ENRICHMENT: this parameter allows modification of the fuel enrichment during idle condition, and it can be modified by +/- 20 steps maximum.

F) DISABLE/ENABLE ADAPTIVE LEARN: This button is used to activate or deactivate the ADAPTIVE LEARN STRATEGY.

G) RESET MODIFICATIONS: This button zeros all the modifications that have been entered; that is, it deletes both the changes performed by the Adaptive Learn and the manual corrections performed as in (B).

H) ENTER CHANGES: It transmits all the entries of the Adaptive Learn screen to the ECU.

5.7.4.1 Operational principles

During its operation, the LIS calculates a correction factor to the mapped strategy by processing the signal from the Lambda sensor. This is then actuated by the actuators.

This correction factor is called INTEGRATOR (paragraph 6.5.2). The LIS performs the above-mentioned operation to adapt itself to the vehicle's characteristics, i.e. mileage, spark plug conditions, air filter, fuel chemical composition, etc.

The LIS ECU calculates an average of the applied correction factor (INTEGRATOR), subdivided by RPM range. This is displayed in the screen ADAPTIVE LEARN at the item AVERAGE DRIFT (C). See Fig. 5.9.

5.7.4.2 Automatic correction

The value AVERAGE DRIFT (C), see Fig. 5.9, is used by the automatic Adaptive Learn to set up a correction factor that can be seen in the cell CORRECTIVE STEPS PERFORMED, at the AUTOMATIC line (B). The value in the CORRECTIVE STEPS PERFORMED cell is algebraically summed to the value programmed in the map.

5.7.4.3 Manual correction

The values in the AVERAGE DRIFT cells show by how much the carburetion must be further corrected, in the event that the corrections performed by the automatic Adaptive Learn are not sufficient. To this end, it is possible to enter the value of the AVERAGE DRIFT cells in the cell CORRECTIVE STEPS PERFORMED, INSTALLER line, in the appropriate RPM range.

Example:

If a condition similar to the one in Fig. 5.10 occurs, the AVERAGE DRIFT **(1)** value of the first range may be inserted in the cell CORRECTIVE STEPS PERFORMED, at the INSTALLER line **(2)**; the same operation can be performed for the 1,300 and 3,000 RPM range.

For the 3,000-5,300 RPM range, the Adaptive Learn has already performed -2 corrective steps **(3)**, since the AVERAGE DRIFT **(4)** has exceeded the value of cell MAXIMUM MODIFICATION STEPS PERFORMED, at the AUTOMATIC **(5)** line. The possible manual correction is to enter the value of -15 steps AVERAGE DRIFT **(4)** in the cell **(6)** CORRECTIVE STEPS PERFORMED.

The above description is just an example: the values and the set-ups are solely to illustrate the procedure to be followed in order to perform corrections.

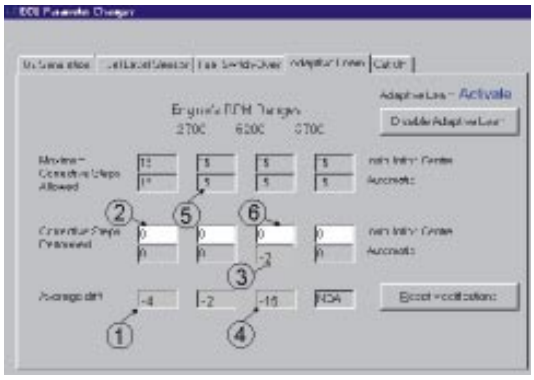

Fig.5.10

5.7.5 CutOff

In this section, Fig.5.11 it is possible to choose the type of cutoff and set the correct parameters to close the gas during deceleration.

TYPE OF CUTOFF:

Fig. 5.11

TOTAL: Selecting this parameter, the system work on cutoff valve and close completely the passage of gas until the number of RPM set on the cell "TOTAL CUTOFF END".

It is also possible to set in the apposite cell the "CUTOFF ENGAGEMENT DELAY".

PARTIAL: Selecting this parameter, the system work on steps motors and close partial the passage of gas until the number of RPM set on the cell "PARTIAL CUTOFF END". It is possible to choose on the apposite cell the per cent "STEPPER-MOTOR OPENING IN PARTIAL CUTOFF".

It is also possible to set in the apposite cell the "CUTOFF ENGAGEMENT DELAY".

TOTAL + PARTIAL: Selecting this parameter, both preceding cutoff are enable. During the decelleration, fist work the TOTAL cutoff while subsequently work the PARTIAL cutoff.

NONE: Selecting this parameter, all type of cutoff are disabled.

5.8 Vehicle Files archive

The “vehicle files” archive consists of ECU-downloadable programs and of instruction files. Each vehicle model has its own specific program, to be downloaded into the LIS ECU. The instruction files include a general section applicable to all installations with the LIS, and a specific section pertinent only to the vehicle to be converted.

The VEHICLES archive is visible on the left side of the screen and it is hierarchically organized on a 3-level tree. This means that in order to access a particular car model it is necessary to move within the tree and choose the correct branch among those available.

The first selection (first level) consists of a choice between an LPG and a NATURAL GAS system. To expand the desired branch, double-click on the branch then click on “+”; or press ENTER; or press the right arrow key on the keyboard when the branch is selected. To navigate on a different branch use the up and down arrow keys on the keyboard, or click on the new branch.

The second level contains the list of vehicle manufacturers in alphabetical order. Again, it is necessary to expand the branch corresponding to the vehicle manufacturer desired (by using the right arrow key on the keyboard or by pressing ENTER).

The third and last level contains the vehicle models. Here it is not possible to further expand the branch. Instead, select the branch by means of the up and down arrow keys on the keyboard (or with the mouse) in order to display the vehicle models.

If a branch has been expanded by mistake, it is possible to collapse it by pressing the ENTER key; by pressing the left arrow key on the keyboard; by clicking on the “-” sign; or by double -clicking on the branch.

The button UPDATE ARCHIVE allows the user to keep the archive updated. For further information on how to update the archive, see section 5.9.1.

To see the GENERAL INSTRUCTIONS, press the button GENERAL INSTRUCTIONS, or ALT-G.

The specific instructions for the vehicle model (available only after the selection of the specific vehicle from the archive) are displayed with the key VEHICLE-SPECIFIC INSTRUCTIONS (ALT-V).

For further details about the INSTRUCTION FILES window, see section 5.9.

5.9 File consulting

If the user selects the consultation of the general instructions or the specific instructions, an INSTRUCTIONS window appears. The instructions are automatically displayed in the last selected language. If the instructions are not available in the desired language, a window is displayed allowing the selection of those languages in which the instructions are available. The instruction files are in ACROBAT READER format. The instruction window provides all the functions that are necessary to view and print the instruction files (Fig 5.12).

The upper part of the instruction window displays the instrument bar, which has these options:

- Print: to partially or completely print the instruction document.

- Zoom: to enlarge or shrink the current display.

- Arrow Keys: to move from one page to another in the case of a multiple page document.

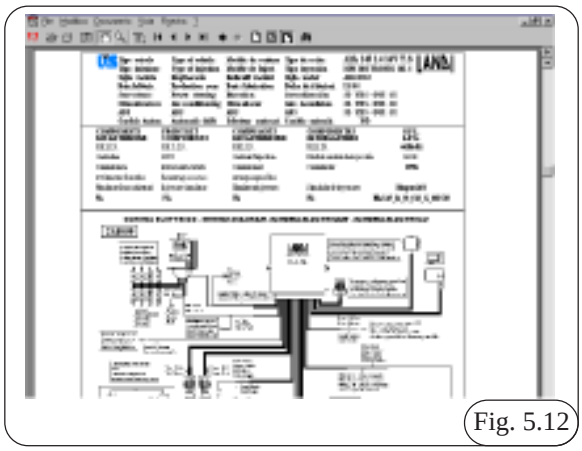

Fig. 5.12

5.9.1 Archive update

Archive updating is totally automatic, and can be performed by the following means (Fig 5.13):

- FLOPPY

- CD ROM

- INTERNET

To update, just click on the appropriate button.

- If FLOPPY is selected, the program prompts the user to load the FLOPPY in the FLOPPY drive-unless the disc is already loaded. With the FLOPPY, that has small capacity, it is possible to do the upgrate of a vehicle limited number.

- If CD ROM is selected, the program prompts the user to load the Landi CD in the CD ROM drive - unless the disc is already loaded. Updating is performed in two phases. In the first phase, new programs are automatically searched; in the second phase, the programs are copied onto the computer’s hard drive. During the second phase, a progress bar is displayed.

- The internet updating procedure is at the moment in development. As soon as it is complete and available, our company will provide all the informations required on how

to perform updating procedures.

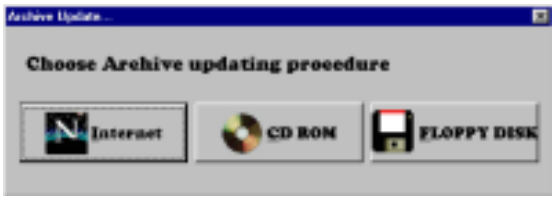

Fig.5.13

5.10 Customer archives

The Landi LIS program can maintain an archive that contains all data concerning the LIS conversions that have been performed. The archive can be used to record both customer data and data concerning the coverted vehicle and the LIS computer.

The customer archive consists of CUSTOMER FILES, each one including the information below:

Customer Section:

- Last Name (must be entered)
- First Name
- Street Address
- City
- Province/State/County
- Telephone

Vehicle Section:

- Vehicle Model
- Engine Displacement
- Vehicle's Production Year
- Program Stored in the ECU
- Version of the Progam Stored in the ECU
- Date of the ECU Programming
- LIS Installation Date
- Regulator-Vaporizer Serial Number (must be entered)
- Vehicle's Plate Number

Each time an LIS installation is performed, the program adds a new file to the archive. This is the only way to add files to the customer archive.

The data of the Customer Archive can only be entered by the operator. The data concerning the Vehicle Data (except vehicle plate number and regulator-vaporizer serial number) are automatically entered by the program. These data CANNOT be changed by the operator, since they identify the LIS computer and its program.

Pivotal data are marked with the word **"obbligatorio"** - thus, a customer file cannot be saved until these data are entered. The rest of the data are optional, and can even be omitted, although this is not recommended.

During the LIS installation phase, the only operation possible is the completion of the file, and exiting of the archive window by clicking on EXIT.

When entering the customer archive by using the F4 key from the Main Screen, it is possible to consult the archive, perform searches, and modify or eliminate customer files. The number of customer files can be seen in the upper left corner.

5.11 Consulting the archive

The customer archive is in alphabetical order, according to the customer's last name. It is possible to consult the archive using the first four buttons on the upper right.

These four buttons give access to:

- the archive's first customer file
- the preceding customer file
- the following customer file
- the last customer file

Fig.5.14

If the desired customer file is the first one of the list, the first two buttons are disabled. Similarly, the third and fourth buttons are disabled when the user is accessing the last customer file.

To quickly access a customer file without scrolling through the archive, the button GO TO can be used. This button permits a search by the customer's last name (or the first letters). The first available file that satisfies the parameters entered will be highlighted (see Fig. 5.15). If there are no customer files that satisfy the parameters entered, the computer makes no selection and displays a message.

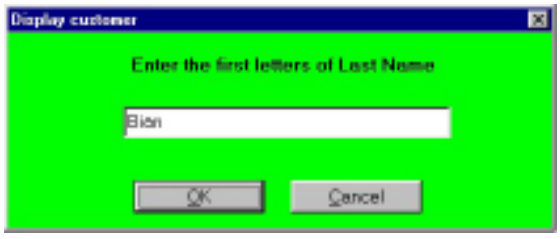

Fig.5.15

5.11.1 Customer search

A useful function of the program is the CUSTOMER SEARCH. This function allows the user to “filter” the archive and display only the files that satisfy the conditions established in the window (see Fig. 5.16). Note that when a search is performed, only part of the archive is displayed. This is indicated by the appearance of the notation SEARCH RESULTS in the upper right corner, as in Fig. 5.17.

These conditions is applicable to all the fields that make up the archive. For example:

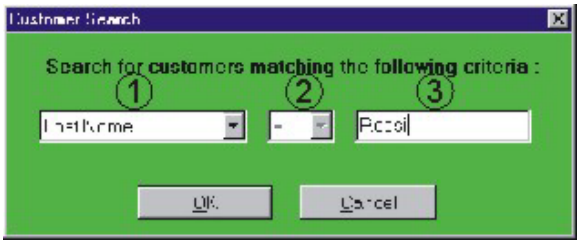

Fig.5.16

- all customers with the ROSSI last name
- all customers with an Alfa Romeo 156 1.8 car
- all customers who have installed the system before 3/3/99

As the above examples illustrate, the search criterion includes three fundamental parts that have to be entered by the operator as in Fig. 5.15:

1 Search field (last name, car model, installation date, etc.)

2 Condition to satisfy (equal to, greater than, smaller than)

3 Value to search (a value pertinent to the entered field)

Note that the “greater than” and “smaller than” conditions (respectively marked with the “>” and “<“ notations) can be applied only to the installation date and to the program creation date fields. This enables the search of files created before or after a certain date.

For other fields, it is only possible to use the “equal to” condition. In this cases, only the initial part of a search value may be entered (eg. ROS will find ROSSI; see Fig. 5.16).

Fig.5.17

Moreover, during a search it is possible to browse the files that have been found with the archive consultation button (See Fig. 5.15).

To end the search and go back to the complete archive, click on the END SEARCH button. Note that if no files satisfy the search criteria, an empty file will be displayed. The only possible action in this case is to press the END SEARCH button before performing another archive operation.

5.11.2 Modifications and deletion of customer Files

To eliminate a customer file, simply highlight the file and press the button DELETE CUSTOMER FILE.

The program requests confirmation before proceeding with the deletion.

To modify the data in a customer file, simply access the cells containing the data and replace with new data. Note that the data that has been automatically entered by the program cannot be changed. To move to the preceding cell, use the ARROW UP key. To go to the following cell, press either the ARROW DOWN key or ENTER key.

As has been explained, dates have to be entered in the valid format.

To confirm the changes, click on the CONFIRM MODIFICATIONS button. If a customer file has been changed by mistake, it is possible to cancel the changes and return to the pre-existing data by clicking on the CANCEL MODIFICATION button. This operation cancels all the changes on the current file. Notice that if these two buttons are enabled, it means that changes have been performed on the current file.

If a change has been performed on a customer file, and the user clicks on either the CONSULT ARCHIVE or the SEARCH buttons, the computer prompts to either save or cancel the changes before executing these commands.

5.12 Program termination

To terminate the program, press the ESC key on the keyboard when in the main screen. If the ECU is connected to the PC, the connection is automatically terminated.

6. Lpg operation parameter verification

After the installation has been completed and the appropriate mechanical and electrical checks have been performed, and after the ECU has been programmed as in sub-heading 6.5, it is possible to proceed with verification for correct system operation while keeping the PC connected to the ECU.

1) Connect the system's working pressure diagnostical device as in Fig. 6.1.

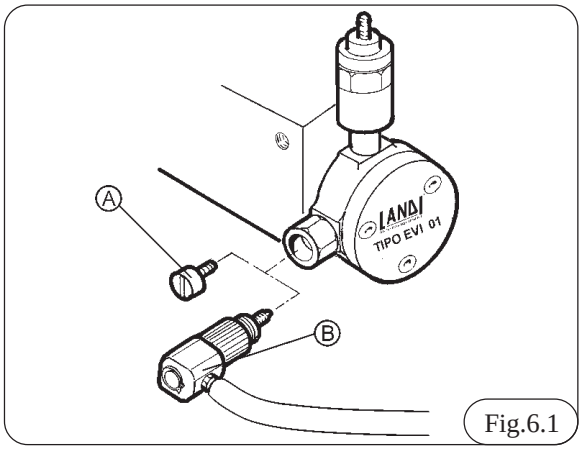

Fig.6.1

2) Undo plug A and screw in the sensor B.
3) Set the fuel switch on the petrol position.
4) Start the engine.
5) Keep the engine running for a few minutes, or until the water temperature reaches 50-60C.
6) Set the fuel switch on LPG position.
7) Make sure that the engine actually operates on LPG by accelerating/decelerating, thus achieving the fuel switch over.
8) With the PC displaying the main menu, press F2. This causes the display of the ECU MANAGEMENT menu, as in Fig. 6.2.
9) Press F1 DISPLAY AND VERIFICATIONS.
10) A window will appear as in Fig. 6.3.

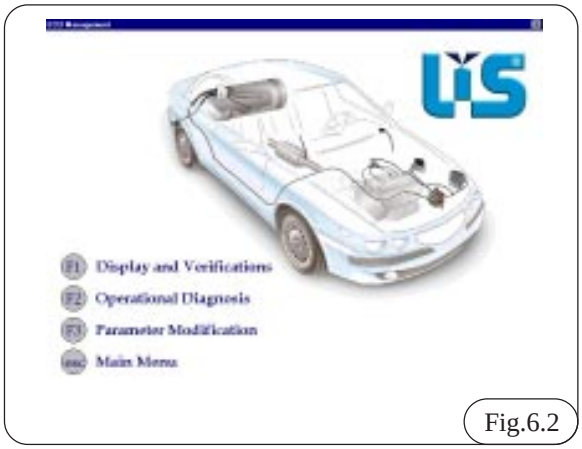

Fig.6.2

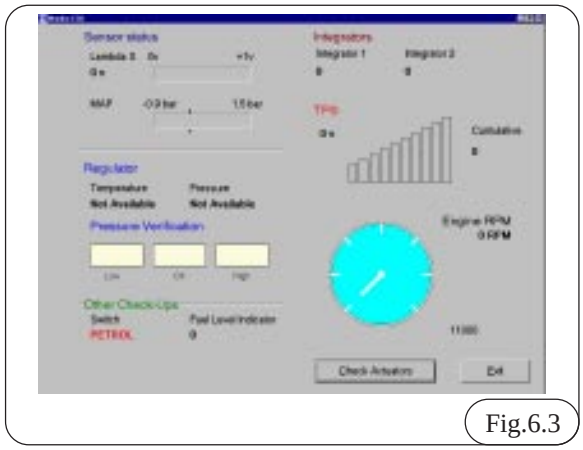

Fig.6.3

With the engine running and idling, the following data must be read in the MONITOR ECU to know that a correct installation and carburetion has been performed:

Sensor status

Lambda ..... 0-1.0V variable read-out
MAP.....the displayed value must be slightly greater than the median mark.

Regulator

Temperature ..... greater than 25°C
Pressur.....0,95 ÷ 0,98

If the pressure is on "Low" or "High", turn pressure regulator-vaporizer's adjusting screw (L) as in Fig. 6.4 until the exact value is achieved and OK is displayed on the screen.

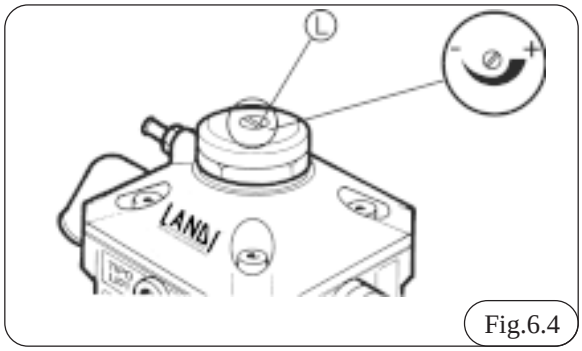

Fig.6.4

TPS

- With direct TPS (idle voltage about 0V), the first bar must be fully lit. When accelerating, all bars must be lit.
- With inverted TPS (idle voltage about 5V), all bars must be lit. When accelerating, all bars must be off.

Integrators

When the above-mentioned procedures have been completed with satisfactory results, it is necessary to road test the vehicle.
To confirm the system's correct operation for good driveability, **Integrator 1** must show an average value between +10 and -10, while **Integrator 2** must show an average value between +20 and -20.
Remove the system's working pressure diagnostical device (B) and screw in the plug (A) as in Fig. 6.1.

7 EMISSION MEASUREMENT

This measurement must be performed in compliance local regulations.

7.1 Idle emissions

CO limit ..... < / = 0.5% vol.

7.2 Fast idle emissions (2,000-2,500 RPM)

CO limit ..... < / 0 0.3% vol.
Lambda .....1 ± 0.03

The emission verifications must be performed on both LPG and petrol.

8 TROUBLE-SHOOTING

8.1 The engine stalls when entering idle

- Go to the screen MONITOR ECU as in Fig. 6.3.
- Determine whether the Lambda sensor signal is lean or rich.
- Click on EXIT.
- View the ECU MANAGEMENT menu.
- Press F3.
- Start Adaptive Learn .
- In cell A, CORRECTIVE STEPS PERFORMED, enter a number ranging between +15 and -15. The number is to be positive if the lambda sensor show a lean signal, or negative if the lambda sensor shows a rich signal. Increase the number by a five step increment each time.
- Return to the ECU MANAGEMENT menu.
- Check for correct idle operation.

Fig.8.1

8.2 Uneven acceleration

If the engine idles properly but during acceleration the RPMs do not increment smoothly, go to the screen ECU PARAMETERS ⇒ ADAPTIVE LEARN and in the area FUEL ENRICHMENT STRATEGY insert:

- a maximum negative value of -5 for rich Lambda sensor signal
- a maximum positive value of +5 for lean Lambda sensor signal
- Insert this value in cell E (see Fig.8.1) FUEL ENRICHMENT STRATEGY.
- Click on the MODIFY button.
- Turn the ignition key off, then on.

8.3 Correct idle with non-optimized integrator values

8.3.1 Integrator 1 out of the +10, -10 range

- From the menu MONITOR ECU go back to ECU MANAGEMENT.
- Press F3
- Enter into ADAPTIVE LEARN (Fig.8.1).
- Algebraically sum the corrective steps of cell (A) and the value AVERAGE DRIFT, and enter the

sum in cell (A). In this case 3, the sum is: -5+2=-3.
- Click on “Modify”.
- Turn the ignition key OFF, then ON.
- Wait for the change to take place.
- Return to MONITOR ECU menu.
- Integrator 1 must come close to the +10, -10 range.

8.3.2 Integrator 2 out of the +20, -20 range

- The following operation must be performed during a road test.
- From the menu MONITOR ECU go back to ECU MANAGEMENT.
- Press F3.
- Enter into ADAPTIVE LEARN (Fig. 8.1).
- Algebraically sum the corrective steps of cells B-C-D to the value in the cell AVERAGE DRIFT and enter it in cells B-C-D.
- In this case, only the 6,200 - 8,700 range is to be corrected. Enter in cell (C): -15 - 2 = -17.
- Click on “Modify”.
- Turn the ignition key OFF, then ON.
- Wait for the change to take place.
- Return to MONITOR ECU menu.
- Integrator 2 must now hover around the +20,-20 range.