

# USE AND SERVICE HANDBOOK

*of the*

**LPG/CNG**

***Sequential system***

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**Dear customer**

We thank you for having purchased a system produced by Tartarini Auto. We congratulate you in your choice of a sequential injection system.

We have written this handbook for you to learn everything about the system and how to use it in the best way possible.

We recommend you read this handbook carefully and thoroughly before starting any first time conversions.

The handbook provides information, advice and important warnings on how to use the system. It will help you fully exploit the technical solutions offered by the sequential system.

We hope you enjoy reading the book and wish you a safe and pleasant journey!

## **CONTENTS**

INTRODUCTION.....	4
FUNCTIONAL DIAGRAM OF THE SYSTEM.....	5
RE-FUELLING.....	8
USING THE SYSTEM.....	11
WHAT TO DO IF.....	14
SERVICING THE SYSTEM.....	15
SERVICE COUPONS.....	16
AT THE GARAGE.....	17

## **INTRODUCTION**

The system is the Multipoint Sequential type. It is controlled by an electronic control unit (also referred to as ECU) that controls the sequence and the injection timing of the Gas. It injects the gas in the gaseous phase through the rail of injectors directly into the suction manifolds, thus dispensing the gas in a particularly precise manner in order to optimise the combustion process.

### **What is LPG ?**

LPG is the abbreviation for “Liquefied Petroleum Gas”. It is a gas mix utilised as a primary economic and safe source of energy.

Its main components are: Propane gas and Butane gas, mixed together in various ratios. LPG does however contain small amounts of other hydrocarbons and inert gasses too. These gasses are produced through the petroleum refining process and are also naturally present in the oil wells and gas supply lines.

In its natural state this mix is gaseous.

LPG is an environment-friendly fuel, since it generates neither lead nor benzene.

### **What is Natural Gas ?**

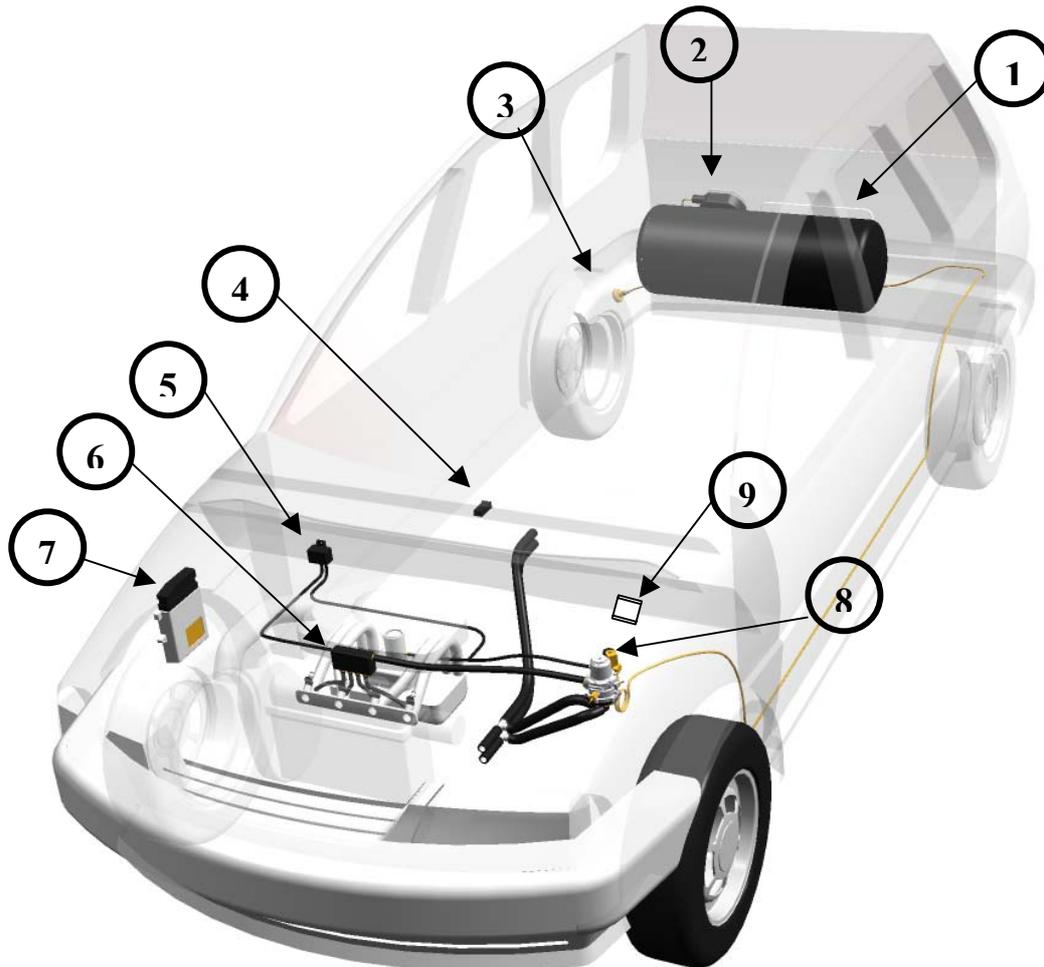
Natural Gas is a gas mix utilised as a primary source of energy.

Its main component is Methane, but it does contain small amounts of other hydrocarbons and inert gasses too.

It is extracted in the form of gas and is transported to the service stations through gas pipes. Worldwide reserves are practically endless and well distributed. The national production in Italy covers over 30% of the total requirement.

CNG is an environment-friendly fuel. Not only is it free from toxic substances but it also considerably reduces the contribution of exhaust fumes in the greenhouse effect and in the production of ozone at ground level.

## FUNCTIONAL DIAGRAM OF THE LPG SYSTEM



### Description of the components

- 1) LPG cylinder
- 2) Multi-valve and safety devices
- 3) LPG re-fuelling port
- 4) Switch unit
- 5) Pressure meter
- 6) Rail of injectors
- 7) ECU of the LPG Sequential injection system
- 8) Pressure Regulator
- 9) Fuse

## **Description of the components**

**1- Cylinder:** It is built according to the European directive ECE 6701 and is manufactured using special sheet steel. It stores the LPG both in liquid and gaseous phase.

**2- Multi-valve and safety devices:** The multi-valve includes: an 80% filling valve that automatically shuts-off when re-fuelling with LPG when the maximum admitted filling level is reached; an overflow valve that trips should a pipe break, preventing all the LPG from dangerously spilling out; an overpressure valve that discharges the LPG stored in the tank externally at a controlled flow rate should the pressure or temperature of the cylinder rise excessively preventing the pressure inside the cylinder from rising further; a solenoid valve that shuts-off the flow of LPG when the engine is not running or when it is running on petrol; a level sensor of the LPG in the liquid phase connected to the level indicator.

**3- LPG re-fuelling port:** This is the device through which the cylinder is filled with LPG. It is equipped with a non-return valve to prevent the gas from flowing back up.

**4- Switch unit:** The switch unit is installed in a handy position for the driver. It is used to switch the vehicle over from Gas to Petrol and vice versa. It also serves as an indicator of the amount of Gas left in the cylinder.

**5- Pressure meter:** The pressure meter informs the gas ECU of the pressure difference between the gas injectors and the suction manifolds.

**6- Rail of injectors:** This device is controlled by the gas ECU and it distributes the correct amount of fuel to each individual cylinder.

**7- Electronic control unit of the sequential injection system:** The electronic control unit receives the signals needed to correct the amount of Gas and to maintain the perfect stoichiometric ratio in order to optimise both consumptions and performance.

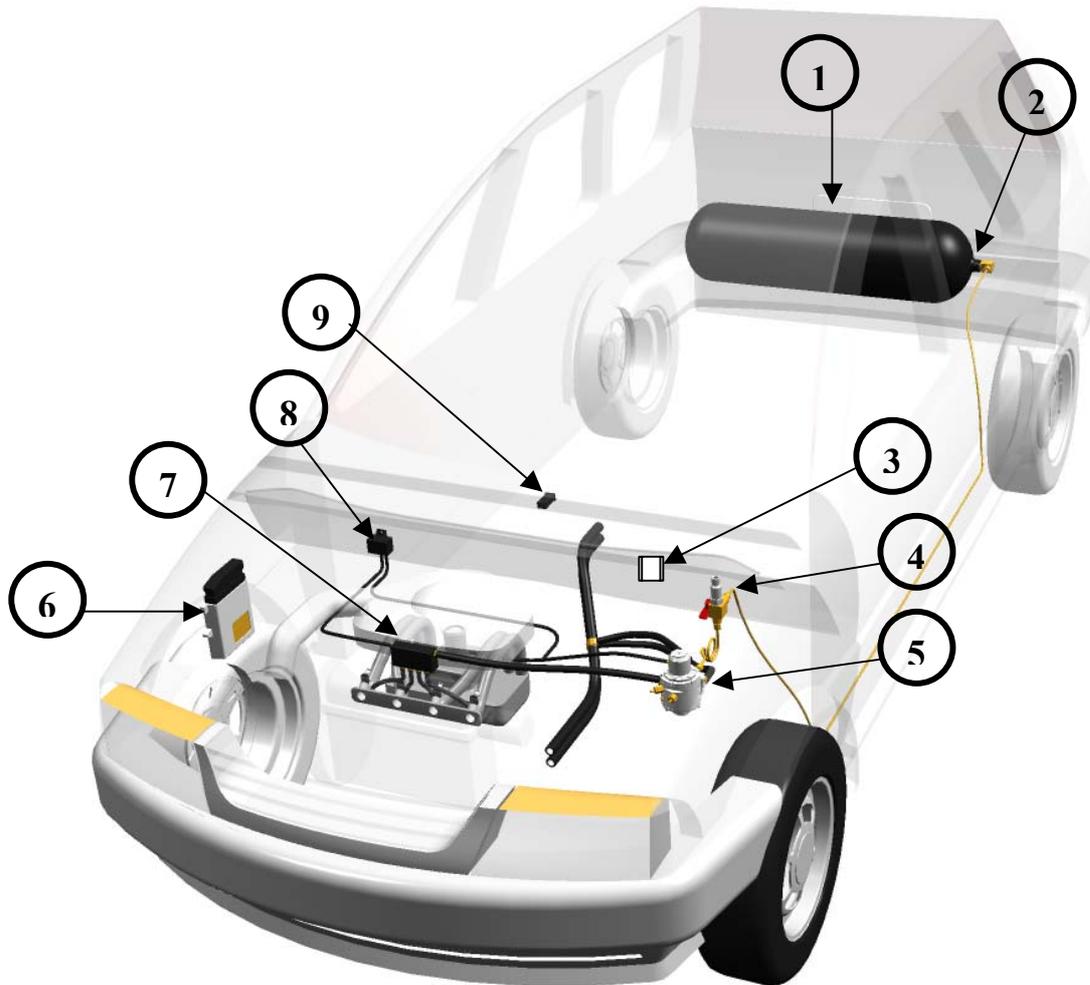
**8- Pressure regulator:** The regulator/vaporiser is a device that reduces the pressure of the LPG from the pressure within the cylinder down to the working pressure. It also vaporises the LPG from the liquid state to the gaseous state. It is equipped with a solenoid valve that shuts-off the flow of Gas when the engine is not running or when it is running on petrol.

**9- Fuse:** The fuse protects the electric system.

Ask the installer to show where the fuse is installed and make a note of the position here below.

**FUSE position**.....

## FUNCTIONAL DIAGRAM OF THE CNG SYSTEM



### Description of the components

- 1) CNG cylinder
- 2) Valve for CNG cylinder
- 3) Fuse
- 4) CNG re-fuelling port
- 5) Pressure regulator
- 6) ECU of the Sequential CNG injection system
- 7) Rail of injectors
- 8) Pressure meter
- 9) Switch unit

## **Description of the components**

### **1- CNG cylinder**

The cylinder stores the CNG in its compressed gaseous state (rated pressure: 200 bar at 15° C).

### **2- Safety valve**

This is a manual tap used to isolate the cylinder from the CNG system so that it can be serviced by Tartarini Service network.

### **3-- Fuse**

The fuse protects the electric system.

Ask the installer to show you where the fuse is installed and make a note of the position here.

**FUSE position**.....

### **4- CNG re-fuelling port**

This is the device through which the cylinder is filled with CNG. It is equipped with a non-return valve to prevent the Gas from flowing back up. It may be located at the back external part of the vehicle.

### **5- Pressure regulator**

The regulator reduces the pressure of the CNG within the cylinder down to the working pressure. It is equipped with a solenoid valve that shuts-off the flow of Gas when the engine is not running or when it is running on petrol.

### **6- ECU of the Etagas injection system**

The ECU receives the signals needed to correct the amount of Gas, maintaining the perfect stoichiometric ratio in order to optimise both consumptions and performance.

### **7- Rail of injectors**

This device is controlled by the gas ECU and it distributes the correct amount of fuel to each individual cylinder.

### **8- Pressure meter**

The pressure meter informs the gas ECU of the difference in pressure between the gas injectors and the suction manifolds.

### **9- Switch unit**

The switch unit is installed in a handy position for the driver. It is used to switch the vehicle from Gas to Petrol and vice versa. It also serves as an indicator of the amount of Gas left in the cylinder.

## AT THE SERVICE STATION

### LPG – 80% filling control

As already mentioned previously the multi-valve stops the LPG re-fuelling phase when 80% (+/- 5%) of the rated capacity of the cylinder is reached.

This allows for a margin for possible expansions in the LPG itself.

Remember that, when you use fuel such as LPG, its self-sufficiency is quite variable, as it not only depends on the driving and vehicle service conditions but also on the different composition of the gas, which may vary not only seasonally but also from one supplier to another.

LPG is indeed a mix of Butane and Propane gasses, which can be mixed in various non-standard ratios.

If, when re-fuelling at the LPG service station, you should notice that the 80% filling limit is exceeded, please immediately contact your local Tartarini service centre.

Check the efficiency of the 80% filling device at least twice a year. Leave all the LPG in the cylinder run out and then when you fill up again for the first time check if the maximum envisaged limit is exceeded.

To make matters simple, we are providing a table indicating the re-fuelling quantities for each rated capacity (the rated capacity is written in the logbook).

#### Cylindrical cylinders

Rated	<b>35</b>	<b>45</b>	<b>55</b>	<b>60</b>	<b>64</b>
Real capacity	26.6 / 29.4	34.7 / 37.8	41.8 / 46.2	45.6 / 50.4	48.4 / 53.5
Rated	<b>67</b>	<b>70</b>	<b>73</b>	<b>80</b>	<b>90</b>
Real capacity	50.3 / 55.6	53.2 / 58.8	55.1 / 60.9	60.8 / 67.2	68.4 / 75.6

#### Toroidal cylinders

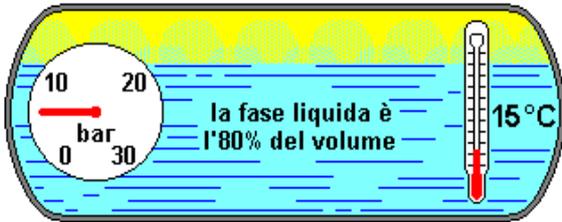
Rated	<b>34</b>	<b>44</b>	<b>48</b>	<b>57</b>	<b>63</b>
Real capacity	25.8 / 28.5	33.4 / 36.9	36.4 / 40.3	43.3 / 47.8	47.8 / 52.9

Since LPG in its liquid state increases in volume by 0.25% for every degrees centigrade rise in temperature, the cylinder must NOT be filled beyond 80% of its capacity to allow the liquid to expand as the temperature rises (due to the environment, vehicle running conditions etc.).

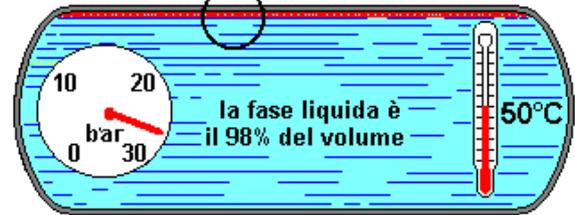
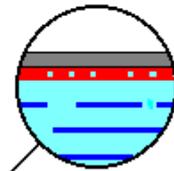
We are providing some notes to better explain some physical aspects that occur within an LPG cylinder.

The illustrations below compare the different effects encountered when filling with 80% of LPG and when filling excessively with roughly 90%.

Regular filling with 80% of the volume in liquid phase.	Excessive filling with roughly 90% of the volume in liquid phase.
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il dettaglio mostra la estrema riduzione della fase gassosa



When filling regularly a gaseous phase of 10% of the volume is left.	When filling excessively only a reduced gaseous phase is left.
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You will notice that, if the cylinder is subjected to a source of external heat such to take the temperature of the LPG inside the cylinder itself to 50°C, there is a residue gaseous phase of 10% when filling up to 80%. Vice versa when filling up to 90% the gaseous phase is considerably reduced.

The LPG cylinder must be inspected and tested every 10 years.

Contact a Tartarini Service centre to have this job done.

**WARNING! Inspections and tests must be carried in compliance with current national legal norms of your country.**

## CNG

The cylinder stores the CNG in its compressed gaseous state (rated pressure: 200 bar at 15°C).

Remember that, when you use gaseous fuel such as CNG, its self-sufficiency is quite variable, as it not only depends on the driving and vehicle service conditions but also on the temperature of the gas.

CNG also heats up during the re-fuelling phase and cools down when the vehicle is running, thus it is subjected to variations in pressure that reduce the usable quantity.

The garage that installs the system will hand over the relative documents together with a plate bearing the test expiry date of each cylinder.

CNG re-fuelling stations are not authorised to fill cylinders that have an expired test date. To check the situation the service station attendants should request the driver to show them these test date plates.

CNG cylinders must be inspected and tested every 5 years.

Contact your local Tartarini service centre for the inspection and testing of the CNG cylinders.

**WARNING! Inspections, tests and other pertinent procedures must be carried in compliance with current national legal norms of your country.**

## USING THE SYSTEM

### Running on petrol.

Turn the switch as shown in fig. 3B and use the vehicle as stated by the manufacturer.

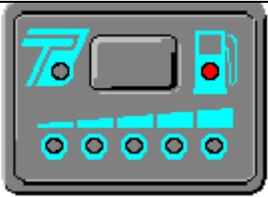
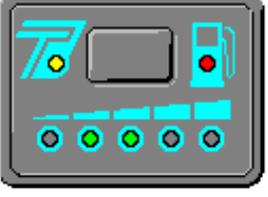
### Running on Gas.

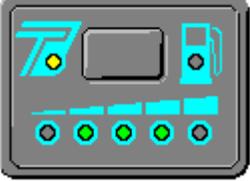
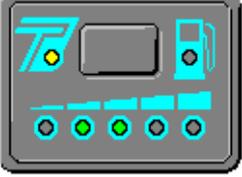
Turn the switch as shown in fig. 3C.

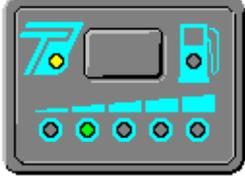
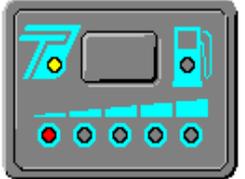
The engine is started on petrol in order to keep the injectors efficient.

You must therefore always keep some petrol in the tank. The recommended amount of petrol to be kept in the tank is at least 10 litres, (petrol reserve LED off) so that the engine can be started or so that you can switch back to petrol should you run out of gas. Once you have started the engine, as soon as the temperature and rpm set in the ECU are reached, the system switches from petrol to gas and the switch unit appears as shown in fig. 3D / H.

### Description of the level sensor and functions of the switch unit

 <p>fig.3a</p>	<p>with the dash boards over since 15 seconds, all the leds of the commutators are switched off</p>
 <p>fig. 3b</p>	<p>With the dashboard turned on and switch turned to petrol, the red petrol LED is lit.</p>
 <p>fig.3c</p>	<p>With the dashboard turned on and switch turned to gas, the yellow gas LED flashes and the red petrol LED remains lit steady. The level indicator LED's light up according to the amount of gas in the cylinder. The vehicle is running on petrol.</p>

 <p>fig.3d</p>	<p>Once the set parameters are exceeded and the set rpm and temperature of the regulator are reached, the vehicle automatically switches to gas.</p> <p>The red petrol LED switches off and the yellow gas LED remains lit steady.</p> <p>The level indicator LED's light up according to the amount of gas in the cylinder.</p> <p>The indicator shows that the cylinder is full of gas, as the four green LED's are all lit</p>
 <p>fig.3e</p>	<p>With the vehicle running on gas the yellow gas LED is lit.</p> <p>The level indicator shows 3/4 of gas, as three green LED's are lit.</p>
 <p>fig.3f</p>	<p>With the vehicle running on gas the yellow gas LED is lit.</p> <p>The level indicator shows 1/2 of gas, as two green LED's are lit.</p>

 <p>fig.3g</p>	<p>With the vehicle running on gas the yellow gas LED is lit. The level indicator shows 1/4 of gas, as one green LED is lit.</p>
 <p>fig.3h</p>	<p>With the vehicle running on gas the yellow gas LED is lit. The level indicator shows that the gas is in reserve, as one red LED is lit.</p>
 <p>fig.3i</p>	<p>When driving with the gas in reserve, the gas continues to run out until the pressure inside the cylinder is no longer within the correct working limit, in which case the system automatically switches to petrol:</p> <ol style="list-style-type: none"> <li>1) When this occurs, the switch unit will buzz.</li> <li>2) Check the level indicator LED's that will be flashing to and fore from right to left and back again.</li> </ol>

## WHAT TO DO IF.....

Proceed as follows if you should operate the switch but the system should fail to change over from petrol to gas or vice versa:

- 1) Check if the fuse that protects the electric system is intact. If this is not the case, replace it with one having the same Ampere rating (max 7.5 A).
- 2) If you do not have a spare fuse like the one described, you can still use the vehicle, naturally on petrol.
- 3) If, when the vehicle is running on Gas, the system automatically switches to petrol and the switch unit buzzes to warn you that the vehicle is running on petrol, simply press the button of the switch unit to manually change over to petrol, consequently the buzzing will stop. At this stage check the following: The fuel level (Gas), if the gas has run out simply re-fuel, press the button of the switch unit and the vehicle will run regularly again.  
If there is some fuel (Gas) in the cylinder, contact your local authorised Tartarini Auto service centre.
- 4) If the switch unit buzzes twice (beep-beep) when you turn the vehicle off, it means that the system has reached the pre-established hours of operation on gas, therefore you need to contact an authorised Tartarini service centre to take the vehicle for a service.

## SERVICING THE SYSTEM

The correct maintenance of the system is crucial in order to guarantee its lasting and perfect operational efficiency.

**WARNING:** The guarantee is annulled if the jobs stated are not carried out.

### Scheduled maintenance programme

Thousands of kilometres	20	40	60	80	100	120	140
Check the pressure of the regulator and the Gas fittings *	•	•	•	•	•	•	•
Check the operational efficiency and the parameters of the gas fuelling system (using auto-diagnosis connector) *	•	•	•	•	•	•	•
Check if the straps that hold the LPG and CNG cylinders in place are tight and secure *	•		•		•		•
Visually check the conditions of the water/gas pipes and Gas fittings. *	•	•	•	•	•	•	•
Check or overhaul the LPG/CNG pressure regulator.		•		•		•	
Check or overhaul the LPG injectors unit.		•		•		•	
Check of overhaul the CNG injectors unit.			•			•	
Replace the LPG filter.	•	•	•	•	•	•	•
Replace the CNG filter.		•		•		•	

( \*) Or every 12 months.

Maintenance jobs are preferably to be carried out by the person who installed the system or by an authorised Tartarini Auto service centre.

## SERVICE COUPONS

<b>First service</b>		<b>Next service</b>	
<b>Garage stamp</b>		<b>Garage stamp</b>	
<b>Km</b>	<b>Date</b>	<b>Km</b>	<b>Date</b>
<b>Description of the repair/replacement</b>		<b>Description of the repair/replacement</b>	
<hr/>		<hr/>	

<b>Next service</b>		<b>Next service</b>	
<b>Garage stamp</b>		<b>Garage stamp</b>	
<b>Km</b>	<b>Data</b>	<b>Km</b>	<b>Data</b>
<b>Description of the repair/replacement</b>		<b>Description of the repair/replacement</b>	
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<b>Next service</b>		<b>Next service</b>	
<b>Garage stamp</b>		<b>Garage stamp</b>	
<b>Km</b>	<b>Date</b>	<b>Km</b>	<b>Date</b>
<b>Description of the repair/replacement</b>		<b>Description of the repair/replacement</b>	
_____		_____	
_____		_____	
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<b>Next service</b>		<b>Next service</b>	
<b>Garage stamp</b>		<b>Garage stamp</b>	
<b>Km</b>	<b>Date</b>	<b>Km</b>	<b>Date</b>
<b>Description of the repair/replacement</b>		<b>Description of the repair/replacement</b>	
_____		_____	
_____		_____	
_____		_____	

## AT THE GARAGE

### PAINTING AND FOLLOWING PAINT DRYING INSTRUCTIONS FOR VEHICLES EQUIPPED WITH LPG/CNG SYSTEMS.

Observe the following instructions if jobs are to be done on vehicles equipped with LPG systems that involve their painting and following paint drying using lamps:

- Check if there is less than 80% of the rated fuel capacity in the cylinder.
- Any jobs on the bodywork are to be carried out in the same way as those of petrol-fuelled vehicles.

**NOTE:** The components of the LPG system, in particular the cylinder, must never be exposed to free/direct flames or very hot sources of heat (electric soldering for example and so on). Whatever the case, none of the components must become hotter than 90°C in any point.

- Once the job has been completed, wait for the vehicle to cool down, then start the engine in LPG operational mode and check for any operational anomalies.

### FOR VEHICLES EQUIPPED WITH CNG SYSTEM

In the case of painting jobs **“in the furnace”** the cylinders are to be taken out of the vehicle and then put back at the end of the job. These jobs will be done by our Tartarini service network upon relative payment.