

Chapter VII Electronic Fuel Injection System

Section I General

I. Description of engine control system

1. Basic composition of electronic control system

Lifan520 series electronic control system is composed of three following parts:

(1)The sensor converts all kinds of non-electrophysic energies of engine into its electrophysic energies, through which its various kinds of relevant information can be supplied to its sub-control unit. The main types of sensors applied for Lifan520 series electronic control system:

①inlet pressure and inlet temperature sensor; ②throttle position sensor; ③cooling fluid temperature sensor; ④pre-heating oxygen sensor; ⑤knock sensor; ⑥crankshaft position sensor; ⑦camshaft position sensor (TRITEC engine); ⑧weak acceleration sensor (national III with OBD and national VI car equipment); ⑨post-heating oxygen sensor (national III with OBD and national VI car equipment);

(2)The electronic control unit is the brain of whole electronic control system, and its English abbreviation is ECU. It analyses and processes all the kinds of information supplied by the sensor, and sends the results to the actuator in the form of commands, so as to make the engine running under the optimum operating conditions.

(3)The actuator performs the commands of electronic control unit. The actuator acts as a hand or foot of electronic control system. The actuator types applied in Lifan520 series electronic control system:

①fuel injector ②ignition coil ③idle stepping motor ④canister solenoid valve ⑤relay (fan, A/C, fuel pump and A/C compressor, etc)

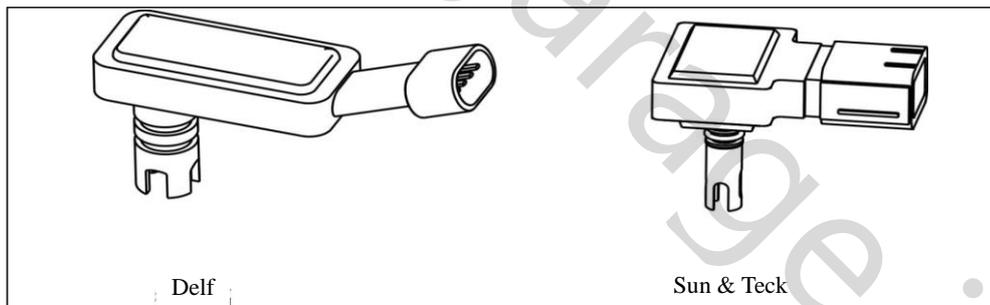


Fig. 7-1 Pressure Temperature Sensor

2. Lifan 520 series 4-stroke engine electronic control system adopts a sequential fuel injection mode.

II. Description of electronic fuel injection system parts

1. Inlet pressure temperature sensor

(1)Schematics and pin circuit

(2)Installation position

This sensor is combined by two sensors, i.e. inlet manifold absolute pressure sensor and inlet temperature sensor, which are installed on the inlet manifold.

(3) Operating principles

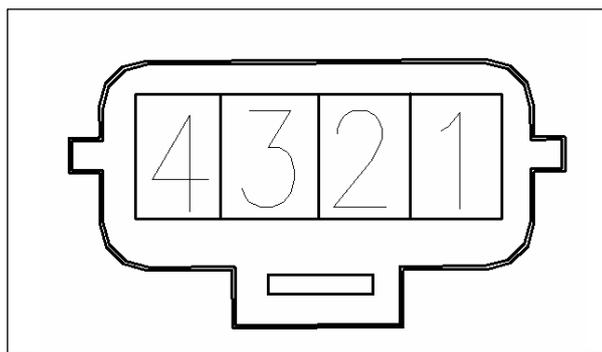


Fig. 7-2 Pins of Pressure Temperature Sensor

The inlet manifold absolute pressure sensor element is made up of a silicon chip. A pressure-sensitive diaphragm is etched in the silicon chip. 4 piezoresistors exist in the pressure-sensitive diaphragm, which combine into a Wheatstone network as pressure strain elements. In addition to this diaphragm, a signal processing circuit is integrated in the silicon chip. The silicon chip and a metal casing are combined into a closed reference space, where the absolute pressure of air is approximate to zero, thus a Micro Electromechanical Systems (MEMS) is formed. The active surface of silicon chip withstands a pressure approaching zero, and its back side withstands the absolute pressure of the tested inlet manifold, which is led into through a connecting pipe.

The thickness of silicon chip is only several micrometers (μm), so any change of inlet manifold absolute pressure will make the silicon chip and 4 piezoresistors mechanically deformed, and then their resistances are also changed. After being processed by the silicon chip signal process circuit, a voltage signal is formed with linear relations to the pressure.

Table 7-1 Definitions of Inlet Pressure Temperature Sensor Pin

Mark	ECU pin	Function and Definition
1	J1-21	5V power-
2	J1-27	Inlet temperature signal
3	J1-04	5V power+
4	J-42	Inlet pressure signal

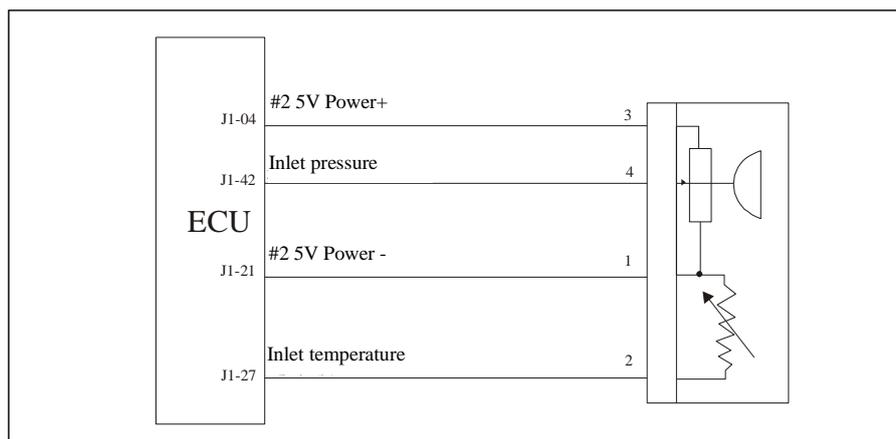


Fig. 7-3 Circuit of Inlet Pressure Temperature Sensor

The inlet temperature sensor element is a negative temperature coefficient (NTC) resistance, and sends a voltage showing the change of inlet temperature to the controller in case of changes of resistance inlet temperature.

(4) Fault symptoms and judgment methods

① Fault symptoms: flameout, poor idle, increase of oil consumption and pollution discharge, etc.

② Causes of common faults: 1. Abnormal high voltage or reverse strong current is produced during the use; 2. The repair process makes the vacuum elements damaged.

③ **Attentions for repair: it's prohibited to impact the vacuum elements with high-pressure gas during the repair; be sure to check whether the output voltage and current of generator are normal in case of finding out the faults and replacing the sensor.**

④ Measuring methods: refer to the relevant information in Section II or III.

2. Throttle position sensor

(1) Schematic and pin

(2) Installation position

It's installed on the throttle body.

(3) Operating principles

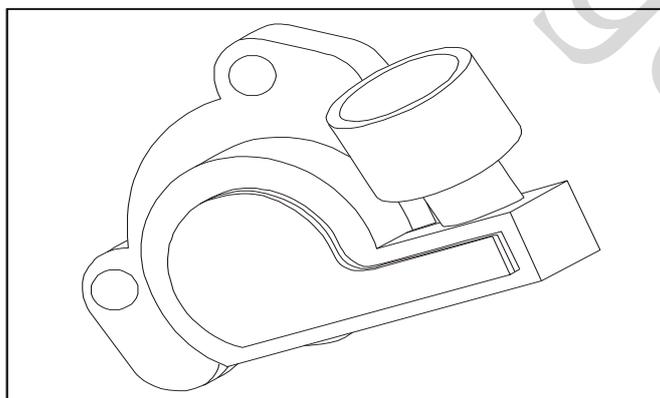


Fig. 7-4 Throttle Position Sensor

This sensor is a sensor with linear output angle, which consists of two circular slide resistances and two slide arms. The rotating shaft of slide arm is connected to the throttle shaft on the same axis. 5V power voltages US are applied to both ends of slide resistance. When the throttle rotates, the slide arm also rotates and moves along the slide resistance, and leads the potential UP of contact out as an output voltage, so it's a rotating potentiometer in fact, a voltage signal of potentiometer output in proportion to throttle position.

(4) Fault symptoms and judgment methods

1) Fault symptoms: engine non-idle or unstable idle, difficult to accelerate or failure to accelerate, increase of engine fuel consumption and exhaust pollution, etc.

2) Causes of common faults:

- ① Poor contact of sensor slide and resistance makes the signal discontinued or cut in and out.
- ② The sensor resistance or its internal circuit is open or short, which leads to no signal voltage or incorrect signal voltage.

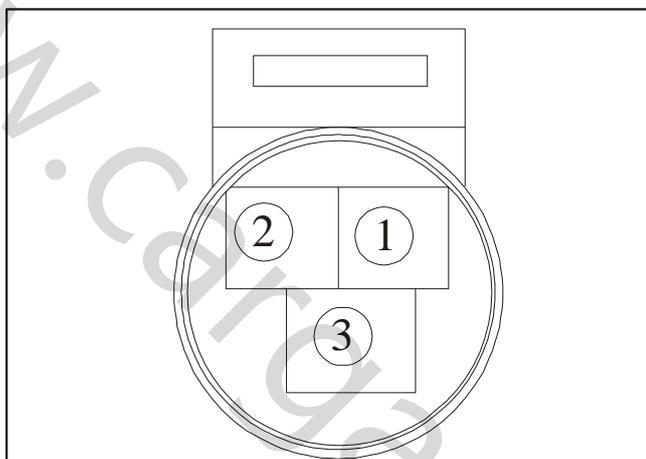


Fig. 7-5 Throttle Position Sensor Pin

Mark	ECU pin	Function & Definition
1	J1-05	Ground
2		Instrument output
3	J1-43	Signal output

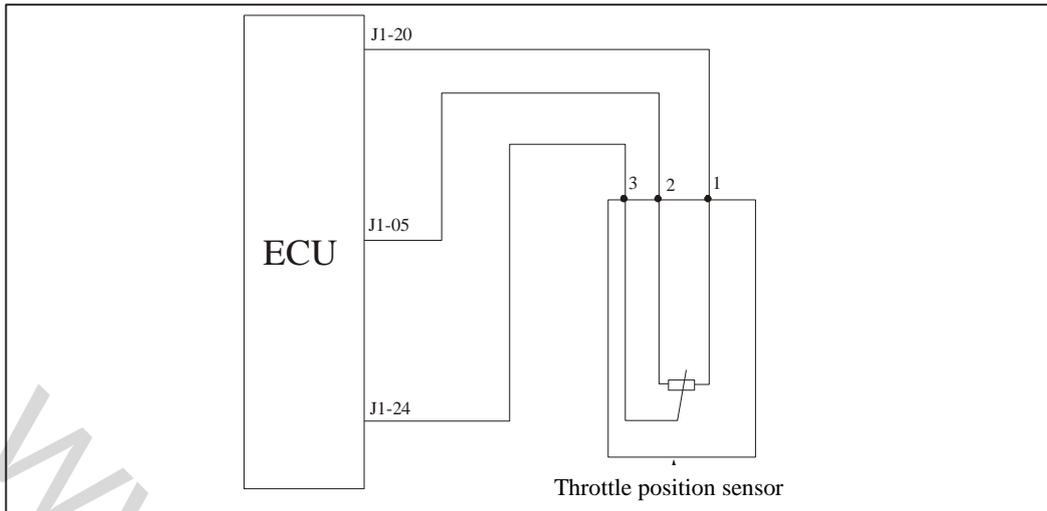


Fig. 7-6 Circuit of throttle position sensor

③ Loosening and deformation of sensor slide, resistance and relevant parts make the voltage of signal incorrect.

3) Attentions for repair: pay attention to the installation position.

④ Measuring methods: refer to the relevant information in Section II or III.

3. Cooling fluid temperature sensor

(1) Schematic and pin

(2) Installation position

It's installed on the water outlet of engine.

(3) Operating principles

This sensor is a negative temperature coefficient (NTC) heat-sensitive resistance, its resistance is reduced against the increase of cooling fluid temperature, but it's not a linear relation. The negative temperature heat-sensitive resistance is installed on a copper plane, as shown in the following figure.

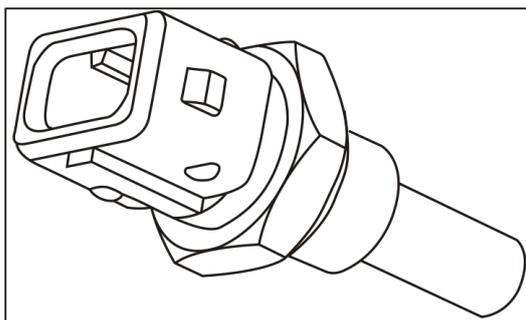


Fig. 7-7 Cooling Fluid Temperature Sensor

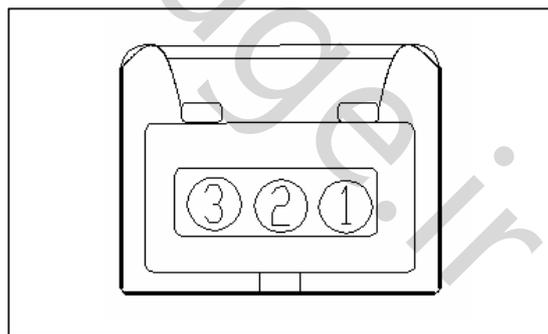


Fig. 7-8 Cooling Fluid Temperature Sensor Pin

Mark	ECU Pin	Function & Definition
1	J1-05	Ground
2		Instrument output
3	J1-43	Signal output

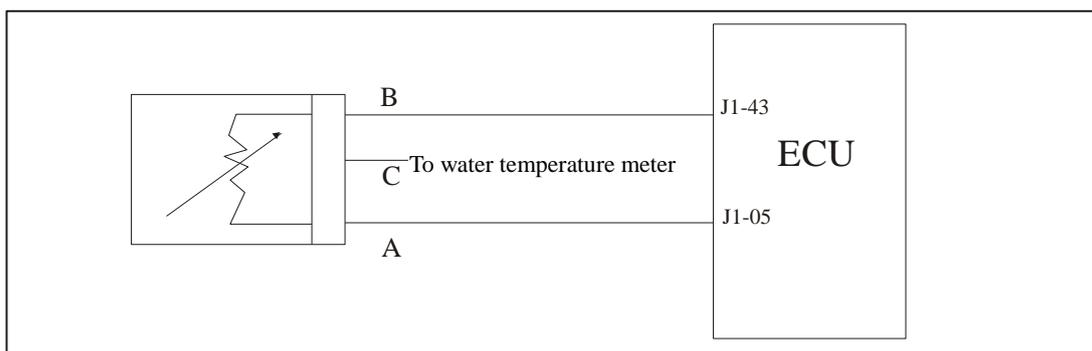


Fig. 7-9 Circuit of Cooling Fluid Temperature Sensor

(4) Fault symptoms and judgment methods

1) Fault symptoms: increase of engine oil consumption and exhaust pollution, difficult cold starting or starting failure, engine gap flameout and idle unsteadiness, etc.

2) Causes of common faults:

① Poor contact of cooling fluid temperature sensor internal circuit makes the sensor signal-free or its signal abnormal.

② Ageing of cooling fluid temperature sensor heat-sensitive elements makes the signal abnormal.

Measuring method: refer to the relevant information in Section II or III.

4. Knock sensor

(1) Schematic and pin

(2) Installation position

Installed on the body of engine 2-3 cylinder.

(3) Operating principles

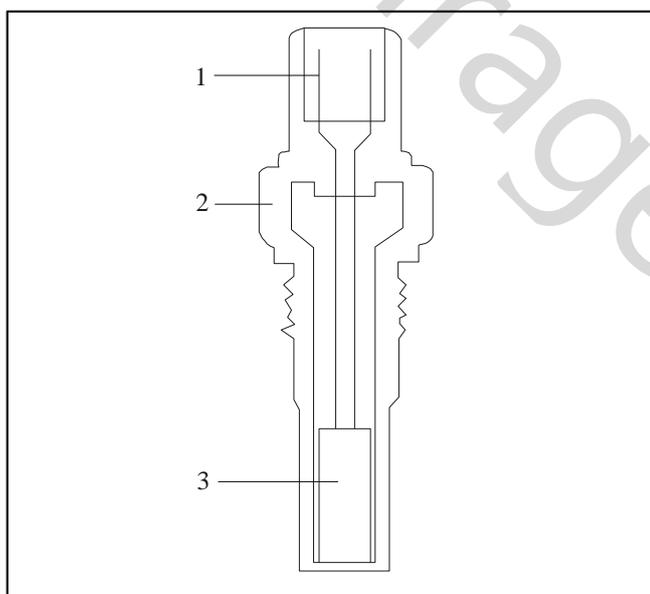


Fig. 7-10 Section of Cooling Fluid Temperature Sensor

1-Electric connector 2-Shell 3-NTC switch

The knock sensor is a vibration acceleration sensor, which is installed on engine cylinder body. One or several sensors can be installed on the cylinder body. The sensing element of sensor is a piezoelectric element. The vibration of engine cylinder body is transferred to the piezoelectric crystal through a mass block in the sensor. The piezoelectric crystal produces a voltage on two polar planes due to the pressure caused by the vibration of mass block, and outputs an alternating voltage signal converted by the vibration signal. Its curve for frequency response characteristics is shown in the following figure. Since the frequency of vibration signals caused by the knock of engine is much higher than that of normal vibration signals of engine, ECU can distinguish the knock signal and non-knock signal after processing the signals of knock sensor.

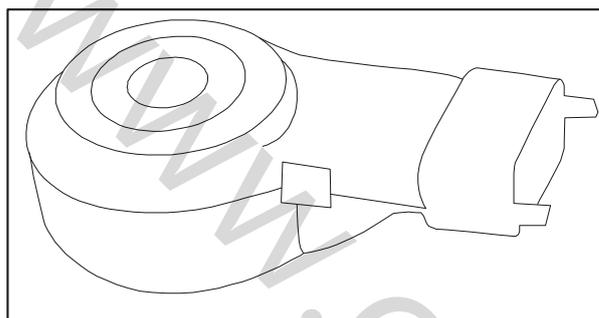


Fig. 7-11 Knock Sensor

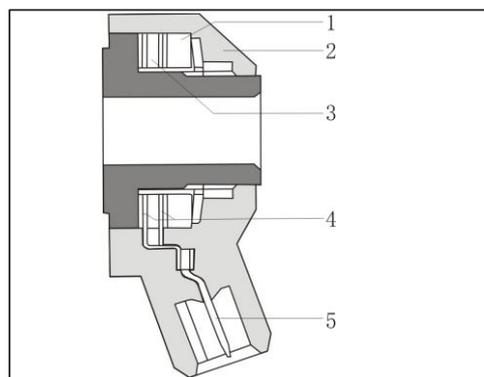


Fig. 7-12 Section of Knock Sensor

1-Vibration block 2-Shell 3-Piezoelectric ceramic body
4-Contact 5-Electric connector

Table 7-4 Definitions of Knock Sensor Pins

Mark	ECU pin	Function & Definition
1	J1-69	Signal+
2	J1-05	Signal-

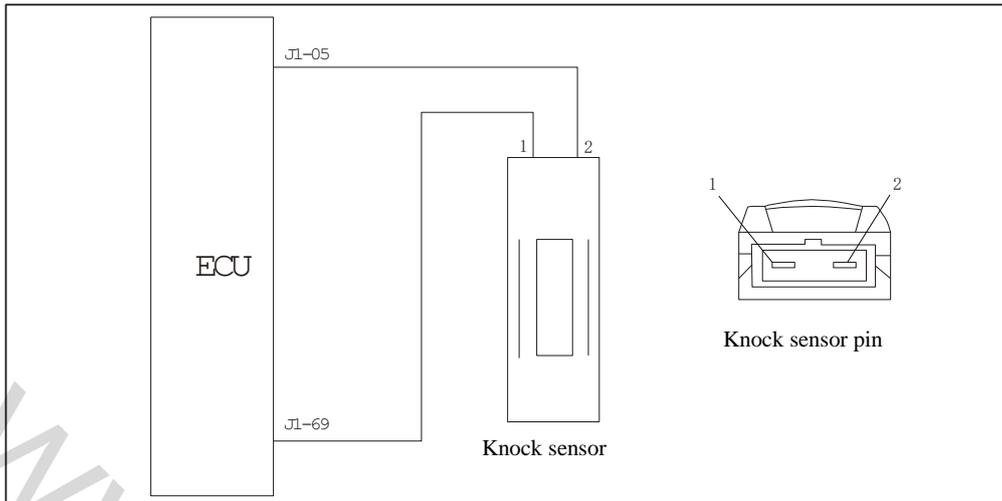


Fig. 7-13 Knock Sensor and Pins

1-Signal high 2-Signal low

The constructions of knock sensors can be divided into the ones with and without cables for customers' selection.

(4)Attentions

Ensure that no fluid like machine oil, cooling fluid, braking fluid or water contacts with the sensor for a long time.

(5)Symptoms and judgment methods

①Fault symptom: poor acceleration, etc.

②Causes of common faults: if various fluids like the machine oil, cooling fluid, braking fluid or water, etc contacts with the sensor for a long time, the sensor will be corroded.

③Measuring methods:

Refer to the relevant information described in Section II or III.

5. Oxygen sensor

(1)Pin

(2)Position

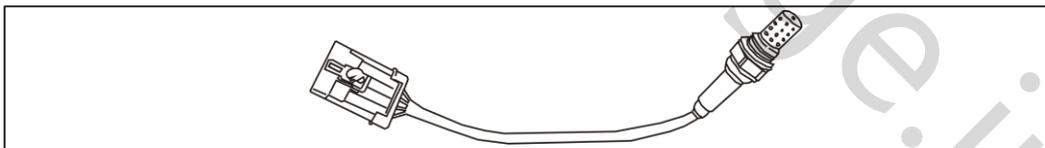


Fig. 7-14 Oxygen Sensor

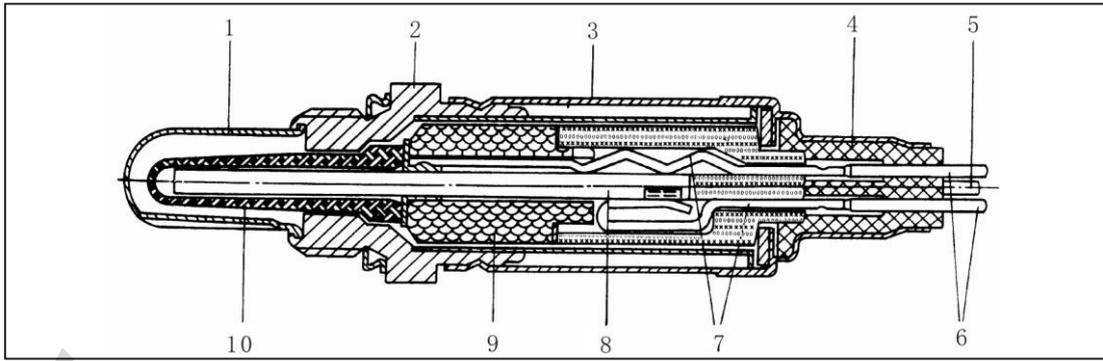


Fig. 7-15 Section of Oxygen Sensor

1-Grooved protecting sleeve 2-Oxygen sensor socket 3-Shell 4-Insulator 5-Electrode 6-Sensor heating resistance power terminal 7-Spring plate 8-Heating resistance 9-Ceramic body 10-Porous ceramics and battery lead plate

Type	Mark	ECU pin	Function & Definition
Front oxygen sensor	1	J1-02	Main relay output
	2	J1-61	oxygen sensor heating control
	3	J1-06	Signal low
	4	J1-62	Signal high
Rear oxygen sensor	1	J1-02	Main relay output
	2	J1-64	Oxygen sensor heating control
	3	J1-06	Signal low
	4	J1-38	Signal high

Installed on the front end of exhaust pipe.

(3) Principles

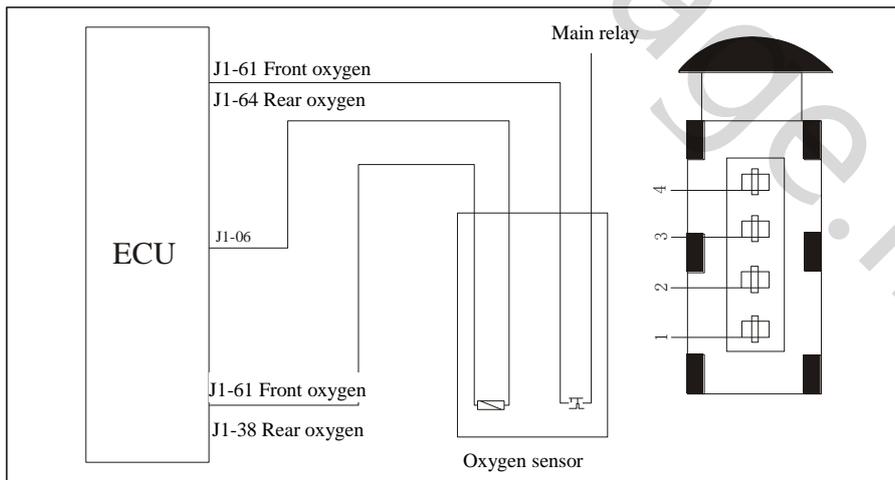


Fig. 7-16 Circuit and Pins of Oxygen Sensor

1-Main relay output 2-Oxygen sensor heating control 3-Signal low 4-Signal

The element of oxygen sensor is a porous ceramic tube, whose external wall side is surrounded by the engine exhaust, and whose internal side is connected to the atmosphere. The sensing ceramic tube wall is a solid electrolyte, and an electric heating tube is installed in it, as shown Fig.-15. The function of oxygen sensor is realized by converting the differences of oxygen ion concentrations inside and outside the sensing ceramic tube into various voltage signals for output. When the temperature of sensing ceramic tube reaches 350°C, it has similar characteristics of solid electrolyte. Due to the specialty of its material, the oxygen ion can flow through the ceramic tube. Based on this property, the sensor converts the concentration differences into potential differences, which leads to the formation of electric signal for output. If the mixed gas is thicker, the difference of oxygen ion inside and outside the ceramic tube will be higher, and its potential difference will be higher, which makes a lot of oxygen ions move from internal side to external side, and makes the output voltage higher (approximate to 800mV-1000mV); if the mixed gas is thinner, the difference of oxygen ion inside and outside the ceramic tube will be lower, and its potential difference will be lower, which makes only a little of oxygen ions move from internal side to external side, and makes the output voltage lower (approximate to 100mV).

(4)Attentions

①Don't make the cable metal locking ring on the side of oxygen sensor improperly heated, especially after the stop of engine.

②It's prohibited to use any cleaning fluid, oily liquid or volatile solid on the oxygen sensor during the repair.

(5)Fault and judgment methods

1) Fault symptoms: increase of engine fuel consumption and exhaust pollution, unstable idle, misfire or quiver, etc.

Causes of common faults:

①Lead poisoning, if the lead is attached to the surface of oxygen sensor at high temperature after applying the leaded gasoline, the sensor can't produce any normal signal.

②Carbon accumulation, after the carbon accumulates on the surface of oxygen sensor platinum sheet, the sensor can't produce any normal voltage signal.

③Poor contact or breakage of oxygen sensor internal circuit leads to no signal voltage for output.

④The damage of oxygen sensor ceramic elements leads to the failure to produce normal voltage signals.

⑤Burning of oxygen sensor heater resistance wire or its open circuit makes the oxygen sensor unable to reach its normal operating temperature.

2) Measuring methods: refer to Section II.

6. Crankshaft position sensor

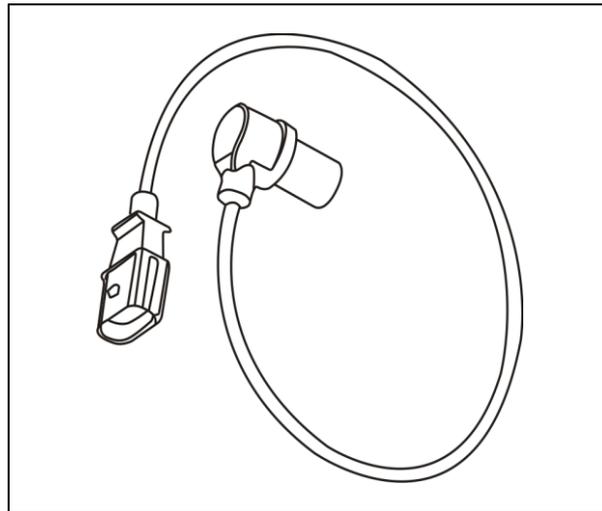


Fig. 7-17 Crankshaft Position Sensor

(1)Schematic and pin

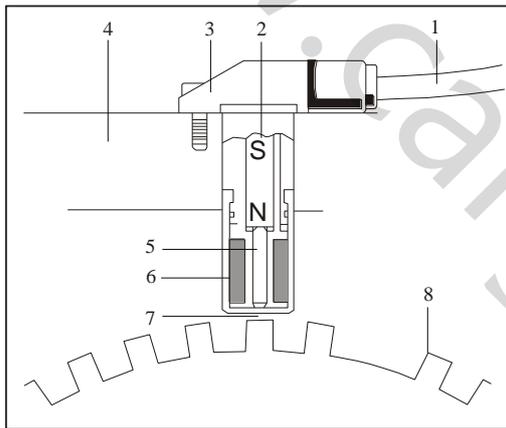


Fig. 7-18 Section of Sensing Speed Sensor

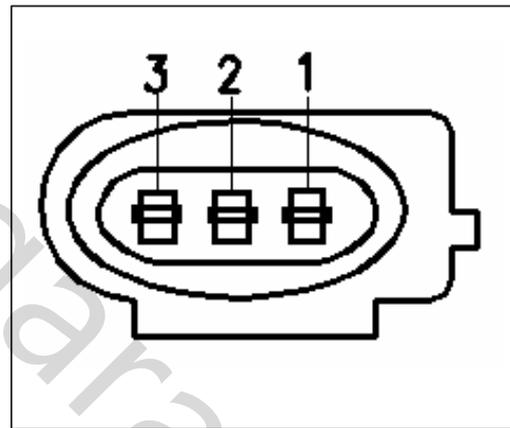


Fig. 7-19 Speed Sensor Pin

- 1-Shielding line 2-Permanent magnet 3-Sensor shell 4-Mounting support
5-Soft magnet core 6-Coil 7-Air gap 8-Gear ring

Table 7-6 Definitions of Speed Sensor Pins

Mark	ECU pin	Function & Definition
1		Shielding line
2	J1-28	Signal low
3	J1-12	Signal high

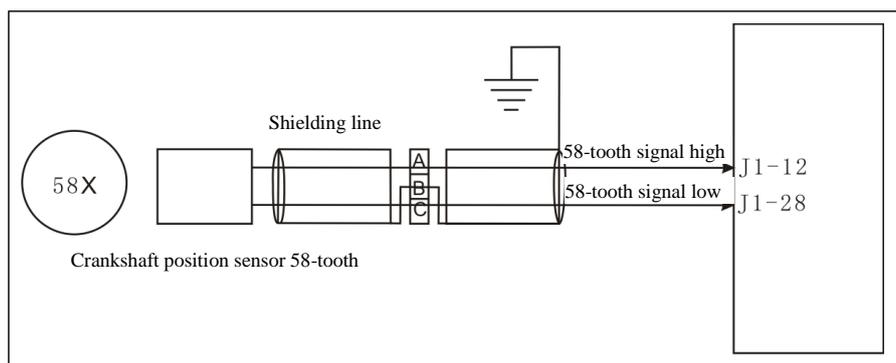


Fig. 7-20 Circuit of Crankshaft Position Sensor

(2) Installation position

It's installed on the engine rear flywheel plane.

(3) Operating principles

The sensing speed sensor matches a pulse disc, which is used to provide the data for engine speeds and crankshaft top dead centers for the ignition system without distributor. The sensing speed sensor consists of a permanent magnet and a coil outside the magnet. The pulse disc is a fluted disc, which is installed on the crankshaft and rotates with a crankshaft. When the tooth top passes by attaching it to the end of sensing speed sensor, the pulse disc made of ferromagnetic material cuts the lines of magnetic force of permanent magnet in the sensing speed sensor, which produces an induced voltage in the coil as a speed signal for output.

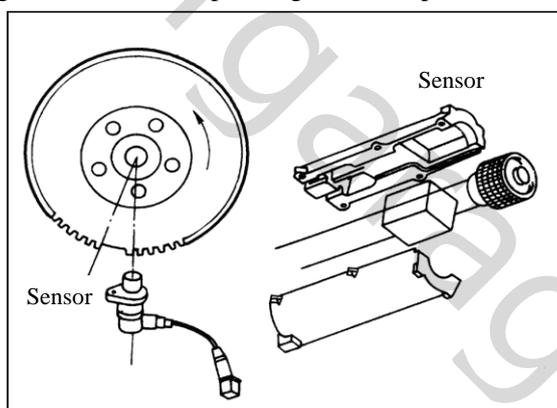


Fig. 7-21 Makeup of Engine Speed Sensor

(4) Attentions for installation

The sensing speed sensor is installed by pressing it other than hammering.

(5) Fault symptoms and judgment methods

1) Fault symptoms: starting failure or immediate shutdown after starting the engine, etc.

2) Causes of common faults:

① Poor contact or open circuit of sensor connector or its internal circuit makes the signal of sensor weak or unavailable for output.

② The short circuit or earth of sensor induction coil makes the signal of sensor weak or unavailable for output.

③ Loosened installation or improper clearance of sensor makes the signal of sensor weak or unavailable for output.

3) Attentions for repair: it's installed by pressing it other than hammering during the repair.

Measuring methods: refer to the relevant information in Section II or III.

7. Camshaft position sensor (this sensor is only used for the system of TRITEC engine.)

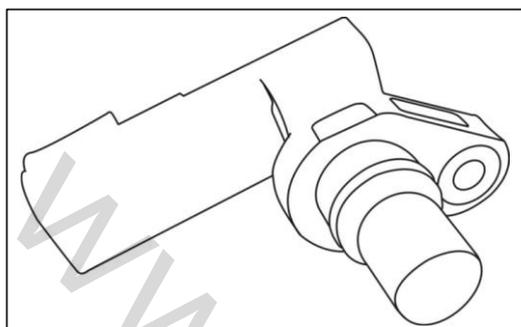


Fig. 7-22 Camshaft Position Sensor

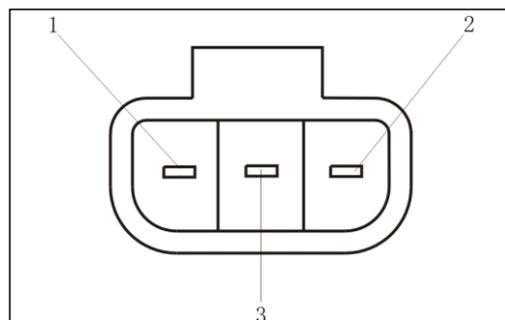


Fig. 7-23 Camshaft Position Sensor

Fig. 7-22 Camshaft Position Sensor

Mark	ECU Pin	Function & Definition
1		Ignition switch
2		Ground
3	J1-10	Signal high

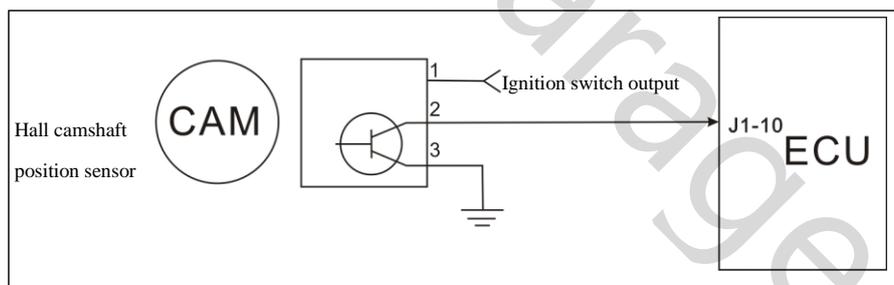


Fig. 7-24 Circuit of Camshaft Position Sensor

(1) Schematic and pin

(2) Installation position

It's on the side of cylinder head.

(3) Operating principles

This sensor is used for the occasion without distributor, matches the pulse disc sensing sensor, and provides the positions of crankshaft and camshaft for ECU, i.e. to distinguish the compression top dead center and exhaust top dead center of crankshaft.

This sensor consists of a Hall sensor and a rotor made of steel plate. Hall sensor is fixed and the rotor is installed on the camshaft. The rotor is a circular steel blade capable of rotating within 180°. When the blade covers Hall sensor, no signals are available for output; otherwise the signals will be outputted. Two and half cycles of camshaft are equal to two whole cycles of crankshaft, and the compression top dead center and exhaust top dead center of crankshaft can be distinguished based on it.

(4) Fault symptoms and judgment methods

- ① Fault symptoms: excessive emission or increase of fuel consumption, etc.
- ② Causes of common faults: man-made faults.
- ③ Measuring methods: refer to the relevant information in Section II or III.

8. Electronic control unit

(1) Schematic and pin

Definitions of national engine controller pins

TRITEC1.6L Definitions of engine controller pins

(2) Installation position

It's installed on the side of engine compartment.

(3) Operating principles

ECU is the core of engine electronic control system, the sensor provides various kinds of electronic control signals for ECU, and then ECU controls a series of actions of fuel injector and ignition coil, etc after their internal calculation, so as to control the operation of engine.

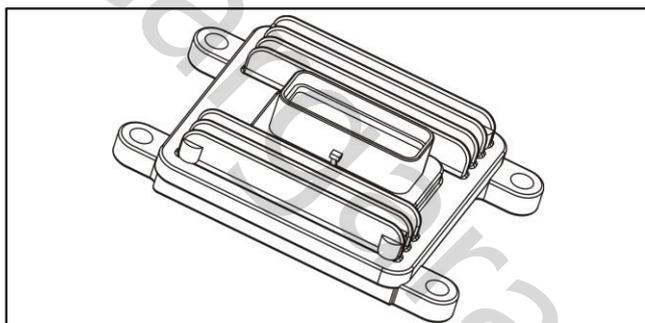


Fig. 7-25 Engine ECU

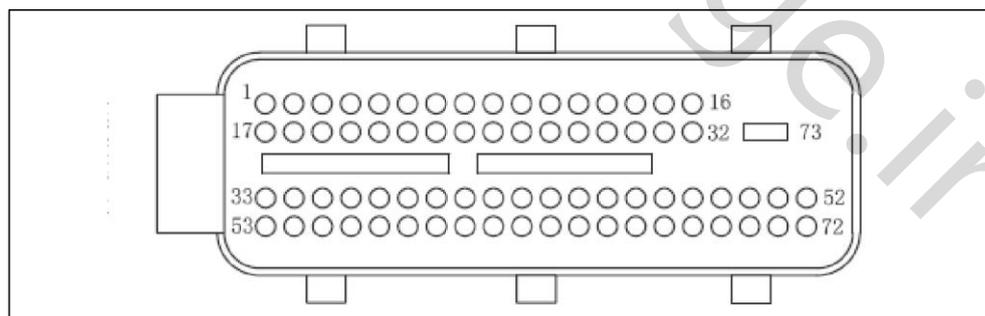


Fig. 7-26 Engine ECU Pin

(4) Fault symptoms and judgment methods

- ① Fault symptoms: unstable idle, poor acceleration, starting failure, overhigh idle, excessive exhaust, starting difficulty, A/C failure, failure of fuel injector control and stop, etc.

② Causes of common faults: 1. The burning and failure of parts in ECU are caused by electric overload of external connection device; 2. The circuit board is rusted due to the entry of water into ECU, etc.

(5) Attentions for repair:

① Don't remove ECU randomly during the repair;

② Remove the battery harness connector for at least 1min before removing ECU;

③ It's prohibited to attach any circuit to the connection wire of ECU.

④ Measuring methods: refer to the relevant information in Section II or III.

Table 7-8 Definition of National Engine Controller Pin

Pin no.	Definition	Pin no.	Definition	Pin no.	Definition
J1-01	Ignition switch	J1-02	Main relay rear power	J1-03	Car speed
J1-04	2# 5V power +	J1-05	1# 5V power-	J1-06	Oxygen sensor signal low
J1-07	Not used	J1-08	Not used	J1-09	Medium-voltage switch signal
J1-10	Not used	J1-11	Serial data	J1-12	Crankshaft 58-tooth signal high
J1-13	Not used	J1-14	Can line negative terminal	J1-15	Can line positive terminal
J1-16	Not used	J1-17	Battery power 1	J1-18	Battery power 2
J1-19	Not used	J1-20	1# 5V power +	J1-21	2# 5V power-
J1-22	Fault diagnosis lamp	J1-23	Not used	J1-24	Throttle position
J1-25	Not used	J1-26	Not used	J1-27	Inlet temperature
J1-28	Crankshaft 58-tooth signal low	J1-29	Not used	J1-30	Not used
J1-31	Engine fault diagnosis lamp	J1-32	Ignition coil A	J1-33	Idle B phase output+
J1-34	Idle A phase output-	J1-35	Acceleration signal	J1-36	Power steering signal
J1-37	Not used	J1-38	Rear oxygen sensor signal high	J1-39	A/C request (+)
J1-40	Not used	J1-41	Not used	J1-42	Inlet pressure
J1-43	Cooling fluid temperature	J1-44	Not used	J1-45	Tachometer
J1-46	A/C compressor clutch relay control	J1-47	Fuel pump relay control	J1-48	Not used
J1-49	Instrument power	J1-50	High-speed fan relay control	J1-51	Not used
J1-52	Ignition coil B	J1-53	Idle A phase output-	J1-54	Idle A phase output+
J1-55	1-cylinder fuel injecting nozzle	J1-56	3-cylinder fuel injecting nozzle	J1-57	
J1-58	Not used	J1-59	Not used	J1-60	Not used

Table 7-9 Definitions of Inlet Engine Controller Pins

Pin no.	Definition	Pin no.	Definition	Pin no.	Definition
J1-01	Ignition switch	J1-26	Evaporated fluid temperature sensor signal	J1-51	
J1-02	Main relay output	J1-27	Inlet temperature signal	J1-52	2,3-cylinder ignition coil
J1-03	Car speed sensor	J1-28	Crankshaft sensor low	J1-53	Stepping motor a-
J1-04	Pressure temperature sensor power	J1-29		J1-54	Stepping motor a+
J1-05	Throttle position negative terminal	J1-30		J1-55	Nozzle 1
J1-06	Front oxygen ground terminal	J1-31	Malfunction indicating lamp	J1-56	Nozzle 3
J1-07		J1-32	1,4 ignition coil	J1-57	
J1-08		J1-33	Stepping motor b+	J1-58	Main relay control
J1-09	A/c compressor switch input	J1-34	Stepping motor b-	J1-59	
J1-10	Camshaft input positive terminal	J1-35	Acceleration signal	J1-60	
J1-11	Diagnostic line	J1-36	Power-assisted steering	J1-61	Front oxygen heating control
J1-12	Crankshaft sensor input negative terminal	J1-37		J1-62	Front oxygen signal
J1-13		J1-38	Rear oxygen signal	J1-63	Canister solenoid valve
J1-14	Can low	J1-39	A/c request	J1-64	Rear oxygen heating control
J1-15	Can high	J1-40		J1-65	
J1-16		J1-41	Neutral position switch	J1-66	
J1-17	Battery positive terminal	J1-42	Manifold pressure sensor	J1-67	Low-speed fan control
J1-18	Battery positive terminal	J1-43	Cooling fluid sensor	J1-68	
J1-19		J1-44		J1-69	Knock sensor signal
J1-20	Throttle position positive terminal	J1-45	Tachometer	J1-70	Nozzle 2
J1-21	Temperature pressure ground	J1-46	A/c compression relay clutch switch	J1-71	Nozzle 4
J1-22	Exhaust fault lamp	J1-47	Fuel pump relay control	J1-72	
J1-23	Ad4	J1-48		J1-73	System ground
J1-24	Throttle position sensor signal	J1-49	Fuel position sensor		
J1-25		J1-50	High-speed fan relay		

9. Electric fuel pump

(1) Schematic, pin schematic and pin

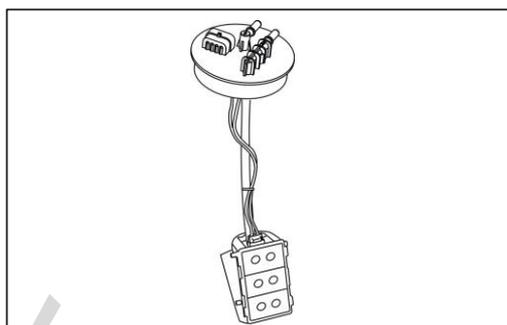


Fig. 7-27 Electric Fuel Pump

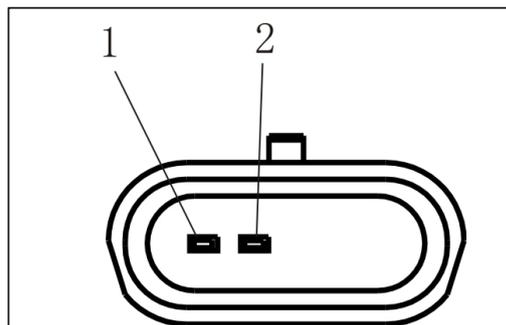


Fig. 7-28 Electric Fuel Pump Pin

- 1- Connect to inertia switch 2-Connect to fuel pump relay
- 2-

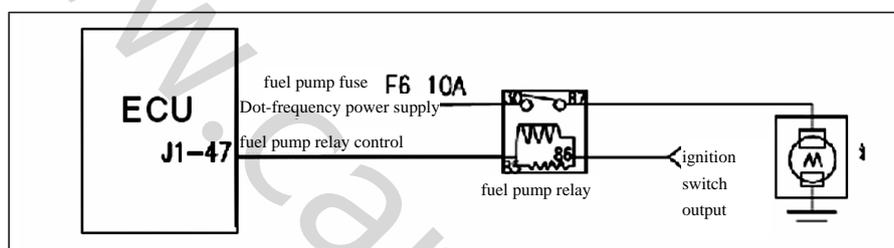


Fig. 7-29 Circuit of Electric Fuel Pump

(2) Installation position

It's installed in the fuel tank.

(3) Operating principles

Electric fuel pump consists of DC motor, blade pump and end cover (integration of check valve, relief valve and anti-electromagnetic interference elements),etc.

Pump and motor are installed on the same shaft and closed in the same housing. The pump and motor in the housing are filled with the gasoline, and adopt the fuel for heat radiation and lubrication. The battery supplies the power to electric fuel pump through the fuel pump relay, and the relay can activate the circuit of electric fuel pump only in case of starting and running engine. When the engine stops due to an accident, the fuel pump will stop automatically.

The maximum pressure of electric fuel pump outlet is determined by the relief valve, which shall be within 450 to 650 kPa. Since this system adopts a non-return oil system, the pressure of whole fuel system shall be determined by the fuel pressure regulator, which is usually 350 kPa.

According to the demands of engine, the electric fuel pump can have different flows. For the convenience of production, the electric fuel pump with the same structure adjusts the speed of motor by adjusting the turn number of coil to adjust the flow, so the electric fuel pump of one car type can't be used for another car type randomly.

(4) Attentions for installation

①The fuel pump shall be carefully taken out of its plastic packing material during the installation. The protective cover can be taken away only when the fuel pump is to be installed immediately. It's absolutely prohibited to take away the strainer of fuel inlet. The foreign materials having entered into the fuel pump fuel inlet or its strainer will lead to the damages to fuel pump. Keep it clean during the installation of fuel pipe.

②According to the demands of engine, the electric fuel pump can have different flows, but the fuel pump with the same shape, which can be installed, shall not be proper, and applied Part No. of fuel pump must be consistent with that of the original one, which may not be mistaken;

③In order to avoid any unexpected damage of fuel pump, don't run it under the dry conditions;

④In case of requiring the replacement of fuel pump, pay attention to the cleaning of fuel tank and pipes as well as replacement of fuel filter.

(5) Fault symptoms and judgment methods

①Fault symptoms: large running noise, poor acceleration or starting failure (starting difficulty), etc.

②Causes of common faults: use of inferior fuel.

③Measuring methods: refer to the relevant information in Section II or III.

10. Electromagnetic fuel injector

(1) Schematic, pin schematic and pin

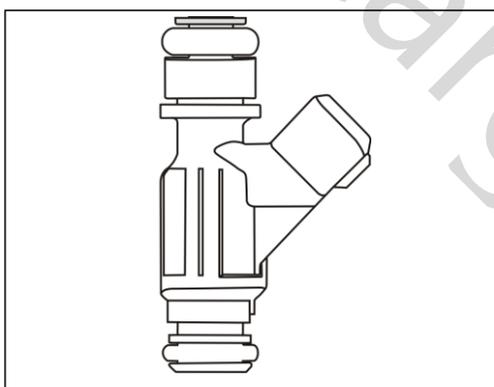


Fig. 7-30 Electromagnetic fuel injecting nozzle

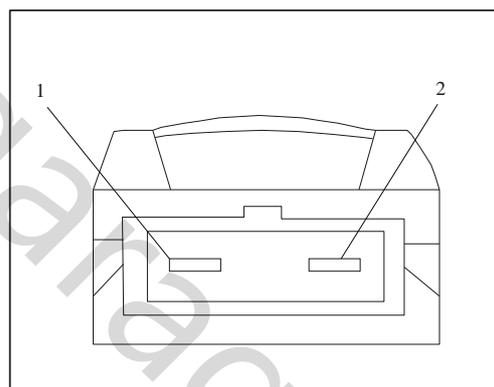


Fig. 7-31 Electromagnetic fuel injecting nozzle pin

Type	Mark	ECU Pin	Function & Definition
Fuel injector 1	1	J1-02	Main relay output
	2	J1-55	1-cylinder control signal
Fuel injector 2	1	J1-02	Main relay output
	2	J1-70	2-cylinder control signal
Fuel injector 3	1	J1-02	Main relay output
	2	J1-56	3-cylinder control signal
Fuel injector 4	1	J1-02	Main relay output
	2	J1-71	4-cylinder control signal

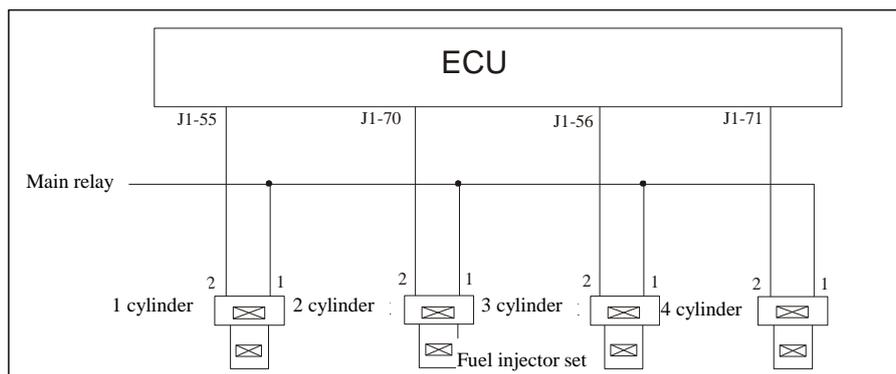


Fig. 7-32 Circuit of Electromagnetic Fuel Injecting Pump

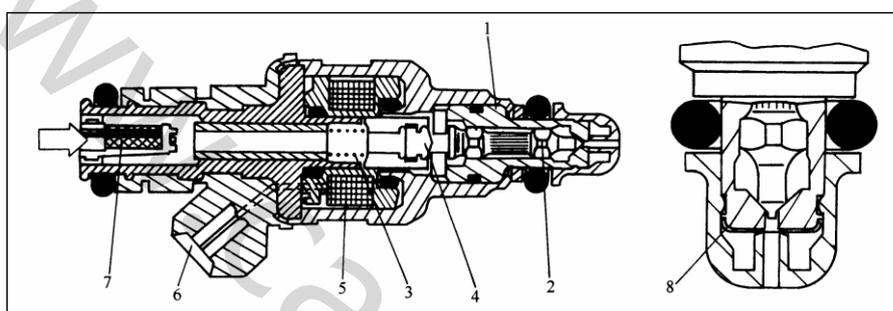


Fig. 7-33 Section of Electromagnetic Fuel Injecting Pump

1-Nozzle body 2-Needle valve 3-Spring 4-Iron core 5-Solenoid coil 6-Circuit plug 7-Strainer 8-Spacer plate

(2) Installation position

It's on the inlet manifold near to the end of inlet valve.

(3) Operating principles

ECU sends an electric pulse the coil of fuel injector to form a magnetic field force. When the magnetic field force is increased to overcome the sum of spring return force, needle valve weight and frictional force, the needle valve rises to activate the fuel injection. When the fuel injection pulse is cut off, the pressure of return spring makes the needle valve closed again.

(4) Attentions for installation

- 1) Confirm the trade mark and product number.
- 2) For a certain fuel injector, be sure to adopt the designated plug, and don't mix it.
- 3) For the convenience of installation, recommend the clean silica-free machine oil to the surface of upper O ring connected to the fuel distributing pipe. Don't make the machine oil pollute the inside and spray orifice of fuel injector.
- 4) Install the fuel injector into fuel injector seat vertical to the seat of fuel injector, and fix the fuel injector to its seat with a clamp.

Note:

① According to the locating mode, the clamp of fuel injector is divided into axial locating clamp and axial/radial locating clamp, which shall not be wrongly used.

②For the installation of fuel injector capable of axial locating, ensure that the middle bayonet of clamp is completely inserted into the clamping slot of fuel injector, and the clamping slots on both sides of clamp are completely inserted into the external flanging of fuel injector seat.

③The fuel injector subject to axial and radial locating requirements shall be installed with an axial/radial locating clamp, the locating block of fuel injector and locating pin of fuel injector seat shall be separately located in the corresponding slots of locating clamp.

④If the fuel injector has two clamping slots, avoid any wrong locating by referring to the installation position of original one. The fuel injector shall be installed by hands, it's prohibited to use a hammer or any similar tool to hit the fuel injector. In case of removing and reinstalling the fuel injector, replace O-ring. At this time, don't damage the sealing face of fuel injector. The supporting washer of O-ring shall not be pulled out of the fuel injector. During the installation, avoid any damage to the inlet end, O-ring, supporting ring, spray orifice and electric plug of fuel injector. In case of any damage, it's prohibited to use any of them. After installing the fuel injector, apply a leak test to the fuel distributing pipe assembly. The leak-free one shall be regarded as qualified.

5) Any failed part shall be removed by hands. Remove the clamp of fuel injector, and then pull the fuel injector out of its seat. Ensure that the seat of fuel injector is clean and pollution-free after removing it.

(5) Fault symptoms and judgment methods

Fault symptoms: poor idle, poor acceleration or starting failure (starting difficulty), etc.

Causes of common faults: the accumulation of gum in the fuel injector, which is caused by the lack of maintenance, leads to its failure.

Measuring methods:

Refer to the relevant information in Section II or III.

11. Fuel pressure regulator

(1)Schematic

(2)Installation position

It's installed on the fuel pump assembly.

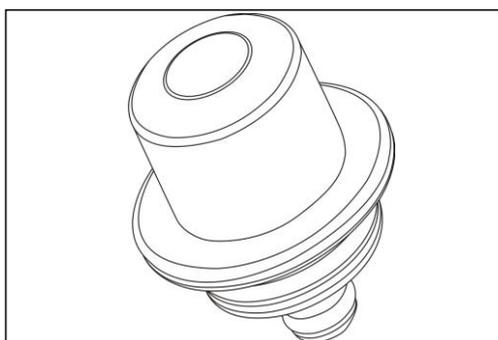


Fig. 7-34 Fuel Pressure Regulator

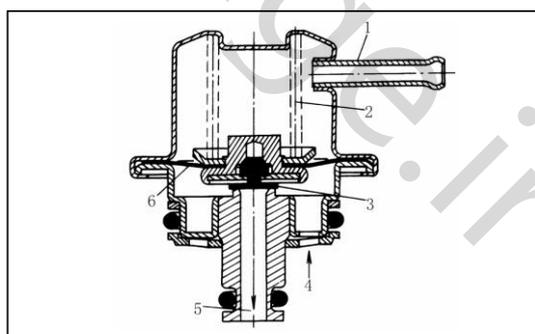


Fig. 7-35 Section of Fuel Pressure Regulator

1-Connect to inlet manifold 2-Spring 3-Valve
4-Fuel inlet hole 5-Fuel return hole 6-Diaphragm

(3)Operating principles

A flexible film made of rubber fiber divides the fuel pressure regulator into upper and lower chambers. The upper chamber is connected to the atmosphere, and the springs exist in this chamber. The lower chamber is full of the fuel come from the fuel inlets around the pressure regulator. The lower part of thin film is subject to the fuel pressure, and its upper part is subject to the sum of atmospheric pressure and spring pressure. The deformation of film can drive the valve seat to make the valve opened or closed, but the applying force of springs can be regarded as constant due to its slight deformation, so the opening and closing of valve are mainly determined by the difference of the fuel pressure in lower chamber and atmospheric pressure in upper chamber. After assuming that the valve is closed at first, due to the increase of pressure difference between upper and lower chambers caused by the increase of fuel pressure, the film is lifted by the fuel pressure, the valve is opened, the fuel is drained to the fuel tank through the oil return opening of pressure regulator, and the pressure of fuel drops until the valve is closed. Thus, the difference between the pressure of fuel system and atmospheric pressure keeps constantly when the operating conditions of engine are changed.

(4)Attentions for installation

Pay attention to the following items during the repair:

①It's prohibited to impact the diaphragm elements with high-pressure gas.

②It's prohibited to clean them with strong corrosive fluid.

③Avoid any deformation caused by the external force.

(5)Fault symptoms and judgment methods

1) Fault symptoms: starting difficulty, unstable idle of engine, increase of air pollution.

2) Causes of common faults:

①Dirt of valve or leaks of pipe fitting caused by its loosening or damages.

②Short or open circuit of solenoid valve coil or its internal circuit leads to the failure of opening the solenoid valve.

3) Measuring methods:

Refer to the relevant information in Section II or III.

12. Steel fuel distributing pipe assembly

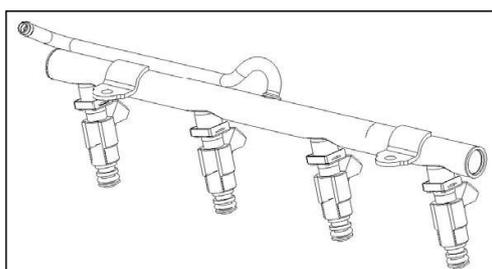


Fig. 7-36 Fuel Distributing Pipe (Tritec 1.6L)

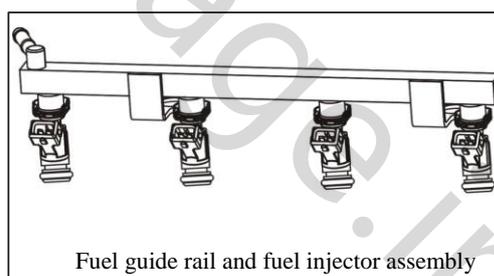


Fig. 7-37 Fuel Distributing Pipe (LF479/481 Series)

(1) Schematic.

(2) Installation position

It's installed on the inlet manifold.

(3)Operating principles

The fuel distributing pipe assembly consists of fuel distributing pipe, fuel injector and fuel injector clamp. It's used to store and distribute the fuel.

(4)Attentions for installation

①The connection of inlet pipe and rubber tube is tightened with a clamp, the model of selected clamp matches the rubber tube, so as to ensure the tightness of inlet pipe and rubber tube.

②No cracks, scars, grooves, burrs or rusts exist in the wall of inlet pipe.

③Before installing the fuel distributing pipe assembly, lubricate the lower O-ring of fuel injector with clean lubricating oil.

(5) Fault symptoms and judgment methods

①Fault symptoms: leakage of fuel system or starting difficulty, etc.

②Causes of common faults: man-made mechanical damage, etc.

③Measuring methods: refer to the relevant information in Section II or III.

13. Idle actuator stepping motor

(1) Schematic and pin

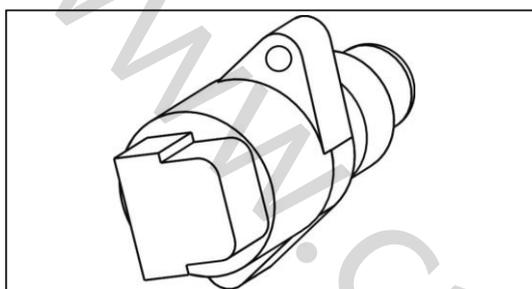


Fig. 7-38 Idle Actuator Stepping Motor

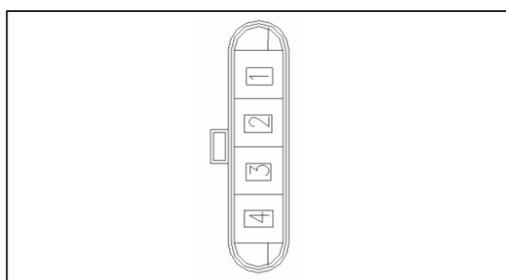


Fig. 7-39 Idle Actuator Stepping Motor Pin

Table 7-11 Definitions of Idle Actuator Stepping Motor Pins

Mark	ECU Pin	Function & Definition
1	J1-34	B-
2	J1-33	B+
3	J1-53	A-
4	J1-54	A+

(2) Installation position

It's on the throttle body.

(3) Operating principles

Stepping motor is a micro-motor, and it consists of several steel stators in a circle and a rotor, as shown in the figure below. Each steel stator is wound by a coil; the rotor is a permanent magnet, whose center is a nut. All the stator coils shall be always powered on. Provided that one of these coils changes its current direction, the rotor turns by a certain angle. When each stator coil changes its current direction in the appropriate sequence, a rotating magnetic field will be formed, which makes the rotor made of permanent magnet turn in a certain direction. If the current direction changing sequence is reversed, the turning direction of rotor will be reversed. The nut connected to the center of rotor drives a screw rod because the screw rod is designed in a non-rotatable structure, so it can move only in axial direction, and it's also called as linear axis. The end socket of screw rod is a chock plug, which can retract or extend to increase or reduce or reduce the sectional area of bypass inlet channel of idle actuator, until it's blocked. Every time the current direction of a certain coil is changed, the rotor will turn by a fixed angle, which is called as

step length, whose value is equal to 360° divided by the number of stators or coils. The step length of this stepping motor rotor is 15° . Correspondingly, the distance moved by screw rod in every step is also fixed. ECU controls the moving steps number of stepping motor by controlling the number of changing the current directions of each coil, so as to adjust the sectional area of bypass channel and air flow through it. The air flow is mainly in linear relations with the step length. A spring is behind the chock plug of screw rod end socket, as shown in the figure below. The force applied in extending direction of chock plug is the sum of stepping motor applying force and spring force; the force applied in retracting direction of chock plug is equal to the stepping motor applying force minus spring force.

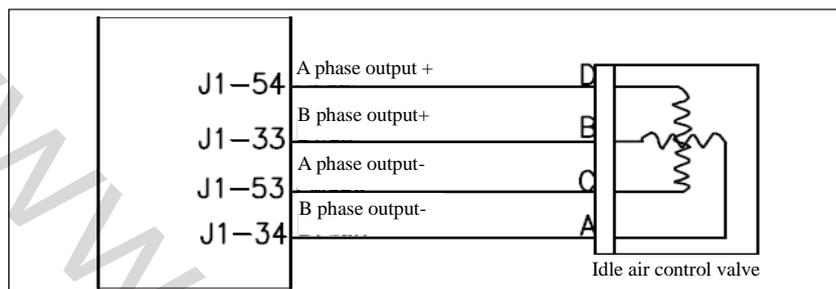


Fig. 7-40 Idle actuator Stepping motor circuit

(4) Attentions for installation

- ① Don't apply any form of force in axial direction to press or pull out the shaft;
- ② Before the idle regulator with a stepping motor is installed into the throttle body, its shaft must be completely retracted;
- ③ Pay attention to the cleaning and care of bypass air channel;
- ④ After removing the battery or ECU, pay attention to the timely self-learning to stepping motor. Self-learning method of M7 system: activate the ignition switch but don't start the engine at once, and restart the engine after waiting for 5s. If the idle of engine is found to be poor at this time, it's required to repeat the above steps.

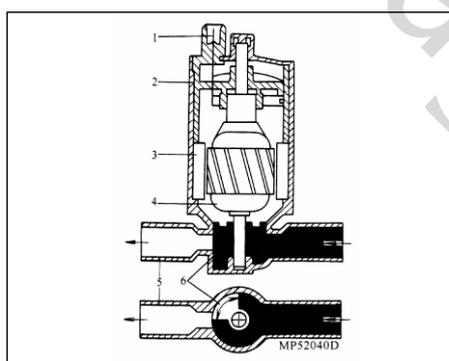


Fig. 7-41 Section of Idle Stepping Motor

1-Connector 2-Shell 3-permanent magnet 4-Rotor 5-Attached air channel 6-Rotary valve

(5) Fault symptoms and judgment methods

- ① Fault symptoms: overhigh idle, idle stop, etc.
- ② Causes of common faults: the partial blockage of bypass air channel caused by the accumulation of dust or oil gas, etc leads to the abnormal adjustment of stepping motor.

③ Measuring methods: refer to the relevant information in Section II or III.

14. Dual-spark ignition coil

(1) Schematic and pin

(2) Installation position

It's on the engine.

(3) Operating principles

The ignition coil consists of primary winding, secondary winding, iron core and shell, etc. When the voltage of battery is applied to the primary winding, the primary winding is charged. Once ECU cuts off the circuit of primary winding, the charging will discontinue, and the high voltage of secondary winding will be sensed.

(4) Fault symptoms and judgment methods

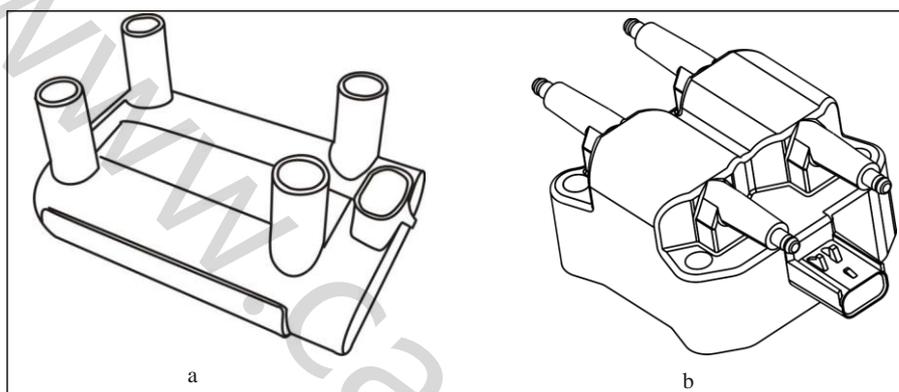


Fig. 7-42 Ignition coil

A-Lifan series engine b-Tritec1.6L

1) Fault symptoms: engine unstable idle, interrupted shutdown or starting failure.

2) Causes of common faults:

① Short circuit, open circuit or earthing of ignition coil winding makes the voltage produced by ignition coil overlow or no high-voltage produced, which will lead to the insufficient ignition energy or failure of ignition.

② The aged insulating materials of ignition coil make its insulating performance worse, and the weak spark or ignition failure of ignition system is caused by the electric leakage of ignition coil.

3) Attentions for repair: during the repair, it's prohibited to test the ignition function by adopting "Short-circuit Spark Method" to avoid any damage to the electronic controller.

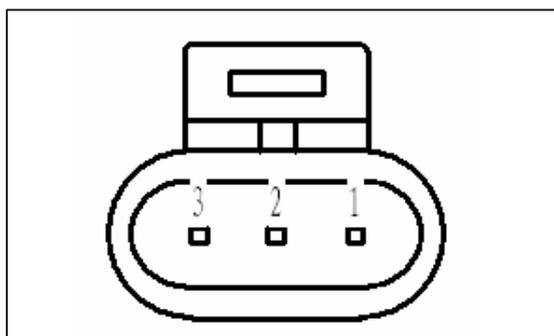


Fig. 7-43 Ignition Coil Pin

Table 7-12 Definitions of Ignition Coil Pins

Mark	ECU Pin	Function & Definition
1	J1-32	Control signals of 1-4 cylinders
2	J1-01	Ignition switch power+
3	J1-52	Control signals of 2-3 cylinders

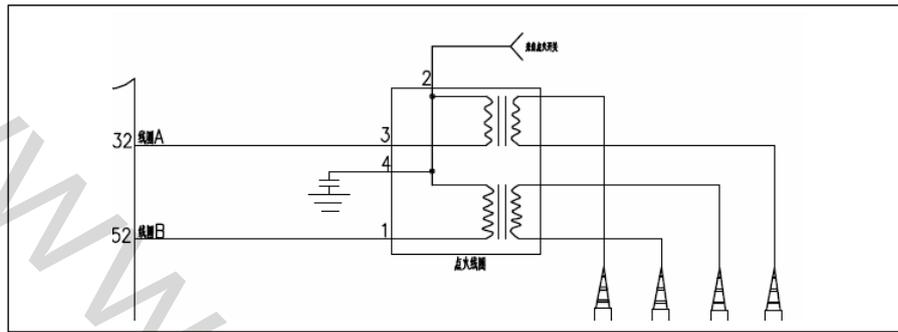


Fig. 7-44 Circuit of Ignition Coil

4) Measuring methods: refer to the relevant information in Section II or III.

15. Canister control valve

(1) Schematic and pin

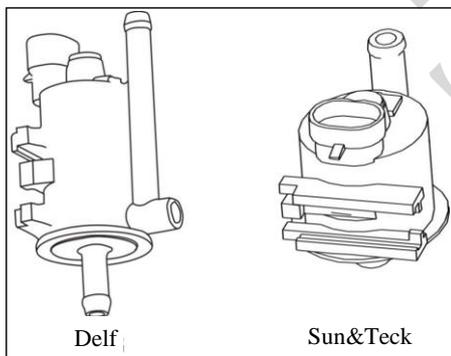


Fig.7-45 Canister Control Valve

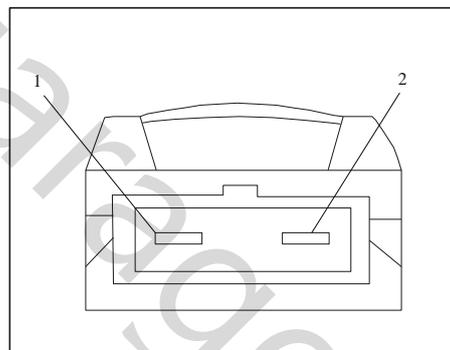


Fig.7-46 Canister Control Valve Pin

Table 7-13 Definitions of Canister Control Valve Pins

Mark	ECU Pin	Function & Definition
1	J1-02	Main relay output
2	J1-63	Control of canister solenoid valve

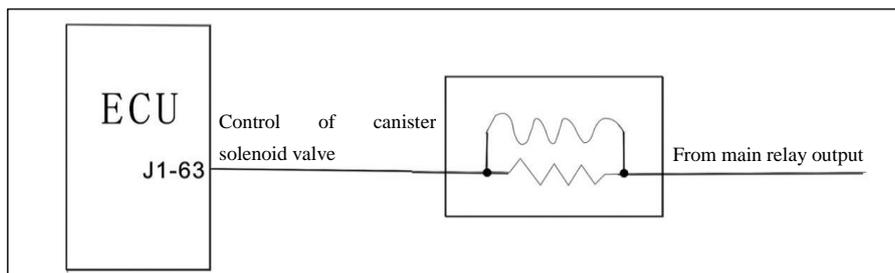


Fig. 7-47 Circuit of Canister Control Valve

(2) Installation position of canister control valve

It's on the vacuum pipe of inlet manifold.

(3) Operating principles

The canister control valve consists of solenoid coil, armature iron and valve, etc. A strainer is set at its inlet. On one hand, the flow of air through the canister control valve is related to the duty factor of ECU's pulse sent to this valve, on other hand the flow is related to the pressure difference between the inlet and outlet of canister control valve. When no electric pulses exist, the canister control valve will be closed.

(4) Attentions for installation

① During the installation, the direction of air flow must be consistent with the specified direction;

② When the failure of control valve is caused by black particles in valve body, and the control valve needs to be replaced, please check the canister;

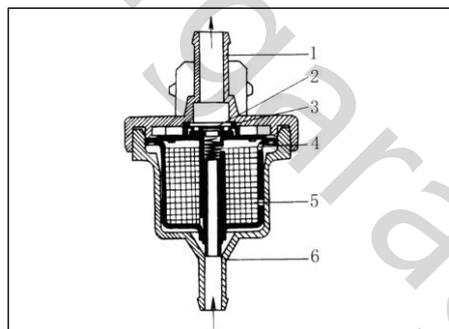


Fig. 7-48 Section of Canister Control Valve

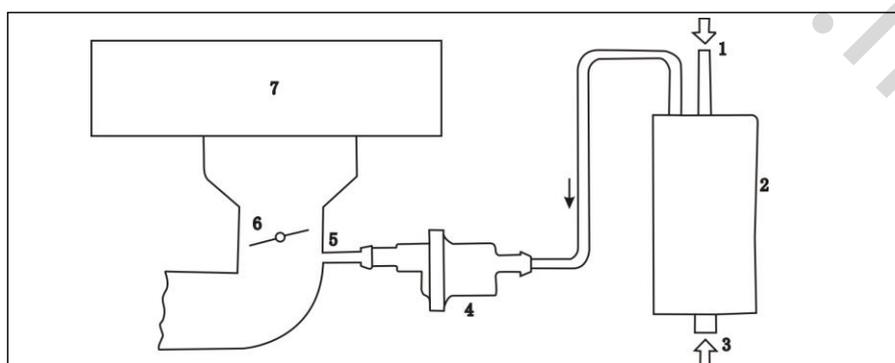


Fig. 7-49 Schematic of Canister Control Valve Operation

1-From oil tank 2-Canister 3-From atmosphere 4-canister control valve 5-to inlet manifold 6-throttle 7-engine

③ During the repair, try to avoid the entry of water or oil etc into the valve;

④ In order to avoid the transmission of solid sound, recommend that the canister control valve is suspended and installed over the hose.

(5) Fault symptoms and judgment methods

① Fault symptoms: failure of function, the gasoline leakage and environmental pollution caused by the excessive accumulation of gasoline steam in active carbon canister.

② Causes of common faults: the rusting or poor tightness caused by the entry of foreign materials, etc.

③ Measuring methods: refer to the relevant information in Section II or III.

16. Active carbon canister

(1) Schematic

(2) Installation position of canister

It's below the left side of engine.

(3) Operating principles

The canister is used to absorb the gasoline steam produced in the fuel tank, and works in the engine. When the canister vent control valve is opened by the control of computer, it makes the air through the inlet manifold due to the action of vacuum absorption take away the absorbed gasoline molecules and avoid their entry into the inlet manifold for burning.

(4) Fault symptoms and judgment methods

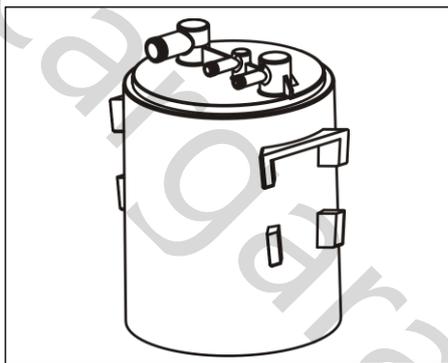


Fig. 7-50 Active Carbon Canister

1) Fault symptoms: increase of car fuel consumption and air pollution.

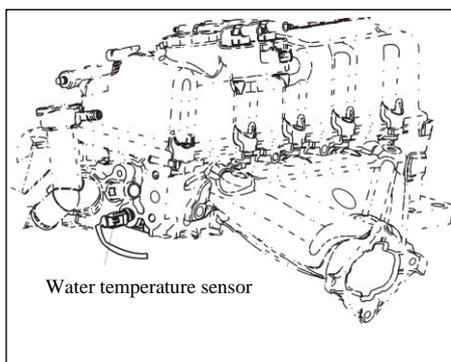


Fig. 7-51 Tritec 1.6L engine System

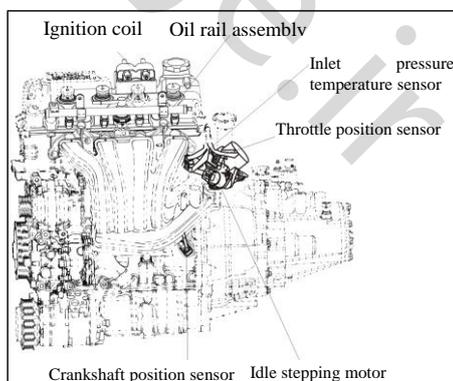


Fig. 7-52 LF481/479 Series Engine System 1

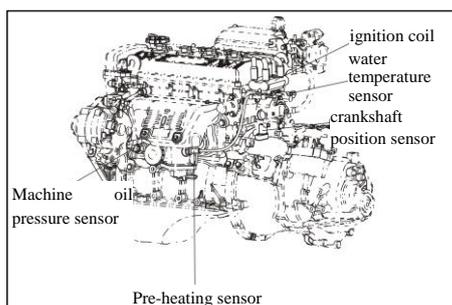


Fig. 7-53 LF481/479 Series Engine System 2

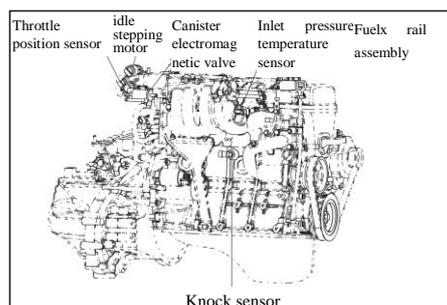


Fig. 7-54 LF481/479 Series Engine System 3

2) Causes of common faults: common faults of canister include dirt or damage, etc, which makes the canister unable to absorb the gasoline steam or vent blockage, resulting in non-return of fuel steam.

3) Check and repair of faults.

The check and repair methods of canister are as follows:

① Check the canister for damages, remove it to check its damages.

② Pull the air pipe of canister open;

③ Start the engine. When the engine temperature reaches at least 60°C, increase the engine speed (3500r/min or so) properly, check the canister air pipe joint for vacuum (air suction).

Normally, it shall be vacuum. If the result is abnormal, it indicates the canister is blocked, and shall be replaced.

II. Installation positions of electronic fuel injection system parts

1. Installation positions of electronic fuel injection system parts

This section includes: throttle valve body assembly, throttle position sensor, idle stepping motor, inlet pressure and inlet temperature sensor, cooling fluid temperature sensor, knock sensor, pre-heating oxygen sensor, crankshaft position sensor, camshaft position sensor, fuel injector, ignition coil and canister solenoid valve. TRITEC and Lifan engine electronic spray elements with the same installation positions and shapes as those of Lifan are indicated in the figures of Lifan engine, and the electronic spray elements of Tritec 1.6L engine, which are different from those of Lifan, are indicated in the figures of Tritec 1.6L engine.

III. Control Circuit of Engine

1. Power supply, grounding and ignition control of engine control module, and circuit of crankshaft position sensor.

2. Circuits of fuel pump, fuel injector and oxygen sensor

3. Idle air control, sensor and waste gas recirculating circuit

4. Circuits of canister solenoid valve, camshaft position sensor, instrument and car speed sensor.

5. Control circuits of combination instrument and fuel pump.

Section II Diagnostic Process for Fault Remedy Based on Fault

Codes

I. Fundamental principles for fault diagnosis of electronic fuel injection system

1. Records for fault messages

The electronic control unit monitors the sensor, actuator, relevant circuits, malfunction indicating lamp, battery voltage and even itself, and check the credibility of sensor output signal, actuator drive signal or internal signal (e.g. oxygen closed-loop control, knock control, idle rotating speed control and battery voltage control, etc). Once any fault occurs to a certain link, or a certain signal value is incredible, the electronic control unit will set the records for fault messages in RAM fault memory at once. The records for fault messages will be stored in form of fault codes, and indicated in the sequence of fault occurrence. The faults can be divided into "stable fault" and "random fault" (e.g. the fault caused by temporary open circuit of harness or poor contact of connector) according to the frequency of its occurrence.

2. Fault state

If the duration of recognized fault exceeds the set stabilization time for the first time, ECU thinks it's a stable fault and stores it as a "stable fault". If this fault disappears, ECU will store it as a "random fault" and "nonexistent fault". If this fault is re-recognized, it's still a "random fault", but "existing" historic faults don't influence the normal operation of engine.

3. Fault type

This system has the following fault types:

- a. Short to power +;
- b. Short to ground;
- c. Open circuit (in case of pull-up or pull-down resistance on input stage, ECU will recognize the open circuit of input interface as its short circuit to power+ or ground);
- d. Incredible signal

4. Limping

For any of recognized key faults, when its duration exceeds the set stabilization time, ECU will adopt appropriate soft strategies, e.g. deactivation of oxygen sensor closed-loop control or other control functions, and set the substituted values for some incredible data, etc. At this time, the working conditions of engine are worse, but the car can still drive. Its purpose is to make the car drive back to home or service station for check and repair, so as to avoid the breakdown of car on the highway or off-road field. Upon recognizing the faults have disappeared, recover the use of normal data.

5. Fault warning

The car equipped with this system has a malfunction indicating lamp. When any fault occurs to a key part like ECU, absolute pressure manifold, absolute pressure sensor, throttle position sensor, cooling fluid temperature sensor, knock sensor, oxygen sensor, camshaft position sensor, fuel injector, two driving stages of idle actuator stepping motor, canister solenoid valve or fan relay, ECU will flash for warning in the corresponding fault position through a malfunction indicating lamp, until this fault position resets.

6. Fault readout

The records for fault messages can come out of the electronic control unit with a fault diagnostic instrument. If the fault is related to the function of fuel-air-mixed gas proportion regulator, the engine must run for a time before reading the records for fault messages.

7. Elimination of records for fault messages

After removing the fault, eliminate the records for fault messages in a memory through the following channels:

- a. Eliminate the records for fault messages through the command of “fault memory 0 reset” with a fault diagnostic instrument;
- b. Pull down the connector of ECU or remove the wire of battery to eliminate the records for fault messages in external RAM.

8. Fault finding:

After obtaining the records for fault messages by adopting the above measures, only the approximate positions of faults can be found, but the detailed faults can't be found, because the cause of a fault message may be the damages of electric element (e.g. Sensor, actuator or ECU, etc), open circuit of conductor, short circuit of conductor to ground or battery positive pole or even a mechanical fault. Any fault is hidden, and its external demonstrating results are all kinds of symptoms. After finding out the symptoms, check whether there are records for fault messages with a fault diagnostic instrument or according to the flashing codes, remedy the relevant faults according to the fault messages, and then find the faults as per the symptoms of engine.

II. Basic steps of fault diagnosis based on fault codes

1. Throttle position sensor

Fault code: P0122 throttle position sensor low voltage

Fault code: P0123 throttle position sensor high voltage

S/N	Operating procedure	Test result	Follow-up step
1	Turn the ignition switch to “ON”.		Next step
2	Pull down the connector of throttle position sensor from the harness, and adopt a multimeter to measure whether the voltage between (1) pin and (2) pin of this connector is 5V or so.	Yes	Next step
		No	5
3	Adopt a multimeter to measure whether the resistance between (1) pin and (2) pin of this sensor is 1.6 to 2.4k or so.	Yes	Next step
		No	Replace the sensor.
4	Turn the throttle position sensor slowly from its one end to the other end, while checking whether the circuit between (1) pin (-) and (3) pin (+) of throttle position sensor is open or short, or its resistance is skipped.	Yes	Replace the sensor.
		No	Replace ECU.
5	Connect an adaptor between ECU and harness, and check whether the circuits between J1-20, J1-05 and J1-24 pins of ECU and (1), (2) and (3) pins of sensor connector are open or short.	Yes	Repair or replace the harness.

2. Knock sensor

Fault code: P0325 fault of knock sensor circuit

S/N	Operating procedure	Test result	Follow-up step
1	After turning off the ignition switch, the engine doesn't run.		Next step
2	Pull down the connector of knock sensor from the harness, and adopt a multimeter to measure whether the resistance between (1) pin and (2) pin of this sensor is more than 1M.	Yes	Next step
		No	Renew the sensor.
3	Hit around the knock sensor lightly with a small hammer, and adopt a multimeter to check whether an AC output signal is produced between (1) pin and (2) pin of this sensor.	Yes	Next step
		No	Replace the sensor.
4	Turn on the ignition switch, but don't start the engine.		Next step
5	Connect an adaptor between ECU and harness, and check whether the circuits between J1-05 and J1-69 pins of ECU and (1) and (2) pins of sensor connector are open or short.	Yes	Repair or replace the harness.
		No	Replace ECU.

3. Inlet pressure and inlet temperature sensor

Fault code: P0107 inlet pressure part low voltage of inlet pressure and inlet temperature sensor

Fault code: P0108 inlet pressure part high voltage of inlet pressure and inlet temperature sensor

Fault code: P0112 inlet temperature part low voltage of inlet pressure and inlet temperature sensor

Fault code: P0113 inlet temperature part high voltage of inlet pressure and inlet temperature sensor

S/N	Operating procedure	Test result	Follow-up step
1	Turn the ignition switch to "ON".		Next step
2	Pull down the connector of inlet pressure and inlet temperature sensor from the harness, and adopt a multimeter to measure whether the voltage between (1) pin and (3) pin of this connector is 5V or so.	Yes	4
		No	Next step
3	Measure whether J1-21, J1-27 & J1-42 pins of ECU and (1), (3) & (4) pins of this sensor connector are open or short.	Yes	Repair or replace the harness.
		No	Next step
4	Turn on the ignition switch, but don't start the engine.		Next step
5	Put in neutral gear, start the engine, and make it idling. Step down the accelerator to approximately full open, and adopt a multimeter to measure whether the voltage between (4) pin and (1) pin of this sensor (J1-42 pin and J1-21 pin of ECU) through an adaptor is gradually increased up to 4V.	Yes	Replace ECU.
		No	Replace ECU. Replace the sensor.

4. Oxygen sensor

Fault code: P0031 Heating oxygen sensor heater control circuit low (front oxygen)

Fault code: P0032 Heating oxygen sensor heater control circuit high (front oxygen)

Fault code: P0037 Heating oxygen sensor heater control circuit low (rear oxygen)

Fault code: P0038 Heating oxygen sensor heater control circuit high (rear oxygen)

Fault code: P0130 fault of oxygen sensor circuit (front oxygen)

Fault code: P0131 low voltage of oxygen sensor circuit (front oxygen)

Fault code: P0132 high voltage of oxygen sensor circuit (front oxygen)

Fault code: P0134 check that the oxygen sensor is inactive (front oxygen)

Fault code: P0136 fault of oxygen sensor circuit (rear oxygen)

Fault code: P0137 low voltage of oxygen sensor circuit (rear oxygen)

Fault code: P0138 high voltage of oxygen sensor circuit (rear oxygen)

Fault code: P0140 check that the oxygen sensor is inactive (rear oxygen)

Fault code: P1166 self-adapting diagnosis fault of oxygen sensor controller

S/N	Operating procedure	Test result	Follow-up step
1	Turn the ignition switch to "ON".		Next step
2	Pull down the connector of oxygen sensor from the harness, and adopt a multimeter to measure whether the battery voltage between (1) pin (+) and (2) pin(-) of this connector is 12V.	Yes	Next step
		No	4
3	Adopt a multimeter to measure whether the resistance between (1) pin and (2) pin of oxygen sensor is 6 to 25.	Yes	Replace the sensor.
		No	Next step
4	Check whether the fuse of oxygen sensor heating circuit is broken.	Yes	Replace the fuse.
		No	Next step
5	Adopt a multimeter to check the circuit between (1) pin of oxygen sensor connector (1) and J1-02 pin of main relay or between (2) pin of this sensor connector and J1-61(front oxygen)/J1-64(rear oxygen) pin of ECU is open or short.	Yes	Repair or replace the harness.
		No	Next step
6	Insert the oxygen sensor connector of harness, put in neutral gear, start the engine, and make it idling until the temperature of cooling fluid reaches its normal value.		Next step
7	Pull down the connector of oxygen sensor from the harness, and adopt a multimeter to measure whether the output voltage between (4) pin (+) and (3) pin(-) of this sensor is 0.1 to 0.9V.	Yes	Next step
		No	Replace the sensor.
8	Connect an adaptor between ECU and harness, and check whether the circuits between J1-06 & J1-62 (front oxygen)/J1-38(rear oxygen) pins of ECU and (3) & (4) pins of this sensor connector are open or short.	Yes	Repair or replace the harness.

5. Cooling fluid temperature sensor

Fault code: P0116 trouble of engine cooling fluid temperature circuit range/performance

Fault code: P0117 low input of engine cooling fluid temperature circuit

Fault code: P0118 high input of engine cooling fluid temperature circuit

Fault code: P0119 intermittent interruption of engine cooling fluid temperature circuit

S/N	Operating procedure	Test result	Follow-up step
1	Turn the ignition switch to "ON".		Next step
2	Pull down the connector of cooling fluid temperature sensor from the harness, and adopt a multimeter to measure whether the voltage between (1) pin (+) and (3) pin(-) of this connector is ca. 5V.	Yes	Next step
		No	4
3	Adopt a multimeter to measure whether the resistance between (1) pin and (3) pin of this sensor corresponds to its temperature (refer to the relevant sections of this repair manual).	Yes	Replace ECU.
		No	Replace the sensor.
4	Connect an adaptor between ECU and harness, and check whether the circuits between J1-05 & J1-43 pins of ECU and (1) & (3) pins of this sensor connector are open or short.	Yes	Repair or replace the harness.
		No	Replace ECU.

6. Fuel injector

Fault code: P0261 Cylinder 1 fuel injector circuit low

Fault code: P0264 Cylinder 2 fuel injector circuit low

Fault code: P0267 Cylinder 3 fuel injector circuit low

Fault code: P0270 Cylinder 4 fuel injector circuit low

Fault code: P0262 Cylinder 1 fuel injector circuit high

Fault code: P0265 Cylinder 2 fuel injector circuit high

Fault code: P0268 Cylinder 3 fuel injector circuit high

Fault code: P0271 Cylinder 4 fuel injector circuit high

S/N	Operating procedure	Test result	Follow-up step
1	After turning off the ignition switch, the engine doesn't run.		
2	Pull down all the connectors of electromagnetic fuel injector from the harness, and connect two pins of multimeter between (1) pin (+) of this connector and ground of engine.		
3	Turn the ignition switch to "ON", observe whether ca. 12V reading of battery voltage is shown on the multimeter for about 1s upon turning on the ignition switch.	Yes	Yes
		All yes	All yes
		No	No
4	Adopt a multimeter to check whether J1-02 pin of main relay output terminal and (1) pin of each electromagnetic fuel injector connector is open or short.	Yes	Yes
		No	No
5	Repair or replace the fuel pump relay, main relay and its circuit.		Next step
6	Connect an adaptor between ECU and harness, and adopt a multimeter to check whether J1-55, J1-70, J1-56 or J1-71 pin of ECU and (2) pin of each electromagnetic fuel injector connector is open or short in turns.	Yes	Repair or replace the harness.
		No	Next step
7	Adopt a multimeter to check whether the resistance between (1) pin and (2) pin of electromagnetic fuel injector is 12 to 16 Ohm at 20°C.	Yes	Repeat Step 7
		All yes	Next step
		No	Replace the electromagnetic fuel injector.
8	Re-insert all the connectors of this fuel injector, put in neutral gear, start the engine, and make it idling. Pull down each electromagnetic fuel injector connector from the harness in turns. Each time a connector is pulled down, check whether the vibration of engine is aggravated.	Yes	Repeat Step 8.
		No	Replace ECU.

7. Driving stage of canister control valve

Fault code: P0444 evaporative emission control system, open circuit of canister control valve

Fault code: P0445 evaporative emission control system, short circuit of canister control valve

S/N	Operating procedure	Test result	Follow-up step
1	Start the engine, and make it idling until the temperature of engine cooling fluid reaches its normal value.		Next step
2	Pull down the connector of canister control valve from the harness, and adopt a multimeter to check whether the battery voltage between both pins of this connector is about 12V.	Yes	Next step
		No	5(check the live wire)
3	Re-insert the canister control valve connector of harness, increase the speed of engine to 1500rpm, touch the valve body, and check whether the canister control valve withstands a slight vibration and impact.	Yes	Next step
		No	7(check the ground wire)
4	Adopt a multimeter to check whether the resistance between (1) pin and (2) pin is 22 to 30.	Yes	Replace ECU.
		No	Replace the canister control valve.
5	Adopt a multimeter to check whether the circuit between J1-02 pin of main relay and (1) pin of canister control valve is open or short.	Yes	Repair or replace the harness.
		No	Next step
6	Repair or replace main relay and its circuit.		Next step
7	Stop the engine, connect an adaptor between ECU and harness, and adopt a multimeter to check whether the circuit between J1-63 pin of ECU and (2) pin of canister control valve is open or short.	Yes	Repair or replace the harness.
		No	Replace ECU.

8. Driving stage of malfunction indicating lamp (MIL)

Fault code: P0650 Control circuit of malfunction indicating lamp MIL

S/N	Operating steps	Test result	Follow-up step
1	Turn the ignition switch to "ON".		Next step
2	Disassemble the instrument panel, pull down the bulb of malfunction indicating lamp, and adopt a multimeter to check whether the battery voltage on the socket of malfunction indicating lamp is ca. 12V.	Yes	Next step
		No	5(check the live wire)
3	Check the bulb of instrument panel malfunction indicating lamp for perfection with a multimeter.	Yes	Next step
		No	Replace the bulb.
4	Connect an adaptor between ECU and harness, and adopt a multimeter to check whether the circuit between J1-31 pin of ECU and input connector of malfunction indicating lamp is open or short.	Yes	Repair or replace the harness.
		No	Replace ECU.
5	Check whether the heating circuit fuse of oxygen sensor circuit is broken.	Yes	Replace the fuse.
		No	Next step
6	Adopt a multimeter to check whether the circuit between #87 pin of main relay and (1) pin of malfunction indicating lamp socket is open or short.	Yes	Repair or replace the harness.
		No	Next step
7	Repair or replace main relay and its circuit.		

9. Driving stage of stepping motor 1# or 2# coil

S/N	Operating steps	Test result	Follow-up step
1	Turn on the ignition switch, but don't start the engine.		Next step
2	Pull down the connector of idle actuator stepping motor from the harness, and adopt a multimeter to check whether the resistances between 1 & 2 pins and 3&4 pins of idle actuator stepping motor are 40 to 80Ω.	Yes	Next step
		No	Replace the idle actuator.
3	Adopt a multimeter to check whether the resistances between 1 & 2 pins and 3&4 pins of idle actuator stepping motor are infinite.	Yes	Next step
		No	Replace the idle actuator.
4	Adopt a multimeter to check whether the battery voltage between 1 & 2 pins and 3&4 pins of idle actuator stepping motor harness connector is ca. ±12V.	Yes	Replace the idle actuator.
		No	Next step
5	Connect an adaptor between ECU and harness, and adopt a multimeter to check whether the circuit between J1-34, J1-33, J1-53 or J1-54 pin of ECU and 1, 2, 3 or 4 pin of idle actuator stepping motor harness connector is open or short.	Yes	Repair or replace the harness.
		No	Replace ECU.

10. Camshaft position sensor (Tretic 1.6L engine configuration)

Fault code: P0340 camshaft position sensor signal fault

S/N	Operating steps	Test result	Follow-up step
1	Connect a diagnostic instrument and an adaptor, and turn the ignition switch to "ON".		Next step
2	Pull down the connector of camshaft position from the harness, adopt a multimeter to check whether the voltage between 3# and 1# pin of camshaft position sensor connector ca. 12V.	Yes	Go to Step 4
		No	Next step
3	Check whether the circuit between 3# pin of camshaft position sensor and 87# pin of main relay is open or short; check whether 1# pin of camshaft position sensor poorly grounded.	Yes	Repair or replace the harness.
		No	Next step
4	Check whether the voltage between 2# pin of camshaft position sensor connector and power - is ca. 9.9V.	Yes	Go to Step 6
		No	Next step
5	Check whether the circuit between 2# pin of camshaft position sensor connector and 10 pin of ECU is open, short to power supply or ground.	Yes	Repair or replace the harness.
		No	Next step
6	Check whether the camshaft signal panel is perfect.	Yes	Help for diagnosis
		No	Replace the signal panel.

11. Crankshaft position sensor

Fault code: P0335 fault of crankshaft position sensor

Fault code: P0336 unreasonable fault of crankshaft position sensor signal

S/N	Operating steps	Test result	Follow-up step
1	Connect a diagnostic instrument and an adaptor, and turn the ignition switch to "OFF".		Next step
2	Pull down the connector of crankshaft position from the harness, adopt a multimeter to check whether the resistance between 2# pin and 3# pin of crankshaft position sensor is 770 to 950Ω at 20°C.	Yes	Next step
		No	Replace the sensor.
3	Check whether the circuit between 2# or 3# pin of crankshaft position sensor connector and 34# or 15# pin of ECU is open, short to power supply or ground.	Yes	Repair or replace the harness.
		No	Next step
4	Check whether the flywheel signal panel is perfect.	Yes	Help for diagnosis
		No	Replace signal panel

12. Fault of car fuel system

Instructions: the following diagnostic procedures are applicable to the non-coexistence of fault codes for inlet pressure, inlet temperature sensor, canister control valve driving circuit and oxygen sensor, etc. If the relevant fault codes exist at the same time, please remedy other faults first, and then check and repair these parts according to the following procedure.

Fault code: P0171 over-upper limit self-adaptation of air-fuel ratio closed-loop control

S/N	Operating steps	Test result	Follow-up step
1	Connect a diagnostic instrument and an adaptor, Turn the ignition switch to "ON".		Next step
2	Start the engine, and make it idling until the temperature of cooling fluid reaches its normal value. Under all the working conditions, observe the changes of "oxygen sensor voltage" shown on the diagnostic instrument, and then confirm whether the shown value keeps at 100mV constantly for a long time under some working conditions.	Yes	Next step
		No	Help for diagnosis
3	Connect a fuel pressure gauge to the inlet pipe end of fuel system, observe whether the fuel pressure keeps at 380kPa or so under all the working conditions.	Yes	Next step
		No	Check and repair the fuel system.
4	Check whether the circuit between 62# or 38# pin of ECU and A# pin (and oxygen sensor opposite to the grey connecting line) or B# pin (and oxygen sensor opposite to the black connecting line) of this sensor connector is short to ground.	Yes	Repair or replace the harness.
		No	Next step
5	A. Check the inlet system for serious leaks;	Yes	Check and repair according to the diagnosis.
	B. Check the fuel injector for blockage;	No	
	C. Check the spark plug for excessive clearance;		
	D. Check the fire control line for overhigh resistance;		
	E. Check the valve for overlarge clearance, etc;	No	Help for diagnosis

Fault code: P0172 over-lower limit self-adaptation of air-fuel ratio closed-loop control

S/N	Operating steps	Test result	Follow-up step
1	Connect a diagnostic instrument and an adaptor, and turn the ignition switch to "ON".		Next step
2	Start the engine, and make it idling until the temperature of cooling fluid reaches its normal value.	Yes	Next step
	under all the working conditions, observe the changes of "oxygen sensor voltage" shown on the diagnostic instrument, and then confirm whether the shown value keeps at 900mV constantly for a long time under some working conditions.	No	Help for diagnosis
3	Connect a fuel pressure gauge to the inlet pipe end of fuel system, and observe whether the fuel pressure keeps at 350kPa or so under all the working conditions.	Yes	Next step
		No	Check and repair the fuel system.
4	check whether the circuit between 62# or 38# pin of ECU and A# pin (and oxygen sensor opposite to the grey connecting line) and B# pin (and oxygen sensor opposite to the black connecting line) of this sensor connector is short to power supply.	Yes	Repair or replace the harness.
		No	Next step
5	A. Check the fuel injector for leaks;	Yes	Check and repair according to the diagnosis.
	B. Check the exhaust pipe for leaks;		
	C. Check whether the ignition timing is incorrect;		
	D. Check the guide pipe of inlet valve for wears;		
	E. Check the valve for oversmall clearance, etc.	No	Help for diagnosis

13. Speed sensor

Fault code: P0500 fault of car speed sensor (Sun & Teck electronic fuel injection system)

Fault code: P0502 fault of car speed sensor (Delf electronic fuel injection system)

S/N	Operating steps	Test result	Follow-up step
1	Connect a diagnostic instrument and an adaptor, Turn the ignition switch to "ON".		Next step
2	Check whether the operation of speedometer pointer is normal.	Yes	Next step
		No	Check and repair the instrument harness.
3	Check whether the voltage between ground wire and power wire of car speed sensor connecting plug is 9 to 14V.	Yes	Next step
		No	Check the harness of car speed sensor.
4	Check whether the operation of car speed sensor is normal.	Yes	Next step
		No	Replace the car speed sensor.
5	Check whether the circuit between signal wire of car speed sensor and 3# pin of ECU is open, short to power supply or ground.	Yes	Repair or replace the harness.
		No	Help for diagnosis

Section III Diagnostic Procedure for Fault Remedy Based on Car

Fault Symptoms

Before starting the steps for fault diagnosis according to the symptoms of engine faults, carry out an initial check first:

1. Ensure that the operation of engine malfunction indicating lamp is normal;
2. Check with a fault diagnostic instrument, and ensure no records for fault messages;
3. Confirm the existence of fault symptoms said by the car owner, and confirm the occurrence conditions of this fault;
4. Check the fuel pipes for leaks;
5. Check the vacuum pipes for fractures, torsion or correct connection;
6. Check the inlet pipe for blockage, leaks, bruising or damages;
7. Check the high-voltage line of ignition system for fracture, ageing or correct ignition sequence;
8. Check whether the wire ground is clean or firm;
9. Check each sensor or actuator connector for loosening or poor contact.

Important:

If the above symptoms exist, carry out the repair work according to the symptoms of this fault first, otherwise the sequent diagnosis and remedy of faults will be adversely influenced.

Help for diagnosis:

1. Ensure that the engine has no fault records;
2. Ensure the existence of said fault symptoms;
3. Check according to the above steps, and ensure no abnormal conditions;
4. During the check and repair, don't neglect the influences of car maintenance, cylinder pressure, mechanical ignition timing and fuel, etc on the system;
5. Replace ECU, and test it.

If these fault symptoms can be eliminated, the faulty part is ECU. If the fault symptoms still exist, replace original ECU, repeat the above procedure, and check and repair them again.

(I) During the starting, the engine can't rotate or rotates slowly.

Parts subject to common faults:

1. battery; 2. starting motor; 3. harness or ignition switch; 4. mechanical part of engine.

Common diagnostic procedure:

S/N	Operating steps	Test result	Follow-up steps
1	Adopt a multimeter to check whether the voltage between both terminals of battery is 8-12V in case of starting the engine.	Yes	Next step
		No	Replace battery
2	Keep ignition switch in starting position, and adopt a multimeter to check whether the voltage of starting motor terminal + is at least 8V.	Yes	Next step
		No	Repair or replace the harness.
3	Disassemble the starting motor, check the operating conditions of starting motor. Pay attention to the check of its open circuit or its seizure caused by poor lubricating.	Yes	Repair or replace the starting motor.
		No	Next step
4	If the fault occurs only in Winter, check whether the excessive resisting force of starting motor is caused by improper selection of engine lubricating oil and gearbox oil.	Yes	Replace with appropriate lubricating oil.
		No	Next step
5	Check whether overlarge mechanical resisting force in the engine leads to the stop or slow rotation of starting motor.	Yes	Check and repair the resisting force in the engine.
		No	Repeat the above steps.

(II) During the starting, the engine can be towed but it can't be successfully started.

Common faulty parts:

1. no fuel in the fuel tank; 2. fuel pump; 3. rotating speed sensor; 4. ignition coil; 5. mechanical part of engine.

Common diagnostic procedure:

S/N	Operating steps	Test result	Follow-up steps
1	Connect to a fuel pressure gauge (the connected point is front end of fuel distributing pipe assembly inlet pipe), start the engine, and check whether the engine fuel pressure is 380kPa or so under all the working conditions.	Yes	Next step
		No	Check and repair the fuel supply system.
2	Connect to the diagnostic instrument of electronic fuel injection system, observe the data of "engine speed", start the engine, and observe whether the speed signals for output exist.	Yes	Next step
		No	Check and repair the circuit of rotating speed sensor.
3	Pull out a cylinder dividing line of one cylinder, connect to the spark plug, make the distance between electrode of spark plug and engine body is ca. 5mm, start the engine, and check whether blue white high-voltage fires exist.	Yes	Next step
		No	Check and repair the ignition system
4	Check the pressure of each engine cylinder, and observe the pressure of engine cylinder is insufficient.	Yes	Remove the mechanical faults of engine.
		No	Next step
5	Connect to the adaptor of electronic fuel injection system, turn on the ignition switch, and check whether the power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding circuit.

(III) Hot starting difficulty

Common faulty parts:

1. Water in fuel; 2. fuel pump; 3. cooling fluid temperature sensor; 4. Fuel pressure regulator vacuum pipe; 5. Ignition coil.

Common diagnostic procedure:

S/N	Operating steps	Test result	Follow-up steps
1	Connect to a fuel pressure gauge (the connected point is front end of fuel distributing pipe assembly inlet pipe), start the engine, and check whether the engine fuel pressure is 380 kPa or so under all the working conditions.	Yes	Next step
		No	Check and repair the fuel supply system
2	Pull out the cylinder dividing line of one cylinder, connect to the spark plug, and make the distance between spark plug electrode and engine body ca. 5mm, start the engine, check whether the blue white high-voltage fires exist.	Yes	Next step
		No	Check and repair the ignition system
3	Pull down the connector of cooling fluid temperature sensor, start the engine, and observe whether the engine is successfully started. (or connect a 300ohm resistance to the connector of cooling fluid temperature sensor in series to substitute the cooling fluid temperature sensor, and observe whether the engine is successfully started.)	Yes	Check and repair the circuit or replace the sensor.
		No	Next step
4	Check the vacuum pipe of fuel pressure regulator for loosening or leaks.	Yes	Check and repair or replace it.
		No	Next step
5	Check the fuel, and observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
6	connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether the power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

(IV) Cold starting difficulty

Common faulty parts:

1. Water in fuel; 2. fuel pump; 3. Cooling fluid temperature sensor; 4. fuel injector; 5. ignition coil; 6. throttle body and idle bypass air channel; 7. Mechanical part of engine.

S/N	Operating steps	Test result	Follow-up step
1	Connect to a fuel pressure gauge(the connected point is front end of fuel distributing pipe assembly inlet pipe), start the engine, and check whether the engine fuel pressure is 380kPa or so under all the working conditions.	Yes	Next step
		No	check and repair the fuel supply system
2	Pull out the cylinder dividing line of one cylinder, connect to spark plug, make the distance between spark plug electrode and engine body ca. 5mm, start the engine, and check whether the blue white high-voltage fires exist.	Yes	Next step
		No	check and repair the ignition system
3	Pull down the connector of cooling fluid temperature sensor, start the engine, and observe whether the engine is successfully started.(or connect a 2500ohm resistance to the connector of cooling fluid temperature sensor in series to substitute the cooling fluid temperature sensor, and observe whether the engine is successfully started.)	Yes	Check and repair the circuit or replace the sensor.
		No	Next step
4	Step down the throttle lightly, and observe whether it's easy to start.	Yes	Clean the throttle and idle air channel.
		No	Next step
5	Disassemble the fuel injector, and adopt a fuel injector-specialized cleaning analyzer to check the fuel injector for leaks or blockage.	Yes	Replace the faulty one.
		No	Next step
6	Check the fuel, and observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
7	Check the pressure of each engine cylinder, and observe whether the pressure of engine cylinder is insufficient.	Yes	Remove the mechanical faults of engine.
		No	Next step
8	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common diagnostic procedure:

(V)Normal rotating speed, but difficult to start at any time

common faulty parts: 1. Water in fuel; 2. fuel pump; 3. Cooling fluid temperature sensor; 4. fuel injector; 5. ignition coil; 6. throttle body and idle bypass air channel; 7. inlet channel; 8. Ignition timing; 9. spark plug; 10. Mechanical part of engine.

1	Check each spark plug of cylinder, and observe whether its model and clearance conform to the specifications.	Yes	Next step
		No	Adjust or replace it.
2	Pull down the connector of cooling fluid temperature sensor, start the engine , and observe whether the engine is successfully started.	Yes	Check and repair the circuit or replace the sensor.
		No	Next step
3	Step down the throttle lightly, and observe whether it's easy to start.	Yes	Clean the throttle and idle air channel.
		No	Next step
4	Disassemble the fuel injector, and adopt a fuel injector-specialized cleaning analyzer to check the fuel injector for leaks or blockage.	Yes	Replace the faulty one.
		No	Next step
5	Check the fuel, and observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
6	Check the pressure of each engine cylinder, and observe whether the pressure of engine cylinder is insufficient.	Yes	Remove the mechanical faults of engine.
		No	Next step
7	Check whether ignition sequence and ignition timing of engine conform to the specifications.	Yes	Next step
		No	Check and repair ignition timing.
8	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common diagnostic procedure:

(VI) Normal starting, but unstable idle speed at any time.

Common faulty parts:

1. Water in fuel; 2. fuel injector; 3. spark plug; 4. throttle body and idle bypass air channel; 5. inlet channel; 6. idle regulator; 7. Ignition timing; 8. spark plug; 9. Mechanical part of engine.

S/N	Operating steps	Test result	Follow-up steps
1	Check the air filter for blockage or inlet channel for leaks.	Yes	Check and repair the inlet system.
		No	Next step
2	Check whether the idle regulator is clamped.	Yes	Clean or replace it.
		No	Next step
3	Check each spark plug of cylinder, and observe whether its model and clearance conform to the specifications.	Yes	Next step
		No	Adjust or replace it.
4	Check whether the carbon deposits exist on throttle body and idle bypass air channel.	Yes	Clean it
		No	Next step
5	Disassemble the fuel injector, and adopt a fuel injector-specialized cleaning analyzer to check the fuel injector for leaks, blockage or poor flow.	Yes	Replace the faulty one.
		No	Next step
6	Check the fuel, and observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
7	Check the pressure of each engine cylinder, and observe whether the differences of engine cylinder pressures exist.	Yes	Remove the mechanical faults of engine.
		No	Next step
8	Check whether engine ignition sequence and ignition timing conform to the specifications.	Yes	Next step
		No	Check and repair ignition timing.
9	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common diagnostic procedure:

(VII) Normal starting, but unstable idle in case of heating the engine.

Common faulty parts:

1. Water in fuel; 2. Cooling fluid temperature sensor; 3. spark plug; 4. throttle body and idle bypass air channel; 5. inlet channel; 6. idle regulator; 7. Mechanical part of engine.

S/N	Operating steps	Test result	Follow-up steps
1	Check the air filter for blockage and inlet channel for leaks.	Yes	check and repair the inlet system
		No	Next step
2	Check each spark plug of cylinder, and observe whether its model and clearance conform to the specifications.	Yes	Next step
		No	Adjust or replace it.
3	Remove the idle regulator, and check whether carbon deposits exist on throttle body, idle regulator and idle bypass air channel.	Yes	Clean the relevant parts.
		No	Next step
4	Pull down the connector of cooling fluid temperature sensor, start the engine, and observe whether the engine idles unstably in case of heating it.	Yes	check and repair the circuit or replace the sensor.
		No	Next step
5	Disassemble the fuel injector, and adopt a fuel injector-specialized cleaning analyzer to check whether fuel injector for leaks, blockage or poor flow.	Yes	Replace the faulty one.
		No	Next step
6	Check the fuel, and observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
7	Check the pressure of each engine cylinder, and observe whether the differences of engine cylinder pressures exist.	Yes	Remove the mechanical faults of engine.
		No	Next step
8	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common diagnostic procedure:

(VIII) Normal starting, but unstable idle after heating the engine.

Common faulty parts:

1. Water in fuel; 2. Cooling fluid temperature sensor; 3. spark plug; 4. throttle body and idle bypass air channel; 5. inlet channel; 6. idle regulator; 7. Mechanical part of engine.

S/N	Operating steps	Test result	Follow-up steps
1	Check air filter for blockage, inlet channel for leaks.	Yes	Check and repair the inlet system.
		No	Next step
2	Check each spark plug of cylinder, and observe whether its model and clearance conform to the specifications.	Yes	Next step
		No	Adjust or replace it.

3	Remove the idle regulator, and check whether carbon deposits exist on throttle body, idle regulator and idle bypass air channel.	Yes	Clean the relevant parts.
		No	Next step
4	Pull down the connector of cooling fluid temperature sensor, start the engine, and observe whether the engine idles unstably in case of heating it.	Yes	Check and repair the circuit or replace the sensor.
		No	Next step
5	Disassemble the fuel injector, and adopt a fuel injector-specialized cleaning analyzer to check whether fuel injector for leaks, blockage or poor flow.	Yes	Replace the faulty one.
		No	Next step
6	Check the fuel, observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
7	Check the pressure of each engine cylinder, and observe whether the differences of engine cylinder pressures exist.	Yes	Remove the mechanical faults of engine.
		No	Next step
8	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common diagnostic procedure:

(IX)Normal starting, but unstable idle or shutdown under partial load (e.g.: start A/C).

Common faulty parts:

1. A/C system; 2. idle regulator; 3. fuel injector.

S/N	Operating steps	Test result	Follow-up steps
1	Remove the idle regulator, and check whether carbon deposits exist on throttle body, idle regulator and idle bypass air channel.	Yes	Clean the relevant parts.
		No	Next step
2	Observe whether the output power of engine is increased in case of starting A/C, i.e. Adopt a diagnostic instrument of electronic fuel injection system to observe the changes of ignition advance angle, fuel injection pulse width and air input.	Yes	Go to Step 4
		No	Next step
3	Connect to an adaptor of electronic fuel injection system, disconnect the connecting line of electronic control unit 75# pin, check whether the end of harness is a high-potential signal in case of starting A/C.	Yes	Next step
		No	check and repair A/C system
4	Check whether the pressure of A/C system, the solenoid clutch of compressor and A/C compression pump are normal.	Yes	Next step
		No	check and repair A/C system
5	Disassemble the fuel injector, adopt a fuel injector-specialized cleaning analyzer to check whether fuel injector for leaks, blockage or poor flow.	Yes	Replace the faulty one.
		No	Next step
6	connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common diagnostic procedure:

(X)Normal starting, but overhigh idle

Common faulty parts:

1. throttle body and idle bypass air channel; 2. Vacuum pipe; 3. idle regulator; 4. Cooling fluid temperature sensor; 5. Ignition timing.

S/N	Operating steps	Test result	Follow-up steps
1	Check whether throttle cable is seized or overtight.	Yes	Adjust.
		No	Next step
2	Check the inlet system and connected vacuum pipe for leaks.	Yes	Check and repair the inlet system.
		No	Next step
3	Remove the idle regulator, and check whether carbon deposits exist on throttle body, idle regulator and idle bypass air channel.	Yes	Clean the relevant parts.
		No	Next step
4	Pull down the connector of cooling fluid temperature sensor, start the engine, and observe whether the idle of engine is overhigh.	Yes	Check and repair the circuit or replace the sensor.
		No	Next step
5	Check whether ignition timing of engine conforms to the specifications.	Yes	Next step
		No	Check and repair ignition timing.
6	connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#, 18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common diagnostic procedure:

(XI)Its rotating speed can't increase or shutdown in case of acceleration.

Common faulty parts:

S/N	Operating steps	Test result	Follow-up steps
1	Check the air filter for blockage.	Yes	Check and repair the inlet system.
		No	Next step
2	Connect to a fuel pressure gauge (the connected point is front end of fuel distributing pipe assembly inlet pipe), start the engine, and check whether the engine fuel pressure is 380kPa or so under all the working conditions.	Yes	Next step
		No	Check and repair the fuel supply system.
3	Check each spark plug of cylinder, and observe whether its model and clearance conform to the specifications.	Yes	Next step
		No	Adjust or replace it.
4	Remove the idle regulator, and check whether carbon deposits exist on throttle body, idle regulator and idle bypass air channel.	Yes	Clean the relevant parts.
		No	Next step

5	Check whether inlet pressure sensor, throttle position sensor or its circuit is normal.	Yes	Next step
		No	Check and repair the circuit or replace the sensor.
6	Disassemble the fuel injector, and adopt a fuel injector-specialized cleaning analyzer to check the fuel injector for leaks or blockage.	Yes	Replace the faulty one.
		No	Next step
7	Check the fuel, observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
8	Check whether engine ignition sequence and ignition timing conform to the specifications.	Yes	Next step
		No	Check and repair ignition timing.
9	Check whether the exhaust pipe is unblocked.	Yes	Next step
		No	Repair or replace the exhaust pipe.
10	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#,18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

1. Water in fuel; 2. inlet pressure sensor and throttle position sensor; 3. spark plug; 4. throttle body and idle bypass air channel; 5. inlet channel; 6. idle regulator; 7. fuel injector; 8. Ignition timing; 9. exhaust pipe.

Common diagnostic procedure:

(XII) Slow response in case of acceleration

S/N	Operating steps	Test result	Follow-up steps
1	Check air filter for blockage.	Yes	Check and repair the inlet system.
		No	Next step
2	Connect to a fuel pressure gauge (the connected point is front end of fuel distributing pipe assembly inlet pipe), start the engine, and check whether engine fuel pressure is 380kPa or so under all the working conditions.	Yes	Next step
		No	check and repair fuel supply system
3	Check each spark plug of cylinder, and observe whether its model and clearance conform to the specifications.	Yes	Next step
		No	Adjust or replace it.
4	Remove the idle regulator, check whether carbon deposits exist on throttle body, idle regulator and idle bypass air channel.	Yes	Clean the relevant parts.
		No	Next step
5	Check whether inlet pressure sensor, throttle position sensor or its circuit is normal.	Yes	Next step
		No	Check and repair the circuit or replace the sensor.
6	Disassemble the fuel injector, adopt a fuel injector-specialized cleaning analyzer to check whether fuel injector for leaks or blockage.	Yes	Replace the faulty one.
		No	Next step

7	Check the fuel, and observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
8	Check whether engine ignition sequence and ignition timing conform to the specifications.	Yes	Next step
		No	Check and repair ignition timing.
9	Check whether the exhaust pipe is unblocked.	Yes	Next step
		No	Repair or replace the exhaust pipe.
10	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#,18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common faulty parts:

1. Water in fuel; 2. inlet pressure sensor and throttle position sensor; 3. spark plug; 4. throttle body and idle bypass air channel; 5. inlet channel; 6. idle regulator; 7. fuel injector; 8. Ignition timing; 9. exhaust pipe.

Common diagnostic procedure:

(XIII) Weak to accelerate, poor performance

S/N	Operating steps	Test result	Follow-up steps
1	Check whether slipping of clutch, low tyre pressure, blockage of braking, incorrect size of tyre or incorrect location of four wheels exists.	Yes	Repair
		No	Next step
2	Check the air filter for blockage.	Yes	Check and repair the inlet system.
		No	Next step
3	Connect to a fuel pressure gauge(the connected point is front end of fuel distributing pipe assembly inlet pipe), start the engine, and check whether the engine fuel pressure is 380kPa or so under all the working conditions.	Yes	Next step
		No	check and repair fuel supply system
4	Pull out the cylinder dividing line of one cylinder, connect to spark plug, make the distance between spark plug electrode and engine body ca. 5mm, start the engine, and check whether the strength of high-voltage fire is normal.	Yes	Next step
		No	check and repair ignition system
5	Check each spark plug of cylinder, and observe whether its model and clearance conform to the specifications.	Yes	Next step
		No	Adjust or replace it.
6	Remove the idle regulator, check whether carbon deposits exist on throttle body, idle regulator and idle bypass air channel.	Yes	Clean the relevant parts.
		No	Next step
7	Check whether inlet pressure sensor, throttle position sensor or its circuit is normal.	Yes	Next step
		No	Check and repair the circuit or replace the sensor.
8	Disassemble the fuel injector, and adopt a fuel injector-specialized cleaning analyzer to check the fuel injector for leaks or blockage.	Yes	Replace the faulty one.
		No	Next step

9	Check the fuel, and observe whether the fault symptoms are caused just after adding in the fuel.	Yes	Replace the fuel.
		No	Next step
10	Check whether engine ignition sequence and ignition timing conform to the specifications.	Yes	Next step
		No	Check and repair ignition timing.
11	Check whether the exhaust pipe is unblocked.	Yes	Next step
		No	Repair or replace the exhaust pipe.
12	Connect to an adaptor of electronic fuel injection system, turn on the ignition switch, check whether power supply of 17#,18#, 04# or 20# pin is normal; check whether 05#, 21# or 73# pin is normally earthed.	Yes	Help for diagnosis
		No	Check and repair the corresponding wire.

Common faulty parts:

1.Water in fuel;2.inlet pressure sensor and throttle position sensor;3.spark plug;4.ignition coil;5.throttle body and idle bypass air channel;6.inlet channel;7.idle regulator;8.fuel injector;9. Ignition timing;10.exhaust pipe.

S/N	Operating steps	Test results	Follow-up steps
1	Check whether the system has enough refrigerant, A/C belt is normal, A/C clutch or pressure switch is normal.	Yes	Next step
		No	Remove the fault.
2	Make the engine idling, and turn on A/C switch. Adopt a fault diagnostic instrument to check the faults of A/C thermal resistance.	Yes	Remove the shown fault.
		No	Next step
3	Turn on A/C switch, connect an adaptor between ECU and harness, and measure the signal input possibility of J1-09 and J1-39 pins (A/C switch) of ECU.	Yes	Next step
		No	check whether harness
4	If this car adopts a low-potential control, check whether A/C still works in case of stopping A/C.	Yes	Replace the bulb or repair the harness.
		No	Next step
5	Check whether J1-46 pin (connected to ground terminal of A/C relay sucking coil)of ECU has a low potential for output.	Yes	Repair A/C relay and harness.
		No	Replace ECU.

Common diagnostic procedure:

(VIX) Fault of A/C system

Common faulty parts:

1. A/C pressure switch; 2.A/C switch request signal; 3.A/C compressor relay; 4.A/C system pipe pressure; 5.A/C controller

S/N	Operating steps	Test results	Follow-up steps
1	Start the engine, and make it idling; listen to the inlet pipe for the sound of leaks.	Yes	Next step
		No	Search for the leaked position, and repair it.
2	Stop the engine, and visually check whether the exhaust pipe, three-way catalyst and muffler are normal.	Yes	Next step
		No	Repair or replace.
3	Remove each conductor connector of ignition coil one by one, and check whether any cylinder doesn't produce a transient fall of engine speed.	Yes	Step 5
		No	Next step
4	Check each fuel injector produces the operating noises at idle speed.	Yes	Next step
		No	check the fuel injector and relevant circuit
5	Remove an igniting metal wire from spark plug; attach this metal wire to a good spark plug; make the end of spark plug to ground, and then go to the engine; check whether the spark is normal.	Yes	Next step
		No	Check ignition coil, electric transistor and their circuits
6	Move away the spark plug, and check whether the dirt exists in it.	Yes	Next step
		No	Repair or replace with standard-type spark plug.
7	Check engine cylinder pressure: standard value 1275 kPa/300rpm; minimum value 981kPa/300rpm; pressure difference between the cylinders: 98kPa/300rpm	Yes	Next step
		No	Check piston, piston ring, inlet valve, inlet valve seat and cylinder top washer.
8	Install all the removed parts; release the fuel pressure to zero; install a fuel pressure scale, and check whether fuel pressure is normal.	Yes	Next step
		No	Check it according to the fuel pressure check method.
9	Check the ignition time: ignition time is $15^{\circ} \pm 5^{\circ}$ BTDC; target idle is M/T: 800 ± 50 rpm;	Yes	Next step
		No	Basic check
10	Start the engine and heat it to normal running temperature; measure the voltage of J1-62 pin (front oxygen sensor high signal) or J1-06 pin (front oxygen sensor low signal) of ECU to ground with a voltmeter; at the engine speed below 2000rpm, check the voltage, the number of changes from 0V-0.3V to 0.6V-1.0V isn't more than 5 within 10s, 0.6V shall exceed the maximum voltage at least once, and 0.3V shall be less than the minimum voltage at least once; the voltage can't exceed 1V.	Yes	Next step
		No	Renew the original oxygen sensor.
11	Check the signal of inlet sensor with a fault diagnostic instrument: 2.0-6.0gm/sec(at idle speed); 7.0-20.0gm/sec(at 2500rpm)	Yes	Replace ECU.
		No	Check the inlet temperature sensor circuit connector for rusting or loosening.

Common diagnostic procedure:

(XV) Accidental fire of engine

Common faulty parts:

S/N	Operating steps	Test results	Follow-up steps
1	Visually check whether the exhaust pipe and muffler are normal.	Yes	Next step
		No	Repair or replace.
2	Start the engine and make it idling; listen to whether the sound of exhaust leaks is produced before three-way catalyst.	Yes	Next step
		No	Repair or replace.
3	Listen to the exhaust manifold of engine for leaks.	Yes	Next step
		No	Repair or replace.
4	Check whether the ignition time is 0° to 15°BTDC; check whether the target idle is M/T: 800±50rpm.	Yes	Next step
		No	Basic check
5	Check the fuel injector; stop the engine, and then turn the ignition switch to "ON"; check whether the voltage of J1-55,J1-70,J1-56 or J1-71 pin of ECU to ground is normal for output.	Yes	Next step
		No	Carry out the diagnostic procedure of fuel injector.
6	Turn the ignition switch to "OFF"; remove the ignition coil, connect a normal spark plug with its tail end to ground, turn the engine, and check whether spark plug is normal.	Yes	Next step
		No	check whether ignition coil
7	Turn the ignition switch to "OFF"; remove the fuel injector, and leave the fuel injecting pipe and all the fuel injector connectors; remove the connector of fuel injecting coil conductor; turn the ignition switch to "ON", and ensure that no gasoline flows out of fuel injector.	Yes	Replace three-way catalyst.
		No	Replace the leaked fuel injector.

1.ignition coil;2.spark plug;3.Serious leakage of inlet system; 4.Connecting conductor from ignition coil to spark plug;5.Fault of fuel injector; 6.engine cylinder pressure

Common diagnostic procedure:

(XVI) Check of three-way catalyst

Common faulty parts: 1. leaks of engine exhaust manifold; 2.leaks of three-way catalyst and muffler;3.fault of fuel injector;4.connecting conductor from ignition coil to spark plug;5.fault of fuel injector;6.engine cylinder pressure

Common diagnostic procedure:

Section IV Repair Work

I. Relief methods of fuel system

The fuel supply pressure of electronic fuel injection system is higher (380kPa or so), and all the fuel pipes adopt high-pressure fuel pipes. Even if the engine doesn't run, a higher pressure still holds in the oil line, so be careful to avoid the removal of oil pipe during the maintenance. In case of repairing the fuel system, relieve the pressure of this system before removing the oil pipe as per the following method: remove the fuel pump relay, and start the engine to make it idling until the engine stops automatically. The disassembly of oil pipe and replacement of fuel filter shall be carried out by skilled personnel in the well-ventilated environment.

II. Removal and installation of fuel tank

Removal procedure

Note: the pressure exists in fuel system. In order to fuel leakage, injury or fire, release the pressure of fuel system before disconnecting the fuel pipe.

1. Release the fuel pressure, and refer to "Pressure Relief of Fuel System" in this section.
2. Disconnect the negative cable of battery.
3. Empty the fuel tank.
4. Disassemble front muffler. Refer to "Exhaust System of Engine".
5. Remove the fuel filling pipe clamp from fuel tank.
6. Disconnect the filling pipe of fuel tank.
7. Disconnect a fuel steaming pipe beside the fuel tank filling pipe.
8. Disconnect the harness connector of fuel pump.
9. Disconnect the inlet pipe and return pipe on right front side of fuel tank.
10. Disassemble the fuel pump. Refer to "fuel pump" in this section.
11. Disassemble the parking brake cable support.
12. Support the fuel tank.
13. Disassemble the fixing nut of fuel tank band.
14. Disassemble the fuel tank band.
15. Be careful to place the fuel tank.
16. Disassemble the fuel tank.
17. Transfer the parts if necessary.

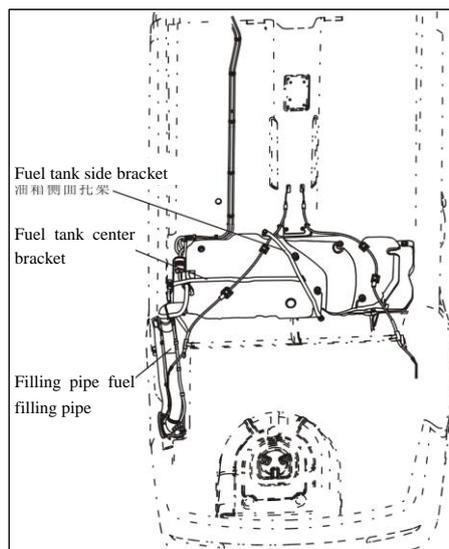


Fig. 7-55 fuel tank

1-fuel pump inspection cover 2-Fuel level sensor inspection cover 3- fuel tank return pipe
4-fuel tank outlet pipe 5-fuel pump connector 6-fuel level sensor connector

Installation procedure

1. Lift the fuel tank in position.
2. Install the fuel tank band.
3. Install the fixing nut of fuel tank band and tighten it to the torque of 23N.m.
4. Install the parking brake cable support.
5. Install the fuel pump. Refer to “fuel pump” in this section.
6. Connect the fuel outlet pipe and return pipe.
7. Connect the harness connector of fuel pump.
8. Connect the fuel steaming pipe.
9. Connect the fuel tank filling pipe.
10. Connect the vent pipe of fuel tank.
11. Attach the fuel filling pipe clamp to fuel tank.
12. Install front muffler. Refer to “engine exhaust system”.
13. Connect the negative cable of battery.
14. Fill the fuel tank.
15. Check the fuel tank and fuel pipe joint.

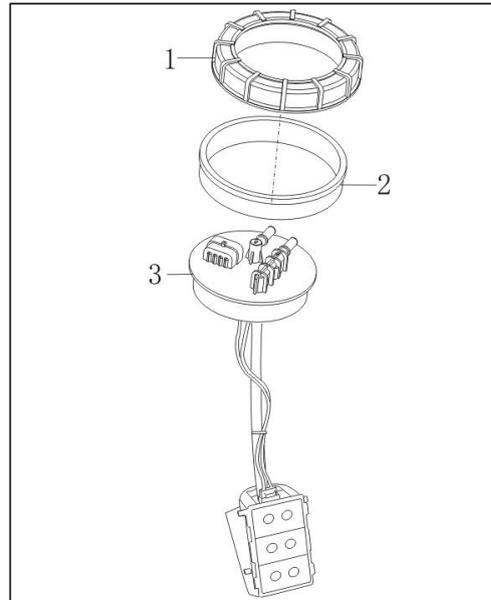


Fig. 7-56 fuel pump

1-fuel pump clamping cover 2-fuel pump clamping cover seal washer 3-electric fuel pump

III. Replacement of fuel pump assembly

Removal procedure

Warning: the pressure exists in fuel system. In order to fuel leakage, injury or fire, release the pressure of fuel system before disconnecting the fuel pipe.

1. Release the fuel pressure, and refer to "Pressure Relief of Fuel System" in this section.
2. Disconnect the negative cable of battery.
3. Remove the rear-row seats.
4. Remove the inspection cover of fuel pump.
5. Disconnect the electric connector of fuel pump assembly.
6. Disconnect the fuel outlet pipe.
7. Disconnect the fuel pipe of fuel tank.
8. Open the fuel pump clamping cover anticlockwise, and remove the seal washer of fuel pump clamping cover.
9. Remove the fuel pump assembly from fuel tank.

Installation procedure

1. Clean the matching face of fuel tank liner.
2. Attach a new liner.
3. Reinstall the fuel pump in its removed position to install the fuel pipe and connector. Attach the connector to the clamping cover of fuel pump, and screw it clockwise until it contacts with the fuel tank.
5. Connect a connector of fuel pump assembly.
6. Install an outlet pipe of fuel pump.
7. Install the fuel pipe of fuel tank.
8. Install the inspection cover of fuel pump.
9. Connect the negative cable of battery.
10. Make the fuel pump running for check.

11. Install the rear-row seats.

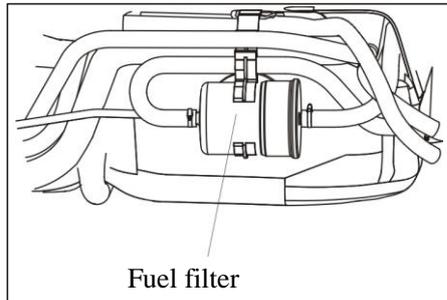


Fig. 7-57 Fuel Filter

IV. Replacement of fuel filter

Removal procedure

Warning: the pressure exists in fuel system. In order to fuel leakage, injury or fire, release the pressure of fuel system before disconnecting the fuel pipe.

1. Release the fuel pressure, and refer to "Pressure Relief of Fuel System" in this section.
2. Disconnect the negative cable of battery.
3. Remove the filter from filter fixing clip.

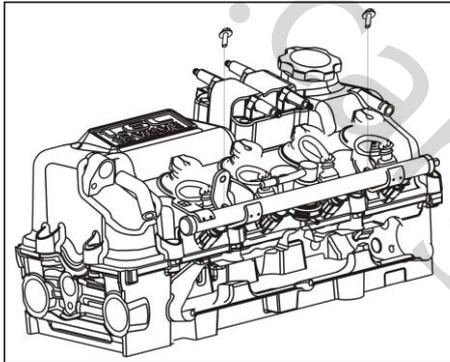


Fig. 7-58 Removal of Tritec 1.6L Engine Fuel Rail
Fixing Bolt

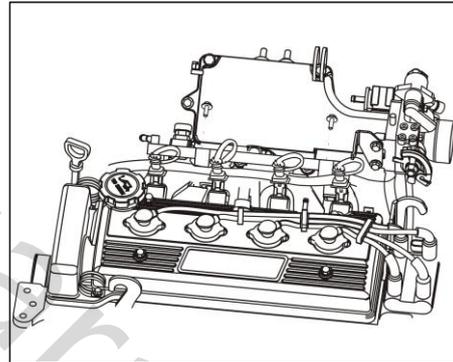


Fig. 7-59 Removal of LF479/481 Engine Fuel Rail
Fixing Bolt

4. Remove the hose clamp from filter, pull out a hose from the pipe of fuel filter, and disconnect inlet/outlet pipe.

Installation procedure

1. Install a new fuel filter into its fixing clamp. Pay attention to the flow direction.
2. Install the fuel filter.
3. Connect the inlet/outlet pipe. Tighten the fuel pipe with a connector clamp.
4. Connect the negative cable of battery.
5. Carry out a leak test of fuel filter.

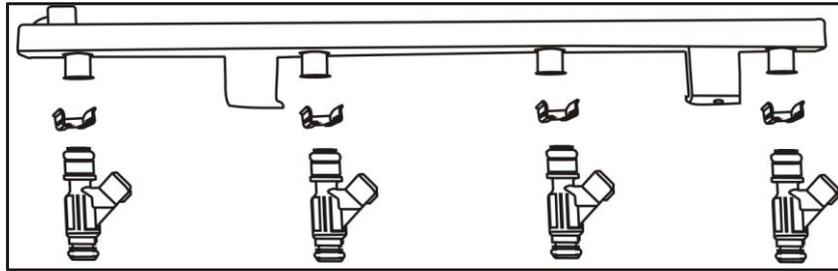


Fig. 7-60 Removal of Fuel Distributor

V. Replacement of fuel rail assembly and fuel injector

Warning: the pressure exists in fuel system. In order to fuel leakage, injury or fire, release the pressure of fuel system before disconnecting the fuel pipe.

1. Release the fuel pressure, and refer to "Pressure Relief of Fuel System" in this section.
2. Disconnect the negative cable of battery.
3. Disconnect the harness connector of fuel injector.
4. Remove the fuel supply pipe.
5. Remove the mounting bolt of fuel rail assembly.

Note: clean the fuel rail assembly with a smoke-like cleaning agent before the removal. It's prohibited to soak the fuel rail assembly in liquid-state cleaning agent. Be careful to remove the fuel rail assembly, so as to avoid the damages to electric connector and connector I injector nozzle. Prevent the dirt or other pollutants from entering into the opened fuel pipe and channel. During the repair, block the interface and hole. If the fuel injector is removed from the fuel rail and holds on the cylinder cover, it's required to replace O seal ring and fixing clamp of fuel injector.

6. Remove the fuel rail with fuel injector.
7. Remove the fixing clamp of fuel injector.
8. Pull it down or outwards to remove the fuel injector.
9. Scrap O seal ring of fuel injector.

Installation procedure

Note: different fuel injectors shall be calibrated according to different flows. Be sure to order a new fuel injector as per part number of original fuel injector.

1. Lubricate new O seal ring of fuel injector with engine oil. Attach this new O seal ring to the fuel injector.
2. Install the fuel injector into the fuel line seat of fuel rail assembly with its end face outwards.
3. Attach the clamp of fuel injector to fuel injector and fuel line wall support of fuel rail.
4. Ensure the clamp is parallel to the harness connector of fuel injector.
5. Install the fuel rail assembly into the cylinder cover.
6. Install the mounting bolt of fuel rail assembly. Its tightening torque is 20-33 N.m.

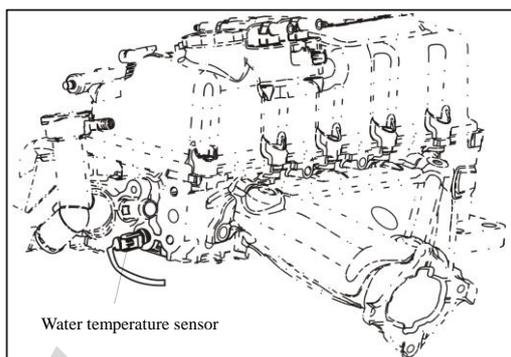


Fig. 7-61 Removal of Tritec 1.6L Engine Water Temperature Sensor

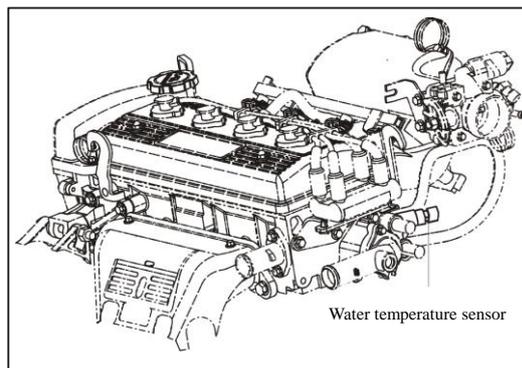


Fig. 7-62 Removal of LF479/481 Engine Water Temperature Sensor

7. Connect the fuel supply hose.
8. Connect the fuel injector harness connector. Turn each fuel injector with a connector to avoid the tension of harness.
9. Connect the negative cable of battery.
10. Carry out the leak test of fuel distributing line and fuel injector.

VI. Replacement of the cooling fluid temperature sensor of engine

Removal procedure

1. Release the pressure of cooling system.
2. Disconnect the negative cable of battery.
3. Disconnect the connector of cooling fluid temperature sensor of engine. The attentions for connector: be careful to handle the cooling fluid temperature sensor of engine. The damages of sensor will influence the correct operation of fuel injecting system.
4. Remove the cooling fluid temperature sensor of engine.

Installation procedure

1. Install the cooling fluid temperature sensor of engine. Its tightening torque is 27 N.m.
2. Connect the connector of cooling fluid temperature sensor of engine.
3. Connect the negative cable of battery.

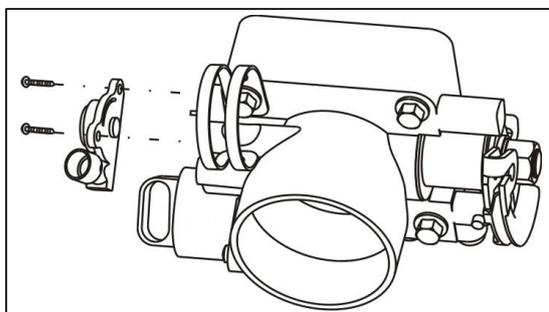


Fig. 7-63 Removal of Throttle Position Sensor

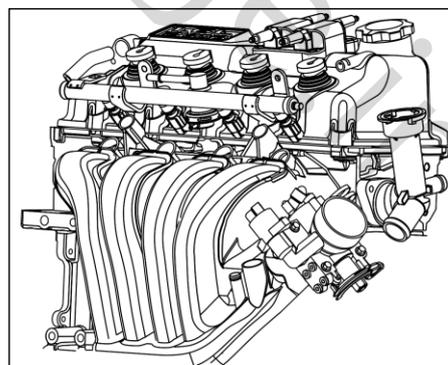


Fig. 7-64 Removal of Tritec 1.6L Engine Throttle Body

VII. Replacement of throttle position sensor

Removal procedure

1. Disconnect the negative cable of battery.
2. Remove the inlet pipe and resonant chamber.
3. Disconnect the connector of throttle position sensor.
4. Remove the fixing bolt of throttle position sensor and throttle position sensor.

Installation procedure

1. In case of closing the throttle valve, place the throttle position sensor on the throttle shaft.
Align the throttle position sensor to the bolt hole.
2. Install the fixing of throttle position sensor. Its tightening torque is 12-15 N.m.
3. Connect the connector of throttle position sensor.
4. Install the inlet pipe and resonant chamber.
5. Connect the negative cable of battery.

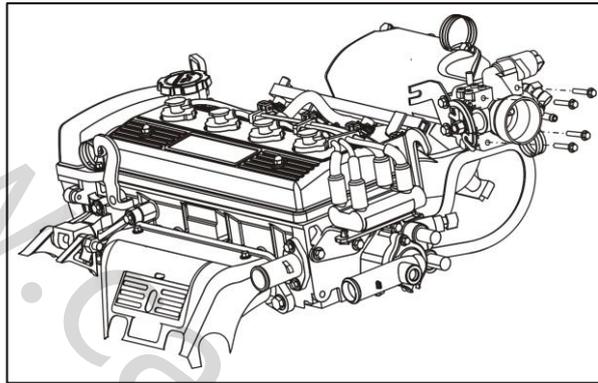


Fig. 7-6 LF479/481 engine throttle body

VIII. Removal and installation of throttle valve body

Removal procedure

1. Disconnect the negative cable of battery.
2. Remove the air filter inlet pipe.
3. Disconnect the vent hose of crankshaft case.
4. Disconnect the refrigerant hose from the throttle valve body (as per the specific car configuration).
5. Open the separation chamber, and disconnect the throttle cable.
6. Disconnect the idle actuator connector from the throttle, and connect the throttle position sensor.
7. Remove the connecting bolt of throttle valve body.
8. Remove the throttle valve body, and scrap its liner.

Note: after removing the throttle valve body assembly, block the opening of inlet manifold. Prevent any object or crumbs from entering into the engine to avoid the damages to it.

Installation procedure

Note: be careful to remove the used liner material on machined aluminum surface. Any sharp tool will damage the seal face. After removing the throttle valve body, clean it in low-temperature impregnated cleaning agent. The throttle position sensor and idle air control valve can't contact any solvent or cleaning agent, otherwise they will be damaged.

1. Clear the matching face of inlet manifold liner.

2. Clean the throttle valve body.
3. Attach the throttle valve body assembly with new liner to inlet manifold.
6. Install the fixing bolt of throttle valve body. Its tightening torque is 15-18 N.m.
7. Connect the connector of throttle position sensor and idle air control valve
8. Connect the hose of cooling fluid to the throttle valve body (as per the detailed car configuration).
9. Connect the vacuum hose to the throttle shell.
10. Connect the throttle cable.

Note: during the shutdown of engine, check whether the accelerator pedal has a free stroke.

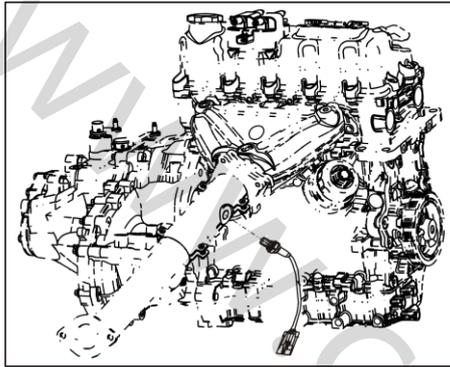


Fig. 7-66 Removal of front oxygen sensor

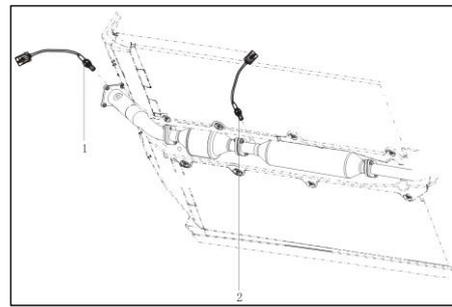


Fig. 7-67 Removal of rear oxygen sensor

1-Front oxygen sensor 2-Rear oxygen sensor

11. Install the air filter inlet pipe.
12. Connect the negative cable of battery.

IX. Replacement of oxygen sensor

Removal procedure

Note: the oxygen sensor adopts a permanently installed lead wire and connector. Any lead wire can't be removed from the oxygen sensor. The damages or removal of lead wire and connector can influence the correct operation of oxygen sensor. Be careful to handle the oxygen sensor. Don't fall the oxygen sensor.

1. Disconnect the negative cable of battery.
2. Disconnect the connector of pre-heating oxygen sensor (HO2S1).

Note: when the engine temperature is below 48°C, the oxygen sensor may be difficult to remove. Any excessive force can damage the threads of exhaust manifold.

3. Be careful to remove pre-heating oxygen sensor from the exhaust manifold.

Installation procedure

Note: apply a special antisticking agent to the oxygen sensor. This agent is composed of liquid-state graphite and glass beads. The graphite will be burnt, but glass beads still exist, so that the sensor is easy to remove. The threads of new sensor and repaired sensor shall be painted with antisticking adhesive. If it's required to remove and reinstall the sensor from the engine, apply the antisticking agent to the threads before installing the sensor.

1. If necessary, apply the antisticking agent to the threads of pre-heating oxygen sensor.

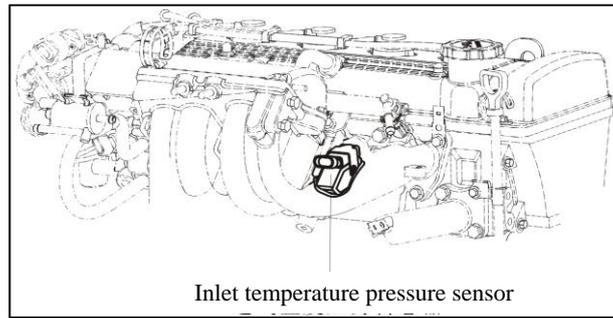


Fig. 7-68 Removal of inlet temperature pressure sensor (domestic)

2. Install pre-heating oxygen sensor into the exhaust manifold. Its tightening torque is 30-32N.m.
3. Connect the connector of pre-heating oxygen sensor.
4. Connect the negative cable of battery.

The removal and installation procedure of after-heating oxygen sensor are the same as those of pre-heating oxygen sensor.

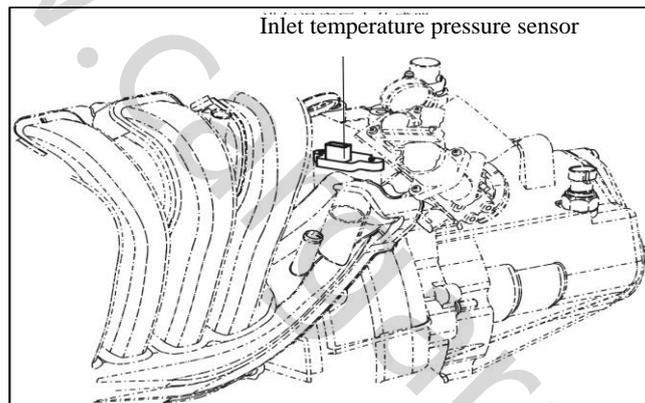


Fig. 7-69 Removal of inlet temperature pressure sensor (imported)

X. Replacement of inlet pressure and inlet temperature sensor

Removal procedure

1. Disconnect the negative cable of battery.
2. Disconnect the connector of inlet pressure and inlet temperature sensor.
3. Remove inlet the mounting screw of pressure and inlet temperature sensor.
4. Pull out this sensor of engine inlet manifold.

Installation procedure

1. Install the inlet pressure and inlet temperature sensor into the engine inlet manifold, and observe O seal ring for damages. If any, it's required to replace this O seal ring.

2. Install the mounting screw of inlet pressure and inlet temperature sensor, and its torque is 10-12 N.m.

3. Connect the connector of inlet pressure and inlet temperature sensor.
4. Connect the negative cable of battery.

XI. Replacement of idle air control valve

Removal procedure

1. Remove the throttle valve body (see this section).
2. Remove the fixing bolt of idle air control valve.

Note: It's prohibited to push the valve pivot on idle air control valve. The force required by moving the pivot can damage the threads in worm gear.

3. Remove the idle air control valve.

Note: it's prohibited to use ketone, otherwise it will damage the parts.

4. Clean the O seal ring, pivot valve seat and air path with the appropriate cleaning agent of fuel system.

Installation procedure

Note: for the idle air control valve, replace it with the same part.

1. Lubricate new O seal ring with engine oil. Attach this O seal ring to the valve. Attach O seal ring of idle air control valve to the throttle valve body.

3. Install the fixing bolt of idle air control valve. Its tightening torque is 10-12 N.m.

4. Install the throttle valve body (see this section).

5. Connect the negative cable of battery.

6. Start the engine and check whether its idle is appropriate.

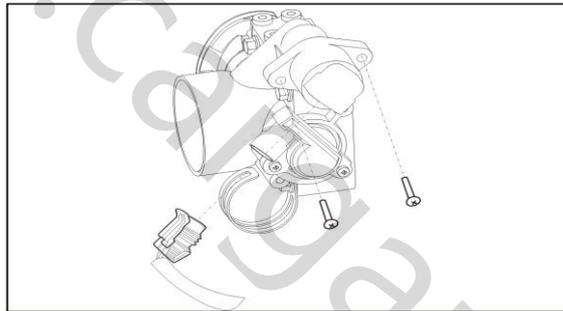


Fig. 7-70 Removal of idle control valve

XII. Replacement of knock sensor

(I) Tritec 1.6L engine

Removal procedure

1. Disconnect the negative cable of battery.
2. Remove the bolt of inlet manifold support.
3. Disconnect the connector of knock sensor.
4. Remove the bolt of knock sensor.
5. Remove the knock sensor.

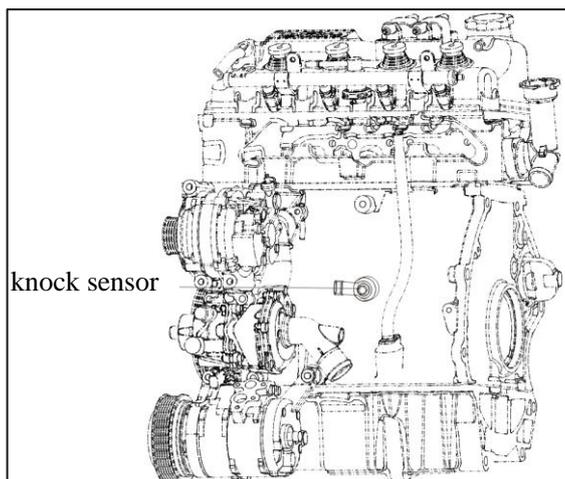


Fig. 7-71 Removal of knock sensor (Tritec 1.6L)

Installation procedure

1. Install the knock sensor with a bolt. Its tightening torque is 22 N.m.
2. Connect the connector of knock sensor.
3. Install the inlet manifold with a bolt.
4. Connect the negative cable of battery.

(II) Lifan engine

Removal procedure

1. Disconnect the negative cable of battery.
2. Disconnect the connector of knock sensor.
3. Remove the bolt of knock sensor.
4. Remove the knock sensor.

Installation procedure

1. Install the knock sensor with a bolt. Its tightening torque is 22 N.m.
2. Connect the connector of knock sensor.
3. Connect the negative cable of battery.

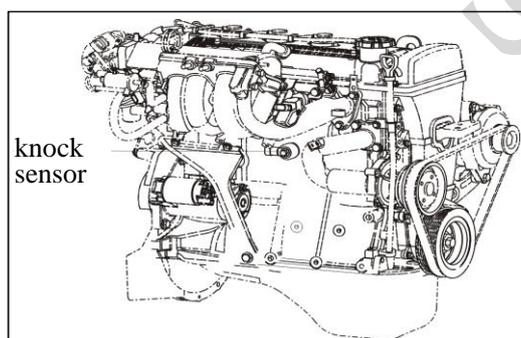


Fig. 7-72 Removal of knock sensor (LF479/481)

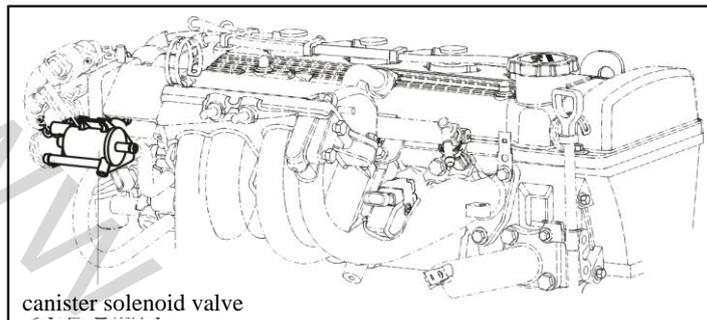
XIII. Replacement and removal procedure of canister

Warning: the fuel steam exists in canister and vacuum hose. It's prohibited to smoke or use open flame.

1. Remove the fixing bolt from flange to car.
2. Remove the canister from the slide.
3. Disconnect the fuel steaming hose of canister.
4. Remove the canister cover.
5. Remove the canister.

Installation procedure

1. Insert the canister into the sliding chute, and slide it in position.
2. Connect the fuel steaming hose of canister. Tighten the flange bolt of evaporative emission canister to the torque of 10 N.m.
3. Install the canister flange bolt.



● Fig. 7-73 Removal of canister solenoid valve

XIV. Removal and installation of canister solenoid valve

Instructions: the canister solenoid valve has several installation positions, the position shown in right figure is only one position installed beside the throttle, and other installation positions have similar removal and installation modes, so they shall not be indicated in the figures any longer.

Removal procedure

1. **Disconnect the negative cable of battery.**
2. **Disconnect the connector of evaporative emission canister solenoid valve.**
3. **Disconnect the vacuum hose from evaporative emission canister solenoid valve.**
4. **Remove the evaporative emission canister solenoid valve from inlet manifold bracket.**

Installation procedure

1. Attach the evaporative emission canister solenoid valve to inlet manifold bracket.
2. Connect the vacuum hose to evaporative emission canister solenoid valve.
3. Connect the connector of evaporative emission canister solenoid valve.
4. Connect the negative cable of battery.

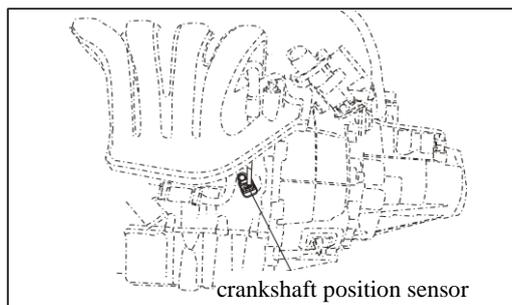


Fig. 7-74 Removal of crankshaft position sensor

XV. Replacement of crankshaft position sensor

Installation procedure

1. Disconnect the negative cable of battery.
2. Disconnect the connector of crankshaft case position sensor.
3. Remove the crankshaft case position sensor bolt.
4. Remove crankshaft case position sensor.

Installation procedure

1. Install the crankshaft case position sensor with a bolt. Its tightening torque is 20 N.m.
2. Connect the connector of crankshaft case position sensor.
3. Connect the negative cable of battery.

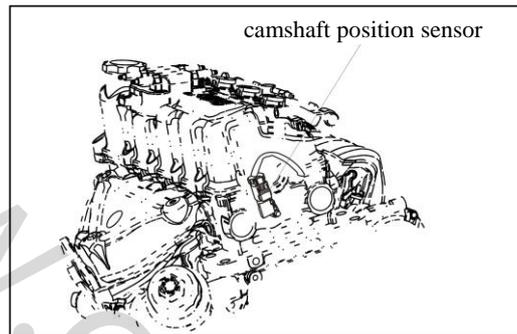


Fig. 7-75 Removal of camshaft position sensor

XVI. Replacement of camshaft position sensor (Tritec engine configuration)

Removal procedure

1. Disconnect the negative cable of battery.
2. Remove the camshaft position sensor.

Installation procedure

1. Install the camshaft position sensor and bolt. Its tightening torque is 15-17 N.m.
2. Connect the negative cable of battery.

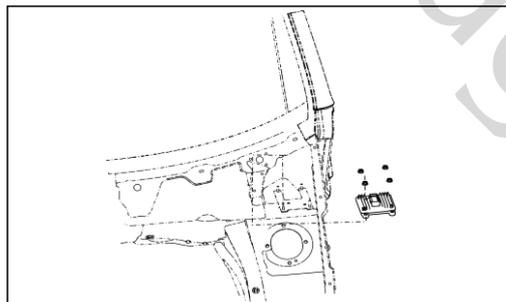


Fig. 7-76 Removal of electronic injector ECU

XVII. Replacement of Engine ECU

Removal procedure

1. Disconnect the negative cable of battery.
2. Disconnect the harness connector of engine ECU, and remove four mounting screws of engine ECU.

Installation procedure

1. Install the engine ECU, and its fixing torque is 16 N.m.
2. Connect the engine ECU harness.
3. Connect to the negative pole of battery.

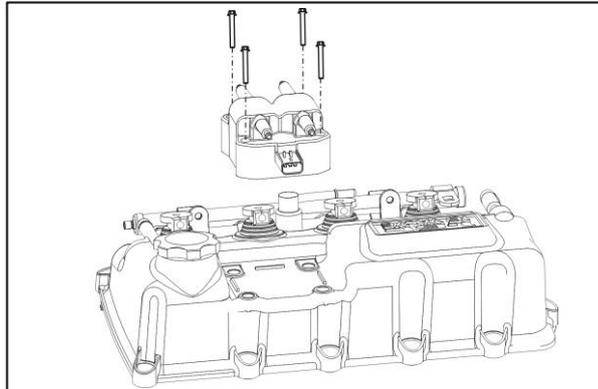


Fig. 7-77 Removal of Ignition Coil (Tritec 1.6L)

XVIII. Replacement of ignition coil

Removal procedure

1. Disconnect the negative pole of battery.
2. Disconnect the harness of ignition coil.
3. Remove the ignition coil.

Installation procedure

1. Install the ignition coil, and fix it. Its fixing torque is 16 N.m.
2. Connect the harness of engine ECU.
3. Connect to the negative pole of battery.

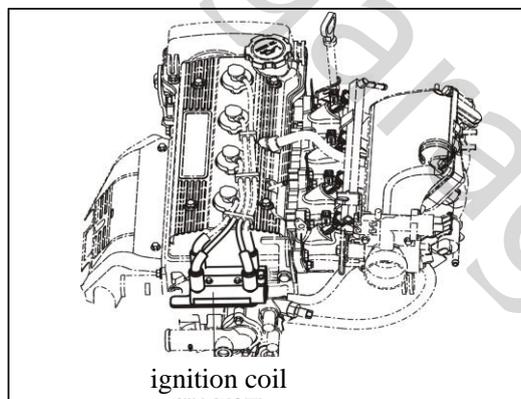


Fig. 7-78 Removal of Ignition Coil (LF479/481)