

# **EFI-2100 Engine Fuel System Analyzer**

User's manual

AOK Garage Equipment Co., Ltd is delighted that you have chosen the EFI-2100 series fuel system analyzer. The most advanced techniques were used during its manufacture, and it underwent rigorous testing before it was released for sale.

## **【STATE】**

Copyright 2000-2013 AOK Garage Equipment Co.,Ltd. Copyright by AOK Garage Equipment Co., Ltd. ("AOK"). No part of this manual may be reproduced or transmitted in any form without the expressed, written permission of AOK. We will do our utmost to ensure the accuracy of the contents of this manual, but does not rule out the errors caused by editor clerical or entry errors. Our products are in continuous updates, so AOK reserves the right to revise this user manual at any time without prior notice.

## **【SUPPORT】**

If you have any problems with the instrument or the functions, and can not get any help from this manual, please consult your dealer before using it. In addition, you can also get help in the following ways:

Visit the official website of AOK to obtain product information and other relevant technical support or ask for advice from the online service on the official website.

# 01 PREPARATION

---

## Introduction / Precautions

---

The EFI-2100 fuel system analyzer is specially designed for fuel system failure detection of electronic fuel injection engine. It can test the pressure and flow of fuel system, and the vacuum in intake manifold and the pressure in exhaust pipe. No need road testing, the systematic function is very clear. The particular quick connector is easy to use and have high-sealing performance. The open design of the adapter, can be upgraded at any time to adapt to the changing models.

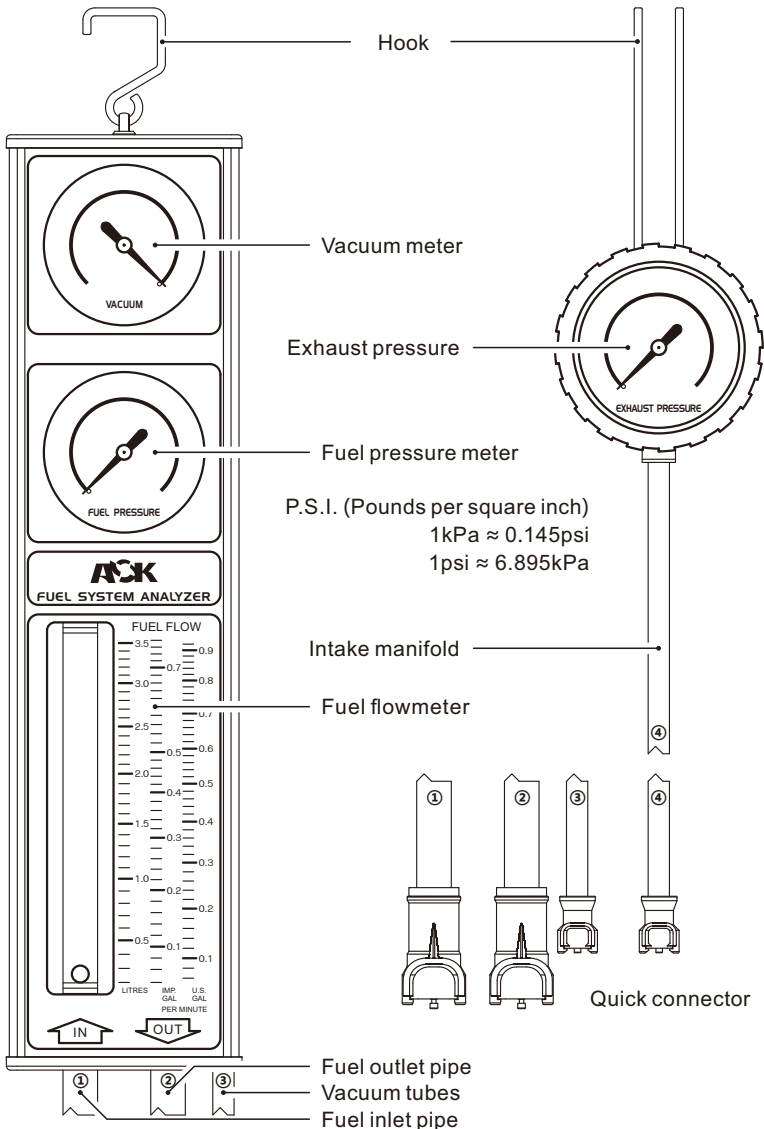
The quick connector uses oil-resistant, high-strength polymer materials, with insulation, will neither cause a short circuit, nor scratch the car paint surface. The quick connector is with high sealing performance, which can ensure the accuracy of the test. The test on the fuel flow, fuel pressure, exhaust back pressure, intake manifold vacuum degree and some others can check out the failure of the electronic fuel injection system quickly and accurately.

### **SAFETY INSTRUCTION:**

- Please read the manual carefully before testing.
- The detector is limited to the fuel system of gasoline vehicles. The maximum pressure of system is not greater than 700kPa (about 7kg/cm<sup>2</sup>).
- Vacuum gauge and back pressure gauge are limited to detecting intake manifold vacuum or exhaust backpressure.
- When removing the oil line, be sure not to produce sparks from static electricity, short circuit, open flames and other reasons, and you should prepare effective firing device for the combustion of gasoline.
- It is prohibited to use other accessories to replace the original equipment parts, to ensure the accuracy and reliability of the original instrument.

# INTRODUCTION **02**

## Part names and functions

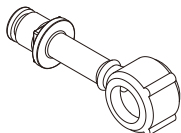


# 03 INTRODUCTION

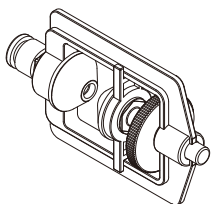
---

## Part names and functions

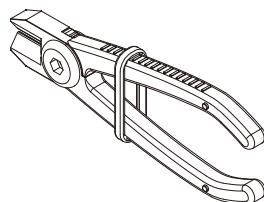
---



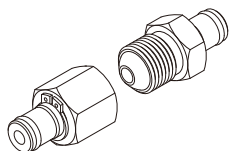
T01-T04



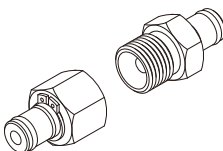
T05



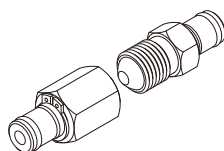
S01/S02



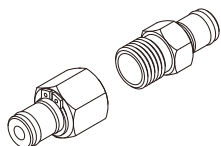
M16A



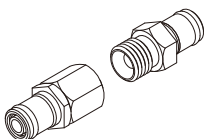
M16B



M14A



M14B

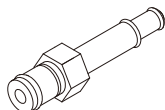


M12B

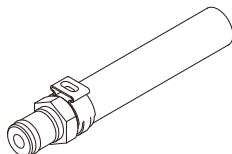
The size of the rubber ring:

● 11×1.9

● 6×1



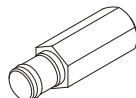
F01



F02/F03



F04



F05

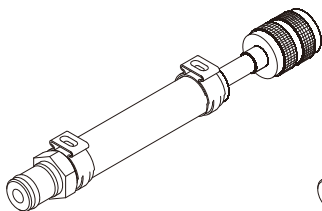
# INTRODUCTION

---

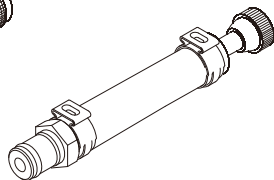
## Part names and functions

---

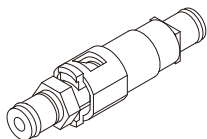
# 04



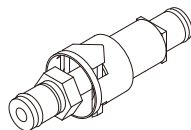
Z01



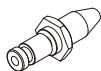
Z02



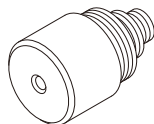
GM



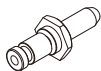
FORD



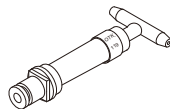
B01



B02



V01



V02

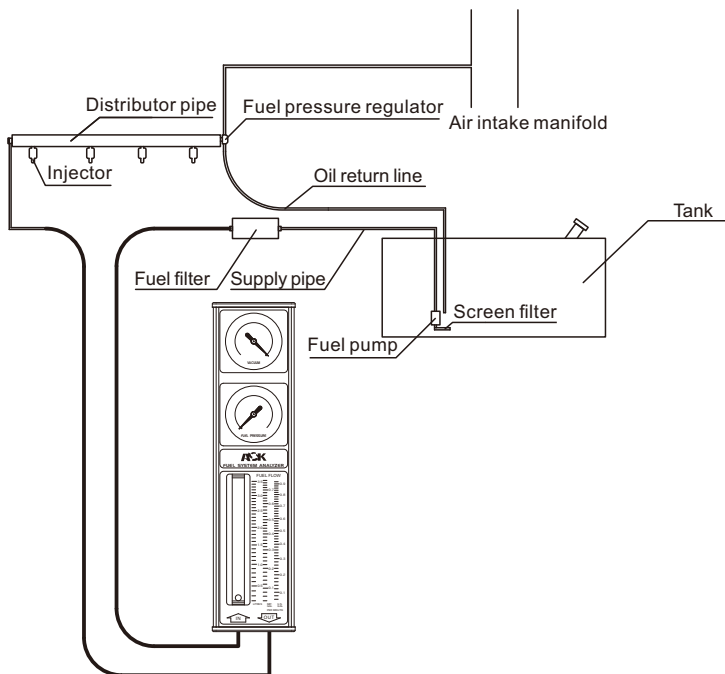
# 05 BASIC OPERATIONS

---

## Fuel pressure / flow test

---

The connection method of the fuel system analyzer with oil return line.

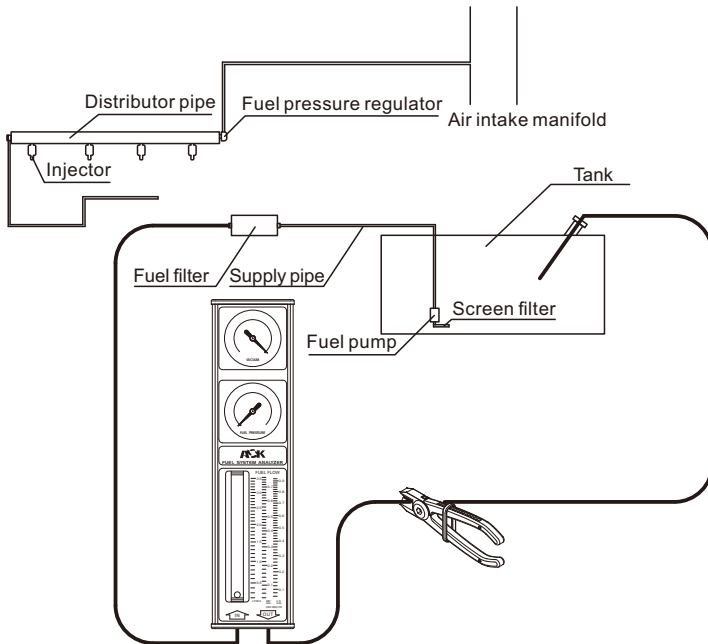


Connect the fuel system analyzer follow the illustration.

# BASIC OPERATIONS

## Fuel pressure / flow test **06**

The connection method of the fuel system analyzer without oil return line.



Connect the fuel system analyzer follow the illustration. If you have not prepared a long hose, please use a container and then drain the fuel in it (attention to the fire). Use a flexible line clamp to throttle suitably, while noting the fuel pressure. (**not greater than 700kPa**). When the fuel pressure is at idle, the fuel flow is the result to measure.



# 07 BASIC OPERATIONS

---

## The EFI system

---

### THE MAINTENANCE OF EFI SYSTEM & DIAGNOSIS INFORMATION

Electronic fuel injection (EFI) system needs to have very precise control for fuel pressure and flow. If pressure and flow can not achieve the manufacturer's label, then engine performance will be seriously affected or extreme cases will occur, even the engine can not be started or run. In each maintenance period, the electronic fuel injection system must be under performance testing. This fuel system analyzer can detect all the parameters of the electronic fuel system.

For abnormal fuel pressure, too low fuel flow (after the petrol filter, the pipe flow in front of the fuel distribution pipe is about 2 liters / minute, with the fuel pressure of about 300kPa. Different values are embodied in different models). Incorrect intake manifold vacuum and excessive exhaust pipe backpressure can both quickly detect a failure of the system and provide relevant information. For example: if the fuel pressure is too high, the three-way catalyst will be invalid; if the fuel pressure is too low, the mixture gas will become disproportionate. Issues related to mixture imbalance will occur such as deflagration, lack of engine power valve burned and other failures may occur.

Electronic fuel system analyzer can help fuel system failure to be checked out rapidly and accurately, thereby improving efficiency, and to avoid the waste of replacing the intact parts caused by the miscarriage of justice.

# BASIC OPERATIONS **08**

---

## The detection of EFI system

---

Electronic fuel injection system can be detected from the following aspects:

- Pressure and flow of oil supply system
- Fuel control valve performance
- Holding pressure of static system
- Whether there is air resistance when system works
- The vacuum degree of intake manifold
- Backpressure of exhaust pipe (pressure before three-way catalyst)

### THE USE OF THE FUEL PRESSURE METER

- The main meter should be hung vertically under the hood or vehicle.
- Main meter includes: fuel pressure gauge, fuel flow meter and hose with a self-locking quick coupling.
- The fuel pressure meter has two scales units of kPa and PSI, with the maximum detected pressure of 700kPa.
- On the flow scale, you can see through the two observation windows. The front scale: l / min, the back of the scale: UK gallons / min, and the United States gallons / min. From the comparison chart on the panel, it is convenient for you to find out the relationship among the British, American and metric flow units.
- Fuel system analyzer is usually connected in series with the vehicle oil line pipe, located on the back of the fuel filter, and before the distribution pipe.
- For other tests, the instrument can be connected to the return line between the fuel pressure regulator valve and the fuel tank. In this position, the instrument will measure the fuel consumption of the engine; check the back oil flow of the

# 09 BASIC OPERATIONS

## The detection of EFI system

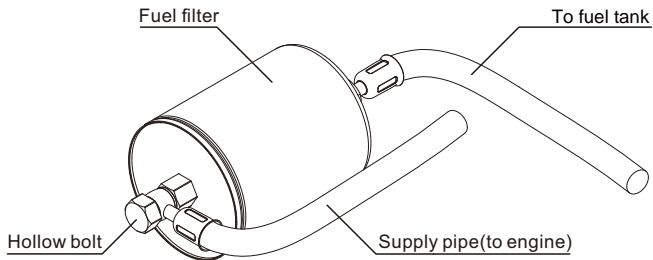
engine and the backpressure of the return oil. Whether the return flow is too small (less than 0.5 L / min) or back pressure is too large will cause the engine to work properly.

### ⚠ Notes:

- Fuel flow direction of the analyzer should be noticed, and the fuel "inflow" and "outflow" should be in line with the instructions on the instrument. If the connection is reversed, there will be no fuel flow. Therefore, apparatus and vehicles will not work properly.
- Select the appropriate tubing connector and connect the main meter to the oil line.
- Suggestion: the connection location should be at the back end of the fuel filter for the design structure at this place may have multiple removals (in each maintenance cycle, the fuel filter must be replaced). It should be avoided demolition at the threaded connection, because after many times of demolition, it is easy to destroy the sealing.

### THE FUEL PRESSURE AND FLOW IN ENGINE OPERATION

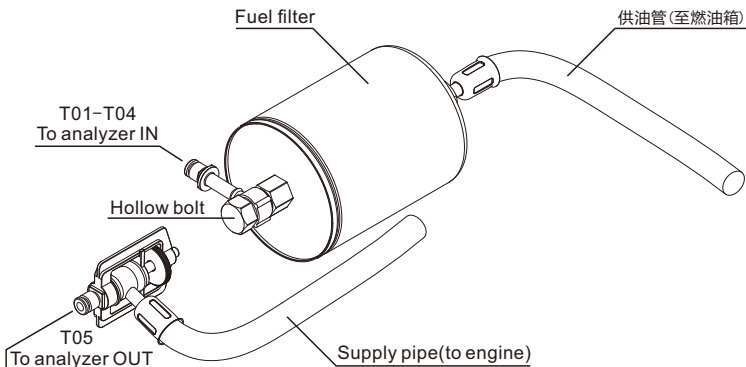
Fuel hose connection diagram with hollow bolt:



# BASIC OPERATIONS **10**

## The detection of EFI system

Choose appropriate connectors, connect fuel system analyzer between the fuel filter and fuel distribution pipe and make sure the connector is solid enough. Start the engine and keep idling. The connection method of universal joints T01 to T04 are as shown in the figure:



### ⚠ Notes:

- Whether there is fuel leak in the vehicle's fuel line connection should be carefully checked before testing.
- The fuel pump flows two liters of fuel oil under the pressure of more than 300 kPa per minute. Even a small leak spray mist of fuel may cause a fire and personal injury. In the fuel system work, we must strictly adhere to the requirements specified by the vehicle manufacturer.

The fuel pump of the electronic fuel injection system is a fixed displacement pump. The significance of the quantitative pump is to have the same amount of fuel output per minute, and when the fuel oil is thorough the regulator, fuel pressure will be

# 11 BASIC OPERATIONS

---

## The detection of EFI system

---

maintained under the throttle. The greater the throttle is, the higher the fuel pressure will be. Fuel lines and hoses have certain throttle effect, but the biggest throttling effect is generated by the fuel pressure regulator. The fuel pressure regulator regulates the throttling effect according to the vacuum adjusting degree of the engine intake manifold, thus ensuring a constant differential pressure across the injector, and leading to that the fuel injection quantity is proportional to the open time of the injector valve. Under normal circumstances, after the fuel filter, the pressure before the stars tubing is about 300KPa ( $3\text{kg}/\text{cm}^2$ ) (different models are slightly different; there are changes for idling, acceleration and different rotational speed); the flow rate is 2 liters / minute (different models are slightly different).

If the flow is lower than 1 L / min or pressure is not normal, it indicates that the fuel system failure has occurred, or fuel pump has serious wear and tear. The cause of the fault should be checked out and excluded.

### CHECK THE FUEL PRESSURE

After used for some time, the vehicle should have fuel pressure detected. There may be different pressures for different vehicle types. The specific values should be found in appropriate maintenance manual.

- When idling operation occurs, the fuel pressure should be consistent with the requirements of the vehicle manufacturer. If the pressure is normal, flow lines of the main meter can be partially clamped, to check whether the fuel pump can provide enough pressure. When the hose is clamped, the pressure will

# BASIC OPERATIONS

---

## The detection of EFI system

# 12

---

rise. When the hose is completely clamped, the pressure will increase to more than 1.5 times of the normal working pressure. If the fuel pump can not meet the above requirements, it should be replaced.

***Tip: When using the tubing clamp around fuel pipe, the pressure gauge should be observed. Do not make pressure over 700kPa for too much pressure can damage the vehicle or fuel system analyzer.***

- If the fuel pressure is too low, the engine will not be started; if there is no pressure or flow, it may be because that the fuel pump is not working; if the pressure is too low or fuel flow is much larger than the normal fuel flow, it may be because that the regulator does not work at all. At this time, there is no throttling effect in the return line of the fuel tank.

- If the fuel pressure is too high (usually accompanied by a decrease in fuel flow and the speed of the fuel pump speed is reduced by high-pressure). There are two possible reasons:

- ◆ Fuel pressure regulator has failure.
- ◆ There is too large throttle in return line from the regulator to the fuel tank.

For checking whether there is too large throttle from the regulator to the fuel tank, steps are as follows:

Access the fuel system analyzer to the return line from the regulator to the fuel oil tank, start the engine and make it begin idle running. If the pressure exceeds about 15kPa, then there is throttling effect in the return line to the fuel tank. Maybe it is

# 13 BASIC OPERATIONS

---

## The detection of EFI system

---

because of bent tubing, that there is throttle for the rubber hose tangles or fuel tank itself. With the height variations of the fuel tank, the pressure in the return line also has small changes.

- The pressure is normal for idle running, but the traffic is low. Reasons may be the fuel pump itself, fuel filter clogged tubing extruded or deformation. Tubing clamp can be used to gradually grip the oil hose of the instrument. Observe the change in pressure. If the pressure can increase to more than 1.5 times, then the fuel pump is normal. It can be judged from the reasons of pump filter being clogged, fuel filter being clogged or fuel tube being extruded to become deformation.

- Check the throttle valve. The throttle valve (pressure regulating valve) adjusts the fuel pressure according to the engine intake manifold vacuum, in order to maintain the constant pressure differential at both ends of the injector. When the throttle is suddenly opened widely, the vacuum degree of the intake manifold will reduce quickly, that is, increase in air pressure. The throttle valve is adjusted and the fuel pressure is increased, with the variation range of 15 - 25kPa. If the throttle is opened or closed rapidly, but the fuel pressure does not change, it means that there is failure for throttle. The vacuum tube can also be unplugged at idle running ( the other end should be clogged, to avoid leak). Observe the change of the fuel pressure; or use a hand vacuum pump to adjust the vacuum degree of the throttle valve, and at the same time, observe the change of the fuel pressure.

# BASIC OPERATIONS **14**

## The detection of EFI system

### CHECK THE FUEL FLOW

The fuel flow in the supply line of the engine is constant, which is about 2 liters / min. Different models have various fuel flows, which can be found from the corresponding repair manuals. When the vehicles have been used for some time, due to normal wear and tear of the fuel pump, the fuel flow will decline, but if it is too low, malfunction will be caused.

***Tips: when measuring the fuel flow, fuel system analyzer must be placed vertically, and use the hook in the upper of the instrument to hook under the hood or other locations.***

If the fuel flow is too low, the probable reasons may be as follows:

- The fuel pump is badly worn.
- Throttle occurs for the fuel oil from the tank to the oil pump (fuel pump filter of the fuel tank clogged).
- Throttle occurs for the fuel oil the pump to the engine fuel (gasoline filter is clogged and tubing is extruded).
- The circuit failure connected to the oil pump cause too low voltage of the oil pump and at this time, the pump speed is lower than the normal speed.

The fuel oil flow back to the fuel tank:

If the fuel system analyzer is connected to the return line from the pressure regulator to the tank, when the engine is switched off and the fuel pump is operated (unplug the fuel pump relay, and use jumper wires to have directly connection) the fuel oil flow to the fuel tank will be the same with that to the



# 15 BASIC OPERATIONS

---

## The detection of EFI system

---

fuel supply. If the engine works, the engine will consume a portion of the fuel, and the fuel flowing into the fuel tank will be reduced. The reduced part is the fuel consumed by the engine. Under any load, the fuel oil flow returning to the fuel tank can not be less than 0.5 liters / min. If the fuel flow is less than 0.5 liters / min, it means that the lubrication system oil capacity can not meet the needs of the engine working under heavy load work. If it is still like this, after cleaning the fuel pump strainer or replacing the fuel filter, the fuel pump should be replaced.

### THE FUEL PRESSURE WHEN THE ENGINE STOPS WORKING

After fuel system analyzer connected to the fuel filter, then fuel oil is distributed in fuel pipe line. When the engine stops working, have the leak test immediately. In normal case, when the engine stops working, there will be some minor piping expansion, and aspirated or stabilized process will occur, leading to a sudden slight decline of the fuel pressure.

When the engine and fuel pump stops working, the fuel pressure will be maintained relying on the "prevent backflow valve" in the fuel pump. In the oil supply line, the fuel pressure is maintained by the fully closed of the fuel injector and the use of fuel pressure regulator. If any of these three devices (including the "prevent backflow valve" in the fuel pump) let out, the fuel pressure in the oil line will be reduced. In addition, if any hose or joint in the oil line leaks, the fuel pressure will be reduced as well.

If the pressure in the oil line is not on hold, checking methods can be done as follows:

# BASIC OPERATIONS **16**

---

## The detection of EFI system

---

- Check the one-way valve, and prevent oil return in the oil pump.

Turn off the engine and fuel pump, using tubing clamp in the supporting tool to clamp the oil outlet host of the fuel system analyzer completely. At this time, what r detected by the fuel system analyzes is the pressure on one side of the fuel pump and it can be judged that the failure is the "prevent backflow valve" of the fuel oil pump.

- Check the leakage of the injector or the pressure regulator.

Remove the clamp of the inlet pipe on the fuel system analyzer, re-start the engine, turn off the engine and clamp the fuel oil system analyzer completely. At this time, what the pressure gaga of fuel oil system analyzer detects the pressure in the fuel line, while the fuel gauge is separated from the fuel pump and the filter. If the pressure is lowered, it is judged that one component of the injector and the regulator leaks. Using the second sub-folder to clamp the return pipe from the regulator into the tank completely, the pressure gauge will detect the pressure in the whole supply line, while the oil return line of the pressure regulator is disconnected. If the pressure continues to drop, it can be judged that it is caused by leakage from one or several injectors. If the pressure stops decreasing, then it can be judged that the drop of the original pressure is caused by the leakage of the internal regulator.

### FUEL QUALITY

Fuel of high-quality is necessary for normal operation of the engine. Under a certain pressure, the fuel oil is hard to be observed for the air bubbles are compressed and its volume is

# 17 BASIC OPERATIONS

---

## The detection of EFI system

---

small. In order to check the degree of gasoline vaporization, the pressure gauge can be observed from the bubbles in the flow meter tube, or it can be observed from pressure gauge at the same time. When the fuel contains a certain amount of gas, the pressure and flow will fluctuate in a small range, rapidly and irregularly. Further examination: remove the fuel pump insurance, start the engine, and reduce the fuel oil pressure in the oil line. When the pressure in the oil line is reduced, the bubbles will expand and it will become visible in the flow meter tube. If it is found that the fuel oil has vaporization problem, the problem may be due to the inhaled air after the fuel pump filter clogged.

Fuel oil containing water can be judged from the tube of the fuel meter, to see if there are phenomena of dirt or muddy. When the fuel pump is closed, it can be judged from the droplet in the flow meter tube.

### READINGS ON THE VACUUM METER

An experienced mechanic of engine can diagnose many faults of engines from the readings of the vacuum gauge on the intake manifold. For example: valve stuck, valve burned, piston seal ring worn, valve guide rod worn or catheter worn, rare of gas mixture and some other faults.

Connect the vacuum meter on the vacuum tube of the fuel pressure regulator, (use the "vacuum test connector" in the matching accessories. Observe the readings of the vacuum/back pressure meter when observing the fuel pressure meter. When the engine works in normal work temperature, the correct vacuum degree of intake manifold can refer to the service manual of corresponding models.

# BASIC OPERATIONS **18**

---

## The detection of EFI system

---

If the readings on the vacuum gauge are not correct, then the detection of the fuel system can not be conducted. Before detecting, reasons causing bad vacuum should be excluded.

When the engine rotate speed is rapidly changed or the engine is loaded, the vacuum degree of the intake manifold and the fuel pressure will change at the same time. When the vacuum varies from zero to a maximum, there will be changes for the readings on the fuel gauge, vacuum gauge, and fuel flow meter at the same time. If they do not change, there might be fault for the fuel pressure regulator.

In order to evaluate the relationship between the degree of vacuum and the fuel pressure, a manual vacuum pump can be connected to the fuel pressure regulator's vacuum pipe, using vacuum gauge to detect the vacuum degree, impacting a vacuum of 40kPa or so, and then clamping the vacuum tube connecting to the fuel pressure regulator. Pay attention to whether the readings on the vacuum have been dropped. If the readings on the vacuum gauge drop, it indicates that the diaphragm of the fuel pressure regulator has been damaged, and the fuel pressure regulator should be replaced.

Keep the engine at idling operation, and use manual vacuum pump to change the degree of vacuum, while observing the fuel gauge at the same time. when fuel pressure is normal, the corresponding degree of vacuum should be -65kpa. And as the increase of the vacuum degree, the fuel oil pressure will decrease. The fuel oil pressure will be at maximum when the vacuum degree is zero.

Remove the vacuum pipe from the fuel pressure regulator, and check the vacuum tube which should have no fuel.

# 19 BASIC OPERATIONS

---

## The detection of EFI system

---

### EXHAUST BACK PRESSURE

The exhaust system of the EFI Engine is equipped with a catalytic converter device. If fuel pressure is too high, it will lead to too thick mixed gas, resulting in the unburned fuel into the exhaust system. The result is to shorten the service life of the catalytic converter apparatus. After long run for the engine, the catalytic converter device in the exhaust system will be blocked by coke and some debris, resulting in unsmooth exhaust gas, so that the pressure will increase before the catalytic converter. Through detecting the back pressure of the exhaust system, it can judge the degree of clogging for the catalytic converter apparatus.

In order to check the exhaust back pressure, back pressure test connector can be used. The oxygen sensor or exhaust gas recirculation valve located on the exhaust manifold can be removed. Connect exhaust pressure meter to the exhaust pipe or exhaust manifold. Start the engine to observe the pressure gauge reading. When the engine is idling, the pressure will not exceed 10 kPa. When it is at 2500rpm, the pressure will not exceed 20 kPa. If the exhaust back pressure exceeds these values, remove the catalytic converter, and check the degree of blockage. If the conversion device is in good working condition, throttling places should be furthered located the exhaust system. In order to avoid the overheating of detection connector, the back pressure test should be completed quickly. Otherwise, it may damage the connector of the component parts in the fuel system analyzer.

# BASIC OPERATIONS **20**

---

## The detection of EFI system

---

### DESCRIPTION

Each model's fuel system might be different, it should be utilized in accordance with its working principles, structure and fault phenomenon.

It is very important for the fuel system analyzer and the connecting hose to evacuate the gasoline before taken in instrument case, because:

To empty the fuel oil in the analyzer, remove the instrument from the vehicle to maintain a vertical position, so that the fuel can be discharged into the container. When the fuel oil in the instrument is evacuated from the instrument, it will have cleaning action on the instrument itself, ready for the next use. Avoid the surface of the instrument contacting with the fuel, especially the instrument transparent cover.

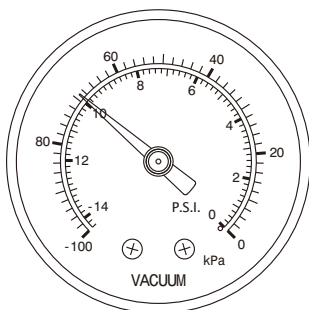
The solvents or abrasive materials can not be used to clean the instrument. It should use soft cloth to wipe clean equipment, hoses. Check whether the instrument accessory kit is complete, whether the "O" type sealing ring is damaged, and whether instrument's zero-scale is accurate.

There might be a small zero bias for the pointer of the vacuum and backpressure meter, which is normal.

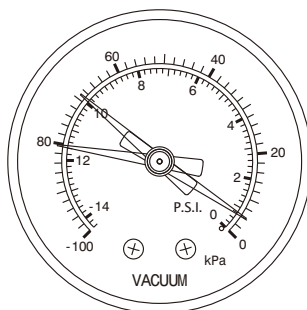
In addition, be especially careful when using fuel oil. Fuel leaked must be cleaned out promptly.

# 21 Meanings for different pointers of vacuum gauge

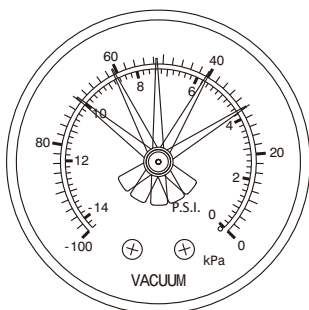
---



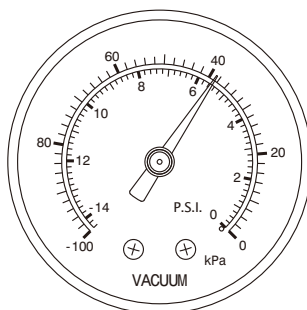
Normal engine: the readings of vacuum gauge are from 55–70kPa. The engine is at idling, and the pointer indication is stable.



Normal engine: when the accelerator is quickly turned on or turned off, the pointer indication is down to 5kPa, and vibration is around 80kPa, followed by a smooth ring back to normal idle speed readings, indicating that the loop and valve is normal.

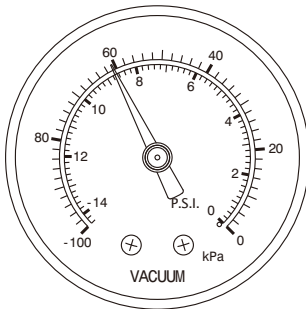


Elastic weakening of the valve spring: the engine is running fast, and the pointer is vibrating in the range of 30-70kPa; engine speed increases, and the pointer vibrations increase

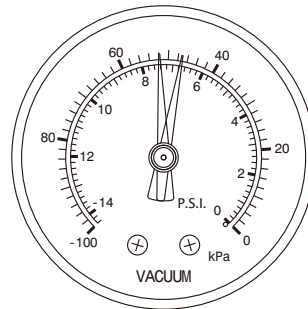


The delaying of the valve timing: measure when the engine is running. The pointer will remain silent when it is among 30-50kPa when the engine is in high idling.

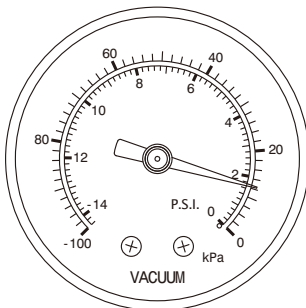
# Meanings for different pointers of vacuum gauge **22**



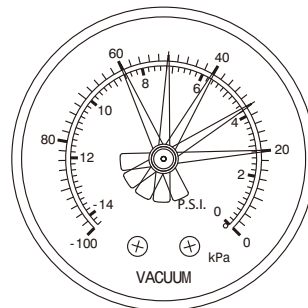
**Ignition delayed:** when the operation of the engine is at high idle, the pointer will be fixed at some location from 45 to 55kPa.



**Misfire:** If the pointer is moving slowly from 47 to 52kPa, the spark plug gap should be checked whether it is too small.



**The leak of intake system:** When the engine is running at idle or above idle, and the pointer is from 10 to 15kPa, the sealing of the intake manifold should be checked.

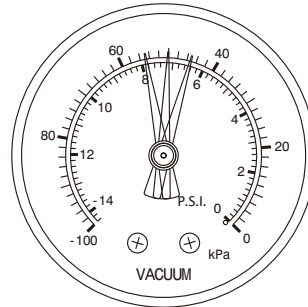
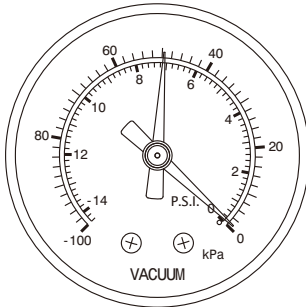


**The leak of cylinder head gasket (leakage among each cylinder):** pointer moves forward or backward regularly from 20 to 60kPa.



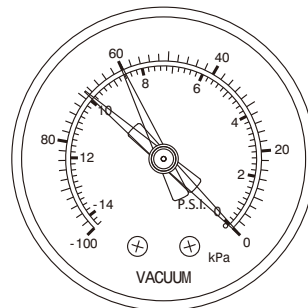
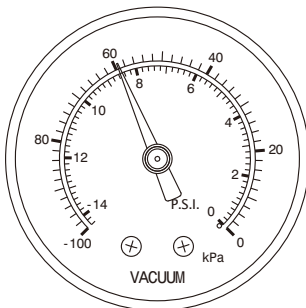
# 23 Meanings for different pointers of vacuum gauge

---



**Exhaust system blockage:** when the engine is launched for the first time, the pointer value will fall back from a higher reading to 0-5kPa, and then gradually rise to the position of 50kPa.

**Mixture imbalance:** the pointer moves back and forth among 45-55kPa.

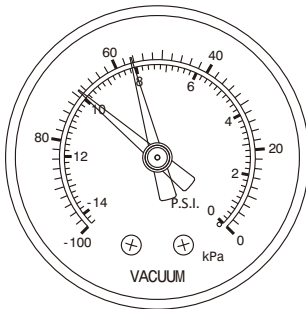


**Poor loop:** when the engine is idling, the pointer will be at some scale 10kPa lower than normal value, which indicates that there is poor lubrication condition.

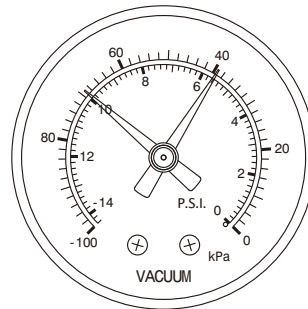
**Poor loop or poor lubrication:** when the accelerator is turned on or turned off rapidly, the pointer will swing back to zero and rise to only 60kPa or even less.

# Meanings for different pointers of vacuum gauge **24**

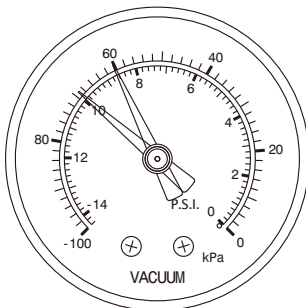
---



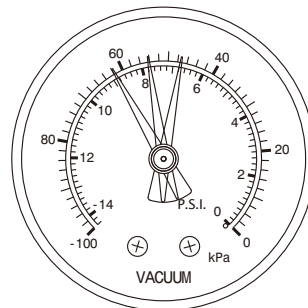
**Valve clogging:** when at idle, the pointer will swing back about 12kPa scales sometimes.



**Valve burned:** when at idle, the pointer will swing back among several scales regularly.



**Valve leak:** when the valve is in the closed position, the pointer will swing back for 7-10kPa scales; when the engine is idling, a single spark plug should be at short circuit, to determine the cylinder that the detected valve locates in.



**The indication for valve worn:** when the engine is idling, the pointer will be in rapid vibration from 47 to 62kPa.

