CONTENTS

Part I Instructions for Use of the Diesel Engine

1.1 Outline drawing of the diesel engine

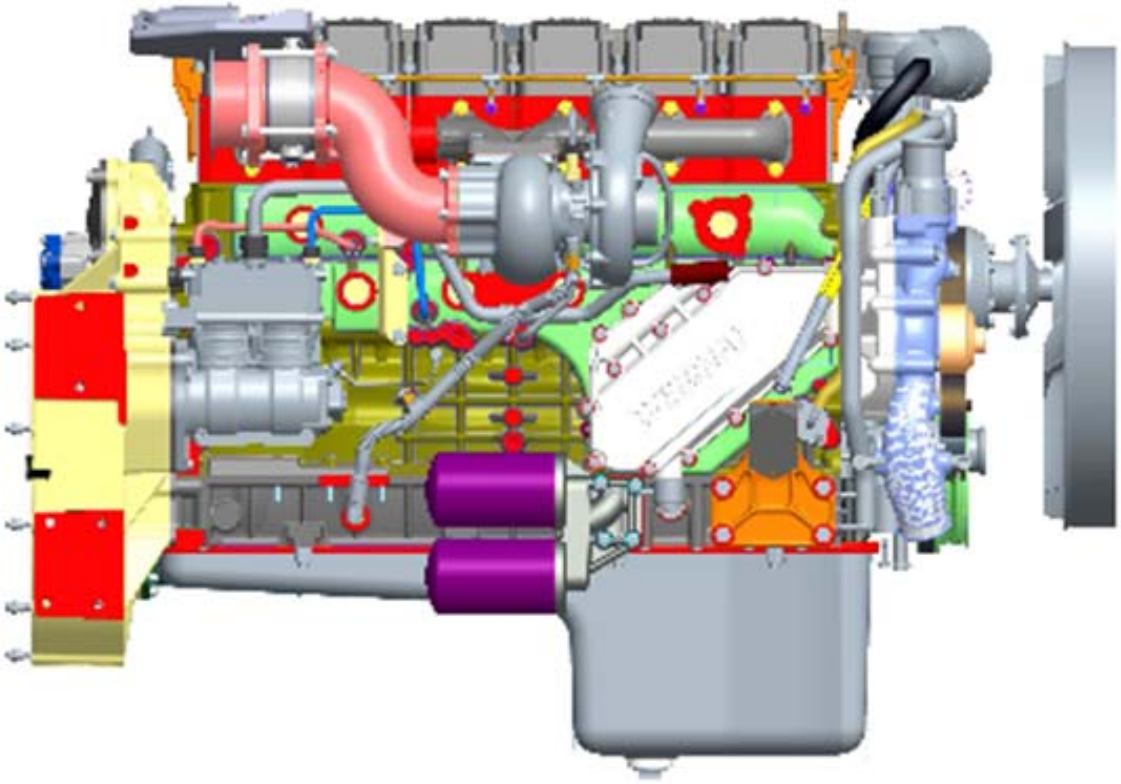


Figure 1-1 Outline drawing of WP12 four-valve Euro V series diesel engine

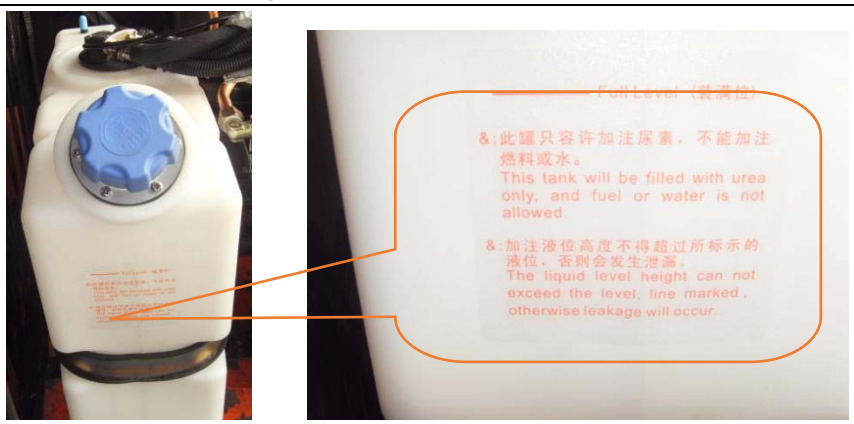


Figure 1-6 Urea level Identification on urea tank

5) Check various accessories of diesel engine

Check if various accessories of diesel engine are connected reliably, and eliminate all abnormalities. Check if the wiring of starting system is normal and if the battery is fully charged. After this, open the fuel tank valve, loose the bleeding screw on the filter and operate the hand pump to remove the air in the fuel system. Check the connection of pipeline of SCR system for urea solution leakage, tighten the connection if necessary.

1.7 Engine startup

1) Turn the power switch and electric key to the starting positions, and switch gear lever to the neutral position.

2) Press down the clutch pedal and throttle pedal, and turn the ignition key to start the engine. The engine may be started in three times of attempts (interval between two successive attempts should be 2 minutes) under the following conditions:

Table 1-2 Starting time of the engine

Start aid	Starting temperature (°C)	Starting time (s)	Starting voltage (V)
Without start aid	-10	≤15	24±4
With electric heating start aid	-30	≤30	

If the engine still fails to be started after three times of attempts, do not try to start the engine unless the causes are found out and the failure is eliminated. After the engine is started, check the readings of instruments. The engine oil pressure gauge shall immediately indicate a pressure. Do not immediately have the cold engine running at a high speed.

3) It is recommended to use the starting aid in case of engine startup at a low temperature. Under the action of relay, the electronic flange is put into service and then heats the incoming air, allowing a smooth startup of the engine at -30°C.

1.8 Running of the diesel engine

1) After the engine is started, run it at idle speed for 3 minutes, and then increase the speed to 1,000r/min-1,200r/min, and add some load. Only when the water outlet temperature is higher than 60°C and the oil temperature is above 50°C, can you operate the engine with full-load. It is recommended to increase the load and speed gradually, and avoid sudden loading or unloading as possible.

2) It is recommended to run the engine under medium load during the running-in period of 60h (for the first 3,000

(1) With the diesel engine in cold state, turn the flywheel with a bar (following the running direction of diesel engine crankshaft) to make the No. 1 cylinder and No. 6 cylinder to TDC, when the notch groove on flywheel should be aligned with the pointer on the flywheel housing cover plate. As shown in figure 2-9.

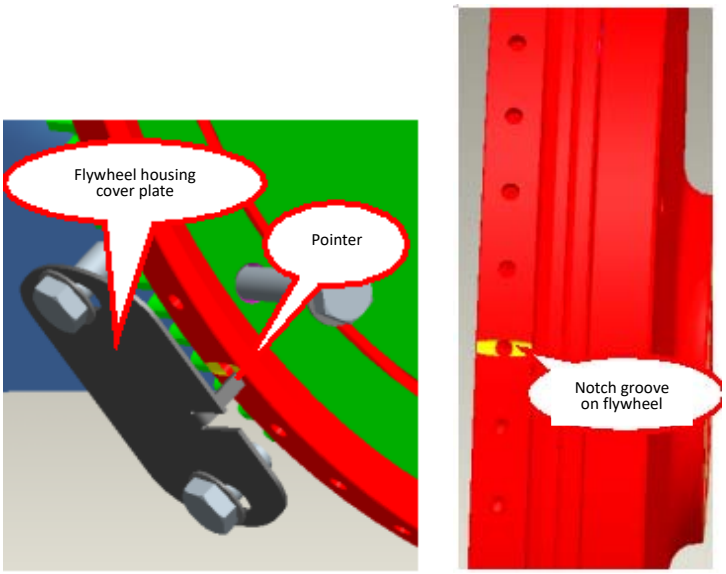


Figure 2-9

(2) Remove the valve rocker arm cover on the cylinder head, and determine if the No. 1 cylinder or No. 6 cylinder is in the compression stroke (as indicated by the existence of clearance between the intake/exhaust valve and the rocker arm).

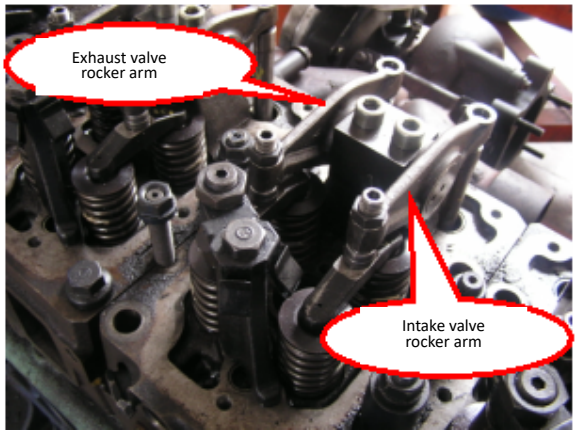


Figure 2-10 Adjustment of valve clearance

(3) Check the clearance between the upper plane of valve bridge and valve rocker arm with feeler gauge. If the clearance is excessive or too small, please adjust the adjusting bolt on the rocker arm to achieve the proper valve clearance.

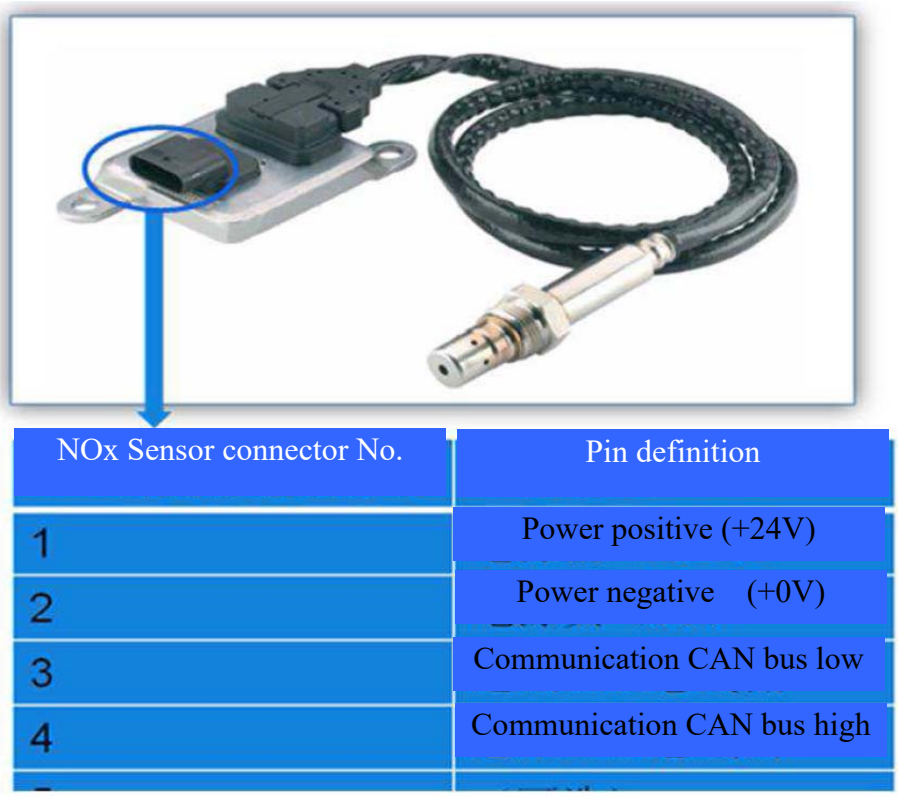
	7. The water pipe sealing element is damaged, and there is air in the pipe.	Check the water pipe, connection, gasket, etc. and replace any damaged parts.
The oil temperature is excessively high	1. The oil level in oil pan is excessively low or the oil pan is in shortage.	Check the oil level and find out the leaking points, and repair them and then add oil.
	2. The water temperature is high.	Find out the causes for excessively high water temperature and eliminate them.
	3. The liquid is not flowing through the oil cooler smoothly.	Check and clean the oil cooler.
The intake temperature is excessively high	1. The intake temperature is excessively high.	Check the heat-sinking capability of intercooler.
The synchronizing signal is erroneous	1. The sensor signal is invalid.	Read the blink code with the blink code lamp. Look up the blink code table for causes and eliminate them.
Flow metering unit is faulty	1. The flow metering unit is faulty.	Check the circuits to see if the flow metering unit or rail pressure sensor is faulty, and request our agency to handle it.
Abnormal fluctuation in rail pressure caused by leakage in fuel piping	1. The rail pressure fluctuates abnormally and the vehicle speed is unsteady.	First switch off the power supply, wait for 1min and then restart the engine. If the failure remains, then check the tightness of fuel piping and remove any failure therein.
Sensor failure	1. There is failure in the intake pressure sensor, water temperature sensor or rail pressure sensor.	Check the intake temperature and pressure sensor, water temperature sensor and rail pressure sensor, and check if the connectors are reliable.

3.2.4 The engine always runs at 1000r/min

Causes	Troubleshooting
1. The electronic accelerator cable is loose or wrongly wired.	Pull and plug the accelerator cable again or check if it is correctly wired, and then rewire it.
2. Water enters into the electronic accelerator connector.	Blow-dry the connector with tools and restart the engine.

3.2.5 Engine idling speed unstable

Causes	Troubleshooting
1. Malfunction of fuel injectors	Check the fuel injector and harness for each cylinder.
2. For vehicle provided with speed sensor, there is speed signal input when the vehicle is not moving.	Check the odometer and speed sensor signals and wiring.
3. The fuel quality is poor or there is water or wax in the fuel.	Clean the fuel system and replace the fuel filter.
4. The fuel injection nozzles atomize	Check and repair them.



NOx Sensor connector No.	Pin definition
1	Power positive (+24V)
2	Power negative (+0V)
3	Communication CAN bus low
4	Communication CAN bus high

Figure 3-12 NO_X sensor assembly

3.3.1.8 Summary of after treatment system fault

If the SCR system is inoperative, the reasons generally may be:

1) Urea pipe leakage or pipe blocked by crystals;

2) Urea pipe joint loosened, causing gas leakage but no urea leakage;

3) The urea injection pipe and return pipe are reversely connected;

4) The urea dosing pump harness connector may be shorted or open or wrongly connected;

5) The installation position of SCR system on the vehicle is improper, causing urea pipe bending or short circuit due to water entering;

6) The exhaust gas temperature sensor is not connected or open-circuited or wrongly connected;

7) The urea tank temperature sensor is abnormal, causing the SCR system in the stop status;

8) ECU or ECU harness problem, the pins of ECU connector or sensor connector are loosened;

9) Urea resistance wires fuse is burnt, the OL fault related to heating is reported;

10) Faults of parts including nozzle, exhaust gas temperature sensor and urea level sensor.

3.3.2 Fault diagnosis of after treatment system and troubleshooting

3.3.2.1 Fault classification

Type I fault: urea pressure build-up failure

Type II fault: Low urea consumption

4.1.3 Tools used

Table 4-2 Tools

Figure	Definition
	2.5mm hexagon wrench
	5mm hexagon wrench
	8mm socket
	Slotted screwdriver
	Special tool
	10mm flat-ended hexagon wrench

To use a method or tool beyond those recommended in this manual, the user shall always ensure the personal safety, avoid danger of life to the user or to others, meanwhile, make sure that the use, maintenance or repair method will not result in damage risk or safety hazard.

4.1.4 Health protection considerations

The following “health care considerations” are specified to reduce the risk of engine maintenance staffs suffering from any contamination.

a) Avoid repeated exposure to used oil for a long time;

b) Wear the protective clothing and water-proof gloves properly, if available;

c) Do not place the oily rag in the pocket;

d) Avoid contaminating clothes especially underwear with oil;

e) Wash working clothes regularly, and throw away the oil-impregnated clothes and shoes that cannot be cleaned up;

f) In case of cut and injury, take first-aid measures as soon as possible;

g) Before working, always apply some protective cream which will make it easier to remove the oil in case that the skin is contaminated with mineral oil;

h) Use soap and hot water, or liquid soap and nail brush to wash hands for the convenience of removing all oil stains. If the grease secreted by skin is washed off, the product containing lanum can moisturize the skin;

i) Do not clean the skin with any gasoline, kerosene, fuel, thinner or solvent;

④ Check if the holes in the cylinder head gasket are aligned with those in the cylinder block; Check if the cylinder head gasket has been correctly installed.

3) Installation of valve rod seal

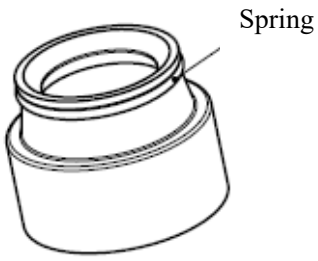


Figure 4-16 Valve rod seal

① The valve rod seal can only be used once, and it must be replaced once it is overhauled;

② Check if the valve rod seal is defective, and if spring of valve rod seal is intact;

③ Install the valve rod seal on the valve guide;

④ Apply lubricating oil onto the lip of valve rod seal;

⑤ Press fit the valve rod seal with special tool and rubber hammer.

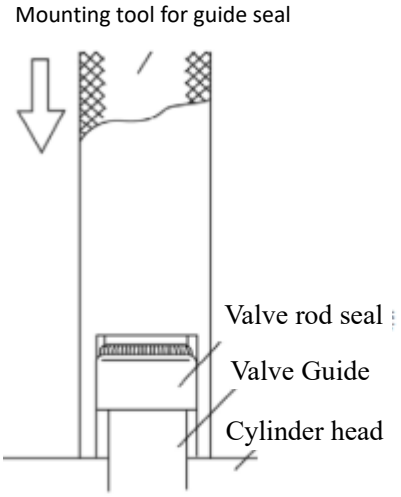


Figure 4-17 Installation of valve rod seal

4) Installation of cylinder head

① Carefully clean the cylinder head and ensure that it is free of dirt like dust and sand, and then clean the lower plane of cylinder head;

② Make sure that there is no foreign material inside the air passage, water passage and cylinder liner, and the cylinder head gasket and lower plane of cylinder head are clean;

③ Before tightening the bolts of cylinder head, the cylinder head shall be located with pin and plane location method;

④ Install the cylinder head.

Disassemble the first ring, second ring and oil control ring respectively with the piston ring mounting pliers, and mark them respectively.

4.3.3.2.2 Inspection and maintenance of piston

1) Check the piston surface and inner cavity, surfaces of piston ring and piston pin for burrs, greasy dirt or impact damages. Check the fillet of throat of combustion chamber and piston pin boss for cracks; replace them if necessary.

2) Check the external of piston ring, the upper and lower end faces of piston rings for abnormal worn.

3) The weight group character “G” of pistons used in the same engine shall be consistent.

4) After the piston rings are installed on the piston, the pistons must not collide with each other.

4.3.3.2.3 Assembly of piston

Fit the piston pin circlip, piston pin and connecting rod body one by one on piston.

4.3.3.3 Disassembly and assembly of connecting rod group

4.3.3.3.1 Exploded view of connecting rod

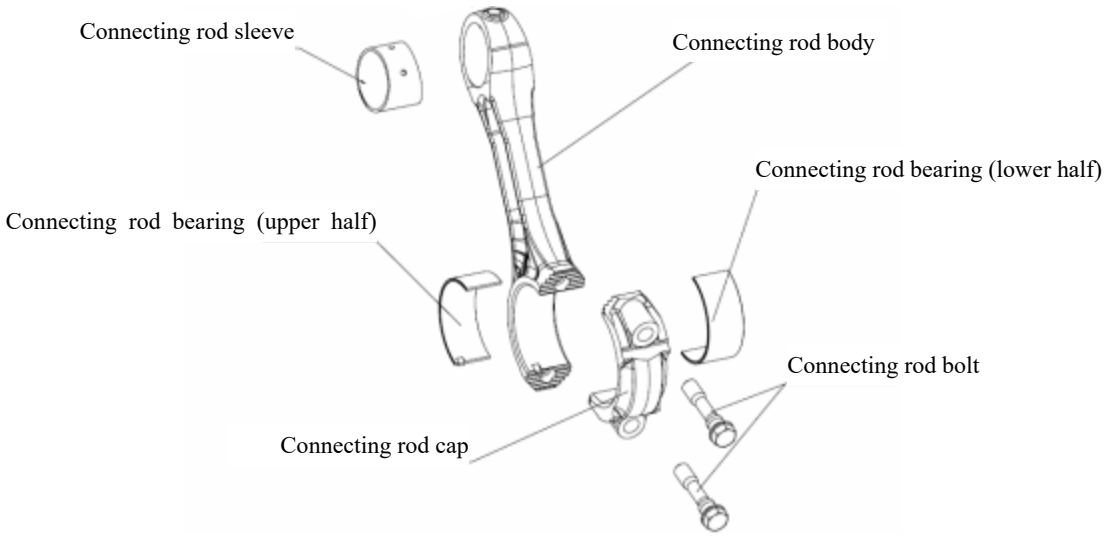


Figure 4-32 Exploded view of connecting rod

4.3.3.3.2 Disassembly of connecting rod

Carefully disassemble the circlips at both sides of piston with internal circlip pliers, and push out the piston pin, and then remove the connecting rod body. Number the connecting rod bodies respectively, and put them in order.

4.3.3.3.3 Inspection and maintenance of connecting rod

1) Check the big and small ends of connecting rod for burrs and impact damages, and make sure that there is no crack, deformation or color change around the oil hole in small end bushing.

2) Check the side faces of connecting rod for abnormal wear; check whether the connecting rod body is bent.

3) Check whether the alloy layer of connecting rod bushing is abnormally worn and there is sign of metal spalling.

② Unscrew the three M12 hex bolts of intermediate gear, remove the intermediate gear subassembly, intermediate gear shaft and idler baffle plate together with the three bolts and prevent the idler baffle plate falling down.

4.4.6.3 Inspection and maintenance of intermediate gear

① Check the threads of mounting bolts for intactness.

② Check every gear for metal flaking and breakage; Check the bearing surface of bolt for crushing and check the threaded or through holes on gear for deformation.

③ Check the shaft and the bushing of intermediate gear for abnormal abrasion and every oil hole for blockage.

4.4.6.4 Assembly of intermediate gear

① Before assembly, check the intermediate gear subassembly, intermediate gear shaft, hex bolts and idler baffle plate for manufacturing and use defects and damages.

② Install the flywheel housing connecting plate and the camshaft timing gear, rotate the camshaft timing gear to make the pinhole on gear web aligned with the pinhole on flywheel housing connecting plate and install the pin for locating. At this time, one groove of gear surface shall align with the counterbore of flywheel housing connecting plate.

③ Install two studs in flywheel housing connecting plate and install the idler baffle plate.

④ The intermediate gear subassembly is made of a large gear and a small gear through hot installation and located by pins. Insert the intermediate gear shaft into the hole of intermediate gear subassembly from the large gear side, locate and install it with studs, screw out the studs, install and tighten the M12 hex bolts. The timing mark of large gear shall align with that of camshaft timing gear (the outer ring groove of inner hub of the large gear shall align with the other groove on the teeth surface of the camshaft timing gear).

4.5 Intake and exhaust system

4.5.1 Disassembly and assembly of intake and exhaust system

4.5.1.1 Exploded view of intake and exhaust system

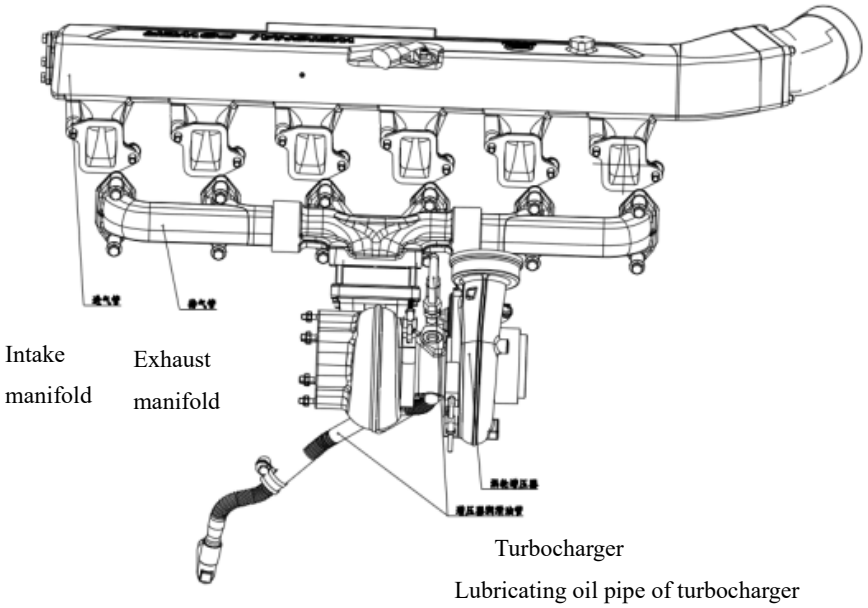


Figure 4-41 Exploded view of intake and exhaust system

4.8.4 Disassembly and assembly of oil cooler cover

4.8.4.1 Exploded view of oil cooler cover

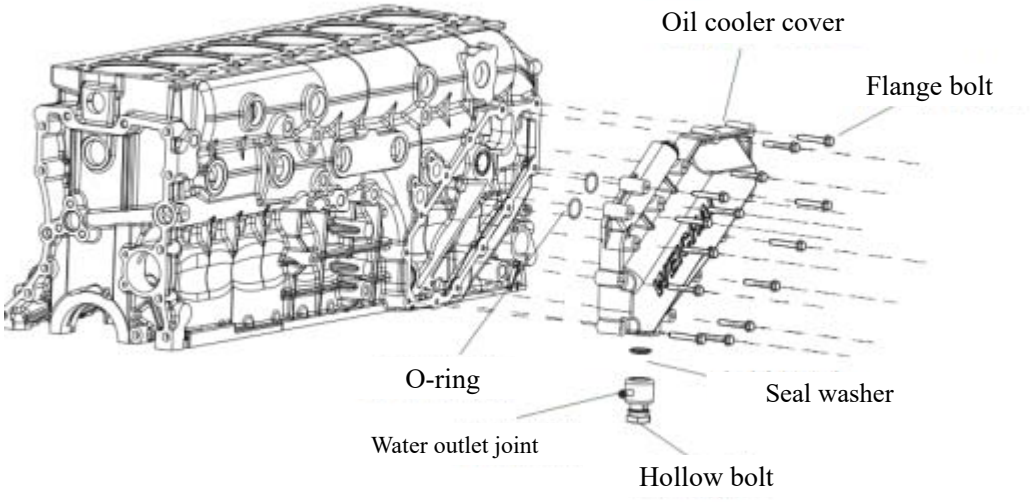


Figure 4-68 Exploded view of oil cooler cover

4.8.4.2 Disassembly procedure of oil cooler cover

Before disassembling, first drain off the coolant from the engine, and loosen the hollow bolts on the oil cooler cover in sequence, then remove the oil cooler cover and O-ring.

4.8.4.3 Inspection and maintenance of oil cooler cover

1) Check the oil cooler cover for cracks and other damages, and replace the oil cooler cover if necessary.

2) Check the seal ring of oil cooler cover for damages; if there is water leak, then check if the seal ring is failure, and replace the seal ring.

4.8.4.4 Assembly of oil cooler cover

1) Before installing the oil cooler cover, first check the oil cooler cover and the seal ring to make sure that there is no manufacture and use defects or damages.

2) Clean the junction surface between the oil cooler cover and the engine block, and install the oil cooler cover.

3) Screw the bolts to oil cooler cover and tighten them.

4) Install the water outlet joint, which shall be applied with seal washer at the two ends of the joint, and then tighten the hollow bolts.

4.8.5 Disassembly and assembly of oil cooler

4.8.5.1 Exploded view of oil cooler

Description	Flash codes	P-Code	Components Related	Problem caused	Error Reasons	Solutions
Actuator _1 is shorted to ground	115	P2670	The solenoid valve and indicating light connected to the whole vehicle; after treatment part is not considered	The relevant components cannot work	K94, K92, K50, K25, K26 and the whole vehicle voltage input	Check if the open-circuit voltage of K94, K92, K50, K25 and K26 is 3.5V; if not, check if it is shorted with other circuit
Actuator _2 is shorted to ground	116	P2685	The wiring harness of urea dosing pump	The urea pressure cannot be set by the urea dosing pump	There is voltage input of the whole vehicle for K93	Unplug the connector of the urea dosing pump to measure if the voltage of K93 at the ECU end is within 0-25mV; if not, check if K93 is shorted with other circuit
The voltage of the storage battery is too high	124	P0563	Alternator and storage battery	ECU is damaged, and the engine cannot be started	The voltage of the storage battery is too high	1. Check the storage battery; 2. Check the alternator; 3. Check the ECU
The voltage of the storage battery is too low	124	P0562	Alternator and storage battery	ECU does not work normally; and the engine is stopped	The voltage of the storage battery is too low	1. Check the storage battery; 2. Check the alternator; 3. Check the ECU
The voltage signal of storage battery is too high	124	P0563	Alternator and storage battery	ECU is damaged, and the engine cannot be started	The voltage signal of the storage battery is too high	1. Check the storage battery; 2. Check the alternator; 3. Check the ECU
The voltage signal of the storage battery is too low	124	P0562	Alternator and storage battery	ECU does not work normally; and the engine is stopped	The voltage of the storage battery is too low	1. Check the storage battery; 2. Check the alternator; 3. Check the ECU

Description	Flash codes	P-Code	Components Related	Problem caused	Error Reasons	Solutions
Voltage signal of vehicle speed sensor is under the lower limit	224	P0502	Speed sensor	The vehicle speed of ECU is taken as default 0; saving flash code	When the engine runs normally for a time, the linear voltage signal of speed sensor is under the lower limit of low level (currently, the calibrated lower limit of low level is 0, so this fault is not going to happen)	Check the connection of earth wire of sensor, whether the speed signal can be received normally; Check whether the induction voltage is weak because of improper installation of sensor; Check if the speed sensor is interfered by other wiring harness or component (such as instrument), leading to higher or instable voltage
Signal pulse width of speed sensor exceeds the upper limit	225	P2158	Speed sensor and speed meter module	The vehicle speed of ECU is taken as default 0; saving flash code	When the engine runs normally for a time, the pulse width of speed signal exceeds 5000 microseconds	Check the connection of earth wire of sensor, whether the speed signal can be received normally; Check whether the induction voltage signal is weak because of improper installation of sensor; Check if the speed sensor and speed meter are interfered by other wiring harness or component (such as instrument), leading to loss of speed pulse voltage signal
Signal pulse width of speed sensor is under the lower limit	225	P2160	Speed sensor and speed meter module	The vehicle speed of ECU is taken as default 0; saving flash code	When the engine runs normally for a time, the pulse width of speed signal is under 400 microseconds	Check if the speed sensor, speed meter and related harness are interfered by other wiring harness or component (such as instrument), leading to high frequency oscillation of speed signal; Check whether the speed meter is working normally