

WP7 Euro VI Diesel Engine Maintenance Manual

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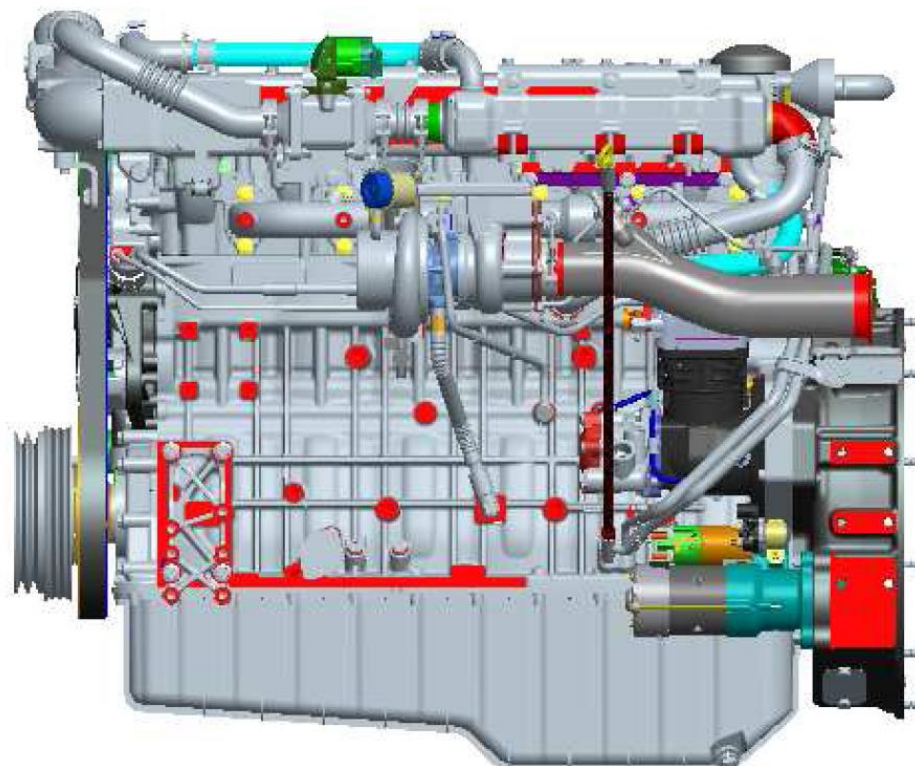
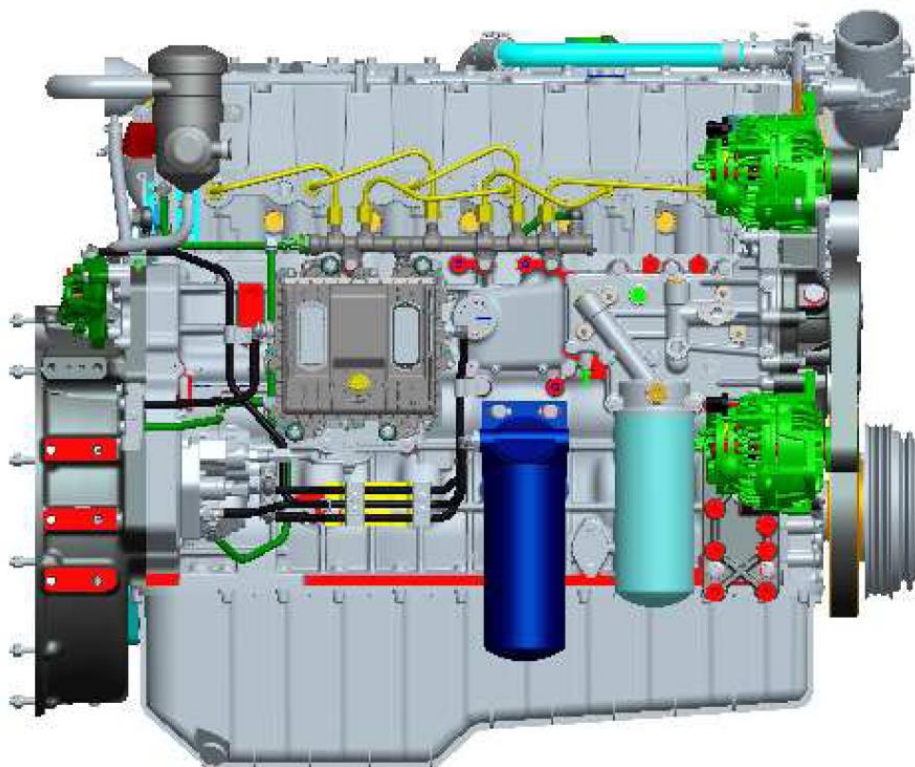
Approved by:

WP7 Euro VI Diesel Engine Maintenance Manual



WEICHAI

Weichai Power Co., Ltd



WP7 Euro VI diesel engine



Special Notice

- Before operating the diesel engine, the operator must read the Operating and Maintenance Manual carefully and strictly observe the operating and maintenance regulations;
- The diesel engine is tested strictly according to the test specification before delivery, it is not allowed to adjust the ECU data or increase the diesel engine power randomly. Otherwise, our company will not provide the 'three guarantees' services;
- The turbocharger rotor is a high speed rotating part, any moving objects (hands, tools, cotton yarn) are prohibited to get close to the turbocharger inlet during machine running to avoid personal injury or machine damage; only the professional maintenance personnel or maintenance stations authorized by Weichai are allowed to remove the rotor components of turbocharger;
- The use times of key bolts are limited, for example, the WP7 series diesel engine connecting rod bolts can only be used one time;
- The grade of oil or fuel added to diesel engine shall comply with the regulations in Operating and Maintenance Manual, the oil or fuel shall be filtered by the special clean filter, and the fuel shall be precipitated for more than 72h; every time before driving, make sure that the filling amount of coolant and oil meets the requirements;
- If there is no air filter equipped on the diesel engine, no operation is allowed so as to avoid the air entering the cylinder before being filtered;
- The user shall carry out 50h test run when operating the new engine;
- After starting a cold diesel engine, speed up slowly, and do not run it at high speed suddenly or idle it for a long time; except exceptional cases, do not stop the vehicle immediately after running with high load; run at low speed for 5~10min firstly and then stop;
- After stopping the vehicle, if the environment temperature is below 0°C and there is no antifreeze in the coolant, the coolant shall be completely drained from the water tank and the diesel engine;
- Check and repair of all parts of electric system shall be carried out by the professional electrical technicians;
- The check and repair of all parts of electronic control system shall be carried out by the professionals of Weichai maintenance stations;
- To prevent corrosion, the diesel engine has been oil sealed before delivery and the oil seal period is generally one year, please check and take essential measures if it exceeds one year.

PREFACE

WP7 Euro VI diesel engine is of high speed diesel engine meeting Euro VI emission regulations developed by Weichai Power Co., Ltd adopting new design concepts. This series of diesel engine is compact in structure, reliable in operation, the technical indexes such as power performance and economical efficiency are excellent, featuring quick starting, simple operation and convenient maintenance, and is ideal power for heavy duty vehicles.

This manual mainly includes the operation precautions, maintenance and service methods, common check and adjustment, and diagnosis and troubleshooting of common faults of WP7 Euro VI diesel engine. During the compilation, we aim at systematic, comprehensive, simple and practical of the manual. It should be noted that determining of diesel engine faults requires special carefulness and certain knowledge and experience, do not disassemble the diesel engine before the causes are found out. Or else, the faults may not be eliminated, or even become more serious due to improper reassembling, particularly the key parts such as electronic control system and turbocharger, for which special instrument or equipment shall be used in checking and maintaining. Users not experienced or having no special equipments shall not disassemble or adjust the diesel engine randomly.

This manual introduces the basic model of WP7 Euro VI series diesel engine. With the development and improvement of products, the contents of this maintenance manual may be lagged; users or dealers can visit the Weichai website <http://www.weichai.com> for the latest product information.

Welcome comments and suggestions from users for our further product improvement.

Feb. 2014

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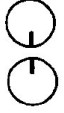
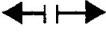
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图 示 标 记 说 明

Description of the illustration marks

	拆卸(组合件) Dismounting (assembly parts)		涂润滑油 Oil coating
	装配(组合件) Fitting (assembly parts)		专用工具,如 S K……, KUKKO, …… ,TS……W Special tools, such as K--- ---, KUKKO, --- ---, TS--- --- W
	打记号 (分解前打上,重新装配时注意对正) Marking (do before disassemble, adjust when assemble)		注意装配方向 Pay attention to assembly direction
	注入—充满(如润滑油、冷却水等) Filling— full charge (such as lubricating oil, cooling water etc.)		放气 Deflating
	排出(例如润滑油、冷却水等) Draining off (lubricating oil or cooling water)		松开(例如:夹紧装置的松开) Unloosing (such as: unloose clamping equipment)
	(防松—粘固)涂液态密封剂 (loose—proof —fixed) Coat fluid sealant		夹紧(例如:夹紧装置的夹固) Clamping (such as: reinforcing clamp equipment)
	防止人身事故(危险场合标记) Accident preventing (marks for dangerous occasion)		检测—调整 (例如:拧紧力矩,尺寸,压力,间隙等) Inspecting —adjusting (such as: tightening torque, dimension pressure and clearance)
	每次装配都要更换 Replacement when re—assembly		检查 Inspecting

Part I Diesel Engine Operating Instruction

1.1 Diesel engine external view

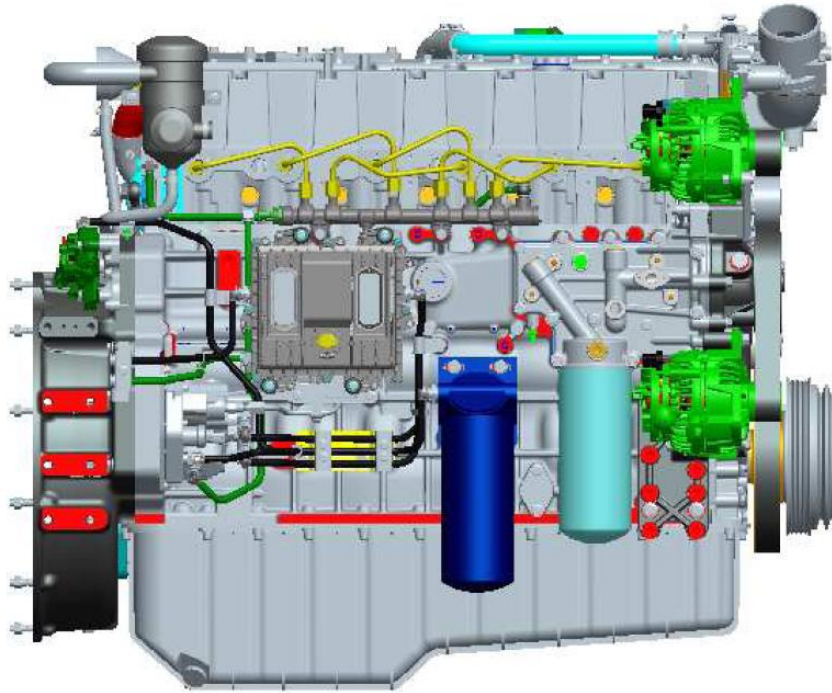


Fig.1-1 WP7 Euro VI diesel engine

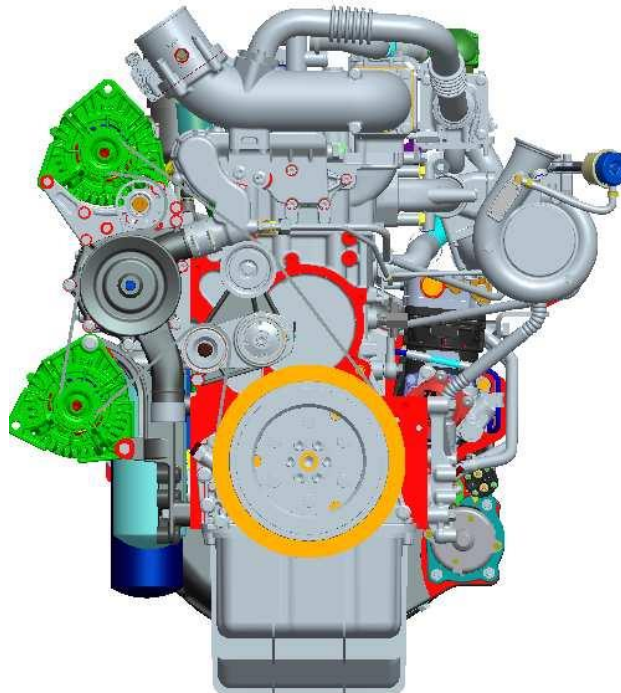


Fig.1-2 WP7 Euro VI diesel engine free end

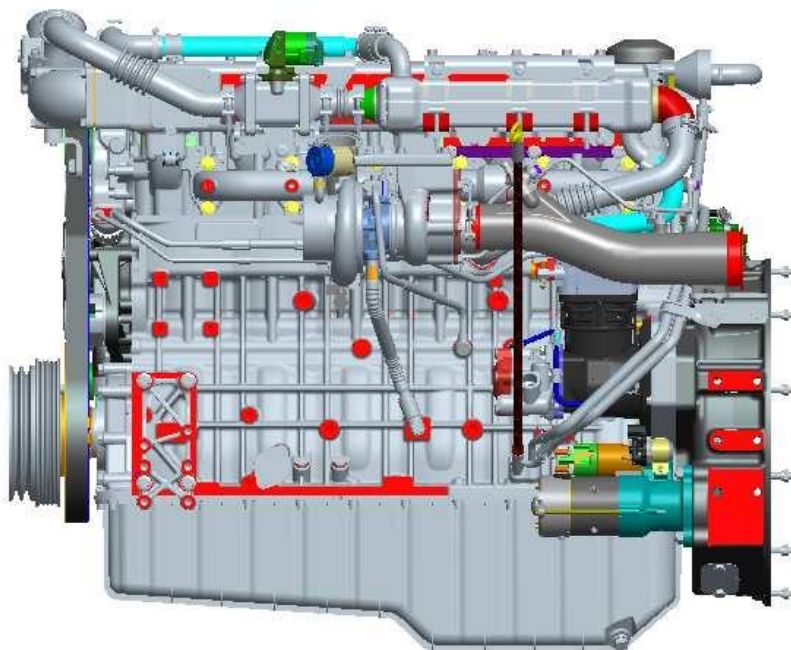


Fig.1-3 WP7 Euro VI diesel engine intake/exhaust side

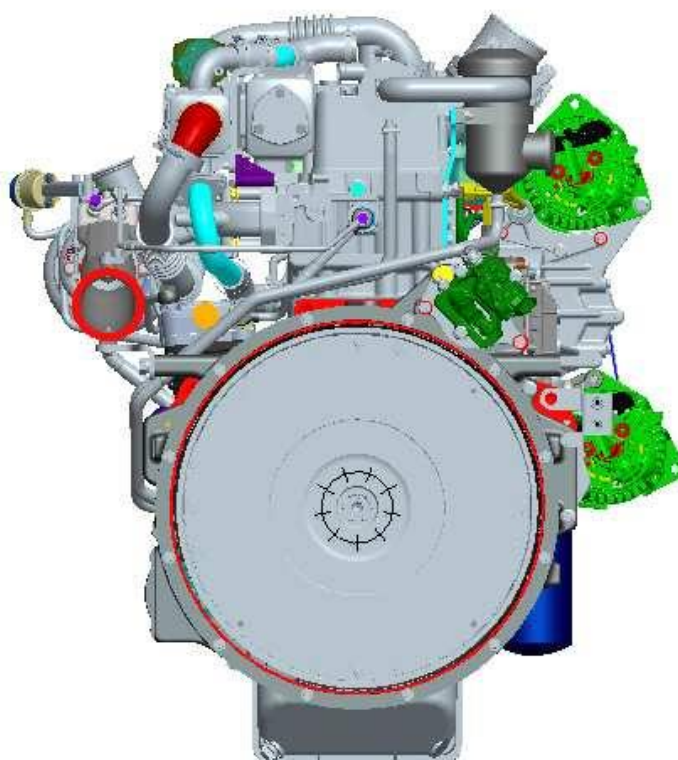
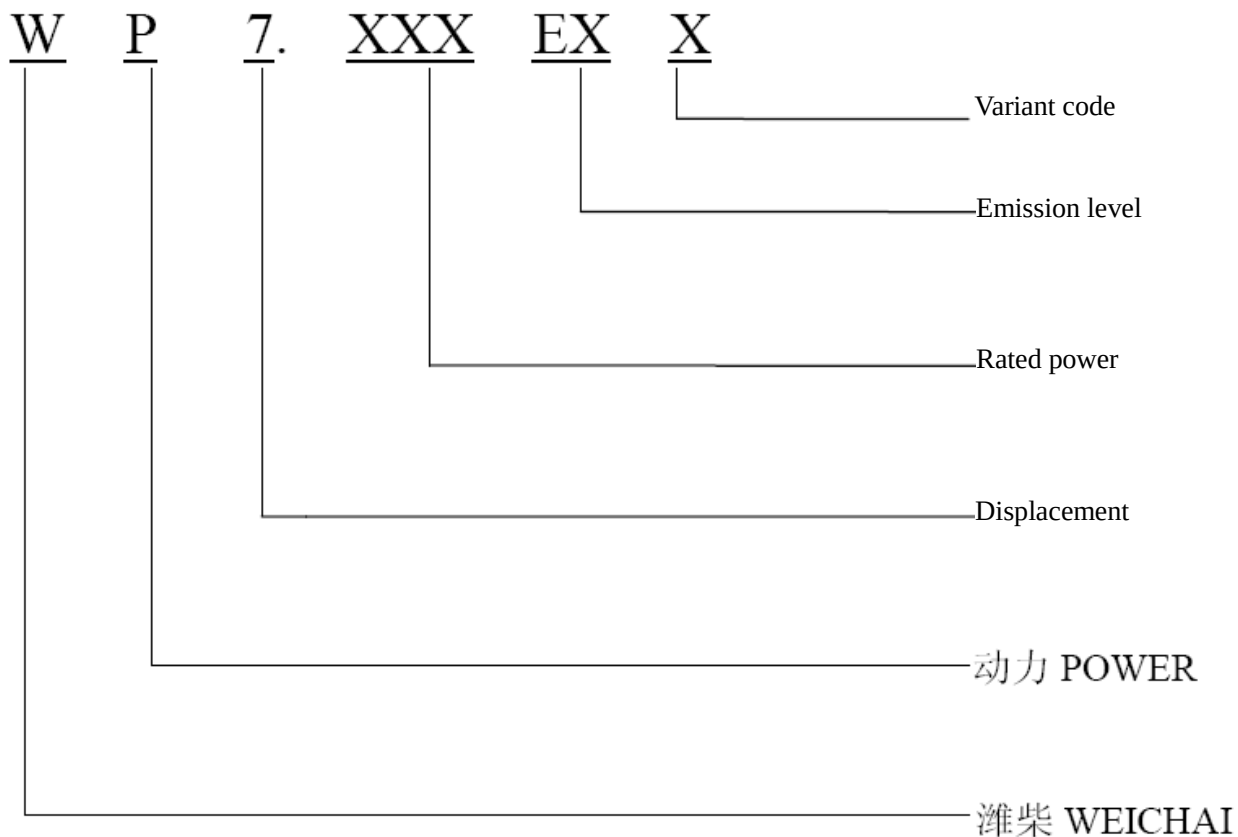


Fig.1-4 WP7 Euro VI diesel engine flywheel end

1.2 Diesel engine model meaning



1.3 Basic parameters of diesel engine

Table 1-1 Performance parameters of WP7 Euro VI diesel engines with common stroke for passenger cars

Model	Unit	WP7.240E61	WP7.270E61	WP7.300E61
Engine type		6-cylinder inline, water-cooled, wet cylinder liner		
Intake mode		Turbocharged and inter-cooled		
Bore × stroke	Mm × mm	108×136		
Displacement	L	7.47		
Rated power/rated speed	kW/r/min	176/2100	199/2100	220/2100
Min. fuel consumption	g/kWh	≤195		
Max. torque/speed	Nm/r/min	1050/1200-1600	1160/1200-1600	1250/1200-1600
Max. no-load speed	r/min	2500±50		
Idle speed	r/min	700±50		
Noise	dB (A)	≤118		
Weight	kg	650		

Table 1-3 Main control parameters for WP7 Euro VI diesel engine

No.	Parameters	Control range
1	Exhaust temperature after turbine, Tr°C	$\leq 600^{\circ}\text{C}$
2	Coolant outlet temperature, °C	$T+1\sim 93$ T=opening temperature of thermostat
3	Oil temperature in main oil passage, °C	85~115
4	Oil pressure, kPa	At rated working conditions: 350~600; at idle speed: 100~250
5	Diesel fuel inlet temperature, °C	38±3
6	Intake temperature after intercooler, °C	50±5
7	Piston air leakage, L/min	≤ 120
8	Exhaust smoke at rated point, Rb	≤ 0.6
9	Exhaust smoke at max torque point, Rb	≤ 1.0
10	Free acceleration smoke, Rb	≤ 2.0

1.4 Notices for use of new diesel engine

- ◆ During the initial 60h or 3000km of new diesel engine operation, the load shall not exceed 75% of the rated load.
- ◆ Rules for initial oil change
For vehicles with annual traveling distance less than 20000km, the initial oil change interval should be: 1000~1500km;
For vehicles with annual traveling distance exceeding 20000km, the initial oil change interval should be: 1500~2000km.
- ◆ Please perform the daily service and maintenance according to the related regulations in the operation manual.

1.5 Unpacking of diesel engine

After unpacking the diesel engine, the user shall check the diesel engine and accessories according to the package list to see whether the appearance of diesel engine is damaged and whether the connected parts are loosened, and then carry out the following works:

- ◆ Clean the antirust layer and anticorrosive agent on the exposed parts.
- ◆ Drain off the oil seal oil in the fuel filter and fuel system parts before starting; or if the engine is started without draining the oil seal oil in the fuel system, the oil must be used up and the normal diesel fuel be supplied in place before running the engine with load. **Users shall note that the oil seal period of diesel engine is one year, check and take essential measures if exceeding this period.**
- ◆ Rotate the flywheel and spray solvent into the intake pipe until the oil seal oil in the cylinder is driven out.
- ◆ Spray solvent into the turbocharger intake/exhaust ports until the oil seal oil is driven out.
- ◆ Base on the agreement between manufacturer and user, the oil pan shall be filled with oil in accordance with the requirement; if oil containing running-in accelerant is filled in the oil pan before delivery, it is suggested that the oil should be drained off after driving the vehicle for 2000km or 50h and then fill with new oil.

- ◆ Base on the agreement between manufacturer and user, if the coolant is already filled according to the user's requirement before delivery, please check the coolant performance when unpacking. If the antifreezing capacity is suitable for -30°C or -35°C, the PH value is 7~8 (neutral), the total hardness number is 5~15°d [9~15°f (hardness)], the coolant can be used. Otherwise, drain the coolant and add new coolant which contains antifreeze.

1.6 Preparations before starting

- ◆ Check the coolant level

If the engine is already installed on the vehicle or test bench, the coolant level can be observed any time through the glass window on the expansion tank. If the coolant is insufficient, open the filling port cover and add coolant. Before opening the filling port cover which is equipped with pressure relief valve and deflating button, please press the deflating button first if the engine is hot. Never add plenty of coolant when the engine is very hot; or else, the sudden great change of temperature will damage the parts. If there is no coolant in special circumstances, please add not very cold water slowly through the filling port until it overflows from the port. Start the engine and run it at 1000r/min, continue to add the coolant until the level is stable and then cover the filling port.

- ◆ Check the fuel level

If the engine is already installed on the vehicle, please turn on the power switch to check the fuel level through the fuel gauge or check the fuel tank.

- ◆ Check the engine oil level

The oil level shall be between the upper and lower marks on the oil dipstick, add oil through the oil filling port if necessary.

- ◆ Check whether the accessories of diesel engine are reliably connected and eliminate any abnormality. Check whether the circuit of starting system is normal and whether the battery is fully charged. Open the fuel tank valve to eliminate the air in the fuel system through the hand pump on the fuel strainer.

1.7 Starting of diesel engine

- ◆ Turn the power switch and electric key to the starting positions and the shifting lever at the neutral position.
- ◆ Press the clutch pedal and accelerator pedal, and turn the electric key to start the diesel engine. If the engine cannot be started in 5-10s, wait for 1min and repeat the above steps. If the starting still fails after continuous 3 times, please stop starting, find out the reason and eliminate the fault. When the engine is started, pay attention to the readings on the instrument and the oil pressure gauge shall immediately display the pressure. Note: Do not run the cold engine at high speed, and operate at idle speed for a period of time but not too long.
- ◆ When starting the diesel engine at low temperature, auxiliary starter shall be used. The electronic heating flange will be activated through the relay to realize smooth starting at -30°C.

1.8 Running of diesel engine

- ◆ After starting the diesel engine, idle for 3min, then accelerate to 1000-1200r/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. The load and speed should be increased gradually, and try to avoid sudden loading and unloading.
- ◆ During the running-in period of 60h, the diesel engine shall run the first 3000km at medium load and the vehicle shall not tow a trailer.

- ◆ Please decelerate timely when traveling on the slopes. Do not work for a long time at high torque or with very low load, because too low speed will cause faults such as oily smoke.
- ◆ During normal operation of diesel engine, continuous running at rated power and rated speed is allowed; however, if at 105% of rated speed and 110% of rated power, it is allowed to run 20min at most. After unloading, idle the diesel engine for 1~2min before stopping.
- ◆ Pay attention to and check the following parameters and positions during operation:
 - Lubrication oil pressure in main oil passage: 350~600kPa.
 - Oil temperature in oil pan: $\leq 115^{\circ}\text{C}$.
 - Coolant outlet temperature: $80^{\circ}\text{C} \sim 95^{\circ}\text{C}$.
 - Exhaust gas temperature after turbine: $\leq 600^{\circ}\text{C}$

Check the exhaust gas color to identify the work quality of fuel injector and the load; in case of serious black smoke or white smoke, please stop the vehicle and make checking. Please check the diesel engine for leakage of water, air and oil and stop the vehicle to eliminate the leakages if there is any.

- ◆ Operators shall be familiar with the following features of diesel engine:
 - A. The fuel consumption is lower at the max torque, and the fuel consumption will rise with the speed increase.
 - B. The torque will reach its highest limit within the engine medium speed range of 1200r/min~1600r/min.
 - C. The engine power increases along with the speed increase and the rated power achieves at the rated speed.
- ◆ Precautions for operation in cold environment
 - A. Fuel: select diesel fuel of different grades according to different outdoor temperatures in winter.
 - B. Lubrication oil: select lubrication oil of different viscosities according to seasons.
 - C. Coolant: add antifreeze to the cooling system, and select different grades of oil with different proportion according to different outdoor temperatures.
 - D. Starting: auxiliary starter can be used in winter if necessary. After starting the diesel engine, you can run the engine at high speed with load only when the oil pressure and water temperature are normal.
 - E. Battery: before the cold season comes, check the electrolyte level, viscosity and unit voltage; if the diesel engine will not be used in a very long period and is stored at very low temperature, the battery shall be taken down and stored in a warm room.
 - F. Parking: when parking in cold weather, unload first, idle for 1~2min and then stop the engine after the oil temperature and water temperature dropped. Please note that after parking, do not drain off the coolant containing antifreeze. If there is no antifreeze in the coolant, open the water drain valves or water plugs of engine body, oil cooler cover, radiator and water inlet pipe and drain off the coolant to avoid engine from being frost cracked.

Part II Diesel Engine Maintenance Guideline

2.1 Fuel, lubricating oil, coolant and auxiliary materials for the diesel engine

2.1.1 Fuel

Summer: 0# diesel fuel (GB252)

Winter: generally -10# light diesel fuel (GB252). If the atmospheric temperature is below -20°C, -20# light diesel fuel shall be adopted; if the outdoor temperature is below -30°C, please adopt -35# diesel fuel.

2.1.2 Engine lubricating oil

For Weichai Power Euro VI series diesel engines, the oil grade should be higher than CJ-4, please refer to table 2-1 for details.

Table 2-1 Weichai Power special oil selection specification

Type	Product		Packing
Diesel engine oil	CJ-4	10W-30 15W-40 20W-50	4L, 18L, 170kg

For Weichai Power special oil, select the viscosity according to the temperatures and refer to table 2-2.

Table 2-2 Viscosity and corresponding environment temperature

SAE viscosity grade	Applicable environmental temperature (°C)
0W-20	-35-20
5W-30	-30-30
10W-30	-25-30
15W-40	-20-40
20W-50	-15-45

Caution:

- 1) Before starting the diesel engine, check the oil level in the oil pan.
- 2) Do not check the oil level when the diesel engine is running.
- 3) The Weichai Power special oil shall not be mixed with other oils.

For oil filling volume and filter element number of various models, please refer to table 2-3.

Table 2-3 Oil filling volume and filter element number of various models

Model	Oil filling volume (L)	Filter number				
		Diesel engine			Gas engine	
		Oil filter	Diesel filter		Oil filter	Gas filter
			Coarse strainer	Fine filter		
WP4	9~12	1	1	1	1	1
WP5	13~16	1	1	1	1	1
WP6	16~24	1	1	1	1	1
WP7	20~24	1	1	1	1	1
WP10	22~26	2	1	1	2	1
WP12	25~28	2	1	1	2	1
WP13	25~28	2	1	1	2	1
Remarks: - The oil filling volumes listed are for reference only, the actual filling volume shall subject to the marks of oil dipstick. - If the vehicle is equipped with the Weichai fuel system protector or fuel filter/water separator, the fuel system protector or fuel filter/water separator shall be replaced when replacing the diesel filter.						

2.1.3 Lubrication of tensioner

Vehicle general lithium-base grease shall be adopted for lubrication of tensioner, please refer to GB5671-85 standard.

2.1.4 Antifreeze for engine cooling system

For the Weichai Power special coolant, there are different specifications with different freezing points (-25°C, -35°C and -40°C). Please choose the Weichai Power special coolant of different freezing points according to the local environment temperature which should be 10°C higher than the freezing point of coolant. Please refer to table 2-4 for details.

Table 2-4 Weichai Power special coolant for heavy duty engines

Type	Coolant	Packing
Heavy duty engine coolant	HEC-II-25 HEC-II-35 HEC-II-40	4kg, 10kg

Caution:

- 1 Regularly check the coolant to avoid corrosion damage and change timely as appropriate.
- 2 It is prohibited to use water or inferior coolant as the engine coolant.

2.1.5 AdBlue

2.1.5.1 AdBlue quality

The quality and performance of reducing agent AdBlue added to the tank shall meet the regulations specified in

ISO 22241, for AdBlue density and composition, please refer to table 2-5. Unqualified DEF may block the AdBlue injection pump or spray nozzle and the metal impurities in unqualified AdBlue may cause the SCR catalyst permanently poisoned, leading to efficiency reduction of SCR catalytic converter; so, please add the AdBlue through official channels or specified filling stations. During normal use, it is prohibited to change the AdBlue with other liquids.

Table 2-5 Refer to ISO22241 for AdBlue composition

Composition	Unit	Minimum	Maximum
Urea Content (% by weight)	%	31.8	33.2
Density at 20°C	kg/m ³	1087	1093
Refracting index at 20°C	-	1.3814	1.3843
Alkalinity as NH ₃	%	-	0.2
Biuret (% by weight)	%	-	0.3
Aldehyde	mg/kg	-	5
Insolubles	mg/kg	-	20
Phosphate PO ₄	mg/kg	-	0.5
Calcium	mg/kg	-	0.5
Iron	mg/kg	-	0.5
Copper	mg/kg	-	0.2
Zinc	mg/kg	-	0.2
Chromium	mg/kg	-	0.2
Nickel	mg/kg	-	0.2
Aluminum	mg/kg	-	0.5
Magnesium	mg/kg	-	0.5
Sodium	mg/kg	-	0.5
Potassium	mg/kg	-	0.5

2.1.5.2 AdBlue storage

It is required that the AdBlue shall be enclosed and stored at the environment temperature of 5°C-25°C and see the shelf life in table 2-6.

Table 2-6 Shelf life of AdBlue

Shelf life of AdBlue	
Environment temperature for storage: °C	Min shelf life (month)
≤10	36
≤25 ^a	18
≤30	12
≤35	6
>35	^b
Caution: For the shelf life specified in the table, the environment storage temperature, the AdBlue early alkalinity, and the difference of evaporation in ventilated and unventilated storage containers are considered.	
^a In order to prevent AdBlue decomposition, the transport or storage temperature should not exceed 25°C.	
^b Check AdBlue quality before use.	

The material of AdBlue storage container should have good compatibility with AdBlue and can prevent chemical reaction and impurity migration. The containers should be made of Austenitic alloy steel, additive-free PTFE/PE/PP conforming to ISO22241-3. When storing at ambient temperature below 5°C, please reserve some space in the storage container as the solidified volume will increase by 7% than the liquid volume.

Pay attention to the effectiveness of AdBlue in the vehicle, the relation between the AdBlue shelf life and the environment temperature during the vehicle storage period is same as shown in the table above. If exceeding the shelf life, drain the AdBlue through the drain valve at the bottom of AdBlue tank before delivery and then fill the qualified.. When the environment temperature is above 35°C, please check whether the AdBlue in the tank is qualified before delivery, if not, please drain the AdBlue and fill the qualified.

2.1.6 Auxiliary material

Table 2-7

No.	Name	Color	Function and application
1	MolykottePulver Fine molybdenum powder	Black	Applied on the bright metal surface to prevent sticking For example: Applied on the outer surface of cylinder liner
2	MolykotteG.u.plus Molybdenum disulfide lubricant	Dark grey	For lubrication before the lubrication oil pressure is built up For example: Applied on the intake valve rod

Table 2-8 Diesel engine sealants and applications

Grade	Application	Applicable parts and positions	Remarks
Loctite 242	Applied on the thread surface for locking to prevent looseness caused by vibration, medium strength	Camshaft thrust washer bolt Camshaft timing gear bolt Idling gear bolt Oil cooler assembly bolt Air compressor shaft end bolt Main oil passage pressure limiting valve bolt Oil pump strainer bolt Bolt of sensor and harness fixing device	As an option, the DriLoc204 thread pre-coating can be used, refer to QWCG107-2005 thread pre-coating technical specifications for details
Loctite 277	Sealing between core and hole	Joint faces of air compressor outlet and connecting elbow Cylinder head plug The section of pipe joint assembly inserted into the water pipe	
Loctite 962	Special sealant for bowl plug	Bowl plug of auxiliary oil passage Bowl plug of main oil passage Bowl plug of cylinder block water chamber Bowl plug of camshaft hole Bowl plug of cylinder head	
Loctite 510	Apply on the bright metal surface for sealing	Engine body rear end face Joint faces of gear oil pump and engine body front end	
Loctite 620	For fixing of cylindrical mating parts	Crankshaft gear mounting position on the crankshaft	
Silica gel	Applied on the bright metal surface for sealing	Joint faces of rotor oil pump and engine body front end	

2.2 Daily maintenance

- ◆ Check the coolant level, oil level and fuel level; check whether the grease at the positions requiring grease is sufficient;
- ◆ Check for leakage of oil, water and air;
- ◆ Whether the external connectors and accessories are well connected and tightened;
- ◆ Whether the fan and belt are too tight or too loose;
- ◆ Oil pressure of diesel engine;
- ◆ Water pressure of diesel engine;
- ◆ Whether the exhaust temperature, color, sound and vibration of diesel engine are normal and whether the speed is stable.

2.3 Daily maintenance

- Check the coolant level and water temperature

Check the coolant level through the sight hole. If the coolant is insufficient, please open the filling port cover and add the coolant.

Caution: press the air release button first before opening the filling port cover to avoid scalding injury d by the hot engine liquid (fig. 2-1, 2-2).

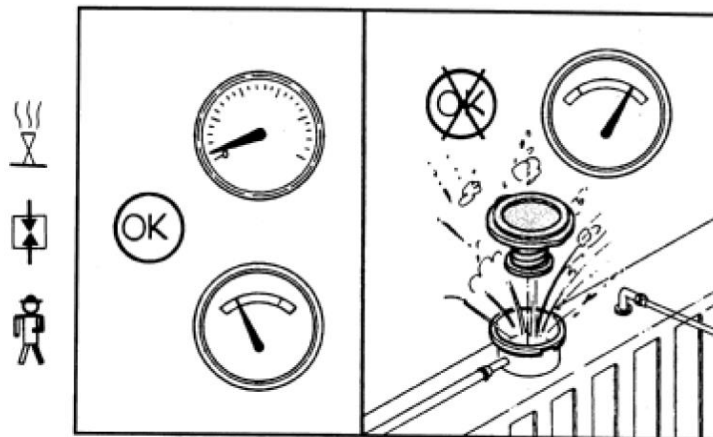


Fig.2-1 Air release button

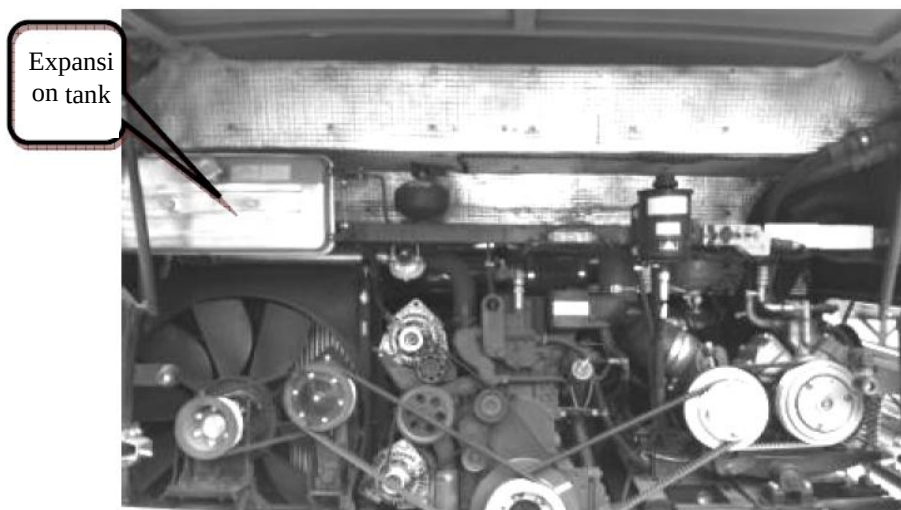


Fig.2-2 Expansion tank

- Check the oil level

When the oil level is below the lower marker or above the upper marker of oil dipstick, it is not allowed to start the diesel engine (fig. 2-3).

Oil level checking should be performed at least 5 min after stopping the diesel engine to let the oil flow back to the oil pan.

The oil capacity difference between the L marker and the H marker of oil dipstick is 3L.

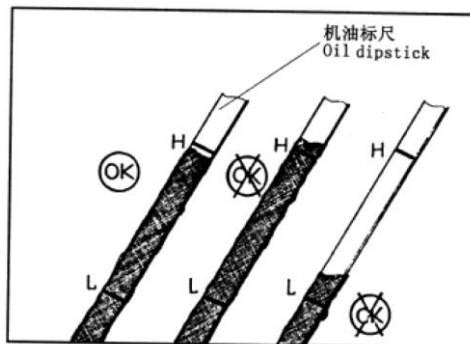


Fig.2-3 Oil dipstick

- Check the fuel level (See the fig. 2-4)



Fig.2-4 Fuel gauge

- Check for leaks of water, oil and gas

Ensure that there is no water, gas or oil leakage.

- Check the belt

The belt is tensioned by the belt tensioner automatically, and users can check the belt tension by pressing the belt manually (fig. 2-5).

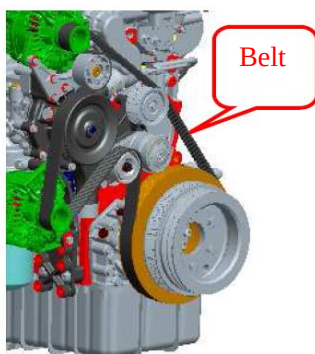


Fig.2-5 Check the belt



Fig.2-6 Check the exhaust gas

- Check whether the exhaust gas color is normal
See figure 2-6, the normal exhaust gas color is light grey. If the exhaust gas color is changed, please find out the reasons for troubleshooting.
- Check whether the engine sound is normal.
- Check whether the speed and vibration are normal.

2.4 Maintenance items of each level

Besides the daily maintenance, the following items shall be maintained:

- Change the diesel engine oil. As shown in fig. 2-7.

Unscrew the drain plug at the bottom of oil pan to drain the oil and then screw on; open the filler cap to add oil to the specified level by observing the oil dipstick, and then install the filler cap.

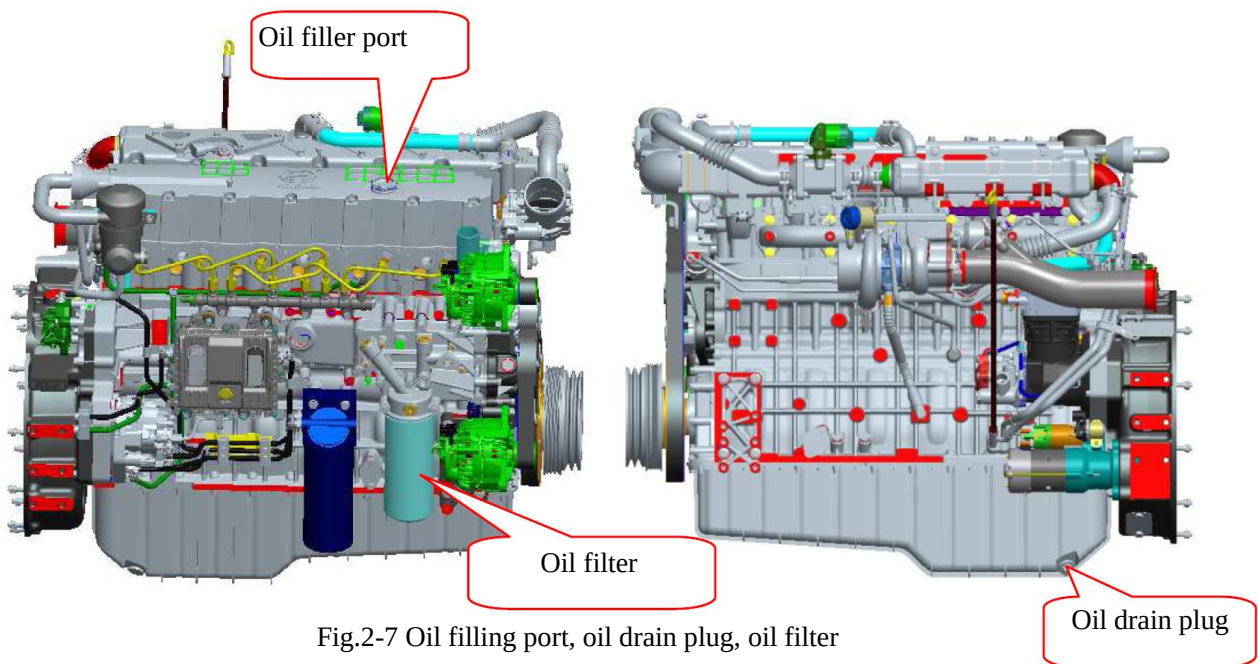


Fig.2-7 Oil filling port, oil drain plug, oil filter

- Replace the oil filter or filter element.
Follow the steps to replace the oil filter:
 - Remove the old oil filter;
 - Fill the new filter with clean oil;
 - Apply oil on the rubber gasket before installing the new oil filter;
 - After the rubber gasket contacts with the base, tighten the filter 3/4 to 1 circle again for sealing;
 - Start the diesel engine and check for oil leakage.
- Check and adjust the intake/exhaust valve clearances
Check and adjust the intake/exhaust valve clearances according to the following steps:
 - When the diesel engine is in cold state, turn the flywheel (with the running direction of diesel engine) and let the 1st and the 6th cylinder pistons at the TDC. At this moment, the flywheel mark line shall be aligned with the OT mark line on the flywheel housing. See fig. 2-8.



Fig.2-8 Flywheel mark line

- B. Remove the valve rocker arm cover on the cylinder head and determine that the 1st cylinder or the 6th cylinder is in the compression stroke (there are clearances between the intake/exhaust valve and rocker arms of the compression stroke cylinder).
- C. Check the clearance between the upper plane of valve bridge and valve rocker arm with feeler gauge according to fig.2-9 and fig.2-10.

For WP7 diesel engine, the intake valve clearance and the exhaust valve clearance should be 0.3mm and 0.5mm respectively. If the clearance is excessive or too small, please adjust the adjusting bolt on the rocker arm to meet the above clearance requirement.

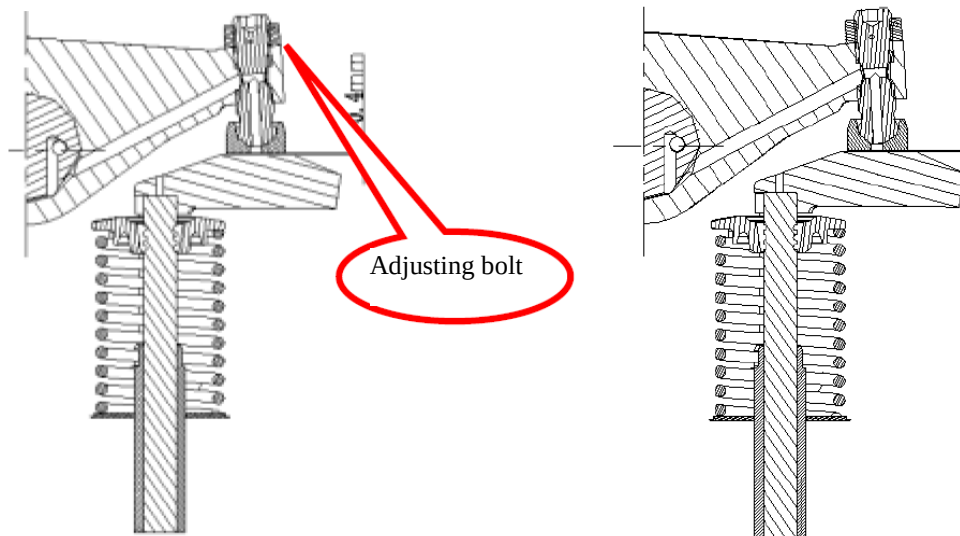


Fig.2-9 Cold state intake valve clearance 0.3mm Fig.2-10 Cold state exhaust valve clearance 0.5mm

- D. After checking the 1st or 6th cylinder, turn the flywheel by 360° to make the 6th or 1st cylinder to the working stroke and check and adjust the remaining valves.

Table 2-9

	1 st cylinder	2 nd cylinder	3 rd cylinder	4 th cylinder	5 th cylinder	6 th cylinder
1 st cylinder compression stroke	Intake/exhaust valves	Intake valve	Exhaust valve	Intake valve	Exhaust valve	Nonadjustable
6 th cylinder compression stroke	Nonadjustable	Exhaust valve	Intake valve	exhaust valve	Intake valve	Intake/exhaust valves

- Replace the fuel filter element (See the fig. 2-11)

Follow the steps to replace the fuel filter element:

- A. Dismantle the old fuel filter element; if the water collector installed on the strainer can be reused, please take it down.
- B. Lubricate the seal.
- C. Tighten the filter by hands until the seal fits the joint.
- D. Continue to tighten the filter by hands until the filter is firmly installed by 3/4 circle.
- E. Eliminate the air in the filter until there is no bubble.
- F. Carry out leakage test.

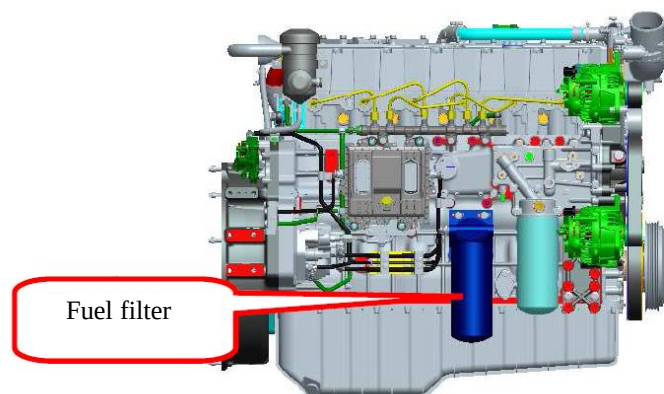


Fig.2-11 Fuel filter

- Check the intake system (see the fig. 2-12)

Check the intake hose for aging or crack and check the clamp for looseness. Tighten or replace the part when necessary to ensure the tightness of intake system.

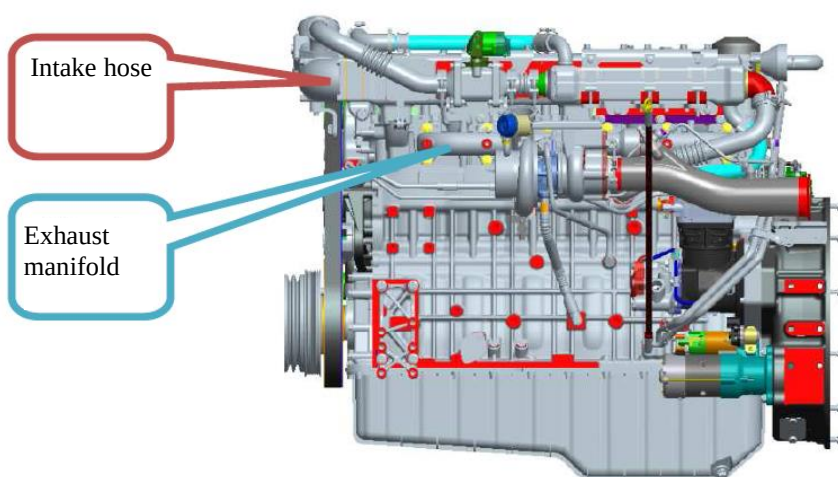


Fig.2-12 Intake/exhaust pipe

- Check the air filter element (fig. 2-13)

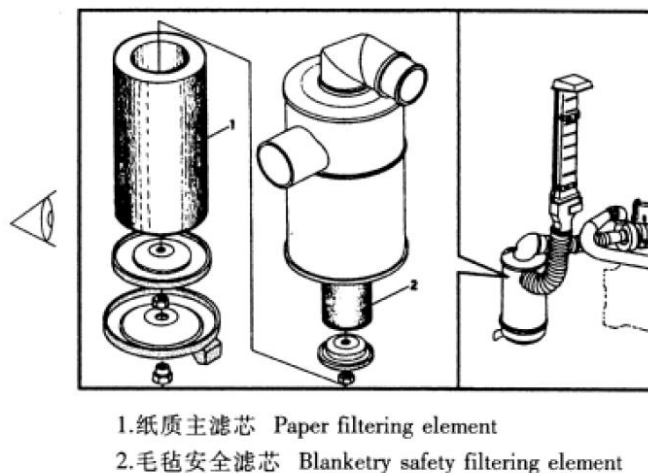


Fig.2-13 Air filter

The maximum allowable intake resistance of diesel engine is 6kPa, check the maximum intake resistance when the diesel engine is running at the rated speed with full-load. When the intake resistance reaches the maximum allowable value, please clean or replace the filter element according to the manufacturer's regulations.

Caution: It is not allowed to operate the engine if there is no air filter; otherwise, the dust and impurities may enter the diesel engine, causing early wear of engine.

Remove the filter element from the air filter, and gently beat the end face with your hand to remove the dust or blow from inside to outside using the compressed air (fig. 2-14).

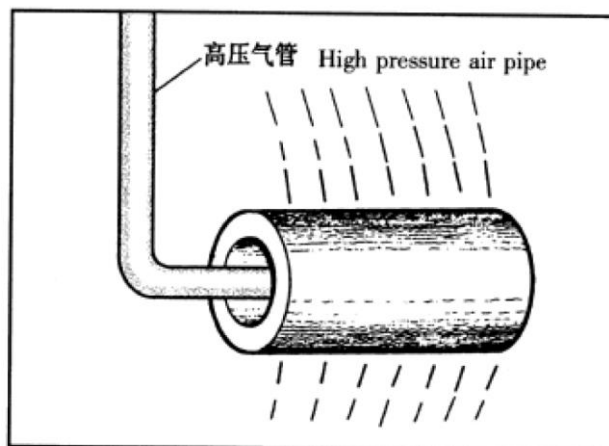


Fig.2-14 Clean the filter element

Caution: Do not damage the filter paper when blowing;

Do not clean the filter paper by using water or oil;

Do not beat or knock the filter element forcibly.

2.5 Maintenance of diesel engine during long-term storage

- Clean the diesel engine;
- Protective measures:
 - Drain the oil after engine warming up, clean the oil filter, and add the antirust oil;
 - Drain the fuel and add the antirust oil mixture;
 - Drain the water and add the coolant with rust inhibitor;
 - Start the engine and idle for 15~25min;
 - Drain the oil, fuel and coolant completely;
 - Protect other parts.
- Storage protection
 - Seal the oil, air/gas and water inlets and outlets using covers or plastic cloth; And wrap the whole diesel engine using antirust film for safekeeping.
- If transportation is needed, engine packaging should be applied.

2.6 Regular maintenance

Table 2-10 Working conditions of matched vehicles

WG I type	WG II type	WG IV type
Working under severe conditions (extremely cold or hot; dusty; short distance transport; working on construction site and city buses, municipal construction vehicles, snow sweeper vehicles or fire trucks) or annual mileage is less than 20,000 km or annual working hours is less than 600h	Annual mileage is less than 6×10^4 km, short or medium distance goods transport	Annual mileage exceeds 6×10^4 km, long distance transport

Table 2-11 Maintenance intervals

Working conditions Item	WG I	WG II	WG III
First check	Having traveled for 1,000~1,500km or traveled for 30~50h	Having traveled for 1,500~2,000km	Having traveled for 1,500~2,000km
Routine check	Every 5,000km or every 150h	Every 10,000km	Every 15,000km
Level-1 maintenance	Every 10,000km or every 300h	Every 20,000km	Every 30,000km
Level-2 maintenance	Every 20,000km or every 600h	Every 40,000km	Every 60,000km
Level-3 maintenance	Every 40,000km or every 1,200h	Every 80,000km	Every 120,000km
Level-4 maintenance	Every 80,000km or every 2,400h	Every 160,000km	Every 240,000km

Table 2-12 Oil change interval specified in vehicle maintenance specifications

Working conditions Item	WG I	WG II	WG III
First check	Having traveled for 1,000~2,000km	Having traveled for 1,500~2,000km	Having travel for 1,500~2,000km
P	Every 5,000km	Every 10,000km	Every 15,000km
WD1	Every 10,000km	Every 20,000km	Every 30,000km
WD2	Every 20,000km	Every 40,000km	Every 60,000km
WD3	Every 40,000km	Every 80,000km	Every 120,000km
WD4	Every 80,000km	Every 160,000km	Every 240,000km

Table 2-13 Oil change intervals base on the oil use conditions (varies due to different oil consumptions)

Normal oil use condition (with normal oil consumption)	Severe oil use condition (with normal oil consumption)	
Ambient air temperature: -10℃ to +30℃ Sulfur content of fuel: less than 0.5% (by weight)	A	Tropical or frigid zone (temperature is always higher than +30℃ or lower than -10℃)
	B	Sulfur content of fuel: 0.5%-1.0%
	C	Sulfur content of fuel: 1.0%-1.5%
Oil use condition	Working condition	
Normal use condition	WG I WG II WG III	Every 5,000km Every 10,000km Every 15,000km
Severe condition A	WG I WG II WG III	Every 5,000km Every 5,000km Every 5,000km
Severe condition B	WG I WG II WG III	Every 5,000km Every 5,000km Every 10,000km
Severe condition C	WG I WG II WG III	Every 5,000km Every 5,000km Every 5,000km
Severe condition A+B	WG I WG II WG III	Every 5,000km Every 5,000km Every 5,000km
Bad condition A+C	WG I WG II WG III	Every 2,500km Every 2,500km Every 2,500km

Table 2-14 Diesel engine maintenance specification

Maintenance items	First check	Routine check	Level-1 maintenance	Level-2 maintenance	Level-3 maintenance	Level-4 maintenance
Change the diesel engine oil	●	●	●	●	●	●
Replace the oil filter or filter element	●	Every time when changing the diesel engine oil				
Check and adjust the valve clearance	●		●	●	●	●
Replace the fuel filter element			●	●	●	●
Check and the coolant	●	●	●	●	●	●
Tighten the cooling pipe clamps	●					
Tighten the intake pipe, hose and flange connectors	●		●	●	●	●
Check the air filter maintenance indicator light or indicator			●	●	●	●
Clean the dust cup of air filter (automatic dust removal type excluded)		●	●	●	●	●
Clean the main element of air filter	When the indicator is lit					
Replace the main element of air filter	Refer to related regulations in the vehicle instruction manual					
Replace the safety element of air filter	After cleaning the main filter element for 5 times					
Check and tighten the V-belt	●	●	●	●	●	●
Check the turbocharger bearing clearance						●
Check and adjust the clutch travel	●	●	●	●	●	●
Note: ● Indicates that maintenance is required. Maintenance must be carried out for diesel engine stored for over half a year. Weichai will provide maintenance suggestions upon user's requests.						

2.7 Maintenance of after treatment system

2.7.1 Maintenance of SCR system

- Make sure that the added and used AdBlue complies with the specification, it is prohibited to replace the AdBlue with other solution (like diesel, water or self-made aqueous urea solution); otherwise, it may cause serious damage of AdBlue pump, or even catalyst poisoning, which will lead to engine emission exceeds the standard requirements and engine torque limit. If the above solution is added by mistaken, please contact the local engine service provider immediately for repair.
- Every day, check the AdBlue level and whether there is leakage, please add AdBlue if the level in the tank is lower than 10%.

- The AdBlue filler port, filling device funnel and adjacent position should always be clean; or else, impurities (dust) will enter the tank when refilling the AdBlue, causing filter blockage, aging and AdBlue contamination.
- After T15 is powered off, the SCR system will enter 90s suck-back duration. During this process, it is prohibited to cut off the whole vehicle power; otherwise, the residual AdBlue in the SCR system may block the AdBlue pump and nozzle, even damage the AdBlue pump and nozzle if the temperature is too low.

2.7.2 Maintenance of DPF system

The DPF is a device for collecting the PM in the diesel engine exhaust gas, and the collected soot can be consumed by passive regeneration or active regeneration, so that high collecting efficiency can be maintained during the whole life cycle of DPF. After the soot is burned, part ash will remain and cannot be eliminated by regeneration, it will accumulate on the inner wall of DPF, reduce the effective filtration area of DPF, and the collecting efficiency of DPF will be affected. Therefore, it must regularly clean the DPF (generally, cleaning cycle should be every 150,000km). Please pay attention to the following items when removing the soot:

- Soot removal must be performed by Weichai service station within the soot removal period to keep the high collecting efficiency of DPF;
- When removing the DPF, handle with care, do not knock or impact the DPF forcibly to avoid ceramic carrier damage in the DPF and engine torque limit;
- When installing the DPF after soot removal, make sure that the tightness of clamps at the original sealing positions are good to avoid leakage of the after treatment parts.

2.7.3 Daily maintenance of after treatment system

- If the after treatment system is installed on the vehicle, the heat shield shall be provided to prevent the vehicle parts or personal from being damaged by high temperature exhaust components;
- Check the after treatment system for leakage of gas, oil or AdBlue;
- Check whether the after treatment system packaging is burnt or damaged, if any, please repair or replace the corresponding parts according to the actual conditions;
- Check whether the temperature and pressure sensors are correctly connected and work normally.
- During DPF regeneration, the carbon granules in DPF will burn, the DPF surface temperature will be high, and so, the after treatment system shall be far away from the flammable materials such as the harnesses;
- Check whether there is white urea crystal in the after treatment system.

Part III Typical Faults of Diesel Engine and Troubleshooting

The WP7 series diesel engines are designed and produced under strict quality assurance system and each diesel engine has been tested according to the regulations before delivery. The diesel engine is a kind of precision machine and its long period functions are closely related to normal maintenance. Early failures of diesel engine are generally caused by the following:

- ◆ Operation against the rules, improper management and operations;
- ◆ Not maintained according to the regulations or the maintenance is replaced by repair;
- ◆ Poor quality of parts, particularly fake and shoddy products will greatly shorten the service life of diesel engine;
- ◆ Improper grades of fuel and lubrication oil or poor quality.

3.1 Diagnostic method

The common diagnostic methods for diesel engine faults are as follows:

- ◆ Observation method: Observe the fault symptom of diesel engine, such as the exhaust smoke, to judge the fault, see figure 3-1.
- ◆ Sound method: Judge the fault position, property and extent by abnormal sound of diesel engine, see figure 3-2.



Fig.3-1 Observation method



Fig.3-2 Sound method

- ◆ Cylinder fuel supply cutoff method: Stop the working of certain cylinder to judge whether the fault occurs on it. If you doubt that fault may occur on one cylinder, cutoff the fuel supply to this cylinder to compare the engine status change before and after cutting off the fuel supply to reduce the range for further finding out the fault position or cause.
- ◆ Comparison method: Replace some assemblies or parts to judge whether fault exists.

Caution:

- 1) **Judgment of diesel engine faults needs special carefulness; do not disassemble the diesel engine before the reasons are found out. Or else, the fault may not be eliminated, or even become more serious due to improper assembly after disassembly.**
- 2) **For the key parts such as high pressure fuel pump and turbocharger, the special instrument or equipment shall be used for check and maintenance, and check and maintenance shall be performed by experienced personnel. Users without experience or equipment shall not disassemble or adjust randomly.**

3.2 Engine fault diagnosis and troubleshooting

3.2.1 Diesel engine starting failure

Fault cause	Troubleshooting
1. Fuel inlet filter screen or hose of fuel delivery pump blocked	Check and remove the dirt, check the cleanliness of fuel
2. There is air in the fuel system	Discharge the air, check the joint tightness
3. High pressure fuel pipe damaged or oil leakage	Repair or replace
4. The ambient temperature is too low	Add the starting auxiliary device
5. Rail pressure sensor damaged	Unplug the rail pressure sensor connector and try to start again
6. The fuel injector harness, sensor harness or vehicle harness connectors are not well connected or short/open circuit of harness	Use the multimeter to check the installation of connector (preferably the "circuit tester"), check the circuit according to the pointer definition of circuit diagram
7. Crankshaft and camshaft Signals are lost	Check whether the sensors are damaged, whether the harnesses are well connected, whether the sensors are loosened

3.2.2 Engine stopped soon after starting

1. Fuel filter blockage	Dismantle the filter body to remove the dirt and water, or replace the filter element if necessary
2. There is air in the fuel system	Check the fuel pipe and joint tightness, check whether the air bleed screw is tightened, and release the remaining air
3. Poor fuel quality, containing too much water	Clean the filter and change the fuel

3.2.3 Engine Power is insufficient

Fault cause	Troubleshooting
1. Wrong synchronous signal	Read the flash codes via the flash code lamp and check the flash code list to find out the reason
2. Flow metering unit fault	Check the circuit to confirm the fault of flow metering unit or rail pressure sensor
3. Sensor fault	Check whether the connectors of intake air temperature and pressure sensors, water temperature sensor and rail pressure sensor are firmly connected
4. Intake blocked (air filter blocked)	Check the air filter and intake pipe and clean or replace the filter element.
5. Too high exhaust back pressure	Check the valve timing and whether the exhaust pipe is blocked, adjust and repair it
6. Low turbocharging system pressure	Check and eliminate the leakage of the pipe connections

7. Fuel pipe leaks or blocked	Check the tightness of fuel pipe and joint, filter pollution degree and repair the fuel pipe or eliminate the blockage, or replace the filter element
8. Poor fuel quality	Clean the fuel tank, filter part and fuel pipe, or change the fuel
9. Too high oil level of oil pan	Check the oil dipstick and drain the excess oil

3.2.4 Too much fuel consumption

Fault cause	Troubleshooting
1. Intake pipe blocked	Check and clean the air filter and intake pipe
2. Too high exhaust back pressure	Check and clean the exhaust pipe and brake valve
3. Poor fuel quality	Change the fuel as required
4. Fuel pipe blocked	Check and repair
5. Fuel pipe leaks	Check and repair

3.2.5 Black exhaust smoke

Fault cause	Troubleshooting
1. Intake pipe blocked or too high exhaust back pressure	Clean.
2. Poor fuel quality	Clean or replace
3. Improper valve timing or fuel supply timing	Adjust as required
4. Poor atomization of fuel spray nozzle	Check, repair or replace
5. Too much fuel injected	Check and adjust (by professionals)
6. Low turbocharging system pressure	Check and eliminate leakage of the pipe and connectors
7. Turbocharger malfunction	Check or replace the assembly
8. Intercooler damaged, causing gas leakage	Replace or repair
9. The action point of smoke limiter is incorrect	Readjust (by professionals)

3.2.6 White or blue exhaust smoke

Fault cause	Troubleshooting
1. Poor fuel quality, containing too much water	Change the fuel
2. The coolant temperature is too low	Check the working temperature of thermostat and replace it if necessary
3. Improper valve timing or fuel supply timing	Check and adjust
4. Poor atomization of fuel spray nozzle.	Check and repair

5. Low compression pressure, incomplete combustion and piston expansion and got stuck (cylinder scuffing)	Check and repair the piston ring, cylinder liner, and cylinder gasket
6. The running-in of piston ring or cylinder liner is unqualified	Continue the running-in
7. The openings of piston rings are not staggered	Adjust and reassemble
8. Failure of piston oil ring	Replace
9. Excessive fitting clearance of piston and cylinder liner	Repair or replace
10. Wear of turbocharger seal ring	Check or replace
11. Wear of turbocharger thrust bearing	Check or replace
12. Blockage of turbocharger oil return pipe	Clean or repair

3.2.7 Unstable speed

Fault cause	Troubleshooting
1. Poor fuel quality, containing water or wax	Change the fuel
2. Air enters the fuel suction pipe	Check the fuel pipe and joint tightness and release the air
3. The regulator weight or regulator spring cannot work normally	Check and adjust (by professionals)
4. Uneven fuel supply	Check and adjust (by professionals)
5. Unstable atomization of spray nozzle	Check and repair
6. Turbocharger surging	Check and clean the flow channel of compressor, eliminate the blockage, remove the carbon deposit in the exhaust gas passage
7. Turbocharger bearing damaged	Replace

3.2.8 Too low oil pressure

Fault cause	Troubleshooting
1. The oil level in oil pan is too low, the oil is insufficient	Check the oil level and leakage and add the oil
2. Failure of pressure regulating valve in main oil passage	Check the valve, clean and repair
3. Oil strainer, oil pipe or joint gasket blocked or cracked	Check and clean the flow channel of compressor, eliminate the blockage, remove the carbon deposit in the exhaust gas passage
4. The oil grade does not meet the specification	Change the oil as required and select the oil of proper grade
5. Oil pump inlet pipe leaks	Check the oil pipe and joints, repair or replace
6. Too high water temperature of	Check the work conditions of cooling system and correct

cooling system, too high oil temperature	
7. Oil filter resistance is too high	Use a new filter element
8. Oil cooler blocked	Check and clean
9. Main oil passage blocked	Check and clean
10. Excessive clearance of bearing shell or bearing shell damaged	Check and replace
11. Excessive wear of part, overhaul is required	Check the engine working parameters and overhaul

3.2.9 High coolant temperature

Fault cause	Troubleshooting
1. The water level in water tank is too low	Check for water leakage positions and add water
2. Water tank blocked	Check, clean or repair the water tank
3. Water pump belt slack	Adjust the tension as required
4. Water pump gasket damaged, water pump impeller worn	Check and repair or replace
5. Thermostat failure	Replace
6. Water pipe damaged, causing the air leaks in	Check the water pipe, joint and gasket and replace the damaged parts
7. The oil level in oil pan is too low, the oil is insufficient	Check the oil level and oil leakage, repair and add the oil

3.2.10 Too fast wear of parts

Fault cause	Troubleshooting
1. Unqualified air filter element or filter element damaged	Check and use the qualified filter element
2. Short circuit of intake system	Check the intake pipe, gasket and connecting pipe casing, repair or replace
3. The oil level in oil pan is too low, the oil is insufficient	Check the oil level and leakage, repair and add the oil
4. Oil passage blocked	Clean the oil passage
5. The oil grade does not meet the specification	Change the oil as required
6. Piston ring broken or worn	Replace the damaged part
7. Cylinder liner or piston worn or cylinder scuffing	Disassemble and check the piston and cylinder liner, repair or replace
8. The oil filter element is not timely replaced	Replace as required

9. Excessive part wear and overhaul is required	Check the mileage and determine the overhaul
10. Misalignment of crankshaft and driven part main shaft	Check the mounting bracket and repair
11. The quality of oil used does not meet the requirement	Use the specified grade of oil meeting the standard requirements

3.2.11 Excessive noise

Fault cause	Troubleshooting
1. Poor fuel quality	Change the fuel
2. Too low coolant temperature	Check the thermostat or replace if necessary
3. Improper valve timing or fuel supply timing	Check, repair or adjust
4. Poor atomization of fuel spray nozzle	Check, repair or adjust
5. Too much fuel injected	Check and adjust (by professionals)
6. Shock absorber worn	Check for damage and bolt connection and replace the damaged parts
7. Air leakage from valve or improper adjustment	Disassemble and check the valve and adjust
8. Excessive gear clearance or the teeth are broken	Check and replace the damaged parts
9. Cylinder line or piston worn or cylinder liner scuffing	Check and repair or replace
10. Push rod is bent or broken	Replace
11. Piston ring is broken or worn	Check or replace the damaged parts
12. Excessive wear of bearing shell	Replace
13. Excessive crankshaft thrust washer clearance	Replace
14. Misalignment of main bearing shells	Replace
15. Misalignment of crankshaft and driven part main shaft	Check the mounting bracket bolt
16. Excessive part wear	Overhaul
17. Turbocharger surging	Eliminate the blockage of air compressor passage and remove the carbon deposit in the air passage
18. Turbocharger seal ring is burnt	Replace
19. Turbocharger bearing damaged, the moving parts rubs against the fixed parts	Replace
20. Foreign matter entered into the turbocharger turbine or compressor impeller	Replace

3.2.12 The starter motor is inoperative

Fault cause	Troubleshooting
1. The battery is not fully charged	Check, charge or replace the battery
2. Poor contact of connecting wires	Clear the circuit and retighten the terminals
3. Fuse burnt	Replace the fuse
4. Poor contact of brush	Clean the brush surface or replace it
5. Short circuit of starter motor	Check and repair the motor or replace the assembly

3.2.13 The starter motor is powerless

Fault cause	Troubleshooting
1. The battery is not fully charged	Charge or replace the battery
2. Bearing liner worn	Replace the assembly
3. Poor contact of brush	Clean the brush surface or replace it
4. The commutator is dirty or burnt	Remove the oil dirt and polish using abrasive paper or replace the assembly
5. Terminal unsoldered	Resolder
6. Poor contact of switch	Check the switch and repair
7. The clutch is worn and slips	Adjust the clutch working torque or replace the assembly

3.2.14 The alternator does not generate electricity

Fault cause	Troubleshooting
1. Short or open circuit, connector looseness	Check the alternator and ammeter wire and repair
2. Short/open circuit of rotor or stator coil, or grounded	Repair or replace the assembly
3. The rectifier valve is damaged	Replace the assembly
4. The terminal paper insulation is damaged, causing the wire disconnection	Repair
5. The regulating voltage of regulator is too low	Repair
6. The regulator contact is burnt	Repair or replace the assembly

3.2.15 The alternator is not fully charged

Fault cause	Troubleshooting
1. Short/open circuit, connector looseness	Repair
2. Short/open circuit of rotor or stator coil, or grounded	Repair or replace the assembly

3. The alternator belt is loosened	Check and adjust the belt tension
4. The alternator rectifier valve is damaged, poor contact of battery	Repair
5. The regulating voltage of regulator is too low	Adjust
6. The field coil or resistor wire of regulator is disconnected	Repair or replace
7. The battery electrolyte is too little or the battery is old	Add the electrolyte or replace the battery

3.2.16 The charging current is unstable

Fault cause	Troubleshooting
1. The rotor or stator coil is about to open-circuited or shorted	Repair or replace
2. Poor contact of brush	Repair
3. Terminal loosened or poor contact	Repair
4. The voltage regulator is damaged	Repair
5. Improper voltage adjustment	Check and adjust

3.2.17 The alternator is overcharged

Fault cause	Troubleshooting
1. Battery internal short circuited	Repair or replace
2. Voltage of regulator is too high	Repair and adjust
3. Poor grounding of regulator	Repair
4. Regulator contact failure or contaminated, or the voltage coil or resistor wire is disconnected	Repair or replace

3.2.18 Abnormal alternator sound

Fault cause	Troubleshooting
1. Improper installation of alternator	Repair
2. Bearing damaged	Replace the bearing
3. The moving parts contact with the fixed parts	Repair or replace
4. Short circuit of rectifier	Replace
5. Short circuit of stator coil	Repair or replace

3.3 After treatment system fault diagnosis and troubleshooting

3.3.1 After treatment system part fault analysis

3.3.1.1 AdBlue pump fault

a) The AdBlue pump cannot build up pressure normally.

Fault symptom: the Malfunction Indicator Light (MIL) is normally on; the AdBlue pump stops after working for a while; the AdBlue is not consumed.

Possible causes:

- 1) Serious air leakage of AdBlue inlet pipe;
- 2) AdBlue leaks from inlet pipe;
- 3) The AdBlue inlet and return pipes are reversely connected.
- 4) The AdBlue inlet pipe is seriously bent.

Troubleshooting:

Check whether the AdBlue suction pipe is firmly connected and whether the suction pipe and the fluid return pipe are reversely connected.

b) The temperature of AdBlue pump is abnormal

Fault symptom: the MIL is normally on; great difference with the environment temperature, the after treatment system cannot work normally.

Possible causes:

- 1) The AdBlue pump power supply end is open-circuited.
- 2) The AdBlue pump control end is open-circuited.

Troubleshooting:

Check the pins of AdBlue pump and whether the connector terminal is improperly inserted.

c) AdBlue injection pressure drop error

Fault symptom: the MIL is normally on; the AdBlue pump stops after working for a while; the AdBlue is not injected; the after treatment system cannot work normally.

Possible causes:

The AdBlue pressure pipe is blocked.

Troubleshooting:

Remove the AdBlue pipe and clean it with water to eliminate the fault. Do not bend the pipe during assembling.

d) The actuation high end of AdBlue reversing valve is open-circuited

Fault symptom: the MIL is normally on, the AdBlue is not consumed.

Fault mechanism: the AdBlue reversing valve is designed in the 12-hole connector of AdBlue pump and controlled by ECU, its function is to prevent the AdBlue residue in the pipe and pump. Every time after the engine flameout, the reversing valve works and suck the AdBlue in the pipe back to the AdBlue tank in 90sec. The

possibility of several faults of a connector is very high, for example, pin comes out because of loosened lock plate or water enters the connector.

Possible causes:

- 1) Connector loosened or pin comes out;
- 2) Water enters the connector;
- 3) Related harness fault.

Troubleshooting:

- 1) Check the AdBlue pump connector;
- 2) Whether one or some pins of connector come out.

e) SCR AdBlue pressure buildup error

Fault symptom: every time after running the vehicle for several minutes to dozens of minutes, the MIL is normally on, the flash code 441 SCR AdBlue pressure buildup error will be reported, and the AdBlue is not consumed.

Fault mechanism: Before AdBlue injection, the AdBlue pump will build up 9bar pressure, and inspect the pressure via the pressure sensor in the AdBlue pump. When the engine is started, the AdBlue pump tries several times to build the AdBlue pressure, if the pressure cannot reach 9bar, this fault will be reported. This fault is generally caused by: too little AdBlue, reverse connection of AdBlue pipes, suction pipe blockage or leakage, leakage from pressure pipe; it is rarely due to AdBlue pump fault.

Possible causes:

- 1) Too little AdBlue;
- 2) The suction pipes are wrongly connected, blocked or leak air;
- 3) The pressure pipe leaks;
- 4) The AdBlue pump is blocked or mechanical fault of AdBlue pump.

Measures and steps:

- 1) Check whether the AdBlue level is proper;
- 2) Check whether the AdBlue pipes are wrongly or reversely connected;
- 3) Check whether the suction pipe is bent or blocked;
- 4) Check the suction pipe and pressure pipe for leakage;
- 5) If no problem is detected in the above steps, check whether the AdBlue pump joint is obviously blocked.

3.3.1.2 AdBlue tank fault

The AdBlue tank mainly includes the tank housing and level/temperature sensor assembly. Sensor faults easily occur, and the common faults include: incorrect level indication, abnormal temperature display, MIL normally on and level/temperature sensor fault. These faults are mainly caused by: sensor damage, sensor connector not firmly connected or short circuit, and related harness faults. Sometimes, if the level/temperature sensor is not matched with the electric parameters required by Weichai, for example, the customer buys the AdBlue tank and did not notify Weichai, this may cause abnormal AdBlue level or temperature, even sensor fault is reported.

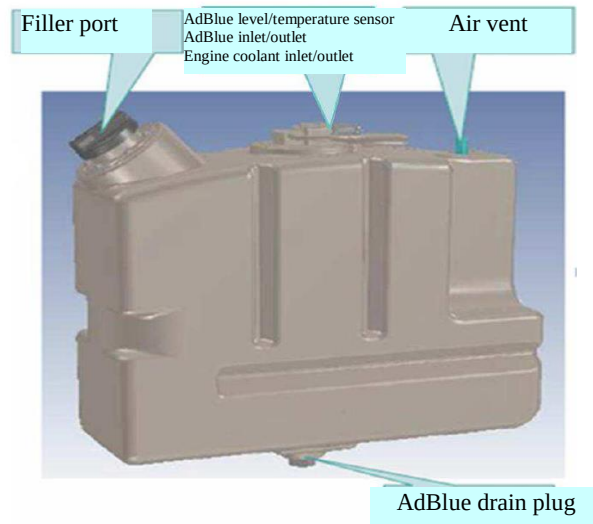


Fig.3-3 AdBlue tank

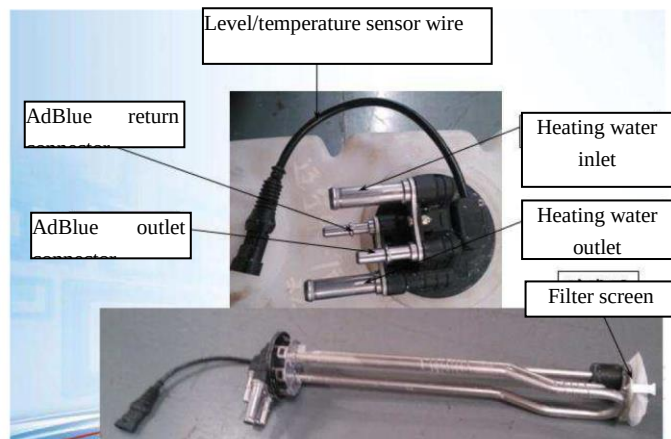


Fig.3-4 AdBlue tank connection

- a) AdBlue level sensor voltage higher than the upper limit

Fault symptom: MIL is normally on, the flash code 445 that the AdBlue level sensor voltage exceeds the upper limit is reported, and the AdBlue level indicated on the instrument is incorrect.

Fault mechanism: If this fault does not exist before the vehicle delivery and it appears after the vehicle traveling for a period of time, this is generally caused by open circuit of sensor harness or connector. Please inspect whether the 1# pin (ECU pin K57) of sensor connector is open-circuited or shorted to power supply. If the fault cannot be eliminated, further check other pins and harnesses for faults.

Possible causes:

- 1) The pin of sensor connector or vehicle harness connector is loosened;
- 2) The harness open circuit or not firmly connected;
- 3) 1# pin shorted to power supply;
- 4) Sensor damage or sensor parameter not matched with the Weichai's requirement.

Measures and steps:

- 1) Check the places with highest failure rate: sensor connector and harness;
- 2) Check the pins after unplugging the sensor connector;
- 3) Retighten the pins.

b) Abnormal AdBlue level/temperature display

Fault symptom: The AdBlue level display is incorrect: for example, when the AdBlue is insufficient, the instrument displays that the AdBlue is 100%; the difference between AdBlue temperature and current environment temperature is great, and the related sensor fault is not reported.

Fault mechanism: Such fault is generally because that the AdBlue tank sensor is not the kind specified by Weichai or the vehicle AdBlue tank is replaced recently but the model of sensor in the tank is different from that mounted on the vehicle before delivery. The electric parameters of the sensor are different, and causing mismatched data calibration and wrong level/temperature display.

Possible causes:

- 1) The customer replaced the AdBlue tank by the kind which is different from the original tank;
- 2) When matching with the vehicle, the AdBlue tank is self purchased but not notified the Weichai technician for data recalibration;
- 3) Sensor or related harness damage, causing the change of electric parameters. This possibility is minor, but the sensor related fault is not reported.

Measures and steps:

- 1) Check the AdBlue tank and sensor and whether the AdBlue tank is same to the original tank on the vehicle;
- 2) Check whether the AdBlue tanks are from different manufacturers.

c) Abnormal Adblue level/temperature display.

Fault symptom:

The AdBlue level/temperature display is incorrect: when the Adblue is very little, the instrument displays that the AdBlue level is 100%; the environment temperature measured by EOL is 21°C, but the AdBlue tank temperature reaches 42°C, this is obvious inconsistency. No other fault of AdBlue level sensor.

Fault mechanism: Such fault is generally because that the AdBlue tank is inconsistent with the product specified by Weichai; or, in special circumstances may due to excessive circuit resistance, excessive resistance in ECU or other electric faults.

Possible causes:

- 1) The AdBlue tank is inconsistent with the product specified by Weichai;
- 2) Excessive resistance of sensor related harness;
- 3) Excessive resistance between two ends of ECU sensor pins.

Measures and steps:

- 1) Check the AdBlue tank and sensor to verify whether the AdBlue tank is the kind specified by Weichai;
- 2) If the AdBlue tank is normal, please check the sensor harness; power on and check whether the resistance is normal;
- 3) Measure the resistance of ECU Adblue level/temperature sensor.

3.3.1.3 Heating element fault

The freezing point of AdBlue is -11.5°C, when the system works at low temperature, the AdBlue will freeze, causing the system inoperative. Therefore, the AdBlue tank needs unfreezing. The AdBlue tank uses the engine coolant for unfreezing and heating. The flow direction of heating coolant route is shown in the figure below.

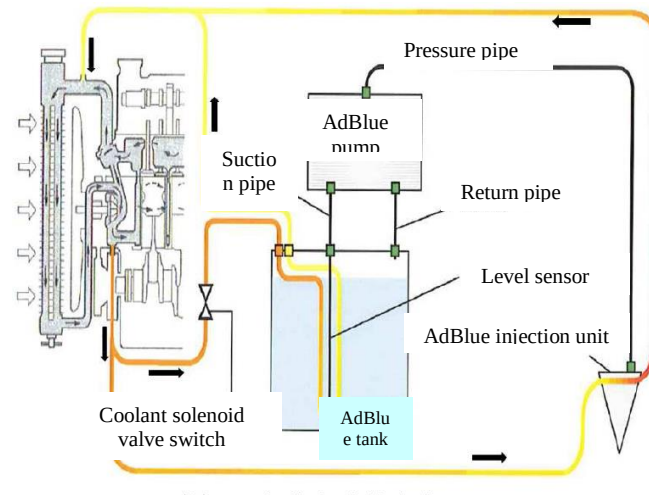
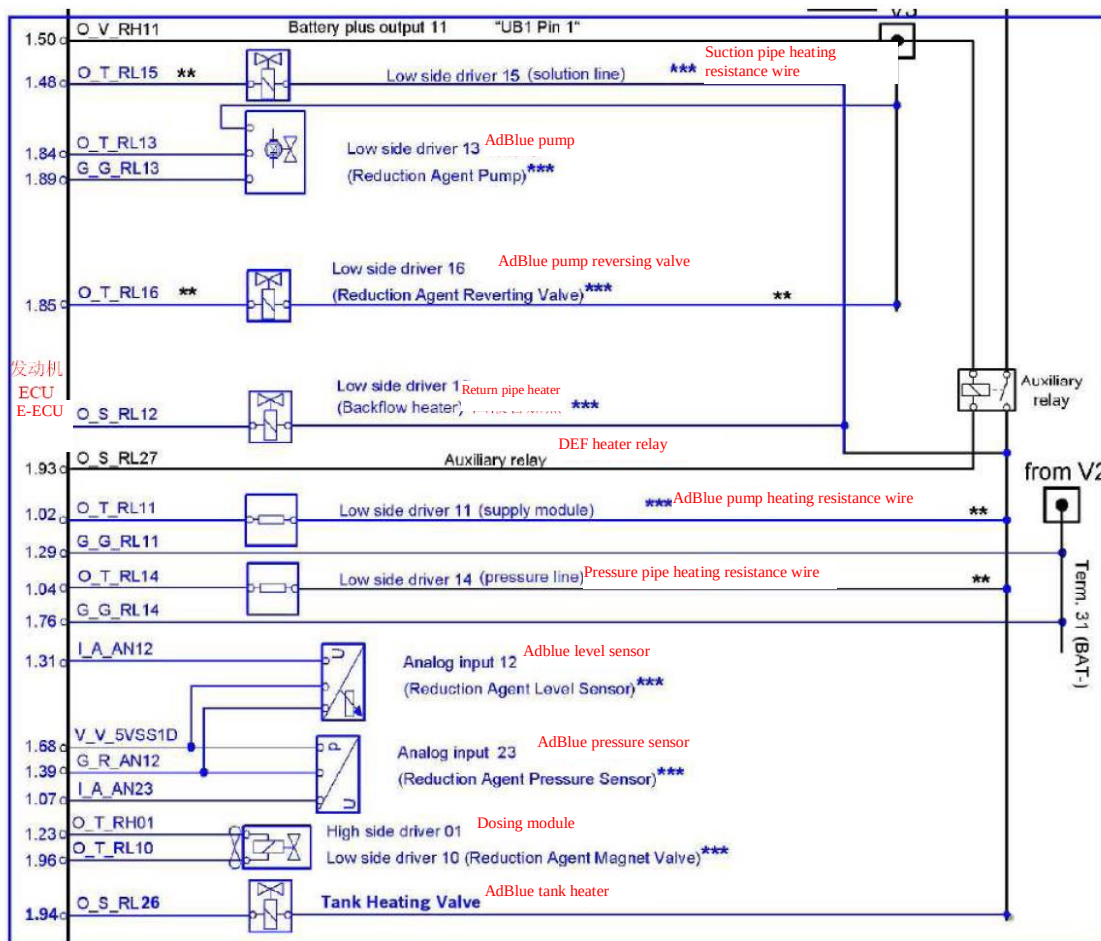


Fig.3-5 Flow direction of heating coolant route

The heating system includes the water heater of AdBlue tank and electric heater of AdBlue pump and AdBlue pipe. For the electric heater, as there are many harnesses and resistance wires, the failure rate is very high, mainly shown by relay damage, open circuit of resistance wires, open/short circuit of harnesses, etc.



AdBlue heater relay

Fig.3-6 Circuit diagram of Adblue heating system

Relay fault detection: the ECU can detect whether the relay is correctly installed, it will report the “open/short circuit of heater relay” fault if the relay is neglected during installation, damaged or there is circuit fault. In such

case, please check whether the related relays, harnesses and connectors are normal.

The water heater faults are mainly: water heater solenoid valve harness/connector faults; mechanical fault (wear, sticking) of water heater solenoid valve that may lead to AdBlue tank heating failure or too low temperature of DEF tank or lead to continuous heating of AdBlue tank and causing too high temperature of AdBlue and AdBlue volatilization, thus the emission of the engine will fail to meet the standard; water heating pipe bending and blockage, leakage from or blockage of pipe and connecting port that may cause heating failure or coolant leakage.

a) Excessive heating of AdBlue tank

Fault symptom: After running for a period of time, the flash code lamp and the MIL are normally on and the fault 446 DEF tank over heating is reported.

Fault mechanism: The AdBlue tank is heated through the engine coolant and the water heater solenoid valve is controlled by EDC17. As the AdBlue is highly volatile at 75°C, the temperature of AdBlue tank shall not be too high. If the water heater solenoid valve cannot be turned off normally, the engine coolant may continue heat the AdBlue tank, causing too high temperature of AdBlue tank and the fault will be reported; For the other causes of high AdBlue tank temperature, the fault will also be reported.

Possible causes:

- 1) The AdBlue tank water heater solenoid valve is stuck at the normally on status;
- 2) The AdBlue tank temperature sensor fault.

Measures and steps:

- 1) Check the actual temperature of AdBlue tank to determine the validity of temperature sensor;
- 2) Check the AdBlue tank water heater solenoid valve and the switch status.

b) Open circuit of AdBlue pipe heater relay

Fault symptom: MIL is normally on and the open circuit fault of AdBlue heater relay is reported.

Fault mechanism: If the AdBlue heater relay is neglected during installation or the circuit is damaged, the open circuit fault will be reported.

Possible causes:

- 1) Relay neglected during installation;
- 2) Relay harness or connector fault.

Measures and steps:

- 1) Check the relay installation;
- 2) Correctly install the relay.

c) Open circuit of AdBlue pipe heating resistance wires

Fault symptom: MIL is normally on and faults of open circuit of AdBlue pipe heating resistance wires and AdBlue pump resistance wires are reported.

Fault mechanism: if the AdBlue pipe and AdBlue pump only connected with heater relay but not connected with the resistance wires or the resistance wires are not connected completely according to the pin diagram, the ECU can also detect the fault.

Possible causes:

- 1) The resistance wires are neglected during installation;
- 2) Not connected according to the pin diagram or there is the fault of open circuit;

3) Other wires not connected completely according to the pin diagram.

Measures and steps:

- 1) Check whether the resistance wires are installed, if installed, please check whether the connectors are loosened;
- 2) Correctly connect the resistance wires and check and confirm the correct connection.
- 3) Internal open circuit of resistance wires, please replace the heating pipe.

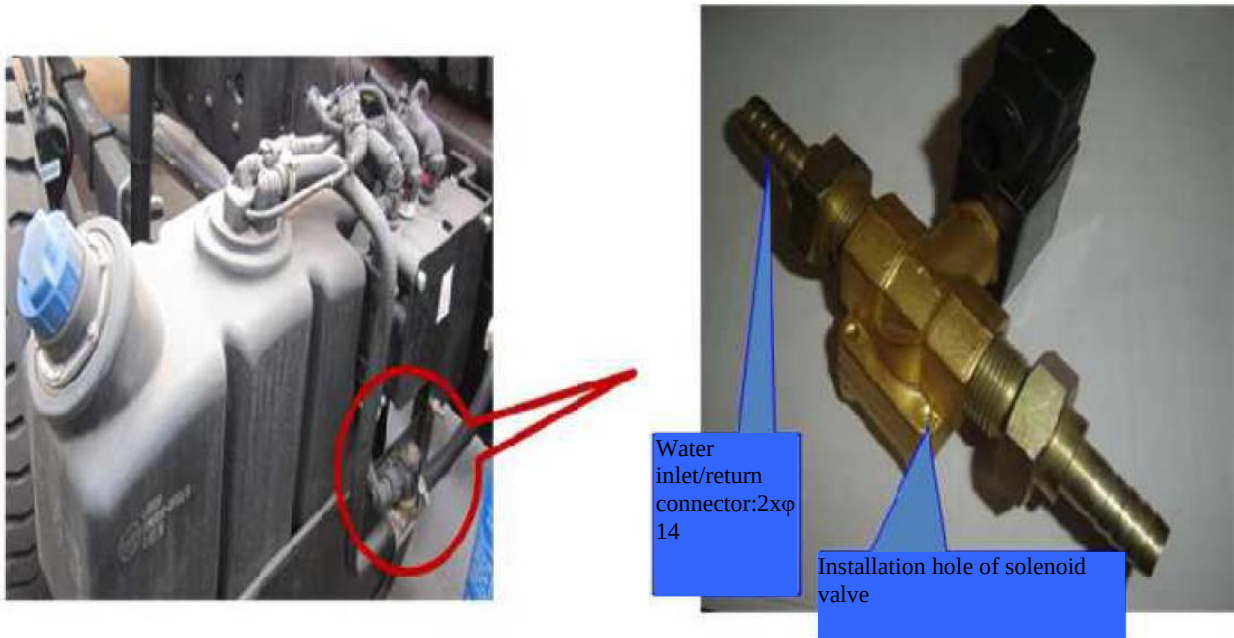


Fig.3-7 Water heater valve for AdBlue

3.3.1.4 AdBlue spray nozzle fault

The structure of AdBlue spray nozzle is relatively simple, and the involved faults are typical.

The faults mainly include:

Spray nozzle solenoid valve faults: Connector or harness damage, causing open/short circuit; solenoid valve coil burnt and this can be judged by measuring the resistance.

Spray nozzle mechanical fault: Poor AdBlue quality or nozzle aging, causing the nozzle wear and higher AdBlue consumption; nozzle blockage because of urea crystals or other PM; or nozzle deformation or crack due to other reasons. The above faults which may affect the AdBlue injection and emissions may limit the engine torque.

a) AdBlue nozzle drive high end shorted to power supply

Fault symptom: MIL is normally on, and the fault 453 SCR DEF nozzle drive high end shorted to power supply is reported.

Fault mechanism: the AdBlue nozzle solenoid valve has 2 pins: 1.96 and 1.23 correspond to connector numbers 2 and 1, the 1.23 pin is the solenoid valve drive high end and 1.96 pin is the drive low end. This fault indicates that the 1.23 pin is shorted to power supply, please check the connector 1.23 and harness.

Possible causes:

- 1) Connector fault, causing the 1.23 pin shorted to power supply;
- 2) 1.23 pin related harness fault, causing short circuit to external power supply.

Measures and steps:

- 1) Check the nozzle connector for damage or short circuit;
- 2) Measure the voltage of 1.23 pin;
- 3) Check the vehicle harness connector.

b) High AdBlue consumption

Fault symptom: The AdBlue consumption is high, the ratio to fuel consumption is far higher than 1/20. No other related fault.

Fault mechanism: If there is no fault reported, it indicates that the harness and electric parts of after treatment system are basically normal.

Possible causes: leakage from AdBlue pipeline, pump or tank, AdBlue spray nozzle wear, causing the AdBlue leaks from the nozzle.

Possible causes:

AdBlue leakage from pipeline and related electric parts;

Spray nozzle wear, causing the increase of AdBlue injection amount.

Measures and steps:

- 1) Check the AdBlue tank, pump and pipeline for leakage;
- 2) If there is no AdBlue leakage, start the vehicle and run it at higher power, so that the exhaust temperature can reach the lowest temperature 200°C for pressure buildup of AdBlue pump pressure until the EOL detects that the AdBlue pump pressure is stable at 9bar;
- 3) Do not stop the engine, keep the engine idling;
- 4) Take out the AdBlue spray nozzle from the exhaust pipe to observe the nozzle for leakage.

3.3.1.5 Diesel metering unit fault

The diesel metering unit includes a casing, a stop valve, two pressure sensors, one temperature sensor and one injection valve.

The involved faults mainly are:

Diesel stop valve and spray nozzle solenoid valve faults; connector or harness damage, causing open/short circuit; solenoid valve coil burnt (this can be judged by measuring the resistance).

Sensor fault: connector or harness damage causing sensor open/short circuit.

a) Diesel injection stop valve shorted to power supply

Fault symptom: MIL is normally on; the fault that the diesel injection stop valve shorted to power supply is reported; the diesel metering unit cannot supply fuel to be injected by the diesel nozzle.

Possible causes:

- 1) Connector fault causing the 1.45 pin shorted to power supply;
- 2) 1.45 pin related harness fault, causing short circuit to external power supply.

Measures and steps:

- 1) Check the nozzle connector for damage or short circuit;
- 2) Measure the voltage of 1.45 pin;
- 3) Check the vehicle harness connector.

b) Diesel injection valve shorted to power supply

Fault symptom: MIL is normally on; the fault that the diesel injection valve shorted to power supply is reported; the upstream pressure sensor of diesel metering unit is normal but the diesel metering unit cannot supply fuel to be injected by the diesel nozzle.

Possible causes:

- 1) Connector fault causing 1.24 pin shorted to power supply;
- 2) 1.24 pin related harness fault, causing short circuit to external power supply.

Measures and steps:

- 1) Check the nozzle connector for damage or short circuit;
- 2) Measure the voltage of 1.24 pin.

3.3.1.6 Diesel injector nozzle fault

The diesel nozzle is a mechanical part and the involved faults are mainly: Diesel injector nozzle wear due to poor fuel quality; PM comes into the injector nozzle and causing blockage; or nozzle deformation or breakage due to high temperature.

Fault symptom: No normal fuel injection.

Possible causes:

- 1) Diesel metering unit damage;
- 2) Oil leakage from fuel connecting pipe of diesel metering unit and diesel injector nozzle;
- 3) Diesel injector nozzle damage or blockage.

Measures and steps:

- 1) Check whether there is oil leakage from the fuel connecting pipe of diesel metering unit and diesel nozzle;
- 2) Check whether the diesel injector nozzle cooling pipe is normal;
- 3) Check the diesel nozzle for blockage or damage.

3.3.1.7 Low NO_x conversion efficiency

The SCR carrier and SCR catalyst are designed in the DOC-DPF-SCR assembly, and if faults occur, the emission may not meet the standard and the engine torque may be limited.

The faults mainly as the following:

Catalyst failure: as the DOC-DPF-SCR assembly is impacted or polluted or covered by other matters (particulates in the black smoke), the catalytic reduction efficiency will be reduced, finally leading to emission fails to meet the standard and engine torque be limited;

DOC-DPF-SCR assembly blockage: DOC-DPF-SCR assembly deformation or blockage due to other reasons, causing high exhaust backpressure, or in serious cases, faults including black smoke, engine speed trembling, powerless, etc.

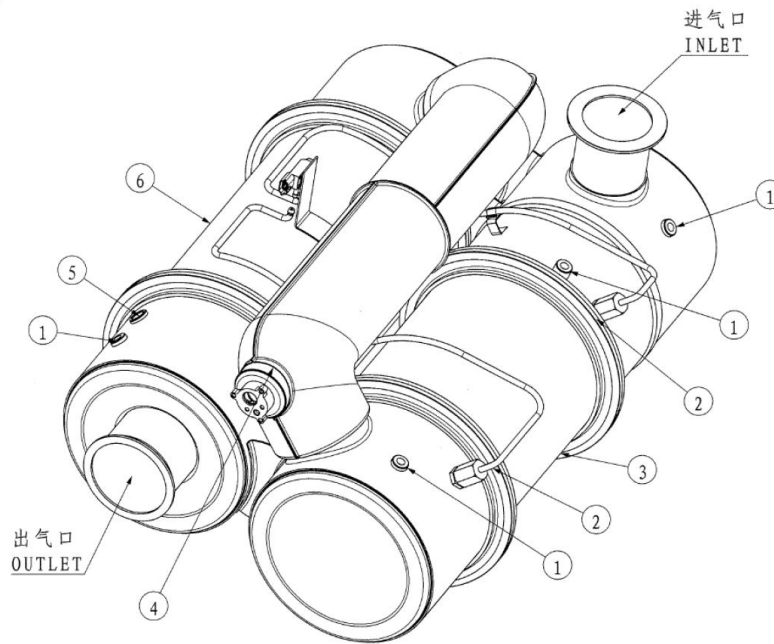


Fig.3-8 DOC-DPF-SCR assembly

a) Actual average conversion efficiency of SCR lowers than the threshold 1 and the threshold 2

Fault symptom: MIL is normally on; normal Adblue injection; and no other related fault.

Fault mechanism: These two faults indicate that the NO_x concentration in exhaust gas is high and exceeds the regulatory requirements. If not repaired timely, it may lead to engine torque limited.

Possible causes:

- 1) Engine original emission deterioration: At the upstream of after treatment system, the exhaust gas from the turbocharger is very bad;
- 2) DOC-DPF-SCR assembly deterioration, causing low conversion efficiency;
- 3) Larger Adblue injection error: the actual injection amount is less than the set value;
- 4) Poor fuel quality.

Measures and steps:

- 1) First, check and judge whether the engine original emission is seriously deteriorated, for example, serious black smoke;
- 2) Check whether the fuel is qualified;
- 3) Check whether the Adblue spray nozzle is blocked or leaks, which causes incorrect control of injection amount;
- 4) Check the DOC-DPF-SCR assembly for aging or crystals or be covered or blocked by soot.

3.3.1.8 DOC (Diesel Oxidation Catalyst) failure

The DOC in the after treatment system functions for NO conversion and diesel injection light-off, the main possible faults are: Catalyst failure or carrier crack or breakage, which causes low catalytic reduction efficiency, and finally leading to emission fails to meet the standard and engine torque being limited.

a) Poor DOC performance

Fault symptom: MIL is normally on; normal diesel injection but the exhaust temperature does not increase.

Possible causes:

- 1) Poor fuel quality;
- 2) Bad engine running environment or the intake air filter is improperly matched or not maintained timely;
- 3) High exhaust temperature causing catalyst aging.

Measures and steps:

- 1) First, check whether the engine status is normal;
- 2) Check whether the fuel is qualified;
- 3) Check whether the air filter is properly matched and ensure the cleanliness of intake system;
- 4) Check the after treatment assembly for vibration or falling off;
- 5) Check whether the DOC-DPF-SCR assembly is aging or covered or blocked by soot.

3.3.1.9 DPF blockage

The DPF mainly functions for reducing the PM in the engine exhaust gas. If the DPF is blocked, the main results will be that the engine exhaust backpressure rises, the engine fuel consumption increases, the differential pressure signal at the ends of DPF exceeds the normal value, and frequent regeneration, etc.

Possible causes:

- 1) Engine PM emission increases due to engine malfunction;
- 2) Regeneration failure due to differential pressure sensor comes off;
- 3) Regeneration failure due to fault of diesel injection system;
- 4) Poor fuel quality;
- 5) Bad engine running environment or the intake air filter is improperly matched or not maintained timely;
- 6) Soot not removed for a long time.

Measures and steps:

- 1) Check whether the engine status is normal;
- 2) Check whether the differential pressure sensor is normal and whether the differential pressure signal gas pipe comes off;
- 3) Check whether the diesel injection system is normal;
- 4) Check whether the fuel quality meets the requirements;
- 5) Check whether the air filter is properly matched and ensure the cleanliness of intake system;
- 6) Whether the soot is removed as required.

3.3.1.10 AdBlue pipe fault

The after treatment system includes 3 sections of AdBlue pipes and 3 types of faults easily occur: pipe blockage, pipe leakage and pipe bending.

Pipe blockage: generally caused by AdBlue crystallization or poor AdBlue quality, which affects the AdBlue injection and pressure build-up, leading to the emission fails to meet the standard;

Pipe leakage: mainly caused by the pipe joints is improper or poor tightness of joint and pipe aging or wear.

Pipe bending: pipe bending will cause AdBlue pressure build-up failure or injection fault, leading to emission fails to meet the standard.

a) AdBlue pressure build-up error of SCR

Fault symptom: MIL is normally on; NO_x emission fails to meet the standard; AdBlue cannot be injected normally.

Fault mechanism: when the exhaust pipe temperature reaches the lowest temperature for pressure build-up, the AdBlue pump starts to build up the pressure and check all AdBlue pipes, AdBlue pump and nozzles for leakage or blockage. If the AdBlue pressure cannot reach 9bar in a very long time, the ECU will determine that there may be AdBlue leakage and reports the fault, and then the after treatment system stops working.

Possible causes:

- 1) The AdBlue pipes are wrongly connected or there is AdBlue leakage from the suction pipe;
- 2) Leakage from the pressure pipe;
- 3) AdBlue pump fault.

Measures and steps:

- 1) Check the suction pipe for wrong connection, leakage or bending;
- 2) Check whether there is leakage from the pressure pipe;
- 3) Check the joint tightness between pressure pipe and AdBlue pump.

b) SCR not drained completely after previous driving cycle

Fault symptom: after the T15 is powered on; the MIL and flash code lamp are normally on; read the flash code 447 that indicates the SCR is not drained completely after previous driving cycle, there is no such fault before.

Fault mechanism: to avoid AdBlue crystallizing in the pipe and pump which may cause AdBlue pipe blockage or pump damage, it is required that do not turn off the vehicle switch within 90sec after stopping the vehicle. In this 90sec, the AdBlue pump will continues working and the AdBlue in the pipe and pump will be sucked back into the AdBlue tank. This fault will occur if the driver does not operate according to the requirement, for example, turn off the vehicle switch too early.

Possible causes:

Violation operation of driver.

Measures and steps:

- 1) Ask the driver whether the vehicle switch is turned off 90sec after stop of previous driving;
- 2) The driver turned off the vehicle switch too early and the waiting time did not reach 90sec;
- 3) Restart, after stop of next driving cycle, the driver shall operate correctly and turn off the vehicle switch after waiting for 90sec.

3.3.1.11 Faults of after treatment system related sensors

The sensors mainly include the exhaust gas temperature sensor, the environment temperature sensor, the NO_x sensor and the differential pressure sensor.

Exhaust gas temperature sensor and environment temperature sensors

There are mainly 2 types of faults:

- 1) The sensor voltage signal above the upper limit or below the lower limit. If it exceeds the upper limit, the cause is generally that the harness or connector is open-circuited or shorted to power supply; if it is below the lower limit, the cause is generally that the harness or connector is shorted to ground.
- 2) Incorrect temperature indication. In such case, the sensor may not be properly installed, the installation position may be improper, or the sensor may be damaged.

When fault of environment temperature sensor occurs, AdBlue heating function will be affected, and causing

AdBlue crystallizing or AdBlue pump blockage. When fault of exhaust gas temperature sensor occurs, it will cause AdBlue injection control failure, diesel injection control failure, and exhaust gas emission failing to meet the standard, etc. In brief, if the faults causing the emission failing to meet the standard are not eliminated timely, they will lead to the engine torque is limited.

NO_x sensor

When this sensor fails, the measured NO_x concentration cannot be sent to EDC17 via the AT101 message, and the "AT101 message timeout" fault will be reported. This fault is generally caused by wire problems: the NO_x sensor has 4 wires connected with the vehicle harness, they respectively are the power positive, power negative, communication CAN low, and communication CAN high. Please check whether the voltages of 4 wires harnesses and connector are normal and whether there is open/short circuit fault of harness and connector. If the harness and connector are normal, the NO_x sensor may be damaged, please replace the NO_x sensor for verification.

Fault of differential pressure sensor always results in DPF regeneration failure or wrong differential pressure and is generally due to connector looseness of differential pressure sensor and gas leakage from the pipe of sensor section, please check the circuit, two ends of differential pressure sensor and DPF tank timely to verify whether there are the circuit and exhaust gas leakage faults and whether the DPF tank is damaged.

a) Voltage signal of exhaust gas temperature sensor exceeds the upper limit

Fault symptom: the MIL and flash code lamp are normally on; the fault that the voltage signal of upstream temperature sensor exceeds the upper limit is reported; when the fault of exceeding the upper limit occurs, measure the exhaust gas temperature using EOL and the reading is obviously incorrect and does not change.

Fault mechanism: Exhaust gas temperature sensor and related circuit or connector faults, causing the sensor open-circuited. When this fault is detected, the exhaust gas temperature measured by EOL is the default value.

Possible causes:

- 1) Exhaust gas temperature sensor connector or circuit opened;
- 2) Sensor aging or damage;
- 3) Sensor ECU connector circuit fault, causing the sensor open-circuited.

Measures and steps:

- 1) Check the exhaust gas temperature sensor connector;
- 2) Check whether the sensor harness is normally conductive.

b) Unbelievable environment temperature signal

Fault symptom: After the vehicle running for a period of time, the MIL and flash code lamp are normally on; the fault of flash code 235 that the environment temperature signal is unbelievable will be reported.

Fault mechanism: The environment temperature sensor is used for measuring the current atmosphere temperature. If the ECU detects that the environment temperatures are obviously inconsistent, such as too high or too low, this fault will be reported. The cause of this fault is generally: wrong installation position of environment temperature sensor, for example, installed in the engine compartment, too close to the heat source, abnormal sensor circuit resistance, or sensor fault.

Possible causes:

- 1) Wrong installation position of environment temperature sensor;
- 2) Excessive sensor circuit resistance;
- 3) Environment temperature sensor damage.

Measures and steps:

- 1) Check whether the installation position of the environment temperature sensor meets the requirement;
- 2) Check whether the sensor is close to the heat source;

3) Adjust the installation position of the environment temperature sensor as required.

c) Error of CAN receiving frame AT101 timeout

Fault symptom: flash code light and MIL are normally on; the error of 421 CAN receiving frame AT101 timeout is reported.

Fault mechanism: after the NO_x concentration sensor measuring the NO_x concentration, the measured results are sent to the ECU through the AT101 message in the CAN bus; if the ECU cannot receive the AT101 message, this fault will be reported.

Possible causes:

- 1) NO_x sensor wire fault, causing the AT101 cannot be sent out;
- 2) The NO_x sensor is damaged;
- 3) CAN bus network fault.

Measures and steps:

Voltages of 4 pins (No.1, 2, 3, 4) in NO_x sensor shall be respectively 24V, 0V, 2.2V and 2.8V, determine whether there is fault of wrong connection or open/short circuit.

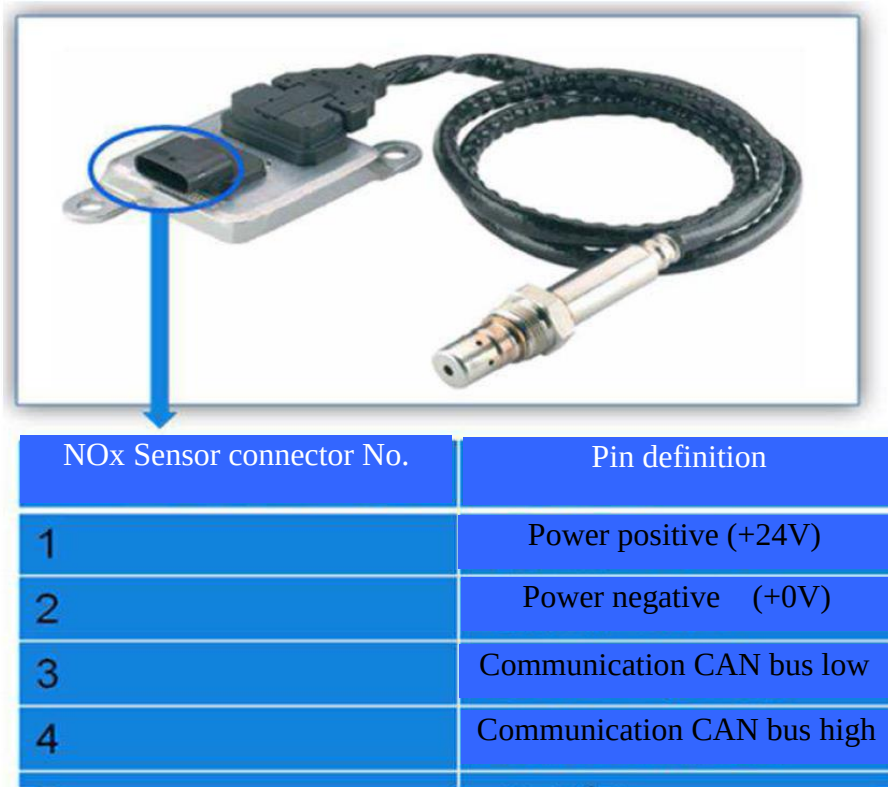


Fig.3-9 NO_x sensor assembly

3.3.1.12 Summary of after treatment system fault

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

- 1) AdBlue pipe leakage or pipe blocked by crystals;
- 2) AdBlue pipe joint loosened, causing gas leakage but no AdBlue leakage;
- 3) The AdBlue injection pipe and return pipe are reversely connected;
- 4) The AdBlue pump harness connector may be shorted or open or wrongly connected;

- 5) The installation position of SCR system on the vehicle is improper, causing AdBlue 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 AdBlue 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) AdBlue resistance wires fuse is burnt, the OL fault related to heating is reported;
- 10) Faults of parts including nozzle, exhaust gas temperature sensor and AdBlue level sensor.

3.3.2 Fault diagnosis of after treatment system and troubleshooting

3.3.2.1 Fault classification

Type I fault: AdBlue pressure build-up failure

Type II fault: Low AdBlue consumption

Type III fault: OBD torque is limited and there are codes that cannot be cleared

Type IV fault: MIL

Type V fault: AdBlue heating not released

Type VI fault: low NO_x conversion efficiency

Type VII fault: NO_x conversion efficiency monitoring not released

Type VIII fault: incorrect NO_x value measured

Type IX fault: ammonia smell

Type X fault: AdBlue crystallization

Type XI fault: other faults

3.3.2.1 Troubleshooting

I) AdBlue pressure build-up failure

- Step 1: read the flash code base on the flash code lamp, decide the fault point and focus on the pressure build-up related fault and faults of pressure build-up related parts (such as: spray nozzle, reversing valve, AdBlue pump, heater relay, resistance wires, exhaust gas temperature sensor, AdBlue tank temperature sensor).
- Step 2: in cold regions, base on the fault code, first check the AdBlue heating parts to ensure that the AdBlue heating function is normal.
- Step 3: related fault information can be obtain from Step 1; if there is no pressure build-up related function fault and only related part fault, please check the spray nozzle, reversing valve, AdBlue pump, heater relay, resistance wires, exhaust gas temperature sensor, AdBlue tank temperature sensor and their harnesses, as the part fault may cause the system does not try to build up the pressure, the pressurized released upstream exhaust gas temperature is 180°C.
- Step 4: power off and restart, if the system still does not try to build up the pressure, check whether the harnesses of the parts are reversely connected.
- Step 5: related fault information can be obtain from Step 1; if there is pressure build-up related function fault but no related part fault, it indicates that the parts are normal; please check the installation of AdBlue pipe and AdBlue leakage and blockage, the system may tried to build up the pressure but failed.

- Step 6: power off and restart, if the system tried to build up the pressure but failed, check whether the harnesses of the parts are reversely connected.
- Step 7: poor signal quality may also lead to the system pressure build-up failure, such as signals for the level and temperature in the AdBlue pump.
- Step 8: check and calibrate the data if necessary.

II) Low AdBlue consumption

- Step 1: read the flash code based on the flash code lamp, decide the fault point and focus on the pressure build-up related fault and faults of pressure build-up related parts (such as: spray nozzle, reversing valve, AdBlue pump, heater relay, resistance wires, exhaust gas temperature sensor, AdBlue tank temperature sensor).
- Step 2: in cold regions, base on the fault code, first check the AdBlue heating parts to ensure that the AdBlue heating function is normal.
- Step 3: check whether the AdBlue pressure build-up is normal; in case of pressure build-up failure, please refer to Type I fault for checking.
- Step 4: if the pressure build-up is successful, dismantle the spray nozzle for further check and observe whether the injection is normal. If the spray nozzle is mechanically stuck, it cannot be diagnosed.
- Step 5: ask about the vehicle operating conditions; if the vehicle travels with low load for most time, it will lead to low exhaust gas temperature, the AdBlue injection is not released at the lowest temperature 200°C.
- Step 6: further check the harnesses to see whether the harnesses are reversely connected.
- Step 7: check and calibrate the data if necessary.

III) OBD torque is limited and there are codes that cannot be cleared

- Step 1: read the flash code based on the flash code lamp, decide the fault point; focus on the functional fault and part fault that lead to the OBD torque is limited and the existence of codes that cannot be cleared, see the appendix A “OBD torque limit and codes that cannot be cleared”.
- Step 2: base on the result of fault code in Step 1, determine which fault causes the OBD torque limit and appearance of codes that cannot be cleared with reference to appendix A.
- Step 3: check and calibrate the data if necessary;
- Step 4: check and eliminate the faults referring to fault diagnostic manual.

IV) MIL

- Step 1: Read the flash code based on flash code lamp, decide the fault point; focus on the functional fault and part fault causing the MIL lights up.
- Step 2: base on the result of fault code in Step 1, determine the fault causing the MIL lights up with reference to appendix A.
- Step 3: check the MIL and its harness to verify whether the MIL functions normally.
- Step 4: check and calibrate the data if necessary.
- Step 5: check and eliminate the faults referring to fault diagnostic manual.

V) AdBlue heating not released

- Step 1: read the flash code based on the flash code lamp, decide the fault point; focus on the faults related to

AdBlue heating and environment temperature sensor.

- Step 2: base on the results in Step 1, check the environment temperature sensor and its harness if necessary to verify whether the sensor functions normally.
- Step 3: base on the results in Step 1, check the AdBlue heater relay, solenoid valve and the harnesses if necessary.
- Step 4: base on the results in Step 1, check the AdBlue heating resistance wire and harnesses and the AdBlue tank heating water pipe.
- Step 5: if the AdBlue pump heating fault is reported and the fault still exists after powering off and restarting, please replace the AdBlue pump if necessary.
- Step 6: check and calibrate the data if necessary.
- Step 7: check and eliminate the faults referring to fault diagnostic manual.

VI) Low NO_x conversion efficiency

- Step 1: read the flash code based on the flash code lamp, decide the fault point; focus on the fault related to NO_x conversion efficiency.
- Step 2: carry out the following checks in sequence:
 - a) Check the NO_x sensor and exhaust pipe: if the measuring signal of NO_x sensor is stronger, it will cause the conversion efficiency fault;
 - b) Check the AdBlue injection: if the AdBlue injection amount is less, it will cause the measuring signal of NO_x sensor stronger, which will lead to conversion efficiency fault;
 - c) Check the spray nozzle: in case of spray nozzle faults (such as mechanically stuck or partially stuck), the system cannot detect the mechanical fault, the AdBlue injection amount will be less, and this will cause the measuring signal of NO_x sensor stronger, which will lead to conversion efficiency fault;
 - d) Check the AdBlue pressure: if there is leakage from the AdBlue pipe, the AdBlue pressure will be lower, the actual AdBlue injection amount will be less, causing the measuring signal of NO_x sensor stronger and conversion efficiency fault;
 - e) Check the AdBlue: if the AdBlue quality is poor, its concentration will be low and the impurity content will be high, which will lead to measuring signal of NO_x sensor stronger and the conversion efficiency fault;
 - f) Check whether the AdBlue is crystallized; if the crystallization formed in the DOC-DPF-SCR assembly, the conversion efficiency will slow down;
 - g) Check the engine and DOC-DPF-SCR assembly: if the aging of engine or DOC-DPF-SCR assembly is serious, it will cause too much NO_x original emission or too strong measuring signal of NO_x sensor, which will lead to conversion efficiency fault;
 - h) Check the factors related to environment: if the environment temperature/pressure sensor is failure and the vehicle travels in extreme (high altitude, cold, hot) environment, the fault of conversion efficiency will be reported, particularly in the high altitude regions;
- Step 3: check and calibrate the data if necessary; if the specific calibration for releasing the engine operating conditions is improper, the fault may be wrongly reported.

VII) NO_x conversion efficiency monitoring not released

- Step 1: read the flash code based on the flash code lamp, decide the fault point; focus on the fault related to NO_x conversion efficiency.
- Step 2: check the NO_x sensor, make sure that the NO_x sensor functions normally, the ECU can read the measured NO_x value and the NO_x sensor status is "1".
- Step 3: check the AdBlue injection release conditions, including: SCR is in the dose control mode, the AdBlue

pressure is about 9bar, the exhaust gas temperature is above 200°C, make sure that the AdBlue injection is released.

- Step 4: check the ADBLue injection status and make sure that the AdBlue is being injected.
- Step 5: check the environment temperature and environment pressure sensors and their harnesses; make sure that the two sensors function normally, the environment pressure is above 900hpa and the environment temperature is above 2°C.
- Step 6: make sure that the engine operating conditions are within the proper scope (exhaust gas temperature: >300°C, gas flow: >500kg/h).
- Step 7: check and calibrate the data if necessary; if the specific calibration for release of engine working conditions is improper, the NO_x conversion efficiency monitoring will not be released.

VIII) Incorrect measured NO_x value

- Step 1: read the flash code based on the flash code lamp, decide the fault point; focus on the faults related to NO_x signal.
- Step 2: check the NO_x sensor and exhaust pipe; make sure that there is no much gas leakage from the exhaust pipe and the NO_x sensor is correctly installed. See the SCR after treatment system matching and installation specification for details.
- Step 3: check the NO_x sensor harness; make sure that the communication and power supply are normal.
- Step 4: check the exhaust back pressure; the exhaust back pressure affects the molecular number entering the NO_x sensor, thus affecting the NO_x measurement.
- Step 5: check the proportions of NO and NO₂ in the exhaust gas; if the NO₂ proportion is higher, the measured NO_x value is higher.
- Step 6: check and calibrate the data if necessary; confirm that the release of sending and receiving of NO_x sensor related message are correct.

IX) Ammonia smell

- Step 1: read the flash code based on the flash code lamp, decide the fault point; focus on the AdBlue injection amount related faults, including parts: speed sensor, fuel injector, air intake pressure/temperature sensors, exhaust gas temperature sensor, spray nozzle, and AdBlue pressure sensor.
- Step 2: check the speed sensor and its harness; the speed signal is one basis for calculating the AdBlue injection amount.
- Step 3: check the fuel injection; if the actual fuel injection amount is less than the set amount, the AdBlue injection amount will be relatively too much.
- Step 4: check the air intake pressure/temperature sensors and their harnesses; the air intake is one basis for calculating the AdBlue injection amount.
- Step 5: check the exhaust gas temperature sensor and its harness; the exhaust gas signal is one basis for calculating the AdBlue injection amount.
- Step 6: check the AdBlue pressure sensor and its harness; if the measuring difference of AdBlue pressure signal is excessive, it will cause the correction of AdBlue injection amount based on AdBlue pressure is larger, which will lead to too much AdBlue injection.
- Step 7: check the spray nozzle and its harness; if the nozzle is stuck at the normally open position, the AdBlue injection amount will exceed the set amount too much.
- Step 8: check and calibrate the data if necessary; make sure that the calibration of engine original emission and air intake are precise.

X) AdBlue crystallization

- Step 1: read the flash code based on the flash code lamp, decide the fault point; focus on the faults related to NO_x conversion efficiency and NO_x signal.
- Step 2: too much AdBlue injection amount is one cause of AdBlue crystallization, please refer to the check method and steps of Type IX fault.
- Step 3: check the design and material of exhaust pipe.
- Step 4: check the design and material of spray nozzle base.
- Step 5: check whether the injection direction of nozzle meets the specification.
- Step 6: check and calibrate the data if necessary; make sure that the calibration of engine original emission and air intake are precise.

Part IV Engine Disassembling and Assembling

4.1 Overview

When disassembling and assembling the engine, please strictly observe the instructions in the manual for operation and pay attention to the operations marked with danger signs and safety signs to ensure personal safety and avoid accidents.

The removal steps and installation steps of engine parts are reverse, so, if no special remark is required, only one kind of steps will be given in this manual.

The tightening torque of special bolts will be given in the related installation steps; please refer to the Part V Tightening Torque of Standard Bolts if no special remark is given.

4.1.1 Danger signs



This sign is the world-recognized warning sign. In this manual, the sign is used for emphasizing the importance of the following information. Make sure that you understand the results of dangers and methods of preventing the dangers. Actions violating the warning information may cause property loss, personal injury or even casualties.

The common danger signs are used for general warning. In this manual, the warning information is divided into different types (minor injury, serious injury, death) according to the level of results.

This warning sign indicates a potential danger. If not prevented, it may cause serious injury or death or even great property loss.

This warning sign indicates a potential danger. If not prevented, it may cause minor injury or property loss. The warning sign is also used for warning of danger operations.

The information provided by this caution is used for describing the correct operation and installation of engine products. The dangers cannot be prevented only by reading the text simply, users shall correctly understand the information contained in the caution for correct operation.

Not all cases are covered in the warning information of this guide! If the procedures and methods you choose are not within the recommendation scope, please make sure that this operation will not pose any danger to you, other people and the equipment.

4.1.2 Safety signs

Table 4-1 Safety signs

Sign	Definition
	Wear the gloves!
	Wear the ear protectors!
	Wear the goggles!
	Wear the helmet!
	Wear the protective shoes!
	Wear the protective mask!
	Wear the protective clothes!
	No open flame!
	No smoking!
	Mobile phone prohibited!
	Danger: battery electrolyte!
	Danger: live cable, electric shock hazard!
	Inflammables!
	Away from the hanging heavy objects!
	Fire extinguisher nearby!

During engine operation, many potential hazards may occur with no sign. Therefore, warning aim at each kind of potential hazard cannot be given in this manual. If the procedures you adopt are not within the scope of special recommendations of this manual, please make sure that the procedures run safely and will not cause any material damage.

4.1.3 Special tool

Table 4-2 Special tool

Piston installation taper sleeve	Cylinder liner detacher	Circlip pliers	Change lever
Fuel injector detacher for common rail pump	Valve spring compressing apparatus	Turbocharger oil joint detacher	Front oil seal installer
Rear oil seal installer	Valve oil seal installer	copper hammer	Fuel injector detacher
Cylinder liner installer			

If the methods or tools used are not recommended in this manual, the user shall first ensure his safety to avoid life danger to himself or to other people and ensure that the operation, maintenance or repair methods will not cause any damage or safety hazard.

4.1.4 Health protection precautions

The following “Health protection precautions” are aimed at minimizing the pollution risk.

- Avoid repeat contact with the used oil for a long time.
- If possible, please wear protective clothing and waterproof gloves.
- Do not place the oil stained rag into the pocket.
- Avoid contaminating the clothes (particularly underwear) by oil.
- Frequently wash the work clothes. Discard the oil stained clothes and shoes if they cannot be cleaned.
- In case of cut and injury, please take first aid measures.
- Coat the protective cream before working; if mineral oil splashes on the skin, it will be easier to remove.
- Use the soap and hot water or use hand sanitizer and nailbrush to wash hands to remove the oil stain. If the skin naturally secreted oil is removed when washing hands, the product containing lanolin can be used to moisten the skin.
- It is not allowed to clean the skin using gasoline, kerosene, fuel, thinner or solvent.
- In case of skin discomfort, please go to a doctor immediately.
- If possible, remove the oil of parts before handling.
- Please wear the goggles or mask to avoid hurting the eyes. The eye flushing fluid shall be easily reached.
- When repairing the engine, the oil or other liquid shall not splash to the ground. In case of accidental leakage of hydrocarbon or other liquid, please take essential measures to isolate the area to keep environment cleanliness and protect people against injury.
- Observe the safety and environmental standards in the country where the vehicle is operated for handling, storage and recovery of hydrocarbon, ethylene, ethylene glycol or petroleum.

4.1.5 Environment protection measures

Please observe the local environment protection laws and regulations for disposal of waste oil and hydrocarbon. Please consult the local officials for details.

4.1.6 Engine disassembling and assembling precautions

Accidents related to operation, maintenance and repair of engine are mostly caused due to not observing the safety

rules and basic precautions. Users shall be aware of the dangers and take preventive measures to avoid accidents. Operation, maintenance and repair of engine shall be performed by trained personnel with proper skills and tools.

Violation of the instructions given in this manual may cause serious accidents, even endanger the life. Weichai Power Co., Ltd cannot foresee all the potential dangers. Besides, rules and notes in this manual cannot cover all contents.

Before continuing the maintenance or repair, place the “Please do not use” signboard or similar signs on the starter switch.

Before using the barring rod, please take essential preventive measures aim at its operation.

Ensure that the repair site and surrounding environment are suitable for safety operation.

Ensure that the repair shop and engine surrounding area are clean and tidy.

Before operation, please take off the finger ring, necklace and watch and wear proper work clothes.

Before work, please verify whether the protective devices (goggles, gloves, shoes, mask, work clothes and helmet) are within the validity.

Please do not use the defective or improper tools.

Please stop the engine during maintenance or repair.

4.2 Engine block group

4.2.1 Exploded view

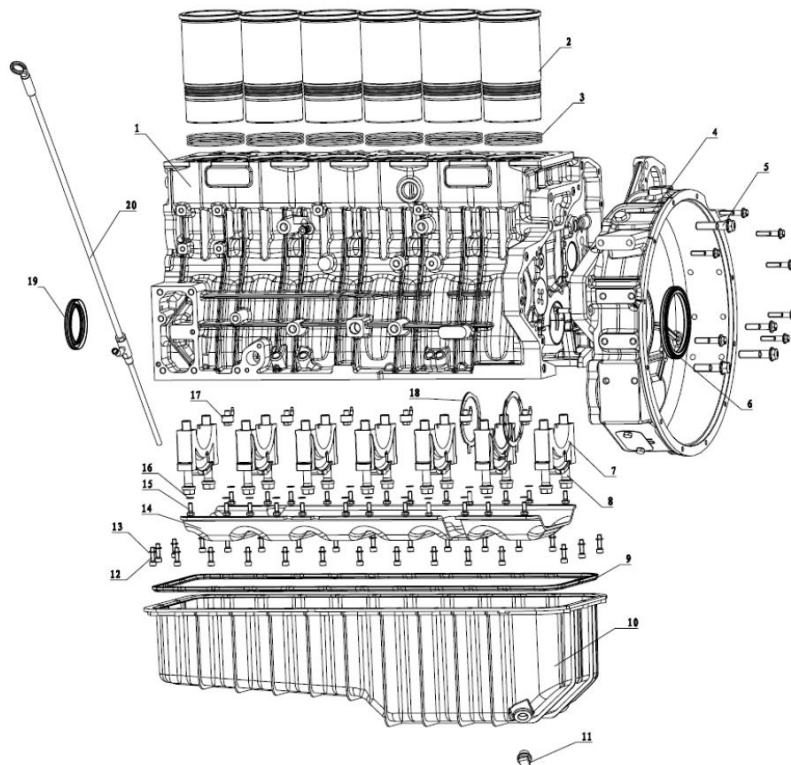


Fig.4-1 Exploded view of engine block group

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	气缸体	Cylinder Block
2	气缸套	Cylinder Liner
3	密封圈	O-ring
4	飞轮壳	Flywheel Housing
5	六角头螺栓	Hexagon Screw
6	后油封	Rear Oil Seal
7	主轴承盖	Main Bearing Cap
8	主轴承螺栓	Main Bearing Bolt
9	密封胶条	Rubber Sealing Ring
10	油底壳	Oil Pan
11	磁性放油螺塞	Magnetic Screw Plug
12	内六角圆柱头螺钉	Hexagon Socket Head Cap Screw
13	波形弹性垫圈	Wave Spring Washer
14	机体加强板	Block Stiffening Plate
15	六角头螺栓	Hexagon Screw
16	波形弹性垫圈	Wave Spring Washer
17	活塞喷嘴组件	Piston Nozzle Set
18	止推片	Thrusting Plate
19	前油封	Front Oil Seal
20	油标尺总成	Dipstick Assembly

4.2.2 Installation and removal of rear oil seal

4.2.2.1 Removal steps of rear oil seal

Take out the rear oil seal using the special tool.

4.2.2.2 Installation steps of rear oil seal

Coat the lubrication oil evenly on the surfaces of oil seal before using the special installer to press and assemble the rear oil seal.

4.2.2.3 Precautions

Be careful during operations to avoid scratching the crankshaft assembly. The oil seal shall not be reused, please use new rear oil seal after disassembling the engine.

4.2.3 Installation and removal of oil pan

4.2.3.1 Removal steps of oil pan

Follow the reverse order of installation steps below for removal.

4.2.3.2 Installation steps of oil pan

- 1) Press the seal ring on the oil pan assembly, the seal ring shall not be distorted; the seal gasket joint shall be on the straight side of the oil pan, not the circular arc transition.
- 2) Coat the silicone sealant on the gap of joint surfaces of front end cover, engine block and oil pan, the silicone sealant shall be even and uninterrupted and 2-3mm in diameter.
- 3) Before using the hexagon socket head bolts and washers to install the oil pan assembly on the engine block, please check whether there are foreign materials in the cylinder body; turn the engine crankshaft by 360° along the flywheel rotation direction to check whether there is interference between the crank arm/oil pump gear and the oil pan and eliminate in case of any. Symmetrically tighten the fixing bolts of oil pan to the tightening torque of 29~35Nm.
- 4) Clean the magnetic bolt assembly before screw on the magnetic bolt assembly with seal ring.

4.2.3.3 Check and maintenance of oil pan

- a. Check the oil pan for cleanliness and burrs.
- b. Check whether the seal rings are falling off.
- c. Check the bolt pre-tightening and symmetrical tightening, and the torque shall be 29~35Nm.
- d. Check whether there are foreign materials in the engine block.
- e. Check whether it is smooth when barring.

4.2.3.4 Precautions

- a. The joint surfaces of front end cover, cylinder block and oil pan are coated with sealant, please disassemble carefully to avoid damaging the joint surfaces and use the detergent to remove the sealant.
- b. The seal rings can be used only once and new ones shall be used after removal.
- c. Pretighten the bolts symmetrically in a crossed manner from middle to two sides and then tighten the bolts to tightening torque of 29~35Nm.

4.2.3.5 Main removal and installation tools

Oil pressure impulse wrench, socket wrench, and barring tool.

4.2.4 Installation and removal of flywheel housing

4.2.4.1 Removal steps of flywheel housing

Follow the reverse order of installation steps below for removal.

4.2.4.2 Installation steps of flywheel housing

- Press the locating bush into the rear end of cylinder block, and the locating bush shall be free of edge failure.
- Polish the joint surfaces of cylinder block and flywheel housing, clean and remove the oil and coat 510 sealant. The sealant line shall be even and uninterrupted.
- Coat clean lubrication oil on the bolt threads and supporting surface of flywheel housing and install the flywheel housing.
- Bolt tightening of flywheel housing:

M10 bolt: first tighten the bolt to contact state, 1st time tighten to 26-36Nm, and 2nd time tighten to 64-90Nm;

M12 bolt: first tighten the bolt to contact state, 1st time tighten to 44-54Nm, and 2nd time tighten to 110-135Nm;

M16 bolt: first tighten the bolt to contact state, 1st time tighten to 108-132Nm, and 2nd time tighten to 270-330Nm;

The bolts of flywheel housing can be used for twice.

Use the special paint marker for paint sealing after the bolts are tightened in place.

4.2.4.3 Precautions

- The joint surfaces of cylinder block and flywheel housing are coated with sealant, please disassemble carefully to avoid damaging the joint surfaces and use the detergent to remove the sealant.
- Coat lubricating oil when installing the bolts of flywheel housing, and the bolts of flywheel housing can be used twice.

Table 4-3 Tightening torque for flywheel housing

Bolt specification	Tightening torque (apply lubricating oil),Nm
M10	64-90
M12	110-135
M16	270-330

4.2.4.4 Main removal and installation tools

Oil pressure impulse wrench and socket wrench.

4.2.5 Installation and removal of front oil seal

4.2.5.1 Removal steps of front oil seal

Take off the front oil seal of crankshaft using the tools.

4.2.5.2 Installation steps of front oil seal

Place the front oil seal in the inner hole of oil pump cover and the outer diameter area of crankshaft front end, coat the clean lubricating oil on the inner ring of front oil seal, and the oil seal shall be normal and not be twisted.

4.2.5.3 Precautions

Be careful during the removal to avoid scratching the crankshaft. Use new oil seal after removal.

4.2.6 Installation and removal of oil pump cover

4.2.6.1 Removal steps of oil pump cover

Follow the reverse order of installation steps below for removal.

4.2.6.2 Installation steps of oil pump cover

- a. Polish the fitting surfaces of cylinder block front end and oil pump cover, and clean and remove the oil.
- b. Press the locating bush in the cylinder block, and the locating bush shall be free of edge cut or burrs.
- c. Coat the Loctite 510 sealant on the joint surfaces of cylinder block front end and oil pump cover, and the sealant line shall be even and uninterrupted.
- c. Use the hexagon bolts to install the oil pump cover on the cylinder block. Align the oil pump cover location hole with the locating bush, coat the Loctite 242 sealant on the thread sealing portion, and the tightening torque of bolts shall be 44-58Nm.
- e. Use the special paint marker for paint sealing after the bolts are tightened in place.

4.2.6.3 Precautions

- a. The joint surfaces of cylinder block and oil pump cover are coated with sealant, please remove carefully to avoid damaging the joint surfaces and remove the sealant using detergent.
- b. The bolt surface is coated with sealant, please remove the sealant carefully and avoid damaging the threads.

4.2.6.4 Main removal and installation tools

Locating bush press-in tooling, copper hammer, and oil pressure impulse wrench.

4.2.7 Installation and removal of main bearing cover and main bearing bolt

4.2.7.1 Removal steps of main bearing cover

Follow the reverse order of installation steps below for removal.

4.2.7.2 Installation steps of main bearing cover

- a. Wipe the lower bearing shell and main bearing cover, and then press the lower bearing shell into the main bearing cover, install the lower thrust plat with the oil groove facing outward. Before installation, check whether the lower bearing shell and thrust plate are impacted or scratched, apply lithium-base grease on the inside of lower thrust plate and wipe the foreign material scratched from bearing shell port.
- b. Install the main bearing cover onto the cylinder block.
- c. Apply clean lubricating oil to the supporting face of main bearing bolt and threaded part of main bearing bolts.
- d. Mount the main bearing bolts without tightening.
- e. Check the crankshaft radial clearance by rotating the crankshaft, and ensure that the crankshaft could rotate flexibly, without stuck.

- f. Refer to the tightening procedures to tighten the main bearing bolts in the way shown below: 1st time, use the low-torque and pneumatic wrench; 2nd time, torque to 145Nm; 3rd time, turn by 60 degree to reach 310-420Nm.
- g. After the main bearing bolts are tightened, check whether the axial clearance of crankshaft is 0.120-0.289mm and check for crankshaft turning torque.

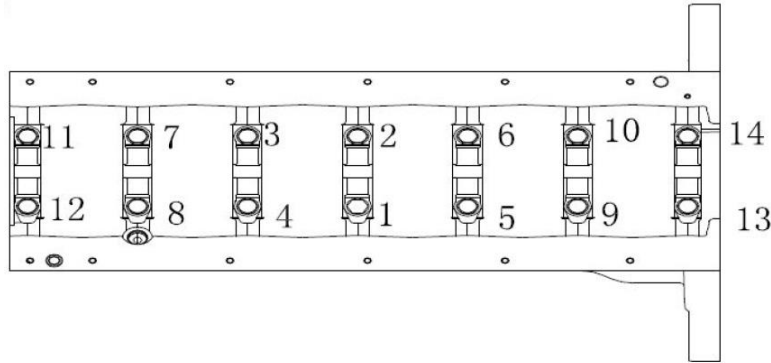


Fig. 4-2 Tighten sequence for the main bearing bolts

4.2.8 Installation and removal of injector

4.2.8.1 Removal steps of injector

Loosen the bolt and get off the injector.

4.2.8.2 Installation steps of injector

Use the hollow bolts with washer to fix the injector assembly onto the cylinder body, then tighten the hollow bolt and check whether the injector is unobstructed, whether the joint surfaces of the injector and cylinder block are free of impact damages or burrs and repair or replace it if necessary. When the hollow bolt is screwed in, correct the position of injector by using the positioning pin.

4.2.8.3 Precautions

Do check whether the nozzle is unobstructed, if so, replace it with new one.

4.2.9 Installation and removal of cylinder liner

4.2.9.1 Removal steps of cylinder liner

Remove the cylinder liner with the special cylinder liner detacher.

4.2.9.2 Installation steps of cylinder liner

- a. Install the O-ring into its groove. Besides, the upper O-ring should be put into the tool withdrawal groove.
- b. Press the cylinder liner together with the O-ring into the cylinder block with cylinder liner installer.

4.2.9.3 Precautions

Cylinder liner projection should be 0.03-0.08mm. After the cylinder liner is replaced, leakage test should be performed.

4.3 Cylinder head group

Cylinder head is located on the top of cylinder body. And the combustion chamber is formed by cylinder head fire ring, cylinder head gasket, cylinder liner, piston top and piston ring. The followings are connected to the cylinder head: intake manifold assembly, exhaust manifold assembly, cylinder head cover assembly, oil-gas separator assembly, cylinder head bolts, cylinder head gasket, engine hanger, partial fuel system and valve train etc.

4.3.1 Removal and installation of cylinder head group

4.3.1.1 Exploded drawing of cylinder head group

Cylinder head group mainly consists of cylinder head cover, cylinder head, water outlet pipe, oil-gas separator and hanger plate, with assembly position shown in fig. 4-3.

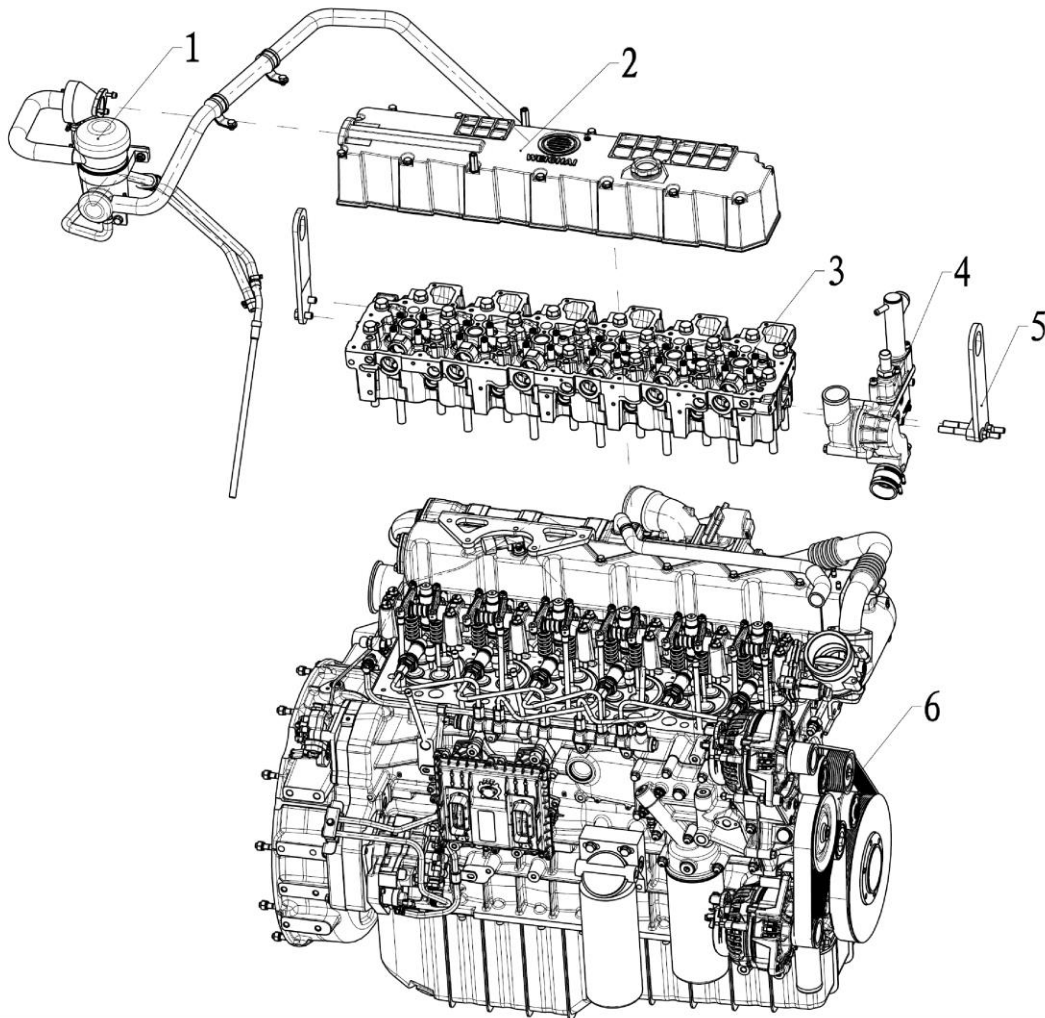


Fig. 4-3 Cylinder head group and installation location schematic

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	油气分离器	Oil-gas Separator
2	气缸盖罩	Cylinder Head Cover
3	气缸盖	Cylinder Head
4	出水管	Water Outlet Pipe
5	吊板	Engine Hanger Plate
6	柴油机	Diesel Engine

4.3.1.2 Removal steps of cylinder head group

Steps shown below:

- a. Remove the oil-gas separator assembly;
- b. Remove the exhaust manifold assembly by following the instructions of removal of intake and exhaust system;
- c. Remove the intake manifold assembly by following the instructions of removal of intake and exhaust system;
- d. Remove the engine hanger plate;
- e. Remove the water outlet pipe assembly;
- f. Remove the high-pressure fuel pipe, the high-pressure connector, the thread sleeve of high-pressure connector and the fuel return pipeline of fuel system. For more information, refer to the fuel system removal instructions.
- g. Remove the cylinder head cover assembly;
- h. Remove the fuel injector harness by following the removal instructions for the fuel system.
- i. Remove the rocker shaft assembly, the pushrod and the valve bridge by following the removal instructions for valve train..
- j. Remove the fuel injector pressure plate and fuel injector by following the removal instructions for fuel system.
- k. Remove the cylinder head assembly and cylinder head gasket.
- l. Remove the valve spring, upper seats of intake and exhaust valve springs, valve cotter and valve by following the removal instructions for valve train.
- m. Remove the valve stem seal sleeve.

4.3.1.3 Installation steps of cylinder head group

The installation should be performed in the reverse order of removal.

4.3.2 Removal and installation of oil-gas separator

4.3.2.1 Exploded drawing of removal and installation of oil-gas separator

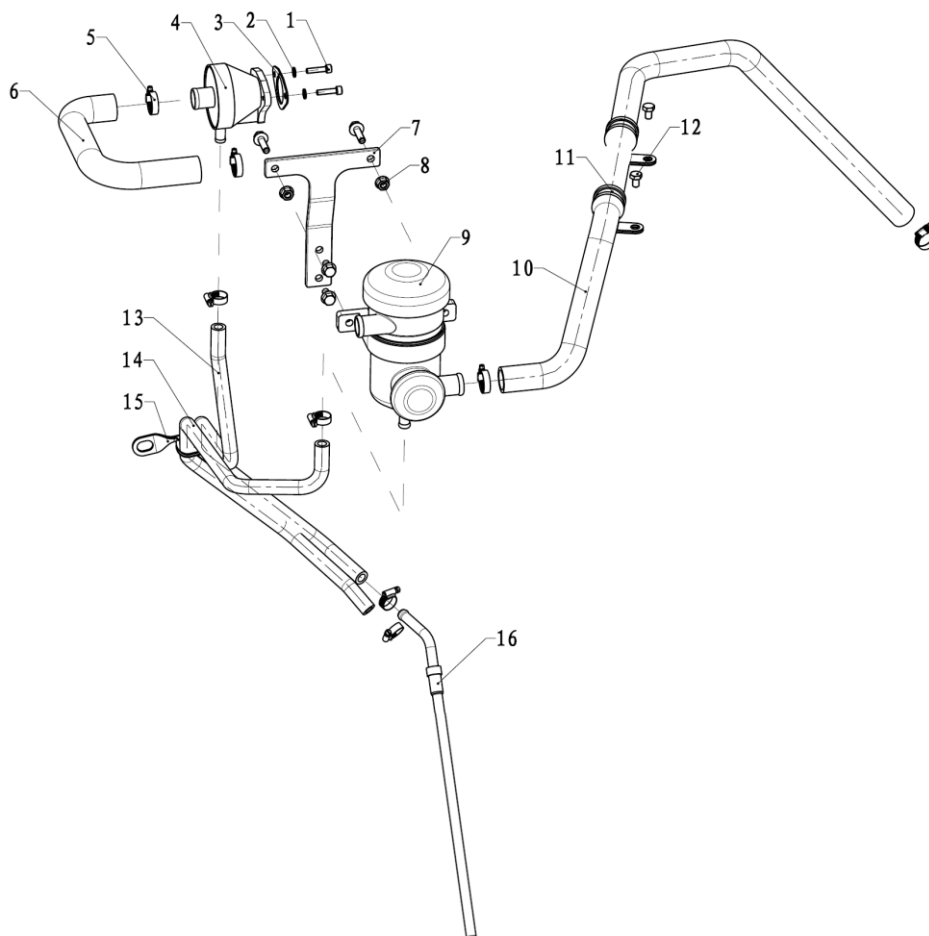


Fig. 4-4 Oil-gas separator subassembly and installation location schematic

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	螺栓	Bolt
2	垫圈	Plain Washer
3	密封垫片	Gasket
4	油气预分离器	Oil-gas Pre-separator
5	卡箍	Clamp
6	预分离器出气管	Pre-separator Air-outlet Pipe
7	油气分离器支架	Oil-gas Separator Bracket
8	螺母	Nut
9	油气分离器	Oil-gas separator
10	油气分离器出气管	Oil-gas separator Air-outlet Pipe
11	管夹	Pipe Clamp Assembly
12	螺栓	Bolt
13	预分离器回油管	Pre-separator Drain Pipe

序号 Pos.	中文名称 Denomination	英文名称 Denomination
14	油气分离器回油管	Oil-gas separator Drain Pipe
15	管夹	Pipe Clamp Assembly
16	管接头	Pipe Joint

4.3.2.2 Removal steps of oil-gas separator

- Remove the clamps of both oil-gas pre-separator and air-outlet pipe of oil-gas separator.
- Remove the clamps of both oil-gas pre-separator and oil-drain pipe of oil-gas separator.
- Remove the two fixing bolts connecting the oil-gas separator and the support.
- Remove the two fixing bolts connecting the oil-gas pre-separator and the cylinder head cover.
- Remove the oil-gas separator support.
- For further disassembling of oil-gas separator, refer to the fig. 4-4.

4.3.2.3 Inspection and maintenance of oil-gas separator

- Check the air-outlet pipe of oil-gas pre-separator for aging, cracking or damage , and if any, replace the related parts.
- Check the oil-drain pipe of oil-gas pre-separator for aging, cracking or damage, if any, replace the related parts.
- Check whether the oil-gas separator is cracked or leaks oil etc, if so, replace the related parts.
- Check the connection between oil-gas pre-separator and cylinder head cover for oil leakage, if any, replace the related parts.
- Use the compressed air less than 5kPa to check the oil-gas separator for leaks.. If any, replace it with a new one.
- If the oil-gas separator has the efficiency significantly dropped, timely replace the filter element.

4.3.2.4 Installation steps of oil-gas separator

- The installation should be performed in the reverse order of removal. Note: determine the corresponding relations of hoses and connecting ports; tighten the clamps to ensure no oil or gas leaking from the connection of the rubber hose and oil-gas separator; be careful not to damage the plastic pipe joint of oil-gas separator; fix the rubber pipe with the clamp and prevent the pipe from being damaged or squashed for oil draining or gas being drained smoothly.
- Before installing the oil-gas pre-separator, clean the sealing surface of cylinder head cover to ensure it is clean and free of scratch.

4.3.3 Removal, inspection, repair and installation of engine hanger plate

4.3.3.1 Exploded drawing of engine hanger plate

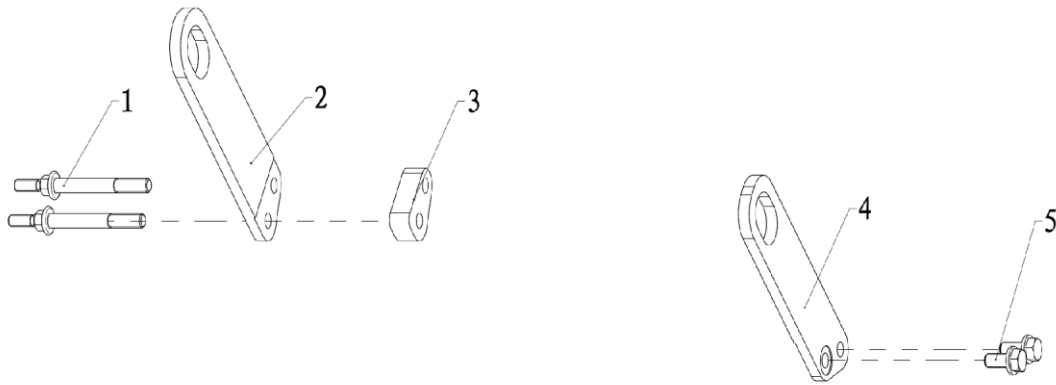


Fig. 4-5 Engine hanger plate subassembly and installation location schematic

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	六角法兰面螺栓	Hexagon Flange Bolt
2	前吊板平垫圈	Front Hanger Plate
3	垫块	Cushion block
4	后吊板	Rear Hanger Plate
5	六角头螺栓	Hexagon Flange Bolt

4.3.3.2 Removal steps of engine hanger plate

- Loosen the two M12×87 bolts attached to the hanger plate at the front end of engine to remove the front hanger plate.
- Loosen the two M12×25 bolts attached to the t hanger plate at the rear end of engine to remove the rear hanger plate.

4.3.3.3 Inspection and maintenance of engine hanger plate

- Check the engine hanger plate for cracks and bending. Before removal, check whether the hanger is bent. If so, measure the clearance between the hanger plate and water-outlet pipe and rocker cover assembly. If the measured clearance is less than 4mm, replace the hanger plate.
- During hoisting the engine, check whether the front hanger plate is bent or deformed, which otherwise could damage to the water-outlet pipe assembly.
- Check whether the bolts attached to the front and rear hanger plates are failed. If so, replace it with the new ones.

4.3.3.4 Installation steps of engine hanger plate

- Tighten the M12 hex flange bolts attached to the front and rear hanger plates to 120Nm.
- Installation location of engine hanger plate and bolts are shown in fig. 4-5.

4.3.4 Removal, inspection, maintenance and installation of water-outlet pipe

4.3.4.1 Exploded view of water-outlet pipe

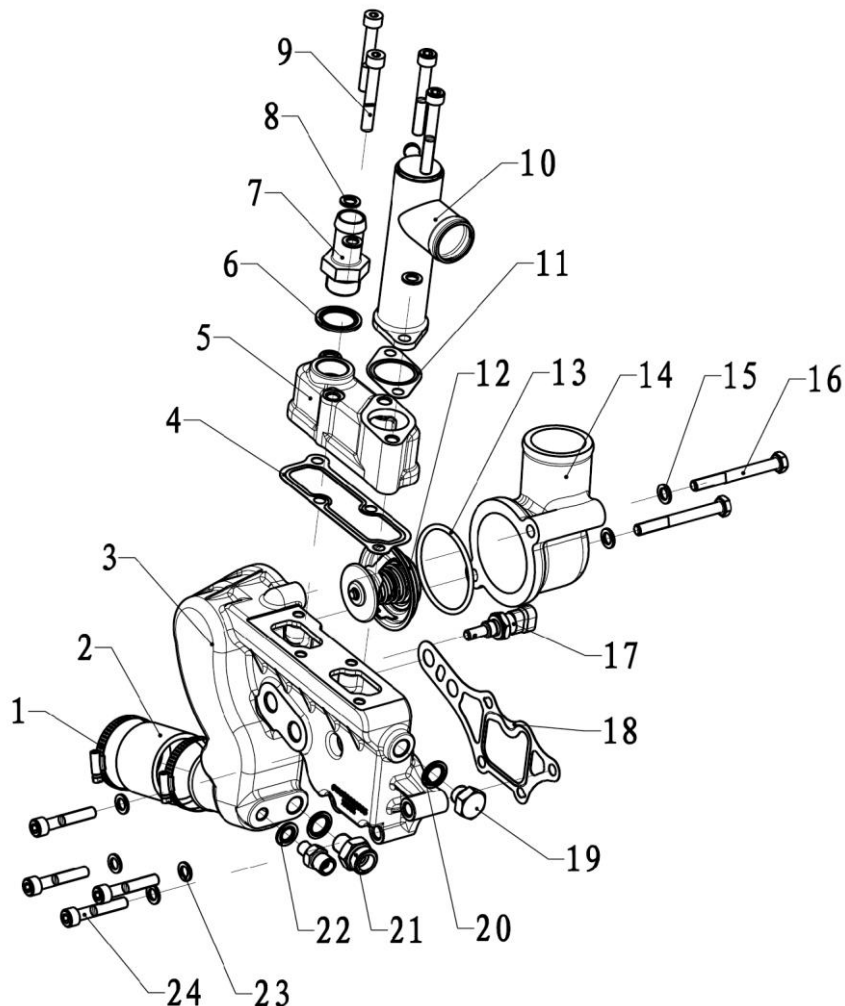


Fig. 4-6 Water outlet pipe subassembly and installation location schematic

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	卡箍	Clamp
2	胶管	Rubber Pipe
3	出水管	Outlet Water Pipe
4	出水管盖垫片	Water Outlet Pipe Cover Gasket
5	出水管盖	Water Outlet Pipe Cover
6	垫圈	Sealing Washer
7	暖风接头	Warm Air Pipe Joint
8	垫圈	Wave spring washer
9	螺栓	Bolt

序号 Pos.	中文名称 Denomination	英文名称 Denomination
10	三通管	Three-way Pipe
11	垫片	Gasket
12	节温器	Thermostat
13	O型圈	O-Ring
14	节温器盖	Thermostat Cover
15	垫圈	Wave spring washer
16	螺栓	Bolt
17	传感器	Temperature Sensor
18	出水管垫片	Outlet Water Pipe Gasket
19	螺塞	Hexagon Screw Plug
20	垫圈	Sealing Washer
21	管接头	Pipe Joint
22	垫圈	Sealing Washer
23	垫圈	Wave spring washer
24	螺栓	Bolt

4.3.4.2 Removal steps of water-outlet pipe

- Loosen the clamps of water-outlet pipe and whole-vehicle radiator connection pipe.
- Loosen the clamps of water-outlet pipe and expansion tank connection pipe.
- Loosen the clamps of water-outlet pipe and warm air connection pipe.
- Loosen the clamps of water-outlet pipe and EGR water-return connection pipe.
- Loosen the clamps of water-outlet pipe and water pump connection pipe.
- Remove the joint of water-return pipe and water-outlet pipe of air compressor.
- Remove the sensor and sensor harness of the water-outlet pipe.
- Remove the two bolts (M12×87) attached to engine hanger plate.
- Remove the four bolts (M8×45) attached to the water-outlet pipe.
- Remove the water-outlet pipe assembly.
- For further removal of water-outlet pipe, refer to the fig. 4-6.

4.3.4.3 Inspection and maintenance of water-outlet pipe

- Before removal, check whether the water-outlet pipe is leaked, cracked or corroded. If needed, replace the cracked water-outlet pipe. In case of corrosion affecting the reliability, find out the causes and replace with the new one.
- Check whether the each joint of water-outlet pipe is cracked or corroded. If needed, replace with the new one.

- c. If each joint is leaked, replace and tighten it, at last, recheck it again.
- d. To replace the pipe joint, clean the sealing surface of the water-outlet pipe to ensure there is no adhesive, high spot or scratch.

4.3.4.4 Installation steps of water-outlet pipe

- a. The water-outlet pipe gasket, water-outlet pipe cover gasket and three-way pipe gasket are disposable and should be replaced in case of repair.
- b. The fitting surfaces of water-outlet pipe and gasket must be clean, free of adhesive, high spot and scratch.
- c. Install the clean water-outlet pipe on the cylinder head and fix it by using the corresponding bolts.
- d. Check whether the corresponding rubber hose is cracked, aged or damaged. If any, replace it.
- e. Rubber hose should be connected in place and clamped.
- f. To replace the pipe joint, coat it with sealant, then screw or press the joint into the water-outlet pipe.

4.3.5 Removal, inspection, maintenance and installation of cylinder head cover

4.3.5.1 Exploded drawing of cylinder head cover

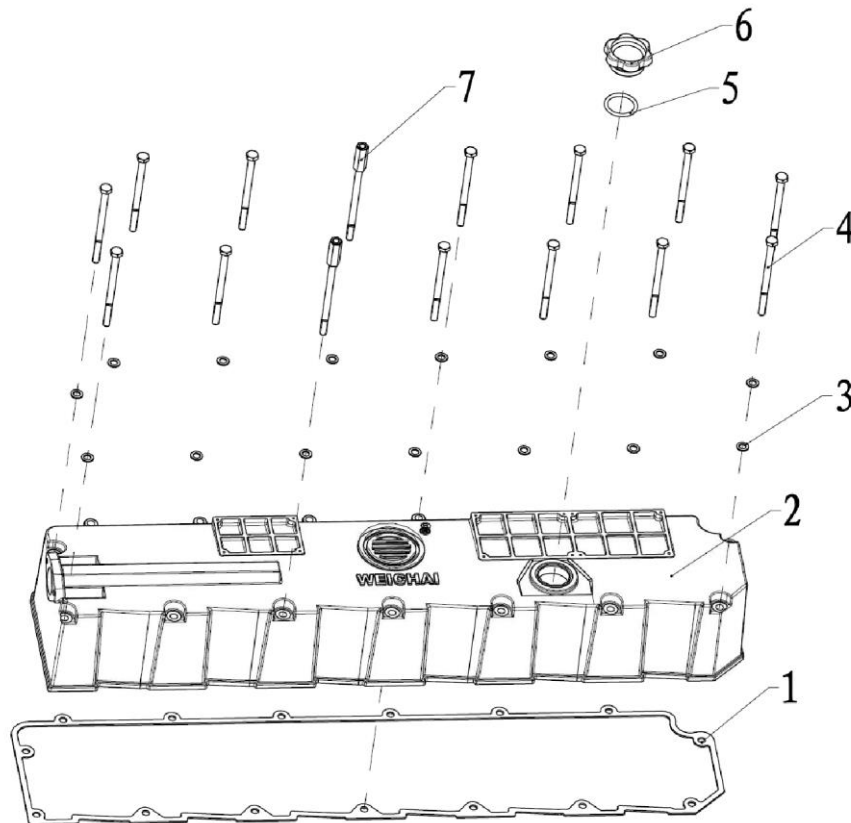


Fig. 4-7 Cylinder head cover subassembly and installation location schematic

序号 Pos.	中文名称 Denomination	英文名 Denomination
1	气缸盖罩垫片	Cylinder head cover gasket
2	气缸盖罩	Cylinder head cover
3	垫圈	Wave spring washer
4	螺栓	Hexagon head bolt
5	O型圈	O-ring
6	螺塞	Bolt
7	支撑块	Back-up block

4.3.5.2 Removal steps of cylinder head cover

- Sequentially loosen the bolts attached to the cylinder head cover, vertically upward take out the cylinder head cover and cylinder head cover gasket.
- For further removal of cylinder head cover, refer to the fig. 4-7 Cylinder head cover assembly and installation location.

4.3.5.3 Inspection and maintenance of cylinder head cover

- Before removal, check whether the cylinder head cover gasket is leaked or not. If needed, please carefully check the related parts.
- Before removal, check whether the cylinder head cover is leaked, cracked or damaged. If needed, replace it with the new one.
- Before removal, check whether the oil filler is leaked. If needed, please carefully check the related parts.
- If the cylinder head cover gasket leaks oil, after removing the cylinder head cover and cylinder head cover gasket, check whether the gasket is failed, or whether the cylinder head cover seal is scratched or whether the cylinder head seal surface is deformed. Replace the failed cylinder head cover gasket, the deformed or scratched cylinder head cover.
- If the oil filler is leaked, check whether the oil filler thread and seal are failed after removal. If so, replace the oil filler cover. If the seal surface between the cylinder head cover and oil filler cover is leaked, replace the cylinder head cover.
- Check the contact surface of the cylinder head cover and oil-gas separator for oil leakage. If any, check whether the cylinder head cover seal surface is scratched. If so, replace it. If the oil-gas separator seal is failed, replace it.

4.3.5.4 Installation steps of cylinder head cover

- Cylinder head cover gasket is disposable. After repair, replace with the new one. Before installing the cylinder head cover gasket, firstly check if the new gasket is free of manufacturing defect or damage.
- Clean the upper surface of cylinder head and correctly install the cylinder head cover gasket.
- Clean the cylinder head cover and correctly install it onto the cylinder head.
- Install the bolts of cylinder head cover and symmetrically tighten them.
- Clean the oil filler cap and sealing surface of cylinder head cover and tighten the oil filler cap.

4.3.6 Removal, inspection, maintenance and installation of cylinder head

4.3.6.1 Exploded drawing of cylinder head

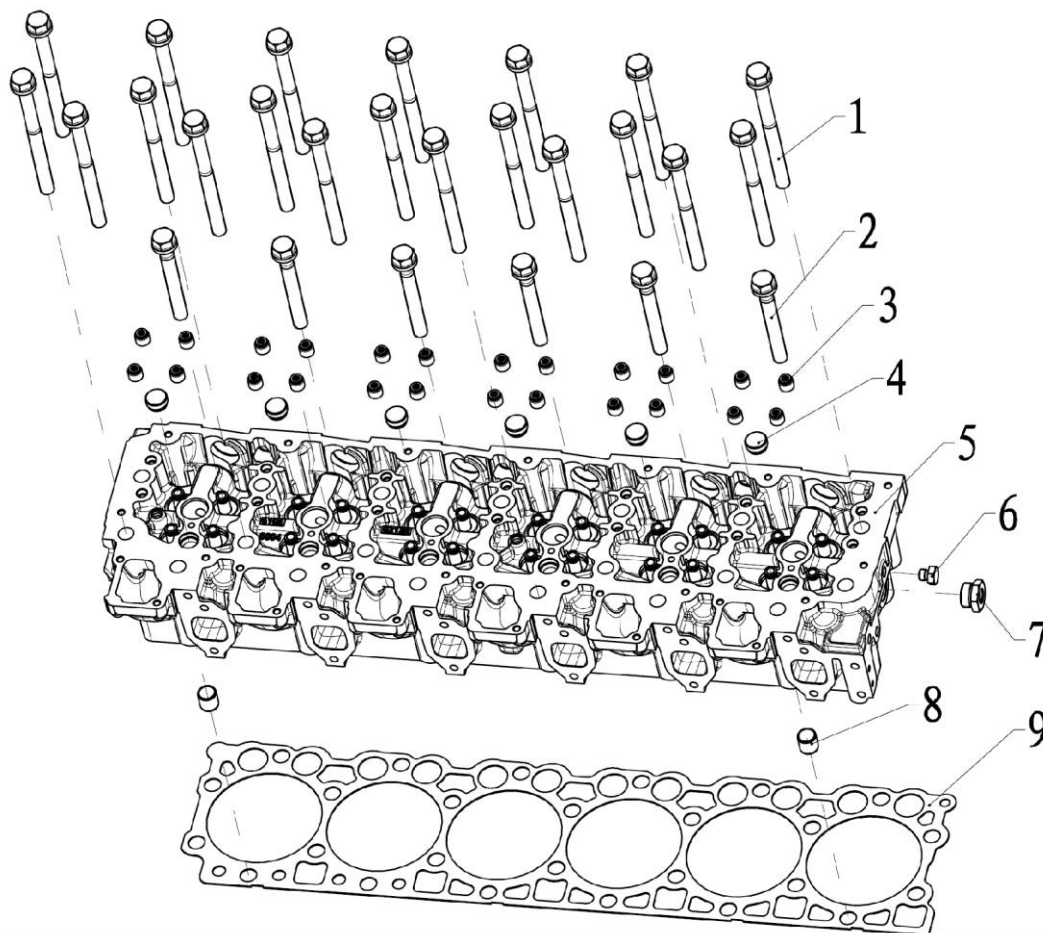


Fig. 4-8 Cylinder head subassembly and installation location schematic

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	长螺栓	Long Bolt
2	短螺栓	Short Bolt
3	气门杆密封套	Valve Stem Seal
4	支撑销	Parallel Pin
5	气缸盖总成	Cylinder Head Subassembly
6	六角螺塞	Hexagon Screw Plug
7	六角螺塞	Hexagon Screw Plug
8	定位套	Orientation
9	气缸盖垫片	Cylinder Head Gasket

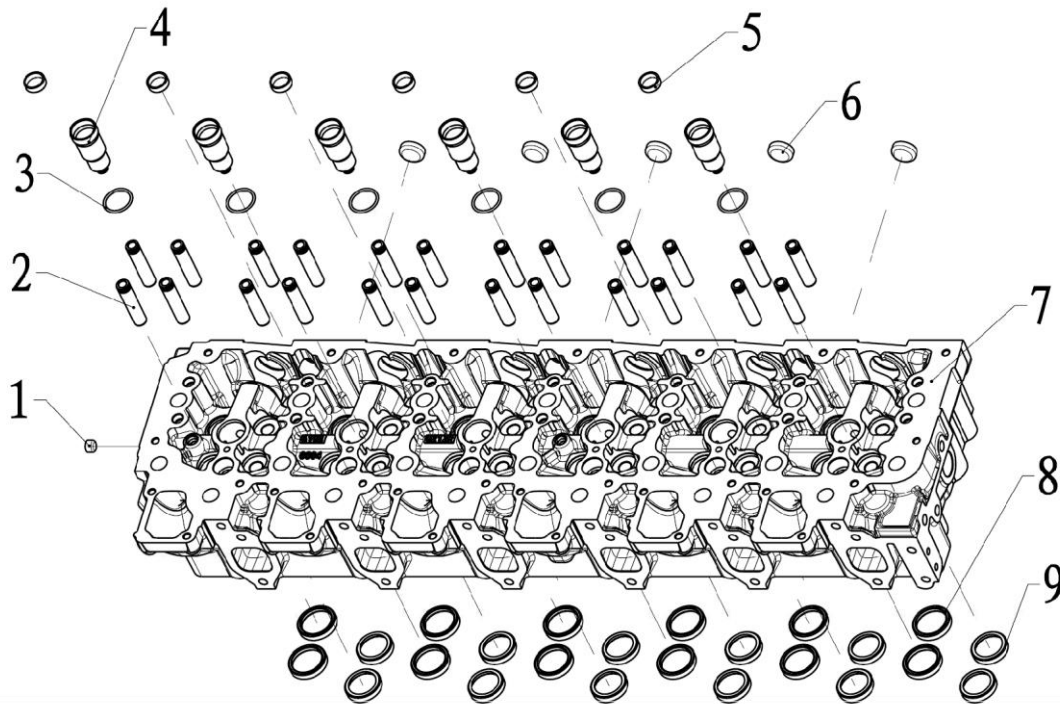


Fig. 4-9 Cylinder head subassembly and installation location schematic

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	碗形塞	Bowl Plug
2	导管	Valve Guide
3	O型圈	O-Ring
4	喷油器衬套	Injector Sleeve
5	碗形塞	Bowl Plug
6	碗形塞	Bowl Plug
7	气缸盖	Cylinder Head
8	进气门座	Intake Valve Seat
9	排气门座	Exhaust Valve Seat

4.3.6.2 Removal steps of cylinder head

- Before removing the cylinder head, ensure that the valve train parts on the cylinder head (such as the rocker shaft assembly and pushrod etc.) are already removed.
- Before removing the cylinder head, ensure the fuel injector on the cylinder head is unloaded to prevent the head of fuel injector nozzle from being impacted.
- Before removing the cylinder head, ensure the thread insert of high-pressure connector in the fuel system is already removed. Otherwise, the short bolt for the cylinder head at the bottom of thread insert of high-pressure connector cannot be removed.
- Sequentially loosen the cylinder head bolts. For WP7 engine cylinder head, there are 26 bolts (20 long bolts and 6 short ones). Make ensure that all the cylinder head bolts are loosened before lifting the cylinder head.

- e. Remove the cylinder head and then put it onto the objects with low hardness, such as the paper plate, template and plastic plate etc to prevent the cylinder head bottom being impacted or scratched.
- f. After the cylinder head is removed, clean the top surface of cylinder block to prevent the coolant or others enter into the combustion chamber and causing other failures.
- g. Remove the cylinder head gasket.
- h. Remove the intake and exhaust valves by following the instruction of removing the valve train.
- i. Remove the valve stem seal.
- j. Cylinder head subassembly and installation location schematic are shown in fig. 4-8 and fig. 4-9.

4.3.6.3 Inspection and maintenance of cylinder head

1) Cylinder head

Before removing the cylinder head, firstly check whether there is water, oil or gas is leaked from the cylinder head or other abnormal phenomenon, and then find out the causes.

Clean the cylinder head, specially the combustion chamber surface, valve base, intake and exhaust valves, intake and exhaust ports. Remove the surface carbon and adhesive and then check the surface state.

① Appearance check

Visually check whether the cylinder head is discolored or cracked. If so, dye penetration inspection should be performed.

② Valve protrusion

Valve protrusion means the vertical distance from the valve bottom to the cylinder head bottom. The difference between the measured valve protrusion and required one could indicate the wear of valve and valve seat. Use the depth micrometer to measure the valve protrusion, as shown in fig. 4-10.

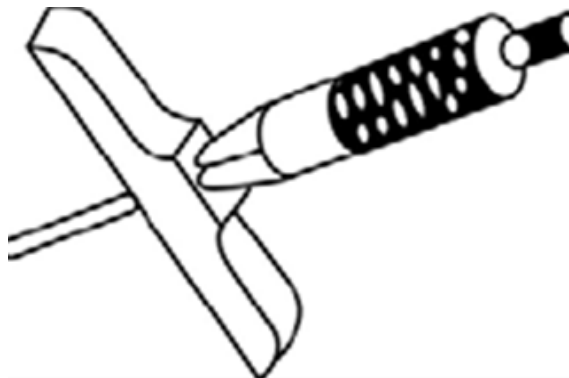


Fig. 4-10 Depth micrometer

For the required valve protrusion value, refer to table 4-4. If the valve protrusion exceeds the allowable range, replace the cylinder head to ensure the reliability of diesel engine. If the valve protrusion does not exceed the allowable value, remove the valve to check whether the valve and valve seat seal face are obviously worn or damaged.

Table 4-4 Required valve protrusion

	Required valve protrusion, mm
Intake valve	0.88~1.04
Exhaust valve	0.96~1.03

③ Inside diameter of valve guide

The inside of valve guide is the contact surface of valve guide and valve stem. If the inside diameter of valve guide is beyond the allowed value due to wear, it could affect the valve guide, dropping the reliability of diesel engine. The inside diameter of valve guide can be measured with the inside micrometer, shown in fig. 4-11. The allowable range of valve guide inside diameter is 7.6-7.69mm. Otherwise, replace the valve guide to guarantee the diesel engine reliability.

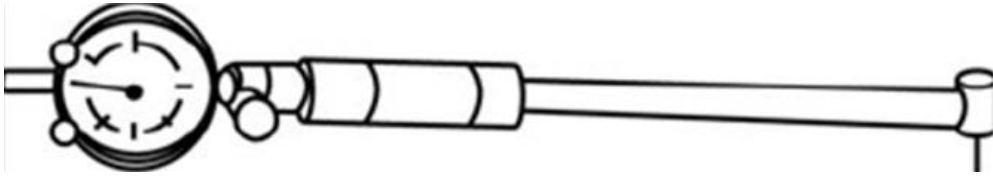


Fig. 4-11 Inside micrometer

2) Cylinder head gasket

If gas/water/oil leaks from the cylinder head gasket, check and replace the cylinder head gasket.

For removal method, refer to the description of removal of cylinder head gasket. Check whether the cylinder head gasket is damaged. If so, find out the cause. Replace the used gasket with new one as long as it is removed.

3) Valve stem seal

It could not only seal the lubricating oil at the valve stem but also lubricate the valve stem, preventing the valve stem from being adhered to the valve guide. Before removing the valves, check whether the valve stem seal comes off. After removal of valves, carefully check the integrity of valve stem seal and whether it is cracked or aged; check whether the spring on the valve stem seal is deformed. If the corresponding valve and valve guide are severely worn, replace it together with the valve stem seal.

4) Cylinder head holes need to be sealed

Check the surface of harness hole on the cylinder head for scratching.. If any, replace the cylinder head.

Check the mounting hole of high-pressure connector thread insert on the cylinder head for scratching. . If any, replace the cylinder head.

4.3.6.4 Installation steps of cylinder head

1) Valve stem seal

Valve stem seal and its installation are shown in fig. 4-12.

- ① Valve stem seal is disposable and should be replaced in case of repair.
- ② Check whether the valve stem seal and its spring are good.
- ③ Install the valve stem seal onto the valve guide.
- ④ Apply lubricating oil to the lip of valve stem seal.
- ⑤ Install the valve stem seal with the valve stem seal installer and rubber hammer.

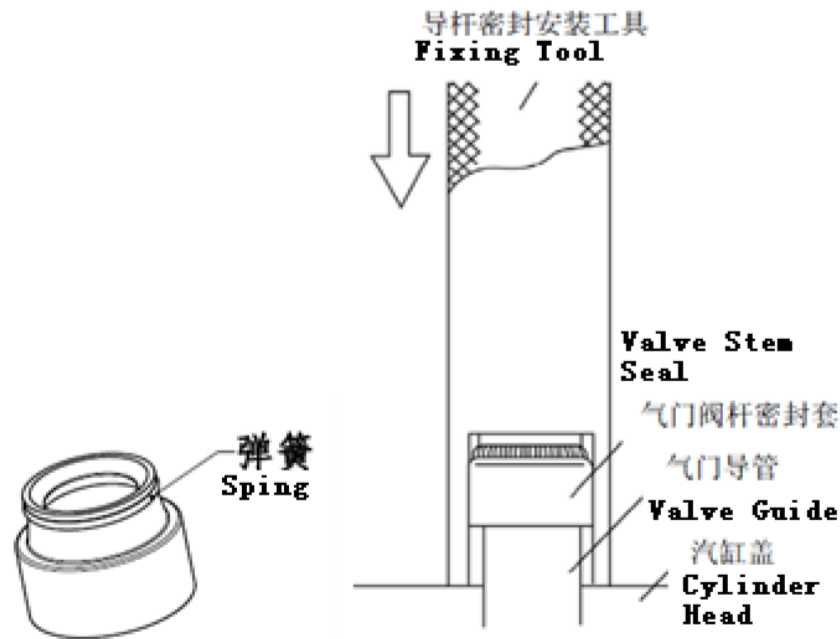


Fig. 4-12 Valve stem seal and its installation

2) Installation of cylinder head gasket

- ① The cylinder head gasket is disposable and should be replaced in case of repair (fig. 4-13).
- ② Wipe the inside wall of cylinder liner, apply the clean lubricating oil, then clean the upper surface of cylinder body, at last install the cylinder head gasket by aligning with the pin holes.
- ③ Check whether the cylinder head gasket is correctly installed.

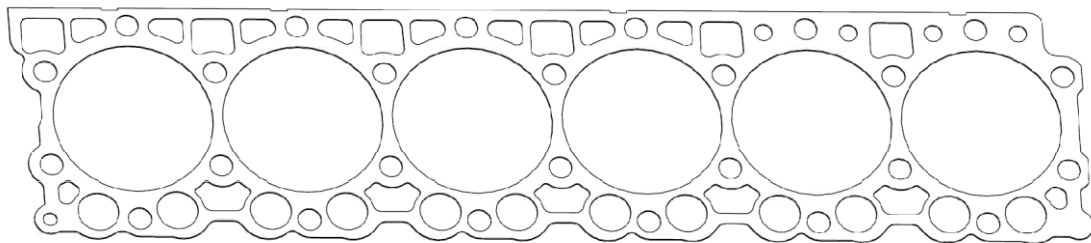


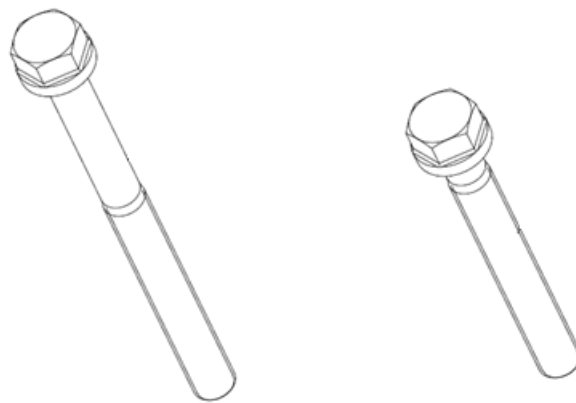
Fig.4-13. Cylinder head gasket

3) Installation of cylinder head

- ① Carefully wipe the cylinder head to ensure there is no dust, iron chips or sand etc, and then the lower surface of cylinder head.
- ② Check whether there is foreign material in cylinder and ensure the cylinder head gasket and lower surface of cylinder head are clean.
- ③ Before tightening the cylinder head bolts, locate the cylinder head by using the pin-surface way.
- ④ Install the cylinder head.

4) Installation of cylinder head bolts

- ① The cylinder head bolts are classified into long and short ones, as shown in fig. 4-14.
- ② The cylinder head bolts could be reused for three times, with the tightening sequence shown in fig. 4-15.
- ③ Align the cylinder head, and then tighten the cylinder head bolts in five times, the threads and load-bearing surface of which should be previously lubricated with oil.
- ④ For the first time, use the low-torque pneumatic wrench or torque wrench, as shown in fig. 4-16.
- ⑤ For the second time: reach 75-90 Nm.
- ⑥ For the third time: rotate the bolts by 70° in sequence.
- ⑦ For the fourth time: rotate the bolts by 70° in sequence.
- ⑧ For the fifth time: rotate the bolts by 70° in sequence.
- ⑨ At last, check whether the torque reaches 240-340Nm. The bolts with torque unable to be reached should be replaced and then be tightened in five times according to the above process requirements.



a. Long bolt

b. Short bolt

Fig. 4-14 Schematic of cylinder head long and short bolts

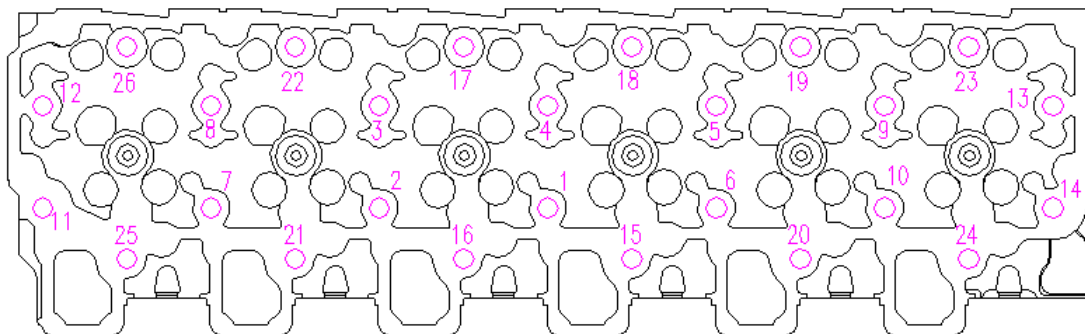


Fig. 4-15 Tightening Sequence of cylinder head bolts

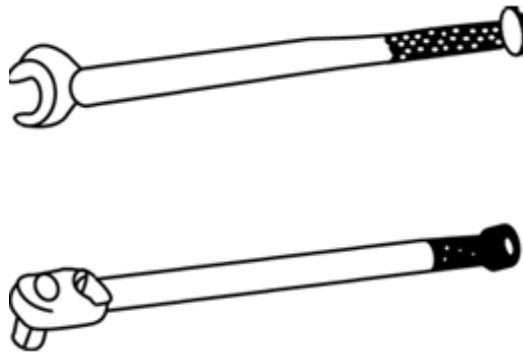


Fig. 4-16 Torque wrench

4.4 Crankshaft system

4.4.1 Removal, cleaning and installation of crankshaft system

The crankshaft system mainly includes the crankshaft, flywheel, timing gear, flywheel flange, oil pump gear, flywheel ring gear, flywheel bolts, shock absorber, shock absorber bolts, pulley, pulley shim and pulley bolts etc. The oil pump gear, timing gear and flywheel flange are installed at hot state onto the crankshaft, then riveted at the end of crankshaft oil hole and cannot be removed from the crankshaft in case of repair, which is called as the crankshaft assembly together with the crankshaft itself. The crankshaft pulley model is chosen based on the engine usage. Maybe there is no crankshaft pulley on some model. Crankshaft system is shown in fig. 4-17.

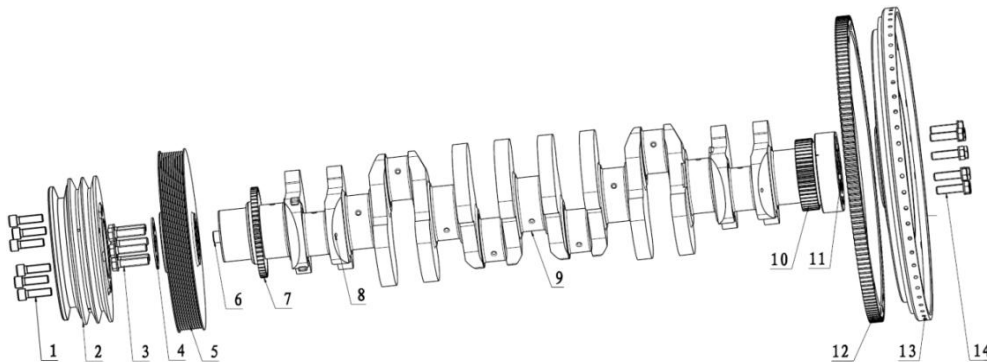


Fig. 4-17 WP7 crankshaft system parts

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	皮带轮螺栓	Pulley bolt
2	皮带轮	Pulley
3	减振器螺栓	Shock absorber bolt
4	皮带轮垫板	Pulley shim
5	减振器	Torsional Vibration Damper
6	定位销	Locating pin
7	机油泵齿轮	Oil Pump Gear
8	拉铆钉	Pulling Rivet
9	曲轴总成	Crankshaft Assembly
10	曲轴正时齿轮	Crankshaft Timing Gear
11	定位销	Locating pin

12	飞轮齿圈	Flywheel Ring Gear
13	飞轮	Flywheel
14	飞轮螺栓	Flywheel Bolt

The main functions of crankshaft system are to convert the piston reciprocating into the crankshaft rotating, output the torque through flywheel which could reserve the energy simultaneously, conquer the resistance of non-working stroke and have the engine running steadily. The parts of crankshaft system, as the core part of diesel engine, could not only bear the high load, but also rotate at high speed, so care must be given to it during maintenance.

- ☆a. Do not impact or scratch the joint faces.
- ☆b. Ensure that the joint faces are clean and free of oil and rust stains.
- ☆c. Refer to the stipulated torque and sequence to tighten the bolts.
- ☆d. Impacting or knocking the torsional vibration damper could lead to failure.

4.4.2 Installation and removal of crankshaft

4.4.2.1 Removal steps of crankshaft

- a. With the engine crankshaft case facing upward, check whether the each main bearing cover is marked. If not, mark them sequentially (at the same side).
- b. Remove the main bearing covers in the sequence of both ends and then middle and put them in order.
- c. Remove the crankshaft, front and rear thrust plates and flywheel end bearing. Remove the oil seal and then put the crankshaft onto the bracket (if the crankshaft is to be stored for long time, it should be vertically placed.)
- d. The removed parts should be proper placed by category.

4.4.2.2 Inspection and maintenance of Crankshaft

- a. Check whether each part is good.
- b. Check for cracks at the main journal, the round corner of connecting rod journal and the oil gallery. If any, replace the crankshaft.
- c. Check the main journal and connecting rod journal for wear, and crankshaft for bend or torsion. Replace the crankshaft if necessary.
- d. Check the main journal, connecting-rod journal and front and rear oil seals for groove-type wear or metal coming off, metal bonding and discoloration. Replace the crankshaft if necessary.
- e. Clean the bearing shell and check the bearing shell for groove-type wear or metal coming off and metal occlusions. Replace the bearing shell if necessary. It is suggested to timely replace the bearing shell to protect the crankshaft.
- f. Check whether the main bearing bolts and flywheel bolts are good.
- g. Check the bolt clamping surface and the joint faces of parts for crushing and cracks.

4.4.2.3 Installation steps of crankshaft

- a. Wipe the crankshaft holes at the bottom of cylinder body, and then press the upper bearing shell into the holes.

- ① Before installing the upper bearing shell, strictly check it for impact damages. If any, replace it.
 - ② After being installed, the oil hole on the upper bearing shell should be aligned with the oil hole and oil groove on the cylinder block. Staggered away from the oil hole diameter by $1/5 \sim 1/4$ is prohibited to be installed. The upper bearing shell should be completely fitted with the holes at the bottom of cylinder body.
 - ③ Remove the foreign material scraped from the shell opening.
- b. Apply clean lubricating oil to the inside surface of upper bearing shell.
 - c. Wipe the oil on the cylinder block installation surface of main bearing cover.
 - d. Hoist the crankshaft, use the compressed air to blow the oil galley and wipe the main journal and connecting rod journal. Then gently lower it into cylinder block, during which the crankshaft should be free of any impact damages.
 - ① Before hoisting, carefully check the crankshaft for impact damages. If needed, replace it.
 - ② During hoisting, impact or scratch is prohibited.
 - ③ Apply clean lubricating oil to main journals after being installed.
 - e. Wipe the upper thrust plate and then install it into the main thrust plate groove between the cylinder block and crankshaft. The oil groove of upper thrust plate should face outside and contact the crankshaft.
 - f. Wipe the lower bearing shell and main bearing cover and then press the lower bearing shell into the main bearing cover, at last install the lower thrust plate.
 - ① The oil groove of lower thrust plate should face outside and contact the crankshaft.
 - ② Before installation, carefully check whether the bearing shell or lower thrust plate is scratched.
 - ③ Apply the vehicle-purpose lithium-base grease to the inside of lower thrust plate.
 - ④ Remove the foreign material scraped from the shell opening.
 - g. Install the main bearing cover onto the cylinder block.
 - h. Apply clean lubricating oil to the supporting face and the threaded part of main bearing bolts.
 - i. Install the main bearing bolts without tightening.
 - j. Rotate the crankshaft to check the radial clearance of crankshaft by hand. The crankshaft should be rotated freely, without any stuck phenomenon.
 - k. Tighten the main bearing bolts in order.

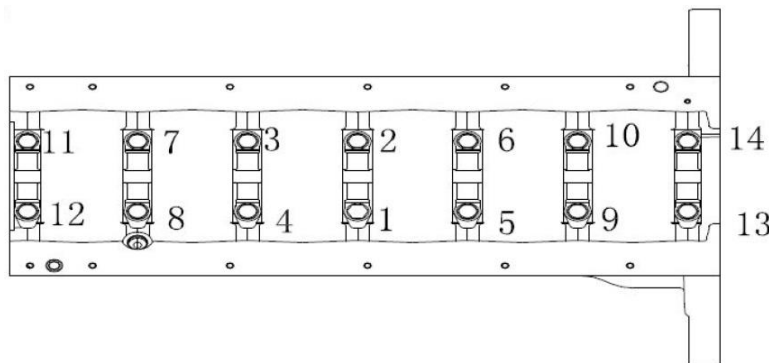


Fig. 4-18 Tightening order of the main bearing bolts

- ① At 1st time, tightening with the low-torque pneumatic wrench; at 2nd time, use the torque wrench to tighten it to 145Nm; at 3rd time, rotate it by 60° to have the torque reach 310-420Nm.
- ② The main bearing can be reused 2 times.

- m. After the main bearing bolts are tightened, check the torque and measure the axial clearance of crankshaft. Axial clearance of crankshaft is should be 0.120-0.289 mm.

4.4.3 Installation and removal of flywheel

- a. Install the flywheel ring gear onto the flywheel.
- b. Press the groove ball bearing into the flywheel shaft hole. Before that, wipe the outer race and apply lithium grease to the inside of hole.
- c. Apply the rust-proof oil to the inner machined surface of flywheel.
- d. Use the hexagon bolt to fix the flywheel parts onto the flywheel flange, but do not tighten them. Apply the clean lubricating oil to the threaded portion and the supporting surface of flywheel bolts.
- e. Tighten the flywheel bolts
 - ① Crossly tighten the flywheel bolts to 35-40Nm, rotate it by $35^{\circ}\pm 5^{\circ}$ and then tighten the bolts to above 120Nm.. The bolts can be reused 2 times.
 - ② After the bolts are tightened, seal the bolts by using special paint marker, the paint sealing direction should be the same.

4.4.4 Installation and removal of pulley

- a. Fix the torsional vibration damper onto the pulley.

The bolts should be tightened to 80-100Nm.
- b. Press the locating sleeve into the pin hole at the front end of crankshaft.
- c. Fix the crankshaft pulley onto the crankshaft with hexagon bolts, and then tighten the bolts.

The tightening torque of bolt should be 110-145Nm. After the bolts are tightened, seal the bolts by using special paint marker.

4.5 Piston and connecting rod subassembly

4.5.1 Exploded view

Piston and connecting rod subassembly mainly include the piston, connecting rod, piston rings, piston pin, piston pin circlip and connecting rod bearing shell. The types and number of parts and attachments are dependent on the engine structure and performance requirements. WP7 engine piston and connecting rod subassembly schematic is shown in fig 4-19.. The main function of piston and connecting rod subassembly is to transfer the explosion pressure to the crankshaft, driving the crankshaft to rotate.

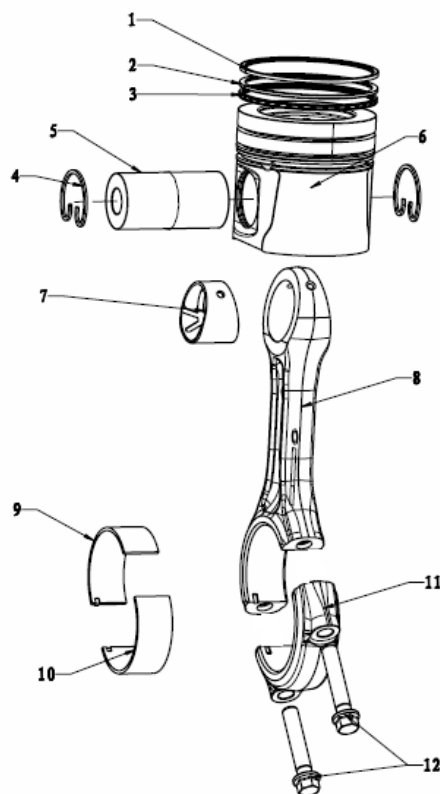


Fig. 4-19 Piston and connecting rod subassembly structure

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	第一道气环	First piston ring
2	第二道气环	Second piston ring
3	油环	Oil ring
4	活塞销挡圈	Piston pin circlip
5	活塞销	Piston pin
6	活塞	Piston
7	连杆衬套	Con-rod bush
8	连杆体	Con-rod body
9	连杆上瓦	Con-rod upper bearing shell
10	连杆下瓦	Con-rod lower bearing shell
11	连杆盖	Con-rod cover
12	连杆螺栓	Con-rod bolt

4.5.2 Installation and removal of piston and connecting rod subassembly

4.5.2.1 Removal steps of piston and connecting rod subassembly

- a. Inspection before removal
 - ① Check the axial clearance of connecting rod.
 - ② Check the tightening torque of connecting rod bolts.
- b. Set the engine inclined, make the piston to be removed at the BDC through engine barring and remove the connecting rod bolts and connecting rod cover.
- c. Make the piston at the TDC, and knock out the piston with a wooden hammer, during which, care must be taken to prevent the large end of connecting rod from being struck into the cylinder block.
- d. Remove the other pistons similarly, and place the pistons on a clean mat in sequential order.
- e. Use the internal circlip pliers to carefully remove the circlips at both ends of piston pin and push the piston pin out and at last remove the connecting rod body. Separately number the piston pins and connecting rods and then sequentially place them.
- f. Remove the 1st ring, 2nd ring and oil ring with the piston ring mounting pliers and then mark them.
- g. Inspection after removal
 - ① The large and small ends of connecting rod must be free of burrs or impact damages; check there is no crack, discoloration or deformation around the oil port of small-end shaft shell.
 - ② Mark the cylinder number on one end of connecting rod bolts, and mark cylinder number pointing to the flywheel on the top of piston.
 - ③ Check the piston surface, inside chamber, piston ring and piston pin for burrs, oil stains and impact damages.
 - ④ Weight grouping marks “G” on pistons of one vehicle should be the same.
 - ⑤ Piston size grouping mark (i.e. Roman digits I or II) should be consistent with that of the cylinder liner.
 - ⑥ The matching digits of connecting rod body and connecting rod cover must be the same.
 - ⑦ Connecting rod weight grouping letters on one engine should be the same.

4.5.2.2 Inspection and repair of piston and connecting rod subassembly

- a. Turn the flywheel with barring rod and check the axial clearance of connecting rod by hand, which should be 0.15-0.35mm.
- b. Turn the flywheel with barring rod, the rotation of crankshaft should be smooth and free without stuck phenomenon.

4.5.2.3 Installation steps of piston and connecting rod subassembly

- a. Install a circlip into the piston circlip groove with the circlip pliers, then rotate the circlip to ensure it could completely fit in. The angular face of the circlip should be inwards. Besides, the opening of piston pin circlip should face upwards.
- b. Insert the small end of connecting rod into the piston cavity, then align the small end of connecting rod to the piston pin hole and install the piston pin and piston pin circlip at the other side. The inclined opening of connecting rod should be opposite in direction with the oil inlet hole of piston cooling passage. The small head hole of the connecting rod and piston pin before being installed should be applied with the proper lubricating oil.
- c. Sequence the installed piston and connecting rod subassemblies referring to the cylinder number, then sequentially mount the oil ring, 2nd gas ring and 1st gas ring into the ring grooves with the piston-ring mounting pliers. The “TOP” on the piston ring should face upwards. Besides, the ring should rotate flexibly in the groove.

- d. Clean the inside wall of cylinder, crank arm of crankshaft and piston and connecting rod subassembly, then apply the clean lubricating oil to each pair of moving parts.
- e. Adjust the direction of opening of each ring: for 1st ring, the opening should be installed where it offsets the center line of piston pin by 30°; the 2nd ring opening should stagger the 1st ring opening by 120°; the oil ring opening should stagger the 1st gas ring opening and 2nd gas ring opening by 120 degree and be at the vertical centerline of piston pin center line. As shown in following figure.

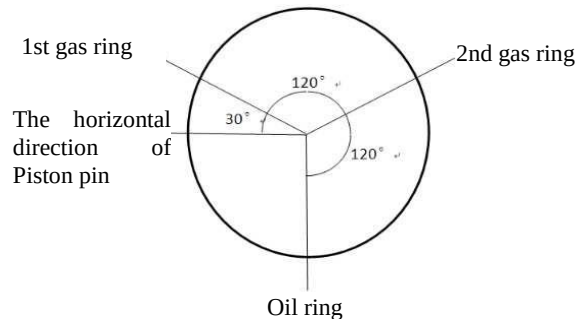


Fig. 4-20 Piston ring installation schematic

- f. Make the 1st cylinder and 6th cylinder at the BDC through engine barring, then install the 1st and 6th cylinder pistons and connecting rod subassembly, at last, loosely fix the bolts attached to the connecting rod. The parting surface of connecting rod should face the left side of cylinder block, namely, the oil cooler side. The piston cylinder No. should be same as the cylinder No.; the connecting rod cover should be matched with the connecting rod body; the connecting rod bolts before being installed should be coated with clean lubricating oil.
- g. Tighten the connecting rod bolts: before that, clean the bolt holes. Firstly tighten the connecting rod bolts to $70 \pm 2 \text{ Nm}$, then rotate the bolts by $60^\circ \pm 5^\circ$. Adopt the same method to install other cylinders.

4.5.2.4 The main working tools

- a. Internal circlip pliers - install the circlip of piston pin
- b. Piston ring pliers - remove or install the piston ring



Fig. 4-21 Piston ring pliers

- c. Guide sleeve - piston
- d. Feeler - measure the clearance of piston ring opening and clearance between the ring groove and shaft

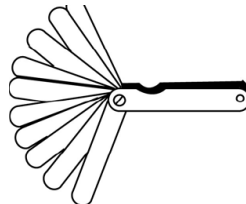


Fig. 4-22 Feeler

4.6 Valve train

4.6.1 Exploded view

Valve train mainly includes the camshaft, timing gear, tappet, pushrod, rocker arm and rocker shaft etc. The function of valve train is to ensure the sufficient valve opening and the intake valve and exhaust valve be closed or opened at the stipulated time and.

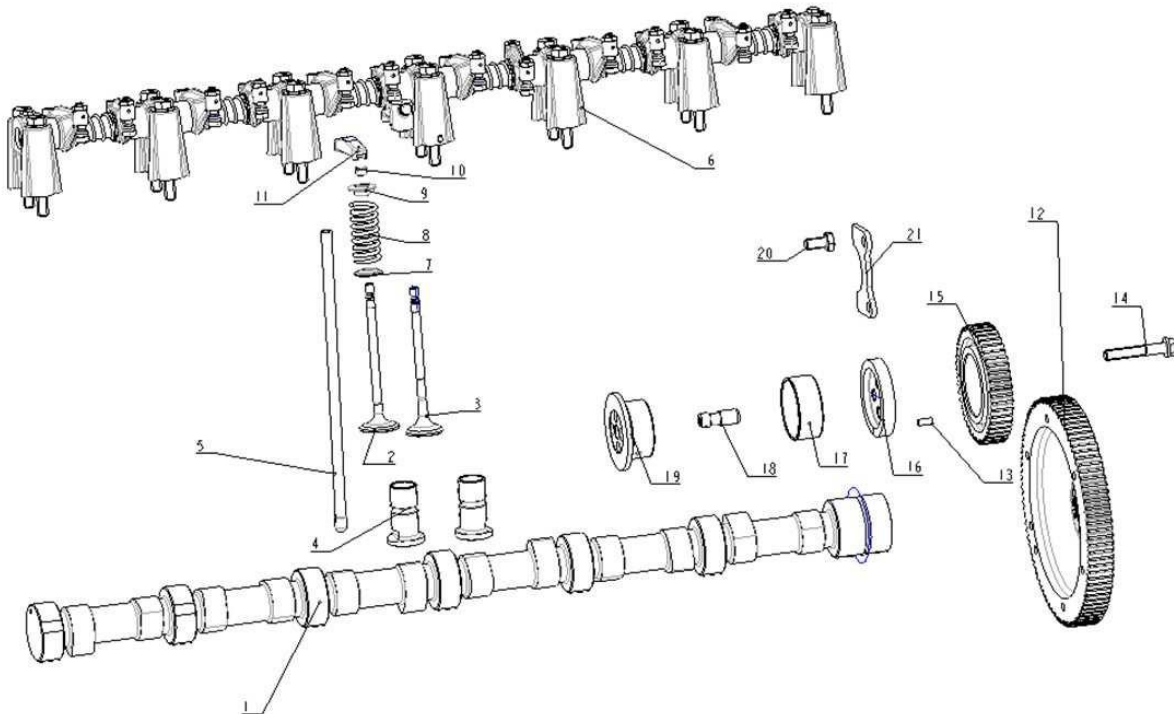


Fig.4-23. Exploded view of valve train

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	凸轮轴	Camshaft
2	进气门	Intake valve
3	排气门	Exhaust valve
4	挺柱	Tappet
5	气门推杆总成	Push rod
6	摇臂轴总成	Rocker assembly
7	弹簧下座	Spring plate
8	气门弹簧	Valve spring
9	气门弹簧座	Spring plate
10	气门锁夹	Valve cone
11	气门桥	Valve bridge
12	凸轮轴齿轮	Camshaft gear
13	圆柱销	Cylindrical pin
14	六角头螺栓	Screw
15	中间齿轮	Idler gear

16	垫片	Gasket
17	衬套	Bush
18	中间齿轮轴	Idler gear pin
19	惰轮轴	Idler gear shaft
20	六角头螺栓	Screw
21	凸轮轴止推片	Camshaft thrust plate

4.6.2 Installation and removal of camshaft

4.6.2.1 Exploded view of camshaft

WP7 diesel engine camshaft mainly includes the main bearing journal and intake and exhaust cams, shown in fig. 4-24. It mainly functions to have the valves closed/opened according to the stipulated work sequence and valve timing, guaranteeing the valve lift. Cams are periodically impacted due to valve intermittent opening. Therefore the cam surface should be wear resistant and camshaft should have the sufficient toughness and stiffness. WP7 engine camshaft adopts the full-support mode that could prevent the camshaft from being deformed, affecting the valve timing.

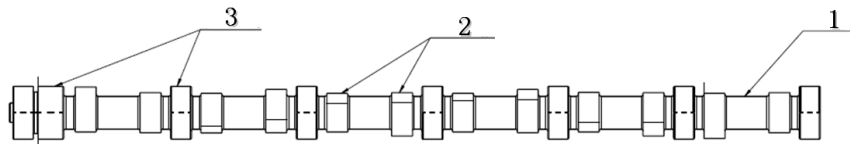


Fig. 4-24. WP7 engine camshaft

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	凸轮轴	Camshaft
2	进排气凸轮	Inlet and exhaust cams
3	凸轮轴主轴颈	Camshaft main journals

4.6.2.2 Removal steps of camshaft

- Rotate the camshaft to check whether the camshaft could rotate flexibly, free of stuck phenomenon.
- Check the axial play of camshaft comparing with the previous by using dial indicator, with the records shown in table 4-5. The dial indicator is shown in fig. 4-25.

Table 4-5 Axial play of camshaft

Product	Axial clearance before removal	Axial clearance after installation	Difference
WP7		0.1~0.4	



Fig. 4-25 Dial indicator

- c. On the workbench for installing or removing the engine, rotate the crankshaft to have the timing gear of camshaft at the state with the 1st cylinder at TDC.
- d. Remove the camshaft timing gear and camshaft and prevent the camshaft from being impacted.

4.6.2.3 Camshaft inspection and repair

- a. Check whether the cam surface contacted with the tappet is worn, or whether the main journal is stuck or worn. If it is slightly damaged, repair or send it back to the original manufacturer; if it is severely damaged, replace it with a new one.
- b. Measurement of the camshaft main journal circular runout (Table 4-6).

Table 4-6 Circular runout of camshaft main journal

Cam	Permissible max value of circular runout	Measured value
2 nd main journal	0.04	
3 rd main journal	0.05	
4 th main journal	0.06	
5 th main journal	0.05	
6 th main journal	0.04	

- c. Determine whether the camshaft is to be repaired or replaced with a new one.

4.6.2.4 Installation of camshaft

- a. Wipe the camshaft hole and then coat it with proper and clean lubricating oil with pressure oilcan shown in fig. 4-26. Check the camshaft bushing for impact and scratch damages. If any, dispose it.



Fig. 4-26 Pressure oilcan

- b. Wipe the camshaft to check for impact and scratch damages. If needed, repair it, and then use the special tooling to install the camshaft into the camshaft hole.

Besides, the tools for installing camshaft should be clean and coated with lubricating oil. During installation, do not impact the camshaft surface and camshaft bushing.

c. Install the camshaft thrust plate and then fix it with hexagon bolts, as shown in fig. 4-27.

- ① The thread part of bolt should be coated with Loctite 242 sealant.
- ② Apply clean lubricating oil to the thrust plate.
- ③ The camshaft should rotate smoothly, free of stuck phenomenon.

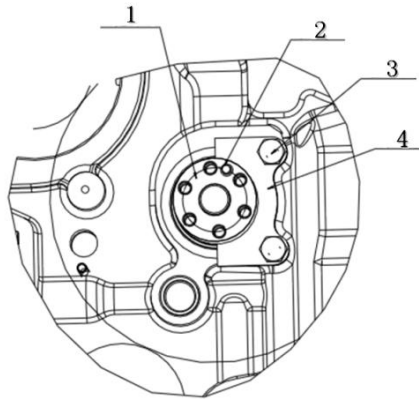


Fig. 4-27 Camshaft installation drawing

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	凸轮轴	Camshaft
2	圆柱销	Cylindrical pin
3	六角头螺栓	Screw
4	凸轮轴止推片	Camshaft thrust plate

d. Apply Loctite 277 sealant to the outer face of $\Phi 60$ bowl plug, then press it into the camshaft hole with the special tooling. After that, use the towel to wipe away the surplus sealant. After installation, there must be no edge failure on the bowl plug (fig. 4-28). Besides, the outer end surface should be lower than the end surface of bowl plug hole.

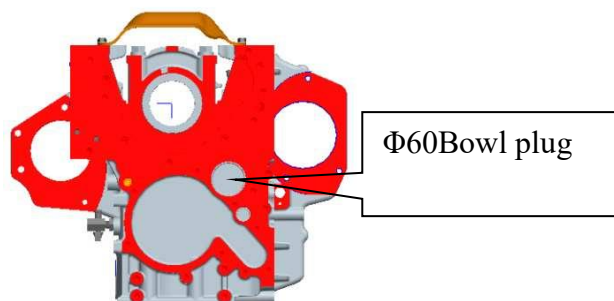


Fig. 4-28 Installation position of bowl plug

Tooling and auxiliary material needed during installation:

Installation steps	Name of tooling	Auxiliary material
①	Pressure oilcan	Lubricating oil and towel
②	Camshaft guide tooling Pressure oilcan	Lubricating oil and towel
③	Socket wrench Manual wrench Pressure oilcan	Loctite 242 sealant Lubricating oil
④	Tooling for bowl plug Iron bar	Loctite 277 sealant Towel

- e. After installation, check the axial clearance of camshaft, and rotate the crankshaft to check whether the camshaft could run freely.
- f. Measure the axial clearance of camshaft, it should be within 0.1~0.4.

4.6.3 Installation and removal of rocker shaft assembly

4.6.3.1 Exploded view of rocker shaft assembly

Rocker, actually a dual-arm lever as shown in fig. 4-29, is used to convert the direction of force from the push rod to drive the valve. WP7 engine adopts the rocker shaft assembly. The valve rockers are connected in series with a rocker shaft, with the rocker spring and washer in between the rockers. Then the rocker bracket is fixed onto the cylinder head.

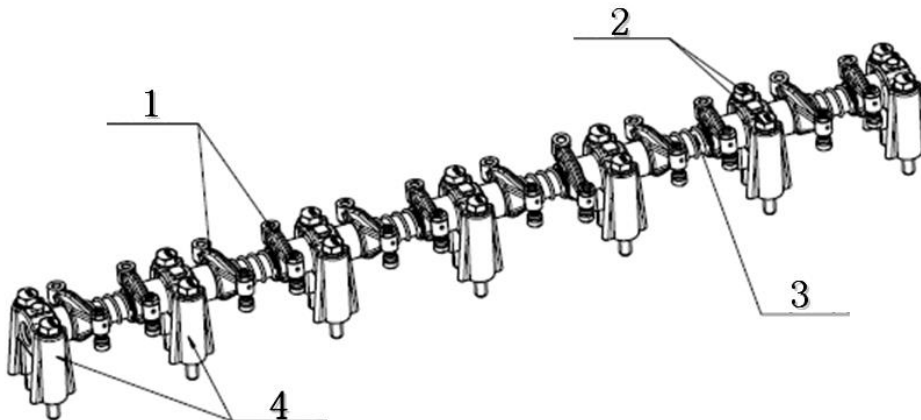


Fig. 4-29 Rocker shaft assembly

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	进排气摇臂	Intake and Exhaust Rocker Arm
2	六角头螺栓	Screw
3	摇臂轴	Rocker shaft
4	摇臂座	Rocker Bracket

4.6.3.2 Removal steps of rocker shaft assembly

- Open the rocker cover to check the rocker and rocker for deformation, fracture and cracks.
- Rotate the crankshaft to observe whether the rocker could rotate freely.
- Check the whether the valve clearance is changed.
- After the inspection is over, in case of any failure, loosen the screws attached to the rocker bracket, then slightly take out the rocker shaft assembly.

4.6.3.3 Inspection and maintenance of rocker shaft assembly

- Clean the rocker shaft assembly and check the rocker and rocker bracket for cracks.
- Check whether the rocker holes and rocker shaft are cracked or worn.
- Check the contact surface between the rocker and valve bridge and ball pin are worn.
- Check whether each oil galley is unobstructed.
- Check whether the rocker shaft assembly needs to be replaced.

4.6.3.4 Installation steps of rocker shaft assembly

- Install the valve pushrod assembly and valve bridge.

The upper opening of valve bridge should be toward the exhaust side.

- Install the harness bracket, rocker bracket onto the cylinder head with bolts.
- Tighten the rocker bracket bolts with the torque wrench to 60-77Nm (as shown in fig. 4-30). After the bolts are tightened in place, seal the bolt positions by using paining marker.

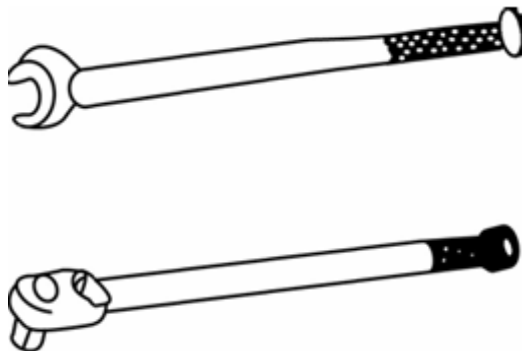


Fig. 4-30 Torque wrench

- Rotate the crankshaft to observe whether the rocker could rotate freely.
- Check and adjust the exhaust and intake valve clearances.

4.6.3.5 The main working tools

Installation steps	No.	Name of tooling	Auxiliary material
1	16mm	Socket wrench	
2	16mm 20~100Nm	Socket wrench Torque wrench	Marker

4.7 Intake and exhaust system

4.7.1 Removal and preassembling of intake and exhaust system

Intake and exhaust system mainly includes the intake manifold, exhaust manifold, turbocharger, oil return pipe of turbocharger, EGR cooler and related connectors.

4.7.1.1 Removal steps of intake and exhaust system

- Loosen the air filter bolts and rubber hose clamps to remove the air filter and connecting pipe.
- Loosen the inter-cooler pipe and rubber hose clamps to remove the inter-cooler pipe at both outlet of turbocharger compressor and inlet of intake manifold.
- Loosen the bolts attached to the oil-return pipe and oil-inlet pipe of turbocharger to remove the oil-return/inlet pipes and gaskets.
- Loosen the fixing bolts attached to exhaust tail pipe and turbocharger to remove the turbocharger.
- Remove the intake heater wire, and sequentially loosen the intake manifold bolts to remove the intake manifold. For details, please see 4.6.2 Removal, inspection, repair and installation of intake manifold.
- Sequentially remove the heat shield bolts, heat shield, exhaust manifold bolts and exhaust manifold. For exhaust manifold removal, inspection, repair and installation, see the 4.6.3.

4.7.1.2 Installation steps of intake and exhaust system

The installation should be performed in the reverse order of removal.

4.7.2 Installation and removal of intake manifold

4.7.2.1 Exploded view of intake manifold

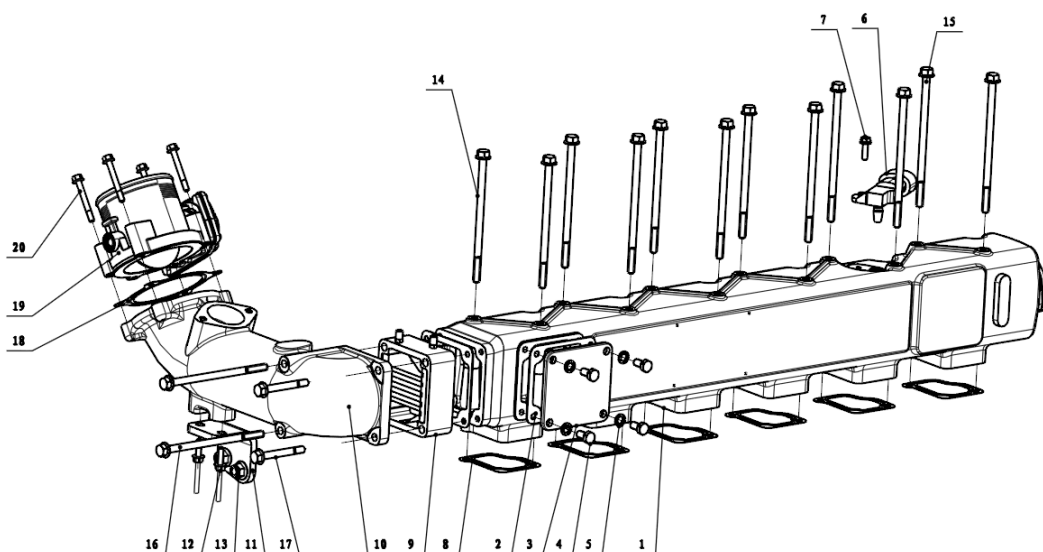


Fig. 4-31 Exploded view of intake system

序号 Pos	中文名称 Denomination	英文名称 Denomination
1	进气管总成	Air intake manifold
2	垫片	Washer
3	进气管盖板	Intake manifold cover
4	六角头螺栓	Hexagon head bolt
5	波形弹性垫圈	Wave spring washer
6	压力温度传感器	Pressure and temperature sensor
7	排气管紧固螺栓	Fixing bolt for exhaust manifold
8	垫片	Washer
9	进气管垫片	Washer
10	加热器	Heater
11	进气接管	Intake Connecting Pipe
12	固定支架	Fixed Bracket
13	六角法兰面螺栓	Hexagon screw
14	全金属六角法兰锁紧螺母	All-metal Hexagon Flange Lock nut
15	进气管紧固螺栓	Hexagon screw
16	进气管紧固螺栓	Hexagon screw
17	六角法兰面螺栓	Hexagon screw
18	六角法兰面螺栓	Hexagon screw
19	进气节流阀垫片	Intake throttle gasket
20	进气节流阀	Intake throttle
21	六角法兰面螺栓	Hexagon screw

4.7.2.2 Removal steps of intake manifold

- Sequentially loosen the intake manifold bolts and remove the intake manifold, intake connecting pipe and gasket.
- Loosen the nuts attached to intake connecting pipe to remove the intake connecting pipe, intake heater and heater gasket.
- Loosen the nuts attached to the intake manifold end cover to sequentially remove the intake manifold end cover and gasket.

4.7.2.3 Inspection and maintenance of intake manifold

- Check whether the intake manifold is cracked or deformed. If so, replace it with new intake manifold.
- Check whether the intake manifold gasket and end cover gasket are deformed, cracked or lost. If so, replace it.
- Check whether the intake heater is burnt, or short-circuited etc. If so, replace it.

4.7.2.4 Installation steps of intake manifold

The installation should be performed in the reverse order of removal. The intake manifold bolts should be tightened to 23Nm.

4.7.3 Installation and removal of exhaust manifold

4.7.3.1 Exploded view of exhaust manifold

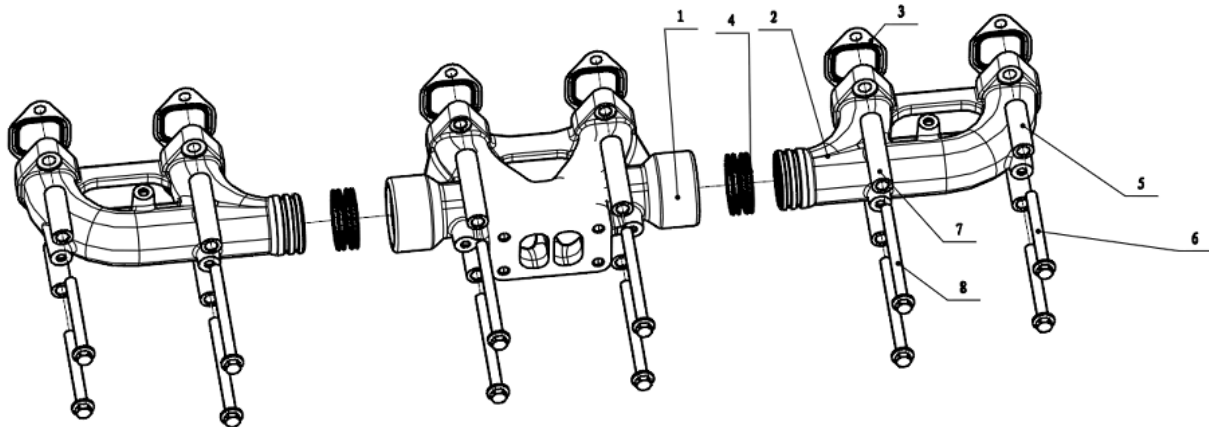


Fig. 4-32 Exploded view of exhaust system

序号 Pos	中文名称 Denomination	英文名称 Denomination
1	中间排气歧管	Middle exhaust manifold
2	前排气歧管	Front exhaust manifold
3	排气管垫片	Exhaust washer
4	排气管密封环	Exhaust Pipe Sealing Ring
5	1套筒	Sleeve
6	排气管紧固螺栓	Bolt For Exhaust Pipe
7	套筒	Sleeve
8	排气管紧固螺栓	Bolt For Exhaust Pipe

4.7.3.2 Removal steps of exhaust manifold

- Sequentially loosen the exhaust manifold bolts to remove the front and rear manifolds, sleeve and gasket.
- Separate the front and rear manifolds to remove the front exhaust manifold and middle manifold.

4.7.3.3 Inspection and maintenance of exhaust manifold

- Check whether the exhaust manifold is cracked or deformed or whether the flange is deformed. If so, replace it with new one.
- Check whether the flange of exhaust manifold is leaked. If so, replace the exhaust manifold gasket.
- Check whether the intake manifold gasket is deformed, cracked or lost. If so, replace it.

4.7.3.4 Installation steps of exhaust manifold

The installation should be performed in the reverse order of removal.

4.7.3.5 Precautions

Pay attention to the following requirements when installing:

- During installing the exhaust manifold, do not scratch the exhaust pipe joint surface.
- The exhaust manifold bolts should be coated with molybdenum disulfide and the exhaust manifold bolts can be reused two times.
- Exhaust system bolts and nuts are made of heat-resistance steel and should not be replaced by the common bolts and nuts.
- Exhaust manifold bolts are shown in following:

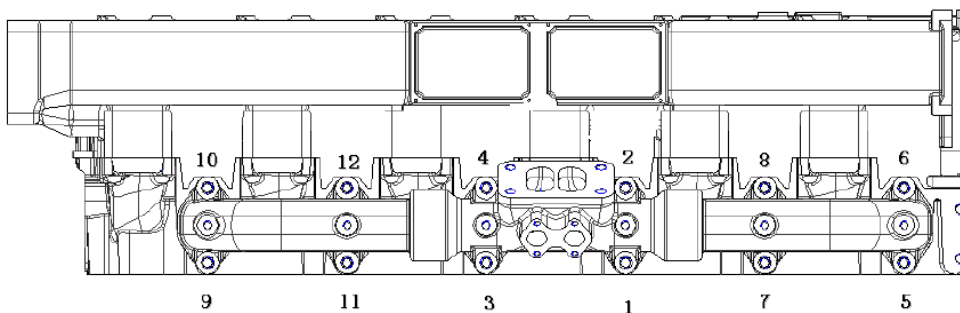


Fig. 4-33 tightening sequence of exhaust manifold bolts

4.7.4 Installation and removal of turbocharger

4.7.4.1 Exploded view of turbocharger

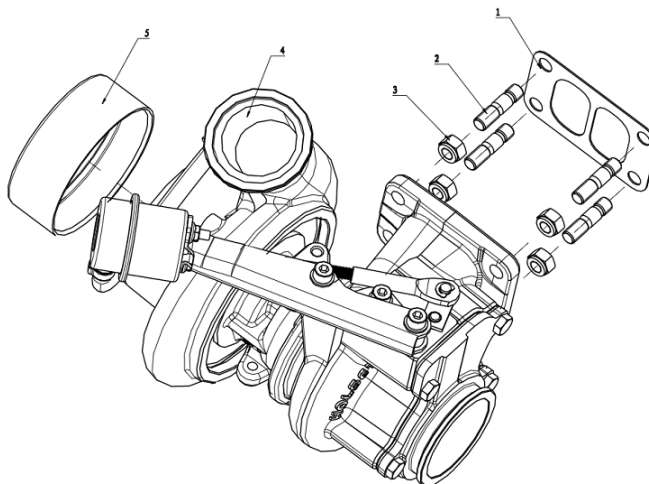


Fig. 4-34 Exploded view of turbocharger

序号 Pos	中文名称 Denomination	英文名称 Denomination
1	增压器垫片	Gasket

2	双头螺柱	Stud bolt
3	2型全金属六角锁紧螺母	Lock Nut
4	涡轮增压器	Turbocharger
5	堵盖	Cover

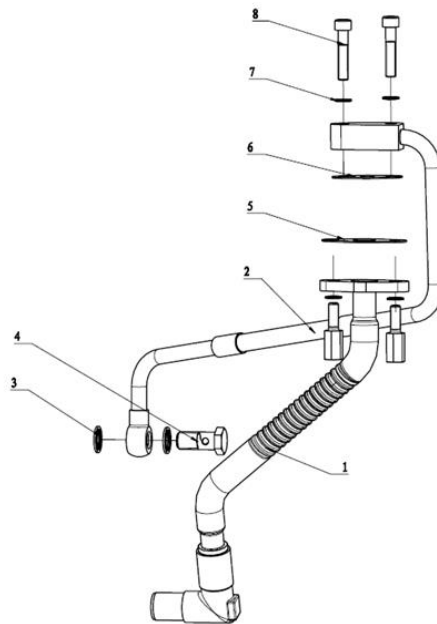


Fig. 4-35 Exploded view of turbocharger lubricating oil pipe

序号 Pos	中文名称 Denomination	英文名称 Denomination
1	增压器回油管组件	Turbocharger oil-outlet pipe set
2	增压器进油管组件	Turbocharger Oil-inlet Pipe Set
3	密封垫圈	Compound Gasket
4	空心螺栓	Hollow Screw
5	回油管法兰垫片	Flange gasket
6	进油管垫片	Oil inlet pipe gasket
7	波形弹性垫圈	Wave spring washer
8	内六角圆柱头螺钉	Hexagon Socket Head Cap Screw

4.7.4.2 Removal steps of turbocharger system

The removal should be performed in the reverse order of installation. The installation steps are shown in section 4.7.4.4.

4.7.4.3 Inspection and repair of turbocharger system

- Check the rotator rotating: manually drive the vanes of air compressor slightly. If it can rotate by one circle and more, it means the rotator is normal; if it stops quickly, it means the bearing is abnormally worn or the rotating part impact against the fixing parts or is stuck. In such case, find out the cause for troubleshooting.

- b. Inspection of rotator axial play: the inspection head of micrometer should be pressed up against the air compressor head, then axially push or pull the shaft and record the difference of measured values, shown in fig. 4-36. The rotator axial play should be within 0.088~0.118mm. In case of exceeding this range, the thrust bearing plate or thrust plate and bearing body are worn, then find out the causes for troubleshooting.

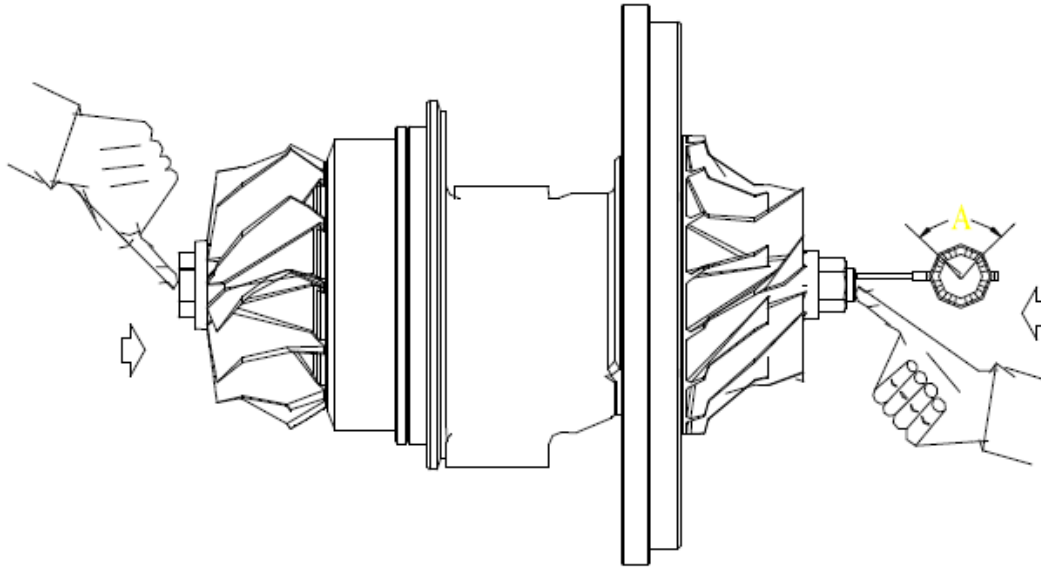


Fig. 4-36 Schematic of measurement of axial clearance

- c. Inspection of radial clearance of air compressor impeller: manually and radically press down or lift up the air compressor impeller, then measure the min and max clearances between the compressor impeller and compressor volute casing, as shown in fig. 4.-37. The measured clearance should be within 0.4~0.8mm. If not, check the bearing for troubleshooting.

Note: Measurements should be done at the cold state of turbocharger.

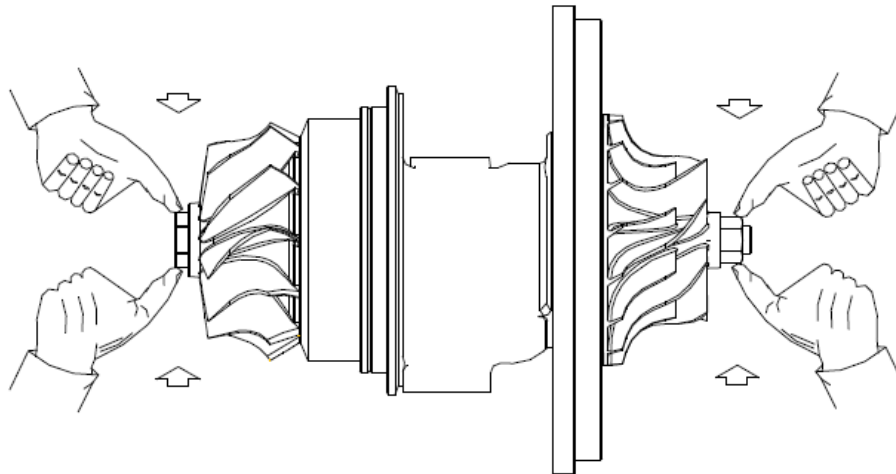


Fig. 4-37 Schematic of measurement of radial clearance

Daily maintenance:

- Check whether the pipe connection between the turbocharger and engine is loosened. If so, timely troubleshoot.
- Check the turbocharger for air/oil leaks.. If any, timely troubleshoot.
- Check whether the screws attached to the turbocharger is loosened. If so, troubleshoot.
- Check the air filter for dust. If there is too much dust, timely clean it.

4.7.4.4 Installation steps of turbocharger system

- a. Screw the pre-installed oil-inlet pipe of turbocharger into the main oil passage rear screw plug of cylinder block and tighten it. Pay attention to that the oil-inlet pipe position for convenient connection with turbocharger.
- b. Install the turbocharger gasket on the exhaust manifold flange.
- c. Install the turbocharger oil-return pipe and studs on the turbocharger assembly, and apply the molybdenum disulfide and clean lubricating oil to the studs. The tightening torque for bolts attached to the oil-return pipe should be 22-29Nm.
- d. Install the turbocharger assembly on the exhaust manifold flange with gasket; loosely install the II-type full-metal lock nuts and then tighten them.
- e. Apply proper clean lubricating oil to the oil-inlet port of turbocharger, and wipe the overflowed lubricating oil.
- f. Install the oil-inlet pipe and its gasket of turbocharger. Loosely install the hexagon head bolt and self-lock washer and tighten up with torque of 22-29Nm. The turbocharger impeller rotation should be flexible and without jamming.
- g. Knock in the oil-return elbow, with the insert end cylindrical face applied with Loctite 271 thread sealant.
- h. Install the oil-return hose and hose clamps, then tighten them. Pay attention to that the directions of two clamps should be consistent and align the oil-return pipe.
- i. All gaskets should be reused for merely once and then replaced in case of repairing again.

4.7.5 Installation and removal of EGR system

4.7.5.1 Exploded drawing of EGR system

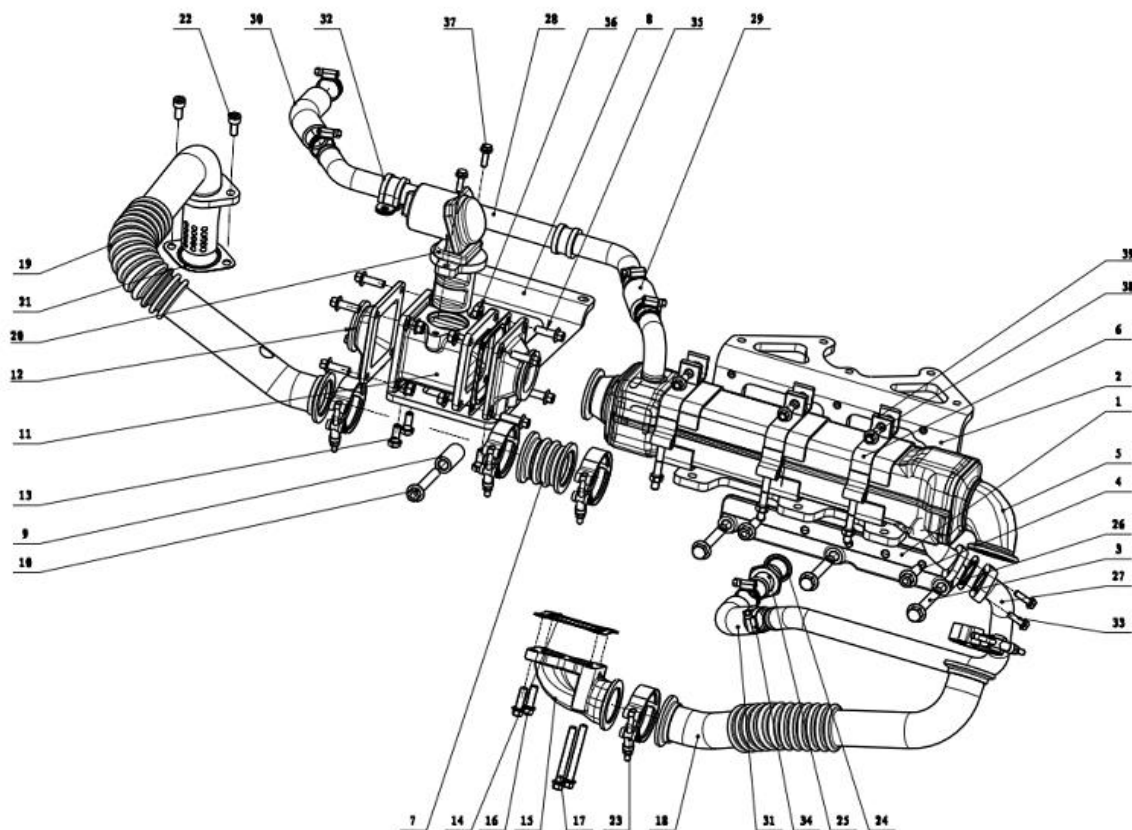


Fig. 4-38 Exploded view of EGR system

序号 Pos	中文名称 Denomination	英文名称 Denomination
1	EGR冷却器支架	EGR Cooler Bracket
2	EGR冷却器支架	EGR Cooler Bracket
3	六角法兰面螺栓	Hexagon Flange Bolt
4	六角法兰面螺栓	Hexagon Flange Bolt
5	EGR冷却器	EGR Cooler
6	卡箍	Clamp
7	波纹管	Sylphon Bellows
8	EGR阀座支架	EGR Valve Seat Bracket
9	套筒	Sleeve
10	六角法兰面螺栓	Hexagon Flange Bolt
11	EGR阀座	EGR Valve Seat

序号 Pos	中文名称 Denomination	英文名称 Denomination
12	连接盖	Connecting Cap
13	六角头螺栓全螺纹	Hexagon Head Bolt
14	EGR进气法兰垫片	Gasket for EGR Air-inlet Connecting Flange
15	废气管接头	Waste Gas Pipe Connector
16	六角法兰面螺栓	Hexagon flange bolt
17	六角法兰面螺栓	Hexagon flange bolt
18	EGR进气管组件	EGR Air-inlet Pipe Set
19	EGR出气管组件	EGR Gas Exhaust Pipe Set
20	EGR阀	EGR Valve
21	EGR出气法兰垫片	Gasket for EGR Air-inlet Connecting Flange
22	内六角圆柱头螺钉	Hexagon Socket Head Cap Screw
23	卡箍	Clamp
24	组合密封垫圈	Sealing ring
25	进气管接头	Intake pipe connector
26	垫片	Gasket
27	EGR冷却器进水管组件	EGR Cooler Water-inlet Pipe Set
28	EGR冷却器出水管	EGR Cooler Water-outlet Pipe
29	胶管	Rubber tube
30	冷却液连接胶管	Coolant Connecting Rubber Pipe
31	冷却液连接胶管	Coolant Connecting Rubber Pipe
32	管夹	Pipe Clamp
33	排气管紧固螺栓	Fixing bolt for exhaust pipe
34	卡箍	Clamp
35	六角法兰面螺栓	Hexagon Flange Bolt
36	六角法兰面螺母	Hexagon Flange Nut
37	排气管紧固螺栓	Fixing bolt for exhaust pipe
38	六角法兰面螺栓	Hexagon Flange Bolt
39	压紧块	Clamping Block

4.7.5.2 Removal steps of EGR system

- 1) Loosen the bolts for EGR air-inlet pipe set, gas exhaust pipe set, clamps and fixing bolts attached to the water pipe, then remove the EGR cooler and EGR valve base.
- 2) Loosen the fixing bolts attached to EGR valve base to remove the EGR valve.
- 3) Loosen the fixing bolts to remove the EGR cooler bracket.

4.7.5.3 Inspection and repair of EGR system

- 1) Before removal, check the clamps of EGR system for gas/water leaks.
- 2) Before removal, check whether the gasket of EGR valve seat is reliably sealed.
- 3) After removal, check the EGR air inlet/outlet pipes and EGR cooler for foreign material.

4.7.5.4 Installation steps of EGR system

- 1) Fix the EGR valve base bracket and EGR cooler bracket onto the engine intake manifold.
- 2) Assemble EGR valve base, gasket and connecting cover and then fix them onto the bracket of EGR valve base.
- 3) Install the EGR cooler onto the EGR cooler bracket, then loosely install the clamps and clamping blocks.
- 4) Install the bellows and tighten the clamps.
- 5) Sequentially install the EGR air-inlet pipe set, EGR cooler water-inlet pipe set, EGR cooler water-outlet pipe set and EGR gas exhaust pipe.
- 6) Tighten the bolts attached to the EGR cooler.
- 7) Install the EGR valve

4.7.5.5 Precautions

- 1) EGR system principle and functions:

EGR control system is used to bring partial exhaust gas in the exhaust manifold into the fresh air of intake manifold and enters the cylinder for combustion. That could control the generation of NO_x to reduce the emission by reducing the oxygen concentration and highest combustion temperature in cylinder. Besides, the ECU could precisely control the EGR valve to be opened or closed, controlling the EGR exhaust gas flow. In order to further reduce the intake temperature, the EGR system is equipped with EGR cooler of which coolant could cool down the temperature of returned exhaust gas.

- 2) The bolts of the exhaust pipe joint and exhaust pipe are heatproof and coated with molybdenum disulfide, therefore, they cannot be replaced by the common bolts.
- 3) The power supply can be cut off only 15s after the engine be switched off, because EGR valve will perform the self learn and clean for five times.
- 4) As the EGR engine cannot use the fuel with high content of S, it is required that the S content should be below 50ppm (China IV standard Fuel) to reduce corrosion of cooler caused by acid compound in the exhaust gas.

4.7.6 Installation and removal of diesel injection system

4.7.6.1 Exploded view of diesel injection system

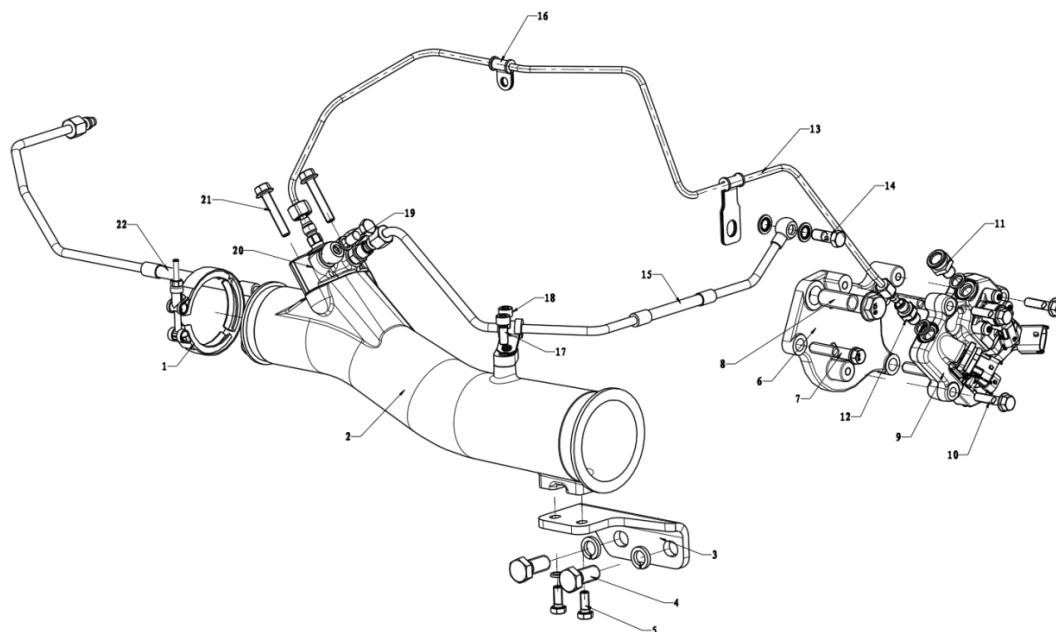


Fig. 4-39 Exploded view of diesel injection system

序号 Pos	中文名称 Denomination	英文名称 Denomination
1	卡箍	Clamp
2	排气尾管	Exhaust Tail Pipe
3	排气管支架	Exhaust Manifold Bracket
4	六角头螺栓全螺纹	Hexagon Head Bolt Full Thread
5	六角头螺栓	Hexagon head bolt
6	固定支架	Fixed Bracket
7	六角头螺栓	Hexagon screw
8	六角头螺栓	Hexagon screw
9	柴油测量单元	Diesel metering unit
10	六角法兰面螺栓	Hexagon flange bolt
11	管接头	Pipe Joint
12	管接头	Pipe Joint
13	燃油进油管组件	Fuel Inlet Pipe
14	空心螺栓	Hollow Screw
15	喷射单元进水管总成	Injection unit water inlet pipe assembly
16	管夹总成	Pipe Clamp Assembly
17	内六角圆柱头螺钉	Hexagon Socket Head Cap Screw
18	内六角圆柱头螺钉	Hexagon Socket Head Cap Screw
19	空心螺栓	Hollow Screw

序号 Pos	中文名称 Denomination	英文名称 Denomination
20	柴油喷嘴	Diesel injector
21	排气管螺栓	Exhaust Manifold Bolt
22	喷射单元出水管总成	Injection unit water outlet pipe assembly

4.7.6.2 Removal steps of diesel injection system

- 1) Loosen the nuts, hollow bolts and clamps attached to the fuel-inlet pipe, injection unit water inlet pipe assembly, injection unit water outlet pipe assembly, then remove the fuel pipe and water inlet/return pipe.
- 2) Loosen the bolts attached to the diesel injector to remove the diesel injector.
- 3) Loosen the bolts attached to diesel metering unit to remove the diesel metering unit.
- 4) Loosen the bolts attached to diesel metering unit bracket to remove the bracket.

4.7.6.3 Inspection and repair of diesel injection system

- 1) Before Removal, check the connections of diesel injection system for gas/water leaks.
- 2) Before Removal, check the diesel injection system pipes for oil/water leaks. w
- 3) After removal, check the water inlet/outlet pipes of injection unit and fuel inlet pipe for foreign material. .
- 4) After removal, check the diesel nozzle for blockage.

4.7.6.4 Installation steps of diesel injection system

- 1) Fix the diesel metering unit bracket onto the engine body.
- 2) Install the diesel metering unit onto the bracket.
- 3) Install the diesel injector onto the exhaust tail pipe.
- 4) Install the fuel inlet pipe and tighten the union nuts.
- 5) Install the water inlet/outlet pipe assemblies of fuel injection unit and tighten the union nuts and hollow bolts.
- 6) Install the clamps.

4.7.6.5 Precautions

- 1) Diesel injection system principle and functions:

DPM system includes the Metering Unit (MU) and Injection Unit (IU) and could inject the diesel fuel into the exhaust pipe. This injection plan is used to the regeneration of the Diesel Particulate Filter (DPF). The diesel fuel injected is burnt in the catalyst in front of DPF to heat the exhaust gas and promote the oxidation of the soot (from 400°C to 600°C).

- 2) The bolts connecting the diesel injector and exhaust pipe are heatproof and should be coated with molybdenum disulfide. The bolts cannot be replaced by the common bolts.
- 3) The inlet pipe of diesel metering unit (MU) should be set at the downstream of fine filter.

4.7.7 Daily inspection of intake and exhaust system

- 1) Check whether the air filter is clogged.
- 2) Check whether the pipeline between the air filter and the inlet of turbocharger compressor housing and clamps are loosened.
- 3) Check whether the pipeline between the turbocharger compressor housing and the inter-cooler and clamps are loosened.
- 4) Check whether the engine exhaust pipe bolts are loosened. If so, tighten or change them.
- 5) Check whether the exhaust manifold is heat discolored, cracked or damaged. If so, timely replace it.
- 6) Check the connection clamps for the turbocharger housing and engine exhaust manifold or other bolts for looseness.
- 7) Check the oil level in the engine oil pan. If it is too low, refill it; if too high, drain the excessive oil to ensure the oil level is normal.
- 8) Check whether the lubricating oil is leaked at the connection of turbocharger housing. If so, find out the causes for troubleshooting.
- 9) Check whether the lubricating oil inlet/return pipes is damaged or throttled.
- 10) Check whether the turbocharger housing is heat discolored, cracked or damaged. If so, timely replace it.
- 11) For turbocharger with abnormal sound, stop using and switch off the engine to find out the causes.
- 12) Check whether the bolts and clamps fixing the EGR cooler are loosened.
- 13) Check whether the EGR valve connection is loosened.
- 14) Check whether there is oil leakage on the pipeline of diesel injection system.

4.7.8 Daily maintenance of intake and exhaust system

- 1) Use the CJ grade oil or higher grade recommended by the engine manufacturer.
- 2) Use the oil filter and air filter recommended by the engine manufacturer.
- 3) Do not use silica gel on the gasket of oil inlet.
- 4) Do not randomly adjust the pressure of bypass valve.
- 5) Periodically replace the oil filter and air filter (every 8000km suggested).
- 6) After replacing the oil, oil filter element or stop for long time, turn the flywheel for 3-5 revolutions before starting engine for turbocharger lubrication.
- 7) After startup, idle for 3-5min to prevent oil lack of turbocharger parts.
- 8) Before stopping, idle for 3-5min to prevent the supercharger parts overheating.
- 9) Idling should not last for 20min or more to prevent against the false oil leakage.
- 10) During rotation, the oil inlet pressure of turbocharger should be kept within 196-392kPa (2-4kgf/cm²). If the engine oil pressure alarm, stop for troubleshooting.
- 11) Lubricating oil inlet temperature should be within 50-80°C; and the return temperature should not exceed 120°C and the max turbine intake temperature is 700°C.
- 12) If the turbocharger is not used for 7 days or more, remove the turbocharger and fill the lubricating oil in the oil inlet.
- 13) Only 15s after the engine is stopped, can the power supply be cut off, because EGR valve will perform the self learn and clean for five times.
- 14) The ambient temperature for normal working of EGR valve is -40°C~70°C; the motor temperature should

not exceed 150°C. Pay attention to the ventilation in engine compartment.

- 15) As the EGR engine cannot use the fuel with high content of S, it is required that the S content should be below 50ppm (China IV standard Fuel) to reduce corrosion of cooler caused by acid compound in the exhaust gas.
- 16) It is required that the EGR engine should be cooled by using the cooling water rather than the hard water such as the well water and lake water that could create water scale to reduce the cooling efficiency of EGR cooler.

Every 8000 km, the following maintenance should be performed:

- 1) Replace the oil, oil filter and air filter.
- 2) Remove the pipeline from the air filter to the inlet of turbocharger air compressor housing. Rotate the compressor impeller that should be flexible, without stuck phenomenon. If not, remove it for inspection.
- 3) Check the axial play and radial clearance; the axial play should be less than 0.15; the main radial side clearance should be more than 0.1. In case of exceeding the range, remove it for inspection.
- 4) If the clearance exceeds the specified value, remove it for inspection. If needed, replace the subassembly repaired or the whole engine.

4.8 Lubricating system

4.8.1 Overview of lubricating system

The functions of lubricating system are to reduce the wear, wash, cool down and prevent against the rust. The oil usage should comply with the company standards. Multi-grade oil is preferred as it is beneficial to the cold state performance of engine. Multi-grade oil for whole-year usage, such as 15W40, should be used within the stipulated range only. For the occasional low temperature conditions, take some measures to preheat the oil or change with the oil suitable for the ambient temperature.

WP7 series diesel engines adopt the pressure lubrication. Namely, the oil is sucked from the oil pan and be filtered by the suction strainer and then be pumped into the oil filter and oil cooler, making the oil reach where the parts are to be lubricated through the oil pipeline system. Most of the oil reaches the main bearing and passes the oil holes on the crankshaft and finally reaches the connecting rod bearings. The cylinder liner surface and piston pin are lubricated with the oil sprayed by nozzle. Valve control system, turbocharger, common rail pump, air compressor and intermediate gear bearing adopt also the pressure lubrication with the aids of oil pipeline and oil grooves. The piston top is cooled by the way that the nozzle sprays oil into the inner cooling oil cavity. The oil is cooled by cooling water in the oil cooler. And the oil pressure in oil circulation system is regulated by the relief valve in the oil pump. WP7 series diesel engine oil circuit is shown in fig. 4-40.

When the diesel engine starts, oil pressure may be slightly high because the oil temperature is low and viscosity is high. But, as the coolant temperature rises, the oil becomes hot, and the oil pressure could gradually drop. At full load of engine, if the coolant temperature is between 80°C~95°C, the normal oil pressure should be 350kPa~550kPa.

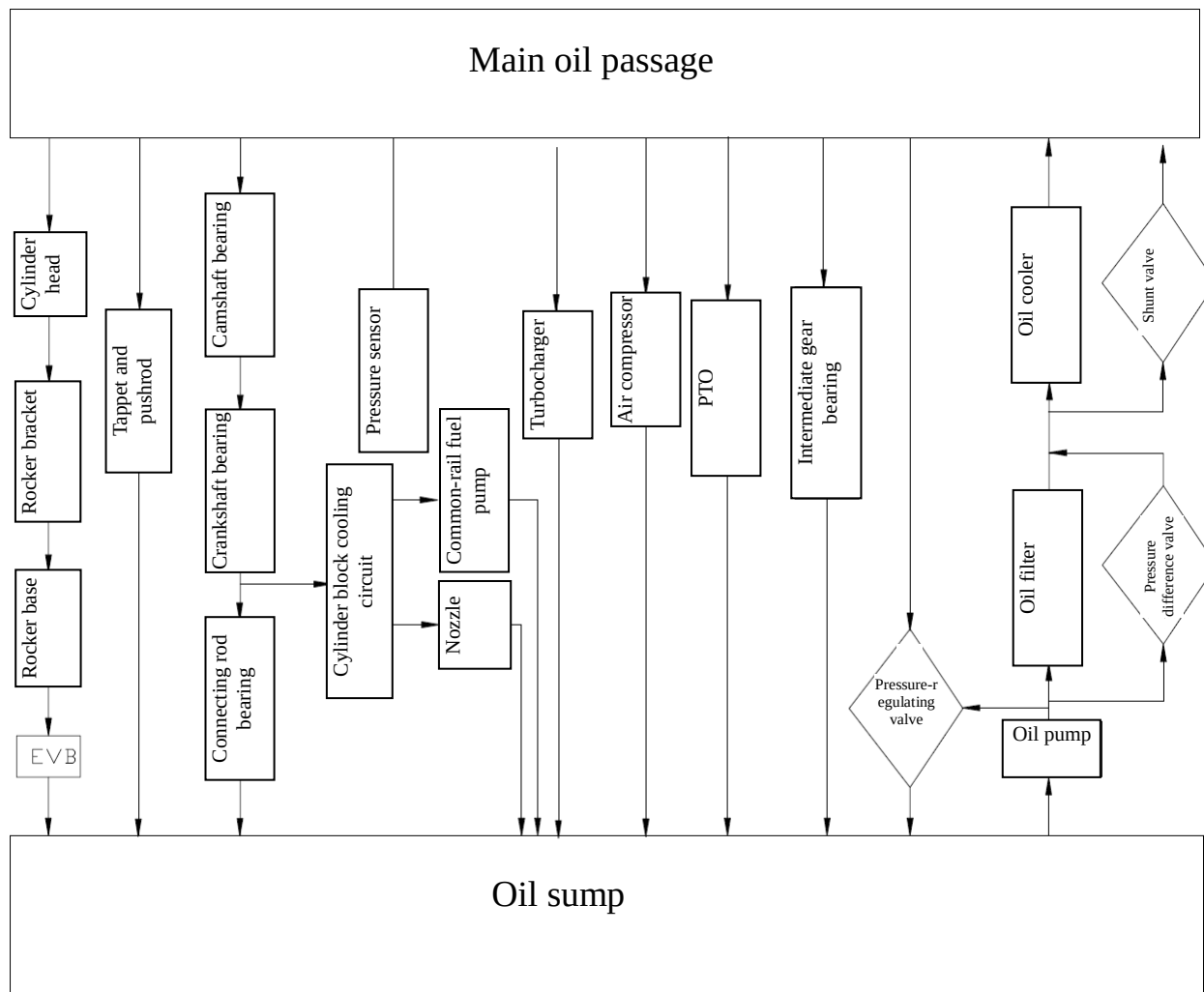


Fig. 4-40. Schematic of WP7 series diesel engine oil circuit

4.8.2 Exploded view of lubricating system

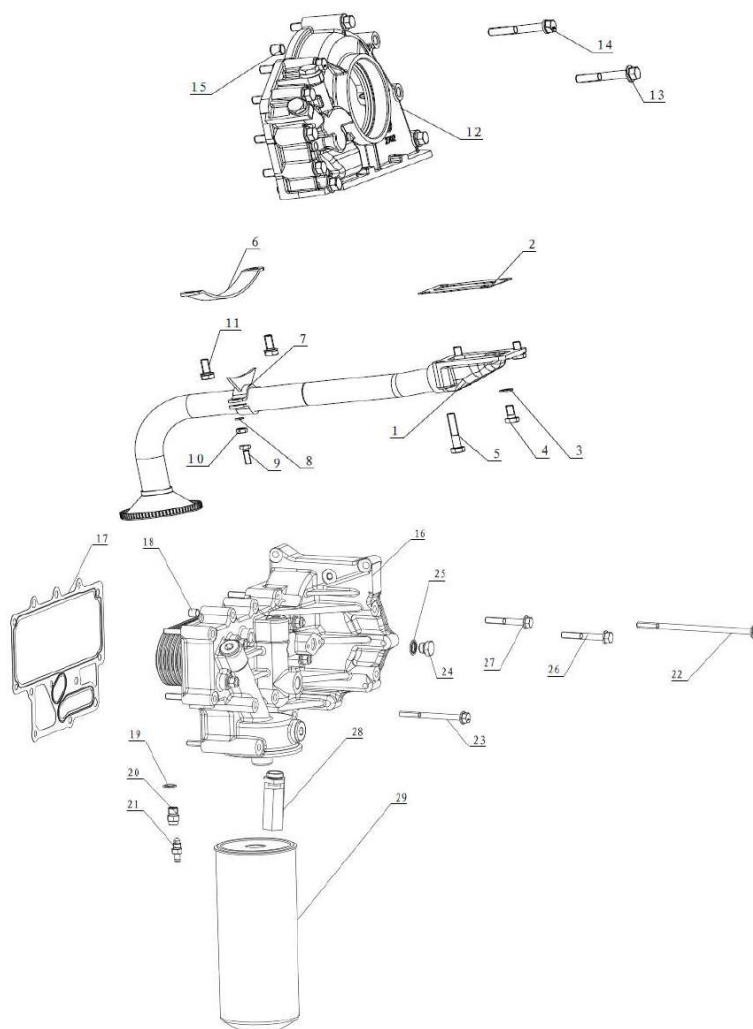


Fig. 4-41 Exploded view of WP7 series diesel engine lubricating system

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	机油集滤器	Lubricating oil suction strainer
2	集滤器垫片	Oil Suction Strainer Gasket
3	波形弹性垫圈	Wave spring washer
4	六角头螺栓	Hexagon Head Bolt
5	六角头螺栓	Screw
6	机油集滤器支架	Oil suction strainer bracket
7	支架板	Bracket plate
8	弹簧垫圈	Spring washer
9	六角头螺栓	Hexagon head bolt
10	1型六角螺母	I-type hexagon nut
11	六角头螺栓	Screw

序号 Pos.	中文名称 Denomination	英文名称 Denomination
12	机油泵	Oil pump
13	六角法兰面螺栓	Hexagon Flange Bolt
14	六角法兰面螺栓	Hexagon Flange Bolt
15	定位套	Dowel Pin
16	机油冷却器总成	Oil cooler assembly
17	机油冷却器盖垫片	Oil cooler cover gasket
18	定位套	Dowel Pin
19	组合密封垫圈	Sealing washer
20	放水阀座	Outlet valve socket
21	放水阀芯	Outlet valve core
22	六角法兰面螺栓	Screw
23	六角法兰面螺栓	Screw
24	六角头螺塞	Screw Plug
25	密封垫圈	Sealing washer
26	六角法兰面螺栓	Screw
27	六角法兰面螺栓	Screw
28	主油道限压阀	Relief valve
29	机油滤清器	Oil filter

4.8.3 Installation and removal of oil cooler core

- 1) Loosen all the bolts M8 attached to the oil cooler cover to remove the oil cooler cover. Before that, drain the coolant out of engine.
- 2) Clean the sealing joint surfaces of oil cooler cover and cylinder block.

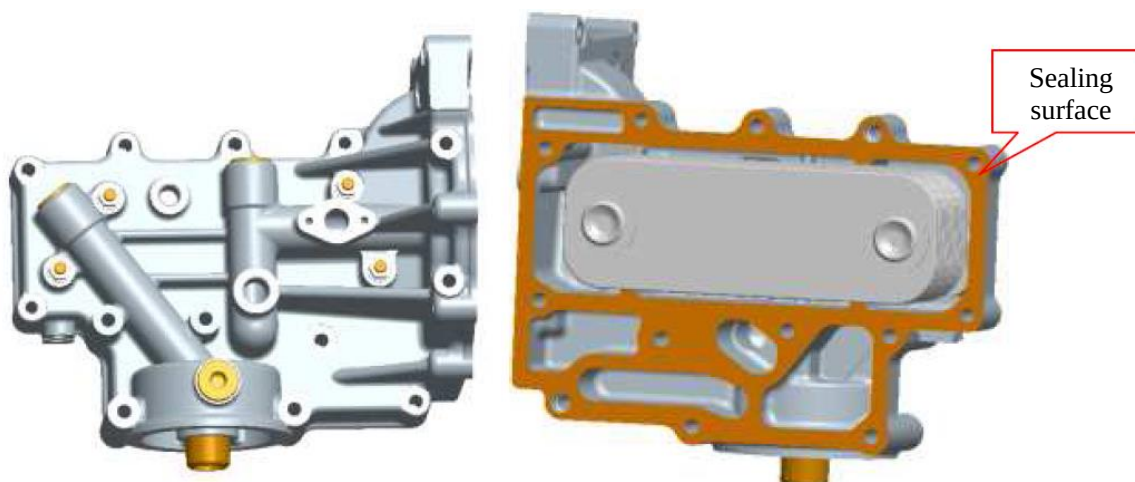


Fig. 4-42 Oil cooler

- 3) Loosen the four M8 bolts for oil cooler core.
- 4) Remove the oil cooler core to clean the flange joint surface of cylinder block for oil cooler core.

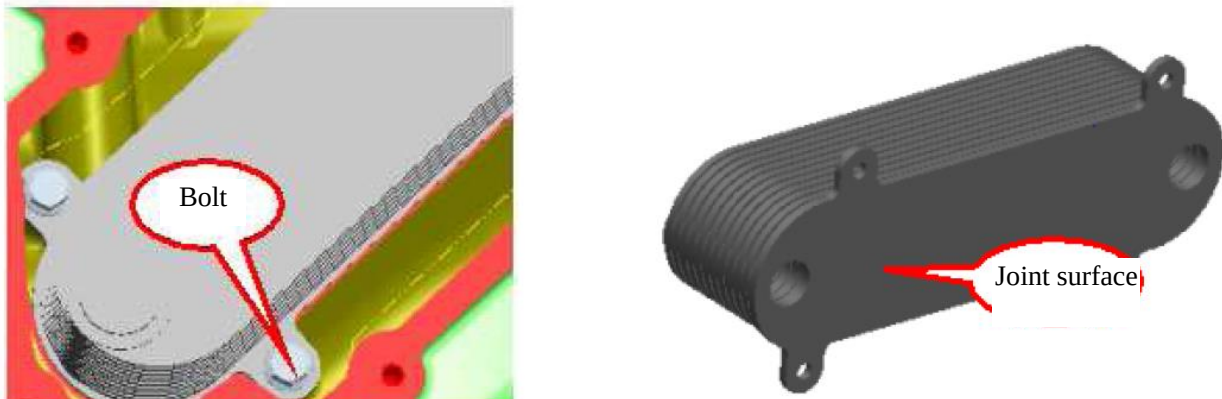


Fig. 4-43 Oil cooler core

- 5) Install the new oil cooler core and then tighten the four bolts attached to the oil cooler core.
- Note: Before tightening the bolts, apply Loctite 242 sealant to the threads.
- 6) Install the oil cooler cover, tighten all outside bolts.

4.8.4 Installation and removal of oil pump

Note: During replacing the oil pump, do not damage the front oil seal in of crankshaft.

- 1) Remove the oil pan and the oil suction strainer.
- 2) Loosen the pressure plate fixing the oil suction pipe.

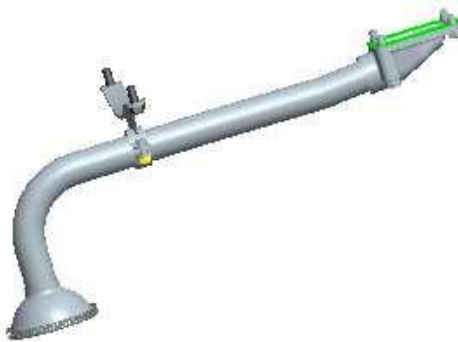


Fig. 4-44 Suction strainer

- 3) Remove the belt.
- 4) Remove the crankshaft pulley and torsional vibration damper.
- 5) Remove all the M10 bolts attached to the front cover. During removing the front cover, care must be taken not to damage the front oil seal of crankshaft.

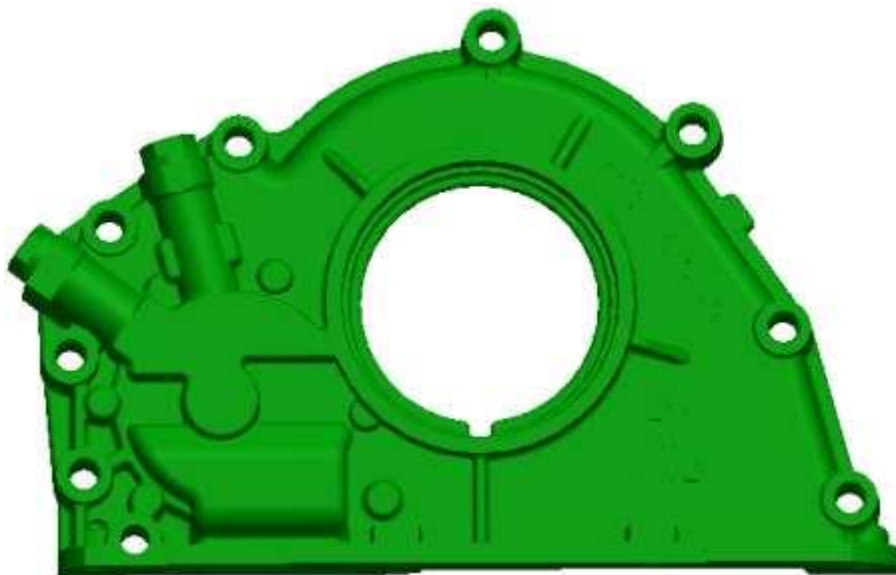


Fig. 4-45 Front cover

- 6) Change with the new oil pump and clean the joint surface of cylinder block and oil pump.

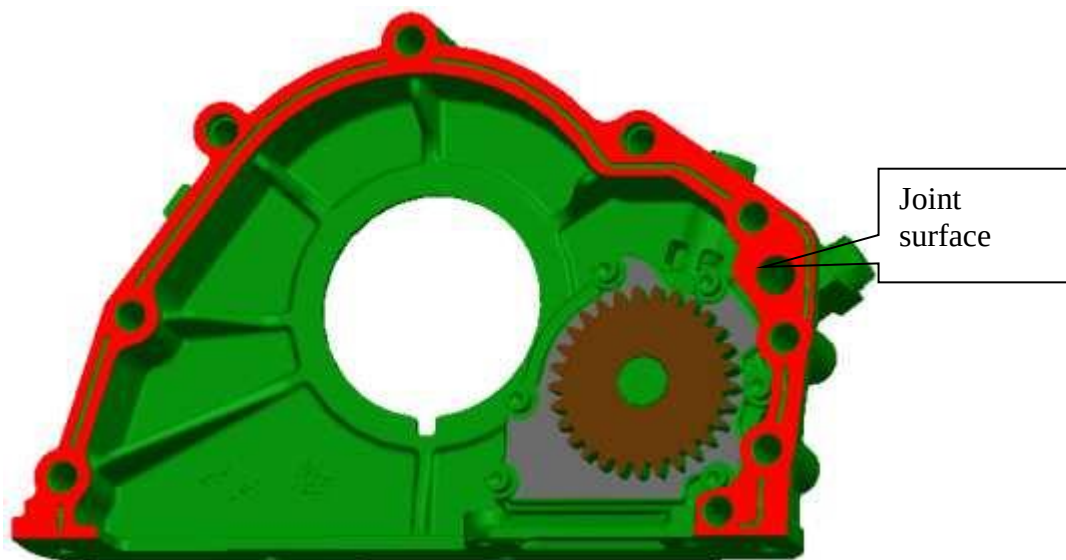


Fig. 4-46 Joint surface the cylinder block and oil pump

4.9. Cooling system

4.9.1 Overview

The function of cooling system is to ensure that the diesel engine is able to work continuously at proper temperature. The compulsory circulative cooling could have the engine quickly reach the running temperature. The cooling system of WP7 series diesel engine is shown in fig. 4-47.

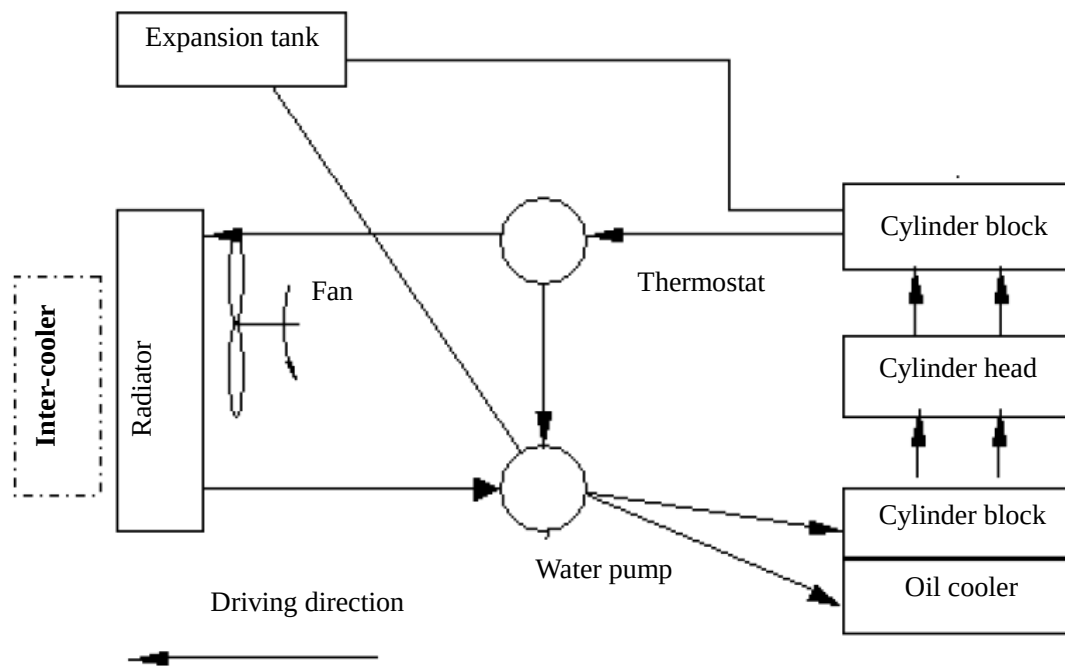


Fig. 4-47 Schematic of WP7 series diesel engine cooling system

4.9.2 Installation and removal of belt

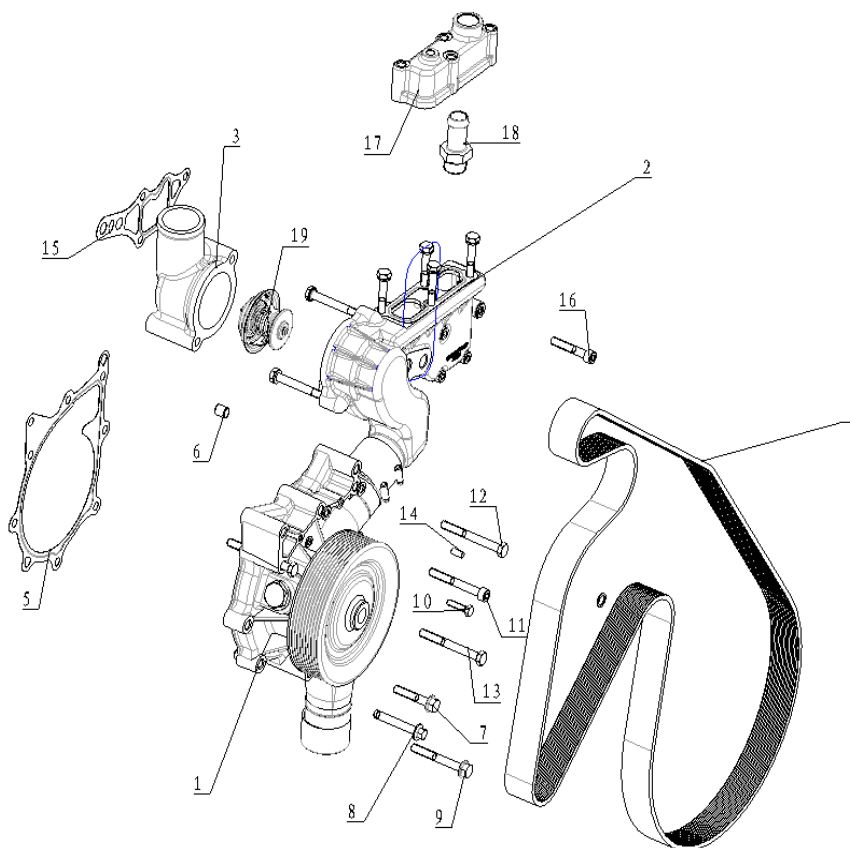


Fig. 4-48 Exploded view of cooling system

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	水泵总成	Water pump
2	出水管	Water outlet pipe
3	节温器盖	Thermostat cover
4	多楔带	Poly V-belt
5	水泵垫片	Gasket
6	定位套	Dowel Pin
7	六角法兰螺栓	Screw
8	六角法兰螺栓	Screw
9	内六角圆柱头螺钉	Screw
10	六角法兰螺栓	Screw
11	六角法兰螺栓	Screw
12	六角法兰螺栓	Screw
13	六角法兰螺栓	Screw
14	圆柱销	Pin
15	出水管垫片	Gasket
16	内六角圆柱头螺钉	Screw
17	出水管盖	Outlet pipe head
18	暖风接头	Joint
19	节温器总成	Thermostat

- 1) Use the open-end wrench to clamp the nut on the belt tensioner, rotate the belt tensioner to align the axial lines of two holes on the belt tensioner. Then quickly insert the small cylindrical pin to have the belt tensioner unable to reset. In such case, the 10-groove belt can be removed.
- 2) Install the new belt, pull out the small cylindrical pin, the belt will tension automatically.

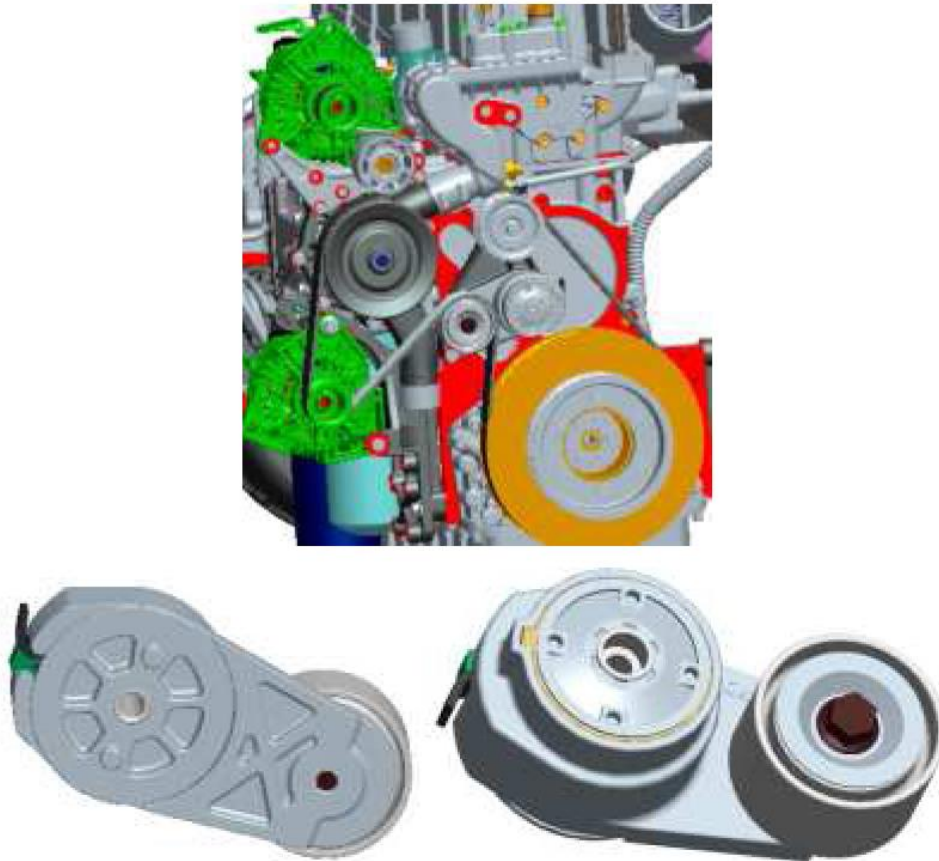


Fig. 4-49 Auto tensioner

4.9.3 Installation and removal of water pump

The water pump of WP7 series diesel engine is installed at the front end of diesel engine. Besides, the water inlet/return chambers are all arranged at the exhaust side of cylinder block, with the water return chamber in the upper and water inlet in the lower. The thermostat featuring compact structure is installed inside the water outlet pipe end. There are two outlets on the thermostat, one way to the radiator and other way to the inlet port of water pump (namely small circulation). When the coolant temperature reaches 83°C, the thermostat begins to open and to fully open when the coolant temperature reaches 92°C. In such case, all the coolant will be cooled by the radiator and then be pumped into the cylinder block by the water pump. But when the coolant temperature is less than 83°C, the thermostat will cut off the above passage, having the coolant directly to the inlet of water pump and the diesel engine temperature will rise quickly to the required hot operation conditions. That could prevent the low-temperature wear, prolonging the use life of diesel engine.

Removal steps are shown below:

- 1) Refer to the methods of replacing the belt to remove the 10-groove poly V-belt;
- 2) Remove the belt tensioner with wrench;
- 3) Remove the idler pulley with wrench;
- 4) Remove the bolts attached the water pump to engine block with wrench;
- 5) Remove the water pump and replace with a new one with new gasket. Install all the parts with the reverse sequence of the above steps.

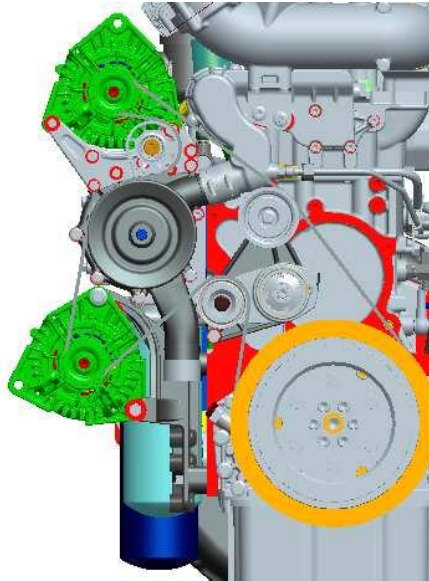


Fig. 4-50 Water pump

4.9.4 Expansion water tank

The expansion water tank is provided by the whole-vehicle manufacturer rather than the diesel engine manufacturer. The cooling efficiency and functions of a cooling system are greatly dependent on whether this system is supplied with the system pressure or there are no bubbles, both of these features are mainly affected by the expansion tank. The functions of expansion tank are as follows:

- 1) Receive the heated and expanded coolant.
- 2) Receive the coolant overflowing together with the air through the ventilation pipeline, and separate the air in the cooling system.
- 3) Reverse a certain amount of coolant to compensate the leakage.
- 4) Stabilize and limit the pressure in cooling system.
- 5) Facilitate to fill the coolant and inspect the coolant level.

For the cooling system of WP7 series diesel engine, an independent or semi-independent expansion tank must be equipped. The pressure in the expansion tank should be maintained at 50kPa, the mounting position of expansion tank should be higher than diesel engine and radiator by 400mm, and should be at the top point of the circulative pipeline of whole cooling system. If needed, expansion tank internal partition should be designed to avoid severe coolant sloshing in case of accelerating, decelerating or cornering etc.

The expansion tank capacity should be greater than or equal to the 15% of total coolant capacity of cooling system and the air capacity should be 7~12% of total coolant capacity. This means that: for the first time, the coolant can be filled up to 60% of the expansion tank capacity and the remaining is used for coolant expansion.

4.9.5 Fan

Basic- type WP7 series diesel engine adopts the circular plastic fan that is driven through silicon-oil clutch (namely viscous transmission). According to the user requirements, rigid transmission is available. The viscous fan is controlled by bimetal temperature sensor, which could not only save the energy, but also ensure the diesel engine possess the good heat state, benefiting the diesel engine running and useful life.

4.10 Fuel system

4.10.1 Functions and work processes

WP7 diesel engine fuel supply system mainly consists of fuel injection pump, high-pressure fuel pipe, fuel injector, common rail pipe, ECU, fuel filter, and low-pressure fuel pipe etc.

Functions: according to the diesel engine work conditions to inject the atomized fuel with set quantity and set pressure into the combustion chamber timely. Thus, the atomized fuel could evenly mix with the air, to realize the combustion and work.

Work processes: as the diesel engine works, the fuel delivery pump could pump the precipitated and clean diesel in the fuel tank into the diesel filter through the low-pressure fuel pipe for further filtration with two parallel paper filter elements. At last, the fuel is fed into the low-pressure fuel chamber in the fuel injection pump.

4.10.2 Removal, inspection, maintenance and assembly of fuel injection pump

4.10.2.1 Exploded view of fuel injection pump

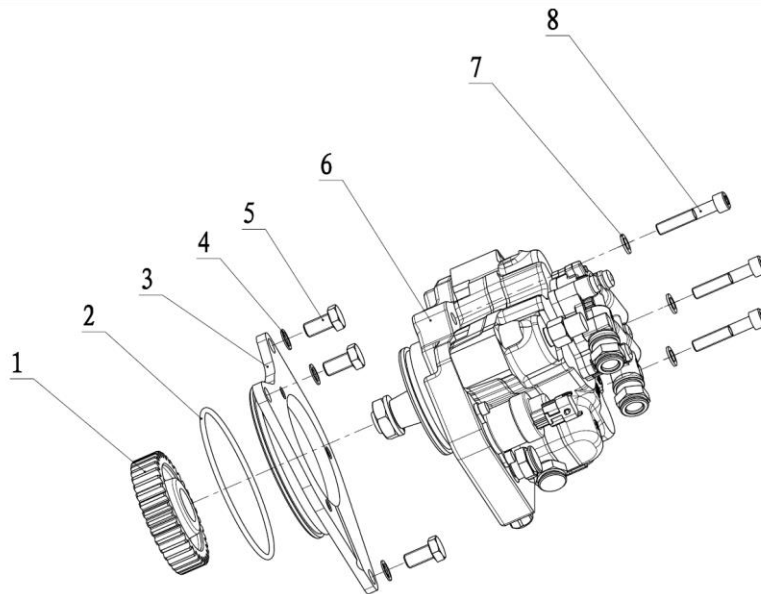


Fig. 4-51. Exploded view of high-pressure fuel pump

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	喷油泵齿轮	Fuel Injection Pump Gear
2	O形密封圈	O-ring
3	喷油泵法兰	Fuel Injection Pump Flange
4	波形弹性垫圈	Wave spring washer
5	六角头螺栓	Hexagon Bolt
6	喷油泵	Fuel Injection Pump
7	波形弹性垫圈	Wave spring washer
8	内六角圆柱头螺钉	Hexagon socket head cap screw

4.10.2.2 Removal steps of fuel injection pump

- 1) Remove the hexagon bolts attached the fuel injection pump flange to the gear chamber.
- 2) Remove the fuel injection pump and gear set from the engine.
- 3) Remove the lock nuts attached to the fuel injection pump and fuel injection pump gear.
- 4) Remove the hexagon socket head cap screws attached the fuel injection pump to the flange.
- 5) Remove the fuel injection pump flange.

4.10.2.3 Inspection and maintenance of fuel injection pump

- 1) Check whether the threads at the front end of camshaft of fuel injection pump are damaged.
- 2) Check whether the connector of fuel metering unit is damaged, and whether the pins are rusted or bent etc.
- 3) Check whether the high/low-pressure fuel port is damaged, or whether there is foreign material on it.

4.10.2.4 Installation steps of fuel injection pump

- 1) Assembly the fuel injection pump flange and fuel injection pump. Apply a little lubricating oil to the rubber ring of fuel injection pump.
- 2) Install the M8 hexagon socket head cap screws attached the fuel injection pump to the flange and then tighten them to (30 ± 5) Nm.
- 3) Install the fuel injection pump gear and then tighten the lock nuts (M18×1.5) of fuel injection pump gear to (105 ± 5) Nm.
- 4) Install the fuel injection pump set and fix the bolts. The O-ring on the fuel injection pump flange should be coated with lubricating oil. When mounting, the O-ring should not be excessively tensioned but slowly set it onto the positioning flange to prevent the O-ring from being damaged.

4.10.3 Removal, inspection, maintenance and assembly of high-pressure fuel pipe

4.10.3.1 Exploded view of high-pressure fuel pipe

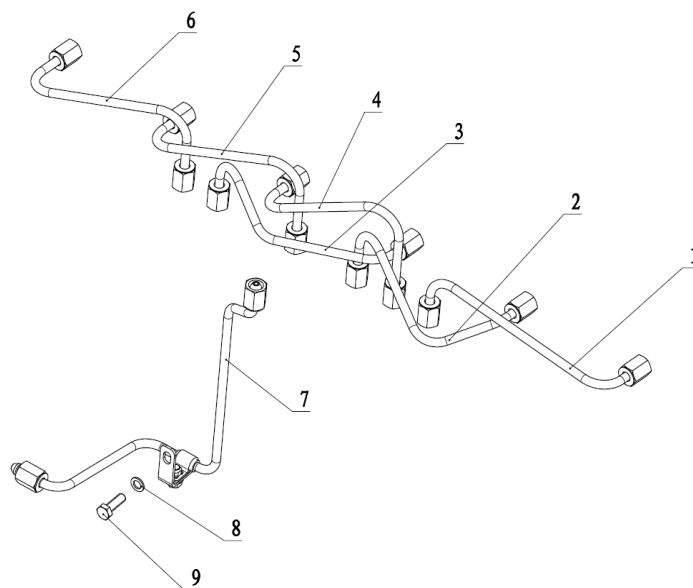


Fig. 4-52. Exploded view of high-pressure fuel pump

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	第<1>缸 高压油管总成	Cylinder 1 High-pressure Fuel Pipe Assembly
2	第<2>缸高压油管总成	Cylinder 2 High-pressure Fuel Pipe Assembly
3	第<3>缸 高压油管总成	Cylinder 3 High-pressure Fuel Pipe Assembly
4	第<4>缸	Cylinder 4
	高压油管总成	High-pressure Fuel Pipe Assembly
5	第<5>缸 高压油管总成	Cylinder 5 High-pressure Fuel Pipe Assembly
6	第<6>缸 高压油管总成	Cylinder 6 High-pressure Fuel Pipe Assembly
7	泵到轨 高压油管总成	Pump to Rail High-pressure Fuel Pipe Assembly
8	弹簧垫圈	Spring Washer
9	六角头螺栓	Hexagon Bolt

4.10.3.2 Removal steps of high-pressure fuel pipe

- 1) Remove the bracket of high-pressure fuel pipe.
- 2) Remove the high-pressure fuel pipe.

4.10.3.3 Inspection and maintenance of high-pressure fuel pipe

- 1) Check the both joints of high-pressure fuel pipe for severe deformation or obvious indentation.
- 2) Check whether there is foreign material on the high-pressure fuel pipe.

4.10.3.4 Installation steps of high-pressure fuel pipe

The installation should be performed in the reverse order of removal.

Note: the nuts attached to high-pressure fuel pipe should be tightened to: 35-45Nm (fuel injector end) and to 35-45Nm (rail end and fuel pump end).

4.10.4 Removal, inspection, maintenance and assembly of fuel injector

4.10.4.1 Exploded view of fuel injector

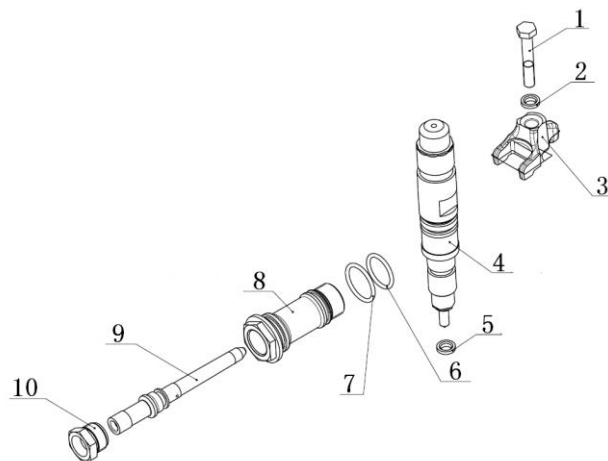


Fig. 4-53 Exploded view of fuel injector

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	六角头螺栓	Hexagon Bolt
2	球面垫圈	Spherical Washer
3	喷油器压板	Fuel Injector Clamp
4	喷油器	Fuel Injector
5	密封垫圈	Sealing Washer
6	O形密封圈	O-ring
7	O形密封圈	O-ring
8	高压连接器外套	Thread Sleeve
9	高压接头	High-pressure Connector
10	压紧螺套	Gland Nut

4.10.4.2 Removal steps of fuel injector

- 1) Loosen the hexagon bolt attached to clamp of fuel injector to remove the clamping block.
- 2) Loosen the gland nut and remove the high-pressure connector.
- 3) Remove the fuel injector and nozzle end gasket with special tools.

4.10.4.3 Inspection and maintenance of fuel injector

- 1) The replacement of fuel injector nozzle should be done by the Bosch service station.
- 2) Fuel injector nameplate is engraved.
- 3) Engraving position: At the solenoid valve on the top of fuel injector.
- 4) Engraving specifications: 1st line: fuel injector model;
2nd line: Weichai parts No.;
3rd line: Bosch parts No.
- 5) Note: the fuel injector with different part No. cannot be exchanged.

4.10.4.4 Installation steps of fuel injector

Sequence to install the fuel injector and high-pressure connector:

The following parts should be applied with lubricating oil: O-rings of both fuel injector and high-pressure connector, seal ring of gland nut, thread of high-pressure connector and contact surfaces between the nut and connector. Before installation, remove all the protecting caps. (Note: As the surface lubrication treatment of O-rings of both fuel injector and high-pressure connector have been carried out by BOSCH, lubricating oil can be omitted during installation.)

- 1) Put the fuel injector into the cylinder head and then tighten the clamp bolt of the fuel injector to 3N·m.
- 2) Loosen the clamp bolt of fuel injector to make the axial force acting on the fuel injector be equal to 0kN.
- 3) Screw the gland nut with seal ring into the cylinder head with torque of 60-90Nm.
- 4) Pretighten the high-pressure connector (nut) to 15-20Nm.
- 5) Pretighten the clamp bolts of the fuel injector to 8Nm and rotate it by 90°.
- 6) Tighten the high-pressure connector (nut) to 50-60Nm.
- 7) High-pressure connector, O-ring and gasket are disposable.

4.10.5 Removal, inspection, maintenance and assembly of common rail

4.10.5.1 Exploded view of common rail

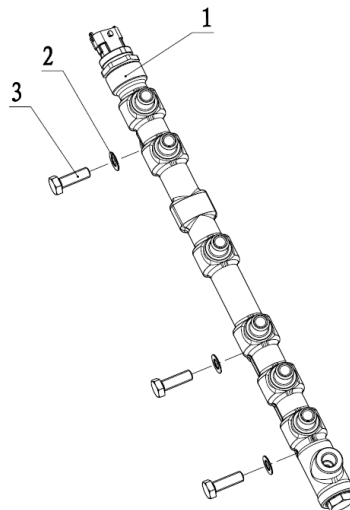


Fig. 4-54 Exploded view of common rail

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	共轨管	Common Rail
2	波形弹性垫圈	Wave Spring Washer
3	六角头螺栓	Hexagon Bolt

4.10.5.2 Removal steps of common rail

- 1) Remove the three bolts attached to common rail.
- 2) Remove the common rail.

4.10.5.3 Inspection and maintenance of common rail

- 1) Check whether the connector of rail pressure sensor is damaged, or whether the pins are rusted or bent etc. If needed, replace the common rail.
- 2) Check whether the high/low-pressure fuel port is damaged, or whether there is foreign material on it. If damaged, replace the common rail.

4.10.5.4 Installation steps of common rail

The installation should be performed in the reverse order of removal.

4.10.6 Removal, inspection, maintenance and assembly of ECU

4.10.6.1 Exploded view of ECU

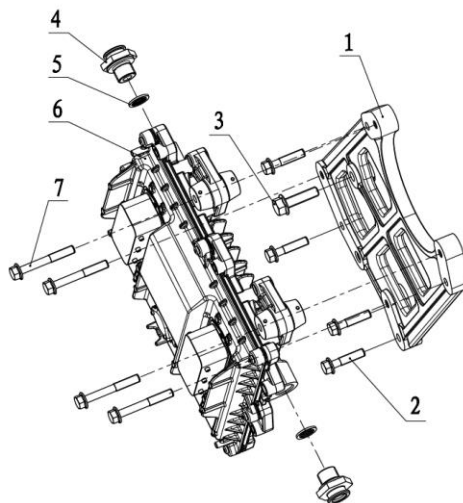


Fig. 4-55 Exploded view of ECU

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	ECU支架	ECU Bracket
2	六角法兰面螺栓	Hexagon Flange Bolt
3	六角法兰面螺栓	Hexagon Flange Bolt
4	管接头	Pipe Joint
5	组合密封垫圈	Sealing Washer
6	电控单元	Electronic Control Unit (ECU)
7	六角法兰面螺栓	Hexagon Flange Bolt

4.10.6.2 Removal steps of ECU

4.10.6.3 Inspection and maintenance of ECU

- 1) Check whether the pins inside of ECU connector could work normally. In case of pins rusted, bent, broken or lost etc., replace the ECU.
- 2) Check whether the ECU connector (plastic part) is damaged. If the locking or sealing part is damaged, replace the ECU.

4.10.6.4 Installation steps of ECU

The installation should be performed in the reverse order of removal.

4.10.7 Removal, inspection, maintenance and assembly of fuel filter

4.10.7.1 Exploded view of fuel filter

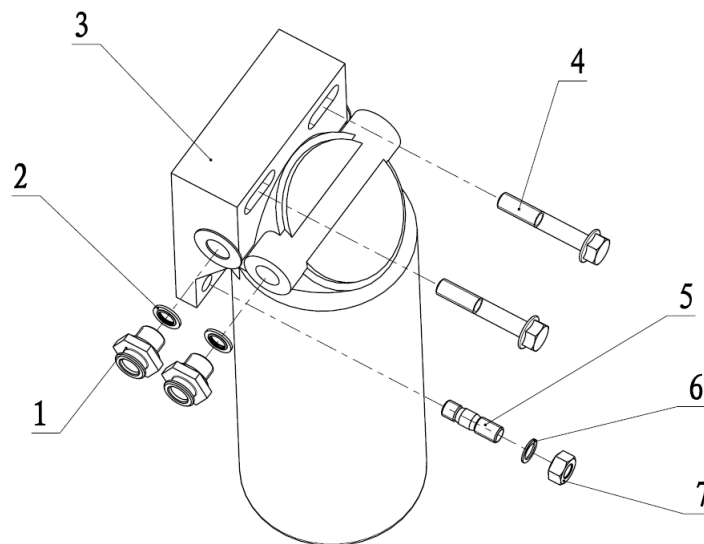


Fig. 4-56 Exploded view of fine fuel filter

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	管接头	Pipe Joint
2	组合密封垫圈	Sealing Washer
3	燃油精滤器	Fine Fuel Filter
4	六角法兰面螺栓	Hexagon Flange Bolt
5	双头螺柱	Stud
6	波形弹性垫圈	Wave Spring Washer
7	1型六角螺母	Hexagon Nut, Style 1-Fine Pitch Thread

4.10.7.2 Removal steps of fuel filter

- 1) Remove the two bolts and one nut attached to the fuel filter.

- 2) Remove the fine fuel filter.
- 3) Remove the pipe joints at the both ends of fuel fine filter.

4.10.7.3 Inspection and maintenance of fuel filter

For replacement of fuel filter, refer to the maintenance specification and the following steps:

- 1) Remove the old fuel filter element.
- 2) Lubricate the seal port.
- 3) Manually tighten the filter until its seal port connected to the interface.
- 4) Tighten up the filter with special tooling (about 3/4 turn).
- 5) Drain the air in the filter until no bubbles appear
- 6) Perform leak test.

4.10.7.4 Steps to remove the fuel filter

The installation should be performed in the reverse order of removal.

4.10.8 Removal, inspection, maintenance and assembly of low-pressure fuel pipe

4.10.8.1 Exploded view of low-pressure fuel pipe

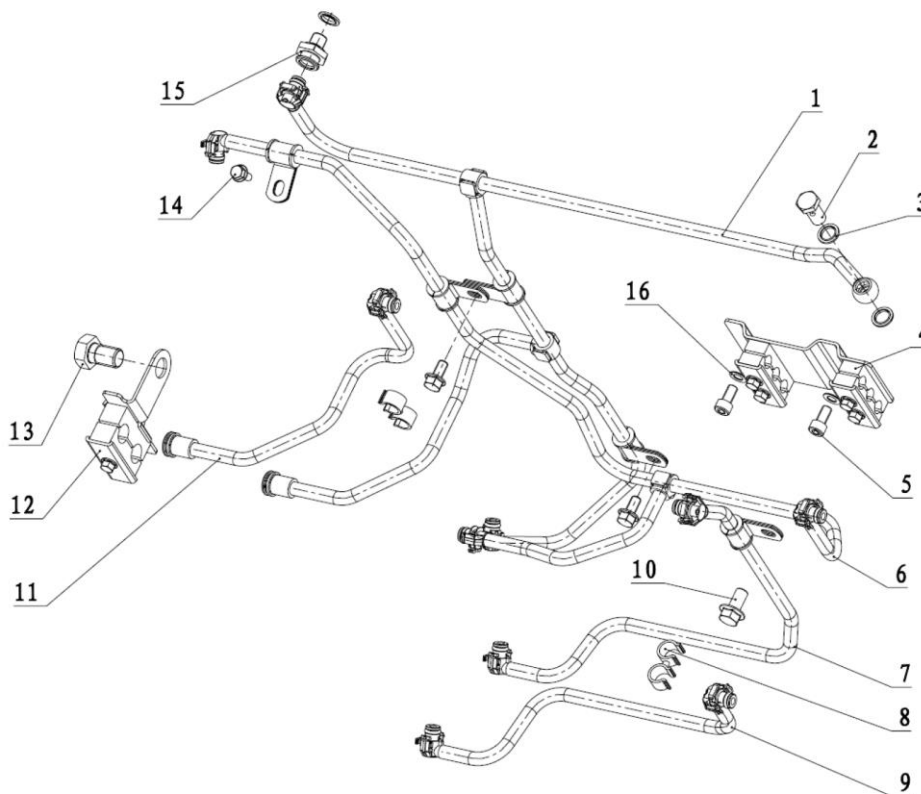


Fig. 4-57 Exploded view of low-pressure fuel pump

序号 Pos.	中文名称 Denomination	英文名称 Denomination
1	燃油回油管组件	Fuel Return Pipe Set
2	空心螺栓	Hollow Screw
3	组合密封垫圈	Sealing Washer
4	管夹总成	Pipe Clamp Assembly
5	内六角圆柱头螺钉	Hexagon socket head cap screw
6	精滤器-喷油泵燃油管总成	Fuel Pipe Assembly from Fuel Fine Filter to Fuel Injection Pump
7	ECU-输油泵燃油管总成	Fuel Pipe Assembly from ECU to Fuel Supply Pump
8	管卡	Pipe Clamp
9	输油泵-精滤器燃油管总成	Fuel Pipe Assembly from Fuel Supply Pump to Fuel Fine Filter
10	六角法兰面螺栓	Hexagon Flange Bolt
11	粗滤器-ECU燃油管总成	Fuel Pipe Assembly from Fuel Coarse Filter to ECU
12	管夹总成	Pipe Clamp Assembly
13	六角头螺栓	Hexagon Bolt
14	六角法兰面螺栓	Hexagon Flange Bolt
15	管接头	Pipe Joint
16	波形弹性垫圈	Wave Spring Washer

4.10.8.2 Removal steps of low-pressure fuel pipe

- 1) Remove the bolts attached to the fuel pipe clamps and the clamps.
- 2) Loosen the fuel-pipe quick-insert connector manually or with auxiliary tools, sequentially remove the low-pressure pipelines.

4.10.8.3 Inspection and maintenance of low-pressure fuel pipe

- 1) Check whether the locking set and seal ring of quick-insert connector are damaged. If damaged, replace the fuel pipe.
- 2) Check whether the fuel pipe is worn or broken. If so, replace the fuel pipe.
- 3) Check whether there is foreign material in the quick-insert connector, if so, remove it.

4.10.8.4 Installation steps of low-pressure fuel pipe

The installation should be performed in the reverse order of removal.

4.10.9 Precautions

- 1) Use the qualified fuel. Generally, in summer, use the 0# light diesel fuel and in winter, use the -10 light diesel fuel.
- 2) The fuel to be filled must be clean, free of any foreign material and moisture. Therefore, the fuel must be precipitated for 48h before being filled. The filter element and fuel delivery pump trainer should be periodically cleaned. The damaged ones should be timely replaced.
- 3) The fuel mixed with air could influence normal working of the fuel pump, therefore, the air in the fuel pump and low pressure pipe must be drained by loosening the relief valve and consistently pressing the hand pump on the fuel delivery pump if the fuel pump is stopped for long time or after the fuel pipe or joint is replaced.

4.11 Electrical system

The electrical system includes the alternator, starter, electric heating flange, pressure sensor, rpm sensor and relay etc.

4.11.1 Alternator

The alternator with transistor regulator of WP7 series diesel engine has the rated voltage of 28V. The alternator is connected to the battery in parallel and performs self excitation during working. The alternator circuit is shown in fig. 4-58.

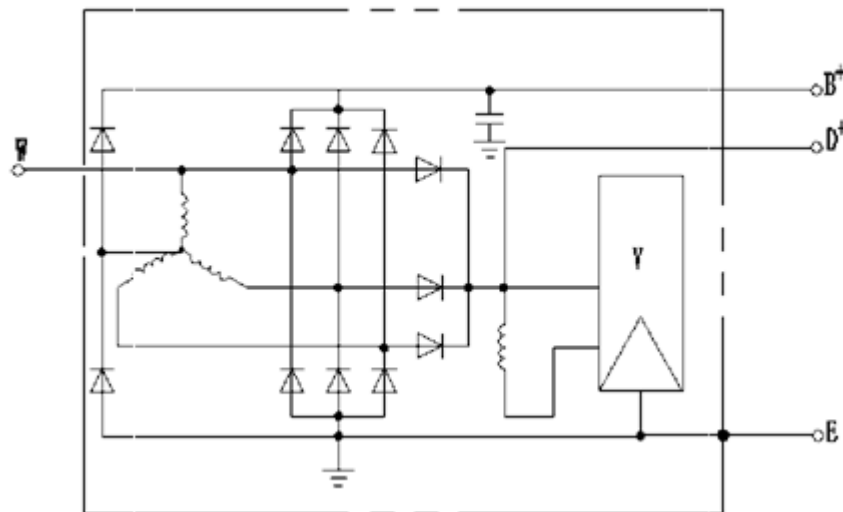


Fig. 4-58 Schematic diagram of alternator

Precautions in installing and wiring the alternator:

- ◆ The alternator must be cooled fully.
- ◆ The alternator must be dust-proof, splash-proof and resistant to oil.
- ◆ Check the tension of belt.
- ◆ The alternator can only be connected to the voltage regulator and battery.

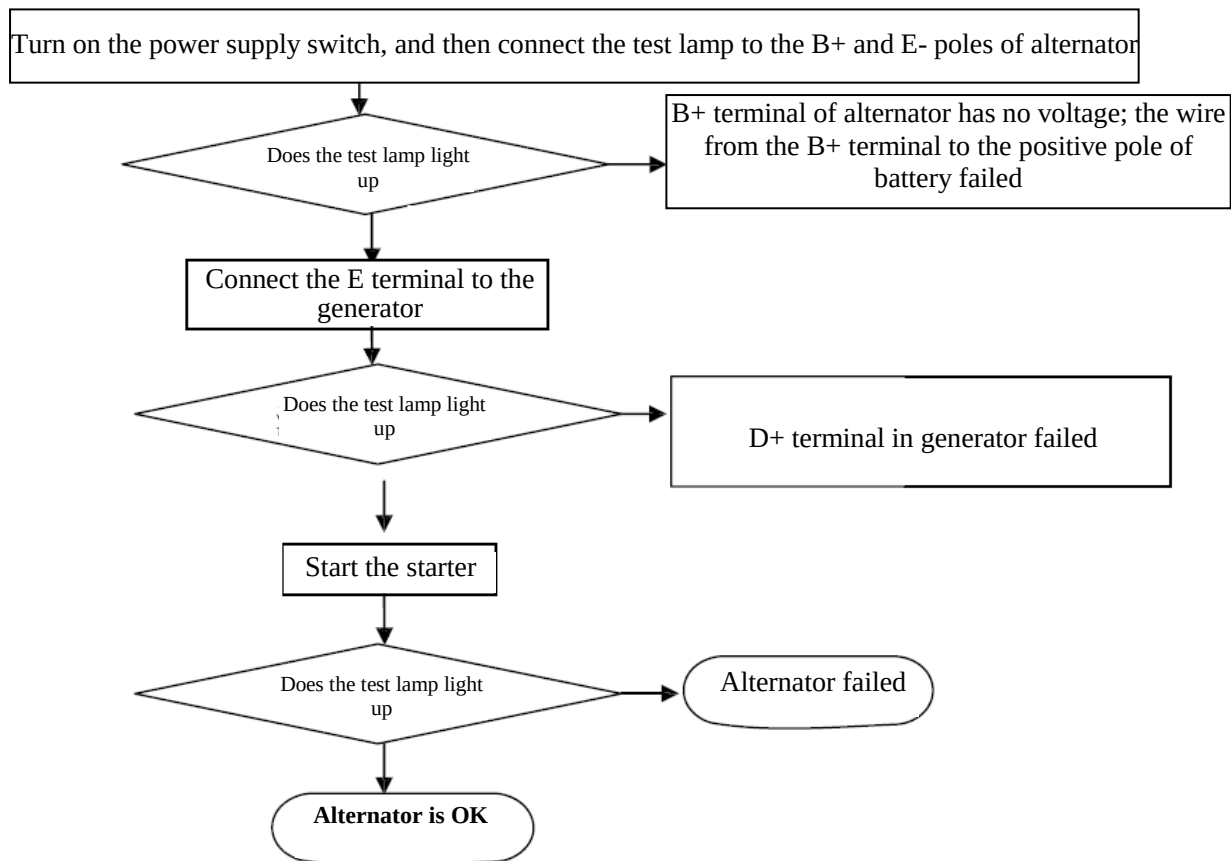


Fig. 4-52 Flow chart on diagnosis of generator failure

4.11.2 Starter

The Starter of WP7 series diesel engine is of DC starter with solenoid control, gear drive, and friction disc type one-way clutch for torque transmission. Its power is 5.4kW. The starter circuit is shown in fig. 4-59.

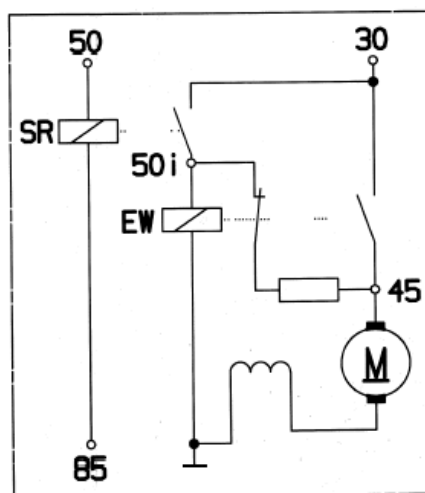


Fig. 4-60 Starter circuit

In order to ensure the starter could work normally, pay attention to that:

- ◆ Protect water, mud or oil splashing, install protective shield if necessary.
- ◆ The allowable temperature of starter housing should not be higher than 100°C.
- ◆ If the driver cannot monitor the starting procedure, for example, the commercial vehicle with the starter installed at the tail, the starter relay must be installed in order to protect the starter and the gears. Besides, the starter relay

must have the current capacity higher than 80A. As soon as the diesel engine normally works, cut off the starter circuit immediately. The axis of starter relay must be parallel to the ground and vertical to the vehicle running direction to prevent against the vibration and shock that could lead to starter being accidentally engaged.

4.12 After treatment system

4.12.1 Adblue pump

4.12.1.1 AdBlue pump structure

The function of AdBlue pump is to pressurize the adblue in the adblue tank and pump it to the dosing module and pump the excess AdBlue back to the tank, maintaining the system pressure at 9bar. After the engine is switched off, The AdBlue pump should suck the AdBlue in the system back to the tank to avoid system failure caused by the residual. The appearance structure of Bosch DeNOx 2.2 system AdBlue pump is shown in Fig. 4-61.

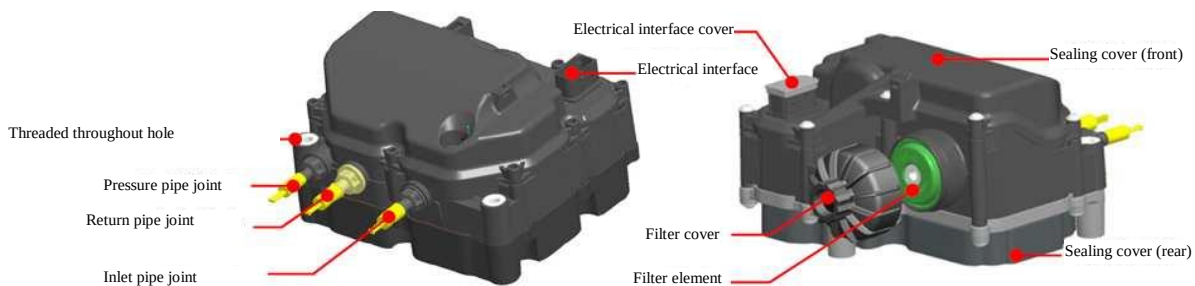


Fig. 4-61 DeNOx2.2 system AdBlue pump structure

The AdBlue pump has three hydraulic pipeline joints: inlet pipe joint, return pipe joint and pressure pipe joint, providing the Adblue pipeline from the tank to the dosing module.

The joint specifications should meet the requirements in SAE J2044 standard. The specifications and definitions of three joints are shown in table 4-7.

Table 4-7 DeNOx 2.2 AdBlue pump joint specifications and definitions

Name	Specifications	Description
Inlet pipe joint	SAE J2044 3/8"	Inlet, connected to the AdBlue suction pipe
Return pipe joint	SAE J2044 3/8"	Outlet, connected to the AdBlue return pipe
Pressure pipe joint	SAE J2044 5/16"	Outlet, connected to the AdBlue pressure pipe

When installing the AdBlue pipe, be sure to confirm that the AdBlue pipe joint is well matching with the joint on pump. Otherwise, the system cannot work normally.

A replaceable filter is designed in the AdBlue pump to prevent the particles in the AdBlue (diameter $>30\mu\text{m}$) from entering the injection valve. Besides, the filter element and attached balance elements should be periodically replaced.

An electrical interface is designed on the front end seal cover of AdBlue pump serving as DCU/ECU control interface.

4.12.1.2 Installation of AdBlue pump

The AdBlue pump requires very high cleanness, shown in fig. 4-62, therefore, do not remove the protective caps until this pump is to be installed.



Fig. 4-62 Before installation, remove the protective caps

Remove the protective caps and install the pump on the vehicle properly to ensure the system could work normally. For Weichai integrated-type AdBlue pump, the AdBlue pump can be directly installed onto the corresponding place on the AdBlue tank.

For the non-integrated type AdBlue pump, install the AdBlue pump according to fig. 4-63. On the front view, the allowable installation angle for the AdBlue pump is in between 315° and 45°. In case of exceeding the range, the system cannot work normally. On the side view (parallel to the gravity direction), it is allowed that the AdBlue pump is installed between 315° and 45°. In case of exceeding this range, the AdBlue could retain in the pump.

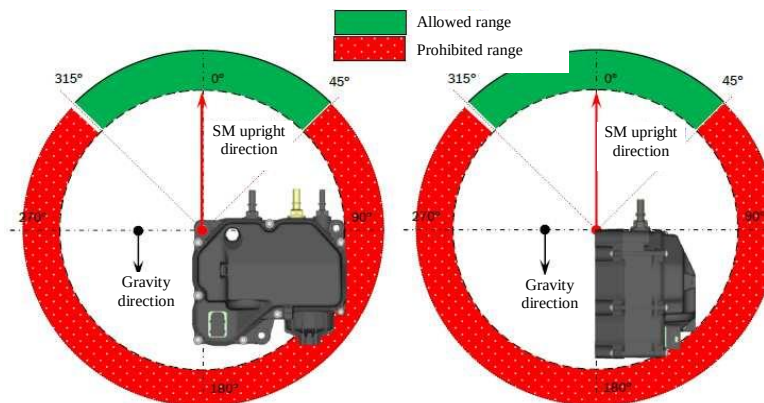


Fig. 4-63 Installation angle of AdBlue pump

Left: front view and right: side view

There are three installation holes on the AdBlue pump (fig. 4-64). The minimum bolt length is 90mm. The isolating plate should be used with the surface contact pressure of 260N/mm². It is suggested that the torque should be 19Nm±20%.

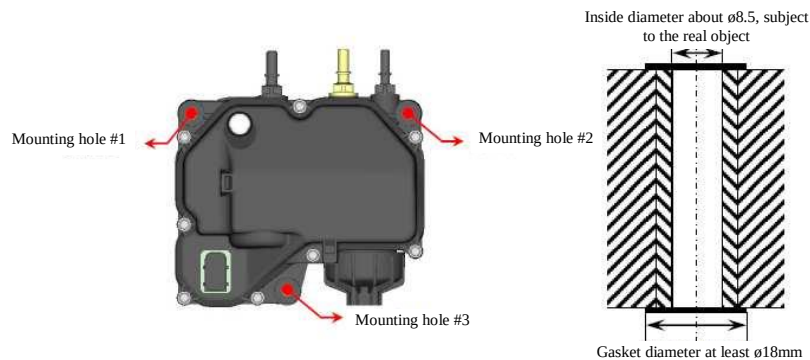


Fig. 4-64 Positions and dimensions of AdBlue pump installation holes

4.12.1.3 Maintenance of AdBlue pump

AdBlue pump filter element in DeNOx 2.2 system should be replaced every three years or 100,000km. In case of severe working environment, replace it according to the practical conditions. Before replacing, clean the outside surface of AdBlue pump. During installation, filter element must not be polluted. The filter cap should be tightened to 20Nm+5Nm.

Table 4-8 Replacement steps of AdBlue pump filter element

1	Screw off the filter cover with 27mm wrench (DIN3124/SO2725-1).	
2	Remove the balancer.	
3	If the filter element is gray, use the gray end of special tool; if the filter element is black, use the black end. Insert the correct tool end into the filter element until “Click” is heard, which means the tool is in place.	
4	Pull the filter element out. If needed, use the grooves of tools and other tools.	
5	Use the water to clean the outside of filter element cap.	

6	Lubricate the O-rings at both ends of HCF filter element, install the filter elements. (MobilVelociteNo.6 is recommended, as other lubricant could lead to failure.).	
7	Torque the filter cap to 20+5Nm with 27mm wrench (DIN3124/ISO2715-1).	

To fix the harness of AdBlue pump, it is required that the distance from 1st fixing point of harness to the joint should be less than 200mm. The fixing point and part to be fixed should be on the same vibration source.

4.12.2 AdBlue dosing module

4.12.2.1 Structure of AdBlue dosing module

The function of AdBlue dosing module is to spray the pressurized AdBlue by the AdBlue pump into the exhaust gas. The appearance structure of AdBlue dosing module is shown in Fig. 4-65, including one AdBlue pipe joint and two coolant pipe joint of which specifications should confirm to the SAEJ2044 standard. The size of AdBlue pipe joint is 5/16" and is connected to the AdBlue pressure pipe.

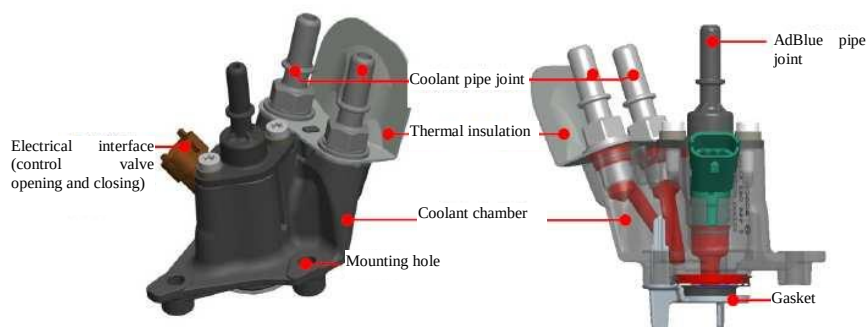


Fig. 4-65 Structure of AdBlue dosing module

The size of the two coolant pipe joints are of 3/8", the two joints are respectively the return port and inlet port of coolant for cooling the AdBlue dosing module to prevent failure at high temperature. The coolant-inlet and

coolant-return pipe joints can be replaceable. For the position of coolant intake on the engine, please refer to the coolant intake and coolant return positions for AdBlue tank.

4.12.2.2 Installation of AdBlue dosing module

The AdBlue dosing module requires very high cleanness (fig. 4-66), therefore, do not remove the protective caps until the dosing module is to be installed.

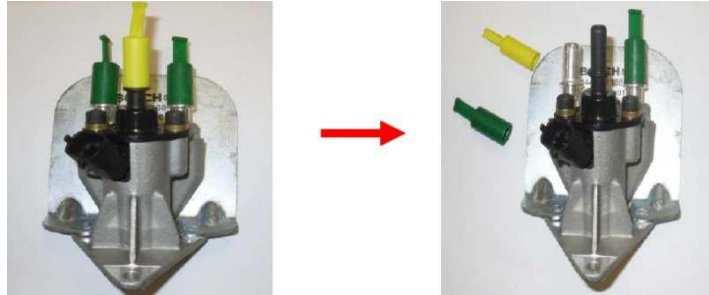


Fig. 4-66 Before installation, remove the protective caps

In order to ensure the system could effectively work, the AdBlue dosing module should be correctly installed on the vehicle.

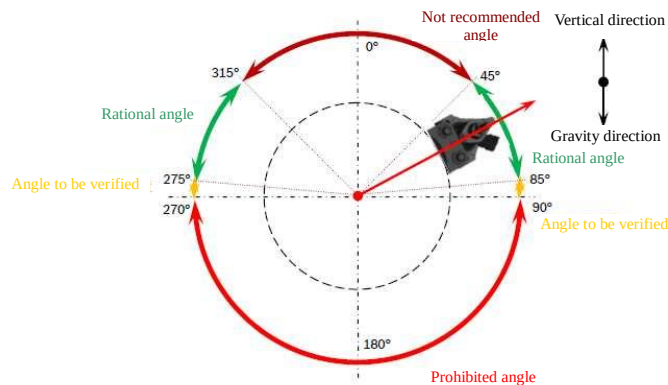


Fig. 4-67 Schematic of installation angle of dosing module on the straight pipeline

Install the dosing module according to the requirements in fig. 4-67. The best installation angle range should be from 45° to 85° and from 275° to 315°. If the exhaust pipe is so designed that it could sufficiently avoid the AdBlue and soot in the exhaust gas from accumulating on the pipe wall, it is acceptable that the angle range from 85° to 90° and 270° to 275°. The angle from 315° to 45° is not suggested, as the dosing module may overheat. The angle from 85° to 275° is prohibited, as the dosing module may be blocked by urea crystals or soot.

The dosing module can be installed onto the straight pipeline and bend pipeline. For the straight pipeline, it is suggested that the installation angle is 30°. For the installation on bend pipeline, refer to fig. 4-68 (right) and the dosing module should be installed as near as possible to the corner to have the AdBlue injected into the straight pipeline section along the gas flow direction. The dosing module angle should increase by 3-5° by approaching the center line of exhaust pipe to compensate the deflection due to exhaust flowing.

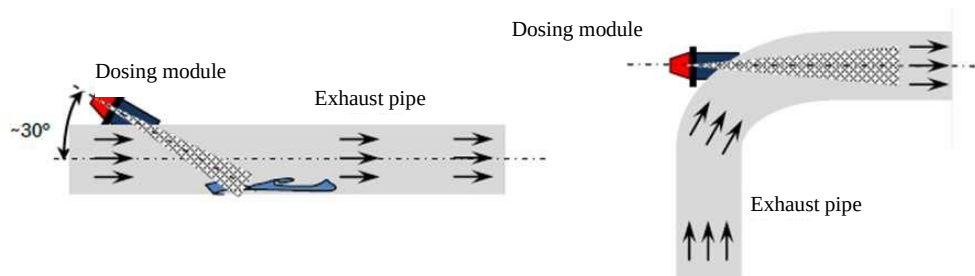


Fig. 4-68 Schematic of installation inclination of dosing module on straight exhaust pipe (left) and bend pipe

(right)

The installation sequence of dosing module is shown in fig. 4-69: firstly fix the mounting hole #1 and then the mounting holes #2 and #3. The min diameter of contact surface (screw cap or gasket) should be 12mm and the max contact pressure is 180N/mm². It is suggested that the torque should be 8±2Nm (reference value of friction coefficient is 0.14). The shortest screw length should be 20mm.

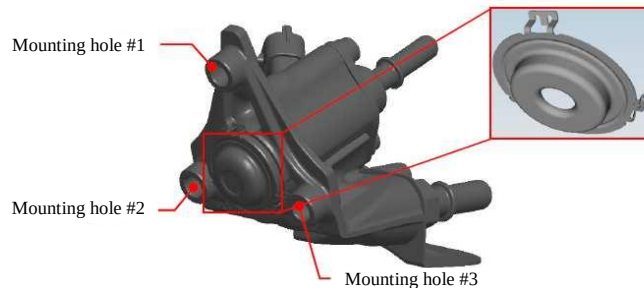


Fig. 4-69 Dosing module installation order

The gasket at the bottom of dosing module is disposable and should be replaced after each removal. The replacement process is shown in Fig. 4-70. When replacing, poke the three contact points on the disc by using a tweezers (do not use the sharp tools to pry the edges) and then remove it. Clean the seal area but do not contact the dosing module. Then reinstall the new gasket.



Fig. 4-70 Replacement of dosing module gasket

To fix the dosing module harness, the distance from the 1st fixing point of harness to the joint should be less than 100mm. Besides, harness installation position should share the same vibration source with the dosing module.

4.12.3 AdBlue tank

4.12.3.1 Appearance of AdBlue tank

The AdBlue tank is used to store the AdBlue. The Weichai integrated-type adblue tank is integrated h the AdBlue pump on the tank. The appearance of Weichai integrated AdBlue tank is shown in Fig. 4-71.

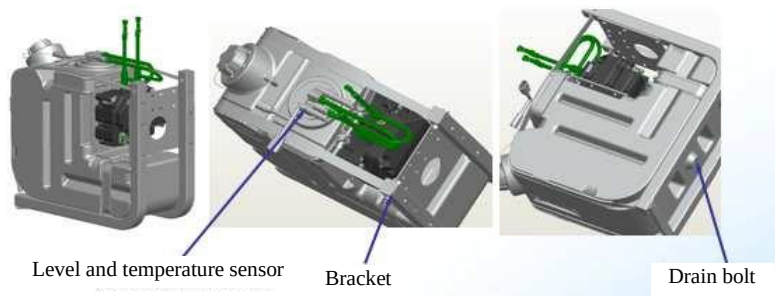


Fig. 4-71 Weichai integrated AdBlue tank

The appearance of level and temperature sensor is shown in Fig. 4-72. For the specifications and definitions of AdBlue return/outlet joints and coolant inlet and /return joints, see the table 4-9.

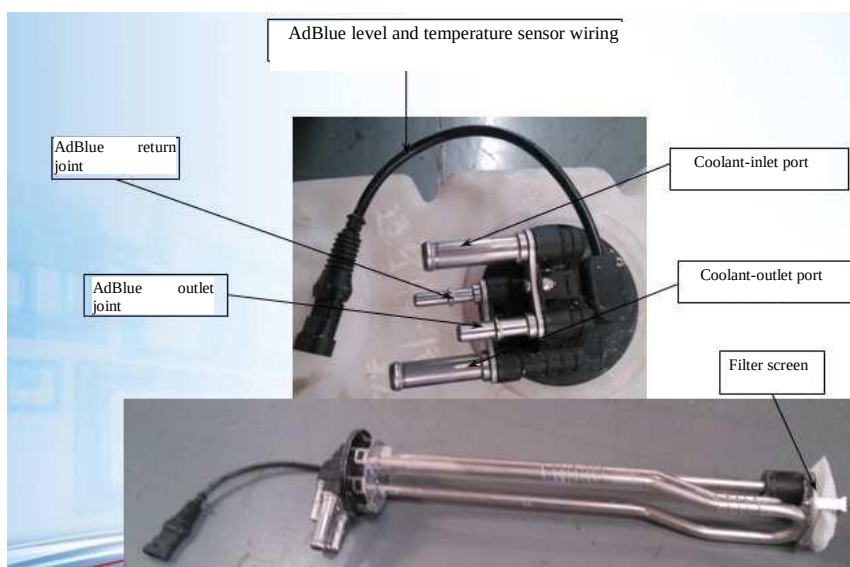


Fig. 4-72 Level and temperature sensor

Table 4-9 Specifications and definitions for AdBlue return/outlet joints of level and temperature sensor and coolant inlet/outlet

Name	Specifications	Description
AdBlue outlet pipe joint	SAE J2044 3/8"	Outlet, connected to the AdBlue suction pipe
AdBlue return pipe joint	SAE J2044 3/16"	Inlet, connected to the AdBlue return pipe
Coolant inlet	Outside diameter 14, inside diameter 10	Inlet, connected to the heating water inflow
Coolant outlet	Outside diameter 14, inside diameter 10	Outlet, connected to the heating water outflow

4.12.3.2 Installation of AdBlue tank

Before installing the AdBlue tank, ensure the interfaces of level and temperature sensor are well protected, as shown in fig. 4-73 to prevent the foreign material from entering the system pipeline.



Fig. 4-73 All interfaces of level and temperature sensor should be well protected

The AdBlue tank should be so designed that it is away from the heat sources, for example, the engine, transmission, SCR system and exhaust pipe etc. Otherwise, that could lead to the AdBlue deterioration.

The freezing point of AdBlue is -11.5°C . If the system works at low temperature, the AdBlue may freeze, leading to the system unable to work. Therefore, the AdBlue tank need unfreezing and needs to be heated by using the coolant. The heating pipeline is shown in fig. 4-74.

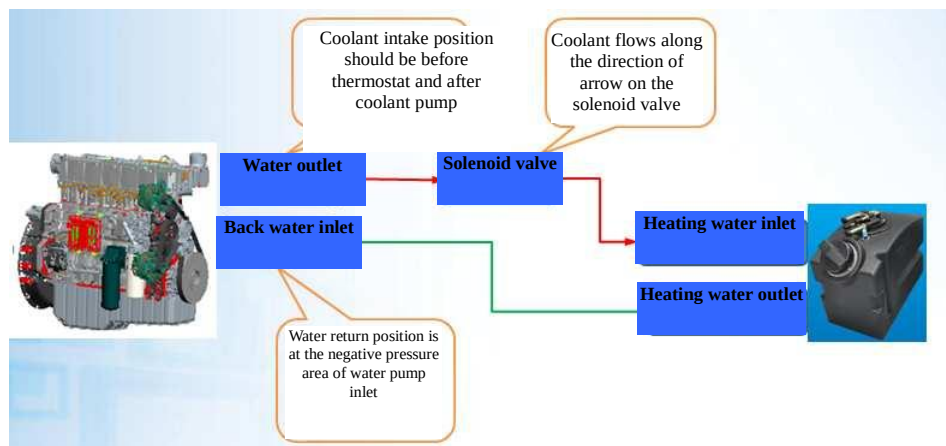


Fig. 4-74 System heating water flow direction

4.12.3.3 Maintenance of AdBlue tank

The max level in the AdBlue tank should be 100% of AdBlue filling capacity. If the AdBlue drops to 20% of AdBlue filling capacity, it is required to refill.

Each year when the engine is maintained, open the drain plug at the bottom of AdBlue tank to drain the sediment.

Irregularly check whether there is white crystal at the vent valve or filler port, if any, remove it with clean water or wipe it away with wet rag. If the vent valve is plugged, clean it with water or replace it.

Replace the filter screen in the tank every 2-3 years;

Irregular check whether the connector and pipeline joint are good.

4.12.4 AdBlue pipeline

Before installation, ensure that the both ends of AdBlue pipe are well protected, as shown in fig. 4-75, to prevent the dirt or foreign material from entering the system.



Fig. 4-75 Confirm that the protection is good before installation

The AdBlue pipeline should be correctly installed, which otherwise could lead to system unable to work normally. Before installation, confirm the Adblue pipe joint size and the quick connector model should match with that of tank, pump and dosing module. The matching of AdBlue pipe and pump and tank is shown in table 4-10.

Table 4-10 The matching of AdBlue pipe and pump and tank

Name	Pipe diameter /mm	Joint size	Description	Description
AdBlue suction pipe	Outside diameter 8, inside diameter 6	SAE J2044 3/8"	3/8 straight pipe connected to bend	Straight at the tank and bent at the pump
AdBlue pressure pipe	Outside diameter 8, inside diameter 7	SAEJ20443/16"	5/16 straight pipe connected to bend	Straight at the pump and bent at the dosing module
AdBlue return pipe	Outside diameter 8, inside diameter 7	SAEJ20443/16"	3/8 bend pipe connected to 5/16 straight pipe	Straight at the tank and bent at the pump
		SAEJ20443/8"		

During installation, the AdBlue pipe should not be bent; otherwise the system cannot work normally as shown in fig. 4-76.



Fig. 4-76 AdBlue pipe severely bent

4.12.5 DOC-DPF-SCR assembly

DOC-DPF-SCR assembly, as the barrel-shaped structure, integrates the DOC, DPF and SCR into one assembly. The appearance of DOC-DPF-SCR assembly is shown in fig. 4-77.

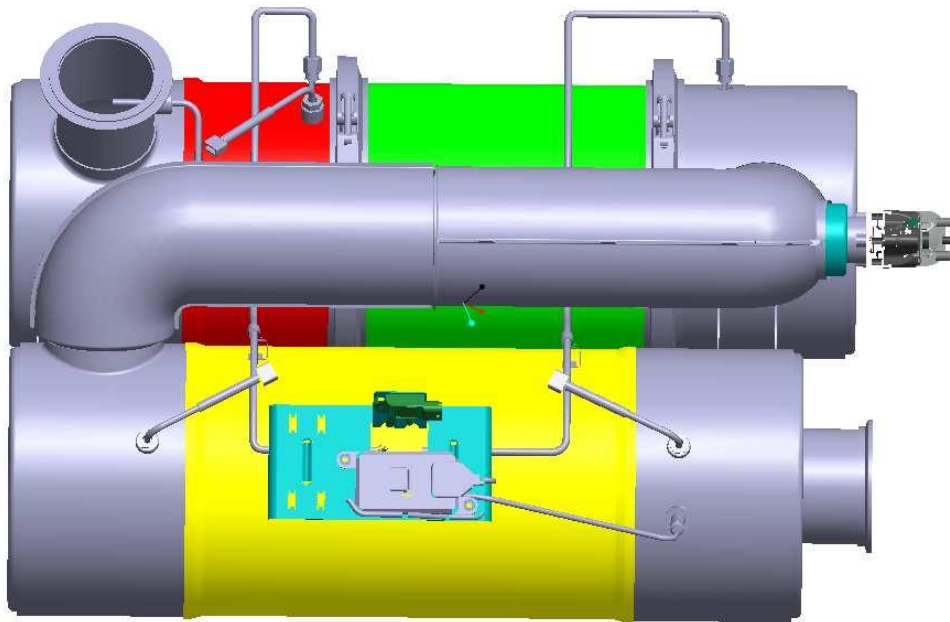
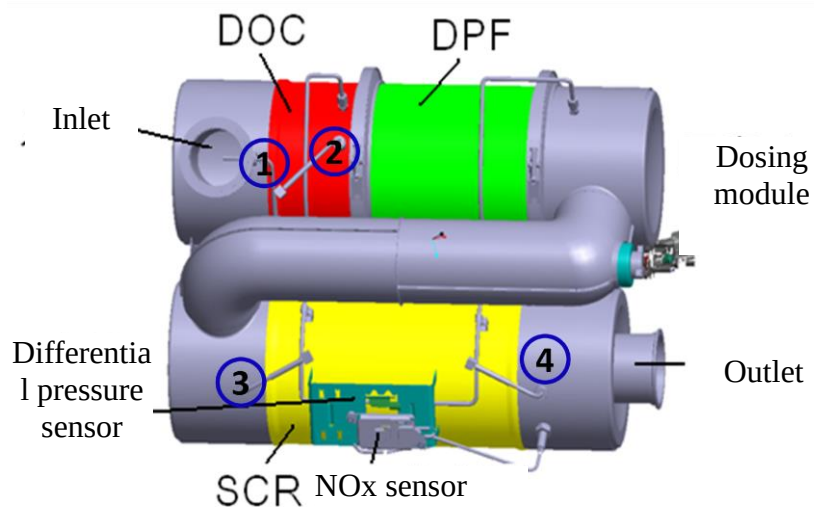


Fig. 4-77 Appearance of DOC-DPF-SCR assembly

On the DOC-DPF-SCR assembly, there is one dosing module, four exhaust temperature sensors, one NOx sensor and one differential pressure sensor, as shown in fig. 4-78.



- 1-Temperature sensor before DOC 2-Temperature sensor after DOC
3-Temperature sensor before SCR 4-Temperature sensor after SCR

Fig. 4-78 DOC-DPF-SCR assembly

4.12.6 Sensor

The sensors related to the after treatment system include the liquid level and temperature sensor integrated on the AdBlue tank, exhaust temperature sensor, NOx sensor, ambient temperature sensor and differential pressure sensor. Sensors in Euro-VI after treatment system mainly include two NOx sensors, four exhaust temperature sensors, one differential pressure sensor and one ambient temperature sensor.

There are two NO_x sensors: one sensor is installed on the exhaust pipe downstream of the turbocharger and upstream of DOC-DPF-SCR assembly and upstream of the nozzle of active DPF re-generation system; the other is installed on the DOC-DPF-SCR assembly and downstream of SCR. The NO_x sensor and exhaust temperature sensor are so installed that they are vertical to the gas flow direction. When installing the sensor assembly, adequate clearance should be reversed for removal. The NO_x sensor probe should be tightened to 50Nm. The harness should be away from the heat source. The exhaust temperature sensor should be tightened to 45Nm±5Nm.

Ambient temperature sensor should be mounted at the place reflecting the ambient temperature objectively so as to avoid the whole-vehicle heat source from influencing the sensor.

The NO_x sensor should be so installed onto the exhaust tail pipe and should be perpendicular to the exhaust pipe and angle should be in between -80° and 80°. The NO_x sensor and installation angle schematic is shown in fig. 4-79.

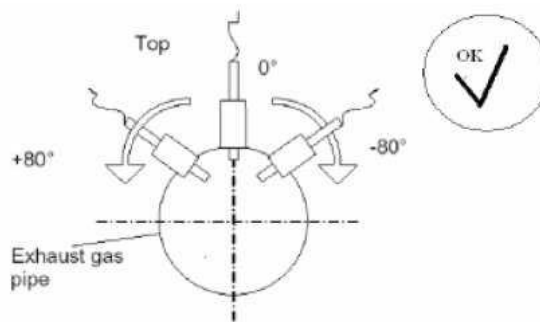


Fig. 4-79 NO_x sensor and installation angle

In order to avoid the signal transmission from being broken or failed due to the connector loosened or damaged because of vehicle vibration, the surplus harness should be fixed with clamps. The harness should not be severely bent, otherwise the wire will be easily damaged. Harness fixing requirements: L1>10mm, arc length L2>50mm, α is between 45°~135°. Each parameter is shown in fig. 4-80.

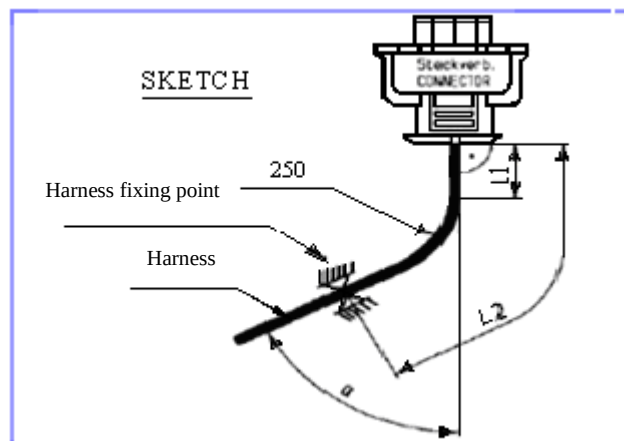


Fig. 4-80 Fixing of sensor and executor harness

Precautions in installing and fixing of the harness:

There should be no visible wire exposed to the air between the harness cable and connector. The insulation sleeve should be complete.

The harness should have the sufficient protection and be away from the sharp edge to avoid wear and short circuit during the vehicle running for long time.

It is required that the connector should be installed in place to avoid bringing the unnecessary trouble to the vehicle offline and diagnosis. Meanwhile, in order to ensure the communication is reliable, the harness should be bound or fixed orderly.

The harness must not be severely elbowed at the harness connector. Besides, the wire connectors should be free of oil contamination, water, scraps, dirt or other impurities. If the metal wire is exposed, wrap it with adhesive tape to avoid short-circuit.

The fixing method for the exhaust temperature sensor and NOx sensor harnesses is shown in fig. 4-81.



Fig. 4-81 Correct harness fixing method

4.12.7 AdBlue

In DeNOx 2.2 system, the international standard AdBlue with mass fraction of 32.5% should be used. The composition of AdBlue is shown in table 4-11. For more information of AdBlue, refer to DIN70070/ISO22241 standards.

Table 4-11 Adblue composition

Composition	Unit	Min.	Feature value	Max. value
Urea content (% by weight)	%	31.8	32.5	33.3
Alkalinity as NH ₃	%	—	—	0.2
Biuret (% by weight)	%	—	—	0.3
Insolubles	mg/kg	—	—	20
Phosphate (PO ₄)	mg/kg	—	—	0.5
Calcium	mg/kg	—	—	0.5
Iron	mg/kg	—	—	0.5
Copper	mg/kg	—	—	0.2
Zinc	mg/kg	—	—	0.2
Chromium	mg/kg	—	—	0.2
Aluminum	mg/kg	—	—	0.5
Nickel	mg/kg	—	—	0.2
Magnesium	mg/kg	—	—	0.5
Sodium	mg/kg	—	—	0.5
Potassium	mg/kg	—	—	0.5

Physical features related to AdBlue:

Solute	CO(NH ₂)
Solute molar mass	60.06g/mol
Solute concentration	32.5%
Density	1090.0kg/m ³
PH value	Alkalescence, 9.0~9.5
Corrosive	High
Characters	Colorless, weak pungent smell
Refraction ratio	1.3829
Condensation point	-11.5°C (relationship between urea concentration and condensation point is shown in fig. 4.2)
Boiling point	103°C
Viscosity (25°C)	About 1.4mPa·s
Thermal conductivity (25°C)	About 0.570W/m·K
Specific heat (25°C)	About 340kJ/kg·K
Surface tension (20°C)	Min. 65mN/m

AdBlue should be stored in closed container and be placed in the shady and dry warehouse, away from the strong oxidizing agent. Dump the Adblue directly into the tank is prohibited to prevent it from polluting the environment. It is suggested to use the special filling equipment.



AdBlue is corrosive to the skin, if it is splashed onto the skin or into eyes, quickly flush it away with water. If you feel pain, go to the hospital for help. If you accidentally swallow the **AdBlue**, emetic is prohibited, immediately go to the hospital for help.

4.12.8 Use and maintenance of DeNOx 2.2 system

According to the current China IV OBD regulations, if the AdBlue tank liquid level is less than 10%, its indicator on the instrument panel could light up for warning. In such case, fill the AdBlue timely.

The AdBlue should be supplied by the authorized dealers or professional manufacturer. At present, as the infrastructure for filling the AdBlue is not well perfect, the appropriate amount of AdBlue should be reserved to avoid lacking, which otherwise lead to engine torque being limited. It is prohibited to use privately prepared or disqualified AdBlue or replace it with other fluid, as the foreign material or metallic icon could affect the normally working of the system, shortening the service life, and the user is responsible for the loss caused thereby.

After the diesel engine is started, when the engine speed and exhaust temperature reaches the set values, the DeNOx 2.2 system begins to work. After the engine is stopped, the system enters into the reverse pumping stage, emptying the AdBlue in the system, which will last for 2-3 minutes and during which, do not cut off the main power supply.

After the DeNOx 2.2 system is closed (the whole reverse pump is over), the system can be stored at -40~25°C for 4 months or less time at high temperature, without removal. During storage, do not disconnect the hydraulic and electrical system. And avoid evaporation of the AdBlue in the dosing module and pump. It is suggested that the tank should be filled up with AdBlue before stop.

After the storage time limit is exceeded, pre-operate the system before starting with steps shown below:

- 1) Refill the tank with AdBlue;
2. Replace the filter in the pump;

3. Start DeNOx2.2 system.

If anomalies occurred during system startup,, stop starting and restart it after the DCU/ECU main relay is stopped (stopping period is dependent on the applications). If the system fails to start again, contact the service station for help.

As he DeNOx2.2 system should be inspected with the professional diagnostic instrument, therefore, this diagnostic instrument must be provided in the service station.



In the process of driving, if the MIL in the operator cabin lights up, timely go to the near service station for professional inspection.

If there is no diagnostic instrument, appearance inspection should be performed. If the AdBlue tank lamp on the instrument panel lights up, it means the AdBlue is less than 10%, timely fill it. For filling method, see section 4.12.3.3.

To replace or remove the dosing module, it is needed to stop the engine for one hour to cool the exhaust pipe. For installation process, see section 4.12.2.2. Pay attention to that the gasket at the bottom is disposable and should be replaced every time when installing.

Every 3 years or 100,000km, replace the AdBlue pump filter element. For the replacement process, see section 4.12.1.3.

Chapter V Tightening torque and method of key bolts of diesel engine

5.1 Main bearing bolts

The thread and supporting surface of four M18 bolts should be coated with lubricating oil before tightening by 4 times in the sequence shown in fig. 5-1

For the 1st time, tighten them by using low-torque pneumatic wrench.

At the 2nd time, reach 145Nm; at the 3rd time, rotate it by 50°; at last, the torque should reach $370 \pm 20 \text{ Nm}$.

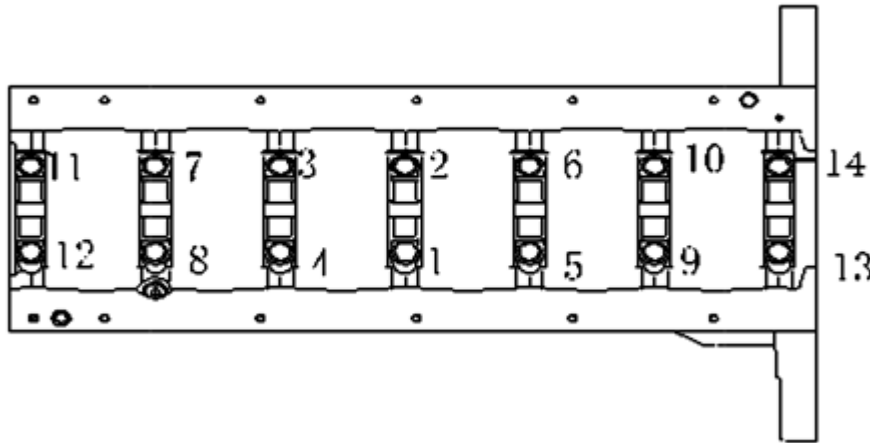


Fig. 5-1 Tightening sequence for main bearing bolts

5.2 Cylinder head bolts

Align the cylinder head, and then tighten, in five times, the cylinder head bolts of which threads and load-bearing surfaces should be applied with lubricating oil.

For the 1st time, tighten them by using low-torque pneumatic wrench.

At the 2nd time, reach 75Nm; at the 3rd time, rotate by 70° in sequence; at the 4th time, rotate by 70° in sequence; at the 5th time, rotate by 70° again to have the torque reach 240^{+30}_0 Nm .

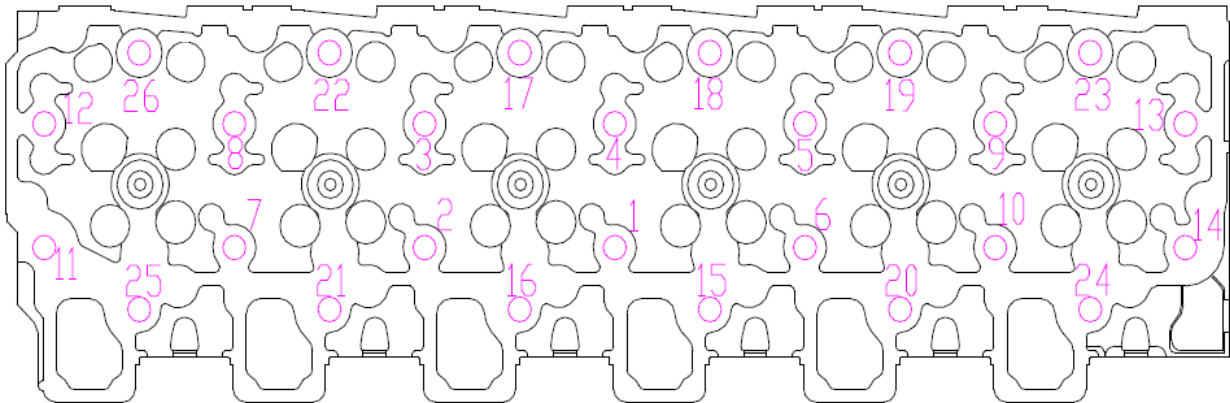


Fig. 5-2 Tightening sequence for cylinder head bolts

5.3 Connecting rod bolts

Manually tighten them: firstly screw on the bolts, then torque them to 45Nm symmetrically; at the 2nd time, rotate by 60°, at the 3rd time, rotate by 60° to reach 160^{+30}_0 Nm.

Note: The connecting rod bolts cannot be reused.

After the connecting rod bolts are tightened in place, do paint sealing.

5.4 Flywheel bolts

Manual tighten: apply lubricating oil on the threads and load-bearing surfaces of bolts and before screw on and then tighten them cross tighten to 50^{+20}_0 Nm, then rotate them by $70^\circ \pm 5^\circ$ for two times to have the torque reach 155 ± 5 Nm. If the torque of bolt cannot reach 155 ± 5 Nm, replace it. The flywheel bolts can be reused for two times.

5.5 Tightening torque and method of other bolts and nuts

Table 5-1 Bolts (nuts) and tightening requirements

Bolt name	Bolt size	Tightening specification	Overall length mm	Reusable times (including the initial installation)
Crankshaft pulley bolt	M12×1.5-10.9	110Nm+10Nm	35	2
Torsional vibration damper bolt	M10	20Nm+10Nm	48	2
Flywheel bolt	M12×1.5-10.9	155Nm+5Nm	85	2
High-pressure fuel pump bolt	M8	30Nm+5Nm	20	
Air compressor gear bolt	M20×1.5	200+50Nm		2
Rocker arm bracket bolt	M10	70Nm+7Nm	115	
Common rail pump gear nut	M18×1.5	105±5Nm		2
Fuel injector bolt	M8-8.8	8Nm+90°	50	3
Camshaft gear bolt	M8	32Nm+4Nm	22	2
Exhaust manifold bolt	M10	65Nm-80Nm	90	2
Water pump bolt	M8	23Nm+5Nm		

Table 5-2 Tightening torques of standard bolts

Bolt name	Bolt size	Tightening specification	Bolt size	Tightening specification
Standard M6 bolt	8.8	8Nm	10.9	13Nm
Standard M8 bolt	8.8	22Nm	10.9	31Nm
Standard M10 bolt	8.8	39Nm	10.9	58Nm
Standard M12 bolt	8.8	70Nm	10.9	100Nm

- Note: ① The angle value means the rotated angle after the specified torque is reached.
- ② All bolts and nuts should meet the related requirements. The bolts and nuts with different strength grades should be correctly installed and not be exchanged. The reuse the bolt within the specified number of times, otherwise could lead to the severe consequence.