

Euro IV standard WP4 diesel engine

PREFACE

WP4 diesel engine is a high-speed engine line researched and developed by WeiChai manufacturer. WP4 diesel engine has outstanding technical indicators such as compact structure, reliable use, motivation, economy, ... and features such as quick start, simple operation, convenient repair and maintenance, especially the very advanced exhaust index, which can meet the international advanced exhaust standards.

This manual mainly includes remarkable notes, methods of care and maintenance, normal adjustments and inspections, diagnostics to correct common problems in the use of diesel engines applied for Euro IV standard WP4 vehicles. In the editing process, the systematic and comprehensive, simple and practical features shall be focused on. What we want to point out here is that the judgment of a diesel engine breakdown is a meticulous task, requiring a certain amount of knowledge and experience. Before finding out reason, it is not advisable to remove the engine in an arbitrary way to avoid an incorrect re-installation, which creates a more serious problem. Especially important parts such as electronic control systems, turbochargers, etc. for inspection or repair must have specialized equipment. Therefore customers who have neither experience nor specialized equipment should not arbitrarily disassemble or adjust the engine.

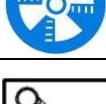
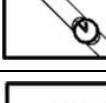
For the later upgraded products of this diesel engine line, the manufacturer will not make specifical notification for any change therein, customers can find out the latest product information on the website. <http://www.weichai.com>.

SPECIAL ATTENTIONS

- The operator of a diesel engine must, prior to operation, carefully read the manual for operation and maintenance, repair of diesel engines, strictly follow the operation and maintenance procedures specified by this manual.
- All engines of Weichai manufacturer have been tested strictly according to regulations before leaving the factory. Therefore, do not arbitrarily adjust ECU data, adjust engine capacity. The manufacturer will not be responsible for warranty if you violate the above reminders. Please pay attention to it.
- The turbine of the turbocharger is a high-speed rotating component part. When the machine is in operation, prohibit any objects (such as hands, tools, cotton yarn ...) near the entrance of the turbocharger to avoid damaging people or machines. No one other than repairmen or a Thaco authorized service technician can disassemble component parts of turbine.
- Important bolts will limit the number of uses (eg, the WP4 transmission bolt as a disposable bolt), should not be used beyond the limit.
- Categories of diesel and lubricating oil for engines must be in accordance with the regulations of the operation and maintenance manual and must be filtered through a dedicated filter. Diesel oil must undergo over 72 hours of deposition. Before driving, it's required to check and confirm whether the amount of coolant and lubricating oil are filled on demand.
- It is strictly forbidden for diesel engines to work in the absence of air filters, avoiding the case where the untreated air has entered the cylinder.
- The engine must stop for a long time then restart. After starting, it must speed up slowly, not to operate the engine at a high speed suddenly and run the idle speed too long (time of ilde speed must not exceed 3 minutes). After operating with a heavy load, do not immediately stop car (except in special cases), it must run at low speed for 5 to 10 minutes before stopping.
- After stopping the car, if the ambient temperature is likely to drop below 0 degrees, but there is no antifreeze additive in the coolant, then cooling water should be discharged inside the tank and in the engine.
- Inspection and repair of electrical equipment components must be carried out by qualified technicians.
- To prevent rust, the diesel engine, before leaving the factory, has been coated with an anti-rust oil. The duration of this anti-rust oil layer is 1 year, when it exceeds 1 year, it is recommended to check the engine and apply the necessary additional plan.
- When replacing major components or parts that affect exhaust emissions (tuborcharge, injection pumps, injectors, ECU, rear-discharge treatment systems, EGR systems), it's recommended to ensure that the manufacturer and model of rcomponent parts replaced with original components are similar. Otherwise, we will

not assume any responsibility for all consequences occurred.

EXPLANATION OF THE SIGNS

	Wear protective gloves		Danger of electric shock
	Wear protective clothing		Be careful to get injured by getting stuck in the machine
	Wear ear protection		Be careful to be caught
	Wear goggles		Be careful when hoisting heavy objects
	Wear a helmet		Be careful of hot steam
	Wear protective shoes		Be careful of explosion accident
	Wear protective masks		Be careful of corrosion
	Attention to ventilation		Be careful to be burned
	Control moment		Avoid rotating details
	Need to check		No fire
	Requirement on tools		No smoking
			No touching

The problems related to engine use, maintenance and repair are mostly caused by non-compliance with safety rules and basic precautions.

Users before operating, maintaining or repairing engines must be trained, have certain skills and must use appropriate tools.

Failure to follow the relevant guidelines in accordance with this manual may result in serious accidents. The manufacturer has not listed all the potential dangers, the rules and guidelines specified in this manual are not absolutely complete.

**NOTES WHEN DISMANTLING, INSTALLATING AND REPAIRING THE
ENGINE**

- Before repairs, it is necessary to prepare all necessary tools, specialized tools, measuring machines, etc., which are needed during the repair process.
- Suitable mounting brackets and lifting tools, using a lifting or jacking machine with enough lift to raise the engine, using chains, electrical cables or hoists for serving as lifting devices, do not use ropes.
- Before craning or flipping the engine, use specialized crane tools and flip tools.
- To properly use genuine parts, otherwise, it will reduce engine lifespan or cause injury to users.
- To make sure the repair place and surroundings are safe for operation.
- To ensure the repair shop or around the engine cleaned up.
- Before starting work, remove jewelry such as watches, rings ... and wear protective clothing during the operation.
- Before starting the work, check the protective equipment to see if it is still in use (glasses, gloves, shoes, masks, clothing, helmets, etc.)
- To prepare a fire extinguisher around the repair area.
- Do not allow battery fluid to come into contact with clothes, skin or eyes, otherwise it will burn the skin, burn clothes, and when charging the battery, it's recommended to avoid a spark or flame, etc.
- When dismantling complex components, prepare the corresponding marks at the place of removal or other signs.
- It's recommended to confirm whether the component parts after dismantling can be reused. See detailed instructions in this manual.
- It's recommended to periodically calibrate measuring devices.

NOTES

Since the variants of the company product is very abundant, the images inserted in this manual are for illustration purposes only, which may not be exactly the same as the actual product you are using, the specific structure will take the actual engine as a standard.

The symbols in the illustrated image show the steps to be noted in the process of operation or the conditions to be met. Please pay attention to it!

TABLE OF CONTENT

PART I. GUIDELINES FOR DIESEL ENGINE OPERATIONS	16
1. Drawings of external construction of the diesel engine	16
2. Symbol of diesel engine model	18
3. Basic parameters of diesel engine	18
4. Things to know when using a new diesel engine	19
5. Lifting and moving diesel engines	20
6. Unsealing new engine	20
7. Preparation before starting up the engine	21
8. Start-up diesel engine	21
9. Operate diesel engine	21
PART II. GUIDELINES FOR CARE, MAINTENANCE OF DIESEL ENGINE	24
1. Fuel, lubricant, coolant and admixtures	24
1.1. Fuel	24
1.2. Engine lubricating oil	24
1.3. Coolant	26
1.4. Urea solution	26
1.5. Admixture	28
2. Periodic maintenance cycle and regulations on engine maintenance	30
2.1. Periodic maintenance cycle	30
2.2. Regulations on engine maintenance	32
2.2.4. Daily checks	33
PART III: TYPICAL TROUBLES OF DIESEL ENGINE AND THE TREATMENTS	40
1. Diagnostic method	40
1.1. Traditional diagnostic methods	40
1.2. OBD trouble diagnosis system	41
2. Causes and methods to handle common problems of diesel engines	44
2.1. Low Nox conversion efficiency	44
2.2. Weak engine	45
2.3. The engine cannot start	48
2.4. Generator is inactive	51
2.5. Urea is constantly heated	52
2.6. Failure to create pressure urea	53
2.7. Urea consumes too little or does not consume	54
2.8. Urea consumption	56
2.9. Crystalline urea	57
2.10. Consumption of high lubricating oil	58
2.11. High fuel consumption	59

2.12. Trouble in Air compressor.....	61
2.13. Starter is inactive.	61
PART IV: INSTALLATION AND DISINSTALLATION OF ENGINE.....	63
1. General introduction.....	63
1.1. Warning symbols	63
1.2. Safety symbols	64
1.3. Tools used.....	65
1.4. Points to pay attention to protect health.....	65
1.5. Environmental protection measures.....	66
1.6. Points to note when assembling and disassembling diesel engines.....	66
2. Disassemble, check and repair the main bearing bushing assembly	67
2.1. Preparation.....	67
2.2. Drawings analysing the main bearing bushing assembly	67
2.3. Steps to disassble the main bearing bushing assembly	68
2.4. Points to note when checking and repairing main-bearing bushing	68
2.5. Steps for installing the main-bearing bushing	68
3. Disinstallation- Installation and check-repair of the two-level balance structure	69
3.1. Drawings of the two-level balance structure analysis	69
3.2. Preparation and tools for disassembling and assembling the two-level balance structure	70
3.3. Steps to disassemble the two-level balance structure.....	70
3.4. The main points when checking and repairing the two balance structure	70
3.5. Steps to install the two-level balance structure	70
4. Disinstallation – Installation and check-repair of the sensor.....	71
4.1. Installation of the sensor	71
5. Disinstallation- Installation and check-repair of low pressure oil pipe assembly.....	73
5.1. Tools and preparation work before disassembling – assembling low pressure oil pipe assembly.	73
5.2. Analysis of low pressure oil pipe assembly.....	73
5.3. Steps to remove low pressure oil pipe assembly	74
5.4. Main points when checking and repairing low pressure oil pipe assembly	74
5.5. Steps to install low pressure oil pipe assembly	75
6. Disinstallation – installation and check - repair of common rail tube assembly	75
6.1. Prepare before removing the common rail tube assembly	75
6.2. Steps to disassemble the common-rail tube assembly.....	75
6.3. Key points when checking and repairing common rail tube assembly	75
6.4. Steps to install common rail tube assembly.....	75
7. Disassembly-installation and check-repair of the water outlet pipes	75
7.1. Tools and preparation to disassemble and assemble the water outlet pipes.....	75
7.2. Drawings for analysis of water outlet pipes	76

7.3. Steps to disassemble the water outlet pipes	76
7.4. The basic points when checking and repairing the water outlet pipe	78
7.5. Steps to install the water outlet pipes	78
8. Dismantling, checking and repairing engine rack	78
8.1. Tools and preparations for dismantling engine rack	78
8.2. Drawings for analysis of engine rack	78
8.3. Steps to disassemble engine rack.....	79
8.4. The main points when checking and repairing the engine rack	79
8.5. Steps to install the engine rack.....	79
9. Disinstallation- Installation and check-repair of the generator	79
9.1. Drawings of generator analysis	79
9.2. Steps to disassemble the generator	80
9.3. Steps to assemble the generator.....	80
10. Disassemble – assemble and check – repair of the engine hook	80
10.1.Preparation before disassembling the engine hook.....	80
10.2.Drawings for analysis of engine hook	80
10.3.Steps to disassemble the engine hook	80
10.4.The main points when checking and repairing engine hook	81
10.5.Steps to assemble the engine hook.....	81
11. Disassemble – assemble and check – repair of the oil injectors	81
11.1.Tools and preparations for disassembling and assembling oil injectors.....	81
11.2.Drawings for analysis of oil injectors.....	81
11.3.Steps to dismantle injectors	82
11.4.The main points when checking and repairing injectors	82
11.5.Steps for installing oil injectors.....	82
12. Disinstallation, installation and check, repair of the high-pressure pumps	83
12.1.Tools and preparation before disassembling and assembling high pressure pumps.....	83
12.2.Drawings for analysis of high-pressure pump	83
12.3.Steps to disassemble high-pressure pump	83
12.4.Main points when checking and repairing high pressure pumps	84
12.5.Steps to install high pressure pump.....	84
13. Disinstallation, installation, check and repair of turbocharger	86
13.1.Tools and preparation for disassembling and assembling tuborcharge	86
13.3.Steps to disassemble tuborcharge	86
13.4.The main points when checking and repairing turbocharger	87
13.5.Steps to install tuborcharge.....	88
14. Disinstallation, installation and check, repair of the urea injector	89

14.1. Assemble of the urea injector.....	89
15. Disinstallation, installation and check, repair of the urea pump	90
15.1. Assembling urea pump	90
16. Disinstallation, installation and check, repair of urea pipes	91
16.1. Assembling urea pipes.....	91
17. Disinstallation, installation and check, repair of urea tank	93
17.1. Assembling urea tank	93
18. Disinstallation, installation, check and repair of pulley and belt	94
18.1. Tools and preparation work for disassembling and assembling pulleys and belts	94
18.2. Drawings for analysis of pulleys and belts.....	94
18.3. Steps for disassembling pulleys and belts	94
18.4. Steps to assemble pulleys and belts	95
19. Disinstallation, installation, check and repair of exhaust pipes	95
19.1. Tools and preparation work for disassembling and assembling exhaust pipes	95
19.2. Drawings of exhaust pipe analysis.....	95
19.3. Steps to disassemble exhaust pipes	95
19.4. Check and repair of the exhaust pipe	95
19.5. Steps to assemble exhaust pipe	96
20. Disassembly, installation, check and repair of the crankshaft pulleys	96
20.1. Tools and preparation for dismantling and assembling the crankshaft pulley	96
20.2. Steps to disassemble cylinder head cover	96
20.3. Drawings of the crankshaft pulley	96
20.4. Steps to assemble crankshaft pulley.....	97
20.5. Basic points when checking and repairing the crankshaft pulley.....	97
20.6. Steps to assemble crankshaft pulley.....	97
21. Disinstallation, installation, check and repair of crankshaft	98
21.1. Tools and preparations for disassembling and assembling crankshaft.....	98
21.2. Drawings of crankshaft	98
21.3. Steps to disassemble crankshaft	99
21.4. Main points when checking and repairing crankshaft.....	99
21.5. Steps to assemble crankshaft	99
22. Disassembly, installation, check and repair of the tempered panel of the engine body	101
22.1. Tools and preparation for disassembling and assembling the tempered panel of the engine body	101
22.2. Drawings of the tempered panel of the engine body.....	101
22.3. Steps to disassemble the tempered panel of engine body	102
22.4. The main points when checking and repairing the tempred panel of the engine body	102
Lift up and down gently, avoid collision.....	102

22.5. Steps to assemble the tempered panel of the engine body	102
23. Disassembly, installation, check and repair of the engine body	102
23.1. Tools and preparation work to disassemble and assemble the engine body	102
23.2. Drawings of the engine body	102
23.3. Steps to disassemble the engine body	103
23.4. The main points when checking and repairing the engine body	103
23.5. Steps to install the engine body.....	104
24. Disassembly, installation and check, repair of cooling module and oil filter	104
24.1. Tools and preparation for disassembling and assembling the cooling module and oil filter	104
24.2. Drawings of the oil filter and oil cooler.....	104
24.3. Steps to disassemble the oil filter and oil cooler	105
24.4. The main points when checking and repairing the cooling modules and oil filters	105
24.5. Steps for installing oil filters and oil cooler asembly.....	105
25. Disassembly, installation, check and repair of the oil pump.....	106
25.1. Tools and preparation for disassembling and assembling the oil pump.....	106
25.2. Drawings of the oil pump.....	106
25.3. Steps to disassemble the oil pump	106
25.4. The main points when checking and repairing the oil pump.....	107
25.5. Steps to assemble the oil pump	107
26. Disassembly, assembly, check and repair of the retaining ring	107
26.1.Tools and preparation for disassembling and assembling the retaining ring.....	107
26.2.Drawings of retaining ring.....	108
26.3.Steps to disassemble the retaining ring.....	108
26.4.The main points when checking and repairing the retaining ring	108
26.5. Steps to assemble the retaining ring	109
27. Use and check, repair of the pneumatic-type urea injecting system	109
27.1.Overview of checking and repairing the pneumatic-type urea injecting system	109
28. Disassembly, installation, check and repair of the cylinder head cover	111
28.1.Preparation before disassembling, assembling the cylinder head cover.....	111
28.2.Drawings of the cylinder head cover.....	111
28.3.Steps to disassemble the cylinder head cover	112
28.4.Main points when checking and repairing the cylinder head cover	112
28.5. Steps to assemble the cylinder head cover.....	114
29. Disassembly, installation, check and repair of the rocker cover	116
29.1.Tools and preparation for disassembling and assembling the rocker cover.....	116
29.2.Drawings of the rocker cover.....	116
29.3. Steps to disassembling the rocker cover	117

29.4.The main points when checking and repairing the rocker cover.....	117
29.5.Steps to install the rocker cover	118
30.Disassembly, installation, check and repair of the water pump.....	118
30.1.Tools and preparation work for disassembling and assembling the water pump.....	118
30.2.Drawings of the water pump.....	118
30.3.Steps to disassemble the water pump	119
30.4.The main points when checking and repairing the water pump.....	119
30.5.Steps to install the water pump	119
31.Disassembly, installation, check and repair of the inlet pipes into water pump.....	119
31.1.Tools and preparation work for disassembling and assembling the inlet pipes into water pump	119
31.2.Drawings of the water supply pipes into water pump	120
31.3.Steps to disassemble the water supply pipes to the water pump	120
31.4.The main points when checking and repairing water supply pipes into water pump	120
Check component parts to see if it is complete. Check whether the rubber washer of the water inlet into the cooling module and the oil filter, the water inlet is intact, the contact surfaces must not have oil stains, traces of collision.....	120
31.5.Steps to install water supply pipes into water pumps.....	120
32.Disassembly, installation, check and repair the oil pan	121
32.1.Tools and preparation for disassembling, assembling the oil pan.....	121
32.2.Drawings of the oil pan.....	121
32.3.Steps to disassemble the oil pan	121
32.4.The main points when checking and repairing the oil pan.....	121
32.5.Steps to install the oil pan	121
33.Disassembly, installation, check and repair of the oil gauge.....	122
31.1.Tools and preparation for disassembling, assembling the oil gauge.....	122
31.2.Drawings of the oil gauge	122
31.3.Steps to disassemble the oil gauge	122
31.4.The main points when checking and repairing oil gauge	123
31.5.Steps to install the oil gauge	123
32.Disassembly, installation, check and repair of the piston injector	123
32.1.Tools and preparation for disassembling, assembling the piston injector	123
32.2.Drawings of the piston injector	124
32.3.Steps to disassemble the piston injector	124
32.4.The main points when checking and repairing the piston injector	124
32.5.Steps to assemble the piston injector.....	124
33.Disassembly, installation, check and repair the piston rod assembly.....	124
33.1.Tools and preparation work for disassembling and assembling the piston rod assembly	124
33.2.Drawings of the piston rod assembly	125

33.3.Steps to disassemble the piston rod assembly.....	125
33.4.The main points when checking and repairing the piston rod assembly	126
33.5.Steps to install the piston rod assembly	127
34.Disassembly, installation, check and repair of the hydraulic pump.....	128
34.1.Tools and preparations for dismantling and assembling the hydraulic pumps	128
34.2.Drawings of the hydraulic pump	128
34.3.Steps to disassemble hydraulic pump.....	129
34.4.The main points when checking and repairing hydraulic pump	129
34.5.Steps to install the hydraulic pump	129
35.Disassembly, installation and check, repair of electronic control unit (ECU).....	129
35.1.Tools and preparation for disassembling and assembling the electronic control unit (ECU)	129
35.2.The main points when checking and repairing the electronic control unit (ECU)	129
36.Disassembly, installation and check, repair of wire bundles and electronic control sensors	129
36.1.Tools and preparations for disassembling and assembling wire bundles and electronic control sensors.....	129
36.2.Drawings of wire bundles and electronic control sensors.....	129
36.3.Steps to disassemble the wire bundles and electronic control sensor	130
36.4. Steps to assemble the wire bundles and electronic control sensor.....	130
37.Disassembly, installation and check, repair of air compressors.....	130
37.1.Tools and preparation work for disassembling and assembling air compressor.....	130
37.2.Drawings of the air compressor.....	130
37.3.Steps to disassemble the air compressor	131
38.Disassembly, installation, check and repair of thermostatic valves	132
38.1.Tools and preparations to remove and install thermostatic valves	132
38.2.Drawings of thermostat valve	132
38.3.Steps to disassemble thermostat valve.....	132
38.4.The main points when checking and repairing of thermostat valves	132
38.5.Steps to assemble thermostat valve.....	132
39.Disassemble, installation, check and repair starter	132
39.1.Tools and preparation work for disassembling and assembling the starter	132
39.2.Drawings of the starter.....	133
39.3.Steps to disassemble the starter	133
39.4.Steps to assemble the starter	133
40.Disassembly, installation and check, repair of air intake pipes	133
40.1.Tools and preparation work for disassembling and assembling the air intake pipe	133
40.2.Drawings of the air intake pipe	133
40.3.Steps to disassemble the air intake pipe.....	134
40.4.The main points when checking and repairing the air intake pipe	135

40.5.Steps to assemble the air intake pipe.....	135
41.Disassembly, installation, check and repair of air distribution structure.....	135
41.1.Tools and preparations for disassembling, assembling the air distribution structure	135
41.2.Drawings of air distribution structure.....	135
41.3.Steps to disassemble the air distribution structure.....	136
41.4.The main points when checking and repairing the air distribution structure	138
41.5.Steps to install the air distribution structure	138
42.Disassembly, installation, check and repair of the oil filter net of the oil pan.....	141
42.1.Tools and preparation work for disassembling and assembling the oil filter net of the oil pan ..	141
42.2.Drawings of oil filter net	142
42.3.Steps to disassemble the oil filter net	142
42.4.The main points when checking and repairing the oil filter net.....	142
42.5.Steps to assemble the oil filter net	143
43.Disassembly, installation, check and repair of the flywheel shell.....	143
43.1.Tools and preparations for dismantling and assembling flywheel shell.....	143
43.2.Drawings of the flywheel shell.....	143
43.3.Steps to disassemble the flywheel shell	143
43.4.The main points when checking and repairing the flywheel shell	144
43.5.Steps to assemble the flywheel shell	144
44.Disassembly, installation, check and repair of the flywheel	145
44.1.Tools and preparations for dismantling and assembling flywheels	145
44.2.Drawings of the flywheel	145
44.3.Steps to diasemble the flywheel	145
44.4.The main points when checking and repairing the flywheel	145
44.5.Steps to assemble the flywheel.....	146
45.Disassembly, installation, check and repair of the pressure oil pipe assembly	146
45.1.Tools and preparations for disassembling and assembling high-pressure oil pipe assembly....	146
45.2.Steps to disassemble high pressure oil pipe assembly.....	147
45.3.The main points when checking and repairing high-pressure oil pipe assembly.....	147
45.4.Drawings of the high pressure oil pipe assembly	147
45.5.Steps to assemble high-pressure iol pipe assembly	147
46.Disassembly, installation, check and repair of the gear drive assembly	148
46.1.Tools and preparation work for disassembling and assembling gear drive assemblies	148
46.2.Drawings of gear drive assembly	148
46.3.Steps to disassemble gear drive assembly	148
46.4.The main points when checking and repairing gear drive assemblylly	149
46.5.Steps to install the grear drive assembly.....	149

47.Disassembly, installation, check and repair of gear chamber	149
47.1.Tools and preparation for disassembling and assembling the gear chamber	149
47.2.Drawings of gear chamber.....	150
47.3.Steps to disassemble the gear chamber.....	150
47.4.The main points when checking and repairing the gear chamber	150
47.5.Check the state of the gear chamber, the contiguous surfaces must not have sharp spines, oil stains, collision,	150
47.6.Steps to assemble gear chamber	150

PART I. GUIDELINES FOR DIESEL ENGINE OPERATIONS

1. Drawings of external construction of the diesel engine

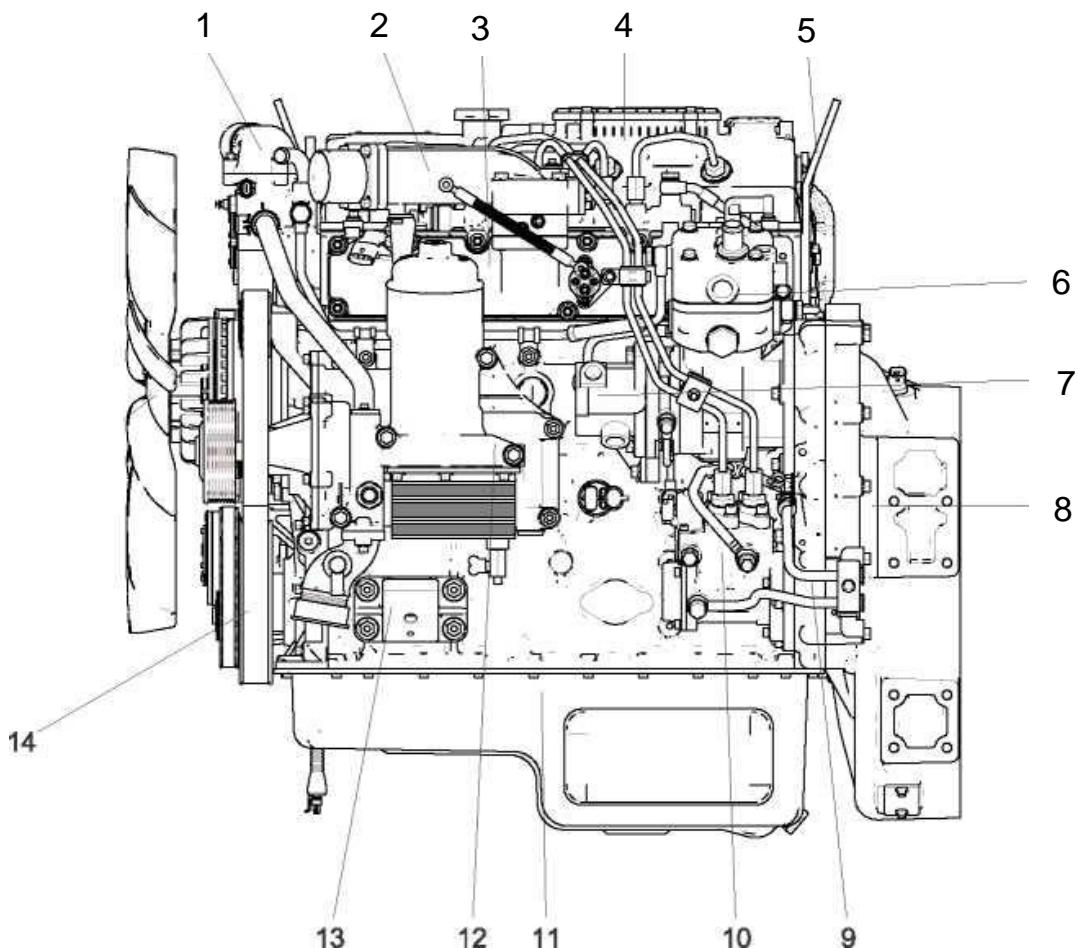


Figure 1-1: Drawing of the external construction of Euro IV standard WP4 electronic oil pump diesel engine

No.	Description	No.	Description
1	Thermostat	8	Flywheel shell
2	Intake adapter	9	Sprocket chamber
3	Intake pipe	10	Injection pump
4	Valve cover	11	Oil pan
5	Hanger	12	Oil filter assy and oil cooler
6	Air Compressor	13	Engine bracket
7	Hydraulic pump	14	Belt

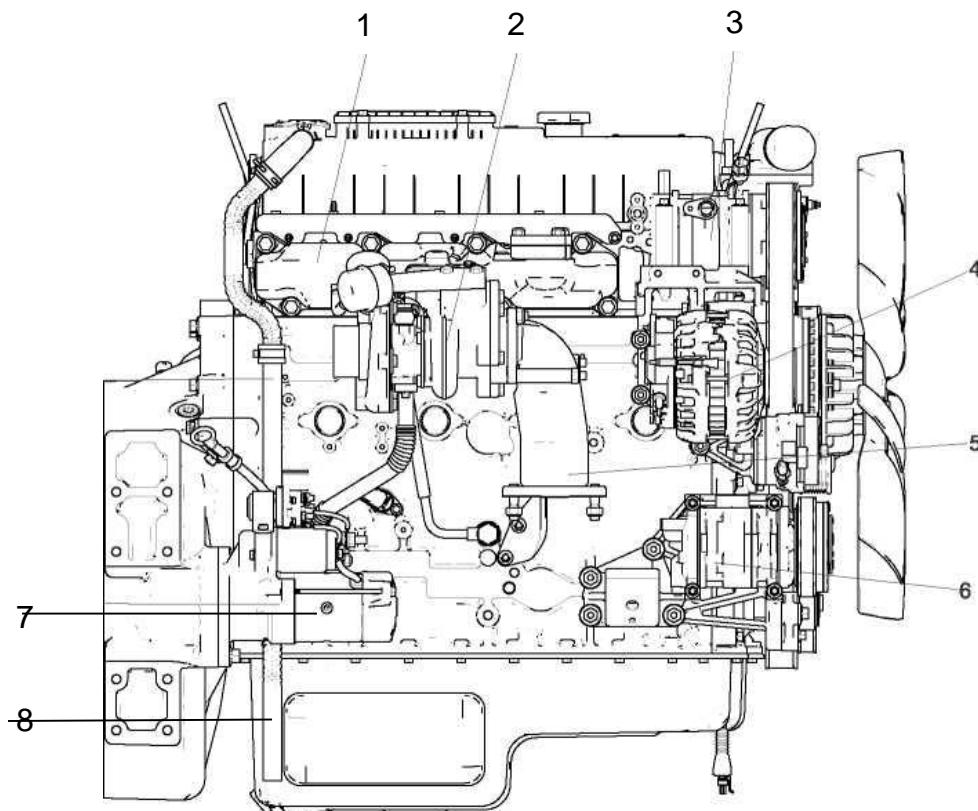


Figure 1-2: Side face of Euro IV standard WP4 electronic oil pump diesel engine

No.	Description
1	Baffle of exhaust pipe
2	Turbocharged
3	Air-conditioning block
4	Generator
5	Exhaust pipe
6	Air-conditioning block
7	Starter
8	Exhaust pipe of air separator filter

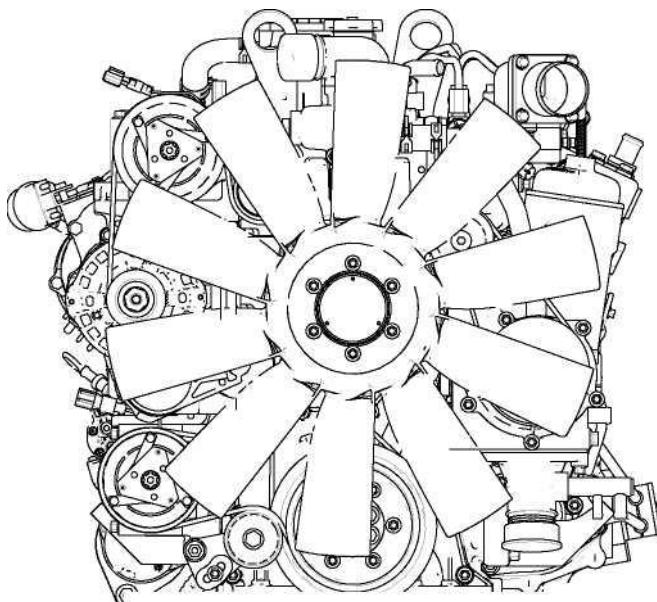
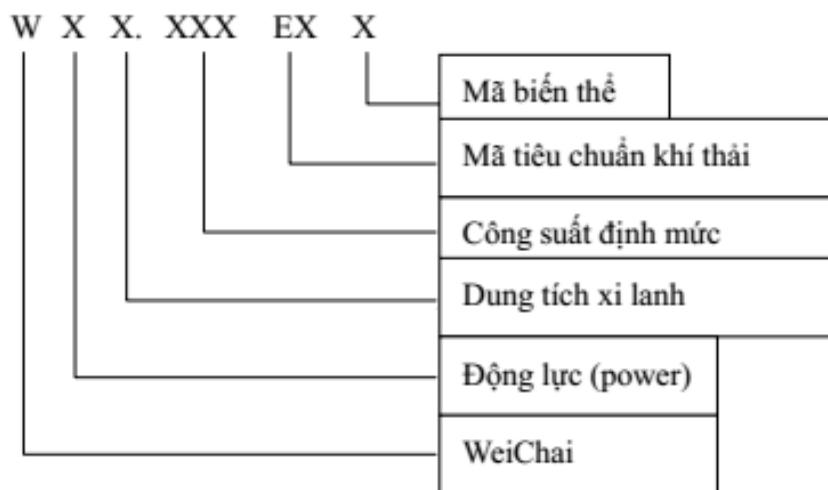


Figure 1-3: Front side of Euro IV standard WP4 electronic oil pump diesel engine

2. Symbol of diesel engine model



3. Basic parameters of diesel engine

Table 1-1 Parameters and features of Euro IV standard WP4 electronic oil pump diesel engine

Content	Specification
Engine type	4 phases, cooling with water, high-pressure common rail, electronic control
Gas charging method	Turbocharge, cooling with intercooler
Diameter of Cylinder / route (mm)	105x118(WP4.1N) 108x125(WP4.6N)

Number of cylinder	4	
Cylinder capacity	4.088(WP4.1N) 4.58(WP4.6N)	
Compression ratio	18	
Fire sequence	1-3-4-2	
Fuel system	High-pressure Common rail, electronic control	
Type of start-up	Electric start	
Lubrication type	Lubrication by pressure	
Cooling type	Forced circulation, cooling with water	
Oil pressure (Kpa)	Rated point	350-550
	Point of idle speed	100-250
Volume of lubricating oil (L)	See details in Part II of this document	
Rotation direction of the crankshaft (viewed from the fan side)	By clockwise	
Number of valve of each cylinder	4	
Emission standards	Euro IV	
Early injection		
Output coolant temperature (°c)	80~100	
	550	
Temperature of intake air after cooling in the intercooler	50±5	
Lifespan (km)	80.000 (WP4.1N) 50.000 (WP4.6N)	

4. Things to know when using a new diesel engine

- Within 60 hours of using the first engine (or 3000km), it is necessary to limit the load of the engine to not exceed 75% of the rated load.
- Regulations on the first change of oil.
 - For vehicles with a number of kilometers used every year not up to 20,000 km, the first time of oil change: 1000km-1500km.
 - For vehicles with the number of kilometers used each year in excess of 20,000 km, the first time of oil change: 1500km-2000km.
- Daily maintenance care as specified in the instruction manual.

5. Lifting and moving diesel engines

When lifting or moving diesel engines, make sure that the centerline of the crankshaft is balanced, it is prohibited to lift sidelong or lift one side. Lifting and laying down should be gently slow (refer to Figure 1-5).

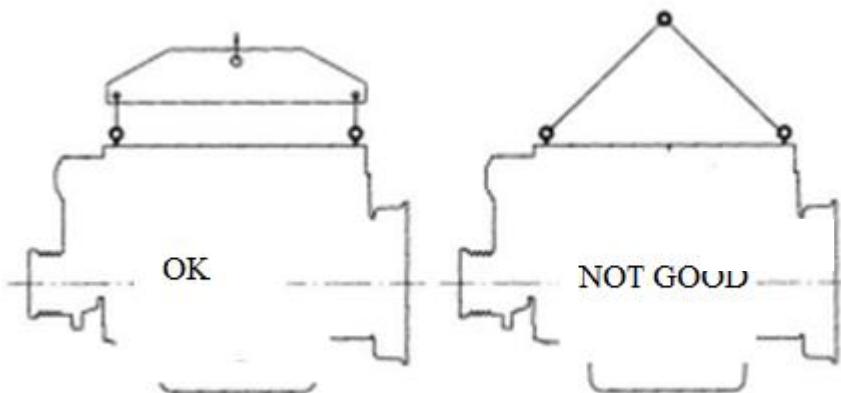


Figure 1-4 Drawings on how to install the hoist for lifting engine

6. Unsealing new engine

After opening the engine case, customers first need to tally the engine and the attached accessories according to the factory list, check the engine appearance to see if there is any damage, connecting parts is loose, then proceed with the following tasks:

- Wipe the primer, corrosion resistant layer of external components.
- Discharge fully anti-rust oil out of the oil filter and components of fuel system.
- **The anti-rust oil of diesel engine is only valid for one year, when it expires, it should check and select the necessary addition.**
- Move the flywheel, at the same time, spray the solvent into the air-pipe, spray until the rust-free oil in the cylinder is depleted.
- Spray the solvent into the intake port and release the air of the turbocharger until it has completely removed the anti-rust oil.
- Based on the agreement between the factory and the customer, if the oil pan of the engine has not been filled with oil, proceed it as prescribed. If the oil pan has been filled with oil when leaving factory, it is recommended that the customer, after operating 2000km (or operating for 50 hours) must discharge the old oil and replace the new oil.
- Depending on the agreement between the factory and the customer, if the cooling solution has been filled up when leaving the factory at the request of the customer, when opening the new engine, it is necessary to check the features of the cooling solution. If anti-freezing capacity reaches -30 °C or -35 °C, PH level reaches 7 ~ 8 (neutral), total hardness reaches 5 ~ 15 ° d (9 ~ 15 ° f (hardness)), it can be used.

Otherwise, it is recommended to flush out and refill the antifreeze coolant.

7. Preparation before starting up the engine

- Check the surface of the coolant through the glass hole of the auxiliary water tank. Open the lid installed with the pressure relief valve and the air discharge plug to fill in coolant, if the engine is in a hot state, the air discharge plug must be pressed when opening the lid. Avoid pouring large amounts of coolant when the engine is in a hot state, otherwise it may damage components due to a large temperature change. In special cases, if cooling water is lacking severely, it's allowed to pour not too cold water at a slow speed until it spills out. Start the engine, continue to fill the cooling water while the engine is running (1000 r / min) until the water surface is stable and close the lid.
- Check the fuel level: If the engine is installed in the vehicle, turn on the power to check the fuel level on the dashboard or check the fuel level in the tank.
- Check the engine lubricating oil level: The lubricating oil level must be between the upper and lower lines of the oil gauge, if necessary, add it.
- Check whether the connection of the engine accessories is firm. Check whether the transmission of start-up system is normal or not, whether the battery is full of electricity. Then use hand pump on the raw fuel filter to eliminate air in the fuel system.

8. Start-up diesel engine

- Leave the power switch and electric lock of the vehicle in the starting position, leave the gear stick in the zero position and start the engine.
- Depress the clutch pedal and accelerator pedal, turn the key to start the engine. If the engine fails to start up for 5 ~ 10 seconds, wait 1 minute before repeating the above process. But if failure to start-up in consecutive 3 times, stop to investigate the cause and resolve the problem before restarting. After starting the engine, pay attention to the displays on the dashboard, the oil pressure gauge must immediately display the pressure. Be careful not to allow the engine in cool state immediately operate at high speed, run idle speed for a while but not for too long.
- Under low ambient temperature conditions, if you want to start up a diesel engine, it is recommended to use a starter aid device, through a relay to make the electronic heater flange work. Since then, it is possible to start smoothly in a temperature environment of -30 °C.

9. Operate diesel engine

- After starting, first run the idle speed for 3 minutes, then increase the rpm to 1000 r / min - 1200 r / min and increase the load slightly. Only when the outlet water temperature is higher than 60 ° C and the lubricating oil temperature is higher than

50 ° C is it allowed to operate with full load. Increasing the load and increasing the rpm must be carried out slowly, avoiding the sudden increase or decrease of load.

- Within 60 hours of running-in period (running the first 3000km), it needs to operate with average load or less, the vehicle does not pull on the trailer.
- When running on a slope, it is necessary to reduce the speed in a timely manner, and do not work for a long time in a large torque state. Do not leave the load too small, because at this time the revolution is too low, easy to lead occurrence of breakdowns such as lubricating oil leaking, etc.
- When the engine is in normal use, it allows continuous operation in rated power and rated revolution, but if operating at 105% of the rated revolution and 110% of the rated power, it's allowed to operate only 20 minutes in maximum. After reducing the load, run idle speed for another 1-2 minutes and then stop the car.
- During use, regularly pay attention to the parameters and check the following items:
 - Pressure of main lubricating oil at 350 kPa ~600 kPa.
 - Lubricating oil temperature at the oil pan ≤ 115 .
 - Temperature of coolant at $80^{\circ}\text{C} \sim 95^{\circ}\text{C}$.
 - Temperature of exhaust gas after passing turbocharger $\leq 600^{\circ}\text{C}$.
 - Check the color of the exhaust gas, take the color of the exhaust gas to determine the working efficiency of the injector and the use condition of the load, if there is too much black smoke or white smoke, it is necessary to stop the vehicle to check.
 - Pay attention to check whether the engine has leakage of water, gas, and oil. If detected, it is recommended to stop the vehicle for processing.
- The following characteristics of diesel engines which operators need to know:
 - When the torque reaches the maximum, the fuel consumption is quite low, the revolution increases, the fuel consumption also increases..
 - Torque reaches maximum when the revolution is in the middle range (1200 r/min ~ 1700 r/min).
 - When the revolution is increased, the capacity increases, the capacity reaches the rated level at the rated revolution.
- Points to note when operating engine in a cold climate:
 - Fuel: base on different winter outdoor temperatures to choose the type of diesel accordingly.
 - Lubricating oil: depending on the season, choose lubricating oil with different lubrication index.

- Coolant: the cooling system adds anti-freezing additives, depending on the outdoor temperature to choose different coolants with different quantities.
- Start-up: in winter if necessary, you can use auxiliary starter. After starting the engine, wait for the oil pressure and water temperature to return normal, then increase the load and operate at high speed.
- Battery: before entering the cold season, it is necessary to check the electrolyte solution, oil and unit voltage. If the engine has not been used for a long time and the temperature is too low, remove the battery and store it at a place with standard temperature.
- Stop the car: when stopping the car in cold weather, it is advisable to reduce the load first and run idle speed within 1-2 minutes. Wait for the temperature of all parts to lower and then stop. Note that after stopping the vehicle, it is not allowed to discharge the coolant added the antifreeze additive. If the coolant has not added the anti-freeze additive, it is necessary to open the water drain valve or the water block of the body, the lid of oil intercooler, the water tank, the water supply pipe, ... rinse the coolant to avoid engine frozen and cracked.

PART II. GUIDELINES FOR CARE, MAINTENANCE OF DIESEL ENGINE

1. Fuel, lubricant, coolant and admixtures

1.1. Fuel

Summer: Diesel No.0 (GB252)

Winter: normally use light diesel No. -10 (GB252), but when the ambient temperature where engine is used is below -20 °C, it is recommended to use diesel No. -20, when the outdoor temperature is below -30 °C, it should use diesel No. -35.

1.2. Engine lubricating oil

WeiChai's Euro II standard diesel engine uses CF-4 lubricating oil, Euro III standard diesel engine uses CH-4 lubricating oil, Euro IV standard diesel engine uses CI-4 lubricating oil, Euro V standard diesel engine uses CJ-4 lubricating oil, gas-engine uses specialized oil for gas-engine, refer to specific standard in table 2-1.

Table 2-1: Regulations for selecting specialized lubricating oils for WeiChai engines

Product	Category		Packing method	Type of engine used
Lubricating oil for diesel engines	CF-4	10W/30 15W-40 20W-50	4L, 18L, 170kg	Euro II emission standard Diesel engine: line WD615, WD10, WD618, WD12, 226B,...
	CH-4	10W/30 15W-40 20W-50	4L, 18L, 170kg	Euro III emission standard Diesel engine: line WP4, WP5, WP4, WP10, WP12, WP13,...
	CI-4	10W/30 15W-40 20W-50	4L, 18L, 170kg	Euro IV emission standard Diesel engine: line WP4, WP5, WP4, WP10, WP12, WP13,...
	CJ-4	10W/30 15W-40 20W-50	4L, 18, 170kg	Euro V emission standard Diesel engine: line WP4, WP4.1, WP5, WP4, WP10, WP12, WP13,...
Specialized lubricating oil for gas engine	10W-30 15W-40		4L, 18L, 170kg	Natural gas engine

Lubricating oil specialized for WeiChai engine is based on temperature to select, refer to table 2-2

Table 2-2: Table of relationship between level of oil and ambient temperature

Level of SAE oil	Appropriate ambient temperature (°C)
0W-20	-35 ÷ 20
5W-30	-30 ÷ 30
10W-30	-25 ÷ 30
15W-40	-20 ÷ 40
20W-50	-15 ÷ 45

➤ Notes:

- 1) Before starting the engine, check the lubricating oil level in the oil pan.
- 2) Do not check the lubricating oil level while the engine is operating.
- 3) It is not allowed to replace specialized lubricating oil for WeiChai engine with lubricating oil of other manufacturers.

For amount of lubricating oil for WeiChai engine models and number of filters, refer to table 2-3

Table 2-3: The amount of lubrication oil for WeiChai engine models and the number of filters

Engine model	Amount of lubricating oil (L)	Number of filter					
		Diesel engine			Diesel engine		
		Oil filter	Diesel filter	Pre-filter	Fine-filter	Oil filter	Gas 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
WP9	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

Notes:

- 1) Data on the amount of lubricant filled is for reference only, the actual filling amount is based on oil gauge.
- 2) If a water separating filter integrated with 3 functions or a normal water separating filter is installed on the vehicle, when replacing the fuel filter, it is necessary to replace the water separating filter.

1.3. Coolant

Coolant specialized for WeiChai engine have different types of freezing points such as -25°C, -35°C, -40°C, and customers should base on the ambient temperature where the vehicle operates to choose WieChai engine specialized coolant with a corresponding freezing point, the principle of selection is that the freezing point is lower than the ambient temperature of about 10 ° C, refer to table 2-4.

Table 2-4: WeiChai dynamic heavy-duty engine specialized coolant

Name of Product	Type of product	Specification
Heavy-duty engine coolant	HEC-II-25 HEC-II-35 HEC-II-40	4kg, 10kg

Notes:

- 1) Check the coolant periodically, avoid the damage caused by corrosion, based on the situation to replace it in time.**
- 2) It is strictly prohibited to use water and poor quality coolant as a coolant for the engine.**

1.4. Urea solution

Inadequate urea solution is likely to cause SCR catalyst poisoning and loss of efficacy or inadequate recovery efficiency (if chemical elements in urea solution such as phosphorus, sodium, potassium, calcium, ... exceed the standard, it is very easy to lead to catalyst poisoning, if the concentration of urea solution does not meet the requirements, it is easy to cause leaking NH3 too much or the effect of NOx recovery is not enough. In result, emissions exceed the standard and an trouble light warns. Therefore, the quality and features of urea solution must match the content specified in ISO 22241. For specific requirements, refer to table 2-5.

Table 2-5: Urea composition (refer to ISO 22241)

Composition	Unit	Lowest limit	Highest limit
Percentage of urea quality	%	31,8	33,2

Density at 20°C	kg/m ³	1087	1093
Refractive index at 20°C	-	1,3814	1,3843
Percentage of ammonia quality	%		0,2
Percentage of biuret	%	-	0.3
Acetaldehyde	mg/kg	-	5
Insoluble substance	mg/kg	-	20
Phosphorus	mg/kg	-	0.5
Calcium	mg/kg	-	0.5
Iron	mg/kg	-	0.5
Copper I	mg/kg	-	0.2
Zinc	mg/kg	-	0.2
Crom	mg/kg	-	0.2
Niken	mg/kg	-	0.2
Aluminum	mg/kg	-	0.5
Magie	mg/kg	-	0.5
Sodium	mg/kg	-	0.5
	mg/kg	-	0.5

❖ Store the urea solution

The urea solution used for vehicles required for use must be stored at 5°C-25°C and absolutely protected from light. For the expiry date, see table 2-6.

Table 2-6: Shelf life of the urea solution for vehicles

Shelf life of the urea solution for vehicles	
Storage environment temperature °C	Minimum expiry date (month)
Over 10	36
Over 25	18
Over 30	12
Over 35	6
Over 35	b

Note: The shelf life specified in the table above is mainly based on factors such as storage environment temperature and initial alkalinity of urea solution. There is also another factor such as whether or not ventilation is available and the degree of evaporation varies due to the different distance between urea and containers.

- a. To avoid resolution of urea solution, transport and storage should be avoided at temperatures of 25°C or more for a long time.
- b. Before using, check each batch of urea solution to see if it meets the standard.

Material of urea containers must have good compatibility with urea solution, does not cause chemical reaction, does not cause the impurities moving. It's recommended to use suitable materials in accordance with the requirements set in the standard IS022241-3. For example, a container made from materials such as cast alloy, Teflon without additives, Polyethylene without additives, Polypropylene without additives, ... If stored at 5°C or less, leave a suitable gap in a container, because in solid state, the volume of urea will increase by 7% compared to when in liquid form.

For vehicles with urea solution available, pay attention to the shelf life of the urea solution. For the relationship between the shelf life of the urea solution and the ambient temperature during the inventory of the vehicle, see table 2. -6. If the time of inventory exceeds the shelf life, the vehicle before leaving the factory must be discharged urea through the exhaust valve at the bottom of the urea tank, filled with the new good-quality urea solution. When the ambient temperature exceeds 35°C, the vehicles before leaving the factory must check the quality of the urea solution in the tank to see if it is still guaranteed, otherwise the urea solution must be replaced with quality assurance.



- Urine solution must be contained in a closed container, stored in a cool, dry place, avoiding strong oxidizing agents. When pouring, if poured directly into the urea tank, it is easy to spill out, causing environmental pollution, should use specialized pouring equipment.

- The urea solution is corrosive to the skin; if during the dripping process it is careless to stick to the skin or eyes, it is necessary to quickly use clean water; If you still have pain, you must go to the doctor. If unfortunately swallowed, do not try to vomit, but quickly go to the hospital.

1.5. Admixture

Table 2-7: Admixture for diesel engine

No.	Name	Color	Purpose of use and application
1	(Molybdenum powder)	Black	Apply to the surface of smooth metal to prevent jamming. For example, apply on the outside of the cylinder ...
2	Molybdenum disulfide oil	Dark grey	It has a lubricating effect when the pressure of the lubricating oil has not yet formed. For example, apply on intake valve rod.

Table 2-8: Reference Table of glue for diesel engines

Type	Main purpose of use	Parts using glue	Remarks
WeiChai dedicated glue 242	Apply on the threaded surface to hold it firmly, preventing vibrates resulting in loose, medium intensity.	Camshaft retaining ring bolt. Camshaft gear bolts. Intermediate gear bolts. Front cover plate bolts. Lubricant filter base bolts. Lubricating oil cooler bolts .. Screw plug for regulating cooling tank. Bolts of device fixing fuel line Thread of air compressor shaft. Bolts of mesh filtering oil Bolts of device fixing bundles and sensors.	This is a selectable item, can use DriLoc204 glue as primer for thread.
WeiChai dedicated glue 262	Apply on the threaded surface to lock it tightly, to seal or avoid vibrates, causing loose.	Bolts of cylinder head cover	

WeiChai dedicated glue 271	Fix to prevent loosen	Oil gauge of oil blocking hole	
WeiChai dedicated glue 277	Seal between core and hole.	The remaining oil gauge	
WeiChai dedicated glue 270	Seal the surface of the tip of cylinder head cover	Push rod – cylinder head cover	
WeiChai dedicated glue 518 (sản phẩm nâng cấp từ 510)	Apply on polished metal surfaces, for sealing.	<p>The contact surface between the engine block and the crankshaft compartment.</p> <p>Front body and front cover plate, back side and flywheel link plate.</p> <p>The contact surface between the oil filter base and the crankshaft compartment.</p> <p>Rear end of water pump - front side of body.</p> <p>Plate linked flywheel shell - flywheel shell.</p> <p>The junction face between the engine block and the lubricating oil cooler cover.</p> <p>The junction face between the engine block and the cover of the lubricating oil hole.</p>	

2. Periodic maintenance cycle and regulations on engine maintenance

2.1. Periodic maintenance cycle

Table 2-9: Periodic maintenance cycle of engines

Purpose	Light trucks, passenger cars	
Types of maintenance	First maintenance	Periodic maintenance
Maintenance cycle	(3000~5000) km or one month	30000km or 6 months
Oil change	•	•
Replace oil filter or filter core	•	•
Check for adjustment of the valve gap	•	•
Check water pump (lubrication by grease)		•
Replace fuel filter core	•	•
Check the amount of coolant and add sufficiently	•	•
Tighten the belt of the cooling pipe	•	
Retighten the connectors of air intake pipe, flexible pipe and flange	•	•
Check the indicator light or maintenance alarm of the air filter		•
Clean up the dust-collecting core of the air filter (except for the use of automatic dust exhaust filter)		•
Clean up the main filter core of the air filter	If the indicator light is on	
Replace the new main filter of air filter	Refer to the relevant provisions in this document	
Replace the new safety filter core of air filter	After cleaning the main filter core 5 times	
Check and tighten the belt	•	•
Check for gaps of turbocharger bearings	Carry out after every 240000km	
Check and adjust the route of the clutch	•	•
Filter core of urea pump		•
Washer of urea injectors	Carry out on each removal of the urea injector	
Clean the urea tank and the filter core of urea tank		•

Clean the sensor filter net of urea tank		•
Clean the filter net of intake pipe to the urea pump		•
<ul style="list-style-type: none"> ➤ Note 1: signs of maintenance ➤ Note 2: any engine that is not used for half a year or more must perform the corresponding maintenance, for example, re-apply anti-rust oil, ... ➤ Note 3: For road vehicles with high speed and standard load (light trucks), after operating every 5000km, it's required to fill with more oil up to the upper limit, buses, cars, passenger cars, coups, after operating every 15,000 km, must add lubricating oil up to the upper limit line. ➤ Note 4: The Supplier will provide maintenance advice based on customer requirements. 		

2.2. Regulations on engine maintenance

2.2.1. Clean the engine

- After heating the engine, discharge the lubricating oil, clean the lubricating oil filter, apply rust-proof oil.
- Discharge diesel oil, pour anti-rust mixed oil.
- Discharge water, pour coolant containing anti-rust substance.
- Start and run idle speed for 15 ~ 25 minutes.
- Discharge lubricant oil, diesel oil, coolant.
- Protect other parts.

2.2.2. Protect the engine during storage

Use sealed lids or nylon bag to seal the inlets and outlets of oil, gas, and water;
Use an anti-rust nylon film to cover the engine.

Note: If you need to transport, add packing outside.

2.2.3. Anti-rust oil

The shelf-life of anti-rust oil on a diesel engine is 1 year, the whole oil which is over 1 year must be coated with oil, specifically requirements and measures are as follows:

- The oil coating process for the engine must be carried out in a clean environment, the engine and components before coating oil must be cleaned, no rust, no stains of oil or dust.
- Based on specific requirements, it is possible to use one of the measures such as dipping, spraying, sweeping, pouring, ... to coat the oil for the engine.
- Oil coating parts and related technology requirements:
 - Oil coating for the air intake and discharge system: in the state where engine is operated by a starter or actuator, use JB-1 lubricating oil containing pneumatic gun to inject into the air intake port for at least 15 seconds.
 - Oil coating for turbochargers: in the state where engine is operated by actuator

or static state, use JB-1 lubricating oil-containing pneumatic gun to inject into the air intake and discharge port for at least 5 seconds.

- Oil coating for air compressors: in the state where engine is operated by an actuator or idle speed state, use JB-1 lubricating oil-containing pneumatic gun to inject into the compressor's air intake port for at least 5 seconds.



Figure 2-1: Shape of pneumatic spray gun

2.2.4. Daily checks

- Check the coolant level, water temperature.
 - Observe the coolant level through the glass observation hole, if the coolant is not enough, you can open the lid to pour more. Figure 2-1 and Figure 2-2 illustrate the safety signs of the lid of cooling water filling hole and auxiliary water tank.
- **Note: when opening the lid to pour the solution, first press the air release button, avoid letting the coolant solution get hot due to the engine is in hot state, causing burned.**

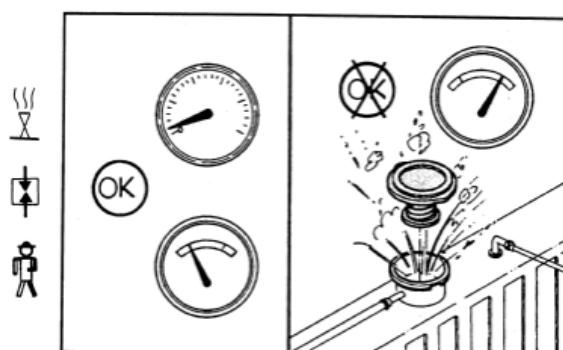


Figure 2-2: Air release button

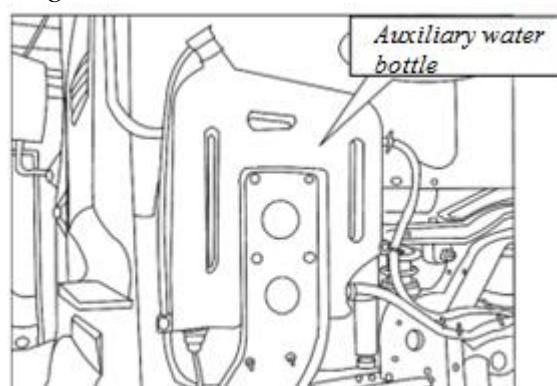


Figure 2-3: Auxiliary water bottle

- Check lubrication level
- When the lubricating oil level is lower than the bottom line of the oil gauge or higher than the top line of the oil gauge, the engine should not be started.
- The inspection of the engine lubricating oil level after the engine stops working should be carried out after the engine has stopped for 5 minutes, so that the lubricating oil has enough time to flow into oil pan.
- The amount of lubricating oil from the lowest position to the highest position of the oil gauge varies by 3 liters.

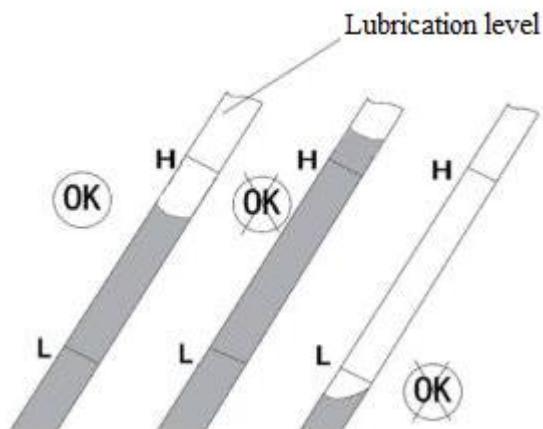


Figure 2-4: Explaination of the symbols on lubricant oil guage

- Check fuel level. Illustrative figure:



Figure 2-5: Fuel gauge

- Check oil leakage, air leakage, water leakage: The whole engine does not have leakage of water, gas and oil.
- Check ventilator: Visually check whether the impellerr is damaged, whether the bolts are solid.
- Check the belt: The belt is automatically stretched by pulley, the customer can press the belt to check its tension, as shown in Figure 2-5..

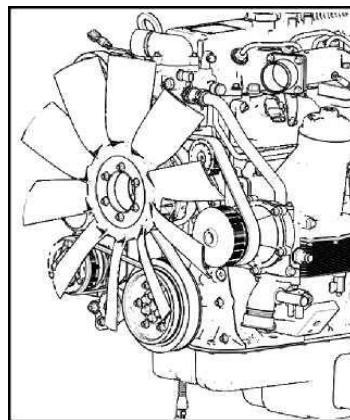


Figure 2-6: Check the belt

- Check if the exhaust gas color is normal. Illustrative figure:



Figure 2-7: Check exhaust gas

The normal color of the exhaust gas is light gray. If color changes, investigate the cause and handle it.

- Check the sound to see if it is normal.
- Check the revolution, vibration to see if it is normal.

2.2.5. Daily care

- Check the coolant level, lubricating oil level, fuel level; to see if grease lubricant in places required is adequate
- Check whether oil, water, or gas leak.
- Check whether external parts and accessories closely linked
- Check whether the ventilator, the belt is too tight or too loose.
- Engine oil pressure.
- Engine water temperature.
- Check whether the temperature, color, sound, vibration of the exhaust gas is normal, whether revolution is stable.

2.2.6. Maintenance content of maintenance levels

In addition to completing the daily maintenance content, the following contents must also be carried out:

- Replace lubricating oil.
- Tighten the retainer at the bottom of the oil pan, discharge the lubricating oil and then turn the retainer back (Fig. 2-8).
- Open the lid of the lubricating oil hole, fill with the lubricating oil from the lubricating oil hole, observe the line on the oil gauge until it reaches the required level, close the lid (Figure 2-9).

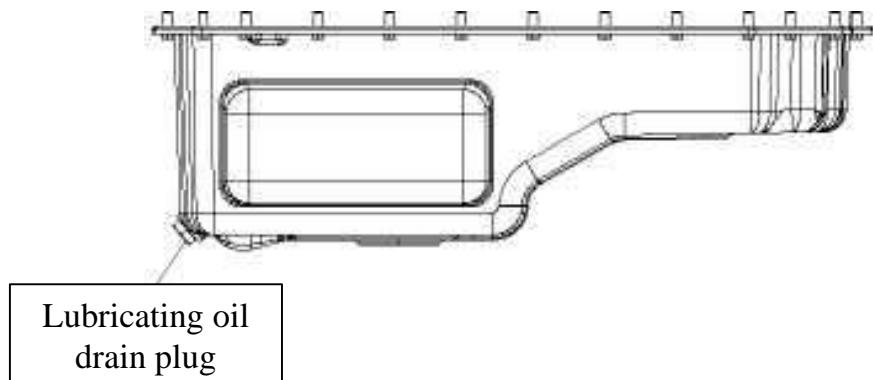


Figure 2-8: Location of lubricating oil discharge

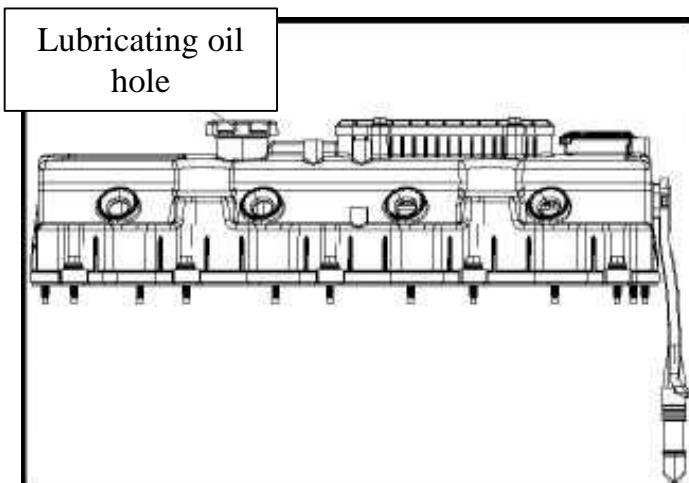


Figure 2-9: Location of pouring lubricating oil

- Replace lubricating oil filter or filter core: when replacing lubricating oil filter, take the following steps:
- Loosen the oil filter lid to about 10-15mm (when the lid reveals a corresponding small hole after being screwed about 10mm), leave it in place for 3-4 minutes, wait for the dirty oil to discharge to the oil pan and then remove the filter lid (usually the filter core will be brought out).
- Remove the filter core and filter lid, remove the O-ring gasket on the filter lid. Then, insert the new O-ring gasket and apply the oil to the gasket surface, insert the filter core into the groove on the filter lid and apply oil to the small O-ring gasket beneath the filter core.
- Install assembly of the filter lid and the filter core on the filter base, tighten the

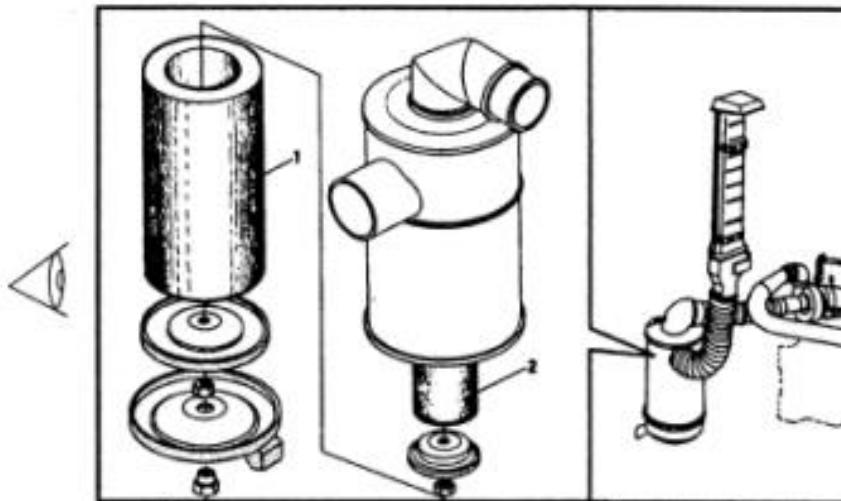
filter lid as required for the tightening force indicated on the filter lid.

- Start the engine to check whether oil leaks.



Avoid installing separate filters core and filter lid, filter core and filter lid must be installed together before installing on the filter base.

- Replace new fuel filter and filter cores
 - Remove the filter core of the old fuel filter, if the water separating filter installed on the pre-filtration is usable, remove the water separating filter.
 - Lubricate neck of the filter.
 - Use hands to twist the filter until the port installed on the filter is adjacent to the port installed on the engine.
 - Continue to use hands to twist filter until the filter is firmly installed (about $\frac{3}{4}$ round).
 - Discharge air until there are no more bubbles.
 - Conduct a test to see if there is a leak.
- Check and adjust the clearance of suction valves
 - It is very important to adjust the valve clearance. If the valve clearance is too small, when the engine is operating, the valves will close tightly due to expansion by heat, leading to air leakage, reducing the engine power. If the valve clearance is too large, the opening and closing time of the suction valve will be shortened, causing insufficient air intake or air exhausting uncleanly. It also reduces engine power and makes components such as suction valve, discharge valve, rocker, camshaft..., strongly impact.
 - The valve clearance should be within $0.30 \pm 0.03\text{mm}$, the discharge valve clearance should be within $0.40 \pm 0.03\text{mm}$, the EVB clearance is $0.35 \pm 0.03\text{mm}$.
 - Adjusting the valve clearance should be carried out when the engine is in a cold state. When adjusting, remove the rocker cover, move the crankshaft, so that the line carved dead point on the machine 1 on the flywheel ring is aligned with the line carved on the flywheel shell.
- Check the intake air system: check whether the exhauster is aging or cracked, whether the tightening belts are loose. If necessary, tighten or replace components, ensuring the tightness of the intake air system
- Check the air filter core. Figure 2-10 is an illustration of air filter.



1. Main filter core is made of papers.
2. Safety filter core is made of wool carpet

Figure 2-10: Air filter

- The maximum permissible air intake resistance of diesel engine is 7kPa, forced to check the maximum air intake resistance when the revolution reaches the rated level and operates with the full load, when the air intake resistance reaches the maximum permissible limit, it's required to clean or replace the new filter core according to the manufacturer's regulations.
- **Note: do not allow the use of the engine when there is no air filter.**
Otherwise, dust and impurities entering the engine will cause the engine to quickly wear out.
- After the filter core is newly removed from the air filter, pat the surface for dust to fall off, it can also use compressed air to blow back (blowing from the inside out). Figure 2-16 is illustration of air filter core cleaning.

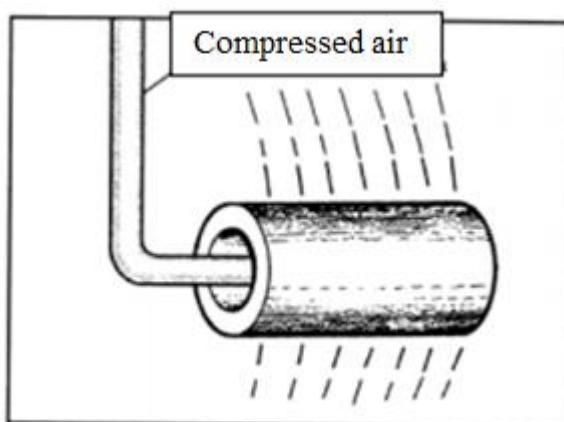


Figure 2-11: Cleaning filter core

- **Notes:**
- Do not blow to make filter paper broken.
 - Do not use water or oil to wash filter paper.
 - Do not use a strong force to pat or tap into the filter core.
 - Check the urea pump filter core: every maintenance, remove the urea pump filter

core. After that, wash with water and reinstall, do not use strong force to pat or tap the filter core.

- **Note: every time you replace or remove the urea injector, check the status of the urea injector. If there are symptoms of being damaged or deformed, it is necessary to replace the new urea injector.**
- Clean the urea tank and filter core of urea tank: when performing maintenance, it is necessary to check the cleanliness of the urea tank and the filter core of urea tank, if necessary, clean them.

PART III: TYPICAL TROUBLES OF DIESEL ENGINE AND THE TREATMENTS

The Euro IV standard WP4 diesel engine is designed and manufactured with a strict quality assurance system. Each engine before leaving the factory has to be tested according to regulations. At the same time, diesel engine is the type of correct machine, its efficiency must reach the long-term guarantee, which is attached to daily maintenance and care. The causes make engine rapidly damaged often has the following types:

- 1) Wrong operation compared to stipulations, poor management and use;
- 2) Do not carry out the care and maintenance according to regulations, even consider that the repair is to replace the maintenance;
- 3) Unqualified manufacturing parts, especially customers buy poor quality counterfeit products due to cheap price, which will significantly reduce the life of diesel engines;
- 4) Choose fuel and lubricating oil of the wrong type or poor quality.

1. Diagnostic method

The method commonly used to diagnose diesel engine problems has the following types:

1.1. Traditional diagnostic methods

- Observation method: through observing the characteristics of diesel engine troubles such as emissions, ... to judge the status of troubles. See Figure 3-1 for illustration.



Figure 3-1. Observation method

- Listening method: through an abnormal sound of the engine, relying on hearing to judge the part occurring the trouble as well as the nature and extent of the trouble. As shown in Figure 3-2.



Figure 3-2. Listening method

- The method to make the cylinder stop working: make a certain cylinder to stop working, then rely on it to judge whether the problem is due to the cylinder. It is common to stop supplying oil to cylinder which is suspected to occur a problem, comparing the change of engine state before and after cylinder stops working, narrowing the scope for finding a location arising and the cause of the trouble.
- Comparative method: for certain components, use an alternative method to determine if there is a problem there.

➤ Notes:

- The judgment of the cause of diesel engine failure is a very meticulous task. When not clarifying the cause, the engine should not be arbitrarily removed. Otherwise, it's not only impossible to resolve the problem, but it also may cause a more serious problem due to incorrect re-installation after removal.
- For key parts such as high pressure pumps, turbochargers, ... the check and repair not only need specialized equipment but also require workers with certain experience, so if customer has no conditions of equipments and are inexperienced, do not arbitrarily remove and adjust above parts.

1.2. OBD trouble diagnosis system

1.2.1. Check MIL, SVS lamps

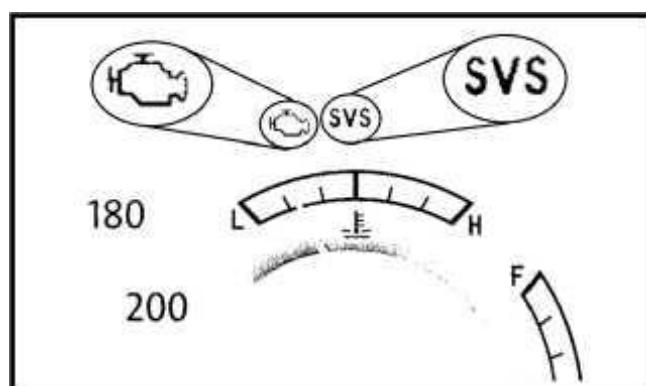


Figure 3-2. MIL and SVS lamps

- a) The MIL lamp is used to report troubles related to rear-discharge handling. Normally, after the engine starts, the MIL lamp will be in continuous light state, if there is no problem, after 10 seconds of starting, the MIL lamp will automatically turn off.
- If the MIL lamp is light continuously after the engine has been started for a

long time, first check whether the fault code occurs, possibly due to a problem. If there is no problem, it can be based on a circuit diagram to check the transmission circuit to see if it is short-circuited to the ground.

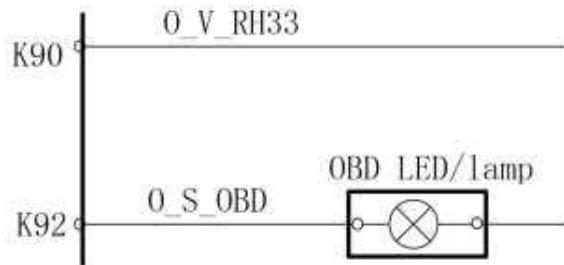


Figure 3-3. OBD circuit diagram

- If the MIL lamp blinks, check the transmission circuit to see if it is a bad connection.
- If after starting, MIL lamp is not light up, check the transmission circuit, confirm whether the light bulb is damaged.
- b) SVS lamp is used to report problems related to the engine system, when starting, it will check itself, light up for a while and then turn off.
- After starting, it's continuously light up, first confirm whether the fault code is shown; If there is no problem, it is necessary to check whether it is caused by a circuit problem.
- After starting, if the SVS lamp is not light up, it may be due to a malfunction of the circuit or light bulb.

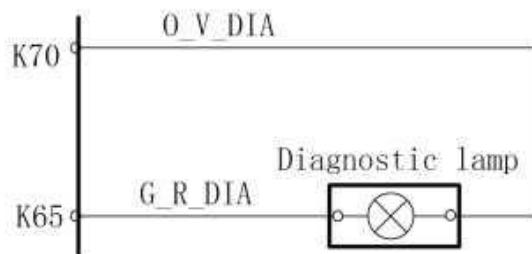


Figure 3-4. SVS circuit diagram

1.2.2. Codes to diagnose the problem

Based on the problem code, it is possible to check the name of the problem occurred to the engine and the related Chinese description, also check the error code of the trouble (this code can be found from the ECU of engine), P-code (this code can be found in the car when the engine is connected to the whole vehicle) and the part related to the problem, the cause of the trouble and the solution, ... which facilitates repairers can quickly find out the cause of the engine problem. For the problem diagnosis codes, see Annex A.

Table 3-1 OBD problem diagnosis method

No.	Test location	Test method
1	Preliminarily position direction and breakdown point	Based on the phenomenon and reaction of the problem, preliminarily judge whether the problem belongs to which aspect (mechanical part, electrical part, or components), do not replace the component parts in a way without direction.
2	Read trouble code (P code, error code)	Trouble codes are divided into historical troubles and current troubles, historical troubles do not affect the vehicle's features, through read-write-delete-read-write (analysis) to determine the trouble point affecting the car's features.
3	Base on the trouble code to investigate the trouble	<ul style="list-style-type: none"> • Step-by-step test, implementation is as follows: specific problem shall be specifically analyzed, before the breakdown point has not been determined, do not replace any components. Most trouble codes represent only a part of the problem, which is not accurate enough to the extent to determine which sensors or components are in trouble. When looking for problems, it must in conjunction with the actual operation of the engine, with an overview of the trouble point. The scope of finding trouble codes related to engines is classified as follows: <ul style="list-style-type: none"> - Fuel system breakdown code: oil tank, oil filter, pipe and connector, high pressure pump and common rail, injectors; - Air system breakdown codes: air filter, pipeline, turbocharger, air pressure sensor, air tank, ... • Preliminary examination of electrical parts: bundles of wires, jacks, sensors, actuators, ...
4	Find the problem when there is no breakdown code	If the breakdown code cannot be read, check the diagnostic device and ECU communication cable bundle to see if it is normal. If there is no trouble code, base on experience and data flow to conduct judgment analysis.

2. Causes and methods to handle common problems of diesel engines

2.1. Low Nox conversion efficiency

Step	Test location	Test method
Step 1	Base on the trouble code to determine the trouble point	Base on the error code lamp to read the error code, determine the fault point. The focus is the trouble related to NOx conversion efficiency.
Step 2	Check the NOx sensor and exhaust pipe	Check the NOx sensor and exhaust pipe, if the signal of the NOx sensor measured is quite large, it will lead to the failure of conversion efficiency.
Step 3	Check the amount of urea injection	Check the urea injection, if the amount of urea injection is slightly low, it will lead to the signal of the NOx sensor measured is quite large, then will lead to the failure of conversion efficiency.
Step 4	Check the injectors	Check the injector, if the problem from the injector (if the mechanic part is stuck or part is stuck, the system cannot find such mechanical failure), the amount of urea injection will be quite small, will lead to the measured signal of the NOx sensor is quite large, followed by the failure of transformation performance.
Step 5	Check the urea pressure	Check the urea pressure, if the urea pipe is leaked, the urea pressure controlling will be quite low, the actual urea amount will be quite small, which will lead to the measuring signal of the NOx sensor is rather large, and that leads to the failure of transformation performance;
Step 6	Check the urea solution	Check the urea solution, if the quality of the urea solution is non-standard (low concentration, many impurities, ...), it will lead to a measuring signal of a NOx sensor is rather large, then lead to the failure of transformation performance.
Step 7	Check if the urea is crystallized	Check if the urea is crystallized, if there is crystallization inside the SCR box, the transformation efficiency of the box will decrease.
Step 8	Check engine and SCR box	Check engines and SCR box, if the engine or the SCR box is severely aging, it will lead to a rather large initial NOx discharge or the measuring signal of the NOx sensor is quite large, leading to the resulting in the failure of transformation performance.
Step 9	Check out the relevant	Check environmental-related factors, if the temperature sensor, environmental pressure is broken, the vehicle

	environmental factors	operates in a similar "high 3" environment, it may report a special transformation performance problem, especially in high altitude areas;
Step 10	Check calibration data	Check the calibration data, if the specific conditions show the working condition of the engine is unreasonable, it can be misunderstood and false.

2.2. Weak engine

Step	Test location	Test method
Step 1	Confirm fuel quality	Confirm whether the fuel quality, the category of fuel is suitable for the engine type or whether the fuel quality is too poor.
Step 2	Check the gas	<p>1. Check the gas to see if it is blocked by foreign objects or other physical causes that lead to pedal depressed not 100%, check whether the feedback voltage of the accelerator when the accelerator pedal is down reaches 100%. or not.</p> <p>2. Insufficient intake of gas:</p> <ul style="list-style-type: none"> - Filter dirty, blocked air; Rubber air intake pipe is leaked, blocked or crushed when the car runs at high speed. - Inappropriate turbocharger, check turbine side or compressed air side to see if there is a phenomenon of oil shortage, oil leakage, if impellerr is damage or not. - Damaged air tank, large resistance, when checking, it needs to see if there is any damage or blockage, the rubber pipe connecting the air inlet is loose. - Air cooling tank which is not good, will cause the air temperature to be too high, the air intake efficiency decreases. It is necessary to check the cleaning of oil sludge and impurities on the heat sink as well as in the inner pipe, improving the efficiency of heat sink. <p>3. Large exhaust gas return pressure: if the exhaust pipe is clogged, the return pressure of the exhaust gas system is too large, which will naturally cause the exhaust gas concentration in the cylinder to rise, causing the fire rate of the gas mixture decreases, the effective pressure of the cylinder decreases, the combustion efficiency decreases. Check the exhaust gas pipe to see whether there is a phenomenon of</p>

		<p>blockage. In the front and gear exhaust pipe, whether there is a lot of coal dust, whether valve of the exhaust brake has flexibility, check the tightness of the exhaust pipe and the connector; SCR box is blocked.</p> <p>4. The oil intake line is not clear, the oil inlet coonector, the oil return pipe must be locked, the pipe must not be too small and too long, ensuring the oil intake pipe and oil return pipe clear, no phenomenon of gas leak.</p> <p>5. In the oil pan, there is no residue of poor quality fuel, impurity residue, if many impurities, it will clog the filter net.</p> <p>6. Problem in which oil intake pipe, oil return pipe, hand pump does not provide enough oil, the oil gauge is damaged.</p>
Step 3	Check the steam line	<p>Test sequence: air filter ► air-intake rubber pipe ► tuborcharge ► wind tank ► combustion chamber ► exhaust pipe (butterfly valve) ► SCR tank.</p>
Step 4	Check low pressure oil lines	<p>Test sequence: fuel tank ► pre-filtration ► gears ► fine filtration ► high pressure pumps</p>
Step 5	Check high-pressure oil lines	<p>Test sequence: High pressure pump ► common rail tube ► injector</p> <ul style="list-style-type: none"> - High pressure pump is worn; High pressure pump is a device that maintains the oil intake pressure, which is an important part of the engine, if it is damaged, it will directly cause the engine fail to operate. Poor oil quality, damaged oil filter, broken oil hand pump will cause the piston and control valve of the pump to be worn, making the oil intake pressure decreased. - Common rail tube in common rail system has the effect of storing oil and pressure, the most important part of it is common rail pressure sensor. If the signal of the common rail pressure sensor is incorrect, it will reduce the oil pressure in the pipe, directly reducing the amount of oil injection. - The valve opening and closing to control the amount of oil injection more or less through the control of the electromagnetic valve. Types of damage include: a nozzle is cumulated a lot of coal dust, injection valve

		is stuck, electromagnetic valve is damaged.
Step 6	Configuration disorder	Check injector, tuborcharge, etc
Step 7	Check the tightness, clearance of valves	1. Gaskets of cylinder head cover is leaked 2. Valves and valve base are not fully sealed 3. The valve clearance is unreasonable, causing insufficient air intake
Step 8	Check the ability to protect the engine overheating	When the engine is weak, check whether the engine temperature is too high, so leads to automatically protect the engine.
Step 9	Check the ability to protect the tuborcharge	whether the operating status compared to the operating range of the tuborcharge, so activating the tuborcharge protection mode by limiting oil injection.
Step 10	Check to limit the amount of smoke	Whether the vehicle is in a high terrain location, so limiting the amount of smoke
Step 11	Trouble of rear treatment part	1. Trouble of injectors; 2. Trouble of urea pump; 3. Trouble of urea pipe; 4. Trouble of urea tank; 5. Trouble of Nox sensor; ➤ These above 5 troubles will cause the engine to activate the rear treatment torque limit, limiting the upper limit value of the output torque, making the user feel the engine weak. After finding the trouble point, repair or replace components that are newly in trouble, after the problem has been dealt with, the state of torque restraining is no longer available
Step 12	Check the general configuration of the engine	Is the configuration given for the engine assy suitable?
Step 13	Check clutch	Check if the clutch is seriously worn, slipped, etc

Step 14	Check the powertrain system under chassis	Whether friction of the chassis powertrain system is too large, the braking clearance is reasonable
Step 15	Check the air pressure of the wheel	Whether the tire is broken or flat
Step 16	Check ECU data	ECU data is not compatible, the market distorts data
Step 17	Ask customers	<ol style="list-style-type: none"> 1. Complaints about engine: motivation, economy, level of exhaust gas; 2. Driving habits: gearshift to change speed, running N mode 3. Psychology of comparisons

2.3. The engine cannot start

Step	Test location	Test method
Step 1	Confirm fuel quality	Confirm whether the fuel quality, the type of fuel is suitable for the engine type or whether the fuel quality is too poor.
Step 2	heck fuel level, fuel gauge	Check the fuel level in the tank, compare it with the fuel gauge to see if the gauge is working properly.
Step 3	Check fuel tank	Check if the oil tank is clean, make sure there is no strange object, the air vents are not blocked.
Step 4	Check the digital switch, the zero speed switch	Check the position of the gear stick to see if it is in the position of zero speed switch, if it's normal.
Step 5	Check secondary starter	Check the secondary starter to see if it is normal.
Step 6	Check battery voltage	Check the battery voltage to see if it is normal (minimum starting voltage is 13-16V).
Step 7	Check the battery of the car	Check if the car's battery is normal.
Step 8	Check the starter relay	Check the wiring of the starter relay to see if it is open-circuit or connected wrongly, see if the relay is broken.
Step 9	Check the start up	Judge whether the engine starter works normally,

	of engine	after starting, whether the starter is inactive. (1) If it's inactive: - Check if the circuit of the vehicle lock switch is normal, whether there is the interrupted connection. - Check the wiring of the starter relay to see if the circuit is open-circuit or wrongly connected, check whether the relay is damaged, eliminating the problem of the starter circuit problem. (2) If the starter works - Continue checking the engine drive to see if it is flexible - check to see if the air alignment is correct;
Step 10	Check low pressure oil lines	Check low pressure oil line, pre-filter, fine filter to see if there is gas residue, leakage or congestion; check whether the hand pump works, check to see if the piston valve port of the hand pump, the oil filler is clogged
Step 11	Check high-pressure oil lines	Flow meter is opened continuously, because the wire bundle is wrongly connected, the flow meter has no power source, the flow hole 0 is blocked. Check the high pressure pump: when the engine stops working, loosen the oil port and the oil return port of the high pressure pump, when the motor is opened, there will be normally oil flowing out, the phenomenon of oil drain can refer to the model of normal motor; If there is no oil flow or unusual oil flow, think about the problem of pump. The device measures the amount of oil stuck in a position that is always closed or has a slightly small aperture; Internal oil lines or valve assemblys may have been clogged with particulate objects; If the oil flows normally, check the oil return amount of the injector.

Step 12	Configuration disorder	<p>Use a trouble diagnostic machine to check: continue to check if common rail pressure is normally generated, if the common rail pressure is abnormal, it can be caused by injectors, common rail pipes, high pressure pumps, intake ECU. Continue to check the 4 power wire from the battery to the ECU, unplug the car's main cord bundle jack to see if there is a trace of power surge to the ECU, there may be a bad contact ECU jack or the sealing component is broken, causing water penetrated or the voltage is too high, ... resulting in power surge.</p>
Step 13	Use a trouble-diagnostic machine to check whether the flywheel signal disc and the cam-wheel drive signal disc are synchronized (signal 48). Otherwise, check if the crankshaft sensor or camshaft sensor is damaged; if not damaged, check installation of crankshaft rotation speed sensor, cam shaft, wire bundle test and flywheel gear quality.	<p>Due to the installation of the mechanical part or the sensor bundle problem leads to false signals of camshaft and crankshaft or no signal, it is not possible to synchronize, fail to inject the oil normally.</p>
Step 14	Use a trouble diagnostics machine to check trouble codes	<p>1) Common trouble code: Using trouble diagnosis machine to check trouble codes, common synchronized signal trouble codes include:</p> <ul style="list-style-type: none"> P0304: Camshaft signal loss P0335: Crankshaft signal loss P0341: Camshaft signal error P0336: Crankshaft signal error <p>2) Check camshaft and crankshaft signals: Check the resistance of the sensor (at 20 ° c is $860\Omega \pm 86\Omega$) Check if the position for installing the sensor is accurate (clearance: 0.3mm ~ 1.2mm); Check the bundle of wires from the sensor to the ECU to see if the circuit is open; Check the cord bundle plug.</p> <p>3) Check the synchronous signal: Check if the sensor is dirty making the signal false;</p>

		<p>Check the bundle to see if it is twisted or blocked, eliminating the other signal wires nearby causing electromagnetic interference;</p> <p>Compare with the variable valve timing system drawing upon delivery, confirm whether the relative position relationship between the crankshaft and camshaft is correct;</p> <p>Check if the machining signal wheel is correct, the signal wheel has a heterogeneous width and elevation.</p> <p>4) Check the installation position of the mechanical part:</p> <p>Position of the flywheel installation: when the piston is located at the dead point on machine 1, the angle from the crankshaft position corresponding of the sensor to the position of the missing gear must be homogeneous to the angle in the design drawing;</p> <p>Variable valve timing relationship between crankshaft and camshaft: after fixing the crankshaft position, check the camshaft position, then the relative position between the crankshaft and camshaft must be homogeneous to the position in the design drawing.</p>
--	--	---

2.4. Generator is inactive

Step	Test location	Test method
Step 1	Check the line	Check the transmission line from generator to Ammeter to see if there is a circuit break, short circuit, loose plug.
Step 2	Check the belt	The transmitter belt is loosen, check and adjust the belt tension.
Step 3	Check rotor and stator windings	The rotor coil, the stator coil is circuit break, short circuit, short-circuit to the ground, repairs or replaces new assy.
Step 4	Check rectifier tube	The rectifier tube is broken, replacing the new assy.
Step 5	Check the insulating paper of the pile mounting wires	The insulating paper of the pile mounting wire is damaged, the conductor is broken.
Step 6	Check the voltage adjustment	The voltage regulator regulates voltage too low or too high.

Step 7	Check the contact point of the voltage regulator	The contact point of the voltage regulator is melted, repaired or replaced with new assy.
Step 8	Check rectifier tube	The rectifier tube is damaged, the contact battery is not good.
Step 9	Check the voltage regulator	The magnetic coil or voltage regulator resistor circuit is broken, repaired or replaced with a new assy.
Step 10	Check electrolyte solution	The electrolyte solution of the battery is too small or the battery is too old, add electrolyte solution or replace the new battery.
Step 11	Check carbon brush	Carbon brush is in bad contact.
Step 12	Check battery pile	The pile is loose, in bad contact
Step 13	Check the voltage regulator	voltage regulator is damaged.
Step 14	Check the voltage adjustment	Unreasonable voltage adjustment.
Step 15	Check if the voltage regulator is short-circuit with the ground	The voltage regulator has a short circuit with the ground.
Step 16	Check the contact tip of the voltage regulator	The contact tip of the voltage regulator is insensitive, dirty, voltage coil or resistor line is broken.

2.5. Urea is constantly heated

Step	Test location	Test method
Step 1	Use the error diagnostic machine to read trouble codes, identify trouble points	Base on the trouble code read by the error diagnostic machine to determine the incident point, focus on checking the incident related to the urea heating sensor and the environment temperature sensor.
Step 2	Check the environment temperature sensor and its wire bundle	Based on the result of step 1, check the environment temperature sensor and its bundle, confirm whether the sensor is normal or not.

Step 3	Check the electromagnetic valve of urea heating relay and its wire bundle.	Based on the result of step 1, check the relay, the electromagnetic valve of the urea heater and its wire bundle.
Step 4	Check the urea heating resistor and its bundle	Based on the result of step 1, check the urea heating resistance and the bundle of wire, the urea heating water line.
Step 5	Check the urea pump heater	If the urea pump heater reports the trouble, after the power is turned off and the problem still exists, if necessary, replace the urea pump.
Step 6	Check calibration data	Check calibration data.

2.6. Failure to create pressure urea

Step	Test location	Test method
Step 1	Base on the trouble code to determine the trouble point	Base on the trouble code to determine the breakdown point, the focus is on the function problem related to pressure generation and pressure-related parts such as: injector, inverse valve, urea pump, heating relay, heating resistance wire, exhaust temperature sensor, temperature sensor for urea tank.
Step 2	Check the urea heating part	If it is in a place where the weather is cold, based on the trouble code, first check the urea heating part, ensuring that the urea heating function is normal. If there is also a problem related to urea heater, you can refer to section 3.5.4 – trouble of continuously heating urea to check each step.
Step 3	Check trouble of related parts	Obtain information related to the trouble after step 1, if there is no problem related to the pressure-generating function but only the trouble of related part, check the parts such as injectors, inverse valves, urea pumps, heating relay, heating resistance wire, exhaust gas temperature sensor, urea tank temperature sensor, ... and their bundle of wires, which may be a problem of certain parts causing the system never tried to create pressure, the temperature of upstream exhaust gas SCR when pressurized and discharged is 180°C.

Step 4	Check the wire bundle	Disconnect the power and re-connect. if the system still does not try to create pressure, it is necessary to check the bundle of wires between the parts to be inverse connected, continue to check the bundle of wires
Step 5	Check whether urea is leakage or blocked	The relevant trouble information can be found in step 1, if there is a trouble in pressure function without the problem related parts, it means the parts have no problems, then check the installation of urea pipes, whether there is leakage or obstruction of urea, it may be the system tried to pressure but failed.
Step 6	Check the wire bundle	Disconnect the power and re-connect, if the system has tried to create pressure but failed, it is necessary to think of the bundle of wires connecting between the parts to be inverse connecting, continue to check the bundle of wires.
Step 7	Check the level of urea solution	The urea tank containing no urea can also lead to the system not creating pressure, the relevant information refer to the section of urea solution.
Step 8	Check calibration data	Check calibration data

2.7. Urea consumes too little or does not consume

Step	Test location	Test method
Step 1	Check the total amount of urea consumed and the total amount of fuel consumed	Ask the customer if the amount of urea consumption is zero or consume with a small amount (using the error diagnostic machine to get data on the total amount of urea consumption and total fuel consumption in the data line for comparison and reference).
Step 2	Use the diagnostic machine to read ECU trouble codes	Use the diagnostic machine's software to read the ECU trouble codes, base on the result of the trouble code, determine which incident has resulted in abnormal urea consumption.
Step 3	Trouble in failure to create urea pressure	If the failure of the urea pressure is reported, refer to section 3.5.3 – Trouble in failure of the urea pressure to carry out a step-by-step test.

Step 4	Trouble in low NOx conversion performance	If the trouble of low NOx conversion performance is reported, refer to section 2.1. Low conversion performance NOx trouble to conduct a step-by-step test.
Step 5	Ask customers	If the consumption is quite small, ask the customer information related to the working condition of the engine. When the exhaust gas temperature does not reach a high level, the low consumption of urea is normal, the car has no other problems, proving that this situation will not affect the amount of oil consumption as well as the dynamics of car.
Step 6	Read trouble codes from Diagnostic Machine	If the amount of urea consumption is too little or not completely consumed, the total amount of urea consumption read by the diagnostic machine is very small. Connected to diagnostic machine, network connection and actuator. Read the problem code, if a trouble code exists, before the problem is resolved, the incident code cannot be deleted.
Step 7	Base on the trouble codes to check the corresponding incident	If the trouble code of the ECU controller exists the component problem related to rear treatment such as urea pump, urea injector, SCR exhaust gas temperature sensor, open circuit, short circuit, ..., base on the trouble description to check the corresponding trouble, until the trouble is resolved, do not show the trouble code.
Step 8	Urea injection test	<p>Use the function of urea injection test in the Diagnostic Machine software, check the operation of the urea injection system.</p> <p>(1) If urea injected from 3 holes of the urea injector is in a normal dew state, accompanied by a suction sound of the injector valve, it shows that injector works normally.</p> <p>(2) If it does not inject urea: check the urea pipe to see if it is bent, leaking or inverted. If the pipe has a problem, handle the problem of the pipe; If the pipe does not have problems, use a diagnostic machine to conduct the urea injection test, withdraw the pressure tube of the solution outlet of the urea pump, see if the urea is flowing out.</p>

Step 9	Check urea pump	<p>If the solution outlet port of the urea pump has no urea flowing out, check the connector of the urea pump to see if it is blocked, if it is blocked, it will be cleaned or replaced.</p> <p>If the solution outlet port of the urea pump has urea following out, check the injection hole of the urea injector to see if it is clogged. If it is blocked, clean the injector and use the Diagnostic Machine to repeat the urea injection test. If the urea injector still does not spray, replace the new injector.</p> <p>The trouble of failure to urea injection must be checked in order, when the pipe has not been determined to be inserted correctly or not, it is not possible to replace the urea pump, when the pump has not been determined to work normally or not, do not replace new injectors. Check out the steps in the process, find out the exact point of the incident, avoid misjudgment.</p>
--------	-----------------	---

2.8. Urea consumption

Step	Test location	Test method
Step 1	Check the ratio between the urea consumption value and fuel consumption value	Ask the customer about the ratio between the urea consumption value and the recent fuel consumption value (diagnostic software can be used, using data flow, using the ratio of total urea consumption value and total fuel consumption value for reference, this method is correct).
Step 2	Normal consumption	If the ratio is less than 10%, explain to the customer that the amount of such urea consumption is in the normal range, compared to the passenger cars, it may not be the same, possibly a car model, working status, driving habits will create certain differences.
Step 3	Urea injection test	If the urea consumption is greater than 10%, remove the urea injector from the rear treatment box (only remove the mounting bolts, do not remove the power plug), connect to the diagnostic machine, network and actuator, Use the urea injection test in the actuator of the diagnostic machine.

Step 4	Crystalline urea	If detecting inside the exhaust pipe or the rear treatment box has crystalline urea, refer to section 2.9. Trouble of Crystalline urea, to conduct a step-by-step test.
Step 5	Injection status of urea injector	<p>Check the injection status of urea injector:</p> <p>(1) Conditions such as large amount of ureainjection, or injection in column, continuous injection will cause a large amount of injection. It needs to replace new injectors.</p> <p>(2) The amount of urea injection is shown in the form of mist spraying from 3 spray holes, while spraying in an intermittent cycle, accompanied by the suction sound of the injector valve, it means that urea injection is normal; Wait for the diagnostic machine to finish testing. If after stopping urea injection, the urea injector has a phenomenon of untight sealing, the leakage of urea, it should replace the new injector; If after closing without leakage of urea, check if the urea pipe is leaked.</p>
Step 6	Check consumption status urea	The ratio of urea consumption less than 10% is normal, if the amount of consumption is significantly higher than this ratio, check the spraying status of the injector. If the customer uses poor quality urea or addes more water into urea, making the injection hole of the urea injector becomes bigger, the inside of the SCR box is seriously crystallized, there is no warranty.

2.9. Crystalline urea

Step	Test location	Test method
Step 1	Check crystallization	Check to confirm if the inside of the exhaust pipe and the rear treatment box have crystalline urea.
Step 2	Check connection	Check the clamp connecting the exhaust pipe to see if it is loose, broken, or leaking gas.
Step 3	Check the tightness	Check the position of the base of urea injector to see if it is sealed and air-leakage or not.
Step 4	Check urea solution	Check whether the urea solution used by the customer is a solution with a concentration of 32.5% of the standard, whether the urea meets the prescribed standard.

2.10. Consumption of high lubricating oil

Step	Test location	Test method
Step 1	Re-verify the oil consumption rate	Re-verify the oil consumption rate, calculate the ratio of oil amount to the number of kilometers
Step 2	Check for oil leak	Check if the engine has an oil leak. Tighten screws, pipe button and connectors. If necessary, replace the new sealing gasket.
Step 3	Check the ventilation system of the crankshaft chamber	Check crankshaft ventilation system to see if there is leakage, clean ventilation device of crankshaft chamber.
Step 4	Check air pneumatic pipes	Check whether the inside of the pneumatic pipe has oil.
Step 5	Check the oil gauge	Check the divider of the gauge.
Step 6	Check the duration of oil change	Confirm whether time for oil change is correct
Step 7	Check if it is in accordance with technical regulations	Confirm whether the oil complies with the technical regulations in working conditions. Otherwise, replace the oil filter
Step 8	Check whether tuborcharge is leaked	Check whether the pneumatic part and the sealing device of tuborcharge, oil seal are leaked.
Step 9	Check if the oil cooler is leaked	Check if the oil cooler is leaked. Check whether the inside of the oil cooler has oil remained.
Step 10	Check contamination of oil	Oil is contaminated with coolant and fuel. Conduct an oil analysis to determine the dirt in the oil.
Step 11	Check gas leak	If too much gas leaked from the combustion chamber, check whether the piston ring is installed accurately.

Step 12	Check the condition in the cylinder	Check worn and damaged condition of piston, cylinder, piston ring.
---------	-------------------------------------	--

2.11. High fuel consumption

Step	Test location	Test method
Step 1	Ask customers	Directly ask the customer to verify the problem, to see if it's due to external factors such as environment, special working status, specific time period, etc. affecting the rate of fuel consumption
Step 2	Verify with customer about driving habits	Check if the driving habits of customers are correct. It means to check if the customer makes a gear shift when there is a reasonable revolution, if the customer has a habit to increase or decrease the throttle abruptly, if the customer often operates at high rpm?
Step 3	Check fuel quality	Check whether the fuel is leaked, oil number is suitable for engine type, oil quality is poor, ...
Step 4	Check the resistance of the vehicle	Check whether the resistance of the vehicle is too large. For example: the size of a large freight.
Step 5	Check speedometer, fuel gauge	Check whether the speedometer, fuel gauge are normal.
Step 6	Check airways	<p>Order of inspection: air filter ► air-intake rubber pipe ► air tank ► combustion chamber ► air exhaust pipe (butterfly valve) -► SCR tank. Specific operations have two points as follows:</p> <ul style="list-style-type: none"> 1. Insufficient intake of air <ul style="list-style-type: none"> - Air filter is dirty, clogged; Air-intake rubber pipe is leaking gas, congested or crushed when vehicles run at high speeds. - Turborcharge is incompatible, check turbine head and air compressor to see if there is phenomenon of oil lacking, oil flowing, impeller deformation. - The air tank is broken, the resistance is large, when checking, it is necessary to pay attention to see if there is any breakage or blockage, the part linking the air-intake and air-exhaust rubber pipe is loose, ... - The cooling air tank which is not good, will cause

		<p>the intake air temperature to be too high, the air-intake efficiency is reduced. It is necessary to check the oil sludge and impurities on the heat sink and inside the internal oil line to improve the efficiency of the heat sink.</p> <p>2. Large exhaust return pressure</p> <ul style="list-style-type: none"> - If the exhaust pipe is clogged, causing the return pressure of the exhaust system is too large, the residual exhaust content in the cylinder will, of course, increase, reducing the combustion rate of the mixed gas, the effective pressure of cylinder reduced, combustion efficiency reduced. Be sure to check whether the exhaust pipe is blocked, in the front and rear exhaust pipes, there is accumulated with a large amount of coal dust or not, the exhaust brake valve moves flexibly or not, the tightness of the exhaust pipe and the connector; SCR tank is congested or not. - Loading oil into the oil tank is not smooth, connectors of the oil intake pipe and oil return pipe must be locked tightly, the pipe muNo. be neither too small nor too long, ensuring the oil return oil pipe is smooth without air leakage phenomenon. - In the oil pan, there is no residue of poor quality oil, impurities, ... too much impurity will clog the filter net. - The problem of oil intake, oil return pipes, hand pump does not provide enough oil, the oil gauge is damaged.
Step 7	Check low pressure oil lines	<p>Order of inspection: fuel tank ► pre-filter ► gears ► fine filter ► high pressure pump</p>
Step 8	Check high-pressure oil lines	<p>Order of inspection: High pressure pump ► Common rail-> injector</p> <p>1. High pressure pump is worn, high pressure pump is a part to maintain oil supply pressure, which is a key part of the engine, its failure will make the engine inactive. Poor oil quality, damaged oil filter, broken hand pump, all will cause piston and control valve of high pressure pump worn out, reducing oil supply pressure.</p> <p>2. In common rail system, common rail pipe has</p>

		<p>function of containing oil and pressure, its important part is common-rail pressure sensor. If the rail pressure sensor signal is inaccurate, it will reduce the oil pressure in the pipe, directly reducing the amount of oil injection.</p> <p>3. Injector valve opens and closes to control more or less oil through the electromagnetic valve. Types of malfunction include: the injector accumulates many coal dust, injector valve is stuck, and electromagnetic valve is damaged.</p>
Step 9	Check ECU data	ECU data is not compatible, the market distorts data
Step 10	Check the tightness, the valve clearance	<ol style="list-style-type: none"> 1. Cylinder head cover gasket is air-leaked. 2. Valves and valve base are not fully sealed 3. The valve clearance is unreasonable, causing insufficient air intake
Step 11	Check the problem in the cylinder	Trouble in engine cylinder, friction increases.
Step 12	Check the drive system	The drive system is not compatible with the engine or drive system with malfunction.

2.12. Trouble in Air compressor

Step	Test location	Test method
Step 1	Check pressure relief valve	Check the pressure relief valve assembly to see if it is jammed, clean and replace the liquid valve.
Step 2	Check valve seat	Remove and check the cylinder head cover, check valve seat, replace the deformed or broken valve seat.
Step 3	Check valve base plate	Remove and check the cylinder head cover, clean the valve base plate.

2.13. Starter is inactive.

Step	Test location	Test method
Step 1	Check battery	The battery is running out of power. Check, charge or replace the new battery.
Step 2	Check fuse	Fuse is damaged, replace new fuses.
Step 3	Check conductor	The conductor is in bad contact, re-check the line, tighten the wire mounting piles.

Step 4	Check starter	The starter itself is short-circuiting, check to repair motor or replace assy.
Step 5	Check carbon brust	The carbon brush is in bad contact, clean the brush surface, if necessary, replace the assy.
Step 6	Check ball bearings	Ball bearings are worn out, replace new assy.
Step 7	Check the rectifier	The rectifier is dirty or burnout, clean oil stains and use sandpaper to polish, if necessary, replace them with new ones.
Step 8	Check the line	The tip of the wire is broken, weld it.
Step 9	Check the switch	The switch is in bad contact, check the switch and repair it
Step 10	Check the clutch	Clutch is worn and slipped. Adjust the working torque of the clutch or replace the assy.

PART IV: INSTALLATION AND DISINSTALLATION OF ENGINE

1. General introduction

When disassembling a diesel engine, please operate in accordance with the instructions in this manual, and also pay attention to the operations remarked as safety and dangerous in this manual, to ensure safety for people and avoid accident.

Because the steps to assemble and disassemble the diesel engine are opposite, if there is no special notes, this manual only takes one section to guide.

Torque tightening special bolts will be guided in the relevant installation and disinstallation steps, if there is no special note, please refer to chapter V: standard bolt tightening torque.

1.1. Warning symbols



This warning symbol is recognized by the world. In this manual, this symbol is used to emphasize the importance of the information below. You must be surely aware of the consequences caused by a dangerous situation and how to avoid danger. Violations of warning information can lead to property losses, accidents for people, even death.

Dangerous warnings that we often see and use for common warnings. In this manual particularly, warning information is categorized into different types based on the level of dangerous consequences it can lead to (minor injury, serious injury and death).

This warning symbol represents a potentially dangerous situation, if this situation cannot be avoided, it can lead to serious injury to people, even death.

This warning symbol indicates a potentially dangerous situation, if this situation cannot be avoided, it may result in minor injury or property loss. This warning icon is also used to alert dangerous operations.

The information provided by this form of "notes" is to explain how to correctly operate and install the product engine of the company. However, merely reading this manual cannot eliminate dangerous situations, only correctly understanding the information included in this note is useful for accurate use.

The warning information in this manual cannot cover all situations that may occur when using! If the programs and methods that customers decide to use are within the scope of our introduction, make sure that these operations do not pose any danger to you, the surrounding people or the equipment.

1.2. Safety symbols

In the process of using diesel engines, there may be potential dangers without any forewarning. Therefore, this manual cannot make separate warning for each specific type of potential hazard. If the program you use is not in the special introduction category, make sure that the program can operate safely and does not cause any physical damage.

Table 4-1: Safety symbols

Image	Meaning
	Wear protective gloves
	Wear ear protection
	Wear eye protection
	Wear head protection
	Wear protection shoes
	Wear a protective mask
	Wear protection clothing
	No fire!
	No smoking!
	No mobile phones!
	Danger: battery acid solution
	Danger: cables have electricity, be careful of electric shock
	Flammable objects

	Keep away from heavy objects hung
	there is a fire extinguisher nearby

1.3. Tools used

If the tool or method used is not within the scope of this manual, the customer must first ensure safety for himself or herself, avoid bringing danger to the person who directly uses it or others. and, at the same time, ensure that such methods of use, maintenance and repair cannot create the risk of damage or risk of unsafe.

Table 4-2: Tools used

Image	Meaning
	2,5mm hex wrenches
	5mm hex wrenches
	8mm socket ratchet wrenches
	Pan head socket
	Specialized tools
	10mm-tip hex wrenches

1.4. Points to pay attention to protect health

"The points to pay attention to protect health" below are to minimize the risk of contamination.

- Avoid repeated contact for a long time with used oil.
- If conditions permit, wear protective clothing and wear waterproof gloves.
- Do not put the rags wiped with oil into the pocket.
- Limit oil sticking to clothing, especially underwears.
- Often wash protective clothing, remove oil-contaminated clothes and shoes that cannot be washed.

- f) If being injured, take emergency measures immediately.
- g) Prior to working, a protective cream must be applied; When the oil sticks to the skin, it is easy to clean.
- h) Use soap and hot water, or use hand sanitizer and brush to wash your hands, to clean grease and grease. If washing hands removes the natural oils on the skin, the product containing sheep's fat can replace the natural moisture on the skin, which helps to soften the skin.
- i) Do not use gasoline, kerosene, diesel, banana oil or solvents to wash your skin.
- j) If your skin feels uncomfortable, immediately seek medical attention.
- k) If possible, clean the oil on component parts before shipping them.
- l) When working at risk of eye damage, use protective glasses or masks. Glass wash solution must be placed in an easy-to-reach place.
- m) When repairing diesel engines, do not let oil or other liquids to fall to the ground. If hydrocarbons or other liquids are leaked, use all necessary measures to isolate the leak area, keep the environment clean and protect people from impact.
- n) Transportation, storage and recovery of hydrocarbons, ethylene, ethylene glycol or petroleum must comply with the country's safety and environmental standards.

1.5. Environmental protection measures

Regarding the treatment of waste oil and hydrocarbons, comply with the laws relating to environmental protection. For details, please go to state agencies for advice.

1.6. Points to note when assembling and disassembling diesel engines

- Accidents related to the use, maintenance and repair of engines are mostly due to non-compliance with safety regulations and basic attention points. Therefore, customers should be aware of possible hazards and take corresponding precautions. If you want to manipulate, maintain and repair engines, you must be trained relevant knowledge, have enough skills to use and use appropriate tools.
- If you violate the relevant guidelines stipulated in this manual, it may lead to serious accidents, even life-threatening. The manufacturer cannot anticipate all the potential dangers. Therefore, the rules and guidelines specified in this manual are not sufficient.
- Before continuing to carry out maintenance or repair operations, place "Do not use" signs or similar symbols on the starter switch.
- Before using leverage, necessary precautions should be taken with respect to the specific use situation.
- Ensure the repair place and surroundings safe to operate.
- Make sure the repair workshop or the area around the engine is clean and tidy.

- Before starting work, remove the rings, necklaces and watches. Wear protective gear that fits in your body.
- Before working, check the corresponding protective equipment (glasses, gloves, masks, protective clothing, helmets) to see if they are in expiry date.
- Do not use tools that are in trouble or inappropriate.
- During maintenance or repair, turn off the engine.

2. Disassemble, check and repair the main bearing bushing assembly

2.1. Preparation

Equipment: wrench with torque, screw machine, tool kit, ...

Before removing the main bearing bushing, it is necessary to remove the flywheel shell, flywheel, front cover, pulley tensioning belt of crankshaft, main bearing cover, connecting rod piston, etc

2.2. Drawings analysing the main bearing bushing assembly

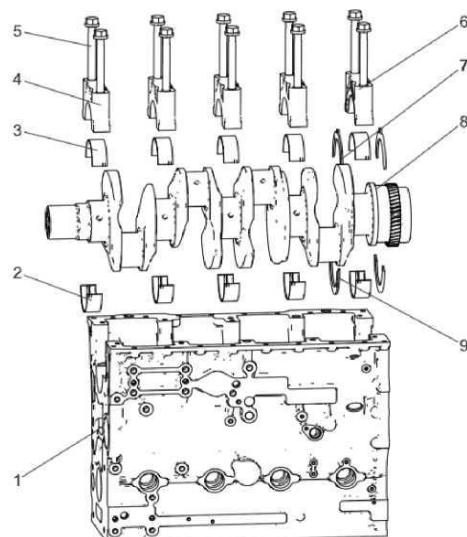


Figure 4-1. Drawings analysing the main bearing bushing assembly

No.	Name of details
1	Engine body
2	Main upper bearing bushing
3	Main lower bearing bushing
4	Main-bearing cover
5	Main-bearing bolts
6	Thrust bearing cover

7	Lower retaining ring
8	Crankshaft assy
9	Upper retaining ring

2.3. Steps to disassble the main bearing bushing assembly

Use hand to push the bushing out of the side face, while marking the removed pieces of bushing, corresponding to the base hole on the body and main-bearing cover..

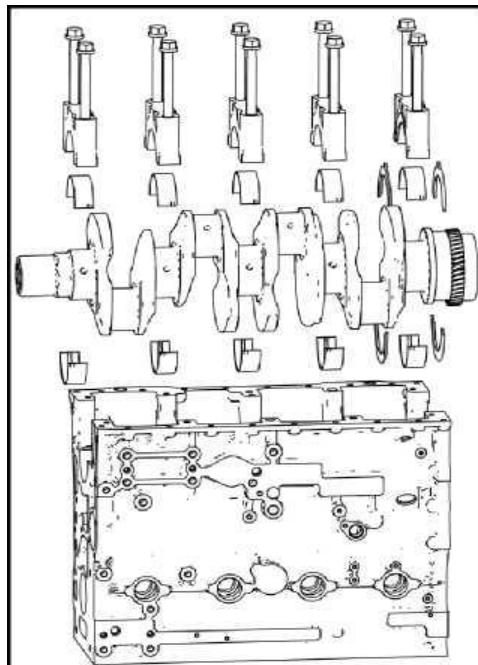


Figure 4-2. Drawings to disassemble main-bearing bushing

2.4. Points to note when checking and repairing main-bearing bushing

- a) Clean the bushing, check the wear of the bushing.
- b) Check the bushing if there is a metal peeling, damage to the positioning lip ring and horizontal cracks.

2.5. Steps for installing the main-bearing bushing

- a) Firstly, clean and dry the bushing and the holes
- b) If the bushing is not replaced, when installing, it will be in the correct order as same as disinstallation. In turn install the body (upper bushing) and the main bearing cover (lower bushing), pay attention to distinguish upper and lower bushing; If you replace a new bushing, just install it directly. When installation, the lip ring must be aligned, applied enough lubricating oil.

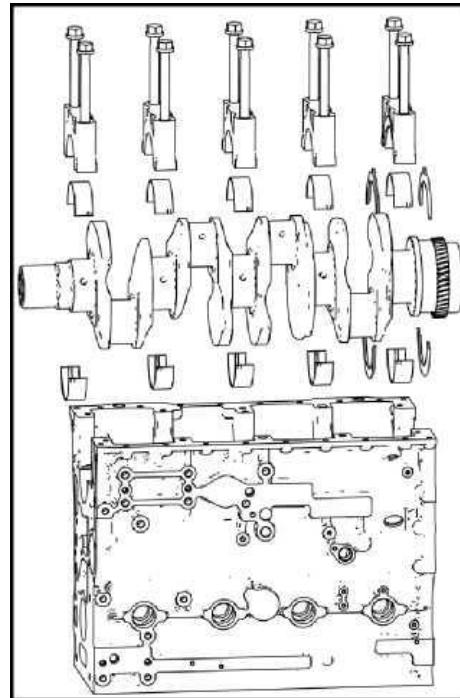


Figure 4-3. Drawings of installation of main-bearing bushing

3. Disinstallation- Installation and check-repair of the two-level balance structure

3.1. Drawings of the two-level balance structure analysis

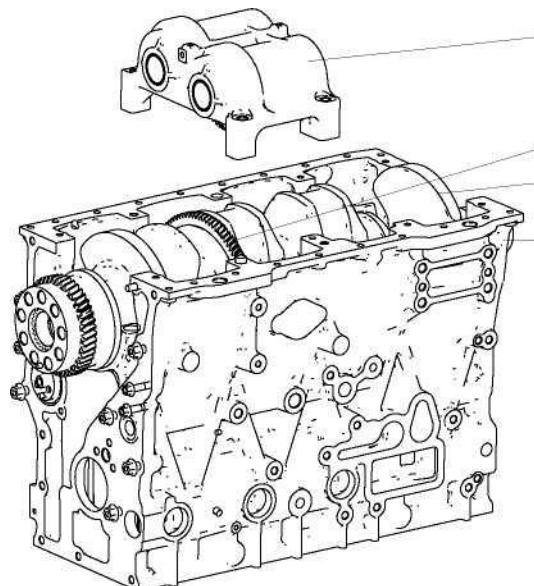


Figure 4-4. Drawings of the two-level balance structure analysis

No.	NAME OF DETAILS
1	Hexagon flange bolts
2	Locating bushing
3	Two-level balance structure

4	Two-level balance structure gears
5	Crankshaft
6	Engine body

3.2. Preparation and tools for disassembling and assembling the two-level balance structure

Equipment conditions: torque wrench, screw machine, crankshaft rotating tool, gauge, ... Before disassembling, remove the oil pan, mounting bracket of the oil filter net of the oil pan and the oil filter net,...

3.3. Steps to disassemble the two-level balance structure

- a) Firstly, remove the oil pan, mounting bracket of the oil filter net of the oil pan and the oil filter net.
- b) Check the bolts symbol inserted in the two-level balance structure, confirm whether the bolts are rotating. Remove bolts inserted in the two-level balance structure.
- c) Remove the two-level balance structure: after removing bolts fixing the two-level balance structure, disassemble the two-level balance structure, the final dismantling drawing as shown in Figure 5-5, check the rotating status of the active shaft and the passive shaft of the two-level balancing structure, check the clearance of the active gears and the passive gears of the two-level balanced structure, check the worn condition of the active gear surface and gear ring.

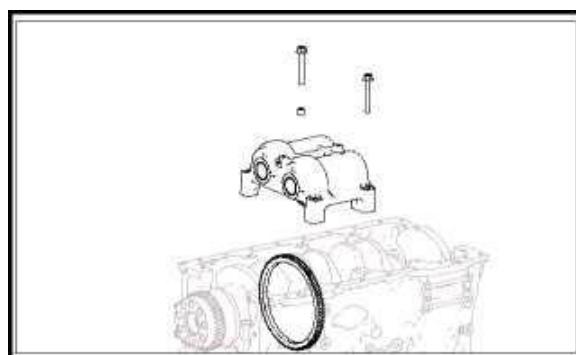


Figure 4-5. Drawings of dismantling the two-level balance structure

3.4. The main points when checking and repairing the two balance structure

- a) Check to see if the threads of the mounting bolts are intact.
- b) Whether the gears have the condition that the gear surface peeled off, broken, the force bearing surface is broken or not.
- c) Check whether the rotation status of the active shaft and the passive shaft of the two-level balance structure is jammed. Whether oil holes is blocked by dirt or foreign objects.

3.5. Steps to install the two-level balance structure

- a) Rotate crankshaft to the dead point on the compression period of machine 1.
- b) Check whether the rotation status of the two-level balance structure has the

phenomenon of being stuck or not. Install a two-level balance structure, insert the positioning tube into the corresponding positioning hole on the body, and align the symbol 1 of the active gear and the symbol 2 of the gear ring in alignment as shown in Figure 2-6. Then tighten two hexagonal flange bolts of the two-level balance structure according to the specified tightening force.

- c) Install the oil filter net mounting bracket, then tighten the two hexagonal flange bolts used between the oil filter net mounting bracket and the two level balance structure according to the specified tightening force, check the clearance between the active gears and gear ring.

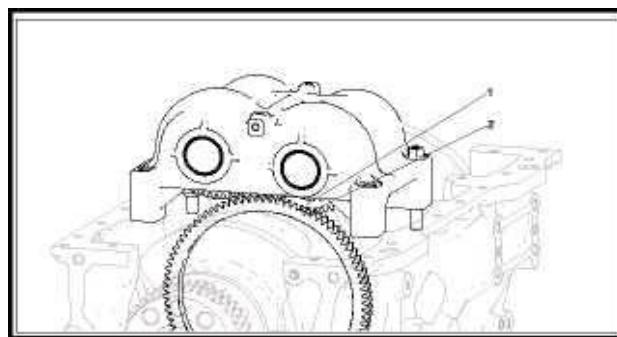


Figure 4-6. Drawings of installing the two-level balance structure

4. Disinstallation – Installation and check-repair of the sensor

4.1. Installation of the sensor

For sensors related to rear-treatment of Euro IV standard DeNO_x 2.2 system in addition to the fluid level temperature sensor integrated on the urea tank, there is also exhaust gas temperature sensor, Nitroxide sensor and environment temperature sensor.

- a) The mounting direction of NO_x sensor and the exhaust gas temperature sensor are perpendicular to the direction of the air flow, before integrating the sensor, it is required to leave a sufficient gap to facilitate the disinstallation; when installing Nitroxide sensor probe, the tightening force is 50N.m, wire bundle should avoid contact with high temperature object; Tightening force for the exhaust gas temperature sensor is 45N.m ± 5N.m.
- b) The ambient temperature sensor is required to be installed in a location can objectively reflect the ambient temperature, preventing the vehicle's heat source from affecting the measurement results of the sensor.
- c) Nitroxide sensor is installed at the tail end of the exhaust pipe and the outlet port of the rear-treatment tank, the mounting direction must be perpendicular to the exhaust pipe in the range of -80 ~ 80 degrees, the figure below is an illustration of the NO_x sensor and mounting angle.

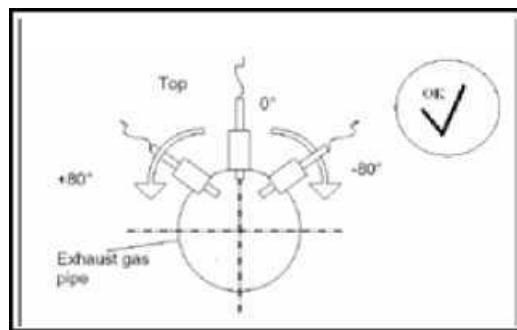


Figure 4-7. Illustration of the NO_x sensor and mounting angle

- d) To prevent the fact that the vibration during operation of the vehicle makes the jacks of the wire bundle loose, damaged, disrupt the signal or failed to transmiss signal, causing the system to operate abnormally, for the amount of excess wire, use the clamp to fix it. When fixing, the bend angle of the wire bundle should not be too large, otherwise after a long time of operation, it will easily damage. Requirements on fixing wire bundle: $L_1 > 10\text{mm}$, arc length $L_2 > 50\text{mm}$, α in the range of $45 \sim 135$, the parameters are shown in Figure 2-8.

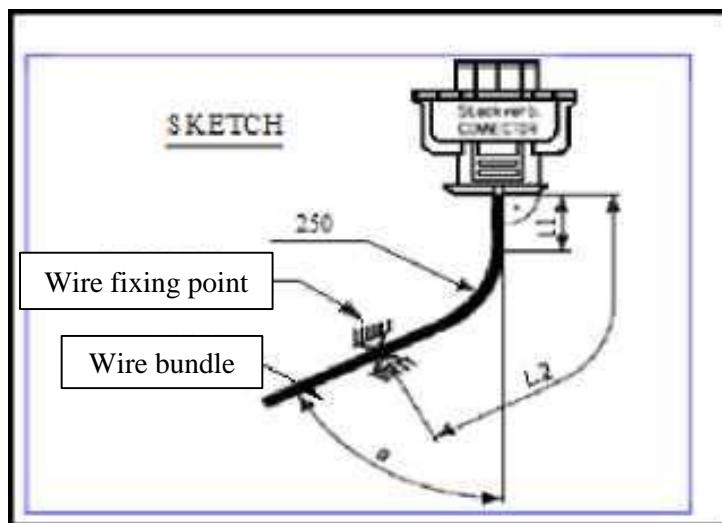


Figure 4-8. Requirements on fixing the wire bundle of sensor and actuators

- e) When installing and fixing bundle of wires, pay attention to the following points:
- When connecting wires with jacks, it's strictly forbiddened to see visible wires exposed directly in the air, insulation shields must be completed. When arranging a bundle of wires on the vehicle, it is necessary to do well the protection measures, avoid near sharp corners on the car, avoid during the long time operation of the vehicle, causing the bundle to be worn, causing the phenomenon of short-circuiting, ... The jacks must be inserted fully, avoid the situation of loose plugging, bring unnecessary inconvenience to the delivery and diagnose the car, and to ensure reliability for signal transmission, bundles of wires should be tied and fixed in an orderly manner.



Figure 4-9. Method of accurately fixing wire bundles

- At the position of the jacks of the wire bundle, make sure the bundle is not too bent, the position of the wiring connector must not be affected by impurities such as stains, water, iron chips, mud, ... if there is a head of metal wire exposed, use sealant to cover it, avoiding short-circuiting. The right figure is an illustration of the method to fix a wire bundle of exhaust gas temperature sensor and NO_x sensor.

5. Disinstallation- Installation and check-repair of low pressure oil pipe assembly

- 5.1. Tools and preparation work before disassembling – assembling low pressure oil pipe assembly.

Tools for disinstallation and installation: open-wrenches

- 5.2. Analysis of low pressure oil pipe assembly

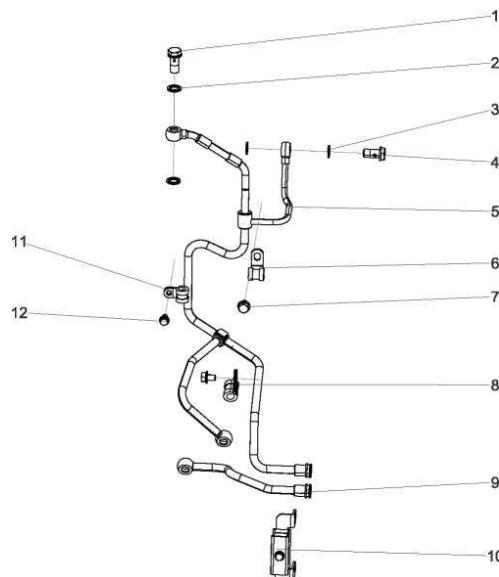


Figure 4-10. Drawing of analysis of low pressure oil pipe assembly

No.	NAME OF DETAILS	No.	NAME OF DETAILS
1	Hollow bolts	7	Hexagon flange bolts
2	Sealing washer	8	Pipe clamp assy
3	Sealing washer assembly	9	Oil intake pipe assy
4	Hollow bolts	10	Oil pipe bracket assy
5	Oil return pipe assy	11	Pipe clamp assy
6	Pipe clamp assy	12	Hexagon flange bolts

5.3. Steps to remove low pressure oil pipe assembly

- a) Remove the bolts fixing the oil return pipe assy and the outlet oil pipe bracket assy.

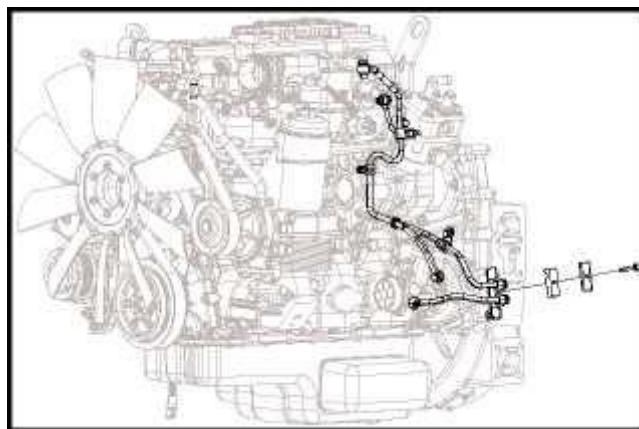


Figure 4-11. Drawings to remove low pressure oil pipe assembly

- b) Remove the oil pipe bracket assy.
- Remove bolts fixing oil pipe assy.
 - Remove oil pipes.

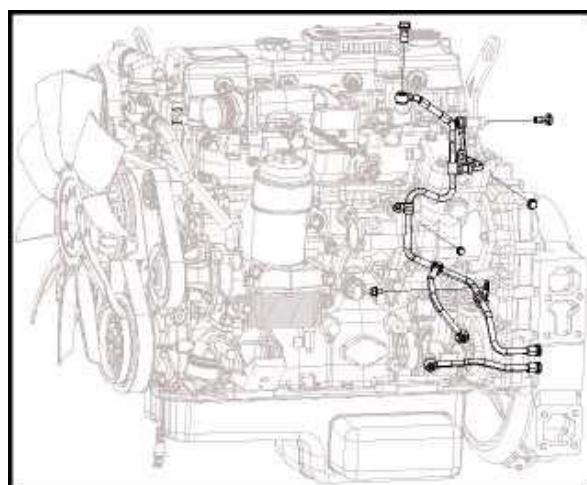


Figure 4-12. Drawing to remove the oil pipe bracket assy.

5.4. Main points when checking and repairing low pressure oil pipe assembly

Check if the sealing washer surface is intact. If there is damage, replace the new spare parts

5.5. Steps to install low pressure oil pipe assembly

Steps of installation is reverse to steps of disassembly

6. Disassembly – installation and check - repair of common rail tube assembly

6.1. Prepare before removing the common rail tube assembly

- Tools for disassembly and installation: Socket Ratchet Wrenches
- Preparation before disassembly
- Remove the high-pressure oil pipe assembly

6.2. Steps to disassemble the common-rail tube assembly

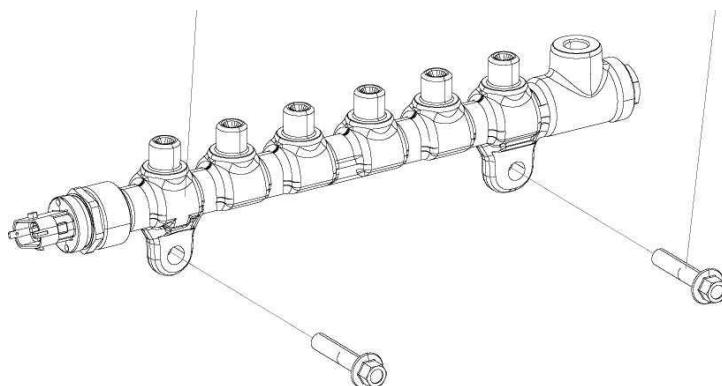


Figure 4-13. Drawings of analysis of the common-rail tube assembly

- Remove hexagonal flange bolts.
- Remove common-rail tube.

6.3. Key points when checking and repairing common rail tube assembly

- Check whether the common rail tube and high pressure oil pipe connectors are intact, if there is damage, replace the new components.
- Check whether the pin in the common rail pressure sensor is normal.

6.4. Steps to install common rail tube assembly

It's reverse to steps of disassembly.

7. Disassembly-installation and check-repair of the water outlet pipes

7.1. Tools and preparation to disassemble and assemble the water outlet pipes

- Tools for disassemble and assemble: tubes and wrenches.
- Preparation before disassembling: before removing, discharge fully the coolant in the engine, remove the water pipe connected to the hot-air connector and the air exhaust, pneumatic water-return hose, remove the wire bundles connected with the water temperature sensor.

7.2. Drawings for analysis of water outlet pipes

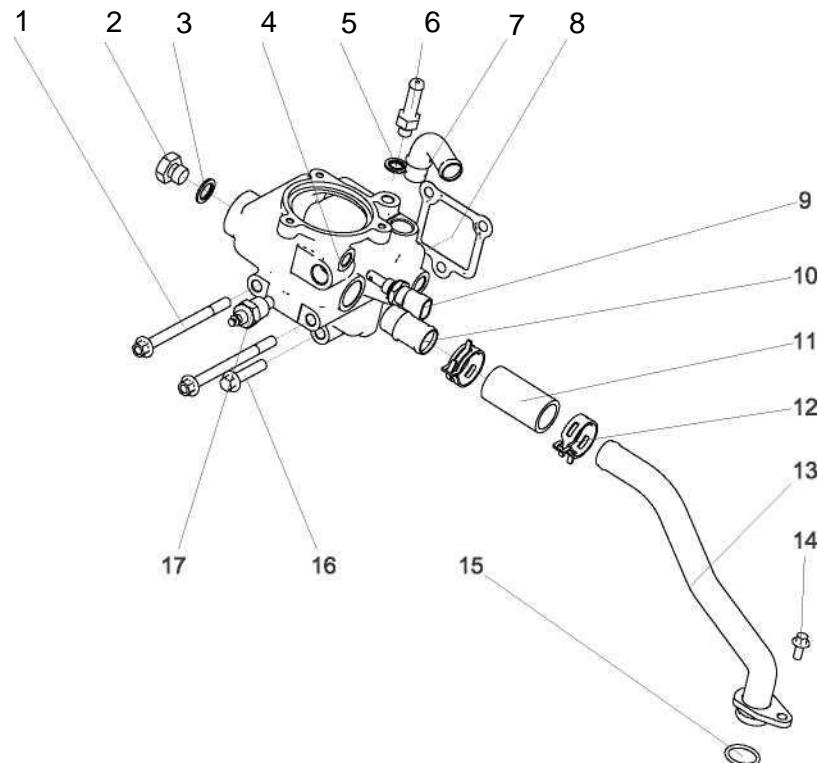


Figure 4-14. Drawings for analysis of common-rail assembly

No.	NAME OF DETAILS	No.	NAME OF DETAILS
1	M8x105 hexagon flange bolts	10	Water pipe connector
2	Plug screw	11	Rubber hose connecting coolant
3	Sealing washer	12	Flexible hose clamp
4	Water outlet pipe	13	Water pipe of water pump
5	Sealing washer	14	M6x14 hexagon flange bolts
6	Air exhaust pipe	15	O-ring gaskets
7	Water pipe connector	16	M8M0 hexagon flange bolts
8	Sealing gaskets	17	Water temperature sensor
9	Water temperature sensor		

7.3. Steps to disassemble the water outlet pipes

- Remove the bolts on the water return tube flange of the small cycle and the clamp on the small circulation tube.

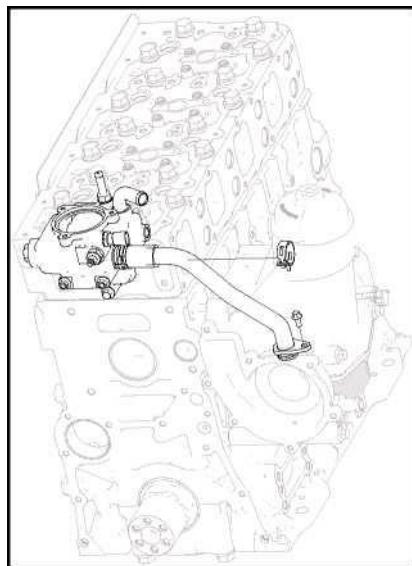


Figure 4-15. Drawing for analysis of bolts and clamps of a small recirculation water return pipe

- b) Remove the small recirculation water return hose and the rubber hose connecting the coolant.

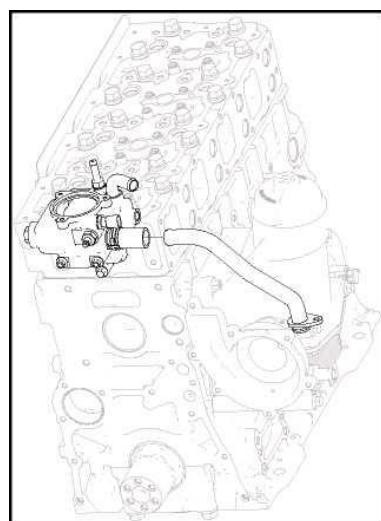


Figure 4-16. Drawing for analysis of the small recirculation water return hose and the rubber hose connecting the coolant

- c) Remove 3 bolts fixing the water outlet pipe, remove the water outlet pipe.

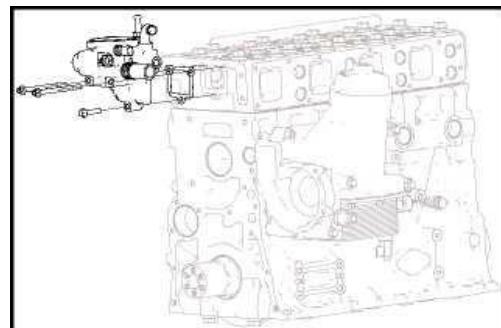


Figure 4-17. Drawing of disassembling the water outlet pipe

7.4. The basic points when checking and repairing the water outlet pipe

- a) Check the water outlet pipe, the rubber hose connecting the coolant, ... to see if there are damages such as cracks,
- b) Check the location of the connector to see if there is a leak.

7.5. Steps to install the water outlet pipes

- a) Check the sealing side of the outlet pipes and the sealing side of the cylinder head cover, ensuring the sealing side intact, without scratches and dents.
- b) For the pipe connector inserted into the pipe, apply the sealant on the connecting surface and insert it to the water pipe; For the threaded connector, insert screws and sensors to the water pipe, replace the new washers.
- c) The washer sealing the water outlet pipe needs to be replaced, install the water outlet pipe on the cylinder head cover, in the middle separating by sealing washers and tightened with hexagonal flange bolts.
- d) The O-ring gasket at the position of the small recirculating water return connector also needs to be replaced, inserted into the cooling module and the oil filter, tightened with hexagonal flange bolts.
- e) Install the rubber hose to connect the coolant to the water return hose connector and the outlet pipe of the small recirculation, use the clamp to tighten.

8. Dismantling, checking and repairing engine rack

8.1. Tools and preparations for dismantling engine rack

- a) Tools for disinstallation: prepare tubes or wrenches
- b) Preparation before dismantling: place the engine on the flip rack or hoist the engine.

8.2. Drawings for analysis of engine rack

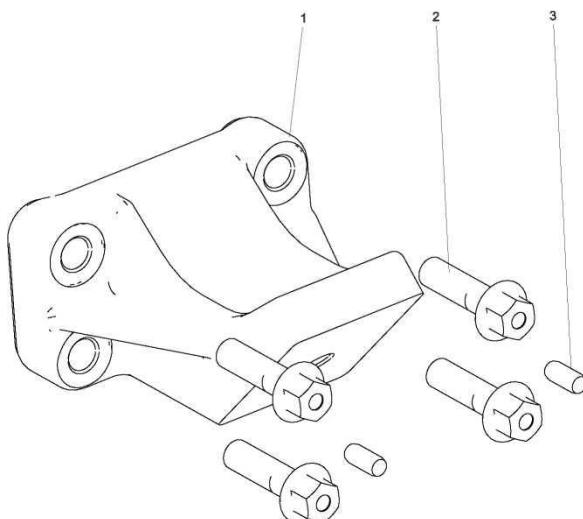


Figure 4-18. Drawings for analysis of engine rack

No.	NAME OF DETAILS
1	Engine rack
2	Hexagon flange bolts
3	Locating pin

8.3. Steps to disassemble engine rack

- a) Remove hexagonal flange bolts.
- b) Two hands firmly hold the engine rack and remove it.

8.4. The main points when checking and repairing the engine rack

Check the engine rack and bolts to see if there is any damage, if any, promptly replace the new components; Check if the bolts are loose, if so, tighten them in time.

8.5. Steps to install the engine rack

They are reverse to steps of disinstallation.

9. Disinstallation- Installation and check-repair of the generator

9.1. Drawings of generator analysis

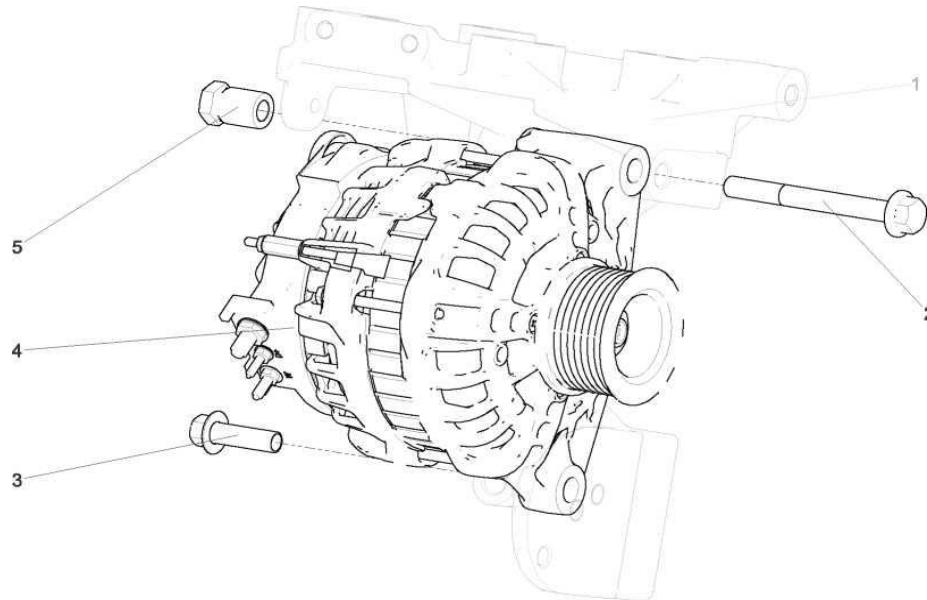


Figure 4-19. Drawings of generator analysis

No.	NAME OF DETAILS
1	Generator rack
2	Hexagon flange bolts
3	Hexagon flange bolts
4	Generator
5	Adjustable screw-nut

9.2. Steps to disassemble the generator

- Remove short-hanging angle hexagonal flange bolts.
- Remove long-hanging angle hexagonal flange bolts.
- Remove the generator.

9.3. Steps to assemble the generator

- Keep the generator balanced.
- Insert the long-hanging angle bolts, twist the screw-nut.
- Lift the generator, install short –hanging angle bolts.
- Tighten bolts.

10. Disassemble – assemble and check – repair of the engine hook

10.1. Preparation before disassembling the engine hook

Tools: socket ratchet wrenches or screw machine, torque wrenches, open wrenches

10.2. Drawings for analysis of engine hook



Figure 4-20. Drawings for analysis of engine hook

No.	NAME OF DETAILS
1	Hook bolts
2	Engine hook
3	Hook bolts
4	Hook bolts
5	Engine hook

10.3. Steps to disassemble the engine hook

- In turn remove 3 M8 bolts fixing the hook on the front end and the rear end of the engine, remove the engine hook.



Figure 4-21. Remove the engine hook

10.4. The main points when checking and repairing engine hook

- Check whether the engine hook has cracks or deformations. If there are serious cracks or deformations, the hook must be replaced.
- In the process of hoisting the engine, note to see if the hook is curling and deformed.
- Check whether the bolts of the front hook and the rear hook are damaged, if it is damaged, replace the new bolts.

10.5. Steps to assemble the engine hook

- Tighten M8 hexagonal flange bolts on the front and rear hook of the engine, tightening force is $37\pm3\text{Nm}$.
- The steps of assemble are reverse to ones of disassemble.

11. Disassemble – assemble and check – repair of the oil injectors

11.1. Tools and preparations for disassembling and assembling oil injectors

- Tools for disassemble and assemble.
- Socket ratchet wrenches.
- Preparation before disassemble.
- Remove the rocker cover, high-pressure oil pipe, disassemble the engine wire bundle connected to the injectors.

11.2. Drawings for analysis of oil injectors

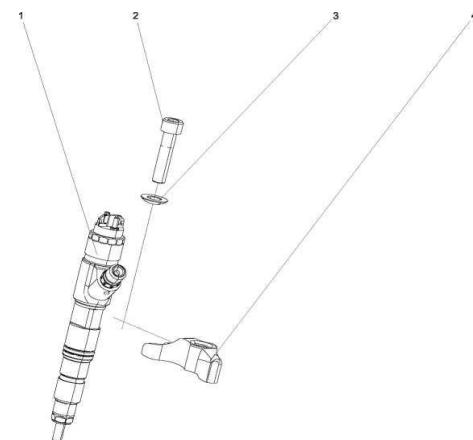


Figure 4-22. Drawings for analysis of oil injectors

No.	NAME OF DETAILS
1	Injectors
2	Butt-head hex screw
3	Spherical washers
4	Injector pads

11.3. Steps to dismantle injectors

- a) Remove the butt-head hexagonal screw fixing the injector pads.

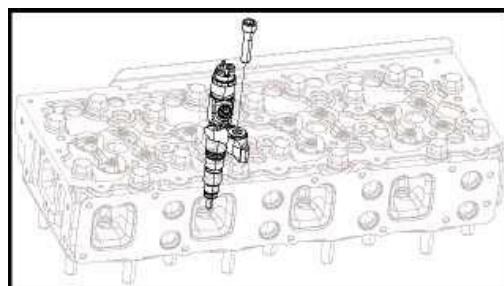


Figure 4-23. Remove the screws fixing injector

- b) Remove spherical washers and injector pads.
c) Remove the injector from the slice cap.

11.4. The main points when checking and repairing injectors

- a) Check the status of the coal dust accumulation of the oil tip, if necessary, conduct cleaning.
- b) Replacing the nozzle of the injector must be done at the Bosch warranty repair station.
- c) Injector gasket is used only once, after removing the injector, it must be replaced.
- d) When taking care of maintenance and adjustment of the valve clearance, after removing the injector and the rocker cover, use a special cleaning paper or a clean towel to seal the injecting hole on the rocker cover, to avoid impurities falling into the hole of the rocker cover base, before inserting the injector, clean the injector and its hole:
- Clean the outer surface of the removed injector, wipe away the traces of coal dust and glue, ... it's recommended to use ultrasound to conduct cleaning.
 - Spray detergent 755 to clean oil stains in the hole.
 - Use specialized tools to clean coal dust and impurities in the hole.
 - Use a towel to wipe off the oil and coal dust, avoid impurities on the injector gasket.

11.5. Steps for installing oil injectors

- a) Put the injector into the base hole on the rocker cover.
- b) In turn install the injector pads, spherical washers.
- c) Install the butt-head hexagon screws, use the tightening force (65 ± 5) N.m to fix the screws.

12. Disinstallation, installation and check, repair of the high-pressure pumps

12.1. Tools and preparation before disassembling and assembling high pressure pumps

- a) Tools for disinstallation and installation.
- b) Socket ratchet wrenches.
- c) Preparation before disinstallation.
- d) Remove related components such as low pressure oil pipe, high pressure oil pipe.

12.2. Drawings for analysis of high-pressure pump

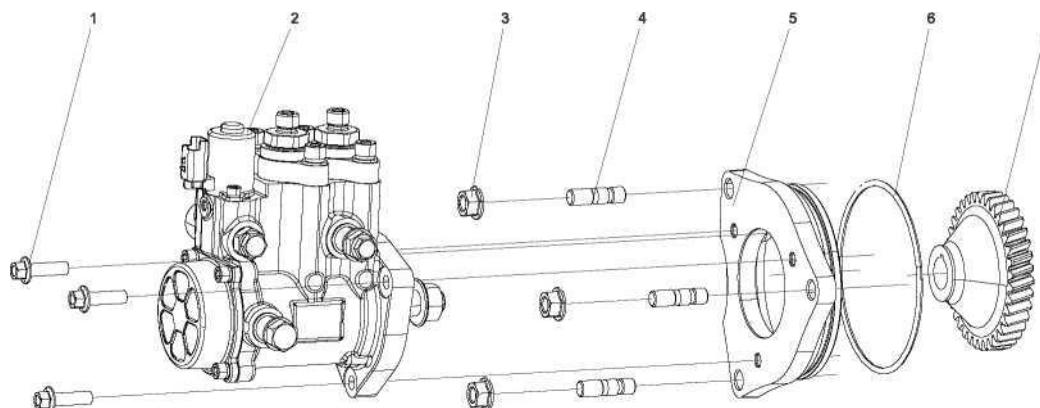


Figure 4-24. Drawings for analysis of high-pressure pump

No.	NAME OF DETAILS
1	Hexagon flange bolts
2	High-pressure pump assy
3	Hexagon flange bolts
4	Stud bolt
5	High pressure pump flange
6	Sealing rubber O-ring gasket
7	High pressure pump gear

12.3. Steps to disassemble high-pressure pump

- a) Remove bolts with two thread ends fixing high pressure pump flange with gear chamber

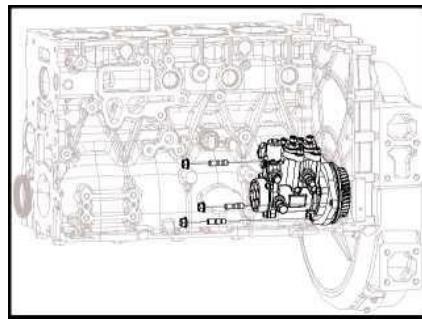


Figure 4-25. Remove bolts with two thread ends fixing high pressure pump flange with gear chamber

- b) Remove the high pressure pump and gear from the engine.

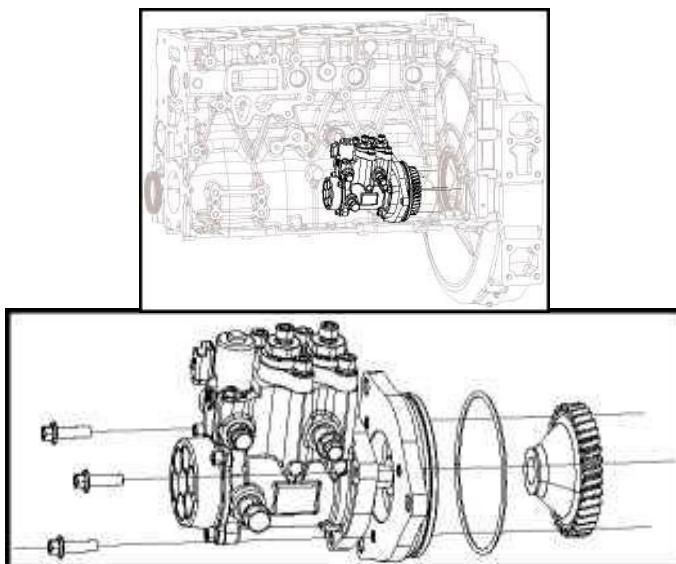


Figure 4-26. Remove the high pressure pump and gear from the engine

- c) Remove the screws tightening high pressure pump.
- d) Remove hexagon flange bolts connecting between high pressure pump and high pressure pump flange.
- e) Remove high pressure pump flange.

12.4. Main points when checking and repairing high pressure pumps

- a) Check high pressure pump flange to see if there is oil leakage.
- b) Check the O-ring rubber gasket, whether the oil gauge is intact. If damaged, replace it.
- c) Check high pressure pumps, if there are problems such as cracks, ... it needs to replace a new high pressure pumps.

12.5. Steps to install high pressure pump

- a) Install high-pressure pump flange, O-ring rubber sealing washer on high pressure pump should be applied a little lubricant.

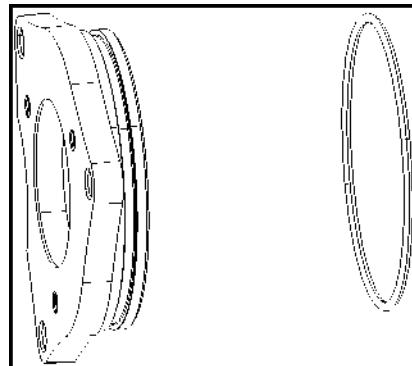


Figure 4-27. Installation of high pressure pump flange

- b) Install hexagon flange bolts connecting high pressure pump and high pressure pump flange.

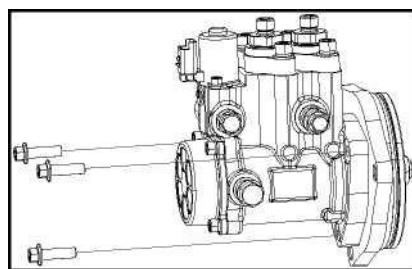


Figure 4-28. Installation of bolts fixing high pressure pump

- c) Install high pressure pump gears, screws tightening high pressure gear pump are type of M14x1.5: tighten once with force up to (90~95) N.m.

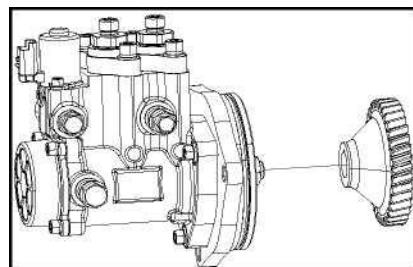


Figure 4-29. Installation of high pressure pump gears

- d) Tighten 3 two-threaded ends bolts fixing the high pressure flange on the gear chamber, use hexagonal flange screws to tight.

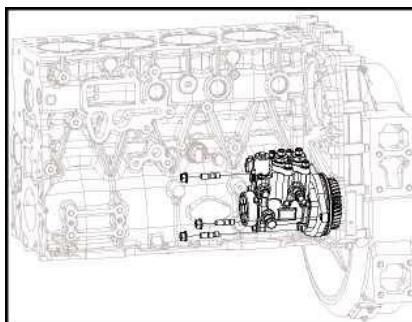


Figure 4-30. Installation of high pressure pump on the body

13. Disinstallation, installation, check and repair of turbocharger

13.1. Tools and preparation for disassembling and assembling tuborcharge

- a) Disinstallation and installation requires all common repair tools.
- b) Preparation before disinstallation: Remove the air filter and rubber hose, gas tank pipe and end exhaust pipe connected to the vehicle.

13.2. Drawings for analysis of tuborcharge

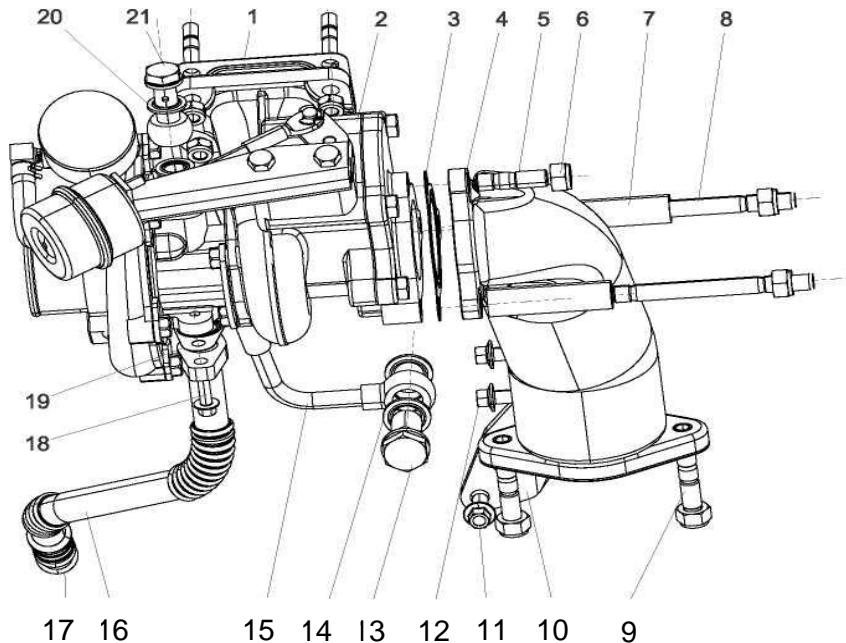


Figure 4-31. Drawings for analysis of tuborcharge

No.	NAME OF DETAILS	No.	NAME OF DETAILS
1	Tuborcharge gasket	12	Exhaust pipe bolts
2	Tuborcharge	13	Hollow bolts
3	Gasket	14	Sealing washer
4	Exhaust pipe	15	Tuborcharge oil inlet pipe
5	Heat-resistant double-threaded head bolts	16	Tuborcharge oil return pipe
6	Screws	17	O-ring rubber washer
7	Bushing	18	Hexagon flange bolts
8	Double-threaded head bolts	19	Gaskets
9	Double-threaded head bolts	20	Sealing washer
10	Rack	21	Hollow bolts
11	Hexagon flange bolts		

13.3. Steps to disassemble tuborcharge

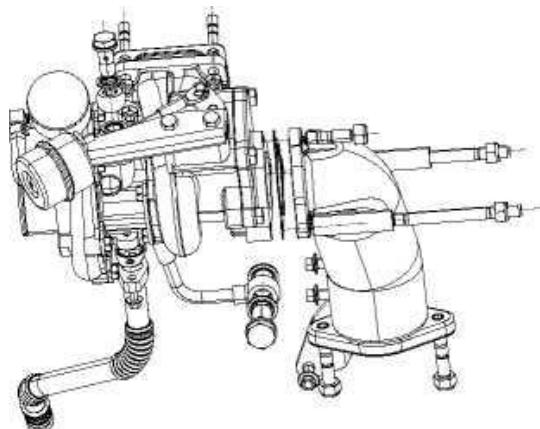


Figure 4-32. Steps to disassemble tuborcharge

- a) Remove the bolts tightening the rack of the exhaust pipe, remove the bolts tightening the exhaust pipe, remove the exhaust pipe and its gaskets in turn.
 - b) Remove the bolts of the tuborcharge oil return pipe, remove the tuborcharge oil return pipe and its gasket in turn.
 - c) Remove the hollow bolts tightening the tuborcharge oil inlet pipes, remove the hollow bolts, the combination sealing washer and the tuborcharge oil inlet pipes respectively.
 - d) Remove bolts fixing tuborcharge.
 - e) Remove tuborcharge and its gasket in turn.
- 13.4. The main points when checking and repairing turbocharger
- a) Check the connection between the tuborcharge and the engine pipe to see if it is loose, if so, handle it promptly.
 - b) Check to see if there is a phenomenon of air leak, oil leakage, if any, promptly handle.
 - c) Check the screw tightening the tuborcharge to see if it is loose, if so, it should be handled promptly.
 - d) Check the air filter, if too much dust accumulates, promptly clean or replace.
 - e) Check the operating status of the rotor of tuborcharge.
 - f) Gently pull the compressed turbine impeller with your hand, if there is one rotation or more, it is normal, if quickly stop, it shows that the bearing is abnormally worn or that the rotating device and the fixed device have phenomenon collision or jamming, it's required to analyze causes and handle it.
 - g) Check the displacement distance of the rotor.
 - h) Place the top part of the displacement meter to the head of the compressed turbine, use the hand to push to the axis direction and then make the axis rotate, measure the value and record the difference of the meter, as shown in figure 2-31: The displacement distance of the rotor must be <0.09mm, if it exceeds this value, it indicates that the bearing or retaining ring and the bearing body are worn, it's required to analyse the cause and handle it.

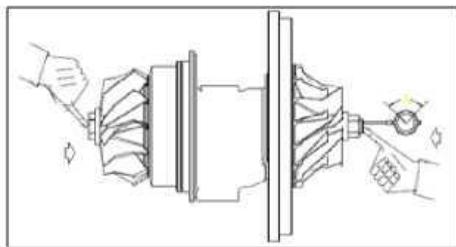


Figure 4-33. Measure the value and record the difference of the meter

Notes: This measurement should be carried out when tuborcharge is in a cool state.

- i) Check the radial clearance of compressed turbine impeller.
- j) Use a hand to compress or push the compressed turbine impellerr to the side (diameter direction) as shown in Figure 2-32, use a ruler to measure the smallest and largest clearance values between compressed turbine impeller and turbine shell, as shown in figure. This value must be within the range (0.183~0.57) mm, if it exceeds this value, it is necessary to check bearings and handle it

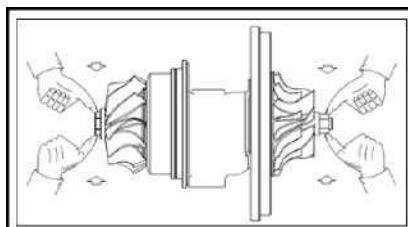


Figure 4-34. Measure the value and record the difference of the meter

Notes: This measurement should be carried out when tuborcharge is in a cool state.

- k) When disassembling and assembling tuborcharge, if detecting a problem that cannot be handled or not eligible for disinstallation, it must be sent to the production or repair department for treatment.

Notes:

- Bolts and screws used for connecting tuborcharge with exhaust pipes are those with specialized heat-resistant steel materials, not to use ordinary screws and bolts to replace.
- All types of gaskets are used only once, when repairing, they must be replaced.
- Do not apply grease to oil return gaskets.
- Do not arbitrarily adjust the pressure of the tuborcharge exhaust valve.
- If tuborcharge has not been used for a long time (7 days or more), it's required to disassemble tuborcharge and fill the lubricant into the oil intake hole to use it.

13.5. Steps to install tuborcharge

- a) Double-threaded bolts fixing tuborcharge must be applied molybdenum disulfide, the shorter threaded ends shall be inserted into the exhaust pipe flange, install tuborcharge gasket.
- b) Install tuborcharge, tighten fixed screws, tightening force is 35 ± 3 N.m.
- c) In turn install the gaskets of oil return tube of tuborcharge and oil return tubes, apply molybdenum disulfide and clean lubricant to the fixed bolts and then tighten, the rubber ring at the end of the oil return pipe must not be distorted.
- d) Pour a sufficient amount of clean lubricant into the oil intake hole, wipe off the oil flowing out and use the hand to rotate the turbine axis to lubricate the suspension ball bearings and thrust ball bearings.
- e) Install combination sealing washer, tuborcharge oil intake pipe and hollow bolts.
- f) Install exhaust pipe gaskets, exhaust pipe, tightening force is 65 ± 3 N.m.
- g) Install the exhaust pipe rack.
- h) Install air filters and rubber hoses, air tank pipes and exhaust pipes connected to the vehicle.

14. Disinstallation, installation and check, repair of the urea injector

14.1. Assemble of the urea injector

- a) Urea injecting device (urea injector) is an injector made of stainless steel, its injection range is 50-5000ml/h, composed of urea tube connectors, sealing gaskets and fixed screws (M6), please refer to the figure below:

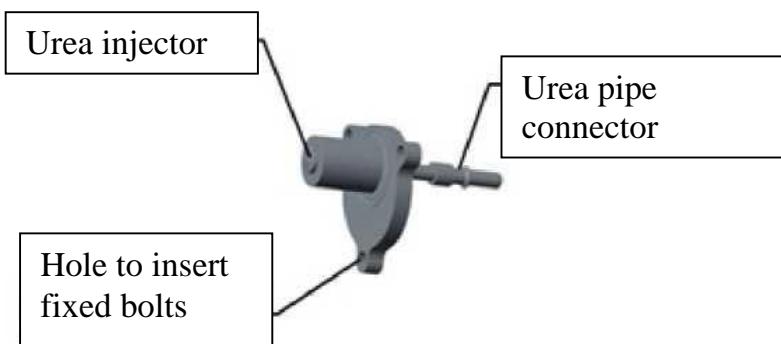


Figure 4-35: Urea injecting device

- b) Requirements for installing urea injectors:

- When installing booster injectors, use 3 M6x25 bolts to fix on the base, tightening force is 8 ± 2 N.m. For the injector which has only one port connecting urea pipe with the size of 1/4' (6.3mm), we do no need to control electrically and make cooling with water.
- The nozzle of the urea injector must have the same direction as the direction of the air flow. Urea injector mounted on the integrated SCR catalytic silencer will be installed on the horn-shaped device at the inlet of the silencer. The

installation of urea injector is determined by the position and angle of fitting injector base, as shown below.

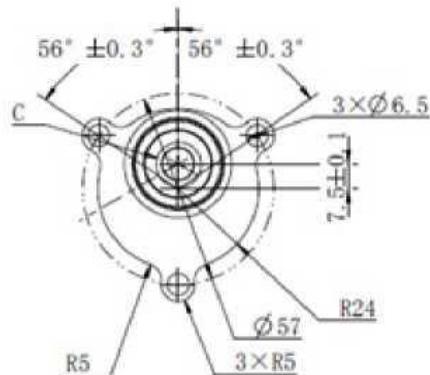


Figure 4-36. The location of fitting urea injector base

15. Disinstallation, installation and check, repair of the urea pump

15.1. Assembling urea pump

- The dosing injection pump will be installed according to strict requirements in direction, it's required to install the upward arrow on the pump body, as shown below.:

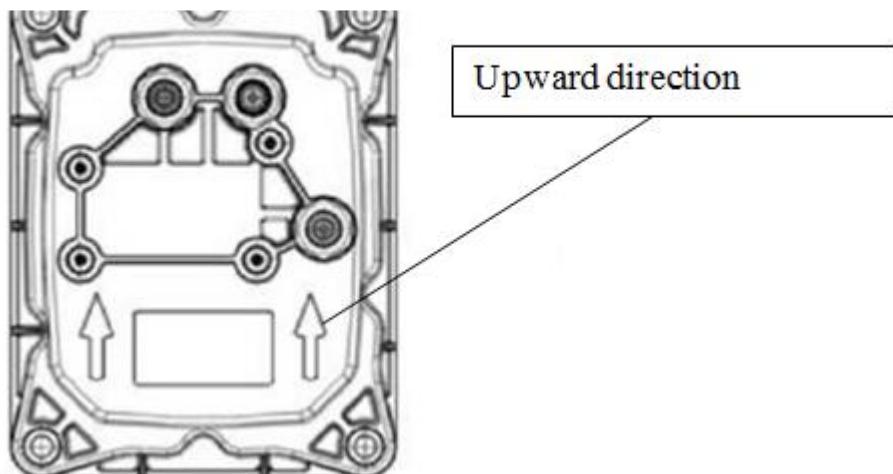


Figure 4-37. Calculating direction when installing the dosing injection pump

- The vibration acceleration of the position installing the dosing injection pump must be less than 8G, if not satisfy the requirements, it must use the damper. When installing a dosing pump, keep its Z axis upright, use 4 M8 bolts to fix it, the flatness of the mounting surface is required to be below 0.5mm. When mounted on a vehicle, the dosing injection pump often does not need to be separately protected, so it is installed in a place where there is little rain and mud splashing, avoiding making jacks damaged unexpectedly. If it's still

possible to be impacted by other parts or stones, it need to use a guard cover with IP69K protection level.

- The connection pipe between the dosing pump and the injector should use a flexible hose, to allow a relative vibration between it and the exhaust pipe.
- The urea pump should be installed near the urea tank, minimizing the possibility of air being blocked in the solution feeding pipe, the solution feeding tube is as short as possible, with maximum length not exceeding 6m.
- When connecting the power line to the urea pump, it is required to take electricity from the total port of the car battery, and at the same time need to install additional protective equipment at the positive power source, the specification is 10A.

16. Disinstallation, installation and check, repair of urea pipes

16.1. Assembling urea pipes

- a) The urea pipe is the urea path, before installing, ensure that the two ends are well protected, as shown on the right figure, to avoid dirt and impurities entering the pipeline and then into the system, causing the system damaged.
- b) When installing the urea pipe, it's required to install the corresponding pair correctly, otherwise, it will cause the system to be inactive. Before installing, it is necessary to confirm the size of the urea pipe connector, the model of the quick connector must correspond exactly to the model of the urea tank, the urea pump and the urea injector. The following table is the corresponding combination of urea tube with pump and urea tank.



Figure 4-38. Before installing, confirm whether it's well protected.

Name of connecting port	Description of connecting port	Size-pump head	Size – tank head
Solution suction pipeline	Connect the urea outlet port and the urea pump inlet port	SAEJ2044 3/8"	SAEJ2044 3/8"
Solution return pipeline	Connect the urea pump outlet port and the urea tank return port	SAEJ2044 5/16"	SAEJ2044 5/16"
Pressure pipeline	Connect urea injection pump port and urea injector	SAEJ2044 1/4"	SAEJ2044 1/4"
Air pipeline	Connect the pneumatic pipe to the filter of urea pump	F-type QS connector, 6 mm outer diameter	F-type QS connector, 6 mm outer diameter
Filtration pipeline	Connect the filter of urea pump to the urea pump inlet port	F-type QS connector, 6 mm outer diameter	F-type QS connector, 6 mm outer diameter
Notes: Pressure pipelines used by the main factory is required an inner diameter of 3mm			



- c) When installing, it is not allowed the urea pipes are curved, if the pipe is bent seriously, as shown in the right figure, it will make the system inactive.



Figure 4-39. The urea pipeline is severely curved and folded

17. Disinstallation, installation and check, repair of urea tank

17.1. Assembling urea tank

- a) Before installing the urea tank, it is necessary to confirm whether the connection ports of the solution level temperature sensor are well protected as shown in the figure, to avoid impurities entering the system piping, making the system inactive.
- b) When installing urea tank on the vehicle, it is necessary to keep away from the heat source, try to avoid the urea tank under the influence of heat radiation coming from the engine, gearbox, SCR catalytic converter, exhaust pipe ... which makes urea solution deformed.



Figure 4-40. The connecting ports of the solution level temperature sensor are well protected

- c) The freezing point of the urea solution is -11.5°C , when the system works at low temperatures, the urea will freeze, causing the system to be inactive, so it is necessary to defrost the urea tank, urea tank uses engine coolant for defrosting and heating, direction of the heating water line is as shown in the figure.

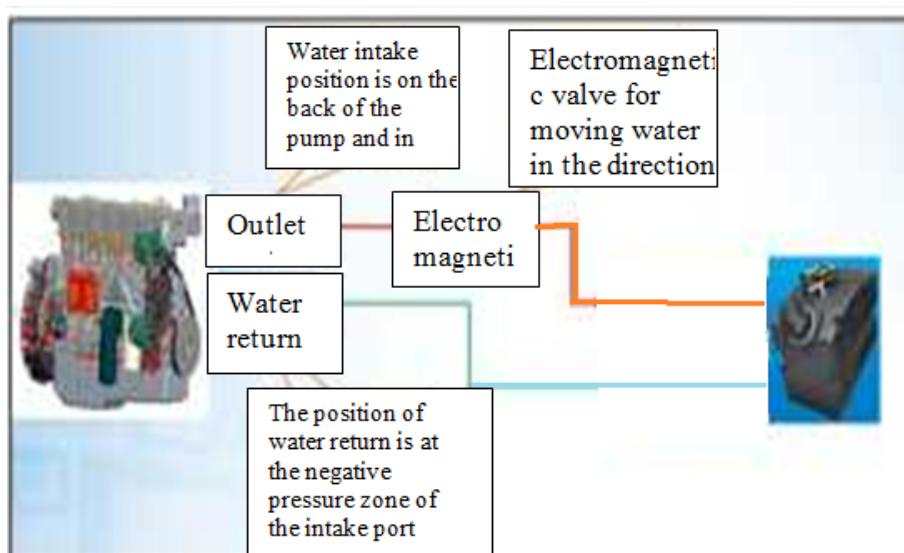


Figure 4-41. Direction of system heating water

18. Disinstalation, installation, check and repair of pulley and belt

18.1. Tools and preparation work for disassembling and assembling pulleys and belts

- a) Tools for disinstalation and installation: socket ratchet wrenches or screw machine, open wrenches, ...
- b) Preparation before disassembling: disassembling the propeller assembly and propeller clutch.

18.2. Drawings for analysis of pulleys and belts

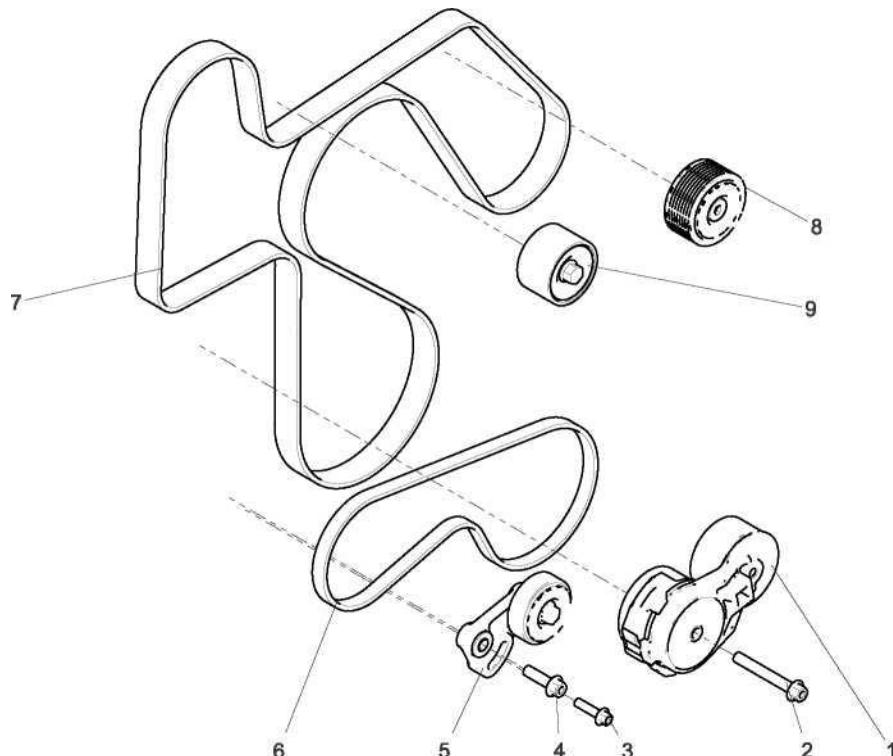


Figure 4-42. Drawings for analysis of pulleys and belts

No.	NAME OF DETAILS	No.	NAME OF DETAILS
1	Automatic belt tension pulley	6	Belt
2	Hexagon flange bolts	7	Belt
3	Hexagon flange bolts	8	Bonding gear
4	Hexagon flange bolts	9	Bonding gear
5	Belt tension pulley assy		

18.3. Steps for disassembling pulleys and belts

- a) Remove the outer layer of belt tension pulley assy
- b) Remove the outer layer belt
- c) Remove the inner layer of automatic belt tension pulley.
- d) Remove the inner layer belt.

e) Remove the bonding gears.

18.4. Steps to assemble pulleys and belts

a) Install the bonding gears, automatic tensioning pulleys. Temporary installa inner layer belts. Fit the belt around the pulley of damper, pulley of the fan, two bonding gears, air conditioning block, pulley of generator and automatic tensioning pulley wheel and pulley is in nature state, non-tensioning. Use the 4-angle wrench to turn the automatic tensioning pulley in a counter-clockwise direction, put the belt into, confirm the belt is completely inserted in the groove and then stretch the belt.

b) Install the belt tension pulley and belt assy.

19. Disinstallation, installation, check and repair of exhaust pipes

19.1. Tools and preparation work for disassembling and assembling exhaust pipes

a) Tools for disinstallation and installation: tall necessary tools.

b) Preparation before removing the exhaust pipe

19.2. Drawings of exhaust pipe analysis

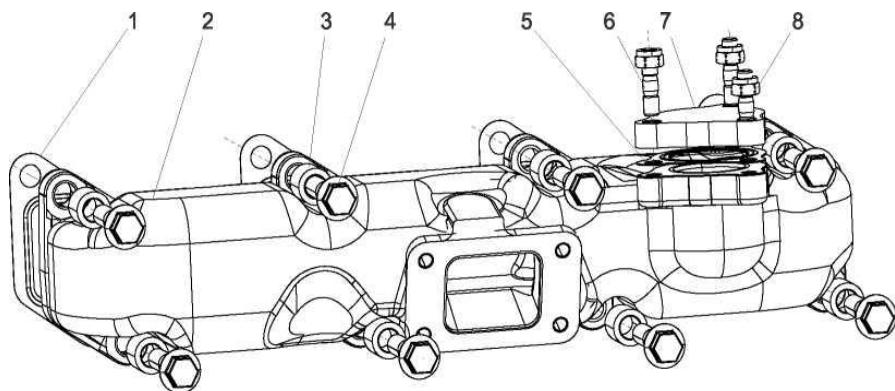


Figure 4-43. Drawings of exhaust pipe analysis

No.	NAME OF DETAILS	No.	NAME OF DETAILS
1	Gasket of exhaust pipe	5	Gasket
2	Thermal insulation cover of exhaust pipe	6	Stud bolt
3	Bushing	7	Flange
4	Bolts of exhaust pipe	8	Screw

19.3. Steps to disassemble exhaust pipes

Dismantle the bolts tightening the exhaust pipe in turn, remove the bolts of exhaust pipe, bushings, exhaust pipe and gaskets of exhaust pipe.

19.4. Check and repair of the exhaust pipe

a) Check if there is a strange object inside the exhaust system.

- b) Check the exhaust pipe body to see if there are cracks, ... no, the flange is deformed or not, if any, it must replace the new exhaust pipe.
- c) Check the position of the exhaust pipe flange to see if there is an air leak, if any, replace the new gaskets for exhaust pipe.
- d) Check exhaust pipe gaskets to see if they are deformed, torn, chipped, ... if any, replace them.
- e) All bolts and screws of the exhaust system are made of heat-resistant steel, not to use ordinary bolts and screws for replacement.
- f) When tightening bolts or screws, it is necessary to apply additional flame retardant, it's required to tighten exhaust pipe bolts as follows: tightening order as shown in Figure 2-41 (order of tightening bolts of exhaust pipe), wherein bolts with symbols 1 and 4 have the effect of locating, divided into 3 times to tighten bolts in sequence number, the first time has a tightening force of 25 Nm, the second time has a tightening force of 50 Nm, the third time after finishing tightening has the required tightening force of (65 ~ 80) Nm. Bolts of exhaust pipe can be used twice.

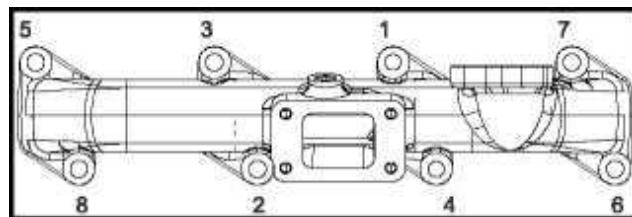


Figure 4-44. Order of tightening bolts of exhaust pipe

19.5. Steps to assemble exhaust pipe

Steps of installation is reverse to ones of disinstallation.

20. Disassembly, installation, check and repair of the crankshaft pulleys

20.1. Tools and preparation for dismantling and assembling the crankshaft pulley

When installing to fix bundle of wires, pay attention to the following points:

20.2. Steps to disassemble cylinder head cover

- a) Equipment conditions: torque wrench, automatic screw machine,
- b) Preparation before disinstallation: before removing the crankshaft pulley, remove the belt.

20.3. Drawings of the crankshaft pulley

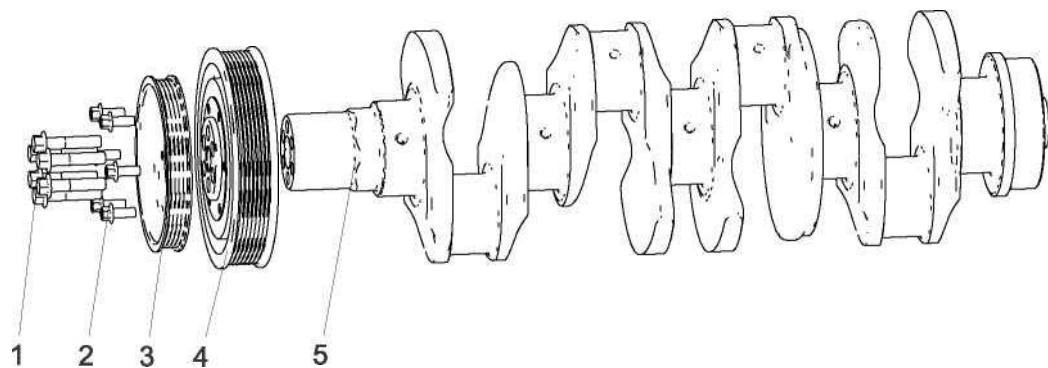


Figure 4-45. Drawings of the crankshaft pulley

No.	NAME OF DETAILS
1	Crankshaft damping bolts
2	Hexagon flange bolts
3	Crankshaft pulley
4	Torsional vibration damping
5	Crankshaft

20.4. Steps to assemble crankshaft pulley

First remove the hexagon flange bolts, then remove the crankshaft pulley from the torsional vibration dampers. Then remove the bolts of the torsional vibration damper and then remove the damper from the shaft head.

20.5. Basic points when checking and repairing the crankshaft pulley

- Check the torsional vibration dampers to see if it's scratched, peeled and deformed.
- Check the pulley to see if it is damaged, place where bolts tighten is broken or not.
- Check whether the torsional vibration dampers, hexagon flange bolts are damaged.
- Visually check the rubber damper to see if the inner and outer rings are turned, the rubber brace is cracked or not.

20.6. Steps to assemble crankshaft pulley

- Assemble crankshaft pulley assy.
- Assemble crankshaft pulley assy (including rubber dampers, crankshaft pulleys) at the top of the crankshaft via positioning retaining ring and guide bar.
- Tighten bolts.
- Before installing, apply a small amount of lubricant to the damping bolt head.

Use 6 damping bolts M10x1.25 to fix the torsional vibration damper on the crankshaft, tighten symmetrically, the first time reaches (40 ± 3) Nm, the 2nd time rotating $(90^\circ \pm 5^\circ)$.

21. Disinstallation, installation, check and repair of crankshaft

21.1. Tools and preparations for disassembling and assembling crankshaft

- a) Tools for disassembling and assembling
- b) Torque wrenches, automatic screw machine, crane, headless leaded bolts, ...
- c) Preparation before disassembly:
 - Before removing the crankshaft pulley, remove the belt.
 - Before removing the crankshaft assy, remove all flywheels, flywheel shell, front covers, crankshaft pulleys, main bearing covers and piston rods.

21.2. Drawings of crankshaft

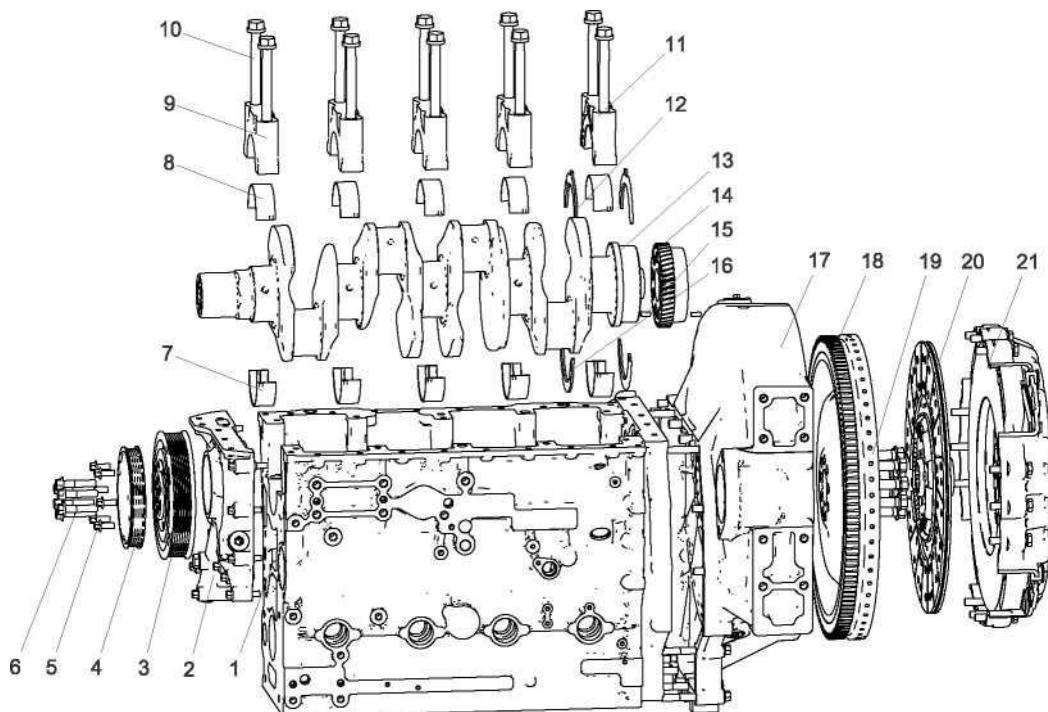


Figure 4-46. Drawings of crankshaft

No.	NAME OF DETAILS	No.	NAME OF DETAILS
1	Engine body	12	Lower retaining ring
2	Front cover	13	Crankshaft
3	Damper	14	Crankshaft gears
4	Crankshaft pulleys	15	Locating pin
5	Hexagon flange bolts	16	Upper retaining ring
6	Damper bolts	17	Flywheel shell
7	Upper main-bearing bushing	18	Flywheel assy

8	Lower main-bearing bushing	19	Flywheel bolts
9	Main-bearing cover	20	Friction disc
10	Main-bearing bolts	21	Clutch pressure plate
11	Main thrust ball bearing cover		

21.3. Steps to disassemble crankshaft

- a) Before removing the crankshaft detail assembly, it is necessary to first remove the crankshaft pulley, the front cover, the piston rod assembly, flywheel, flywheel shell, Turn the camera body upside down, remove the main bearing bolts, remove the main bearing cover and the lower main-bearing bushing, place it out in sequence.
- b) Remove the front and rear retaining ring, remove the oil seal. Use a crane to hoist crankshaft assy, put up on the rack (if the time to put outside is too long, the crankshaft needs to be placed vertically), take the upper main-bearing bushing out and put them in order.
- c) Place all removable parts according to the specified type.

21.4. Main points when checking and repairing crankshaft

- a) Check to see if the neck of main shaft, the neck of the rod and the round corners are cracked; check to smooth the oil pipe, see if there are abnormalities such as cracks,
- b) Check the wear status of the main shaft neck, the rod neck to see if there are the fibriform wears, metal peeling and cracks.
- c) Check the wear condition at the oil seal position.
- d) Check the main bearing bolts to see if there is broken lace,
- e) Check whether the front end and rear end bolt hole of the crankshaft is cracked, the gear hole is broken or not,
- f) Abrasion of crankshaft neck, curvature, bend, warp of crankshaft.
- g) Check whether the front and rear sides of the crankshaft is worn.

21.5. Steps to assemble crankshaft

- a) Crane crankshaft and place it on the rack, avoid collision scratching.
- b) Check the junction of the crankshaft and the inner chamber of the oil line.
 - Check the adjacent faces of the crankshaft for any trace of collision, if necessary, replace them;
 - Use compressed air to clean the inner chamber of the oil line, ensuring that the inner chamber of the oil line is clean and smooth.
- c) Clean the upper main bearing bushing and base hole on the body, press the upper main bearing bushing into the base hole of the body.
 - Before pressing bushing, it is necessary to check whether there is any trace of

collision, the shaft is not reused.

- After pressing the bushing, its oil hole must be straight with the oil hole on the body, the upper bushing must completely match the base hole of the main bearing of the engine block.
 - Wipe off the object that was peeled off by the bushing.
- d) Apply clean lubricant on the inner surface of bushing.
- e) Crane crankshaft, using compressed air to clean the oil line hole and wipe the main shaft neck and the rod neck with a towel, then gently put into the engine block, during that process, the crankshaft is not required to be impacted.
- f) Install the upper retaining ring into the groove of the retaining ring between the body and the crankshaft.

The oil groove of the upper retaining ring must be outward (towards the crankshaft).

- g) Clean the lower main bearing bushing and the main bearing cover, press the lower main bearing bushing into the main bearing cover and install the lower retaining ring.
- The oil groove of the lower retaining ring must be outward (towards the crankshaft).
 - Before installing, it is necessary to check carefully the shaft bushing and lower retaining ring to see if there are scratches.
 - The inner surface of the lower retaining ring should be applied with Lithium grease used for vehicles.
 - Wipe off the strange object peeled off by the bushing.
- h) Install the main bearing cover on the engine body.
- i) Install the main bearing bolts.
- Before installing the main bearing bolts, carefully check the contact surface between the main bearing bolt with the main bearing cover to see if there is strange object, avoid the strange object scratching the main bearing cover, and use the hand to check.
 - Apply clean lubricant on the load-bearing surface and thread of main bearing bolt.
- j) Tighten the main bearing bolts
- Tighten according to the order number in the figure: main bearing bolt M14 (10 heads), can be used 3 times. Divide into 3 times to tighten according to the order number in the figure. For the first time, temporarily tighten 80 NTM; 2nd time, rotatate 90 ° in order; 3rd time rotate 60 ° in order.

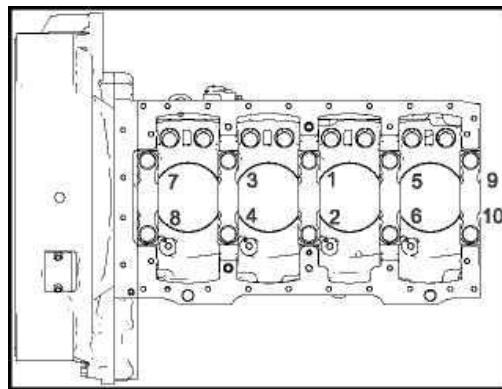


Figure 4-47. Order to tighten the main bearing bolt

- The crankshaft must move flexibly without obstruction.

k) Check shaft- toward clearance of crankshaft

The shaft-toward clearance of crankshaft is (0.1~0.34) mm.

22. Disassembly, installation, check and repair of the tempered panel of the engine body

22.1. Tools and preparation for disassembling and assembling the tempered panel of the engine body

Required equipment: torque wrenches, automatic screw gun, crane truck,...

22.2. Drawings of the tempered panel of the engine body

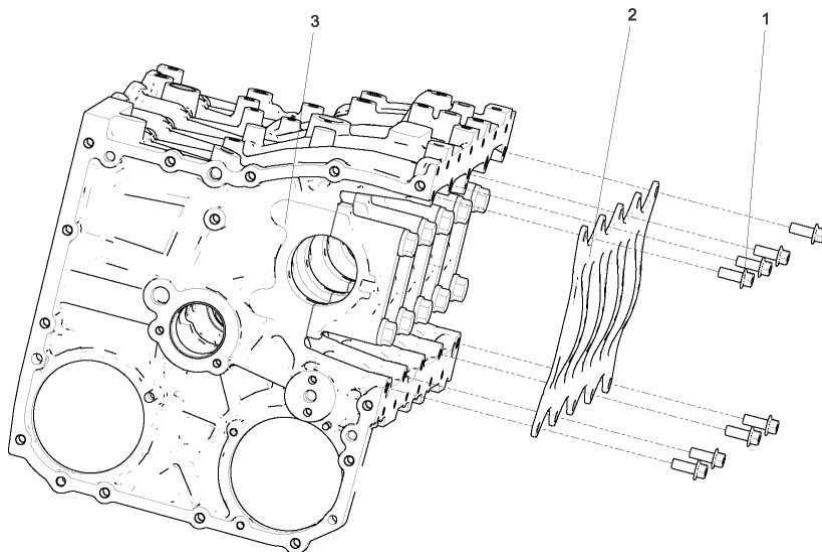


Figure 4-48. Drawings of the tempered panel of the engine body

No.	NAME OF DETAILS
1	Hexagon flange bolts
2	The tempered panel of engine body
3	The engine body

22.3. Steps to disassemble the tempered panel of engine body

Using a wrench to remove the fixed bolts, take out the body panels.

22.4. The main points when checking and repairing the tempered panel of the engine body

Lift up and down gently, avoid collision

22.5. Steps to assemble the tempered panel of the engine body

Put the tempered panel of the engine body closely to the engine body bottom surface, tighten the bolts for fixing.

23. Disassembly, installation, check and repair of the engine body

23.1. Tools and preparation work to disassemble and assemble the engine body

- a) Tools for disassembly and installation: socket ratchet wrenches, copper hammer,...
- b) Preparation before disassembly: remove gearbox and clutch, remove flywheel, flywheel shell, gear chamber and oil pan.

23.2. Drawings of the engine body

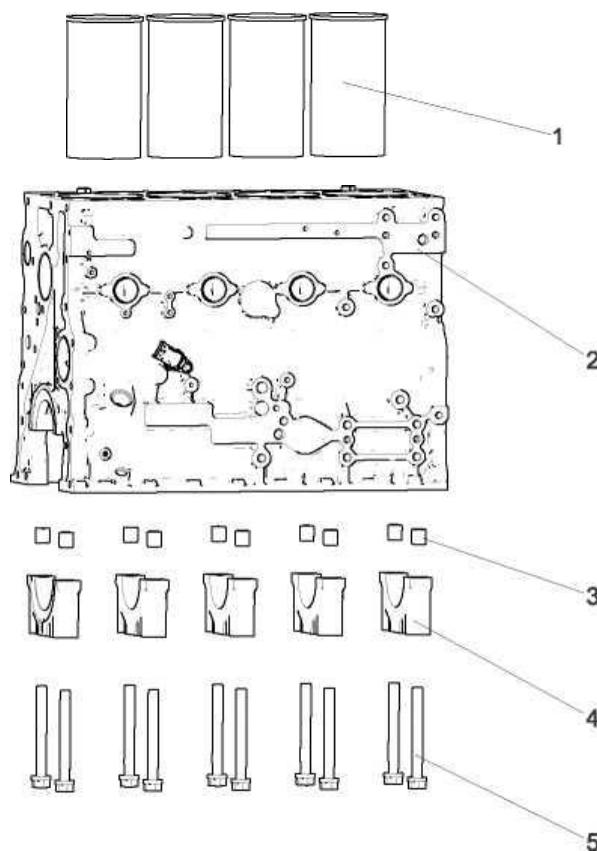


Figure 4-49. Drawings of the engine body

No.	NAME OF DETAILS
1	Cylinder
2	Engine body
3	Locating bushing
4	Main-bearing cover
5	Main-bearing bolts

23.3. Steps to disassemble the engine body

- a) Remove the cylinder: use a copper hammer to lightly tap the bottom of the cylinder, tap evenly around the circle, the cylinder will gradually be pushed out.

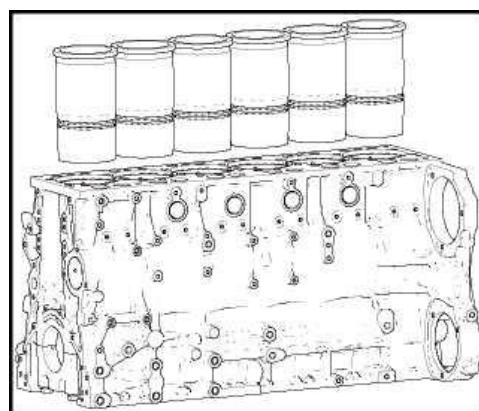


Figure 4-50. Remove cylinder

- b) Remove main bearing bolts: use bushing, automatic wrench or normal wrench to remove main bearing bolts and main bearing covers.

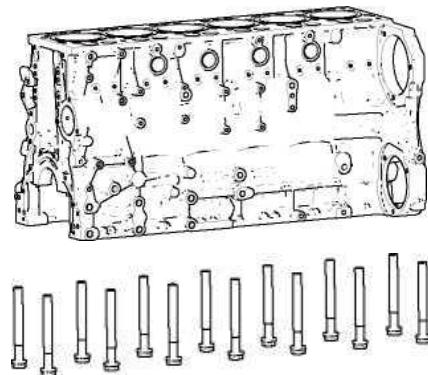


Figure 4-51. Remove main bearing bolts and main bearing cover

23.4. The main points when checking and repairing the engine body

Compare with the list of components to see if the components are complete. Check the status of the engine body, contact surfaces must not have sharp spines, oil stains, scratches, ...

- a) Requirements when installing main bearing bolts

- b) Before installing, the threaded side and load-bearing surface of the main bearing bolts must be applied lubricant, divided into 4 times according to the order in the figure, bolts can be reused 3 times.

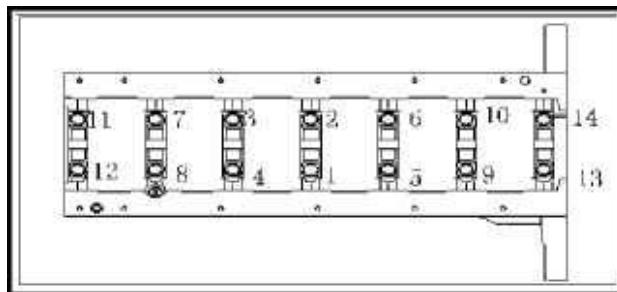


Figure 4-52. Order to tighten the main bearing bolts

- For the first time, temporarily tighten at 80 Nm; For the second time, it is tightened to 105 Nm.
- For 3rd time, rotate 90 ° in order; for the 4th time, rotate 60 ° in order.
- c) Requirements on installing cylinder
- d) Before installing the cylinder, check it carefully to see if there are cracks or defects, and clean it at the same time.

23.5. Steps to install the engine body

Steps of installation are reverse to ones of disassembly.

24. Disassembly, installation and check, repair of cooling module and oil filter

24.1. Tools and preparation for disassembling and assembling the cooling module and oil filter

- a) Tools for disassembling and assembling: tubes, wrenches
- b) Preparation before disassembling: discharge the coolant in the engine, remove the hot-air water return hose, and remove the small recirculating water return hose; remove the belt; turn the oil filter lid (10 ~ 15) mm, leave for 3-4 minutes, drain the oil in the oil filter to the oil pan.

24.2. Drawings of the oil filter and oil cooler

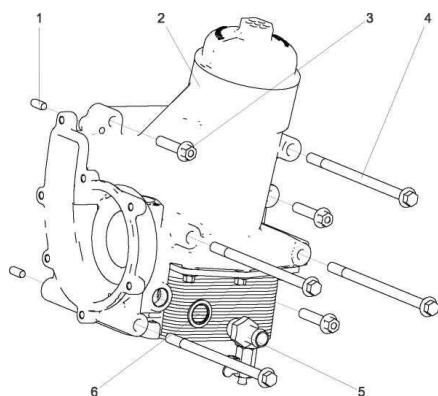


Figure 4-53. Drawings of the oil filter and oil cooler

No.	DESCRIPTION	No.	DESCRIPTION
1	Locating pin	4	Hexagon flange bolts M10x170
2	Oil filter and oil cooler assy	5	Water pipe connector
3	Hexagon flange bolts M10M5	6	Combination sealing washer

24.3. Steps to disassemble the oil filter and oil cooler

- a) Remove bolts tightening the oil filter and oil cooler.
- b) Remove the oil filter and oil cooler.

24.4. The main points when checking and repairing the cooling modules and oil filters

- a) Check the assembling surface of the cooling assembly and oil filter to see if there are cracks.
- b) Check the twisted case of the water pump to see if it is worn out and scratched.
- c) Check the assembling surface of the oil cooler to see if there are oil leaks, oil penetration.
- d) Check the assembling surface of the hot-air water pipe connector to see if there are water leaks, water penetration.

24.5. Steps for installing oil filters and oil cooler asembly

- a) Steps to assemble the assy on the engine body:
 - Check the contact surface between the engine body and the oil filter oil cooler assy to see if there is a sharp spine, at the same time handle and clean them; check the rubber sealing washer of the oil filer and oil cooler assy to see if they are inserted correctly into the gasket groove (3 points). For the used oil filter and oil cooler assy, when reassembling, they must be replaced with the new sealing washer.
 - Close the locating pin to the mounting hole on the engine body.
 - Accurately view the oil filter and oil cooler assy with locating pin and then install it into the engine body, and use hexagon flange bolts to fix.
- b) Steps for installing components in the assy:
 - Put gaskets sealing assembling surfaces of oil filter and oil cooler completely inserted into gasket grooves, install lubricating oil cooler and tighten bolts.
 - Put large sized O-ring gasket into the gasket groove of oil filter cover, apply lubricants on gaskets.
 - Check whether the bottom gasket of the oil filter core is intact, twist the filter

core to be inserted into the groove of the filter cover.

- Install the filter lid and filter core on the filter base, tighten the filter lid as required for the tightening force indicated on the filter cover.

25. Disassembly, installation, check and repair of the oil pump

25.1. Tools and preparation for disassembling and assembling the oil pump

- a) Tools for disassembling and assembling: tubes or wrenches.
- b) Preparation before disassembling: remove the belt, impeller and propeller clutch, crankshaft pulley, oil pan, filter net of oil pan.

25.2. Drawings of the oil pump

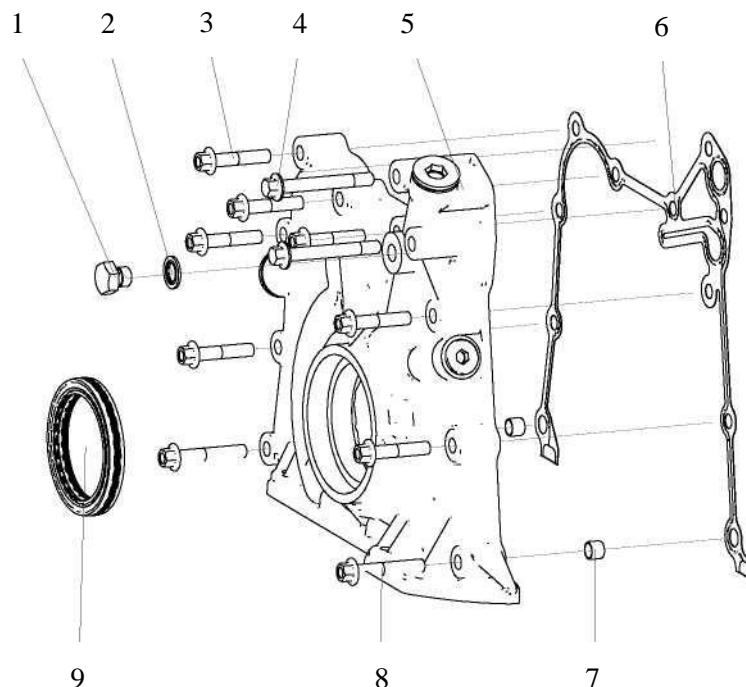


Figure 4-54: Drawings of the oil pump

No.	DESCRIPTION	No.	DESCRIPTION
1	Plug Screws	6	The oil pump gasket
2	Combination sealing washer	7	Locating bushing
3	M8 Hexagon flange bolts	8	M8M8 hexagon flange bolts
4	M8X65 hexagon flange bolts	9	The top oil seal
5	Oil pump		

25.3. Steps to disassemble the oil pump

- a) Remove the top oil seal: before removing it, use specialized tools or use screwdrivers to pierce on the oil seal lip, directly remove the oil seal, in the process of removing, pay attention to protect the surface of the crankshaft and

seal cavity of the oil pumps, avoid scratching the crankshaft and seal surfaces.

- b) Remove the oil pump bolts in turn.
- c) Remove the oil pump and its gaskets in turn from the body.

25.4. The main points when checking and repairing the oil pump

- a) Check whether the oil pump is flexible
- b) Check the contact surface between the rotating shaft in the oil pump with the crankshaft to see if it is heavily worn.
- c) Check the oil pump plug screw to see if there is phenomenon of oil leakage, oil seepage.
- d) Check the junction between the oil pump and the engine body, the oil pan to see if there is any damage.
- e) Check if the locating bushing of oil pump is intact

25.5. Steps to assemble the oil pump

- a) Install the oil pump locating bushing: install 2 oil pump locating bushings on the engine body.
- b) Install the gaskets of the oil pump: replace the oil pump gasket, insert the gasket through 2 oil pump locating bushings and install it into the engine body.
- c) Install the oil pump assy: install the oil pump assy on the body, tighten the bolts.
- d) Install the top oil seal: when installing oil seal, use hands to hold the outer diameter of the seal, check the outer diameter, the seal lip, ... to make sure there are no scratches, impurities, then check the seal cavity on the crankshaft and the oil pump, ensuring that the cavity surface is not scratched or has no sharp spines, ... You can cover an appropriate amount of lubricant on the shaft surface and beveled corner, install oil seal on the crankshaft, then use the specialized tool to press into the seal cavity; If there is no tool, it is recommended to use a blocker, use copper hammer to evenly tap in the circle-direction on the blocker to install the seal, finally check the status of the seal, making sure the seal is not skew.

26. Disassembly, assembly, check and repair of the retaining ring

26.1. Tools and preparation for disassembling and assembling the retaining ring

- a) Tools for disassembling and assembling.
- b) Torque wrenches, automatic screw gun, crane, headless leaded bolts
- c) Preparation before disassembling.
- d) Before removing the retaining ring, it's required to remove the crankshaft pulley, front cover, clutch, flywheel, flywheel shell, gear assembly, piston rod, etc.

26.2. Drawings of retaining ring

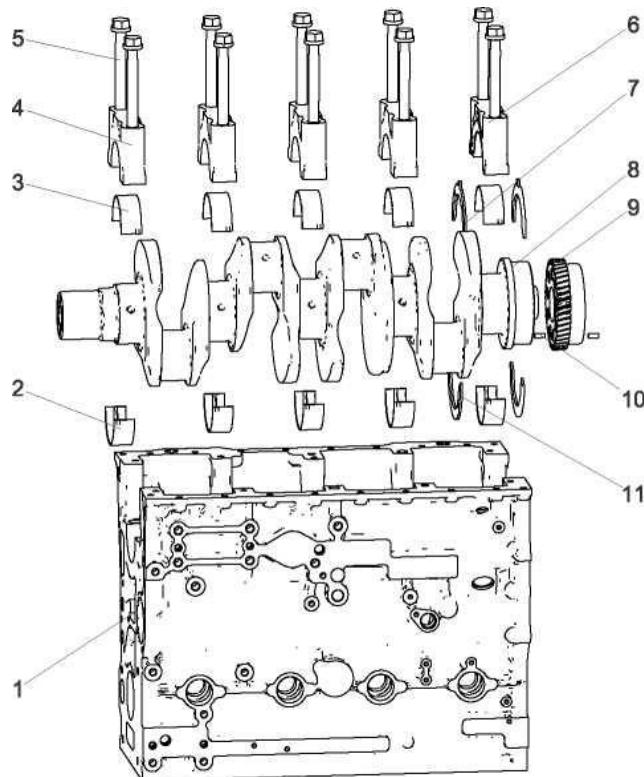


Figure 4-55. Drawings of retaining ring

NO.	DESCRIPTION	NO.	DESCRIPTION
1	The engine body	7	Lower retaining ring
2	Upper main-bearing bushing	8	Crankshaft
3	Lower main-bearing bushing	9	Crankshaft gear
4	Main-bearing cover	10	Locating pin
5	Main-bearing bolts	11	Upper retaining ring
6	Main-bearing ball cover		

26.3. Steps to disassemble the retaining ring

- Remove the lower retaining ring from the side face of the 5th bearing cover.
- Remove fully main-bearing cover and lower shaft bushing, crane crankshaft to place on the rack.
- Remove the upper retaining ring from the side face of the fifth retaining level on the engine body.

26.4. The main points when checking and repairing the retaining ring

- Check if the retaining ring is intact, has trace of collision

- b) Check the retaining ring to see if it is damaged, peeled, deformed, broken,

26.5. Steps to assemble the retaining ring

- a) Clean the bushing the main bearing and the hole on the engine body, press the bushing on the main bearing into the hole in the engine body, apply the lubricant on the inner side of the upper shaft, crane the crankshaft and gently place on the engine body.
- b) Install the upper retaining ring on the groove of the retaining ring between the body and the crankshaft.

The oil groove of the upper retaining ring must face outwards (towards the crankshaft).

- c) Clean the lower bushing of the main bearing and the main bearing cover, press the lower bushing of the main bearing into the main bearing cover and then install the lower retaining ring.
 - The oil groove of the lower retaining ring must face outward (towards the crankshaft).
 - Before installing, check carefully whether the lower retaining ring has trace of collision.
 - Apply Lithium grease used for cars on the inner side the lower retaining ring.
- d) Fit the main bearing cover to the body, install the main bearing bolts, check the 34mm crankshaft directional clearance.

27. Use and check, repair of the pneumatic-type urea injecting system

27.1. Overview of checking and repairing the pneumatic-type urea injecting system

- ECU: DCUBAM beyond the time limit (P0060): the historical incident has not been processed; Check the circuit of the current fault, if the circuit is normal, check the jack to see if it is watered. If all is normal, replace the urea pump.
- Exhaust gas exceeding the standard: the actual conversion efficiency of SCR is lower ... (P01FA, P01FB): proving that the hardware components are not in trouble, contact the customer to suggest replacing the standard-quality oil.
- DCU: notice type; untreated; If it can be deleted, delete, if it cannot be deleted, do not handle with it; If pressure sensor voltage signal is unreliable, replace the new urea pump for the current trouble; trouble of solution intake pipe, trouble of solution return pipe, trouble of air pipe, injector or clogged injecting pipe; check related pipelines, if it is a trouble of solution intake pipe, there is a quite large potential of trouble related to the urea tank; for trouble of air pipeline, the large possibility is that the pressure of the boiler is insufficient; for trouble of the injecting pipe, large possibility is that the injecting pipe is folded and curved; for the trouble of solution return pipe, a large possibility is of a trouble inside of urea pump, and it's required to replace the urea pump.

- Principles:
- a) If the rear-treatment system is in trouble, handle it. Otherwise, the lamp will not light, it will not affect the motivation of the engine.
 - b) Urea does not consume, if there is a trouble code, solve according to the trouble code; if there is no trouble code, the ambient temperature and the temperature of solution level sensor are abnormal, or the working condition does not reach the urea injecting condition.
- Trouble of the solution intake pipeline
 - ✓ The effect of the trouble: ECU reports the trouble 005C, the lamp immediately lights up, immediately restricts torque.
 - + Check the solution intake pipeline to see if there is state of clogging, crystallization, flexing, etc.
 - + Check the filter net of the urea solution intake port.
 - + The actual level of urea in the urea tank is not enough. Check the actual solution level in the urea tank to see if it is suitable for the level on the meter, the amount of urea in the tank is about to run out, but the solution level sensor is abnormal so it cannot be checked.
 - The solution return pipe is clogged.
 - ✓ Effect of trouble: ECU reports the trouble 005B, the lamp lights up but does not limit torque.
 - + Check the solution return pipe to see there is a blockage, clean the pipeline.
 - + The sensor inside the urea pump is broken, leading to this trouble. Please reconnect. The success or failure of the reconnection belongs to current trouble of the pressure sensor. If there is a trouble, it is due to the pressure sensor, can replace the urea pump; If trouble does not appear, check the solution return pipe.
 - Trouble of air pipeline
 - ✓ The effect of the trouble: ECU reports the trouble 005C, immediately lights up, immediately restricts torque
 - + Vapor pressure is not enough. Check whether the air pressure meter is greater than 6 bar.
 - + The air pipe is pulled out or leaked. Check the airway to see if it's leaked.
 - + The pneumatic filter is clogged. Check air pipeline to urea pump.
 - + Pneumatic pipe bends or collapses.
 - Injecting tube or injectors are clogged.
 - ✓ The effect of the trouble: ECU reports the trouble 005C, the lamp immediately lights up, immediately restricts torque;
 - + The injector is clogged: during the inspection of the rear-treatment system, observe whether the urea injector has a blockage, and clean the injector. In pneumatic urea injecting system, the injector will not be congested, if there

is a blockage, it means there is a strang object in the urea solution, it is necessary to rinse the urea injector in the reverse direction.

- + The injecting tube is curved: check the injecting tube to see if there is a curved condition, when assembling the vehicle, to make it convenient to arrange the power line and the pipelines, it is often tied neatly, let the injecting tube restore its old state.
- The power supply voltage is too high / too low
 - ✓ The effect of the trouble: ECU reports the trouble 005C, the lamp immediately lights up, immediately restricts torque.
 - ✓ Troubleshooting principle: when urea pump voltage is > 32V, < 16V, it will report this trouble
 - ✓ Check the voltage between the urea pump jacks and the car's cord bundle; If it is correct with the principle of trouble reporting, the battery must be repaired.
 - ✓ Report-type trouble
 - ✓ This trouble is divided into two states that are "out of date" (or not received) and "abnormal".
 - ✓ Type of trouble reported over the expiry date indicates that the ECU cannot be found when the DCU is in working state.
 - ✓ Type of abnormal report trouble demonstrates that the DCU received from the ECU an error signal.

28. Disassembly, installation, check and repair of the cylinder head cover

28.1. Preparation before disassembling, assembling the cylinder head cover

- a) Equipment: tubes or screw machine, torque wrenches, open wrenches.
- b) Preparation before disassembly: remove injectors, rocker cover, air intake pipes, air exhaust pipes, water discharge pipes, high pressure oil pipes and other components that can be fixed on the cylinder head cover or related in removing the cylinder head cover.

28.2. Drawings of the cylinder head cover

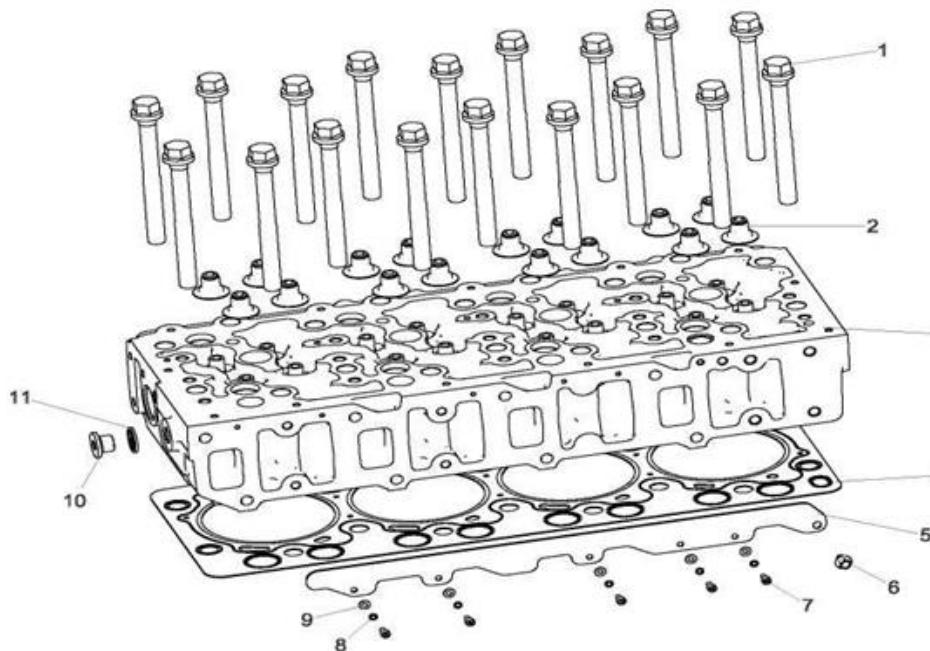


Figure 4-56. Drawings of the cylinder head cover

28.3. Steps to disassemble the cylinder head cover

- Before disassembling the cylinder head cover, make sure that the components of the air distribution system installed on the cylinder head cover (such as the rocker arm, push rod, etc.) have been removed.
- Before disassembling the cylinder head cover, make sure that the injectors installed on the cylinder head cover have been removed.
- Before disassembling the cylinder head cover, make sure that the high pressure oil pipes installed on the cylinder head cover have been removed.
- Remove bolts of the cylinder head cover in turn. Make sure that the entire bolts of the cylinder head cover have been removed before the cylinder head cover can be removed.
- Remove the cylinder head cover, place the cylinder head cover on the low hardness surfaces such as paper sheets, film sheets, plastic sheets, etc. to avoid the underside of the cylinder head cover cracked and scratched.
- After removing the cylinder head cover, depending on the actual situation to clean the coolant and other impurities on the top of the engine body, avoid cooling water and other impurities into the combustion chamber, causing the other troubles.
- Remove the gaskets of the cylinder head cover.
- Remove the exhaust valves, the suction valves, refer to the instruction to remove the air distribution mechanism.
- Remove the valve seal.

28.4. Main points when checking and repairing the cylinder head cover

- The cylinder head cover
 - Before disassembling the cylinder head cover, check whether the cylinder

head cover has traces of water leakage, oil leakage, air leakage and any other abnormal phenomena, in order to be able to locate the exact location of the problem. At the same time, analyze the problem accurately.

- Clean the cylinder head cover, focus on cleaning the surface of combustion chamber, valve base, suction and exhaust valves, air intake pipe, air exhaust pipe, remove the dust and glue stains, and check the surface condition.
- Check carefully the change of color of the cylinder head cover and cracks, if there is a crack, check by pouring color to find.
- The settlement of the valves is the distance from the bottom of the valve to the lower surface of the cylinder head cover, the actual measured difference of the valve settlement and the required theoretical value can represent the wear and tear of the valve and its valve. Use a depth gauge to measure the settlement of the valve, as shown in figure.

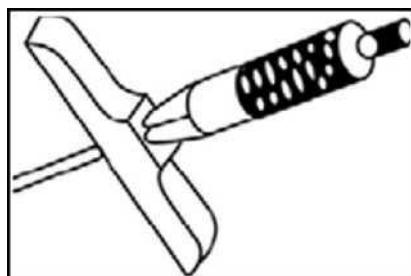


Figure 4-57. The depth gauge

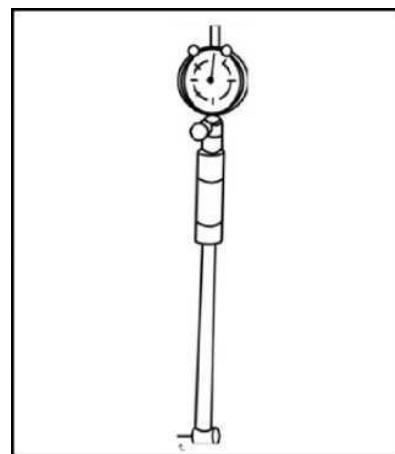


Figure 4-58. Inner diameter gauge

- For the theoretical value according to the requirements of the valve settlement, refer to the table. If the settlement exceeds the permitted range, it must be replaced with the cylinder head cover to ensure reliability for the engine. If the valve settlement has not exceeded the allowable value, remove the valve to check the valve and the sealing surface of the valve base to see if they are clearly worn and other damage.

	Required value for valve settlement (mm)
Suction valve	-0.43 ~ -0.13 (the positive value indicates that the valve is exposed on the cylinder head cover, the negative value indicates valve indented)
Exhaust valve	0.15 ~ 0.45 (the positive value indicates that the valve is exposed on the cylinder head cover, the negative value indicates valve indented)

b) The inner diameter of the valve leaded bushing is the contact surface between the valve leaded bushing and the moving part of valve. If the inner diameter of valve leaded bushing excesses the allowable value due to being worn, it will affect the leading effect of the valve, reduce the reliability of the engine operation. Measuring the size of the inner diameter of the valve leaded bushing can use the inner diameter gauge to measure, as shown in figure. The value of the inner diameter of the valve leaded bushing has an permitted range of 7 ~ 7015) mm, if it exceeds the permitted range, it must be replaced with new one to ensure reliability when the engine is operating.

c) Gaskets of the cylinder head cover

- If the gasket of the cylinder head cover shows signs of air leakage, water leakage, oil leakage, it must be checked to replace the new gasket for the cylinder head cover.
- For method of disassembly, refer to the method of removing the cylinder head cover in above part. Check if the gasket of the cylinder head cover has any visible damage and analyze the cause, regardless of whether the cylinder head cover has a trouble, after disassembling it, it must be replaced.

d) Valve seal

- The valve seal is used to seal the lubricant on the valve body, in addition it works to apply a certain amount of lubricant to the valve body, avoiding the valve body from dry friction with the leaded bushing, causing stickiness. Before disassembling valve, check whether all oil seals are loose.
- After removing the valves, carefully check whether the oil seal is intact, whether there is a crack or aging; Check the spring on the oil seal to see if it is deformed. If valve and the leaded bushing have severe abrasion, oil seal must be replaced with them.

28.5. Steps to assemble the cylinder head cover

- a) Valve seal.
- b) Valve seal and method of installation are shown in figure.

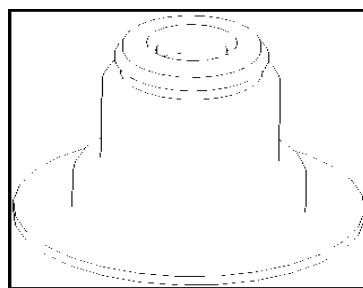


Figure 4-59 Valve oil seal

- The valve seal is only used once, if removed, it must be replaced.
 - Check the oil seal to see if there is any defect, if the oil seal spring is intact.
 - Install the valve oil seal on the valve leaded bushing.
 - Apply lubricant to the lip ring of the valve oil seal.
 - Use specialized tools to install the valve oil seal and rubber hammer to tap the seal inserted into.
- c) Assembling gasket of the cylinder head cover
- The gasket of the cylinder head cover can only be used once, if it is used again, it must be replaced immediately.
 - Clean the inner surface of the cylinder, apply the lubricant, wipe the upper surface of the engine body, and then place the gasket of the cylinder head cover into the corresponding latch hole.
 - Check if the gasket is correctly installed.
- d) Assembling the cylinder head cover
- Thoroughly wipe the cylinder head cover, make sure there are no dust, iron chips, sand, ..., then wipe the lower surface of the cylinder head cover.
 - Check if the cylinder has a strange object, make sure that the gasket of cylinder head cover and its lower surface are clean.
 - Before tightening the cylinder head cover bolts, the cylinder head cover, use a flat-pin to locate.
 - Install the cylinder head cover.
- e) Install bolts of the cylinder head cover
- Bolts of the cylinder head cover are as shown in figure.

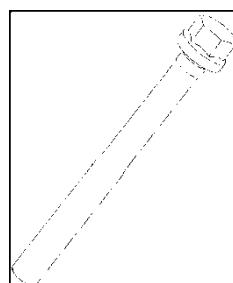


Figure 4-60: Bolts of the cylinder

- Bolts of the cylinder head cover are used 3 times. Order to tighten the bolts of the cylinder head cover is as shown in figure.

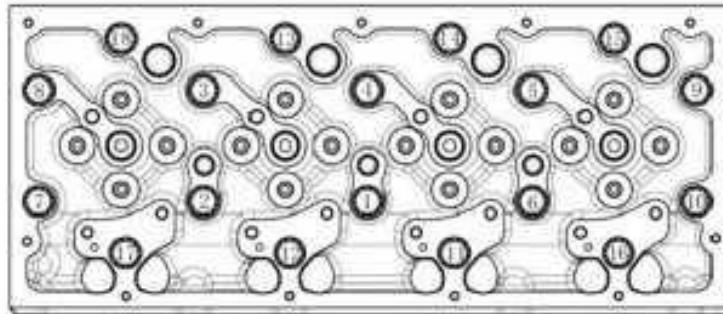


Figure 4-61: The cylinder head cover

- Watch the cylinder head cover in order, apply lubricant to the thread and load-bearing surface of the bolts of the cylinder head cover, divide into 3 times.
- First time, use low torque to lightly rotate wrench or torque wrench to tighten bolt to 80N.m.
- Second time, rotate 90 ° in order.
- Third time, rotate 90 ° in order

29. Disassembly, installation, check and repair of the rocker cover

29.1. Tools and preparation for disassembling and assembling the rocker cover

- a) Specialized tools for disassembling and assembling: socket ratchet wrenches or screw machine, open-wrenches, tools for fitting seal, ...
- b) Remove components that cover the rocker cover.

29.2. Drawings of the rocker cover

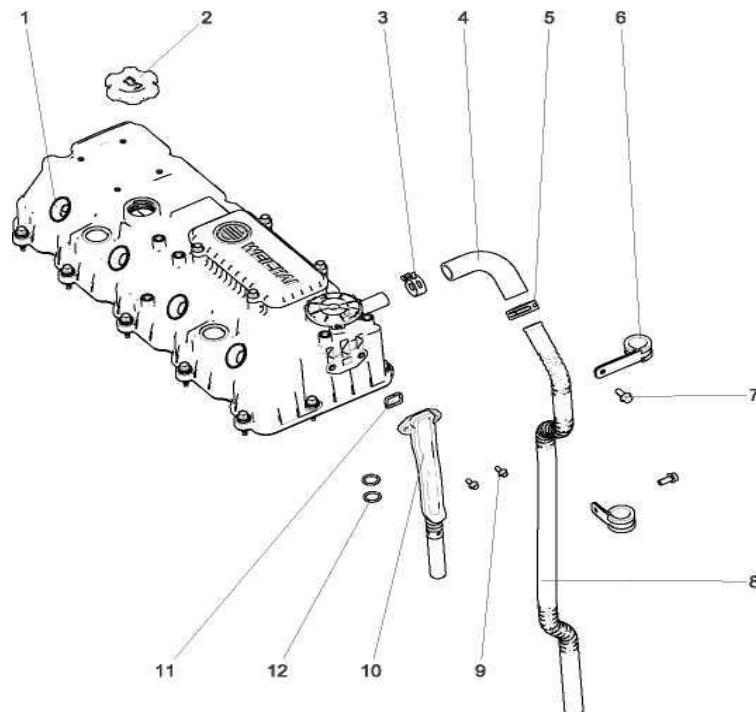


Figure 4-62: Drawings of the rocker cover

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Rocker cover assy	7	Hexagon flange bolts
2	Oil filling hole cap	8	Air exhaust pipe of air filter
3	Flexible pipe clamp	9	Hexagon flange bolts
4	Rubber pipe connecting airway	10	Oil return pipe of air filter
5	Flexible pipe clamp	11	Washer
6	Pipe clamp	12	O-ring rubber gasket

29.3. Steps to disassembling the rocker cover

- Remove all components that affect the disassembly of the rocker cover
- Remove the pipe clamps fixing the exhaust pipe that separates the air, remove the flexible hose clamps, remove the air exhaust pipeline of the air separation filter.
- Remove the bolts fixing the oil return pipe of filter bolts, remove the oil return pipe assy
- Remove the bolts fixing the rocker cover assy, take the rocker cover off by the vertical direction upward.

29.4. The main points when checking and repairing the rocker cover

- Before disassembly, check whether there is phenomenon of oil penetration around the rocker cover. If any, check the relevant parts carefully.
- Before disassembly, check the rocker cover to see if there are conditions such

- as cracking, if any, replace with the new rocker cover.
- c) Before disassembly, check the location of the oil filling hole to see if there is phenomenon of oil seepage, if any, check the relevant parts carefully.
 - d) If the rocker cover gasket is covered with oil, when removing the rocker cover and the gasket of the rocker cover, check the gasket to see if it is damaged, if the sealing surface of the rocker cover is scratched and deformed. If the gasket is damaged, replace it with new one, if the rocker cover itself is deformed or scratched, replace with the new one.
 - e) If the location of the oil filling port is leaking oil, when removing the cover of the oil filling hole, check the thread of the oil filling hole and the sealing washer to see if it is damaged, and if it is damaged, replace with the new cover of the oil filling hole. If the sealing surface contacted between the rocker cover and the cover of the oil filling hole has scratches, leading to the oil leak, the rocker cover should be replaced with new one.
 - f) Check the oil seal of the rocker cover to see if it is scratched or cracked, if any, it must be replaced with new one.

29.5. Steps to install the rocker cover

- a) Clean the rocker cover and the air discharge port, install the oil filling port.
- b) Check the status of the oil seals and the cylinder head cover, make sure there are no defects and injuries caused by production.
- c) Clean the top surface of the cylinder head cover.
- d) Check the rocker cover to see if there are defects such as cracks, install the rocker cover and tighten the bolts.
- e) Check the washer sealing the oil return pipe of the air separation filter, make sure there are no cracks or scratches, install the oil return pipe and tighten the bolts.
- f) Install the air discharge pipe of the air separator filter, use a hose clamp to fix it.

30. Disassembly, installation, check and repair of the water pump

30.1. Tools and preparation work for disassembling and assembling the water pump

- a) Tools for disassembling and assembling: tubes or wrenches.
- b) Preparation before dismantling: before disassembling, discharge fully the antifreeze solution in the engine; remove the belt.

30.2. Drawings of the water pump

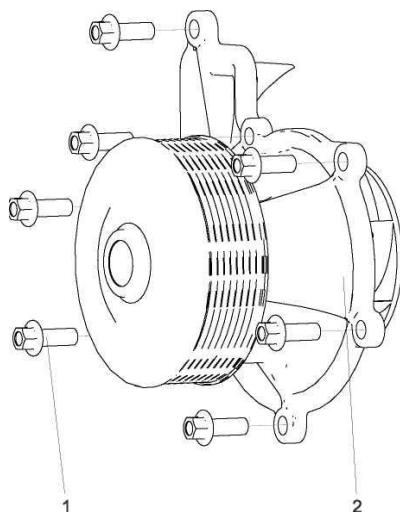


Figure 4-63. Drawings of the water pump

NO.	DESCRIPTION
1	Water pump
2	Hexagon flange bolts

30.3. Steps to disassemble the water pump

- a) Remove 7 hexagon flange bolts
- b) Remove the water pump assy.

30.4. The main points when checking and repairing the water pump

- a) Check the impeller of the water pump to see if there is an abnormal abrasion or erosion.
- b) Check the pulley tensioning belt of the water pump to see if it is cracked.
- c) Check the outer shell of the water pump to see if it is cracked.

30.5. Steps to install the water pump

- a) Check the gaskets at the side installing the water pump to see if it is intact, ensuring that the gasket is completely inserted in the gasket groove; Check whether water pump movement is flexible.
- b) Use hexagon flange bolts to install water pump on cooling modules and oil filters.

31. Disassembly, installation, check and repair of the inlet pipes into water pump

31.1. Tools and preparation work for disassembling and assembling the inlet pipes into water pump

- a) Tools for disassembling and assembling: socket ratchet wrenches.
- b) Preparation before disassembling: remove the rubber hose connecting the water tank with the water supply pipe into the water pump; Remove the water return tube of the rear-treatment system.

31.2. Drawings of the water supply pipes into water pump

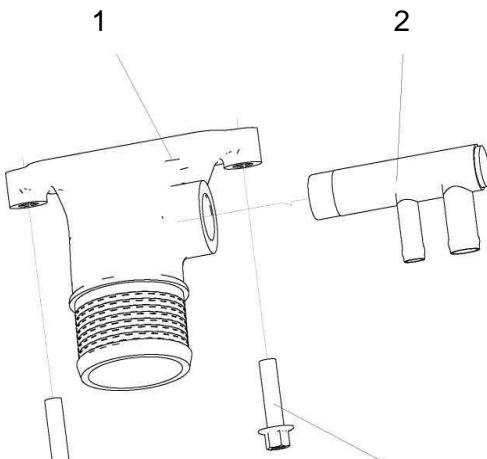


Figure 4-64 Drawings of the water inlet pipes into water pump

NO.	DESCRIPTION
1	Water supply pipe to the water pump
2	Water pipe connector
3	Hexagon flange bolts M8x30

31.3. Steps to disassemble the water supply pipes to the water pump

- a) Remove 2 hexagon flange bolts.
- b) Remove the water supply pipes to the water pump.

31.4. The main points when checking and repairing water supply pipes into water pump

Check component parts to see if it is complete. Check whether the rubber washer of the water inlet into the cooling module and the oil filter, the water inlet is intact, the contact surfaces must not have oil stains, traces of collision.

31.5. Steps to install water supply pipes into water pumps

- a) Check the rubber washer of the water supply pipes into the water pump in the cooling module and the oil filter to see if it is intact, make sure the sealing washer has completely inserted into the gasket groove.
- b) Temporarily fit the connector of water pipes to water supply pipes into the water pump, large pipes are inserted into small pipes, contact surface is applied with sealant.
- c) Install water supply pipes of the water pump into cooling modules and oil filter,

use 2 hexagon flange bolts to tighten.

32. Disassembly, installation, check and repair the oil pan

32.1. Tools and preparation for disassembling, assembling the oil pan

- a) Tools for disassembling and assembling the oil pan.
- b) Preparation before disassembling: remove the oil discharge pin of the oil pan, discharge fully oil.

32.2. Drawings of the oil pan

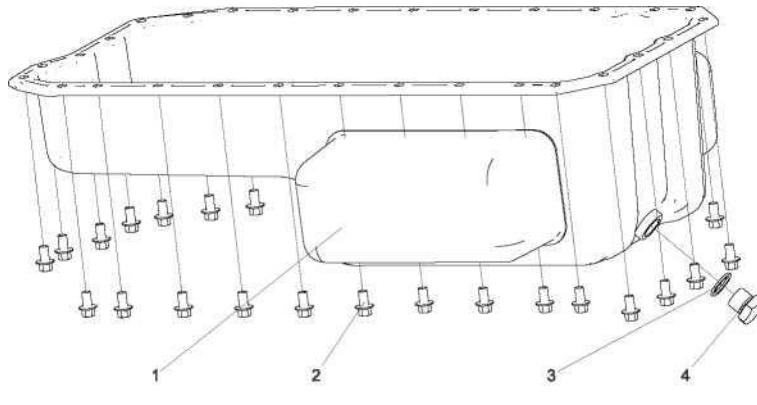


Figure 4-65. Drawings of the oil pan

NO.	DESCRIPTION
1	Oil pan assy
2	Hexagon flange bolts M8X14
3	Combination sealing washer
4	Oil discharge pin

32.3. Steps to disassemble the oil pan

- a) Remove the bolts tightening the oil pan.
- b) Remove the oil pan, when removing, do not damage the sealing surface between the oil pan with the engine body, after removing, clean the sealants at the sealing side between the oil pan and engine body.

32.4. The main points when checking and repairing the oil pan

- a) Check the sealing side between the oil pan and the engine body to see if it is damaged.
- b) Check the weld position of the oil pan to see if there are cracks and leakage.

32.5. Steps to install the oil pan

- a) Use a towel to clean the sealing side between the oil pan and the engine body, apply silicone glue to the sealing side of the engine body or the oil pan, the sealant line must be continuous and evenly without interruption.
- b) Watch the bottom side of the engine body with threaded hole, insert the oil pan.
- c) Tighten bolts to the oil pan, tightening order is from the middle to the two sides.

d) Insert the sealing washer to the oil discharge pin and tighten it, for new used seal sealing washer, it should be replaced with new one.

33. Disassembly, installation, check and repair of the oil gauge

31.1. Tools and preparation for disassembling, assembling the oil gauge

a) Tools for disassembling and assembling: tubes or wrenches.

b) Preparation before disassembling: remove the oil pan.

31.2. Drawings of the oil gauge

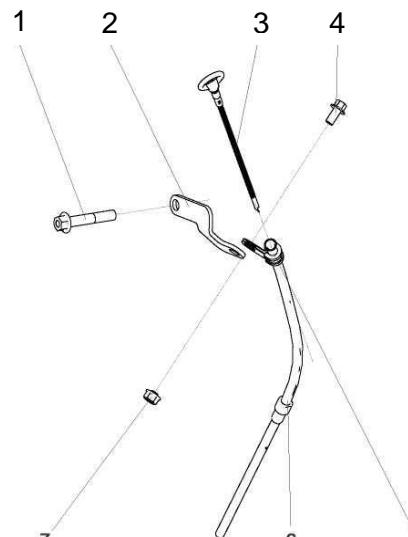


Figure 4-66. Drawings of the oil gauge

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Hexagon flange bolts M10x60	5	Pipe clamp assy
2	Rack	6	Oil gauge tube
3	Oil gauge	7	Hexagon flange bolts
4	Hexagon flange bolts M8x16		

31.3. Steps to disassemble the oil gauge

a) Draw the oil gauge.

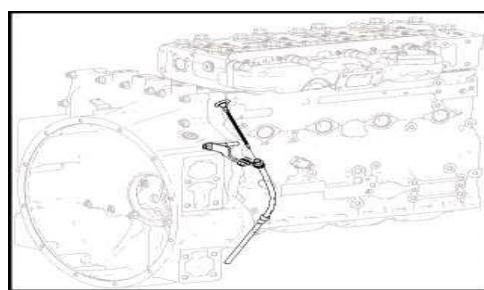


Figure 4-67. Draw the oil gauge

b) Remove screws fixing the oil gauge tube, remove the clamp.

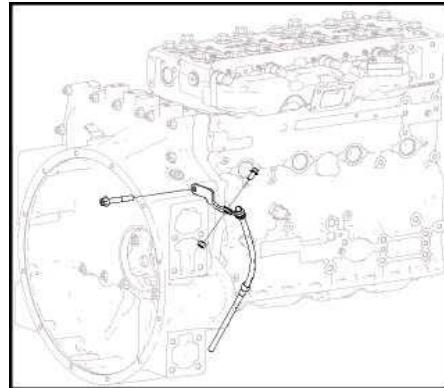


Figure 4-68. Remove the details fixing the oil gauge

- c) Tap back from the bottom of the oil gauge tube, causing it to be pushed out from the hole on the engine body

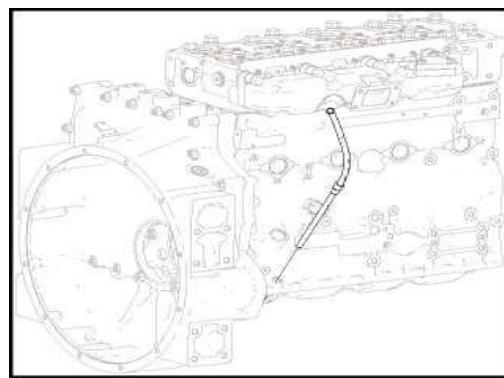


Figure 4-69. Remove the oil gauge tube

31.4. The main points when checking and repairing oil gauge

- a) Check whether the oil gauge tube is damaged or loose.
- b) Check whether the oil gauge assembly is for damaged.
- c) Check the washer sealing the oil gauge to see if the oil is cracked and damaged.

31.5. Steps to install the oil gauge

The order of assembling is in reverse with the disassembling order, when assembling it, is to be applied the sealant to the contiguous surface between the oil gauge and the engine body.

32. Disassembly, installation, check and repair of the piston injector

32.1. Tools and preparation for disassembling, assembling the piston injector

- a) Tools for disassembling and assembling the piston injector.
- b) Preparation before disassembling: remove parts such as crankshaft, ...

32.2. Drawings of the piston injector

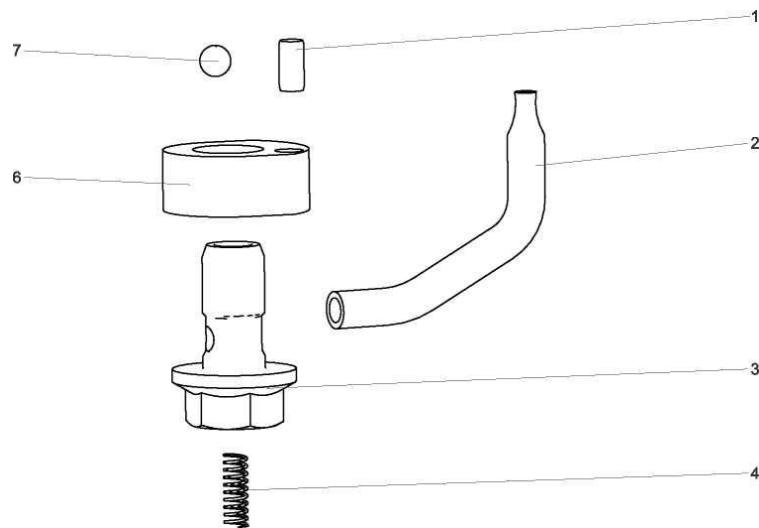


Figure 4-70. Drawings of the piston injector

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Locating pin	5	Injector checking ring
2	Piston injector	6	Injector body
3	Hollow bolts of injector	7	Steel ball
4	Spring injector		

32.3. Steps to disassemble the piston injector

- a) Remove the hollow bolts of the injector.
- b) Remove the injector assy.

32.4. The main points when checking and repairing the piston injector

It is necessary to check whether the injector is smooth, if there is a blockage, it is necessary to replace with the new one.

32.5. Steps to assemble the piston injector

- a) Check whether the injector is smooth, check the interface between the engine body and the injector to see if there are signs of collision and sharp spines, if necessary, repair or replace.
- b) When screwing the hollow bolts, use the locating pin to align the position of the injector.

33. Disassembly, installation, check and repair the piston rod assembly

33.1. Tools and preparation work for disassembling and assembling the piston rod assembly

- a) Tools for disassembling and assembling.
- b) Torque wrenches, automatic screw gun, crane, needle nose pliers,
- c) Preparation before dssassembling.
- d) Before disassembling the piston rod assembly, remove the cylinder head cover, the air distribution mechanism, the oil pan....

33.2. Drawings of the piston rod assembly

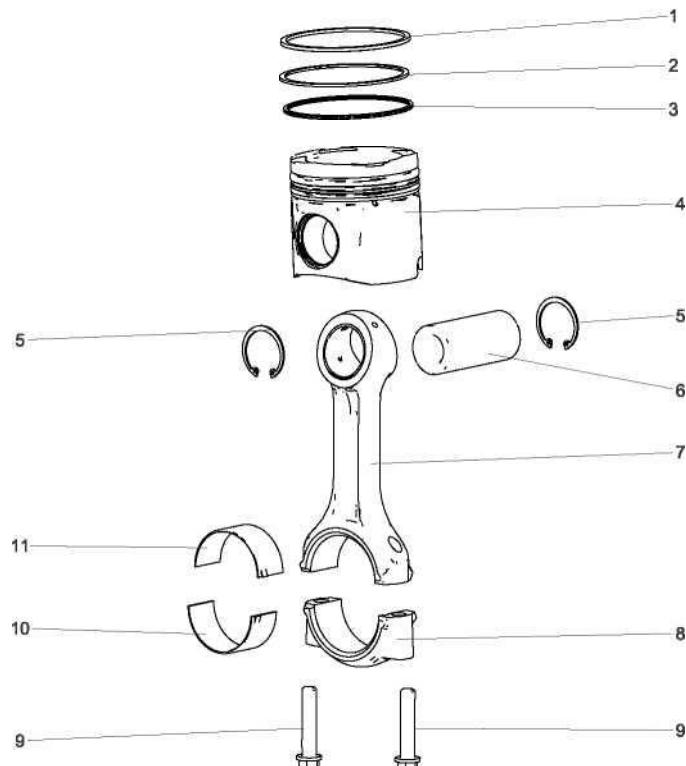


Figure 4-71. Drawings of the piston rod assembly

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Air piston ring1	7	Connecting rod body
2	Air piston ring2	8	Connecting rod cap
3	Oil piston ring	9	Connecting rod bolt
4	Piston	10	Lower bushing of connecting rod
5	Piston pin retaining ring	11	Upper bushing of connecting rod
6	Piston pin		

33.3. Steps to disassemble the piston rod assembly

- a) Carefully clean coal dust on top of the cylinder, not to damage the inside of the cylinder. Set the engine tilting, rotate the piston rod to be removed at the lower dead end, remove the connecting rod bolt and the connecting rod cover. Turn the piston back to the upper dead point, use a wooden hammer to tap the piston

loosen out, taking care to avoid making the rod end bigger and jammed the body. Put the crankshaft bushing and the connecting rod cover out in the correct order.

- b) Use the pliers to block holes carefully and remove the spring retaining ring on the sides of the piston, while push the piston pin out, remove the connecting rod. Number the piston pin and the connecting rod and place them in order.
- c) Use a pliers to fix the air piston ring no.1, the air piston ring No.2, oil piston ring respectively and mark them in turn.
- d) For the bushing of the connecting rod shaft, use radial force and tangential force to remove the shaft bushing from the mounting position, remove the bushing. Be sure to number the sequence according to the cylinder, put them out in order.

33.4. The main points when checking and repairing the piston rod assembly

- a) Check the rounded corners of the combustion chamber, piston pin base to see if there is a crack, if any, it must be replaced with new one; check the skirt, piston head to see if there is friction with the cylinder; Check the piston pin to see if there is normal wear.
- b) Check whether the piston ring is trapped in the groove.
- c) Check the outer ring of the piston ring to see if there is normal wear; Check the top surface and the bottom surface of the piston ring to see if there is normal wear.
- d) Check the outer side of the piston pin to see if there is normal wear.
- e) Check the bottom hole at the big end of the connecting rod, the rod body and the oil hole of small end to see if there are cracks.
- f) Check the side of the connecting rod to see if it is normally worn, check the warping status of the rod body.
- g) Check whether that the alloy layer of the connecting rod has normal wear, peeling phenomenon or not.
- h) The cylinder number on the connecting rod body and the connecting rod cover must be identical; If the connecting rods are equal, the weighting symbol must be identical.
- i) If there is a scratch or damage on the body of the connecting rod, it must be replaced with new one.
- j) The bolts of the connecting rod are used up to 3 times.
- k) Visually check the bushing of the connecting rod to see if the bushing surface has scratches or sharp spikes.

- l) Before installing the bushing of the connecting rod, clean the bottom hole and bushing, the bottom hole and back side of bushing should not be lubricated.
- m) If there is a phenomenon of corrosion, erosion, peeling and scratching in the surface of the connecting rod busing, the connecting rod bushing must be replaced with new one.
- n) Check whether the worn state of the connecting rod bushing, the alloy layer has the phenomenon of discoloration, peeling, shifting,

33.5. Steps to install the piston rod assembly

- a) Using radial force and tangential force make the bushing of the connecting rod far away the edge of the fracture face and enter the installation position, avoiding being scratched by the back of the steel. Make sure the locating lip of the connecting rod bushing is straightened with the groove on the big end of the connecting rod and the connecting rod cover. Note after installation, apply lubricant to the inner side of bushing.

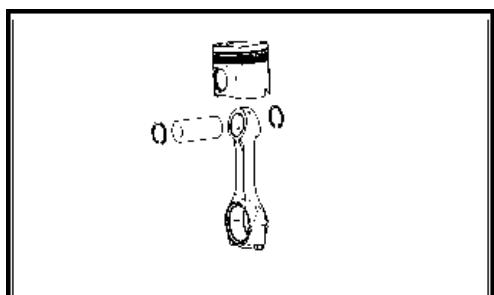


Figure 4-72. Installation of piston pin

- b) Using the circlip piler for the hole to place an elastic retaining ring for the hole in the ring groove on the piston, while move the retaining ring, make sure the retaining ring is completely inserted.
- c) Insert the small end of the connecting rod into the inner chamber of the piston, and also adjust the small end of the rod straight to the piston pin, then insert the piston pin, finally insert the retaining ring of the piston pin on the other side. The retaining ring mouth is at a position of 30° from the center line of the piston, the two rings are deflected 60° apart. Note that before installing, the small end of connecting rod and piston pin must be cleaned and applied with a moderate amount of lubricant, the factory's symbol on the connecting rod must be on the same side with the directional symbol of the piston, the connecting rod and piston of the same engine are at the same level of quality.
- d) Arrange assembled piston rod groups in the order of cylinders and then hang them up, then use the pliers to assemble the oil piston ring, air piston ring no.2, air piston ring no.1 into the piston ring groove respectively. Make sure the piston ring is mounted in parallel to the grooves, not warping. The "TOP" face of the cylinder must be facing upwards, the piston ring must move flexibly in

the groove.

- e) Adjust the direction of the piston ring ports: The port of air piston ring no.1 is installed at a position deviating 30° from the center line of the piston pin, the port of the air piston ring No.2 is installed at a position deviating 120° from the port of the air piston ring No.1, the port of the oil piston ring is installed at a position deviating 120° from the port of the air piston ring No.1 and 120° from the port of the air piston ring No.2, and at the middle position of the center line of the piston pin.
- f) Clean the inner side of the cylinder, the crank and the piston rod assembly, and the secondary moving parts must be lubricated.
- g) Rotate the engine arm for machines 1 and 4 located near the lower dead end, when giving the directional sign of the piston pointing toward the top of the engine, gently place the piston rod assy into the cylinder, insert the piston ring to be close to the cylinder. Use a compressor to push the piston deeply into the cylinder. Then pull the connecting rod downwards and insert it into the neck of the connecting rod. Bolts of the connecting rod: temporarily tighten at 40N.m in the first time, turn 90 for the second time.
- h) Note: The cylinder number on the piston must be same to the actual cylinder order, the lid and body of the connecting rod must be used in pairs, before installing the bolts of the connecting rod, apply the clean lubricant. Install the remaining cylinders according to the above method.

34. Disassembly, installation, check and repair of the hydraulic pump

34.1. Tools and preparations for dismantling and assembling the hydraulic pumps

- a) Tools for disassembling and assembling: common tools for disassembling and assembling.
- b) Preparation before disassembling: remove the components affecting the disassembly of hydraulic pump.

34.2. Drawings of the hydraulic pump

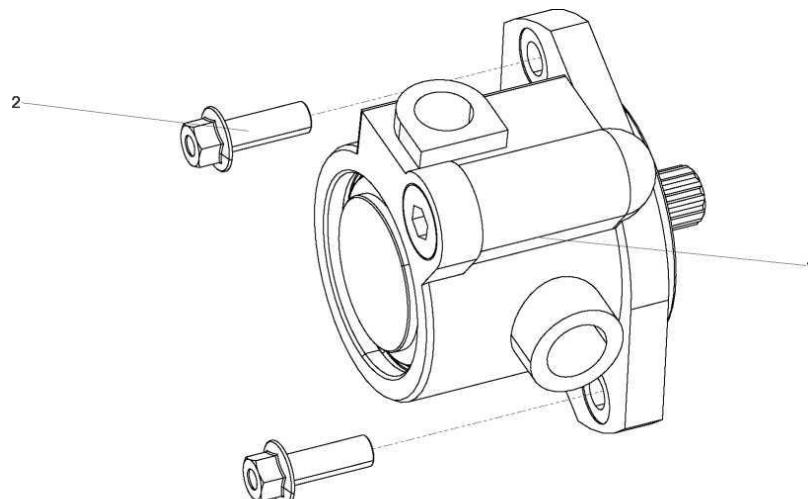


Figure 4-73 Drawings of the hydraulic

NO.	DESCRIPTION
1	Hydraulic pump
2	Hexagon flange bolts

34.3. Steps to disassemble hydraulic pump

Remove 2 hexagon flange bolts, take the hydraulic pump out in the axial direction.

34.4. The main points when checking and repairing hydraulic pump

- a) Check the hydraulic pump surface to see if there is oil leakage phenomenon, if any, it must replace with the new hydraulic pump
- b) Check the hydraulic pump to see if the steering wheel is heavy, if any, replace with the new hydraulic pump.
- c) Check the hydraulic pump assy to see if it's damaged, if any, replace with the new hydraulic pump.

34.5. Steps to install the hydraulic pump

The disassembling steps are in reverse to the assembling steps.

35. Disassembly, installation and check, repair of electronic control unit (ECU)

35.1. Tools and preparation for disassembling and assembling the electronic control unit (ECU)

- a) Tools for disassembling and assembling: socket ratchet wrenches.
- b) Prepare before dismantling: Based on the specific location of the ECU on the engine to decide, remove the relevant components around the ECU.

35.2. The main points when checking and repairing the electronic control unit (ECU)

- a) Check the ECU surface to see if there are oil stains, collision, and rubber washer to see if they have elasticity.
- b) Check the plug pins on the ECU socket to see if it's damaged

36. Disassembly, installation and check, repair of wire bundles and electronic control sensors

36.1. Tools and preparations for disassembling and assembling wire bundles and electronic control sensors

- a) Tools for disassembling and assembling: socket ratchet wrenches
- b) Preparation before disassembling

36.2. Drawings of wire bundles and electronic control sensors

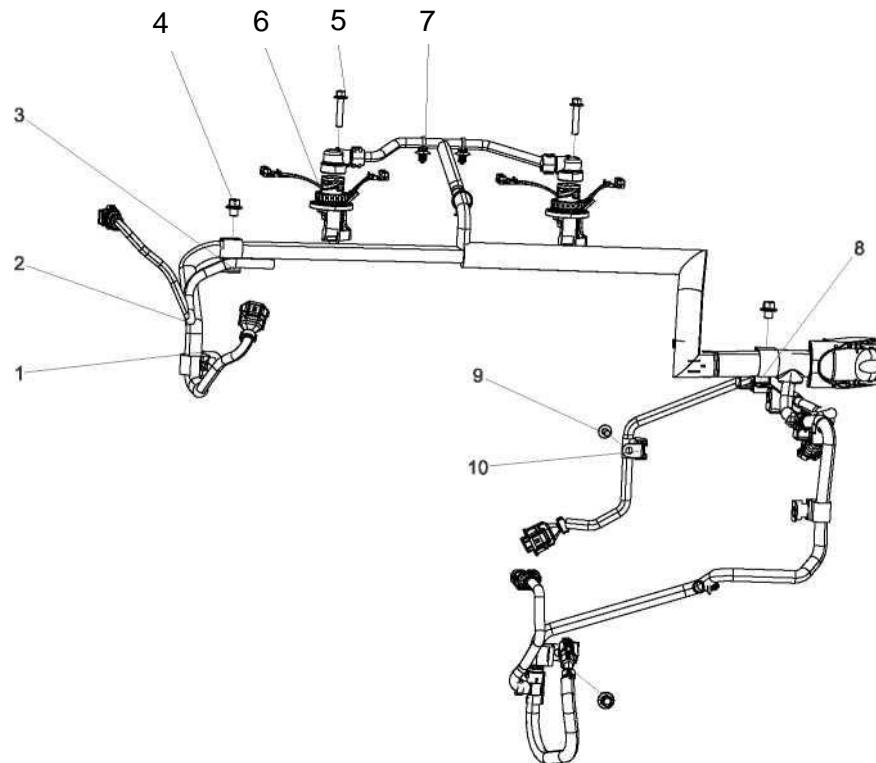


Figure 4-74. Drawings of wire bundles and electronic control sensors

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Wire bundle rack	6	Oil injector wire bundle
2	Engine wire bundle	7	Drawstring
3	Wire bundle rack	8	Wire bundle rack
4	Hexagon flange bolts	9	Hexagon flange bolts
5	Hexagon flange bolts	10	Wire bundle rack

36.3. Steps to disassemble the wire bundles and electronic control sensor

- Remove the bracket fixing the engine wire bundle.
- Remove the wire bundle of the engine

36.4. Steps to assemble the wire bundles and electronic control sensor

Reverse to the disassembling steps.

37. Disassembly, installation and check, repair of air compressors

37.1. Tools and preparation work for disassembling and assembling air compressor

- Disassembling tools: socket ratchet wrenches or screw machine, open wrenches, ...
- Preparation before disassembly: remove the lubricating oil pipe from the air compressor.

37.2. Drawings of the air compressor

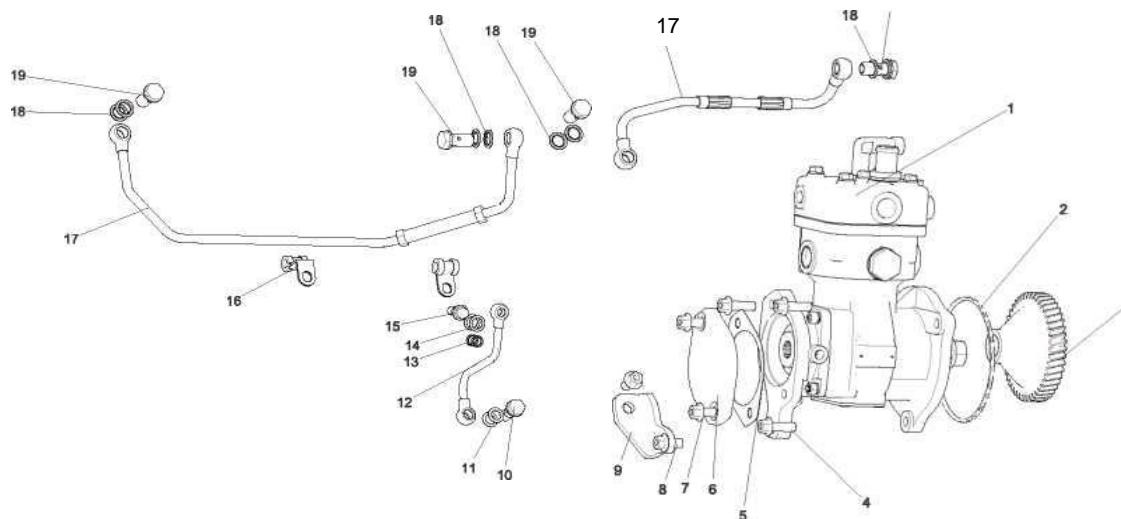


Figure 4-75. Drawings of the air compressor

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Air compressor assy	11	Combination sealing washer
2	O-ring rubber sealing washer	12	Air-compressor lubricant pipe
3	Air compressor gear	13	Combination sealing washer
4	Hexagon flange bolts	14	Combination sealing washer
5	Washer	15	Hollow bolts
6	Cap	16	Pipe clamp
7	Hexagon flange bolts	17	Air-compressor water return pipe
8	Hexagon flange bolts	18	Combination sealing washer
9	Air compressor rack	19	Hollow bolts
10	Hollow bolts	20	Air-compressor water supply pipe

37.3. Steps to disassemble the air compressor

- Remove the water pipe supplying into the air compressor

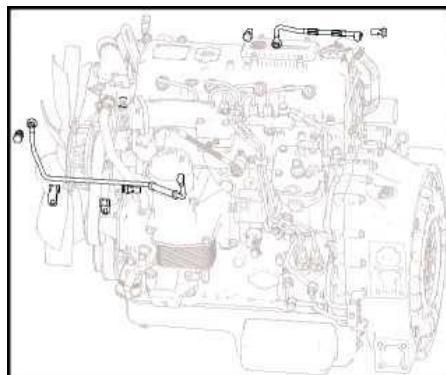


Figure 4-76. Remove the inlet-outlet water pipe

- b) Unscrew the bolts connecting rack of the air compressors.
- c) Remove the bolts connecting the air compressor to the engine body.
- d) Maintain balance with the air compressor and remove it from the engine body.

38. Disassembly, installation, check and repair of thermostatic valves

38.1. Tools and preparations to remove and install thermostatic valves

- a) Disassemble tools: prepare tubes or wrenches.
- b) Preparation before dismantling: before disassembly, it is necessary to discharge fully the cooling solution in the engine, remove the rubber tube of the large circulation cycle related to the thermostat valve and the water tank.

38.2. Drawings of thermostat valve

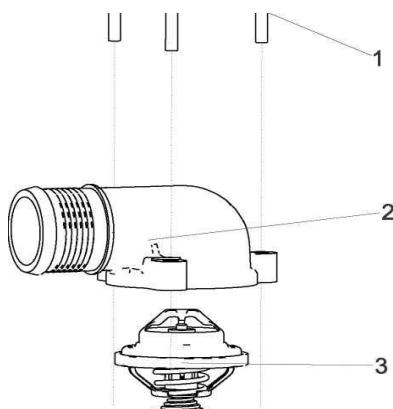


Figure 4-77. Drawings of thermostat valve

NO.	DESCRIPTION
1	Hexagon flange bolts M6x28
2	Thermostatic valve cap
3	Thermostatic valve

38.3. Steps to disassemble thermostat valve

- a) Remove 3 hexagon flange bolts.
- b) Remove the thermostat valve cap.
- c) Remove the thermostat valve from the water discharge pipe.

38.4. The main points when checking and repairing of thermostat valves

- a) Check the thermostat valve cap to see if it's cracked, if any, replace with the new thermostatic valve cap.
- b) Check if the thermostatic valve is stuck or cracked, if any, replace with the new thermostatic valve.

38.5. Steps to assemble thermostat valve

Assembling steps are in reverse to the disassembling ones.

39. Disassemble, installation, check and repair starter

39.1. Tools and preparation work for disassembling and assembling the starter

- a) Tools for disassembling and assembling: common tools for disassembling and

assembling.

- b) Preparation before disassembling: none

39.2. Drawings of the starter

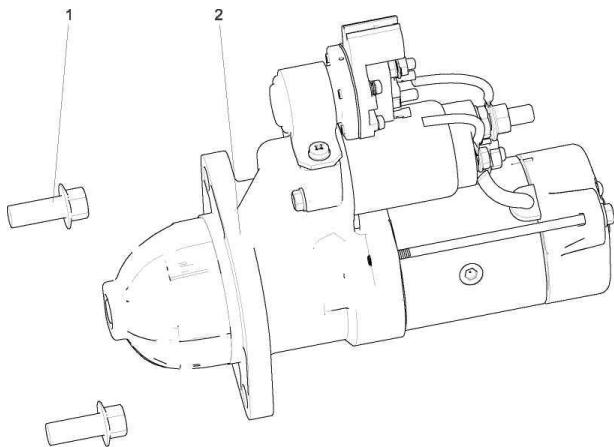


Figure 4-78. Drawings of the starter

39.3. Steps to disassemble the starter

- a) Remove hexagon flange bolts.
- b) Firmly hold the starter, remove the starter in the direction parallel to the rotation axis of its own gear.

39.4. Steps to assemble the starter

- a) Starter gears should be applied with Lithium grease used for vehicles.
- b) Install the starter.
- c) Tighten hexagon flange bolts.

40. Disassembly, installation and check, repair of air intake pipes

40.1. Tools and preparation work for disassembling and assembling the air intake pipe

- a) Common tools for the repair process.
- b) Preparation before disassembling: first remove the rubber hose connecting the air tank

40.2. Drawings of the air intake pipe

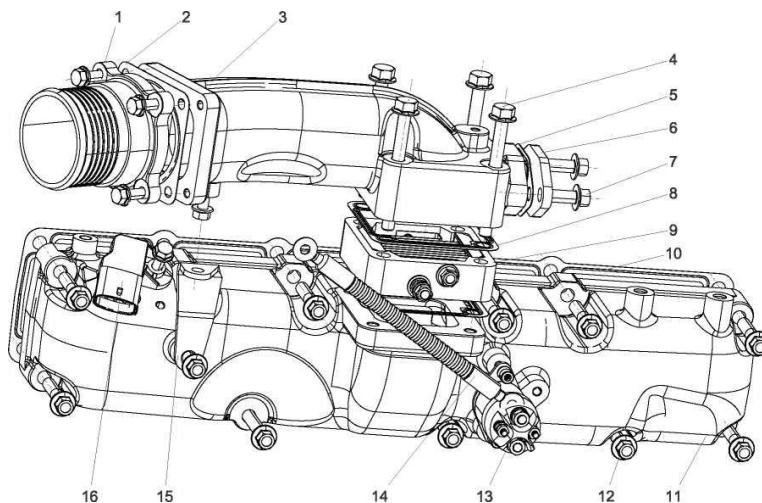


Figure 4-79. Drawings of the air intake pipe

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Air intake connector	9	Heater
2	Air intake valve gasket	10	Air-intake pipe gasket
3	Air intake connector	11	Air intake pipe
4	Hexagon flange bolts	12	Hexagon flange bolts
5	Gioăng mặt bích xả khí EGR	13	Rơ le
6	Tấm nắp Air intake pipe	14	Bó dây hệ thống gia nhiệt
7	Hexagon flange bolts	15	Rack
8	Air-intake pipe gasket	16	Cùm cảm biến áp suất khí nạp

40.3. Steps to disassemble the air intake pipe

- a) Remove hexagon flange bolts and then remove its intake pipe and its gasket.

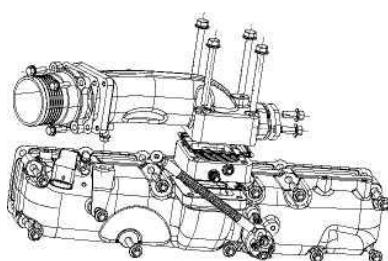


Figure 4-80. Bolts tightening the air intake pipe

- b) Remove bolts tightening the air intake pipe.
- c) Remove the bolts fixing the air intake pipe, remove the air intake pipe and its gaskets and the heater in turn.
- d) Remove the bolts of the air intake pipe, take the bolts of the air intake pipe, air

intake pipe and its gasket in turn.

40.4. The main points when checking and repairing the air intake pipe

- a) Check the inner side of the air intake pipe to see if there is any impurities or dirt, if any, clean it.
- b) Check the gaskets of the air intake pipe to see if they are deformed, torn, etc., if any, replace them.
- c) Check whether the air intake heater is burnt or short-circuited, if necessary, replace with new one.
- d) Tighten the air intake pipe with the cooling pipe, avoid air leakage.

40.5. Steps to assemble the air intake pipe

The assembling steps are reverse to the steps of disassembling, the pole of the wires of the air heater directs outward.

41. Disassembly, installation, check and repair of air distribution structure

41.1. Tools and preparations for disassembling, assembling the air distribution structure

- a) Tools for disassembling, assembling: meter, torque wrenches, lubricating oil tank and lubricating oil, towel, camshaft guider.
- b) Preparation before disassembling:
 - Process of disassembly is carried out on the rack.
 - After removing the flywheel shell, intermediate gears, continue to remove camshaft gears and camshaft.
 - After pulling out the camshaft, pull the jack out from the bottom of the engine body.
 - After removing the rocker cover, proceed to remove the rocker and the rocker arm.
 - After removing the rocker arm assy in a monolithic form, continue remove the pushing rod.
 - After removing the cylinder head cover, remove the cylinder head cover from the body and proceed to remove the valves.

41.2. Drawings of air distribution structure

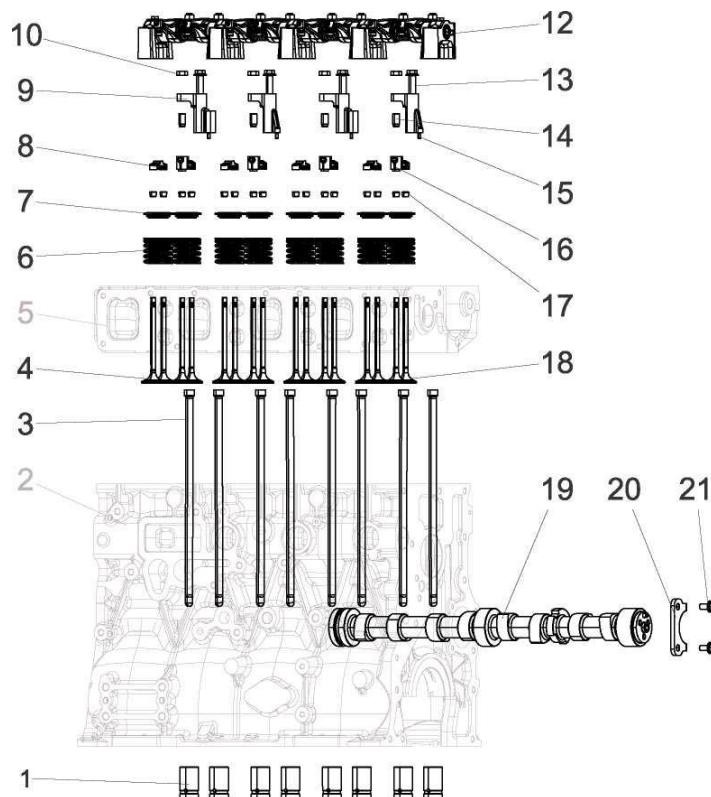


Figure 4-81. Drawings of air distribution structure

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Jack	12	Camshaft assy
2	The engine body	13	Hexagonal head flange bolts
3	Push rod	14	Adjusting screw
4	Suction valve	15	Locating pin
5	The cylinder head cover	16	EVB valve bridge assy
6	Valve spring	17	Blocking clamp
7	Valve spring base	18	Exhaust valve
8	Suction valve bridge	19	Camshaft assy
9	EVB rack	20	Retaining ring
10	Screws	21	Hexagonal head flange bolts
11	Hexagonal flange head bolts		

41.3. Steps to disassemble the air distribution structure

- Unscrew the rocker and the rocker arm, see details in the section of the steps to remove the rocker and rocker arm.
- Remove the suction and discharge valve, see details in the section of the steps to remove the valves

- c) Remove the jack and push rod, see details in the section of the steps to remove the jack and the push rod.
- d) Remove the camshaft and camshaft gear, see details in the section of the steps to remove camshaft and camshaft gear
- Steps to remove the valves
 - Remove the valve bridge, use spring compression device or pilers for installing valves or other tool to compress the spring of valves, pull out the locking clamp of valve, remove the base on the valve spring and the valve spring out.
 - Take the valves out from the valve base.
- Steps to disassemble the jack and the pushing rod
 - After removing the rocker and the rocker arm, directly remove the pushing rod and place them in order.

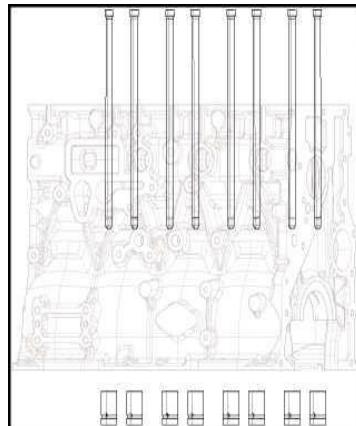


Figure 4-82. Drawings of the jack and pushing rod

- After removing the camshaft, take the jack out from the bottom of the engine body, place them in order from inside to outside.
- Steps to disassemble the camshaft
 - Rotate the camshaft, check whether the camshaft and the gears are flexibly moving, blocked or not.
 - Use the gauge to check camshaft compared to its previous state to see if the axial direction is tilted.
 - Check the clearance between the camshaft gears with other gears.
 - On the engine dismantling table, turn the crankshaft so that the camshaft gears are located at the upper dead end of the machine 1. Check the hexagon bolts fixing camshaft to see if there is a loose phenomenon, ... or not, remove the hexagon head bolts of the camshaft and camshaft gears respectively.
 - Remove the hexagon bolts of camshaft, remove the retaining ring, gently

remove the camshaft, avoiding the camshaft bushing impacted.

41.4. The main points when checking and repairing the air distribution structure

- a) The main points when checking and repairing the rocker and rocker arm
 - Clean the rocker, observe the appearance of the rocker to see if there are defects such as cracks, ... or not.
 - Check the inner hole of the rocker to see if it is worn and scratched, measure the diameter of the hole.
 - Check the screw adjusting the rocker and the arc face of the remaining side to see if it is worn.
 - Check if the oil lines are clear.
 - Measure the diameter of the rocker hole and the diameter of the rocker arm, calculate the combined clearance.
 - Check the washer of rocker, the rocker arm, the inner hole of the rocker to see if it is worn out, the rocker spring is deformed.
- b) Main points when checking and repairing the valves
 - Check if the valve body and the head of the valve body are worn.
 - Check the tip of the valve to see if it is worn or damaged.
 - Check the tip and the arc side of the valve to see if there is an accumulation of coal dust or burnt.
 - Check if the top face of the valve bridge is worn, if the part exposed to the valve has abrasion marks.
- c) Main points when checking and repairing the jack and push rod
 - Clean the push rod and jack.
 - Check the oil line of the push rod jack to see if it is clear.
 - Check if the pushing rod are warped, the degree of abrasion of the surface.
 - Check the convex and concave head of the push rod to see if they are worn.
 - Check the surface and bottom of the jack to see if it is worn.
- d) Main points when checking and repairing camshaft
 - Check the camshaft surface where contact with the jack is worn, whether the shaft neck is sticky or worn.
 - Check whether the hexagon bolts fixing the camshaft gear are deformed or not, gear are broken due to impact or serious wear.

41.5. Steps to install the air distribution structure

- a) Install camshaft and the camshaft timing gears, see details in the section of steps to disassemble the camshaft and the camshaft timing gears.
- b) Install the jack and push rod, see details in the section of steps to assemble the jack and push rod.
- c) Install the suction and discharge valves, see details in the section of steps to install suction and discharge valves.
- d) Install the rocker and the rocker arm, see details in the section of steps to install the rocker and rocker arm.

➤ Steps to install the camshaft assy

- After disassembling, check camshafts, the camshaft gears, if it is abraded or any other parameter has a big deviation, it is necessary to repair or replace the camshaft, its gears.
- Clean the camshaft hole, check the camshaft bushing to see if there are scratches, do not repair and reuse, and apply a moderate amount of clean lubricant.
- Clean the camshaft, check whether the camshaft is scratched, if necessary, repair it, then use specialized tool (camshaft guide) to install camshaft into camshaft hole, the camshaft guide must be clean and oiled, when assembling, pay attention to avoid collision and scratches for the camshaft surface and the camshaft bushing.
- Install the camshaft brake ring, apply oil to the brake ring, tighten with the hexagon head bolts, tighten and try to rotate the camshaft to see that its movement is flexible and not jammed.
- Apply 277 sealant to the outer ring of the 060 oil eye, use the specialized tool to close it to the camshaft hole, after fitting the oil eye, wipe the excess glue with the towel, and the eye oil will not be crimped.
- Measure the oil clearance of the camshaft.
- Install camshaft gears: rotate crankshaft to dead point on machine 1, view straightly the pin hole on camshaft gear with locating pin on camshaft, turn camshaft so that symbols on camshaft gear are aline with symbols of the crankshaft gears (at this time the crankshaft symbol is also fitted with the camshaft gear symbol, apply the 242 sealant on the thread of the hexagon head bolt and tighten. The tightening force of camshaft gear bolts is 32-36N.m, after fully tightening, use a marker with specialized paint to apply paint. The clearance between crankshaft gear and camshaft gear is 22mm.

➤ Steps to assemble jack and push rod

- Check the jack and push rod to see if there is a problem, if any, proceed to replace it. Before installing the jack, use compressed air to clean, and check the

oil hole to see if it is clear.

- Apply clean lubricating oil to the jack hole of the engine body and the outer side of the valve jack, apply the oil evenly.
 - From the bottom of the engine body, gently put the jack into the jack hole, the jack moves freely in its hole, use the hand to feel the resistance equally. Install the camshaft, see details in the section of steps to install camshaft.
 - Attach the base of the rocker to the cylinder head cover, check whether the push rod is clean and the weld is intact.
 - Apply clean oil to the pushing rod, make sure that the ball joint has enough oil.
 - Insert the push rod, gently insert the push rod through the cylinder head cover and place it inside the jack
- Steps to assemble valves and spring

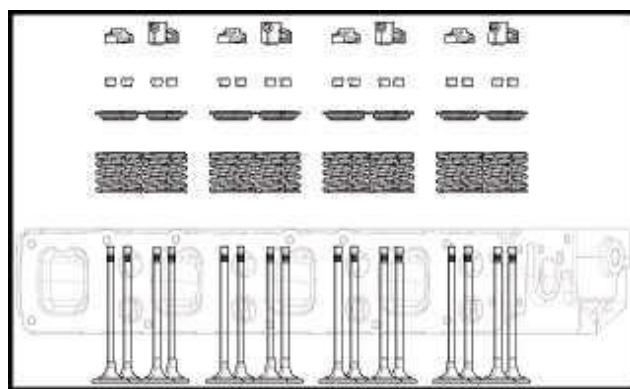


Figure 4-83. Drawings of installing valves and spring

- If the valve has phenomena such as wear, accumulating a lot of coal dust or being burnt, ..., it is necessary to replace with the new one.
- Apply evenly molibden disulfide to the body of discharge valve and suction valve, then install the suction and discharge valves on the cylinder head cover, making sure the suction and discharge valves move smoothly without getting stuck in the leaded bushing.
- Turn the cylinder head cover on, install the base under the suction and discharge valve spring, after the bottom base of the valve spring is fully inserted into the position, install the oil seal on the guide rod of the suction, discharge valves, continue to install the valve oil seal.

Notes: Before assembling, check whether the spring inside the valve seal is intact

- Install the valve springs, the upper base of the valve springs.
 - Install the valve clamp by compression method.
 - Install the valve bridge, the upper lip of the valve bridge is toward the discharge valve.
- Steps to assemble the rocker and rocker arm

- Check the cleaning of the components to be installed, make sure there are no signs of collision, scratches, or rust.
- After finishing installation of the push rod, see details in the section of the steps to install the push rod and the jack, the steps to assemble the valves, use bolts to insert through the bracket to fix the wire bundle and base of the rocker, insert the base of the rocker into the cylinder head cover.
- Tighten the bolts fixing the rocker base, the force tightening bolts fixing the rocker base is 60-77 N.m, after tightening the bolts to the fullest extent, use paintbrushes to paint all.
- Check and adjust the suction valve clearance according to the following method: Turn the engine to the dead point on the compression period of machine 1, adjust the suction valve clearance of machine 1 and machine 2, the discharge valve clearance of machine 1 and machine 3; suction valve clearance is (0.3 ± 0.03) mm; discharge valve clearance is (0.4 ± 0.03) mm; EVB clearance (0.35 ± 0.03) mm. Force tightening bolts adjusting the suction and discharge valve is (25 ± 5) N.m, force tightening EVB screw is $(30 \sim 40)$ N.m.
- Check and adjust the discharge valve clearance according to the following method:
 - + Put the piston in the EVB valve bridge in the compressed state completely down, adjust the lock nut and screw adjusting the discharge valve clearance, adjust the discharge valve clearance equal to (0.4 ± 0.03) mm; Remove the EVB adjusting screw, insert the standard 0.35 ruler below the EVB adjusting screw, adjust the EVB clearance equally to (0.35 ± 0.03) mm, then the piston in the EVB valve bridge is also in the state of being compressed down completely.
 - + Turn the engine to the position of the dead point on the compression period, adjust the clearance of the suction valves 3, 4 and discharge valves 2, 4. The suction valve clearance is (0.3 ± 0.03) mm; discharge valve clearance is (0.4 ± 0.03) mm; EVB clearance is (0.35 ± 0.03) mm.
 - + After adjusting the suction and discharge valves clearance in the cold state, it is necessary to check the machine 1 so that the suction valve opens and the discharge valve closes, before the the suction valve opens the dead point over $(17 \pm 5)^\circ$, after the discharge valve closes the dead point over $(17 \pm 5)^\circ$, after the suction valve closes the dead point below $(28 \pm 5)^\circ$, before the discharge valve opens the dead point below $(57 \pm 5)^\circ$, while recording on the recording card.

42. Disassembly, installation, check and repair of the oil filter net of the oil pan

42.1. Tools and preparation work for disassembling and assembling the oil filter net of the oil pan

- a) Tools for disassembling and assembling: tubes or wrenches.
- b) Preparation before disassembling: first remove the oil pan.

42.2. Drawings of oil filter net

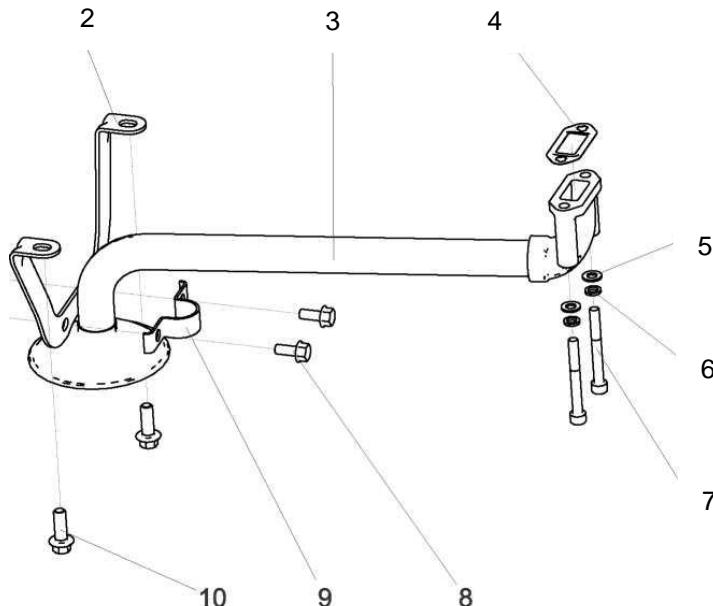


Figure 4-84 Drawings of oil filter net

NO.	DESCRIPTION	NO.	DESCRIPTION
1	M8 Hexagon flange bolts	6	M8 spring washer
2	Oil filter rack	7	Butt-head hexagon screws
3	Oil filter assy	8	Hexagon flange bolts M8x20
4	Oil filter gasket	9	Pipe clamp
5	M8 flat washer	10	Hexagon flange bolts M10x28

42.3. Steps to disassemble the oil filter net

- a) Remove screws, bolts, fixed pipe clamps, oil filter net clamps, remove bolts fixing the rack of the oil filter net, remove the rack of the oil filter net
- b) Remove the bolts fixing the oil filter net flange, take the oil filter net assy and its gasket out.

42.4. The main points when checking and repairing the oil filter net

- a) Check whether the filter net is clogged.
- b) Check the oil filter net assy to see if there is a crack or break.
- c) Check the oil filter rack to see if there is a crack or break.

42.5. Steps to assemble the oil filter net

- a) Use a towel to clean the filter net flange and the contact surface on the oil pump.
- b) Install the oil filter net and gaskets on the oil pump.
- c) Install temporarily the oil filter net rack on the engine body.
- d) Use the clamp to fix the oil filter net, use bolts and screws to fix the oil filter net into the rack, if the pipe clamp is used, replace with the new clamp.
- e) Tighten bolts fixing the rack of the oil filter net.

43. Disassembly, installation, check and repair of the flywheel shell

43.1. Tools and preparations for dismantling and assembling flywheel shell

- a) Tools for disassembling and assembling: socket ratchet wrenches
- b) Preparation before disassembling: remove the gearbox and clutch, remove the flywheel.

43.2. Drawings of the flywheel shell

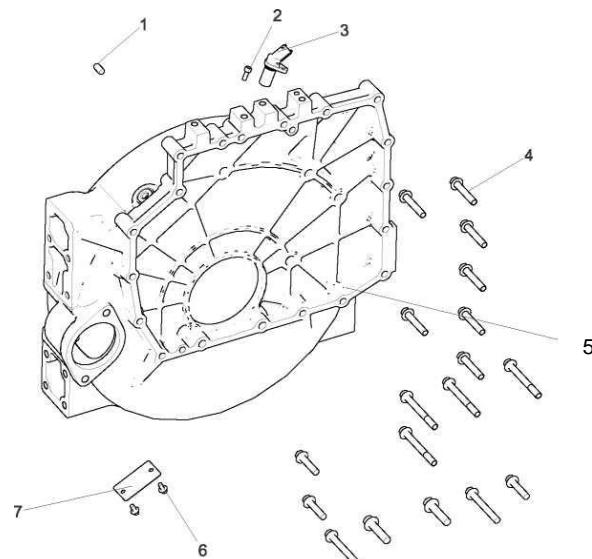


Figure 4-85. Drawings of the flywheel shell

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Locating pin	5	Flywheel shell
2	Bolts fixing sensor	6	Hexagon flange bolts
3	Revolution sensor	7	Observation hole cover
4	Hexagon flange bolts		

43.3. Steps to disassemble the flywheel shell

The disassembling steps are reverse to the assembling ones.

43.4. The main points when checking and repairing the flywheel shell

- a) Compare with the parts list, check if the parts are full.
- b) Check the status of the rear cover plate, flywheel shell and the engine body.
- c) The contiguous surfaces must not have sharp spines, oil stains, or signs of collision

43.5. Steps to assemble the flywheel shell

- a) Fit 2 locating pins to the tail of the engine block. (Name of equipment: copper hammer)

Notes: Locating pins must be fully fitted.

- b) Check the contiguous surface between the engine block and the flywheel shell to see if it is clean, sharp spines or not, and remove grease and oil, then apply sealant 510. (Tools: glue applicator, Auxiliary substances: the 755 cleanser, the 510 sealant).

Notes: The sealant line must be uniform, continuous, uninterrupted.

- c) Crane the flywheel shell for mounting, for the specification, the bolts and the number of bolts of the rear-bearing flywheel shell and the rear non-bearing flywheel shell are the same, the mounting method is the same.

- Apply clean lubricating oil to the thread and load-bearing surface of flywheel shell bolts.
- Tightening order: first tighten the middle bolts in order ① to ⑧ (M12x70); Next tightening bolts in the outer ring of the flywheel shell according to ordinal number (1 and 2: M12x60; 3-14: M12x80; 9 and 10: M10x75).

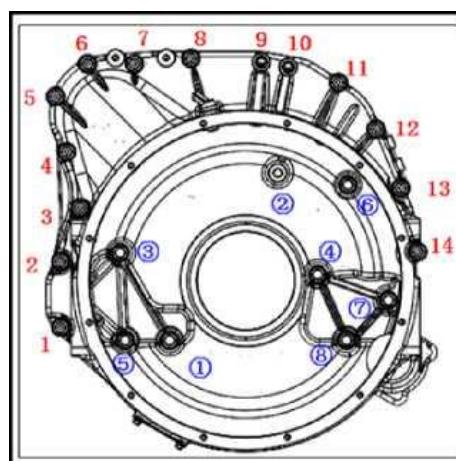


Figure 4-86. Order to install bolts of the flywheel shell

- Bolts of flywheel shell are used twice.
- After temporarily tightening the bolts, check the flat state of the flywheel shell bottom with the ground plane of the engine body, not exceeding 0.5mm.

- After tightening the bolts, use a specialized paint pen to cover the paint to seal, uniform coating direction. (auxiliary tool: sign pen).
- Use 2 hexagon flange bolts to fix the observation hole to the flywheel shell and tighten the bolts.

44. Disassembly, installation, check and repair of the flywheel

44.1. Tools and preparations for dismantling and assembling flywheels

- a) Tools for disassembling and assembling: Torque wrenches, automatic screw machine, guide screw, ...
- b) Preparation before dismantling: Before removing the flywheel, remove all equipment connected to the flywheel output, such as a clutch.

44.2. Drawings of the flywheel

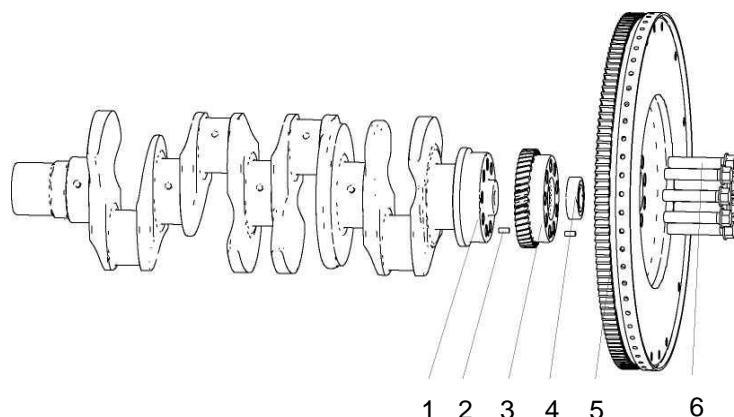


Figure 4-87. Drawings of flywheel

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Crankshaft	4	Deep-groove ball bearings
2	Locating pin	5	Flywheel assy
3	Crankshaft gear	6	Flywheel bolts

44.3. Steps to disassemble the flywheel

Remove the flywheel bolts, take the flywheel assy out, deep-groove ball bearings, and the crankshaft gears.

44.4. The main points when checking and repairing the flywheel

- a) Whether flywheel bolts have damaged like broken lace, ... or not.
- b) Whether the flywheel surface has been crushed.
- c) Whether the flywheel gear is damaged?

- d) Whether faces contacting flywheels such as flywheels with clutches are cracked.

44.5. Steps to assemble the flywheel

- a) Close the locating pin to the crankshaft tail, so that the pin is fully inserted. Install air gears to the crankshaft.
- b) Insert the crankshaft tail oil seal into the crankshaft gears, and also use the oil pressor to press the crankshaft tail oil seal into.
- c) Install deep-groove ball bearings into the hole mounted on the flywheel, so that the bearings are inserted into the hole bottom.
- d) Fit the locating pin to the crankshaft air gear tail, insert the pin completely.
- e) Install flywheel.
 - Insert the leaded rod of the flywheel into two symmetrical bolt holes on the crankshaft.
 - Insert the flywheel through the leaded rod into the flywheel shell.
- f) Insert flywheel bolts through the flywheel and crankshaft gears and fit the flywheel to the crankshaft.
 - Apply clean lubricating oil to the thread and load-bearing surface of flywheel bolts.
 - Tighten the flywheel bolts according to the order shown in the figure.

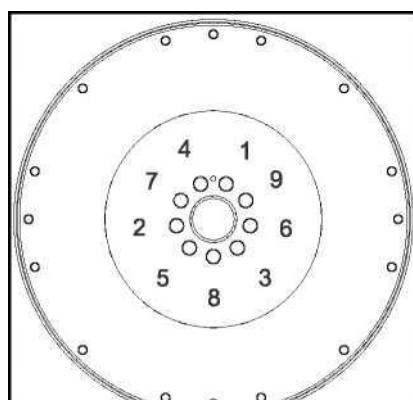


Figure 4-88. Order to tighten the flywheel bolts

- Temporary tightening at cross angle; for 1st time, use 80N.m force to tighten cross angle; 2nd time, rotate a 60° angle in order; 3rd time, turn a 60° angle in order.
- Flywheel bolts can be used 3 times in maximum.

45. Disassembly, installation, check and repair of the pressure oil pipe assembly

45.1. Tools and preparations for disassembling and assembling high-pressure oil pipe

assembly

- a) Tools for disassembling and assembling: open wrenches
- b) Preparation before disassembling

45.2. Steps to disassemble high pressure oil pipe assembly

- a) Loose the hexagon flange bolts, remove pipe clamps, continue to remove high pressure oil pipe from pump to common rail.
- b) Remove high pressure oil pipe from common rail to injector.

45.3. The main points when checking and repairing high-pressure oil pipe assembly

Check if the high pressure oil pipe connector is intact, if there is damage, replace the oil pipe.

45.4. Drawings of the high pressure oil pipe assembly

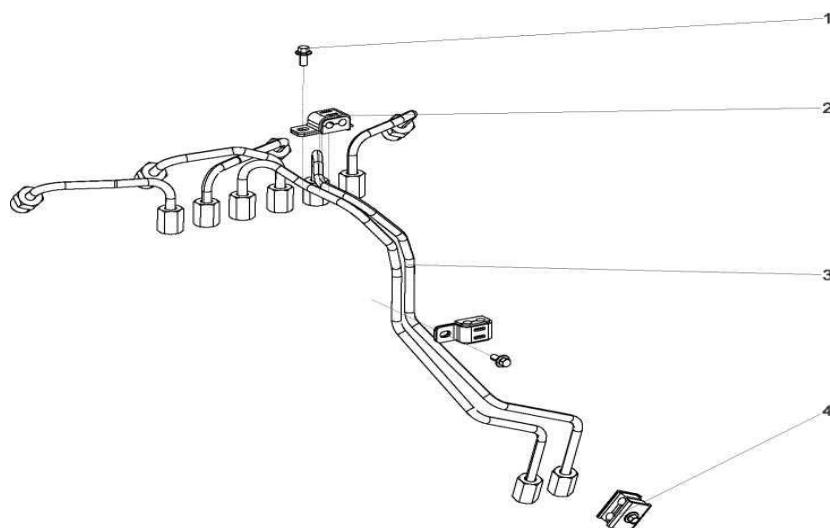


Figure 4-89. Drawings of the high pressure oil pipe assembly

NO.	DESCRIPTION
1	Hexagon flange bolts
2	Pipe clamp assy
3	High pressure oil pipe assy
4	Pipe clamp assy

45.5. Steps to assemble high-pressure oil pipe assembly

Reverse to disassembling steps

Notes: High pressure oil pipe screw tightening force at the side of the injector is (30~40) N.m, on the common rail side and on the high pressure side is (30~40)N.m.

46. Disassembly, installation, check and repair of the gear drive assembly

46.1. Tools and preparation work for disassembling and assembling gear drive assemblies

Preparation of equipment: torque wrenches, screwdrivers, rotary tools, gauge, etc. before removing gear drive assembly, remove all high pressure pumps and air compressor, etc

46.2. Drawings of gear drive assembly

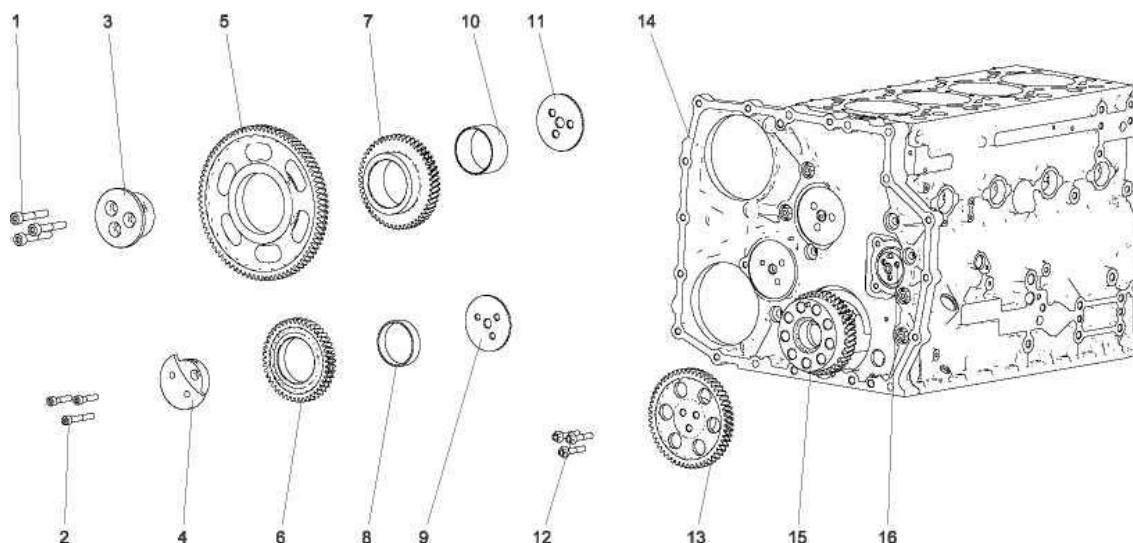


Figure 4-90. Drawings of gear drive assembly

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Butt-head hexagon screws	9	Gear cap
2	Butt-head hexagon screws	10	Gear bushing
3	Intermediate gear shaft	11	Gear cap
4	Intermediate gear shaft	12	Hexagon flange bolts
5	Large intermediate gears	13	Camshaft gear
6	Intermediate gears	14	The engine body
7	Small intermediate gears	15	Crankshaft gear
8	Gear bushing	16	Camshaft

46.3. Steps to disassemble gear drive assembly

- Rotate crankshaft, check the camshaft assy and camshaft gears to see if they are flexibly moving without obstruction.
- Use the meter to check the camshaft compared to its previous state to see if there is a shaft shift.

- c) Check the clearance between the camshaft gears and the crankshaft gears, the clearance between the intermediate gear and crankshaft gears.
- d) Remove intermediate gear bolts, take intermediate gear shafts, small and large intermediate gear assemblies and gear cap out, as shown in Figure 5-124. Remove high-pressure pump intermediate gear bolts, intermediate gear shaft, intermediate gear assembly and gear cap, as shown in Figure 5-125.
- e) Check the camshaft gear bolts to see if the phenomenon is loose, remove the camshaft gear bolts, remove the camshaft gears; Finally, as shown in Figure 5-126.

46.4. The main points when checking and repairing gear drive assembly

- a) Whether bolt threads are intact.
- b) Whether the gear has peeled, broken, the load-bearing surface of the bolt has broken, the threaded hole on the gear or shaft hole is deformed or not.
- c) Whether there is an abnormal wear between the connecting gears and intermediate gear bushing. Whether oil holes are blocked by dirt or foreign objects.

46.5. Steps to install the gear drive assembly

- a) Install camshaft gears: find the locating pin on the camshaft assy and pin hole on the camshaft gears, straighten the pin hole on the camshaft gear with locating pin on the camshaft assy then press, finally tighten the camshaft gear bolt according to the specified tightening force.
- b) Put the intermediate gear shaft into the high-pressure pump intermediate gear assy, straighten the intermediate gear shaft bolt hole with the bolt hole of the gear cap, then use the bolts to fit the intermediate gear assy to the engine body and tighten the bolts according to the specified tightening force.
- c) As shown below, rotate the crankshaft to the dead point on machine 1, so that the 3-gear symbol on the large intermediate gear matches the symbol of gear 4 on the crankshaft, the 6-gear symbol on the high pressure pump intermediate gear matches the symbol of gear 1 on the small intermediate gear, the symbol of gear 5 on the camshaft gear matches the symbol of gear 2 on the small intermediate gear, then tightening the large and small intermediate gear assembly together according to tightening rules.
- d) Measure the distance between gears.

47. Disassembly, installation, check and repair of gear chamber

47.1. Tools and preparation for disassembling and assembling the gear chamber

- a) Tools for disassembling and assembling: socket ratchet wrenches, copper hammer,...

b) Preparation before disassembling: remove mask, oil pan and top oil seal.

47.2. Drawings of gear chamber

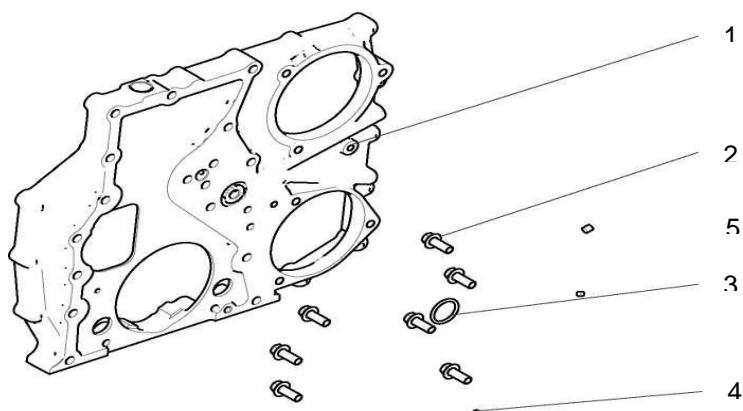
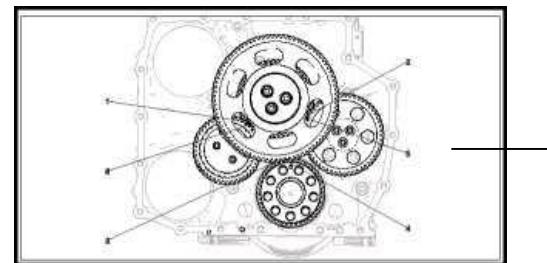


Figure 4-91 Drawings of gear chamber

NO.	DESCRIPTION
1	Gear chamber
2	Hexagon flange bolts
3	O-ring gasket
4	Sealing button
5	Locating pin

47.3. Steps to disassemble the gear chamber

- a) Remove the front cover of the engine.
- b) Remove hexagon flange bolts.

47.4. The main points when checking and repairing the gear chamber

- a) Compare the parts list and check if the component is complete.

47.5. Check the state of the gear chamber, the contiguous surfaces must not have sharp spines, oil stains, collision, ...

47.6. Steps to assemble gear chamber

Steps for assembling are reverse to ones for disassembling.

Maintenance Manual

FAST 6DS Series Transmission

3906_17204

V1.0

Contents

1 Summary	2
1.1 Preface	2
1.2 Structure Features	3
1.2.1 Twin-Countershaft Structure	3
1.2.2 Gear Shifting Device.....	4
1.2.3 Anti-Off-Gear Device.....	6
1.2.4 Shifting Control Mechanism	6
1.3 Nomenclature.....	8
2 specification	9
3 Main Structure and work principle	10
3.1 Power Flow Lines	10
3.2 Overview of Main Section	11
3.3 Structure of Transmissions	12
4 Maintenance and Operation	13
4.1 maintenance	13
4.1.1 Oil level	13
4.1.2 Oil Grade	13
4.1.3 Maintenance Interval	14
4.1.4 Repair Conditions and Requirements	14
4.2 Operation	15
4.2.1 Working Temperature	15
4.2.2 Working Inclination Angle	15
4.2.3 Towing and sliding	15
4.2.4 Instructions of Operation	16
5 Disassembly and Assembly	17
5.1 Disassembly 6DS 50T Transmission	17
5.1.1 Disassembly Transmission Assembly	17
5.1.2 Disassembly the Yoke Frame	21
5.1.3 Disassembly the main shaft	23
5.2 Assembly the 6 DS 50T Transmission	28
5.2.1 Assembly Yoke Frame	28
5.2.2 Assembly main shaft and transmission	31
5.3 Assembly 6DS 180T Transmission	32
5.3.1 Assembly Main Shaft	32
5.3.2 Assembly 6 DS 180 T Transmission	38

1 Summary

1.1 Preface

Based on the traditional technical platform of the twin-countershaft transmissions, Shaanxi Fast Auto Drive Group Co., Ltd. independently develop the Twin-Countershaft Transmission 6DS series with the input torque from 500Nm to 2000 Nm.

The design concept of 6DS series are new and unique: single-case structure, power split through twin countershafts, except for the reverse gear, all the other gears are engaged with synchronizers, dual-cone lock-ring synchronizers for 1st, 2nd, 3rd and 4th gears, synchro-torque greatly increased, and single-cone lock-ring synchronizer for 5th and 6th gears.

6DS series transmissions are also featured with proper ratio arrangement, thin-and-fine tooth gears, smooth engagement, smaller noise, shifting with synchronizers, clear gear positions, easy shifting, and various shifting modes such as single-rod and double-rod.

Advanced manufacturing methods are adopted for the twin countershafts of 6DS series transmissions, and besides, all the other components are machined with imported equipments(mainly CNC and machining centers), and heat treated with IPSEN Continuous Furnace and Aichelin Chamber Furnace. Key components are all made by dedicated production lines.

The transmissions can be matched with hydraulic retarders and electric eddy retarders, and are widely applied on large-size and luxurious buses, and also on some special-purpose vehicles.

Based on different requirements, Shaanxi Fast Auto Drive Group Co., Ltd. offer customized design, tailor-made products, related service support and spare parts supply.

The tenet of Fast Company is to provide satisfactory products and service for customers. Warmly welcome all the customers to visit us for business consultancies, negotiation, tour and guidelines. We will try our best to serve you.

1.2 Structure Features

1.2.1 Twin-Countershaft Structure

The transmission adopts two identical countershafts with an alternate angle of 180°. Power from input shaft is split to the two countershafts and then goes to the main shaft. In theory, each of the two countershafts carries 1/2 torque, this makes the center distance smaller, the width of gear thinner, axial dimension shorter and the weight lighter.

As the output flange is directly connected with the propeller shaft, a bearing support is added on the front end of the main shaft. Gears on main shaft are floating radically, and mesh with corresponding gears on the twin countershafts, which facilitate even distribution of torque. In working status, radial force from countershaft gears exerted on main shaft offsets, so in theory, main shaft only bears torque no bending moment, which greatly improves working condition of main shaft and bearings and enhances the reliability and durability of transmission.

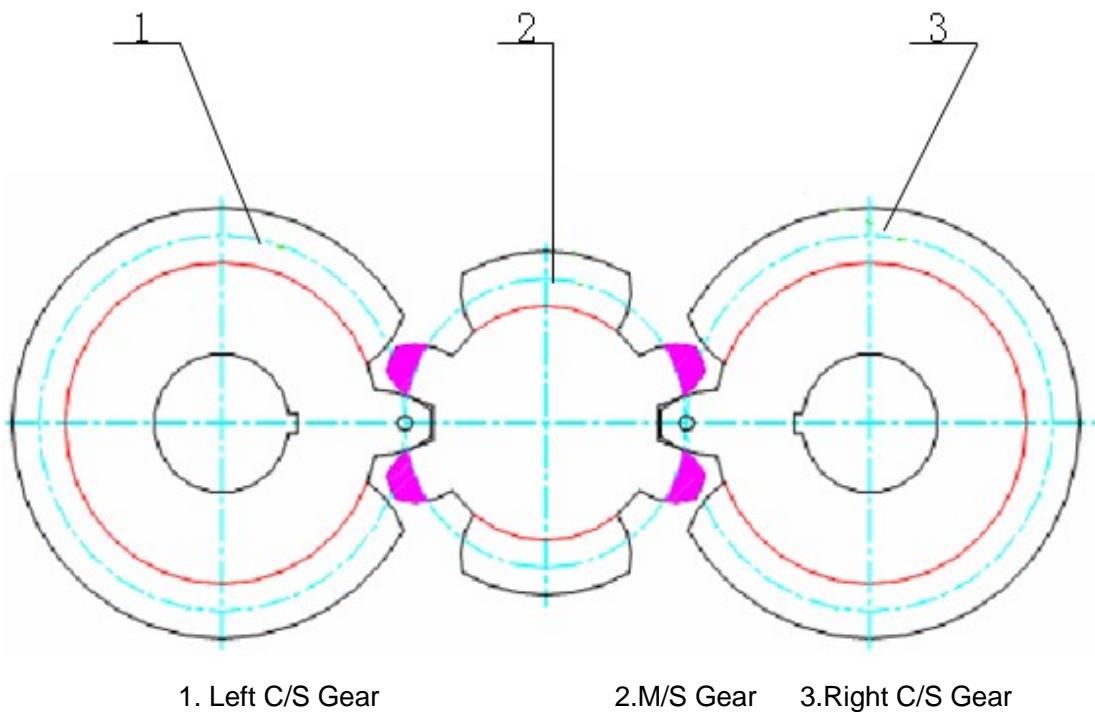


Figure1-1 Timing of Gears in Gearbox Assembly

“Timing” is necessary to guarantee correct engagement between countershaft gears and main shaft gears. See Figure 5 for details. Generally speaking, gears on main shaft are all with even number teeth

1.2.2 Gear Shifting Device

The transmission is shifted by synchronizers: dual-cone lock-ring synchronizers for 1st, 2nd, 3rd and 4th gears, single-cone lock-ring synchronizer for 5th and 6th gears. For the axial section view, please refer to Figure 1-2.

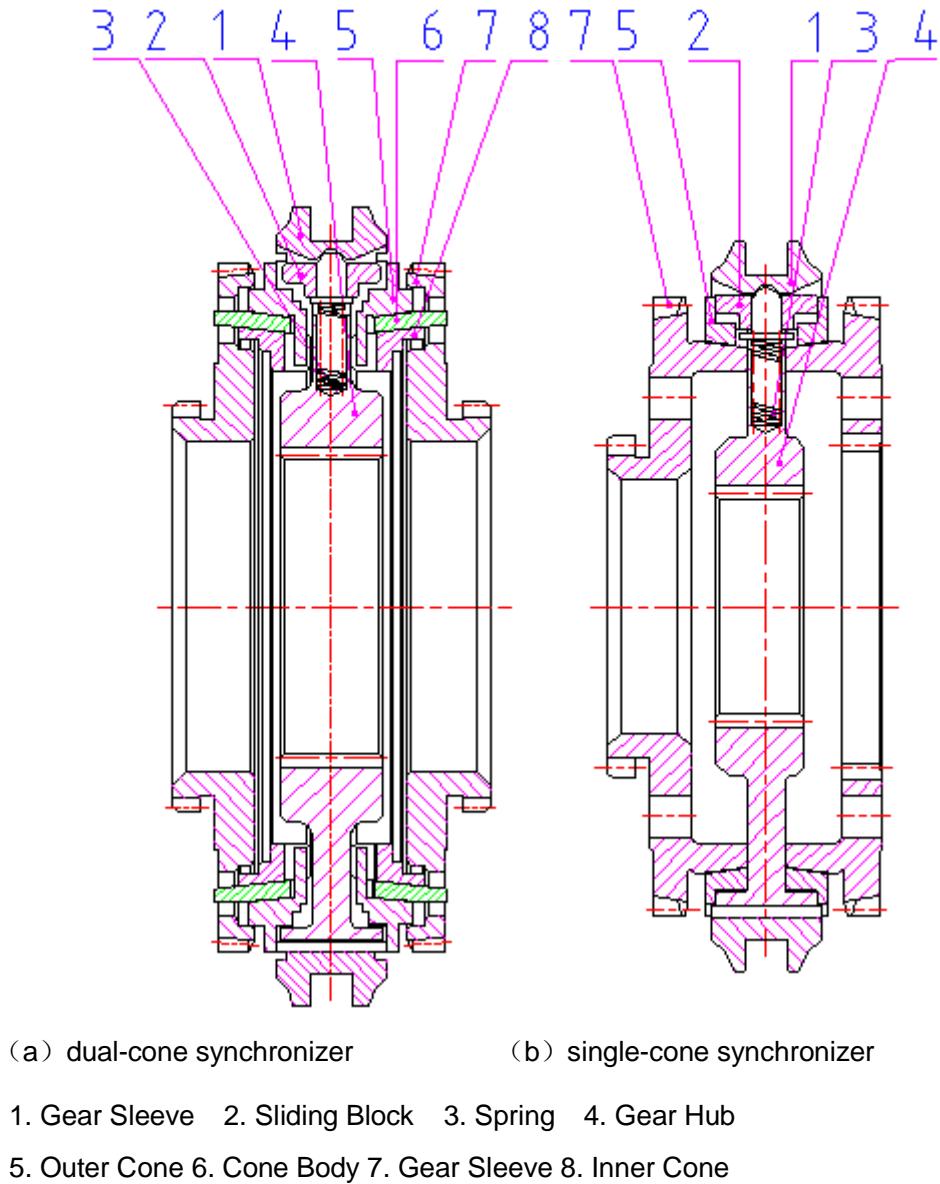


Figure1-2 Synchronizer Sub-Assembly

The lock-ring synchronizer has compact structure、good performance、high reliability and low cost, so it is widely used currently. The only shortage is that its friction torque is a little small. The dual-cone lock-ring synchronizer is a newly designed synchronizer device, based on similar working theory and structure of the traditional lock-ring synchronizer. It inherits the advantages of the traditional type but

greatly improves the friction torque.

Synchronizer shown by Figure 1-2 (a) has dual-cone faces on both sides, the components Gear Sleeve(1), Gear Hub(4), Sliding Block(2), Spring(3) are shared by both sides; there are three (5,6,8) conical bodies on each side, and six single keys on Outer Cone (5) are connected with six keyways on Inner Cone(8), so Outer Cone (5) and Inner Cone(8) rotate with main shaft. Six projections on Cone Body(6) are connected with six holes on Meshing Gear Ring(7), so cone body rotates with gears on main shaft. As a result, when upshifting or downshifting, there is angular velocity difference between M/S gears and main shaft, now the two sliding friction conical faces of the synchronizer cone starts to work; because if the total dimensions are the same, axial thrust force exerted on Gear Sleeve(1) generates synchro friction torque on the friction conical face, which equals to the friction torque sum of the two friction conical faces, namely, when shifting gears, the produced synchro friction torque is almost twice of single-cone synchronizer, which greatly improves the synchronizer performance and makes easier, smoother, faster and reliable gear shifting.

6DS series transmissions adopt two kinds of synchronizers in terms of different structures. Figure 1-2 (a) is dual-conical faced synchronizers, two sets and for 1st and 2nd gears and 3rd and 4th gears respectively. Due to two sets of friction pairs in such kind of synchronizer, the synchro-torque is greatly improved, making shifting easier. Figure 1-2 (b) is single-conical faced synchronizer, used for 5th and 6th gears. Due to smaller ratio step, so here single-conical faced synchronized is applied. These two kinds of synchronizers both belong to lock-ring inertia synchronizers, and there is a middle position within it for neutral.

Friction rings all adopt quality alloy steel manufactured by precision forging; hi-performance friction material is bonded on the friction cones, which guarantees the easy shifting.

1.2.3 Anti-Off-Gear Device

To avoid spontaneous off-gear phenomenon when the gearbox is working, synchronizers for all the forward speeds and the sliding clutch for the reverse gear of transmissions are equipped with anti-off-gear devices. The principle is to use dog teeth to generate an axial force to avoid gear going off unexpectedly. Refer to figure1-3.

Dog teeth are applied on the internal splines of synchronizer sliding sleeve and on the meshing external splines of the conical gear ring. When torque is transferred, thanks to the dog teeth, an axial force P_a is generated to keep sliding sleeve and conical gear ring from going off spontaneously.

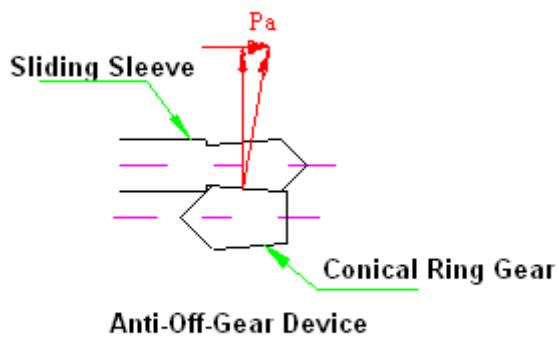
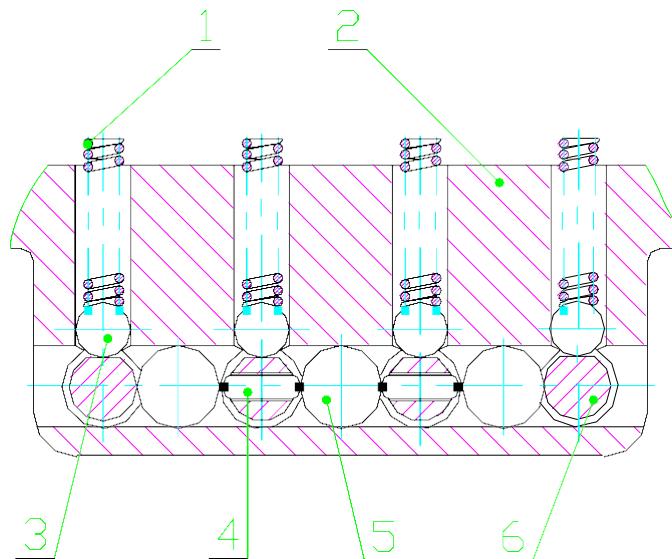


Figure1-3 Overview of Anti-off-Gear Device

1.2.4 Shifting Control Mechanism

Remote control mode is adopted on this transmission model. The interlock and self-locking device is installed. See Figure1-4 below.



1. Self-Lock Spring 2. Shift Bar Housing 3. Steel Ball

4. Interlock Pin 5. Steel Ball 6. Yoke Bar

Figure1-4 Interlock and Self-locking Device

Figure 1-5 shows the shift pattern based at the external shift lever of the shifting control mechanism of transmission in the standard option. The neutral position is between the 3rd and 4th gears.

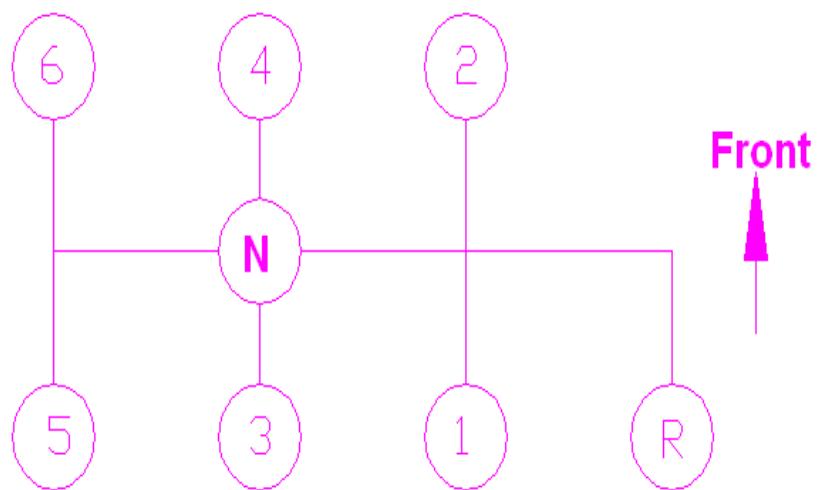
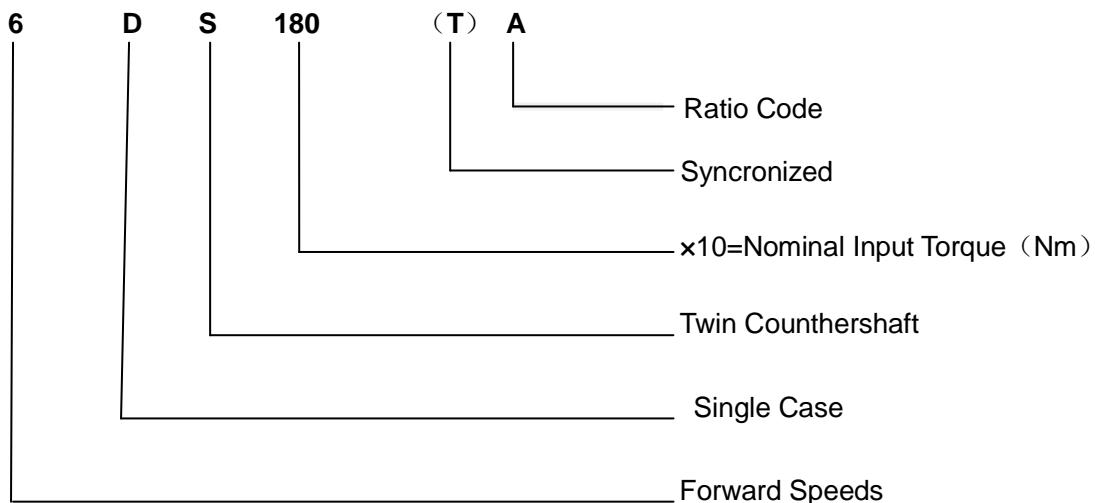


Figure1-5 Shift Pattern at External Shift Lever

1.3 Nomenclature



2 specification

Table2-1 Specifications of 6DS Series Transmission

Model	Gear Ratios							Oil (L)	M.IT (Nm)	R.I.P (Kw)	Wt. (Kg)
	1	2	3	4	5	6	R				
6DS50T	6.67	4.01	2.42	1.52	1.00	0.78	6.13	6	500	100	144
6DS80T	6.67	4.01	2.42	1.52	1.00	0.78	6.13	6	800	160	144
6DS100T	0.77	1.00	1.44	2.26	3.77	6.71	6.17	11.5	1000	199	255
6DS130T	0.77	1.00	1.44	2.26	3.77	6.71	6.17	11.5	1300	250	255
6DS150T	7.04	4.10	2.48	1.56	1.00	0.74	6.26	13			
6DS150	7.04	4.10	2.48	1.56	1.00	0.74	6.26	13			
6DS150TA	8.43	4.91	2.97	1.87	1.33	1.00	7.50	13			
6DS150TC	6.34	3.69	2.23	1.4	1.00	0.75	5.63	13			
6DS180T	7.04	4.10	2.48	1.56	1.00	0.74	6.26	13			
6DS180	7.04	4.10	2.48	1.56	1.00	0.74	6.26	13			
6DS180TA	8.43	4.91	2.97	1.87	1.33	1.00	7.50	13			
6DS200T	7.04	4.10	2.48	1.56	1.00	0.74	6.26	13	2000		

Notes:

- a. "Wt" is the weight that includes clutch housing, doesn't include lubricating oil or release device;
- b."Oil Capacity" is only reference purpose, and for details, please refer to related contents below.
- c. M.I.T: Max. Input Torque.
- d. R.I.P: Rate Input Power

3 Main Structure and work principle

3.1 Power Flow Lines

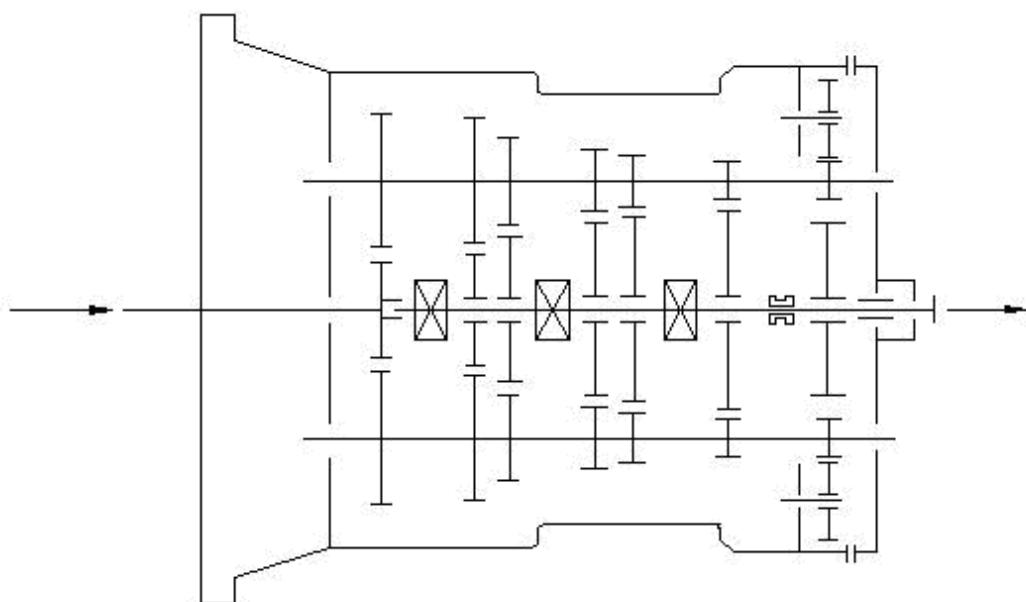


Figure 3-1 Structure Sketch

Speeds

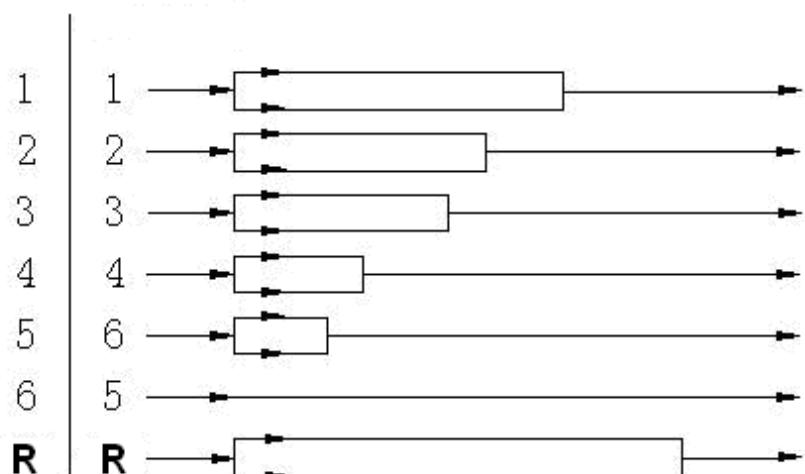


Figure 3-2 Power flow line

3.2 Overview of Main Section

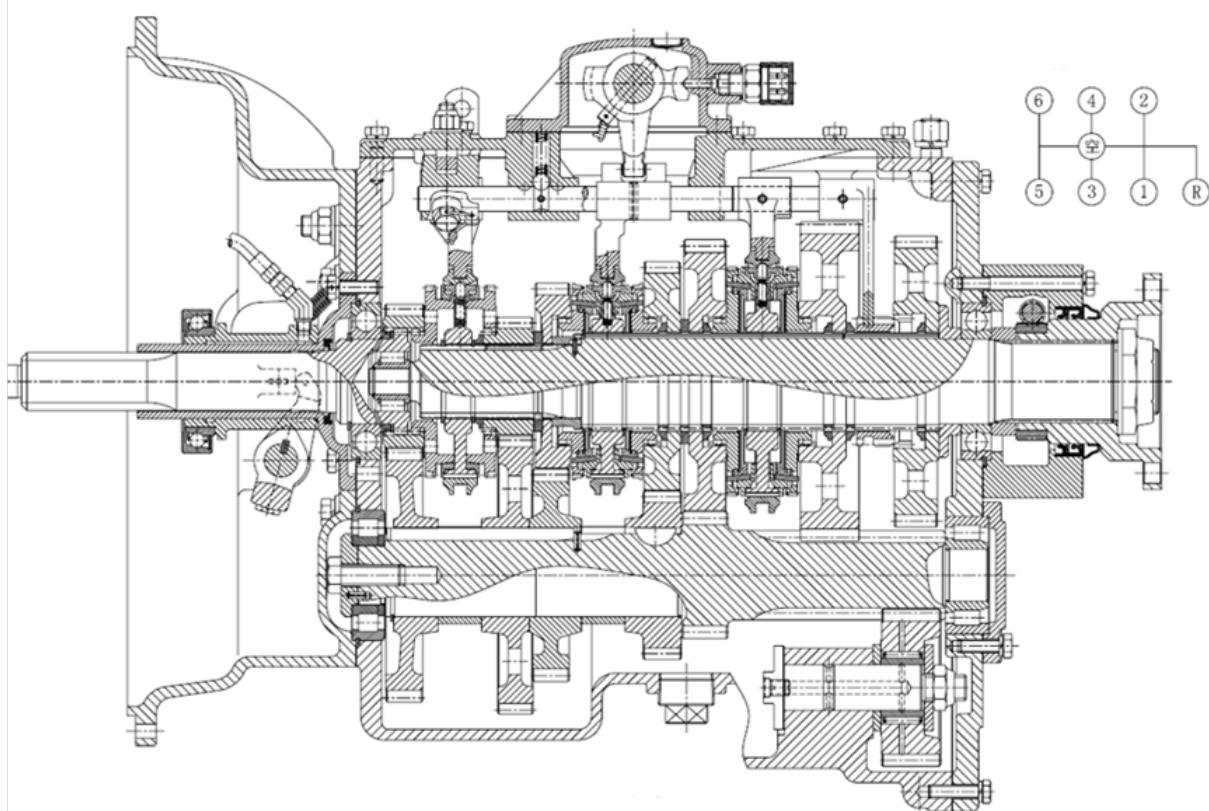


Figure 3-3 Overview of Main Section

Note:

Figure 3-3 only applies for 6DS150T, as a reference when you work on other models.

3.3 Structure of Transmissions

The structures of transmissions are some differences among the models, the detail Information will be found in spare parts catalogue, please check the catalogue if you need further information regarding the structure.

4 Maintenance and Operation

Proper operation and regular maintenance is critical to the safety running of vehicles and to a longer life of gearboxes. Please strictly observe the procedures as the description in the below.

4.1 Maintenance

4.1.1 Oil level

To regularly check the oil level is necessary. When doing the inspection, please park the vehicle at a horizontal level. Don't check oil level immediately after the vehicle stops, make sure the oil cools down and then do the inspection.

Observe oil level through the tapered hole located on the side surface of transmission case. Correct oil level should be parallel with the lower edge of the observation hole (see Figure4-1), make sure the level is within 5mm lower than the lower edge.

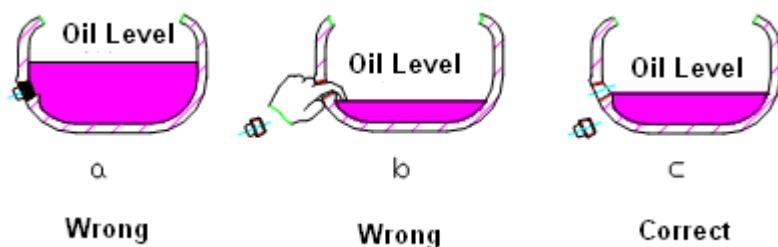


Figure 4-1 General View of Oil Level

Note:

Excessive filling of oil will increase the risk of high temperature and leakage of the oil; increased oil severe shortage of oil Will increase the possibility to burn the gear caused by poor lubrication.

4.1.2 Oil Grade

Transmission should be filled with 85W/90 GL-5 vehicle gear oil.

4.1.3 Maintenance Interval

Thoroughly drain out the oil before changing the new. Strictly observe the oil change intervals stated below and at the same time, for particular cases, please change oil also according to the working conditions and environments.

For new transmissions, oil should be changed after running 2000-5000 Km.

Check oil level and leaking each 10,000 Km, make up at any time.

Change oil every 50,000 Km.

4.1.4 Repair Conditions and Requirements

Repair conditions:

- a. Skip gears or off gears
- b. Gear shifting difficultly
- c. Overheating of Gearbox
- d. Abnormal Sound

Repair Requirements

- (1) Bearings: proper radial and axial clearance; no pittings or scaling on steel balls, rolling blocks or rolling rails of bearing.
- (2) Gears: no pittings or scaling on tooth surface; gears should be changed when they turn into tapered teeth due to wear or meshing length reduced due to shifting shocks.
- (3) Splines: check the wear amount of splines of all the shafts, if sliding clutch or output flange deviates to the side of splines due to wear, please change.
- (4) Thrust Washer: change if scratch appearance or thickness reduced on the surface of the thrust washer.
- (5) Gray iron castings: change if crack appears or severe wear.
- (6) Oil Seals: check oil seals of input shaft bearing cover and speedometer, and change if wear or

scratch occurs on the edge of the oil seal.

(7) O-Ring: change if crack or deformation occurs.

(8) Synchronizers: inspection and maintenance is needed if difficult shifting takes place, or over-wearing of yoke groove or color changed due to over-heating occurs.

4.2 Operation

4.2.1 Working Temperature

The lubrication oil temperature cannot be above 120°C and bellow -40°C in a continuous work period. If the temperature above 120°C, the lubrication oil will decomposes and life of the transmission will be shortened; while under -40°C, sealing parts like oil seals will be broken, and oil leakage occur.

4.2.2 Working Inclination Angle

The working inclination angle of transmissions should be less than 12°, otherwise lubrication will be not complete. The working inclination angle equals to the angle (that the transmission is installed on the chassis) plus slope angle. If beyond 12°, please install oil pump to guarantee good lubrication.

4.2.3 Towing and sliding

In the normal situation, continuous rotation of gears and shafts will provide enough lubrication for the transmission. But when towing vehicle which power train still connected, output shaft will rotate with the axle under condition that the countershaft gears and main shaft gears of the main case don't rotate, that will destroy the transmission badly due to shortage of lubrication. So please note the following:

- 1) When the engine is shut down, never slide in the neutral position;
- 2) Don't press down the clutch pedal, otherwise the vehicle would slide in the neutral;
- 3) When towing is necessary, draw out the half shaft or disconnect the propeller shaft, or tow with the drive wheels apart from the road.

4.2.4 Instructions of Operation

- (1) Start the vehicle with the 1st or 2nd gear according to road conditions;
- (2) Clutch must be completely disconnected when shifting gears, and the shift lever should be in place.
- (3) Before starting the vehicle, parking brake should be released; for vehicles with air brake, after connecting brake valve, wait until the air pressure to increase to the level able to release brake, then start the vehicle by putting into gears.
- (4) When putting into the reverse gear, stop the vehicle first, then put into the reverse, otherwise internal parts of transmission are apt to be damaged. For reverse gear, you have to apply a relatively bigger shifting force to overcome the resistance of reverse lock.
- (5) Frequently check breather, and clear impurities once found.
- (6) Any abnormal sound or obviously heavier shifting force detected, please stop the vehicle and inspect, start the vehicle only after the problems are solved.

5 Disassembly and Assembly

In this Chapter, only introduce the disassembling of 6DS 50T assembly, the assembling of 6DS 180T assembly, disassembling the main shaft and yoke frame of 6DS 50T and the assembling of 6DS 50T yoke frame; in the chapter 5.3.1, also introduce the assembling of main shaft of 6DS 180T. As the familiar structure in 6DS series transmissions, you could follow the procedure described in this chapter as a reference when you tend to disassembly or assembly the others model in 6DS series transmission as well as its subassemblies.

5.1 Disassembly 6DS 50T Transmission

5.1.1 Disassembly Transmission Assembly

1. Loosen flange nut with special tool take out the flange.



2. Remove clutch release device assembly.



3. Detach bearing cover of input shaft, check oil seal edge.



4. Detach the snap ring on input shaft with clip pliers.



5. Knock input shaft and detach input shaft assembly



6. Detach two bolts and spring washer combination on one side of clutch housing from front to back.



7. Turn transmission case over , detach control device assembly



8. Detach reverse switch. Detach all bolt and spring washer combination connecting clutch housing and main case



9. Detach rear bearing cover assembly and gasket



10. Take out speedometer driving gear and

bush



11. Loosen all bolts and spring washer combination around the rear cover housing , detach the assembly of bearing snap ring and spring washer for shaft at the rear end of left and right countershafts , steel wire retainer ring of rear bearing of main shaft and two bolts & spring washer combination with clip pliers.

12. Install two bolts into the screw holes , and make rear cover housing separate form main case then take it



13. Detach rear bearing of left/right countershaft with special tool.



14. Remove the bearing at end of the main shaft.



15. Remove the bolts and spring washer combination connecting the clutch housing and main case.



16. Remove the location plug and washer.



17. Install two bolts into screw hole as a carriage; remove the main case from the clutch housing.



18. Remove two location bolts of yoke frame.



19. Fix the main shaft, the countershaft and yoke frame together with iron wire, remove them from the clutch housing.



5.1.2 Disassembly the Yoke Frame

1. Remove location plug and washer.



2. Remove the spring cylinder pin on the 5/6 guide block.



3. Pull out the 5/6 guide block.



4. Extract 5/6 speed yoke bar



5. Take out the locking balls.



6. Extract 3/4 speed yoke bar and the locking ball.



7. Take out 1/2 speed yoke bar and the locking ball as way as the reverse speed.



8. Take out the inter-locking spring from the yoke frame.



9. Disassembly the yoke frame completely.



5.1.3 Disassembly the main shaft

1. Remove spring clip at the top of the main

shaft.

2. Remove the one friction compounding of
5/6 speed synchronizer.



3. Remove the snap ring on the synchronizer
hub



4. Remove the sliding sleeve of 5/6 speed
Synchronizer.



5. Remove the synchronizer hub with the puller.



6. Remove the spline gasket of 5/6 speed.



7. Remove the over speed gear.



8. Remove the fourth gear.



9. Extract the long hex key.



10. Detach the spline washer and the 3/4 speed synchronizer assembly.



11. Remove the spline gasket.



12. Remove the third gear.



13. Detach the spline gasket.



14. Remove the second gear.



15. Detach the spline gasket and the 1/2 speed synchronizer assembly.



16. Detach the spline gasket and the first gear.



17 Remove the spline gasket and the sliding sleeve of the reverse speed.



18. Remove the spline gasket and the reverse gear.

19. Remove the baffle plate of the reverse gear.



5.2 Assembly the 6 DS 50T Transmission

5.2.1 Assembly Yoke Frame

1. Place the York frame on the work bench, and put four inter-locking spring into the holes



2. Insert 5/6 yoke bar into half of frame hole, make the inter-lock ball to press the inter-lock spring with a tool, rotate yoke bar and push it through the frame with the flat side downward.



3. Assemble reversing guide block of 5/6 speed, smash into spring cylinder pin.



4. Assemble guide block of 5/6 speed, smash into spring cylinder pin



5. Assemble two inter-lock balls



6. Put yoke bar through the block

5/6 speed, assemble support shaft pin into yoke bar of 3/4 speed.



7. Assemble lock-in ball, and push yoke bar of 3/4 speed in place.



8. Rotate the yoke bar to expose inter-pin hole, assembly the inter-lock pin and turn the yoke bar of 3/4 speed back to the start position.



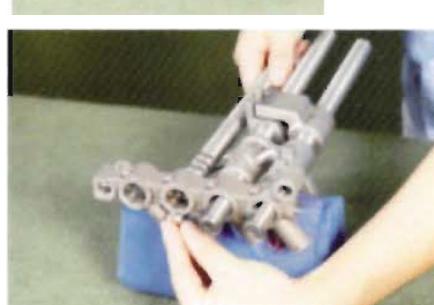
9. Assemble 3/4 speed yoke ,smash into spring cylinder pin.



10. Assembly two lock-in balls



11. Assembly inter-lock ball and push the yoke bar of 1/2 speed in place



12. Rotate the yoke bar to expose inter-pin hole, assembly the inter-lock pin and turn the yoke bar of 1/2 speed back to the start position.



13. Assemble the 5/6 speed yoke and guide block of the 1/2 speed, smash into spring cylinder pin. Assemble the 1/2 speed yoke and smash into the spring cylinder pin.



14. Install two inter-lock balls



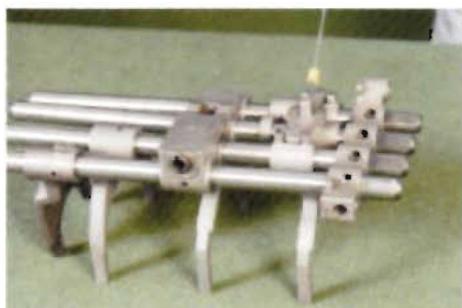
15. Install the inter-lock ball, and push the

yoke bar of reverse speed in place.

16. Install the reverse guide block, and then smash into the spring cylinder pin. Install the reverse speed yoke bar and then smash into the spring cylinder pin



17. Assemble swing block, now the yoke frame subassembly is completed.



5.2.2 Assembly main shaft and transmission

Assembling the main shaft and transmission operates just to following the reverse procedure of the disassembly of main shaft and transmission .Please refer to chapter5.1.1, 5.1.2

5.3 Assembly 6DS 180T Transmission

5.3.1 Assembly Main Shaft

1. Put main shaft onto the bench, with big end downward, cylindrical roller bearing of main shaft head can be pre-installed.



2. Put spline gasket with flange side upward onto the third gear groove from downward of main shaft. Rotate one teeth distance and make the straight of groove inside and outside, insert a long hex key through the spline gasket in the place.



3. Mount the 1/2 synchronizer compounding, then install a snap ring.

Note: aperture of snap ring aims at the hex key.



4. Mount the gear hub of the 1/2 speed synchronizer.

Note: Wide groove aims at the hex key



5. Install a snap ring on another side of gear ring.



6. Mount the friction compounding of the

synchronizer.

7. Put spline gasket with flange side downward onto the corresponding groove .Rotate one teeth distance and make the straight of groove inside and outside, then push a hex key upward.



8. Mount the second gear on the main shaft with meshing teeth downward.



9. Mount the space on the main shaft, rotate one teeth distance and insert a hex key in place.



10. Mount the third gear on the main shaft with meshing teeth upward.



11. Put spline gasket onto the corresponding groove .Rotate one teeth distance and then push a hex key upward.



12. Mount friction compounding of the 3/4 synchronizer.



13. Install a snap ring in place.

Note: aperture of snap ring aims at the hex key.



14. Mount the synchronizer hub and another snap ring.

Note: aperture of snap ring aims at the hex key.



15. Mount the spring cylinder pin into the hole.



16 Mount the friction compounding of the 3/4 speed synchronizer on the main shaft.



17. Install the spacer on the main shaft with aperture of space aims at the pin hole; insert the hex key to the bottom of spacer.



18. Mount the fourth gear on the main shaft with meshing teeth downward.



19. Mount the space on the main shaft, rotate one teeth distance and insert a short hex key downward in place.



20. Install the override gear onto the shaft with meshing teeth upward.



21. Mount a snap ring on shaft in place.



22. Mount the friction compounding of the 5/6 speed synchronizer on the main shaft with interior meshing teeth on the main shaft.



23. Mount the synchronize hub of the 5/6 speed onto main shaft.



24. Install the snap ring onto the main shaft.



25. Mount the friction compounding of the 5/6 speed synchronizer on the main shaft with external meshing teeth on the main shaft



26. Mark on any pairs of symmetry groove

and tooth top of the first gear.

27. Sub-assembly of main shaft has been finished. The rest components will be used for assembling transmission assy.

Note:

The clearance of main shaft gears can be ensure by machining precision, free from adjustment.



5.3.2 Assembly 6 DS 180 T Transmission

1. Mark the teeth aiming at the square key groove of the two countershafts before assembling.



2. Mark on any pairs of symmetry tooth groove on the input shaft.



3. Put the transmission case vertically on the bench, mount left ,right and reverse countershaft in place.



4. Put the countershaft into the bottom of cavity, have the mark on the driver gear aim at the bearing hole of input shaft.



5. Put another countershaft into another side cavity, and have the mark on the driver gear aim at the bearing hole of input shaft.



6. Put the main shaft in place.

Note:

Lifting the countershaft can reduce the difficult to install the main shaft.

Fixing 5/6 speed synchronizer with self-made tool will prevent the compounding from falling off.



7. Mount the input shaft in place.



8. Mount the gasket and bearing cover onto the main shaft, aligned with oil return hole and avoid damaged the oil sealer.



9. Adjust the position among the shafts, ensure the bearing at front end of the main shaft in the place and 5/6 speed synchronizer meshes with input shaft gears properly.



10. Mount the first gear of main shaft in

place.

11. Mount the spline gasket onto the rear end of main shaft, insert the short hex after rotating one tooth distance.



12.Put sliding bush of main shaft in place, make wide groove aim at hex key, mount main shaft.



13. Extract short hex key.



14. Mount reverse gear and baffle plate on the rear end of main shaft in place respectively.

Note: mount short hex key and long hex key into the same tooth groove(the spline gasket at the rear end of the first gear 6DS 130T is replaced by spacer).

15. Mount thrust washers of left countershaft, right and reverse countershafts respectively.



16. Mount two cylindrical roller bearings without external ring respectively.



17.Slightly lift two countershaft and main shaft and adjust the position .the mount the gears of two countershafts and reverse countershaft in place with groove surface outward respectively.



18. Mount lock washer and hex nylon locking nut and fasten the nut, tightening torque:240-260Nm.



19. Put the gasket of rear cover the rear contact surface of the case, then mount rear cover housing in place.



20. Mount ball bearing with groove and steel-wire retainer ring combination at the rear end of main shaft on the bearing hole aiming at rear cover in place.



21. Rotate input shaft gears ,make marked tooth groove on the left side mesh with driver gear of left countershaft ,ensure the marked the first gear of the main shaft mesh with marked gears left countershaft.



22. Knock rear bearing of left countershaft into the rear end in place , Put front bearing of left countershaft ,mount the gasket first with the words outward ,then knock it in place ,in the same way, timing the gears of the right countershaft and mount front and rear bearing.



23. rotate the input shaft, verify correct timing.



24. Put front baffle plate assembly of countershaft, gum anaerobic adhesive on the screw.



25. Fasten the bolts. Torque:122-162Nm.



26. Mount clutch housing gasket and clutch housing assembly onto end surface of front transmission case.



27. Fasten six fixing bolts, Torque: 108-135Nm, Then fasten six nylon nut, Torque: 220-240Nm, finally rotate input shaft by hands to check if rotated flexible and smoothly.



28. Put hex bolt and spring washer combination, gum the bolts of hole, then install rear cover housing and diagonally tighten the bolts. Torque:47.5-61Nm.



29.Put bearing cover gasket of main shaft on contact surface, aiming at oil return hole on.



30. Put rear bearing cover assembly of main shaft on contact surface of rear cover, aiming at oil return hole. Put a hex bolt with hole of head and locate it , mount five hex bolt and spring washer combination onto screw holes.



31. Diagonally tighten it in place. Torque: 47.5-61 Nm.



32. Put rear bearing cover gasket of countershaft on contact surface, aiming at screw hole.Put rear bearing cover of countershaft on the contact surface,with aperture toward main shaft. Fasten hex bolt and spring washer combination onto countershaft cover, Torque: 47.5-61Nm.

33. Mount driving gear of speedometer onto



the rear end of main shaft.

34. Shift two gears in main case.



35. Mount flange kit onto rear of main shaft, Tighten flange nut, shift the two gears off. Torque: 609-677Nm.



36. Check sliding bush of main shaft synchronizer and reverse speed in neutral position.



37. Put shift bar cover on the top of transmission case, mount shift bar assembly with yoke in neutral position in place



38. Mount five gummed hex bolt and spring washer combination into corresponding hole.



39. Mount lifting lug and hex hole and spring washer combination in place and diagonally tighten it; Torque :47.5-61Nm.



40. Put into four lock-in bolts.



41. Mount a thick lock-in spring with yellow mark on 5/6 speed position, and then mount three thin lock-in springs with green mark in place.



42. Mount gasket and operation assembly onto contact surface of shift bar.



43. Diagonally tighten two location nuts into cone-groove of operation housing ,the fasten rest nuts.



44. Finish assembly of transmission.



Update Record

Date	Section	Title	Update reason	Recorder
2014/03/31	All chapter		Renew the service manual	Jeffrey Lyu

TABLE OF CONTENTS

PART 1: CONSTRUCTION	2
1. General construction.....	2
2. Construction of horizontal bumper	3
3. Construction of disc brake	4
4. Construction of the hub assemble of the disc brake	5
PART 2: OPERATION AND MAINTENANCE	7
1. New front axle operation	7
2. Maintenance of axles.....	7
PART 3: CHECK, ADJUSTMENT AND REPAIR.....	8
1. Removal process	8
1.1. Removing the horizontal bumper	8
1.2. Removing the cacuum power booster and front brake bar	8
1.3. Removing the total of hub and removing the front hub.....	9
1.4. Removing the shunt articulation and swivel axis	10
2. Check and sanitation	11
2.1. Check.....	11
2.2. Sanitation.....	16
3. Assembling and adjusting	16
3.1. Assembling the front axle.....	16
3.2. Table of tightening force	19
4. Common problems.....	19
5. The components are easily damaged	21

PART 1: CONSTRUCTION

1. General construction

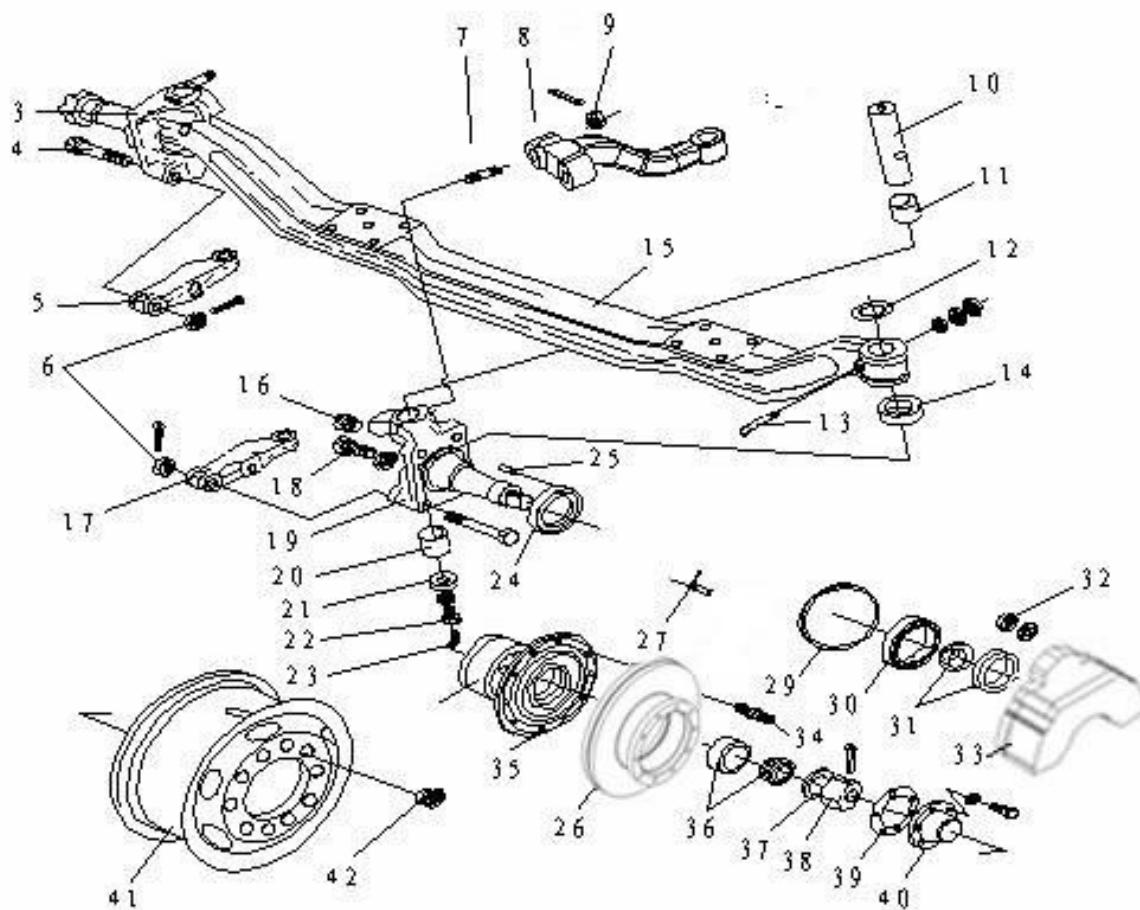


Figure 1-1. General construction of the front axle.

No.	Name of the component	No.	Name of the component	No.	Name of the component
3	Right shunt articulation	16	Oil thrust bolts	30	Total of oil seal of front hub
4	Bolt	17	Left shunt bar	31	Total of oil seal in the hub
5	Right shunt bar	18	Steering angle limit bolts	32	Nuts
6	Milled nut	19	Left shunt articulation	33	Front shoe brake
7	Stud bolt	20	Below rubber	34	Bolts of left/right disc wheel

No.	Name of the component	No.	Name of the component	No.	Name of the component
8	Bumper pitman arm	21	Sealing plug	35	Hub assemble of axle
9	Milled nut	22	Bolts	36	Ball-bearing outside hub
10	Main pintle of shunt articulation	23	Lubricant fitting	37	Side plate
11	Upper rubber	24	Carrying ring of front oil thrusting plate	38	Milled nut
12	Side plate of shunt articulation	25	Round cylindrical pin	39	Sealing washer
13	Lock plug	26	Front brake disc	40	Hub cover
14	Thrust ball-bearing	27	Sensor ABS	41	Total of front cylinder
15	Front axle	29	Ring gear ABS	42	Disc rawlplug

2. Construction of horizontal bumper

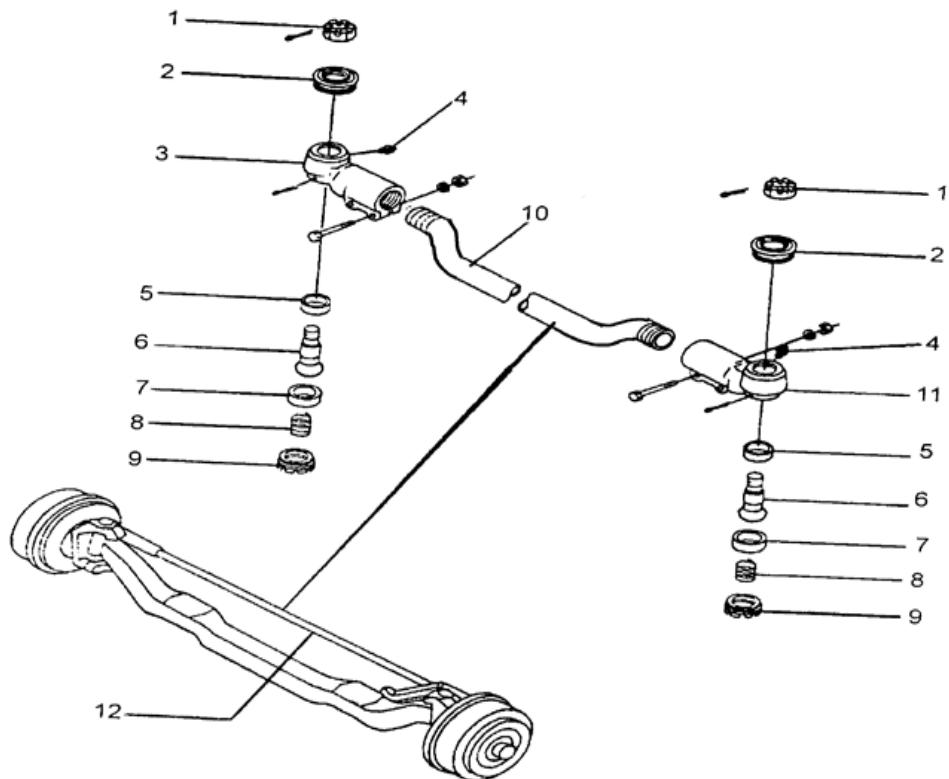


Figure 1-2. Construction of horizontal shunt brake.

No.	Name of the component	No.	Name of the component	No.	Name of the component
1	Milled nut	5	Upper cover	9	Sealing plug
2	Total of shaft sleeve	6	Tie rod pin	10	Horizontal spar
3	Total of right tie rod head	7	Below cover	11	Total of left tie rod head
4	Lubricant fitting	8	Cylindrical springs	12	Total of horizontal bumper

3. Construction of disc brake

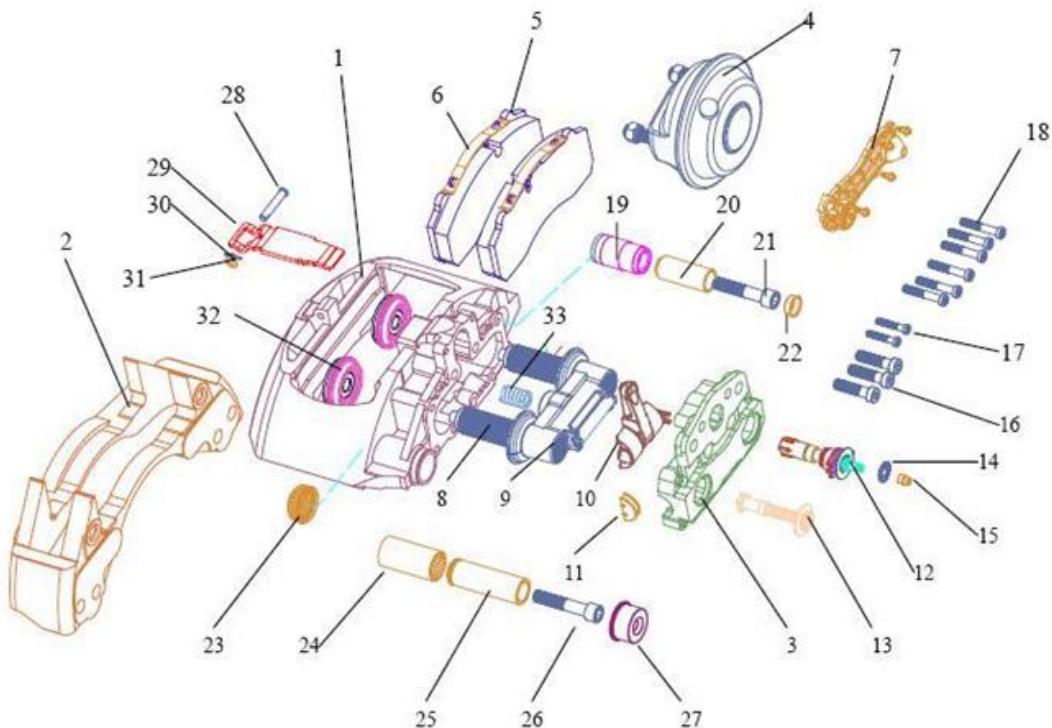


Figure 1-3. Construction of disc brake.

No.	Name of the component	No.	Name of the component	No.	Name of the component
1	Left right front shoe brake	12	Total of controller	23	Cover of king rod
2	Cover of shoe brake	13	Total of passive self-regulation mechanism	24	Copper washer
3	Manhole cover of left right front shoe brake	14	Active connecting wheel	25	King rod
4	Left right cacuum power booster	15	Momen protection plate	26	Long king rod bolts
5	Brake pads	16	Bolts I	27	Cover
6	Spring of brake pad	17	Bolts II	28	Lock shalf
7	Shaft sleeve of automatic controller	18	Bolts III	29	Sheathing sheet of brake pad
8	Controller	19	Total of shell	30	Plug
9	Rigging screw base	20	Short plug	31	Washer
10	Bearing bar	21	Bolts of short plug	32	Stirrup
11	Rubber sealing plug	22	Short plug cover	33	Return spring

4. Construction of the hub assemble of the disc brake

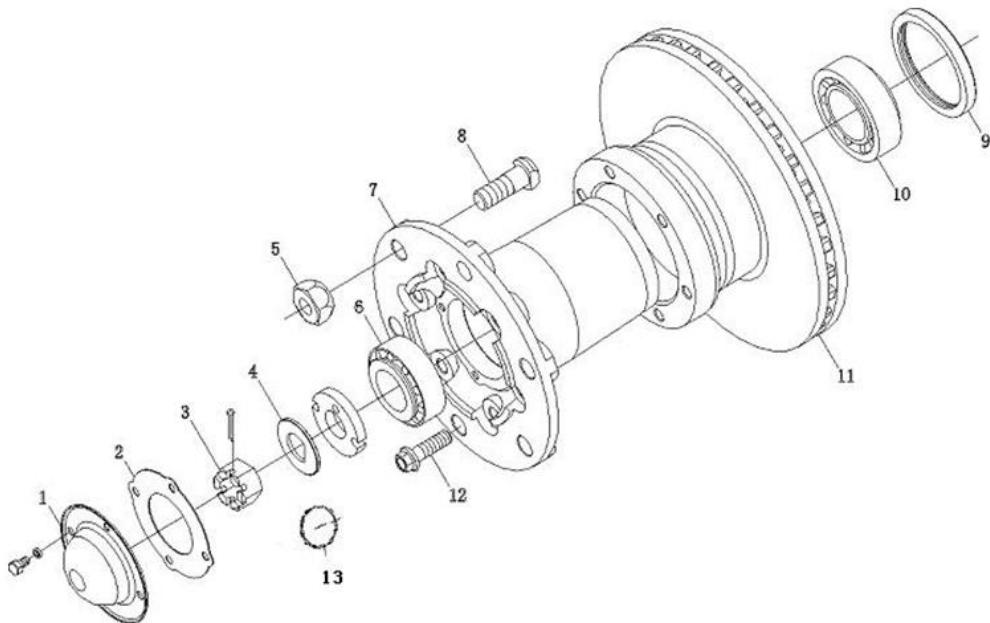


Figure 1-4. Construction of disc brake hub.

No.	Name of the component	No.	Name of the component
1	Cowl of the front burner	8	Disc bolts
2	Waterproof washer	9	Total of oil seal of front hub
3	Bolt nut of slot	10	Inner ball-bearing
4	Abrasion reducing plate	11	Brake disc
5	Bolt nut of disc	12	Bolts tightening brake disc
6	Outer ball-bearing	13	Thread sensing front axle
7	Hub		

PART 2: OPERATION AND MAINTENANCE**1. New front axle operation**

- 1.1. Before putting it into use, it is necessary to add lubricating oil to the reducer and add the oil fully to the lubricant fitting on the axle.
- 1.2. After using the new axle, it is necessary to pass the running-in of 1500km and adjust the brake gap. Checking the tightness of the bolts, nuts (except the adhesive bolts).

2. Maintenance of axles

- 2.1. Each time operating 2000km: need to add oil into lubricant fitting.
- 2.2. Each time operating 8000-10000km: check the tightening status of brake bases, loose status of hub ball bearings, abrasion status of brake pads. If the brake pads wear out of the limit or concave, it is necessary to renew, check the quality of the gear oil in the axle cover. If it is deformed or too loose, replace the new oil. Check the loose status of the tie rod in the horizontal bumper, check the tightening status of wheel disc bolts .
- 2.3. Checking the brake pads adjustment handle jack: each time operating 2000km, turn the hexagonal head of the handle jack to adjust the brake gap counterclockwise and measure the torque (repeat measurement 3 times). If the torque value is less than 18N.m, it means that the handle jack to adjust the brake pad's gap has been damaged and needs to be replaced promptly.
- 2.4. Each time operating 20000-25000km: need to replace oil for the ball-bearing.
- 2.5. Failure to periodically check the vehicle means refusal of warranty from the supplier.

➤ Some notes with the axle:

- 1) Prohibit the use of excessive load according to the vehicle axle design.
- 2) Prohibit the use of the axle with errors.
- 3) Prohibit arbitrarily removing the defective axle.
- 4) Prohibit changing the structures or specifications of the axle.

PART 3: CHECK, ADJUSTMENT AND REPAIR

1. Removal process

1.1. Removing the horizontal bumper

- 1) Removing the cotter key on the nut connecting the tie rod head with the shunt bar.
- 2) Removing the horizontal bumper.
- 3) Removing the bolt connecting the head and the horizontal bumper bar.
- 4) Removing the tie rod assemble.
- 5) Removing the cotter key in the tie rod assemble, removing the slot bolt and other components (removal process as shown in Figure 5-1).

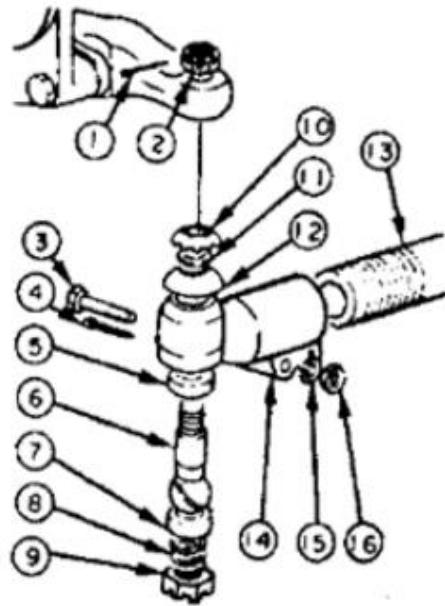


Figure 3-1. Removal process

1.2. Removing the cacuum power booster and front brake bar

- 1) Pulling out the cotter key on the plug connecting the cacuum power booster, pulling out the plug connecting the cacuum power booster and brake bar, removing the cacuum power booster and cacuum power booster base (Figure 3-2).
- 2) Removing the washer, bolts connecting between positioned bracket and brake bar (Figure 3-3).
- 3) Removing the washer and bolts positioned on the camshaft (Figure 3-4).
- 4) Using the 12 spanner to remove the bolts on the brake bar counterclockwise (due to the large tightening force, there will be a clattering sound). Then, removing the brake bar (Figure 3-5).



Figure 3-2



Figure 3-3



Figure 3-4



Figure 3-5

1.3. Removing the total of hub and removing the front hub

1) Removing shoe brake

- Removing the cacuum power booster (Figure 3-6).
- Removing the bolts connecting the shunt articulation and shoe brake (Figure 3-7).



Figure 3-6

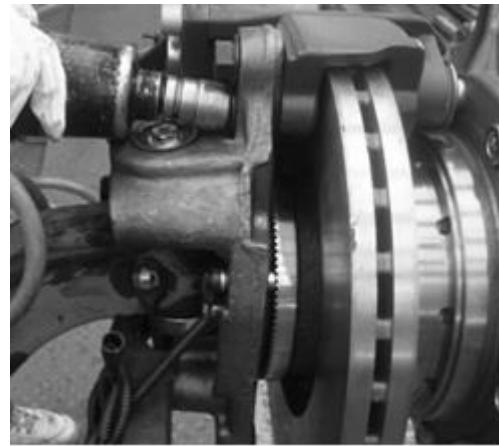


Figure 3-7

2) Removing the axle hub assemble

- Removing the cover of the ball bearing cowl (Figure 3-8).
- Removing washers, rivets, cotter keys, etc. (Figure 3-9).
- Removing the outer ball-bearing of the hub (Figure 3-10).
- Removing the hub and total of shoe brake, removing the inner ball-bearing (Figure 3-11).

➤ **Note: The cylinder is very heavy so it takes 2 people to work together to ensure safety.**

- Using the hoist to hoist ball-bearing and brackets.



Figure 3-8



Figure 3-9

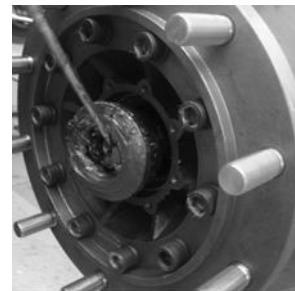


Figure 3-10

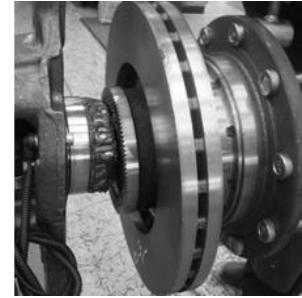


Figure 3-11

3) Removing other parts

- Loosening the bolts connecting hubs with brake discs .
- Removing the total of oil seal of the hub.

➤ **Note: Normally, the removed oil seal will not be reused.**

- Then, finding the missing position on the hub and removing the 2 ball bearings.
- Removing the ABS washer.

1.4. Removing the shunt articulation and swivel axis

- 1) Removing the brake bar (Figure 3-12).
- 2) Removing the sealing plugs and other components on the main pintle.
- 3) Loosening the nut positioning the swivel axis with the axle beam until the outside of the bolt nut is equal to the outside of the axle beam (Figure 3-13).



Figure 3-12.

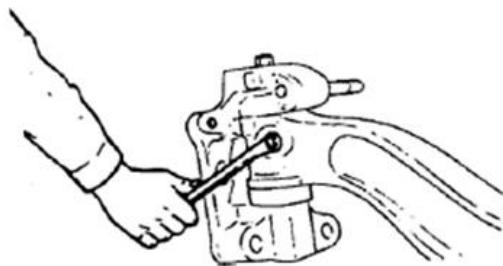


Figure 3-13.

- 4) Using a copper hammer to beat the nut, loosening the swivel axis position plug.
- 5) Removing the nut and the swivel axis position plug.
- 6) Using copper hammers and copper sticks to remove the swivel axis (Figure 3-14).
- 7) Removing the shunt articulations and the washers (Figure 3-15& 3-16).

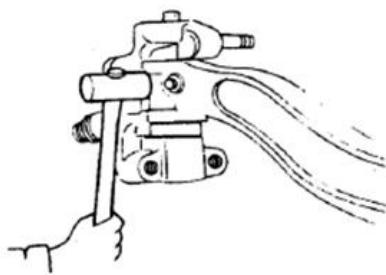


Figure 3-14.

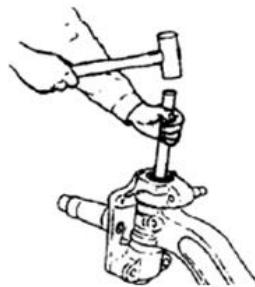


Figure 3-15.

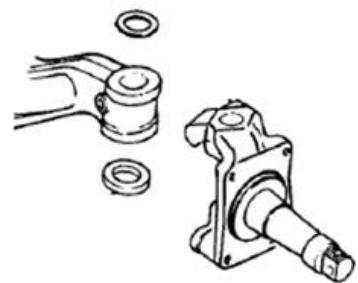


Figure 3-16.

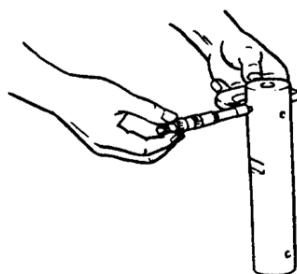
2. Check and sanitation

2.1. Check

Before cleaning the components, it is necessary to use a check tool. Based on the repair requirement that determine whether the component can continue to be repaired. Damaged components need to be repaired or replaced as required. If one of the two components interconnected is severely damaged, the gap between the two pieces is too large, according to the actual situation to replace one of the two components. The check method is as follows:

2.1.1. The main plug and shunt articulation

- a) Checking the outer diameter of the swivel axis, if the outer diameter is smaller than the limit, renew it (Figure 3-17).



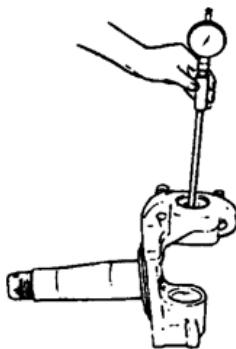
The right size: $\varnothing 52$

Wear limit: $\varnothing 51.9$

Tool: caliper

Figure 3-17.

- b) At some different points, the outer diameter of the swivel axis and the inner diameter of the bushing are of medium diameter. When the difference in average diameter is greater than the wear limit, it is necessary to replace the swivel axis or bushing (Figure 3-18).



Repair standard: 0.01~0.10mm

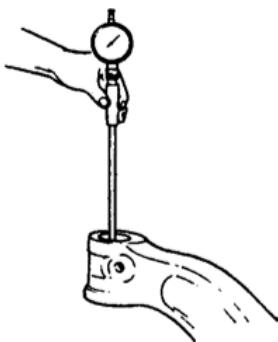
Wear limit: 0.20mm

Tool: caliper

Figure 3-18.

2.1.2. Main swivel axis bush of front axle

On the plane perpendicular to the front axle, measure the inner diameter of the bushing at several locations. If the gap between the swivel axis and the bushing is greater than the wear limit, or if the bushing is misaligned, repairing, increasing the swivel axis's diameter (Figure 3-19).



Repair standard: 0-0.04mm

Wear limit: 0.15mm

Tool: caliper

Figure 3-19.

2.1.3. Curved and twisted deformation of the front axle

- Putting the front axle on the repair table, using installation surface of the air suspension base to make the standard surface.
- Using a rope to hang a heavy object so that the 2 ends of the thread enter the 2 holes of the swivel axis, checking whether the straight line connecting the center of the hole at the position installing air suspension base coincides to the rope, if it does not coincide, it means that the axle must be bent front or back. Checking the height of symmetrical positions on the axle to the rope, if the height does not match, it means that the axle has been deformed up and down (Figure 3-20).

- c) Looking from both sides, check whether the position of the two swivel axes coincides. At the same time, checking whether the two planes at the installing position of the air suspension coincide. If two swivel axes do not coincide with each other or the two planes at the installing position of the air suspension do not coincide (forming a vertical tilt angle of the axle), the axle is twisted (Figure 3-21).

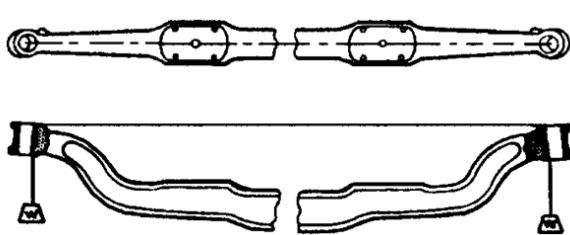


Figure 3-20.

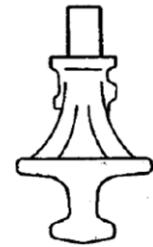
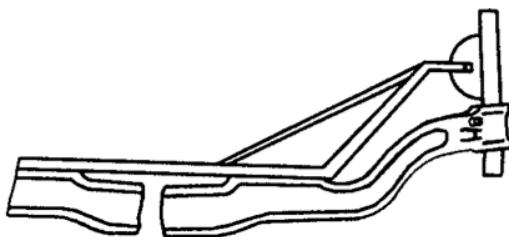


Figure 3-21.

2.1.4. Camber angle of swivel axis

Using a dedicated protractor and center plug to check as shown below. In the position of installing the air suspension base, placing the protractor so that the line in the protractor is parallel to the swivel axis, reading the number on the protractor. If the number on the protractor is not the same as the standard, the Camber angle is wrong or the swivel axis bushing is worn (Figure 3-22).



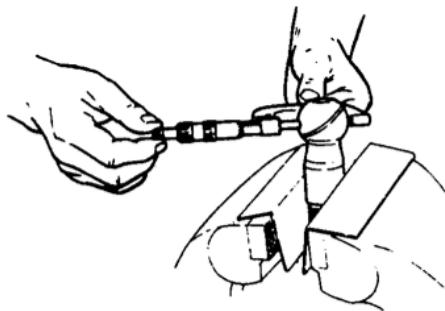
Standard camber angle: $7^\circ \pm 10'$

Tool: Protractor

Figure 3-22.

2.1.5. The tie rod head plug of horizontal bumper

If the tie rod head plug of horizontal bumper is loose or unusually worn, it is necessary to replace (Figure 3-23).



Wear limit: 37.5mm

Tool: caliper

Figure 3-23.

2.1.6 Front brake disc

a) Checking the thickness of brake pads and brake discs

A= disc brake thickness (completely new status), 45mm.

B= Disc brake thickness (after use) if $\leq 37\text{mm}$, need to be replaced.

C= 30mm brake pads thickness.

D= 9mm base plate thickness.

E= wear limit of friction plate. Limit 2mm.

F= wear limit of friction plate = thickness of base plate + minimum thickness of shims. 11mm.

Note:

- If the disc brake thickness is $\leq 39\text{mm}$, it is necessary to replace the brake disc, 37mm is the minimum thickness limit allowed.
- The brake pads are burnt, worn unevenly or stucked the lubricant, it must be replaced immediately.
- Replacing brake pads on the axle at the same time, it is not allowed to replace one side of the axle.

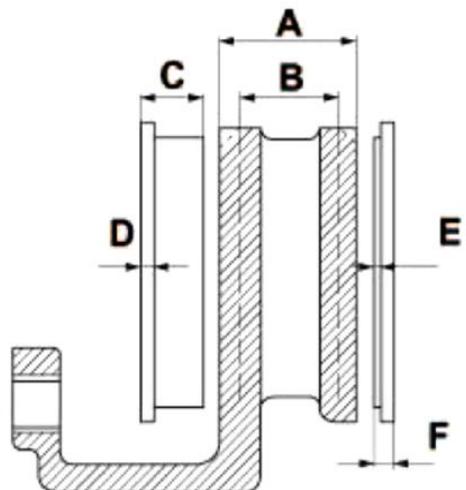


Figure 3-24

b) Checking the roughness of the brake disc surface (Figure 3-25).

a: Friction surface.

A1: Small scratches are acceptable.

B1: Scratches with depth or width less than 1.5mm are acceptable.

C1: Evenness below 1.5mm is acceptable.

D1: Scratches acrossing the surface are not acceptable.

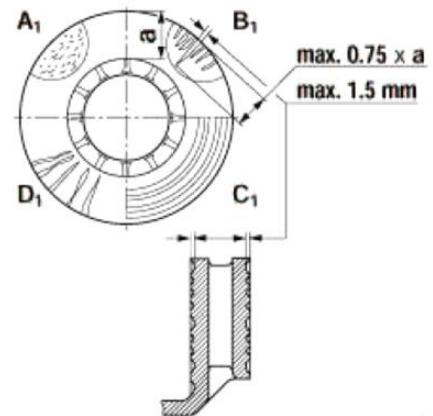


Figure 3-25

c) Hub

- Inner and outer ball-bearing are not worn.
- Whether the ball-bearing base is worn.

d) Checking whether the brake shoe slips normally.

Using the hand force (without the use of assistive devices) to push the shoe brake, if the shoe brake slips along the guide pin and the itinerary is greater than 30mm, then it is normal, otherwise it is necessary to change the short plug, long plug, etc. and related parts.

e) Checking the gap of brake pads and brake discs.

Pushing the shoe brake assemble inward, using the appropriate tool to separate from the push plate. Then measuring the distance of the base plate and push plate, the distance is within 0.7-1.2mm.

On the principle of maintenance and redundancy: every parts has a limit for repair or abrasion, it is necessary to renew it before the parts are damaged or abraded to the allowable limit..

All parts need to be through visual observation and infrared inspection. If abnormal signs are detected, conduct repair or replace as required.

After removing all rubber parts such as O-washer, oil seals, etc., it is necessary to check whether you can continue to use it.

Unusual cases			
Uneven adrasion	1 side adrasion	Deformation	Bent
Crack	Scratch	Discoloration	Rust
No matching	There are strange voices (ball bearings)	Weak or ineffective (springs)	Metamorphosis (brake pads)

2.2. Sanitation

Components can stick with oil or dust. Therefore, cleaning components is indispensable. Usually sanitation measures include washing with steam, gasoline, acid or alkaline solutions, neutral solutions, etc. In the process of cleaning may arise situations that the parts are damaged, so during the cleaning process should be carefully checked.

a) Metal

- Gasoline: gasoline for mud does not have permeability or solubility, it should be considered when using gasoline to clean metal surfaces, using a brush or other tool to remove mud, and then wash twice.
- Alkali: using alkaline solution to handle cast iron or cast steel surface. If the material is made from an alloy, do not use alkaline solution to handle.

b) Rubber components: Can not use fossil oil, can use alcohol to clean, can also use clean cloth to wipe.

c) Anti-rust: After cleaning the oil on the surface of the component, adding clean oil to prevent rust.

3. Assembling and adjusting

The front axle assembly procedure is opposite to the removal process, but pay attention to the tightening force..

3.1. Assembling the front axle

3.1.1. Assembling the shunt articulation and swivel axis

1) Adding the oil into the thrust ball-bearing.

- 2) Temporarily assembling the shunt articulation, washer, thrust ball-bearing (Figure 3-26).

Note: Thrust ball-bearings of small parts need to be facing towards the front axle.

- 3) Measuring the distance from the shunt articulation to the front axle, selecting the appropriate washer, ensuring the gap from 0.05-0.15mm (Figure 3-27).

Note: Washer can only use 1 piece, there are a total of 8 types of washer: 2.1-2.8mm.

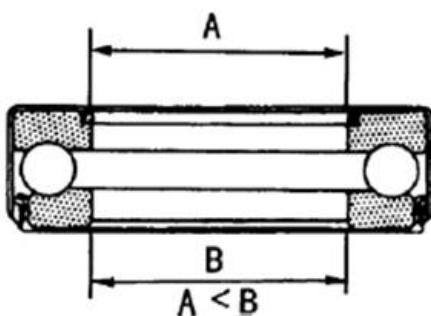


Figure 3-26.

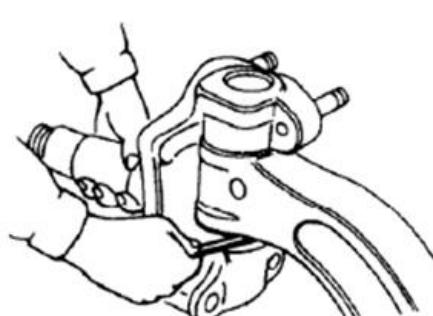


Figure 3-27.

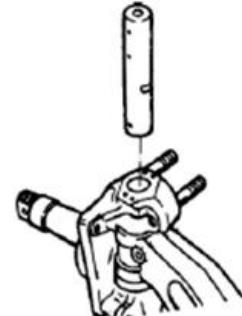


Figure 3-28.

- 4) Adding a thin layer of lubricant on the swivel axis.
- 5) Installing the swivel axis, adjusting the position (Figure 3-28).
- 6) Installing positioning plug and assemble of washer, nut (Figure 3-29).
- 7) Using a measure of the pull force at the free end of the shunt articulation (Figure 3-30).
- 8) Installing limited bolts (Figure 3-31).

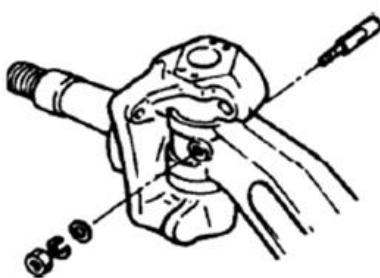


Figure 3-29.

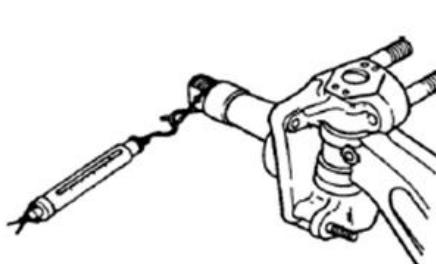


Figure 3-30.

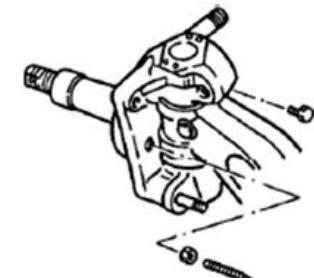


Figure 3-31.

- 9) Installing oil thrust seal and other parts under the swivel axis.
- 10) Installing the nut and the cotter key into place.

3.1.2. Installing the total of vertical steering pitman arm, bearing, cacuum power booster

- 1) First, installing the stud bolt. After that, installing the bumper pitman arm. Finally, installing the milled nut and cotter key.
- 2) Installing cacuum power booster base on the shunt articulation, installing the washers and nuts.
- 3) Installing cacuum power booster on the base.

3.1.3. Installing the brake assemble and hub

- 1) Installing the oil seal on the shunt articulation.
- 2) Installing the inner ball-bearing on the shunt articulation.
- 3) Adding the lubricant on the empty position in the hub.
- 4) Installing the brake assemble and hub.
- 5) Installing the brake assemble and hub on the shunt articulation.
- 6) Using specialized tools to install ball bearings.
- 7) Adjusting the tightening force.

3.1.4. Installing automatic brake bar

- 1) Adding the lubricant to the camshaft, installing the brake bar on the camshaft. Making sure the direction of the brake bar is in the right direction. Tightening the nut in a clockwise direction, so that the brake bar fits into the U-head of the cacuum power booster. Adding the lubricant to the round lock, installing the nut and cotter key.
- 2) Pushing the brake bar in the direction of the upward arrow until it cannot be pushed anymore. The goal is to ensure the gap of the brake pads and brake discs is consistent with the design. Then installing the positioning base to the camshaft outer cover, on the positioning base, install the washer, position and tightening the bolts (via U-shaped bolts and stud bolts, tightening force is 20-30N.m) .
- 3) Installing the washer, nut on the camshaft. Checking the handle jack position to adjust the gap of the brake pads that is within a certain gap, requiring a gap of 0.5-1 mm. If the deviation is larger, removing the brake bar and readjusting the camshaft until it is satisfactory, and finally locking the cotter key.

4) Using the 12 spanner to tighten the nut on the brake bar clockwise until it cannot be tightened anymore. At this time, the brake discs and brake pads are contact. Then twisting it back 270° (due to the large tightening force, there will be a clattering sound). The goal is to ensure the axle can operate and not be rubbed. Requirement for gap is from 0.5-0.8mm.

3.1.5. Adjusting the toe-in of the front wheel.

- 1) First, loosening the fixed positions on the horizontal bumper.
- 2) Turning the horizontal spar that the toe-in of the wheel is from 0-2mm .
- 3) Tightening the fixed position while the deflection angle is not more than 4°.

3.1.6. Adjusting the ABS system

When installing the ABS sensor to the sensor base, make sure that the sensor is left out of the base. After installing, the lubricant oil on the ABS sensor should be cleaned if available.

3.2. Table of tightening force

Bolt-nut	Value (N.m)	Bolt-nut	Value (N.m)
Nut connecting between the head and horizontal track rod	25-40	Nuts of handle bar	350-450
Cowl nut of swivel axis	60-80	Nuts of brake pad's base	160-210
Steering angle bolts	80-100	Bolts of brake bar sheathing sheet	140-180
2-head bolts	100-140	Bolts, brackets of brace	20-30
Bumper nuts	280-350	Adjustment nuts	180-220
	100-140	Nuts of tie rod head	250-310
Cacuum power booster adjustment bolts	140-180	Nuts of binding screw clamp	70-80

4. Common problems

Problem	Reason	Solution
Ball bearing is	Rotation force of ball bearing is large	Readjusting

hardened	Lack of oil or wrong type of oil	Pumping extra oil or changing oil
	Dirt sticks to ball-bearings	Cleaning and pumping oil
Problem	Reason	Solution
Braking force is not enough	Camshaft is not flexible	Checking the camshaft, if necessary, replacing the camshaft, checking the ball-bearings for lack of oil
	The cacuum power booster is not enough itinerary	Adjusting itinerary
	The brake pads are too hot or deformed	Replacing the brake pad
	The brake pad contact is not enough	Adjusting the contact position
Braking force is not enough	The cylinder sticks to the water	When running, lightly brake, discharge the water.
	There is oil between the cylinder and brake pads	Cleaning oil and replacing brake pad
Brakes made a sound	Brake pads are worn	Replacing brake pad
	The brake pad surface is hard and metamorphosed	Replacing brake pad
	The hub is worn unevenly or the installation is uncertain	Adjusting the hub, tightening the bolt
	The base of the friction plate on the brake pads and friction pads are not tight	Tightening the bolt
	The brake pad bases are loose	Tightening the bolt
	The ball-bearing shalf of the burner is worn	Replacing the new ball-bearing
	The hub is deformed	Replacing the hub
Wheel is worn	The camshaft has no oil or brake arm is not returned	Repairing damaged parts
	Brake bases or return springs of the cacuum power booster are damaged.	Renewing
Driving heavily,	The position of the toe-in angle is not correct (wrong camber angle)	Readjusting

the front axle may be damaged	Gap of the swivel axis and bush is large	Readjusting the gap
	Reverse installation of thrust ball-bearing	Reinstalling
	Lack of slippery	Adding oil
	Tie rod is too hard or too loose	Checking the oil of tie rod
The guide wheel is vibrated	Ball-bearing is worn	Replacing ball-bearing
	Gap of the swivel axis and bush is large	Checking the parts or renewing
	Swivel joint is deformed	Replacing swivel joint
	The wheel position is not correct	Checking and repositioning
The vehicle is deflected to the left or right	The wheel position is not correct	Checking and repositioning
	The front axle is curved	Adjusting or changing axle
	Brake is loose	Referring to the brake system
	Wheel bolts are loose	Re-checking the tightening force according to the standard
Tire is worn unevenly or quickly	The wheel position is not correct	Checking and repositioning
	Ball-bearing is damaged or bolt is loose	Changing the ball-bearing, re-checking the tightening force
	The steering tie rod head is too tight or too loose	Re-checking, if necessary, renewing

5. The components are easily damaged

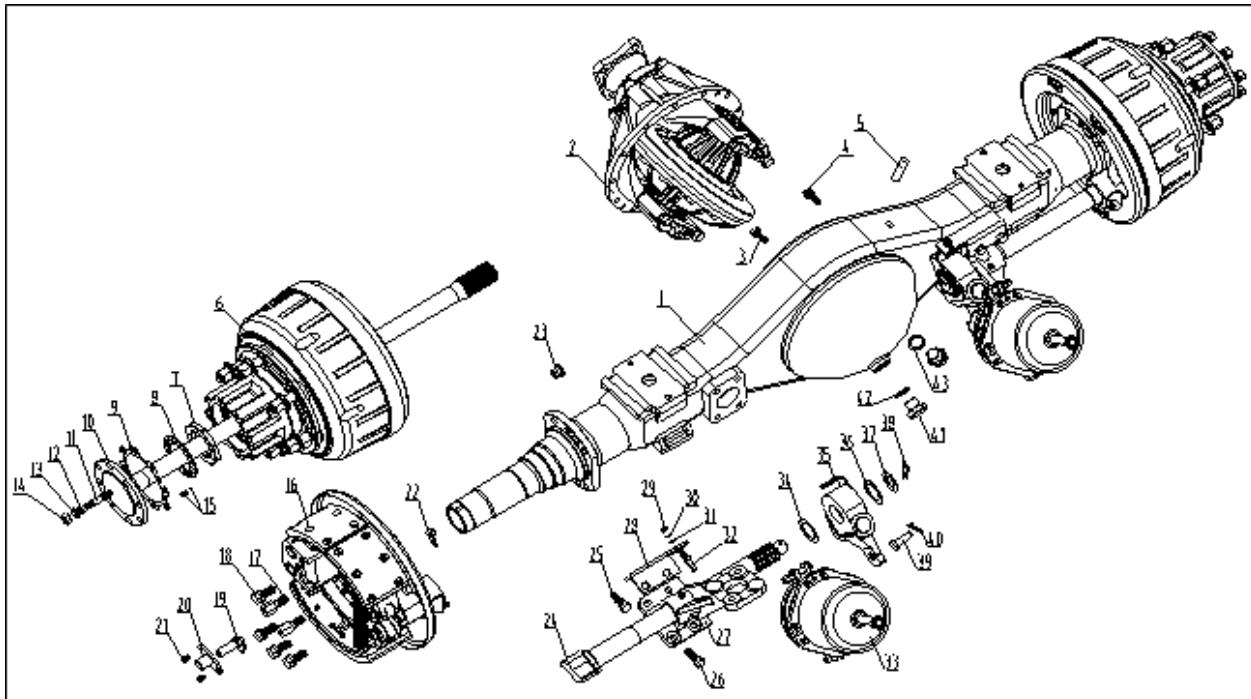
No.	Name	Quantity
1	Brake pads	8
2	Rivet – Brake pads	80
3	Ball-bearing inside the hub	2
4	Ball-bearing outside the hub	2
5	Thrust ball-bearing	2
6	Oil seal	2
7	Washer	2
8	Front brake	2
9	Shaft sleeve and base of brake plate	8

TABLE OF CONTENTS

PART 1: CONSTRUCTION	2
1. General construction.....	2
2. Brake assemble	4
3. Hub and drum assemble	5
4. Different assamble.....	6
PART 2: OPERATION AND MAINTENANCE	8
1. Using new axles.....	8
2. Maintenance of axles.....	8
PART 3: CHECK, ADJUSTMENT AND REPAIR.....	9
1. Removal process	9
1) Removing axle cover and brake assemble.....	9
2) Removing the axle core	11
3) Removing the differential.....	11
4) Removing the brake pad's gap adjustment handle jack.....	12
2. Check and sanitation	13
1) Check.....	13
2) Sanitation.....	14
3. Assembling and adjusting	14
3.1. Table of tightening force	14
3.2. Location using sealant glue	15
3.3. Adjustment of axle	15
3.4. Repair standard.....	16
PART 4: COMMON PROBLEM S.....	18
PART 5: THE COMPONENTS ARE EASILY DAMAGED	21

PART 1: CONSTRUCTION

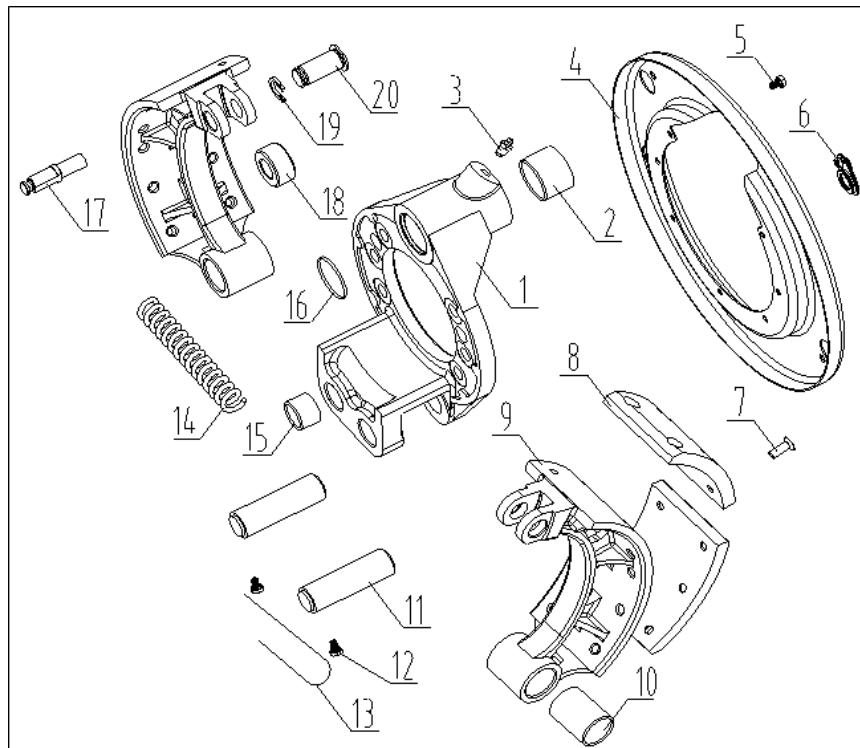
1. General construction



No.	Name of the component	No.	Name of the component	No.	Name of the component
1	Axle sleeve	16	Back brake assemble	31	Washer
2	Axle core	17	Bolt- side plate and ABS	32	Fixed adjustment axle
3	Stud fixed the axle core	18	Hexagonal bolts	33	Right/ left locker brake chamber
	Nuts		Lock washer	34	Camshelf adjustment washer
	Lock washer	19	Sensor ABS	35	Brake pad's gap adjustment handle jack
4	Bolts	20	Fixed base ABS	36	Adjustment washer
	Lock washer	21	Hexagonal bolts	37	Washer outside

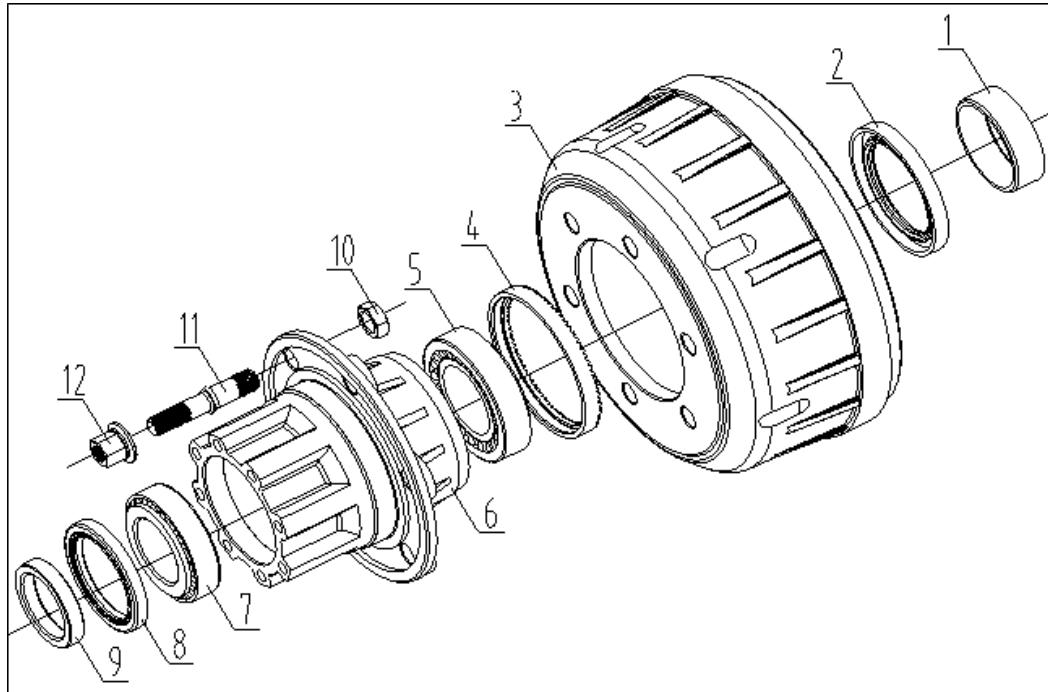
5	Breather plug		Lock washer	38	Split key
6	Left rear-hub and drum	22	Single catch	39	Piston pin
	Right rear-hub and drum		Hexagonal bolts		Washer
7	Nut to adjust the ball bearing of the hub	23	Vehicle speed sensor cowl	40	Split key
8	Lock washer	24	Right/ left camshaft	41	Plug to close the oil hole
9	Half-shaft paper washer	25	Hexagonal bolts	42	Sealing pad of sealing plug
10	Half-shaft		Lock washer	43	Oil discharge plug
11	Half-shaft bolts	26	Hexagonal bolts		Adjustment of washer
12	Cone cowl of half-shaft bolts		Lock washer		
13	Lock washer	27	Right/left back base of locker		
14	Hexagonal nuts	28	Right/left base of fixed adjustment handle jack		
15	Hexagonal bolts	29	Nuts		
	Lock washer	30	Lock washer		

2. Brake assemble



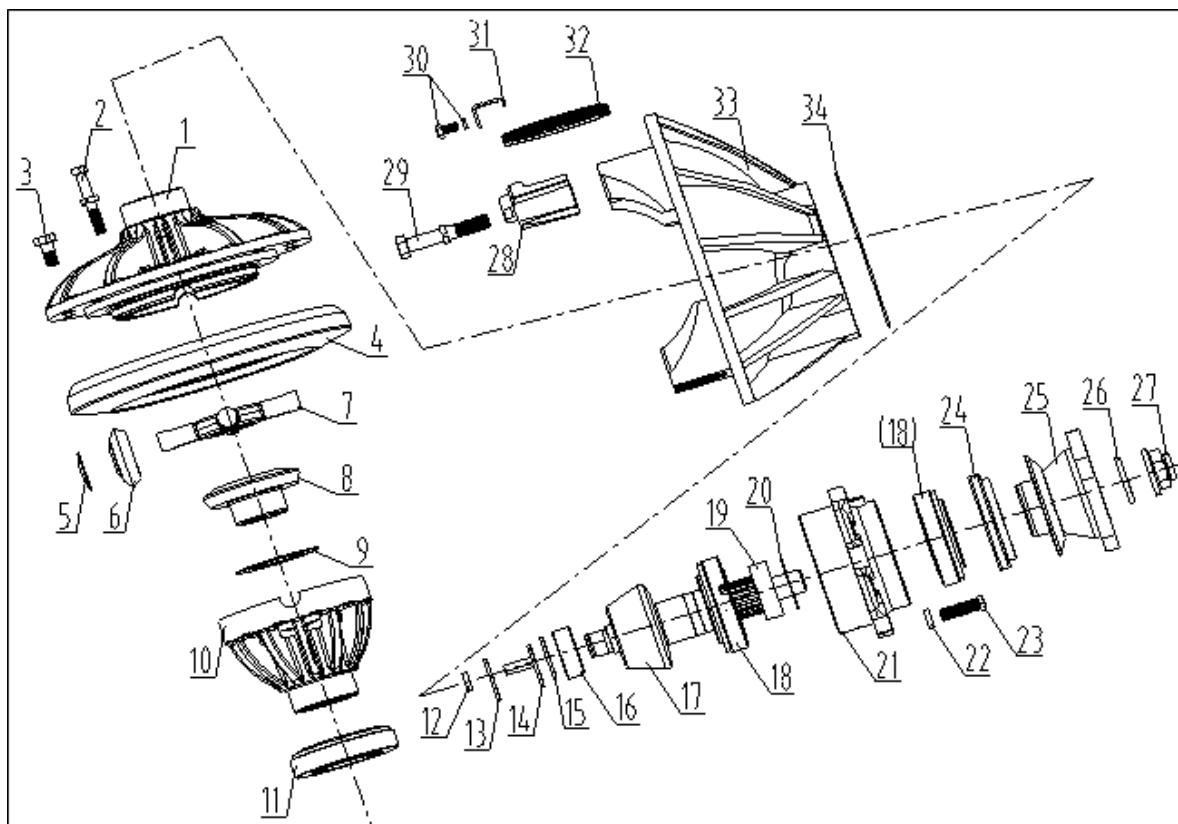
No.	Name of the component	No.	Name of the component
1	Base plate of back shoe brake	11	Axle of brake pads
2	Bushing- Base plate of back shoe brake	12	Brake pad fixed scre
3	Lubricant fitting	13	Lock cord
4	Dust shields cowl for rear brakes	14	Retun spring
5	Hexagonal bolt	15	Bushing of brake lining
	Lock washer	16	Seal ring
6	Dust-proof observation hole sealing plug	17	Return pin
7	Rivet		Nut
8	Rear brake friction plate	18	Ball-bearing
9	Brake lining	19	Lock washer
10	Bushing of brake lining	20	Ball-bearing

3. Hub and drum assemble



No.	Name of the component	No.	Name of the component
1	Inner oil seal base	8	Outer oil seal of the hub
2	Inner oil seal of the rear hub	9	Rear oil seal base
3	Rear drum	10	Drum fixed nut
4	Convolution ABS	11	Rear left wheel bolts
5	Bearing cone		Rear right wheel bolts
6	Hub	12	Left inner nut of the right rear wheel
7	Bearing cone		Right outer nut of the right rear wheel

4. Different assamble



No.	Name of the component	No.	Name of the component	No.	Name of the component
1	Left cover of the differential	13	Thrust strip	27	Driving gear nut
2	Hexagonal bolt	14	Thrust strip	28	Ball-bearing cover
	Lock washer	15	Clamp	29	Hexagonal bolt
3	Bolt	16	Ball-bearing for guiding the driving gear		Lock washer
4	Driven gear	17	Driving gear	30	Bolt
5	Washer of epicyclic gear	18	Ball-bearing of driving gear		Lock washer
6	Epicyclic gear	19	Thrust bearing of driving ball - bearing	31	Left/right adjustment locknut

7	Cross axis	20	Driving gear ball- bearing adjustment washer	32	Different adjustment nut
8	Half-shaft gear	21	Ball-bearing base	33	Different assamble cover
9	Washer of half-shaft gear	22	Lock washer	34	Driving gear adjustment washer
10	Left cover of differential	23	Hexagonal bolt		
11	Difference ball-bearing	24	Oil seal of driving gear		
12	Hexagonal nut	25	Flange		
	Lock washer	26	Driving gear fixed cowl		

PART 2: OPERATION AND MAINTENANCE

1. Using new axles

- 1.1. Before putting it into use, it is necessary to add lubricating oil to the reducer and add the oil fully to the lubricant fitting on the axle.
- 1.2. After using the new axle, it is necessary to pass the running-in of 1500km and adjust the brake gap. Checking the tightness of the bolts, nuts (except the adhesive bolts).

2. Maintenance of axles

- 2.1. Regular cleaning of mud and dirt, dust on axle vents.
- 2.2. Regularly check the oil discharge plug and filler opening, if leakage is detected, tighten it or replace the gasket, sealing gasket.
- 2.3. Each time operating 2000km: need to add oil into lubricant fitting, clean the vent button, check tighten the half-shaft bolts, check the gear oil height in the axle cover.
- 2.4. Each time operating 8000-10000km: check the tightening status of brake bases, loose status of hub ball bearings, abrasion status of brake pads. If the brake pads wear out of the limit or concave, it is necessary to renew, check the quality of the gear oil in the axle cover. If it is deformed or too loose, replace the new oil

➤**Note: Replace oil for the first 8000km.**

- 2.5. Checking the brake pads adjustment handle jack: turn the hexagonal head of the handle jack to adjust the counterclockwise brake gap and measure the torque (repeat measurement 3 times). If the torque value is less than 18N.m, it means that the handle jack to adjust the brake pad's gap has been damaged and needs to be replaced promptly.

PART 3: CHECK, ADJUSTMENT AND REPAIR

1. Removal process

The back axle assembly is made up of 3 parts: axle cover, brake assemble, axle core (differential). The process of removing the axle in principle follows the following steps:

- 1) Discharging oil of gear.
- 2) Removing the drive axle connecting to the back axle.
- 3) Removing horizontal half-shaft.
- 4) Removing the axle core (difference).
- 5) Removing the connection between the locker brake chamber pipelines.
- 6) Removing the drum and hub assemble.
- 7) Removing the brake assemble.
- 8) Removing the axle cover.

Note:

- Before removing, measure the gaps of the gears.
- When removing the differential: before removing the ball-bearing cover, mark on the ball-bearing cover to avoid incorrectly reassembling.

- 1) Removing axle cover and brake assemble

- 1) Fixing axle.
- 2) Using wrench to remove the half-shaft bolts.
- 3) Gently pulling out the half-shaft, at the same time, through the oil seal of splined, slowly turning the half-shaft to avoid damage to the oil seal. If the half-shaft is difficult to turn, it is possible to use a hammer to lightly tap the middle part of the half-shaft end, until the half-shaft is loose as shown in Figure 3-1.
- 4) Using the screwdriver to remove the 3 screws, removing the cover plate.
- 5) Using specialized tools to open the bolts as shown in Figure 3-2.

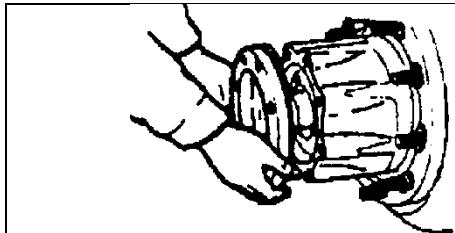


Figure 3-1

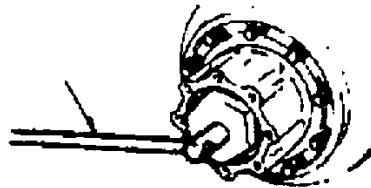


Figure 3-2

➤ **Note:** Before removing the bolts, it is necessary to mark to avoid incorrectly reassembling.

6) Turning the cylinder slightly, and using the hoist to pull out, lightly tapping the cylinder to loosen the inner ball-bearing. When the ball-bearing is loose, proceed to remove the cylinder. At this time paying attention to the weight of the large constituent, carefully injured. Also making sure the ball-bearings are not damaged.

❖ **Note:** Steps 1 to 6 are cylinder removal procedures.

7) Using a dedicated tool to remove the return spring.

➤ **Note:** Before removing any steel wire or wire, fix 2 brake pads (Figure 3-3).

8) Removing the brake pad.

a) Removing steel wire and screws (Figure 3-4).

b) Removing the brake pad plug and taking the brake pads down (Figure 3-5).

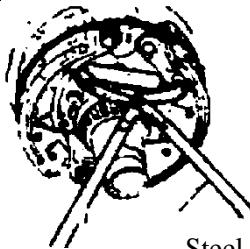


Figure 3-3

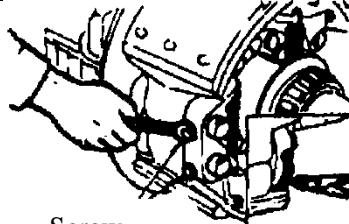


Figure 3-4

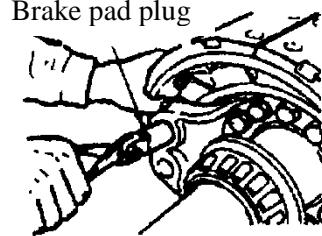
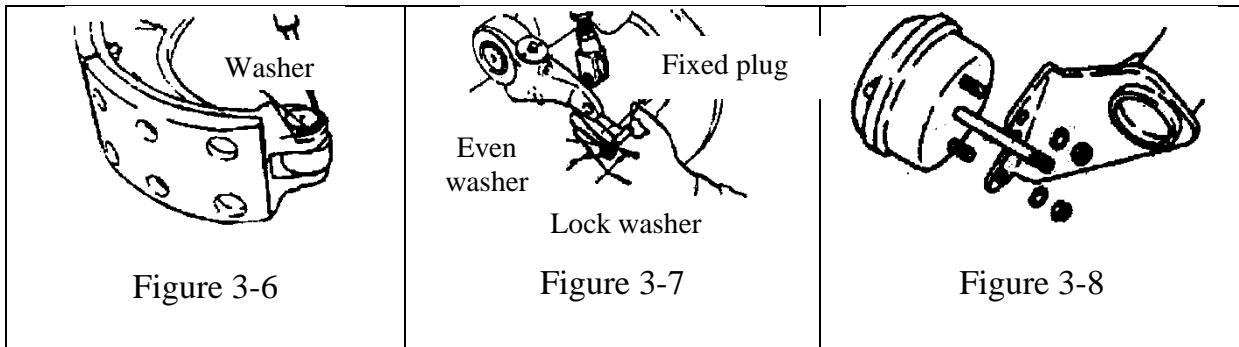


Figure 3-5

9) Removing the washer (Figure 3-6).

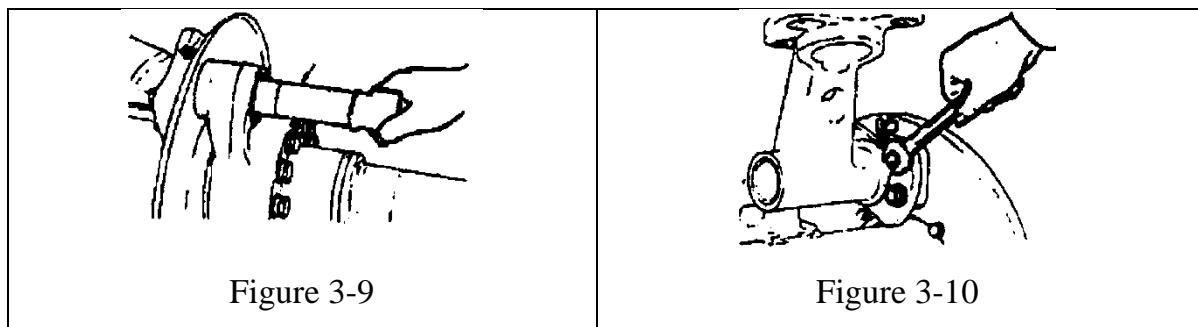
10) Removing the fixed plug, even washer, lock washer (Figure 3-7).

11) Removing the bolt nut and steam pipe, removing the cacuum power booster on the mounting foot (Figure 3-8).



- 12) Removing the brake pad's gap adjustment handle jack.
- 13) Removing the camshaft (Figure 3-9).

➤ **Note: if removing the camshaft, it is necessary to mark to avoid incorrectly reassembling**
- 14) Removing the cacuum power booster's support base (Figure 3-10).
- 15) Removing the shaft sleeve.



- 2) Removing the axle core
 - 1) Before removing it, it is necessary to mark the gap of the axle core
 - 2) Removing the keeper.
 - 3) Marking in the axle cover and ball-bearing axle
 - 4) Loosening the bolt of the ball-bearing cover.
 - 5) Removing the ball-bearing cover and bolts.
 - 6) Removing the differential.
 - 7) Removing the driving gear and O-rings.
- 3) Removing the differential
 - 1) Removing the right cover of the differential (Figures 3-11 and 3-12).

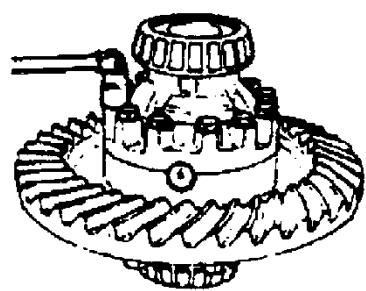


Figure 3-11

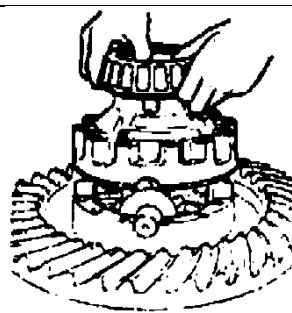


Figure 3-12

2) Removing the washer and half-shaft gear.

3) Measuring and noting the gaps of the gears (Figure 3-14).

➤ **Note: Before measuring, tighten the cross axis.**

4) Removing the cross axis, then removing the anti-pad and epicyclic gear (Figure 3-15).

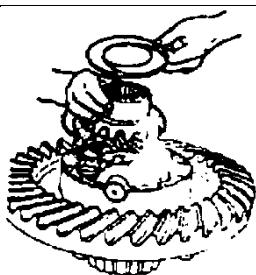


Figure 3-13

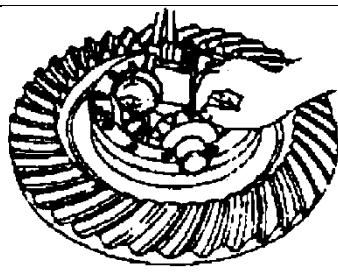


Figure 3-14

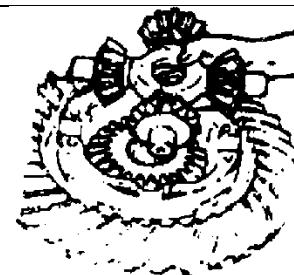


Figure 3-15

5) Removing the half-shaft and washer (Figure 3-16)

6) Removing driven gears in the difference cover (Figure 3-17)

7) Removing the ball- bearing in the differential (Figure 3-18)

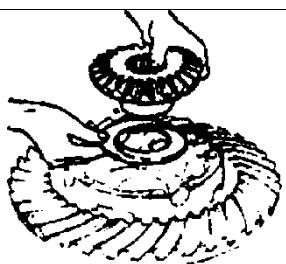


Figure 3-16

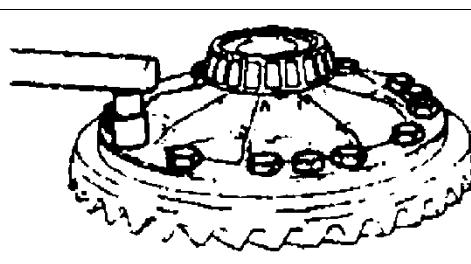


Figure 3-17

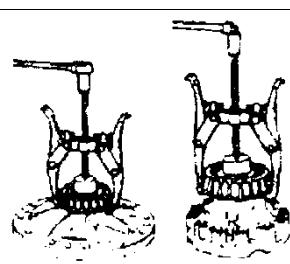


Figure 3-18

4) Removing the brake pad's gap adjustment handle jack

- 1) Releasing the brake, removing the cotter key on the cacuum power booster so that the brake pad's gap adjustment handle jack is not connected to the cacuum power booster.
- 2) Removing the nut fixing the brake pad's gap adjustment handle jack.
- 3) Removing the fixing pin and washer in the camshaft position.
- 4) Using the torque spanner to tighten the bolts on the brake pad's gap adjustment handle jack counterclockwise and removing the brake pad's gap adjustment handle jack.

2. Check and sanitation

1) Check

Before cleaning the components, it is necessary to use a check tool. Based on the repair requirement that determine whether the component can continue to be repaired. Damaged components need to be repaired or replaced as required. If one of the two components interconnected is severely damaged, the gap between the two pieces is too large, according to the actual situation to replace one of the two components.

On the principle of maintenance and redundancy: every part has a limit for repair or abrasion, it is necessary to renew it before the parts are damaged or abraded to the allowable limit.

All parts need to be through visual observation and infrared inspection. If abnormal signs are detected, conduct repair or replace as required.

After removing all rubber parts such as washer, oil seals, etc., it is necessary to check whether you can continue to use it.

Unusual cases:

- Abrasion and uneven adrasion.
- Rust.
- Bend, deformation.
- Scratch.
- Getting broken, cracked.

- Loss of effect or weakness.
- Metamorphosis.
- The position of contact is not tight.
- There are strange voices (ball bearings, etc.).
- Discoloration.

2) Sanitation

Components sometimes stick with oil. Therefore, cleaning components is indispensable. Usually sanitation measures include washing with gasoline, acid or alkaline solutions, neutral solutions, etc.

a) Metal

- 1) Gasoline: unlike other methods, gasoline for mud does not have permeability or solubility unless the component surface is machined correctly. If not, use a brush or other tool to remove mud, and then wash twice.
- 2) Alkali: using alkaline solution to handle cast iron or cast steel surface, the result is very good. If the material is made from an alloy, do not use alkaline solution to handle.
- b) Rubber components: Can not use fossil oil, can use alcohol to clean, can also use clean cloth to wipe.
- c) Anti-rust: After cleaning the oil on the surface of the component, adding clean oil to prevent rust.

3. Assembling and adjusting

The back axle assembly procedure is opposite to the removal process, but pay attention to the tightening force.

3.1. Table of tightening force

Bolt-nut	Value (N.m)	Bolt-nut	Value (N.m)
Bolt discharging lubricating oil of axle	130-150	Bolt checking lubricating oil of axle	130-150
Back shoe brake plate	180-220	Back locker brake chamber bolt	100-140
Large bolts on driving	220-250	Bolts of ball-bearing	60-80

gears		base	
Large bolts on driven gears	120-145	Bolts of difference cover	55-75
Bolts of ball-bearing	120-150	Bolts of dust stop plate	20~30
Bolts of half-shaft	75-95	Bolts connecting axle cover and reducer	65-80
Bolts of the cacuum power booster base	120-130	Adjustment bolt nut	200-250
Bolts connecting combustion head and cylinder	300-250		

3.2. Location using sealant glue

Location	Types of glue
Bolts of driven gear	Dri-Loc204 Priming glue
Bolts of difference cover	
Bolts of axle cover and reducer	Vibra-Seal503 Priming glue
Location of axle flange	HZ-1 Waterproof glue RTV oil resistance

3.3. Adjustment of axle

3.3.1. Adjustment of brake pad's gap

- 1) Adding oil on the camshaft, assembling the the brake pad's gap adjustment handle jack to the camshaft, ensuring the direction of the camshaft is in the direction of the cacuum power booster. Tightening the bolts to the handle jack clockwise, to let the handle jack in the U-slot of the cacuum power booster.
- 2) Pushing the brake pad's gap adjustment handle jack in the direction of the arrow until it cannot be pushed anymore, the purpose is to ensure the gap of the brake pads and cylinder is in accordance with the design. Then installing the positioning base on the camshaft outer cover, on the

positioning base, installing the washer, locating the position and tightening the bolt (using the U tree on pat, the force is not less than 20N.m).

- 3) Installing the washer, the nut on the camshaft, checking the position of the brake pad's gap adjustment handle jack that are within a certain gap, requiring a gap of 0.5-1 mm. If the deviation is larger, adjust the camshaft until it meets the requirements, finally locking the cotter key.
- 4) Using the Sw17 spanner to turn the hexagonal head of the brake arm clockwise until it stops, at which time the brake pads and cylinders are in contact. Then measuring the rotation counterclockwise 1-2 times so that the distance between the brake pads and cylinders is 0.6mm. At this time the axle can operate and not be rubbed.

3.3.2. Adjustment of wheel ball-bearings

- 1) Removing the lock plugs, using specialized spanner to tighten the boly nut, tighten force is 200-250N.m.
- 2) Turning the cylinder 2-3 round, leaving the ball bearing in place.
- 3) Turning the bolt nut to adjust the opposite 1/6-1/4 round, turning additionally the cylinder 2-3 times.Using the gauge to measure the pull force, the pull force is within 30-50N (if not yet, readjust)
- 4) Installing the lock plug, both sides use 2 hexagonal bolt nuts (Q151B0616) and washer rod (Q40306) to tighten, the tightening force is from 9-11N.m, making the anti-release seal.
- 5) Finally installing the oil shield oil seal.

3.4. Repair standard

Name	Standard	Limit of repair	Limit of abrasion
Gap of epicyclic gear and cross axis in the axle core	0.10-0.14 mm		0.3 mm
Gap of the convex of the half-shalf and	0.21-0.31 mm		0.60 mm

difference cover			
Gap of the driving gear and the driven gear	0.15-0.25 mm	0.60 mm	
Gap of half-shalf and epicyclic gear	0.25-0.35 mm	0.5 mm	
Diameter in the cylinder		330 mm	332 mm
Degree of change of the cylinder's diameter	0-0.1 mm	0.2 mm	
Thickness of brake pads		12-13mm	8.5mm
Gap of the cylinder and the brake pad	0.6mm		
the cacuum power booster's itinerary	24mm	45mm	
Gap of the camshalf	0.40-0.46mm		0.7mm
Gap of the brake pad shalf and rubber	0.16-0.26mm		0.56mm
Tightening force of main ball bearing shaft	2.5-3.5kg		
Force of differential's base	9.6-15.8kg		
Rotation force of ball bearing	30-50N		
Rotation force of the reducer	5.5-7.5kg		

PART 4: COMMON PROBLEM S

Problem	Reason	Solution
Noise	Gap of the differential's gear is not enough	Replacing the washer or gear
	Gap of the driving and driven gear is large	
	Rotation force of driving gear is small	Readjusting
	Half-shaft, epicyclic gear, cross axis have worn or damaged washer	Repairing or replacing broken parts
	Lack of lubricating oil	Adding lubricating oil
Oil leakage	Oil seal is loose, damaged and worn	Replacing oil seal
	Bolts of the reducer are loose	Tightening according to the standard
	Sealant glue is damaged	Shooting glue again
	Pat bolts of ball-bearing are loose	Tightening according to the standard
	Lubricating oil discharge bolts are loose or damaged	Tightening according to the standard or replacing
	Overload causes axle deformation	Repairing or replacing the axle cover
	The air vent is not blocked or damaged	Cleaning or renewing
Ball-bearing is hardened	Rotation force of ball-bearing is large	Readjusting
	Lack of oil or wrong type of oil	Pumping extra oil or changing oil
	Dirt sticks to ball-bearings	Cleaning and pumping oil
	Because the sealant oil seal is broken, it leads to water penetration	Replacing oil seal
Braking	Camshaft is not flexible	Checking the camshaft, if necessary, replacing the camshaft, checking the ball-bearings for lack of oil

force is not enough	The cacuum power booster is not enough itinerary	Adjusting itinerary
Problem	Reason	Solution
Braking force is not enough	The brake pads are too hot or deformed	Replacing the brake pad
	The brake pad contact is not enough	Adjusting the contact position
	The cylinder sticks to the water	When running, lightly brake, discharge the water.
	There is oil between the cylinder and brake pads	Cleaning oil and replacing brake pad
	Braking steam is not enough	Checking the steam pipe
	The fork adjusting the gap of the brake pads is ineffective	Readjusting or replacing
Brakes made a sound	Brake pads are worn	Replacing brake pad
	The brake pads are hard and metamorphosed	Replacing brake pad
	The cylinder is worn unevenly or the installation is uncertain	Adjusting the cylinder, tightening the bolt
	The base of the friction plate on the brake pads and friction pads are not tight	Tightening the bolt
	The brake pad bases of the bolts are loose	Tightening the bolt
	The ball-bearing shalf of the burner is worn	Replacing the new ball-bearing
	The cylinder is deformed	Adjusting or replacing the cylinder
Unstable brakes	The cylinder installation is not correct	Tightening the bolt
	Return spring is broken	Renewing the spring
	The friction plate with oil or metamorphism	Cleaning or renewing
	Brake base are damaged	Renewing

Wheel is worn	The camshaft has no oil or the brake pad's gap adjustment handle jack is not returned	Repairing damaged parts
	Brake bases or return springs of the cacuum power booster are damaged.	Renewing

PART 5: THE COMPONENTS ARE EASILY DAMAGED

No.	Name	Quantity
1	Total oil seal inside the burner	2
2	Half-shalf	2
3	Total oil seal outside the burner	2
4	Back brake pad	8
5	Rivet fixing the friction plate	48
6	Back cylinder	2
7	Oil seal – discs gear	1
8	Sealant oil seal	2
9	Bolts of back disc	20
10	Ball-bearing guiding for disc gear	1
11	Left cacuum power booster	1
12	Right cacuum power booster	1
13	Ball-bearing of disc gear	2
14	Ball-bearing of differential	2
15	Ball-bearing inside the back wheel burners	2
16	Ball-bearing outside the back wheel burners	2
17	Oil shield of lubricant oil discharge bolts	2

Operation & Repair & Maintenance Manual

—Propeller Shaft System

BUS MODEL: Thaco Garden 79SE

Bus propeller shaft is characterized as with high torque and large swing angle. The nominal dynamic torque is 4000 N.m, maximum torque can be 10,000 N.m. Maximum swing angle can be 25°.

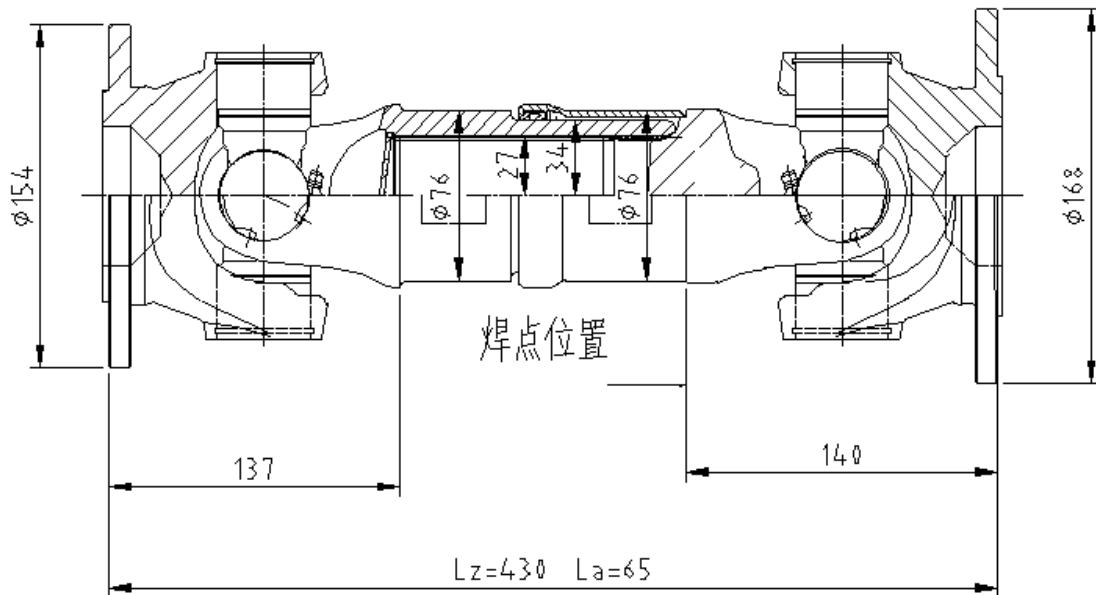


Figure 1. The structure of propeller shaft

I. Disassembling the propeller shaft.

Before disassembling the propeller shaft, securely wedge the front and rear wheel with seat pads. Firstly disassemble the flange connecting propeller shaft and rear axle, then take down the flange connecting with the transmission. Before dismantling the propeller shaft, mark the position facing the propeller shaft expanding cover and spline shaft in order to avoid making mistakes during reassembling and ensure dynamic balance accuracy.

1. Disassembling of spider needle bearing

Firstly disassemble retainer ring (or locking piece and cover plate) of needle bearing, take out the needle bearing assembly. Pay attention not to let the assembly fall apart.

2. Disassembling the spline shaft and expanding cover

Hold the fork of universal shaft in the spline shaft sleeve, unscrew oil seal cover, take out the oil seal and washer then pull out the spline shaft.

Use light oil and metal wire brush to clean off greasy dirt on the non-machined surface, then use base solution to clean metal parts. Rubber parts should be cleaned by alcohol, then blowed to dry.

II. Inspection of propeller shaft parts.

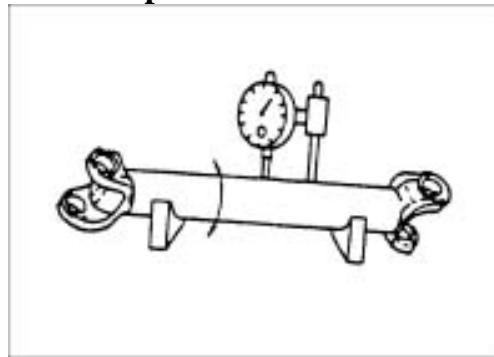


Figure 2. Inspection of propeller

1. Lay two ends of the propeller shaft on a V-shaped iron, measure the amount of its radial run-out.

Service standard: 0.75 mm

Use limit: 1.50 mm

If the run-out exceeds tolerance, the shaft should be adjusted or replaced.

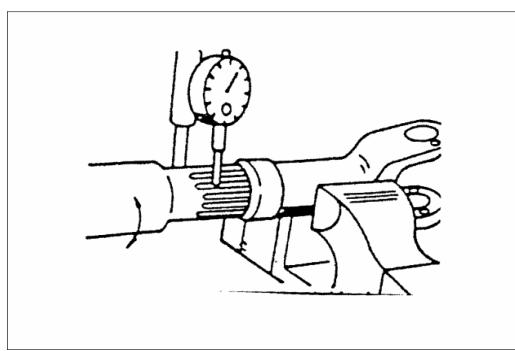


Figure 2. Check shaft and sleeve

2. Insert the spline shaft into its sleeve, check the clearance between them.

Service standard: 0.025 mm

Wear standard: 0.400 mm

The shaft shall be replaced if the clearance is larger than required.

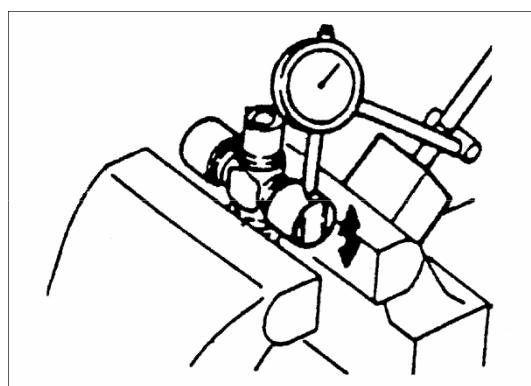


Figure 3. Check needle bearing

3. Put the needle bearing on the universal joint spider, push the bearing vertically, check the it's play.

Service standard: 0.02 mm

Wear standard: 0.15 mm

The bearing or spider should be replaced if the clearance exceeds tolerance.

III. Assembling of propeller shaft parts.

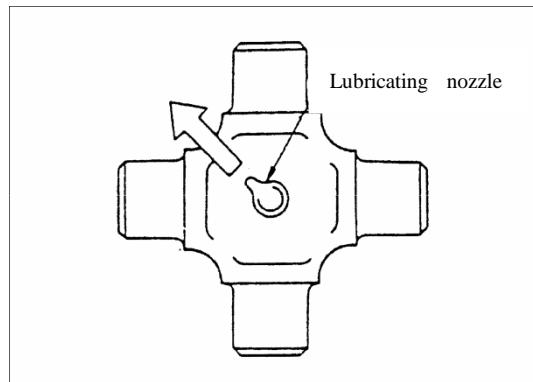


Figure 4. Assembly lubricating nozzle

1. Install the lubricating nozzle on the universal joint spider as shown in the figure below.

Then install the dustproof cover.

Hold the spline shaft with a vice and install the spider, apply lubricant grease to the needle bearing firstly.

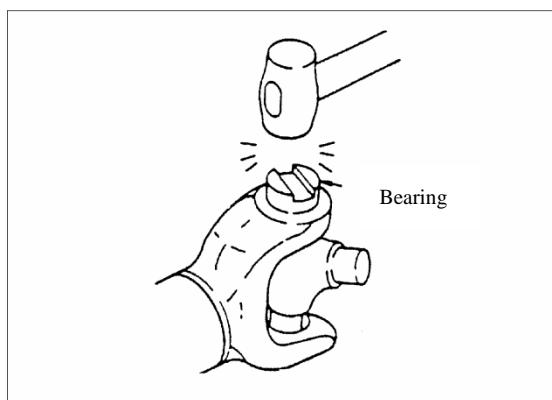


Figure 5. Assembly needle bearing

2. Use a copper hammer to knock on the bearing when it is assembled. Install the retainer ring (or cover plate and locking piece). Install flange yoke. The spider and flange yoke shall be install onto the splined sleeve with the same method.

Insert the splined sleeve according to the mark made when the spline shaft is dismantled.

Finally, put on the oil seal and dustproof cover. Connect the propeller shaft assembly with transmission output shaft , tighten the bolt of propeller shaft with a torque of 125-145 N.m. Connect the propeller shaft assembly with input flange of rear axle, tighten the bolt of propeller shaft with a torque of 180-220 N.m.

TABLE OF CONTENTS

PREFACE.....	3
PART 1: OPERATING	4
PART 2: MAINTENANCE.....	5
1. Daily maintenance items.....	5
2. Periodic safety check.....	6
3. Level 2 maintenance.....	6
4. Level 3 maintenance.....	7
PART 3: INCIDENT ANALYSIS	8
1. Incident of the buffer	8
1.1. Leakages.....	8
1.2. The washer for installing buffers is prolonged or pulled apart, buffers are pulled apart.	8
1.3. The bushing of buffer is damaged	8
1.4. The buffer is bent	8
2. Incident of air tank.....	9
2.1. The air tank has collapsed (no air supply).....	9
2.2. The air bag is abraded	9
2.3. The air tank is protruding	9
2.4. The air tank cover is swollen.....	9
2.5. The air tank is not correct (too low)	10
2.6. The air tank is skewed, the washer is eccentric in contact	10
2.7. The air bag is cracked.....	10
2.8. Reducing elasticity, increasing hardness.....	10
3. Incidents of height adjustment valve.....	10
3.1. Vehicle is tilted.....	10
3.2. The connecting bar is pulled apart, crank adjusting valve turns backwards.	10
3.3. Valve reacts slowly	11
4. Incidents of structural details with the suspension system.....	11
4.1. The wheel is unusually deflected, abraded.....	11
4.2. Vehicle moves unstable, the movement is difficult.....	11
5. Incidents of rubber bush	11
5.1. The rubber bush is broken	11
PART 4: INSTALLATION, ADJUSTMENT AND REPAIR	12

1.	Installation and adjustment	12
2.	Repair	13
3.	Tightening moment table.....	17

PREFACE

This maintenance manual provides customers with the necessary information to carry out maintenance, inspection and safe use of air suspension on Bus.

The specifications, codes and number of details mentioned in this maintenance manual are only in accordance with the standard configuration of the air suspension system of Komman Company. If not identical to the standard installation configuration, please contact the manufacturer. Please proceed with maintenance and use of the product according to the requirements set out in this maintenance manual so that customers can use the product “effectively and safely”.

PART 1: OPERATING

The air suspension system has outstanding features, providing reliability when used and without problems when used on long distances. When minor incidents such as leaking gas pipes or damaged air bags occur, the pressure protection valve in the pipeline can still maintain the pressure to brake the car, moreover, the washers inside the spring will now have the function of becoming a support rubber washer, the car can still move at a slow speed to the nearest warranty station to perform repairs.

Accurate use will minimize and avoid other unintended incidents to the air suspension system.

1. No overload allowed.
2. The pressure supplied to the air suspension system is maintained in the range of 6.0 bar (if exceeding 6.0 bar, the pressure maintaining valve will operate and the maximum allowable pressure for air control system is 7.0 bar).
3. The position on the air suspension system does not need to use lubricating oil, especially prohibit the use of lubricants in rubber parts.
4. Maintenance of products according to regulations (see part 2, maintenance).

PART 2: MAINTENANCE

The manufacturer will provide quality warranty services for products that has manufactured and supplied (from the date of sale).

Product's name	Maintenance time	Number of Km	Note
Main details	2 years	200000	Apply on condition comes first
Buffer, air bag	1 year	100000	
Backing	1 year	80000	
Types of valves	1 year	50000	
Vulnerable details	Only applicable for damaged details		

During the warranty period, if product quality is problematic, customers are free of providing, maintaining and replacing components by authorized showrooms dealer stores of Komman company.

➤ Tasks include:

- Provide information or documentation on instructions for maintenance, repair and assembly of products.
- Provide components that need to be replaced, with shipping.

➤ Responsibilities of the person installing the product

- Installation based on standards and guidelines.
- Ensure accuracy and safety when operating.
- Notify the owner and provide documents so that the customer can maintain and use it exactly as required by the product.

➤ Limitation of warranty

The company will not be responsible for cases when sharing Komman's suspension system with components that have not been approved by Komman, or use other replacement parts from other manufacturers that have not been verified by Komman.

1. Daily maintenance items

- 1.1. Check every day or before using the car.
- 1.2. Content to check includes:

- 1.2.1. Visually check the amount of air supplied in the gas tank.
- 1.2.2. The height of the suspension system is normal, the system does not leak.

The simple check method is: when receiving a car from the manufacturer, stop the car on a flat road surface, measure 4 points from the center of the wheel to the point on the vehicle chassis, determine the fixed distance and record 4 values. Every time you check, just stop the car at a flat surface, measuring and checking these 4 values without any change means that the height of the suspension system is still normal and the system does not leak.

- 1.3. If the check fails, fix and correct the problem if necessary.

2. Periodic safety check

- 2.1. Periodic safety check can be based on maintenance time, distance of 1500-2000km or based on regulations on safety check time to proceed.

- 2.2. When checking, it is necessary to stop the car in a clean and flat place, it is best to park the car at a repair station with an inspection tunnel, fix the brakes on the vehicle (below is a description of the types of maintenance checks).

- 2.3. Safety check items:

- 2.3.1. All components are tightened and not loosened. Bolts, nuts are not loose, dirty, rusted and damaged, abrasive.

- 2.3.2. The pressure must not exceed 6.0 Mpa, the air must be fully loaded, the air suspension must be firmly placed at the same height and check whether the air suspension is abrasive, damaged or inflated, the gap range must be 25mm or more.

- 2.3.3. Check whether the buffers are leaking oil and working normally.

The easy way to check the buffers for normal operation is: after moving, the buffer generate heat proves that the buffer works normally.

➤ **Note: The buffer may cause burns to the hands**

- 2.3.4. All components and welds are not cracked.

3. Level 2 maintenance

- 3.1. After traveling 8000km or relying on the level 2 maintenance period to conduct maintenance, repair and check once.

3.2. Content of level 2 maintenance

- 3.2.1. Check suspension system and the tightening of bolts and nuts; when necessary, replace nuts or washers
- 3.2.2. Spring check like section 2.3.2
- 3.2.3. Buffer check like section 2.3.3
- 3.2.4. Drain the water in the compressed air tank
- 3.2.5. Check and repair the height of the control valve
- 3.2.6. Check the height of the suspension system in accordance with the design value, the error should not exceed $\pm 5\text{mm}$. When necessary, adjust the height of the control valve to adjust the height of the suspension system.

4. Level 3 maintenance

- 4.1. Rely on the road of 80,000km or 1 year, level 3 maintenance carries out maintenance and repair of the suspension system.
- 4.2. Content of level 3 maintenance: In addition to the level 2 maintenance items, strengthen checking whether the components of the suspension system are loosened, abrasive, cracked, damaged to promptly repair and replace.

PART 3: INCIDENT ANALYSIS

Although Komman air suspension is of good quality, safe to use and avoids problems when used in long distance, it is also impossible to avoid incidents caused by the adjustment process or maintenance process. To help customers to "judge and solve" problems when repairing and save up to the maximum time and repair costs. Below is a list of possible incidents and situations that may occur and the causes of the air suspension problem.

1. Incident of the buffer

1.1. Leakages

- The height of the suspended frame is not suitable, too high or too low.
- Incorrect installation of buffers, reverse installation or installation position of the leaf spring on buffer is not correct.
- The buffer is not correct.
- The gap around the buffers is not enough.

1.2. The washer for installing buffers is prolonged or pulled apart, buffers are pulled apart.

- Suspended frame is too high.
- Incorrectly installate the buffers, the installation position of the leaf spring on the buffers is too high.
- The buffer is not correct.

1.3. The bushing of buffer is damaged

- The heigh of suspended frame is too high or too low.
- Incorrectly installate the buffers, installation of bolts are not tightened or loose.
- The buffer is not correct.
- Normal abrasion.

1.4. The buffer is bent

- The buffer is not correct.
 - Incorrectly installate the buffers, the position of the leaf spring installed on the buffers is too low.
 - The air tank is not correct.

Note: Buffer is easily damaged, the warranty period is 1 year or 80,000 km. In cases where no cause is found, if there is no repeated damage in a short period of time, it is considered normal.

2. Incident of air tank

2.1. The air tank has collapsed (no air supply).

- The air pressure in the tank is low.
- Pressure protection valve is disabled or the pipe is dirty.
- The air control pipes are leaked or blocked.
- The valve determining the height is disabled or the connecting end of the connecting bars is loosened.

2.2. The air bag is abraded

- The gap around the air tank is not 25mm.
- The welds of the chassis adjustment bar with the leaf spring is open or the damaged rubber bush slips the suspension frame, causing friction between the wheel and air bag.
- Caused by the damaged buffersm, the pipe is loose plus the airbag friction.
- Outside the plunger on the bottom washer of the air tank is attached by sand and glass fragments.

2.3. The air tank is protruding

- The height of suspended frame is low, the air tank works with low pressure for a long time.
- The valve determining the height is disabled or the connecting end of the connecting bars is loosened.
- The air tank is not correct (too high).
- The supply pressure is too low, the vehicle is overloaded.

2.4. The air tank cover is swollen

- The buffer is invalid, damaged or improper.
- The valve determining the height does not work.
- The height of suspended frame is too high, the tank works for a long time in conditions exceeding the normal pressure

2.5. The air tank is not correct (too low)

- The connection between the airbag with the upper half edge or the plunger is cracked and leaked or gas leakage is at the location of bolts and nuts.
- Supply pressure is too high, severe overload.
- The disabled buffers cause damage or improper product, the air bag is stretched too long.
- The washers are eccentric in contact, corroding the position between the airbag and the cover or piston.

2.6. The air tank is skewed, the washer is eccentric in contact

- Incorrectly installing the air tank, spring is tilted vertically.
- Incorrectly installing the air tank, spring is tilted horizontally.
- The welds of the chassis adjustment bar with the leaf spring is open or the damaged rubber bush of reverse bar slips the suspension frame.

2.7. The air bag is cracked

- Using lubricating oil for air bags reduces the age of use.
- Normal depreciation.

2.8. Reducing elasticity, increasing hardness

- The air in the air tank has not escaped out all the time, more water is deposited in the air tank.

Note: If using normally, the age of use of the air tank is usually 3-5 years

3. Incidents of height adjustment valve**3.1. Vehicle is tilted**

- The valve determining the height is adjusted incorrectly, if the height of the suspension system on the back axle significantly different from the design value, the vehicle will tilt vertically, if the height difference between the suspension system of the two adjustment axes is too large, the vehicle will be tilted horizontally.
- Any fault of each valve determining the height or fault of blocked pipes can cause control errors for that airbag.

3.2. The connecting bar is pulled apart, crank adjusting valve turns backwards.

- Incorrectly installing the valve.

- The height of the connecting bar is not correct.

3.3. Valve reacts slowly

- Supply pressure is too low.
- The valves determining the height or pipes are dirty, deformed.
- The water in the air bag has not escaped out all the time, in cold weather days, it will happen freezing in pipes or valves.
- The diameter of the pipe and the connecting end is too small.

4. Incidents of structural details with the suspension system

4.1. The wheel is unusually deflected, abraded

- Incorrectly locating the front and back axles.
- The weld is open on the adjusting bar of the chassis with the leaf spring, the bolt locking the axle is loose.
- The bolt for installing backing is loose. The rubber bush of the backing is abraded or damaged

4.2. Vehicle moves unstable, the movement is difficult

- The bolt of the chassis or the connecting bolt is loose.
- The fixed bolt for installation of axles is loose.
- The weld is open on the adjusting bar of the chassis with the leaf spring, the rubber bush is abraded or damaged (the bolt for installing backing is loose), the suspended frame is slipped

5. Incidents of rubber bush

5.1. The rubber bush is broken

- Serious overloading.
- The adherence between rubber and metal is not good or vulcanization of rubber is not guaranteed (belongs to product quality problem).
- Using lubricating oil reduces the age of the product.

PART 4: INSTALLATION, ADJUSTMENT AND REPAIR**1. Installation and adjustment**

1.1. Quality control methods and parameters for installation and adjustment of air suspension systems

1.1.1. The deviation of the front axle center line (in the direction from top to bottom) is not greater than 5/1000mm. The deviation of the front axle center line comparing with the center line of the chassis (in the direction from left to right) is not greater than 5mm.

a) Adjustment method

Use the method of adding and reducing the gasket at the position of connection of the front leaf spring with the leaf spring or adding and reducing the gasket by adjusting the distance between the two ends of the backing with the leaf spring.

b) Check method

- Taking 2 holes to install bolts on the front axle, and find 2 symmetrical holes on the left and right beams of the chassis, measuring the deviation of the 2 symmetrical holes connecting the bolts to the left and right beams.
- Each length is required to be about 1000mm, the deviation of the symmetrical line does not exceed 5mm.

1.1.2. The deviation of the back axle center line (in the direction from top to bottom) is not greater than 5 / 1000mm. The deviation of the back axle center line comparing with the center line of the chassis (in the direction from left to right) is not greater than 5mm.

a) Adjustment method :

Use the method of adding and reducing the gasket at the position of connection of the V-shaped gasket with the V-shaped backing or adjusting horizontal backing (bottom) and 2 ends of leaf spring.

b) Check method

- Taking 2 holes to install bolt on the back axle, and find 2 positions of symmetrical holes on the left and right beams of the chassis, measuring the deviation of the 2 symmetrical holes connecting the bolts to the left and right beams of the chassis.

- Each length is required to be about 1000mm, the deviation of the symmetrical line does not exceed 5mm.

1.1.3. The deviation of the symmetrical line between the two axles must not be greater than 5mm

Check method

- Stopping the vehicle on a flat, hard ground.
- At the center position of the front and back axle tires, using perpendicular to straighten to the ground and marking the sign.
- Making the vehicle move, the difference between the two marked points is not greater than 10mm.

1.1.4. The height when assembling airbags is: $H \pm 5\text{mm}$ (the height when assembling the front and back buffers is: $H \pm 5\text{mm}$)

- a) Adjustment method: adjusting the valve to control the height of the front and back of the suspension system.
- b) Check method: taking the bottom of the air bag as standard, measuring the distance H from the bottom of the air bag to the surface of the airbag, according to the requirements of the air bag height, the deviation should not exceed $\pm 5\text{mm}$.

1.1.5. When sufficient air is supplied to the air tank, there is still over 25mm gap around.

➤ **Note: The load impacting on the front air tank is not heavy, the low pressure is only enough to support the suspension system's height, it seems that the amount of air is insufficient, even if it is flat, this phenomenon is completely normal.**

2. Repair

2.1. Preparation: When repairing, it is necessary to stop the car in a clean and flat place, it is best to repair at repair tunnel, fix the brake, block the tire. Based on the content to be repaired, use the appropriate lever-jack or elevator to increase the height of the chassis and remove the tire.

2.2. Buffer replacement

2.2.1. Removing upper and lower bolts, taking out buffers.

2.2.2. Replacing new buffers, sufficient tightening of bolts force.

2.2.3. After traveling a certain distance, check whether the buffers are working normally.

➤ **Note: The buffer and air tank should be based on the construction of the suspension system to select the appropriate use. It is absolutely necessary to replace the buffer properly, otherwise it will reduce the function and age of the suspension system, which can easily damage the suspension system.**

2.3. Replacing the air tank

2.3.1. Using the lever-jack or elevator to increase the height of the classic to 90mm.

2.3.2. Removing the nut at the connecting position between the tie rod of valve adjusting height and the tie rod bearer, then lower the tie rod to the bottom to discharge the air inside for 2 front air tanks or 4 back air tanks.

2.3.3. Removing damaged air tank.

2.3.4. Installing the new air tank. 2 ends of the air tank is attached to the exit of the upper bearing plate and the plunger of the air bag, tightening the air bag at the contact position.

2.3.5. Reinstalling the removed nuts as above.

2.3.6. Taking the lever-jack or elevator.

2.3.7. Starting the machine causes the pressure in the system to reach the value of turning off the pressure machine, checking whether the system has an air leak (maximum permissible pressure is 7.0 bar).

2.4. Checking, maintaining, adjusting and replacing height adjustment valves.

2.4.1. Check height adjustment valves

Using this method to check the status of the height control valve, determining whether the device is disabled to eliminate waste replacement, the check method is as follows:

- a) The air supplied to the system must be greater than 6.0 Bar.
- b) Loosening the nut connecting between the tie rod of the height adjustment valve and the tie rod bearer.
- c) Lifting the tie rod of the height adjustment valve in the vertical direction upwards, stopping for 10 seconds, if the air supplied to the air tank is sufficient, the vehicle will be lifted high.

- d) The tie rod of the height adjustment valve is in the middle, at which point the valve will stop supplying air to the air bag and the air bag cannot discharge air.
- e) Lowering the tie rod of the height adjustment valve, stopping for 10 seconds. The air tank discharges air, the vehicle automatically lowers.
- f) The tie rod of the height adjustment valve is in the middle, at which point the valve will stop supplying air to the air bag and the air bag cannot discharge air.

2.4.2. Height adjustment valve maintenance

- a) Regular visual check of the gaps around the valve, the tie rod of the height adjustment valve and the bearer are not hindered in the operating range of the axle.
- b) Periodically maintaining the air supply system, removing impurities in the air pipeline, strictly prohibiting the use of the grease to lubricate the valve.
- c) Periodically discharging the air in the air tank. In cold weather conditions, drying recommendations to prevent damage to the valve due to freezing water.

2.4.3. Valve adjustment

- a) During maintenance and repair of the vehicle, if the height H of the suspended frame is greater than $\pm 5\text{mm}$, after eliminating all causes, if it is confirmed that due to the height adjustment valve, it is recommended to adjust the valve and the bearer connecting the tie rod of the height adjustment valve.
- b) Order and method of adjusting height adjustment valve:
 - Removing the nut between the tie rod of the height adjustment valve and the bearer (for the back axle, carry out 2 valves at the same time).
 - Lifting the tie rod of the height adjustment valve in the vertical direction upwards, if the pressure is sufficient, the air tank will have enough air and lift the vehicle.
 - Place the bearing plate (one on each side of the vehicle) with the appropriate height below the chassis (based on the measured height of the suspended frame), then lowering the tie rod of the height adjustment valve to discharge the air inside the air tank and making the chassis slowly contact the bearing plate.
 - Continuously lowering the tie rod of the height adjustment valve, stopping for 10-15 seconds and taking the tie rod to the middle position, then checking whether the

suspended frame has the value $H \pm 1.5\text{mm}$. If not, it must be operated again from the beginning, using the method of adjusting the height of the bearing plate or adding the lower washer.

- Adjusting the length of the tie rod of the height adjustment valve so that the position of the air tank is in the most balanced position, then tightening the connecting nuts between the tie rod and the bearer to 33-38Nm.
- Supplying air to the system with the pressure greater than 6.0 Bar, removing the bearing plate under the chassis then checking all the air tanks that the amount of air supplied must have correct height of the bearer and ensuring the system does not leak air.

2.4.4. Height control valve replacement

- a) Put the lifting jack or bearing base into position under the chassis, at this time the height of the suspended frame is at the correct level
- b) Removing the connecting nut between the tie rod of the height adjustment valve and the bearer (for the back axle, carry out 2 valves at the same time). Lowering the tie rod of the height adjustment valve, discharging the air in the air bag
- c) Removing the ends connecting between the valves and the air pipe and removing the air pipe, then removing the height adjustment valve.
- d) Reinstalling the new height adjustment valve in reverse with the removal steps.
- e) Adjusting the length of the tie rod of the height adjustment valve so that the position of the air tank is in the most balanced position, then tightening the connecting nut between the tie rod and the bearer to 33-38N.m.
- f) Removing the lift jacks or bearing bases.
- g) With an air supply greater than 6.0 Bar, checking whether the system has an air leak, whether the air tank has correct height of the suspended frame, if not, tightening the nut. If the height of the suspended frame is incorrect, refer to section 2.4.3 adjusting the height adjustment valve

2.5. Backing replacement

- 2.5.1. Put the lifting jack or bearing base into position under the chassis, at this time the height of the suspended frame is at the correct level

2.5.2. Removing the damaged backing

2.5.3. Installing new backing according to the standard of tightening force below.

- a) It is recommended to measure the difference between the length of the old backing and the new backing (the distance bearing center between the front and back backings), determined when installing the new backing, the distance between the leaf spring and the backing is not increased, change the washer.
- b) Installing the appropriate thickness washer on the surface of the leaf spring, then assemble the new backing, temporarily tightening the components so that there is no gap, then check whether the positioning axis is correct, then tightening according to the specified tightening force.

2.6. Replacing the rubber cladding stabilizer bar

2.6.1. Removing the rubber face panel

2.6.2. Removing the rubber cladding old stabilizer bar

2.6.3. Cleaning the position of the connection on the stabilizer bar

2.6.4. Checking for damage, if a crack in the stabilizer bar is detected, performing a new replacement.

2.6.5. Installing the rubber cladding new stabilizer bar in reverse with the removal steps

➤ **Note: The stabilizer bar cannot be repaired when there are cracks but only replaced with new stabilizer bar**

3. Tightening moment table

Installing position		Specification of bolts	Tightening force of phosphate bolt (N.m)	Tightening force of galvanized (N.m)	Tightening force of bolts (N.m)
Air tank, fork, valve, rubber,	Air tank	Self-tight hexagonal bolts	M12	/	100
		Lock nut	M18×1.5	230	/
					300

etc. and parts which are easily damaged		Thin lock nut	M18×1.5	130	/	150
		I hexagonal nut	M18×1.5	210	/	270
		Bolt (without nut)	M18×1.5	230	/	300
	Load valves and accessories	Hexagonal nut level 8.8	M6	/	10	8
			M8	/	25	20
	Buffer	Belong to NCC	M16×1.5	90		
		Lock nut	M16×1.5	230	/	290
			M20×1.5	400	/	500
			M24×1.5	560	/	700
			M30×1.5	780	/	950
	Strut frame	Thin nut	M16×1.5	120	/	140
			M20×1.5	200	/	270
		Bolt (without nut)	M14×1.5	/	250	190
		Common self-locking nut	M14×1.5	/	250	190
		Lock nut	M20×1.5	400	/	500
			M22×1.5	500	/	600
Connecting details	Base of air tank, backing, backing pat, buffer pat, etc.	Common nuts	M10	/	80	60
			M12	/	140	110
			M14×1.5	/	250	190
	Lock nut	M16×1.5	230	/	290	
		M18×1.5 (X2.0)	360	/	420	

			M20×1.5	460	/	600	
			M22×1.5	640	/	800	
			M24×2	850	/	1000	
			M27×2	1100	/	1200	
			M30×2	1100	/	1200	
Backing	Slotted nut	M24×2	260				
		M33×2	400				
Bolt (without nut)			M12	/	140	110	
Bolt (without nut)			M14	/	200	170	
Bolt (without nut)			M16×1.5	230	/	290	
Bolt (without nut)			M18×1.5	360	/	420	
Bolt (without nut)			X2.0)				
Bolt (without nut)			M20×1.5 (X2.0)	460	/	600	
Note:							
1) According to the tightening force standard, if the bolts have nuts, following the tightening force of the nuts, otherwise apply the bolt without nut. 2) With nuts, tightening at the end of the nut, tightening force takes standard plus 20%.							

CLUTCH (CL)

1. CLUTCH	2
2. DISASSEMBLY AND ASSEMBLY OF	5
3. CLUTCH FAILURES AND REMOVAL	9

1. CLUTCH

D395 clutch is a kind of dry type helical spring friction clutch. Pressing force is generated by compression coiled springs arranged on the circumference. In order to reduce the thermal deformation loss of springs as far as possible, springs are made of heat proof material through special process and additionally, the springs and pressure plate contact each other on a narrow convex surface. Therefore, thermal transmission is reduced quite.

Thermal vibration caused by unstable power output is intrinsic for an internal combustion engine. Therefore, noise due to resonance of power train gears will be generated under some running conditions at certain engine speed. D395 clutch driven disc is provided with torsional vibration absorber, which may eliminate or reduct to a great extent such resonance so as to mitigate the impact and reduct the noise, thus lengthening the service life of power train components, improving the driving comfort and enabling smooth start of.

D395 clutch can transfer the maximum engine torque reliably. It can engage easily and smoothly and disengage completely. It also has the ability to absorb vibration and impact and to reduce noise. It is a kind of ideal clutch for heavy duty vehicle.

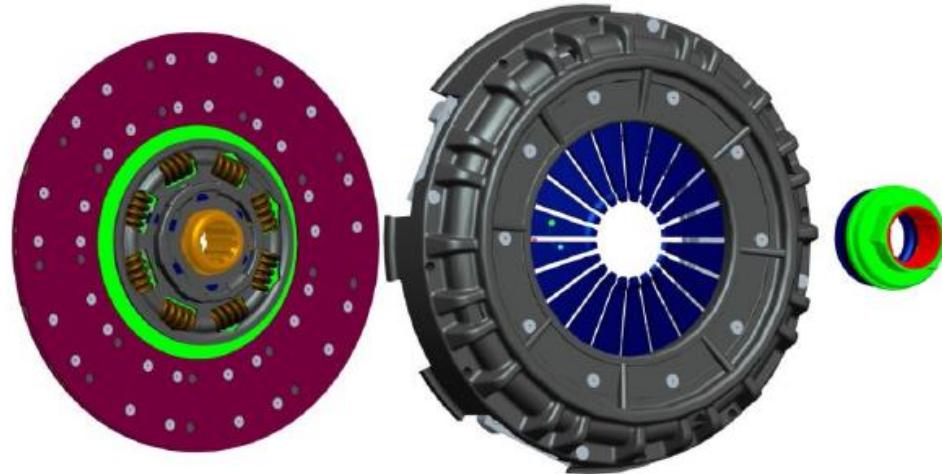


Figure 1. Clutch

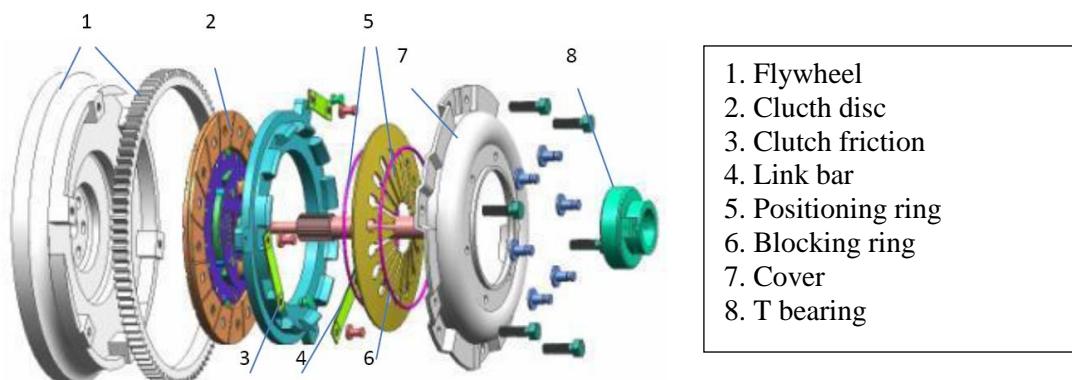


Figure 2. Assembly clutch

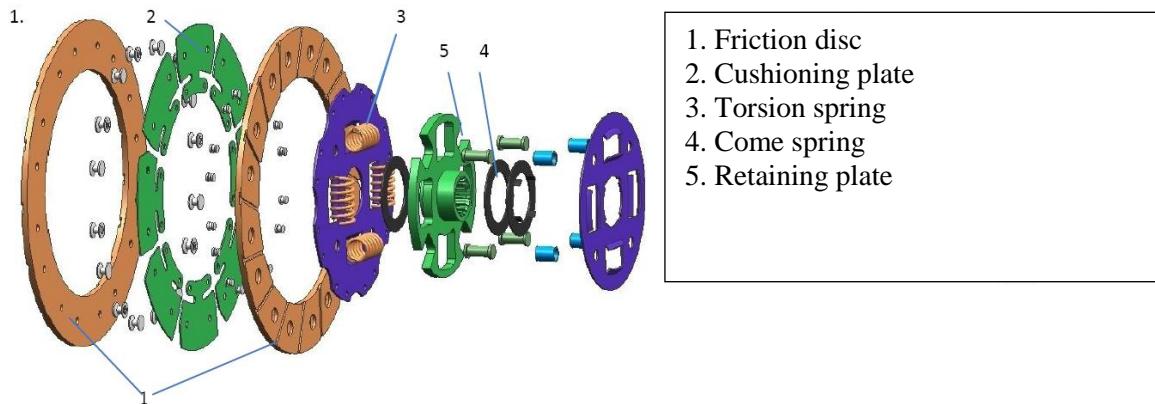


Figure 3. Clutch disc creation

As shown in the figure, D395 clutch is provided with conventional pressure plate and torsion springs are arranged on the circumference of the driven disc. It consists of clutch pressure disc, driven disc (clutch friction disc), pressure disc cover, clutch spring, diaphragm, housing and release bearing, clutch shifter and shifter shaft mounted on the transmission disconnection slider, etc. The pressure plate is connected with the pressure plate cover through diaphragm. Clutch springs are arranged on the circumference between the pressure plate cover and the pressure plate. After the pressure plate assembly is connected with the flywheel, the pressure plate holds down the driven friction disc tightly onto the end surface of flywheel so as to transfer the torque. The magnitude of torque to be transferred depends on the total compression force of clutch springs. When the clutch pedal is pressed, the release bearing is forced by the link gear and clutch shifter to force down the release lever so that the pressure plate shaft is made move backwards to allow the clutch to separate completely. The clutch should be able to disengage completely and engage.

Clutch pressure plate cover is made of grey cast iron and the characteristics of push type clutch. Cast housing to allow higher clamp load, higher heat capacity to allow high temperature, reliable diaphragm spring, well release.

Pressure plate is a key part of clutch. On the non-machining surface of pressure plate, wide angle 6 spring damper with friction device.

The working surface of pressure plate can be polished and the maximum polishing amount is 1 mm. A spacer with corresponding thickness should be added on the clutch spring seat when the polishing amount of pressure plate exceeds 0.5.

Wavy spring plate strap is mounted between the clutch driven disc lining and the driven steel strap, and has the function of damping to allow smooth engagement of clutch. A torsional vibration absorber is equipped on the driven disk. Pre-absorber is installed between the inner hubs of driven disc mainly to eliminate the torsional vibration during idling of engine. A main absorber is mounted between the outer hub and driven steel strap and consists of tangentially arranged helical spring and antifriction.

In order to prevent direct contact of release bearing with release lever (diaphragm) and thereby to prevent release lever wearing, a withdrawal collar is hitched by spring at the end of the release lever (diaphragm). In case of disengagement, the release bearing will press directly on the withdrawal collar so as to push the release lever (diaphragm) to disengage the.

Basic parameters of D395:

Type: D395 clutch.

Adjusting height of release lever: 70 ± 2.6 mm

Pressing force of pressure plate: 11000 ± 1500 N

Max disengaging force: 3800 N

Disengaging stroke of pressure plate: $10 + 2$ mm

Mass of pressure plate assembly: 27 kg

Max allowable speed: 2800 rpm

Mass of driven disc: 5.0 kg

Thickness of driven disc 10 ± 0.3 mm

Min thickness of driven disc: 7.0 ± 0.3 mm

Thickness of single friction lining: 3.5 mm

Allowable wear of single friction lining: 1.5 mm

Allowable side face runout of driven disc: 0.5 mm.

2. DISASSEMBLY AND ASSEMBLY OF

- a. Inspect the flywheel

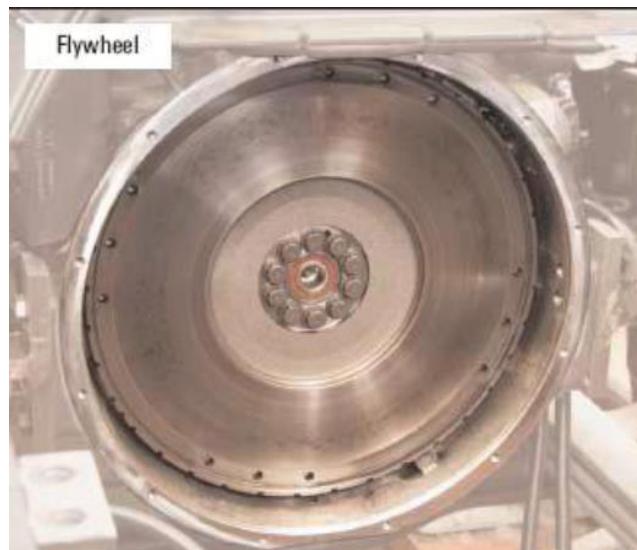


Figure 4. Inspect the flywheel

Inspect flywheel for flatness and any damage.

Inspect damaged threads.

Inspect the e.g facing damage at O.D.

Inspect the pilot bearing for free, easy rotation.

Keep bent axle, flywheel housing around away from oil or any other dirt.

Remove any dirt, grease or oil from the flywheel.

- b. Inspect the cover.



Figure 5. Inspect the cover

Inspect cover for damage.

Inspect the straps for any damage.

Inspect the diaphragm finger for deformation or any damage.

Lack of rivit.

Remove any dirt, grease or oil from the cover.

- c. Inspect the clutch disk.



Figure 6. Inspect the clutch disk

Inspect disk for damage due to dropping.

Inspect the disk for deformation.

Lack of rivet .

Keep dirt, oil ,grease away from clutch. Check disk spline and transmission input shaft spline for any damage and make sure that the disk can move easily on the shaft.

d. Inspect the releaser



Figure 7. Inspect releaser for oil leak

Inspect releaser for oil leak.

Inspect releaser for easy rotation.

Don't clean releaser with water, that will cause releaser failure.

Inspect transmission input shaft guide quill, release fork and diaphragm finger for any damage.

2. The clutch has been adjusted properly before delivery, so generally no adjustment is required during use. If adjustment is actually needed, it must be done by means of the adjusting nut on a special technical appliance, preventing pressure disc from tilting. The cambered surfaces on the end faces of the six release levers must contact the withdrawal collar. Runout of withdrawal collar end face should not exceed 0.4mm.

3. In order to ensure smooth operation of clutch, the pressure plate assembly and driven disc assembly has be balanced before delivery. No parts should be dismounted randomly in use. When the clutch has to be disassembled for repair purpose, a mark can be done at first. After repair is done, assemble it as per the original mark and balance it again.

4. When mounting or dismounting the clutch onto or from the engine, the bolts or nut to fix the clutch on the flywheel must be tightened or unscrewed alternately in a diagonal manner.

5. When installing the clutch, the driven disc spline and spline of transmission shaft 1 should be properly lubricated by heat resistant and overpressure resistant lubricating grease in such a way that the driven disc can move freely on the spline of transmission shaft 1. Excessive lubrication will make the friction lining be stained with oil, causing clutch slip, so take care to prevent.

6. During installation, take care not to damage the driven disc spline. Prevent the driven disc axial movement from being obstructed, causing inability to release.

7. Disengagement stroke of clutch must meet the requirement. Excessive engagement stroke may cause the release lever to contact the driven disc, very dangerous. Too small engagement stroke may result in incomplete disengagement of clutch.

8. When the clutch is in the engaged state, a clearance of 2 to 3 mm should be kept between the release bearing and diaphragm so that pressure plate can still press on the friction lining without interference in case of wearing of friction lining. Thus, engine torque can be transferred reliably.

9. The release bearing must be able to slide freely on the bushing of transmission shaft 1. Therefore, make sure the sliding plane is lubricated sufficiently and the bushing is positioned accurately.

10. The driven disc assembly should be replaced in time when the friction lining has been worn to the operating limit so as to prevent clutch slip, which may score the surfaces of pressure plate and fly wheel.

11. D395 clutch housing is made of grey cast iron, so during handling, place it carefully and never throw it randomly. Never hold and lift up the withdraw collar so as not to cause deformation of torsion spring.

12. It should be used correctly. Prevent clutch slip due to improper operations such as (a) starting at high throttle and high gear; (b) when changing into a high gear, pressing the accelerator pedal hard before the vehicle speed is high enough; (c) starting continuously the vehicle on a slope for many times; and (d) pressing down the accelerator pedal and pressing the clutch pedal halfway, trying to rush by force in case of wheel slip or sticking on the muddy road, etc. This will generate high temperature on the clutch due to continuous hard friction, causing pressure spring resilience to fade due to overheat, hence resulting in slip and if seriously, friction lining burning out, pressure plate deformation or even heat crack, which may bring forward serious aftermath.

13. In order to ensure coaxiality of clutch friction lining with flywheel and facilitate smooth thrusting in, clutch centering pin had better be used in installation of pressure plate assembly. The clutch centering pin is actually a transmission shaft 1. For installation, pass the centering pin through the driven disc and insert it into flywheel center bearing hole. After fixing the pressure plate assembly and flywheel, withdraw the centering pin (as shown in the figure).

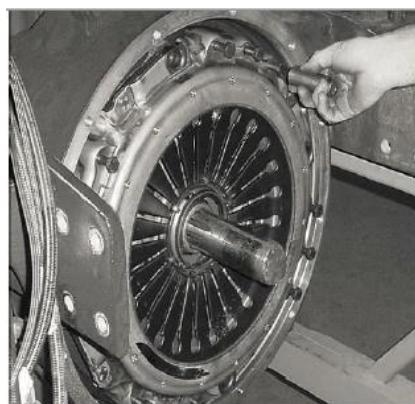


Figure 8. Installation of Pressure Plate (Using a Centering Pin)

14. When the driven disc is to be replaced, use a calliper to measure the free thickness of driven disc friction lining, which should be made not exceed 10.3 mm. Otherwise, incomplete disengagement of clutch may happen after installation.

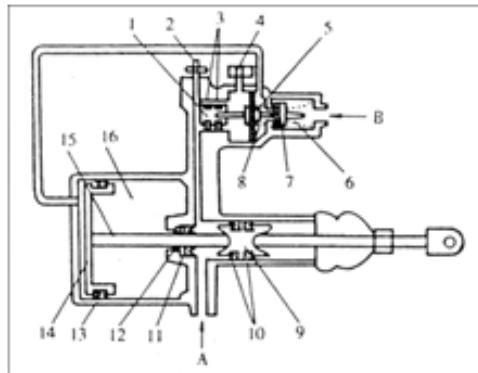


Figure 9. Schematic Diagram of Clutch Booster Structure

1. Control piston; 2. Bleeding screw; 3. Gasket; 4. Exhaust port; 5. Diaphragm assembly; 6. Spring; 7. Poppet valve; 8. Spring; 9. Hydraulic cylinder piston; 10. Gasket; 11. Gasket; 12. Oil seal; 13. Gasket; 14 Power Piston; 15. Push rod; 16. Spring; A – Oil inlet; B – Air inlet

CONTROL MECHANISM OF CLUTCH

Clutch control system of large buses is the hydraulic controlled, air-boosting remote control system. It consists of clutch pedal, clutch control master cylinder and clutch air-boosting hydraulic control cylinder.

When the clutch pedal is pressed down, the pressure oil from clutch master cylinder flows through oil inlet A (as shown in the figure) and then is divided into two branches. One of the branches forces the hydraulic cylinder piston 9 to move rightwards and the other branch is applied on the control piston 1, which forces the push rod of diaphragm assembly 5 to move rightwards so as to push the poppet valve 7 open. At this moment, the compressed air in the air reservoir enters into power cylinder through air passage from air inlet A and is applied on the power piston 14, thus forcing the power piston 14 and push rod 15 to move rightwards. This way, boosting is provided.

When the clutch pedal is released, the oil pressure reduces. The control piston 1 moves leftwards. The poppet valve 7 shut down the air source. The air in the power cylinder is discharged from the exhaust port 4 through the center hole of diaphragm assembly 5. The push rod 15 returns to its original position with the function of spring 16.

After installation of a new master cylinder and a boosting cylinder, or maintenance of the master cylinder and the boosting cylinder, air should be discharged from the hydraulic control system. Otherwise, the boosting cylinder cannot operate normally and the clutch cannot be released completely. An air bleed screw is provided on the boosting cylinder. First of all, fill up the oil tank attached on the master cylinder with automatic transmission oil (or hydraulic oil). Then press down the clutch pedal several times. Finally, press down to the end and hold the pedal. Loosen the air bleed screw on the boosting cylinder. Oil with air will be discharged. When discharging is finished, tighten the air bleed screw and press the pedal repeatedly again to discharge air. Repeat the above discharging procedure several times until pure oil is discharged from the air bleed screw. Then tighten the air bleed screw. Air discharging is finished.

3. CLUTCH FAILURES AND REMOVAL

Failure	Cause	Removal method
Clutch slipping	<p>1. The pressure spring is worn and too flexible, or resilience fades due to thermal deformation</p> <p>2. There is oil stain on the friction surface</p> <p>3. Clutch is overheated and friction lining is burnt out</p> <p>4. Friction lining is worn excessively</p> <p>5. No clearance is available between the release bearing and withdrawal collar</p> <p>6. Driven disc or pressure plate warps or deforms</p> <p>7. For a hydraulically controlled clutch, the pedal stroke is getting higher and higher during use</p> <p>8. Improper operation.</p>	<p>1. Replace the pressure plate assembly.</p> <p>2. Check and eliminate the source of oil stain. Remove the oil stain from friction surface or replace the driven disc.</p> <p>3. Replace the driven disc</p> <p>4. When wear limit is reached, replace the driven disc. Never rivet the friction lining randomly.</p> <p>5. Adjust the clearance to 2 to 3 mm</p> <p>6. Replace the driven disc or pressure plate assembly</p> <p>7. Check and adjust the stroke of master cylinder push rod or boosting cylinder push rod. Clear the oil passage. Make sure that the boosting cylinder push rod can return to the original position agilely.</p> <p>8. Operate correctly.</p>
Incomplete disengagement of clutch	<p>1. The adjusting position of release lever has changed and the pressure disc is inclined.</p> <p>2. Driven disc or pressure plate warps or deforms.</p> <p>3. Axial movement of driven disc is unsmooth.</p> <p>4. Friction lining is affected with damp and hence is adhered on the flywheel. Clutch of a new vehicle can not be released due to long time non-use.</p> <p>5. Transmission shaft 1 is not aligned with crankshaft.</p> <p>6. Free travel of pedal is excessive and clutch cannot be completely disengaged.</p> <p>7. For hydraulically operated clutch, oil passage system is short of oil or oil pressure is insufficient or there is air in it.</p>	<p>1. Adjust it according to the requirement.</p> <p>2. Replace the driven disc or pressure plate assembly.</p> <p>3. Repair the injured spline fit set. Remove the dirt and rust and apply oil on it.</p> <p>4. Treat the friction lining. Replace the driven disc in case of serious adherence.</p> <p>5. Check if they have been assembled as per the requirement.</p> <p>6. Adjust the free travel of pedal and check the disengagement stroke of clutch.</p> <p>7. Check and correct the sealing of the oil passage system and fill the oil or discharge the air from oil passage system completely.</p>

Vibration of clutch	<p>1. The adjusting position of release lever has changed.</p> <p>2. Driven disc warps, deflects and deforms.</p> <p>3. Difference in thickness of driven disc is too great. Friction lining surface is unsmooth and contact surface is uneven.</p> <p>4. Spring is broken, deflects or is thermal deformed, causing uneven pressure of pressure plate.</p> <p>5. Release bearing does not contact normally.</p> <p>6. Other causes such as:</p> <ul style="list-style-type: none"> (a) The fixing screws of pressure plate housing and flywheel are loose; (b) Shock prevention warm glue of the engine legs is damaged or the fixing screws are loose; (c) The fixing screws of transmission and flywheel housing are loose; (d) The newly replaced drive shaft oil seal is too tight; (e) Dragging of foot brake or hand brake. 	<p>1. Adjust it as per the requirement.</p> <p>2. Replace the driven disc.</p> <p>3. Replace the driven disc.</p> <p>4. Replace the pressure plate assembly</p> <p>5. Check the release bearing and release yoke for normal operation. Replace it if necessary.</p> <p>6. Find out the cause and shoot the trouble.</p>
Non-returning of boosting cylinder	The gaskets of boosting cylinder hydraulic piston, control piston or air boosting piston are seized, causing the piston unable to return rapidly.	Disassemble and check the boosting cylinder and replace the gaskets.
Non-act of boosting cylinder	<p>1. Air exists in the hydraulic control system.</p> <p>2. It is short of oil</p> <p>3. Gasket of master cylinder piston is damaged</p>	<p>1. Discharge air.</p> <p>2. Replenish oil.</p> <p>3. Replace the gasket.</p>
Oil discharged from boosting cylinder air exhaust port	The gasket between boosting cylinder and hydraulic cylinder is damaged.	Disassemble and check the boosting cylinder and replace the oil-air separation gasket.
Air leakage from boosting cylinder air exhaust port	The air boosting poppet valve of boosting cylinder is not sealed tightly	Replace the air boosting poppet valve
Heavy clutch pedal	<p>1. Air boosting cylinder does not operate.</p> <p>2. Air pressure is too low.</p>	<p>1. Examine and repair the air boosting cylinder.</p> <p>2. Check and find out the cause of low pressure.</p>

TABLE OF CONTENTS

1. Summary.....	2
2. Operation and maintenance.....	2
2.1. Checking the oil tank	3
2.2. Performing air discharge step on the hydraulic system	3
2.3. Steps to change lubricating oil	4
2.4. Adjusting limit valve.....	4
3. Guessing error and maintaining	4

1. Summary

Principle of operation:

When you rotate the hand wheel from left to right, the moment will transfer to the valve cover, the twisted bar is connected to the active axle via the control device. At the same time, the tire resistance will be transferred back to the drop arm, through the structure of the ball screw to the twisted bar. After that, the twisted bar is deformed and the valve cover on the active axle rotates a certain angle compared to the valve slot. The pressure from the power steering pump goes to the top or bottom of the piston to push the piston up and down. Finally, the actuator pulls the tire back to the right or left by the drop arm.

This specification is only suitable for SB brand Power Steering Gearbox. Illustrations and symbols on the specification make it easy to find the location of parts and names.

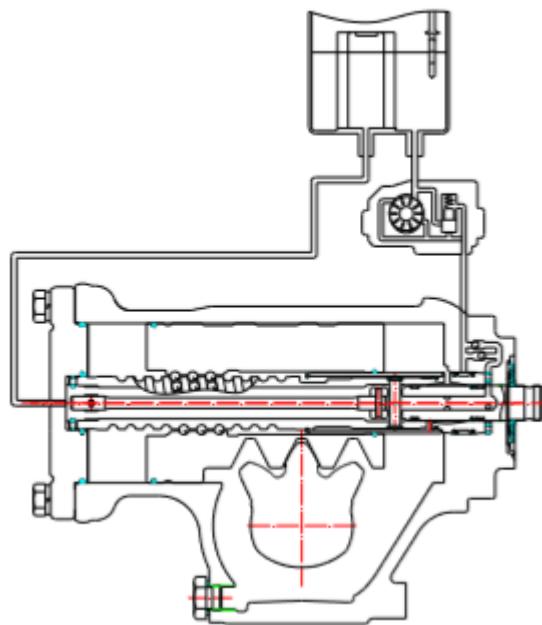


Figure 1. Operation principle

2. Operation and maintenance

➤ **Note:**

- 1) When the hand wheel turns to the maximum position and stops immediately, the stop time must not exceed 10 seconds.

- 2) If it is difficult to control the hand wheel, please stop and check the vehicle. If the Power Steering Gearbox is difficult to drive (for example, power steering pump problem), the vehicle can be controlled by increasing the force of the driver's impact on the hand wheel by hand but cannot work for long time.
- 3) The steering oil and oil filter element should be replaced when the vehicle runs about 5,000 km and after every 25,000 km depending on the user's usage.
- 4) Steering system and steering oil tank must be added to N32 or similar products. This oil is usually high intensity, good viscosity. At a temperature of 50°C, the viscosity is about $27 \times 10^6 \text{ m}^2 / \text{S}$. Please do not choose poor quality oil or mix with other oil. How to add oil should follow the technical characteristics of the Power Steering Gearbox.
- 5) The power steering pump and the steering oil tank must be placed as close as possible, the oil bottom must be higher than the entry of the oil pump.
- 6) If you are not sure about the operating principle of the steering system, let the technicians and professional repairmen check and adjust.

2.1. Checking the oil tank

- 1) Starting the engine in a flat place and let the engine spin slowly. Then, driving the hand wheel clockwise or counterclockwise. If the oil has air bubbles (air bell) or white oil appears inside the oil tank, the new oil must be changed or air is discharged because if the oil has air bubbles or is emulsified, it means the oil has mixed with air.
- 2) If the properties of oil are constant and there is no air in the oil. If only a slightly higher oil level is needed, a leak problem may occur, please check and repair this part. Then, add oil to the designated location.

2.2. Performing air discharge step on the hydraulic system

- 1) Turn the hand wheel all the way from left to right and vice versa a few times to add more oil to the tank.
- 2) When the lubricating oil is stable (does not change the oil level and no air bubbles). Restarting the engine, turn the hand wheel all the way from left to right and vice versa a few times. If no bubbles appear, it is done.

2.3. Steps to change lubricating oil

- 1) Using a shim to hold the front tire.
- 2) Opening the cover of the oil tank, installing the air exhaust pipe.
- 3) Restarting the engine (less than 10 seconds) to discharge air bubbles in the oil pump and oil tank.
- 4) Turning off the device, turning the hand wheel all the way from left to right and vice versa a few times and discharging air bubbles from the system.
- 5) Cleaning oil tank and oil filter.
- 6) Cleaning oil pump, safety valve, butterfly throttle-valve and oil pipe.
- 7) After completing the above 6 steps, adding new oil with the filter until the new oil flow spills out of the filter's mouth.
- 8) Installing and tightening the filter. Then, discharging the air.

2.4. Adjusting limit valve

- 1) Before installing the Power Steering Gearbox, loosening the nut to the end of the bolt.
- 2) Starting the engine, turning the hand wheel from left to right. After that, twisting the limit valve and adjusting the bolts, fixing the nut; turning the hand wheel from right to left and repeat in the next step.
- 3) Note: when the position of the bolts in the front axle is changed, the corresponding bolts on the steering system must be adjusted, or the function of the limited valve will be lost and damage the steering system.

3. Guessing error and maintaining

When there are some steering system problems, please do not rush to collapse and repair the steering wheel. In fact, the steering wheel is the last check, there are a few other parts that should be checked first:

- 1) Checking hand wheel, tires
- 2) Checking whether the oil level of the tank is normal.
- 3) Checking whether the oil pipe is properly installed. If not, correcting or replacing it.
- 4) Checking whether the front tire is fixed and is loose.

TABLE OF GUESSING ERROR AND REPAIRING

Cases	Reason	Solution
Difficult to drive	<p>1. Too little oil in the tank or oil level is lower than the required level.</p> <p>2. Roan sealing of oil pumps is not good.</p> <p>3. The oil pipe is blocked because there is too much sediment in the oil filter; the old pump is damaged</p> <p>4. The oil pump is damaged and contains lead.</p> <p>5. Safety valve, spring are damaged.</p> <p>6. The sealing ring of the Power Steering Gearbox and damper is damaged.</p>	<p>1. Checking whether oil leaks and repairing. Then, if there is no problem, filling the tank with oil.</p> <p>2. Renewing roan sealing of oil pumps and discharging the air.</p> <p>3. Sealing the connector or replacing the connector or new sealing ring.</p> <p>4. Cleaning oil pipes and oil filters.</p> <p>5. Renewing.</p> <p>6. Replacing damaged parts and renewing sealing ring.</p>
Unusually turn the hand wheel	<p>1. Pressure from power steering pump is low. Air from hydraulic pipes leaks.</p> <p>2. The exhaust pipe is blocked.</p> <p>3. Steering control valve or cylinder is locked.</p> <p>4. Place of control valve is not suitable</p>	<p>1. Checking the safety valve, renewing it if necessary. Keeping the leaked place safely. Then discharging the air.</p> <p>2. Replacing the exhaust pipe.</p> <p>3. Maintenance.</p> <p>4. Maintenance.</p>
The hand wheel works in the wrong	<p>1. The lubricating oil is dusty so the control valve cannot work properly.</p>	<p>1. Cleaning steering system and changing lubricating oil.</p> <p>2. Adjusting the control valve to</p>

direction(should check on 2 sides)	2. The core of the steering control valve is in the central position but the joint is not identical to the slot of the valve body. 3. The flow of oil pump or high pressure oil pipes is not well arranged.	the central position or renewing the control valve. 3. Checking butterfly throttle-valve or high pressure oil pipe.
Hardness is not the same when driving to the right or left.	1. The core of the steering control valve is in the central position but the joint is not identical to the slot of the valve body. 2. There is dust on the control valve, so the resistance from right and left is different. 3. Some sealing parts in a certain hole has been damaged. 4. Damaged oil pipelines lead to no good adjustment.	1. Adjusting the control valve to the central position or renewing the control valve. 2. Cleaning the control valve. 3. Renewing the sealing parts. 4. Checking where the leak is and repairing it. Adjusting again.
The hand wheel is shaken when turning.	1. Low oil level. 2. Air leakage on hydraulic oil spring leads to reduction of the oil pump's pressure. 3. Oil pump is blocked.	1. Adding new oil and finding where the leak is. 2. Maintaining the leaked place to discharge the air. Checking whether the oil pump belt is slippery, whether the oil pump safety valve is adjustable, renewing the oil pump if necessary. 3. Checking the control valve.
There is noise	1. The oil level in the tank is too	1. Checking where the leak is

when turning the hand wheel.	<p>low, so the air easily enters.</p> <ol style="list-style-type: none"> 2. Air leakage on hydraulic oil spring leads to reduction of the oil pump's pressure. 3. Oil filter is blocked or there is too much dust in the hydraulic oil spring. 4. The connector of the oil pipe is loose or damaged. 5. The oil pump is broken. 	<p>and repairing it, adding oil and discharging air.</p> <ol style="list-style-type: none"> 2. Repairing the leaked location. Then discharging the air. 3. Cleaning dust and pumping the oil. 4. Fixing the connector or renewing the oil pipe. 5. Renewing.
There is noise when turning the hand wheel	5. The function of the steering control valve is not good.	5. Maintaining.
There are air bubbles in the tank, the oil level or output pressure of oil pump is too low.	1. There is air or leakage in the steering system.	1. Checking for leaks in the system and repair, if the oil level is not low, but there is air bubbles in the pipeline, moving it away from the vehicle, checking the cover, screwing and repairing it.
Heavy hand wheel	<ol style="list-style-type: none"> 1. Oil level is low. 2. Oil flow of oil pump is too high. 	<ol style="list-style-type: none"> 1. Please adding steering power oil as required. 2. Please checking the pressure of the pump and repairing it.
Oil pressure from the pump is low.	<ol style="list-style-type: none"> 1. Control valve does not work. 2. Pressure circuit or oil pump Stator is uneven. 3. Broken oil distributes on shell and oil pump stator. 	<ol style="list-style-type: none"> 1. Cleaning dirt. 2. Flattening. 3. Replacing damaged parts and cleaning it. 4. Reinstalling properly.

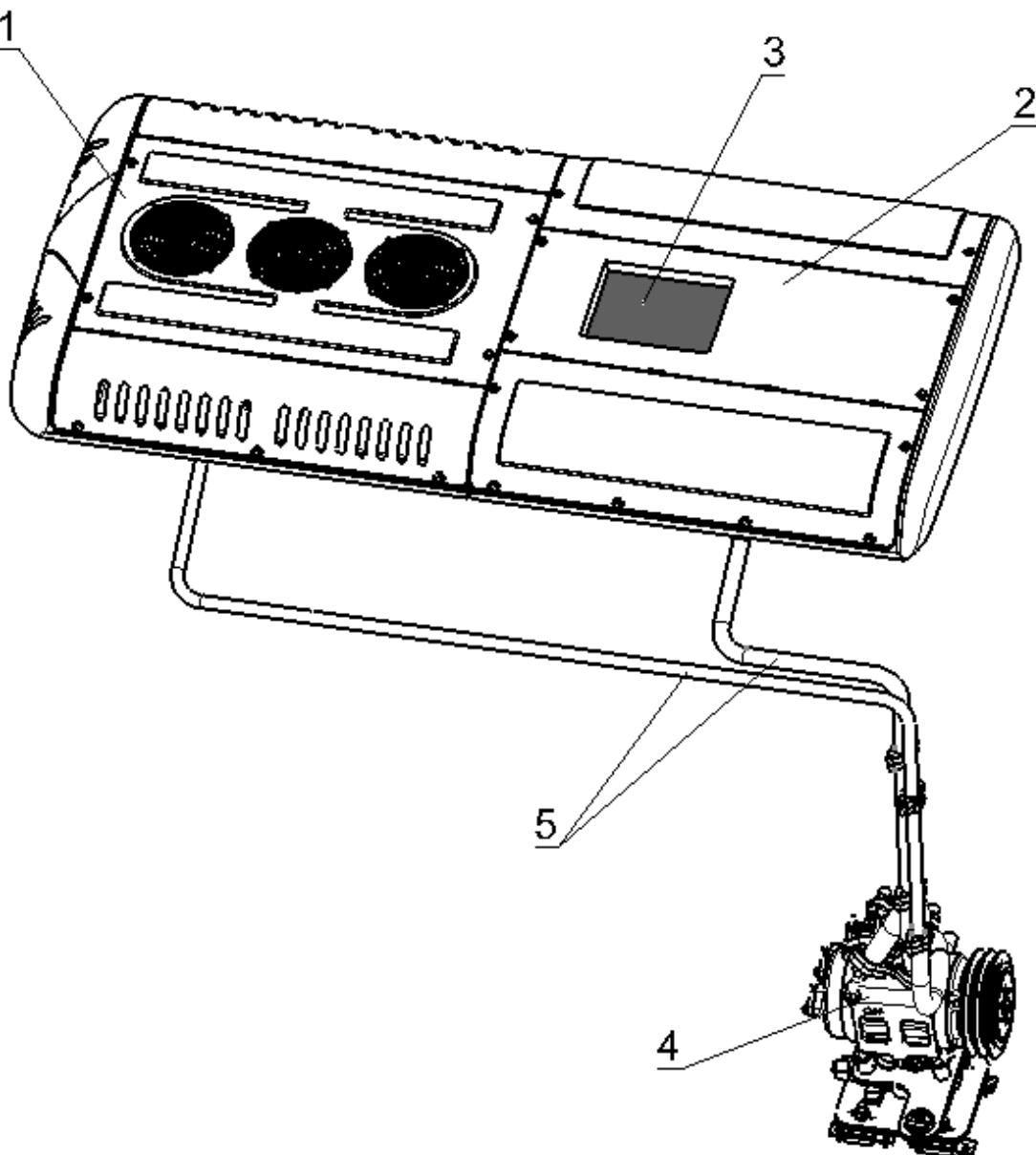
	<p>4. The impeller installs incorrectly.</p> <p>5. The impeller is blocked in the groove of the oil pump roto.</p> <p>6. A small amount of broken oil distributes in the shell.</p>	<p>5. Cleaning.</p> <p>6. Renewing the parts.</p>
--	---	---

TABLE OF CONTENTS

PART 1: TECHNICAL SPECIFICATIONS OF AIR CONDITIONING SYSTEM	2
PART 2: DESCRIBING THE AIR CONDITIONING SYSTEM	3
PART 3: MAINTENANCE, GUESSING AND REPAIR OF ERRORS	4
1. Maintenance	4
1.1. Warning for drivers	4
1.2. Air filter check.....	4
1.3. Belt check	4
1.4. Magnetic clutch check.....	5
1.5. Compressor lubricating oil check.....	5
1.6. Check of the gas filter and the amount of gas	6
1.7. Note when checking air conditioner.....	7
2. Troubleshooting of air conditioning system	10
2.1. The damage of the electrical part.....	11
2.2. The damage caused by part's errors	12
3. Other incidents	13

PART 1: TECHNICAL SPECIFICATIONS OF AIR CONDITIONING SYSTEM

Size of evaporator (L x W x H)	1350 mm x 1640 mm x 185 mm
Cooling capacity	20000 kcal/h
Weight of evaporator	48 Kg
Size of condenser (L x W x H)	1350 mm x 1561 mm x 185 mm
Wind flow	3500m ³ /h
Weight of condenser	78 Kg
Cold gas compressor	TM-43
Compressor capacity	425 cc/rev
Weight of Compressor	13.5 Kg

PART 2: DESCRIBING THE AIR CONDITIONING SYSTEM

- 1. Condenser
- 2. Evaporator
- 3. Control

- 4. Gas compressor
- 5. Gas pipe

PART 3: MAINTENANCE, GUESSING AND REPAIR OF ERRORS**1. Maintenance****1.1. Warning for drivers**

- When the air conditioner warning light appears on the dashboard, you need to turn off the air conditioning system. If the operation continues, the magnetic clutch may be damaged by the clutch from continuously closed and disconnected.
- Turning on the air conditioner when the engine just starts, sudden acceleration may result in compressor failure.
- Following the instructions below to avoid accidents during air conditioning repairs.
 - ✓ Using ladders and ladders must be firmly fixed when using.
 - ✓ Wearing protective shoes to avoid slipping.
 - ✓ Making sure to disconnect the start switch when working in the engine compartment.

1.2. Air filter check

Check of the air filter is a very important step, it needs to be cleaned every week. To clean the air filter with compressed air, blow the air in the opposite direction to the air flow when the air conditioner operates. Then removing dirt with warm water or neutral detergent. Drying before reinstalling.

1.3. Belt check

- 1) Checking belt is also a very important check step.



Figure 1. Waring appears

- 2) Checking belt tension every week, and adjusting to a reasonable tension.

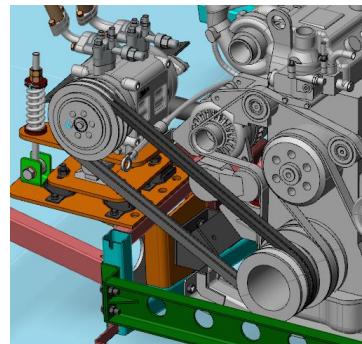


Figure 2. Belt check

- 3) If the tension is outside the standard, loosen nut (figure 4) counterclockwise, adjust nut (figure 5) clockwise to standard tension, lock nut (figure 6) clockwise.

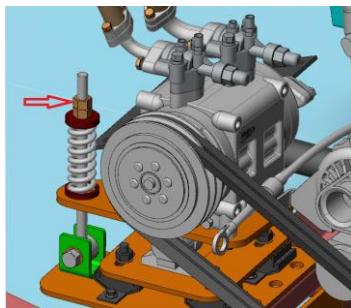


Figure 4

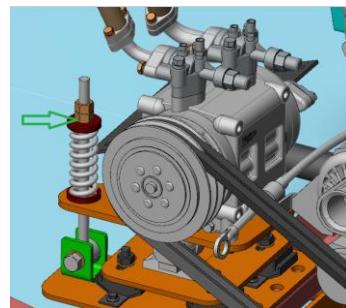


Figure 5

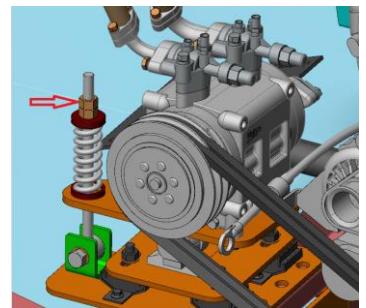


Figure 6

1.4. Magnetic clutch check

- 1) Checking the magnetic clutch.
- 2) Checking the operation of the magnetic clutch from turning on and off the compressor's close switch. If the magnetic clutch does not work properly, checking the electric control part.



Figure 7: Check clutch

- 3) Checking the gap of the magnetic clutch with a leaf ruler (0.5 mm).

1.5. Compressor lubricating oil check

- 1) Compressor oil is very important, it affects the smooth operation of the air conditioning system.
- 2) Checking the color and capacity of the lubricating oil monthly through the eye to check compressor check.

Reasonable oil level is 1/2 ~ 2/3 of the glass height.



Figure 8:Oil check

- 3) Adding oil if missing and don't forget to check the oil when replacing any details.
- 4) If the amount of oil is too much, it will reduce the heat exchange capacity. If the amount of oil is too small, it will reduce lubrication.
- 5) Through the color of the lubricating oil can guess the damage:

- ✓ If the oil is black, the compressor needs to be checked because the color can be changed by carbonization.
- ✓ If the oil is silver, the steering knuckle parts of the compressor's connecting rod may have become worn out, checking the compressor
- ✓ If the oil is milky, water may have mixed in the gas. These cases usually occur due to maintenance and repair errors, or when vacuum is not good.
- ✓ It is necessary to avoid working on the gas line operating on rainy days.

1.6. Check of the gas filter and the amount of gas



*Figure 9: Position more oil
and repairing.*

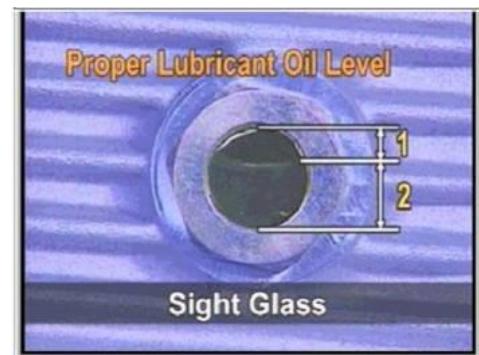


Figure 10. Oil level

- 1) When the gas line is contaminated, the filter may be blocked. Check the filter block by using the hand to feel the difference in temperature between the inlet pipe and the outlet pipe. If not blocked, the temperature will be equal at both ends of the filter.
- 2) If there is a temperature difference, it is necessary to replace the filter. You should check the gas filter every month.
- 3) Inadequate cold refrigerant gas will affect cooling capacity. Checking the amount of gas every week.
- 4) Checking the amount of gas through the check eye after turning on the air conditioner for 5 minutes.
- 5) When enough cold refrigerant gas, do not see bubbles in the check eye.
- 6) If you see a bubble, it means lack of gas.

1.7. Note when checking air conditioner

1) When the ambient temperature is low, bubbles can appear despite enough cold refrigerant gas. Therefore, checking the amount of cold refrigerant gas when the ambient temperature is over 20°C.

2) When the tachometer changes rapidly, bubbles can also appear despite enough cold



Figure 11. Gas filter

- 7) If there are many large bubbles, it means that there is a lot of gas.



Figure 12. Check eye

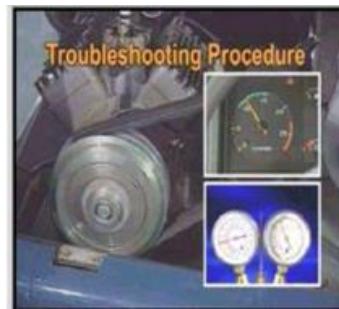


Figure 12. Check gas

refrigerant gas. Please maintain the speed of 1,100 revolutions / minute when conducting the check.

3) After a long period of operation, the amount of cold refrigerant gas may be lacking because there is a very small leak in the system, so need to add cold refrigerant gas. However, after adding the gas, the air conditioning system quickly lacks gas again, which means that the system has been seriously leaked, needing to find leaks and repairing.

4) Gas leakages will be damp due to cold refrigerant gas and clinging oil , so it can be checked with the naked eye.

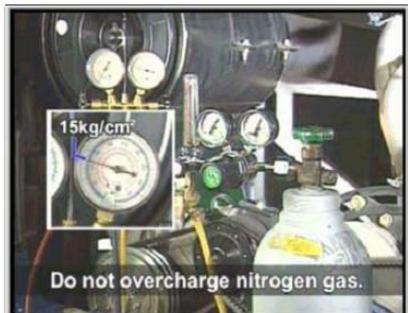
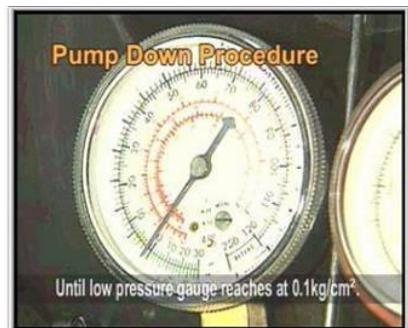


Figure 13. Gas leakage

- 5) When checking gas leakage, first check the connectors and welds.
- 6) When damage occurs on the low-pressure assembly, the gas accumulation is very helpful.
- 7) Gas accumulation means moving all cold refrigerant gas on low pressure place to high pressure place. At this time, it is possible to carry out repair or replacement of the compressor, evaporator, butterfly throttle-valve, filter, low pressure pipeline without discharging gas.
- 8) The process of gas accumulation according to the following steps:
- ✓ Attaching the gas meter to the air conditioning system.
 - ✓ Fully closing the gas valve on the roof to block the gas line.
 - ✓ Starting the engine and turn on the air conditioner close button, when the red warning light appears on the control panel and low-pressure side pressure drops below 0.6 kg / cm², the compressor stops working due to magnetic clutches from interrupts.

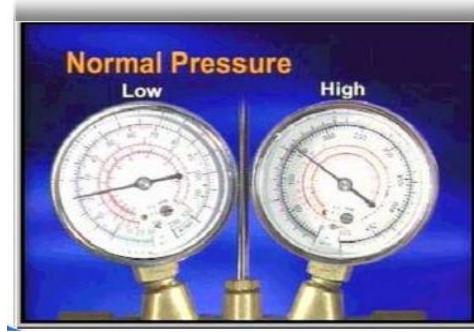
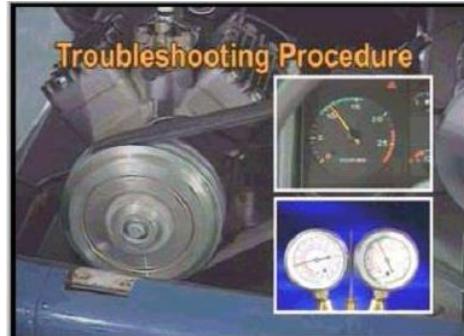


- ✓ Just then, turning off the engine and completely closing the high-pressure close valve on the output of the compressor.
 - ✓ At this time, the gas has been transferred and kept on the high-pressure line, be careful to observe the pressure gauge of the low pressure part. If this pressure gauge moves up gradually, it means that the accumulation process fails or you need to tighten the gas close valve.
 - ✓ And although the meter is below $0.6 \text{ kg} / \text{cm}^2$, you should remove the low pressure pipeline to prevent strong pressure discharge (including oil) because there is still a small amount of gas remaining.
 - ✓ After finishing the work, use a vacuum pump to empty the air in the low pressure line and check for leakage. Opening the gas close valve at the compressor and on the roof.
- 9) When performing maintenance and repair of the air conditioning system, attention must be paid to the following issues:
- ✓ Using nitrogen gas to check the seal will avoid moisture entering the system, but should not exceed $15\text{kg} / \text{cm}^2$ of nitrogen gas.
 - ✓ If over $15\text{kg} / \text{cm}^2$ is loaded, it will cause an explosion.
 - ✓ When refueling, maintain the tachometer of 1,100 revolutions / minute and add gas through the low pressure side charging connection.
 - ✓ If the refueling procedure is carried out incorrectly, it can cause serious damage to the compressors.
 - ✓ Do not adjust the butterfly throttle-valve. In fact, adjusting the butterfly throttle-valve when



you see poor air conditioning is wrong. We need to find the exact cause for this case.

- ✓ Do not change metal tubes or flexible tube. This change can result in reduced cooling capacity due to cold gas flow barrier and can cause cracking.

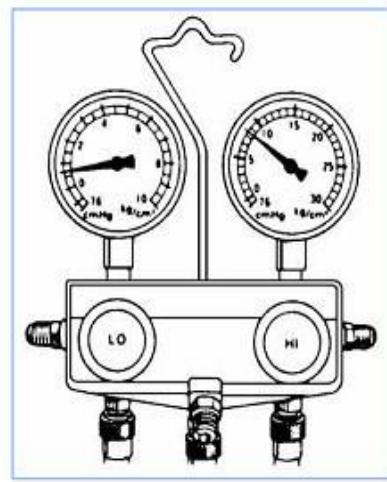


- 10) When the warning light is on, or when the cooling capacity is unsatisfactory, use the gas meter to check.

➤ **Check process:**

- Attaching the meter to the gas charging port on the low and high pressure parts.
- Starting the engine and turning on the air conditioner to fan at the highest wind level.
- Running air conditioner for more than 5 minutes at 1,100 revolutions/ minute, then reading the indicator shown on the meter .
 - ✓ When the ambient temperature is **25°C**, the pressure is **normal** if the high pressure is about **8 ~ 18kg / cm²** and the low pressure is about **1.5 ~ 3kg / cm²**.
 - ✓ However, normal pressure may change depending on the ambient temperature and humidity.
 - ✓ If the ambient temperature is high, low pressure is almost unchanged but high pressure slightly increases.
 - ✓ If the ambient temperature is low, low pressure is almost unchanged but high pressure slightly drops.

2. Troubleshooting of air conditioning system



2.1. The damage of the electrical part

INCIDENT	REASON	TROUBLE SHOOTING	NOTE
Air conditioner does not work.	<ul style="list-style-type: none"> - 3A fuse (in the fuse box) is exploded. - The main fuse of the air conditioner is broken. 	Replacement	After replacing if the fuse continues to explode, check the mass touch.
Operation of the condenser fan is wrong	<ul style="list-style-type: none"> - The electric wire is broken. - Error of thermostat. 	<ul style="list-style-type: none"> - Re-connection - Relacement 	Air conditioning fuse board or thermostat
Compressor does not work (turning condenser fan).	<ul style="list-style-type: none"> - 3A fuse (in the fuse box) is exploded. - The electric wire is broken. - Error from electric solenoid of magnetic clutch. 	<ul style="list-style-type: none"> - Relacement - Re-connection - Relacement 	Checking the magnetic clutch gap (0.5mm). Making sure the power lines are good for mass.
Fan of condenser does not run.	<ul style="list-style-type: none"> - 20A fuse (in the fuse box) is exploded. - The electric wire is broken. 	<ul style="list-style-type: none"> - Relacement - Re-connection 	After replacing if the fuse continues to explode, check the mass touch.
The warning light is always on when the A/C operates.	The electric wire of the high / low pressure switch touches the mass of the chassis	Repair	Checking the operation of the compressor and condenser fan
Other incidents.	<ul style="list-style-type: none"> - Relay error. - Touching the mass or breaking the electric wire - Fuse explodes. 	<ul style="list-style-type: none"> Repair or Relacement 	If the relay fails, replace it with a backup relay in the fuse box

2.2. The damage caused by part's errors

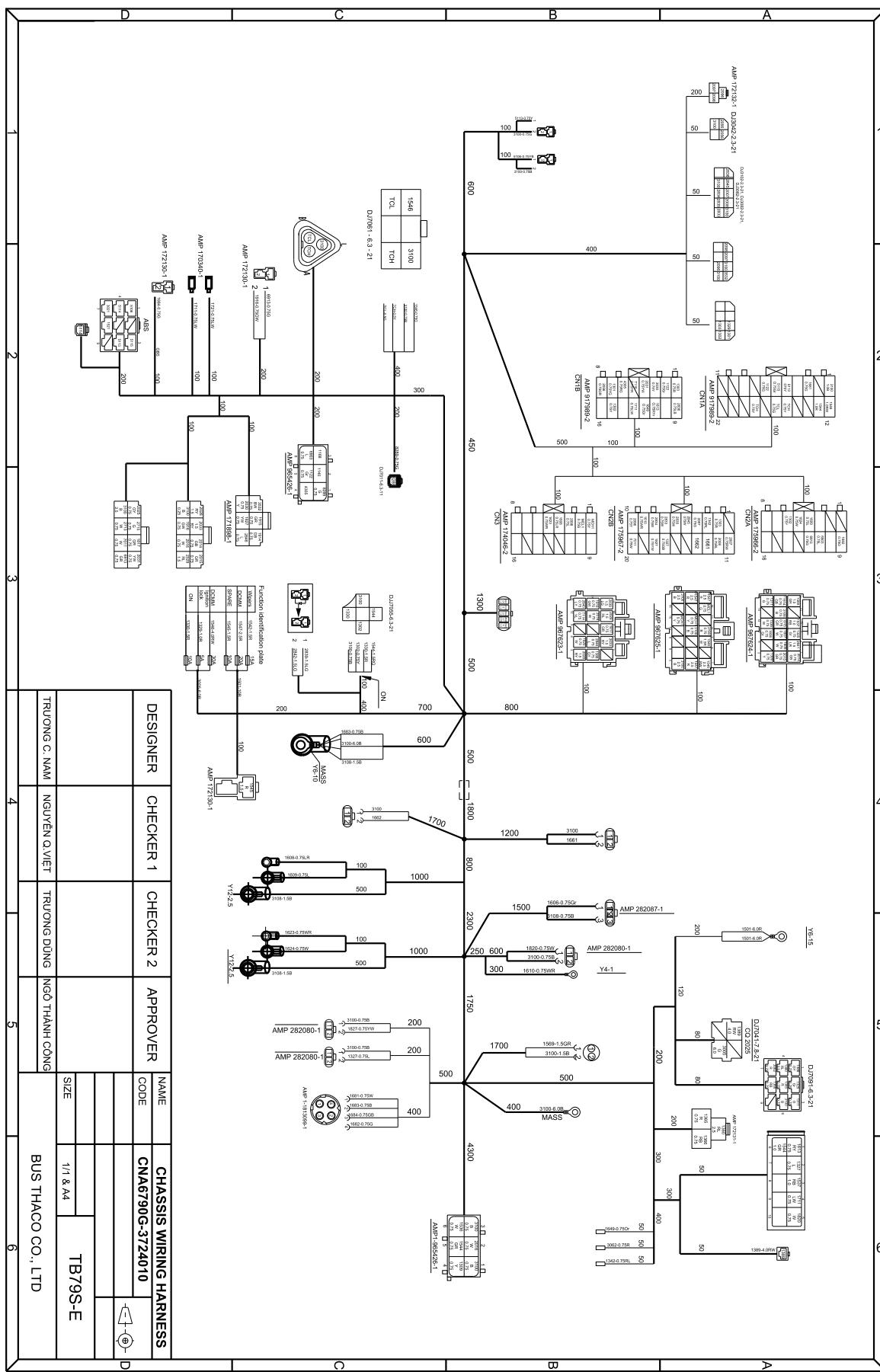
INCIDENT	REASON	TROUBLE SHOOTING	NOTE
High-high pressure	1. Condenser is dirty or blocked 2. Overcharge gas 3. Gas filter is blocked 4. There is air in the system 5. Error of condenser fan	1. Cleaning by compressed air 2. Discharging gas 3. Replacing filter particles 4. Cleaning air 5. Replacement	Observing gas charging meter and gas check eye
High-low pressure	Loading lack of gas	Adding gas	If the gas check eye does not see bubble, which means that there is excess gas
Low-high pressure	1. The heat-sensing ball of the butterfly throttle-valve is poorly insulated and the contact is not good 2. Van luppe of the compressor is broken	1. Tightening contact and insulation points.	Normal pressure: High pressure: 8 ~ 18 kg / cm ² Low pressure: 1.5 ~ 3 kg / cm ²
Low-low pressure	1. Loading lack of gas 2. Pipes, filters and butterfly throttle-valves are blocked. 3. Open the wind in the evaporator 4. Wind filter is dirty 5. There is moisture in the	1. Checking the gas leakage and adding 2. Repair/ placement 3. Closing up 4. Washing wind filter net 5. Cleaning air 6. Replacing the butterfly throttle-valve	When the gas filter is blocked, the inlet and outlet temperatures are diffrent. Gas pressure for gas leak check is

	system 6. Butterfly throttle-valve is damaged		not higher than 1.8 times normal pressure
--	---	--	---

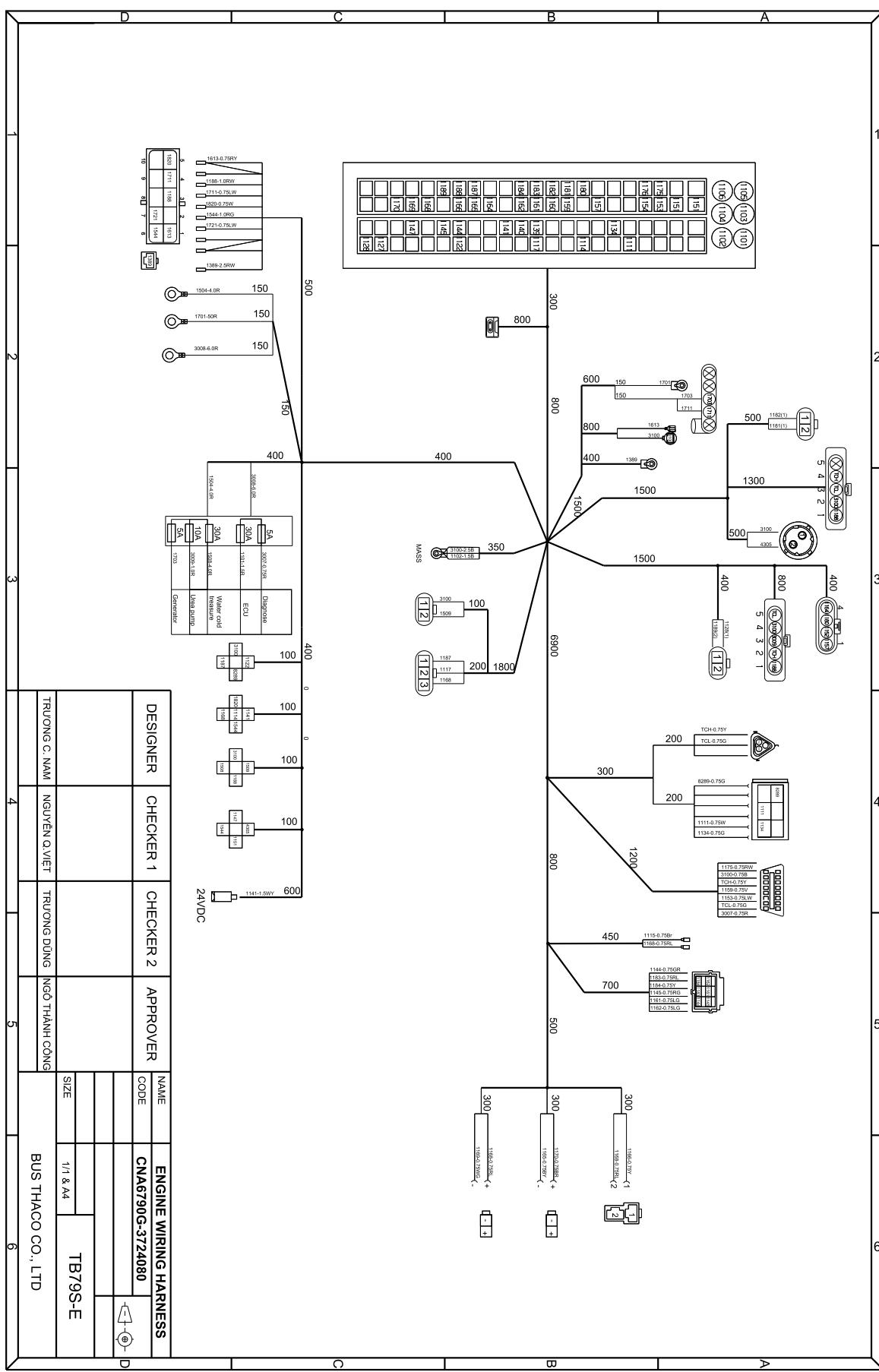
3. Other incidents

INCIDENT	REASON	TROUBLE SHOOTING
There is abnormal vibration or noise	1. Bolts and nuts are loosed 2. The belt is too tight 3. The belt is too loose 4. The intermediate puli suffer from dry lubricant oil 5. The intermediate puli ball and clutch is worn out a lot 6. The bearer is broken 7. The buffer rubber is aging	1. Tightening 2. Adjustment 3. Adjustment 4. Greasing 5. Replacement 6. Replacement 7. Replacement

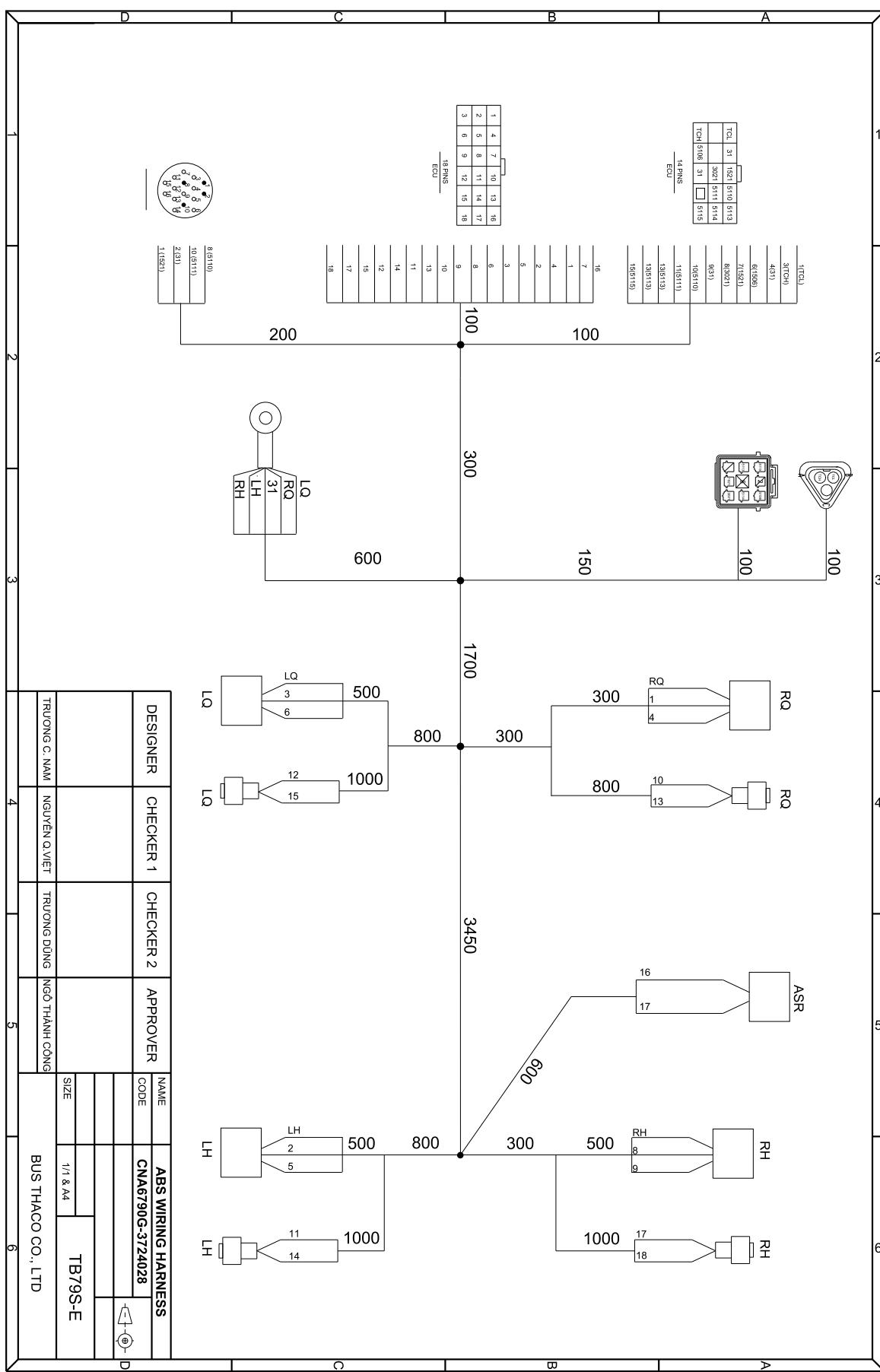
CHASSIS WIRING HARNESS



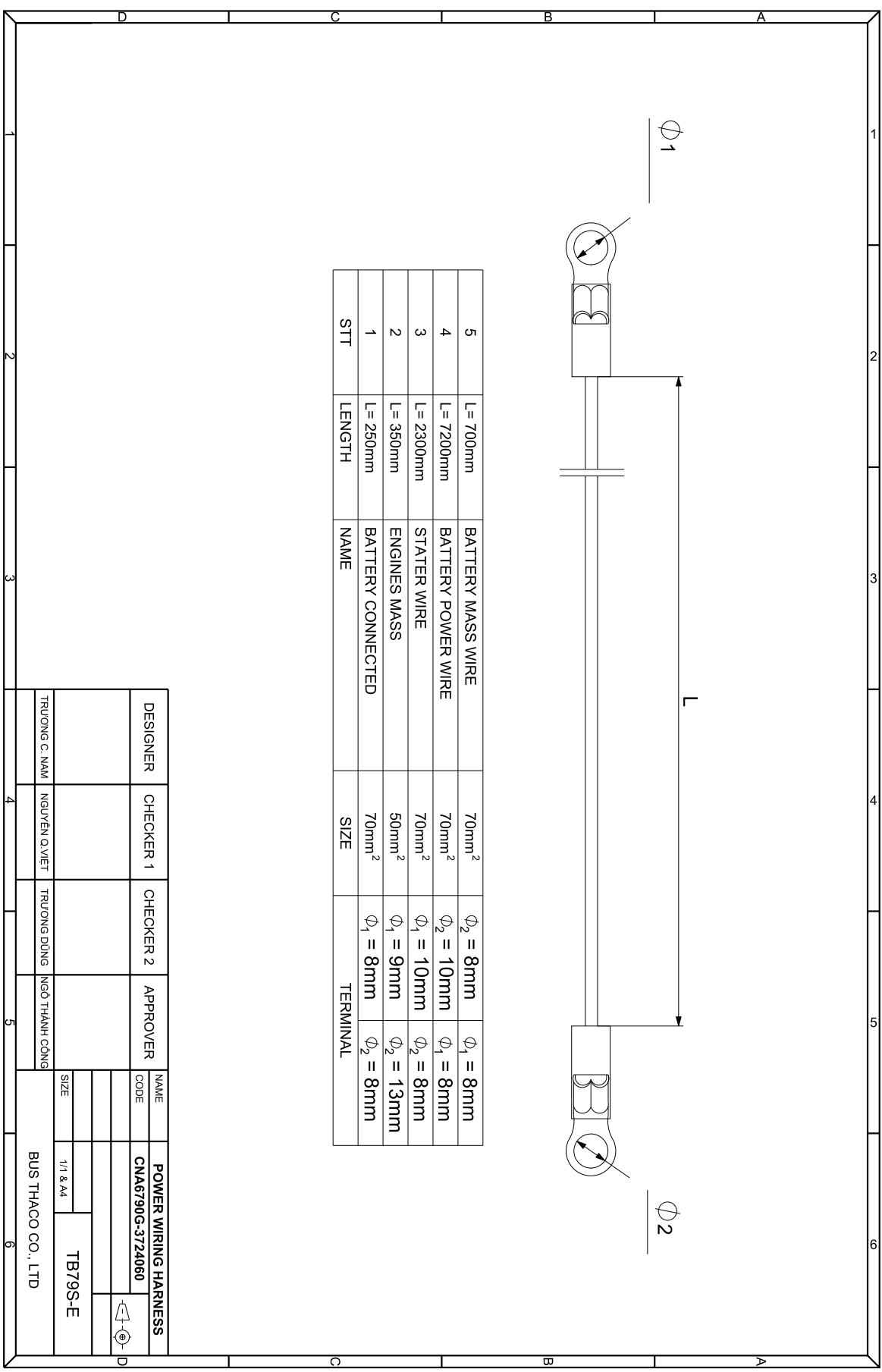
ENGINE WIRING HARNESS



ABS WIRING HARNESS



POWER WIRING HARNESS



POWER BOX CQ2025

