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Chapter 1 Diesel Engine

1.1 General introduction of diesel engine

1.1.1 Specifications of diesel engine

Table 1-1

Engine model	YND485Q	490QB	490QZL	4100QB	4100QB-2
Type	In-line, water cooling, four-stroke, direct ejection		Exhaust gas turbo mid-cooling and supercharging	Vertical, in-line, water cooling, four-stroke, direct ejection	
Number of cylinders-bore x stroke (mm)	4 - 85×90	4 - 90×105	4 - 90×100	4 - 100×105	4 - 100×115
Cylinder sleeve style	wet				
Total displacement, L	2.156	2.67	2.54	3.298	3.612
Compression ratio	18	18	17	17.5	
Rated power and speed (KW/r/min)	13 ~ 36/1500 ~ 3200	48/3200	52.5/3200	58.8/3200	66.2/3200
Maximal torque/speed (N.m/min)	≥56.4	166.6/2200	183/2000~22 40	201/2000~22 00	230/2000~22 00
Fuel consumption at rated working condition, g/kw.h	≤247	≤265.2	≤255	≤238	
Oil consumption g/kw.h	2.72	≤2.72	≤1.63	≤2	
Highest	Speed at rated power +10%				

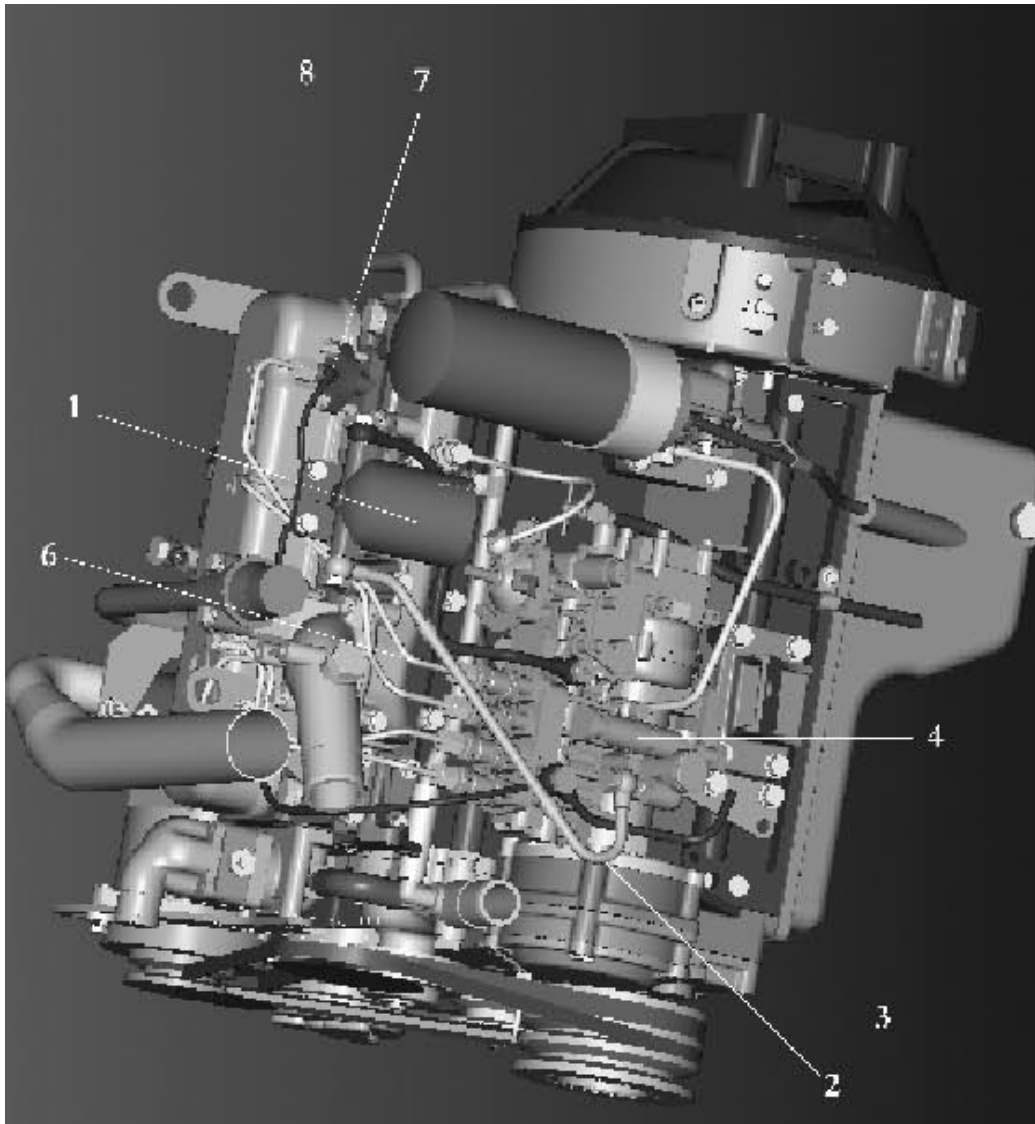


Fig. 1-3 Intake system of fuel supply system

1-fuel filter; 2-fuel pipe-to fuel inject pump; 3-fuel pump-to fuel filter; 4-fuel delivery pump;
5-fuel inject pump; 6-high pressure fuel pump; 7-fuel return pipe of fuel injector; 8-fuel injector.

2. Change and repair

A. Disassemble:

Tool: Wrench

Disassemble the fuel delivery pipe between fuel delivery pump and fuel filter.



Disassemble the fuel delivery pipe between fuel



1.3.2 High pressure fuel pipe assembly

1 Description

·High pressure fuel pipe is used to deliver the high pressure fuel supercharged by fuel inject pump to fuel injector.

The four high pressure pipes have different shapes but the same length and are fastened by several pipe clamps at relevant portion. The pipe clamps will fix the high pressure fuel pipes as so to reduce their vibration.

2. Change and repair

A. Disassemble:

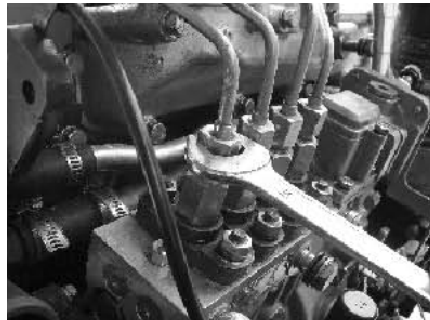
Tool: Wrench

Loosen the bolt of high pressure fuel pipe clamps and disassemble the clamps.



Tool: Wrench

Loosen the connecting bolts between high pressure fuel pipes and fuel inject pump as well as between fuel injector and high pressure fuel pipes and disassemble high pressure fuel pipes.



B. Installing:

Tool: Wrench

Connect the connecting bolts at two ends of high pressure fuel pipe respectively to fuel inject pump and fuel injector inlet and then tighten the nuts.



Tool: Wrench

Tighten the high pressure fuel pipe clamp bolts at their original position.



1.3.5 Fuel inject pump

1 Description

·Fuel inject pump is used to increase the pressure of fuel. It can deliver high pressure fuel of certain quantity at certain time through high pressure fuel pipe to fuel injector according to the relevant working conditions

·The fuel inject pump is a kind of in-line plunger pump. It together with speed regulator and fuel delivery pump forms fuel inject pump assembly.

2. Change and repair

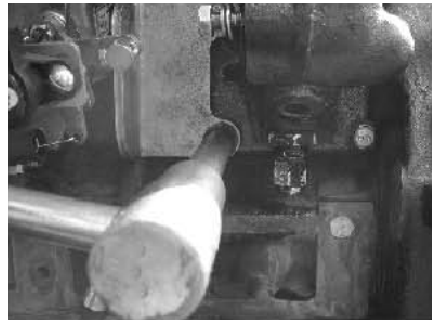
A. Disassemble:

Prior work:

- (1) Disassemble high pressure fuel pipe;
- (2) Disassemble connecting bolts between low pressure fuel pipes, boost compensator pipe, lubricating oil pipe, and, fuel inject pump;
- (3) Disassemble throttle wire and fuel shut-off solenoid valve wire;
- (4) Disassemble front plate of gear chamber cover.

Tool: Sleeve

Disassemble bolt of auxiliary bracket of fuel inject pump.



Tool: Sleeve

Disassemble fastening nuts of fuel inject pump and advance device.



Tool: Wrench

Disassemble the bolt outside medium flange of fuel inject pump.



1.5 Cooling system

Cooling system adopts forced closed circulation liquid cooling. Its main parts/components include water pump, water tank, thermostat, water filter, etc.

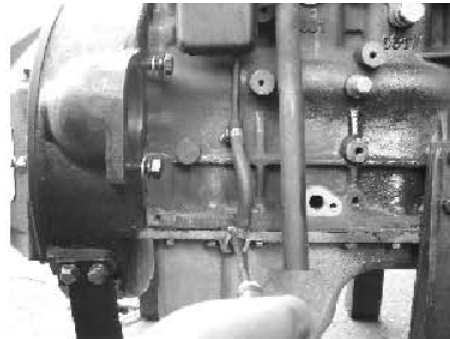
Working process of cooling system: water pump sucks a small amount of coolant cooled by water tank and delivers it to oil cooler. Most of coolant flows into cylinder body water cavity so as to cool cylinder body (see Fig. 1-7), to cylinder cover water cavity to cool cylinder cover, and then to thermostat (see Fig. 1-8) from water outlet pipe of whose cover the coolant flows into water tank, thus completing a circulation.

When diesel engine begins to work, water outlet valve of thermostat is closed and all the coolant of diesel engine refluxes to water pump through thermostat bypass valve to recycle (small circulation). When the temperature of the coolant through thermostat reaches 76°C , water outlet valve is opened and a part of coolant flows to water tank. When the temperature rises to 86°C , water outlet valve is opened completely and bypass valve closed completely (big circulation) (see Fig. 1-9), all the coolant flows to water tank.

1.5.1 Air-conditioning compressor belt, water pump belt pulley, tension pulley and crankshaft pulley

1. Description: belt passes across air-conditioning compressor belt pulley, water pump belt pulley, tension pulley, and crankshaft pulley.

Tool: screwdriver
Take down the clamp between oil return rubber hose and oil pan.



Tool: Wrench
Disassemble the bolt on the left of ventilator and take down the hook.



B. Installing:
Tool: insert O-ring into ventilator mounting plane.



Tool: Wrench
Fix the ventilator hook assembly on which O-ring has been sleeved on cylinder body using two hexagon bolts.

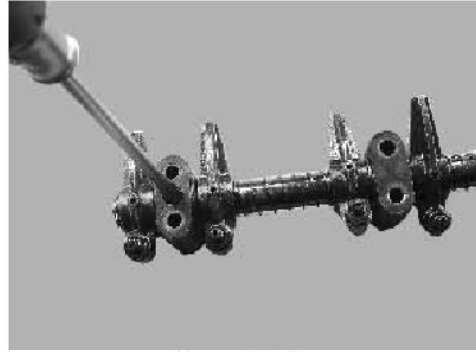


Tool: screwdriver
Fasten the clamp on oil return rubber hose.

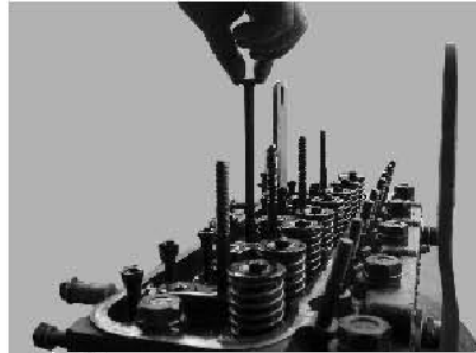


Tools: Wrench, screwdriver

Screw locking screw in rear rocker shaft bracket and tighten relevant nut, install retaining ring on the rear end of rocker shaft.

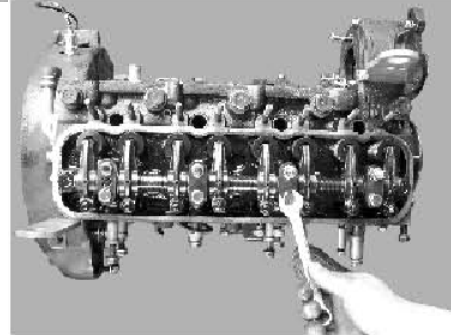


Install push rod in lifter socket.



Tool: Wrench 13mm

Fix rocker mechanism on cylinder cover using bolt.



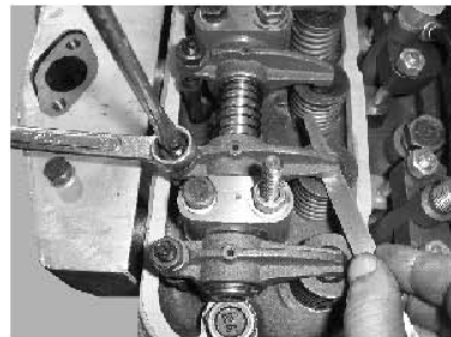
Regulate valve clearance

Tool: thickness gauge

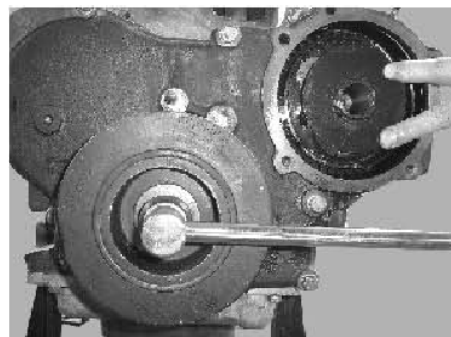
Clearance of intake valve: 0.20-0.25

Clearance of exhaust valve: 0.20-0.25

During measuring or regulating valve clearance, diesel engine should be in cold state. The measured clearance is the right one when the thickness gauge can slide between rocker and valve top face, but, at the same time, adhesive resistance can be felt.



Using socket wrench, turn diesel engine slowly. When the needle aligns with the scale mark "0" on belt pulley, the pistons of the first cylinder and the



Check that the piston pin should rotate smoothly in small end bushing of connecting rod. Furthermore, after piston rod is assembled, when connecting rod swing right and left, its small end should not collide with piston top and combustion chamber bottom.

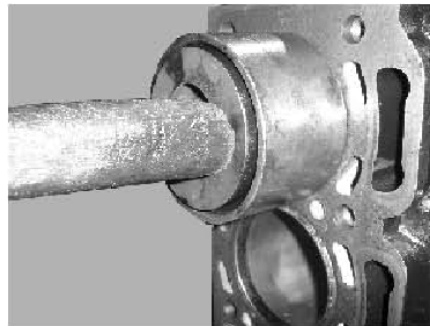
Fill connecting rod bearing and cylinder bushing hole with clean oil.



Tool: Guide sleeve

Install piston connecting rod component into cylinder bushing hole.

Caution: ensure that the slot of piston skirt faces with the side with nozzle installed on cylinder body.

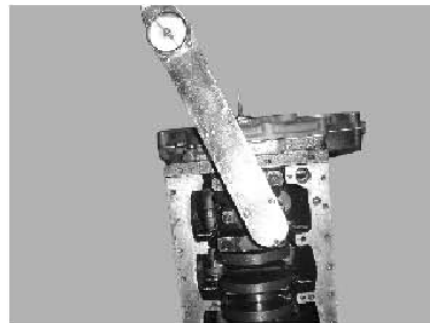


Tool: Wrench 21mm

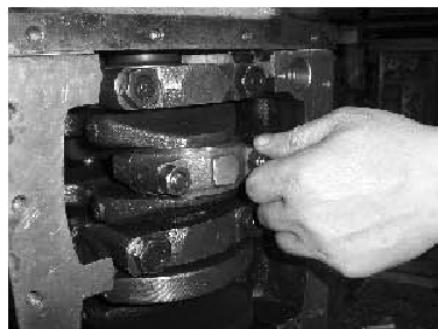
Close connecting rod body using connecting rod cover. After applying the bearing surface of connecting rod bolt and the mating surface of connecting rod cover with MoS2 or diesel engine oil, screw in connecting rod bolt.

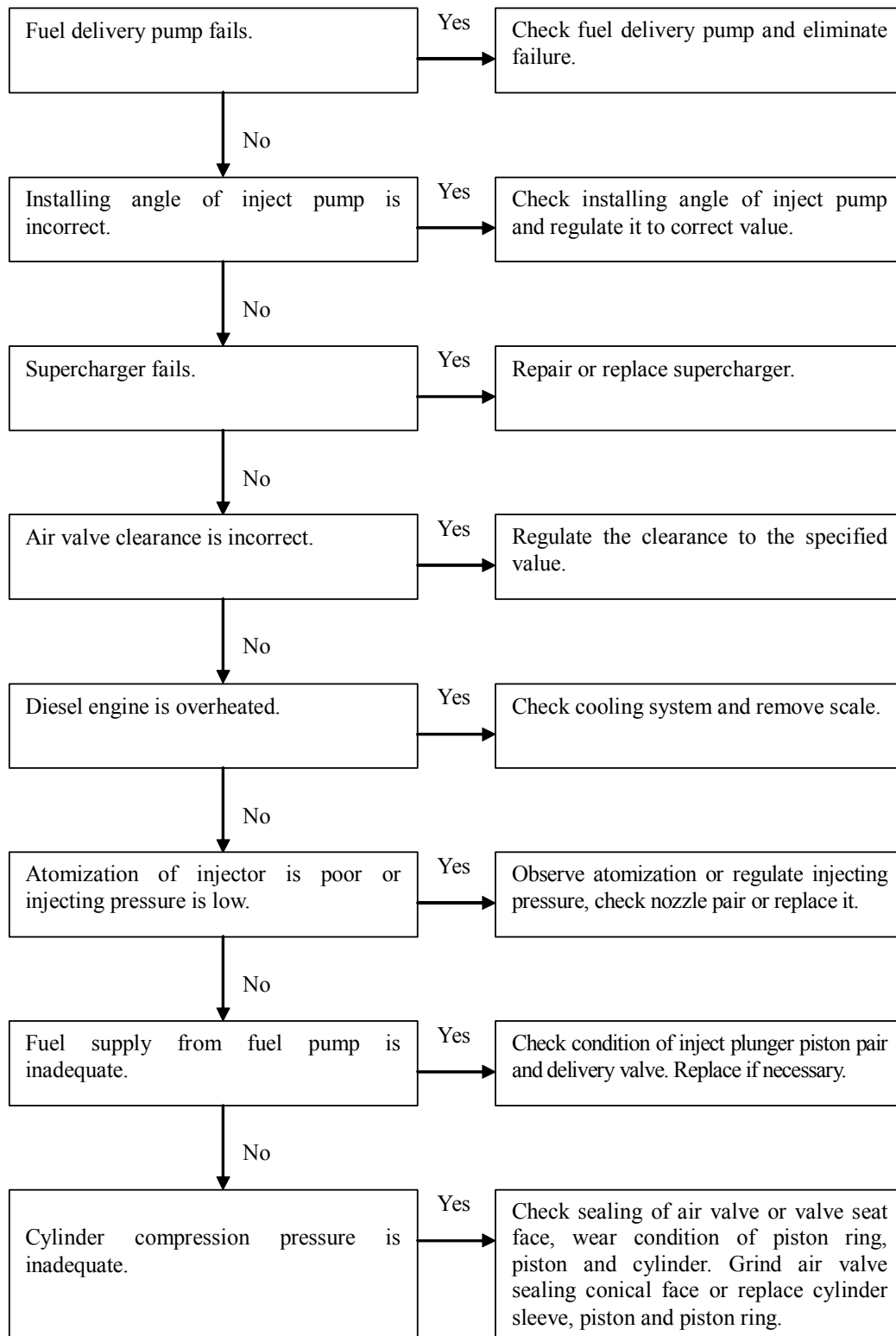
Caution: the matching marks on connecting rod cover and body should be on the same side.

Tighten connecting rod nut, pre-tighten to the torque of 70-80N.m by torque method.



Feel with hands that there should be axial clearance between big end of connecting rod and connecting rod journal.





decrease the thickness of sealing gasket 3 of bearing external ring (Fig. 3-12).The principle to determine the thickness of gasket is that, under the premise that there is no oil leakage from bearing cover sealing, press the end face of bearing external ring as tight as possible, namely, reduce the axial clearance as possible.

(4) The planes of odometer drive gear and the cam of the second shaft should be even to avoid oil leakage.

(5) The normally engaging gear pair between intermediate shaft and the second shaft should align with each other. If they don't align with each other, adjust by adjusting the position of intermediate shaft at the front and the rear end.

(6) For assembled gear transmission mechanism, check whether the gear engagement accords with the requirements;

Engaging clearance: 0.10-0.50mm for normally engaging gear, the use limit is 0.80mm; 0.10-0.40mm for jointing gear, the use limit is 0.60mm.

Engaging impression: should at the middle of gear engaging face and should not be less than 60% of the engaging surface.

(7) When covering transmission cover, check that there should be no any foreign matter remained in the cover, all gears of various stops and shift fork should be at neutral position; after installation, perform engagement test for all stops, there should not be any abnormality.

3.8 Maintenance of transmission

The main work of transmission maintenance is inspection and replacement of gear oil.

3.8.1 Inspection of gear oil

Park the vehicle on horizontal ground and unscrew oil level check plug, check whether the level of transmission gear oil meets the requirements and whether the gear oil is dirty or deteriorated. Replace gear oil if necessary.

3.8.2 Replacement of gear oil

Set transmission gear at neutral position, start engine and engage clutch. Let the engine operate at idle for 3-5min and then stop it and drain out transmission gear oil entirely. Fill fresh gear oil of specified brand with specified quantity.

3.9 Common failures and diagnostics

The common failures of transmission are oil leakage, abnormal sound, automatic disengagement, mixed disengagement, etc.

3.9.1 Oil leakage:

(1) Phenomenon: there are obvious oil trace at peripherals of transmission cover, peripheral of side cover of

driving force) and torsion load transmitted by the main transmitter, additional load by gravity of the main reducer and etc., the stresses are so complicated and there are so many wears. It includes: bending, deformation and cracking of the axle shell; wear and deformation of combination plane of the axle shell and main reducer shell; wear of excessive combination of the half shaft sleeve tube and the axle shell; wear of shaft neck of bearing of wheel hub of half shaft sleeve tube and the matching part of bearing of external end of semi-floating half shaft and etc.

Bending and deformation of the axle shell make bending alternating stress on the half shaft which causes tiredness and cracking, meanwhile, the wheel generates internal inclination and toe-in (or negative toe-in), which accelerates wear and leads to abnormal wear.

The half shaft sleeve tube and axle shell are excessive matching, owing to micro-motion wear, the outmost shaft neck is most likely to be loosed, and it is hard to find out if we do not pull the sleeve tube out. After the matching clearance becomes larger, depending on the second outmost shaft neck support, the suspension arm is lengthened to make the support toughness reduced. At this time, the following may occur: when the wheel is overhead, the brake clearance is done; after the wheel is placed down on the ground, it is hard to brake. The cause is that when the wheel will not take the force, after it is placed on the ground, reaction of supports makes the half shaft bend upwards to reduce clearance at the lower part of the wheel brake.

Cracking of the axle shell is generally on the steel plate base with maximum bending torque and brake bottom plate with collective torsion stress.

5.3.2 Main reducer shell

Main wear of the main reducer shell

Main wear of the main reducer is wear of the bearing hole, location error between the axis and axis, axis and the plane location error out-tolerance. Especially verticality and position tolerance of axis of the driving and driven bevel gears affects most on reliability of the main reducer. When the error is excessive, there should be no correct meshing mark and meshing clearance, which causes non-conformed meshing mark and reduced area. It dose not only make noise, but also shortens service life of the gear for collective stresses.

5.3.3 Half shaft

Main wear of the half shaft includes wear, distortion and breaking of the spline. For the half shaft spline is the one bearing the maximum torque, with big wear and distortion. Breaking of the half shaft is generally at round corner of the flange root and spline end with collective stresses.

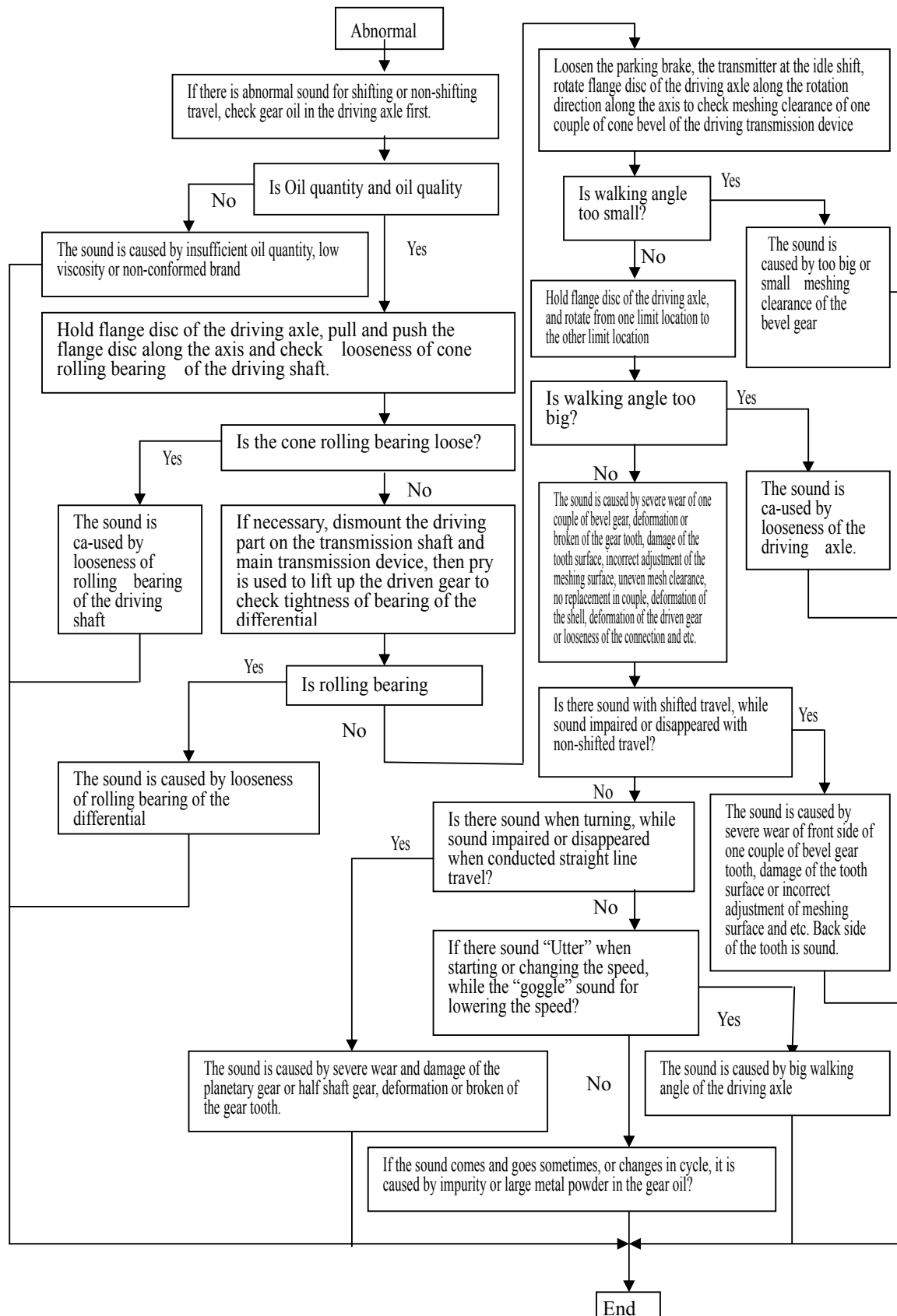


Figure 5-4 Diagnosis flow chart for abnormal sound

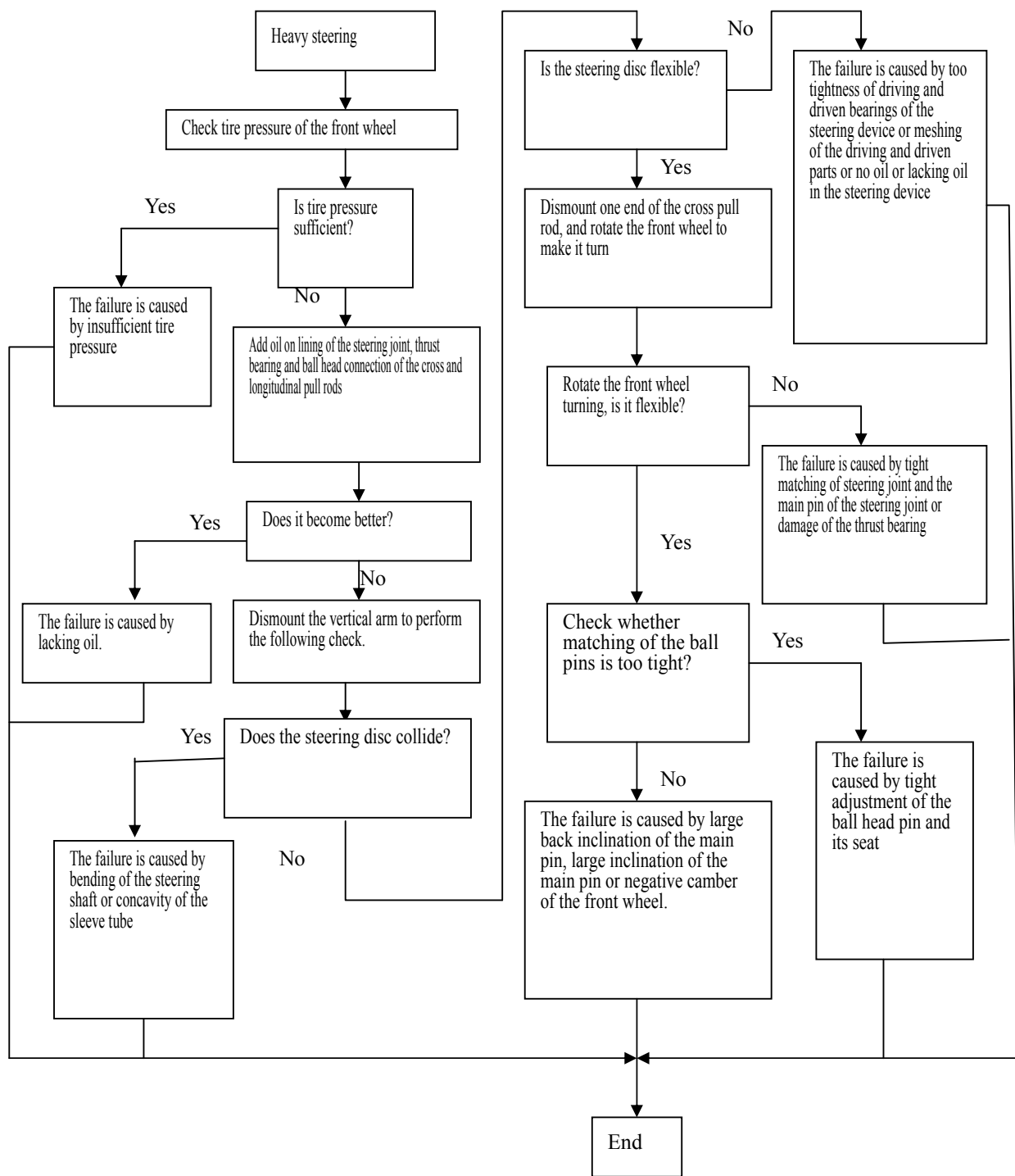


Figure 7-5 Flow chart for heavy steering

deformation of brake drum is big, and the abrasion of the lining middle is strengthened which is easy to create the scorch and obviously reduce the braking performance.

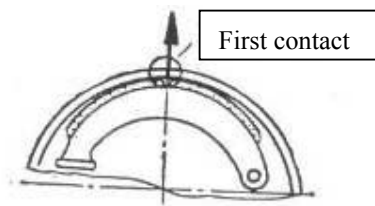


Fig. 8 - 9 Contact of brake shoe middle

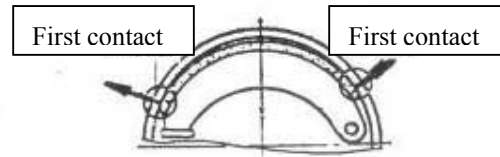


Fig.

8 - 10 Contact of two-end brake

and brake drum shoe and brake drum

3) Anastomosis of two ends of shoe and drum

When the shoe isn't opened, the two-end clearance between friction lining and brake drum is less than the middle clearance. If proper adjustment, when the shoe is opened, maybe first realize the anastomosis of two ends of friction lining and brake drum, and then realize the anastomosis the middle after two ends (Fig. 8-10). So, there are two contacts for each shoe and brake drum, the contact surface near to the

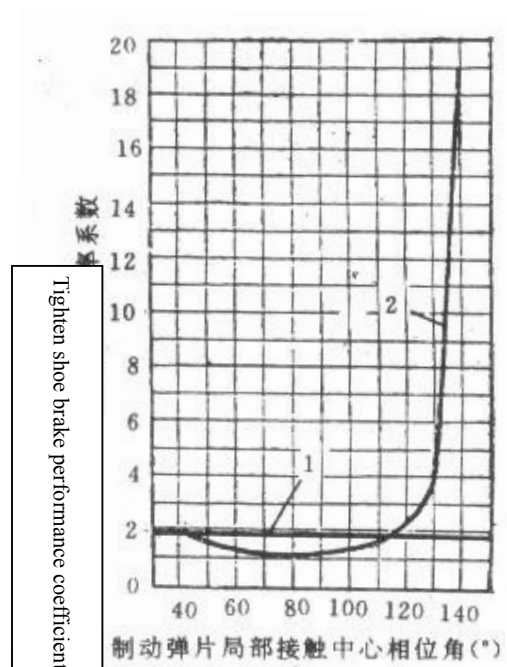
middle will be increased and pressure distribution is uniform. The deformation of brake drum is

smaller, working temperature of the brake is lower, but the

Otherwise, by the effects of friction force of friction lining end, the shoe creates the bend and the deformation to rapidly realize the anastomosis with the drum, and trend to the comprehensive anastomosis based on the abrasion and the brake increase.

Fig. 8-11 is braking performance change curve of brake friction pair of certain auto brake leading shoe calculated when contacting on each position. From this figure, when two ends of frictional plate of brake shoe are contacted, the braking performance is better than the middle contact and the braking torque is big.

From above analysis, it is impossible to make synchronously comprehensive anastomosis, and the braking performance of first two-end anastomosis is better than first the middle anastomosis. And



Tighten shoe brake performance coefficient

Phase angle of local contact enter of the brake piece