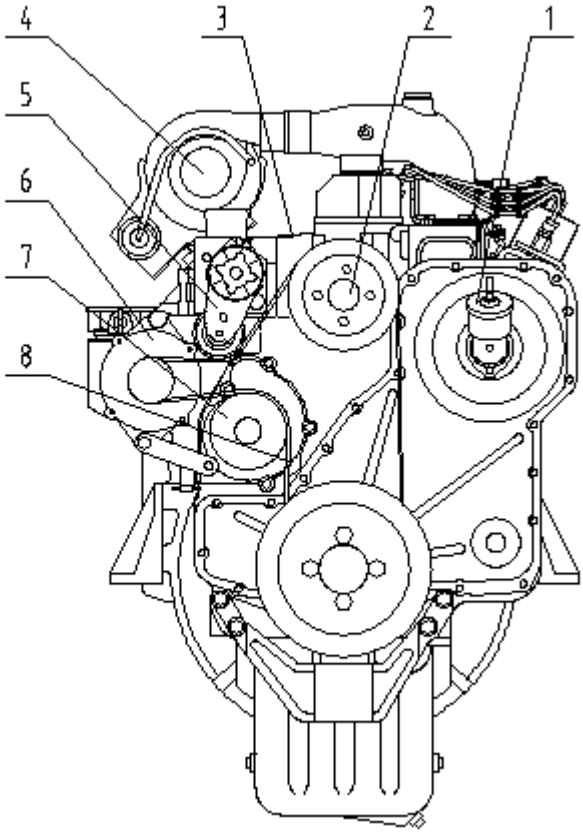
Chapter One An Introduction for the Structure D114 Series Diesel Engine

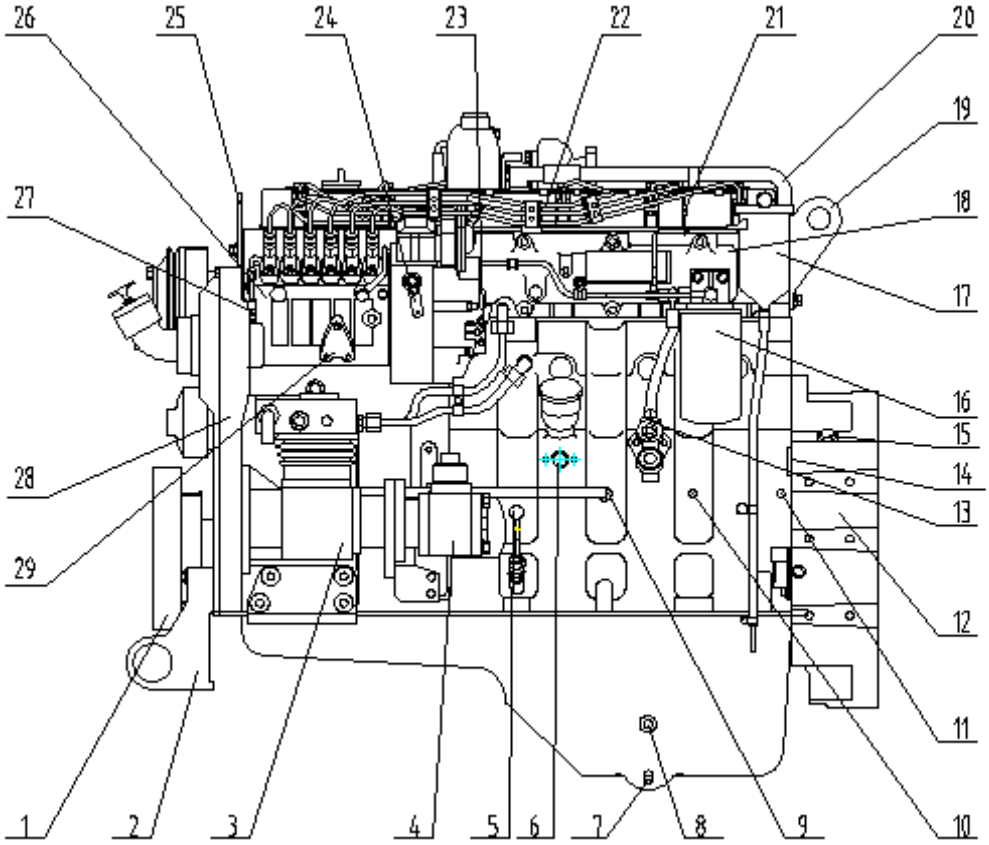
1.1 Outside View of the Diesel Engine

As different engine models have different outside views, this instruction can only provide the outside view of basic model for reference.



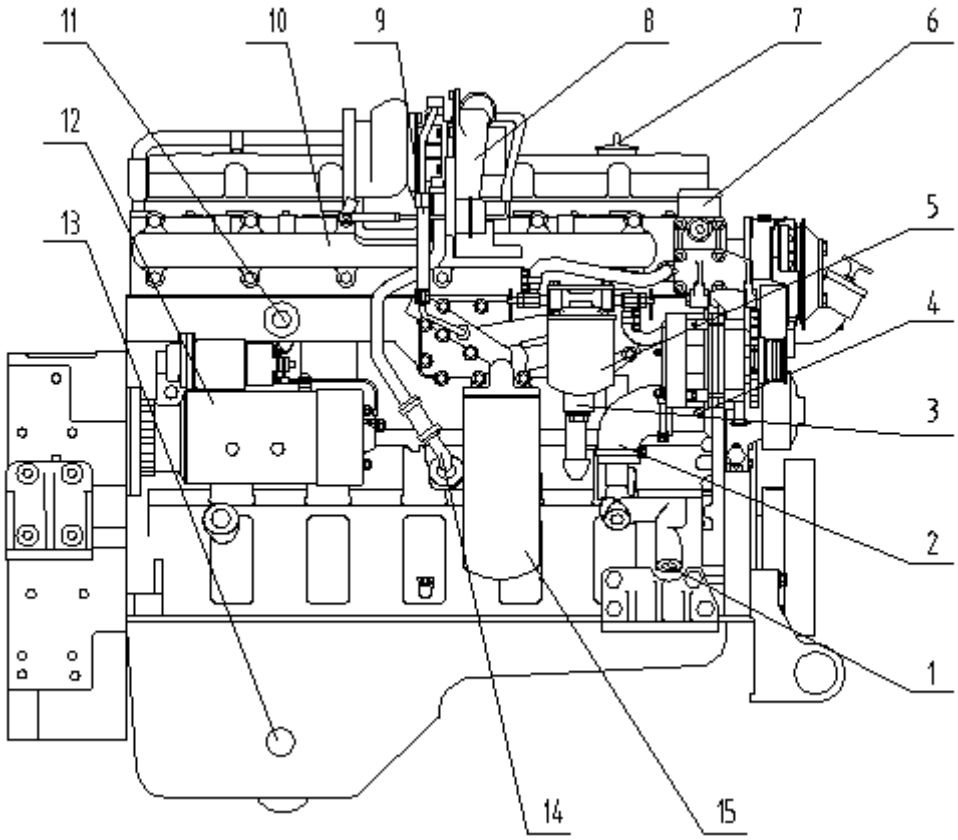
Front View

1. Refueling cap 2. Fan belt wheel 3. Heating water interface Z1/24. Air inlet of booster
5. Belt regulating wheel 6. Charging generator 7. Water pump 8. Drive belt



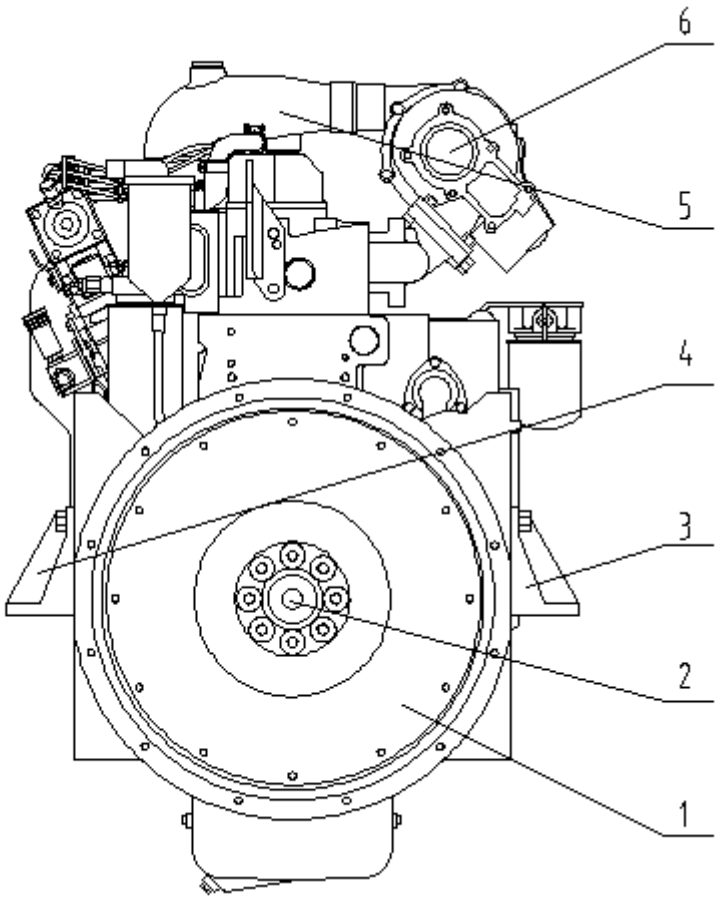
Left Side View

1. crankshaft vibration damper 2. front supporting 3. air compressor 4. steering pump 5. dipstick 6. timing pin of diesel engine 7. M18×1.5 purge cock 8. M16×1.5 oil temperature sensor joint 9. Z1/8 pressure engine oil connector 10. Z1/8 oil pressure sensor joint 12. bell housing 13. diesel supply pump 14. barring connector of diesel engine 15. M18×1.5 speed sensor connector 16. fuel filter 17. gas-oil separator 18. Intake tube 19. back ring 20. Breather pipe 21. fuel return tube of fuel injector 22. high-pressure fuel tube 23. speed regulation handle 24. emergency cut-off handle 25. front ring 26. injection pump 27. fuel return connector 28. gear chamber29. injection pump timing pin



Right Side View

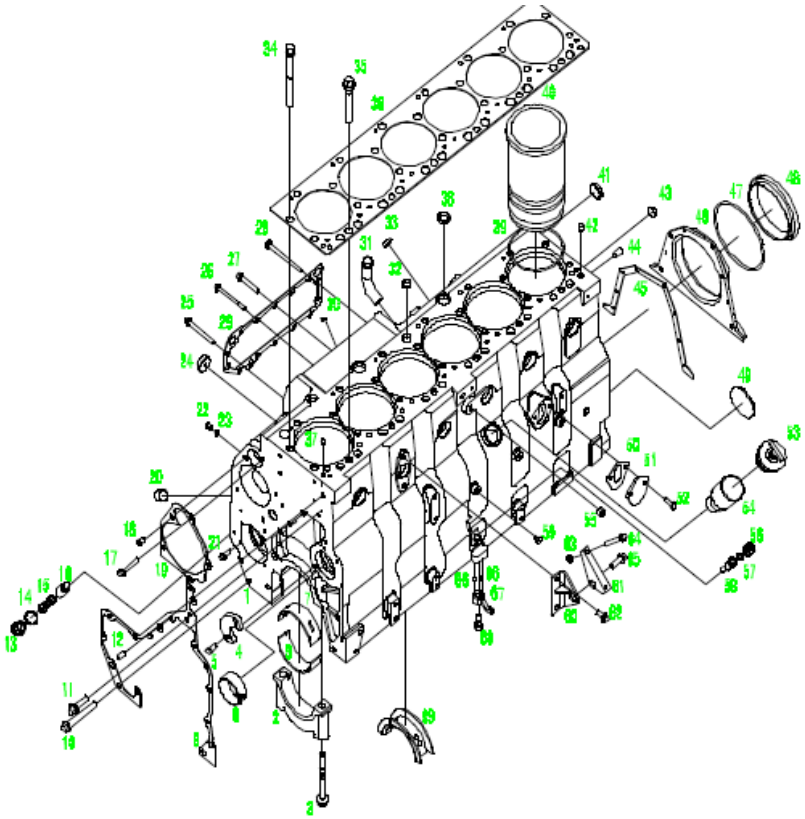
1. maximum pressure liming valve of engine oil pump 2. water inlet elbow of water pump 3. oil-pressure regulation valve 4. cold-start water temperature sensor 5. water filter 6. discharging tube 7. refueling cap 8. booster 9. fuel inlet of booster 10. exhaust pipe 11. mounting hole for cooling water heater 12. cranking motor 13. M22×1.5 electric heater connector 14. fuel return tube of booster 15. engine oil filter



Back Side View

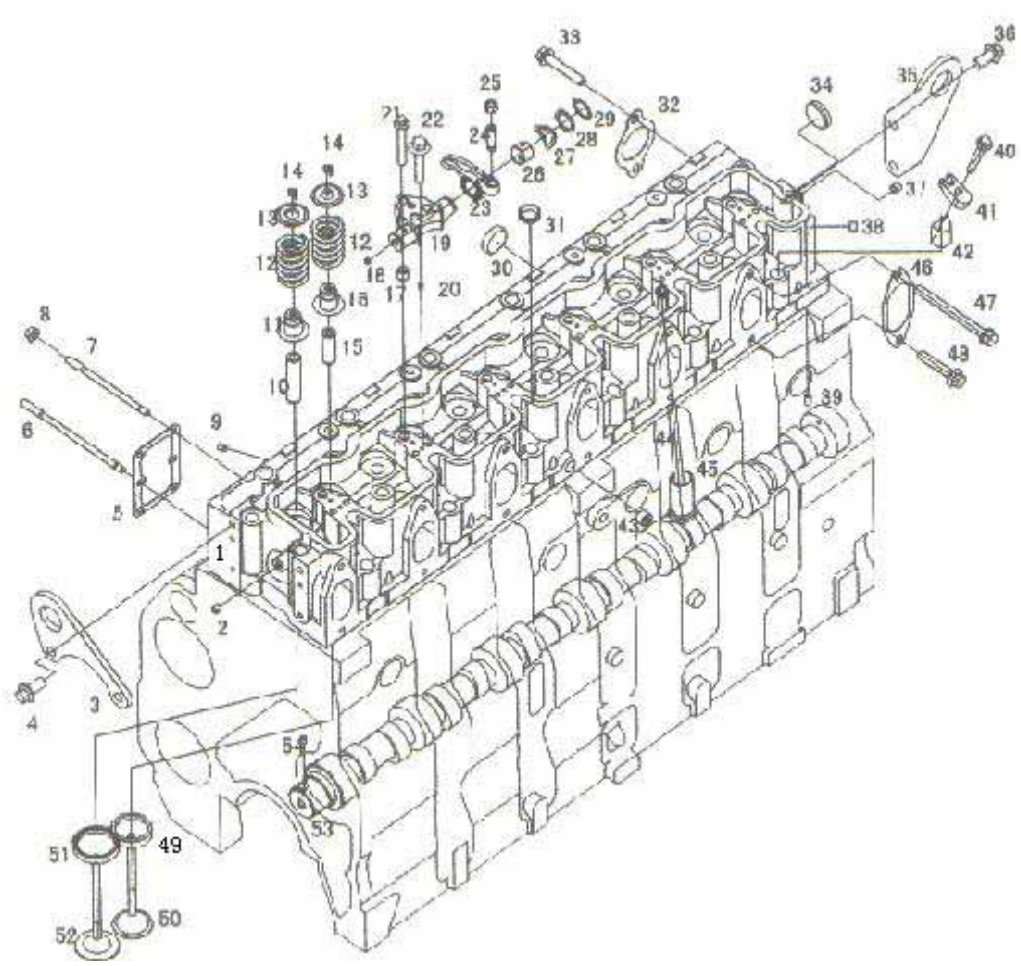
1. flywheel 2. bearing 3. right back supporting 4. left back supporting 5. gas freeing pipe of compressor 6. air outlet of booster turbine

1.2 Engine Body and Cylinder Jacket



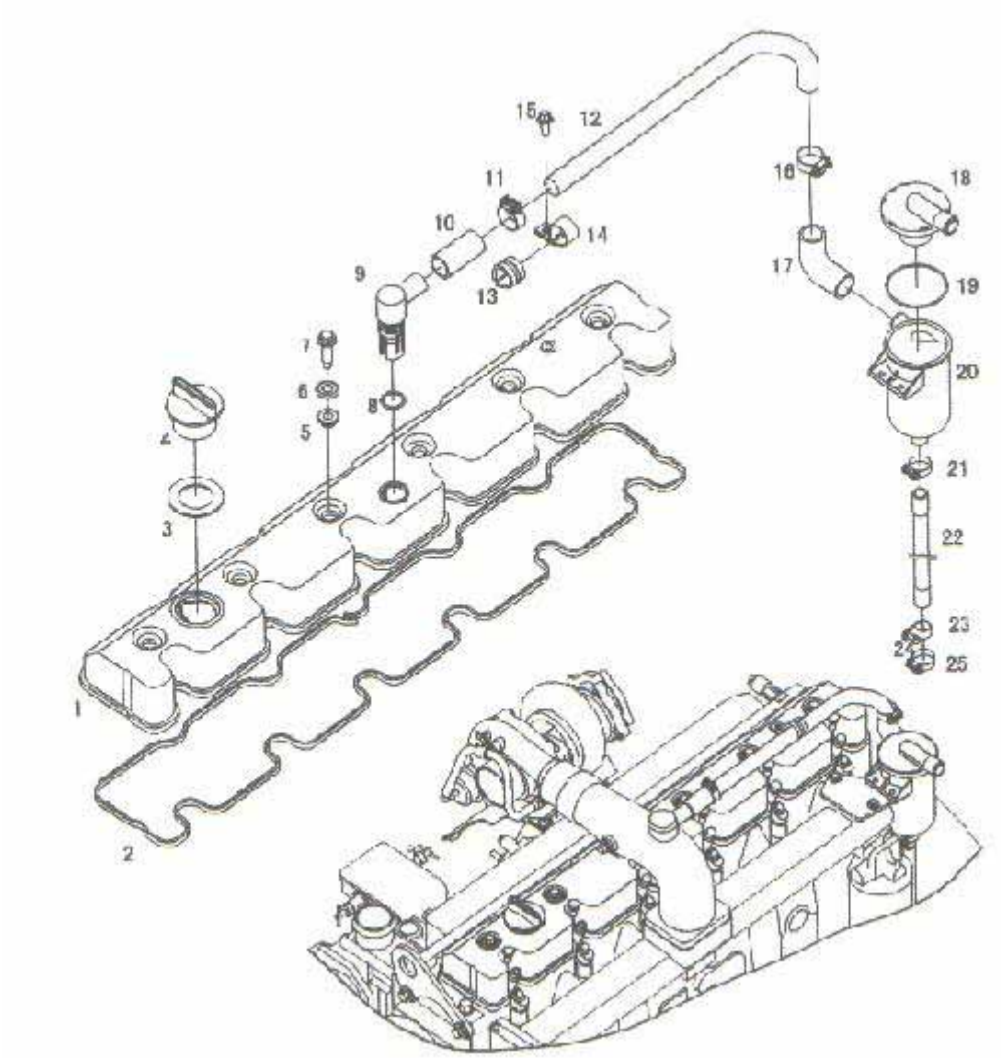
1.engine body 2. main bearing cap 3. main bearing cap bolt 4. camshaft thrust plate 5. hexagon-headed bolt 6. camshaft bearing 7. upper shell of main bearing 8. lower shell of main bearing 9. gear chamber gasket 10. hexagonal flange face bolt 11. Hexagonal flange face bolt 12. cylindrical pin 13. plug screw 14. Copper gasket 15. spring 16. pressure limiting valve plunger 17. hexagonal flange face bolt 18. elastic cylindrical pin 19. water pump gasket 20. hexagon socket screw 21. hexagonal flange face bolt 22. hexagonal socket head plug 23. copper gasket 24. choke plug 25. hexagonal flange face bolt 26. hexagonal flange face bolt 27. hexagonal flange face bolt 28. hexagonal flange face bolt 29. engine oil cooler gasket 30. choke plug 31. fuel return tube 32. choke plug 33. choke plug 34. long bolt of cylinder head 35. short bolt of cylinder head 36. cylinder cap gasket 37. cylinder choke plug 38. choke plug 39. water sealing ring cylinder jacket 40. cylinder jacket 41. choke plug 42. cylindrical pin 43. cylindrical pin 44. choke plug 45. rear cover plate 46. rear cover 47. rear cover 0-type sealing ring 48. bent axle rear-end oil seal 49. cam bearing saddle bore choke plug 50. gasket seal of fuel delivery pump 51. cover plate of fuel delivery pump hole 52. hexagonal flange bolt 53. refueling cap assembly 54. welding assembly of refueling tube 55. hexagonal socket head plug 56. union nut 57. copper gasket 58. dipstick 59. plug screw 60. welding assembly of fixed support of fuel pump 61. fuel pump bracket 62. hexagonal flange face bolt 63. spherical washer 64. hexagonal flange face bolt 65. hexagonal flange face bolt 66. cylindrical pin 67.piston-cooling fuel nozzle 68. pressure valve 69. crank thrust bearing

1.3 Cylinder Head and Valve Actuating Mechanism



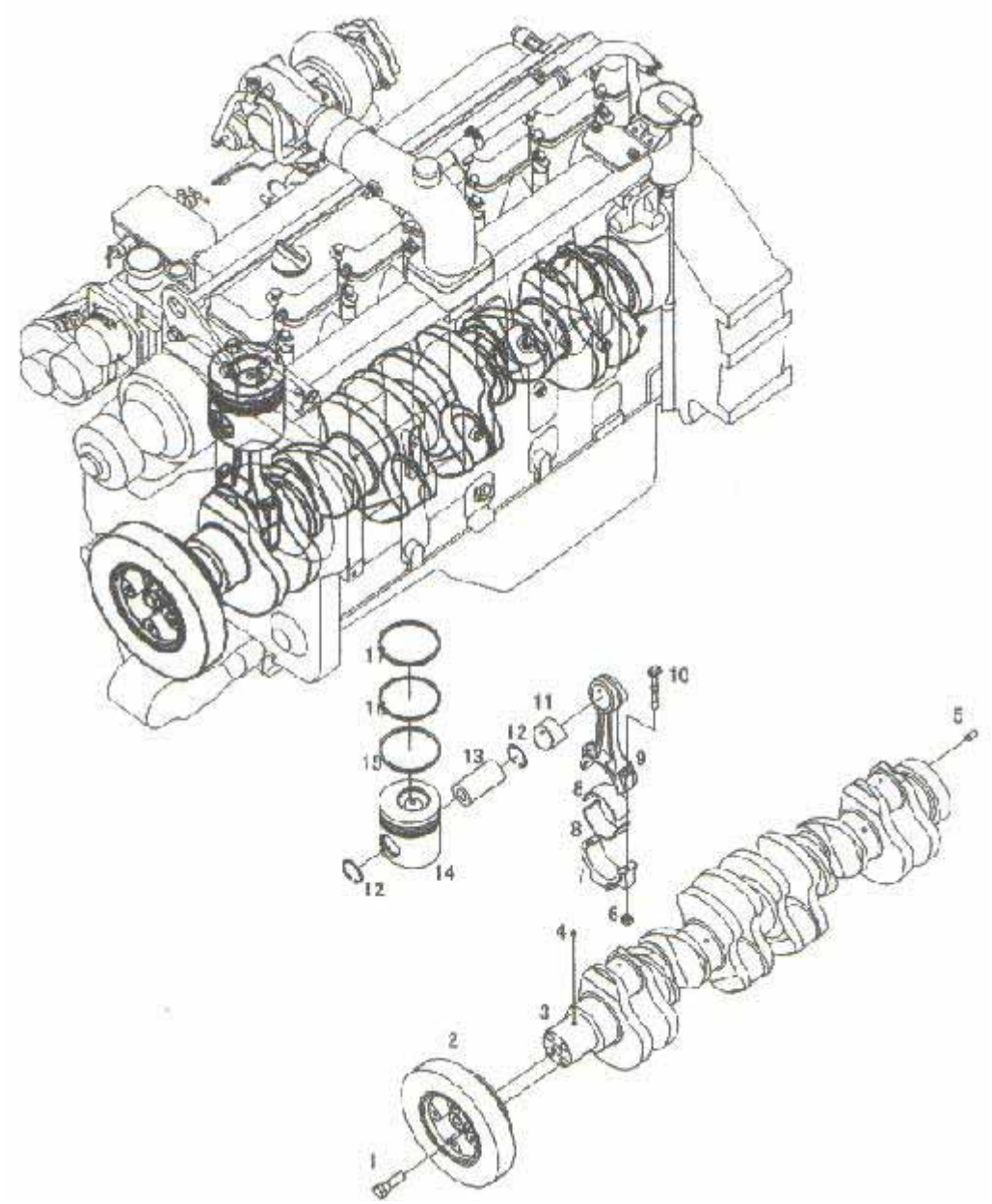
1. cylinder head 2. hexagonal socket head plug 3. font ring 4. hexagonal flange face bolt 5. thermosistor pad 6. thermosistor stud bolt 7. thermosistor stud bolt 8. hexagonal flange face bolt 9. choke plug 10. intake valve shaft guide 11. intake valve stem oil seal 12. valve spring 13. upper seat of valve spring 14. valve lock clamp 15. exhaust valve shaft guide 16. exhaust valve stem oil seal 17. locating pin 18 choke plug 19. rockshaft 20. cylindrical pin 21. hexagonal flange face bolt 22. hexagonal flange face bolt 23. rocker arm 24. regulating screw of rocker arm 25. small-size hexnut 26. rockshaft 27. wave-pattern elastic pad 28. rocker arm thrust plate 29. washer on shaft 30. choke plug 31. choke plug 32. exhaust pipe gasket 33. exhaust pipe bolt 34. choke plug 35. rear ring 36. hexagonal flange face bolt 37. choke plug 38. hexagonal socket head plug 39. orifice plug 40. hexagonal flange face bolt 41. fuel injector platen 42. seat pad of fuel injector platen 43. hexagonal socket head plug 44. push rod 45. tappet 46. intake tube gasket 47. intake tube bolt 48. hexagonal flange face bolt 49. exhaust valve seat 50. exhaust valve 51. intake valve seat 52. intake valve 53. camshaft 54. locating pin

1.4 Cylinder Head Cover Shell and Crankcase Ventilation Installation



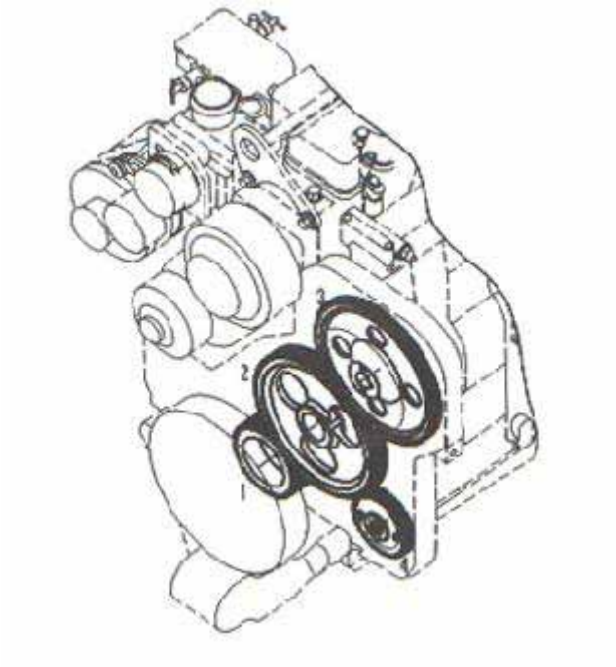
1. cylinder head cover shell 2. sealing belt of cylinder head cover 3. sealing gasket of refueling cap 4. refueling cap 5. sealing ring of cover shell bolt 6. sealing ring gasket of cover shell bolt 7. cylinder cover shell bolt 8. O-type rubber sealing ring 9. breather pipe 10. rubber tube 11. clamp 12. breather tube 13. clamp jacket 14. clamp 15. hexagonal flange face bolt 16. clamp 17. rubber bend 18. oil-gas separator 19. O-type rubber sealing ring 20. oil-gas separator 21. clamp 22. fuel return tube of oil-gas separator 23. clamp 24. bolt 25. clamp

1.5 Dynamical System Components and Parts



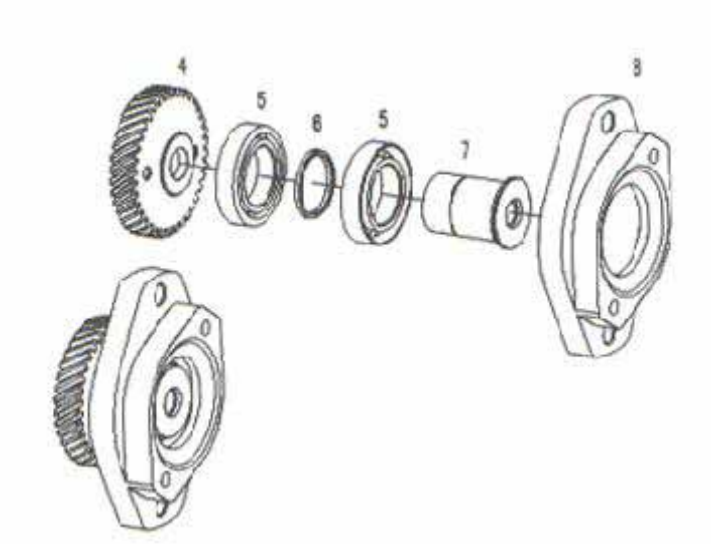
1. vibration damper bolt 2. torshional vibration damper 3. bent axle 4, cylinder pin 5. cylinder pin 6. connecting rod 7. connecting rod cap 8. connecting rod bearing shell 9. connecting rod 10. connecting rod bolt 11. connecting rod bushing 12. circlip for hole 13. piston pin 14. piston 15. components and parts of fuel ring 16. inscribe taper-face ring 17. ladder-shaped rubbish ring

1.6 Transmission Gear



Transmission Gear

1. crankshaft toothed wheel 2. camshaft gear 3. high-pressure fuel pump gear 4. air compressor gear (auxiliary power take-off gear)



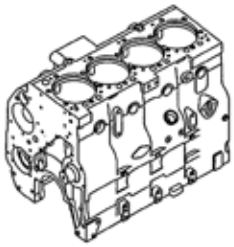
Auxiliary Power Take-off Gear

4. air compressor gear 5. bearing 6. space ring 7. spline shaft 8. bearing seat

Chapter Two Features of Main Parts of D114 Series Diesel Engine

2.1 Engine Body (high-strength gray pig iron)

1. Gantry cylinder block; this engine body performs well in stiffness.



2. Integrated and multifunction design is adopted in this diesel engine. Components which are casted together with the engine body include:

(1)engine oil pump shell

(2) water pump cone shell

(3) plate-fin engine oil cooler shell

Thought this design makes the casting and machining more difficult, it makes the structure of diesel engine becomes compact. And under this design the diesel will be smaller in size, lighter and stiffer.

3. Vertical-form waviness stiffener of the engine body and the side wall of crank case can absorb the vibration and the noise of the whole machine. They not only make the engine body lighter, but also make the body stiffer.

4. There are two parts in main bearing saddle bore of the engine body: the top half which connects with diaphragm plate of crank case in top axle box is called upper saddle of bearing; the bottom half which separates with the top axle box is called lower saddle of main bearing, or main bearing cap. Sedimentation fuel groove on the upper saddle connects two fuel holes to deliver engine oil in main fuel duct to cam bearing hole.

5. Six cold fuel nozzles which are installed on the bottom of main fuel duct of engine body are used to cool top inner wall of 1-6 cylinder pistons and moving parts such as lubrication piston pin.

6. Six cylinder jacket saddle bores on the top engine of body serve as the supporting surfaces of cylinder jacket installing. The adjacent supporting surfaces are through in the middle. This structure can guarantee cylinder jacket shoulder can be installed on the top saddle bore of the engine body and guarantee the center distance of cylinder is stable (137 mm).

2.2 Cylinder Jacket

1. Cylinder jacket is made of wear-resistant alloy cast iron with high phosphorus. Centrifugal casting which makes the structure more tightly guarantees the cylinder jacket can bear high temperature and high pressure of working

gas. It prolongs operating period and reduces the cost of repairs.

2. Wet sleeve. The space between sleeve and engine body is water chamber. As cooling water can contact the outside surface of sleeve directly, so it has a good cooling effect. Wet sleeve can be casted and dismantled easily.

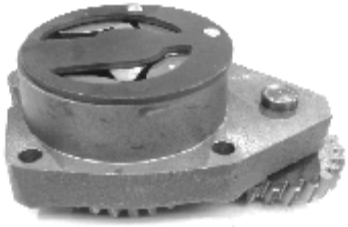
3. Overhead installation. The flange on the upper end is used to conduct axial location of cylinder jacket. That the lower surface of flange and fit seat of engine body tightly connects seals the top of cylinder jacket. There is no gasket. It is the bearing point of the cylinder jacket.

4. Three heat-resisting rubber water-sealing rings are installed in three grooves which are in the excircle of bottom cylinder jacket to avoid cooling water flowing into fuel pan.

2.3 Engine Oil Pump

1. Rotary Engine Oil Pump

It is mainly consisted of (1) pump body (2) inner rotor (3) outer rotor (4) idle



gear (5) gear (6) driving shaft and (7) baseboard.

2. Inner rotor has 4 convex teeth, while outer rotor has 5 concave teeth. In the process of rotating, though touching points of tooth profile of inner and outer rotors are changing, they can connect with each other all the time and don't affect each other. Inner and outer rotors forms 4 work chambers whose volumes are changing.

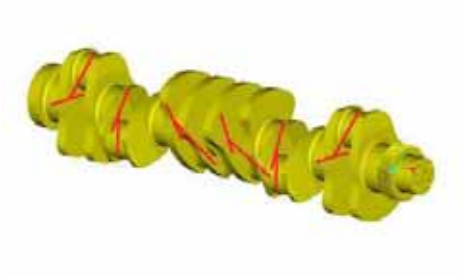
3. Crankshaft gear drives engine oil pump gear by idle gear of engine oil pump to make the inner rotor of engine oil pump rotate. As the space between inner rotor and outer rotor become bigger, working chamber of oil inlet produces vacuum suction. Engine oil is sucked into the empty chamber. Rotor rotates again. Oil pressure increases, for working chamber with engine oil becomes smaller. The pressurized oil is brought to the oil outlet and delivered into fuel duct of engine body.

Rotary engine oil pump has the following advantages: compact structure, well-distributed fuel, high oil absorption vacuum, large quality of pumping fuel, low noise.

2.4 Crank Axle (SAE1548 steel-made die forging)

1. Unitary die forging; orthodrome angle. After being fashioned the surfaces,

main journal and rod journal are quenched to be conducted carbonitriding polish treatment. 8 balance weights (two sides of the first, third, fourth and sixth edges have rod journals) are conducted precise dynamic balance.



2. Fuel duct: Besides the first main journal, every main journal has oil-taking through-hole which perpendicular to center line of crank axle. An oil hole is punched where the seventh rod journal leans to main journal to connect the straight hole.

3. Supporting mode: sliding bearing is adopted. It is hung on the fifth-range main bearing of engine body.

4. Driving gear of crank axle and front axle of crank axle are hotly jacketed together.

2.5 Piston (eutectic silicon-aluminum alloy)

1. Piston top

Piston top is double-squishing swirl reentrant combustion chamber. There is no air valve pit.

It can increase swirling action of gas mixture, improve combustibility, increase thermal efficiency and reduce manufacturing cost.

2. piston ring belt

It refers to the part to install piston ring. It can also be called leakage control part. As this part transferring the heat of top piston is in high temperature, so its diameter is smaller than skirt section.

(1) Ladder-shaped nickeliferous wear-resisting cast iron which is inlayed in the first circular groove can not only reduce heating degree of the first ring and

prolong the service life but also increase forces on the piston.

(2) The first gas ring is tubbish ring; the second gas ring is inscribing taper-face ring; the third fuel ring is spring packing ring. There is no fuel return hole in fuel ring.

3. piston skirt

It is guiding part of the piston. Piston skirt guides piston conduct advance and return movement and bears lateral pressure of piston. Piston pin is installed in this part.

(1) Piston pin and pin seat are floating. Piston pin can freely rotate.

(2) A broad groove is under the piston pin hole of two sides the skirt. It is benefit for the returning of engine oil which is scraping from the fuel ring.

(3) A bent groove is on the skirt bottom where is close to side of main fuel duct. It can prevent the piston touching cooling fuel injection when the piston moves to the lower dead center

2.6 connecting rod (AISI1541 forged steel)

1. Connecting rod body

"I"-shape section structure is adopted to guarantee its strength and stiffness, and

lighten the weight.

2. small end of connecting rod

Wedge-shape structure is adopted to reduce the lode of small end brushing. Fuel supply hole are on the two side of small end brushing.

3. big end of connecting rod

Big end is in subdivision structure. Its form is lat incision. Incision separation surface is perpendicular to the center line of connecting rod body.

It is convenient to process the big end which has good stiffness. Connecting bolt is not easily affected by shearing action.

4. connecting rod bolt, nut

Middle section of bolt body serves as the fixed position of subdivision combing part of connecting rod

5. Big end of connecting rod and the cap are made in pair. Paring marks and balance weight are marked on the same side.

2.7 camshaft (20 Cr low carbon alloy steel)

It is the drive element of valve actuating mechanism. Cam face should be wear-resisting and keeps in peach shape.

1. Camshaft and cam of high-order square wire are made of 20Cr steel.

2. Transmission gear of camshaft and camshaft are hotly jacketed together.
3. The number of camshaft bearing is the same to the number of cam main journal. Camshaft is made of high-tin aluminum alloy. Gas distribution will not be in chaos, even if the cam bends.

2.8 tappet (with chilling layer (close to clear chill layer) cast iron)

Tappet, a slave element of valve actuating mechanism, is used to make the cam move. Undersurface is in flat-bottom mushroom shape. The center deviating from the center of cam center rotates tappet to make force and wearing degree evenly.

2.9 Cylinder Head (HT-250 high strength gray pig iron)

1. cross-flow cylinder head which connects with the engine body has the biggest structure stiffness.

2. Spiral air inlet forms intensive vortex. Air inlet flow losses are small.

3. Cylinder head is casted with an interlayer water chamber. It has three water inlets, of two are connected with air inlet chamber of cylinder head directly, one is connected with air exhaust chamber of cylinder head. Nose bridge of cooling air valve and fuel injector reaches air inlet of cylinder head later and join with the cooling water from two water inlet holes. Then they flow along the top of cylinder head cooling water chamber and then cross the chamber top obliquely to return to the air exhaust side. The liquid flows along length-wise direction to the total water outer on the right of the front of cylinder head and then flows into thermostat shell.

4. There are many fuel ducts casted in various lengths in cylinder head. Engine oil flows into rocker arms, lubricating rocker arms and other components of every cylinder along the long-hole fuel duct which cut through the whole cylinder cap.

5. Thermostat seat body and cylinder head are casted together.

2.10 transmission gear train

Only all gears should be assembled according to the marks can guarantee air inlet and air exhaust valves can open and close at regular time. Number of gear teeth, tooth space of gear meshing, wear limit of all tooth space is 0.33mm

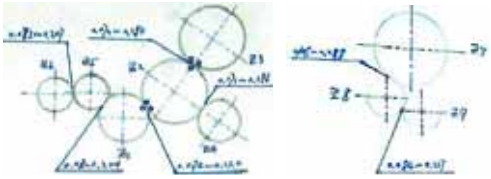
Z1 crankshaft gear= 42 tooth

Z2 camshaft gear= 84 tooth

Z3 fuel injection gear=84 tooth

Z4 air compressor pump gear= 37 tooth

Z5 engine oil pump idle gear= 23 tooth

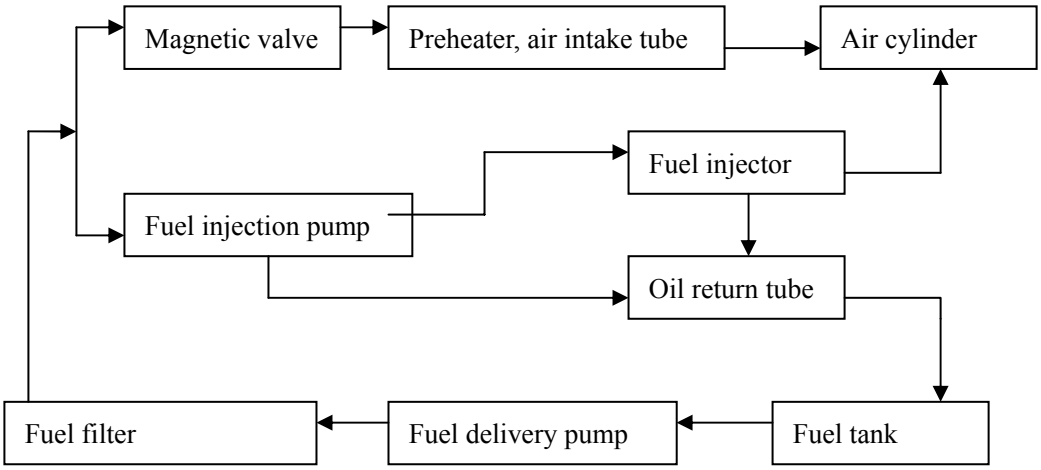
Z6 engine oil pump gear= 28 tooth 

2.11 valve timing diagram

air valve angle	Open	close	Total open angle	intake-exhaust overlapping angle
Air inlet valve	Up to 22.5 ° before the point	Down to 67.5 ° before the point	237°	48°
Air outlet valve	Down to 34.5 ° behind the point	Up to 22.5 ° behind the point	273°	

Chapter Three Main Features of D114 Series Diesel Engine

3.1 Fuel System



1. Fuel Delivery Pump

(1) Maximum resistance of fuel absorption is 13.3kpa.

(2) Oil level can be 100cm lower than fuel delivery pump.

Maximum pressure of fuel delivery pump outlet: low flow is 82kpa, high flow is 172kpa.

2. Magnetic valve, preheater

They are clod starting devices. Magnetic valve is an electronic switch which controls the oil entering into the preheater. Preheater is used to ignite incoming diesel to preheat incoming air. Then diesel engine can be easily started.

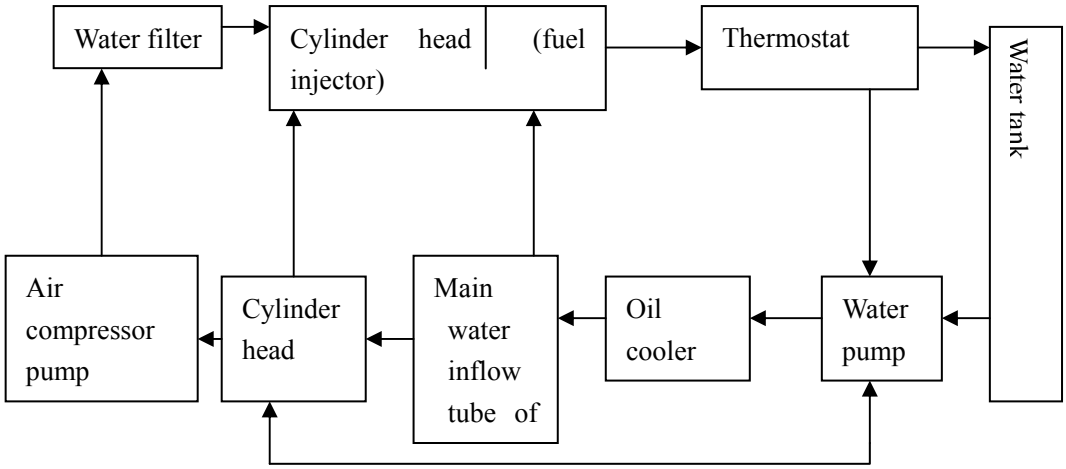
3. Fuel injector

Main mating fuel injection nozzles have 5 and 6 holes. Its injection pressure is 25-30 Mpa. Different types used different fuel injection nozzles.

4. Fuel injection pump

D6114B adopts high-pressure oil pump produced by Shanghai Yijie Company (diesel engine for engineering machinery), Shandong Longkou Oil pump and Fuel Nozzle Limited Liability Company (diesel engine for automobile) and Denso (Euro III).

3.2 Cooling System



1. thermostat

Cooling liquid goes in small circulation and return to the water pump, if water temperature is lower than 76℃.

Cooling liquid goes in big circulation, if water temperature is higher than 90℃. The thermostat is fully open in this case. Cooling water goes to water tank.

Cooling liquid goes both in small circulation and big circulation, if water temperature is between 76℃ to 90℃.

2. Water pump

Centrifugal water pump has compact structure and is convenient to install. Roller bearing and water pump bearing are made as one part. Water seal ring is made of ceram- black lead fiction pairs. It is reliable in use and is good in durability. Impeller is steel plate stamping parts with shield. Shrouded impeller with shield improves the efficiency of water pump.

3. Cooling liquid flow and pressure

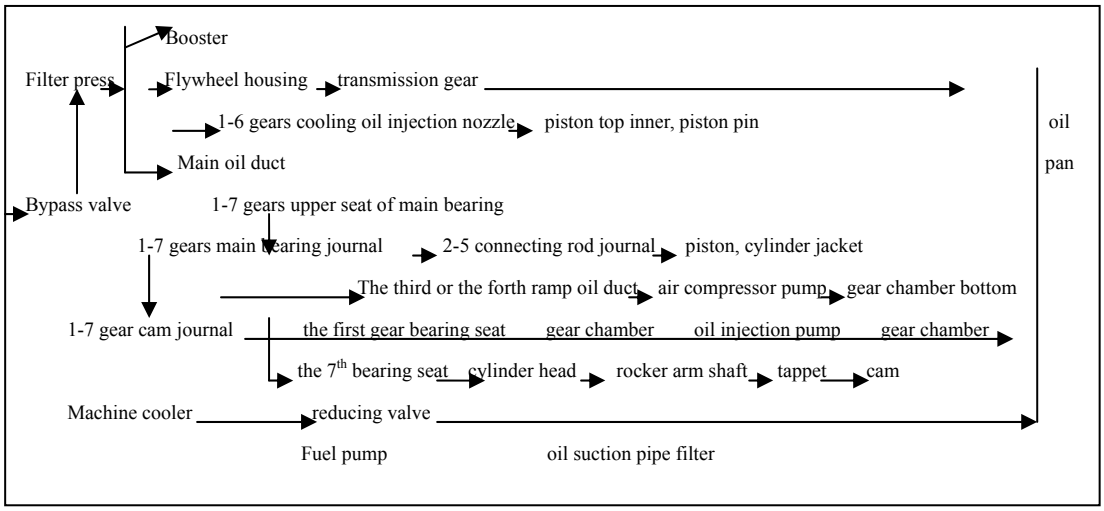
Thermostat is fully open. When it is 2200r/min, flow is 350 L/min and pressure is 96 Kpa.

4. Fin engine oil cooler

It has the advantages of: small size, light weight, high structural strength, resistance of high pressure, wide heat dissipation surface and good cooling effect.

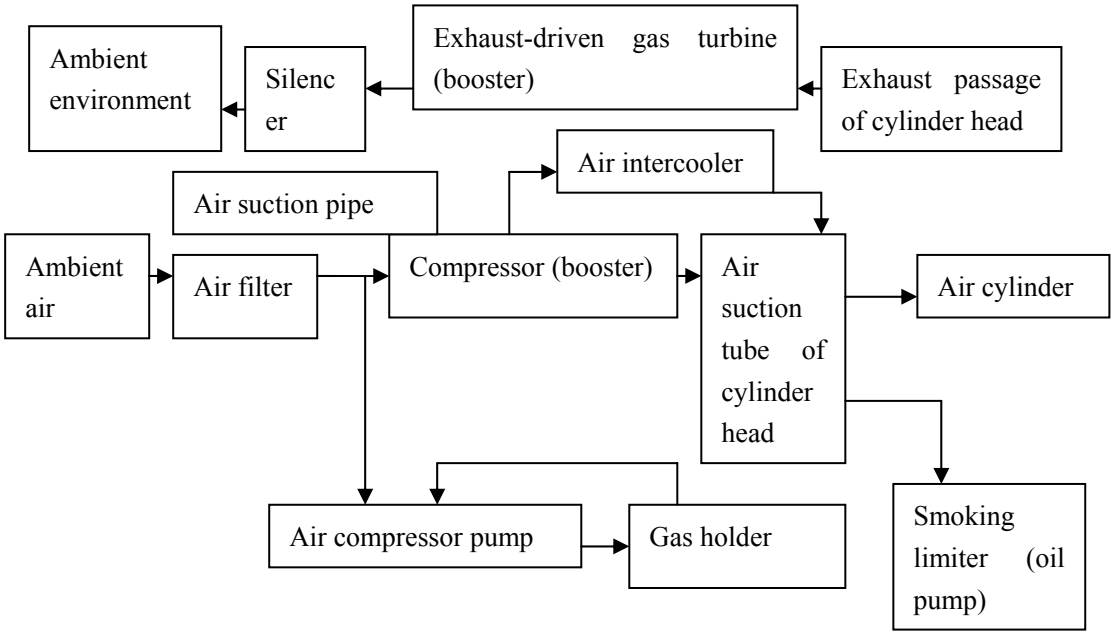
5. volume of cooling liquid of cooling system: 25-30 liters

3.3 lubricating system



1. Reducing valve opens and engine oil returns to oil pan, when pressure of engine oil is ≥505Kpa.
2. Bypass valve opens when pressure difference is ≥127Kpa.
3. Engine oil pressure: minimum pressure is 100Kpa, when it is in idling. Minimum pressure is 350Kpa, when it is in declared working condition. Some types can reduce to 280Kpa.
4. Engine oil temperature is≤115℃ in declared working condition.
5. capacity of lubrication system: 24L

3.4 Air inflow and exhaust system



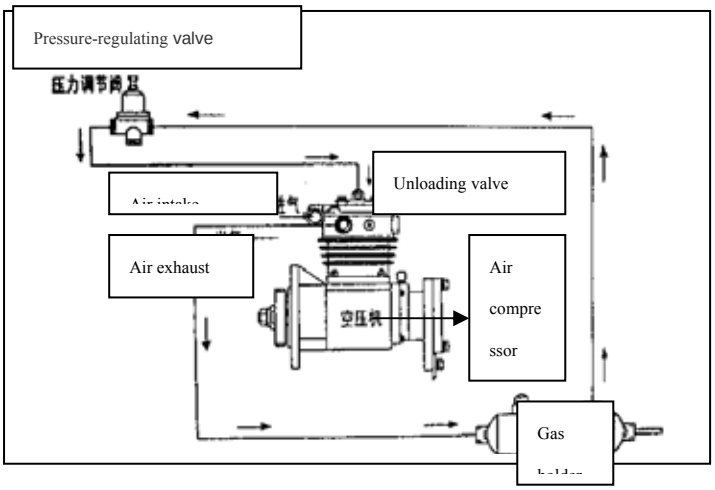
1. Air filter

   Dry-type air filter has three degree of filtering. The efficiency can reach 99%. The first degree is wind blade ring which can make the intake air generate rotational flow whirl. Under the centrifugal force, most dust particles (about 85%) are collected into integrate disk. The second degree is the plicated cylindric paper filter element which can get rid of the rest of dusk. The third degree paper filter

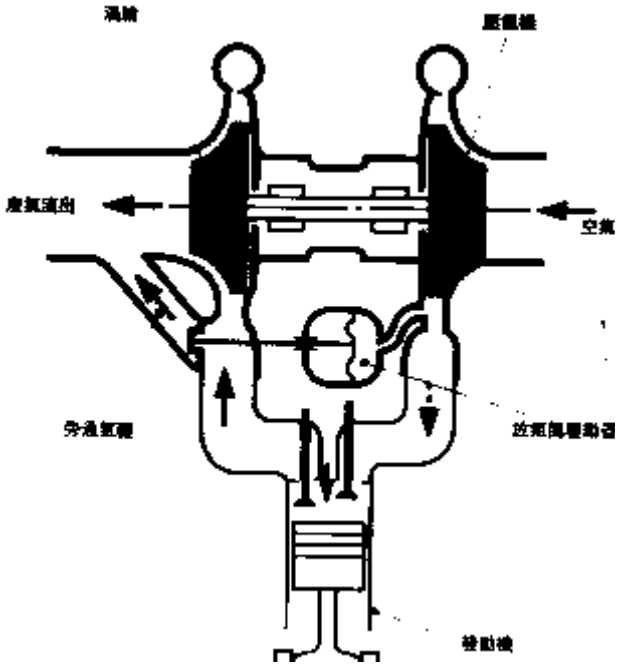
cartridge is safety filter element. Yellow mark indicates safe area which means it can still be used. It can not be used, if the red mark rises. The rising of red mark indicates that the device is in maintenance area.

2. Diesel engine with turbochanger is clean, energy-conservative and effective.
3. Air compressor adopts single cylinder reciprocating type air compressor. There are on-load mode and no-load mode in continuous operation. It is controlled by pressure-regulating valve (option) and unloading valve control.

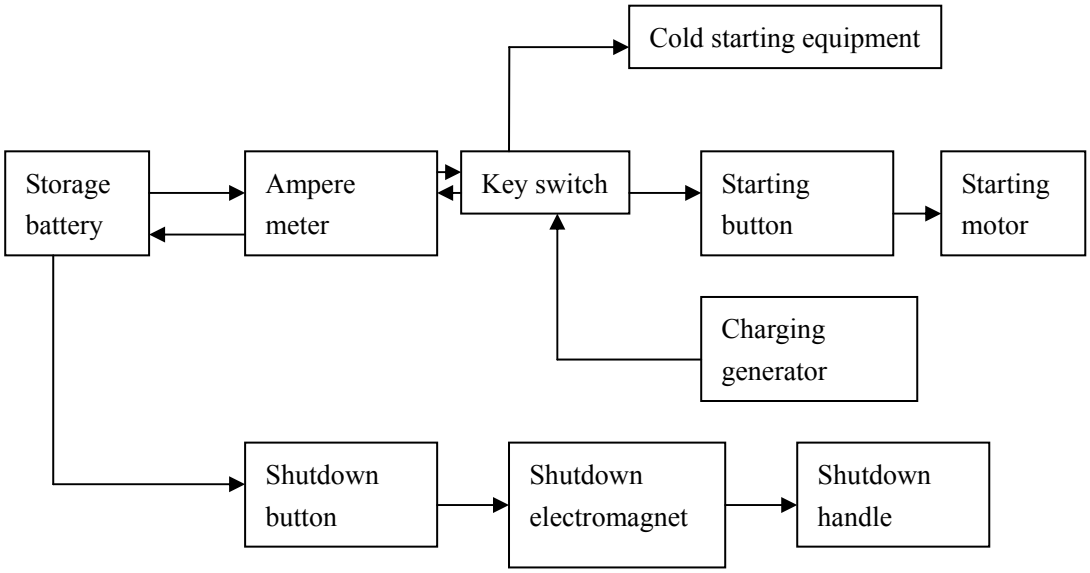
Single cylinder piston air compressor pump



Booster with the function of air exhausting



3.5 starting system



1. starting motor:

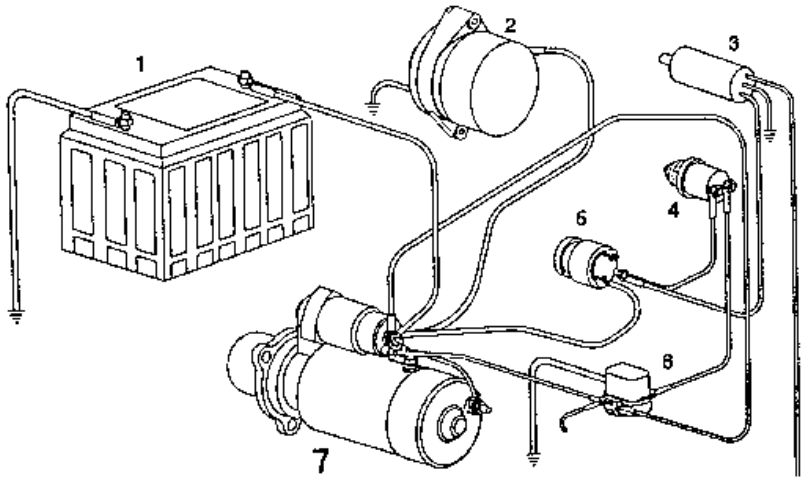
Rated voltage: 24 V, rated power: 7.5 KW

The motor is a direct current series excitation motor with electromagnetic switch and one-way ratchet wheel cluth structure.

2. Electric generator

Rated voltage: 28V, rated rotate speed: 6000r/min. 。JFZ2811: 36A/1KW

JFZ2503: 55A/1.5KW



1. storage battery 2. electric generator 3. shutdown electromagnet 4. starting button 5. key switch 6. starting relay 7. starting motor

JFZ: (1) integrate alternator

(2) IC regulator is employed to gather the generator and regulator into one part.

(3) Stepless voltage regulation guarantees the stability of the device. Maintenance is convenient. Connecting wires are less.

3. storage battery

Our factory demand that mode 6－Q－195,12V,195Ah is adopted. Counter electrode 6×27 pieces.

(Remarks): The storage battery should have the advantage of high capacity, low temperature resistance and efficient current efficiency, if the machine is used in plateau area.

Chapter Four Main Technical Parameters of D114 Series Diesel Engine

4.1.1 toque specifications of main fastening bolts, plug screws, link bolts and connector nuts

- connecting rod bolt (M12) pretension torque 55±5N·m
  final angle 60° ± 3°
- cylinder head bolt (M14) the first pretension torque 50N·m
  the second pretension torque 115±5N·m
  final angle 60° ± 3°
- main bearing cap bolt (M14) the first pretension torque 50N·m
  the second pretension torque 95±5N·m
  final angle 90° ± 5°
- fastening bolt of flywheel (M16) pretension torque 70±5N·m
  final angle 25° ± 3°
- fastening bolt of damper (M16) the first pretension torque 50N·m
  the second pretension torque 100±5N·m
  final angle 30° ± 5°
- fastening bolt of gear chamber (M8) 25 N·m
- fastening bolt of flywheel (M12) 77 N·m
- front supporting bolt of diesel engine (M12) 112 N·m
  with no front supporting bolt 60 N·m
- camshaft thrust plate draw bolt (M8) 25 N·m
- rear oil seal bonnet bolt (M6) 9 N·m
- connector bolt of piston cooling oil injection nozzle (M10) 35 N·m
- pug screw of diesel engine timing pin (M16) 25 N·m
- belt pulley bolt of crankshaft front end (M12) 77 N·m
- air valve rocker fastening bolt (M8) 25 N·m
- rocker regulating screw (M10) 45N·m
- cylinder head cover bolt (M8) 25 N·m
- fastening bolt of diesel engine hanger plate (M12) 77 N·m

fastening bolts in cooling system

- erection bolt of water pump (M8) 25 N·m
- fastening bolt of fan belt pulley (M12) 77 N·m
- fastening bolt of fan bearing seat (M8) 25 N·m
- fastening bolt of regulating wheel (M10) 45 N·m
- fastening bolt of fixed plate of regulating wheel (M8) 25 N·m
- thermosistor body- discharging tube fastening bolt (M8) 25 N·m
- inflow rubber bent clamp bolt (M6) 9N·m

Fastening bolts in lubricating system

- fastening bolt of engine oil pump (M8) 25N·m
- engine oil filter （11/2"） rotating 3/4 circle after being touched
- spring plug screw of engine oil filter pressure-limiting valve (M24) 80N·m

- fastening bolt of engine oil cooler cover (M8) 25 N·m
- fastening bolt of oil pan (M8) 25 N·m
- drain plug of oil pan (M18) 80 N·m
- heater plug of oil pan (M22) 80 N·m
- fastening bolt of fuel sucking pipe flange (M6) 9 N·m
- fastening bolt of fuel sucking pipe bracket (M6) 9 N·m
- fastening bolt of crankcase breather pipe clamp (M8) 18 N·m

Fastening bolts in air intake and exhaust system

- fastening bolt of air intake pipe (M10) 45N·m
- fastening bolt of air exhaust pipe (M10) 45N·m
- fastening bolt of booster (M10) 45N·m
- fastening bolt of compressor air-freeing pipe (M8) 25N·m
- hose clamp bolt of compressor air-freeing pipe (M6) 9N·m
- link bolt of booster oil inlet tube (M12) 30N·m
- fastening bolt of oil return pipe flange (M8) 25N·m
- hose clamp bolt of booster oil return pipe(M5) 9N·m
- clamp bolt of turbine air-freeing V belt (M6) 15N·m

Fastening bolts in compressed air system

- fastening bolt of air compressor (or PTO) flange (M12) 77N·m
- fastening bolt of air compressor (orPTO) transmission gear (M16) 134N·m
- oil inlet pipe connector nut of air compressor (M12) 15N·m
- water inlet and outlet pipe connector nut of air compressor (M18) 35N·m
- fastening bolt for air compressor bracket and body (M10) 45N·m
- fastening bolt for air compressor supporting plate and air compressor bracket (M10) 45N·m

Fastening bolts in fuel system

- fastening bolt for oil injection pump flange (M10) 45N·m
- fastening bolt of oil injection pump transmission gear
  P7 improved pump (M18) 105N·m
  EP-9 oil injection pump (M18) 137N·m
  Bosch P7100 (M20) 170 N·m
- link bolt for oil inlet and oil outlet of oil injection pump(M14) 35N·m
- fastening bolt for oil injection pump and bracket (M10) 40 N·m
- fastening bolt for oil injection pump and engine body (M10) 77 N·m
- timing pin plug of oil injection pump 15 N·m
- connector nut of high-pressure tube (M14) 45 N·m
- fastening bolt for high-pressure oil tube clamp bracket (M8) 25 N·m
- high-pressure clamp bolt (M6) 9 N·m
- fastening bolt of oil injector (M8) 25 N·m
- link bolt of oil return tube of oil injector
  M6 10 N·m
  M6 15 N·m
- fastening bolt of fuel delivery pump (M8) 25 N·m
- link bolt of oil inlet tube of fuel delivery pump (M14) 35 N·m

- connector nut of oil outlet tube of fuel delivery pump (M16) 30 N·m
- fuel filter (1") rotating 3/4 circle after being touched
- fastening nut of fuel filter seat (M8) 25 N·m
- link bolt for oil inlet tube and oil outlet tube of fuel filter(M12) 28 N·m
- connector nut of air tube of smoke-limiting device (M12) 25 N·m
- fastening bolt of shutdown electromagnet (M6) 10 N·m

Fastening bolts in electrical system

- fastening bolt of starting motor (M16) 77N·m
- fastening bolt of generator (M10) 45N·m
- generator stay
  - end of water pump (M8) 25N·m
  - end of generator (M10) 45N·m
- fastening bolt of generator bracket (M8) 25N·m
- fastening nut of generator belt pulley (M16) 80 N·m
- temperature sensor (Z 3/8) 35 N·m
- engine oil heater (M22), stamping oil pan 120 N·m
  aluminum oil pan 100 N·m
- oil pressure switch (Z1/8) 20 N·m

4.1.2 signs of bolt performance level and recommended intension torque

National standard stipulates that bolt performance level is comprised by two parts of numbers which are separated by " • ". The sign is marked in raised type or debossed type on the top of bolt head or is marked on the side of the head in debossed type.

The first part of numbers (before " • ") is 1/100 of indicated extension strength (σb).

The second part of numbers (after " • ") is 10 times of the ratio (yield ratio) of indicated yield strength (σ0.2) and indicated extension strength (σb).

Recommended intension torques of bolts in different performance levels

Performance level	8.8		10.9	
Bolt diameter （mm）	torque		torque	
	Cast iron	Aluminium	Cast iron	Aluminum
6	9	7	14	11
8	25	18	32	25
10	40	30	60	45
12	70	55	105	80
14	115	90	160	125
16	180	140	240	190

18	230	180	320	250

Notes: 1. Fastening bolts which are not listed in section 8.4.1 are recommended to adopt the intension torques listed in the table above.

2. Torques listed in the table above are only applicable to bolt, thread of nut which are needed to be lubricated.

4.1.3 recommended intension torque of tapered plug

Plug specification		torque N·m	
thread	Full diameter of effective thread	Cast iron or steel	aluminum
1/16	8.1	15	5
1/8	10.4	20	15
1/4	13.7	25	20
3/8	17.3	35	25
1/2	21.6	55	35
3/4	26.7	75	45
1	33.5	95	60
11/4	42.2	115	75
11/2	48.3	135	85

4.1.4 recommended intension torque of pipe connector link bolt

specification	M8×1	M10×1	M12×1.25	M14×1.5	M16×1.5	M18×1.5	M20×1.5	M22×1.5
torque（N·m）	13	22	32	45	50	65	85	105

Notes: The torqueses listed above are applicable to steel or cast iron substrate.

4.2 sealant and lubricant used in diesel assembling

4.2.1 Only designated sealant can be used, when the following components are assembled.

- Pipe connection of all tapered plugs and tapered thread are coated Loctite 567.
- Seal surface of gear chamber shroud is coated Loctite 5900.
- All gaskets are not coated with sealant.
- All expansion choke plug and the circle surface of choke plug of rear cam bearing saddle bore are coated Loctite 11747.
- Fastening bolt of oil injection pump flange, fastening bolt of air compressor flange, input end thread surfaces of stud bolt in thermosostor and stud bolt in engine oil cooler flange, and thread surface of fastening bolt in bell housing are coated Loctite 271.
- Thread surfaces of fastening bolt of air exhaust pipe and fastening stud bolt

of booster (input end) are coated Loctite 76732.

- Oil filling pipes on the two sides of engine body, oil return pipe of booster and the excircle with which dipstick pipe mates with engine body are coated Loctite 680.

4.2.2 When the following components are assembled, the matching surface and thread surface must be coated with 15W-40 diesel engine oil.

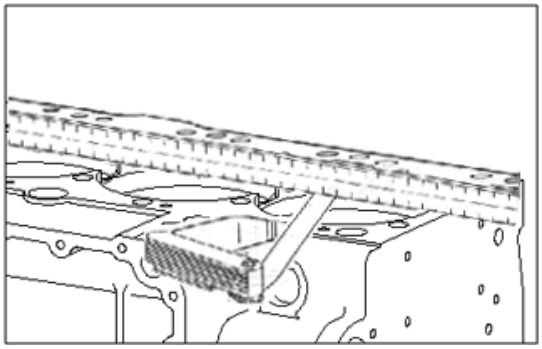
- Connecting rod bearing bushing (The back of the bearing bushing is nor coated engine oil)
- Main bearing bushing (The back of the bearing bushing is nor coated engine oil)
- Molded surface and axle diameter of cam
- Tappet
- Piston
- Piston ring
- Piston pin
- Components of rocker arm
- Push rod
- O type seal ring of cylinder jacket
- Tooth surface of every transmission gear
- Air valve stem and its seal ring
- Engine oil pressure-regulation valve
- Seal ring of engine oil filter
- Seal ring of diesel filter
- Main bearing bolt
- Cylinder head bolt
- Connecting rod bolt
- Fastening bolt of flywheel
- Fastening bolt of damper
- Other fastening bolts

4.3 Specification of main parts and the wear limit

When the used diesel engine is examined and repaired and reset, the specification of all parts should meet the requirement. The components which are out of use limit should be repaired or changed.

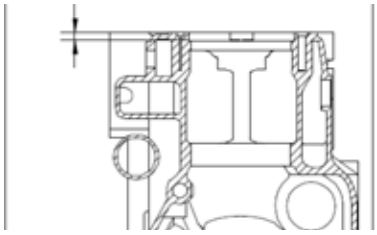
4.3.1 Engine Body

The flatness of top plane of used engine body should meet the following requirements: whole scale of plane: 0.06mm; local scale which is less than 50mm: 0.012.



If the flatness of whole plane is more than 0.10mm or the flatness of local scale which is less than 50mm is more than 0.025, the body should be changed or repaired. Top plane is polished according to maintenance guidance. When the polished engine body is used, specified cylinder head gasket with specified thickness should be installed to guarantee normal compressor ratio and avoid the valve touching piston.

Depth of bearing surface of cylinder jacket is 9.985-10.015 mm. If the wear of the bearing surface effects protrusion of cylinder jacket, the engine body should be changed or repaired according to maintenance guidance.



If the repaired engine body is used, a gasket with specified thickness should be installed on the bearing surface to guarantee the protrusion of cylinder jacket.

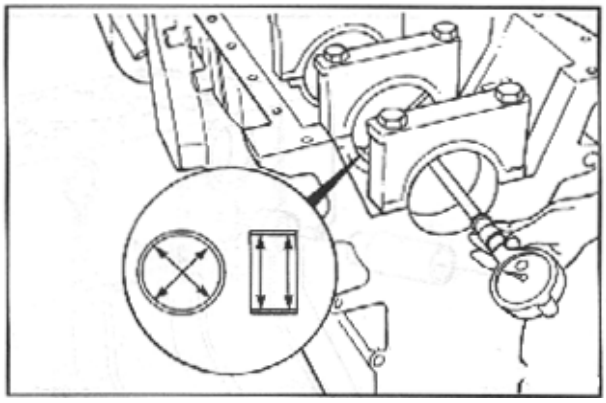
When the main bearing bolt is tightened to the specified torque:

Inner diameter of main bearing saddle bore: $\Phi 105 \pm 0.011$

Inner diameter of main bearing: $\Phi 98 ^{+0.131}_{+0.089}$

Maximum non-coaxiality of hole: 0.02 mm

Fit clearance with crankshaft journal: 0.076-0.144mm



Camshaft bearing saddle bore and hole diameter of bearing:

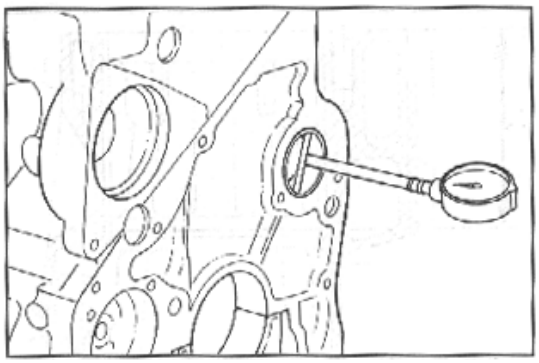
Diameter of saddle bore: $\Phi 64 \pm 0.015$

Bore diameter of bearing: $\Phi 60 ^{+0.155}_{+0.085}$

Non-coaxiality of hole: 0.02 mm

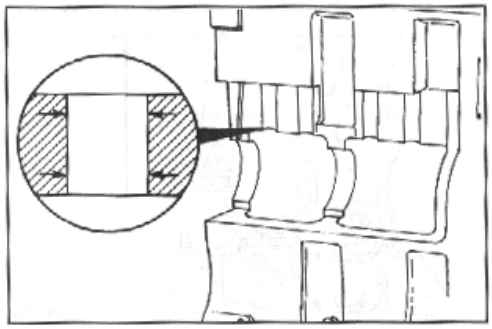
Fit clearance with crankshaft journal: 0.075-0.164mm; maximum: 0.20mm

Wear limit of bearing bore: $\Phi 60.20$



Diameter of tappet hole: $\Phi 20^{+0.021}_{.0}$

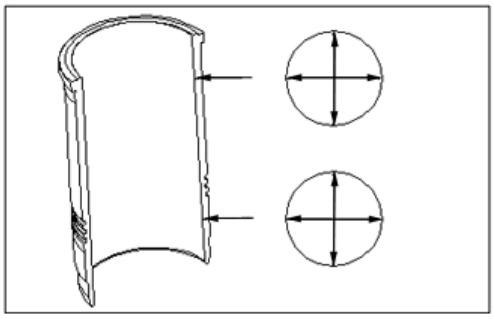
Fit clearance with tappet: 0.02-0.054mm
Wear limit of tappet hole (minimum diameter): 28.075
Limiting fit clearance with tappet: 0.17mm



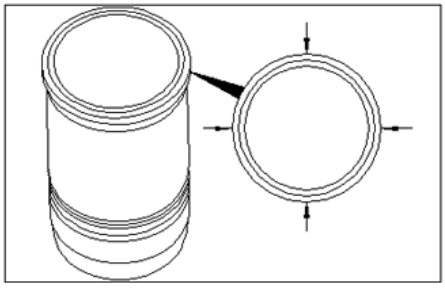
4.3.2 Cylinder jacket

Bore diameter of cylinder jacket: $\Phi 114^{+0.035}_{.0}$

Out-of-roundness of cylinder jacket bore: 0.0125

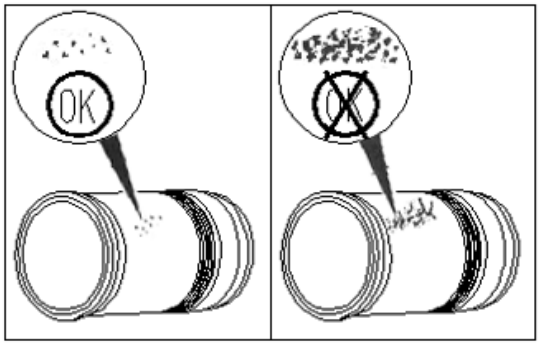


External diameter of setting circle of cylinder jacket: $\Phi 130^{-0.014}_{-0.039}$

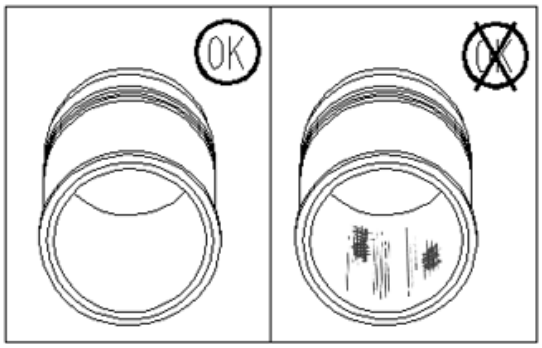


If the outside surface of cylinder jacket generates large-scale hole erosion whose

depth is more than 1.5mm, the cylinder jacket should be changed.



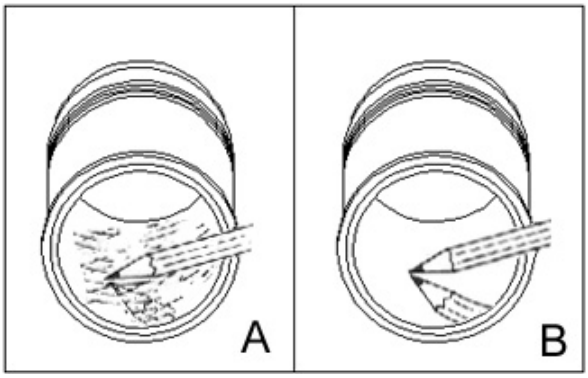
If cylinder jacket bore generates cinch mark which can be found by fingernail, the cylinder jacket should be changed.



The identification of wear degree of cylinder jacket bore

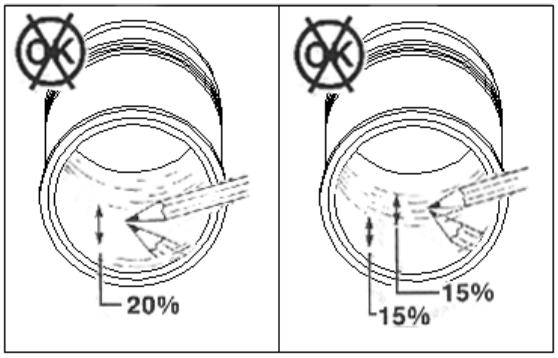
Picture (A) shows medium wear, namely, visible boning stripe can still be found in wear area.

Picture (B) is serious wear, namely, the original boning stripe can not be seen in wear area.



The cylinder jacket should be changed, if inner surface of cylinder jacket in piston ring travel range appears the following phenomena:

- Serious wear appears on 20% inner surface.
- 15% serious wear and 15% medium wear

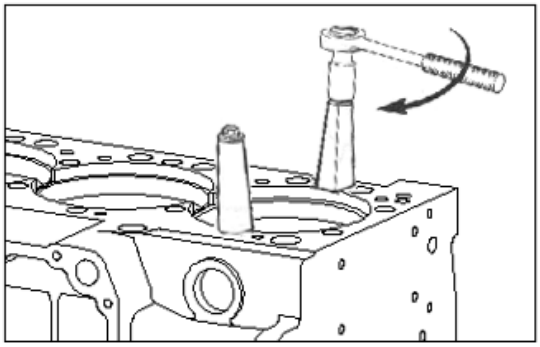


Protrusion of cylinder jacket

Before measuring the protrusion, the operator should press cylinder jacket and bearing surface of engine body tightly by special tightening tool.

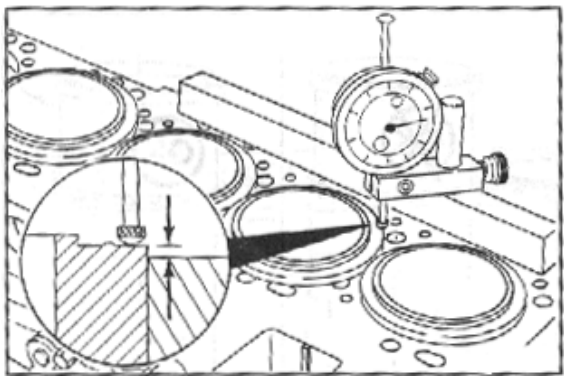
Tightening torque of two tightening tools is 68Nm.

Special tightening tool should be removed, when the cylinder jacket is pressed tightly.



Under the condition that cylinder jacket with no press, protrusions of four points are measured every 90° , namely, the distance between top plane of engine body and flange plane of cylinder jacket is measured.

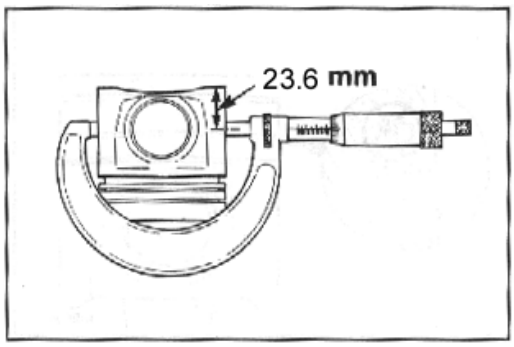
The protrusion of cylinder jacket should be controlled within 0.03mm-0.08mm.



4.3.3 Piston

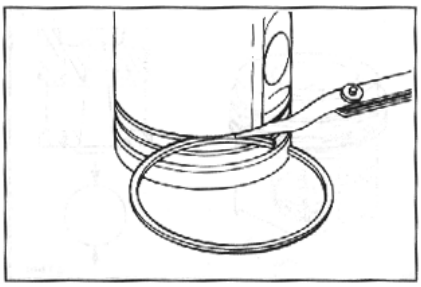
The picture shows the size of piston skirt.

Size of piston skirt (mm)	Wear limit (minimum diameter, mm
Φ113.87±0.007	Φ113.78



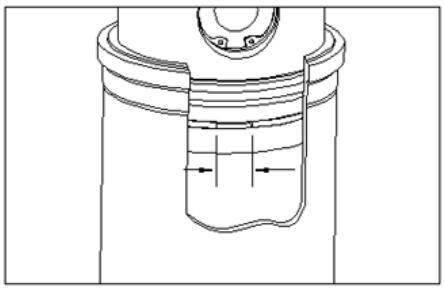
Piston backlash is measured by new piston ring and thickness gauge.

	Backlash (mm)	Wear limit (mm)
The first ring		
The second ring	0.06-0.92	0.016
Oil ring	0.03-0.62	0.012



Closed clearance of piston ring is measured in special measuring tool (inner diameter 114.02 0.005)

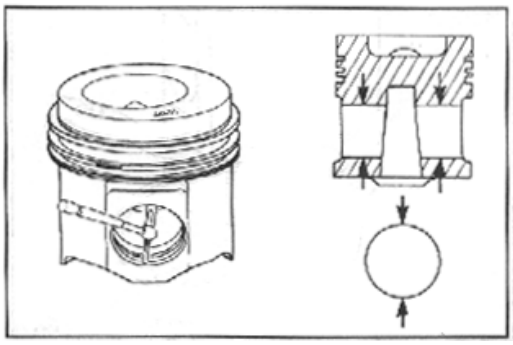
	Closed clearance (mm)	Wear limit (mm)
The first, second rings	0.4-0.6	1.4
Oil ring	0.3-0.5	1.4



Diameter of piston pin hole is $\Phi 45^{+0.010}_{+0.003}$ in ambient temperature of 20℃.

Notes: Diameter increase 0.013mm, when the temperature of piston pin increase 5℃.

Fit clearance of piston pin and piston pin hole	Wear limit (mm)
0.003-0.017	0.05

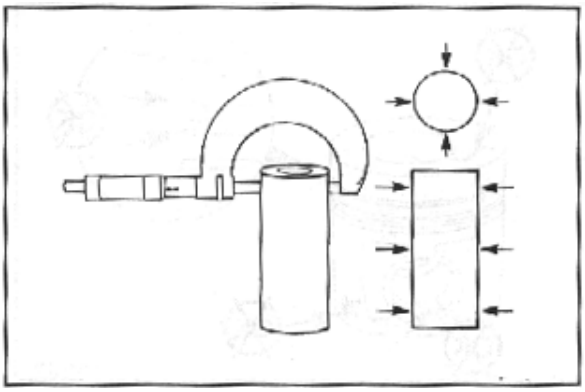


△ Notes: The original quality grouping mark of piston should be clear before the piston being changed. The quality of newly-installed piston should be the same to the group of the original piston. Make sure that the mass difference of piston in one diesel engine can not be larger than 10g.

4.3.4 Piston pin

External diameter of piston pin: $\Phi 45^{\ 0}_{-0.007}$

If scratch and bruise are found or the out-of-roundness is more than 0.03mm, the piston should be changed.

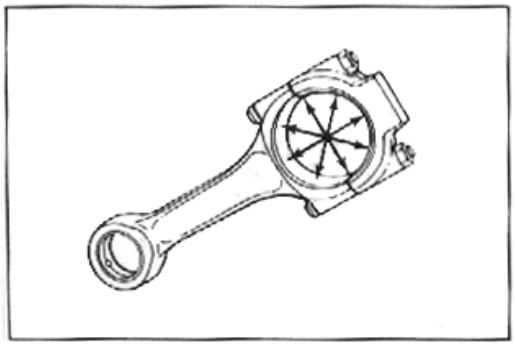


4.3.5 Connecting rod

Big end hole of connecting rod: $\Phi 81 \pm 0.011$

Inner bore of connecting rod bearing: $\Phi 76^{+0.101}_{+0.059}$

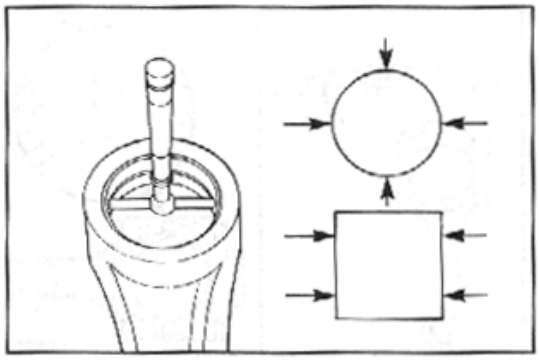
Fit clearance with connecting rod journal: 0.046-0.114mm



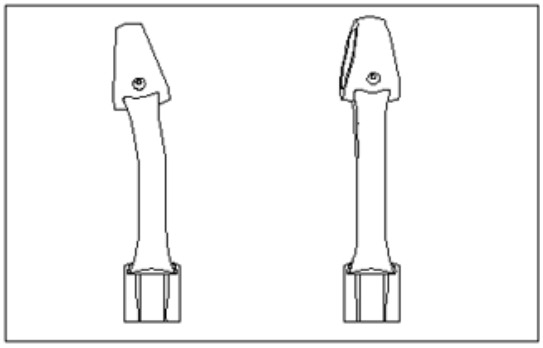
Small end hole of connecting rod: $\Phi 49 \pm 0.012$

Inner bore of connecting rod bearing$\Phi 45^{+0.041}_{+0.025}$

Fit clearance of piston (mm)	Wear limit (maximum clearance, mm)
0.025-0.048	0.08



Nonparallelism and torsion of centre line of connecting rod small and big bearing hole
Nonparallelism: 100: 0.03
Torsion: 100: 0.06

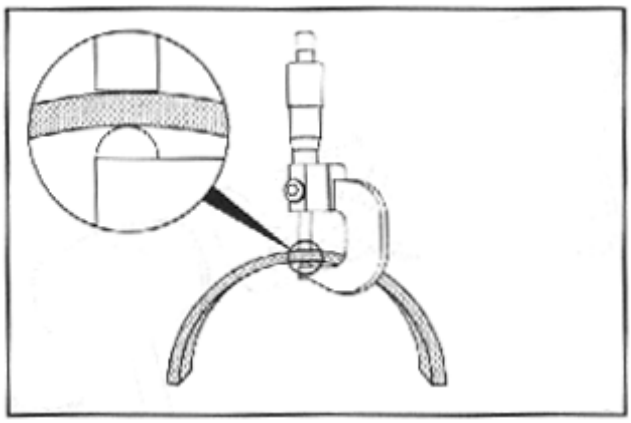


▲warning: If nonparallelism and torsion of centre line of connecting rod small and big bearing hole is beyond the specified value, it indicates that abnormal bend and twist appear in connecting rod. On this condition, the connecting rod can not be used. It is not allowed to use the straightening connecting rod to avoid grave accident which may injure people.

4.3.6 Main bearing

Thickness of main bearing and wear limit

Thickness of main bearing (mm)	Nominal thickening size (mm)	Wear limit (minimum thickness, mm)
$3.50^{-0.05}_{-0.06}$	Standard size	3.34
$3.75^{-0.05}_{-0.06}$	0.25	3.59
$4.00^{-0.05}_{-0.06}$	0.50	3.84
$4.25^{-0.05}_{-0.06}$	0.75	4.09
$4.50^{-0.05}_{-0.06}$	1.00	4.34



Notes: Crank bearing whose main journal has been polished should add thickening main journal whose thickness is the same to the polishing size of main journal. Thickening mark can be found on the back of main bearing steel.

Fit clearance of new main bearing and crank shaft journal is 0.076-0.144 mm.

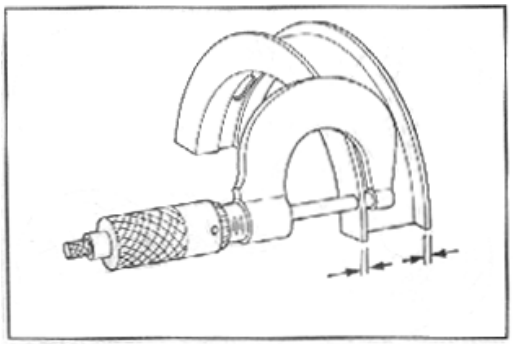
4.3.7 Crank thrust bearing

The thickness and wear limit of crank thrust bearing are same to that of main bearing.

Flange thickens of crank thrust bearing: 3.54±0.025

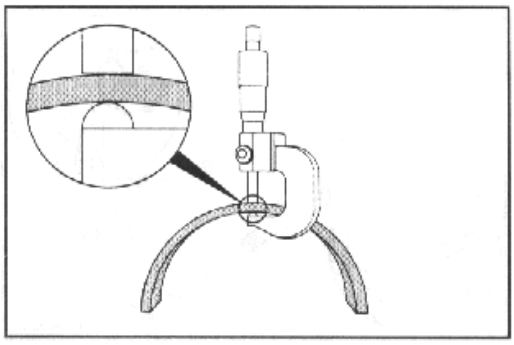
Crank thrust clearance

Crank thrust clearance (mm)	Wear limit (maximum thrust clearance, mm)
0.100-0.274	0.50



4.3.8 Connecting bearing

Thickness of connecting bearing (mm)	Wear limit (maximum thrust clearance, mm)
$2.5^{-0.035}_{-0.045}$	2.43

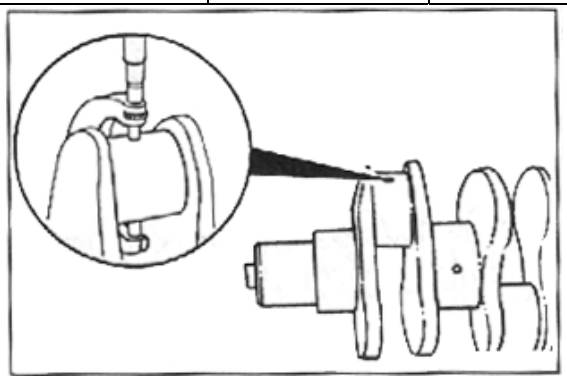


4.3.9 Crank axle

Connecting rod journal

When the connecting rod journal reaches the wear limit, it can be reused by being polished. It can be polished for four times. Size and service limit of every polishing:

Connecting rod journal (mm)	Polishing time	Wear limit (minimum diameter, mm)
Φ76±0.013	Standard size	Φ75.962
Φ75.712±0.013	The first polishing (0.25)	Φ75.674
Φ75.462±0.013	The second polishing (0.50)	Φ75.424
Φ75.212±0.013	The third polishing (0.75)	Φ75.174
Φ75.962±0.013	The fourth polishing (1.00)	Φ75.924

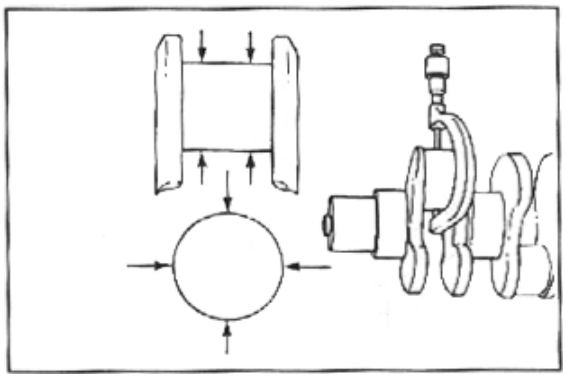


Fit clearance of connecting rod journal and connecting rod bearing: 0.046-0.114mm

Out-of-roundness and conical degree of connecting rod journal which are caused by wear can not be more than the following values.

Out-of-roundness: 0.05 mm

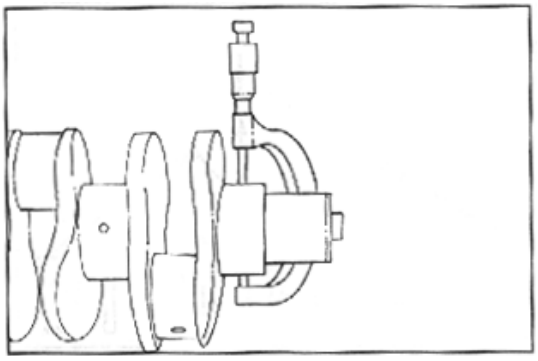
Conical degree: 0.013mm



Main journal

When main journal reaches the wear limit, it can be reused by being polished. It can be polished for four times. Size and service limit of every polishing:

Connecting rod journal (mm)	Polishing time	Wear limit (minimum diameter, mm)
Φ98±0.013	Standard size	Φ97.962
Φ97.712±0.013	The first polishing (0.25)	Φ97.674
Φ97.462±0.013	The second polishing (0.50)	Φ97.424
Φ97.212±0.013	The third polishing (0.75)	Φ97.174
Φ96.962±0.013	The fourth polishing (1.00)	Φ97.924

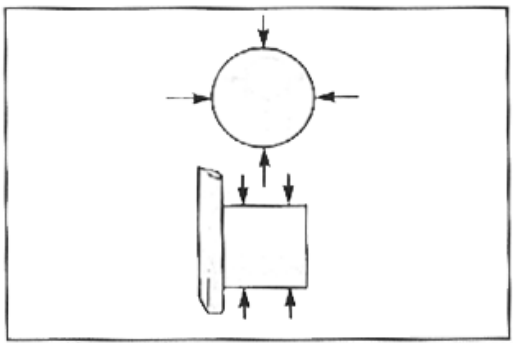


Fit clearance of main journal and main bearing is 0.076-0.144mm

Out-of-roundness and conical degree of connecting rod journal which are caused by wear can not be more than the following values.

Out-of-roundness: 0.05 mm

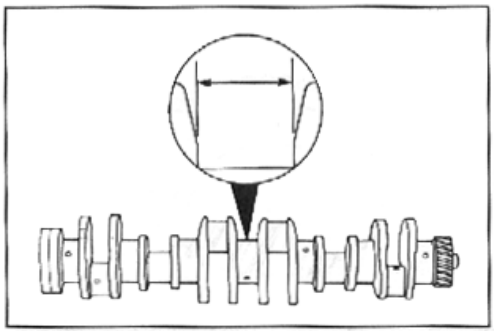
Conical degree: 0.013mm



Width of thrust surface

Thrust surface width of the fourth main journal of crank axle is $43^{+0.062}_{0}$

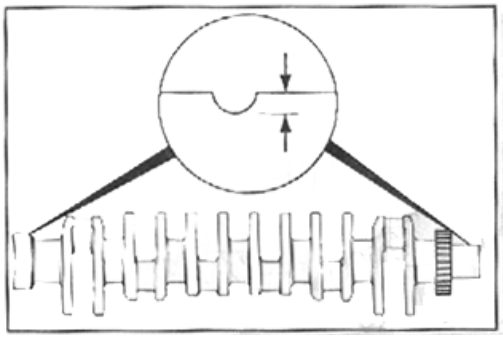
Thrust surface can be polished for 2 times, if abnormal wear is found on the thrust surface. 0.25mm can be polished for every time.



Front and rear journals of crank

Depth limit of wear groove in the journals which match with front and rear oil seals is 0.25mm.

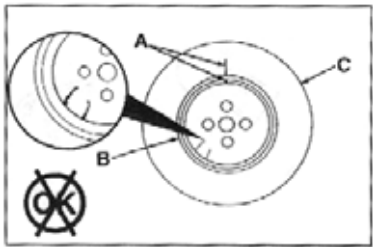
According to the maintenance instruction, a jacket should be added oil sealing journal, if wear depth of oil sealing journal is beyond the limit mentioned above. Crank whose oil sealing journal is added jacket should use specified front and rear oil seal which has smaller inner bore.



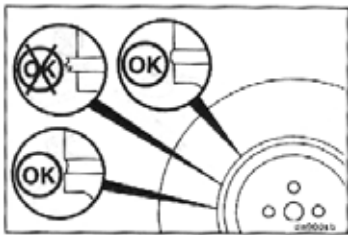
4.3.10 Damper

Rubber damper

If dislocation distance of line (A) on the outside circle of damper is more than 1.6mm and flaw can be found in inner circle, the damper should be changed.

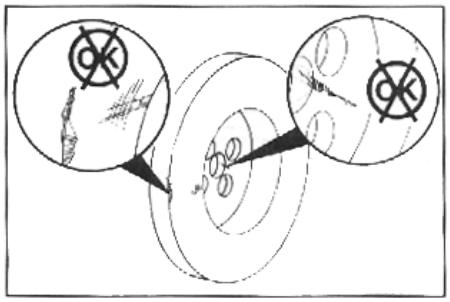


If rubber ring of damper is broken or the dislocation distance of rubber is more than 3.2 mm, the damper should be changed.

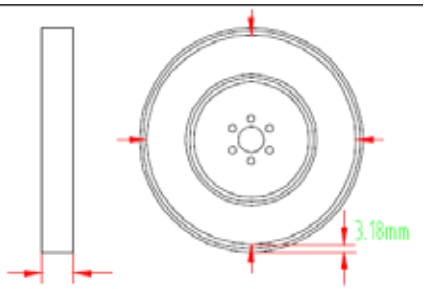


Silicone oil damper

If flaw is found in junction plate of silicone oil damper or the shell surface is uneven, the damper should be changed.

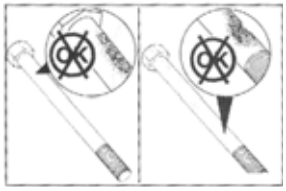


Silicon oil in silicon oil damper will become thick and swelling, when the damper works for a period of time. On this condition, as the thickness of damper is constant, so the external diameter of damper will swell and slotting collar will increase. The damper should be changed, if the distance between inner ring of slotting and outside diameter of damper is more than 0.25mm (judged by fracture width of paint).

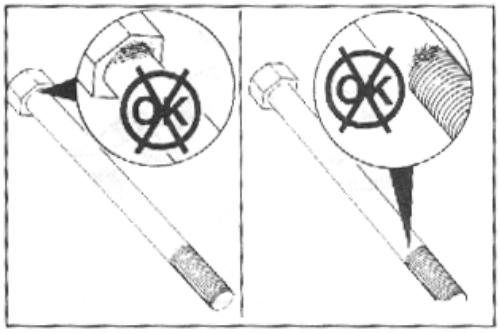


4.3.11 cylinder head bolt, main bearing cap bolt, damper bolt, flywheel bolt

If the corrosion area of cylinder head bolt shank is more than 1cm^2 and corrosion depth is more than 0.1mm, the cylinder head bolt should be discarded as useless.



Fillet of bolt head bearing surface and thread root of all bolts mentioned above should not be corroded. If corrosion is found on these two parts, the bolts can not be used anymore.



Free length of bolt

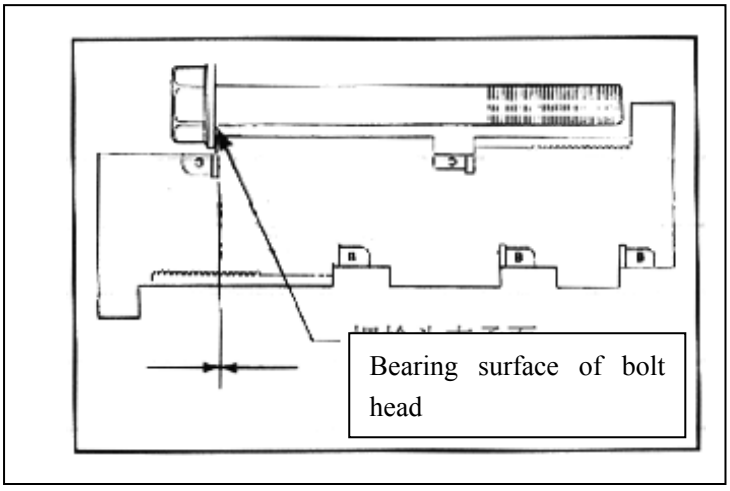
As bolt stress of connecting rod is relatively low, plasticity permanent deformation will not appear under the normal condition.

However, plasticity permanent deformation can be found in cylinder head bolt, main bearing cap bolt, damper bolt, flywheel bolt, when they are used for a period of time. Free length of them should be checked before reusing. If free length is beyond the limit value, they can not be reused.

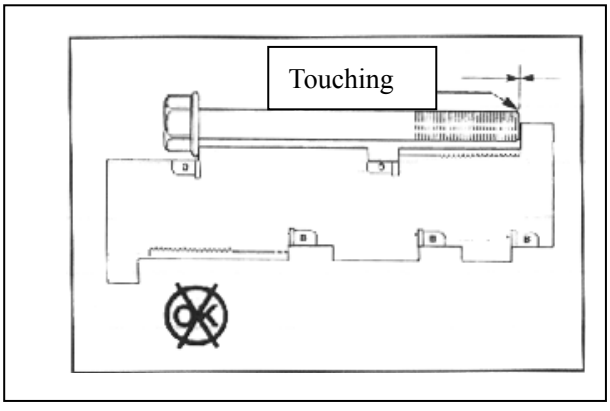
The measurement of free length of bolt

Free length of bolt is measured by free length measurement gauge of bolt.

The following picture shows this process: Bolt head is put into relative groove of measurement gauge. Bearing surface of the head should stick to basal plane of measurement gauge.



It is indicated that free length of bolt is beyond the limit for plasticity permanence deformation, if the end surface of bolt touches limit surface of gauge. In this case, the bolt can not be reused.

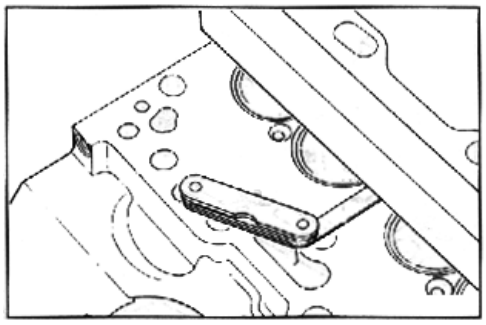


4.3.12 Cylinder head

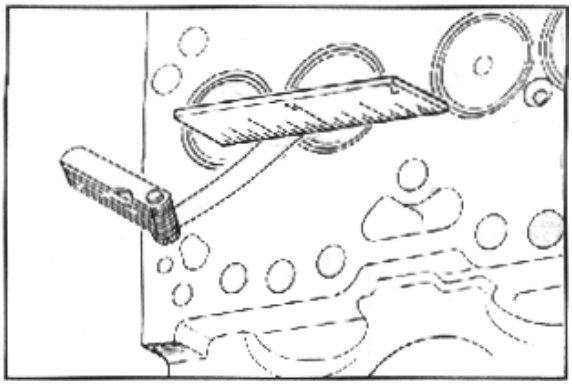
The flatness of cylinder head base plane is measured by ruler and thickness gauge. Specified flatness is:

Range of overall length: 0.08mm

100mm range: 0.04mm

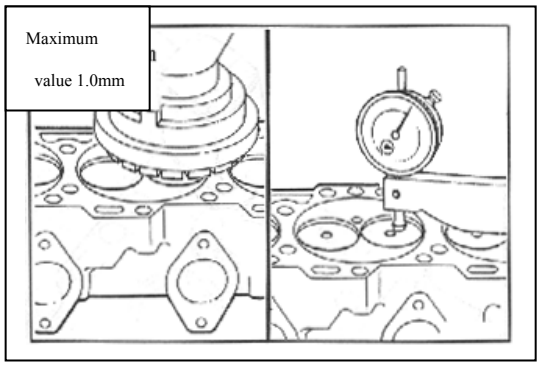


Flatness of cylinder hole and water hole is checked by 50mm ruler and thickness gauge. If the value or the maximum wear is more than 0.025mm or corrosion is found, the cylinder head can not be reused. Cylinder head should be changed or repaired.

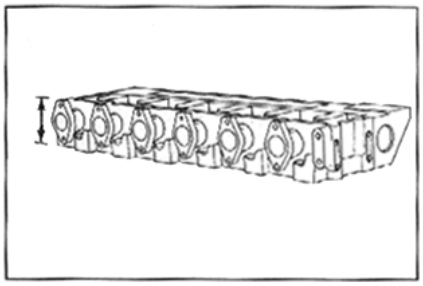


In the process of flatness repairing, the maximum repairing amount of cylinder head base plane is 1.0mm.

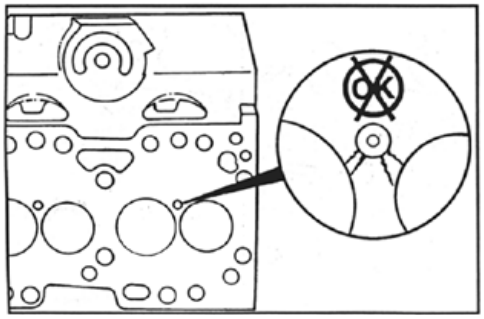
After the base plane of cylinder head being repaired, base plane depth of air valve and protrusion of air inlet valve should be checked. If the depth of air inlet valve is less than 1.2mm or depth of exhaust valve is less than 1.5mm, surface of air valve should be polished to specified value. If protrusion height of oil injector is more than 3mm, oil injector gasket should be thickened to make the protrusion meet the requirement (2.5-3.0mm).



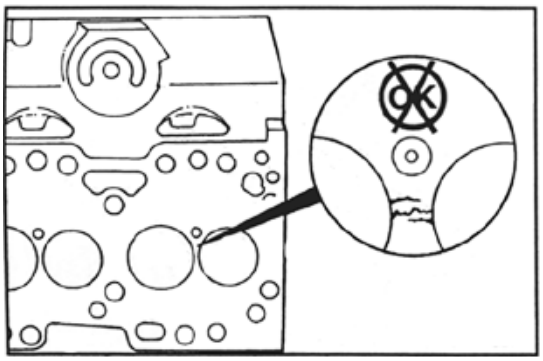
Height of new cylinder head is 134.85-135.15 mm. If the height is less than 133.85, the cylinder head can not be used anymore.



If fracture extending from hole of oil injector to air valve seat can be seen on the bottom of cylinder head, the cylinder head should be changed.

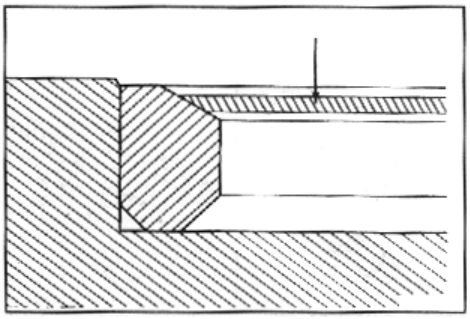


If fracture is found between two air valve seat bores of cylinder head bottom, the cylinder head should be changed.



Width of sealing line on air valve seat ring is 1.5mm-2.0mm.

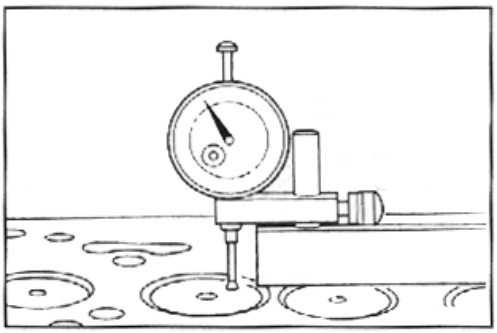
If the width of sealing line is beyond the upper limit, the air valve seat ring should be changed.



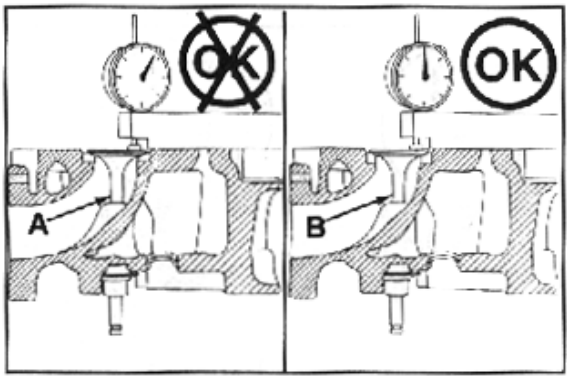
Concave depths (distance between base plane of cylinder head and base plane of valve) of inlet and exhaust valves

Inlet valve: 1.10-1.50mm

Exhaust valve: 1.40-1.80mm

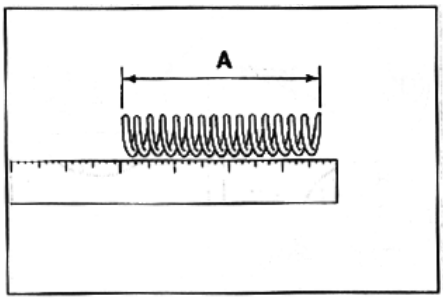


If concave depth of used air valve (A) is beyond the limit, new air valve (B0) should be installed before changing valve seat ring. If concave depth of new air valve is in prescribed limit, it only need to polish air valve seat ring (no need to change) and use new valve.



4.3.13 air valve spring

Free length of air valve spring (new) is 66.7mm

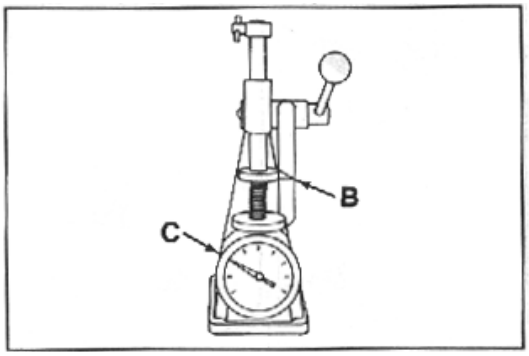


Load of air valve spring in active length

Active length: 41.4mm

Load: 837.4-925.6N

If spring load in active length is lower than the minimum value mentioned above, the spring must be changed.

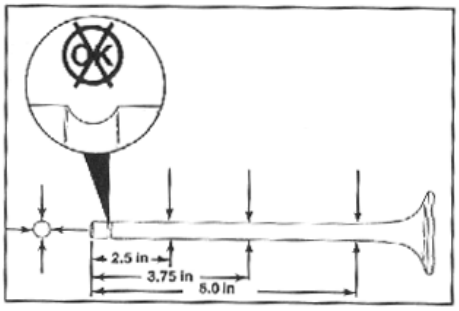


4.3.14 air valve

Diameter of air valve stem

Diameter of inlet valve stem: $\Phi 9^{-0.025}_{-0.040}$

Diameter of exhaust valve stem: $\Phi 9^{-0.035}_{-0.050}$

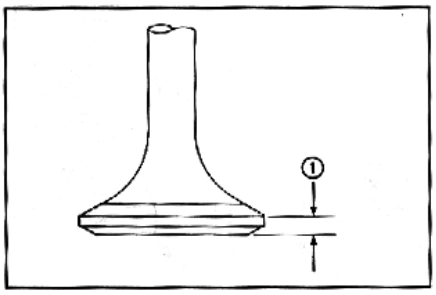


Minimum thickness of air valve head

Inlet valve: 3.00mm

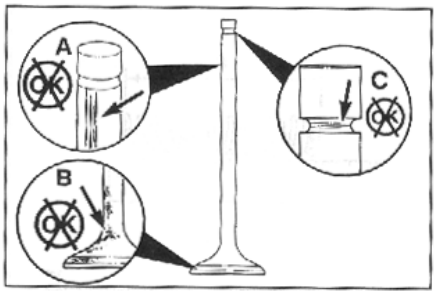
Exhaust valve: 2.30mm

If thickness of inlet valve head is less than 2.85 by being worn or thickness of exhaust valve head is less than 2.15 by being worn, the valve should be changed.

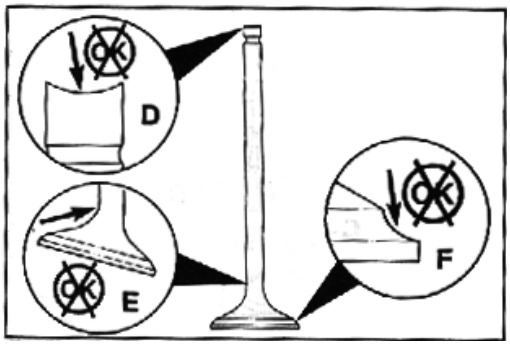


As long as the situations in the following picture appear, the air valve should be changed.

- Stem is worn; Diameter of inlet valve stem is less thanΦ8.95; Diameter of exhaust valve stem is less thanΦ8.94 (A)
- Corrosion pits can be found in stem or seat (B)
- Clamp groove is seriously worn (C).



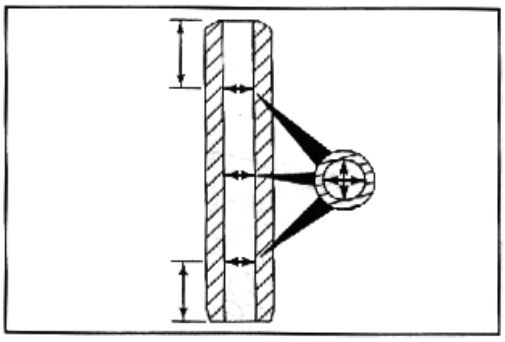
- End face of air valve stem is seriously worn (D)
- air valve stem bends (E)
- Fracture can be found in air valve head or the seat is seriously worn (F).



4.3.15 air valve guide pipe

Bore diameter of air valve shaft guide: $\Phi 9^{+0.015}_{0}$

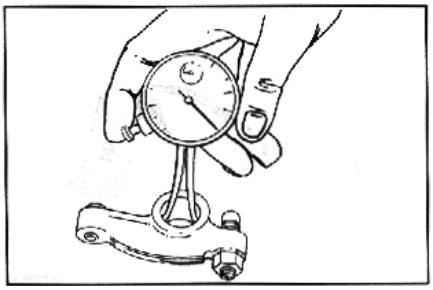
If bore diameter is more thanΦ9.05 by being worn, the guide pipe should be changed.



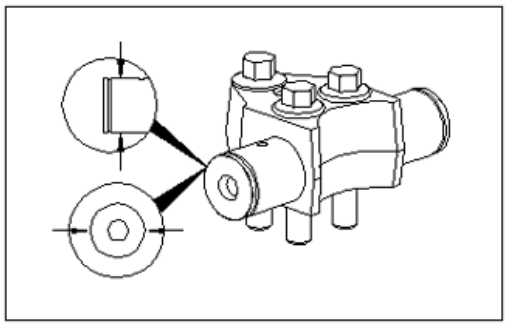
4.3.16 Rocker arm

Bore diameter of rocker arm bearing: $\Phi 22^{+0.033}_{+0.020}$

If bearing bore and rocker journal are worn and its fit clearance is more than 0.15mm, rocker arm bearing or rocker shaft should be changed.



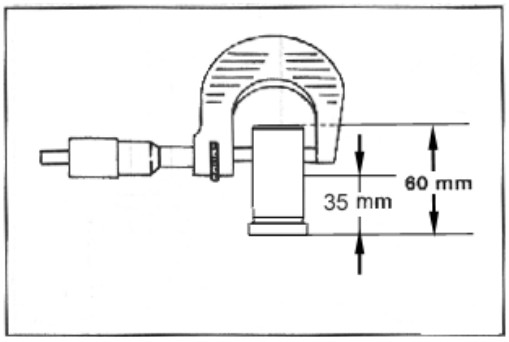
Diameter of rocker shaft $\Phi 22^{\ 0}_{-0.013}$



4.3.17 Tappet

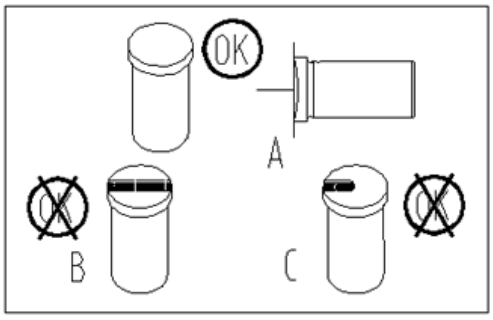
Diameter of tappet $\Phi 28^{-0.020}_{-0.033}$

Wear limit of tappet diameter: 27.915 or limit of fit clearance with tappet hole: 0.17mm



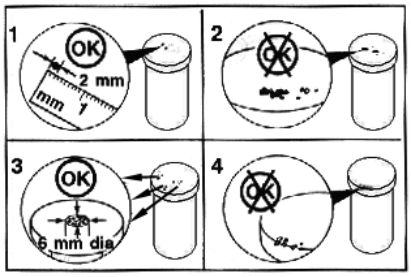
Base plane wear of tappet

- A- unavoidable wear, wear limit: 0.025mm
- B, C- abnormal wear, tappet with abnormal wear must be changed.



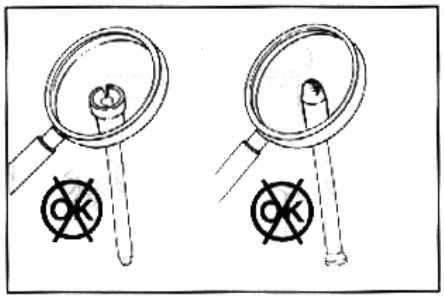
1- The one with individual pit which is less than 2mm can still be used.
2- The one with interconnected pits can not be used.

3- the tappet can still be used, if diameter of every intensive needle point is less than 6mm and these needle points occupy less than 40% area,
4- Pit on the border of bottom base plane is not allowed.

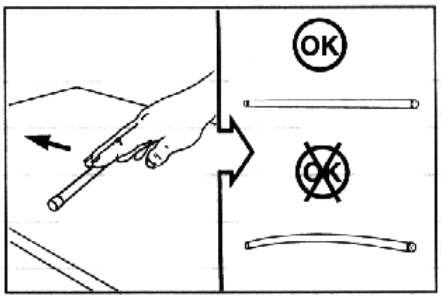


4.3.18 Push rod

The push rod should be changed, if fracture, nick or other obvious damages are found on the push rod.

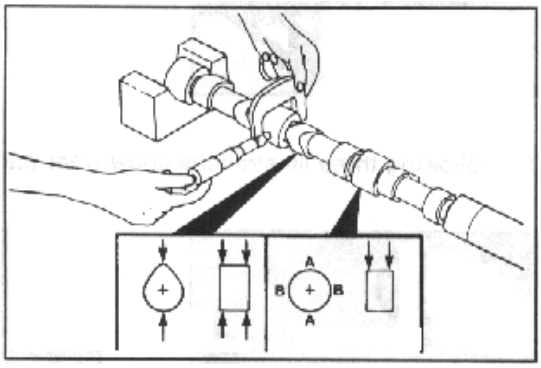


If push rod bends and its straightness value is more than 0.5mm, the push rod should be changed.



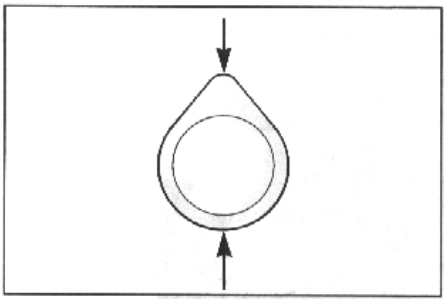
4.3.19 Camshaft

Diameter of camshaft: Φ60 0.0095
Wear limit: Φ59.962
Fit clearance limit with bearing: 0.20mm

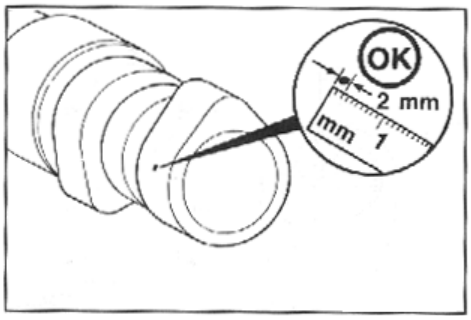


Height of camshaft peach peak

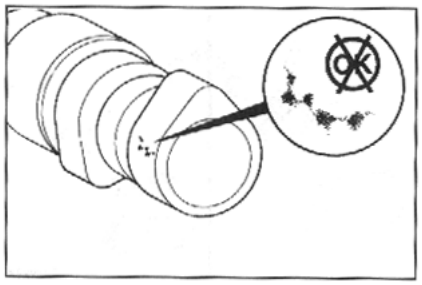
	Standard size	Wear limit
Air admission cam	52.4495±0.16	52.13
Air exhaust cam	45.8307±0.16	45.51
Eccentric wheel (fuel delivery pump)	41.50±0.10	41.30



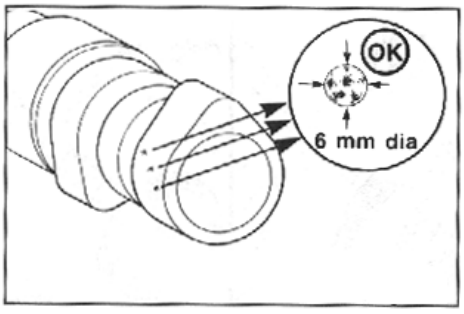
Single pit whose diameter is less than 2mm can appear on the surface of cam.



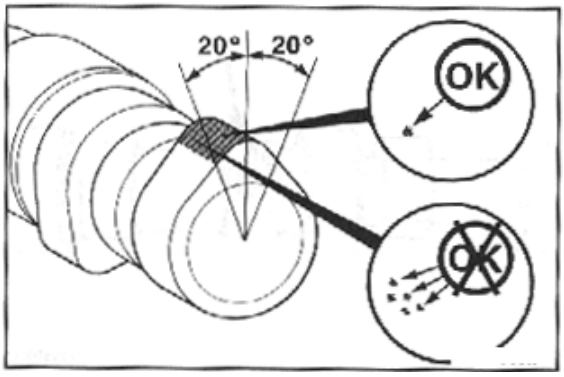
Cam surface can not appear interconnected pits. The interconnected pits should be regarded as a big pit.



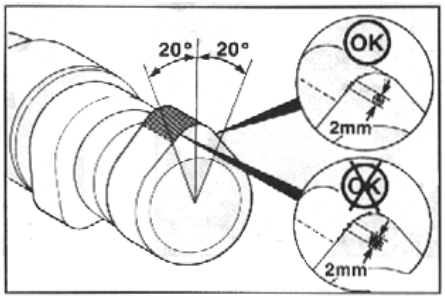
Diameter of interconnected pits can not be more than Φ6.



Only one small pit can appear in the scope of±20 of cam peach peak.



For the pit in the area within±20 of cam peach peak, its diameter on the surface edge can not be more than 2mm.

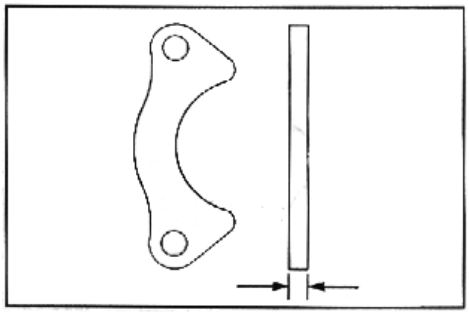


For the pit in the area beyond±20 of cam peach peak, its diameter on the surface edge can not be more than 6mm

4.3.20 Thrust Plate of Camshaft

Thickness of thrust plate: $9.6^{-0.01}_{-0.04}$

Wear limit: 9.34mm or thrust clearance limit of camshaft: 0.42mm

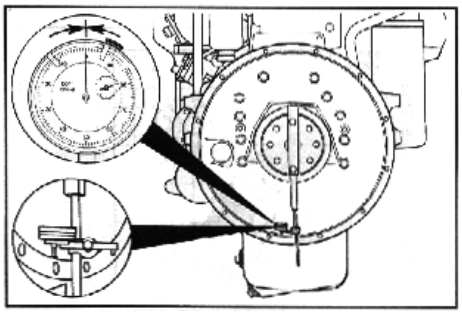


4.3.21 Location Hole Concentricity of Flywheel Shell

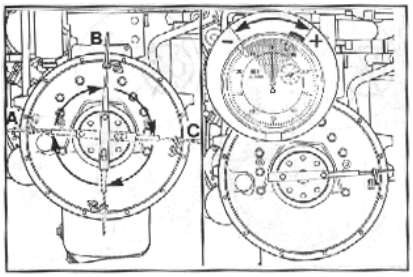
Dial indicator is installed in the camshaft

△ The stiffness of the rod connecting dial indicator should be good. The dial indicator can not slip on the rod, or the accuracy of readings will be affected.

Turn dial indicator to the position of 6 o'clock and adjust the reading of dial indicator to 0.



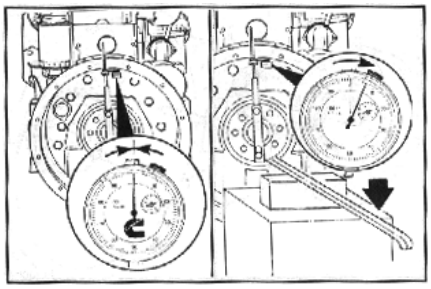
Slowly turn crankshaft and record readings of 9 o'clock (a), 12 (o'clock b) and 3 o'clock (c). Recalibrate the reading of 6 o'clock to 0.



Readings of a, b and c can be either negative or positive. According to the following attached pictures, these readings are to be judged whether in the allowable scope.

Turn the crankshaft to make the dial indicator on the position of 12 o'clock. Adjust the reading of dial indicator to 0.

Lever rear flange of crankshaft upward with crowbar (it can not be more than bearing clearance) and record reading (d) of dial indicator. d is vertical bearing clearance. d is always positive.



Confirm whether horizontal and vertical nonconcentricity values are in the allowed scope.

Total horizontal nonconcentricity value: reading of 9 o'clock, reading of 3 o'clock

Total vertical nonconcentricity value: reading of 12 o'clock+ bearing clearance

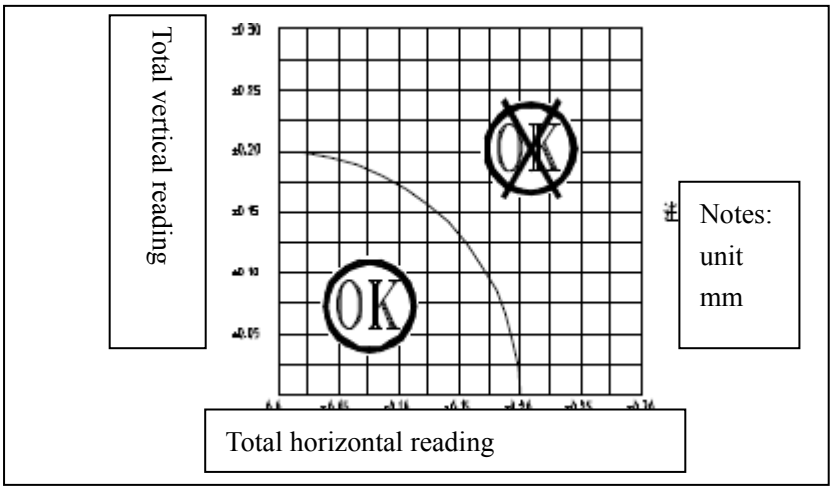
Computation sheet of concentricity

9 o'clock 3 o'clock	a = 0.004 c = -0.002
Total horizontal nonconcentricity	a - c = 0.006
12 o'clock	b = 0.003

bearing clearance	d = 0.002
Total vertical nonconcentricity	b + d = 0.006

Abscissa indicates horizontal nonconcentricity value. Ordinate indicates ertical nonconcentricity value.

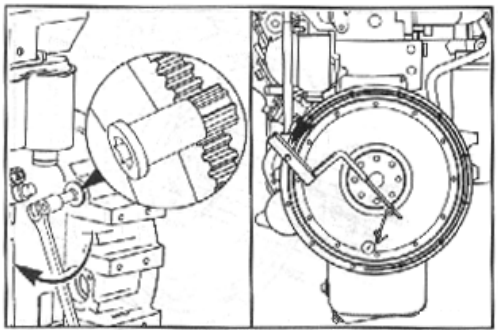
Intersection point of coordinate axis which passes by these two points mentioned above must be in shadow scope of attached picture, or nonconcentricity of location hole of flywheel hole can't meet the requirement. If the nonconcentricity is unqualified, flywheel shell should be changed. Concentricity should be remeasured, if flywheel is changed.



4.3.22 Flywheel

Concentricity of location hole of flywheel

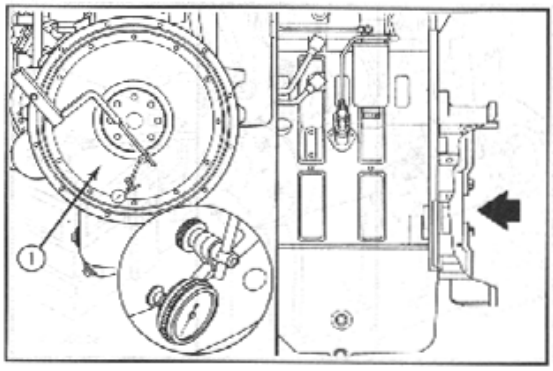
Reading of dial indicator should not be more than 0.20mm when crank rotates a circle, or the flywheel should be changed.



Bounce of flywheel plane

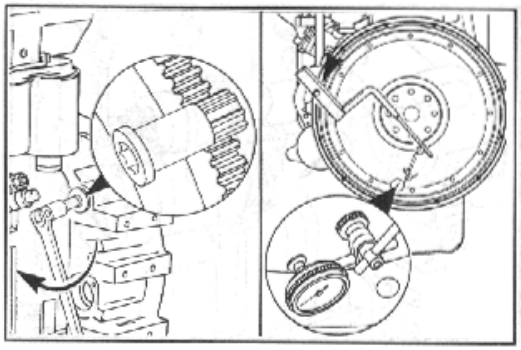
Dial indicator is employed to measure the bounce of flywheel.

Notes: In the process of measuring, the flywheel should be pushed to the free end to make the crankshaft stick to thrust surface.



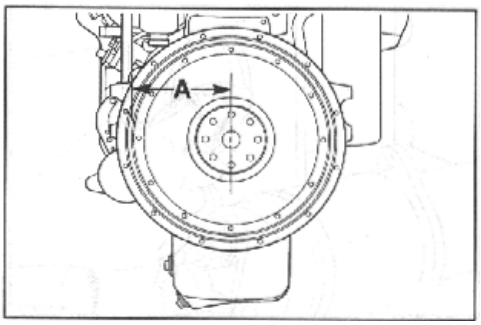
Bounce values of four equidistant points on the flywheel surface are measured when crank rotates a circle.

△ Notes: flywheel should be pushed forward to make the crankshaft stick to the thrust surface before reading the reading of every point.



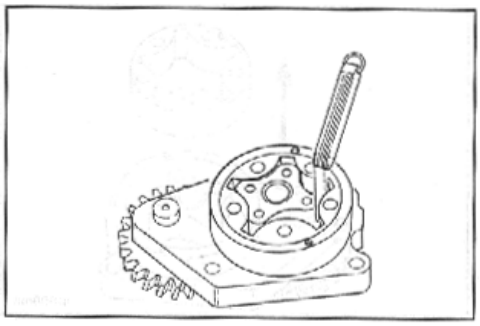
Bounce value of flywheel should not go beyond the following limit values:

Radius of flywheel (A),mm	maximum bounce value, mm
203	0.20
254	0.25
305	0.30
356	0.35
406	0.40

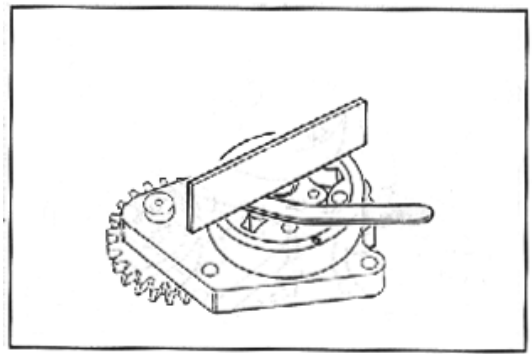


4.3.23 Engine oil pump

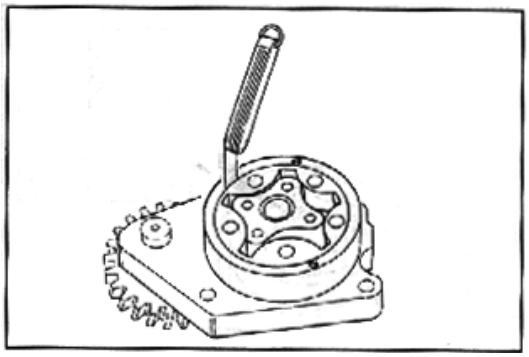
Clearance of tooth top between inner rotor and outer rotor: 0.04-0.187 mm



Clearance of end face of rotator: 0.04-0.114mm



Radial clearance of outer rotator: 0.10-0.16mm

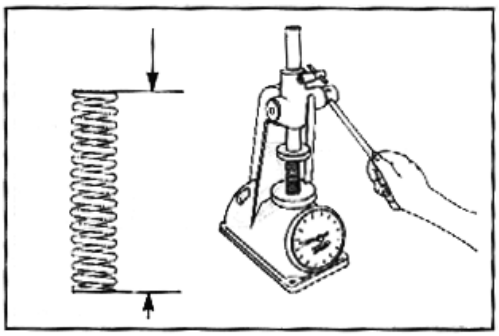


4.3.24 engine oil pressure-regulating valve spring

- Free length: $80^{+3.5}_{+1.0}$
- Installation position

Spring length: 59mm
Load: 156.4N

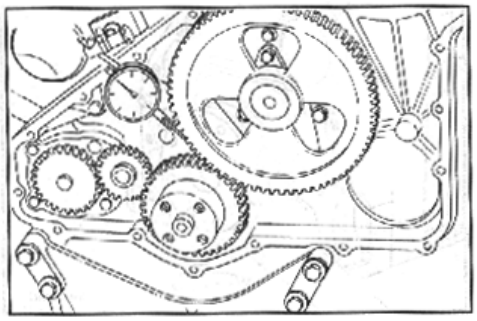
- Open position:
  Spring length: 54.5mm
  Load: 190N



4.3.25 Backlash of difference gears

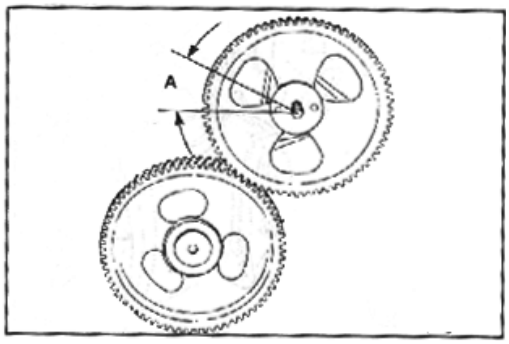
Backlash between crankshaft and camshaft gear

Specified value mm	Wear limit mm
0.084-0.220	0.330



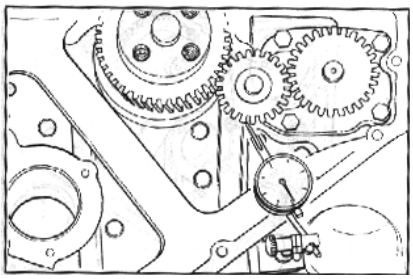
Backlash between gear of oil injection pump and gear of camshaft

Specified value mm	Wear limit mm
0.072-0.280	0.330



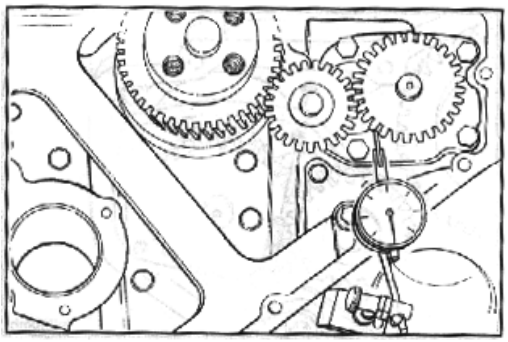
Backlash between crankshaft gear and idle gear of engine oil pump

Specified value mm	Wear limit mm
0.08-0.204	0.330



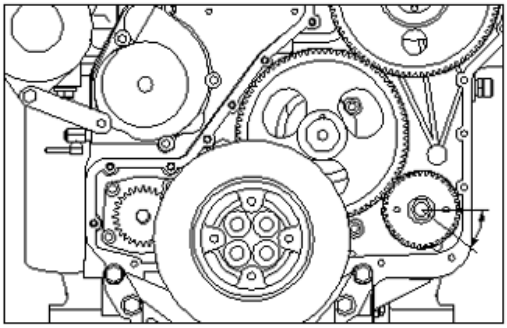
Backlash between idle gear of engine oil and gear of engine oil pump:

Specified value mm	Wear limit mm
0.072-0.207	0.330



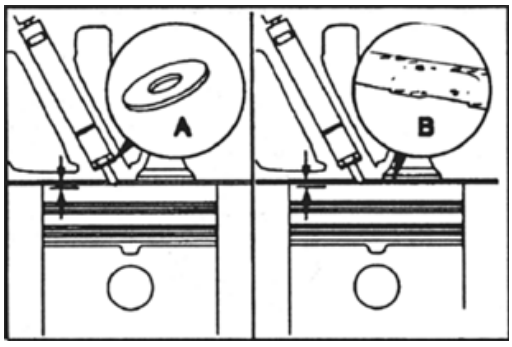
Backlash between gear of air compressor pump and gear of camshaft:

Specified value mm	Wear limit mm
0.071-0.296	0.330



4.3.26 the height that fuel injector higher than base plated of cylinder head:

$3^{0}_{-0.5}$ mm



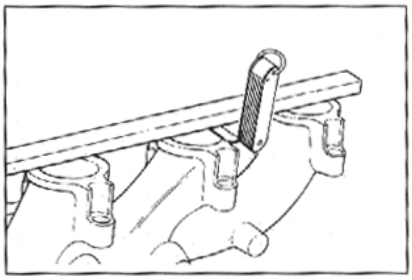
4.3.27 Flange flatness of air exhaust pipe

Flatness limit of flange installation in exhaust pipe:

6 flanges: 0.20mm

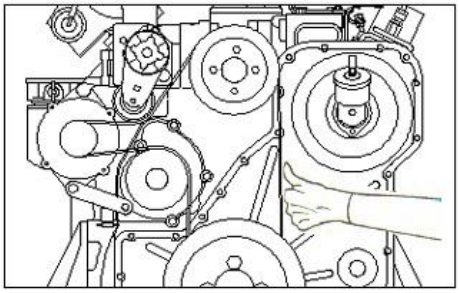
Adjacent two flanges: 0.10mm

Flatness limit of flange installation in booster: 0.13mm



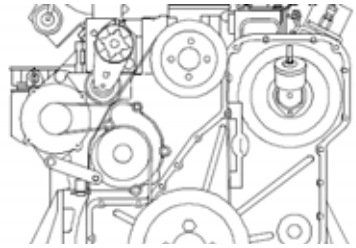
4.3.28 Tension force of drive belt

Deflection of belt measured on the biggest span of belt should not be more than 9.5-12.7mm.



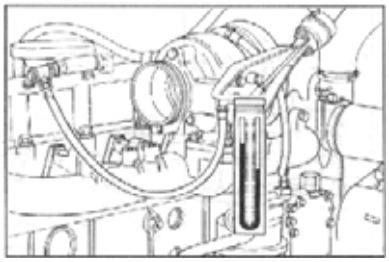
Tension force is measured by tension meter P/N93865 produced by Gates Nitta Driving Belt Limited Company:

Tension limit of belt (minimum):360-490N



4.3.29 Air Loss of Crankcase

Specified value L/min	Wear limit L/min
130	226



Chapter Five Assembly Technology of Main Components of D114 Series Diesel Engine

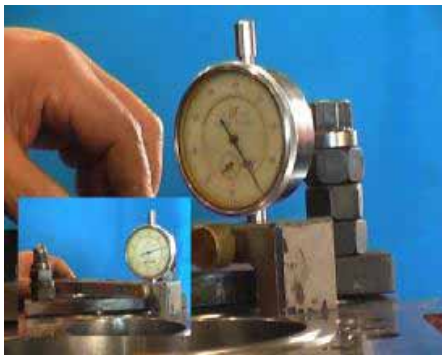
5.1.1 press-fit of cylinder jacket parts

1. The confirmation of no bruising on the top and bottom of cylinder jacket. Before the installation, water seal ring should be checked to make sure that its surface is smooth. And then water seal ring is applied to the groove of cylinder jacket. In this process, please make sure that seal ring is not twisty. The surface is applied CF-4 engine oil.

2. Press-fit of cylinder jacket. When cylinder jacket is pressed slowly, please make sure that cylinder jacket affords even force. Specific tool is used to press cylinder jacket. tightening torque of two bolts is 68±3N•m.

5.1.2 The inspection of inner diameter of cylinder jacket and protruding height

1. The circle is divided into three equal parts. Dial indicator is employed to measure the protruding height of cylinder jacket. Protruding height of cylinder jacket is 0.03-0.08mm. Difference value between average protruding heights of two adjacent cylinder jackets should not be more than 0.04mm.



2. Loosen pressing tool. **E**quispaced three points are gotten from the circles which are 25mm, 100mm and 170mm away from the top of cylinder jacket by inside dial indicator. Then the inner diameter is measured. The size of inner diameter of cylinder jacket is Φ114mm. the tolerance is 0-0.035mm.

5.2 The installation of engine oil pump components

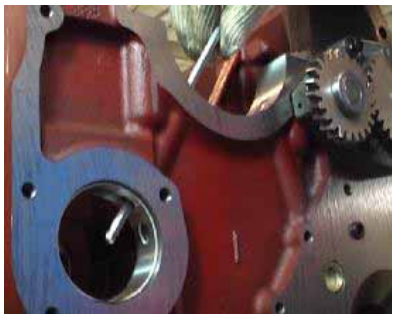
1. Firstly check whether the pump body is polluted and then lubricate it with clean engine oil. Be sure that stagnation phenomenon doesn't appear when gear of engine oil pump and inner rotor rotate.

2. Follow the order of diagonal line to tighten the fastening bolt of engine oil pump. The first tightening torque is 5N•m; the second tightening torque is 30±3N•m

3. Check gear of engine oil pump to make sure that the rotation of inner rotor doesn't stagnant. Make sure that plane clearance between flange surface of pump body and engine body is 0.75-1.25mm.

5.3.1 The installation of camshaft bushing and cooling jet

1. Apply defined amount of clean CF-4 fuel oil on the surface of camshaft bushing.
2. Knock the bushing slowly into camshaft hole by tool. The bushing should not protrude from two side faces of bearing saddle bore. Bearing connector faces the top of engine body.
3. Insert a φ4mm pole into the hole of bushing and engine body. It is qualified, if the pole can pass the oil hole.



5.3.2 The installation of piston cooling nozzle

Apply defined amount of clean CF-4 engine oil on the thread of pressure valve. Install the piston cooling nozzle which has location pin in the specified position of engine body. Be sure the installation direction is correct. Screw the nozzle into 3-5 tooth, and then tighten it with definite torque wrench. Tightening torque is 40±4N•m.

5.4.1 The installation of bearing bushing and crankshaft

Install the lower half main bearing of main bearing cap into the first, second, third, fifth, sixth and seventh gears. Install crank thrust bearing into the fourth gear of main bearing cap. Apply clean CF-4 engine oil over the inner surface of bearing. Be sure that the back of bearing clean and has no engine oil.

5.4.2 The installation of main bearing bushing and crankshaft

1. Apply defined amount of engine oil over the inner surface of upper half main bearing. Install it on main bearing seat of the body. Make sure that the back of bearing

clean and has no engine oil.

2. Install crank thrust bearing. Apply clean CF-4 engine oil over thrust surface and inner surface of bearing. Be sure that the back of bearing clean and has no engine oil.

5.4.3 The installation of main shaft bushing and crankshaft

1. Slowly put crank shaft into main bearing seat. Make sure that the crank shaft can rotate smoothly.

2. Install main bearing caps of all gears into the matching bearing seat gears of the engine body. Make sure that main bearing cap and engine body should be faying. Be careful that the order of main bearing cap can not be altered.

Notes: Arrow direction of main bearing cap direct the front end of engine body. The first and the seventh main bearing cap can not protrude from the front and the end faced of engine body.

3. Apply defined amount of clean CF-4 engine oil on supporting surface of bolt head of main bearing and the thread. Screw it into 3-4 tooth and then tighten it with definite torque wrench. Tightening torque is 30-35N•m. Please don't screw it forcibly.

The tightening of the bolt of main bearing cap

4. Tighten bolts from main bearing cap bolt of the fourth gear to the two sides. Tightening torque: the first time is 50 N•m; the second time is 90±5N•m; the third

time rotate 90°±5°. The crankshaft should be turned for one circle to check whether it is stagnant, if one tightening is finished.

5.4.4 The measurement of gyroscopic moment and clearance of crankshaft

1. Inspect gyroscopic moment of crankshaft to make sure that its value is not bigger than 24 N•m. If gyroscopic moment is bigger than 24 N•m, please inspect the installation of main bearing cap and the size and reinstall.

2. Measure the thrust clearance of crankshaft. The clearance is 0.10mm -0.274mm

3. Measure normal backlash of crankshaft and the gear of engine oil pump. The backlash is 0.08-0.20mm.

5.5.1 The installation of piston connecting-rod group

1. Check components of piston connecting-rod group: companion marks of connecting rod and cap are in accordance. Quality marks on the piston top and part numbers are same in one group. Piston ring can rotate smoothly. Piston rings are gas ring 1, gas ring2 and oil ring from the top to the bottom. Oil ring should have holding spring.

2. The surface with assembly mark should be on the top, when the first and the second rings are installed. Before the installing oil ring, please make sure that joining position of holding spring faces the mouth of oil ring. Make sure that the opening position of rings should be separated 120° in the process of installing the third ring. There is no fracture. Small head of connecting rod and piston pin can rotate smoothly.

3. Piston pin is installed seat hole of piston pin which is heated by 50℃-70℃ oil and installed connecting rod which has been installed with bearing shell. In this process, please make sure that location tongue and part number on the piston top should be on the same side.

4. Apply clean CF-4 engine oil over bearing shell.

5. Turn crankshaft with turning plate to make connecting rod journal of two gears (1 and 6, 3 and 4, 2 and 5) are in the lower dead point. Apply clean CF-4 engine oil on piston ring, piston skirt and cylinder jacket bore. Put guiding jacket on upper border of cylinder jacket which in on the top of engine body. And then install components of piston connecting rod group into cylinder jacket. The gap of piston skirt faces cooling nozzle of piston. “FRONT←” indicates that the component shold face the front end of engine body. Openings of piston rings are separated 120° and avoid the position of the openings on the both ends of piston. Rings never get stuck.

6. Apply a little engine oil on bolt thread of connecting rod, contact plane of nut and connecting rod, and inner surface of connecting rod bearing bore. Screw nuts into connecting rod caps according to pairing mark. Be sure that the side with circular bead is glued to connecting rod cap. Tighten the nuts with definite torque wrench. Tightening torque is 30±3N•m.

5.5.2 Tightening connecting rod bolt

1. Turn the crankshaft. Tighten connecting rod bolts of six gears with definite torque wrench and angle regulator. Tightening torque for the first time is 55±5N • m. It rotates 60° ±3° for the second time.

2. Recheck whether connecting rod cap numbers of gears matches their connecting rod body.

5.5.3 The measurement of gyrotraverse moment of crankshaft and axial clearance between head face of big end of connecting rod and crankshaft

1. Stir big end of connecting rod, if connecting rod of piston has been installed. The connecting rod can do endwise slip smoothly on crankshaft pin. Axial clearance between head face of big end of connecting rod and crankshaft is 0.17-0.42mm.

2. Crankshaft can rotate smoothly, when connecting rod of piston has been installed. No stagnancy appears. Gyrotraverse moment of crankshaft is ≤100N•m.

5.6.1 The installation of camshaft

1. Apply defined amount of clean CF-4 engine oil on the surface of camshaft guider, convexity of camshaft, journal, thrust surface and cam hole. Hold camshaft and insert it into cam hole.

2. “00” fixed timing mark on the gear of camshaft should be inserted into “0” fixed timing mark of camshaft gear, when camshaft is installed into engine body.

3. Thrust plate is installed on the front end of engine body. Thrust plate locks to journal on the front end of camshaft. Install and tighten hexagon-headed bolt. Tightening torque is 35±3N•m.

5.6.2 The inspection of axial clearance of camshaft and normal backlash of gear

1. Camshaft can be smoothly turned with turning tools, when the camshaft has been installed into the engine body.

2. Firstly, push camshaft backward enough and install dial indicator whose needle direct 0. And then pull the camshaft. Axial clearance of camshaft should be in the scope of 0.10-0.20mm.

3. Normal backlash of crankshaft gear and camshaft gear is 0.08-0.22mm.

5.7.1 The installation of rear oil seal of crankshaft and components of flywheel

Apply self-preparing suds over the excircle of crankshaft rear end oil seal. Put rear oil seal of crankshaft into rear flange of crankshaft with guidance jacket. And then press rear oil seal of crankshaft slowly into oil seal seat hole of rear plate with oil sealing tool.

5.7.2 The installation of flywheel housing

1. Check whether the flywheel housing is clean. Apply flywheel housing into location pin and fasten flywheel housing on the end face of engine body with bolt. Tighten bolts from the middle one to opposite angles of two sides. tightening torque: cast aluminum flywheel housing is 80±8N•m; Cast iron flywheel housing is 112± 10N•m. In the last, retighten them with definite torque wrench.

2. When the installation of flywheel housing is finished, please check circular runout of rear location inner circle to crankshaft center line and end face runout of flywheel shell to crankshaft center line. These two values should not be more than 0.30mm.

3. Apply CF-4 engine oil over O-type seal ring and barring hole. Install O-type seal ring on barring plug. And then put them together into barring hole of flywheel housing.

5.8 The installation of injection pump

1. Apply refined amount of sealant over thread of stud bolt (butt end). And then screw the thread into corresponding position of gear chamber.

2. Fasten welding assembly of oil pump fixed support to corresponding position on the side of engine body with bolts. Bolts are not fastened temporarily. Fuel injection pump assembly is installed on gear chamber and welding assembly of oil pump fixed support by bolts and nuts.

3. Install woodruff key into keyway of high-pressure pump transmission shaft. And then install gear of oil injection pump on transmission shaft of oil injection pump. Fasten them with nuts. Tightening torque is 180±5N•m.

4. The installation of high-pressure oil pump with no woodruff key. Firstly, turn the motor to compression upper dead center of the first cylinder. Secondly, turn camshaft of oil pump slowly until to the position showed in the picture: locating plate of flyball is completely locked in locating pin groove. And then install gear of oil injection pump in transmission shaft of oil injection pump. Tighten with nut. The tightening torque is ： 180±5N•m. Location pin of oil pump should be pulled out before tightening nut, or oil pump may be damaged.

Notes: Timing mark of oil injection pump gear should match with timing mark of camshaft gear (Oil pump with no woodruff key doesn’t need to check this mark.).

5. Normal backlash between oil injection pump gear and camshaft gear is 0.07-0.28mm.

Measure the normal backlash between air compressor gear and camshaft gear. The backlash is 0.07-0.29mm.

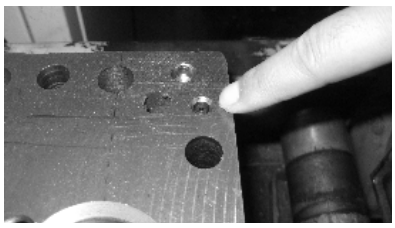
5.9 The installation of cylinder cap components

1. Clean top surface of engine body, and then knock the locating pin into the top surface of engine body. Protruding height is 6^{+1}_{0} mm. The measurement is conducted by height gauge.

2. Set gasket of cylinder cap into locating pin. Be sure that gasket and top surface hole of engine body are coincident. Hoist the cylinder cap assemble on the top surface of engine body.

3. Install air valve, oil seal of air valve, spring, upper seat of spring and lock clamp in cylinder cap (Please distinguish air admission valve and air exhaust valve.).

4. Install closure plug into oil groove which is near the sixth cylinder and supplies oil to rocker arm. Closure plug should be lower than base plate of cylinder cap. Install choke plugs of rocker main oil duct on the two sides of cylinder cap.



5. Apply defined amount of clean CF-4 engine oil over bolt thread of cylinder cap and flat surface of bolt head. Screw cylinder cap bolt into 4-7 tooth.

6. Pretighten the bolts from the middle one of cylinder cap, and then pretighten the two sides crosswise. Process of tightening:

The first time: 50N•m

The second time: 115±5N•m

The third time: Lad bolts rotate 60° ±5°;

Through bolts rotate 90° ±5°

5.10.1 The installation of push rod and rocker arm components

1. Apply defined amount of clean CF-4 engine oil one the surface of push rod and socket of concave ball, and then insert it into push rod hole on cylinder cap. The lower end falls to the tappet.

2. Fasten rocker arm components on cylinder cap with fastening bolt of rocker arm shaft and hexagonal flange face bolt. Tighten it with definite torque wrench. Tightening torque is: 35±4N•m.

3. Check whether round end of adjusting screw of rocker arm is in the socket of push rod.

5.10.2 Adjustment of air valve clearance

1. Turn the crankshaft. Adjust air admission valves of 1, 2 and 4 cylinders and air exhaust valves of 1, 3, 5 cylinders, when piston of the first cylinder is on compression upper dead center. The turn the crankshaft for one circle to make the piston of the sixth cylinder on compression upper dead center. Adjust air admission valves of 3, 5 and 6 cylinders and air exhaust valve of 2, 4, 6 cylinders. Specified values of air admission valve clearance and air exhaust valve clearance are: air admission valve clearance is 0.30 ±0.08mm; air exhaust valve clearance is 0.50 ± 0.08mm.

2. Keep the position by screwdriver, if the clearance has been adjusted. Tighten rating nut of rocker arm with definite torque wrench. Tightening torque is 43±3N•m. Knock all rating nuts with copper hammers.

3. Turn crankshaft and recheck the clearances of air admission and air exhaust valves.

5.11 The installation of fuel injection components and housing components

1. Set O-type seal ring of fuel injector into the grove of fuel injector and apply industrial Vaseline over it. Apply proper amount of industrial Vaseline on front end of oil injector circular bead and then put oil injector gasket.

2. Make spherical gasket and tightening bolt of oil injector cross platen bolt hole of oil injector. Then rock oil injector and platen which is used to clamp oil injector to install them into oil injector hole. The operator can also knock them into oil injector hole with oil injector tool.

3. Platen of oil injector should ride on spherical bolt of cylinder cap. Tighten fastening bolt of oil injector with dedicated tightening wrench. Tightening torque is：33±2N•m.

5.11.2 The installation of cylinder housing components

1. Check whether cylinder housing components have sand hole and whether sealing strip is installed.

2. Add proper amount of engine oil into corresponding screw on rocker seat. Cover the housing.

3. Apply proper amount of clean CF-4 engine oil on O-type sealing strip of housing tightening bolt.

4. Tighten fastening bolt with definite torque wrench. Tightening torque is 28± 2N•m.

5.13 The installation of high-pressure fuel pipeline

1. Install two terminals of high-pressure pipeline components on oil outlet of oil pump and oil inlet of oil injector. Tighten interface nuts of the two terminals. Tightening torque is: 45±4N•m.

2. Fasten high-pressure pipes successively with bolt, normalized form spring gasket, fixed support of oil pipe, upper clamping piece and gasket of clamping piece. Tightening torque of bolt is 25±2N•m.

5.14 The installation of flywheel and starting ring components

1. Screw guide pin of flywheel into the flange on the rear of crankshaft for at least 8 tooth.

2. Set starting ring components of flywheel and fasten it on the rear flange of crankshaft with flywheel bolt. Remove guide pin.

3. Apply little engine oil on the supporting surface and thread when install flywheel nut. Tighten nuts for time times diagonally. Tightening torque: the first time 50±5N•m; the second time 100±5N•m; the third time 220±10N•m

4. When the installation is finished, the check circular runout of flywheel end face to crank centre line and radial circular runout of bearing hole of cluth. The former one should not be more than 0.20mm; the latter can not be more than 0.15mm.

5. Install antifriction bearing and check ring.

Chapter Six Maintenance of D114 Series Diesel Engine

6.1 Maintenance Project of D114 Engine

Maintenance of diesel engine is consisted of the following parts:

Operational maintenance: It includes everyday static maintenance and everyday operation inspection.

Maintenance is conducted when the engine has been worked for 10,000 kilometers, 250 hours or 3 months.

Maintenance is conducted when the engine has been worked for 19,000 kilometers, 500 hours or 6 months.

Maintenance is conducted when the engine has been worked for 38,000 kilometers, 1000 hours or 12 months.

6.2 Operational Maintenance Details

Before starting the engine, please conduct operational maintenance firstly. Check liquid levels of engine oil and cooling liquid. Inspect the components which may be loose, leaking or broken, belts which may be worn or broken and the changes of diesel engine.

1. The inspection of engine oil level

Check engine oil level, when the engine has been off for at least 5 minutes. It is forbidden to start the diesel engine, if oil level is lower than the mark of "L" on the dipstick or oil level is higher than mark of "H".

2. The inspection of cooling liquid level

Only when the temperature of cooling liquid is lower than 50℃, it is allowed to open filler cap or chock plug of access hatch of radiator or expansion tank. Cooling liquid should be added, when cooling liquid level is 50mm lower than access hatch. Concentrations of cooling liquid and its additive should meet the requirements.

3. The inspection of cooling fan

Check whether fracture, rivet looseness, blade looseness and blade bending appear in fan. Make sure that the fan is safe to use. If it is necessary, please tighten fastening bolts and change broken fan.

4. Inspecting whether the belt is worn or broken

Check if flaw cane be seen on the belt. The belt should be changed, if lengthways and crosswise perforative flaw appears or the belt is worn or materials split off.

5. Inspection of leakage and other abnormal phenomena on diesel engine

Inspect components of diesel engine pipeline, especially air admission and air exhaust systems to find out that whether components are loose or broken,.

6. Water and sedimentation clearing in oil-water separator of diesel engine

Open bottom valve of oil-water separator or fuel colander to discharge water and sedimentation. Close the valve when clean fuel flow out.

Notes: If there are too many water and sedimentation discharging out, please change oil-water separator.

6.3 Maintenance is conducted when the engine has been worked for 10,000 kilometers,

250 hours or 3 months.

The following maintenance items should be done, if the operational maintenance has been done.

1. renewing engine oil and engine oil filter

(1) Only when the engine oil is in hot state and pollutant is in suspension sate, oil can be discharged. When the temperature of diesel engine reaches 60℃, the diesel engine can be shut down. Remove oil discharging plug and discharge engine oil.

(2) Clean the pollutant of engine oil filter sear. Remove engine oil filter and wash O-type sealing ring of filter seat.

(3) Fill engine oil filter with clean engine oil. Then apply clean engine oil over the sealing surface of sealing ring. Install engine oil filter according to installation instruction which is formulated by filter producer. In normal temperature environment, only dedicated engine oil 15W/40 CH-4 can be used in D114 diesel engine. Inject clean engine oil into motor to make the oil level reach the standard level.

(4) The installation of oil discharging plug. Start the motor to make it run in idling state. Firstly, check whether oil leakage can be found in engine oil filter and oil discharging plug. Then shut down motor and wait for about 15 minutes. Recheck oil level to make sure that oil level is between L and H.

2. renewal of cooling liquid filter

(1) The filler cap of radiator can be removed after the car stopping, only when the temperature of cooling liquid is lower than 50℃. Please close shut off water inlet and outlet shutoff valves before renewing cooling liquid filter to avoid hot cooling liquid hurting people. Remove cooling liquid filter and clean sealing surface of filter seat.

(2) Apply a thin layer of engine oil over rubber seal gasket surface of new filter. Then install the filter according to the instruction of filter producer. After the installation, be sure that water inlet and water outlet shutoff valves of filter are open before installing filler cap of radiator.

3. The inspection of air admission system

(1) Check whether fissure or hole can be seen in joint rubber pipe of booster, intercooler and air filter and whether the clamp is loose. If the phenomena mentioned above appear, please tighten or change components to make sure that air admission system is air-proof.

(2) Check whether air admission and air outlet chambers of intercooler has fissure, hole or other damage. Inspect whether intercooler pipe, radiating fin and welding joint has crack or has other damages. Please remove intercooler to wash, if engine oil or dust is found in intercooler.

Notes: Corrosive cleaner is forbidden to wash intercooler.

5. The inspection of air filter

Motor can be used only when air filter is installed. Air filter must be cleaned regularly. If motor is operated in dusty environment, maintenance and renewal cycle should be shortened to make sure that air filter can normally work. If indicator of air

filter warns, please wash or change filter element of air filter.

6.4 Maintenance is conducted when the engine has been worked for 19,000 kilometers, 500 hours or 6 months.

The following maintenance items should be done on the basis of operational maintenance and maintenance of prior cycle:

Renewal of fuel filter: clean the area around fuel filter seat. Remove fuel filter and clean sealing surface of filter seat. Fill fuel filter with clean diesel. Lubricate rubber sealing ring with clean engine oil. Install fuel filter.

Notes: filter should be installed according to installation instruction formulated by fuel filter producer.

6.5 Maintenance is conducted when the engine has been worked for 38,000 kilometers, 1000 hours or 12 months.

The following maintenance items should be done on the basis of operational maintenance and maintenance of prior two cycles:

1. The inspection of belt tensioning condition

Measure the deflection of belt in extreme span. The biggest deflection can not be more than 13mm.

Tensile force of extreme span can be measured by tensile force gauge. Tension force limit is 360-490N.

2. The inspection of belt, bearing of regulating wheel and bearing of fan transmission shaft

Remove transmission belt to check whether it is broken. Turn regulating wheel to check whether bearing of regulating wheel is abnormal.

Notes: Regulating wheel should turn smoothly. It can not be stuck or make radial or axial movement. Turn fan to check whether abnormity can be found in rotation axis bearing. When fan rotate, it can not vibrate or make obvious axial movement.

3. The installation of transmission belt

If it is hard to fix the transmission belt, the operator can put belt on the gear which has groove and then push the belt along water pump belt. Check whether fastening bolt of regulating wheel is loose. Tightening torque of bolt is 45N•m.

4. The regulation of air valve clearance

Under the state of diesel engine shutdown, remove components around the housing, such as supporting clamp, rubber pipe clamp, connector of crankcase air-pipe and oil injector and cylinder housing. Then regulate air valve clearance according to assembly technique.

6.6 Maintenance is conducted when the engine has been worked for 77,000 kilometers, 2000 hours or 24 months.

The following maintenance items should be done on the basis of operational maintenance and maintenance of prior three cycles:

1. washing cooling system

Cooling system and corresponding components should be washed regularly to guarantee the cooling and anticorrosion effects

(1) Open discharging valves of radiator and cooling water pump of motor to

discharge cooling liquid.

(2) Fill cooling system of motor with sodium carbonate cleanout fluid. Start the motor and make the motor run 5 minutes in the condition that the temperature of cooling liquid is higher than 80℃. Shut down motor and drain cleanout fluid. Fill cooling system with flash water. Be careful that new cooling water filter can not be installed in this process Start the motor and make the motor run 5 minutes in the condition that the temperature of cooling liquid is higher than 80℃. Shut down motor and drain cooling water

(3) The injection cooling liquid. Air in cooling water chamber must be exhausted in the process of injecting. Inject cooling liquid slowly to avoid air resistance. It may cost 2-3 minutes to exhaust air. Cooling liquid should be injected to the bottom of water filler of radiator or liquid level access hatch

(4) Assemble pressure cap of radiator filler. Start motor until the temperature of water is higher than 80℃. Then check whether leakage phenomenon can be found in cooling system. Recheck cooling liquid level, when temperature of cooling liquid is lower than 50℃ after the shutdown.

Notes: It is forbidden to use water as cooling liquid only without adding other additives. This will cause serious accident in motor.

2. The inspection of torshional vibration damper

Check whether inner ring and outer ring of torshional vibration damper moves. Damper should be changed, if the dislocation is more than 1.6mm; or fragment of rubber falls; or rubber ring is 3.2mm lower than metal surface; or comparing with outer ring, inner ring moves forward.

3. The inspection of air compressor

Moving parts of air compressor need small quantity of engine oil to lubricate. Gum deposit and carbon deposition will appear, if air compressor work for a long time in normal condition. It is necessary to check the air compressor to make sure that piston ring of air compressor still has tightness.

6.7 The inspection of concentrations of antifreeze solution and cooling liquid

It is necessary to add antifreeze solution to diesel engine in any weather condition. The reason is that the addition of antifreeze solution can not only increase boiling point of cooling liquid, but also lower tits freezing point. In this case, operation temperature range of diesel engine is enlarged. The concentration of antifreeze solution should guarantee that the freezing point of cooling liquid 10℃ lower than local lowest temperature. Inspect additive concentration of cooling liquid with cooling liquid detection paper of D6114 series diesel engine. (Make the detection every half a month.)

Notes: additive concentration of cooling liquid should in the prescribed range. Cooling system components will be corrosive, diesel engine will be broken, if the concentration is too low. If the concentration is too high, cooling liquid will be in colloid and block cooling liquid pipe. And diesel engine will be overheating.

Chapter Seven Common Faults of D114 Series Diesel Engine and Fault Clearing Measures

Handbook for fault solution of diesel engine

This chapter introduces typical operation faults of diesel engine, the causes and solution method. According to this handbook, the operator cam correctly judge, remove the fault and repair the engine. You can consult maintenance center which is authorized by our company, if you find the fault isn't listed here. We will do our best to help you and give a satisfying solution.

In order to remove faults smoothly and shorten fault clearing time, please follow the following working procedure:

- Please inspect fault details before removing it: such as working condition of diesel engine before fault appearing-load, sea level elevation, ambient temperature, condition of environmental dust and the road condition. Fault nature- the machine exasperates slowly or the fault appears abruptly, or the fault appears intermittently. Judge whether fault appears after fuel or engine oil changing.

  Fault phenomena: color of exhausting air, temperature of cooling liquid, consumption of cooling liquid, whether cooling liquid leaks , temperature of engine oil, consumption of engine oil, whether engine oil leaks , noise of diesel engine. Check whether cooling liquid is polluted by other materials, such as engine oil, rust or caky sedimentation. Check whether engine oil is polluted by water, fuel or the like. Check the situation of vibration of diesel engine.
- Make a rigor and systematic analysis for fault.
- Associate symptoms of fault with diesel engine system and basic components.
- Associate the present fault with the lasted repairmen or maintenance.
- Make several detailed inspections, before overhaul diesel engine.
- The easiest and the most obvious fault should be settled firstly.
- Confirm fault cause and repair it completely.
- Run diesel engine when repairmen is finished to prove that the fault has been removed.

7.1 Fault symptoms

In this section, some typical fault symptoms are listed. If the following symptoms appear, the user should timely check and analyze and take proper steps to solve the problems. Otherwise, serious accident may happen.

- Diesel engine can not move or move slowly.
- Diesel engine can not shut down.
- Idle running for warming up is not stable.
- Pressure of engine oil is too high or too low.
- Consumption of engine oil is excessive.
- Temperature of cooling liquid is too high.
- Consumption of cooling liquid is excessive.
- Temperature of cooling liquid is too low.

- Cooling liquid is contaminated.
- Engine oil is contaminated.
- Fuel or engine oil leaks from air exhaust pipe.
- Diesel engine spews out black smoke, when it is in load.
- Power of diesel engine is insufficient.
- Diesel engine shuts down.
- Diesel engine knocks cylinder.
- Fuel consumption of diesel engine is excessive.
- Vibration of diesel engine is severe.
- Noise of diesel engine is too high.
- Generator doesn't charge or undercharge.
- Air leakage of diesel engine crankcase is very large.
- Air compressor pressurizing is slow.
- Cold-starting aids of heater plug appear fault.

7.2 Fault inspection and fault clearing measures

In order to shorten fault clearing time, please read the list fault clearing measures carefully before preparing to clear fault. Please take the measures from the top to the bottom until the fault is cleared.

7.2.1 Diesel engine can not move or move slowly.

Inspection items	Inspection content and treatment measures
Motor meshes driving equipment. Crankshaft cannot turn smoothly.	Remove driving equipment and check load of fault accessories. Turn the generator with jigger gear to check turning resistance.
Starting circuit is loose or corrosive. There is no voltage in magnetic coil of starting engine.	Wash and tighten connector of the circuit.
Accumulator undercharges	Check voltage of accumulator. The voltage is 24V. Concentration of electrolyte is 1.28-1.30. If it is necessary, charge the accumulator.
The adjustment of shutdown handle holder by motor-driven or mutual operation is not in correct way.	Correctly adjust motor-driven or mutual operation shutdown handle holder.
Cold start auxiliary equipment is needed in winter. Diesel engine shuts down and is not used for a long time.	If it is necessary, please check/ repair cold start auxiliary equipment.
a. Air is in fuel system b. Fuel can't be supplied. c. There is no fuel in fuel case.	a. Exhaust air in fuel system. Check the leakage of oil inlet pipeline. Clean or change oil-water separator, fuel filter. b. Add fuel
Air admission system is blocked.	Check flow resistance of air admission system. Check air filter.
Oil injector is failed or loses efficacy.	Check/change oil injector.

Compression pressure of generator is low.	Check compression ration to confirm the problem. Check whether air leaks from air valve.
Oil injection pump is failed or loses efficacy.	Examine injection pump.

7.2.2 Diesel engine can't shut down.

Inspection items	Inspection content and treatment measures
Shutdown electromagnet Shutdown handle doesn't place on shutdown position.	Check whether circuit of electromagnet is in good condition. Check whether electromagnet acts. Check whether shutdown handle locks. Check whether shutdown rocker return spring of speed controller can pull connecting rod to shutdown position.

7.2.3 Warming-up idle running is not steady.

Inspection items	Inspection content and treatment measures
Rotate speed of idling is too low. There is air in fuel system.	Check and regulate idling regulating screw. Exhaust air of fuel system and check the leakage of oil absorption part.
Oil return relief valve of fuel doesn't work.	Check/ change oil return relief valve of fuel.
Fuel delivery pump doesn't work.	Check/ change fuel delivery pump.
Fuel supply is insufficient.	Wash colander and strainer and check resistance of fuel pipe.
Fuel injection nozzle is blocked or doesn't work.	Check/ change fuel injection nozzle.
Injection timing of oil injection pump is not correct.	Check injection timing of oil injection pump.
Motor support is broken The adjustment of air valve clearance is improper. Compression pressure of motor is low.	Change support. Correctly regulate air admission clearance and air exhaust clearance. Remove oil injector and install cylinder pressure gauge and connector. Turn crankshaft with starting motor. Check cylinder pressure to inspect the tightness of piston and air valve. Check compressor pressure and repair it according to the requirements.
Oil injection pump doesn't work.	Remove oil injection pump to examine. Check the dust in oil outlet valve.

7.2.4 Pressure of engine oil is too high or too low.

Inspection items	Inspection content and treatment measures
Engine oil level is incorrect.	Add or discharge engine oil of motor.
Engine oil pressure-regulating valve doesn't work.	Check and wash valve. If the valve is broken, change a new one.
Fuel leaks into engine oil, but the motor run normally.	Remove and check seal of core retainer plate. Change the oil delivery pump which leaks oil.

	Change engine oil.
Engine oil is diluted by water.	Check engine oil cooler to find out the reason why oil is diluted by water. Change engine oil.
Engine oil specification is incorrect.	Examine and verify the engine oil.
Pipeline connector is loose. Choke plug of oil pipeline falls off.	Check the engine oil leakage on the positions of front end of cylinder cap, side face of fuel injection pump, engine oil cooler housing and gear chamber.
Temperature of motor cooling liquid is 100° C higher than normal temperature. This cause viscosity declines.	Refer to fault clearing procedure of cooling liquid temperature exceeding normal value.
Pressure of engine oil gauge fails.	Examine and verify whether oil pressure gauge and pressure sensor works well with oil device of manual pump.
Pressure regulating valve locks in starting position or spring breaks down.	Check or wash. Change spring, if it is broken.
Engine oil filter is blocked.	Change engine oil or change filter.
Engine oil cooler is blocked.	Check or change engine oil cooler.

7.2.5 Consumption of engine oil is excessive.

Inspection items	Inspection content and treatment measures
Outside oil leakage Oil added in crankcase is full.	Check engine oil leakage condition. Check engine oil level.
Engine oil quality is incorrect (specification or viscosity)	1. Guarantee that engine oil is qualified. Check whether the dilution of fuel leads to viscosity decreases. 2. Make an inspection. Shorten oil changing period.
Oil leakage can be found in engine oil cooler.	Make an inspection to check whether engine oil can be found in cooling liquid.
Air compressor absorbs oil, if air compressor is installed.	Refer to fault clearing procedure of “air compressor absorbs oil to air system”
Air loss of crankcase is excessive. Engine oil is out of air port.	Check engine oil leakage trace of air port. Inspect oil-air separator. Measure quantity of air leakage. Follow the regulations to repair.
Leaking oil from turbocharger goes into air admission pipe. Valve rod sealing ring of air exhaust pipe is worn.	Check engine oil leakage trace of turbocharger inlet or outlet. Check/change valve rod sealing ring.
Seal of piston ring doesn’t work. Consumption of engine oil is excessive.	Conduct compressor inspection. Follow the regulations to repair.

7.2.6 Temperature of cooling liquid is too high.

Inspection items	Inspection content and treatment measures
Cooling liquid level is low.	Add cooling liquid. Find out and clear cause of water leakage.
Cooling fin of radiator and air admission	Check cooling fin of radiator and intercooler. If

intercooler is blocked or broken (refer to automobile).	it is necessary, wash or repair cooling fin.
Air flowing into radiator is insufficient or is blocked.	Check and repair wind scooper, shutter regulator, fan sensor and fan cluth.
Radiator hose is shriveled, blocked or leaking.	Check the hose. If it is necessary, change a new one.
Wind scooper of cooling fan is broken or separates from fan.	Check wind scooper. Repair/change or reinstall.
Pressure cap of radiator is incorrect or fails to work.	Examine and verify pressure cap of radiator. Starting pressure 50kPa. If it is necessary, change a new one.
Water pump or fan drive belt is loose.	Check regulating wheel of belt.
Water temperature sensor or water temperature gauge fails to work	Examine and verify sensor and water temperature gauge with known thermometer. If it is necessary, repair it or change a new one.
Thermosistor doesn't work.	Examine and verify/change thermosistor.
Radiator shutter doesn't open completely. Wind shield cover closed in cold weather.	Examine shutter. Repair or change shutter, if it is necessary. Open radiator shutter and its control air pipe to check whether leakage can be found.
Cooling system can find air or fuel.	1. Check whether water inlet hose clamp of water pump is loose. 2. Check whether cylinder gasket leaks air.
Water pump fails to work.	Measure water outlet pressure of diesel engine. Water pump should be changed, if water leakage happens several times.
Water ducts of radiator, cylinder cap, cylinder gasket and cylinder body are blocked.	Dredge water duct of cooling system. Inject new cooling liquid.
Oil of oil injection pump is excessive.	Check/change oil injection pump.
System design problem is found in cooling system of automobile or equipment.	Contact automobile or equipment manufacturerto improve fan, radiator and other components of cooling system. When diesel engine works in 2000r/min, temperature of water outlet is 88℃, water pressure is ≥ 70kPa.

7.2.7 Consumption of cooling liquid is excessive.

Inspection items	Inspection content and treatment measures
Water leaks from water tank or driving cab radiator. Water leaks from motor.	Check radiator, heater, hose and their connector to find out from where water leaks. Check seal or gasket of motor and components and water outlet switch to find out from where water leaks.
Overheat or compressor air leakage of cylinder lead to water tank overflow.	Find out the causes of overheat and air leakage (refer to fault clearing procedure- temperature

	of cooling liquid is too high).
Water leaks from oil cooler of reduction gear box.	Check whether cooling liquid and engine oil of reduction gear box mixes.
Water leakage is found in cylinder cap of water-cooling air compressor and cylinder cap gasket.	Check whether cooling liquid can be found in engine oil. Check/change cylinder cap and its gasket.
Water leakage can be found in intercooler, if intercooler motor is pressurized.	Check/change intercooler. Check whether cooling oil can be found in induction manifold or engine oil.
Water leakage is found in engine oil cooler.	Check/change engine oil cooler. Check whether cooling oil can be found in engine oil
Cylinder gasket leaks water.	Check/change cylinder gasket.
Water sealing ring of cylinder leaks water.	Dismantle oil pan and check whether water sealing ring of cylinder leaks water.
Cylinder cap cracks. Air hole or elastic choke plug leaks water.	Check/ change cylinder cap.
Cooling liquid gallery of engine body leaks water.	Check/change engine body. Refer to engine overhaul handbook.

7.2.8 Temperature of cooling liquid is too low.

Inspection items	Inspection content and treatment measures
Too much air flow past radiator.	Check fan cluth and fan according as requirement. Refer to introduction of producer.
Radiator shutter locks in the maximum opening.	Check shutter. If it is necessary, repair or change it.

7.2.9 Cooling liquid is contaminated

Inspection items	Inspection content and treatment measures
Cooling liquid has been used for a long time. The mixture of antifreeze liquid, DCA4 and water is incorrect.	Drain cooling liquid and wash cooling system. Fill cooling system with correct mixture of antifreeze liquid, DCA4 and water.
Engine oil cooler of speed changing box.	Check/change
Engine oil cooler, intercooler, cylinder gasket, and cylinder jacket water sealing ring of cylinder cap are broken. Cracks appear in engine body.	Change corresponding components.

7.2.10 Engine oil is contaminated.

Inspection items	Inspection content and treatment measures
Cooling liquid is found in engine oil. Internal parts of motor leaks water.	Check and change corresponding parts.
Fuel sediment is excessive.	Check engine oil and expired date of filter. Use qualified engine oil.
Fuel is found in engine oil. Motor running is running too cold.	Idling running time of engine is too long. This causes engine run under normal temperature.
Oil leaks from fuel delivery pump sealing.	Change fuel delivery pump.

Oil injection pump plunder is worn.	Change injection pump.

7.2.11 Fuel or engine oil leaks from air exhaust pipe.

Inspection items	Inspection content and treatment measures
Air inflow is blocked.	Check/change components of cleaner insert part. Motor idle performance period can not be too long.
Oil return pipe of turbocharger is blocked.	Check/ dredge oil-way. Decrease pressure of crankcase.
Oil leaks from sealing ring of turbocharger.	Check/change turbocharger.

7.2.12 Diesel engine spews out black smoke, when it is in load.

Inspection items	Inspection content and treatment measures
Motor is overloaded.	Use lower speed gear.
Air is found in fuel system.	Exhaust air and check the leakage of oil absorption.
Ai filter is blocked.	Check/ change air filter.
The space between booster and air admission pipe or air exhaust pipe leaks air.	Check air exhaust pipe of gas compressor, connector of intercooler and hose connector to find out form where air leaks.
Air passing by intercooler is blocked.	Check cooling fan. If it is necessary, wash and repair fan.
Oil injection pump timing is incorrect.	Check and adjust oil injection pump timing.
Gaskets installed under fuel spray nozzle are more than needed amount.	Take off needless gasket.
Turbocharger fails to work.	Dismantle fuel spray nozzle and test. If it is necessary, change the nozzle..
Turbocharger fails to work.	Change turbocharger.
Motor running is too cold (temperature of outlet cooling liquid is lower than 60° C.).	Check thermostat.
Smoking limiter fails to work. Oil injection supplied too much oil.	Dismantle oil injection pump and examine and verify.
Piston ring seal fails to work.	Check the smoking condition of oil filler. Measure pressure of diesel engine crankcase. It should be repaired, if it is necessary.

7.2.13 Power of diesel engine is insufficient.

Inspection items	Inspection content and treatment measures
Automobile is overloading.	Check broken parts, driving parts, additive load caused by brake fault and other additive load of automobile.
The connection of accelerator connecting rod is improper.	Conduct whole journal inspection of oil valve control rod. Adjust oil valve connecting rod.
Partial route of mechanical shutdown rod is	Check/ adjust shutdown electromagnet

hindered.	connecting rod.
Fuel is not qualified.	Start the automobile by temporary oil box with qualified diesel oil to test and verify.
Air connector of smoking limiter leaks air or is blocked. Control film of booster air exhaust valve is broken. Air control connector of booster air exhaust valve is broken.	Tighten connector. If it is necessary, change tube, connector and control film.
High-pressure fuel pipe and connector is broken.	Tighten/change connector or high-pressure fuel pipe.
Air is found in fuel system.	Exhaust air of fuel system. Check oil inlet pipe to find out from where oil leaks.
Supply of fuel is not smooth.	Wash colander and strainer. Check resistance of oil inlet pipe. Change fuel filter.
Fuel return relief valve fails to work.	Check/change fuel return relief valve.
Fuel delivery pump is broken.	Check/change fuel delivery pump.
Engine oil level is too high.	Discharge oil to normal oil level.
Air inlet temperature is too high.	1. In hot weather, introduce air outside engine cover into booster. 2. Check whether cooling fin of intercooler is blocked. 3. Check inner resistance of intercooler. Wash or change intercooler. 4. Check/wash pipes leading to intercooler.
Air inlet or air exhaust system is blocked.	Check resistance of air inlet system and air outlet system. Check air filter. If it is necessary, change the part.
Fuel temperature is high (higher than 70° C).	Inject proper amount of fuel. Shut down fuel heater.
Air leaks from the space between booster and air inlet pipe.	Check and repair air leakage in air outlet pipe of compressor, connecting pipe of intercooler, and host.
Air leaks from the space between booster and air exhaust pipe.	Check and solve the problem of air leakage. Check flaw of air exhaust pipe.
Fuel spray nozzle is worn or fails to work.	Check/change oil spray nozzle.
Booster is broken.	Check boost pressure. Change booster, if boost pressure is too high.
Air valve clearance is improper.	Adjust air valve clearance into correct value. Check push rod, spring and other components.
Oil injection pump timing is incorrect.	Check oil injection pump timing.
Oil injection pump is worn or fails to work.	Dismantle fuel spray pump. Examine and verify oil injection amount.
Compressor pressure is low.	Check compressor pressure. Repair the machine as requirement.

7.2.14 Diesel engine shuts down.

Inspection items	Inspection content and treatment measures
Fuel is contaminated.	Start the diesel engine by the fuel tank which is filled with qualified fuel to examine.
Air can be found in fuel system.	Check connectors which are loose. Check and change broken high-pressure oil pipe.
Fuel return relief valve fails to work.	Check/change fuel relief valve.
Fuel delivery pump fails to work.	Check/change fuel delivery pump.
The supply of fuel is blocked.	Clean colander and strainer. Check resistance of fuel pipe. Change fuel filter.
The adjustment of air valve clearance is incorrect.	Check push rod spring and adjust air valve.
Fuel spray nozzle is blocked or fails to work.	Change fuel spray nozzle.
Injection pump timing is incorrect.	Check/adjust injection pump timing.
Compression pressure of one or more than one cylinders is low.	Inspect compressor pressure to find out causes of problems (such as piston ring, cylinder gasket or air valve).
Camshaft timing is incorrect.	Check/adjust gear driving system timing.
Camshaft, pushrod is broken.	Check/change broken components.

7.2.15 Diesel engine knocks cylinder.

Inspection items	Inspection content and treatment measures
Air is found in fuel system.	Exhaust air of fuel system. Check whether oil absorption pipe is broken.
Fuel is unqualified.	Start the engine with temporary oil tank which is filled with qualified oil to examine and verify.
Motor is overloading.	Use low gear to prove that diesel engine is not over design load.
Oil injection timing is incorrect.	Check oil injection timing.
Fuel injector fails to work.	Dismantle oil injector. Check and repair it.

7.2.16 Fuel consumption of diesel engine is excessive.

Inspection items	Inspection content and treatment measures
Fuel leaks	Check outside leakage. Check whether the oil is diluted by fuel. Inspect fuel delivery pump and inner leakage of oil injection pump.
Addition load caused by auxiliary assembly faults.	Check/ repair auxiliary assembly and components of automobile (refer to regulations formulated by the producer.)
Operation technique	Check. Change the operation of speed changing bar gear and idle correctly.
Fuel is unqualified.	Start the engine with temporary oil tank which is filled with qualified oil to examine and verify.
Improper air inlet resistance and air outlet	

resistance	
Injection pump is incorrect.	Check and adjust oil injection timing.
Oil injector is worn or fails to work.	Check/ change oil injector.
Air leaks from air valve	Check/cjamge air valve.

7.2.17 Vibration of diesel engine is severe.

Inspection items	Inspection content and treatment measures
Motor running is unstable.	Refer to fault clearing procedure for roughness of motor or flameout.
Engine frame is loose or broken.	Check/change engine frame (refer to repair introduction of manufacturer).
Fan is broken. Accessory fails to work.	Check/change components (refer to repair introduction of manufacturer).
Damper fails to work.	Check and change damper.
Components of fan transmission shaft fail to work.	Check/change components of fan transmission shaft.
Alternator bearing is worn or broken.	Check/change alternator.
Disalignment of flywheel appears.	Check/ adjust concentricity.
Moving parts is loose or broken.	Find out the causes why crankshaft and connecting rod are broken and components are imbalenced. Please contact our authorized complaint center to solve this problem.
Components of driving system are worn and imbalanced.	Check/ change components as the requirements of manufacturer.

7.2.18 Noise of diesel engine is too high.

Inspection items	Inspection content and treatment measures
Drive belt howls. Tensile force is insufficient. Abnormal high load appear.	1. Check belt regulating wheel. Check drive belt to make sure that water pump, regulating wheel, fan hub and alternator can rotate normally.
Air leakage is found air inlet and air outlet.	
Air valve clearance is too big.	Adjust air valve clearance. Make sure that push rod of air valve is not bend. Rocker arm is not seriously worn.
Turbocharger makes noise.	Check whether booster impeller and turbocharger impeller scrape the shell.
Transmission gear makes noise.	Check/change damper.

7.2.19Generator doesn't charge or undercharge.

Inspection items	Inspection content and treatment measures
Connector of storage battery is loose or corrosive. The condition of storage battery.	Clean/tighten battery connector. Check charging degree of storage battery.
Generator belt slips.	Check/change belt regulating wheel.

Instrument or indicator light fails to work.	Check/change instrument or indicator light.
Generator lead wire is loose or broken.	Repair lead wire.
Generator fails to work,	Change generator.

7.2.20 Air leakage of diesel engine crankcase is very large.

Inspection items	Inspection content and treatment measures
Breather pipe of crankcase ventilation device is blocked. Air leaks from turbocharger seal.	Check whether breather pipe of crankcase ventilation device is blocked. Check sealing device of turbocharger.
Air compressor fails to work.	Check air compressor.
Air valve guide pipe of cylinder is excessively worn.	This item needs to change cylinder cap. Please contact our authorized complaint center to solve this problem.
Piston ring is broken or worn.	Inspect piston ring and cylinder jacket. Please contact our authorized complaint center to solve this problem.

7.2.21 Too much oil is on air compressor.

Inspection items	Inspection content and treatment measures
Cylinder or piston of air compressor is worn or broken.	Inspect air outlet pipe of air compressor.

7.2.22Air compressor pressurizing is slow.

Inspection items	Inspection content and treatment measures
Air leaks from air system. Carbon deposition in air compressor air outlet pipe is excessive.	Check whether air leaks from air compressor gasket. Check air outlet pipe.
Unloading valve components of air compressor fail to work.	Check the operation of unloading valve.
Air leaks from air inlet valve and air outlet valve of air compressor.	Check components of air inlet valve and air outlet valve.
Air regulator fails to work. Or the regulation is incorrect.	Check the operation of air regulator.

7.2.23Cold-starting aids of heater plug appear fault.

Inspection items	Inspection content and treatment measures
Indicator light doesn't flash. Preheater plug warming is insufficient. Time from indicator light flashing to engine starting is too long.	Start the engine until the indicator lights begin to flash. If the time from indicator light flashing to engine starting is more than 30s, reconnect auxiliary assembly circuit of air inlet preheater.
Voltage is lower than 20V (24V storage battery).	Charging. Change storage battery.
Indicator light is not on.	Inspect bulb, socket and electrical wire.
Preheater plug is not warming.	Check/repair the circuit to preheater plug.
Electrical heater of preheater plug is broken.	Inspect/repair electric heater of preheater plug.

Temperature sensor is broken.	Inspect temperature sensor. Change a new one, if it is necessary.
Electrical system of diesel engine is broken.	Check whether earth wire and insulation wire is worn, whether connector is corrosive and whether connector is in good condition.
Fuel doesn't flow into preheater plug.	Inspect sediment in fuel pipe. Heat fuel pipe and preheater plug to remove wax deposit.
Electromagnet valve is not open.	Inspect electromagnet valve.
Preheater plug filter is blocked.	Dismantle fuel pipe. Wash filter.
Preheater plug is carbonized or blocked.	Inspect whether preheater plug is blocked or carbonized.
Fuel leaks from fuel pipe.	Repair the place where leaks fuel.
Earth wire of controller is broken.	Inspect whether earth wire is corrosive and whether the connector is loose.
No electricity is in controller.	Inspect whether "15" and "30" connectors of controller are loose or broken. Check circuit and staring switch.
Controller is broken.	Inspect controller logic. Change controller.