

6105 Series Engine Manual

Manual de Operación y Mantenimiento Motores Serie 6105

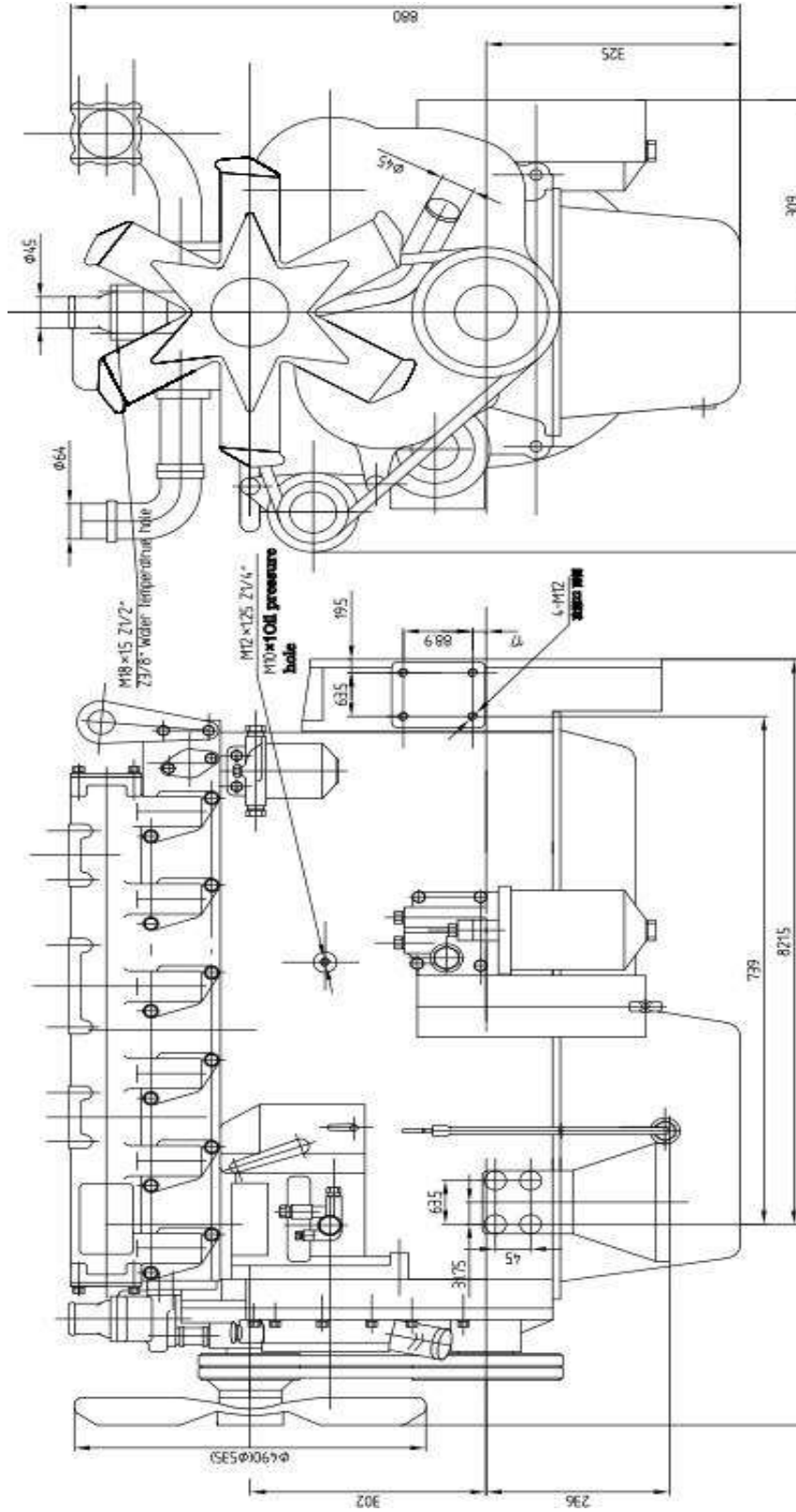


Motores Diesel Remington

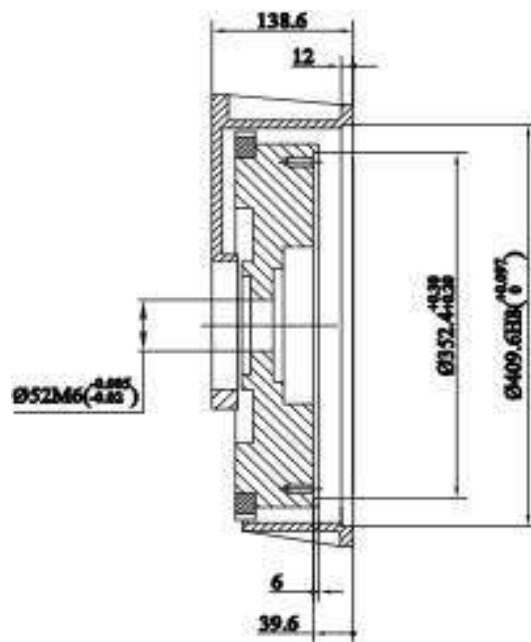
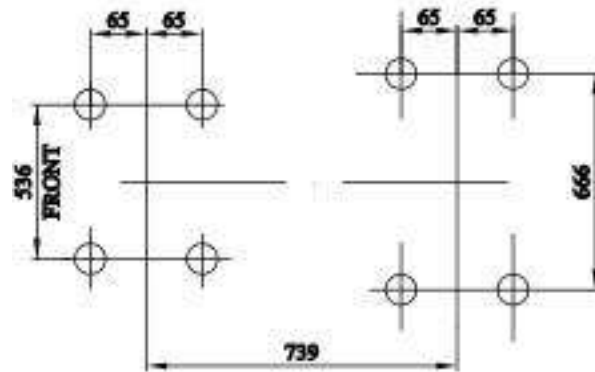
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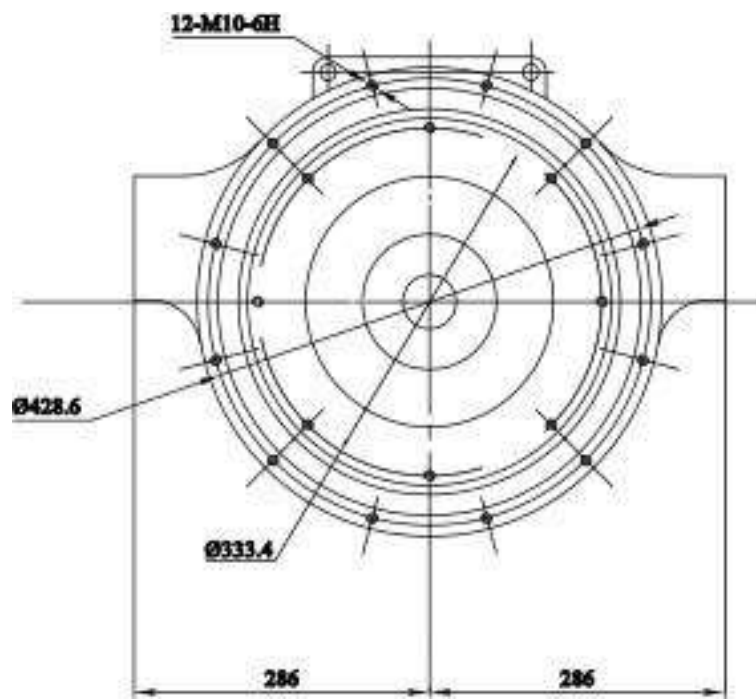
■ **IMPORTANTE:** Adicional a estos términos y condiciones de garantía, aplican también todas las condiciones y se deben seguir todas las instrucciones, detalladas en el Manual Original de Fábrica entregado con su equipo. Todos los términos de garantía están sujetos a las condiciones y limitaciones detalladas a continuación en este Manual.



R6105 Foot installation drawing

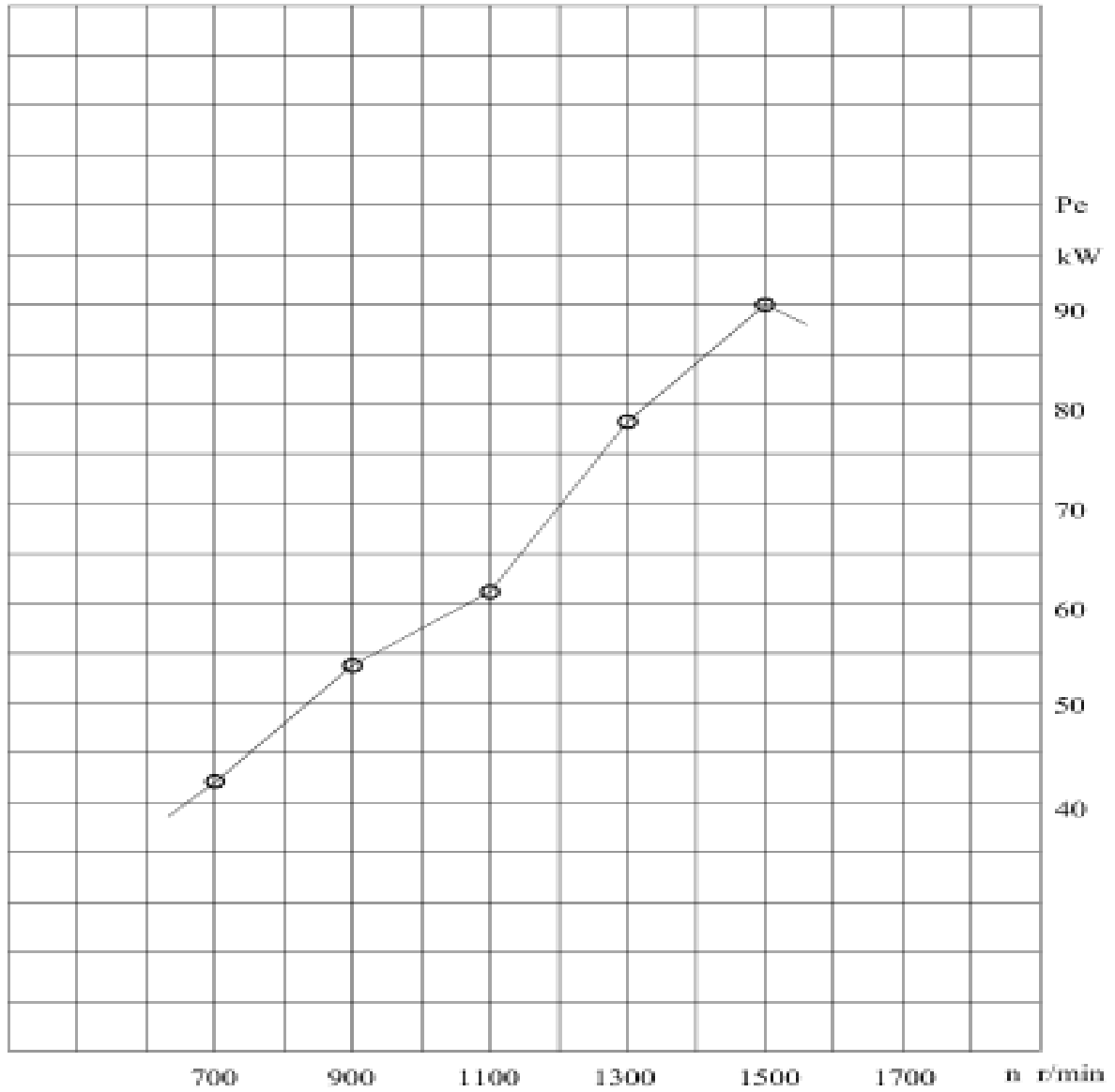


6105 DIESEL ENGINE OVERALL DRAWING

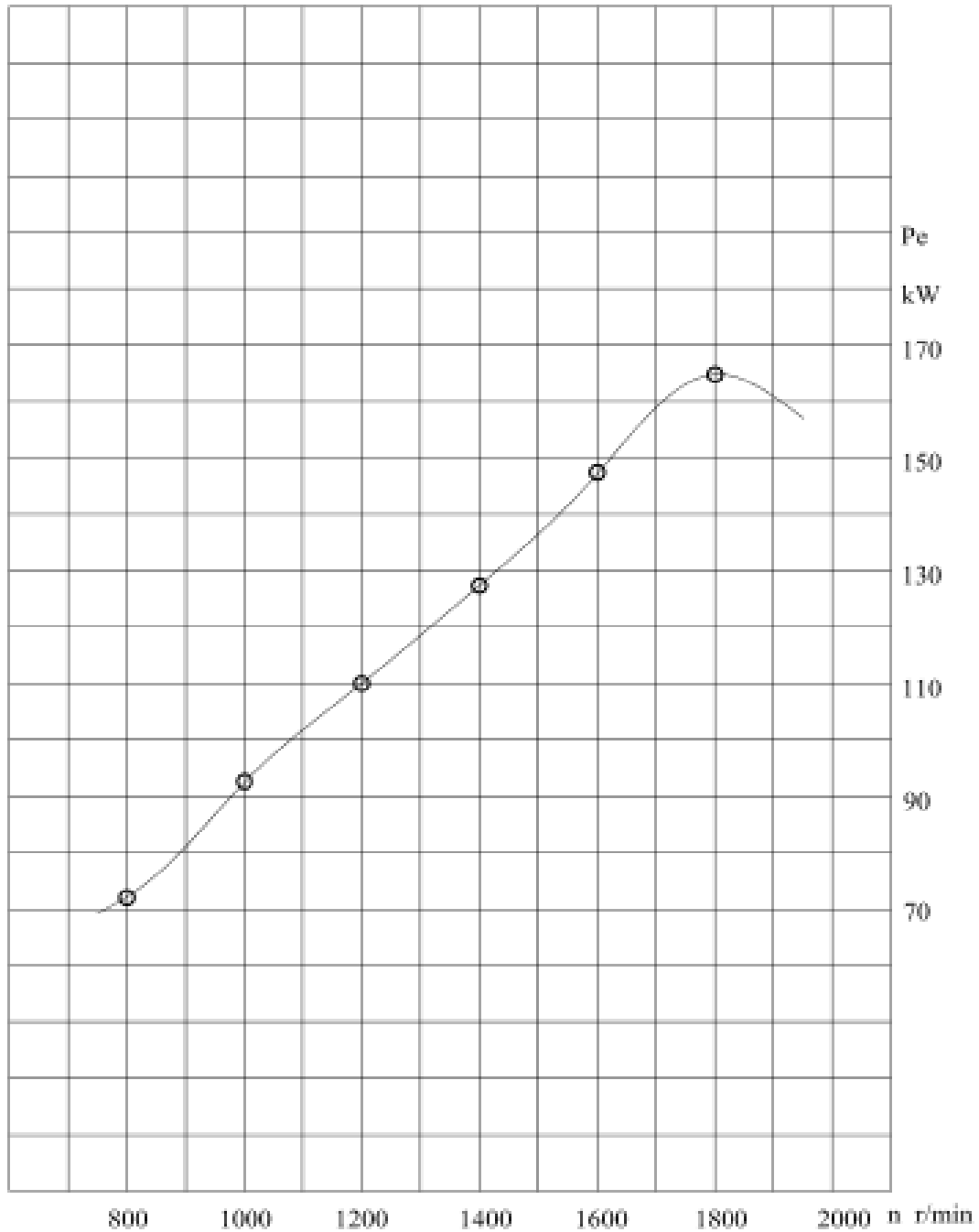


6105
DIESEL ENGINE OVERALL DRAWING

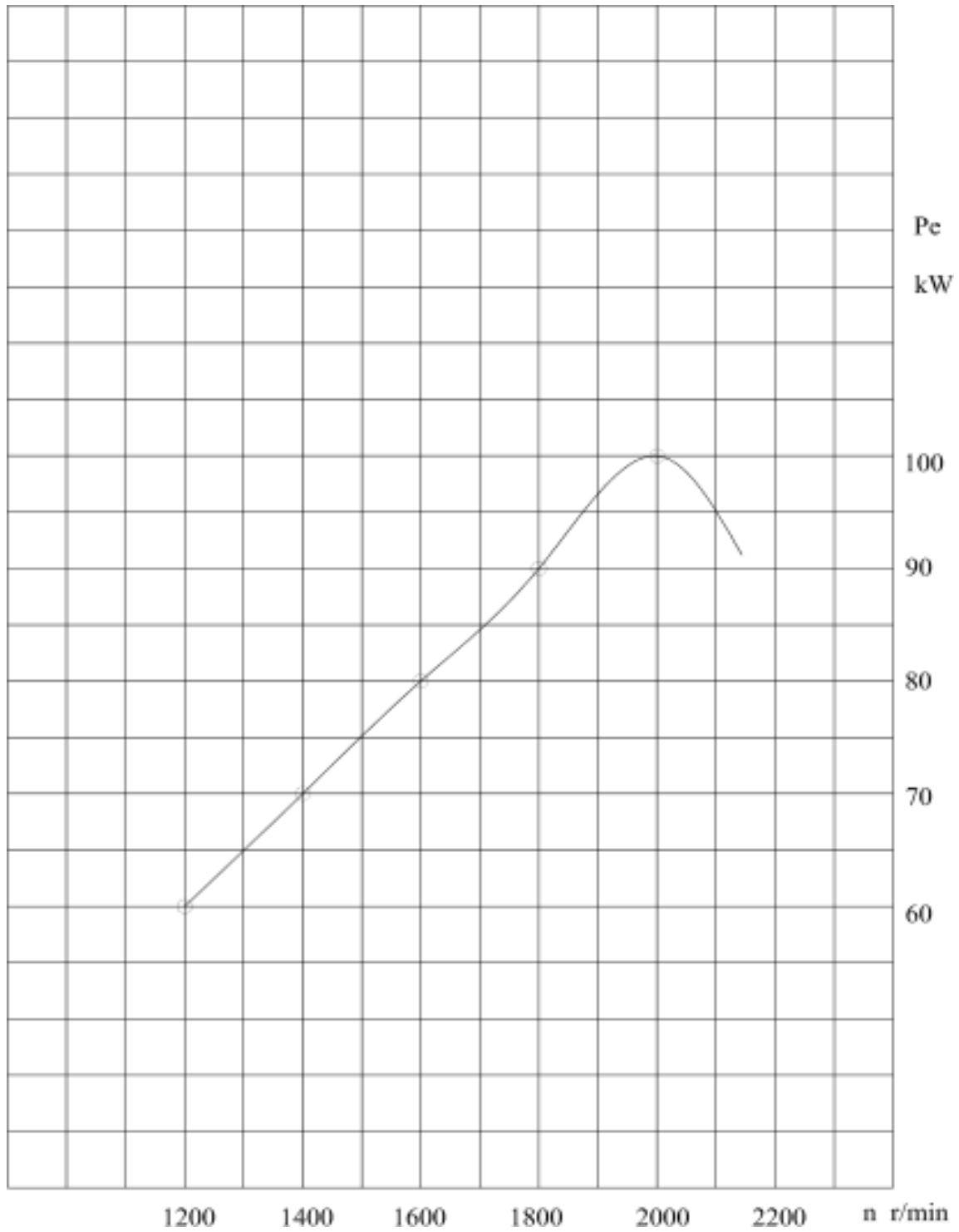
6105ZD (1500r/min)



R6105ZD(1500r/min)
CURVE FOR ENGINE SPEED AND OUTPUT



**6105IZLD (1800r/min)
CURVE FOR ENGINE SPEED AND OUTPUT**



6105ZG(2000r/min)
CURVE FOR ENGINE SPEED AND OUTPUT

CHAPTER 1

Main Technical Specifications and Data of Diesel Engine

§1 Main Technical Specification

ENGINE FOR POWER GENERATION

1.1- 6105 (Stroke 125-135mm) series

§2 Main Technical Data

Model		6105	6105 D	6105 Z	6105 ZD	6105 AZLD	6105 IZLD			
Type		Four strokes, water cooling, inline, direct injecting combustion chamber, electric starting								
Cylinder No. - Bore*Stroke(mm)		6 - 105× (125)				130	135			
Total Displacement of Piston (L)		6.49								
Pressure Ratio		17:1			16:1					
Firing order		1 - 5 - 3 - 6 - 2 - 4								
Air intake mode		Naturally Aspirated		Supercharge			Supercharge、 Intercooling			
Rated power (Kw)	1 H output	82	68.2	95.5	99	121	145.2			
	12H output	74.5	62	105	90	110	132			
Rated speed (r/min)		2000	1500	2000	1500	1500	1500			
Average effective pressure (kPa)		689	764	882	1109	1355	1626			
Speed characteristic	Max Torque(N.m)	410		525						
	Max Torque /Speed (r/min)	1400		1600						
	Torque reservation (%)	/	/	/	/	/	/	/	/	/
Speed regulation characteristic	Steady governingspeed(%)	Mechanical ≤5.0 ; electronic≤3.0								
	Transient governing speed(%)	≤10.0								
	Steady speed waving(%)	≤1.0								
Fuel consumption(g/Kw.h)		≤239			≤232			≤224		
Oil consumption (g/Kw.h)		≤1.63								
Highest Iding Speed(r/min)		≤2376	≤1725	≤2376	≤1725	≤1725	≤1725			
Lowest Iding Speed (r/min)		≤600								
Lowest working Stable Speed (r/min)		/	/	/	/	/	/	/	/	/
Crankshaft Rotating Direction		Counter clockwise (facing to the power output end)								
Cooling Mode		Forced water cooling								
Lubricating Mode		Compound type with pressure and splash								
Net Mass (kg)		520	9	6540			580-600			

1、 DIESEL ENGINE Various temperature and pressure range:(Under standard condition)

1.1 Oil temperture : Non turbocharged model \leq 95°C ; turbocharged model \leq 105°C.

1.2 Cooling water temperture : Non turbocharged model \leq 90°C ; turbocharged model \leq 95°C.

1.3 Exhaust temperture : \leq 600°C (after turbine)

1.4 Oil pressure of Main fuel line : 0.3~0.55Mpa. (Idling condition \geq 0.1MPa)

1.5 Injector spraying pressure : $21_{-0}^{+1.0}$ Mpa

2、 Main bolts Tightening Torque:

2.1 Cylinder head bolts : 180 \pm 5N.m

2.2 Main bearing bolts : 210 \pm 10N.m

2.3 Flywheel bolts : 210 \pm 10N.m

2.4 Connecting rod bolts : 120 \pm 10N.m

2.5 Crankshaft pulley bolts : 230 \pm 10N.m

3、 Main regulation datas

3.1 Valve clearances

Intake valve (cold state) 0.30~0.40mm ; (hot state) 0.25~0.35mm.

Exhaust valve (cold state) 0.40~0.50mm ; (hot state) 0.35~0.45mm.

3.2 Compression rest clearances : 1.0~1.20mm

3.3 Valve subside volume : 1.15 ~1.30mm

3.4 Fuel feeding Advanced Corner : (Crankshaft corner)

1500~2200r/min model : 17 $^{\circ}$ \pm 1 $^{\circ}$

4、 Valve timing : (Crankshaft corner)

Intake valve opens : Before TDC 12 ~ 36 °

Intake valve closes : After BDC 38 ~ 64 °

Exhaust valve opens : Before BDC 55 ~ 70 °

Exhaust valve closes : After TDC 12 ~ 34 °

CHAPTER 2 Specification of Main Accessories



No.	Model		Accessories specification	
	Accessory		6105series	
1	Oil pump	Type	Single grade gear type	
		Displacement L/min	≥90	
		Speed r/min	2800	
2	Water pump	Type	volute chamber、 single attraction、 Centrifugal type	
		Discharge m	≥7.50	
		Displacement L/min	≥200	
		Speed r/min	≥2800	
		Rotating Vbelt	2×B1500	
3	Injection pump	Type	6 cylinder A in-line plunger pump	
		Plunger diameter (mm)	9.5	
		Rated speed(r/min)	1100 ; 750 ; 1100 ; 750	
		Governor model	RSV mechanical centrifugal full range type	
4	Injector	Type	Low inertia type KBEL-P0040 or CKBEL68S026***...	
		Injection nozzle mate type	Long holetype (CDLLA150S017)	
		Hole No.×Hole diameter (mm)	4×0.27~0.32	
		Injection pressure (Mpa)	21 ^{+1.0} ₋₀	
5	Fuel filter		CS0708B 、 C0710B4	
6	Oil filter		J1012B , J0818 or JX0811A	
7	Air filter		K2139	
8	Starting motor	Model	QDJ2608	
		Voltage/Output (V/kW)	24/5.5	
		Gear tooth no.(Z)	11	
9	Dynamo	Model	JF251 or JF2314	
		Voltage(V)	28	
		Output(kW)	0.50~0.70	
10	Battery capacity		2×1 20A.h	
11	Radiator/Intercooler (m ²)	41.85/(23.8)		74.7/(23.8)
12	Turbocharger/model	Pulsing type/J82		Pulsingtype /J86~90

CHAPER 3Fit clearances and wear limits of Main Accessories

No.	Item	Theoretic value (mm)	Fit character	Installation clearance (mm)	Wear limit (mm)
1	Clearance between main bearing neck and main bearing hole	$\text{Ø}85 \frac{\text{shaft}^{+0}}{\text{hole}^{+0.086}_{-0.020}_{+0.040}}$	radial clearance	0.040~0.106	0.30
2	Clearance between connecting rod bearing neck and hole	$\text{Ø}72 \frac{\text{shaft}^{+0}}{\text{hole}^{+0.075}_{-0.020}_{+0.040}}$	radial clearance	0.04~0.095	0.30
3	Clearance between Connecting big end and crankshaft	$35 \frac{\text{shaft face}^{+0.20}}{\text{head width}^{+0.10}_{-0.20}}$	axial clearance	0.20~0.40	0.70
4	Min.clearance of piston skirt and cylinder head hole	$\text{Ø}105 \frac{\text{shaft}^{-0.11}}{\text{hole}^{+0.035}_{-0.14}_{+0.0}}$	radial clearance	0.11~0.175	0.30
5	Clearance between Pistion pin and connecting rod bushing	$\text{Ø}36 \frac{\text{shaft}^{+0.002}}{\text{hole}^{+0.047}_{-0.003}_{+0.027}}$	radial clearance	0.025~0.050	0.15
6	Clearance of piston pin and piston pin seat	$\text{Ø}36 \frac{\text{shaft}^{+0.002}}{\text{hole}^{+0.012}_{-0.003}_{+0.005}}$	radial clearance	0.003~0.015	0.05
7	1 st ring height and groove	/	End Face clearance	0.065~0.105	0.40
8	2 nd ring height and groove	/	End Face clearance	0.040~0.080	0.30
9	Oil ring height and groove	/	End Face clearance	0.045~0.08	0.25
10	End clearance of 1 st piston ring	/	/	0.40~0.60	1.00~1.20
11	End clearance of 2 nd piston ring			0.30~0.50	1.10~1.20
12	End clearance of oil ring			0.20~0.40	1.00~1.20
13	Clearance between Camshaft bearing and bushing hole	$\text{Ø}54 \frac{\text{shaft}^{+0}}{\text{hole}^{+0.10}_{-0.025}_{+0.062}}$	radial clearance	0.062~0.125	0.25
14	Clearance between camshaft and thrust plate		axial clearance	0.05~0.15	0.40
15	Clearance between valve tappet and hole	$\text{Ø}30 \frac{\text{shaft}^{+0.040}}{\text{hole}^{+0.025}_{-0.057}_{-0}}$	radial clearance	0.040~0.082	0.20
16	Clearance between Idle gear shaft and bushing hole	$\text{Ø}50.8 \frac{\text{shaft}^{-0.025}}{\text{hole}^{+0.025}_{-0.050}_{-0}}$	radial clearance	0.025~0.075	0.20
17	Clearance between idle gear shaft shoulder and idle gear	/	axial clearance	0.038~0.095	0.25

No.	Item	Theoretic value (mm)	Fit character	Installation clearance (mm)	Wear limit (mm)
18	Clearance between inlet valve stem and guide hole	$\varnothing 9.50 \begin{matrix} \text{shaft } -0.025 \\ \text{hole } +0.019 \end{matrix}$	radial clearance	0.025~0.064	0.20
19	Clearance between exhaust valve stem and guide hole	$\varnothing 9.5 \begin{matrix} \text{shaft } -0.038 \\ \text{hole } +0.019 \end{matrix}$	radial clearance	0.038~0.077	0.30
20	Clearance between cylinder liner above cylinder block upper face	/	/	0.05~0.12	/
21	Gear side clearance	/	/	0.10~0.15	0.50

Chapter II Main Structure of Diesel Engine

1. Cylinder head assembly

Cylinder head is a single piece casting structure, with independent intake, and exhaust ports on both sides. The intake port is a helicoid type designing. In order to decrease the heat load of cylinder head, and consider of the supercharged condition, the cylinder head base wall thickness is different at the area of valve distance and injector seat hole, and cooled by inject cooling water. The valve guide and intake & exhaust valve seats are interference fit with cylinder head very tightly. Valve seat ring is made of heat resisting and wear-resisting Chrome-molybdenum casting.

Intake & exhaust valve and valve seat have been run-in when using, remember the number of cylinder when disassembly and assembly. When sealing condition between valve and valve seat is not good, lapping is necessary, and should be clean before assembly. After long time operating, the width of valve seat contacting area may be over 2.5mm, or valve seat damaged or non-round, reaming should be done, or change valve seat if necessary. When assembly, cylinder head should be heated at about 200°C, then the valve seat can be in-laid, after that ream and lap it at the contact area and make it at 1.3~1.5mm in width, valve setting value is 0.6~1.0mm down.

A copper - asbestos gasket is fitted between the cylinder head and the cylinder block. The cylinder head is tightened on the cylinder block by 18 (for four-cylinder diesel engine) or 26 (for six-cylinder diesel engine) strengthen bolts and quenched bolt gaskets. The cylinder head bolts should be tightened evenly by three times one by one in regulated order and torque. (Fig.1)

2. Cylinder block and related assembly

The cylinder block of series diesel engine is short skirt construction without side opening. The main oil distributing passage is at the left side of cylinder block (view from flywheel end), the fuel injection pump, oil filter, fuel filter and oil cooler are at this side as well. The push – rod chamber are located at the right side of cylinder block, crankshaft case ventilator, generator, starting motor, air compressor and hydraulic pump as well.

A laser quenched wet cylinder liner is fitted in the upper part of cylinder block. In order to press it tight enough, its upper end is 0.05 ~0.12mm, higher than that of cylinder block.

The main bearing at the lower part of cylinder block is a full supporting type. The main bearing cover is positioned horizontally by shoulders at sides of cylinder block, and is machined together with cylinder block, thus can not be changed each other. For this reason, each main bearing cover has its sequential number and a triangle symbol, the arrow of triangle is to the front. Each upper main bearing half has oil holes on it. The bearings are all made of steel back aluminum alloy. The clearance between main bearing and crankshaft journal is not adjustable. Whenever the clearance is over limited value after bearing worn, it must be to change the bearings. When tight the main bearing bolts, each two bolts at one same bearing should be tightened gradually and alternately into specified torque. As there is anti – loose quenched gasket, the main bearing bolts have no locked gasket.

3. Camshaft assembly

The camshaft of series diesel engine is full supporting, the cam is function cam, to adapt different working speed. Camshaft is driven by crankshaft timing gear through idling gear and camshaft timing gear. There are engage marks on the timing gear, the marks should be aligned when assembly. There assembled a camshaft thrust plate between camshaft timing gear and shaft collar, to control the axial clearance of camshaft.

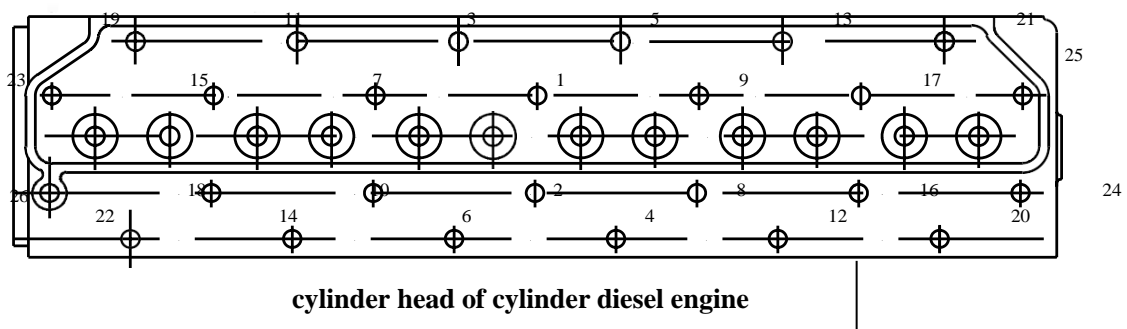


Fig.1 The sequence of tightening cylinder head bolts

The material of valve tappet stem is chill Ferro – nickel(iron) with the bottom surface of quench hardened and phosphorized. The axial line of tappet stem deviate the width central line of the cam 2mm, so that the tappet stem cam rotate surround its own axis to make the contact surface wore evenly. The theoretical valve timing diagram is as Fig. 2. In order to assure the normal running of diesel engine, he adjusting of intake and exhaust valve clearance should be within specified range.

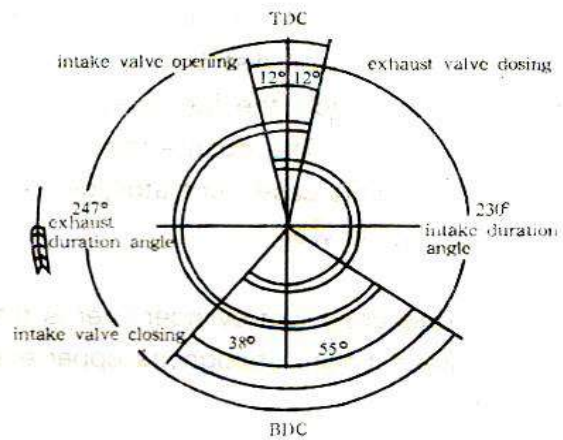


Fig. 2 Theoretical valve timing diagram

4. Piston and connecting rod assembly

Except piston, piston ring and piston pin are different between 100 and 105 series diesel engines, other parts of connecting rod including connecting rod element, connecting rod bearing are all interchangeable.

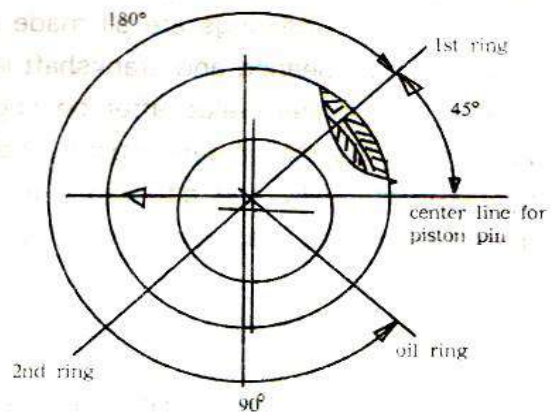


Fig. 3 The opening clearance of piston rings in cylinder liner

Each piston of diesel engine has two compression rings and one scraper ring. The first compression ring is distorted barrel chrome – plate ring of modular cast iron, to improve the abrasive resistance under high temperature. The second ring is taper – face ring.

The side of the first and second piston rings with the word ‘top’ on it, should be faced at top side when assembled. The scraper ring is a component with inner spiral spring. As assembling scraper ring, the opening of the inner spiral spring maintain reed should be at the opposite side of the opening of scraper ring. When piston is assembled, the arrowhead on its top should be at the same side with the word ‘front’ on connecting rod, i. e. the arrowhead on top of the piston should be to the

front of engine. As assembling piston ring, first it should be put in cylinder liner, then be checked with clearance gauge to find out if the opening clearance is in the specified scope. If clearance is too small, repair with file. Piston rings should be staggered -120°C with each other, and meanwhile avoid the direction of piston pin hole. See to Fig. 3. When assemble the piston into engine, the piston ring, piston pin, connecting rod liner and connecting rod bearing should be coated with enough grease. series diesel engine has 'ω' type combustion chamber at the top of piston, with the surface of spraying coating graphite of tin-coated. The piston of series strengthen diesel engine is controllable heat expansion piston with the skirt inlaid by steel sheet. the first is direct to cooling nozzle.

The piston pin is full floating type, and can be rotate in piston pin hole as it getting to certain working temperature, to make wearing evenly. But it is cool, it is interference fit between piston pin and the piston pin hole. So when assemble and disassemble the piston pin, the piston should be preheated to $80 - 90^{\circ}\text{C}$. Assemble piston pin by force at cool temperature is prohibited, otherwise the pinhole may be ruined. Piston pin should stagger 1mm to non-pressure plane relative to piston center, to decrease piston knock.

Connecting rod body and connecting rod cap are positioned by single-tooth, and have marking numbers at same side, when assembled, the number must be registered. The small end bushing of connecting rod is wrapped bush by bimetal material, the oil holes on the bushing should be right aligned to the oil gathering hole at the top of connecting rod small end, to lubricate piston pin and bushing. Connecting rod bolts should be tightened evenly with specified torque strictly, connecting rod bolts are self-locked by friction force. The mass difference of connecting rod for one same diesel engine is less than 12g, and that of piston and connecting rod assembly for one same diesel engine is not bigger than 20g.

Connecting rod bearing of series diesel engine is usually made of steel-backed aluminum alloy material. Connecting rod bearing of strengthen diesel engine is made of steel-backed copper-lead alloy. It is unadjustable for the gap between shaft bearing shell and shaft neck, when wearing capacity is over limited value, the bearing shell must be changed.

5. Crankshaft and flywheel assembly

The crankshaft is made of QT800-3 high strength modular cast iron, and is full sup-

porting type. All the surface of shaft neck is quenched or nitrided, to improve the wearing resistance. For 6 – cylinder high – speed strengthen diesel engine, the crankshaft is made of No. 45 steel material, the main shaft neck and connecting rod shaft neck are treated by induction quench.

The front and rear end are sealed by skeleton structure rubber oil seal. There are two connecting methods of the crankshaft front end, one is multiple keys for full output, another one is flat key. When output power is needed at the front end, Multiple keys and casting pulley should be adopted. Otherwise, flat key and rotary pulley should be used instead. In order to decrease the torsion stress of crankshaft and the noisy of engine, rubber shrunk – in torque insulator element can be used if necessary.

Flywheel is positioned by cylindrical pin, and fastened on the rear end of crankshaft by seven high strength bolts. Flywheel bolts should be tightened gradually according to the sequence shown in Fig. 4 Flywheel bolts are self – locked by flywheel bolt gaskets. The gaskets are made of 15 # steel treated by cementation process.

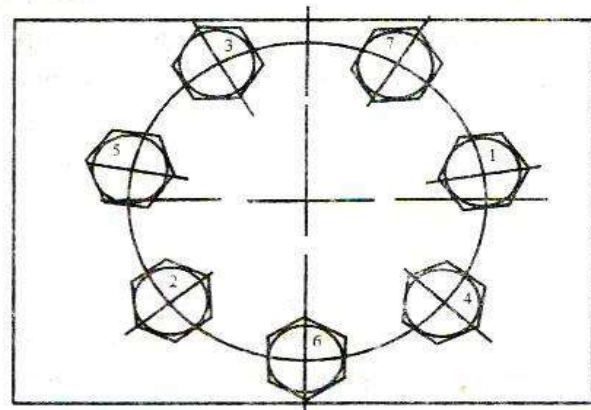


Fig. 4 The tighten sequence of flywheel bolts

The outside of flywheel is marked TDC point, and also the scale range of 0 ~ 30° of advanced used to adjust advanced angle of supplying fuel. Each scale means 1° crankshaft angle of turn. For some models of engines, the TDC point is marked at the flywheel end face of crankshaft pulley.

6. Transmission system

the diesel engine transmission system is including to normal V – belt transmission and the gear transmission inside gear case.

Crankshaft pulley is consisted of two A – type V – belt to drive water pump pulley

and alternator pulley. Different of V – belts are used because of the different position of water pump and alternator. V – belt is tensioned by alternator adjustment mechanism. When press the center of V – belt by finger, 10 ~ 15mm depth should be available.

Crankshaft timing gear drives idling gear, idling gear drives camshaft timing gear, fuel injection pump timing gear and oil pump gear. Camshaft timing gear may drive air compressor gear of work pump gear and hydraulic pump gear if necessary. Hydraulic pump gear may drive the front and the rear hydraulic pump through the transmission splined hobs of hydraulic pump or one of them.

7. Intake and exhaust system

7.1 Intake pipe

The basic construction form of intake pipe for series diesel engine is center inlet type and both ends inlet type, the center inlet type and both ends inlet type, the center inlet type has two styles: single hole style and double holes style.

The construction of the intake pipe is an aluminum single block type. It is connected with the air filter of the turbocharger compressor housing through the inlet connector.

7.2 Exhaust pipe

The construction of the exhaust pipe for series diesel engine is a single – block cast one. It is connected with the silencer and the turbocharger turbine casing through the exhaust connector and other parts. according to their uses, the exhaust pipe is divided into two types: one for natural aspirated engine and another one for supercharged engine. The naturally aspirated engine used type exhaust pipe has two construction styles: center outlet style and ends outlet style. According to the requirement of two types turbochargers, the supercharged engine used type exhaust pipe is divided into two types: pulse supercharging used double outlet holes type and constant pressure supercharging used single outlet hole type.

7.3 Air filter

When the diesel engine is working, clean and fresh air is required to be supplied by the air filter, this can assure to reduce the wear of cylinder liner, piston, piston rings, valve and other parts.

For the air filter equipped with series diesel engine, besides one or two types are equipped by OEM, the common two structure styles are as follows single stage paper filter element style and double stages paper filter element style

7.4 Silencer

In order to reduce the noise and improve the operator's working environment, series diesel engine adopts exhaust silencer. The exhaust gas of the diesel engine expands through the holes of the silencer inner pipes and the noise is reduced. If the silencer is choked, the output of the diesel engine will drop. So the carbon deposit and iron rust inside the silencer should be cleaned periodically according to the working condition of the diesel engine.

The construction of silencers used for four cylinders and six cylinders diesel engine is just the same, only the capacity is different. according to the matched requirement, the connecting pipe can be lengthened or prepared by users.

According to the matched requirement, the main installing mode of silencer for series diesel engine is horizontal style and vertical style.

7.5 Turbocharger

series diesel engine is made by adding a turbocharger between the intake and exhaust pipe of the natural aspirated type diesel engine. Through the turbine, the turbocharger transforms the exhaust energy of the diesel engine to the rotating mechanical energy of the rotor, then the blower is driven to rotate at a high speed and compress the fresh air coming from the air filter, then delivery it to the cylinder. Through supplying more air to the diesel engine, more fuel will be burned thoroughly and the output of the diesel engine will be increased accordingly.

The turbocharger is combined with constant pressure single inlet turbine housing or pulse double inlet turbine housing, turbine assembly, blower pump impeller, blower housing and so on.

The turbocharger is a high speed - rotating machine, its rotating speed will influence the supercharge effect of the diesel engine directly. In order to assure the diesel engine working normally, the lubricating oil supplied to the turbocharger must be double stages filtered. When being used, the turbocharger must be technically main-

tained in time strictly according to the stipulation on the turbocharger – operating manual. The blower must be cleaned regularly according to the operating requirement. The turbocharger should be dismantled by skilled professional technical workers. A point should be paid attention to that when the lock nut on the end of the blower is being tightened, the reticule on the nut should be aligned with the reticules on the rotor shaft cscrow and blower impeller. This can protect the running balance of the rotor from being damaged and assure it working normally.

8. Fuel System

Fuel system is shown in Fig. 5

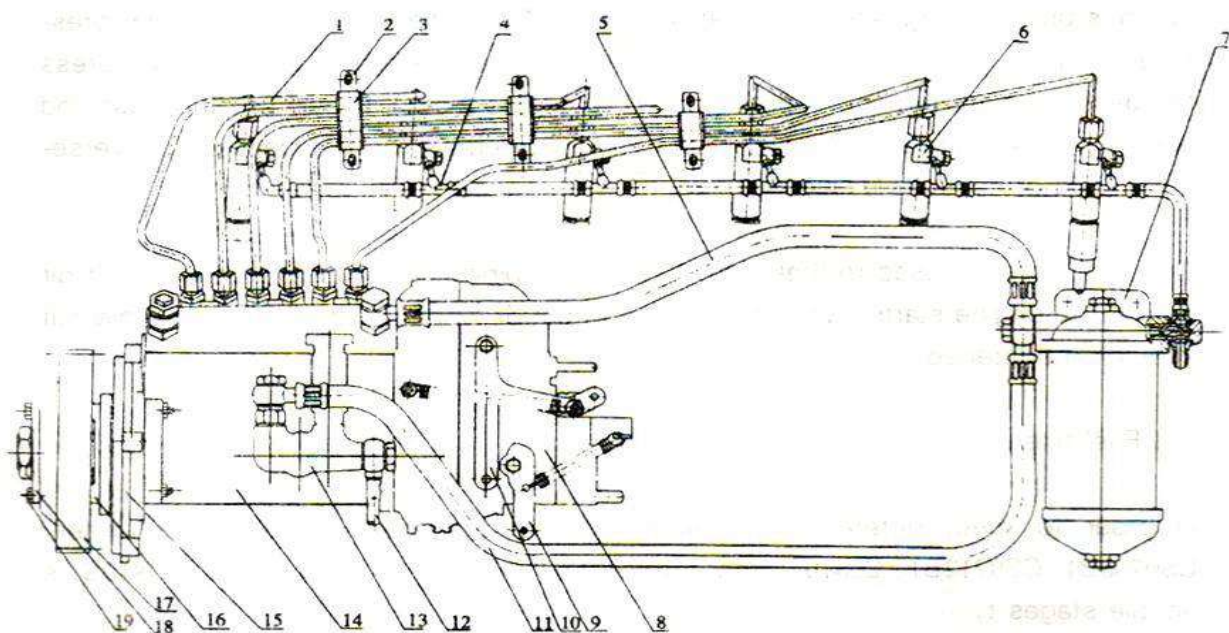


Fig. 5 Fuel system

1. High pressure fuel manifold 2. Pipe clamping plate 3. Rubber gasket 4. Injector fuel return pipe assembly 5. Injection pump fuel inlet pipe assembly 6. Injector 7. Fuel filter assembly 8. Governor 9. Stopping handle 10. Speed adjusted handle 11. Fuel filter inlet pipe assembly 12. Fuel delivery pump inlet pipe assembly 13. Fuel delivery pump 14. Injection pump 15. Injection pump fixed bolt 16. Advancer 17. Injection pump gear 18. Injection pump gear crossing plate 19. Bolt

When the diesel engine is working fuel flows through fuel tank ,inlet pipe ,fuel delivery pump into the fuel filter ,after being filtered, it enters into the injection pump, then being compressed with plunger mate to high pressure, through fuel cock and high pressure fuel pipe, it enters into injector. When the pressure is high enough to open the needle valve nate of the injector, the fuel will be sprayed into combustion chamber in the form of atomization. After spraying, the pressure will gets lower, the needle valve

returns to the seat under the force of spring, the injecting hole no sprays again.

The extra fuel that the fuel delivery pump supplies more than the injection pump used, also with the fuel that the injector needle valve mate leaks and the returning fuel of the fuel filter and the injection pump will flows back to the fuel tank.

8.1 Fuel delivery pump

The purpose of the fuel delivery pump is to keep the low – pressure fuel pipe full of pressed fuel. In order to remain the pressure stable, the piston of the fuel delivery pump is pressure regulated automatically type. When the pressure of the low pressure fuel pipe higher more than the stipulated value, the higher pressure will press the backup spring through the piston and force the piston away from the push rod gradually, this can reduce the amount of the delivered fuel or stop delivering. Inversely, will add or continue delivering.

The hand press is used to make the fuel deliver pipe full of fuel and to wipe off air before the engine starts. When the engine is not at working situation, the handle nut should be tightened.

8.2 Fuel filter

In order to meet different requirements, there are three types of fuel filter: CS0708B1, CS0712B1, C0810S, the former two are single stage type, CO810S is double stages type.

The purpose of the fuel filter is to filter the tiny impurity out of fuel to reduce the wear of the precise mates inside the high pressure and injector.

After the fuel being filtered with element, dirt is kept on the element outer surface. Being made of fuel filter paper, the element should be maintained and replaced regularly. For the fuel filter with water deposited cup, the water in the cup should be drained off regularly.

8.3 High pressure pump.

There is type PM of high – pressure pumps: The body of the type PM pump is an all – in – one – piece style.

The quantity of fuel delivered by the high pressure pump has been adjusted before letting released from factory . It's forbidden to open the high pressure pump inspection window cover to rotate the plunger so as to prevent the delivered fuel quantity and the fuel quantity in cylinder s from being changed . If necessary , the adjustment should be operated on a high pressure pump test bench .

8.4 Governor

There is a RSV mechanical full range type governor . Vehicle diesel engine is equipped with a RFD full range – double poles type governor .

8.5 Injector

The purpose of the injector is to spray the atomized fuel into the combustion chamber timely , and make the atomized fuel combined with air to make up a sophisticated burning procedure .

Series diesel engine adopts J series and P series injector , all these two models are spring low installed and low inertia types injector , The needle valve mate of the injector is a long and holey style , in general , 113 adopts needle valve mate with 5-0.28mm spray holes . The fuel should be atomized evenly after being sprayed , and the fuel stopping should be functioned at once , no fuel late drops of leakage . When the fuel atomized not well , the injector should be tested and adjusted on the injector test bench . The injector opening pressure is 22 (+1.00) Mpa . If the pressure is not suitable , the thickness of the injector pressure adjusted gasket should be adjusted . If the gasket is added more 0.1mm , the injecting pressure will be improved about 1 Mpa .

The needle valve mate is matched mate , never exchanged when dismantled . The J series needle valve mate can't be exchanged with the S series needle valve mate , but their assemblies can be exchanged .

When the injector is installed on the cylinder head , there is a copper washer on the front , this can assure the tightness .

9.0 Lubricating system

The engine is lubricated by pressure oil combined with splash oil . The oil is sucked into the oil pump through the strainer and the enters into the main oil passage after being cooled and filtered . The oil in the main oil passage of the cylinder block is delivered to the main bearings ,

connecting rod bearings , camshaft bushings , high pressure pump , air compressor , vacuum pump . The oil passing through the camshaft bushings , high pressure pump , air compressor , vacuum pump . The oil passing through the camshaft bushing flows through the oil passage in cylinder block and cylinder bead to lubricated the valve mechanism . Piston , piston pin , cylinder liner are all splash lubricated by the oil spilled from the bearings .

For the supercharged engine , there is a special oil passage in the cylinder block for cooling

piston , the oil injected into piston through oil passage and injection nozzle for cooling piston .

For lubricating turbocharger , portion of oil from oil main passage flows into turbocharger through another oil filter to lubricate and cool its bearing , then the oil flows back to the oil sump through over flow oil pipe .

9.1 Oil pump

Four and six cylinders engine all use gear type oil pump .

When the oil pump is being mounted , not too hard or deviated stress on it , the seal ring should be coated with lubricating oil so as not to be damaged .

9.2 Overload overflow valve

If the oil pressure is too low , you should regulate the regulating valve in the oil filter first , then you test and regulate this pressure regulating valve , its opening pressure is 0.8Mpa .

9.3 Oil filter

JX0818 type oil filter used to filter the engine lubricating oil , JX0506 type oil filter used to filter the turbocharger lubricating oil .

There are pressure limiting valve and bypass valve . When the oil filter or the viscosity of the oil is too high , the bypass valve will open , and the oil will enters into the main passage without being filtered through oil cooler or filter to ensure the engine running safely . The bypass valve shouldn't be dismantled and adjusted without authorization . The paper element should be maintained and replaced periodically .

9.4 Oil cooler

Series diesel engine adopts pipe and shell type oil cooler .

The oil cooler is usually installed at the side of the oil filter , oil from oil pump enters into oil cooler through the inlet hole of the shell . Through the hose , the cooling water enters into the cooling element from the special outlet hole at the left of the cylinder block . Because the water and oil has a different temperature and keep flowing , they exchange heat inside the cooler and the oil is cooled then . The cooling water from the cooler flows back into the cylinder head through the hose and the cooled oil flows into the main oil passage through the oil filter .

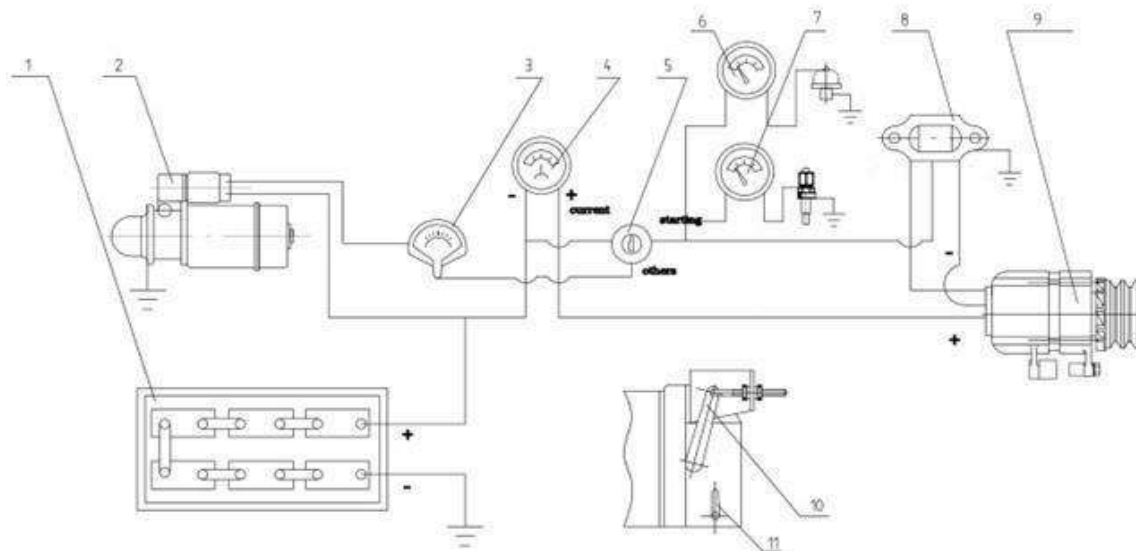
10 Cooling system

The engine adopts close type forced circulation water cooling system .

The cooling water in the radiator is forced by the water pump into the main water passage , which link up front and rear parts located at the left of the cylinder block . It flows into all cylinders evenly to cool the liners , most of the water flows through all holes into cylinder head , the others enter into the rear of the cylinder head through oil cooler . If the oil cooler is not installed , the all cooling water will flows into cylinder head through cylinder block . About 35% of all water in the cylinder head flows transversely through the hole at the bridge of the nose , and it cools the heavy thermal duty angle area . The other water flows vertically as : about 25% water flows to the exhaust manifold side , 30% water flows to the end of the cylinder head and the other 10% water may be short circuit . This layout of cooling water determined by the layout of water holes and their sizes ensures the whole cylinder be cooled evenly and effectively . The used cooling water all flows back into the upper water case of the radiator through the thermostat from the front end of the cylinder head . When the water flows through the radiator , it is cooled with the air breached in or the cylinder head . When the water flows through the radiator , it is cooled with the air breathed in or blow out by the fan , and the whole circulation is achieved . If the temperature of the water is too low , the thermostat will shut down , the water could not enter into the upper water case of the radiator and it flows back into the water pump through the small tube under the thermostat , the little circulation is achieved .

The temperature gauge of series diesel engine can be chosen by users and can be completed with temperature gauge connectors or temperature sensor connectors .

11. Electric system



- 1、 battery 2、 motor 3、 starting switch 4、 ammeter 5、 key switch 6、 pressure gauge
7、 temperature gauge 8、 voltage regulator 9、 alternator 10、 speed 11、 stop

11.1 Battery

The battery for start is a power device of the diesel engine , its performance influence the start of the diesel engine directly , suitable capacity battery should be chosen according to the starting motor's specific property . The battery should be installed near the starting motor so as to shorten the length of the cable between the battery and the starting motor to avoid the voltage drop too hard when the engine starting , the section area 36mm² low voltage connecting cable should be adopted .

When the starting current is highest , for 24V starting motor , the voltage drip should be less than 1V respectively .

The battery with the diesel engine hasn't been charged before delivery , it should be first charged as the battery's requirement before used . When the diesel engine is working , the amount of the charging current should often be noticed . When the needles of the ammeter is reaching to zero , it shows that the battery has been fully charged and the charging circuit can be switched off .

11.2 Silicon rectified dynamo

JF series silicon rectified dynamo is adopted in the diesel engine , there are many type of JF2314 , JF2512 so on .

11.3 Voltage regulator

The use of this voltage regulator is to keep the voltage at the range of 27 – 29V respectively when the speed of the 28V generator changed . The type of generators adopt FT211 voltage regulators respectively .

When the FT211 type regulators are used , the key switch should be turned off as soon as the engine stops in case the battery discharge to the magnetic coil and make the battery insufficient , this will influence , this will influence the next starting .

The regulator is a precise instrument and not be dismantled and regulated at will , if it is necessary to be adjusted , it should be done at special equipment .

11.4 Starting motor

The starting motor is full closed direct current series excitation motor , the engine of 24V system adopts QD278 type starting motor , the QD278 adopts 11 teeth .

The working current of the starting motor is very large , it can only works within a short time , ever starting time can't exceeds 10s . If it's necessary to continuously start , the time distance shouldn't less than 2 minutes in case the starting motor and the battery be damaged .

11.5 Key switch

The key switch has three working positions , at the center position , the whole circuit will be turned off , turning the key clockwise , the preheating – starting switch , voltage regulator and other electric equipment will be switched on and the diesel engine will starts . After the engine starts , the switch should be turned counterclockwise to the end to turn off the preheating – starting switch and in case of any trouble .

CHAPTER III OPERATION OF THE DIESEL ENGINE

1. Transportation, installation, storage and preservation

When the diesel engine is transported, the front and rear lifting bracket should be used to lift the engine and close attention should be paid to protect the appearance, accessories and oil pipes of the diesel engine from being damaged.

If the diesel engine will be transported for a long distance, the air filter and silencer should be dismantled, use plugs and plastics to seal the air intake and exhaust hole, water pump inlet and outlet hole, fuel inlet and outlet hole. If necessary, use plastic cover and wooden case to pack the diesel engine.

If the diesel engine is used for stationary application, the foundation must be firm, the mounting surface must be kept horizontal, the driving equipment should conform to the requirement of stipulation, the working place should be spacious, well ventilated, clean and rain – proof.

If the diesel engine is going to be laid up for a long time, it should be preserved and stored as the below methods;

1) Drain off fuel, oil and cooling water.

2) Remove the injector assembly away from the engine, fill to each cylinder with 200kg dehydrated clean oil (it means: keep the oil heated at 100 – 200°C until no bubble remains, rotate the crankshaft to let the lubricating oil coat evenly on the surfaces of the valves, cylinder liners and pistons, etc. ; then clean the appearance of the nozzle assembly, smear lubricating oil on it and then re – install it to the engine.

3) wrap up the air filter with plastic film, dismantle the silencer and stop up the exhaust hole with wooden plug.

4) wipe off the oil dirt, dust and rust from the outer surface of the engine, smear the unpainted parts surface with thin layer of anti – rusting grease (such as calcium type lubricating grease) , then cover it with paper.

5) Wrap the diesel engine in plastic film

6) the preserved engine should be stored in well ventilated, dry and clean room, it is strictly forbidden to be putted together with corrosive substances. The effective time of this method is 3 months, when the time exceeds the period, please repeat this procedure.

2. Fuel, lubricating oil and cooling water

2.1 Fuel

The diesel engine should adopt different brand of light diesel oil according to the atmospheric temperature (GB252 - 81)

Atmospheric temperature(°C) :	>0	0 ~ -10	-10 ~ -20	-20 ~ 35
Brand of diesel oil:		0	-10	-20 -35

The fuel oil must be kept very clean, before filling it into the fuel tank, you should clear the fuel oil for over 3 days so as to make the dust and water inside the oil precipitated to the bottom, then pick up the top clean fuel oil. the fuel oil must be strictly filtered when filled to the fuel tank.

2.2 oil

The diesel engine should adopt different brand L - ECC diesel lubricating oil according to different area and atmospheric temperature.

AREA	Winter In Cold Area	All Year In Common Area	Summer In The South
TEMPERATURE(°C)	-5 ~ -15	0 ~ 30	> 30
OIL BRAND	20/20W	30	40

The turbocharged diesel engine should adopt L - ECD type diesel lubricating oil (GB11122 - 89)

AREA	Winter In Cold Area	All Year In Common Area	Summer In The South
TEMPERATURE(°C)	-5 ~ -15	0 ~ 30	> 30
OIL BRAND	20/20W	30	40

The lubricating oil must be filtered before it is filled into diesel engine, other brand lubricating oil is forbidden to be used for engine so as to protect the parts such as bearing and piston ring from being damaged.

2.3 Cooling Water

The diesel engine should adopt clear soft water such as tap water, rain water and river water, etc. If hard water is adopted such as well water and spring water which contains much more minerals, the hard water should be softened, otherwise there will be scale on the water passage of the engine and block the water, weaken the cooling effect and result in the engine too hot.

One of below methods can be used to soften water:

(1) boiled, precipitated and filtered before used.

(2) Fill 20g Na_3PO_3 on each 10kg water, precipitated and piston ring form being damaged.

When the temperature is below 0°C , antifreeze mixture can be used for cooling medium. The antifreeze mixture can be mixed with water and alcohol according to the below ratio.

Volume ratio of antifreeze mixture(%)		Ice point of antifreeze mixture $^\circ\text{C}$	
water	alcohol	denatured alcohol	water alcohol
90	10	-3	-5
80	20	-7	-12
71	30	-12	-19
60	40	-19	-29
50	50	-28	-50

When compound and fill the antifreeze mixture, pay attention to:

(1) The antifreeze mixture is poisonous, never drink it.

(2) When the engine is working, the temperature of the antifreeze mixture doesn't exceed 90°C so as to avoid the alcohol volatilize.

(3) test the volume of the antifreeze mixture each 25 - 30hrs, compensate it if not enough.

(4) the volume of antifreeze mixture should be 6% less than the water, because the antifreeze mixture preventive liquid will expand at high temperature.

3. Preparation for starting

- 3.1 The diesel engine should be thoroughly checked before starting. Closed attention should be paid to see whether foundation bolts and the connection with the driven equipment is rigid and reliable, and whether the transmission parts and control systems are sensitive and so on. The engine won't be started unless everything is all right.
- 3.2 Check and replenish the oil sump to keep the oil surface between the top and bottom carved line, fill up cooling water and fuel oil, open the switch of the fuel tank, check the fuel system for leakage and eliminate it if there is any.
- 3.3 It is recommend to vent the air out of fuel system step by step as follows:
At first loosen the venting screw on the filter, pump the fuel with priming hand pump, vent out the air from the fuel passage between the fuel tank and the filter, then loosen the venting screw on the injection pump until the fuel flows out without bubbles.
- 3.4 Check the battery be sufficien or not, connect the battery to the circuit and see whether it is electrified.

4. starting

The diesel engine shouldn't be started until the preparation is completed and meets the requirement. When starting, the clutch should be apart, operate as following steps:

- 4.1 Set the control handle of the fuel valve to the position where the fuel will be delivered rather more.
- 4.2 Turn the circuit switch clockwise and close the circuit.
- 4.3 Turn the starting switch to the "starting position", after the crankshaft is speeded up by the starting motor, the engine is started then.
- 4.4 For the protection of the starting motor and battery, the starting time shouldn't exceed 10s. If need to start continucously, the interval time should be more than 2min. If can't start for continuous 3 times, then don't start until the trouble is found out and elinated.
- 4.5 As soon as the engine starts, turn the starting switch back to the previous position. Set the control handle of the fuel valve to the idel speed position, turn the circuit key switch counterclockwise to the charging position.
- 4.6 Check the oil pressure after the engine starts, the oil pressure in ilde speed never be lower than 0.1mpa. After the engine starts for 5min, stop it and wait for 15 min, check the surface of the oil when the oil flows back to the oil sump, if necessary, add oil to the required level.

5 running

- 5.1 After being started, the engine shouldn't operate at full load immediately. It should be warmed up at low speed without load, only after the temperature of the cooling water reaches to 60°C, it can be speeded up to the highest speed and operates at full load.
- 5.2 When operating, the engine's speed and load should be increased and decreased gradually. In general, shouldn't increase or decrease rapidly.
- 5.3 When the engine is working, should often pay attention to oil pressure, oil temperature, cooling water temperature, charging current, should also observe the color of the exhaust smoke, listen attentively to the voice inside. If any trouble such as overheating, black smoking, knock and others, should stop the engine to check and remedy immediately. It is forbidden to let the engine operate with trouble so as to prevent the engine parts from being damaged.
- 5.4 When the engine working, often pay attention to the oil passage, water passage and union joint, if any leakage, should remedy it at once so as to avoid waste and pollution to the environment.
- 5.5 For new or just overhauled engine, it is permitted to run at full load only after it has worked for over 60h.
- 5.6 It is forbidden to let the engine running at idle speed for a long time.
- 5.7 The injection pump has been adjusted rightly before leaving factory, it is forbidden for users to change it at will. If necessary, it should be adjusted at the injection pump equipment.

6. Stopping

- 6.1 Before stopping the engine, unload first, decrease the engine to the idling speed gradually, when the water temperature falls down below 70°C, turn the stopping lever to stop. After the engine stops, take out the switch key and close the fuel tank valve.
- 6.2 It is forbidden to stop the engine suddenly at high water temperature.
- 6.3 It is not permitted to stop the engine by shutting off the valve of the fuel tank so as to prevent the air from entering into the oil passage.
- 6.4 When it is below 5°C, if the antifreeze mixture is not used, should drain off the cooling water so as to avoid the cylinder block and water pump being frost crack.
- 6.5 The found trouble should be remedied after every stopping, and should often check the engine.

7. Safe and technical operating instruction

- 7.1 It's forbidden to let the person who don't know the operating technique to operate the engine.

- 7.2 The engine can be started only after all the starting preparation has been completed.
- 7.3 Pay close attention to prevent fire, it's forbidden to let the naked flame near the working engine. If the engine is working beside inflammable substance, a fire extinguisher system should be installed on the exhaust manifold.
- 7.4 When the engine is working, never to dismantle or adjust, the operator don't leave the working site.
- 7.5 It's forbidden to let the engine working under no oil pressure, low oil pressure or which abnormal noise inside. If you meet with these cases, the engine should be stopped urgently.
- 7.6 If the engine happens to be overspeed, you should turn the stopping handle to stop it to have a test. If the stopping handle malfunctions, you can stop the engine with the method of plugging up the air inlet hole.

CHAPTER IV Technique maintenance of the diesel engine

Periodic technique maintenance is an important content of using engine normally, in order to remain the engine in good technique state and to prolong it's service life, the technique maintenance system must be seriously performed as standard.

The maintenance of the engine is classified as follows:

- 1) Working day maintenance (per 8 – 10h)
- 2) First grade technique maintenance (accumulative working hours: 50h; or for the cargo vehicle, traveling distance over 2500km)
- 3) Second grade technique maintenance (accumulative working hours: 1000h; or for the cargo vehicle, traveling distance over 50000km)
- 4) Technique maintenance on winter use.

1. Workin day maintenance

- 1.1 Check the oil surface in the oil sump, oil bath type air filter and the power output gear box, if the oil surface is higher, find out the trouble and eliminate it; if the oil is insufficient, the refill it to the required amount.
- 1.2 Check the cooling water surface in the water tank, if insufficient, fill it up. If the air temperature will be under $+5^{\circ}\text{C}$, then drain off the cooling water after stopping.
- 1.3 Check and fasten the shown bolt and nut, eliminate the leak of oil, water and air.
- 1.4 During working at the dusty place, use the compressed air to clean the air filter element.
- 1.5 Clean the mud, dust and oil dirt on the appearance of the engine.

1.6 When the engine is working, listen to the voice, observe the smoke color and eliminate the trouble and abnormal appearance.

2. First grade technique maintenance

2.1 Perform the items on the "working day maintenance"

2.2 Clean the oil filter element with clear fuel. Clean the centrifugal oil filter once on two - maintenance period.

2.3 Clean the dust on the air filter element and inside the dust deposit set. Replace the oil inside the oilbath type air filter.

2.4 Check and adjust the tension of the fan belt.

2.5 Fill the lubricating grease into the weater pump bearing.

2.6 Check all parts of the engine, to do the necessary adjustment if need.

2.7 when the maintenance is finished, start the engine and test it's working appearance, eliminate the trouble and abnormal appearance.

3. Second grade technique maintenance

3.1 Perform the items on the "first grade technique maintenance"

3.2 Replace the oil, clean the oil sump and the oil strainer.

3.3 Clean the oil filter, replace the element.

3.4 Replace the oil in the air compressor.

3.5 Clean the fuel tank, oil delivery pump screen and pipe.
clean the fuel filter element with clear fuel.

3.6 If the engine is supercharged type, then clean the cave and propeller impeller of the turbocharger air pump, and also test the moving and fasten parts.

3.7 Blow off the dust inside the dynamo with wompressed air. Check all parts, eliminate and abnormal parts.

3.8 Check and adjust the valve gap.

3.9 Check the injecting open pressure and it's spray quality of the injector, if need, to adjust it.

3.10 Fill the lubricating grease to the filling boles of the clutch, test the gap between the releasing lever and the releasing bearing.

3.11 Check and adjust the contack working gap and iron core gap every two maintenance period

4. Third grade technique maintenance

- 4.1 Perform the full items on the “second grade technique maintenance”.
- 4.2 Clean the cooling system, wipe off the scale.
- 4.3 Clean the oil cooler.
- 4.4 Replace the air filter element and fuel filter element.
- 4.5 Dismantle and check the cylinder head. Test the valve seal, wipe off the carbon deposit, burnish the valve according the conditions.
- 4.6 Check the fasten situation of the cylinder head bolt, main bearing bolt, connecting rod bolt. For the bolts which tightening torque is insufficient, then tighten it to the set point value.
- 4.7 Check the water pump, replace the lubricating grease, if necessary, replace the water seal.
- 4.8 Check the dynamo, starting motor, clean, repair and fill new lubrication grease.
- 4.9 Check the injection pump, adjust the fuel lead angle, and adjust the injection pump according the conditions.
- 4.10 Test the air compressor, burnish the valve according the situation, and clean the carbon deposit.
- 4.11 Check the clutch, clean the inside dust deposit, oil dirt, and replace the lubricating grease.
- 4.12 Check the turbocharger, clean the parts, wipe off the carbon deposit, and test the rotor freedom allowance.

5. Technique maintenance on winter using

If the temperature maybe lower than 5°C, the engine must be maintained specially.

- 5.1 Must use the winter used oil and fuel, note the damp in the fuel so as to protect the fuel passage from being jammed.
- 5.2 It's better to fill the antifreeze fluid to the cooling system, or must drain off the cooling water after its temperature is lower than 40 – 50°C.
- 5.3 On the cold dseason or area, it's better to prevent the diesel engine(or vehicle from being deposit in the open air, or when starting, it's need to heat the cooling water to preheat the engine body.

CHAPTER V Troubleshooting

1. Start failures

Touble cause and its feature	Remedy
1.1 Troubles in fuel system	1.1
(1) Jammed in the fuel s	(1) Dismantle and clean

(2) Air trapped in the fuel system	(2) Vent the air from the system with the fuel delivery pump, check whether there is leakage of fuel and air in the fuel pipes
(3) Delivery pump fails in delivering fuel or delivers brokenly	(3) Check and repair
(4) Injector sprays abnormally	(4) Check and adjust or replace the needle valve mate
1.2 insufficient compress pressure	1.2
(1) Piston ring and cylinder liner wear	(1) Check and replace worn parts
(2) Piston ring gumming	(2) clear off gumming
(3) Valve leaks	(3) Valve spring broken or elasticity weakens, valve lash is incorrect, valve seal is not good, eliminate the fault
(4) Temperature is low after end of compression	(4) Environmental temperature is low, use preheat starting method
1.3 Trouble in electric devices	1.3
(1) Battery is insufficient	(1) Recharging the battery to the specified point
(2) Connecting of electric devices is not good	(2) Check the tighten of the connection
(3) Starting motor on rotate or rotates insufficiently	(3) Check the starting motor
(4) Clutch of starting motor skids	(4) Check and repair the clutch of the starting motor
(5) Gear of starting motor can't inlay the flywheel gear - rim	(5) Find out the fault and eliminate it
2. Unsteady running of the engine	Remedy
Trouble cause and its feature	1. Handle according to the (1), (2) (3), (4) in the 1.1
(1) Fault in fuel system	2. check the dampness in the fuel
(2) Too much water in fuel	3. Check and eliminate the fault
(3) Leakage in fuel passage	

- | | |
|---|---|
| <ul style="list-style-type: none"> (4) Governor works abnormally (5) Cylinder blows by (6) Uneven fuel delivery to each cylinder (7) Uneven fuel delivery to each cylinder in injection pump (8) Injector sprays not well or the mate be choked (9) The plunger of the injection pump worn out or the spring broken | <ul style="list-style-type: none"> 4. Check and adjust the governor 5. Check the tightening torque of the cylinder head bolt and the seal of the cylinder head gasket 6. (1) Check and adjust <li style="padding-left: 20px;">(2) check the spray quality of the injector, replace the mate if necessary <li style="padding-left: 20px;">(3) Check and replace |
|---|---|

3. Output is insufficient or drops suddenly

Trouble cause and its feature	Remedy
(1) Air filter choked	1. Clean or replace filter element
(2) Valve spring or push rod broken	2. Check and replace
(3) Valve lash is incorrect	3. Check and adjust
(4) Compress pressure is insufficient	4. Handle according to 1.2
(5) Fuel delivery advance angle is incorrect	5. Check and adjust
(6) Air trapped in the fuel system or the system is choked	6. Handle according to (1), (2), (3) in 1.1
(7) Fuel delivery is insufficient	7. Check the plunger of the injection pump and fuel outlet valve
(8) Injector spray not well	8. Check, clean and adjust the pressure
(9) Governor works abnormally	9. Test and repair the governor
(10) Engine overheated	10. Test and repair the cooling system, wipe off the scale
(11) Too much carbon deposited inside the engine	11. Clean off the carbon deposit
(12) Exhaust manifold not expedite	12. Find out the fault and eliminate it.

4. Abnormal noise during engine operation

Trouble cause and its feature	Remedy
(1) Injecting time is too early to	1. Adjust the fuel delivery advance

- | | |
|---|---|
| cause the rhythmic and clear metallic pounding noise be heard inside the cylinder. | angle |
| (2) Injecting time is too late to cause the grave and unclear noise is heard inside the cylinder. | 2. adjust the fuel delivery advance angle |
| (3) Pounding noise can be heard inside the cylinder after the engine starts because of too large gap between the piston and cylinder liner, this noise gets lower along with the warming of the engine. | 3. Check the cylinder clearance, replace the piston or cylinder liner |
| (4) Too large clearance between the piston pin and pinhole, clear and sharp sound, especially when idling. | 4. Replace the parts, assure the stipulated gap |
| (5) Too large clearance between the main bearing and the con – rod bearing, parts pounding sound is heard when the engine speed drops suddenly, grave and strong sound when at low speed. | 5. Replace the parts, assure the stipulated gap |
| (6) The axial gap of the crankshaft is too large, pounding noise when idling. | 6. Replace the thrust plate, assure stipulated gap |
| (7) Valve spring broken, push rod bent, valve clearance too large and so on, disorderly sound or light and rhythmic pounding sound be heard inside the cylinder head cover. | 7. Replace the parts, adjust valve gap |
| (8) Piston touches valve, metallic pounding sound can be heard beside the cylinder head | 8. Check valve clearance and transmitting gear mark |
| (9) Too large gear clearance, pounding sound is heard at the gear case when the speed | 9. Test the gear back lash, replace gear according to the situation |

drops suddenly.

5. Abnormal exhaust smoke

When the engine works normally, the smoke color is light grey, when the load is higher at low time, its color is only dark grey, when the exhaust smoke is blue, white or black, then the smoke color is abnormal. Blue means burning oil; white means fuel fog no burns thoroughly inside the cylinder or water trapped inside the cylinder; black means injecting fuel too much to burn thoroughly. Trouble cause and its feature

5.1

Blue smoke

- (1) Lubricating oil flees, piston ring installed inversely, choked or worn out to badly
- (2) Clearance between valve and pipe hole too large

Remedy

- (1) Check piston ring and eliminate the fault
- (2) Replace the parts and assure the stipulated lash

5.2

White smoke

- (1) Fuel spray be atomized not well, fuel drips
- (2) too much water trapped in the fuel
- (3) Water trapped in the cylinder

Remedy

- (1) Check the injection pressure and the seal of the mate, adjust and clean or replace
- (2) Test the fuel quality
- (3) Inspect the seal of the cylinder gasket, check the water leakage of the cylinder head and cylinder liner, repair or replace

5.3

Black smoke

- (1) Engine is over-loaded

Remedy

- (1) Adjust to the stipulated load

- | | |
|---|--|
| (2) Fuel sprays too much | (2) Adjust the fuel delivery amount of the fuel injection pump |
| (3) Injecting time is too late, late burning is heavy | (3) Adjust the fuel delivery advance angle |
| (4) Valve lash is incorrect or valve seal is not good | (4) Adjust the valve lash and seal, eliminate the fault |
| (5) Air filter choked | (5) Clean the filter element |

6. Insufficient oil pressure

Trouble cause and its feature	Remedy
1. Oil pressure gauge is in trouble or the connecting pipe choked	1. Replace the pressure gauge or dredge the passage
2. Too little oil in the sump	2. Fill oil to the stipulated level
3. Too thin oil	3. Inspect oil grade, check whether the oil be thinned out with fuel or oil temperature too high, eliminate it
4. Oil pump driving and driven gear worn out	4. Replace driving and driven gear
5. Strainer screen and oil filter element blocked	5. Clean or replace
6. Pressure limiting valve and pressure regulating valve spring broken	6. Inspect and replace
7. Oil passage choked or oil leaks	7. Check and eliminate
8. Lash between the bearings too large	8. Test the matching lash

7. Oil temperature too high

Trouble cause and its feature	Remedy
1. Engine is over-loaded	1. Adjust the load
2. oil is insufficient or overmuch	2. Add or reduce the oil according the stipulation
3. Piston ring leaks heavily	3. Replace piston ring or cylinder liner
4. Oil cooler choked inside, dirt	4. Check and clean

deposited outside, influence the heat radiating efficiency

8. The temperature of used cooling water too high

Trouble cause and its feature	Remedy
1. Water temperature gauge or inductor be in trouble	1. Inspect and replace
2. Cooling water is not enough	2. Fill cooling water and get rid of the air from the water passage
3. Flow of cooling water is too small	3.
(1) Flow of water pump is too small	(1) Check the lash of the water impellers , adjust the tension of the fan belt
(2) Too much scale deposit inside the engine	(2) Wipe off the scale deposit
4. The efficiency of radiator is not well	4. Clean off the dirt and scale deposit
5. Engine is over – loaded	5. Adjust to the stipulated load

9. Trouble in the injection pump

Trouble cause and its feature	Remedy
1. No fuel delivery	1.
(1) Fuel deliver pump is out of order	(1) Process according 10.
(2) Fuel filter or fuel passage is choked	(2) Clean or replace
(3) Air trapped in fuel passage	(3) Wipe off air
(4) Fuel outlet Valve Spring broken	(4) Replace spring
2. Fuel delivery uneven	2.
(1) Air trapped in fuel passage	(1) Wipe off air
(2) Fuel outlet valve spring broken	(2) Replace spring
(3) Seal face and outer face worn out	(3) Repair or replace
(4) Plunger mate worn out or spring broken	(4) Replace parts
(5) Plunger choked with impurity	(5) Clean

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|--------------------------------------|---|
| (6) Pressure of inlet fuel is uneven | (6) Inspect fuel delivery pump and filter |
| 3. Insufficient fuel delivery | 3. (1) Replace parts |
| (1) Fuel cock leaks | (2) Tighten the connector |
| (2) Connector of fuel pipe leaks | (3) Replace parts |
| (3) Plunger worn out | |

10. Insufficient fuel supply of the fuel delivery pump

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|---|---|
| 1. Non – return spring broken or seal of the valve seat is not good | 1. Replace spring or repair no – return valve |
| 2. Piston worn out | 2. Replace piston |
| 3. Fuel inlet pipe leaks or choked | 3. Check the seal of the pipes, tighten the screw, dredge the pipes |

11. Injector malfunction

- | Trouble cause and its feature | Remedy |
|---|--|
| 1. Spray less or no spray | 1. |
| (1) Air trapped in the fuel passage | (1) Blow off air |
| (2) Needle is blocked | (2) Repairing or replace |
| (3) Loose combination of the needle valve | (3) Replace |
| (4) Heavy leakage in fuel system | (4) Tighten connector or replace parts |
| (5) Abnormal fuel supply of the injection pump | (5) Inspect fuel supply of the injection |
| 2. Injecting pressure is low
Pressure adjustment washer worn out | 2. Add suitable thick washer |
| 3. Too high injecting pressure | 3. |
| (1) Needle valve blocked | Clean or replace |
| (2) Injecting hole choked | (2) Clean |
| (3) Pressure adjusting washer is too thick | (3) Adjust the pressure adjusted washer |
| 4. Too much of fuel leakage | 4. |
| (1) Needle valve blocked | (1) Repair or replace |
| (2) Needle valve blocked | (2) Clean or replace |
| (3) Pressing cap is loose or distorted | (3) Tighten, replace parts |

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|--|----------------------------|
| (4) Fuel inlet and outlet connector screw is loose | (4) Tighten, replace parts |
| 5. Fuel atomized not well | 5. |
| (1) Needle valve is distorted or worn out | (1) Replace |
| (2) Bad seal of the needle valve | (2) Repair or replace |
| (4) Needle valve blocked | (4) Clean or replace |

12. Governor malfunction

Trouble cause and its feature	Remedy
1. Unsteady speed	1.
(1) Too large of camshaft axile lash	(1) Readjust
(2) Cylinders fuel supply uneven to much	(2) Readjust
(3) Fly - weight assembly installed improperly , too large stagger of fly hammer bracket shaft	(3) Recheck and assemble
(4) Fuel cock worn out or bad seal	(4) Repair or replace
2. Too high idling speed	2.
(1) Operating handle lever no rea - ches its positon	(1) Inspect and adjust
(2) Tooth rod is not flexible	(2) Readjust or repair
3. Speed floating	3.
(1) Speed adjusted spring distorted	(1) Replace the speed adjusted sping
(2) Fly hammer assembly loosen	Check and tighten
(3) Too large friction resistance inside the governor	(3) Repair and eliminate
(4) Too Large axile lash of the injection pump camshaft	(4) Readjust
4. Overrunning of the engine	4.
(1) Toothe rod is not flexible	(1) Readjust and repair
(2) Lubricated not well ,shaft sleeve of the governor burned out.	(2) Check and repair
(3) Fly hammer assembly loosened	(3) check and tighten
(4) high speed limit screw loosened	(4) Readjust

13. Engine stops suddenly

Trouble cause and its feat	Remedy
1. Crankshaft can't be rotated after the engine shtops	1.
(1) Crankshaft jammed with bushing	(1) Inspect, replace parts
(2) Piston jammed with cylinder liner	(2) Inspect, replace parts
2. Crankshaft can be rotated easily	2.
(1) Air trapped in fuel system	(1) Blow out air
(2) Fuel system choked	(2) Clean
(3) Air filter choked	(3) Maintenance the air filter

14. Charged dynamo out of order

Trouble cause and its feature	Remedy
1. Can't be charged at all	1.
(1) Open circuit or short circuit,, circuit cnnecting wrong	(1) Check the circuit connecting
(2) Dynamo claw loosened, rotor circuit opened, brus contacted badly	(2) Repair or check
(3) Dynamo silicon parts out of order	(3) Replace
2. Insufficient charging or charging unsteadily	2.
(1) Brush contacts badly, insufficient spring pressure, oil dirt on slip ring	(1) Check and repair
(2) Transmitting V - belt loosened	(2) Adjust the tension of V - belt
(3) Some silicon parts open circuited	(3) Replace
3. Abnormal sound when working	3.
(1) Dynamo bearing worn out	(1) Replace
(2) Installed improperly	(2) Adjust
(3) Shout circuit inside the stator coil or parts shout circuited	(3) Repair

15. Starting motor malfunction

Trouble cause and its feature	Remedy
1. Starting motor no works	1.
(1) Connecting electric wire contacts badly	(1) Clean and tighten the contacting point
(2) Insufficient charging of the battery	(2) Recharging
(3) Brush contacts badly	(3) Clean the contacting surface of the commutator
(4) Open circuited inside the starting motor itself	(4) Repair
2. Starting motor rotates weakly	2.
(1) Bearing bush worn out	(1) Replace bearing bush
(2) Brush contacted badly	(2) Clean the contacting surface of the commutator
(3) Connecting electric wire contacted badly	(3) Clean and tighten the contacting point
(4) Switch contacted badly	(4) Inspect switch
(5) Insufficient charging of the battery or its capacity is too small	(5) Recharging or replace large capacity battery
(6) Clutch clips	(6) Repair clutch
3. Gear returns hardly	3.
(1) Switch contacting slice burning out and cemented	(1) Repair switch

16. Governor in trouble

Trouble cause and its feature	Remedy
1. No generating electricity at all	1.
(1) Too low of regulating voltage	(1) Inspect and adjust
(2) Connecting wrong	(2) Inspect the connecting
(3) Relay coil worn out, contacting point contacted badly	(3) Repair
2. Charging insufficiently or unsteadily	2.

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|---|------------------------|
| (1) Too low of adjusting voltage | (1) Inspect and adjust |
| (2) Too dirty of contacting point | (2) Clean |
| 5. Overcharge | 3. |
| (1) Adjusting voltage too high or un-adjusted, uncontrolled | (1) Inspect and adjust |

17. Turbocharger in trouble

Trouble cause and its feature	Remedy
1. Engine output drops	1.
(1) Passage of air filter or air pump dirty	(1) Clean
(2) Leakage at the connector of the air pump body	(2) tighten
(3) Leakage at the air inlet connector	(3) Tighten
(4) Air inlet passage of the turbine be choked or dirty	(4) Clean
(5) Floating bearing worn out	(5) Replace
2. Black or blue smoke	2.
(1) Passage of air filter or air pump dirty	(1) Clean
(1) Passage of air filter or air pump dirty	(1) Clean
(2) Altitude or temperature too high	(2) Adjust output
(3) Fuel return pipe of the turbo-charger choked	(3) Wipe out
3. Abnormal noise inside the turbo-charger	3.
(1) Pounding sound	(1) Check and repair
(2) Foreign matter enters into impeller or impeller be worn out	(2) Dismantle, inspect and repair
(3) Seal ring burned out	(3) Replace
4. Rotor rotates not flexibly	4.
(1) Leakage of turbocharger causes carbon deposited	(1) Clean
(2) Floating bearing worn out	(2) Replace
(2) Floating bearing worn out	(2) Replace