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蓝擎WP12国III系列柴油机 使用保养说明书

Operation & Maintenance Manual for
Landking WP12 Euro III Series Diesel Engines



质量安全
XK06-205-00261
XK06-205-00262

潍柴动力股份有限公司
WEICHAI POWER CO., LTD.

蓝擎WP12国III系列柴油机

Landking WP12 Euro III Series Diesel Engines

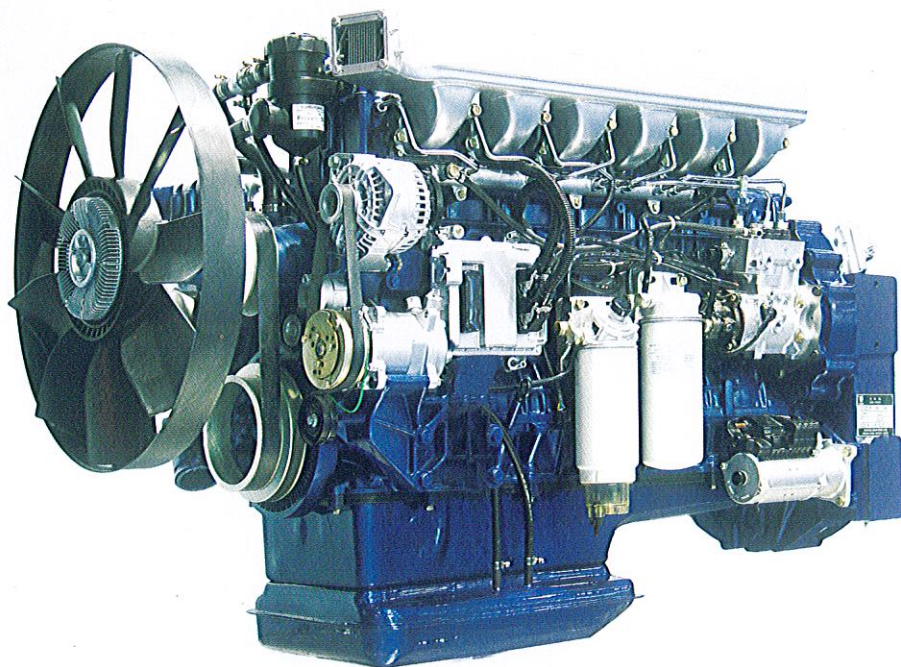


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Special Attention

- The engine operator must read the manual before attempting to operate the diesel engine, adhere to follow the operation and maintenance routine rules in this manual.
- The diesel engine has been tested strictly in accordance with the test specification before leaving the factory. It is forbidden to adjust the data of ECU to increase the power, otherwise all the warranties will be invalidated.
- Customers should not dismantle the precision components like ECU, common rail fuel pump and injector, otherwise all the warranties will be invalidated.
- It is strictly forbidden to dismantle and impact rotor shaft of turbocharger as precision high – speed rotating part, otherwise all the warranties will be invalidated.
- There are strict demands on torque and turned angle for main bearing bolts and connecting rod bolt, loosening and dismantling is forbidden. The connecting rod bolt can be used only one time, otherwise all the warranties will be invalidated.
- Designation of engine oil and fuel filled in the diesel engine must comply with the regulations in the manual. They should be filtered by specified filter cleaner. Fuel should be settled for more than 72 hours. You must confirm if the filled capital of the coolant and engine oil comply with requirements before driving.
- It is forbidden that the diesel engine works without air filter to prevent unfiltered air from entering into the cylinder.
- Before using a new diesel engine, 50 hours test run should be carried out.
- After the engine is cold started, the speed should be increased gradually. It is forbidden to run the engine in high speed suddenly and in idling for a long



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Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

time. After running in high load, you should not stop the engine immediately (except special situation), and you should run in low load about 5 ~ 10 min, then stop it.

- After the engine is stopped, if the ambient temperature is lower than 0℃ and the coolant without antifreeze is used, the coolant in water tank and in the diesel engine should be drained off.
- The examining and repairing of all parts in electrical system should be carried out by specialized operator.
- The examining and repairing of all parts in electrical control system should be carried out by specialized operator from our maintenance station.
- To prevent rust, oil seal is made before leaving factory. Generally, the oil seal period is one year. One year later, the engine should be checked and adopted necessary complement measures.



Preface

WEICHAi POWER CO. , LTD adopts complete new design idea to develop Landking WP12 series diesel engine, meeting Euro III emission regulation. It is the high – speed diesel engine with the potential meeting Euro IV. This diesel engine has good technical indexes of compact structure, good reliability and power, economy, etc. and advantages of rapid starting, simple operation and easy maintenance, etc. It is the ideal power of heavy – duty vehicles.

This manual introduces the main technical data, performance indexes, construction features, and operation and maintenance notices of Landking WP12 series diesel engine. If users operate the engine according to the stipulations of this manual, the service life of the diesel engine should be extended greatly.

The Landking WP12 series diesel engine in this manual is basic model. With continuous development of the products, the structure will be improved. The content of this manual is not very new; please users (or distributors) go to our net (<http://www.weichai.com>) for latest production information.

Welcome users' further suggestions for modification of products.

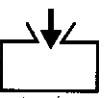
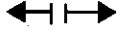
June,2007



Table of Contents

Chapter I Technical General of Products	1
1.1 Power and speed of diesel engine	1
1.2 Main structure features	1
1.3 What is the type of WP12 series diesel engines	1
1.4 WP12 series diesel engine outline drawing	3
1.5 External characteristic curve of WP12 series diesel engines	7
Chapter II Technology and Performance Parameters of Diesel Engines	10
2.1 Main technical parameters of WP12 series diesel engines	10
2.2 Main performance parameters of WP12 series diesel engines	10
2.3 Main performance parameters of WP12N series diesel engines	12
Chapter III Fuel, Lubricant, Coolant and Auxiliary Material	14
3.1 Fuel	14
3.2 Lubricant	14
3.3 Lubricating tensioner	15
3.4 Antifreeze additive of cooling system of engine	15
3.5 Auxiliary material	16
Chapter IV Operation of Diesel Engines	18
4.1 Unpacking	18
4.2 Lifting diesel engine	18
4.3 Installation	19
4.4 Prepare work before start	19
4.5 Start diesel engine	20
4.6 Run diesel engine	20
Chapter V Routine Maintenance	23
5.1 Routine maintenance	23
5.2 Maintenance of all levels	25
5.3 Maintenance of diesel engine when it is used for long time	33
5.4 Periodic maintenance and make record	33
Chapter VI Analysis and Remedy of Common Failures	36
6.1 Diagnosis method	36
6.2 Common failure and solution	37

Description of the illustration marks

	Dismounting(assembly parts)		Oil coating
	Fitting(assembly parts)		S K....., KUKKO,, TS.....W Special tools, such as K - - - - - - , KUKKO, - - - - - , TS - - - - - - - W
	Marking (do before disassemble, adjust when assemble)		Pay attention to assembly direction
	Filling – full charge(such as lubricating oil, cooling water etc.)		Deflating
	Draining off(lubricating oil or cooling water)		Unloosing (such as unloose clamping equipment)
	(loose – proof – fixed) Coat fluid sealant		Clamping (such as ; reinforcing clamp equipment)
	Accident preventing (marks for dangerous occasion)		Inspecting – adjusting(such as ; tightening torque, dimension pressure and clearance)
	Replacement when re – assembly		Inspecting



CHAPTER I TECHNICAL GENERAL OF PRODUCTS

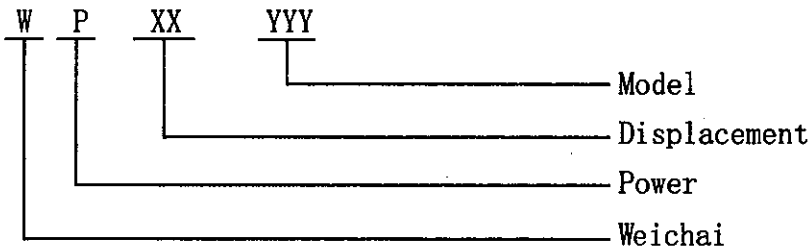
1.1 Power and speed of diesel engine

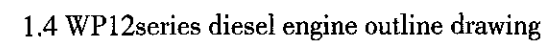
The power of WP12 series diesel engine is between 199kW and 353kW. The rated speed is 1900r/min and 2100r/min.

1.2 Main structure features

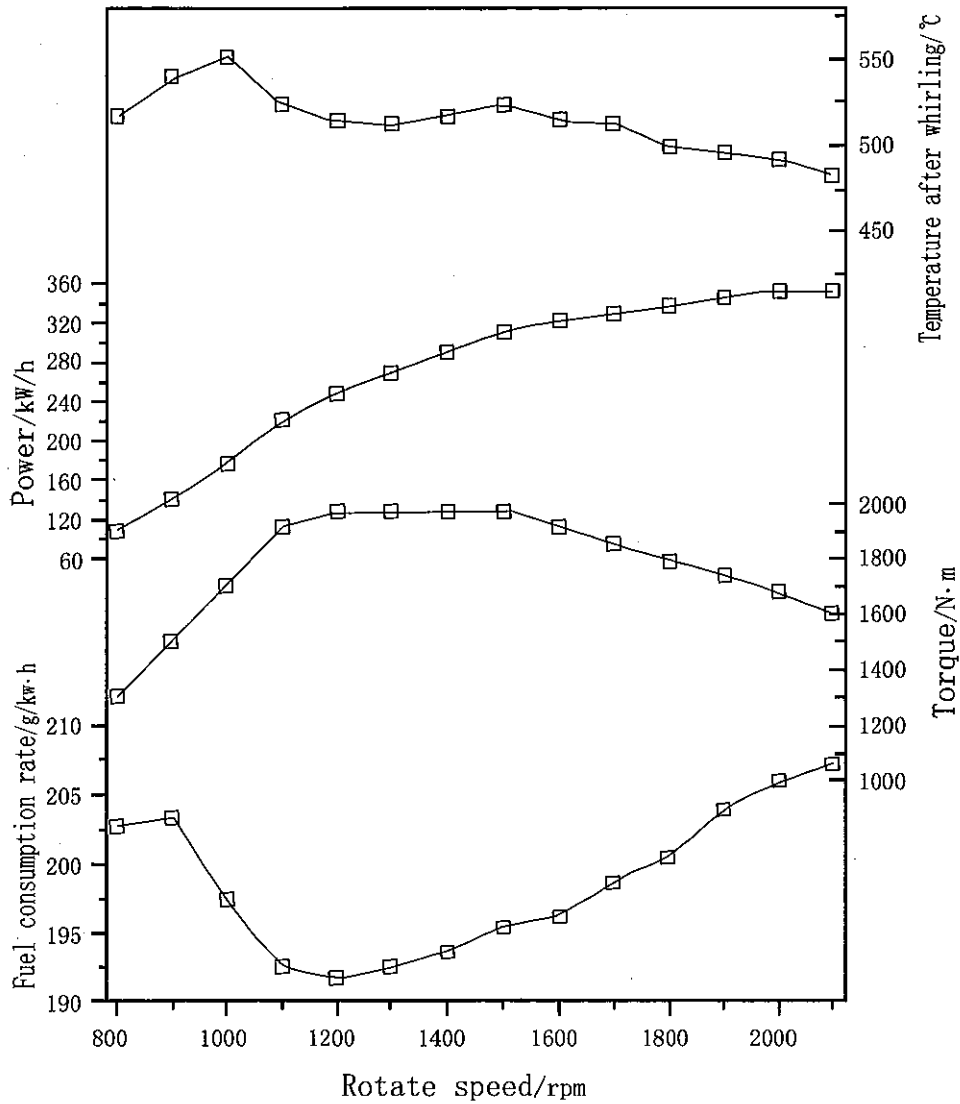
- 1 One cover for one cylinder, which makes engine reliable and easy to disassemble
- 2 Common rail system on the right side (see from free end) is easy to layout machine.
- 3 Main bearing frame structure makes the body very rigid , which is good for reliability and service life.
- 4 The turbocharger is mounted in the middle of the engine. There is not much difference in the dimensions within same series.
- 5 Gear train is mounted at the rear, with compact structure and low noise.
- 6 All series adopt 6 cylinders and inline structure with good compatibility and easy to match up.

1.3 Signification of WP12 series diesel engine model





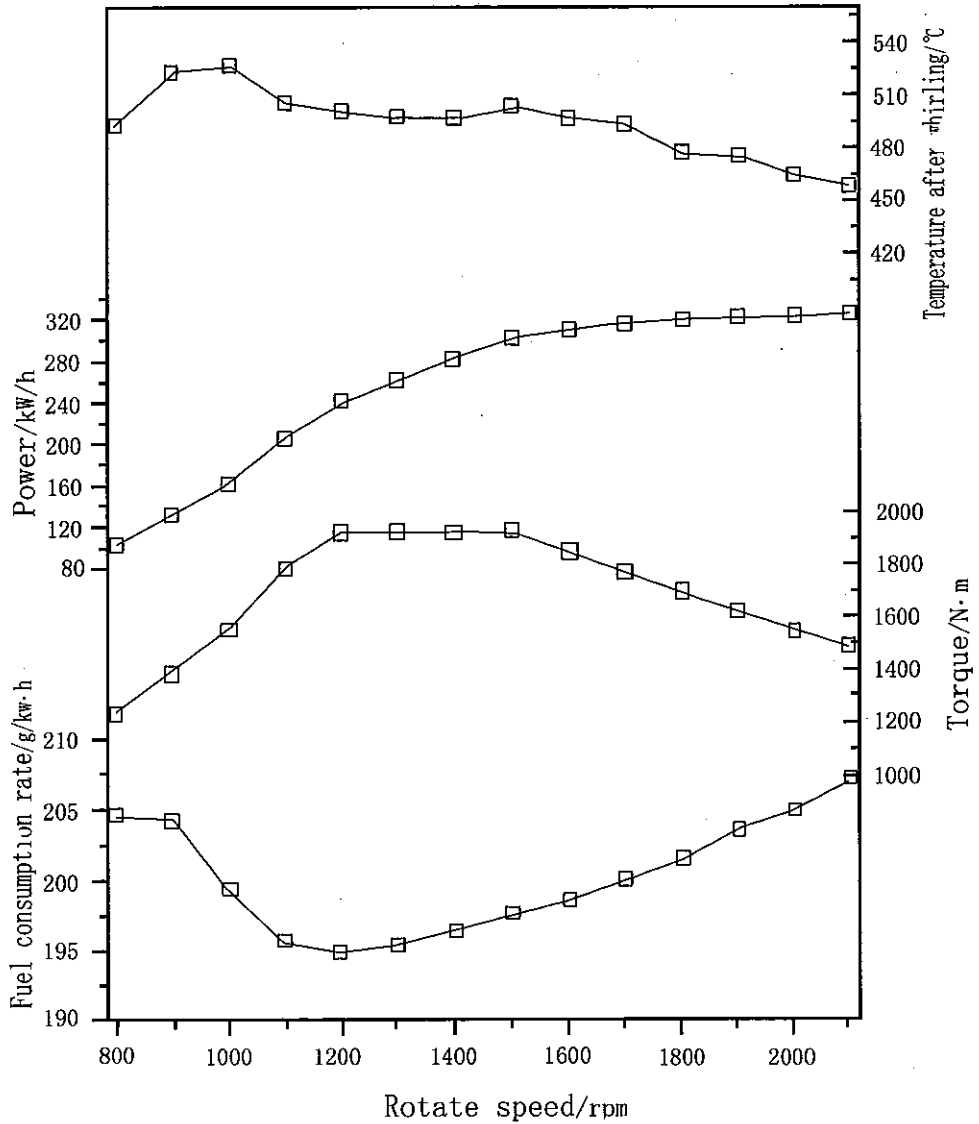
1.5 Full load characteristic curve of WP12 series diesel engines



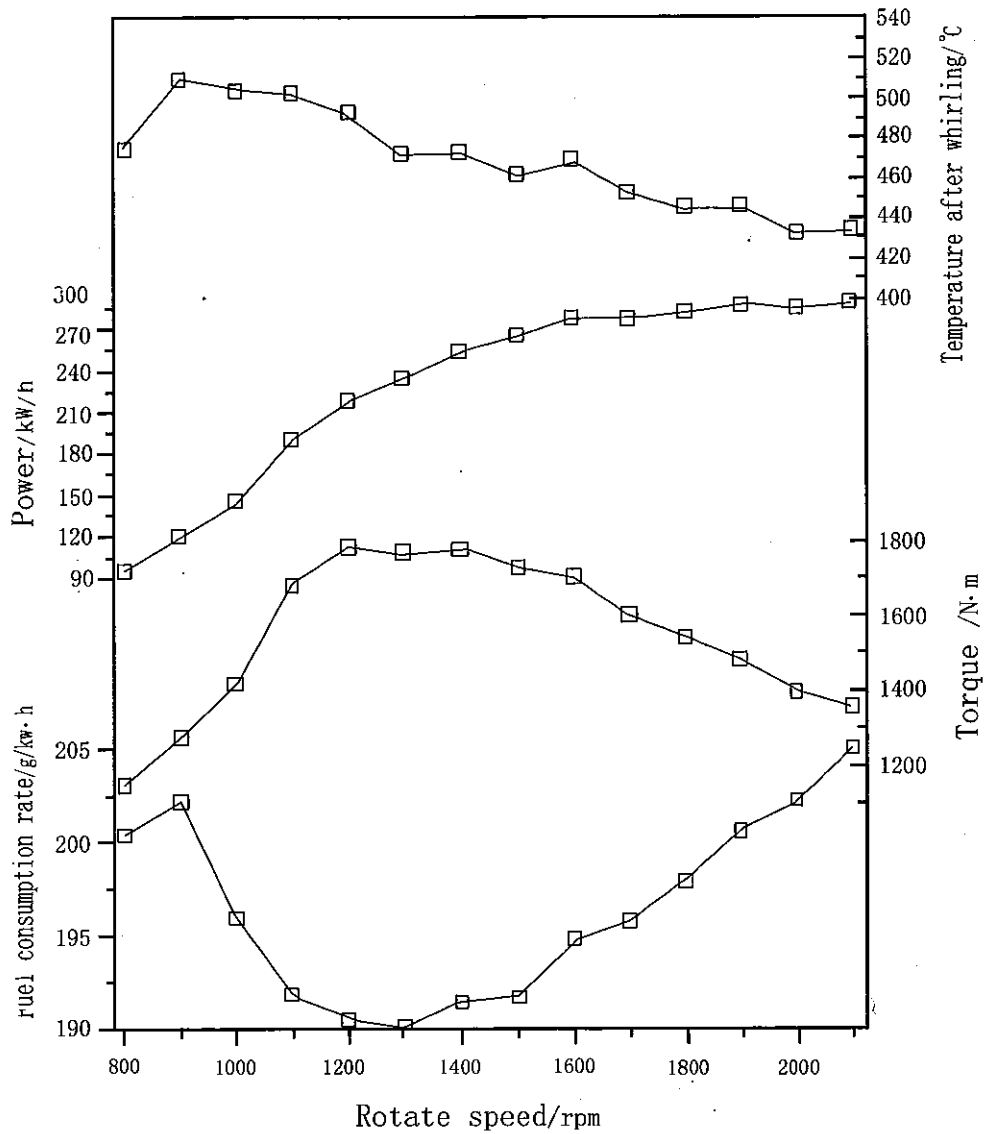
WP12.480 full load characteristic curves



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine



WP12.440 full load characteristic curves



WP12.400 full load characteristic curves



CHAPTER II TECHNOLOGY AND PERFORMANCE

PARAMETERS OF DIESEL ENGINES

2.1 Main technical parameters of WP12 series diesel engines

Table 1

1	Number of cylinders		6	
2	Type		Liquid cooling, 4 - stroke, with EVB, fuel direct injection, turbo - charged and inter - cooled	
3	Cylinder bore/stroke		126/155	
4	Displacement (L)		11.596	
5				
6	Ignition order		1 - 5 - 3 - 6 - 2 - 4	
7	Cold condition valve clearance (mm)		Inlet valve 0.4 , outlet valve 0.6 , EVB system 0.4	
8				
9				
10	Start method		Electric start	
11	Lubricating method		Pressure lubrication	
12	Lubricant volume (L)		36	
13	Cooling method		Water coolant forced circulation	
14	Oil pressure (kPa)		350 - 550	
15	Oil pressure at idle speed (kPa)		≥100	
16	Allowed vertical bevel angle (°)	Front / rear	ong period 10/10	Short period 30/30
17	Allowed horizontal bevel angle (°)	Exhaust side/ in- jection pump side	Long period 45/5	Short period 30/30
18	Rotary direction of crankshaft (see from free end)		Clockwise	

2.2 Main performance parameters of WP12 series diesel engines

Table 2

	Unit	WP12 Euro III Series Diesel Engine			
Model		WP12.375	WP12.400	WP12.440	WP12.480
Type	-	Liquid cooling, four strokes, with EVB, fuel direct injection, turbocharged and intercooled			
Displacement	L	11.596			
Cylinder bore × stroke	mm	126 × 155			

Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine



Number of cylinders	-	6			
Number of valves in every cylinder		4			
Injection equipment		Electrical control high pressure common rail			
Rated power	kW (PS)	276(375)	294(400)	323(440)	353(480)
Rated speed	rpm	2100			
Max torque	N. m	1630	1780	1920	1970
Speed at max torque	rpm	1200 - 1500			
Emission level	-	State Standard of Level III			
Fuel consumption rate at rated power	g/kWh	≤215	≤215	≤212	≤212
Min fuel consumption rate at full load	g/kWh	192			
Cold start without servicing unit	℃	- 10			
White smoke	Non - transparency	Non - transparency after idle speed for 20 second; ≤15%			
Cold start with servicing unit	℃	- 30			
Noise from one meter	dB(A)	< 98			
B10 life	km	800,000			

Table 2 (link up)

	Unit	WP12 Euro III Series Diesel Engine			
Model		WP12.270	WP12.290	WP12.330	
Type	-	Liquid cooling, 4 - stroke, with EVB, fuel direct injection, turbocharged and intercooled			
Displacement	L	11.596			
Cylinder bore × stroke	mm	126 × 155			
Number of cylinders	-	6			
Number of valves in every cylinder		4			
Injection equipment		Electrical control high pressure common rail			
Rated power	kW (PS)	199(270)	213(290)	243(330)	
Rated speed	rpm	2100			
Max torque	N. m	1190	1270	1450	



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Speed at max torque	rpm	1200 – 1500			
Emission level	–	State Standard of Level III			
Fuel consumption rate at rated power	g/kWh	≤210	≤210	≤210	
Min fuel consumption rate at full load	g/kWh	192			
Cold start without servicing unit	℃	– 10			
White smoke	Non – transparency	Non – transparency after idle speed for 20 second ≤15%			
Cold start with servicing unit	℃	– 30			
Noise from one meter	dB(A)	< 98			
B10 life	km	800,000			

2.3 Main performance parameters of WP12N series diesel engines

Table 3

	Unit	WP12 Euro III Series Diesel Engine			
Model		WP12.375N	WP12.400N	WP12.430N	WP12.460N
Type	–	Liquid cooling, four strokes, with EVB, fuel direct injection, turbocharged and intercooled			
Displacement	L	11.596			
Cylinder bore × stroke	mm	126 × 155			
Number of cylinders	–	6			
Number of valves in every cylinder		4			
Injection equipment		Electrical control high pressure common rail			
Rated power	kW (PS)	276(375)	294(400)	316(400)	338(460)
Rated speed	rpm	1900			
Max torque	N.m	1800	1920	2060	2110
Speed at max torque	rpm	1000 – 1400			
Emission level	–	State Standard of Level III			
Fuel consumption rate at rated power	g/kWh	≤201	≤201	≤205	≤205
Min fuel consumption rate at full load	g/kWh	≤190			
Cold start without servicing unit	℃	– 10			

Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine



White smoke	Non - transparency	Non - transparency after idle speed for 20 second: $\leq 15\%$
Cold start with servicing unit	$^{\circ}\text{C}$	- 30
Noise from one meter	dB(A)	< 97
B10 life	km	800,000

Table 3 (link up)

	Unit	WP12 Euro III Series Diesel Engine			
Model		WP12. 270N	WP12. 300N	WP12. 336N	
Type	-	Liquid cooling, 4 - stroke, with EVB, fuel direct injection, turbocharged and intercooled			
Displacement	L	11.596			
Cylinder bore $\times$ stroke	mm	126 $\times$ 155			
Number of cylinders	-	6			
Number of valves in every cylinder		4			
Injection equipment		Electrical control high pressure common rail			
Rated power	kW (PS)	199(270)	221(300)	247(336)	
Rated speed	rpm	1900			
Max torque	N. m	1300	1440	1600	
Speed at max torque	rpm	1000 - 1400			
Emission level	-	State Standard of Level III			
Fuel consumption rate at rated power	g/kWh	≤ 210	≤ 210	≤ 210	
Min fuel consumption rate at full load	g/kWh	192			
Cold start without servicing unit	$^{\circ}\text{C}$	- 10			
White smoke	Non - transparency	Non - transparency after idle speed for 20 second $\leq 15\%$			
Cold start with servicing unit	$^{\circ}\text{C}$	- 30			
Noise from one meter	dB(A)	< 98			
B10 life	km	800,000			



CHAPTER III

FUEL, LUBRICANT, COOLANT AND AUXILIARY MATERIAL

3.1 Fuel

Summer: No. 0 diesel fuel (GB252)

Winter: No. -10 light diesel fuel (GB252) generally. However, select No. -20 diesel fuel when the temperature is lower than -20°C , and No. -35 diesel when temperature is lower than -30°C .

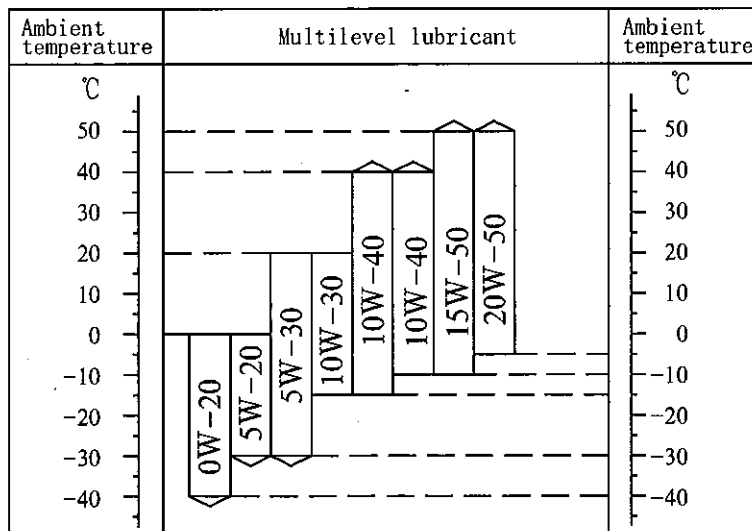
Note: The fuel must conform to the stipulations in the Appendix C of National Standard GB17691 - 2005.

3.2 Lubricating oil

Lubricating oil volume is 36L. It depends on dipstick indicates.

Lubricant selection: In order to make your engine run safely and reliably, please select 15W/40CF - 4 or 20W/40CF - 4 lubricating oil. 15W/40CF - 4 can be applied between -15°C and $+30^{\circ}\text{C}$, and 20W/40CF - 4 can be applied between -10°C and $+30^{\circ}\text{C}$. (Weichai special engine oil is recommended).

Table 4 Lubricating oil grade



Note: WP12 series diesel engines are forbidden to use CE, CD, CC, CB, and CA lubricating oil. When changing oil, filter element should be changed either.



3.3 Lubricating tensioner

Common lithium grease used in the vehicles is adopted to lubricate tensioner. (See GB5671 – 85 standard as reference)

3.4 Antifreeze additive of cooling system of engine

Ethylene glycol is selected as antifreeze additive. It can be replaced by long effect antifreeze additive made in China, but the quality should be reliable. The detailed operating method refers to relative instruction. Two recent types of long effect antifreeze additive made in China are suggested:

JFL – 336 long effect antifreeze additive

FD – 30# long effect antifreeze additive

It is required to note that the long effect antifreeze additive should be replaced as relative requirements in the regular periods.

Calculation of antifreeze additive (as reference)

Total volume of coolant is 40L (when the engine is with radiator)

Current checked antifreezing temperature is -20°C .

The lowest antifreezing temperature required to get is -30°C

The calculation method is that find the point of general volume of coolant (40L) on the abscissa, make a line over this point and find the crossing points with oblique line of -20°C and -30°C . They are called Point 1 and Point 2. (See fig. 3 – 1)

Results: 13.5L antifreeze additive with -20°C .

The difference of antifreeze additive volume of -30°C and -20°C is 4L.

For above 4L, 50% of antifreeze additive should be added again and then calculate it. It is very necessary to overfill 50% of antifreeze additive because some coolant should be drained out before filling antifreeze additive. Antifreeze additive of this coolant is drained out at the same time.

Therefore, the volume of antifreeze additive filled is $4\text{L} + 50\% \times 4\text{L} = 6\text{L}$.



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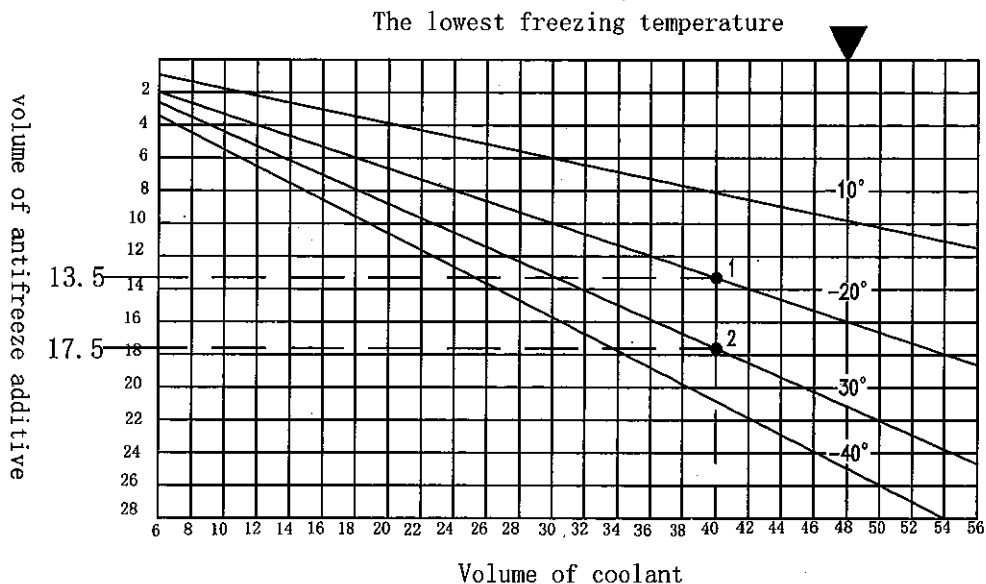


Fig 3 - 1 Antifreeze additive calculating chart

3.5 Auxiliary material

Table 5

No.	Name	Color	Application
1	Molykotte Pulver	Black	On the smooth surface of metal to prevent occluding. g. , On the out surface of cylinder liner etc.
2	Molykotte G. u. plus	Dark gray	To perform as lubricant before the establishment of lubricating oil pressure. e. g. , On the rod of inlet valve



Table 6 Reference table of glue blending of diesel engine

Brand No.	Main application	Glue blending positions list	Comple- ment
LOCTITE 242	Coat it on the surface of thread to fasten, prevent loosening and with middle strength	Flywheel casing bolt Camshaft thrust plate bolt Camshaft timing gear bolt Middle idler bolt Bolt of front end cap Bolt of oil filter bracket Bolt of engine oil cooler Plug of adjusting valve of engine oil cooler Bolt of fixing equipment of oil return pipe of oil pump Thread of shaft end of compressor Bolt of collecting filter Bolt of fixing equipment of sensor and wiring harness	As option, select DriLoc204 thread pre-coating glue to precoat
LOCTITE 262	Coat it on the external surface of thread to lock, seal and prevent loosening.	Support bolt of cylinder head	
LOCTITE 271	Prevent loosening, fastening	Bowl plug of oil stop hole	
LOCTITE 277	Used for seal between core and hole	Other bowl plug	
LOCTITE 270	Used for seal the surface of cylinder top	Push rod pipe - cylinder head	
LOCTITE 518 (update product of 510)	Coat it on the shining metal surface for seal	The joint face of cylinder and crankcase. Connecting plate of front face and front end cover of cylinder body, connecting plate of rear end face and flywheel casing. The joint face of engine oil filter bracket and crankcase Rear cap of water pump and front end face of cylinder body. The connecting plate of flywheel casing and flywheel casing. The joint face of cylinder body and engine oil cooler. The joint face of cylinder body and engine oil filling pipe.	



CHAPTER IV OPERATION OF DIESEL ENGINE

4.1 Unpacking

When unpacking the diesel engine, the user should check diesel engine and accessories as packing list, and examine whether it is damaged, or fittings are loose, etc. Then follow what are below:

- Clean the anti – rust coat of exposed parts and corrosion inhibitor, etc.

- Drain the internal seal oil from parts of fuel filter and fuel system, (It is allowed to start when seal oil of fuel system is not drained out, but just only when the seal oil of fuel system should be consumed completely, and the normal diesel fuel is applied to the fuel system, the diesel engine can be allowed to run with load.)

Note: The oil seal period of diesel engine is one year. If the oil seal is over one year, it should be checked and adopted supplementary measures.

- Move the flywheel and inject solvent into air inlet pipe until seal oil in the cylinder is drained out.

- Inject solvent into inlet/outlet ports of turbocharger until seal oil is drained out.

- As per the agreement of manufacturer and users, fill oil if no oil in the bottom. If the oil with accelerating agent for running in is filled completely in the oil bottom, it is recommended to instead old oil with new oil after the users drive for 2000km (drive for 50 hours).

- As per the agreements of manufacturer and users, when leaving factory, fill coolant as users' requirements, check coolant performance when unpacking it. If the antifreeze ability meets the requirements when the temperature is -30°C or -35°C , PH value is 7 – 8 (neutrality), the total rigidity is $5 - 15^{\circ}\text{d}$ [$9 - 15^{\circ}\text{f}$ (rigidity)], such coolant can be used. If it doesn't meet requirements, drain it out and fill the coolant with antifreeze additive.

4.2 Lifting diesel engine

When lifting engine, keep the centre line of crankshaft level. It is forbidden to lean or just lift single side. It should be slow to make it lifted and down (see Fig 4 – 1).

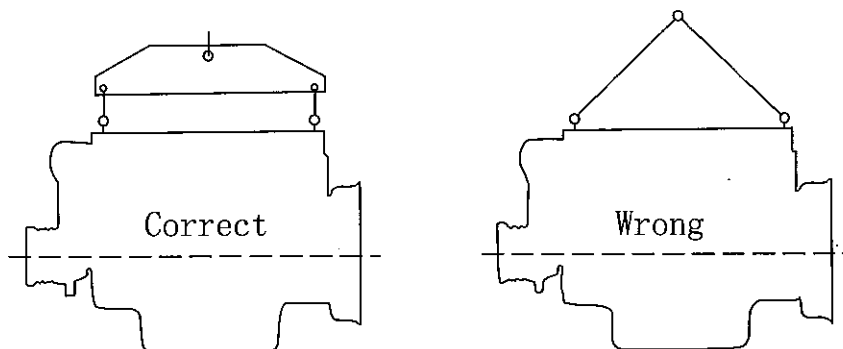


Fig 4 - 1 Lifting drawing of diesel engine

4.3 Installation

When installing the engine to match with other equipments, ensure the center line of crankshaft coaxial with the axial line of input shaft of driving unit (such as gearbox, transmission case or generator, etc.), and ensure crankshaft not to bear additional axial force caused by installation.

4.4 Prepare work before start

● Check the coolant liquid level

If the engine has been installed on the vehicle or bracket, the coolant liquid level should be seen from the glass sight hole on the expansion tank anytime. If the coolant is not enough, open the filling hole cover to fill coolant. When open filling hole cover with relief valve and exhaust valve, press releasing button before open the cover if the engine is hot. It is avoided to fill large amount of coolant when the engine is hot by all means, Parts will be damaged due to sudden temperature change. In the abnormal condition without coolant, it is allowed to fill slowly water which is not very cold. It is filled from the filling hole until it spills over. Start the engine and fill the coolant until the liquid level is stable when engine is running (1000 r/min), and finally cover the filling hole.

● Check the fuel liquid level

If the engine is installed in the vehicle, open the power switch; check the fuel liquid level from fuel meter or fuel box.

● Check engine oil liquid level



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

Engine oil liquid level is in the middle between up scale and down scale. If necessary, fill the oil from its filling hole.

- Check whether all accessories are reliable, and clear off something abnormal. Check whether circuit connection of start system is normal, and storage battery charges fully. Start valve of fuel box, loosen screw used to release air on the fuel prefilter. Release air from the fuel system by hand pump of fuel prefilter.

4.5 Start diesel engine

- When the power switch and electric key of the vehicle are on the start position, as well as gear shift level is on the neutral position, then start engine.

Step down the clutch and accelerator pedals, turn electric key to start diesel engine. If it is not started within 5s to 10s, repeat the process above after one minute. If it is not started for 3 sequential times, stop starting it. Do it after finding causes and removal trouble. Notice readings of all meters after starting the engine. At this time, engine oil pressure meter displays pressure. It should be noticed that cold engine should not be run in high speed. After running for a period (but not too long) in idle speed, it can run in high speed.

In low temperature, start diesel engine by auxiliary equipments. Heat flange by relay to start smoothly in -30°C .

4.6 Run diesel engine

- After starting diesel engine, run in idle speed for several minutes, then rotary speed reaches 1000 – 1200 r/min with part load. When the water outlet temperature is higher than 60°C , and the engine oil temperature is higher than 50°C , it is allowed to run with full load. Load and rotary speed should be increased generally. It should be tried to avoid increasing and reducing load suddenly.

- In 60h wear in period, that is the time when the vehicle runs about 3000km. The diesel engine can work with lower than middle load, and the vehicle is without trailer.

- When driving on the slope, slow down. In the operating condition of high torque, it is not suitable to work for long time and have low load and rotary speed, when occurring oil carry – over.

- When operating diesel engine normally, it is allowed to run continuously as rated power and rotary speed. However, it is allowed to run for 20 minutes at best if running at 105% of ra-



ted rotary speed and 110% of rated power. Stop the engine after reducing load of diesel engine and running in idle speed for 1 – 2 minutes.

- During operation, notice parameters and checking position:

The pressure of main oil duct is 350 – 500kPa.

Oil temperature of oil pan is less than 110℃ ,

The temperature on the coolant outlet is $80 + 5^{\circ}\text{C}$, not over 95°C .

After turbine, air exhausting temperature is less than 600°C .

After inter – cooler, inlet temperature is $50 - 55^{\circ}\text{C}$.

Identify the quality and operating load of fuel injector by checking colors of exhausted gas, If the color is severely bad, stop to check.

Notice to check whether the diesel engine leaks water, gas or oil. If such situation occurs, stop to remove trouble.

- The operators should know the following features of diesel engine:

A. When torque is the highest, fuel is consumed less. When increasing rotary speed, fuel consumption will be increased.

B. The torque is best when engine runs in middle speed (1200 – 1600 r/min).

C. The power of engine increase as the rotary speed increase. When the rated rotary speed is reached, the rated power is reached.

In the cold environment, run the diesel engine, notice:

1. Fuel: As different outdoor temperature in winter, select different brands of diesel engine.

2. Lubricant: As different seasons, select lubricant with different viscosity.

3. Coolant: Fill antifreeze additive into cooling system. As different outdoor temperature, select different brands and quantity.

4. Start: In winter, adopt auxiliary starter if necessary in winter. When oil and water temperature is normal after starting diesel engine, it is allowed to increase load to run in high speed. p

5. Before cold season begins, you must check electrolyte level, viscosity and pressure of storage battery. If the diesel engine isn't used for long time and in the low temperature, remove the storage battery and stock in the warm room.



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Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

6. Stop the engine

When stopping the engine in cold climate, reduce load and run for 1 – 2 minutes in idle speed. After water and oil temperature is lower, stop the engine. It should be noticed that the coolant with antifreeze additive can not be drained out. If the coolant is not filled with antifreeze additive, you must open the valves and water blocks on the cylinder body, engine oil cooler cover, radiator, air inlet pipe, etc. and drain up coolant to prevent the engine from being frozen with cracks.

CHAPTER V ROUTINE MAINTENANCE

5.1 Routine maintenance

Check coolant liquid level, engine oil liquid level, fuel liquid level. Check whether lubricating grease is enough in the required place, whether oil, water and gas is leaked or not, whether connection and tighten outside connecting parts and accessories is good, whether fan and belt are over tight or loose, whether oil pressure, water temperature of diesel engine, as well as exhausting temperature, color, sound, vibration are normal, and whether the rotary speed is stable.

● Check coolant liquid level and water temperature

Observe coolant liquid level from glass sight hole. When the coolant is not enough, open filling hole cover to fill coolant.

Note: You must press air releasing button before open filling hole cover to avoid hot coolant damaging person when engine is hot.

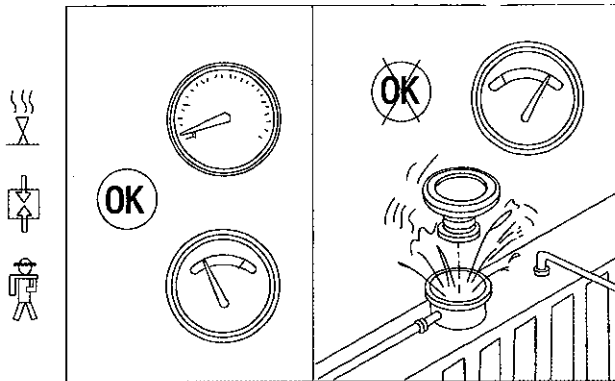


Fig 5 - 1

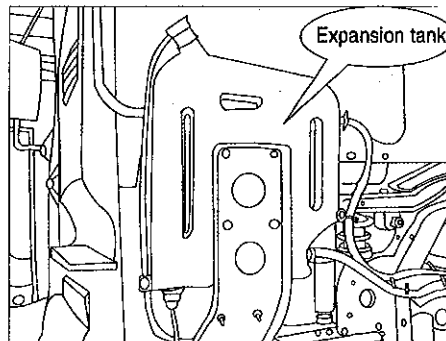


Fig 5 - 2



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

● Check engine oil liquid level

When oil level is lower than down scale of dipstick or higher than up scale, it is not allowed to start diesel engine absolutely. After stopping the diesel engine, check the oil level after 5 minutes at least, and make engine oil flow back oil pan. The difference from down scale to up scale of dipstick is 3L.

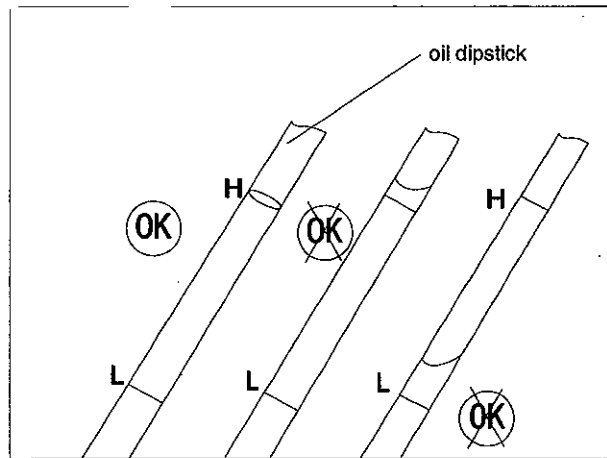


Fig 5 - 3

● Check fuel level

● Check whether the whole engine leaks water, gas and oil.

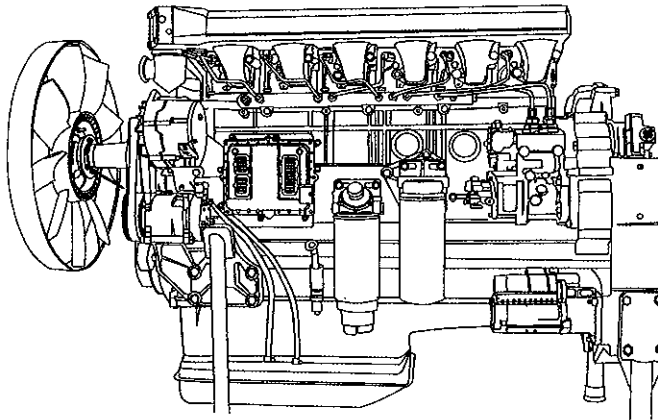


Fig 5 -- 4

● Check fan

See whether the blade of fan is broken, and connecting bolts are tight.

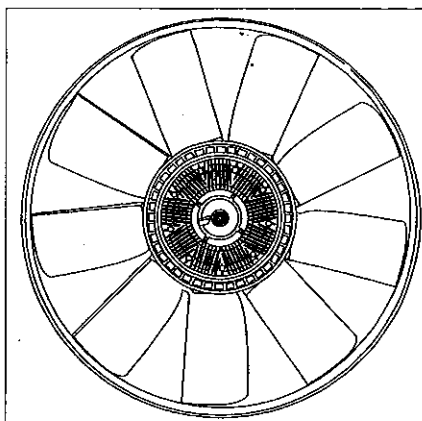


Fig 5 - 5

- Check belt (See Fig 5 - 6)

The belts are tightened by pulley, and users should check the tension of belt by hand.

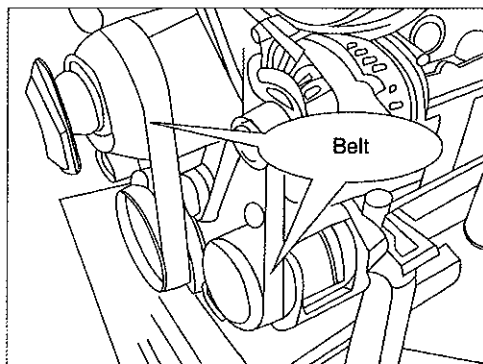


Fig 5 - 6



Fig5 - 7

● Check whether the color of exhausting gas is normal. See Fig 5 - 7: The normal color of exhausting gas is light gray. If color is different, you should check causes and clear off.

- Check whether sound is normal.
- Check whether rotary speed and vibration is normal.

5.2 Maintenance of all levels

Add following content besides daily maintenance:

- Replace diesel oil



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

● Turn out oil draining screw plug on the bottom of oil pan, and drain out engine oil, and then tighten oil draining screw plug. See Fig 5 - 9. Open filling hole cover, (See Fig 5 - 8) fill engine oil from the filling hole to observe scale of dipstick until it meets the requirements, finally cover the filling hole.

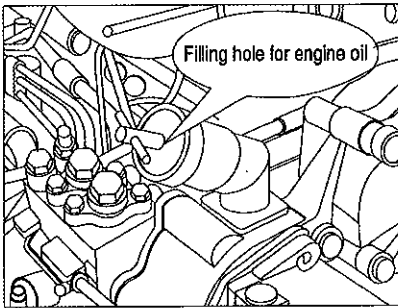


Fig 5 - 8

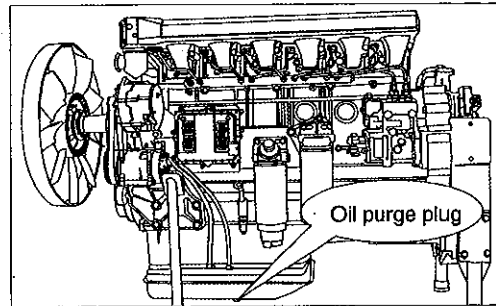


Fig 5 - 9

● Replace oil filter and filter element. See Fig 5 - 10

Replace oil filter as following:

- A. Remove old oil filter
- B. Fill clean oil into new filter
- C. Lay oil on rubber plate before installing new oil filter
- D. When the rubber plate touches the base, tighten $3/4 - 1$ round to seal
- E. Start the engine and check whether it leaks oil

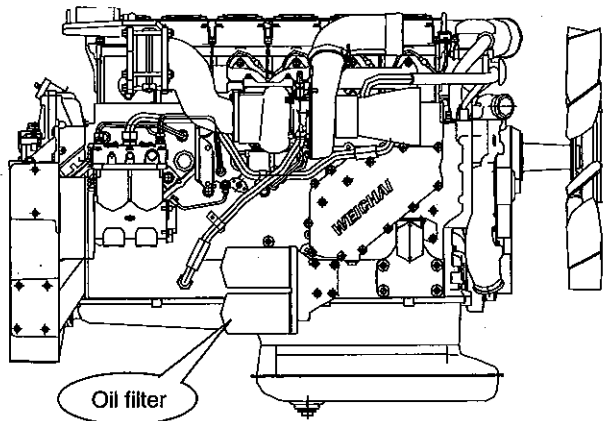


Fig 5 - 10

● Check and adjust inlet/outlet valve clearances

Check and adjust inlet/outlet valve clearances as below:

A. When diesel engine is cold, right barring and make (as the running direction) 1st and 6th cylinders to TDC, at this time, caving groove of the flywheel and indicator on the sight hole are put in order. See Fig 5 - 11.

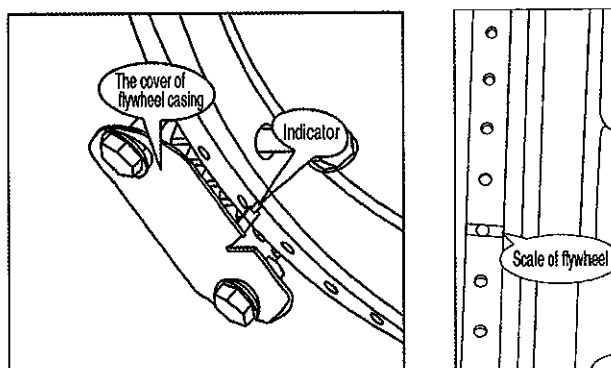


Fig 5 - 11

B. Dismantle valve rocker cover on the cylinder head to judge compressing stroke of cylinder 1 or cylinder 6 (There is clearance between inlet and outlet valves of cylinder with compressing stroke and rocker.). See Fig 5 - 12.

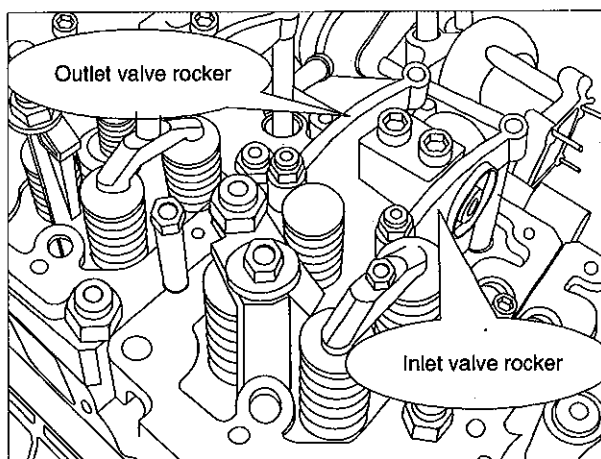


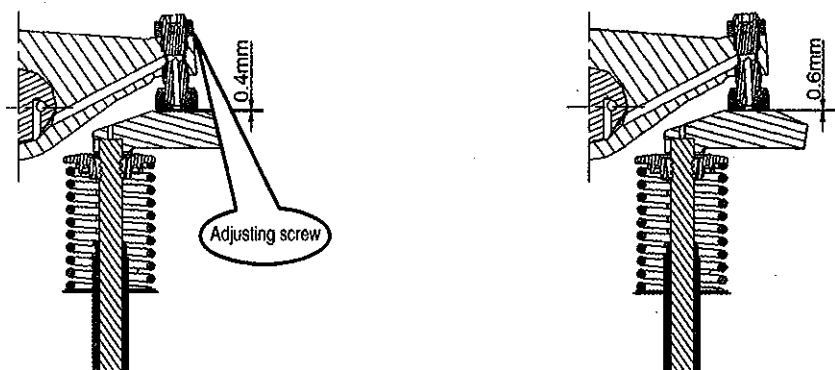
Fig5 - 12

C. As table 7, check the clearance between surface of valve bridge and valve rocker by filler gage. WP12 diesel engine requires inlet valve clearance is 0.4 mm, outlet valve clear-



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ance is 0.6mm. If the clearance is too big or small, you can adjust the adjusting screw on the rocker to get above clearance requirements. See Fig 5 - 13.



The clearance of cold inlet valve is 0.4mm The clearance of cold outlet valve is 0.6mm.

Fig 5 - 13

D. After checking cylinder 1 and cylinder 6, right barring about 360°. Make cylinder 6 or cylinder 1 on the working stroke to check and adjust the other valves.

Table 7

	Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4	Cylinder 5	Cylinder 6
Compression stroke of cylinder 1	Inlet/outlet valve	Inlet valve	Outlet valve	Inlet valve	Outlet valve	Nonad justable
Compression stroke of cylinder 6	Nonad justable	Outlet valve	Inlet valve	Outlet valve	Inlet valve	Inlet/outlet valve

For the outlet valve with EVB, its adjusting steps are below:

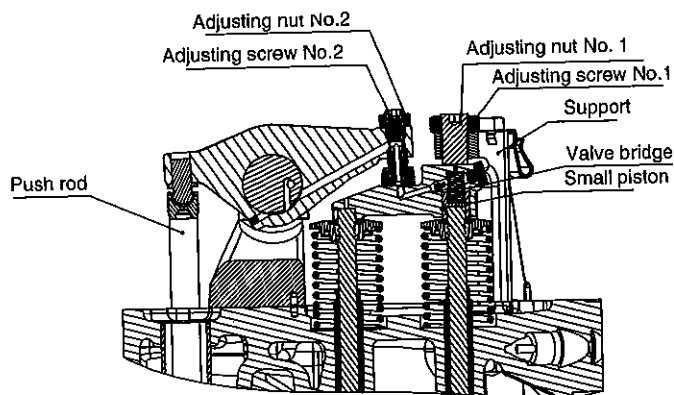


Fig 5 - 14 Adjustment of outlet valve and EVB clearances

Piston is located at compression TDC.

Loosen nut 1.

Adjust the adjusting screw 1 until the touching clearness between valve bridge and the bolt is zero.

Loosen bolt 2

Adjust the adjusting screw 2, insert 0.6mm filler gage between adjusting screw 2 and valve bridge

Adjust the adjusting screw 2 until the small piston moves to the bottom and clamp filler gage.

Adjust the valve clearance to reach 0.6mm, turn the adjusting screw until the filler gage is without clearance. Keep the state to tighten the nut.

Adjust the adjusting screw 1, inset 0.4mm filler gage between valve bridge and adjusting screw 1.

Adjust the adjusting screw 1 until small piston clamps the filler gage at the bottom. Keep this state and tighten the nut.

Check valve clearance again and adjust it if necessary.

● Replace fuel filtering element. See Fig 5 - 15

Replace it as following:

A. Remove old fuel filtering element, if the collector on the prefilter can still be reused, please removes the collector.

B. Lubricating seal

C. Tighten filter by hand until join seal port and joint together.

D. Tighten filter by hand until it is installed steadily (about 3/4 round)

E. Release air until no air bubble

F. Do leaking test.

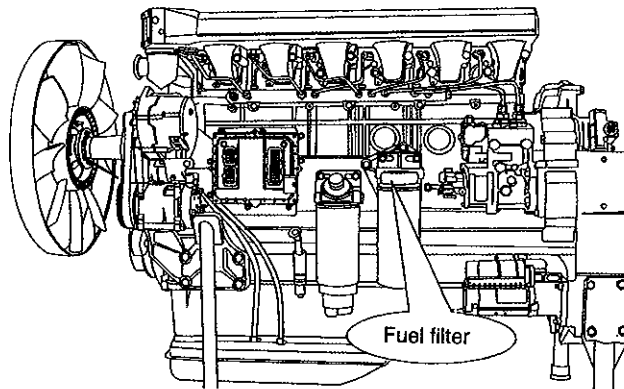


Fig 5 - 15



Note : When replacing spinning prefilter or fitting fuel pipe again, the prefilter should be released. (See Fig 5 - 16)

The steps are below:

1. Stop engine.
2. Remove releasing screw.
3. Pump up by hand pump until only fuel flow out from the releasing screw.
4. Tighten releasing screw again.

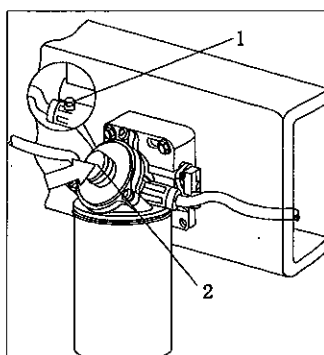


Fig 5 - 16 Prefilter exhausting air

Drain out water from collector

Note:

When the collector is full or spinning filter has been replaced, the water collected should be drain out.

The steps are below (See Fig 5 - 17)

1. Open the fuel purge plug (1) at the bottom of collector (2) to drain out water.
2. Tighten fuel purge plug again.

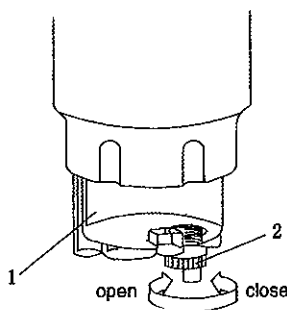


Fig 5 - 17 Collector draining water

Replace collector

The steps are below (See Fig 5 -18)

1. Stop the engine
2. Drain water from collector.
3. If it is possible, remove the screw (1) of collector by hand. If it is too tight, use the tool for loading and unloading in the new collector.
4. Lubricate seal ring (2) of new collector by several dips of oil.
5. Put on screws by hand, and tighten them by tools.
6. If the collector is used on a new spinning filter, check whether it is damaged.
7. Use a torque wrench to mount, torque is 20N. m.

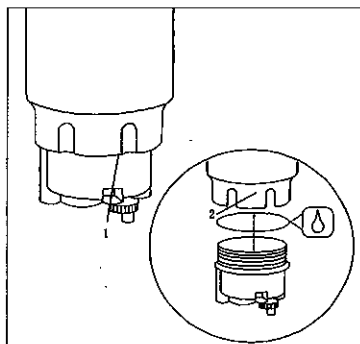


Fig 5 - 18 Replace collector

● Check air inlet system, Fig 5 - 19

Check whether inlet rubber pipe is aging with cracks, and hoop is loose. If necessary, you must fasten or replace parts to ensure the seal of inlet system.

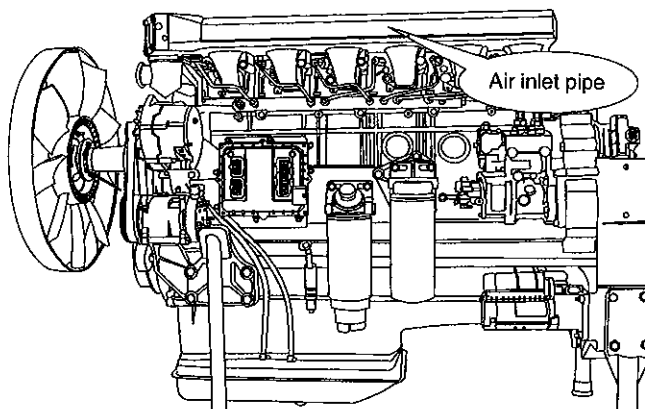


Fig 5 - 19



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

● Check air filtering element

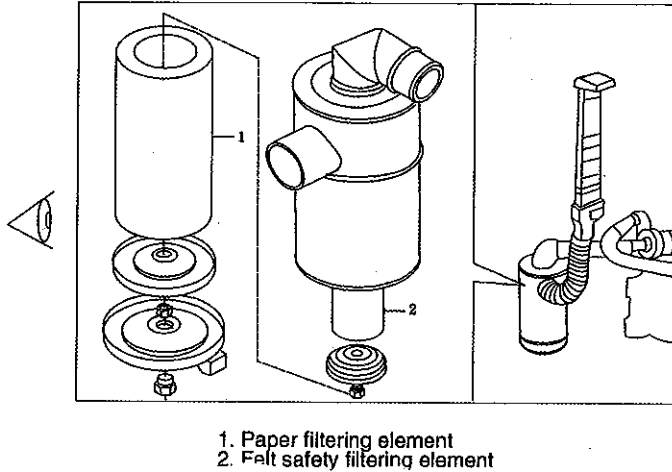


Fig 5 - 20

The max allowable air inlet resistant pressure of diesel engine is 7kPa. The diesel engine must be checked about max inlet resistant pressure at rated rotary speed and with full load. When the air inlet resistant pressure reaches the max allowable values, clean or replace filtering element as manufacturer regulations.

Note: It is not allowed absolutely to run engine without air filter, or the engine will be worn out for dust and foreign substance entering into diesel engine.

Remove air filtering element from air filter, flap lightly end face to make the dust down, blow back by compressed air (from inter to exterior).

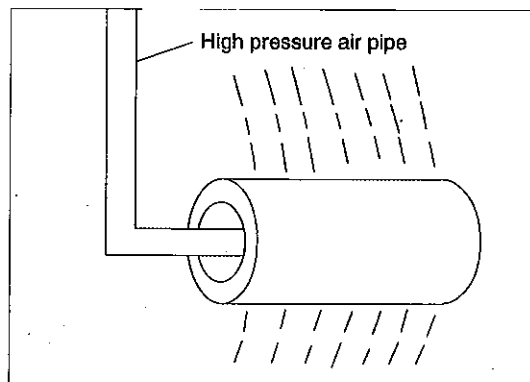


Fig 5 - 21

Note: Don't blow down the filtering paper. Don't clean filtering paper by water and oil.



Don't flap heavily or knock filtering elements.

5.3 Maintenance of diesel engine when it is not used for long time

- Clean diesel engine
- Protection:
 - After warming up, drain out engine oil, clean oil filter and fill rust – prevented oil.
 - Drain out fuel and fill rust – prevented mix oil again.
 - Drain out water and fill coolant with rust – prevented agent.
 - Start and idling run for 15 to 25min.
 - Drain out engine oil, fuel and coolant
 - Protect other parts
- Protection in the period of stocking
 - Pack all inlet/outlet for oil, gas and water by cover or plastic. Seal the complete engine by rust – prevented file.
- If require shipment, the additional package should be necessary.

5.4 Periodic maintenance and record

Table 8 Operation conditions of three types matching with vehicles

(WG I Type)	(WG II Type)	(WG III Type)
Operating condition is abominable (Climate is cold or hot, with high dustiness. Shipping distance is short. It is used in construction site, and used in public buses, municipal engineering vehicles, snow removing vehicles and fire engines) or the yearly number of miles traveled by the vehicle is less than 2×10^4 km or yearly working time is less than 600h.	The yearly number of miles traveled by the vehicle is less than 6×10^4 km. It is used to travel in short and middle distance. (for delivery good)	The yearly number of miles traveled by the vehicle is over 6×10^4 km. It is used in carrier vehicle for long distance.



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

Table 9 Maintenance term

Working condition Items	(WG I Type)	(WG II Type)	(WG III Type)
First inspection	When driving for 1000 – 1500km, and for 30 – 50h	When driving for 1500 – 2000km	When driving for 1500 – 2000km
Routine inspection	Every 5000km or 150h	Every 1×10^4 km	Every 1.5×10^4 km
Level 1 maintenance	Every 1×10^4 km or 300h	Every 2×10^4 km	Every 3×10^4 km
Level 2 maintenance	Every 2×10^4 km or 600h	Every 4×10^4 km	Every 6×10^4 km
Level 3 maintenance	Every 4×10^4 km or 1200h	Every 8×10^4 km	Every 12×10^4 km
Level 4 maintenance	Every 8×10^4 km or 2400h	Every 16×10^4 km	Every 24×10^4 km

Table 10 Changing engine oil term in maintenance regulation of vehicles

Working condition Items	(WG I Type)	(WG II Type)	(WG III Type)
	The yearly number of miles traveled is less than 2×10^4 km	The yearly number of miles traveled is less than 6×10^4 km	The yearly number of miles traveled is over 6×10^4 km
First inspection	When driving for 1000 – 1500km,	When driving for 1500 – 2000km	When driving for 1500 – 2000km
Routine inspection	Every 500km	Every 1×10^4 km	Every 1.5×10^4 km
Level 1 maintenance	Every 1×10^4 km	Every 2×10^4 km	Every 3×10^4 km
Level 2 maintenance	Every 2×10^4 km	Every 4×10^4 km	Every 6×10^4 km
Level 3 maintenance	Every 4×10^4 km	Every 8×10^4 km	Every 12×10^4 km
Level 4 maintenance	Every 8×10^4 km	Every 16×10^4 km	Every 24×10^4 km



Table 11 Maintenance criterion

Maintenance items	First time	Routine	Level 1	Level 2	Level 3	Level 4
Replace engine oil	●	●	●	●	●	●
Replace engine oil filter or filtering element	●	When replacing engine oil				
Check and adjust the clearance of valves	●		●	●	●	●
Replace fuel filter element			●	●	●	●
Check the volume of coolant and fill them	●	●	●	●	●	●
Fasten clamp of coolant pipes	●					
Fasten air inlet pipe, hose pipe and flange connector	●		●	●	●	●
Check maintenance indicator light or indicator of air filter	●		●	●	●	●
Clean dust collecting container of air filter (not including automatic dusting type)		●	●	●	●	●
Clean main filtering element of air filter	When the indicator light is light.					
Replace main filtering element of air filter	Refer to manual and relative regulations					
Replace safety filtering element of air filter	When cleaning main filter element for 5 times					
Check and fasten V - belt	●	●	●	●	●	●
Check clearance of bearing of turbocharger						●
Check and adjust clutch travel	●	●	●	●	●	●
Note : Signal ● represents to require maintenance						



CHAPTER VI

ANALYSIS AND SOLUTION FOR COMMON FAILURES

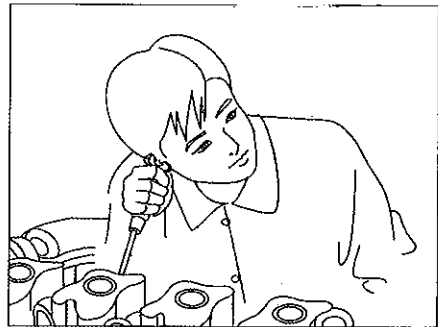
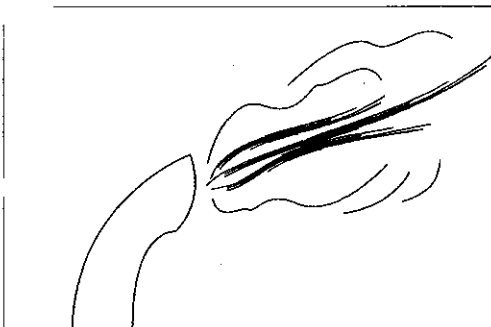
WP12 series diesel engine are designed and fabricated with strict quality system, and the required tests are applied on each engine prior leaving the factory. On the other hand, as diesel engine is a kind of precise machine, the normal maintenance is critical for its long term service. Generally, the reasons for the failure of diesel engine are as follow:

- Illegal operation, lack of management and abnormal application;
- Didn't carry out the maintenance as regulation, or just repair as it is broken;
- Poor quality of fitting, the cheap fake product will shorten the service life much; and
- Improper type fuel and lubricant are applied.

6.1 Estimation method

The common estimation methods for diesel engine failure are as follow:

- Observation: estimate the failure by observe the failure phenomenon like exhaust smoke etc.
- Hearing: estimate the failure part and degree by hearing the abnormal sound.



- Ceasing cylinder: cease the work of certain cylinder to estimate weather the failure is happened in this certain cylinder. The method of "ceasing cylinder" is to cease the fuel supply for the cylinder which is suspected, and compare the difference of engine after ceased the cylinder, which can reduce the range of failure parts.

- Comparing method: replace some assembly parts or components to make sure weather



there are faults on them.

Notes:

1. Estimating the failure of diesel engine is a fairly precise work, it is forbidden to disassemble the engine before acknowledged the failure reason, or the failure may get worse for the improper disassembly.

2. For the key components like high pressure fuel pump, ECU, common rail, turbo-charger etc. , the maintenance and inspection should be implemented by special equipments and operator with qualification, therefore, the client without experiences and conditions on this aspect is forbidden to disassemble the machine.

6.2 Common failure and solution

6.2.1 The diesel engine can not be started

(1) Starting motor fail to run

Starting motor of WP12 series diesel engine is controlled by ECU, in normal condition, ECU output current to starting relay, and the jar will start the starting motor. We mainly inspect the neutral gear as the failure occurred.

There are several factors during the inspection: neutral gear switch, starting relay, jar, and sequence of stop switch under the machine.

● Check the position of natural gear

Before start, check whether the positing of gear handle is on the natural position.

● Check the position of stop switch under the machine (be in OFF position)

Stop switch under the machine is jogging type, and can resume automatically, check weather this switch is in normal condition.

If the switch can not auto resume, check weather the switch is on.

● Checking the wiring of natural gear switch, try emergency start (press ignition switch for more than 5 seconds)

For the engine that the starting motor is controlled by ECU, as starting, ECU estimate whether the nature gear switch is in nature position by its signal, the staring motor won't run without signal to ECU.

● Check whether the voltage of jar is too low to start the starting motor

The voltage of common jar is 24V, the starting motor won't work as the voltage is too low,



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

the multimeter or trouble diagnostic instrument can be used to inspect and read the actual "cell voltage".

- Check whether the starting relay and its wiring is in normal condition

Check whether there are too much oxide on binding post and whether the bolt on binding post is loose or broken.

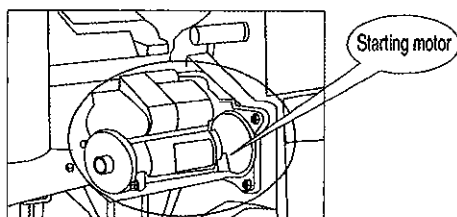
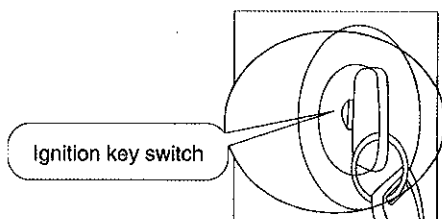
- Check whether the starting motor is broken

Check whether the starting motor is in normal condition by multimeter.

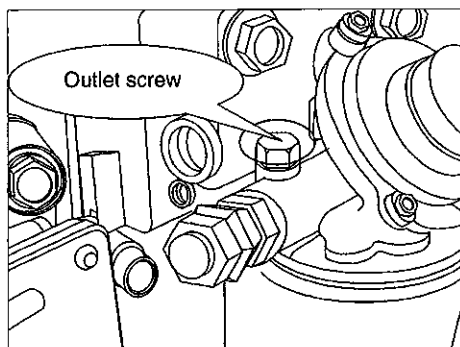
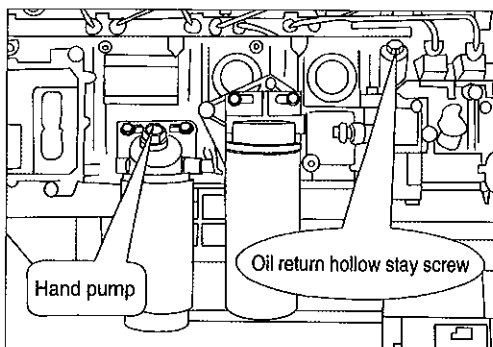
- Check whether the ignition switch and start switch are broken

Turn the ignition key to the position of "ON", check the light on instrument board.

Turn the ignition key to the position of start, check whether the starting motor run or not.



(2) The rail pressure cannot be established (the starting motor is in normal condition but the engine cannot run)





- Check the oil level, and make sure it is not too low

This reason is easy to be ignored, please pay attention.

- Check whether the hand oil pump is in normal condition

Press the hand oil pump by hand to check its condition.

- Check whether there is air in the low pressure fuel way, and release the air (in some cases, the leakage of fuel way is not visible, so please check carefully)

Releasing method: mainly release the air in rough filter. Loose the release screw on prefilter, press the hand pump on prefilter by hand till the fuel is exhausted from exhausting bolt continuously.

If the diesel engine still cannot run after release the air of low pressure fuel way, it is supposed that there is air in the high pressure fuel way, and it also need to be exhausted.

Releasing method: loose a certain high pressure fuel pipe, drive the diesel by starting motor till there is fuel exhausted from fuel pipe continuously. (it is not recommended to disassemble the high pressure fuel joint frequently!)

- Check whether there are leakage on high pressure fuel way

This kind of failure is easy to observe, check whether the joint nut of fuel pipe is loose, if yes, and then fasten it.

- Check whether the fuel way is smooth, or the diesel fuel filter is jammed, it is recommended to replace the filter element in time.

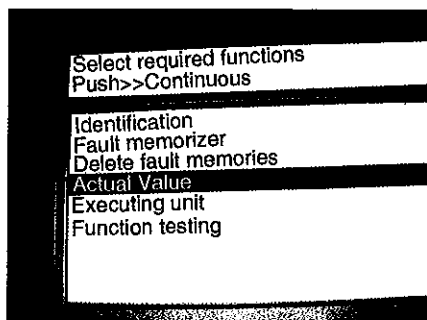
Checking method: loose the outlet bolt of main filter, and start the diesel engine by starting motor, make sure whether there are fuel spray out or flow out, if there only little fuel flow out, the filter is jammed, need to be replaced.

- Check whether the voltage of rail pressure sensor is about 500mV, or the rail setting is 30 – 50MPa, the checking method is:

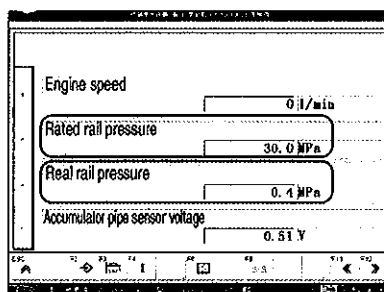
Enter the operation panel of trouble diagnostic instrument, click "real value", then "next step"



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine



All the "real value" will be shown, click "accumulator pipe sensor voltage" and "rated rail pressure"

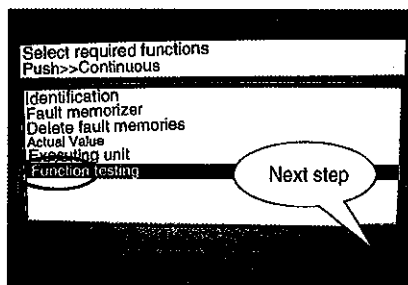


Check plug first if any fault is found, otherwise the rail pressure sensor may broken.

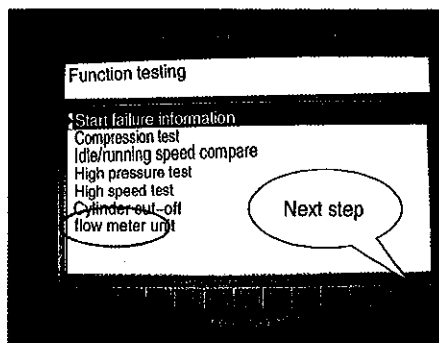
If there is no inspection instruments available, pull out the plug and try to restart the engine (after restart, the engine will switch to "claudication" mode).

- Check the condition of meter unit flow , pull out the plug, and try to restart
 - a. Observe whether there is visible broken on hardware, and the plug connection is tight enough.
 - b. Implement the Meter – unit test by trouble diagnostic instrument.

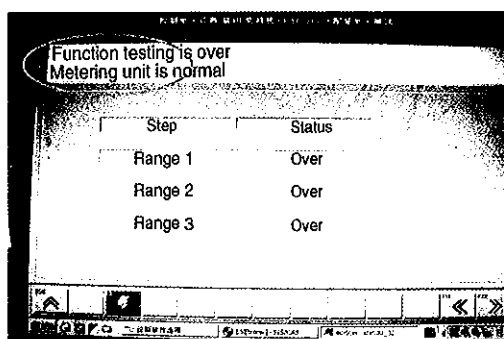
Enter the operation panel of trouble diagnostic instrument, click "function test" and then click next step.



Enter the sub - interface of function test, click "rationing unit test" and click next step.



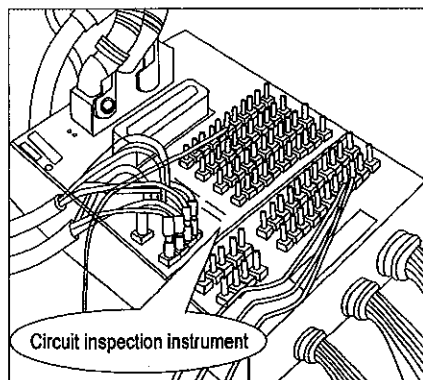
The test condition interface will be shown, after operator confirmed the condition, click next step and start the test.



After test finished, it will show whether the fuel measure is in normal condition

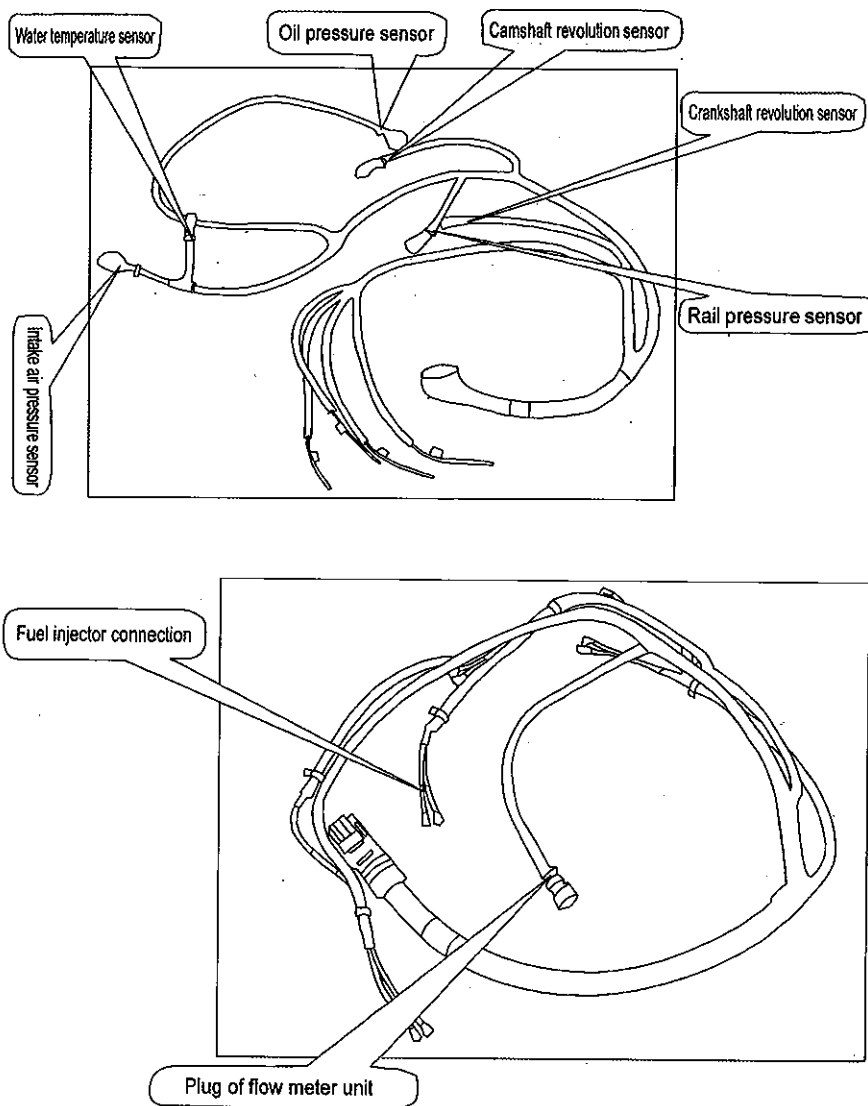
(3) The plug of fuel injector wiring harness, sensor wiring harness and engine wiring harness are loose, or the wiring harness open circuit or short circuit

● Check the installation of plug, check the circuitry in accordance with the pointer of circuit diagram by multi - meter ("circuit inspection instrument" is recommended).





Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine



(4) There are two revolution sensors on diesel engine, which locates on outside of flywheel casing and high pressure fuel pump, and function as crankshaft position sensor and cylinder I-identification Sensor respectively. The fuel injection time of electronic control engine is based on these two sensors. Without these two signals, the diesel engine can not be started.

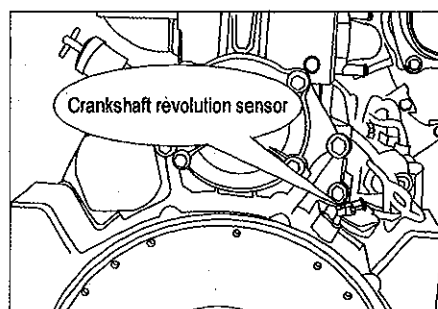
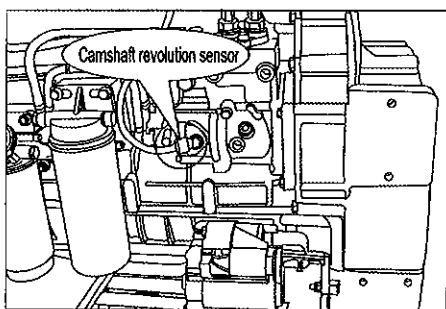
● Reasons for the lose of these two signals

a). Sensor broken, wiring harness open circuit or short circuit

b). Poor fixing of sensor, which cause the clearance between sensor and sensor gear is too big or too small (generally $1 \pm 0.5\text{mm}$)

Solving method: checking whether the sensors are broken, wiring harness are connected well, the sensors are loose etc.

● Operation of assemble and disassemble of high pressure fuel pump and flywheel should be carried out in accordance with the related technique document to ensure the synchronization of signal



6.2.2 Difficult to start

Reason and solution for engine difficult to start

● The diesel engine is left unused for long term; the fuel return pipe should under the fuel Level.

● There is air in the low pressure pipe; release air:

● Crankshaft revolution signal and camshaft revolution signal are too weak, synchronization time is too long; find concrete reason and readjust it.

● Environmental temperature too low, preheating device failure; check the connection of heating flange or replace the preheating device.

● Poor quality of diesel fuel and engine oil; replace by standard oil.



- Interference of the gear rings of starting motor and flywheel; replace the gear rings on starting motor and flywheel.
- There is wearing of piston ring and cylinder liner or poor seal on valve; replace piston ring and cylinder liner or valve seat and valve.
- Exhaust butterfly valve is locked on close position, and can not exhaust air smoothly; replace the butterfly valve.

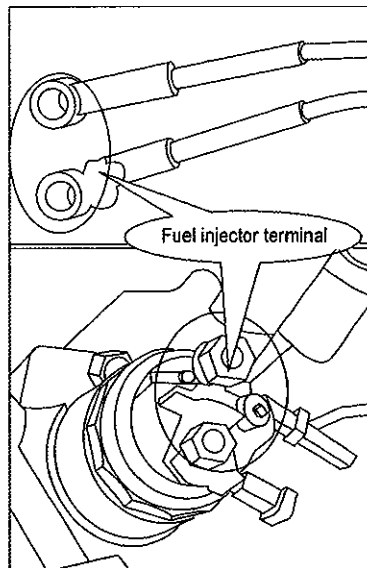
6.2.3 Engine power is low

"Claudication" mode; a mode that the engine run with fault. As ECU inspect the failure on the engine, it will not stop the engine, but limit the power of engine (only can reach to the revolution of 1500), which allow driver drive the vehicle to the nearest maintenance station.

(1) Failure on fuel injector

Failure on fuel injector, including mechanism failure and connection failure.

Mechanism failure: needle valve is locked, as the impurity is too much in fuel or water intrusion, the needle valve is locked in fuel injector, and couldnt move. (Note: In some case, no failure indication on ECU!). Connection failure: disconnection or short circuit by connected on cylinder cover for the reason of the vibration and wearing of wiring harness etc. ECU will indicate failure.





(2) The temperature of water, engine oil or inlet air is too high

As the temperature of water, engine oil or inlet air is too high, ECU will switch into the heat protection function, and limit the engine power. Before failure overcame, the distortion of sensor and meter panel should be fixed first.

Reason for the high water temperature and solution

- a. Water level in the water box is too low, check leakage and water in it.
- b. In low speed or stop of fan, check drive components of fan.
- c. Water box is jammed; check water box, clean or repair
- d. Belt loose of water pump; adjust the tensioning as regulation
- e. Washer broken of water pump; abrasion of water pump impeller; check, and repair or replace

f. Thermostat failure; replace

g. Sealing components of water pipe broken, air intrusion; check water pipe, joint, washer etc. , and replace broken components Reason for the high engine oil temperature and solution

- a. Oil level is too low or lack of oil; check oil level and leakage, repair and oil it
- b. High water temperature; refer the solution above
- c. Oil cooler flow is not smooth; check and clean

Reason for the high air intake temperature and solution

Check the heat dissipation potential of the intercooler

(3) Synchronization signal failure

In this case, often one sensor signal failure.

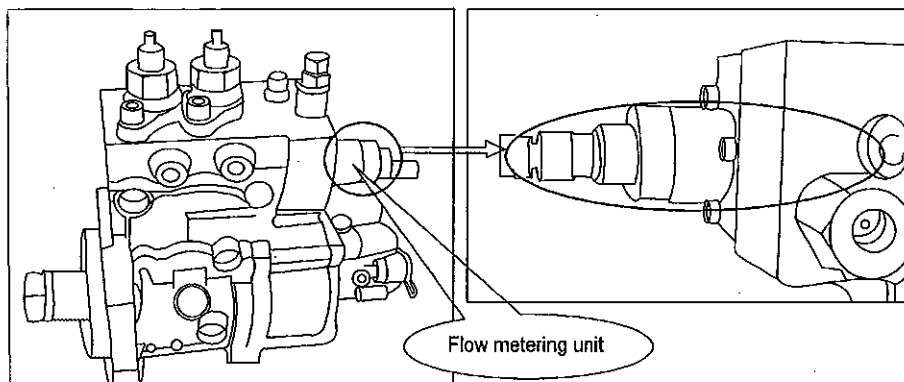
Read flash code by flash reader, check flash code sheet to find out the reason, solution is same to 6.2.1 - (4).

(4) Flow metering unit failure

Flow metering unit is the execution mechanism of rail pressure control, and mounted on high pressure fuel pump, as the failure on it, high pressure fuel pump will supply the fuel to common rail in max. ability, at this time, the pressure discharge valve will be opened, noise like "kaka" will heard from diesel engine. Problem on rail pressure sensor is similar like that.



Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine



● **Solution method:** check circuitry, as confirmed the failure is happened on flow metering or rail pressure sensor, inform the service office.

(5) Irregular undulation caused fuel pipe leakage

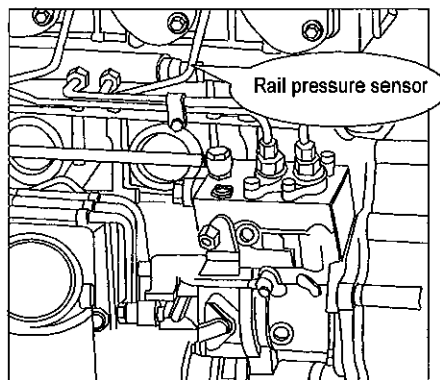
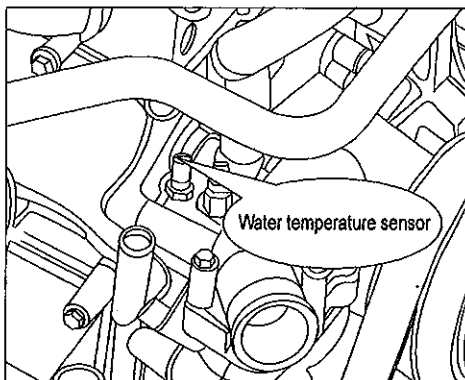
During the driving, vehicle speed will unstable, and "jump" during run.

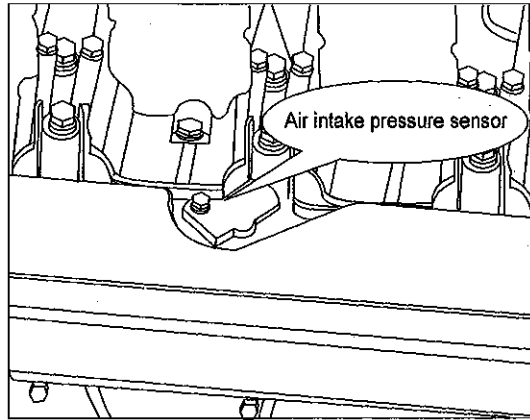
● **Solution method:**

Break the power supply for one minute and restart, if there is no difference, check the seal of fuel pipe and fix it.

(6) Sensor failure

Air inlet pressure sensor (mounted on inlet pipe) is to estimate the air inlet quantity by ECU, water temperature sensor (mounted on water pump) is to estimate the thermal load on engine, and rail pressure sensor is to inspect the fuel pressure in common rail pipe.





● Solution method

Inspect the air intake temperature, pressure, water temperature, rail pressure sensor; make sure the plug is tight enough.

Note: As failures of intake pressure, rail pressure, flow metering unit, crankshaft and camshaft sensor signals occur, the diesel engine will turn into "Claudication" mode.

6.2.4 Engine running at 1000 rpm all the time

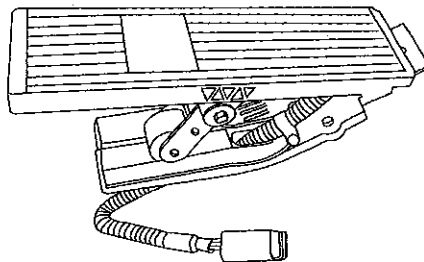
Accelerograph failure: ECU estimate the load by the signal from throttle pedal potentiometer, when failure occurred on throttle pedal, ECU will limit the revolution to 1000 for safety.

● Loose or wrong connection on electronic throttle pedal

Plug it again or check the connection of throttle and reconnect it

● Water intrusion in electronic throttle plug

Drying it by special tool and restart.





Operation and Maintenance Manual for Landking WP12 Euro III Series Diesel Engine

Note: when replace throttle, the same type is needed.

6.2.5 Engine hunting

● Reasons of engine hunting and solution

- a. Fuel injector works in bad abnormally, check fuel injector and wiring harness in each cylinder.
- b. For the vehicle with speed sensor, there are signals input as the vehicle stop: check speed meter, speed sensor and its wiring.
- c. Poor quality of fuel (water or waxiness included): clean fuel system, replace the fuel filter.
- d. Air leakage in low pressure fuel pipe: check the seal of fuel pipe and joint, release the air.
- e. Unstable atomization on fuel injector: check and repair

Note: idling caused by low water temperature is the normal function of ECU

With other load (like turn on air condition), idling will increase the revolution of 100rpm.



Appendix: Table of correction coefficient

a_d P. kPa	T. °C	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
110		0.97322	0.97487	0.97650	0.97813	0.97975	0.98136	0.98297	0.98456	0.98615	0.98773	0.98930	0.99086	0.99242	0.99397	0.99551	0.99704
108		0.97572	0.97737	0.97902	0.98065	0.98227	0.98389	0.98550	0.98710	0.98869	0.99027	0.99185	0.99341	0.99497	0.99652	0.99807	0.99960
106		0.97828	0.97993	0.98158	0.98322	0.98485	0.98647	0.98808	0.98968	0.99128	0.99286	0.99444	0.99602	0.99758	0.99914	1.00068	1.00222
104		0.98089	0.98255	0.98420	0.98584	0.98748	0.98910	0.99072	0.99232	0.99392	0.99552	0.99710	0.99868	1.00024	1.00180	1.00336	1.00490
102		0.98356	0.98523	0.98688	0.98853	0.99016	0.99179	0.99341	0.99503	0.99663	0.99823	0.99981	1.00139	1.00297	1.00453	1.00609	1.00764
100		0.98629	0.98796	0.98962	0.99127	0.99291	0.99455	0.99617	0.99779	0.99940	1.00100	1.00259	1.00417	1.00575	1.00732	1.00888	1.01043
98		0.98909	0.99076	0.99242	0.99408	0.99573	0.99736	0.99899	1.00061	1.00223	1.00383	1.00543	1.00702	1.00860	1.01017	1.01174	1.01330
96		0.99195	0.99362	0.99529	0.99695	0.99860	1.00025	1.00188	1.00351	1.00513	1.00673	1.00834	1.00993	1.01151	1.01309	1.01466	1.01622
94		0.99487	0.99656	0.99823	0.99990	1.00155	1.00320	1.00484	1.00647	1.00809	1.00971	1.01131	1.01291	1.01450	1.01608	1.01766	1.01922
92		0.99787	0.99956	1.00124	1.00291	1.00457	1.00622	1.00787	1.00950	1.01113	1.01275	1.01436	1.01596	1.01756	1.01915	1.02073	1.02230
90		1.00095	1.00264	1.00433	1.00600	1.00767	1.00933	1.01097	1.01262	1.01425	1.01587	1.01749	1.01910	1.02070	1.02229	1.02387	1.02545
88		1.00410	1.00580	1.00749	1.00917	1.01084	1.01251	1.01416	1.01581	1.01744	1.01907	1.02069	1.02231	1.02391	1.02551	1.02710	1.02868
86		1.00734	1.00904	1.01074	1.01242	1.01410	1.01577	1.01743	1.01908	1.02072	1.02236	1.02398	1.02560	1.02721	1.02881	1.03041	1.03200
84		1.01066	1.01237	1.01407	1.01577	1.01745	1.01912	1.02079	1.02244	1.02409	1.02573	1.02736	1.02899	1.03060	1.03221	1.03381	1.03540
82		1.01408	1.01579	1.01750	1.01920	1.02089	1.02257	1.02424	1.02590	1.02755	1.02920	1.03084	1.03246	1.03409	1.03570	1.03730	1.03890
80		1.01759	1.01931	1.02102	1.02273	1.02442	1.02611	1.02778	1.02945	1.03111	1.03276	1.03441	1.03604	1.03767	1.03928	1.04089	1.04250

Note: The temperature in the table is inlet air temperature; the air pressure is dry air pressure (not equal to atmospheric pressure). The temperature range of this table is 10 ~ 40 °C, the air pressure range is 80 ~ 110MPa, all the test should take this range into account by adopting necessary measure or choosing time. Corrected power: $P_{c0} = a_d * P_c$ (where: P_{c0} - corrected power, P_c - measured power, a_d - correction coefficient)

蓝擎 WP12 国 III 系列柴油机使用保养说明书

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