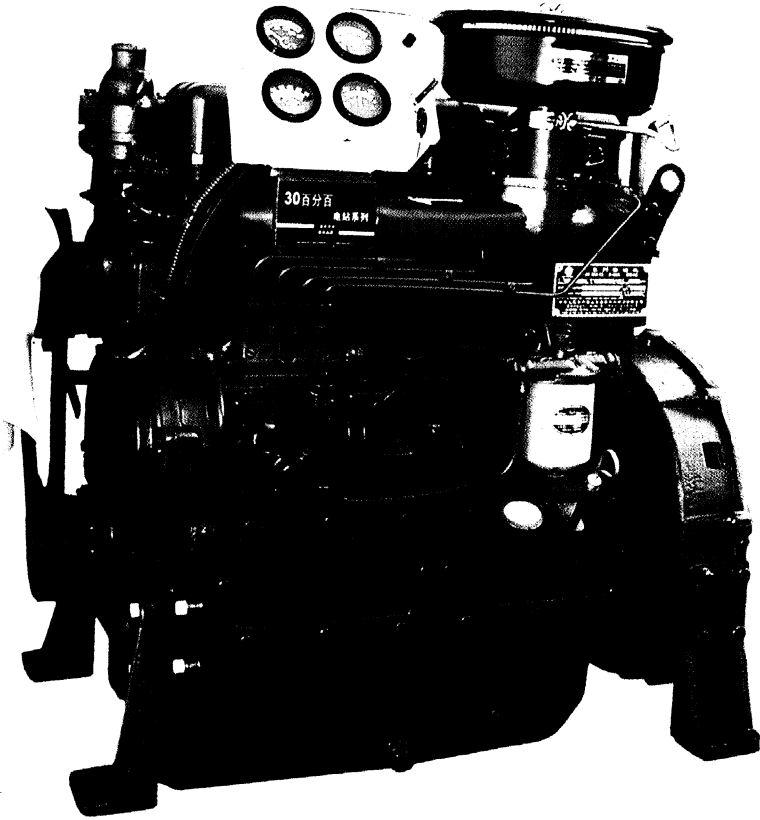




HUAFENGDONGLI

4102 Series Diesel Engine Operation And Maintenance Manual



Shandong Weichai Huafeng Power Co.,Ltd

Preface

HUAFENGDONGLI brand 4102 series diesel engine is a four - stroke, water - cooled, inline and direct injecting combustion chamber type, high - speed diesel engine. 4102 series is bore - enlarged from 95 series. In 1980s our company adopted the comet V combustion system and diesel design technique of Ricardo Consulting Engineers Company and have made great improvement in design. This type diesel engine possesses performances of high power, economy and liability, and reaching a advanced level among the same kinds products all over the world.

The National Science Congress prized HUAFENGDONGLI brand 4102 series diesel engine and it is easy to adapt. According to the different application, through being changed for some of its parts accordingly, it can be used to match with middle tractors, engineering machinery, middle vehicles, generating sets, irrigating machinery and agricultural machinery and so on. 4102 series is developed from 495 series, main parts are reinforced, Electrical system, Inlet system, Exhaust system, Cooling system have improved, and the output range is enlarged. ZH4102 is developed from K4102. It adopts the direct injecting combustion chamber, and improved its economy further. The model, its make - up rule and the meaning of the symbol for every type is as follows:

ZH	4	102	□	□	□ - - □	
K	4	102	□	□	□ - - □	
⑦	⑥	⑤	④	③	②	①

①: Distinguish symbol, Expressed with number sequence

②: Version symbol, expressed with number sequence

③: Application feature symbol, expressed with alphabet

No alphabet: for common use; T: for tractor; G: for engineering machinery; Q: for vehicle; D: for generating set; C: for marine use; P: for power take - off unit; Y: for transporting vehicle use.

④: Construction feature symbol, expressed with alphabet; no alphabet: for natural aspirated model; Z: for turbocharged model.

⑤: Cylinder bore (mm)

⑥: Cylinder number

⑦: Cylinder expanded (ZH: Direct injecting combustion chamber)

In order to keep the diesel engine in good condition in most time, prolong the guarantee period maximally, reduce the cost of usage, we compiled this manual on the basis of the "Nation Rated 495 Diesel Engine Manual" and the change and improvement of products to in-

roduce the operation and maintenance knowledge to the customers.

This operation manual mainly introduces common usage type. For the products is changing and improving continually, there may be some slight difference between the products and that described in this manual and the users are advised to notice it kindly.

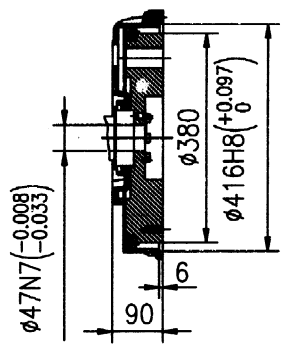
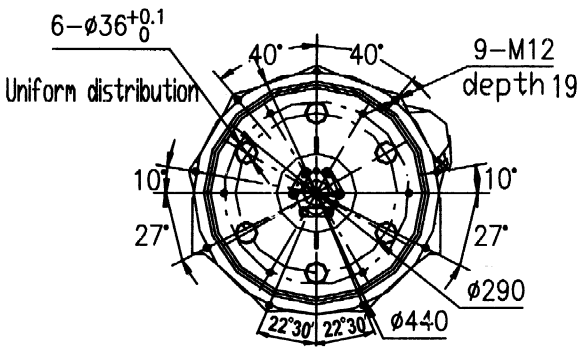
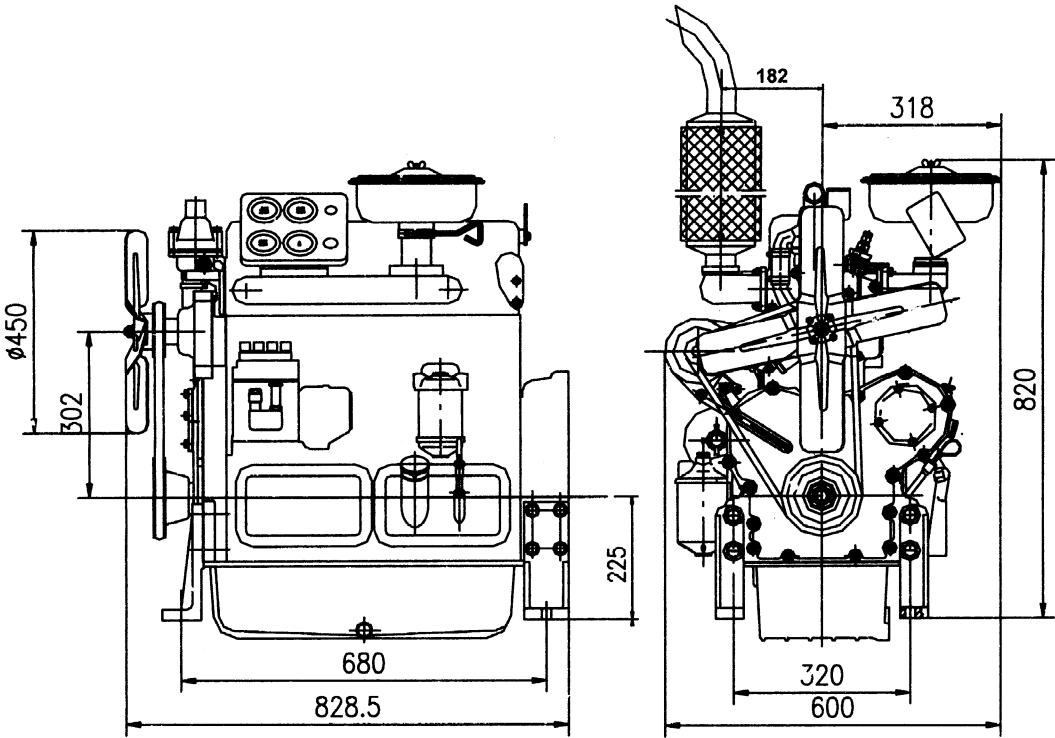
The manual is complied by Yu Caihong, Wei Yunfeng, Zhao Ruian, Wang Jinghai, and Sun Chuanhai. Advised by Li Peiyan, Chen ling, and finally examined and approved by Li Huaiqing.

For the limit of the compilers, there may be some mistakes in the manual, if you find any, please point out so that we can be corrected.

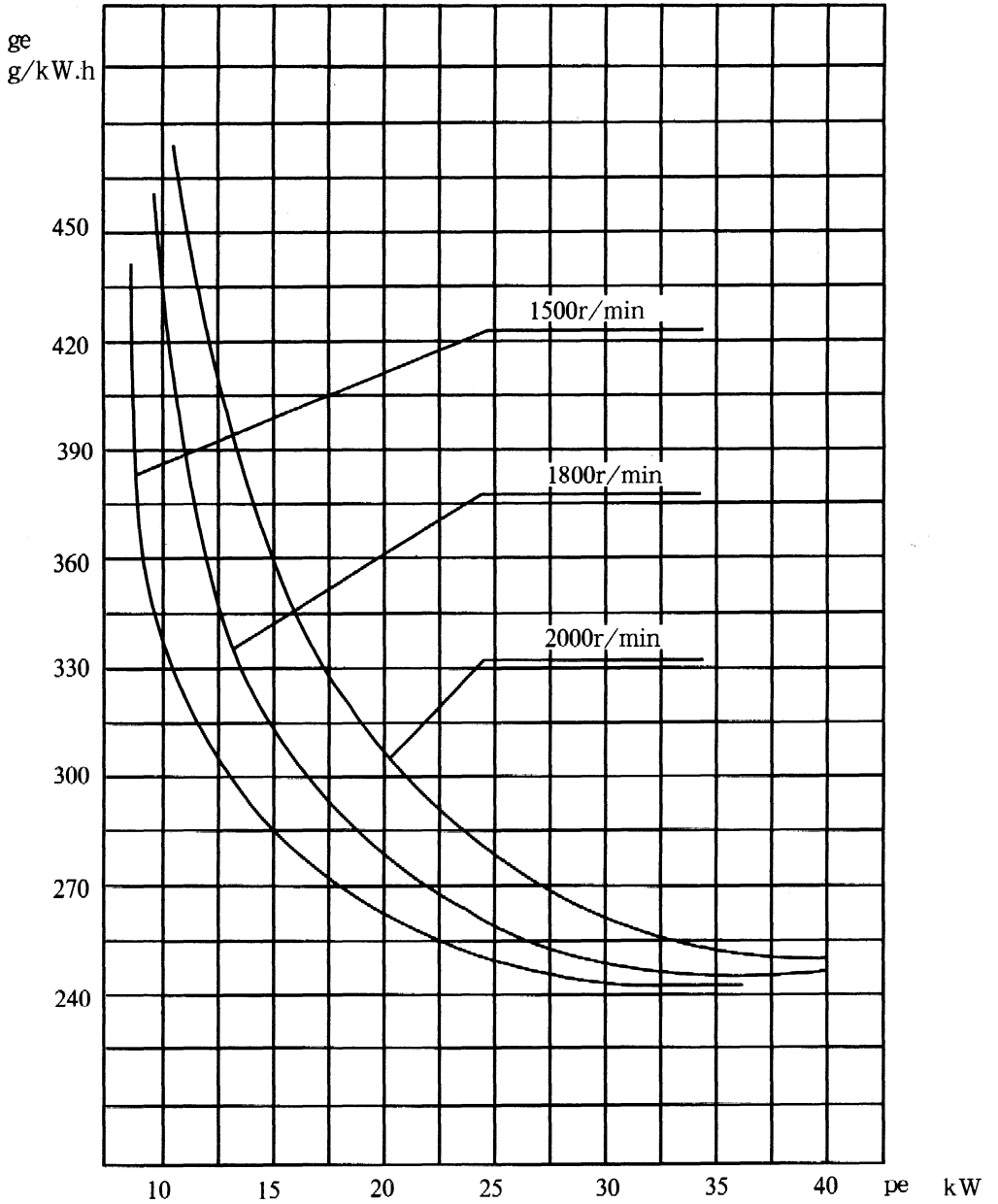
The compiler
November 2005

Attention

1. The diesel engine operators must familiarize themselves with this manual as well as engine construction and strictly follow the procedures of operation and maintenance especially the regulations for safety operation described in this manual.
2. Before operating an engine at full load, the 60 hours running in should be carried out as specified in the manual.
3. Increase its speed gradually after starting a cold engine, never let it run at high speed abruptly, and don't stop the engine instantly while its cooling water is still hot, also don't let the engine running long time without load.
4. If the ambient temperature falls below $+5^{\circ}\text{C}$, drain the cooling water out of the radiator, the lubricating oil cooler and the diesel engine itself completely after stopping the engine. Continuous keeping the water in the oil cooler should be forbidden.
5. Never run the diesel engine without an air cleaner so as to prevent the unfiltered air from entering the cylinders.
6. The engine must be filled with specified grade fuel and lubricating oil, and a special and clean container for each oil should be used. The fuel oil should be settled for 72 hours and filtered before using.
7. The inspection and repair of the components in electrical system must be carried out by the person who has a good knowledge of electricity.
8. The working environment of the diesel engine should be well ventilated to avoid being polluted by waste gas or smoke.
9. The power rating and amending of the diesel engine is according to GB6072.1-2000 the first section of reciprocating internal combustion engine: standard basic condition, the rating and testing method of power, fuel consumption and engine oil consumption.
10. The manufacturing of the diesel engine is according to the common technical requirement for low and middle level powered diesel engine in JB/T8895-1999 and Q/WHF002-2005 495 series diesel engine enterprise standard.
11. The No. of production license of this series diesel engine is: XK06-205-00524, XK06-205-00279.
12. The position of safety warning marks:
 - (1) There's guard against burning mark at the end of the cylinder cover which is beside the exhaust manifold of the diesel engine.
 - (2) There's a guard against fire mark at the oil filler.
 - (3) There's a guard against twinning mark on the inlet manifold.



Outline drawing for K1102D diesel engine



Load characteristic curve for 1500, 1800, 2000r/min diesel engine

4102 Main Technical Specifications

NO	Item / Model		4102	K4102	K4102G	K4102P	ZH4102D
			Four strokes, Water Cooling, Inline, Swirl combustion chamber				
1	Type						
2	Cylinder No. - Bore * Stroke (mm)		4 - - 102 × 115				
3	Total Displacement of Piston (L)		3.76				
4	Pressure Ratio		19:1				
5	Firing Order		1 - 3 - 4 - 2				
6	Air Intake Mode		Naturally Aspirated				
7	Rated Working Condition	1h Output / Speed (kW/r/min)	44/2000	36.3/1500	46.6/2400	44/2000	36.3/1500
		12h Output / Speed (kW/r/min)	40/2000	33/1500		40/2000	33/1500
8	Highest Idling Speed (r/min)		≤2160	≤1575	≤2640	≤2160	≤1575
9	Lowest Idling Stable Speed (r/min)		≤550				
10	Max Torque/Speed (N. m/r/min)		219/1500		213/1680	219/1500	
11	Rated Working Condition	Average Effective Pressure (Kpa)	650	702	620	650	702
12		Fuel Consumption Rate (g/kW. h)	≤258.4		≤266.6	≤258.4	
13		Oil Consumption Rate (g/kW. h)	≤2.04				
14		Exhaust temperature (°C)	≤600				
15	Crankshaft Rotating Direction		Anti - clockwise (Facing to the power output end)				
16	Cooling Mode		Forced Water Cooling				
17	Lubricating Mode		Compound type with pressure and splash				
18	Starting Mode		Electric starting				
19	Net Mass (kg)		320	380	340	450	380

Various temperature and pressure range

Oil temperature	$\leq 100^{\circ}\text{C}$ (the TC Engine) $\leq 95^{\circ}\text{C}$ (naturally aspirated)
Outlet cooling water temperature	$\leq 98^{\circ}\text{C}$ (the TC Engine) $\leq 90^{\circ}\text{C}$ (naturally aspirated)
Oil pressure	0.20 ~ 0.40MPa $\geq 0.5\text{MPa}$, when at idling speed
Fuel injection pressure	$12^{+1.0}\text{MPa}$

Main bolts tightening torque

Cylinder head bolt	160 ~ 180N. m (Direct injecting: 190 ~ 210)
Main bearing bolt	160 ~ 180N. m
Flywheel tightening bolt	100 ~ 120N. m
Connecting rod bolt	100 ~ 120N. m
Gear case bolt	30 ~ 40N. m
Flywheel housing bolt	50 ~ 60N. m

Main adjusting data

Valve lash(cold state)	
Air intake & exhaust valve	0.35 ~ 0.45mm
Valve timing:	
Air intake valve open	$12^{\circ} \pm 3^{\circ}$ before top dead center
Air intake valve open	$36^{\circ} \pm 3^{\circ}$ after bottom dead center
Exhaust valve open	$56^{\circ} \pm 3^{\circ}$ before bottom dead center
Exhaust valve open	$12^{\circ} \pm 3^{\circ}$ after top dead center
Compression clearance	1 ~ 1.2mm
Fuel delivery advance angle:	
1500 ~ 1600r/min	$15^{\circ} \pm 2^{\circ}$ before top dead center
1800 ~ 2000r/min	$17^{\circ} \pm 2^{\circ}$ before top dead center
2400r/min	$18^{\circ} \pm 2^{\circ}$ before top dead center

Matched clearances and wear limit of main parts

NO	Matched parts	Standard size	Matched clearance	Wear limit
1	Crankshaft main journal neck and main bearing	Shaft $\Phi 75 \begin{matrix} 0 \\ -0.019 \end{matrix}$ Hole $\Phi 75 \begin{matrix} +0.135 \\ +0.070 \end{matrix}$	0.070 ~ 0.154	0.30
2	Crankshaft thrust ring and crankshaft		Axial clearance 0.080 ~ 0.230	0.50
3	Crankshaft & connecting rod journal neck and connecting bearing	Shaft $\Phi 65 \begin{matrix} 0 \\ -0.019 \end{matrix}$ Hole $\Phi 65 \begin{matrix} +0.093 \\ +0.050 \end{matrix}$	0.050 ~ 0.112	0.30
4	Connecting rod big end and crankshaft	Shaft $\Phi 38 \begin{matrix} -0.170 \\ -0.330 \end{matrix}$ Hole $\Phi 38 \begin{matrix} +0.100 \\ 0 \end{matrix}$	Axial clearance 0.170 ~ 0.430	0.70
5	Piston skirt and cylinder liner	Shaft $\Phi 102 \begin{matrix} -0.140 \\ -0.170 \end{matrix}$ Hole $\Phi 102 \begin{matrix} +0.035 \\ 0 \end{matrix}$	0.140 ~ 0.205	0.50
6	Piston pin and connecting rod bushing	Shaft $\Phi 35 \begin{matrix} 0 \\ -0.011 \end{matrix}$ Hole $\Phi 35 \begin{matrix} +0.034 \\ +0.009 \end{matrix}$	0.009 ~ 0.045	0.15
7	The first compression ring and ring grave	Shaft $\Phi 3 \begin{matrix} 0 \\ -0.015 \end{matrix}$ Hole $\Phi 3 \begin{matrix} +0.100 \\ +0.008 \end{matrix}$	0.080 ~ 0.115	0.40
8	The second compression ring and ring grave	Shaft $\Phi 2.5 \begin{matrix} 0 \\ -0.015 \end{matrix}$ Hole $\Phi 2.5 \begin{matrix} +0.060 \\ +0.040 \end{matrix}$	0.040 ~ 0.075	0.30
9	Oil ring and ring grave	Shaft $\Phi 5 \begin{matrix} 0 \\ -0.015 \end{matrix}$ Hole $\Phi 5 \begin{matrix} +0.050 \\ +0.030 \end{matrix}$	0.030 ~ 0.065	0.25
10	Gap of first compression ring in cylinder ^{-0.1}	Gauge within $\Phi 102.00$	0.250 ~ 0.500	3.00
11	Gap of second & third compression ring in cylinder	Gauge within $\Phi 102.00$	0.200 ~ 0.450	3.00
12	Gap of oil compression ring in cylinder	Gauge within $\Phi 102.00$	0.200 ~ 0.450	3.00
13	Camshaft journal neck and bushing	Shaft $\Phi 50 \begin{matrix} -0.080 \\ -0.105 \end{matrix}$ Hole $\Phi 50 \begin{matrix} +0.025 \\ 0 \end{matrix}$	0.080 ~ 0.130	0.25

NO	Matched parts	Standard size	Matched clearance	Wear limit
14	Camshaft thrust plate and camshaft	Shaft $\Phi 12 \begin{matrix} -0.050 \\ -0.120 \end{matrix}$ Hole $\Phi 12 \begin{matrix} +0.100 \\ 0 \end{matrix}$	0.050 ~ 0.220	0.40
15	Cylinder liner over the cylinder block surface	Shaft $\Phi 10 \begin{matrix} +0.050 \\ 0 \end{matrix}$ Hole $\Phi 10 \begin{matrix} 0 \\ -0.050 \end{matrix}$	Engine body projection (Selective fitted) 0.030 ~ 0.080	
16	Valve push rod push rod hole	Shaft $\Phi 16 \begin{matrix} -0.016 \\ -0.034 \end{matrix}$ Hole $\Phi 16 \begin{matrix} +0.018 \\ 0 \end{matrix}$	0.016 ~ 0.052	0.20
17	Idler shaft and idler shaft bushing	Shaft $\Phi 26 \begin{matrix} -0.020 \\ -0.041 \end{matrix}$ Hole $\Phi 26 \begin{matrix} +0.021 \\ 0 \end{matrix}$	0.020 ~ 0.062	0.20
18	Air intake valve and valve guide	Shaft $\Phi 9 \begin{matrix} -0.030 \\ -0.050 \end{matrix}$ Hole $\Phi 9 \begin{matrix} +0.022 \\ 0 \end{matrix}$	0.030 ~ 0.072	0.25
19	Exhaust valve and valve guide	Shaft $\Phi 9 \begin{matrix} -0.040 \\ -0.060 \end{matrix}$ Hole $\Phi 9 \begin{matrix} +0.022 \\ 0 \end{matrix}$	0.040 ~ 0.082	0.25
20	Rocker arm shaft and bushing	Shaft $\Phi 16 \begin{matrix} -0.016 \\ -0.034 \end{matrix}$ Hole $\Phi 16 \begin{matrix} +0.018 \\ 0 \end{matrix}$	0.016 ~ 0.052	0.25
21	Idler and idler shaft		Axial clearance 0.100 ~ 0.350	
22	Contacting clearance of various timing gear		Clearance of tooth flank 0.130 ~ 0.170	
23	Oil pump rotor and pump block surface		Adjusting clearance 0.050 ~ 0.100	
24	Contacting clearance between the oil pump		0.060 ~ 0.188	0.50
25	Water pump impeller and pump body		Back clearance 0.200 ~ 0.700	
26	Water pump impeller and packing block		Adjusting clearance 0.400 ~ 0.800	

Electrical System

4102 series diesel engines have 12V and the 24V two kinds of electrical systems. For one wire system cathode earth. In the electrical system the electrical machinery rated voltage and the electric appliance rated voltage must tally with the electrical system voltage.

The battery used for getting up is the diesel engine power equipment, Its performance affects the diesel engine directly the starting, According to the starting motor characteristic choices stipulation capacity of storage battery, the battery installs the position to have to approach the starting motor as far as possible, in order to reduce between the accumulator cell and the starting motor the connecting lead length, preventing when starting the line pressure drop oversized. The connecting lead uses 35 square millimeter low - tension wires. Regarding 12V and 14V starting motor, when the starting current is biggest, the line pressure drop should not to be bigger than 0.5V and 1V.

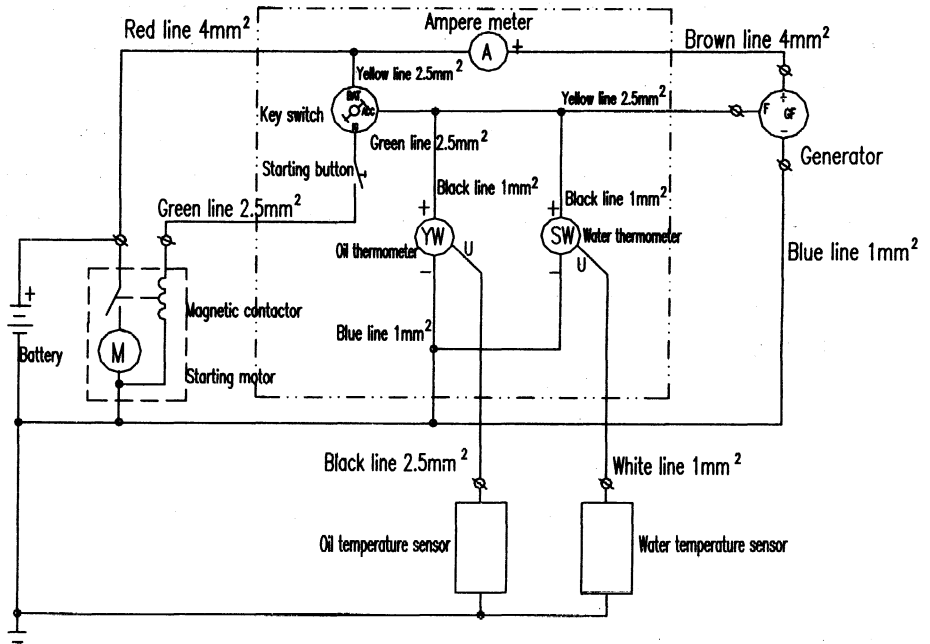
The battery has not charged, before the use you must carry on the initial charge according to the battery request. In the diesel engine generating, you should pay attention to the charging current frequently the size, when the ampere meter indicated value approaches "0", it expressed the battery already filled the electricity, and you may shut off the charging circuit.

The generator uses the JF series silicon rectification generator. The silicon rectification generator has the volume to be small, the structure to be simple, and the low speed charge performance to be good and so on. On the generator top plate is loaded with two groups of silicon rectifier cell. The alternating current outputs which by three groups of windings passes through the three - phase bridge type full - wave rectification turn to direct current, by " + " wiring column outputs. Dont allow with the way which striking a light to earth inspects whether generates work normally, preventing the silicon rectifier cell burning out.


The voltage regulator function is that the voltage will be automatic the output voltage to stabilize in 13.5 ~ 14.5V or in the 27 ~ 29V scope when the rotational speed of 14V generator or 28V generator changes. These two kinds of generators separately match FT111 and the FT211 regulator. If you need to meet the battery control lamp, you change the FT126 and the FT226 regulator. When using the FT111 and the FT211 regulator, you should cut the battery after the engine off immediately, Prevents the battery to the field coil electric discharge, the starting of diesel engine will effect next time. The regulator is the precision electric appliance. Do not have to disassemble the adjustment generally, when it is necessary to adjust on the special purpose equipment.

Starting motor is a totally enclosed direct current series motor. The starting motor revolves electric current oversized, only permits the short time work, each time starting time does not have to surpass 10s. If you must start continuously, the time interval does not have to

be smaller than 2min, and starting the number of times does not to be supposed continuously to surpass 10 times generally, in order to avoid damage starting motor and battery.



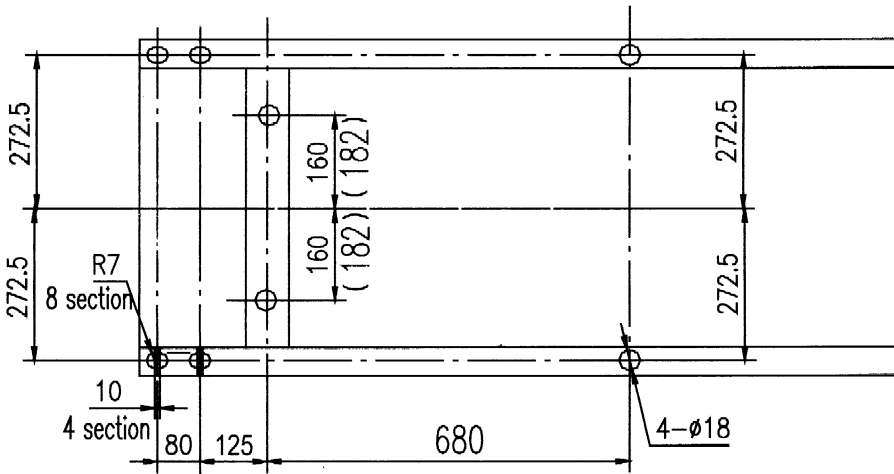
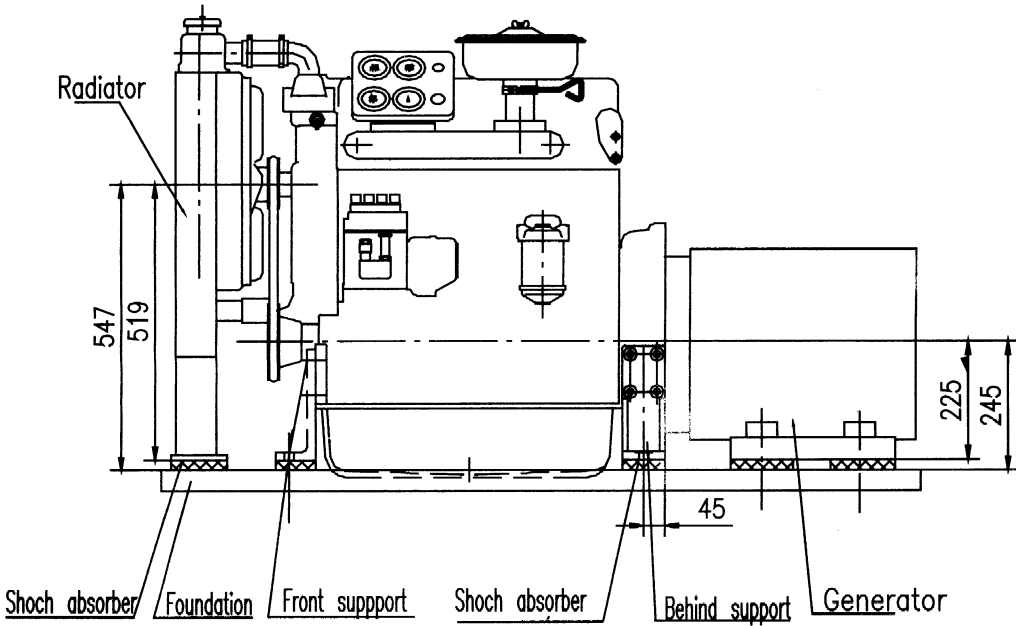
Electrical system schematic drawing

 4102 series diesel engine has used the inductance measuring appliance, when using the meter the power source should use the 14V direct - current power supply or the battery.

The circuit key switch has three working positions. The key turns clockwise to put through the preheating starting switch, the voltage regulator and other electric appliances, the diesel engine may start at. After the diesel engine is started the key should turn anti - clockwise extension, at the same time you should shut off the preheating starting switch, in order to avoid the accident.

The preheating starting switch has four working positions. Turning to "preheating" only puts through the pre - heater, if you turn to "the preheating starting", it may preheat and start. If you do not need preheating you can turn to "the starting" directly. The switch should automatically return to "0" after loosing your hand and the key - off.

Instaii schematic drawing of foundation and radiator
for 4102D series generates electricity diesel



Note: the size in parenthesis are install hole distance
when adopt welds front support

