



MANUAL

OPERATION & MAINTENANCE



UNDERSLUNG REEFER GENERATOR SET



Zhejiang Universal Machinery Co., Ltd.

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1.Safety Precautions

1.1 General Practices

1. Always Wear Goggles Or Safety Glasses. Battery acid can permanently damage the eyes (see First Aid under Battery Hazards).
2. Keep your hands, clothing and tools clear of all fans, pulleys and belts when the unit is running. Be very careful with tools or meters to avoid contacting the rotor, if it is necessary to run the alternator with the end cover removed.
3. Be sure all mounting bolts are tight and the correct length for their particular application.
4. Use extreme caution when drilling holes in the unit. The holes may weaken structural components. Holes drilled into electrical wiring can cause fire, explosion or shock hazard.
5. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
6. Do not work on a generator set in a confined area. Diesel exhaust can become very dangerous under certain conditions.

1.2 Battery Hazards

Few people realize just how dangerous a battery can be. The electrolyte in a lead acid battery is dilute sulfuric acid (H_2SO_4). During charge or discharge functions of a battery, a chemical change takes place within the individual cells.

This causes the gas bubbling we see through the filler hole. The bubbling gases are hydrogen and oxygen. They are EXPLOSIVE. An explosion could occur if a means of ignition is present during this gassing action. A defective battery may suddenly explode even while standing idle.

Added to this danger, is the fall-out of highly corrosive sulfuric acid caused by the explosion. A rubber blanket or other cover can be used to reduce the risk of injury from a possible explosion.

1.21 Precautions

1. Always wear eye protection when servicing a battery. If electrolyte is splashed on the skin or in the eyes, flush immediately under running water. Obtain medical help as soon as possible.
2. Do not remove the vent caps when charging a battery.
3. Make sure the On/Off switch is in the OFF position when disconnecting or connecting the generator set battery. This will prevent an electrical arc which could cause the battery to explode. Disconnect the ground cable first, preferably at a point AWAY FROM THE

BATTERY. Connect the ground cable last, again away from the battery if possible.

4. Do not check a battery by shorting (sparking) across the battery posts. Eye injury may result from the electrical arc or from an explosion.

1.22 First Aid

- EYES: Immediately flush eyes with large amounts of water while holding the eyelids open for at least 15 minutes. Get prompt medical attention.
- SKIN: Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.

1.3Electrical Hazards

1.31 High Voltage

The possibility of serious or even fatal injury from electrical shock exists, when servicing or repairing a generator set. Extreme care must be used when working with an operating generator set. Lethal voltage potentials can exist at the unit power cord, inside the exciter control box, inside any high voltage junction box and within the wiring harnesses.

1.32 Precautions

1. Turn the generator set On/Off switch to OFF before connecting or disconnecting a power plug to the generator set receptacle. Never attempt to stop a refrigeration unit by disconnecting the power plug from an operating generator set.
2. Be certain a unit power plug is clean and dry before connecting it to the generator set receptacle.
3. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
4. Stand on a solid work platform with rubber mats or dry wood if possible. If you slip, you can instinctively grab for support. This can be lethal when working on a generator set.
5. Do not make any rapid moves when working on high voltage circuits. If a tool or other object falls, do not attempt to grab it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
6. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
7. Never work alone on high voltage circuits on the generator set. Another person should always be standing by in the event of an accident to shut off the generator set and to aid a victim.
8. Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

1.33 First Aid

IMMEDIATE action must be initiated after a person has received an electrical shock. Obtain immediate medical assistance if available.

The source of shock must be immediately removed by either shutting down the power or removing the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles) or by a rescuer wearing electrically insulated gloves and safety glasses.

Whichever method is used, do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

If the victim has to be removed from a live circuit, pull the victim off with a non-conductive material.

Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. DO NOT TOUCH the victim. You can receive a shock from current flowing through the victim's body.

After separating the victim from the power source, check immediately for the presence of a pulse and respiration. If a pulse is not present, start CPR (Cardio Pulmonary Resuscitation) and call for emergency medical assistance. If a pulse is present, respiration may be restored by using mouth-to-mouth resuscitation, but call for emergency medical assistance.

1.34 Low Voltage

Control circuits are low voltage (12 Vdc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amperes) can cause severe burns if shorted to ground.

Disconnect the negative terminal of the battery if possible when working on the generator set.

Disconnect the cable end that is away from the battery.

Do not wear jewelry, watches or rings. These items can short out and cause severe burns to the wearer.

1.4 Safety Symbol Summary

This equipment has been supplied with numerous safety and operating decals. These decals provide important operating instructions and warn of dangers and hazards.

! WARNING

Safety instructions

IMPROPER OPERATION CAN CAUSE SEVERE INJURY OR DEATH

- Read the instruction manual carefully before operating or servicing.
- This machine should only be operated by a person with sufficient knowledge and skills.
- High voltage circuits are located inside the output terminal cover and control panel. Close the cover and control panels before operating.
- Warning parts and electrical traces are contained within the enclosure. Close all doors and lock them before operating.
- Before the start key and cathode of battery have to be removed.
- Without this step, it may cause serious injury.

! WARNING

PREVENT BURNING ACCIDENT

If need operate close to the generator, make sure all parts are fully cooled down.

! WARNING

PREVENT BURNING ACCIDENT

do not open radiator cap while it is still hot

! WARNING

BEWARE OF EXHAUST GASES

When operate genset in relatively inclosed space like INDOORS, ensure good ventilation. Or it can cause facial scald.

OIL FILL PORT INSIDE

COOLANT FILL PORT INSIDE

! WARNING

FIRE

- Make sure to stop engine and keep fires away from fuel when refueling.
- Never place flammable material near the machine

DIESEL FUEL (ASTM No.2-D)

! WARNING

FIRE

- Make sure to stop engine and keep fires away from fuel when refueling.
- Never place flammable material near the machine

DIESEL FUEL (ASTM No.2-D)

OIL DRAIN

DIESEL DRAIN

COOLANT DRAIN

!

DANGER

DO NOT PANEL WHILE UNIT IS RUNNING

HIGH VOLTAGE

! WARNING

ELECTRIC SHOCK AND ARC FLASH CAN CAUSE SERIOUS INJURY OR DEATH

SAFETY INSTRUCTIONS

- Read and understand the supplied Operator's Manual before operating the machine. Failure to do so increases the risk of injury to yourself or others.
- Always complete the grounding path from the ground terminal on this genset to an external grounding source
- An isolation (transfer) switch must be installed before connecting this generator to any buildings
- Do not touch running electrical parts. Wearing dry insulating gloves when operating. Don't operate the unit under wet surrounding. Maintain electrical parts in proper condition.

2. Specifications

This generator set is a self-contained, fully automatic diesel-powered unit designed to supply power for reefer containers. It is equipped with a structural steel frame, inside which the diesel engine is installed and directly coupled to an AC generator. The engine adopts a vertical in-line four-cylinder diesel engine manufactured by FAW, matched with a 15 kW brushless double-bearing generator. During unit operation, the voltage controller monitors the generator output voltage in real time and makes dynamic adjustments to ensure the voltage complies with ISO limit requirements.

All electrical control components are integrated into a control box with operating switches and buttons. Gauges are mounted on the control panel, which also acts as the cover of the control box. The deflector assembly and windowed control box door provide comprehensive protection for the control panel.

Auxiliary engine components include storage battery, solid-state charging system, spin-on lubricating oil filter, fuel filter and other essential parts to guarantee stable unit operation. The water pump and radiator cooling fan are belt-driven by the engine crankshaft.

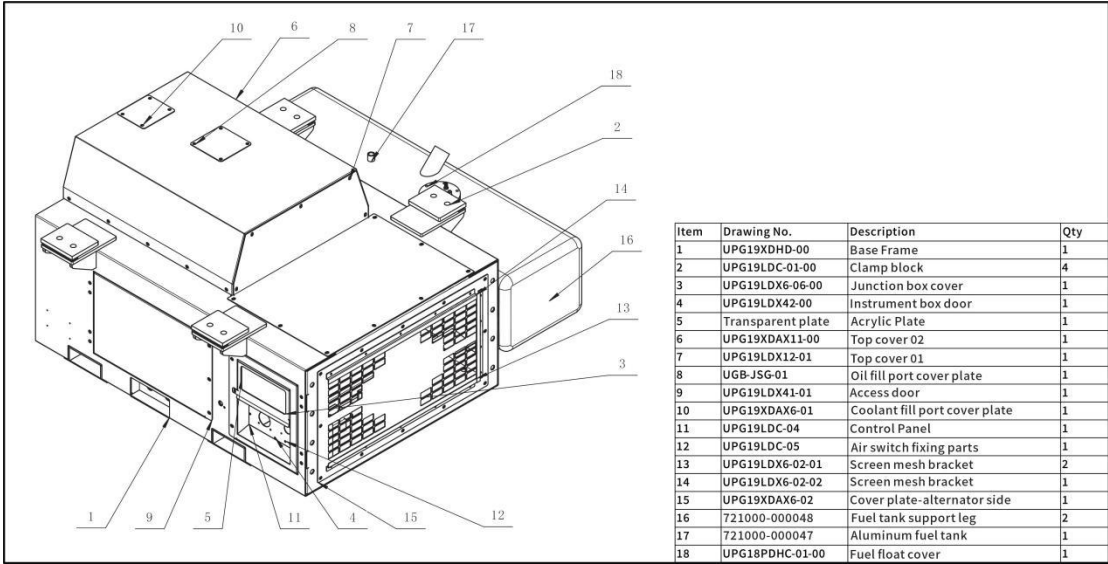
All directional descriptions of the engine are referenced from the flywheel end. This generator set is supplied in a standard base configuration, with optional auto-restart function, or a combined configuration of auto-restart and low coolant sensor. The auto-restart function enables automatic unit restart in case of unexpected shutdown. It is also built with fault indicator lights to alert abnormal conditions such as low oil pressure, high water temperature, overspeed and over-crank

Features:

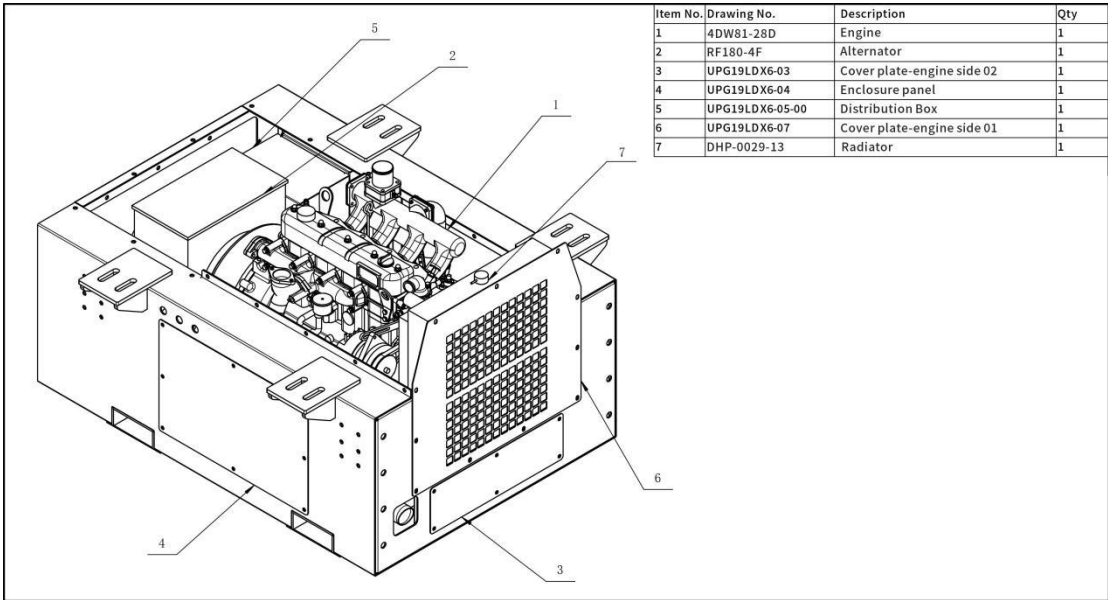
- General structure: Forklift pockets are provided at the bottom of the Genset equipment. The forklift pocket ends are close to prevent damage to the reefer container. The frame contains the water cooled engine and engine accessories, generator, battery, control box and gauges.
- Structural frame and integral fuel tank: The fuel tank is tested and cleaned by diesel fuel at 80-120kpa pressure, the frame and outer surface of the fuel tank are primer coated with an epoxy ester chrome-free paint immediately after shot-blasting, and then finish coated with a high solids polyester baked-on enamel paint. Surface color is black.
- Panels and doors: Metal-door, control box, and receptacle box are primer coated with an epoxy-ester chrome-free paint immediately after shot-blasting, and then finish coated with high polyester baked-on enamel paint. Surface color is white.
- Hardware: All hardware and hinges are stainless steel or electro-less nickel plated for maximum protection from salt water corrosion.

2.1 View

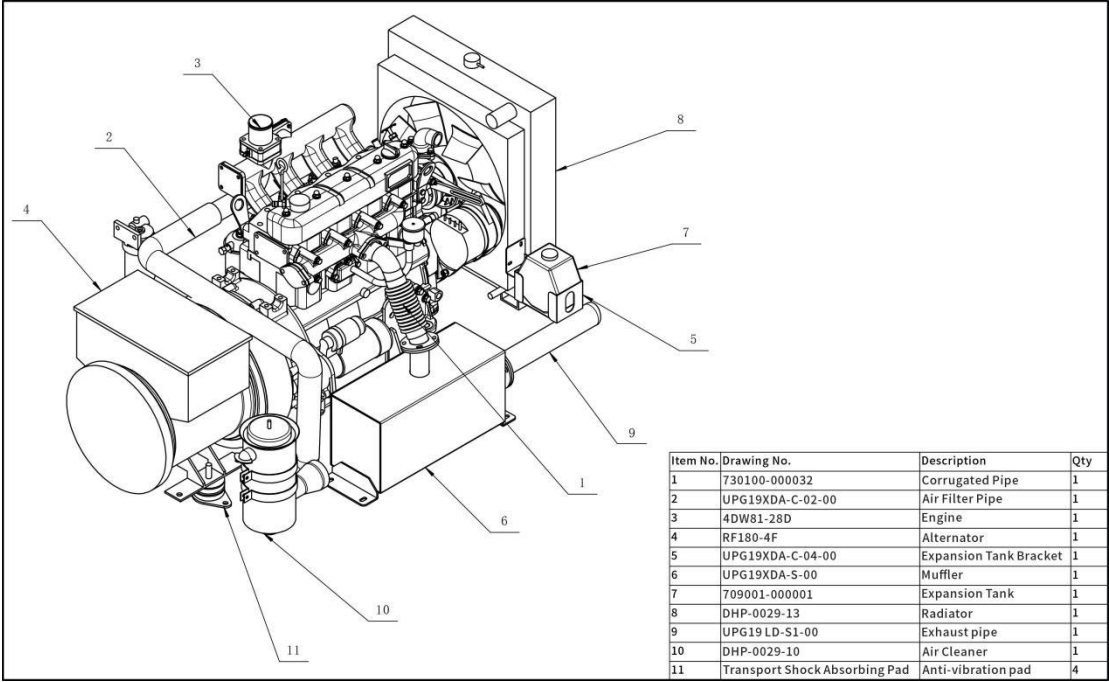
2.11 External



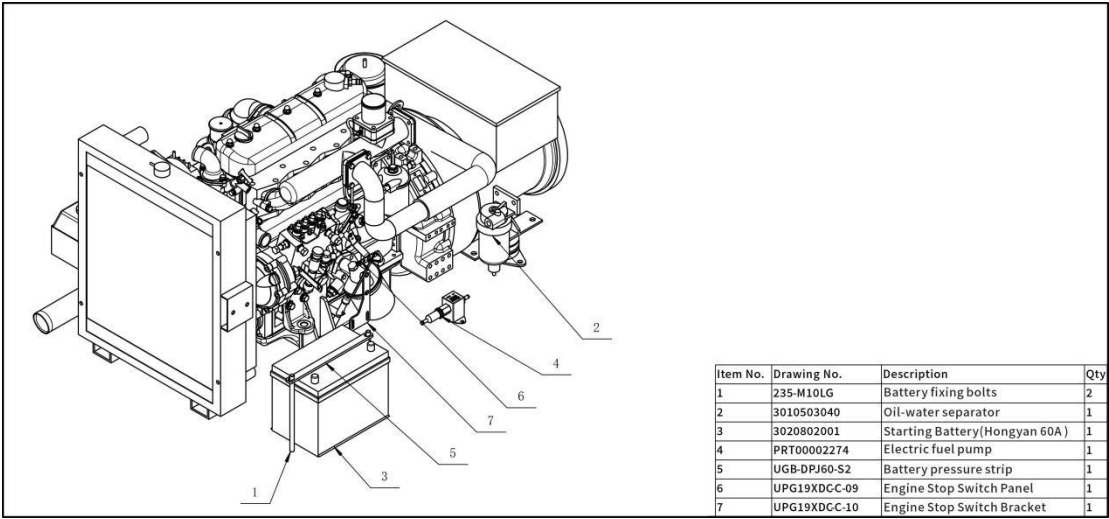
2.22 Internal



2.23 Internal Connections



2.24 Generator



2.2 Main Specifications

Item	Specification
Rated power(kw)	15kw/18.75kva
Frequency(HZ)	60HZ
Voltage(V)	460V
Noise level for silent type(Db)	74/1M
Amps(A)	23.5
ENGINE	Water-cooled,4-stroke
Model	4DW81-28D
12 hours rated power(kw)	20
Cylinders	4
Borex stroke(mm)	85×100
Intake Method	Nature Intake
Displacement(L)	2.27
Cooling starting method	Electric start
Engine manufacturer	FAW
Alternator	RF180-4F
Rated power(kw/kva)	18kw/22.5kva
Rated currenecy(A)	31.5
Power factor (cosφ)	0.8 lagging
Phase/Rotary speed	3-phase,1800rpm
Excitation	Brush less,Self-Excited system
Voltage regulation	Automatic
Net weight(kg)	680
Packing size L×W×H(mm)	1390×1613×828
Fuel tank capacity (L)	180

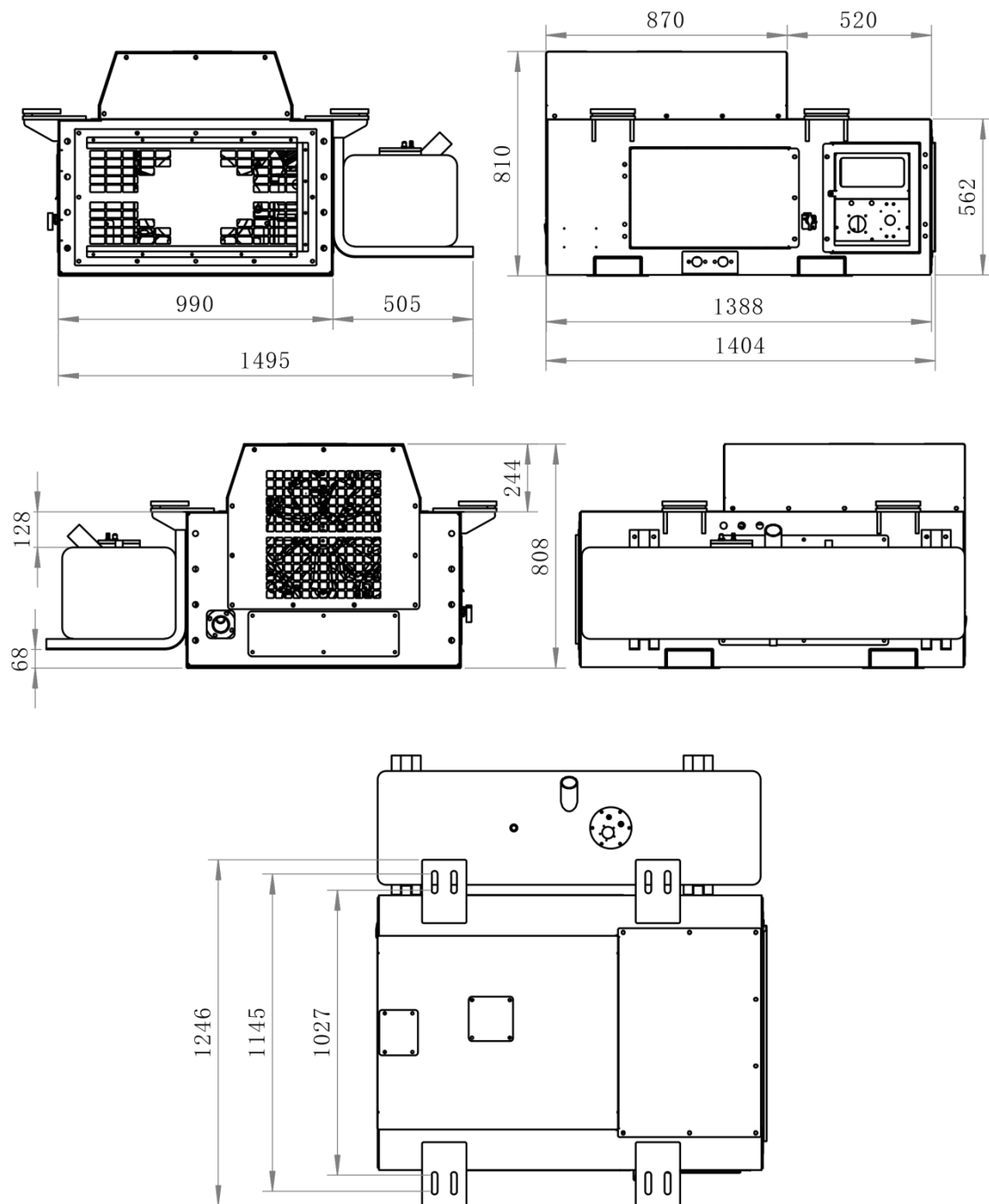
2.3 Engine Specifications

Item	Specification
Type	Vertical, water-cooled, 4-cycle diesel engine
Number of cylinders	4 inline
Bore	85.0 mm
Stroke	100 mm
Displacement	2.27 litres
Aspiration	Naturally aspirated
Compression ratio	17:01
Combustion system	Indirect injection
Rated power(kW)	20
Standby power(kW)	22
Fuel consumption(g/kWh)	240
Oil consumption(L/h)	0.05
Cooling system	Liquid
Total coolant capacity	7.8 litres
LWH	920×610×760 mm
Dry weight	240.0 kg
Rated speed	1800 rpm

2.4 Alternator Specifications

Item	Specification
RATED OUTPUT	18KW/22.5KVA
VOLTAGE&PHASE	460V 3 PHASE
FREQUENCY	60HZ
CONTROL SYSTEM SER. 4	TRANSFORMER SELF EXCITED
VOLTAGE REGULATION	$\pm 5\%$
SUSTAINED SHORT CIRCUIT	SHORT CIRCUIT CURRENT:450%
INSULATION SYSTEM	CLASS H
PROTECTION	IP22
RATED POWER FACTOR	0.8
STATOR WINDING	DOUBLE LAYER CONCENTRIC
WINDING PITCH	TWO THIRDS
WINDING LEADS	12
STATOR WDG RESISTANCE	0.305 hms PER PHASE AT22°C SERIES STAR CONNECTED
ROTOR WDG. R • ESISTANCE	0 . 64 ohms at 22°C
R.F. I. SUPPRESSION	BS EN 61000 -6 -2&BS EN 61000 -6 -4 ,VDE 0875G , VDE0875N . refer to factory for others
WAVEFORM DISTORTION	NO LOAD<1 . 5%NON-DISTORTING BALANCED LINEAR LOAD<5.0%
MAXIMUM OVERSPEED	2250 Rev/Min
BEARING NON-DRIVE END	BALL. 6306-2RS. (ISO)

2.5 Physical Specifications



3. Operation

3.1 Precautions

- When using the diesel engine, it is necessary to make adjustment and maintenance as per this Manual.
- When the engine is cold-started, pre-heating is necessary. Pre-heating time should be 20s~30s, and no more than 40s.
- The starting motor should be used at one time no more than a duration of 5s. Interval between every two starting operations should be more than 2min.
- New diesel engines or engines just subjected to an overhaul must not work at high speed or at full load, until they have worked for a wear-in period of 50~100h, during which they run at a low speed (no more than 2200 r/min) or less load (no more than 70% of full-load).
- Fuel oil for the engines must be clean. Before use, the fuel oil must at least be precipitated for more than 4 days or filtered with silk cloth.
- Normal water temperature (75~90°C) should be kept. Normal engine oil pressure, when the engine is running at a medium speed, should be 196~392 kPa.

3.2 Operation

3.21 Fuel Oil, Engine Oil And Cooling Water

3.211 Diesel Oil

The diesel oil should have a sulfur content of less than 0.5%. Diesel oil with low freezing point should be used in winter. Diesel oil brands should be selected basically as per ambient temperature conditions (see Table 2-1). For example, #-35 diesel oil should be used for ambient temperature of -29°C.

Table 3.211 Relations between diesel oil brands and suitable lowest temperature

Diesel oil brand	#10	#0	#+10	#+20	#+35
Sulfur content (%)	0.2	0.2	0.2	0.2	0.2
Cetane value	45	45	45	45	45
Freezing point (°C)	10	0	-10	-20	-35
Suitable lowest temperature (engine's operating ambient temp.) (°C)	18	4	-5	-14	-29

Diesel oil must be kept highly clean, free of pollution by dust or impurities. Before being injected into the fuel tank, the diesel oil should be kept still for more than 27h. Then

upper part/layer of diesel oil should be taken for use. This is extremely important for preventing the fuel injection pump and plunger from being earlier worn off.

3.212 Engine Oil

Correct selection of engine oil directly helps ensure reliable working and prevention of parts from being abnormally worn-off. A natural air-intake type engine should use oil of Class CC (or Class CD), while a supercharge type engine should use oil of Class CD. In addition, selection of engine oil brands also bases on engine's operating ambient temperature (see Table 2-2). For example, 15W/40# oil should be selected for Class CC or CD, when ambient air temp is -15°C.

If ambient temperature occasionally exceeds its limit, only starting performance will be affected, and the engine itself will not be damaged. Engine oil should be kept clean, free of pollution by dust or impurities. After the engine oil is added, it is necessary to inspect the oil level inside the crankcase sump as follows: pull out the oil dipstick and clean it with gauze, then insert it back; pull it out again and inspect if the oil-level indication is between the upper limit and lower limit. The oil level should at any time be no lower than the lower-limit on oil dipstick.

Table 3.212 Relations between engine oil brands and suitable lowest temperature

Oil brand	5W/30	10W/30	15W/40	20W/40	30	40
Engine's operating ambient temp. (°C)	-25	-20	-15	-10	5	> 25

To ensure the reliable operation of diesel engines, maximize their service life and improve exhaust emission performance, we strongly recommend **Mobil Delvac Legend CH-4 15W-40/20W-50 Heavy Duty Diesel Engine Oil**.

3.213 Cooling Water

rainwater, tap water or clean river-water is preferred as the cooling water. However, tap water with well-water as its source, or well-water, which both contain more minerals, should not be used; otherwise, inside the engine cooling system, more water-scale will be produced, thus cooling effectiveness will be affected and engine be troubled. In winter when the temperature is very low, it is possible to add some anti-freeze liquid to prevent freezing. Most commonly used anti-freeze liquid is ethylene glycol (glycol) water solution or alcohol. When ambient temperature is below 0°C and the engine has difficulty in starting, cooling water can be heated to higher than 80°C so that it can be used normally.

Selection of cooling water:

For engines with advanced water-cooling, its cooling system have a very high requirement for cooling medium used. Please use the coolant, dedicated to Brand Xichai diesel engines. This coolant, conforming to National Standard SH0521-92, not only has an anti-freezing capability and has a freezing point of -3.5°C ~ -4°C, but also has a boiling point as high as 107°C ~ 108°C, effectively preventing the evaporation of water. Also, it can prevent water-scale and prevent the cooling water from forming water-scale and bubbles, by which the cooling effectiveness is improved. In addition it has long-term

effective anti-rust and -corrosion characteristics. This coolant is suitable for the cooling systems of all types of diesel engine, and can be used throughout the year, and has a preservation period as long as 1.5 ~ 2 years. The coolant dedicated to Brand Xichai diesel engines, which contains water (distilled water or ion water), additives and ethylene glycol, can directly be add into the cooling system.

3.22 Inspection & Preparation Before Starting The Engine

- Check each connection on the diesel engine if reliable, and handles (e.g., handle for throttle and stopping etc) if go smoothly and freely.
- Turn the crankshaft for several turns, and check all moving parts if move smoothly and freely.
- Check the oil level in crankcase sump and fuel-injection pump, if at the scale position specified.
- Check the water tank if filled full with the cooling water, and check water-pipe joint(s) if any leaks.
- Check the fuel tank if filled full with diesel oil, and check fuel pipelines if fluently and unclogged, and each fuel-pipeline joint if any leaks, and open the valve(s) of fuel tank.
- Check the storage battery if full. Check each terminal in electrical system if wired correctly and reliably.
- Check each accessory of engine if connected reliably (fuel-injection pump, fuel-transfer pump, diesel oil filter, water pump, fan, charging generator and its support, fan belt, starting motor, engine-oil filter and heat-radiator etc.).

3.23 Starting Of Engine

- Set the speed-governing handle at mid-speed position.
- Loosen the air-discharging screw of engine filter, and push the hand-pressured fuel-transfer pump to remove the air in fuel system. In case the engine is new or has not been used for long time, which means substantial amount of air exists in the fuel oil system, loosen the air-discharging screw of fuel-injection pump and continually push the hand-pressured fuel-transfer pump, to remove the air in the system. For engines often being used, this procedure is not necessary.
- Turn the ignition switch to start-position, and push the starting pushbutton, to start the engine. If the engine does not start, release the pushbutton, and re-start it 2~3 minutes later. If such operation has been performed consecutively for three times and the engine still does not start, then it is necessary to check if any fault, and if so, the engine should not be re-started again until the fault has been eliminated.
- After the engine is started, immediately release the pushbutton, and then turn the ignition switch to another position, to switch on the charging circuit of the generator, to make charging. In addition, immediately adjust the throttle and observe tachometer, and make the engine to be idling and check if it is running normally and if any abnormal sound, with special attention being given to whether the engine-oil pressure is normal. Then, pull the speed-governing handle little by little, so that the engine speed reaches 1800 ~ 2000 r/min; thus the engine is warmed up with no load.
- When the ambient temperature is lower than 0°C and it is difficult to start the engine, perform air-intake pre-heating for 20s. Once the engine is started successfully, the pre-heating should immediately be stopped.

3.24 Running Of Engine

- The engine can work with load, only when the temperature of cooling water reaches 50°C, and temperature of engine-oil reaches 40°C. However, when running with the declared power, the water-out temperature should reaches approx. 80°C.
- Increase/decrease of loads or speed should be gradual and little by little, and usually, an abrupt increase/decrease of loads or speed is not permitted.
- When the engine is running, it is necessary to give attention to whether or not the indications of gauges on gauge-board are normal. Attention should be given to exhaust color and running sound, and stop the engine for inspection, if abnormal conditions are found.

3.25 Stoppage Of Engine

- Before stoppage, load on the engine should be gradually reduced, and speed should be reduced to approx. 800 r/min so that the engine idles. Only until discharging-water temperature decreases to below 70°C, can the engine be stopped by using the stoppage-handle.
- When the ambient temperature is lower than 5°C in winter, if the water temperature is lower than 60°C after stoppage, open the water-discharge valves on engine body and heat-radiator to drain away the cooling water and prevent a frost-crack. The discharge of water is unnecessary if anti-freeze has been added into the water.

4. Maintenance

To prolong the service life of the diesel engine, following maintenance procedures should be followed.

4.1 Daily Care

- Check the engine-oil level in the crankcase sump if it is between the two scale marks and close to the upper scale mark. For an engine that is new or has not been used for long time, after the engine-oil is filled to the upper scale mark, run the engine at a low speed for 5~10 min then stop it, and measure the oil level with the oil dipstick.
- Check the water amount in the heat-radiator.
- Check the engine-oil level in the speed regulator of fuel-injection pump, and add oil to specified position if found insufficient.
- All oil-, water- and gas-leakage in the engine should be eliminated.
- Check each part/device on the engine for their correctness and firmness.
- Check if the support connected to engine is secured and other driven equipment if connected properly.
- Keep the engine clean. Use dry cloth or cloth with dipped gasoline to clean away oil stain and dust, pay special attention to the dry and clean condition of electrical equipment.
- For a new engine, after running for 50h at light-load, it is necessary to change the engine oil (including the oil in speed regulator of fuel-injection pump) and the element of engine-oil filter, and to clean the crankcase sump and engine-oil filter.
- Eliminate the faults and abnormal phenomena if found any.

4.2 Maintenance After Running For Every 100h

In addition to the instructions in "Daily care", followings should also be performed.

- Change the engine-oil in the crankcase sump
- Clean or replace the element of engine-oil filter.
- Replace the element of diesel-oil filter (it can also be replaced after 200h).
- Check the bolts on the cylinder cover if secured.
- Check if valve lash or clearance conform to requirement and adjust it if necessary.
- Check the tension of fan belt and adjust it if necessary.
- Inject some lube grease into the parts with a grease cup.
- Clean away the carbon/soot deposited in air-intake and gas-exhaust pipes and muffler.
- It is necessary, after running every 200h, to check fuel injector for its pressure and atomization conditions, and clean or adjust it if necessary.
- Check the battery for its voltage. Specific gravity of electrolyte should be 1.28~1.29 (atmospheric temperature is 15°C), and should normally be no less than 1.27.

Additionally, check if the electrolyte level is 10~15mm higher than plate electrode, and if sufficient, distilled water should be supplemented.

- After running every 200h or according to water muddiness/turbid-ness, change the cooling water. Take out the thermostat, and fit the lid of thermostat (water-out pipe), and start the engine and change ceaselessly the speed so that the cooling water flow fluctuates, flushing the deposit in cooling system. Then, open the water-discharge valves on heat-radiator and engine body, to discharge the water, and stop the engine. Inject continually clean water via radiator inlet, and start the engine and have the engine idle, so that the water flows. Timely inspect the quality of the water discharged through the discharge-valve, and after found clean, close all discharge valves and stop the engine, and fit back the thermostat.
- When parts that have been removed for maintenance are fit back, it is necessary to ensure their correct position and reliability.

4.3 Maintenance After Running For Every 500h

In addition to the instructions in "Maintenance after running for every 100h", followings should also be performed.

- Check injection pressure of fuel-injector and observe atomization quality, and if necessary, clean and adjust it.
- Check fuel-supply advance angle, and if necessary, adjust it.
- Check gas valve for its tightness, and if found not complying with requirement, grind and correct it.
- Check the tightening condition for bolts on connecting rod, main bearings and flywheel.
- Re-tight the bolts on cylinder cover, and adjust the valve clearance or lash as per requirement.
- Clean or replace the element of air filter. This can, depending on the dusty degree in working environment, be performed as in "Maintenance after running every 100h" or be performed in shorter interval.
- Change the engine-oil in the speed regulator of fuel-injection pump.
- Clean the cooling system. Clean liquid is a mixture of NaOH and water (every 150g NaOH is mixed with 1L water). Before the cleaning, drain away all the water in cooling system, and then fill fully clean liquid and remain 8~12h. Then, run the engine, and stop it after water temperature reaches working temperature. Upon stoppage, immediately discharge the clean liquid, to prevent the deposit of water-scale in the liquid. Finally, clean the cooling system with clean-water.
- Check the working status of thermostat.
- Check each part of starting electric equipment. Check fasteners if secured, and check wire ends if closely contacted, and it should be replaced if scorch-trace found on it.
- Check each part of engine, and repair and adjust them if necessary.

In addition to above information on maintenance, users may perform more detailed maintenance depending on actual conditions.

4.4 Storage

- Before out of service for a long time, the engine, after shutdown, should, as in warm state, be drain completely away the engine-oil, cooling water and fuel oil. Crankcase sump and engine oil filter should be cleaned.
- Corresponding maintenance should be made.
- Remove the intake and exhaust pipes. Fill 200g clean and dehydrated engine-oil, via gasway, into each cylinder (i.e., heat the engine-oil to 110~120°C, until bubbles completely disappear), and turn the crankshaft so that the oil will be uniformly and evenly applied on surfaces of valve, cylinder jacket and piston etc. Fit back the intake and exhaust pipes.
- Oil stain, water-trace and dust on outer surface of the engine should be wiped and cleaned. Unpainted parts, except for those made from rubber or plastic, should be applied with anti-rust oil.
- The outlet inlet of intake and exhaust pipes (muffler) should be blocked with a wooden plug or covered well with plastic cloth, to keep foreign bodies / dust away.
- The engine should be stored in ventilated, dry and clean places, and in its surrounding areas chemicals are forbidden to be stacked.

The engine can be stored for **3 months** if above-mentioned oil-seal procedures are followed. In case this period is exceeded, then oil-seal once more is necessary.

5. Troubles & Troubleshooting

5.1 Engine Does Not Start

5.11 Low Starting Speed

CAUSES

- (1) Battery runs low, or connecting terminals are loosened.
- (2) Starting motor's carbon brush contacts poorly with commutator.
- (3) Starting motor's gearwheel cannot nest the gear ring of flywheel.

METHODS

- (1) Recharge it: tighten the terminals; repair wire-post if necessary.
- (2) Repair or replace the carbon brush.
- (3) Turn the flywheel to another position. If necessary, inspect the installation of starting motor, and eliminate the non-parallelism between the axes of starting motor and gear ring.

5.12 Abnormal Fuel System

CAUSES

- (1) No fuel oil in the fuel tank, or valve of the tank not open.
- (2) Air in fuel system; water in diesel oil; oil leaks at joints.
- (3) Fuel passage clogged.
- (4) Fuel-transfer pump does not supply fuel.
- (5) Fuel injector injects no or little fuel; too-low pressure and poor atomization; fuel injector pressure-adjusting spring is broken; injection-hole is clogged.
- (6) Fuel-injection pump fuel-discharge valve leaks fuel; spring is broken; plunger couple is worn off.

METHODS

- (1) Fill it; or open the valve.
- (2) Remove the air; change the oil; tighten the joints.
- (3) Clean the passage, replace element of diesel oil filter, and clean fuel-in pipe of fuel-transfer pump.
- (4) Inspect if any air leakage on fuel-in pipe. Inspect and repair fuel-transfer pump.
- (5) Dismantle the fuel injector and adjust it on its tester, and inspect if fuel-injection pump starting has more concentricity.
- (6) Grinding it: repair or replace part

5.13 Insufficient Compression Pressure

CAUSES

- (1) Valve clearance too big.
- (2) Valve leaks.
- (3) Cylinder cover gasket leaks.
- (4) Piston ring worn off, stuck; opening overlapped.

METHODS

- (1) Adjust it as per requirement.
- (2) Grind the valve.
- (3) Replace the cylinder cover gasket, and tighten the bolts on cylinder cover.
- (4) Replace it, clean it, adjust it.

5.14 Other Causes

CAUSES

- (1) Air temperature too low; oil viscosity too big.
- (2) Water in combustion chamber or cylinder.

METHODS

- (1) Put some water into the cooling system. Start after pre-heating. Use engine-oil with brand specified.
- (2) Inspect, repair or replace it.

5.2 Abnormal Engine-Oil Pressure

5.21 No Or Little Pressure For Engine-Oil

CAUSES

- (1) Engine-oil level too low; oil deteriorates or is thinned.
- (2) Oil pipe is broken; pipe joint not tight enough causing oil leakage; engine-oil pressure gauge is damaged.
- (3) Engine-oil pump pressure-adjusting spring is deformed or broken.
- (4) Engine-oil pump has too much clearance.
- (5) Engine-oil pump gasket is broken.
- (6) fit clearance between bearings is too much.
- (7) Oil-passage screw-plug is loosened and leaks.

METHODS

- (1) Add the oil; change the oil.
- (2) Weld, tighten or replace it.
- (3) Replace it.
- (4) Return it to factory for repair; replace it.
- (5) Replace it.
- (6) Inspect, adjust or replace it.
- (7) Inspect it; block it.

5.22 Engine-Oil Pressure Too High

CAUSES

- (1) Engine-oil pump's pressure-limiting valve does work abnormally, oil-returning does not go smoothly.
- (2) Air temperature too low, engine-oil viscosity too higher.

METHODS

- (1) Inspect and adjust it.
- (2) Use engine-oil with brand specified; decrease is possible after the engine is warmed up.

5.23 Rocker Arm Cannot Be Added Engine-Oil

CAUSES

- (1) Upper cylinder-head oil-passage and oil-hole at support bottom of rocker arm shaft are clogged.

METHODS

- (1) Clean and make it unclogged.

5.3 Smoke Emitted In Exhaust Gas

5.31 Black Smoke Emitted In Exhaust Gas

CAUSES

- (1) Oil injector is clogged with accumulated soot, and needle valve is clogged.
- (2) Load is too much.
- (3) Fuel injecting is too late, and partial fuel is burned during the course of exhaustion.
- (4) Incorrect valve clearance; valve sealed poorly.
- (5) For each cylinder, fuel supply by fuel-injection pump is not uniform and even.
- (6) Intake pipe, air filter clogged, and air-intake is not smooth.

METHODS

- (1) Inspect, repair or replace it.
- (2) Adjust the load to the range specified.
- (3) Adjust the fuel-supply advance angle of fuel-injection pump.
- (4) Inspect the valve clearance and sealing surface and spring force etc, and eliminate the problems.
- (5) Adjust fuel supply amount for each cylinder.
- (6) Dismantle and clean the filter.

5.32 White Smoke Emitted In Exhaust Gas

CAUSES

- (1) Fuel-injecting pressure is too low; atomization is poor; fuel dripping.
- (2) Cooling water temperature is too low.
- (3) Moisture enters cylinder.

METHODS

- (1) Inspect, adjust, repair or replace the fuel nozzle couple.
- (2) Increase the temperature of cooling water.
- (3) Inspect the gasket of cylinder cover.

5.33 Blue Smoke Emitted In Exhaust Gas

CAUSES

- (1) Piston ring severely worn off, or elasticity not enough due to accumulation of soot, causing engine-oil enter the combustion chamber of the cylinder.
- (2) Engine-oil level too high.
- (3) Conic surface gas ring is mistaken for its upper and lower direction.

METHODS

- (1) Clean or replace the piston ring.
- (2) Discharge excessive oil.
- (3) The side marked with a "Up" should face up.

5.4 Insufficient Power

CAUSES

- (1) Filter gauze in oil-in pipe joint of diesel oil filter or oil-transfer pump is clogged.
- (2) Oil injector has an incorrect pressure or poor atomization.
- (3) Precise pair part of fuel-injection pump is severely worn off.
- (4) Speed governor spring is deformed and loosened, thus rated speed cannot be reached.
- (5) Air enters into fuel system.
- (6) Fuel-supply advance angle is not correct.
- (7) Oil-supply rate for each cylinder is not uniform or even.
- (8) Air filter not fluent or be clogged.
- (9) Valve leaks gas.
- (10) Compression pressure is not enough.
- (11) Valve timing is not correct.
- (12) Hole in oil injector leaks.
- (13) Bolts on cylinder cover loosened.

METHODS

- (1) Clean or replace it.
- (2) Inspect, repair the injector, or replace the oil nozzle couple.
- (3) Adjust oil-supply work-detection plunger couple and oil-delivery valve couple.
- (4) Adjust high-speed limiting screw, and replace speed-governing spring.
- (5) Remove the air in fuel oil system.
- (6) Adjust it as per requirement.
- (7) Adjust the oil-supply rate for each cylinder.
- (8) Clean or replace filter element.
- (9) Inspect valve clearance, spring force, and inspect valve guide for wear-off conditions, and inspect valve if stuck, and inspect valve sealing surface. If necessary, replace part(s) and grind the valve.
- (10) See 5.3 Smoke emitted in exhaust gas.
- (11) Camshaft is severely worn,. The camshaft can possibly be replaced.
- (12) Replace the copper washer, and clean seat hole surface, and tighten uniformly the

- nuts on pressure plate of oil injector.
- (13) Tighten them as per specified tightening-torque.

5.5 Abnormal Sound

CAUSES

- (1) Fuel-supply advance angle is too big, and metal-knock rhythmic sound can be heard from inside of cylinder.
- (2) Oil nozzle drips oil, and needle valve is jammed, causing the sound like "ta, ta, ta"
- (3) Valve clearance too big, and clear and rhythmic knocking-sound
- (4) Piston collides with valve, causing heavy and rhythmic knocking-sound (if put a hand at nut on cylinder cover, vibration can be felt).
- (5) Piston collides with the bottom of cylinder cover, causing heavy and strong knocking-sound.
- (6) Valve spring is broken, valve push-rod is bent, valve tappet is worn off, causing valve mechanism to produce slight knocking-sound.
- (7) Sound due to too much gap between piston and cylinder jacket. This sort of sound will be reduced, with the engine being warmed up.
- (8) If connecting rod bearing gap is too big, when speed is abruptly reduced, heavy and strong knocking-sound can be heard.
- (9) Gap between connecting rod bush and piston pin is too big. This sound is low but sharp, and
- (10) If crankshaft thrust-piece is worn off, gap is too big, the collision sound of crankshaft playing back and forth can be heard.

METHODS

- (1) Adjust the advance angle.
- (2) Clean, repair or replace the needle valve couple.
- (3) Adjust valve clearance.
- (4) Increase the valve clearance a little bigger, correct the gap of connecting rod's bearing, or replace the rod's bush.
- (5) Replace cylinder cover gasket.
- (6) Replace the spring, push-rod and tappet etc, and adjust valve clearance.
- (7) Depending wearing conditions, determine if cylinder jacket and piston are to be replaced.
- (8) Replace connecting rod's bush.
- (9) Replace connecting rod's bush.
- (10) Replace the thrust-piece of crankshaft.

5.6 Severe Vibration

CAUSES

- (1) Oil-supply for each cylinder is not uniform; oil nozzle of one or two cylinders has poor atomization; one or two cylinders severely leak; compression ratio difference is big, etc.
- (2) Water or air enters into diesel oil.
- (3) Poor alignment when the engine is installed; support's bolts are loosened.
- (4) Cylinder(s) is heavily knocked. Engine works roughly.

METHODS

- (1) Inspect and adjust oil-supply rate of fuel-injection pump; repair the oil nozzle;

eliminate the leakage problem; inspect and adjust compression pressure of each cylinder.

- (2) Discharge the air; make the diesel oil to be deposited.
- (3) Correct the alignment; tighten them.
- (4) Inspect the fuel-supply advance angle; apply load after engine is warmed up.

5.7 Engine Overheat

CAUSES

- (1) Fuel enters into crankcase; or engine-oil is mixed by water, it becomes thinner; too much or less engine-oil; low flow-rate and pressure of engine-oil; fit clearance of bearing is too small.
- (2) Water pump impeller is damaged and broken, and fan belt slips; positions of heat radiator and fan are improper; thermostat is failure; cooling system piping is clogged; too thick water-scale in water jacket; water pump displacement is not enough; cylinder cover gasket is broken and fuel gas enters water-passage.

METHODS

- (1) Inspect and replace piston ring; change engine-oil; inspect oil level; inspect wearing conditions of inner/outer rotor; inspect and adjust the fit clearance of each bearing.
- (2) Inspect and replace the impeller; inspect the belt's tightness or replace the belt; inspect the position of heat radiator; inspect the working condition of thermostat; clean the cooling system and water jacket; inspect the clearance of impeller; fill fully water; replace the cylinder cover gasket.

5.8 Too Much Engine-Oil Consumption

CAUSES

- (1) The viscosity of the oil used is too low, or the brand is not correct.
- (2) Piston and cylinder jacket is severely worn; oil-return hole on piston ring groove is clogged.
- (3) Piston ring is stuck by glue; gas ring is fitted with upper and lower faces being reversed; too much wearing.
- (4) Oil leaks on crankshaft front/rear oil-seal, crankcase sump joint plane and side cover etc.
- (5) Engine-oil temperature or pressure is too high, or evaporated and splashed.

METHODS

- (1) The oil, the brand of which is specified (in this Manual), should be used.
- (2) Replace; clean the oil-return hole.
- (3) Clean or replace it.
- (4) Inspect or replace them, if necessary.
- (5) Reduce the temperature (see previous section); inspect and adjust the pressure-limit valve of engine-oil pump.

5.9 Speed Increased Greatly

CAUSES

- (1) Speed governor is failure, and pull-rod is jammed at "large oil flow-rate" position.
- (2) Speed governor's sliding disc shaft sleeve is jammed.

- (3) Adjust-arm is released from shifting fork.

METHODS

- (1) Inspect and repair the speed governor and its pull-rod.
- (2) Inspect and repair it.
- (3) Inspect and repair it.

5.10 Engine Stops By Itself

CAUSES

- (1) Air in oil-passage; oil-transfer pump does not supply oil; diesel oil filter is clogged.
- (2) Piston is jammed in cylinder; journal is jammed by bush.
- (3) Fuel-injection oil-delivery valve is jammed; plunger spring is broken; speed governor sliding disc sleeve is jammed.

METHODS

- (1) Discharge the air; inspect and repair oil-transfer pump; clean diesel oil filter.
- (2) Fit clearance is not correct; repair and replace it.
- (3) Inspect, repair or replace it.

5.11 Rough Idle

CAUSES

- (1) Un-uniform oil flow-rate in each cylinder; oil injector drips oil; pull-rods shifting-fork screw is loosened.
- (2) Gap between shifting-fork and adjusting-arm is too big; steel ball and sliding disc is worn and dent(s) occurs.
- (3) Too much axial moving clearance of fuel-injection pump camshaft.
- (4) Sleeve of sliding disc is jammed.

METHODS

- (1) Make the flow-rate uniform; repair or replace oil nozzle needle-valve couple, secure shifting-fork screw.
- (2) Replace them.
- (3) Adjust it with copper shim.
- (4) Clean, repair or replace it.

5.12 Engine-Oil Raised High

CAUSES

- (1) Cylinder jacket water-seal ring is damaged.
- (2) Cylinder jacket gasket leaks water.
- (3) Cylinder cover or engine body leaks water.

METHODS

- (1) Replace the ring.
- (2) Replace the gasket.
- (3) Inspect and replace it.

6. Spare Parts List

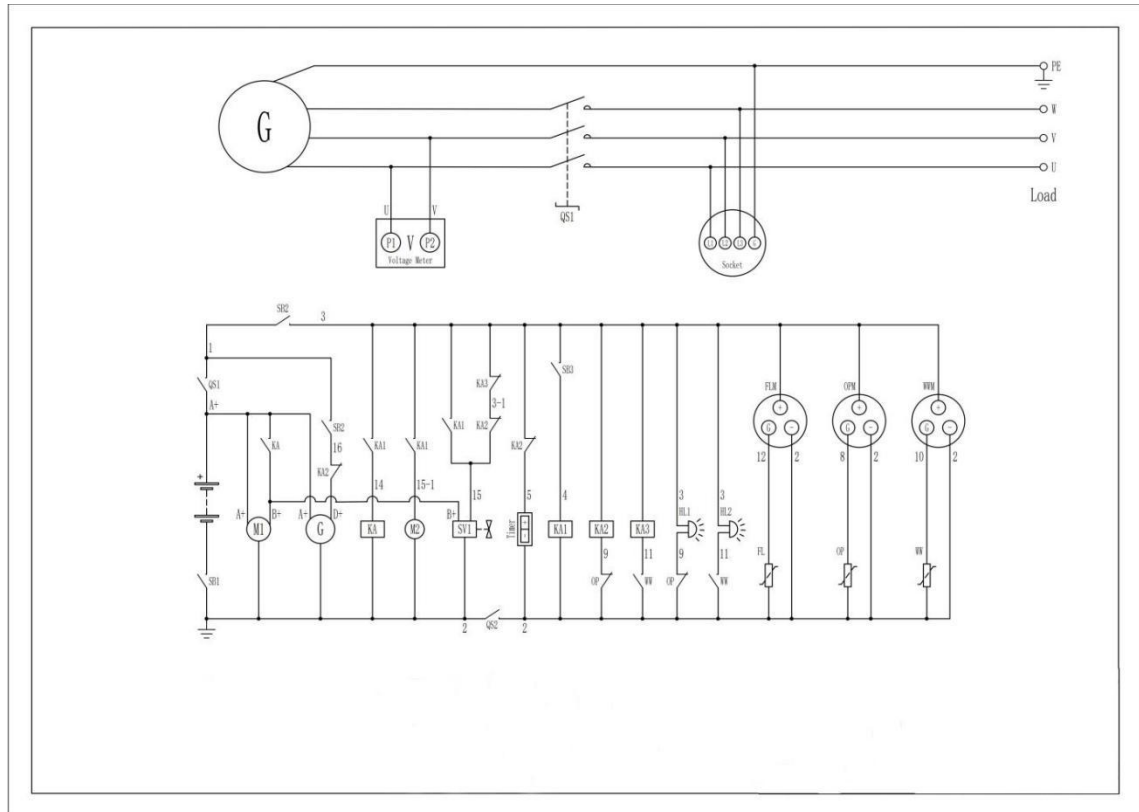
ENGINE: FAW 4DW81

DESCRIPTION	PARTS NO.	UNIT	QTY FOR SINGLE GENSET	STOCKING SUGGESTION FOR 2000 HOURS
Oil filter	1012015AB01-0000	PC	1	20
Fuel filter	1117010-B01-0000K	PC	1	12
Air filter	DHP-0029-04	PC	1	4
Full engine paper washer	WB010000-PJQD	SET	1	2
Fan	1308010-B57-AS10	PC	1	1
Belt	1308032-B45-0000	PC	1	4
Cylinder head gasket	1003022BB01-0000	PC	1	2
Head cover gasket	1003032AB01-0000	PC	1	6
Oil seal-air gate	1007035AB01-0000	PC	8	32
Front oil seal	1005050AB01-0000	PC	1	4
Rear oil seal	1005060AB01-0000	PC	1	2
Intake valve	1007011-B01-0000	PC	4	8
Exhaust valve	1007016-B01-0000	PC	4	8
Thermostat	1306010-B01-0000	PC	1	1
Water seal ring	1002017-B01-0000	PC	8	8
Cylinder liner	1002016-B01-0000	PC	4	2
Piston ring	1004BBB-B01-0000	SET	4	4
piston	1004011-B01-0000	PC	4	4
piston pin	1004018AB01-0000	PC	4	4
Connecting rod assy	1004010AB01-0000	PC	4	2
Rod bearing shell	WB010000-PJLW	SET	1	1
Main bearing shell	WB010000-PJZW	SET	1	1
Thrust plate upper half	1005181-B01-0000	PC	2	2

Thrust plate lower half	1005182-B01-0000	PC	2	2
Injector	1112010-B56-AS10	PC	4	4
Injector "O" ring	1112101-B56-AS10	PC	4	4
Oil pump	1011010AB11YFD10	PC	1	1
Water pump	1307010AB56-HMS20W	PC	1	1
Start motor	3708010-B35-HT10M	PC	1	1
Alternator	3701010-B59-AS10	PC	1	1
Water separator sensor	3818010A531-YFD10	PC	1	1
Oil pressure sensor	3810020-B11-YFD1S	PC	1	1
Petrol engine revolution sensor	1002121-155-SJ10	PC	1	1

DESCRIPTION	STOCKING SUGGESTION FOR 2000 HOURS
DC Pump	1
Indicator	1
Radiator	1
Fuel Level Gauge	1
Voltmeter	1
Coolant Temperature Gauge	1
12V Oil Pressure Gauge	1
Gauges	1

7. Wiring Diagram



1	SB1	Battery Switch	8	SV1	Solenoid Valve	15	HL2	High Coolant TEMP Alarm
2	SB2	Power Switch	9	KA	Start Relay	16	OP	Oil PRE Sensor
3	SB3	Start Switch	10	KA1	Start Intermediate Relay	17	WW	Coolant TEMP Sensor
4	G	Generator	11	KA2	Oil PRE Intermediate Relay	18	FL	Fuel Level Sensor
5	M1	Start motor	12	KA3	Coolant TEMP Intermediate Relay	19	FLM	Fuel Level Gauge
6	M2	Oil Pump	13	HL1	Low Oil PRE Alarm	20	OPM	Oil PRE Gauge
7			14			21	WWM	Coolant TEMP Gauge

8. Warranty&Service

8.1 Warranty Period

12 months from ex-factory date or 1000 running hours from commissioning, whichever comes first.

8.2 Warranty Coverage

Failures caused by manufacturing defects under proper installation, operation and maintenance will be repaired or replaced free of charge by the Seller.

8.3 Warranty Exclusions

- Consumable parts such as filters, belts, rubber parts, fuses, etc.
- Damage caused by improper operation, poor maintenance or overloading
- Parts not supplied or authorized by the Seller
- Damage caused by force majeure, improper transportation or storage

8.4 Warranty Method

Warranty is mainly provided by remote technical support and spare parts supply. On-site service, if required, will be charged separately, with travel costs borne by the Buyer.

8.5 Warranty Claim

The Buyer shall provide nameplate details, running hours, fault description, and relevant photos or videos for warranty claims.