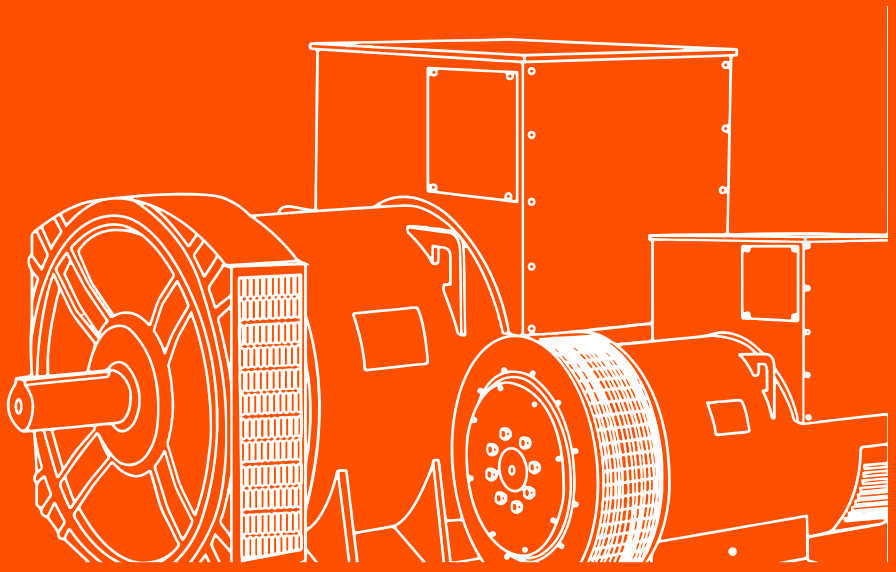
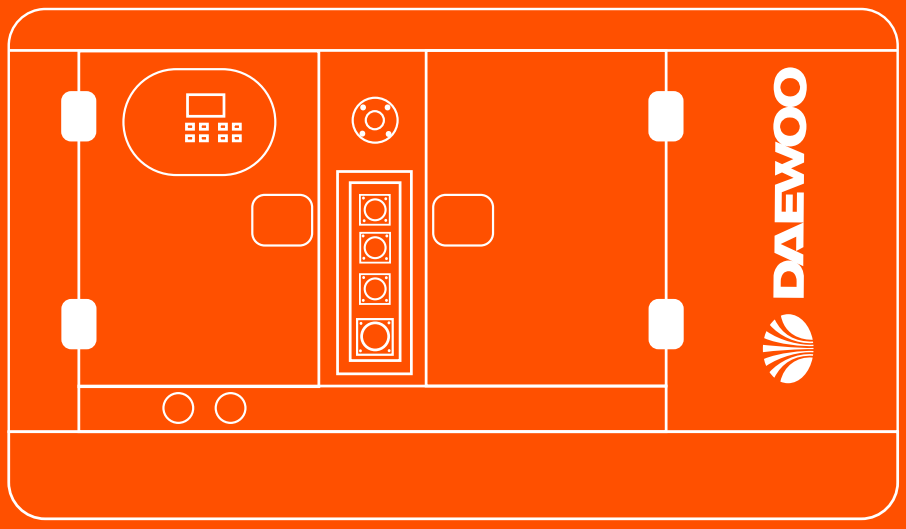
DAEWOO

POWER PRODUCTS

DAGFS-SERIES Silent diesel generator & Digital panel / Brushless synchronous A.C. Alternators





USER'S MANUAL

www.daewoopowerproducts.com

Manufactured under license of **Daewoo International Corporation**, Korea

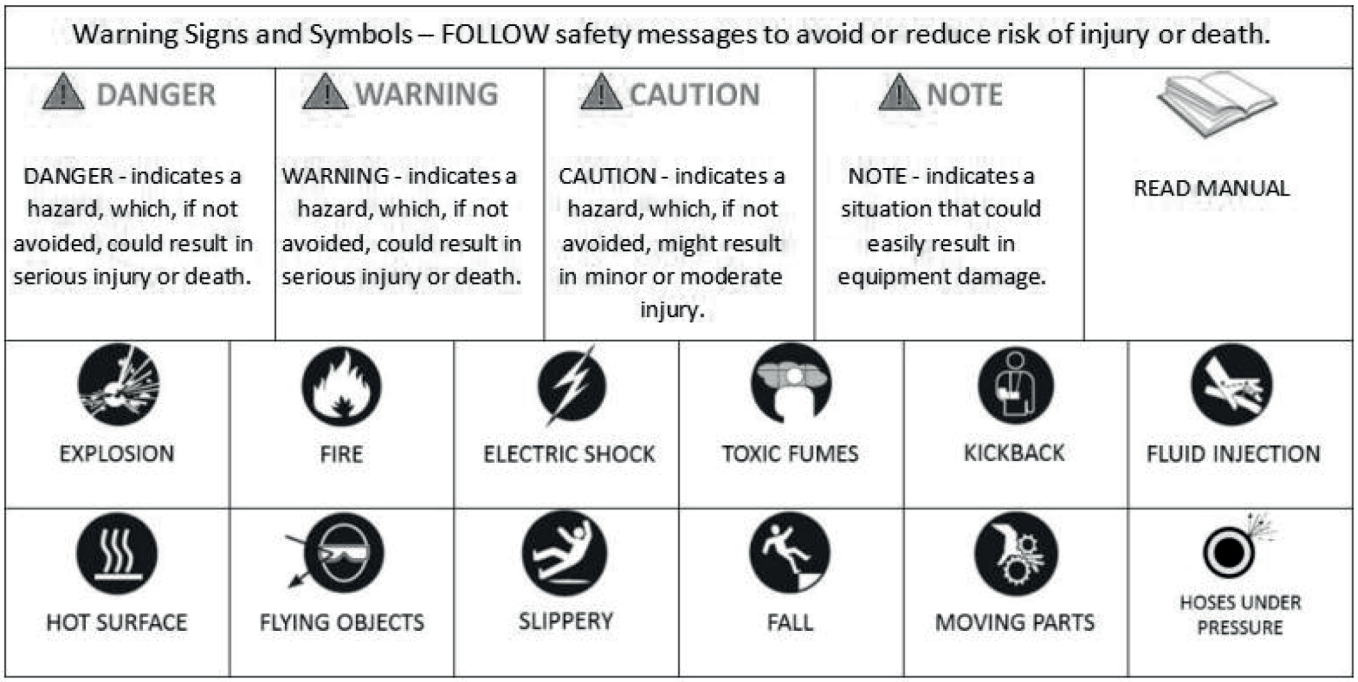
INDEX

1. SAFETY AND WARNING

The operator of the machine:
Is responsible for and has a duty of care in making sure that the machine is operated safely and in accordance with the instructions in this user manual.
Should never leave it in a condition, which would allow an untrained or unauthorised person/s to operate this machine.
Take all due care and diligence for the safety of and with regard to those around whilst using the machine, to include but not limited to;
Elderly, children, pets, livestock and property.

Some or all of the following PPE, warning signs and symbols may appear throughout this manual and you must adhere to their warning/s. Failure to do so may result in personal injury.

Personal Protective Equipment (PPE)



Before operation and maintenance for the generator sets, please read carefully about this manual and make sure a good understanding of this operation manual and other documents which attached with the engine.
Correct installation of the generator set is the precondition of normal operation. Qualified spare parts shall be used for maintenance to ensure good running condition and long life expectancy

The generator set shall be operated only by the staffs who have received training on the operation and the repair shall be made by the authorized staffs. Operator and maintenance staff shall be clear about safety and preventive actions and operation maintenance procedure.

The generator sets can only be started under safety conditions. Please do not start the generator sets when any abnormal condition has been found so that to avoid accidents.
When clean, maintain and repair the generator sets, please shut down the generator set and cut off the connection of negative polar of the battery or dismantle battery connecting cable, and place warning label at the relative place so that to avoid accident.

The exhaust air discharged from engine is harmful for people's health. All of the generator sets installed indoors shall discharge the exhaust gas to outside doors.

During the period of generator set running, the exhaust pipe and silencer will generate high temperature. Therefore when the generator set is installed, these parts need to be covered with insulation materials and be kept far away from inflammable materials. Please ensure good ventilation and organized environment for the generator set's installation room. Please do not place inflammable materials and explosives (liquid) near the engine.

Smoking, spark over, and other fire lighting behaviors are not allowed in the area which is close to the battery and fuel because the mixture of volatilization from fuel and hydrogen generated by battery charging process will cause explosion when it meets sparkle or naked flame.

The generator set installation room shall be facilitated with BC and ABC fire extinguisher, and operators shall be familiar with the knowledge on how to use it.

When fan protection cover or other protection cover has been detached, please do not try to start the generator set; and when the generator set has to be started, please don't put your hand in the area where the protection cover is missing or make repair around these areas. please keep your palm, arm, long hair, jewelry and loose clothes far away from belt pulley, belt and other power transmission parts.

When working in the generator set installation room, please ware working clothes, gloves and hat. After the generator set being started, please don't try to open the cover of the radiator before the anti-freeze fully cooled down, so that to avoid steam (hot water) burst forth to hurt people. Please don't swallow or let your skin contact with the harmful materials such as fuel, anti-freeze, lubricant and electrolyte.

When you skin is spattered with these kinds of liquids, please use plenty of water to rinse.
Long time stay in high noise level environment will cause harm to your hearing. If you have to work around the generator set frequently, you'd better ware the device to protect your ear.

When the generator set need to make cable connections to output power, the operation shall conform to the condition, specification, standard related to power distribution. Qualified cable

shall be used to make power distribution.

When the installation of generator set involves with welding, please do not connect to the ground circuit or make grounding through generator set (engine) so that to avoid the big current generated from welding operation hurt the electric appliance, bearing and bearing bush etc. inside of the generator set. Please ensure the safety of generator set and reliable grounding.

SAFETY LABELS INFORMATION

TRANSPORT WARNING

• Never lift the generating set by attaching to the engine or alternator lifting lugs, instead use the lifting points on the base frame or canopy.
• Ensure that the lifting rigging and supporting structure is in good condition and has a capacity suitable for the load.
• Keep all personnel away from the generating set when it is suspended.

MECHANICAL WARNING

• Do not attempt to operate the generating set with the safety guards removed. While the generating set is run ning do not attempt to reach under or around the guards to do maintenance or for any other reason.
• Keep hands, arms, long hair, loose clothing and jewel ers away from pulleys, belts and other moving parts.

SAFEGUARD WARNING

• Generating sets that are not equipped with sound att enuating enclosures can produce noise levels in excess of 105 dB (A). Prolonged exposure to noise levels above 85 dB (A) is hazardous to hearing.
• Wear protective clothing including gloves and hat whe n working around the generating set.
• If equipped keep access doors on enclosures closed and locke d when not required to be open.
• Avoid contact with hot oil, hot coolant, hot exhaust gases, hot surfaces and sharp edges and corners.

CHEMICAL WARNING

• Ensure that the generating set room is properly ventilated.
• Keep the room, the floor and the generating set clean. When spills of fuel, oil, battery electrolyte or coolant occur, they should be cleaned up immediately.
• Never store flammable liquids near the engine.
• Do not smoke or allow sparks, flames or other sources of ignition around fuel or batteries. Fuel vapors are explosive. Hydrogen gas generated by charging batteries is also explosive.
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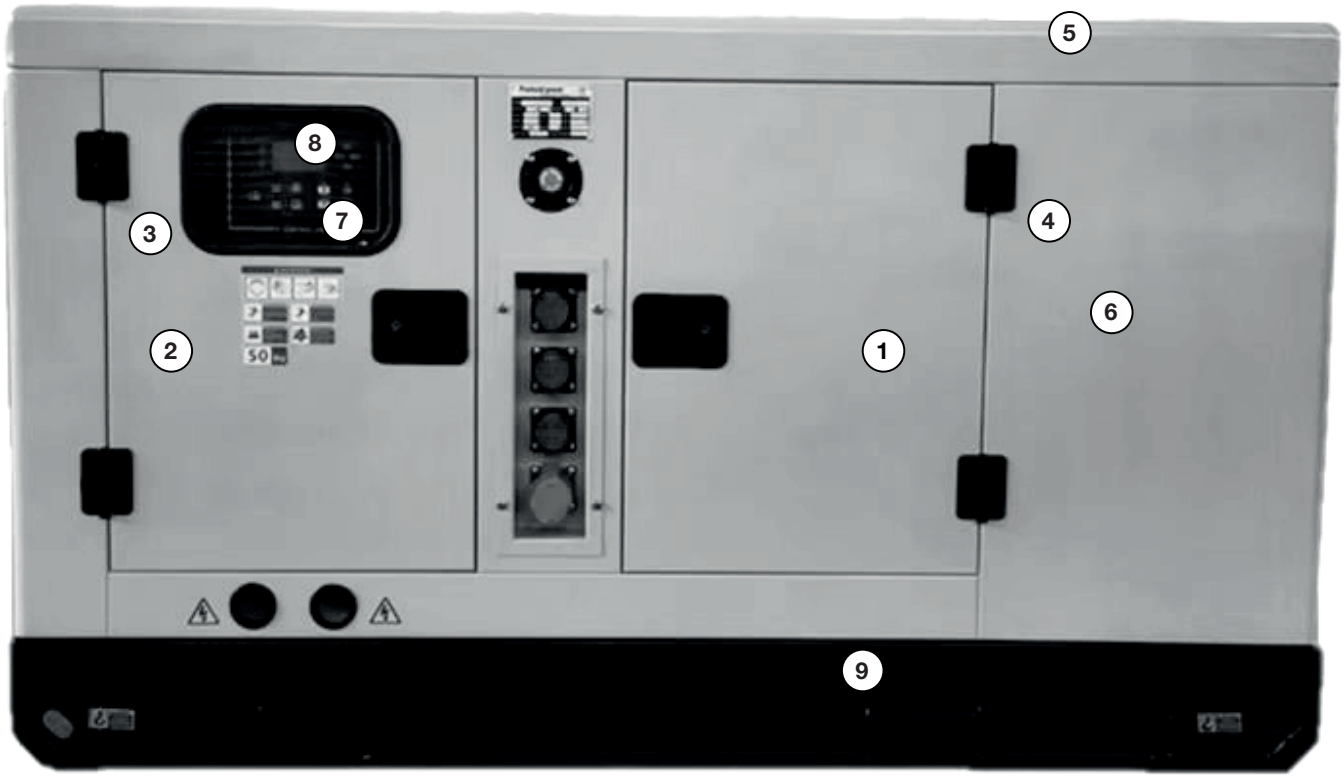
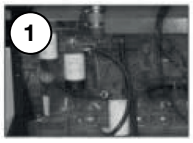
ELECTRICAL WARNING

• The generating set should be shutdown with the battery negative (-) terminal disconnected prior to attempting to connect or disconnect load connections.
• Do not attempt to connect or disconnect load connections while standing in water or on wet or soggy ground.
• Make sure connect generator set to earth.
• Replace the generating set terminal box cover as soon as connection or disconnection of the load cables is complete. Do not operate the generating set without the cover securely in place.
• Connect the generating set only to loads and/ or electrical systems that are compatible with its electrical characteristics and that are within its rated capacity
• Keep all electrical equipment clean and dry. Replace any wiring where the insulation is cracked, cut, abraded or otherwise degraded. Replace terminals that are worn, discolored or corroded. Keep terminals clean and tight.
• Do not touch electrically energized parts of the generating set and/or interconnecting cables or conductors with any part of the body or with any non insulated conductive object.

2. GENERAL INTRODUCTION

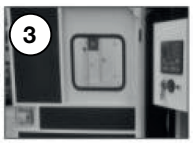


GENERATOR SUPPLY SCOPE



Engine
Brand-new engine

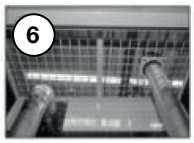
Alternator
Brand new brush
less alternator



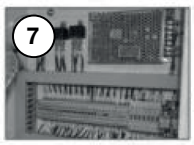
Access
Large Canopy doors for convenient maintain and inspection purpose

Radiator
40°C for open type,
50°C for soundproof type

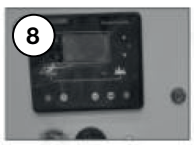
Rain Cover
Strong materials cover to avoid rain and dopant in the genset to make sure generator work regularly



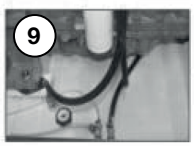
Silencer
Strong thick pipe with heat insulation materials to reduce noise effectively and to avoid excessive temperature
11 in canopy inside



Terminal Box Inside
Regular internal wire connecting to convenient maintain

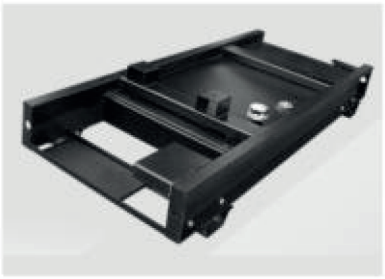


Digital Control Panel
Branded high quality digital control panel rise the reliability and stability of the genset



Fuel Tank
Average 8 hours base fuel tank

A. Product Test logo
Our gensets offered are manufactured strictly accord to the ISO9001-2000 international quality management system.
Our genset at least 1 hour on load testing from 25%,50%, 75%,100%,110%.



1. MORE 8 HOURS BOTTOM FUEL TANK WITH FUEL GUAGE
High strength bending base, long-term durability, non-deformation, anti• corrosion,professional baking paint,large capacity,base tank height 24-35mm/12-35rnm.

2. HIGH PERFORMANCE SOUND SUPPRESSOR
The high-grade rubber shock absorber between diesel engine, alternator and frame,it reduce the vibration,reduce the damage for parts,prolong the service life of the unit, double screw design more solid and durable and prvent the loose when running, and to reduce the vibration noise

3. SUPER QUALITY CANOPY & PAINT
2-6 mm thick high quality ATSM standard steel case,
high temperature baking varnish with position pole oxidation
Avoid off paint,More professional

4. TRANSPORTABITY
One-point lifing eye makes it easy to transport all generator.
Special forklift opening are provided in the base of the machine.

APPLICATION

Continuous service

Used as main power supply to generate electricity for several purposes: motion force, lighting, heating etc. The generator sets can continue running and allow 10% over load for 1 hour per 12 hours under variable load, which is used for remote area.

Standby service

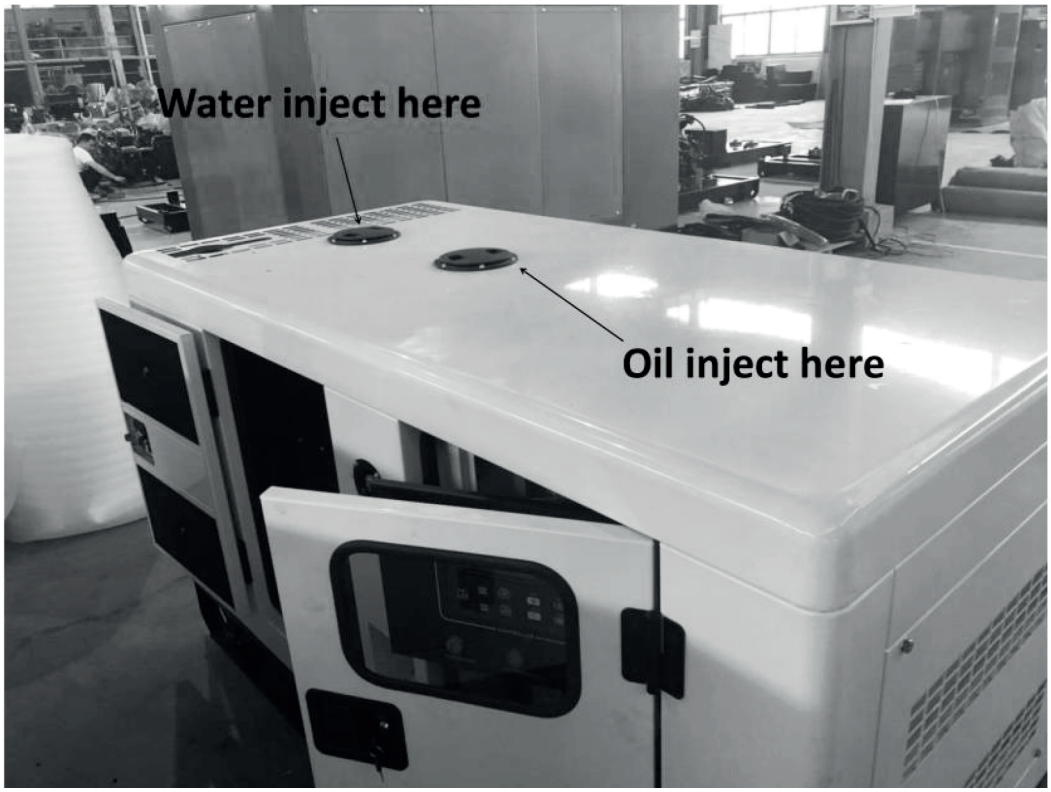
Used as standby power supply to provide continue electric power for non-invariable loads. The generator set is suitable for the area where must ensure continue power supply, such as hospitals, industrial facilities, airports etc. Keep the generator set standby state at any time and st art to run when the mains supply is abnormal.

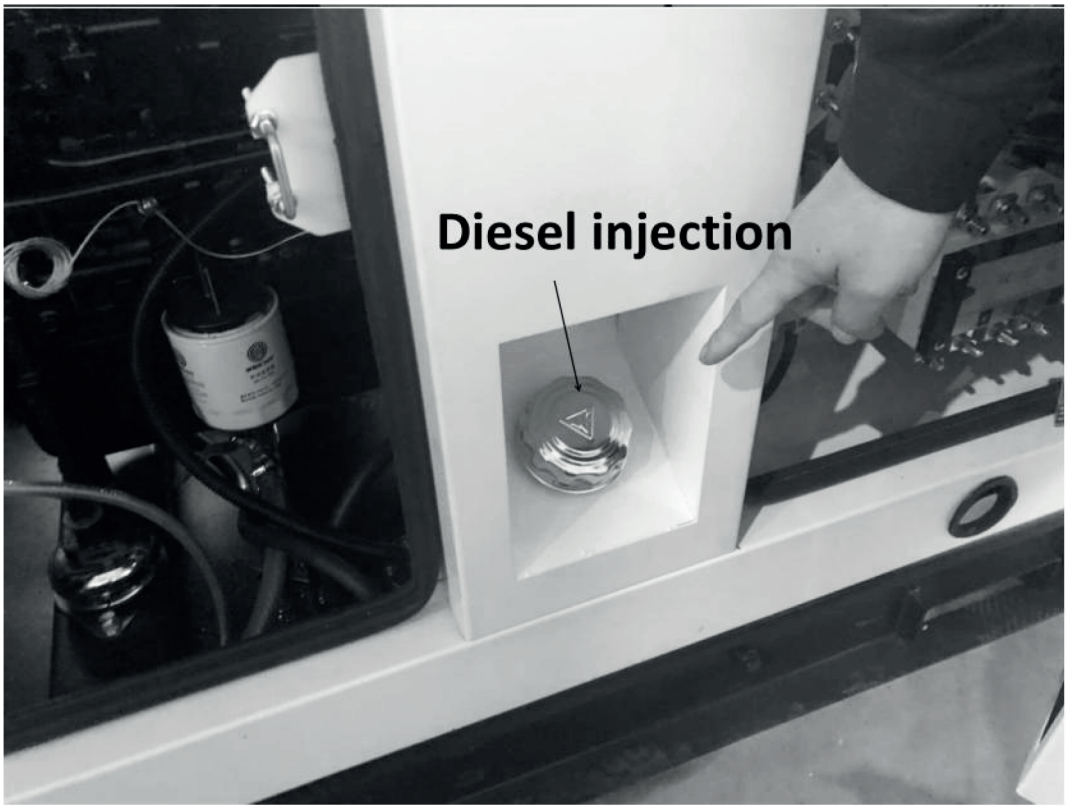
Emergency service

Used as auxiliary power supply to solve energy interruptions that may cause serious problems to people, physical and /or financial damage or to face consumption peaks. The generator set can start in short order to provide steady electric power for the loads when the mains supply happen abnormity, and switch to stop after the mains supply becomes normal. Generally the generator set continues working for several hours.

3. OPERATION INSTRUCTION FOR FIRST START

1) Inject water/oil/diesel





2) Connect the battery, red wire for anode, black wire for cathode

3) Press diesel pump, to exhaust air until feel pressure

4) Turn on the emergency stop button

5) Use the key to turn on the generator, keep it running

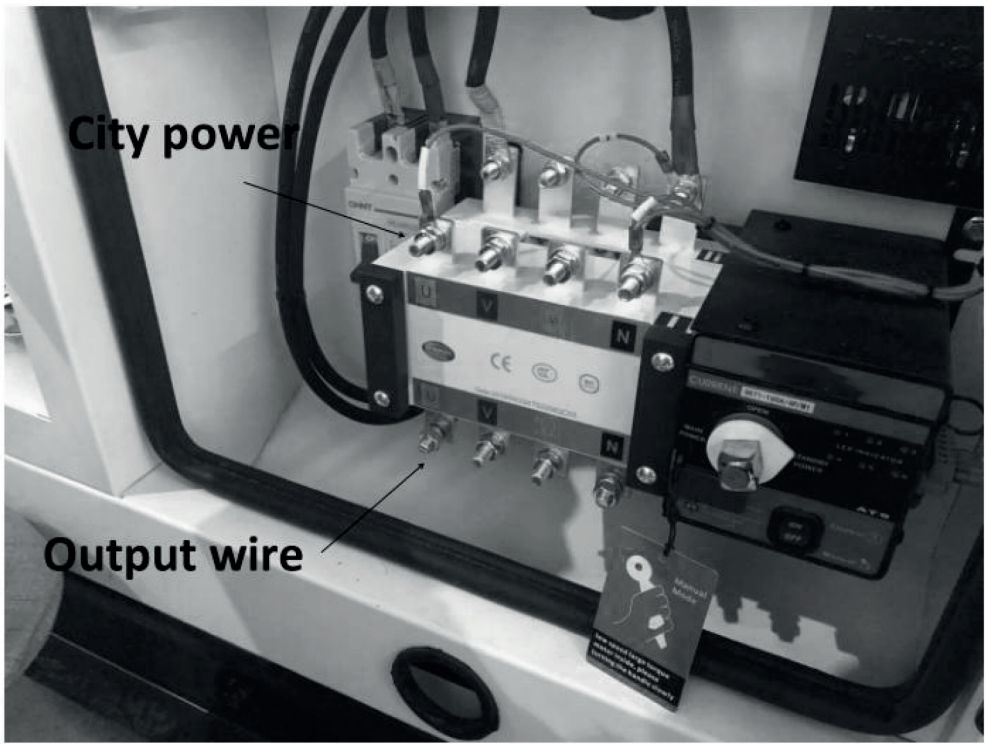
6) Operating control panel, in order: STOP⟶Manual ⟶ Start

Note: Go to next step if engine starts smoothly. If not, turn back to step 3, press the diese pump a few more times

7) Connect city power and output wire, attention: N is null line, U、V、W is firing line

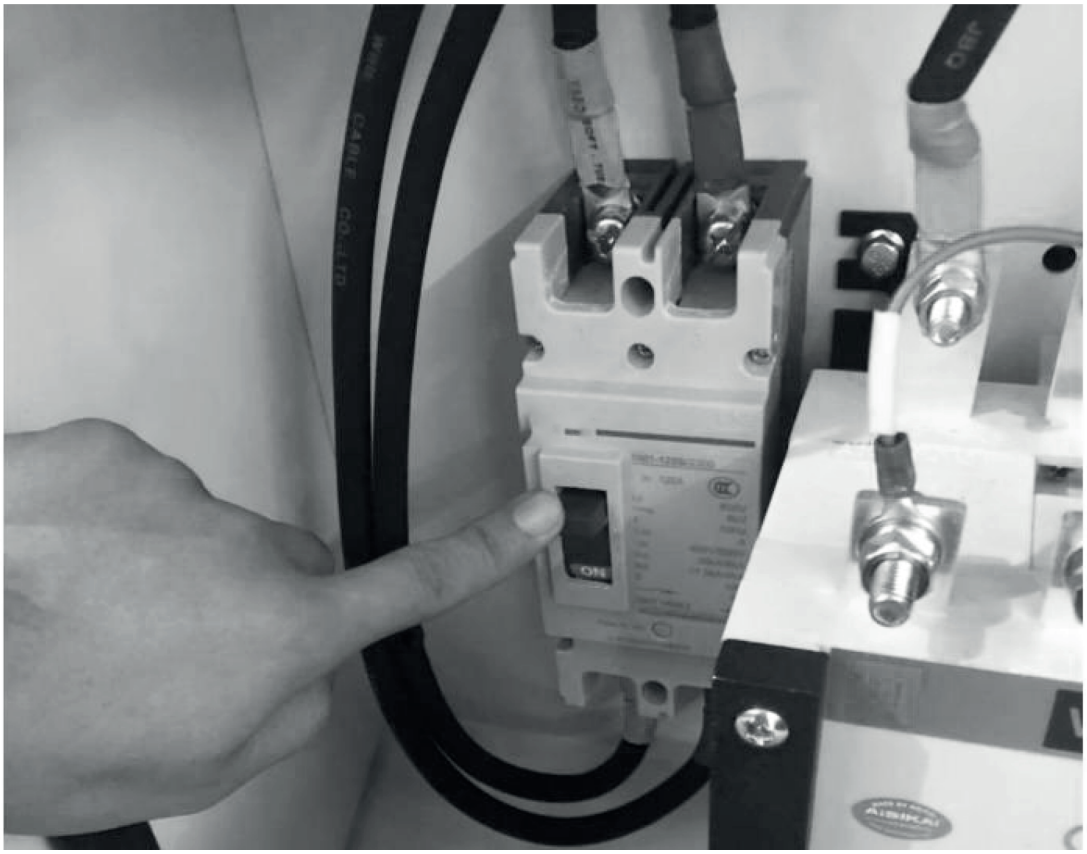
Wire socket above ATS use for city power, bottom for output wire

Firing line connect only with U, null line only with N for single phase city power



8) Operating control panel, in order: Stop ⟶ Auto (set it to auto mode)

Final step: Finish set up the generator and then turn on breaker for auto protection



4. MAINTENANCE

General outline

For different types of generator sets, users need to refer to the matched engine's operation and maintenance manual to implement correct maintenance operation.

In order to obtain maximum operation safety and life expectancy of the generator sets, periodic maintenance is very important. Strictly observance of the terms on generator set's maintenance can ensure generator set's performance and reduce its damage to environment.

Correctly identify and strictly observe the labels (drawings, words and warnings etc.) On diesel generator sets can be of great help to correct maintenance and safe operations.

Maintenance of the generator sets shall be made when it has been stopped and the cable which connect to the negative polar of the battery shall be dis-connected so that to ensure the generator set will not mistakenly start.

Engine

Each time before start the engine
- Check lubricant oil level
- Check coolant level
- Check air filter indicator
- Check the ventilation of radiator and ambient environment
- Check engine's transmission belt
- Check fuel supply status

Generator sets which run frequently need to be checked one time every 6 to 8 hours.
Backup generator sets need to be checked once more after being stopped.
Depends on the new generator set's running status, when it is necessary, within 100 to 300 Hours, following actions shall be taken:
- Check the valve clearance
- Check the fuel injector

For each 0~50 hours of running
- Discharge the water remained in the oil-water separator

For each 50~600 hours of running or at least each 12 months
- Change lubricant and lubricant filter
- Because the quality of lubricant oil, sulfur content of the fuel, and lubricant consumption rate of each engine is different, the interval for lubricant oil change for each generator set will be different. When change the lubricant oil, at the same time oil filter needs to be changed, otherwise the change of oil will become meaningless. On the contrary, if the lubricant oil

remains in good status, we can filter the lubricant much better by change the oil filter.

• Change fuel filter, clean or change first stage fuel filter core, oil water separator's core (some of the generator sets have), check and organize fuel pipes arrangement.
• The change interval of above fuel filter (core) depends on the quality of fuel (if it contains many impurity), the fuel adding method is reasonable or not, the fuel tank is cleaned periodically or not (contaminant discharge). Once the color of engine exhaust air is found to be abnormal and the output power decrease, first the fuel system needs to be checked.

For each 400 hours of running
• Check and adjust the transmission belt and change it when necessary
• Check and clean radiator core
• Discharge deposit in the fuel tank

For each 800 hours of running
• Check if the turbocharger has leakage
• Check if the air inlet pipes has leakage

For each 1200 hours of running
• Adjust valve clearance

For each 2000 hours of running or at least 24 months
• Change air filter (depend on ambient air quality, decide if this need to be changed earlier)
• Change coolant and coolant filter (some generator sets have)
• Thoroughly clean radiator core and water path
For each 2400 hours of running
• Check fuel injector
• Thoroughly check and clean turbo-charger
• Comprehensively check engine equipment

For each 2400 hours of running
• Check fuel injector
• Thoroughly check and clean turbo-charger
• Comprehensively check engine equipment

Alternator
Inside and outside of the alternator shall be cleaned periodically. And the frequency of cleaning depends on the generator set's ambient environment. When the cleaning becomes necessary, following procedures can be followed: cut off all of the powers, wipe off the dirt, contaminant, oil stain, water or any other liquid from the surface. The ventilation mesh also needs to be cleaned. The adhesiveness of these materials to the coils will cause the coils overheat or damage the insulation.

The dirt and contaminant need to be absorbed by dust collector. Please don't use air blow or

high pressure water spray to clean the alternator. The humidity of alternator will decrease insulation resistance. The alternator shall be dried. Please refer to Alternator's Operation and Maintenance Manual for the method of drying and detailed maintenance.

Control panel
Daily maintenance for the control panel shall ensure the cleanness of its surface, make the indicator more clear and easy for reading, and the operation button flexible and reliable. During the generator set's running period, vibration will cause the shift of "0" position in the instrument of control panel and loose of tightened parts, and therefore periodically check the instrument of the control panel and parts and cable's connections are very important. Repair for the control panel can only be done after thorough learning of the principle of this control panel (please refer to Control Panel Operation Manual for details)

Start battery
Batteries which have been stored in a long time shall be properly charged before being used, so that to ensure normal capacitance of the battery. (Densimeter can be used to check the actual capacitance of the battery)

Normal operation and battery charging will cause some water inside of the battery being vaporized. And therefore constant fluid infusion is needed. Before fluid infusion, first the contaminant around the adding hole shall be cleaned so that to avoid them falling into the battery. Then open the adding hole, add proper amount of distilled water or purified water. Do not add too much (shall be according to the indicating line in the battery polar plate), Otherwise the inside electrolyte will overflow from the adding hole when the battery is under discharge or charging, which will cause contamination to the ambient material and environment.
Please do not use the battery to start the generator set under low temperature because the battery capacitance can not output normally under low temperature, and long time discharge may cause battery malfunction(crake or explode).

Warning:
• The battery of the backup generator set shall be periodically maintained and charged. It is suggested that users can buy floating charger for the battery.

5. TECHNICAL DATA

DAGFS-15

SILENT TYPE DIESEL GENERATOR SET

Model	DAGFS-15	Power	12 kW
Engine Model	ZH2105D	Power	15 KVA
Alternator Model	VG-164D	Standby Power	13.2 kW
Frequency	50 Hz	Standby Power	14.52 KVA
Phase/Voltage	3 phase/ 380 V	Net weight	650 kg
Rated Current	23 A	Size	1700x900x1150 mm

DETAILS OF ENGINE

Engine Model	ZH2105D	Cylinder N°	4
Displacement	1.8 L	Bore and Stroke	100 x 115 mm
Rated Power	18 kW	Volume of Oil	13 L
Rated Power	22,5 KVA	Combustion	Vortex Design
Fuel Consumption	236 g/kw.h	Aspiration Type	Natural Aspirated
Governor	Machinery Governor	Radiator Water Tank	50°C
Type	4-stroke, V In-line Water Cool,Electric start	Diesel tank capacity	59 L

DETAILS OF ALTERNATOR

Alternator Model	VG-164D	A.V.R.	SX460
Type	Brushless sel-excited	Protection	IP23
Prime Power	15	Insulation	Class H
Winding Lead	12	Factor	0.8
ATS	100 A	Wire	100% copper wire
Efficient	90%		

DAGFS-25

SILENT TYPE DIESEL GENERATOR SET

Model	DAGFS-25	Power	20 kW
Engine Model	K4100D	Power	25 KVA
Alternator Model	VG-184FS	Standby Power	22 kW
Frequency	50 Hz	Standby Power	28 KVA
Phase/Voltage	3 phase/ 380 V	Net weight	710 kg
Rated Current	38 A	Size	2000x850x1150 mm

DETAILS OF ENGINE

Engine Model	K4100D	Cylinder N°	4
Displacement	3,61 L	Bore and Stroke	100 x 115 mm
Rated Power	30 kW	Volume of Oil	13 L
Rated Power	38 KVA	Combustion	Vortex Design
Fuel Consumption	7 L/H on 75% loading	Aspiration Type	Natural Aspirated
Governor	Machinery Governor	Radiator Water Tank	50°C
Type	4-stroke, V In-line Water Cool,Electric start	Diesel tank capacity	70 L

DETAILS OF ALTERNATOR

Alternator Model	VG-184FS	Efficient	90%
Type	Brushless sel-excited	A.V.R.	SX460
Prime Power	25	Protection	IP23
Winding Lead	12	Insulation	Class H
ATS	100 A	Factor	0.8

DAGFS-35

SILENT TYPE DIESEL GENERATOR SET

Model	DAGFS-35	Power	28 kW
Engine Model	K4102D	Power	35 KVA
Alternator Model	VG-184G	Standby Power	30.8 kW
Frequency	50 Hz	Standby Power	38.5 KVA
Phase/Voltage	3 phase/ 380 V	Net weight	710 kg
Rated Current	53 A	Size	2000x850x1150 mm

DETAILS OF ENGINE

Engine Model	K4102D	Cylinder N°	4
Displacement	3,61 L	Bore and Stroke	100 x 115 mm
Rated Power	36 kW	Volume of Oil	13 L
Rated Power	45 KVA	Combustion	Vortex Design
Fuel Consumption	8.2 L/H on 75% loading	Aspiration Type	Natural Aspirated
Governor	Machinery Governor	Radiator Water Tank	50°C
Type	4-stroke, V In-line Water Cool,Electric start	Diesel tank capacity	72 L

DETAILS OF ALTERNATOR

Alternator Model	VG-184G	Efficient	90%
Type	Brushless sel-excited	A.V.R.	SX460
Prime Power	35	Protection	IP23
Winding Lead	12	Insulation	Class H
ATS	100 A	Factor	0.8

DAGFS-50

SILENT TYPE DIESEL GENERATOR SET

Model	DAGFS-50	Power	40 kW
Engine Model	ZH4105ZD	Power	50 KVA
Alternator Model	VG-224D	Standby Power	44 kW
Frequency	50 Hz	Standby Power	55 KVA
Phase/Voltage	3 phase/ 380 V	Net weight	900 kg
Rated Current	76 A	Size	2150x920x1200 mm

DETAILS OF ENGINE

Engine Model	ZH4105ZD	Cylinder N°	4
Displacement	3,76 L	Bore and Stroke	100 x 115 mm
Rated Power	50 kW	Volume of Oil	13 L
Rated Power	62.5 KVA	Combustion	Vortex Design
Fuel Consumption	11.2 L/H on 75% loading	Aspiration Type	Natural Aspirated
Governor	Machinery Governor	Radiator Water Tank	50°C
Type	4-stroke, V In-line Water Cool,Electric start	Diesel tank capacity	99 L

DETAILS OF ALTERNATOR

Alternator Model	VG-224D	Efficient	90%
Type	Brushless sel-excited	A.V.R.	SX460
Prime Power	50	Protection	IP23
Winding Lead	12	Insulation	Class H
ATS	100 A	Factor	0.8

DAGFS-80

SILENT TYPE DIESEL GENERATOR SET

Model	DAGFS-80	Power	64 kW
Engine Model	R4108IZD	Power	80 KVA
Alternator Model	224GS	Standby Power	70,4 kW
Frequency	50 Hz	Standby Power	88 KVA
Phase/Voltage	3 phase/ 380 V	Net weight	1250 kg
Rated Current	121 A	Size	2350x1000x1350 mm

DETAILS OF ENGINE

Engine Model	R4108IZD	Cylinder N°	4
Displacement	4,95 L	Bore and Stroke	108 x 125 mm
Rated Power	75 kW	Volume of Oil	13 L
Rated Power	93,75 KVA	Combustion	Vortex Design
Fuel Consumption	15 L/H on 75% loading	Aspiration Type	Natural Aspirated
Governor	Machinery Governor	Radiator Water Tank	50°C
Type	4-stroke, V In-line Water Cool,Electric start	Diesel tank capacity	130 L

DETAILS OF ALTERNATOR

Alternator Model	224GS	Efficient	90%
Type	Brushless sel-excited	A.V.R.	SX460
Prime Power	80	Protection	IP23
Winding Lead	12	Insulation	Class H
ATS	160 A	Factor	0.8

DAGFS-100

SILENT TYPE DIESEL GENERATOR SET

Model	DAGFS-100	Power	80 kW
Engine Model	R6105AZD	Power	100 KVA
Alternator Model	274C	Standby Power	88 kW
Frequency	50 Hz	Standby Power	110 KVA
Phase/Voltage	3 phase/ 380 V	Net weight	1400 kg
Rated Current	142 A	Size	2700x1050x1430 mm

DETAILS OF ENGINE

Engine Model	R6105AZD	Cylinder N°	6
Displacement	7,1 L	Bore and Stroke	105 x 135 mm
Rated Power	84 kW	Volume of Oil	13 L
Rated Power	105 KVA	Combustion	Vortex Design
Fuel Consumption	17 L/H on 75% loading	Aspiration Type	Natural Aspirated
Governor	Machinery Governor	Radiator Water Tank	50°C
Type	4-stroke, V In-line Water Cool,Electric start	Diesel tank capacity	135 L

DETAILS OF ALTERNATOR

Alternator Model	274 C	Efficient	90%
Type	Brushless sel-excited	A.V.R.	SX460
Prime Power	100	Protection	IP23
Winding Lead	12	Insulation	Class H
ATS	160 A	Factor	0.8

6. DIGITAL PANEL

KEY FUNCTION DESCRIPTION

Icon	Function	Description
	Stop/ Reset	Can stop generator under Manual/Auto mode; Can reset shutdown alarm; Press this key at least 3 seconds to test panel indicators are OK or not(lamp test); During stopping process, press this key again can stop generator immediately.
	Start	Start genset under Manual or Manual Test mode.
	Manual	Pressing this key will set the module as Manual mode.
	Auto	Pressing this key will set the module as Auto mode.
Close Open	Gens Close/Open	Can control gens to switch on or off in Manual mode. Note: the key is fit for DGS6120 series controllers.
	Close	Can control gens to switch on in Manual mode. Note: the key is fit for DGS6110 series controllers.
	Open	Can control gens to switch off in Manual mode. Note: the key is fit for DGS6110 series controllers.
/OK	Set/ Confirm	Press this key to enter menu interface;Shift cursor to confirm In parameters setting menu.
	Up/Increase	Screen scroll; Up cursor and increase value in setting menu.
	Down/Decrease	Scroll screen; Down cursor and decrease value in setting menu.
/	Home/Return	Return to homepage when in main interface;Exit when in parameters setting interface.

CONTROLLER DIMENSION

Overall Dimensions	Panel Cutout
197mm × 152mm × 47mm	186mm × 141mm

PARAMETER EDITING

After controller powered on,press to enter ito the parameters setting menu,the menu item as shown:
1) Press key to enter the menu interface after controller started,choose 1. (See Fig 1);
2) Press OK key to enter parameter configuration password confirm interface (See Fig 2);
When 1234 is put, part of the parameters can be set; when 0318 is input, all the parameters can be set;
3) Press or key to increase or decrease values;Press OK key to shift cursor and confirm setting;
4) If password is correct.enter into parameter interace; Press key or key to choose

parameter items; Press OK key to enter into current arameter setting menu;
5) If parameter within the range. the setting can be saed in internal FLASH of controller. If out of range, it can.

A. Note: Pressing ☰ key at any time can exit the editor and return to main menu

Fig 1

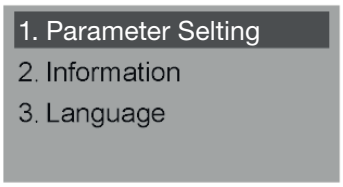
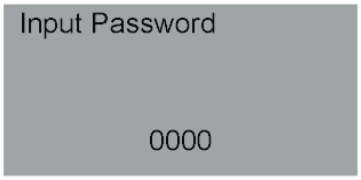


Fig 2



PARAMETER RANGE AND DEFINITION

No.	Items	Range	Default	Description
1	Mains Normal Delay	(0-3600)s	10	The delay from abnormal to normal or from normal to abnormal. It used for ATS(automatic transfer switch)control.
2	Mains Abnormal Delay	(0-3600)s	5	
3	Mains Under Voltage	(30-620)V	184	When mains voltage is under the point, mains under voltage active. When the value is 30,mains under voltage d¡sabled.
4	Mains Over Voltage	(30-620)V	276	When mains voltage is greater than the point, mains over voltage active. When the point is 620V, mains over voltage dlsabled.
5	Transfer Rest Time	(0-99.9)s	1.0	It's the delay from mains open to generator closed or from generator open to mains closed .
6	Start Delay	(0-3600)s	1	Time from mains abnormal or remote start signal is active to start genset.
7	Stop Delay	(0-3600)s	1	Time from mains normal or remote start signal is inactive to genset stop.
8	Start Times	(1-10)times	3	When engine start failure, it's the maximum cranking times.When setting crank times out,controller send start fail signal.
9	Preheat Time	(0-300)s	0	Time of pre-powering heat plug before starter is powered up.
10	Crank Time	(3-60)s	8	Time of starter power up each time .
11	Crank Rest Time	(3-60)s	10	The second waiting time before power up when engine start fail.
12	Safe Running Time	(1-60)s	10	Alarm for low oil pressure,high temp, under speed,under frequency /voltage,charge fail are all inactive.
13	Start Idle TIme	(0-3600)s	0	Idle running time of genset when starting.

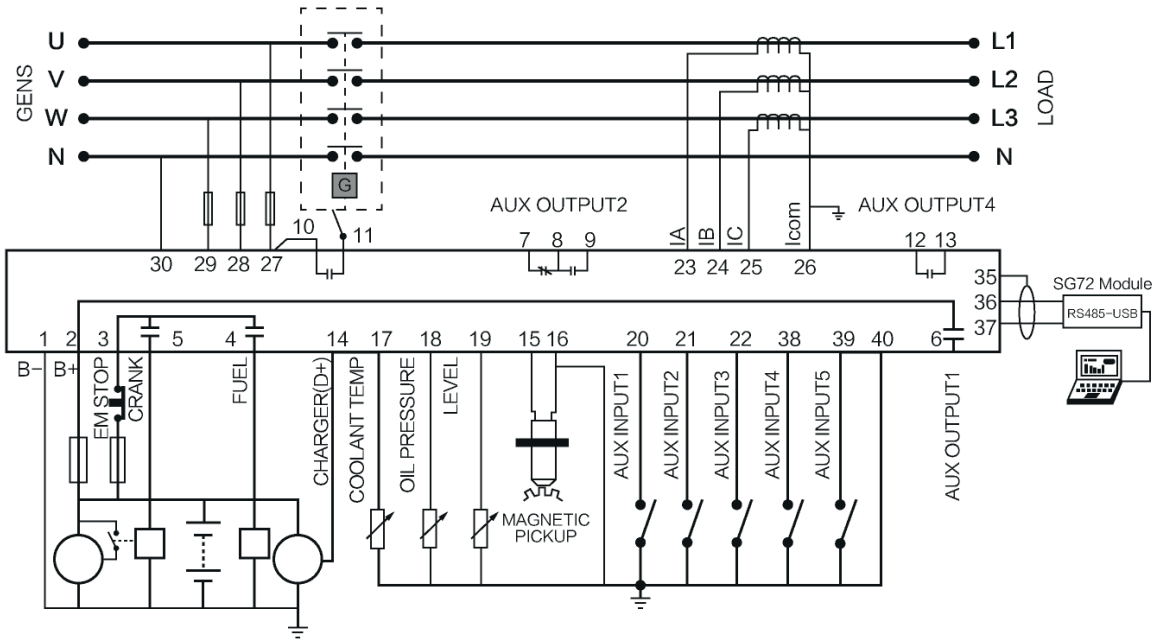
No.	Items	Range	Default	Description
14	WarmIng Up Time	(0-3600)s	10	Warming time between genset switch on and high speed running.
15	Coolant TIme	(3-3600)s	10	Time for cooling before stopping.
16	Stop Idle Time	(0-3600)s	0	Idle running time when genset stop.
17	ETS Time	(0-120)s	20	Stop electromagnet's power on time when genset is stopping.
18	Over Stop Delay	(0-120)s	0	If "ETS output time"set as 0,it is the time from end of idle delay to gen-set at rest; if not 0, it is from end of ETS solenoid delay to gen-set at rest.
19	Switch Close Delay	(0-10)s	5.0	Mains' or generator's switch closing pulse width, when it is 0, output is continuous.
20	FIywheeI Teeth	(10-300)	118	Number of flywheeI teeth,it can detect disconnection conditions and engine speed.
21	Genset Abnormal Delay	(0-20.0)s	10.0	Over or under volt alarm delay .
22	Genset Over Voltage shutdown	(30-620)V	264	When genset voltage is over the point, generator over voltage is active. When the point is 620V, generator over voltage is disabled.
23	Genset Under Voltage	(30-620)V	196	When generator voltage is under the point, generator under voltage is active. When the point is 30V, generator under voltage is disabled.
24	Under Speed shutdown	(0-6000)RPM	1200	When the engine speed is under the point for 10s, shutdown alarm signal is sent out.
25	Over Speed shutdown	(0-6000)RPM	1710	When the engine speed is over the point for 2s shutdown alarm signal is sent.
26	Under Frequency shutdown	(0-75.0)Hz	45.0	When generator frequency is lower than the point (not equal to 0) for 10s, shutdown alarm signal is sent.
27	over Frequency shutdown	(0-75.0)Hz	57.0	When generator's frequency is over the point and continues for 2s, generator over frequency is active.
28	High Temperature shutdown	(80-140)℃	98	When engine temperature sensor value is over this point, it sends out high temp.alarm. When the value is 140,warning alarm won't be sent.(only suited for temperature sensor, except for high temp.pressure alarm signa linputted by programmable input port)
29	Low Oil Pressure shutdown	(0-400)kPa	103	When engine oil pressure sensor value is under this point, Low Oil Pressure alarm is sending out. When the value is 0, warning alarm won't be sent. (only suited for oil pressure sensor, except for low oil pressure alarm signal inputted by programmable input port)

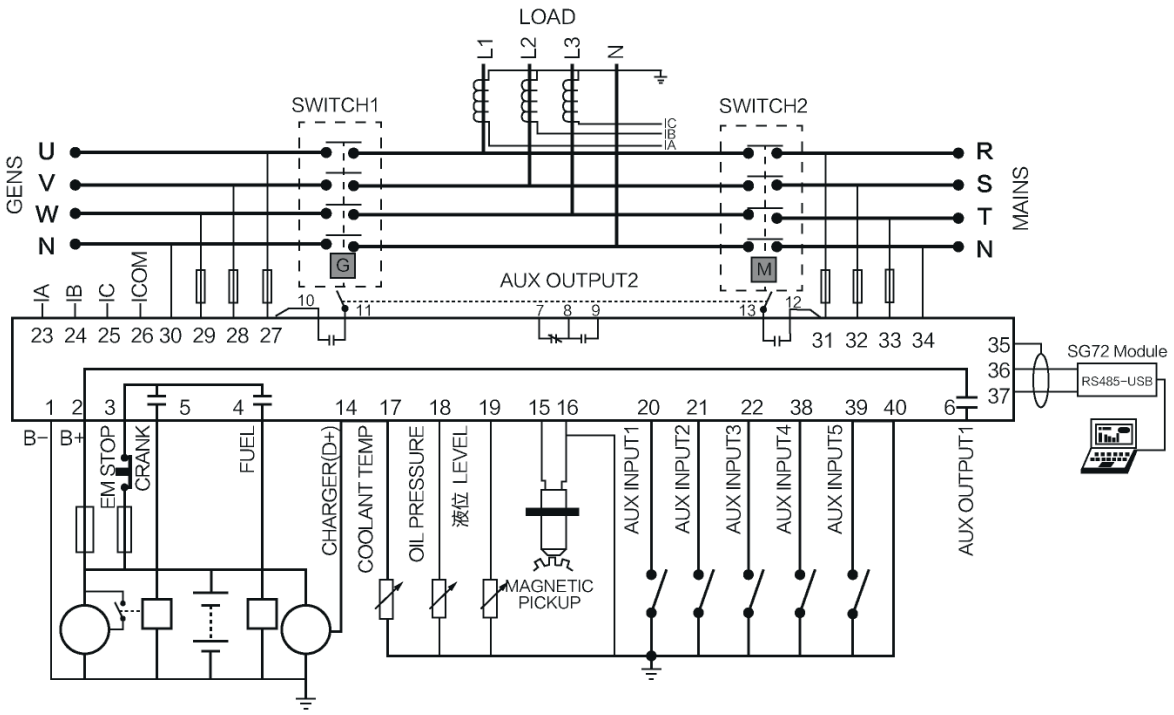
No.	Items	Range	Default	Description
30	Low Fuel Level	(0-100)%	10	When fuel level sensor value under this point and remains for 10s, genset send out warning alarm, only warn but not shutdown .
31	Loss Of Speed Signal Delay	(0-20.0)s	5.0	When the delay setting as 0s,it only warn but not shutdown.
32	Charge Failure	(0-30)V	6.0	During generator is running ,when charge alternator WL/D+voltage is under this point and remain for 5s,generator will warning alarm and shutdown.
33	Battery Over Voltage	(12-40)V	33.0	When generator battery voltage is over the point and remains for 20s, battery over voltage signal is active. it only warn but not shutdown.
34	Battery Under Voltag	(4-30)V	8.0	When generator battery voltage is under the point and remains for 20s, battery under voltage signal is active. it only warn but not shutdown.
35	CT Rate	(5-6000)/5	500	Current transformer rate.
36	Full Load Current	(5-6000)A	500	Rated current of generator,used for calculating over load current.
37	Over Current Percentage	(50-130)%	120	When load current is over the point, the over current delay is initiated.
38	Over Current Delay	(0-3600)s	1296	When load current is over the point, over current signal is sent. When the delay is 0,only warn but not shutdown.
39	Fuel Pump Open	(0-100)%	25	When the fuel level lower than the set value for 10s, send a signal to open fuel pump.
40	Fuel Pump Close	(0-100)%	80	When the fuel level higher than the set value for 10s,send a signal to close fuel pump.
41	Aux.Output 1	(0-17)	2	Factory default: Energized to stop
42	Aux.Output 2	(0-17)	3	Factory default: Idle control
43	Aux.Output 3	(0-17)	5	Factory default: Gens closed
44	Aux.Output 4	(0-17)	6	Factory default: Mains closed
45	Aux. Input 1	(0-15)	1	Factory default: High temperature alarm
46	Aux. Input 1 Active	(0-1)	0	Factory default: close
47	Aux. Input 1 Delay	(0-20.0)s	2.0	
48	Aux. Input 2	(0-15)	2	Factory default: Low oil pressure alarm
49	Aux. Input 2 Active	(0-1)	0	Factory default: close
50	Aux. Input 2 Delay	(0-20.0)s	2.0	
51	Aux. Input 3	(0-15)	10	Factory default: Remote start input

No.	Items	Range	Default	Description
52	Aux. Input 3 Active	(0-1)	0	Factory default: close
53	Aux. Input 3 Delay	(0-20.0)s	2.0	
54	Aux. Input 4	(0-15)	11	Factory default: Low fuel level warn
55	Aux. Input 4 Active	(0-1)	0	Factory default: close
56	Aux. Input 4 Delay	(0-20.0)s	2.0	
57	Aux. Input 5	(0-15)	12	Factory default: Low coolant level warn
58	Aux. Input 5 Active	(0-1)	0	Factory default: close
59	Aux. Input 5 Delay	(0-20.0)s	2.0	
60	Power Mode Select	(0-2)	0	0: Stop Mode; 1:Manual Mode; 2: Auto Mode
61	Module Address	(1-254)	1	The address of controller.
62	Password	(0-9999)	1234	
63	Crank Disconnect Condition	(0-5)	2	Conditions of disconnecting starter (generator, magnetic pickup sensor, oil pressure),Each condition can be used alone and simultaneously to separating the start motor and genset as soon as possible.
64	Engine Speed	(0-3000)RPM	360	When engine speed is ove this point,starter will disconnect.
65	Engine Frequency	(10-30)Hz	14	When generator frequency is over this point, starter will disconnect.
66	Engine Oil Pressure	(0-400)kPa	200	When engine oil pressure is over this point, starter will disconnect.
67	High Temp. Inhibit Select	(0-1)	0	Default: when temperature is over heat, the genset alarm and shutdown.**Note1**
68	Low OP. Inhibit Select	(0-1)	0	Default: when oil pressure is too low, it alarm and shutdown. **Note2**
69	Voltage Input Select	(0-3)	0	0: 3P4W 1: 2P3W 2: 1P2W 3: 3P3W
70	Temp Sensor Select	(0-9)	8	SGX
71	Pressure Sensor Select	(0-9)	8	SGX

No.	Items	Range	Default	Description
72	Liquid Level Sensor Select	(0-5)	3	SGD
73	Poles Number	(2-32)	4	Number of magnetic poles ,used for calculating rotating speed of generator without speed sensor.
74	Temp.Sensor open Circuit Action	(0-2)	1	0: Indication; 1 : Warning; 2: Shutdown
75	Oil Pressure Sensor Open Circuit Action	(0-2)	1	
76	Maintenance time	(0-5000)h	30	It is used for setting genset maintenance interval.
77	Maintenance time out action	(0-2)	0	0: Not used; 1 : Warning; 2: Shutdown When maintenance action type is set as"Not used" maintenance alarm reset.
78	Defined Sensor Curve	(0-2)		0:Defined temperature sensor 1: Defined pressure sensor 2: Defined liquid level sensor select the sensor, input corresponding 8 values.

TYPICAL APPLICATIONS




LOAD
L1
L2
L3
N
SWITCH1
SWITCH2
GENS
U
V
W
N
R
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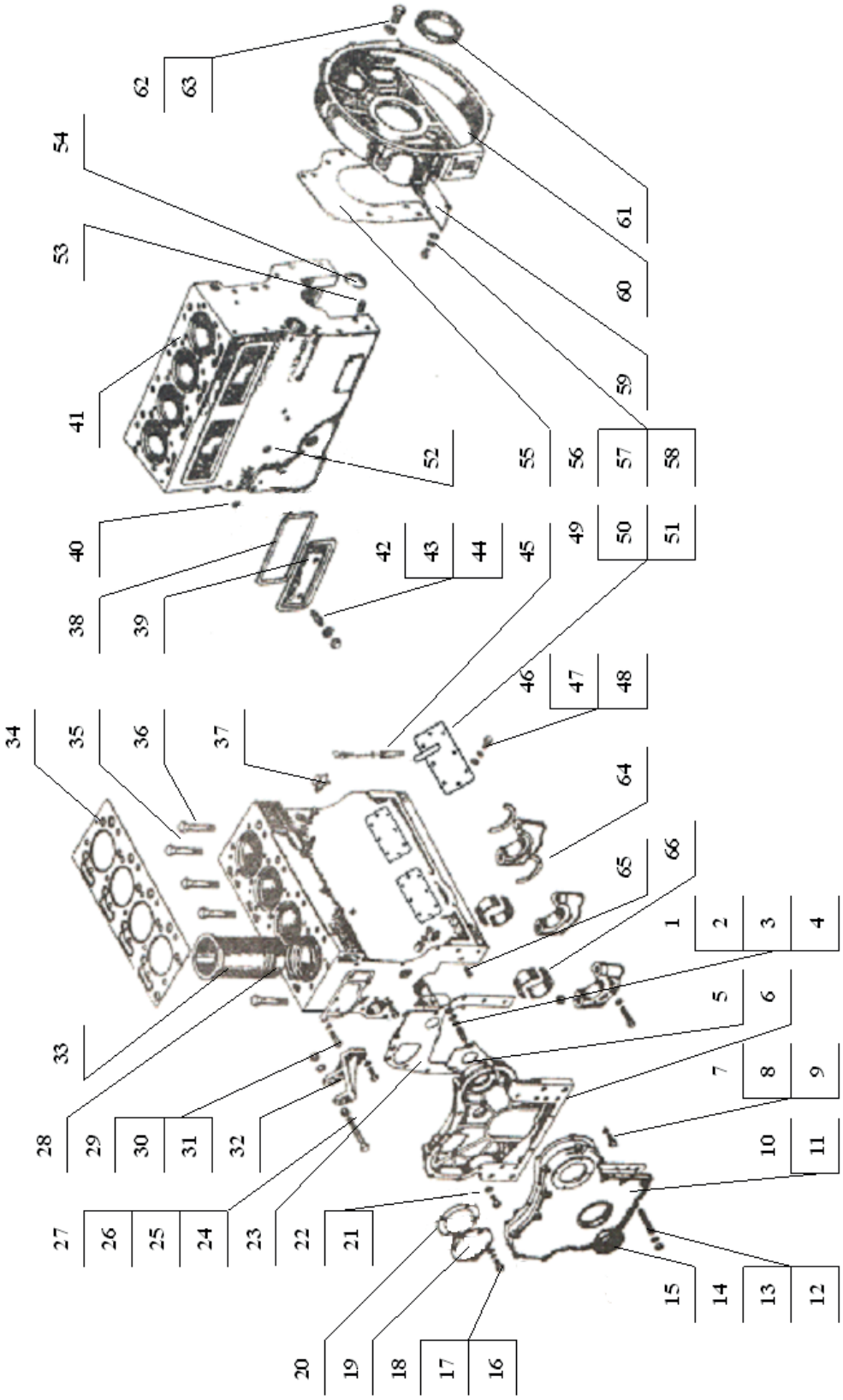
T
N
MAINS
IC
IB
IA
G
M
AUX OUTPUT2
IA
IB
IC
ICOM
23 24 25 26 30 29 28 27
10 11
7 8 9
13 12
31 32 33 34
35
36
37
SG72 Module
RS485-USB
1 2 3 5 4 14 17 18 19 15 16 20 21 22 38 39 40 6
B-
B+
EM STOP
CRANK
FUEL
CHARGER(D+)
COOLANT TEMP
OIL PRESSURE
液位 LEVEL
MAGNETIC PICKUP
AUX INPUT1
AUX INPUT2
AUX INPUT3
AUX INPUT4
AUX INPUT5
AUX OUTPUT1

7. EXPLODING VIEW AND PARTS LIST

(applies to all models)

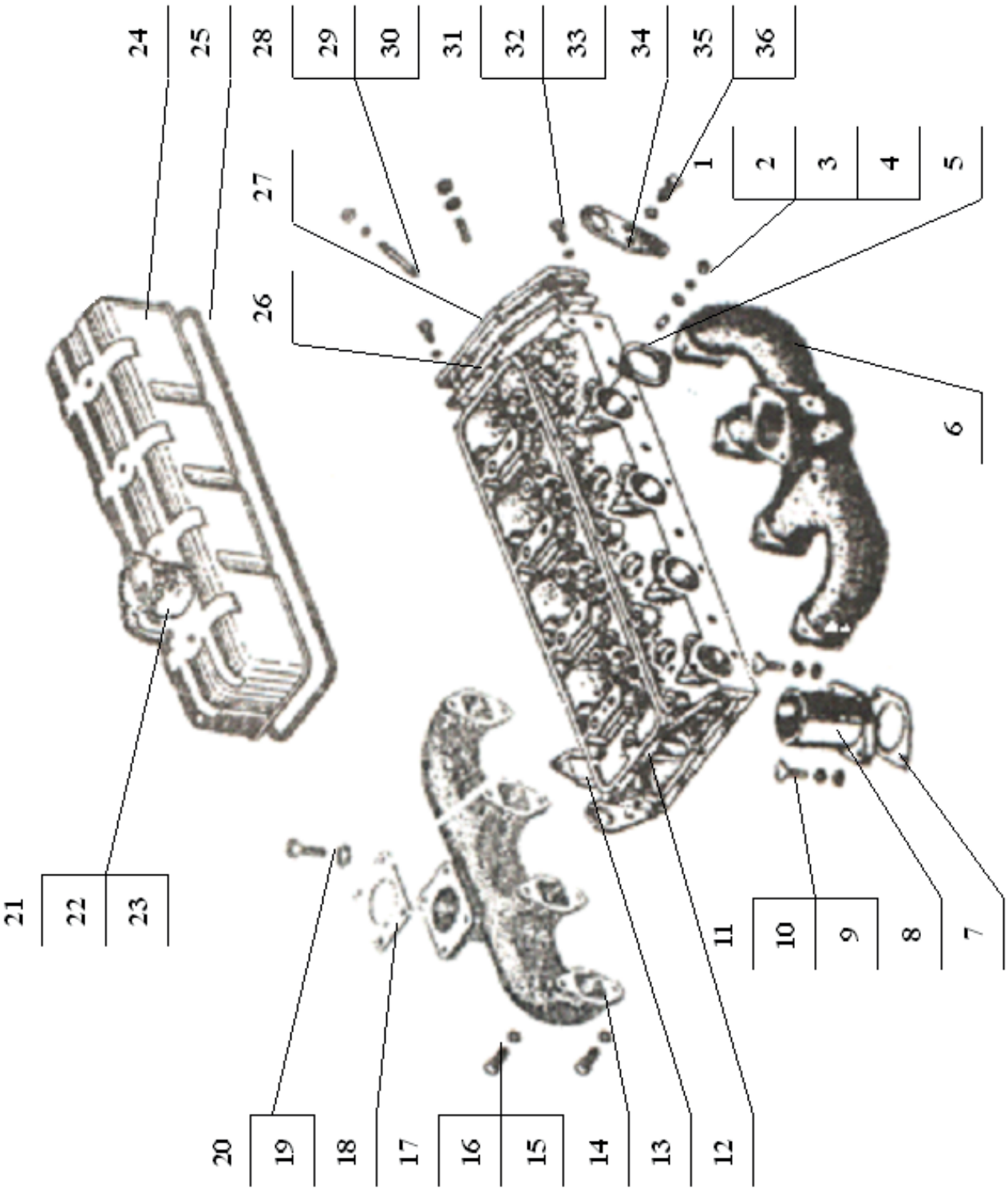
CYLINDER BLOCK ASSEMBLY



NUMBER	PART NAME	QUANTITY
1	Bolt M8X45	3
2	Nut M8	3
3	Spring washerφ8	3
4	Washerφ8	3
5	Gasket of fuel pump	1
6	Gear housing	1
7	Bolt M8X25	8
8	Spring washerφ8	8
9	Washerφ8	8
10	Gasket of gear housing cover	1
11	Gear housing cover	1
12	Bolt M10X70	8
13	Spring washerφ10	8
14	Washerφ10	8
15	Front oil seal FB55X85X12	1
16	Bolt M8X22	4
17	Spring washerφ8	4
18	Washerφ8	4
19	Advanced device cover	1
20	Gasket of advanced device cover	1
21	Bolt M10X25	4
22	Spring washerφ10	4
23	Gasket of gear housing	1
24	Bolt M10X100	1
25	Nut M10	1
26	Spring washerφ10	1
27	Washerφ10	1
28	Water sealing ring	8
29	Bolt M8X25	3
30	Spring washerφ8	3
31	Washerφ8	3
32	Bracket of generator assembly	1
33	Cylinder liner	4

NUMBER	PART NAME	QUANTITY
34	Cylinder head gasket	1
35	Cylinder head bolt (long)	14
36	Cylinder head bolt (short)	4
37	Drain cock	1
38	Rear cover sealing	2
39	Rear cover	2
40	Oil screw ZG3/8	2
41	Cylinder block assembly	1
42	Stud M8X40	4
43	Combined seal washer	4
44	Roof nut M10	4
45	Oil dipstick	1
46	Bolt M8X20	14
47	Spring washerφ8	14
48	Washerφ8	14
49	Gasket of front cover	2
50	Front cover 1	1
51	Front cover 2	1
52	Oil screw ZG1/8	7
53	Locating pin B10X25	2
54	Plug of camshaft φ55	1
55	Gasket of flywheel housing	1
56	Bolt M8X16	2
57	Spring washerφ8	2
58	Washerφ8	2
59	Dust proofed shell	1
60	Flywheel housing	1
61	Rear oil seal FB100X125X12	1
62	Bolt M12X30	8
63	Spring washerφ12	8
64	Thrust plate	1
65	Locating pin B10X25	2
66	Main bearing	5

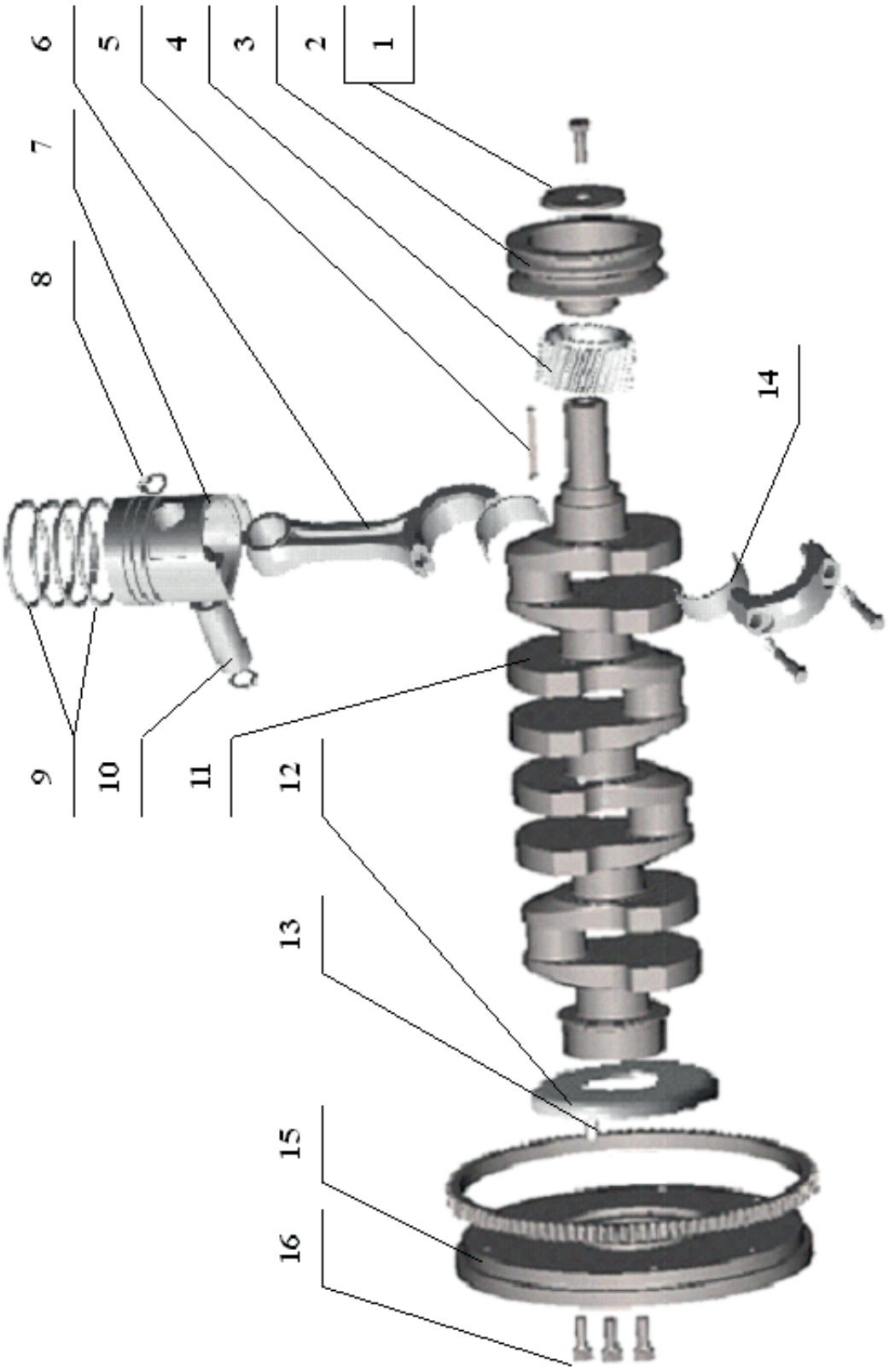
CYLINDER HEAD ASSEMBLY



NUMBER	PART NAME	QUANTITY
1	Bolt M8X45	8
2	Nut M8	8
3	Spring washerφ8	8
4	Washerφ8	8
5	Gasket of inlet manifold	4
6	Inlet manifold	1
7	Gasket of inlet pipe	1
8	Inlet pipe	1
9	Stud M8X50	2
10	Spring washerφ8	2
11	Washerφ8	2
12	Cylinder head assembly	1
13	Gasket of exhaust manifold	4
14	Exhaust manifold	1
15	Bolt M8X25	8
16	Spring washerφ8	8
17	Washerφ8	8
18	Gasket of exhaust pipe	1
19	Bolt M8X25	4
20	Spring washerφ8	4
21	Part of oil-added cover	1
22	Tube for ventilator	1
23	Hoopφ	1
24	Cylinder head cover	1
25	Sealed gasket of cylinder head cover	1
26	Gasket of side cover	1
27	Side cover	1
28	Bolt M8X45	8
29	Nut M8	8
30	Spring washerφ8	8
31	Bolt M8X22	5
32	Spring washerφ8	5
33	Washerφ8	5

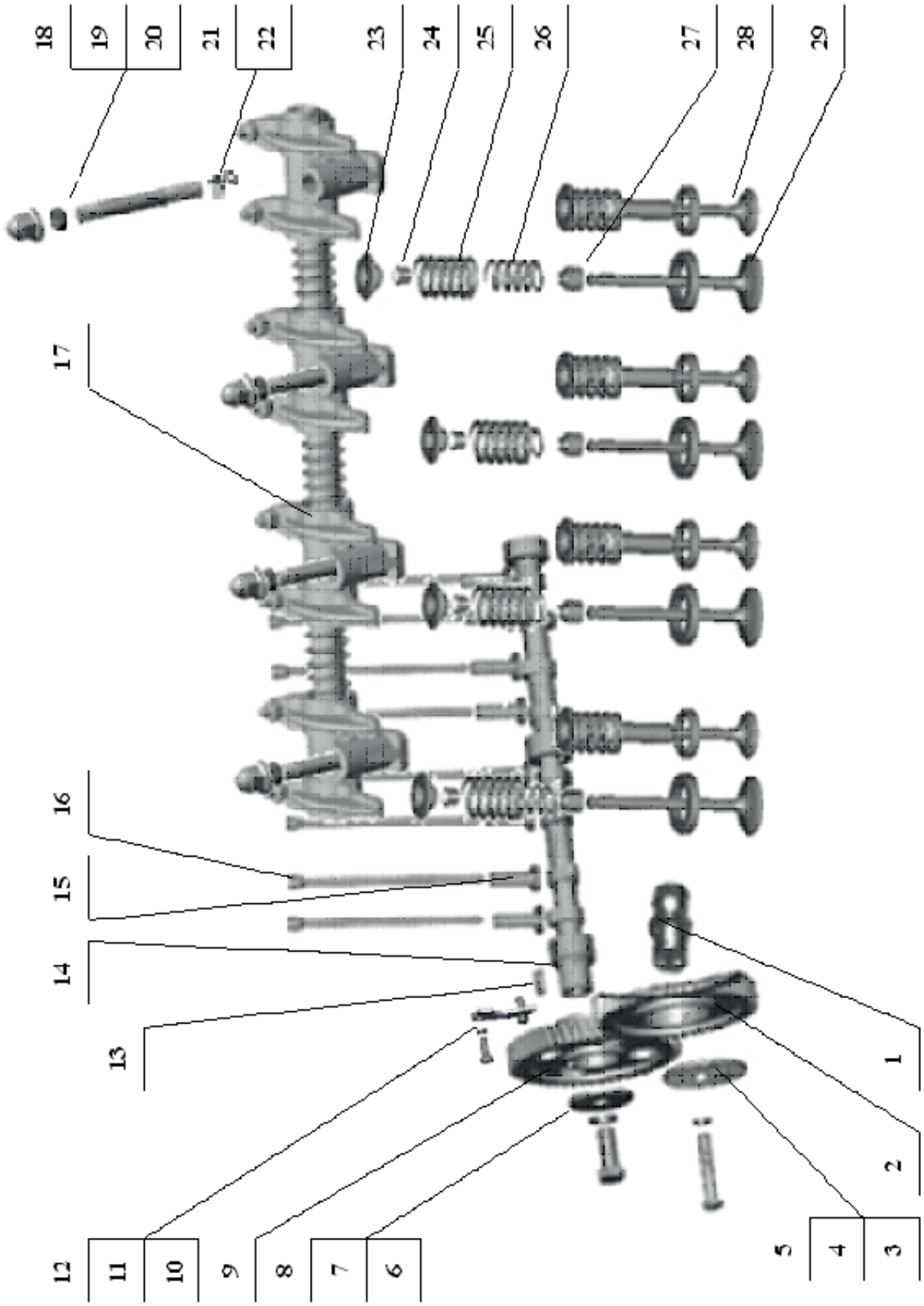
NUMBER	PART NAME	QUANTITY
34	Host ring	2
35	Bolt M10X20	4
36	Spring washerφ10	4

CRANK AND CONNECTING-ROD MECHANISM



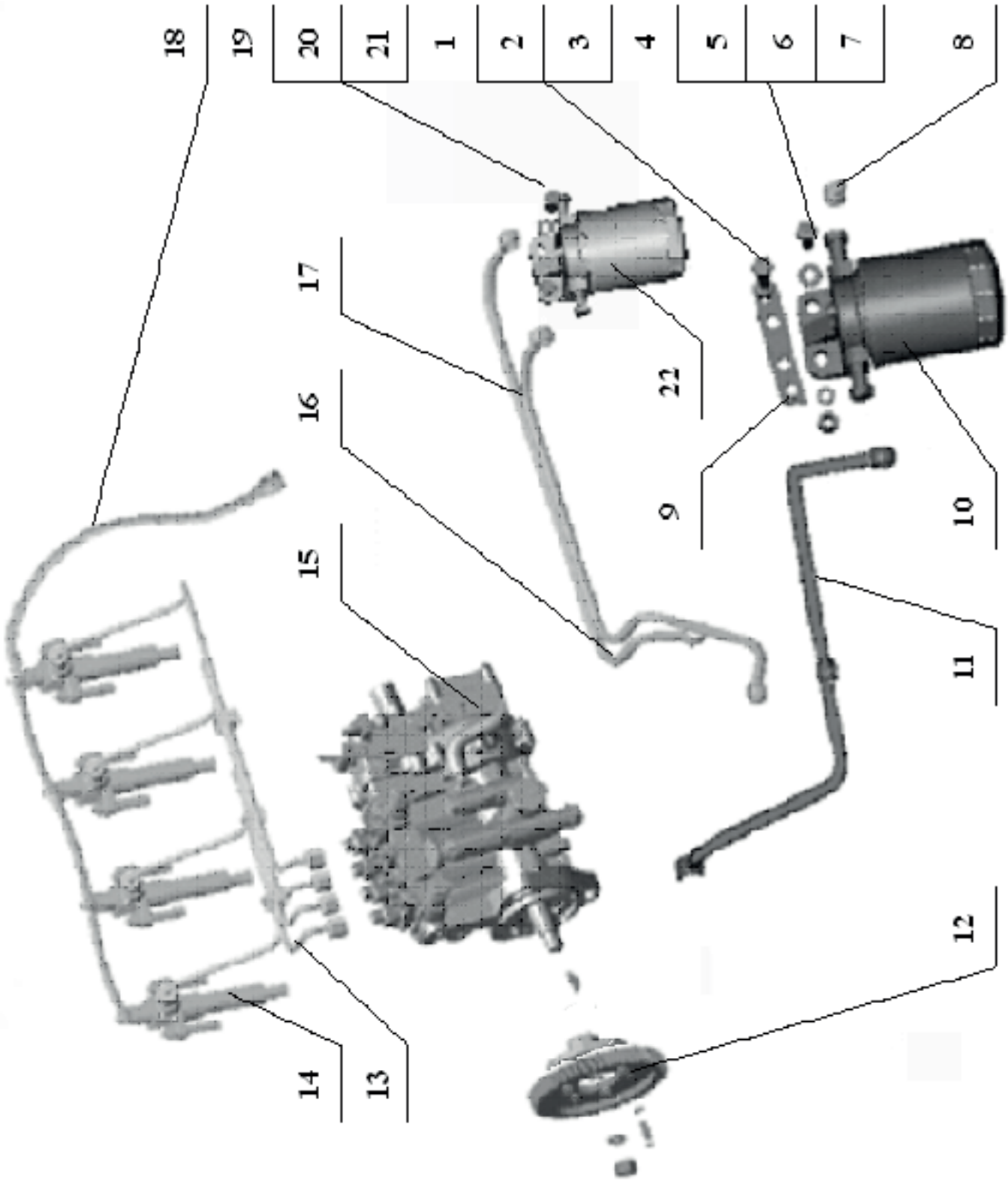
NUMBER	PART NAME	QUANTITY
1	Bolt of crankshaft pulley	1
2	Crankshaft pulley washer	1
3	Crankshaft pulley	1
4	Crankshaft pulley	1
5	Key C10X50	1
6	Connecting-rod	4
7	Piston	4
8	Snap ring 28	8
9	Piston rings	4
10	Piston pin	4
11	Crankshaft	1
12	Oil baffle disc	1
13	Locating pin B10X25	1
14	Connecting-rod bearing	4
15	Flywheel	1
16	Flywheel bolt	6

VALVE ACTUATING MECHANISM



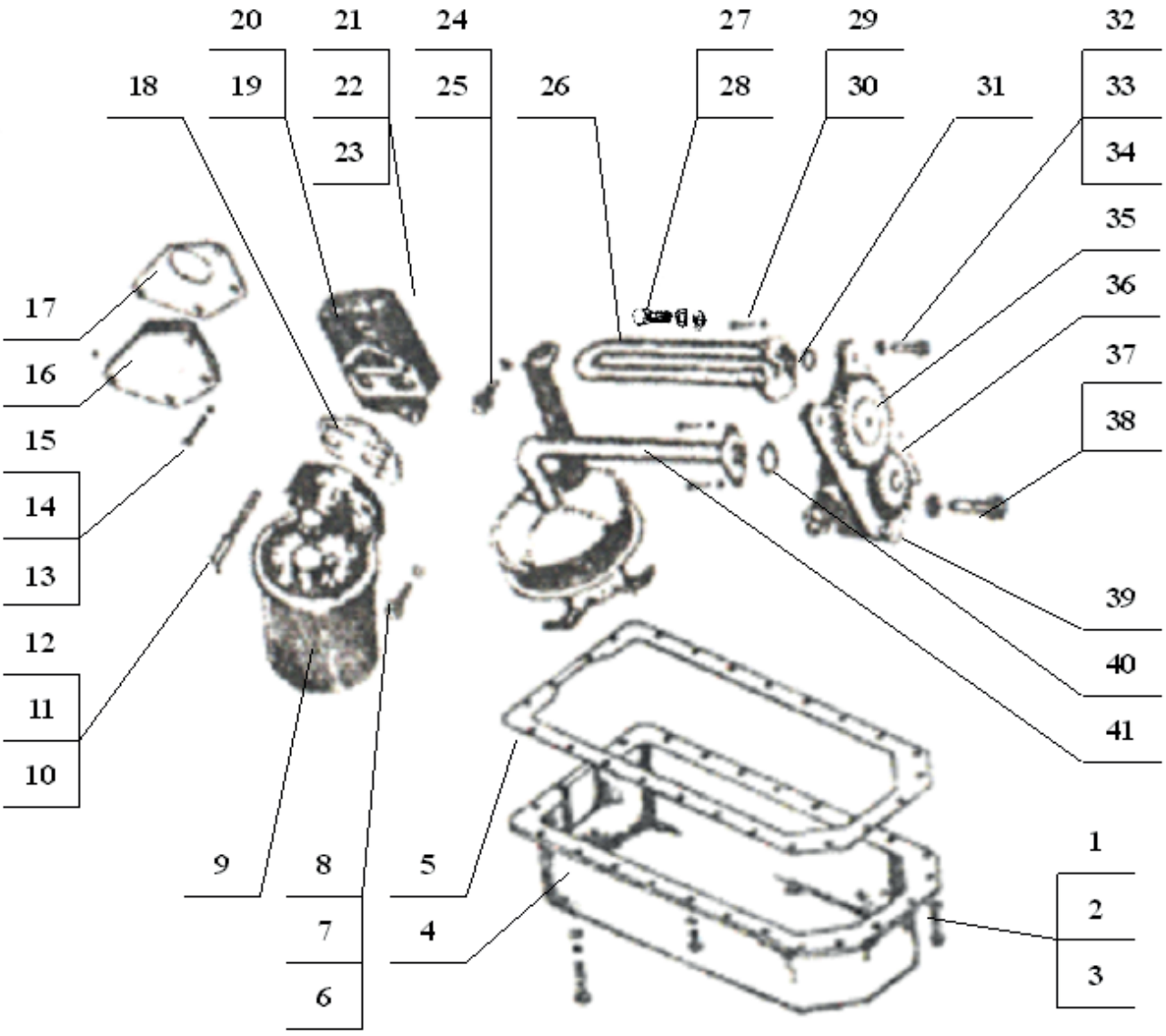
NUMBER	PART NAME	QUANTITY
1	Idle gear shaft	1
2	Idle gear	1
3	Idle gear washer	1
4	Bolt M8X22	1
5	Spring washerφ8	1
6	Bolt M8X30	1
7	Spring washerφ8	1
8	Camshaft washer	1
9	Camshaft gear	1
10	Thrust plate of camshaft	1
11	Bolt M8X25	2
12	Spring washerφ8	2
13	Key C8X22	1
14	Camshaft	1
15	Valve tappet	8
16	Push rod	8
17	Rock-arm assembly	1
18	Rock-arm bolt	4
19	Roof nut M8	4
20	Combined seal washerφ8	4
21	Nut M10	4
22	Spring washerφ10	4
23	Seat of valve spring	8
24	Split of valve spring	8
25	Valve spring (outer)	8
26	Valve spring (inner)	8
27	Valve oil seal	8
28	Exhaust valve	4
29	Inlet valve	4

FUEL SUPPLY SYSTEM



NUMBER	PART NAME	QUANTITY
1	Bolt M8X25	2
2	Spring washerφ8	2
3	Washerφ8	2
4	Bolt M8X25	2
5	Spring washerφ8	2
6	Washerφ8	2
7	Nut M8	2
8	Fuel-in joint	1
9	Bracket for fuel filter	1
10	Fuel filter	1
11	Complex pipe for Income and return	1
12	Fuel pump gear	1
13	High pressure fuel pipe	1
14	Injector assembly S529	4
15	Fuel pump assembly BH4Q90R9	1
16	Transport pipe out fuel pump	1
17	Transport pipe to fuel filter	1

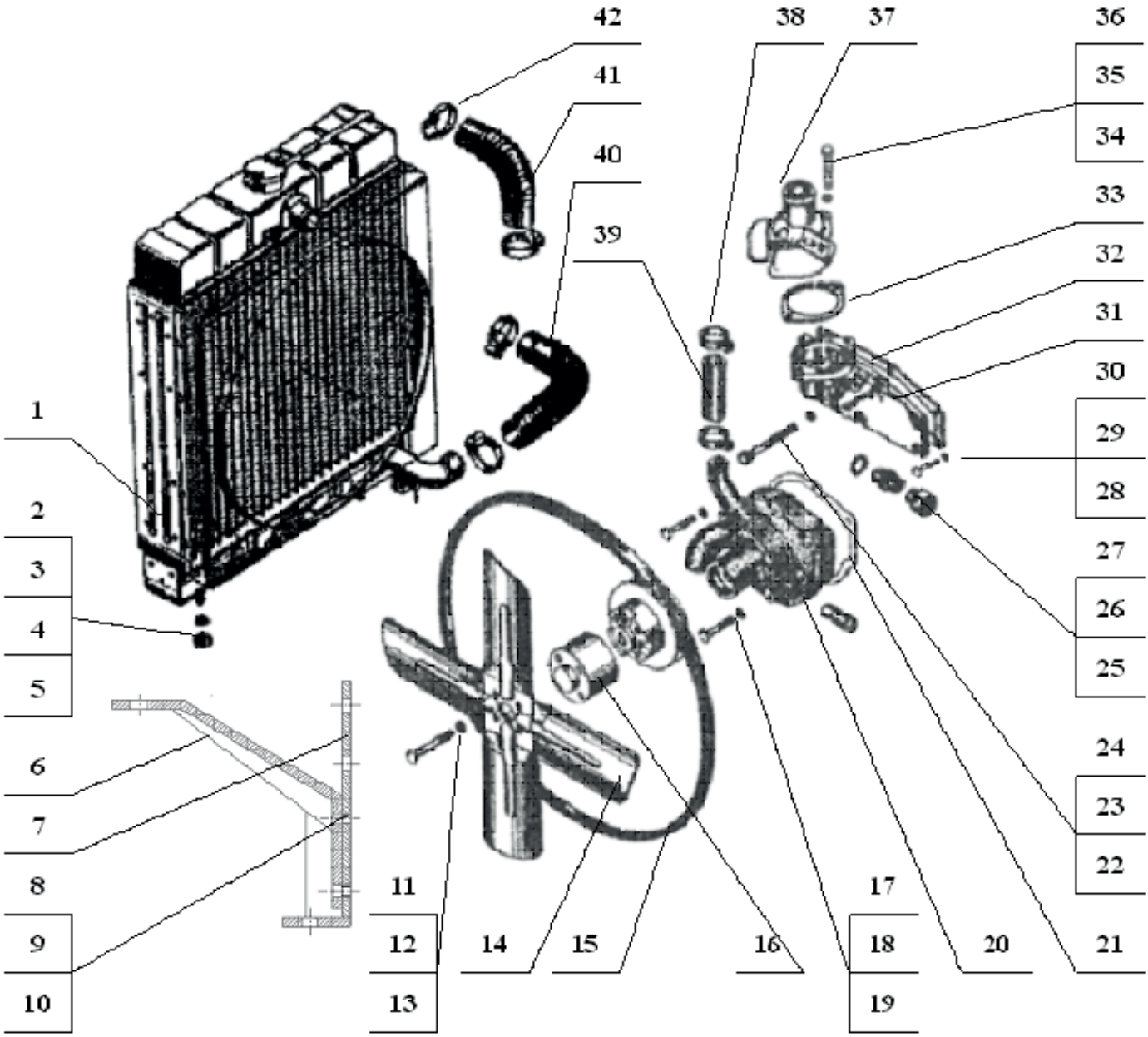
LUBRICATING SYSTEM



NUMBER	PART NAME	QUANTITY
1	Bolt M8X16	3
2	Spring washerφ8	3
3	Washerφ8	3
4	Oil sump	3
5	Gasket of oil sump	1
6	Bolt M8X25	1
7	Spring washerφ8	8
8	Washerφ8	8
9	Oil filter assembly JX0810	8
10	Bolt M8X45	1
11	Spring washerφ8	1
12	Washerφ8	8
13	Bolt M8X25	8
14	Spring washerφ8	8
15	Washerφ8	1
16	Oil returned cover for turbo	4
17	Gasket of oil returned cover for turbo	4
18	Gasket of oil filter assembly	4
19	Connected cover for oil filter	1
20	Gasket of connected cover for oil filter	1
21	Bolt M8X35	4
22	Spring washerφ8	4
23	Washerφ8	1
24	Bolt M8X16	1
25	Spring washerφ8	1
26	Oil pipe	1
27	Hollow bolt M18X1.5	1
28	Bronze washerφ18	8
29	Bolt M6X20	3
30	Spring washerφ6	3
31	O ring 18X2.4	3
32	Bolt M8X22	1
33	Spring washerφ8	4

NUMBER	PART NAME	QUANTITY
34	Washerφ8	2
35	Oil pump driven gear	1
36	Oil pump gear	1
37	Bolt M8X40	1
38	Spring washerφ8	1
39	Oil pump assembly	1
40	O ring 24X2.4	1
41	Oil strainer	1

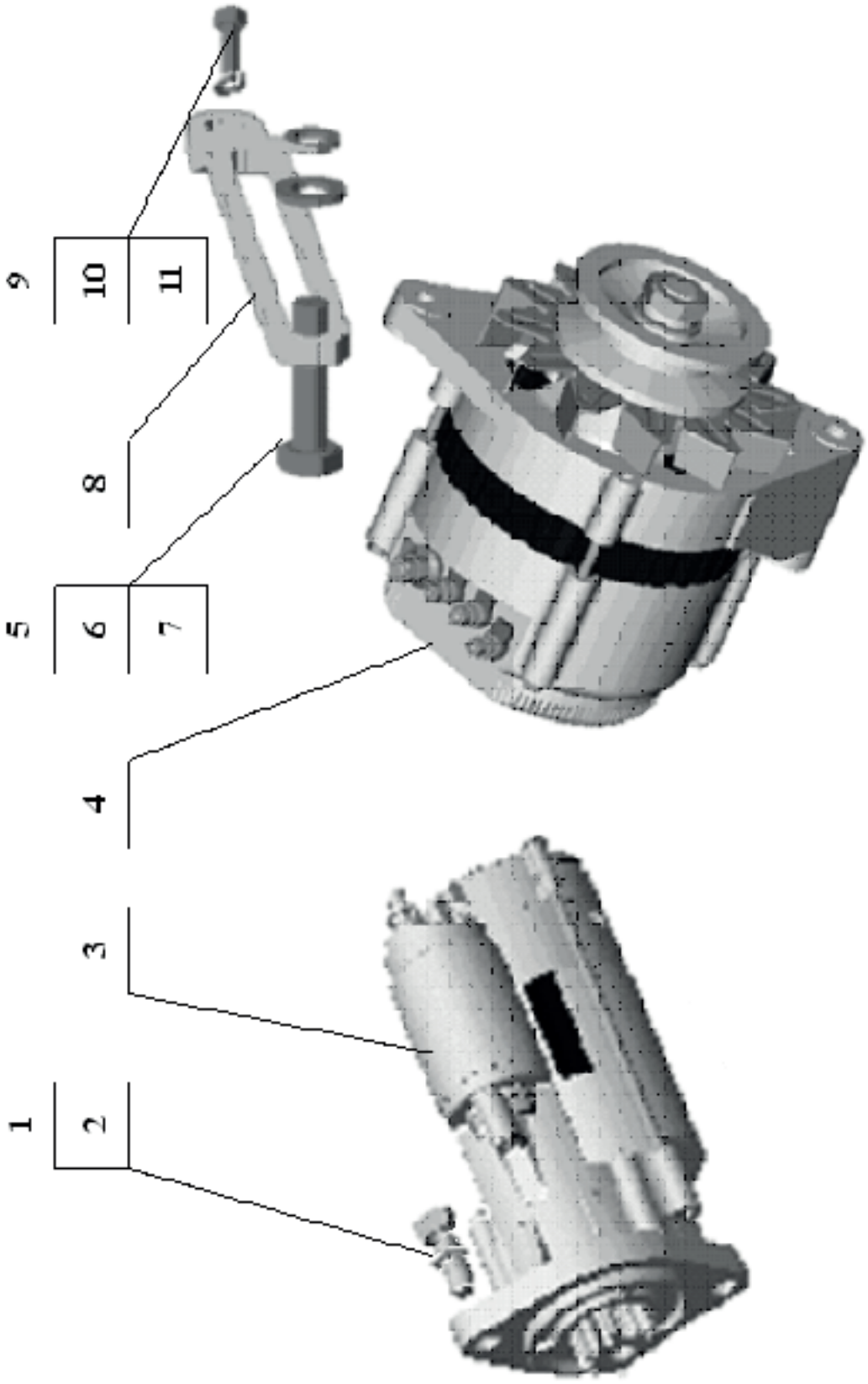
COOLING SYSTEM



NUMBER	PART NAME	QUANTITY
1	Radiator assembly	1
2	Nut M12	2
3	Combined padding block for radiator	2
4	Spring washerφ12	2
5	Washerφ12	2
6	Bracket of radiator	2
7	Front foot	2
8	Bolt M12X25	4
9	Spring washerφ12	4
10	Nut M14	4
11	Bolt M8X35	4
12	Spring washerφ8	4
13	Washerφ8	4
14	Fan	1
15	V Belt 1168	1
16	Padding block for fan	1
17	Bolt M8X45	4
18	Spring washerφ8	4
19	Washerφ8	4
20	Water pump assembly	1
21	Gasket of water pump	1
22	Bolt M8X85	1
23	Spring washerφ8	1
24	Washerφ8	1
25	Water temperature sensor	1
26	Water Temperature Induction Plug Joint	1
27	Combined sealed washer	1
28	Bolt M8X25	3
29	Spring washerφ8	3
30	Washerφ8	3
31	Thermostat housing	1
32	Gasket of thermostat housing	1
33	Gasket of thermostat housing cover	1

NUMBER	PART NAME	QUANTITY
34	Bolt M8X50	2
35	Spring washerφ8	2
36	Washerφ8	2
37	Thermostat housing cover	1
38	Hoopφ26	2
39	Connected tube	1
40	Inlet tube	1
41	Outlet tube	1
42	Hoopφ38	4

ELECTRIC SYSTEM



NUMBER	PART NAME	QUANTITY
1	Bolt M12X30	2
2	Spring washerφ12	2
3	Starting motor assembly	1
4	Generator assembly	1
5	Bolt M8X30	1
6	Spring washerφ8	1
7	Washerφ8	1
8	Adjusted bracket of generator assembly	1
9	Bolt M8X25	1
10	Spring washerφ8	1
11	Washerφ8	1

EC DECLARATION OF CONFORMITY

FUJIAN EPOS ELECTRIC MACHINERY CO.LTD

Model: DAGFS-15, DAGFS-25, DAGFS-35, DAGFS-50, DAGFS-80, DAGFS-100

Brand: DAEWOO

We GBR Corp. LTD, Room 1002, 10/F., David House, 8-20 Nanking Street, Jordan, Kowloon, Hong Kong, China, declare under our sole responsibility that this product is in conformity and accordance with the following standards and regulations.

The undersigned is responsible for the compilation of technical documentation.

With this declaration of compliance we certify that articles :FUJIAN EPOS ELECTRIC MACHINERY CO.LTD are complying the rules of Machinery Directive EN 60204-1:2018; EN ISO 12100:2010; EN ISO 8528-13:2016EN 55012:2007/A1:2009; EN IC 61000-3-2:2019 EN 61000-3-3:2013+A1:2019; EN 55012:2007/A 1:2009
The DAEWOO Products authorized representative declares that these products described under "technical data" are in compliance with:
Machinery Directive EN 60204-1:2018; EN ISO 12100:2010; EN ISO 8528-13:2016EN 55012:2007/A1:2009; EN IC 61000-3-2:2019 EN 61000-3-3:2013+A1:2019; EN 55012:2007/A 1:2009

Signature and Stamp on undersigned responsible.
Date: 28-4-2022
GBR Corporation Ltd.
15/F. 100 Queen´s Road Central, Central, Hong Kong

Signature

DAEWOO POWER PRODUCTS

WARRANTY CARD

Product model	Date of sale
Serial number	Company
Username	Client's signature

The product is in good conditions and fully complete. Read and agree the terms of the warranty.

GUARANTEE

The warranty period starts from the date of sale of the products and covers 2 years for all power products.

During the warranty period, free failures caused due to the use of poor-quality materials in the production and manufacturer workmanship admitted fault are removed. The guarantee comes into force only when warranty card and cutting coupons are properly filled. The product is accepted for repair in its pure form and full completeness.

WARRANTY DOES NOT COVER

- Mechanical damage (cracks, chips, etc.) and damage caused by exposure to aggressive media, foreign objects inside the unit and air vents, as well as for damage occurred as a result of improper storage (corrosion of metal parts);
- Failures caused by overloading or product misuse, use of the product for other purposes. A sure sign of overload products is melting or discoloration of parts due to the high temperature, simultaneous failure of two or more nodes, teaser on the surfaces of the cylinder and the piston or destruction of piston rings. Also, the warranty does not cover failure of the automatic voltage regulator due to incorrect operation;
- Failure caused by clogging of the fuel and cooling systems;
- Wearing parts (carbon brushes, belts, rubber seals, oil seals, shock absorbers, springs, clutches, spark plugs, mufflers, nozzles, pulleys, guide rollers, cables, recoil starter, chucks, collets, removable batteries, filters and safety elements, grease, removable devices, equipment, knives, drills, etc.);
- Electrical cables with mechanical and thermal damage;
- Product opened or repaired by a non-authorized service center.
- Prevention, care products (cleaning, washing, lubrication, etc.), installation and configuration of the product;
- Natural wear products (production share);
- Failures caused by using the product for the needs related to business activities;
- If the warranty card is empty or missing seal (stamp) of the Seller;
- The absence of the holder's signature on the warranty card.

DAEWOO

Product _____

Model _____

Company _____

Date of sale _____

DAEWOO

Product _____

Model _____

Company _____

Date of sale _____

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Product _____

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Company _____

Date of sale _____

INDEX

1. SAFETY PRECAUTIONS

Before operating the generating set, read the generating set operation manual and this generator manual and become familiar with it and the equipment. The following symbols are used in the user manual or on the product:

SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE EQUIPMENT IS CORRECTLY OPERATED AND MAINTAINED.

Many accidents occur because of failure to follow fundamental rules and precautions.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

• Ensure installation meets all applicable safety and lacal electrical codes. Have all installations performed by a qualified electrician.
• Do not operate the generator with protective covers, access covers or terminal box covers removed.
• Disable eng ine start circuits before carrying out maintenance.
• Disable closing circuits and/or place warning notices on any circuit breakers normally used for connection to the mains or other generators, to avoid accidental closure.

Observe all IMPORTANT, CAUTION, WARNING, AND DANGER notices, defined as:

IMPORTANT!	Important, refers to hazard or unsafe method or practice which can result in product damage or related equipment damage.
CAUTION!	Caution, refers to hazard or unsafe method or practice which can result in product damage or injury to personnel.
Warning! 	Warning refers to a hazard or unsafemethod or practice that can result severe injury to personnel, possibly death.
Danger! 	Danger, refers to immediate hazards which will result in severe injury or death to personnel.

Due to our policy of continuous improvement, details in th is manual which were correct at time of printing, may now be due for amendment. Information included must herefore not be regarded as binding.

Photograph
The Front Cover photograph is representative only.

2. INTRODUCTION

2.1 INTRODUCTION

The generator is of brushless rotating field design, available up to 660V at 50Hz or 60Hz. The design, build and text procedures meet a range of British, European and international standards including, BS 5000, BS EN 60034 and ISO 60034, Where applicable. The generators are fitted with the PMG Pilot exciter system and an automatic voltage regulator (AVR). The MX 341 or the MX 321 can be fitted.

2.2 SERIAL NUMBER LOCATION

Each generator has ns unique serial number stamped int. the upper section of the drive end frame end-ring. Inside the term inal box two adhesive rectangular labels have been fixed, each carrying the generator's unique identity number. One label has been fixed to the inside of the terminal box sheet metal-work, and the second label fixed to the main frame of the generator.

2.3 DESIGNATION

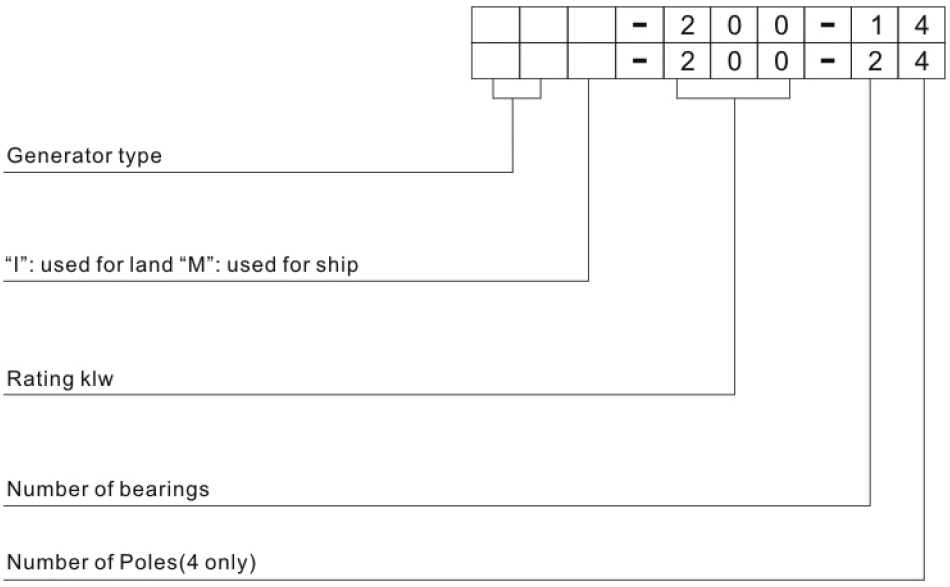

Fig 1

3. PRINCIPLE OPERATION

3.1 EXCITED-AVR CONTROLLED GENERATORS

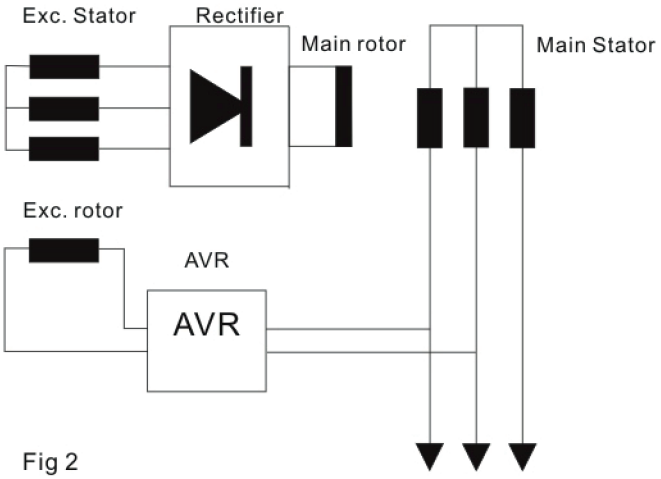

Fig 2

The main stator provides power for excitation of the exciter field via the SX440 AVR which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived from the main stator winding By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the armature.

The SX440 AVR senses average voltage on two phases ensuring close regulation. In addition it detects engine speed and provides voltage fall off with speed. Below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening. The effect of load switching to relieve burden on the engine.

4. APPLICATION OF THE GENERATOR

The generator is supplied as a component part for installation in a generating set. It is not, therefore, practicable to fit all the necessary warning/hazard labels during generator manufacture. The additional labels required are packaged with this manual, together with a drawing identifying their locations.(see below).

It is the responsibility of the generating set manufacturer to ensure that the correct labels are fitted, and are clearly visible.

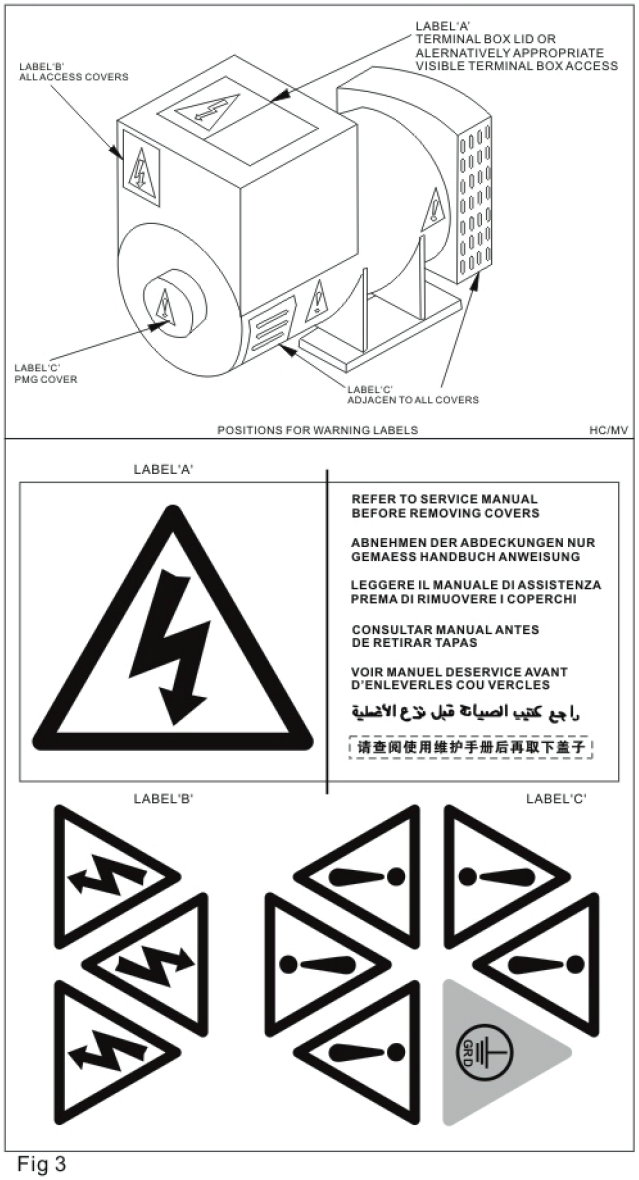

Fig 3

The generators have been designed for use in a maximum ambient temperature of 40°C, and altitude less than 1000 metres above sea level in accordance with Bs5000. Ambient in excess of 40°C, and altitudes above 1000 metres can be tolerated with reduced ratings-refer to the factory.

The generators are of air-ventilated scteen protected dripproof design and are not suitable for mounting outdoors unless adequately protected by the use of canopies. Anticondensation heaters are recommended during storage and for standby duty to ensure winding insulation is maintained in good condition.

When installed in a closed canopy it must be ensured that the ambient temperature of the cooling air to the generator does not exceed that for which the generator has been rated. The canopy should be designed such that the engine air intake to the canopy is separated form the

generator intake, particularly where the radiator cooling fan is required to draw air into the canopy. In addition the generator air intake to the canopy should be designed such that the ingress of moisture is prohibited. Preferably by use of a two stage filter.

The air intake/outlet must be suitable for the air flow given in the following table with additional pressure drops less than or equal to those given in table 1 below:

Frame	Air Flow		Additional (intake/outlet) Pressure Drop
	50Hz 1500 Rev/min	60Hz 1800 Rev/min	
	2.18m³/sec	2.63m³/sec	6 mm water gauge
	4619cfm	5573cfm	(0.25")

Table 1

The generators may be fitted with air f ilters. These are oil charged wire gauze filters and require charging during installation.

IMPORTANT!	Reduction in cooling airflow or inadequate protection to the generator can result in damage and/or failure of windings

Dynamic balancing of the generator rotor assembly has been carried out during manufacture in accordance with BS 6861 Part 1 Grade 2.5 to ensure vibration limits of the generator are in accordance with BS 4999 Part 142.

The main vibration frequencies produced by the component generator are as follows:

	1500rpm	1800rpm
4 pole	25Hz	30Hz

Table 2

The standard terminal box is arranged for cable entry on the right hand side looking from the end of generator. If specified at the time of order cable entry may be arranged on the opposite side.

The terminal box is constructed with removable panels for easy adaptation to suit specific glanding requirements. With in the terminal box there are insulated terminals for line and neutral connections and provision for earthing. Additional earthing points are provided on the generator feet.

The neutral, as supplied from the factory, is NOT connected to the frame.

Warning! ⚠	No earth connections are made on the generator and reference to site regulations for earthing must be made. In correc tearthing or protection arrangements can result in personal injury or death.

Fault current curves (decrement curves), together with generator reactance data, are available on request to assist the system designer to select circuit breakers. Calculate fault currents and ensure discrimination within the load network

4.1 VIBRATION

Vibrations generated by the engine are complex and contain harmonics of 1.5,3,5 or more times the fundamental frequency of vibration. The generator will be subjected to this vibration, Which will result in the generator being subjected to vibration levels higher than those derived from the generator itself.
The generators are designed to withstand the vibration levels encountered on generating sets built to meet the requirements of ISO 8525-9 and BS5000-3. (Where ISO 8525 is taken to be broad band measurements and Bs 5000 refers to the predominant frequency of any vibrations on the generating set.)

Definition of BS 5000-3
Generators shall be capable of continuously with standing linear vibration levels with amplitudes of 0.25 mm between 5 Hz and 8Hz and velocities of 9.0mm/s rms between 8 Hz and 200 Hz when measured at any point directly on the carcass or main frame of the machine. These limits refer only to the predominant frequency of vibration of any complex waveform.

Definition of ISO 8528-9
ISO 8528-9 refers to a broad band of frequencies, the broad band is taken to be between 2 Hertz and 300 Hertz. The table below is an example from ISO 8528-9 (value 1). This simplified table lists the vibration limits by KVA range and speed for acceptable genset operation.

VIBRATION LEVELS AS MEASURED ON THE GENERATOR				
Engine Speed Min-^{1}	**Set Output kVA**	**Vibration Displacement**	**Vibration Velocity**	**Vibration Acceleration**
4 POLE 1500 rmp 50Hz 1800 rmp 60Hz	>30kVA	0.32	20	13
The Broad band is taken as 2 Hz - 300 Hz				Table 2

It is the responsibility of the generating set designer to ensure the alignment of the gen set, stiffness of the bed-frame and mountings are such that the Vibration limits as defined above are met.

If the Vibration levels of the generating set are not within the parameters quoted above:

1. Consult the genset builder. The genset builder should address the genset design to reduce the vibration levels as much as possibie.
2. Discuss, with
3. The impact of not meeting the above levels on both bearing and generator life expectancy.

IMPORTANT!	Important, refers to hazard or unsafe method or practice which can result in product damage or related equipment damage. Exceeding either of the above specifications will have a detrimental effect on the generating bea rings.
IMPORTANT!	(See section on bearings). This will invalidate the generator warranty. If you are in any doubt, contact newage International Linmted

In standby applications where the running time is limited and reduced life expectancy is accepted, higher levels than specified. in BS5000 can be tolerated, up to a maximum of 18mm/sec.

Two bearing generators require a substantial bedplate with Engine/generator mounting pads to ensure a good base for accurate alignment. Close Coupling of engine to generator can increase the overall rig idity of the set. A flexible coupling designed to Suit the Specific engine/generator combination, is recommended to minimise torsional effects.

Alignment of single bearing generators is critical and vibration can occur due to the flexing of the flanges between the engine and generator. A substantial bedplate with engine/generator mounting pads is required.

The maximum bending moment of the engine flange must be checked with the engine manufacturer.

Torsional vibrations occur in all engine-driven shaft systems and may be of a magnitude to cause damage at cerrain critical speeds. It is therefore necessary to consider the torsional vibration effect on the generator shaft and couplings.

It is the responsibility of the generator set manufacturer to ensure compatibility, and for this purpose drawings showing the shaft dimensions and rotor inertia are available for customers to forward to the enginesupplier. In the case of single bearing generator coupling details are included.

IMPORTANT!	Torsional incompatibility and/or excessive vibration levels can cause damage or failure of generator and/or engine components

5. INSTALLATION-PART 1

5.1 LIFTING

Warning! ⚠	Incorrect lifting or inadequate lifting capacity can result In severe personal injury or equipment damage MINIMUM LIFTING CAPACITY REQUIRED IS AS INDICA TED ON THE LIFTING LABEL. Generator lifting lugs should not be used for lifting the complete

Two lifting lugs are provided for use with a shackle and pin type lifting aid, A spreader with chains, to ensure that the lift is vertical, of suitable length and lifting capacity must be used. Lifting points are designed to position the craneage possible, but due to design restrictions it is not possible to guarantee that the generator frame will remain horizontal while lifting, Care is therefore needed to avoid personal injury or equipment damage, The correct lifting arrangement is shown on the label attached to the lifting lug. (See sample below).

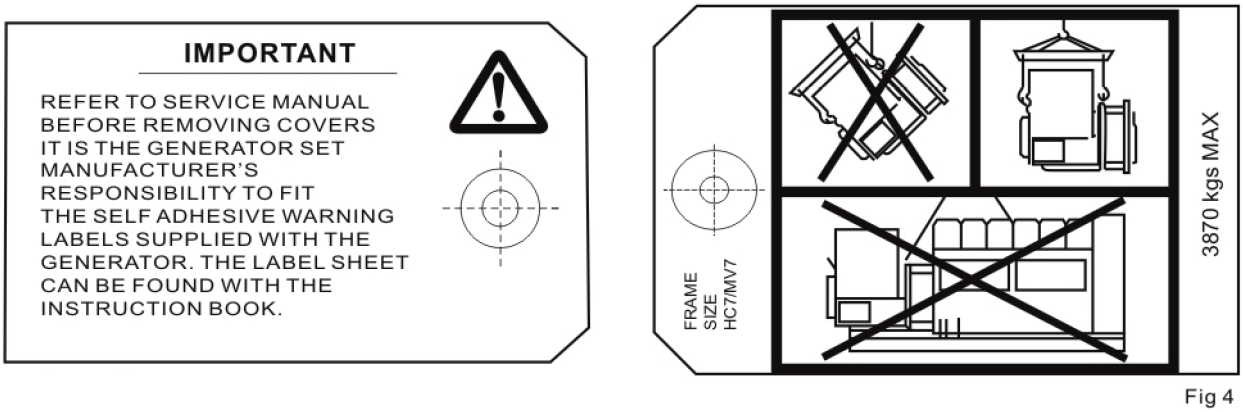

Fig 4

Single bearing generators are supplied fitted with a rotor retaining bar at the drive end of the shaft. Single bearing generators are also fitted with wooden wedges supporting the fan for transit purposes.

Once the bar is removed to couple the rotor to engine, the rotor is free to move in the frame, and care is needed during coupling and alignment to ensure the frame is kept in the horizontal plane.

5.2 ENGINE TO ASSEMBLY GENERATOR COUPLING

During the assembly of the generator to the engine it will be necessary to firstly carefully align, the rotate, the combined Generator rotor - Engine crankshaft assembly, as part of the construction process, to allow location, insertion and tightening of the coupling bolts. This requirement to rotate the combined assemblies exists for both single and two beating units.

During the construction of single bearing units it is necessary to align the generator's coupling holes with the engine flywheel holes. It is suggested that two diametrically opposite

Location dowel pins are fitted to the engine flywheel. The coupling can then slide into final location on the engine flywheel recess. The dowels must be removed and replaced by coupling bolts before the final bolt tightening sequence.

While fitting and tightening the coupling bolts it will be necessary to rotate the engine crankshaft - Generator rotor assembly. Care should be taken to ensure that rotation is carried out in an approved manner that ensures safe working practice when reaching inside the machine to insert or tighten coupling bolts, and that no component of the assembly is damaged by non-approved methods of assembly rotation.

Engine Manufacturers have available a proprietary tool designed to enable manual rotation of the crankshaft assembly. This tool must always be used, having been engineered as an approved method of assembly rotation, by engaging the manually driven pinion with the engine flywheel starter ring-gear.

Danger! 	Before working inside the generator, during the aligning and fitting of coupling bolts, care should be taken to lock the assembly to ensure there is no possibility. Of assembly rotational movement.

5.2.1 TWO BEARING GENERATORS

A flexible coupling should be fitted and aligned in accordance with the coupling manufacturer's instruction.

If a close coupling adaptor is used the alignment of machine faces must be checked by offering the generator up to the engine. Shim the generator feet if necessary. Ensure adaptor guards are fitted after generator/engine assembly is complete.

Open coupled sets require a suitable guard, to be provided by the set builder.

Axial loading of the generator beatings should be avoided. Should it be unavoidable contact the factory for advice.

CAUTION!	Incorrect guarding and/or generator a lignment can result in personal injury and/or equipment damage.

5.2.2 SINGLE BEARING GENERATORS

For transit and storage purposes the generator frame spigot and rotor coupling plates have been coated with a rust preventative This MUST BE removed before assembly to engine.
A practical method for removal of this coating is to clean the mating surface areas with a degreasing agent based on a petroleum solvent.

CAUTION!	Care should be taken not to allow any cleaning agent to come into prolonged contact with skin.

Alignment of single bearing generators is critical. If necessary shim the generator feet to ensure alignment of the machined surfaces.

The sequence of assembly to the engine should generally be as follows:

1. On the engine check the distance from the coupling mating-face on the flywheel to the-flywheel housing mating face. This should be within 0.5mm of nominal dimension. This is necessary toensure that a thrust is not applied to the ac generator bearing or engine bearing.
2. Check that the bolts securing the flexib le plates to the coupling bub are tight and locked into position. Refer to section 7. Subsection 7.5.3.4 for tightening torques.
3. Remove covers from the drive end of the generator to gain access to coupling and adaptor bolts, check coupling joint interfaces are clean and inbrucant free.
4. Check that coupling discs are concentric with adaptor spigot. This can be adjusted by the use of tapered wooden wedges between the fan and adaptor. Alternatively the rotor can be suspended by means of a rope sling through the adaptor opening. Offer the generator to engine and engage both coupling discs and housing spigots at same time, pushing generator towards engine until coupling discs are against flywheel face, and housing spigots located.
5. Fit housing and coupling bolts taking care to use heavy gauge washers between coupling bolt head and coupling disc. Tighten bolts evenly around assembly sufficiently to ensure correct alignment.
6. Tighten housing bolts.
7. Tighten coupling disc to flywheel bolts. Refer to engine manufacturers manual for correct tightening torque.
8. Remove rotor - aligning aids either wooden wedges, or the two M 10 set screws and sheet metal wear plates.

Incorrect guarding and/or generator alignment can result in personal injury and/or equipment damage.

5.3 EARTHING

The generator frame should be solidly bonded to the generating set bed-plate. If anti-vibration mounts are fitted between the generator frame and its bed-plate a suitably rated earth conductor (normally one half of the cross sectional area of the main line cable) should bridge across the anti - vibration mount. Refer to local regulations to ensure that the correct earthing procedure has been followed.

5.4 PRE-RUNNING CHECKS

5.4.1 INSULATION CHECK

Insulation tests should be carried out before running the generator set, both after assembly and after installation on site. (see Section 7.1)

IMPORTANT!	The windings have been H.V. Tested during manufacture and further H.V. Testing may degrade the in sulation with consequent reduction in operating life. Should It be necessary to demonstrate H.V. Testing, for customer acceptance, the tests must be carried out at reduced voltage levels I.e. Test Voltage=0.8(2 X Rated Voltage+1000)

5.4.2 DIRECTION OF ROTATION

The standard direction of rotation is clockwise, as viewed from the drive end. This matches the predominant direction of rotation used by diesel engine manufacturers. The generator can be driven in the opposite direction with a small reduction in efficiency and an increased noise level. The phase rotation will also be effected.

5.4.2.1 PHASE ROTATION

Phase rotation is fixed for the standard direction of rotation, clockwise as viewed from the drive end. If the generator is to be rotated in the counter - clockwise direction it will be necessary to connect the customer output cables accordingly. Refer to the factory for 'reverse rotation wiring diagram'.

5.4.3 VOLTAGE AND FREQUENCY

Check that the voltage and frequency that are required for the generating set application is as indicated on the generator nameplate. If it is necessary to reconnect the stator for the voltage required , refer to diagrams in the back of this manual.

5.4.4 AVR SETTINGS

To make AVR selections and adjustments remove the AVR cover and refer to depending upon type of AVR fitted. Reference to the generator nameplate will indicate AVR type. Most of the AVR adjustments are factory set in positions that will give satisfactory per formance during initial running tests. Subsequent adjustment may be required to achieve Optimum performance of the set under site operating conditions. Refer to 'Load Testing' section for details.

5.4.4.1 TYPE SX440 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig.5 a for location of selection links.

1. Frequency seclection

4 pole 50Hz operation LINK C-50
4 pole 60Hz operation LINK C-60

2. Stability selection terminals

below 90kW	LINKA-C
below 550kW	LINK B-C

3. Stability selection terminals LINK 2-3
LINK4-5
LINK 6-7

4. Excitation Interruption Link LINK K1-K2

AUTOMATIC VOLTAGE REGUALTOR LINKING AND ADJUSTMENTS.

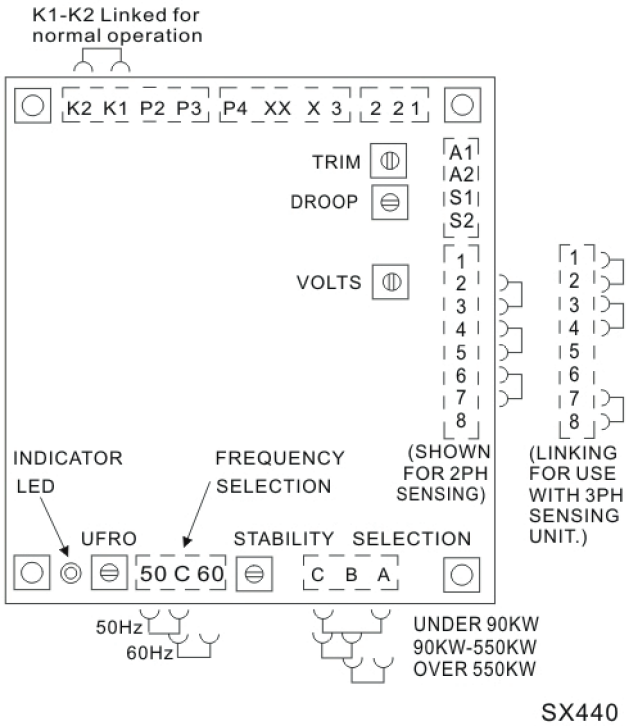

Fig 5

5.5 GENERATOR SET TESTING

Warning! ⚠	During testing It may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing

5.5.1 TEST METERING/CABLING

Connect any instrument wiring and cabling requited for initial test purposes with permanent or spring-clip type connectors Minimum instrumentation for testing should be line to line or line to neutral voltmeter, Hz meter, load current meteting and kW meter. If reactive load is used a power factor meter is desitable.

IMPORTANT!	When fitting power cables for load testing purposes, ensure cable voltage rating is at least equal to the generator rated voltage. The load cable termi nation should be placed on top of the winding lead termination and clam ped between the two nuts provided.

CAUTION!	Check that all wiring terminations for internal or external wiring are secure, and fit all terminal box covers and guards. Failure to secure wiring and/or covers may result In personal Injury and/or equipment failure.

5.6 INITIAL START-UP

Warning! ⚠	During testing it may be necessary to remove covers t o adjus t controls expo sing 'live' terminals or components Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Replace all access covers after adjustments are completed.

On completion of generating set assembly and before starting the generating set ensure that all engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

IMPORTANT!	Over-speeding of the generat or is never advisable as this can result in damage to the generator rotating components special care is necessary during Initial setting of the speed governor.

In addition remove the AVR access cover and turn VOLTS control fully anti - clockwise. Start the generating set and run on no - load at nominal frequency. Slowly turn VOLTS control potentiometer clockwise until rated voltage is reached, refer to fig. 5 for control potentiometer location.

IMPORTANT!	Do not increase the voltage above therated generator voltage shown on the generator nameplate.

This STABILITY control potentiometer will have been pre-set and should normally not require adjustment, but should this be required, usually identified by oscillation of the voltmeter, refer to Fig. 5 for control potentiometer location and proceed as follows:

1. Run the generating set on no-load and check that speed is correct and stable.

2. Turn the STABILITY control potentiometer clockwise, then turn slowly anti-clockwise until the generator voltage starts to become unstable.

The correct setting is slightly clockwise from this position (i. E. Where the machine volts are stable but close to the unstable region).

5.7 LOAD TESTING

Warning! ⚠	During test ing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.

5.7.1 AVR ADJUSTMENTS

Refer to Fig. 5 for control potentiometer locations. Having adjusted VOLTS and STABILITY during the initial start-up procedure, other AVR control functions should not normally need adjustment. If instability on load is experienced, recheck stability setting. Refer to subsection 4.6.
If however, poor voltage regulation on-load or voltage collapse is experienced, refer to the following paragraphs on each function to
A) Check that the symptoms observed do ind icate adjustment is necessary.
B) make the adjustment correctly.

5.7.1.1 UFRO (UNDER FREQUENCY ROLL OFF)

The AVR incorporates an under speed protection circuit that gives a voltage/speed (Hz)characteristic as shown:

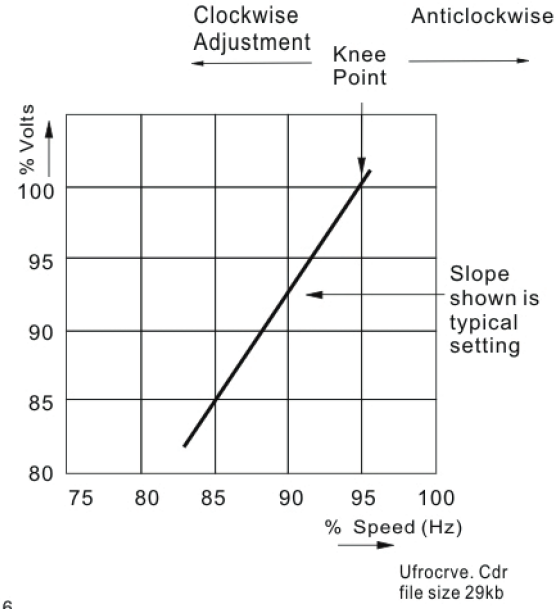

Fig 6

The UFRO control potentiometer sets the "knee Point". Symptoms of incorrect setting are a) the light emitting diode (LED) indicator, just above the UFRO control potentiometer, being permanently lit when the generator is on load, and b) poor voltage regulation on load, i.e. operation on the sloping part of the characteristic

Clockwise adjustment lowers the frequency (speed) setting of the "knee point" and extinguishes the LED. For Optimum setting the LED should illuminate as the frequency falls just below nominal frequency, i.e. 4Hz on a 50Hz generator or 57Hz on a 60Hz generator.

IMPORTANT!	If the LED is i lluminated and no output voltage is present, refer to EXC TRIP and/or OVER/V sections below.

5.8 ACCESSORIES

Refer to the "ACCESSORIES" Section of this manual for setting up procedures related to generator mounted accessories.
If there are accessories for control panel mounting supplied with the generator refer to the specific accessory fitting procedures inserted inside the back cover of this book. Replace AVR access cover after all adjustments are completed.

Warning!	Failure to refit covers can result in personal injury or death.

6. INSTALLATION-PART 2

6.1 GENERAL

The extent of site installation will depend upon the Generating set build, e. g. if the generator is installed in a canopied set with integral switchboards and circuit breaker, on site installation will be limited to connecting up the site load to the generating set output terminals. In this case reference shou ld be made to the generating set manufacturer's instruction book and any pertinent local regulations.

If the generator has been installed on a set without Switchboard or circuit breaker the following points relating to connecting up the generator should be noted.

6.2 GLANDING

IMPORTANT!	To avoid the possibility of swarf e ntering any electrical components in the terminal box, panels must be removed for drilling.

The terminal box is arranged for glanding on the right hand side (or if specifically ordered on the left-hand side) viewed from the end. Both panels are removable for drilling/punching to suit glands/or glanding boxes. If single core cables are taken through the terminal box side panel an insulated or non-magnetic gland plate should be fitted.

At entry to the terminal box incoming cables should be Supported by a recognized glanding method such that minimum unsupported weight, and no axial force, is transferred to the terminal assembly.

Incoming cables external to the terminal box. should be supported. The supports should allow for an adequate radius at each bend, and allow for the vibration of the generating set without putting excessive stress on the cables. Before making final connections, test the insulation resistance of the windings. The AVR should be disconnected during this test and RTD leads grounded.

A 500V Megger or similar instrument should be used. Should the insulation resistance be less than 5MO the windings must be dried out as detailed in the Service and Maintenance section of this manual.

6.3 TORQUE SETTINGS FOR TERMINAL CONNECTIONS

Pre treatment: Clean plated surfaces with a degreasing agent, then lightly abrade them to remove any tarnish. Don't score the surface.

The generator torque settings for all generator connections, links, CT's, accessories, cables, etc. is 45 Nm.

The customer output cables should be connected to the terminals using 8.8 grade steel bolts and associated antivibration hardware. The following table is for your guidance when connecting the customer output cables.

Carry out periodic checks to ensure that the torque settings are correct.

6.4 EARTHING

The neutral of the generator is not bonded to the generator frame as supplied from the factory. An earth terminal is provided inside the terminal box adjacent to the main terminals. Should it be required to operate with the neutral earthed a substantial earth conductor (normally equivalent to one half of the section of the line conductors) must be connected between the neutral and the earth terminal inside the terminal box. It is the responsibility of the generating set builder to ensure the generating set bedplate and generator frame are all bonded to the main earth terminal in the terminal box.

CAUTION!	Reference to local electricity regulations or safety rules should be made go ensure correct earthing procedures h ave been followed.

6.5 PROTECTION

It is the responsibility of the end user and his contractors/subcontractors to ensure that the overall system protection meets the needs of any inspectorate, local electricity authority of safety rules, pertaining to the site and it's location. To enable the system designer to achieve the necessary protection and / or discrimination, fault current curves are available on request from the factory, together with generator reactance values to enable fault current calculations to be made.

Warning! ⚠	Incorrect inst allation and/or protective systems can result in personal injury and/or equipment damage. Installers must be qualified to perform electrical installation work.

6.6 COMMISSIONONG

Ensure that all external cabling is correct and that all of the generating set manufacturer's pre-running checks have been carried out before starting the set.

Generators fitted with air filters should have the filters charged with oil prior to commissioning. Refer to Service section for charging procedure (subsection 7.3.2)

The generator AVR controls will have been adjusted during the generating set manufacturer's tests and should normally not require further adjustment.

Should malfunction occur during commissioning refer to Service and Maintenance section 'Fault Finding' procedure (subsection? A)

7. ACCESSORIES

Generator control accessories may be f itted, as an option, in the generator terminal box. If fitted at the time of supply, the wiring diagram(s) in the back of this book shows the connections. When the options are supplied separately, fitting instructions are provided with the accessory.

7.1 REMOTE VOLTAGE ADJUST

A remote voltage adjust(hand trimmer) can be fitted.

The remote voltage adjustment potentiometer is connected across AVR terminals 1&2.

These terminals are normally linked.

When the remote voltage adjust potentiometer is used the link across terminals 1 & 2 must be removed.

On SX440 the link 1&2 is on an adjacent terminal block.

7.2 PARALLEL OPERATION

IMPORTANT!	Failure to meet conditio ns 1, 2 and 3 when closing the circuit breaker, will generate excessive mechan ical a nd el ectrical stresses, resulting in equipment damage.

Understanding of the following notes on parallel operation is useful before attempting the fitting or setting of the droop kit accessory. When operating in parallel with other generators or the mains, it is essential that the phase sequence of the incoming generator matches that of the busbar and also that all of the following conditions are met before the circuit breaker of the incoming generator is closed on to the busbar (or operational generator).

1. Frequency must match within close limits.
2. voltages must match within close limits.
3. phase angle of voltages must match within close limits.

A variety of techniques, varying from simple synchronising lamps to fully automatic synchronisers, can be used to ensure these conditions are met. Once connected in parallel a minimum instrumentation level per generator of voltmeter, ammeter, wattmeter (measuring total power per generator), and frequency meter is required in order to adjust the engine and generator controls to share KW in relation to engine ratings KVAr in relation to generator ratings.
It is important recognize that:

1. kW are derived from the engine, and speed governor characteristics determine the kW sharing between sets and.
2. KVAr are derived from the generator, and excitation control characteristics determine the KVAr sharing.

Reference should be made to the generating set manufacturer's instructions for setting the governor controls.

7.2.1 DROOP

The most commonly used method of KVAr sharing is to create a generator voltage characteristic that fa lls with a decreasing power factor (increasing KVAr). This is achieved with a current transformer (C.T.) that provides a signal dependent on current phase angle (i.e. power factor) to the AVR. The current transformer has a burden resistor on the AVR board, and a percentage of the burden resistor voltage is summed into the AVR circuit. In creasing droop is obtained by turning the DROOP control potentiometer clockwise.

The diagrams below indicate the effect of droop in a simple two generator system:

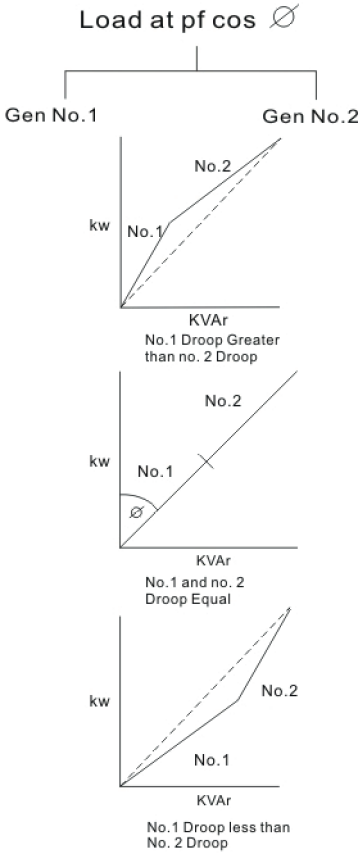

Fig 9

Generally 5% droop at full load current zero power factor is sufficient to ensure KVAr sharing. If the droop accessory has been supplied with the generator it will have been tested to ensure correct polarity and set to a nominal leve of droop. The final level of droop will be set during generating set commissioning. Although nominal droop setting may be factory set it is advisable to go through the setting procedure below.

7.2.1.1 SETTING PROCEDURE

Depending upon available load the fol lowing settings should be used, laa are based on rated current level.

0.8 P. F. load (at full load current) set droop to 3%
Zero P. F. load (at full load current) set droop to 5%

Setting the droop with low power factor load is the most accurate.

Run each generator as a single unit at rated frequency or rated frequency +4% depending upon type of governor and nominal voltage. Apply available load to rated current of the

generator. Adj ust 'DROOP' control potentiometer to give droop in line with above table. clockwise rotation increases amount or droop. Refer to Fig. 5a of 5b for potentiometer locations.

Note 1)
Reverse polarity of the C. T. will raise the generator voltage with load. The polarities S1&S2 shown on the wiring diagrams are correct for clockwise rotation of the generator looking at the drive end. Reversed rotation requires S1&S2 to be reversed.

Note 2)
The most important aspect is to set all generators equal. The precise level of droop is less critical.

Note 3)
A generator operated as a single unit with a drop circuit set at rated load 0.8 power factor is unable to maintain the usual O.S% regulation. A shorting switch can be connected across S1&S2 to restore regulation for single running.

IMPORTANT!	LOSS OF FUEL to an engine can cause Its generator to motor with consequent damage to the generator windings. Reverse power relays should be fitted to trip main circuit breaker.
IMPORTANT!	LOSS OF EXCITATION to the generator can result in large c urrent oscillations with consequent damage to generator winndings. Excitation loss detection equipment should be fitted to trip main circuit breaker.
IMPORTANT!	When using this connection arrangement a shorting switch is required across each C.T. Burden (terminals S1&S2.) The switch must be closed a) when a generating set is not running and b) when a generating set is selected for single running.

Should 'Asiatic' control of the generator be required, request the diagrams from the factory. The setting procedure is exactly the same as for DROOP. (Subsection 7.2.1.1)

8. SERVICE AND MAINTENANCE

As part of routine maintenance procedures. Periodic attention to winding condition (particularly when generators have been idle for a long period) and bearings is recommended. (Refer to subsections 8.1 and 8.2 respectively).

When generators are fitted with air filters regular inspection and filter maintenance is required. (Refer to subsection 8.3).

8.1 WINDING CONDITION

Danger! 	Service and fault finding procedures present hazards that can result in severe personal injury or death. Only personnel qualified to perform electrical and me chanical service should carry out these procedures. Ensure engine start circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply.

Guidance or Typical Insulation Resistance [IR]
Values he following is offered as general information about IR values. The aim is to provide guidance about the typical IR Values for generator from new through to the point of refurbishment.

New machine
The generators Insulation Resistance, along with many Other critical factors, will have been measured during the alternator manufacturing process. The generator will have been transported with an appropriate packaging suitable for the method of delivery to the Generating Set assemblers works, where we expect it to be stored in a suitable location protected from adverse conditions.

However, absolute assurance that generator will arrive at the Gen-set production line with IR values still at the factory test levels of above 100MΩ cannot be guaranteed.

At Generating Sat Manufacturers Works The generator should have been transported and stored such that it will be de livered to the assembly area in a clean dry condition. If held in appropriate storage conditions the generator IR value should typically be 25MΩ If the unused/-new generator's IR values fall below 10MΩ then a drying out procedure should be implemented by one of the processes outlined below before being dispatched to the end customer's site. Some investigation should be undertaken into the storage conditions of the generator while on site.

Generators in Service
Whilst It is known that a generator will give reliable service with an IR value of just 10MΩ. For a relatively new generator to be so low it must have been subjected to inappropriate operating or storage conditions.

Any temporary reduction in IR values can be restored to expected values by following one of the drying out procedures.

8.1.1 WINDING CONDITION ASSESSMENT

CAUTION!	The AVR should be disconnected and the Resistance Temperature Detector (R.T.D.) leads grounded during this test.

The condition of the windings can be assessed by measurement of insulation resistance [IR] between phase to phase, and phase to earth. Measurement of winding insulation should be carried out:-

1. As part of a periodic maintenance plan.
2. After prolong periods of shutdown.
3. When low insulation is suspected, e.g. Damp or wet windings.

Care should be taken when dealing with windings that are suspected of being excessively damp or dirty. The initial measurement of the [IR] insulation Resistance should be established using a low voltage (SOOV) megger type instrument. If manually powered the handle should initially be turned showly so that the full test voltage will not be applied, and only applied for long enough to very quickly assess the situation if low values are suspected or immediately indicated.

Full megger tests or any other form of high voltage test should not be applied until the windings have been dried out and if necessary cleaned.

Procedure for insulation Testing
Disconnect all electronic components, AVR, electronic protection equipment etc. Ground the [RTD'S] Resistance Temperature Detection devices if fitted. Short out the diodes on the rotating diode assembly. Be aware of all components connected to the system under test that could cause false readings or be damaged by the test voltage.

Carry out the insulation test in accordance with the 'operating instructions' for the test equipment. The measured value of insulation resistance for all windings to earth and phase to phase should be compared with the guidance given above for the various 'life stages' of a generator. The minimum acceptable value is 10MΩ.

If low winding insulation is confirmed, one or more of the methods, given below, for drying the windings should be carried out.

8.1.2 METHODS OF DRYING OUT GENERATORS

Cold Run
Providing a generator in good condition but has not been run for some time. It is possible that simply running the genset, without excitation, will raise the IR sufficiently (greater than 10MΩ) to allow the unit to be put into service. Run the generator for approximately 10 minutes with AVR terminals

K1 and K2 open. Visually check that the windings appear dry and carry out an insulation resistance test to prove that the minimum (1.0MO) insulation value has been achieved. If this method fails, use one of the traditional methods outlined below.

Blown Air Drying
Remove the covers from all apertures to allow the escape of the water-laden air. During drying, air must be able to flow freely through the generator in order to carry off the moisture.

Direct hot air from two electrical fan heaters of around 1-3 KW into the generator air inlet apertures. Ensure the heat source is at least 300mm away from the windings to avoid over heating and damage to the insulation.

Apply the heat and plot the insulation value at half hourly intervals. The process is complete when the parameters covered in the section entitled, 'Typical Drying Out Curve', are met.

Remove the heaters, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anticondensation heaters are energized, and retest prior to running.

Shirt Circuit Method
NOTE: This process shou ld only be performed by a competent engineer familiar with safe operating practices within and around generator sets of the type in question. Ensure the generator is safe to work on, initiate all mechanical and electrical safety procedures pertaining to the genset and the site.

Bolt a short ci rcuit of adequate current carrying capacity, across the main terminals of the generator. The shorting link should be capable of taking full load current.

Disconnect the cables from terminals "X" and "XX" of the AVR.

Connect a variable de supply to the "X" (positive) and "XX" (negative) field cables. The de supply must be able to provide a current up to 2.0 Amp at 0-24Volts.

Position a suitable ac ammeter to measure the shorting link current.

Set the de supply voltage to zero and start the generating set. Slowly increase the de voltage to pass current through the exciter field winding. As the excitation current increases, so the stator current in the shorting link will increase. This stator output current level must be monitored, and not allowed to exceed 80% of the generators rated output current.

After every 30 minutes of this exercise: Stop the generator and switch off the separate excitation supply, and measure and record the stator winding IR values, and plot the results.
The resulting graph should be compared with the classic shaped graph. This drying out procedure is complete when the parameters covered in the section entitled 'Typical Drying Out Curve' are met.

Once the insulation Resistance is raised to an acceptable level minimum value 10MΩ - the de supply may be removed and the exciter field leads "X" and "XX" re-connected to their terminals on the AVR.

Rebuild the genset, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anticondensation heaters are energised, and retest the generator prior to running.

Typical Drying Out Curve
Whichever method is used to dry out the generator the resistance should be measured every half-hour and a curve plotted as shown.(Fig 9)

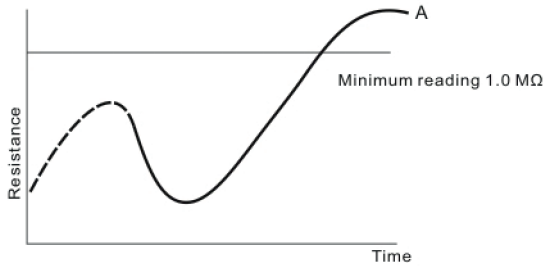

Fig 10

The illustration shows a typical curve for a machine that has absorbed a considerable amount of moisture. The curve indicates a temporary increase in resistance, a fall and then a gradual rise to a steady state. Point 'A', the steady state, must be greater than 1.0MΩ (If the windings are only slightly damp the dotted portion of the curve may not appear).

For general guidance expect that the typical time to reach point 'A' will be approximately 3 hours for a LV 6 generator.

Drying should be continued after point "A" has been reached for at least one hour.

It should be noted that as winding temperature increases, values of insulation resistance may significantly reduce. Therefore, the reference values for insulation resistance can only be established with windings at a temperature of approximately 20°C.

After drying out, the insulation resistances should be rechecked to verify minimum resistances quoted above are achieved. On re-testing it is recommended that the main stator insulation resistance is checked as fol lows:

-Separate the neutral leads.
Ground V and W phase and megger U phase to ground
Ground U and W phase and megger V phase to ground
Ground U and V phase and megger W phase to ground.

If the minimum value of 1.0MΩ is not obtained, drying out must be continued and the test repeated.
If the minimum value of 1.0MΩ for all components cannot be achieved rewinding or refurbishment of the generator will be necessary.

The generator must not be put into service until the minimum value, Of 1.0MΩ for all components, can be achieved.

8.2 BEARINGS

All bearings are supplied from the factory pre-packed with Kluber Asonic GHY 72 grease.
Do not mix kluber Asonic GHY 72 with any grease of different specifications. Mixing grease of differing specifications will reduce bearing life. The specification for Kluber Asonic FHY 72 is available on request from the factory.
Sealed for life bearings are fitted with integral seals and are not re-greasable.

BEARING LIFE

IMPORTANT!	The life of a bearing in service is subject to the working conditions and the environment.
IMPORTANT!	High levels of vibration from the engine or misalignment of the set will stress the bearing and reduce its service life. If the vibration limits set out im BS 5000-3 and ISO 8528-9 are exceeded bearing life will be reduced. Refer to 'vibration' below.
IMPORTANT!	Long stationary periods in an environment where the generator is subject to vibration can cause false brinneling, which puts flats on the ball and grooves on the races, leading to premature failure.
IMPORTANT!	Very humid atmospheric or wet conditions can emulsify the grease causing corrosion and deterioration of the grease, leading to premature failure of the bearings.

HEALTH MONLTORING OF THE BEARINGS

It recommends that the user check the bearing condition, using monitoring equipment, to determine the state of the bearings. The 'best practice' is to take initial readings as a base line and periodically monitor the bearings to detect a deteriorating trend. It will then be possible to plan a bearing change at an appropriate generating set or engine service interval.

VLBRATION

The generators are designed ti withstand the vibration levels encountered on generating sets built to meet the requirements of ISO 8528-9 and BS5000-3. (Where ISO 8528 is taken to be broad band measurements and BS5000 refers to the predominant frequency of any vibrations on the generating set.)

Definition of BSS000-3
Generators shall be capable of continuously withstanding linear vibration levels with amplitudes of 0.25 mm between 5 Hz and velocities of 9.0 mm/s. Between 8 Hz and 200 Hz when measured at any point directly on the carcass or main frame of the machine. These limits refer Only to the predominant frequency of v ibration of any complex waveform.

Definition of ISO 8528-9
ISO 8528-9 refers to a broad band of frequencies, the broad band is taken to be between 2 Hertz and 300 Hertz. The table below is an example from ISO 8528-9 (value 1). This simplified table lists the vibration limits by kVA range and speed for acceptable genset operation.

VIBRATION LEVELS AS MEASURED ON THE CENERATOR				
Engine Speed min-1	Set Output kVA	Vibration Displacement	Vibration Velocity	Vibration Accelera tion
4 PLOE 1500 rpm 50Hz 1800rpm 660Hz	≥10kVA	–	–	–
	>10but ≤50kVA	0.64	40	25
	>50but ≤125kVA	0.4	25	16
	>125but ≤250kVA	0.4	25	16
	>250kVA	0.32	20	13
The 'Broad band' is taken as 5Hz-300Hz				

Tadle 6

IMPORTANT!	Exceeding either o f the above specifications will have a detrimental effect on the life of the bearing. This will invalidate the generator warranty. If you are in any doubt, contact Newage International limited.

If the vibration levels of the generating set are not within the parameters quoted above.
1. consult the genset builder. The genset builder should address the genset design to reduce the vibration levels as much ad possible.
2. Discuss the impact of not meeting the above levels on both bearing and generator life expectancy.

Where requested, or deemed necessary, Newage will work with the genset builder in an attempt to find a satisfactory solution.

BEARING 'SERVICELIFE' EXPECTANCY

Bearing manufacturers recognize that the "service life" of their bearings is dependent upon many factors that are not in their control, they cannot therefore quote a "service life". Although "service life" cannot be guaranteed, it can be maximized by attention to the generating set design. An understanding of the genset application will also help the user to maximize the service life expectancy of the bearings. Particular attention should be paid to the alignment, reduction of vibration levels, environmental protection, maintenance and monitoring procedu-

res. We does not quote life expectancy figures for bearings, but suggests practicable replacement intervals based on the L 10 life of the bearing, the grease and the recommendations of the bearing and grease manufacturers. For general-purpose applications, provid ing the vibration levels do not exceed the levels stated in ISO8528-9* and BS5000-3* and the ambient temperature does not exceed 50°C the following approximations can be applied when * (See section on vibration)

Sealed for life Bearings. - Approximately 30,000hours.

Re-greaseable bearings.- Approximately 40,000hours.

This is provided the correct maintenance is carried out, and only Kluber Asonic GHY 72 grease (or equivalent) is used in all bearings. It is important to note that bearings in service. Under good operating conditions, can continue to run beyond the remembered re placement period. It should also be remembered that the r isk of bearing failure increases with time.

8.3 ALR FILTERS

Air filters for the removal of airborne particulate matter (dus) are offered as an addition to the standard build option. Filters on it's need to be ordered with the generator. Air filters need to be charged with oil before the genset is put to work (see 8.3.2) The frequency of fi lter maintenance will depend upon the severity of the site conditions. Regular inspection of the elements will be required to establish when cleaning is necessary.

Danger! 	Removal of filter elements enables access to LIVE parts. Only remove elements with the generator out of service.

8.3.1 CLEANING PROCEDURE

Remove the filter elements from the filter frames. Immerse of flush the element with a suitable degreasing agent until the element is cleas.

As an alternative procedure a high-pressure water hose with a flat nozzle can be used. Sweep the water spray back and forth across the element from the clean side (fine mesh side of element) holding the nozzle firm ly against the element surface. Cold water may be adequate depending upon type of contamination although hot water is preferable.

The element can be inspected for cleanliness by looking through the filter towards the light.

When the roughly clean, no cloudy areas will be seen. Dry elements thoroughly before attempting to carry out the recharging procedure.

8.3.2 RECHARGING (GHARGING) AIR FILTERS

Charging is best done by totally immersing the dry element into a dip tank containing "Filterkote Type k" or commercial lubricating oil SAE 20/50. oils of higher or lower viscosity are not recommended.

Allow elements to completely drain before refitting the elements into the frames and putting into service.

8.4 FAULT FINDING

IMPORTANT!	Before commencing any faultfinding procedures, examine all wiring for broken or loose connections.

Two types of AVR can be fitted to the WH generator. The Refer to the generator nameplate for type of AVR fitted.

8.4.1 MX341 AVR, FAULT FINDING

No voltage build-up when starting set	1. Check link K1 - K2 on auxiliary terminals. 2. Follow Separate Excitation Test Procedure to check machine and AVR, Refer to subsection 7.5.
Loss of voltage when set running	1. First stop and restart set. If no voltage or voltage collapses after short time, follow separate Excitation Text Procedure. Refer to subsection 7.5.
Generator voltage high followed by collapse	1. Check sensing leads to AVR. 2. Refer to Separate Excitation Test Procedure. Refer to subsection 7.5.
Voltage unstable, either onno-load or with load	1. Check speed stability. 2. Check "STAB" setting. Refer to load Testing section for procedure. Refer to subsection 4.6.
Low voltage no- load	1. Check speed. 2. Check link1-2or external hand trimmer leads for continuity.
Low voltage on- load	1. Check speed. 2. If correct check "UFRO" setting. Refer to subsection 4.7.1.1

Table7

8.5 SEPARATE EXCITATION TEST PROCEDURE

The generator windings, diode assembly and AVR can be checked using the appropriate following sections.

8.5.1 GENERATOR WINDINGS, ROTATING DIODES and PERMANENT MAGNET GENERATOR (PMG)

IMPORTANT!	The resistances quoted apply to a standard winding. For generators having windings or voltages other than those specified refer to factory for details. Ensure all disconnected leads are isolated and free from earth.
IMPORTANT!	Incorrect speed setting will give proportional error in voltage out put.

Checking Generator Windings and Rotating Diodes

This procedure is carried out w ith lead X and XX disconnected at the AVR or transformer control rectifier bridge and using a 12 volt d. c. Supply to leads X and XX.

Start the set and run at rated speed.

Measure the voltages at the main output terminals U, V and W. if voltages are balanced and within +/-10% of the generator nomial voltage, refer to 7 .5.1.1.

Check voltages at AVR terminals 6, 7 and 8. These should be balanced and between 170-250 volts.

If voltages at main terminals are balanced but voltage at 6, 7
and 8 are unbalanced, check continuity of leads 6,7 and 8.

If voltages are unbalanced , refer to 7 .5.1.2.

8.5.1.1 BALANCED MAIN TERMINAL VOLTAGES

If all voltages are balanced within 1 % at the main terminals, it can be assumed that all exciter windings, main windings and main rotating diodes are in good order ,and the fault is in the AVR or transformer control. Refer to subsection 7 .3.2 for test procedure.

If voltages are balanced but low, there is a fault in the main excitation windings or rotating diode assembly. proceed as follows to identity:-

Rectifier Diodes

The diodes on the main rectifier assembly can be checked with a multimeter. The flexible leads connected to each diode should be disconnected at the terminal end, and the forward and reverse resistance checked. A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction. A faulty diode will give a full deflection reading in both directions with the test meter on the 10,000 ohms scale, or an infinity reading in both directions. On an electronic digital meter a healthy diode will give a low

reading in one direction, and a high reading in the other.

Replacement of Faulty Diodes

The rectifier assembly is split into two plates, the positive and negative, and the main rotor is connected across these plates. Each plate carries 3 diodes, the negative plate carrying negative biased diodes and the positive plate carrying positive biased diodes. Care must be taken to ensure that the correct polarity diodes are fitted to each respective plate. When fitting the diodes to the plates they must be tight enough to ensure a good mechanical and electrical contact, but should not be over-tightened. The recommended torque tightening is 4.06-4.74 Nm (36-42lb in).

Surge suppressor

The surge suppressor is a metal-oxide varistor connected across the two rectifier plates to prevent high transient reverse voltages in the fie ld winding from damaging the diodes. This device is not polarized and will show a virtually infinite reading in both directions with an ordinary resistance meter. If defective this will be visible by inspection, since it will normally fail to short circuit and show signs of disintegration. Replace if faulty.

If after establishing and correcting any fault on the rectifier assembly the output is still low when separately excited, then the main rotor, exciter stator and exciter rotor winding resistances should be checked (see Resistance charts), as the fault must be in one of these windings. The exciter stator resistance is measured across leads X and XX. The exciter rotor is conne. Main Excitation Windingscted to six studs that also carry the diode lead t erminals. The main rotor winding is connected across the two rectifier plates. The respective leads must be disconnected before taking the readings.

8.5.1.2 UNBALANCED MAIN TERMINAL VOLTAGES

If voltages are unbalanced, this indicates a fault on the main stator winding or main cables to the circuit breaker. NOTE: Faults on the stator winding or cables may also cause noticeable load increase on t he engine when excitation is applied. Disconnect the main cables and separate the winding leads U1-U2,(U5-U6),V1-V2,(V5-V6),W1-W2,(W5-W6) to isolate each winding section. Note: -leads suffixed 5 and 6 apply to 12 wire windings only.

Measure each section resistance values should be balanced and within+/- 10% fo the value.

Measure insulation resistance between sections and each section to earth.

Unbalanced or incorrect winding resistances and/or low insulation resistances to earth indicate rewinding of the stator will be necessary. Refer to removal and replacement of component assemblies' subsection 8.5.3.

8.5.2 AVR FUNCTION TEST

All types of AVR's can be tested with this procedure:

1. Remove exciter field leads X & XX (F1 &F2) from the AVR terminals X & XX (F1 &F2).
2. Connect a 60W 240V household lamp to AVR terminals X & xx (f1 &f2).
3. Set the AVR VOL TS control potentiometer fully clockwise.
4. Connect a 12V, 1.0A DC supply to the exciter field leads X & XX (F1 &F2) with X (F1)to the positive.
5. Start the generating set and run at rated speed.
6. Check that the generator output voltage is within +/- 10% of rated voltage.

The lamp should glow for approximately 8 seconds and then turn off. Failure to turn off indicates faulty protection circuit and the AVR should be replaced. Turning the "VOLTS"control potentiometer ful ly anti-clockwise should turn off the lamp with all AVR types.

Should the lamp fail to light the AVR is faulty and should be replaced.

IMPORTANT!	After this test turn VOLTS control potentiometer fully anti-clockwise.

8.5.3 REMOVAL AND REPLACEMENT OFCOMPONENT ASSEMBLIES

METRIC THREADS ARE USED THROUGHOUT

CAUTION!	When lifting single bearing generators, care is needed to ensure the generator frame is kept in the horizontal plane. The rotor is free to move in the frame and can slide out if not correctly lifted. Incorrect lifting can cause serious injury to personnel.

8.5.3.1 ANTI-CONENSATION HEATERS

Danger! 	The external mains electricity supply used to power the anti-condensation heater must be switched off and safely isolated before attempting any work adjacent to the heater, or removal of the non drive end bracket on which the anticon heater is mounted. Ensure that the engine is inhibited prior to work in generator.

8.5.3.2 REMOVAL OF BEARINGS

IMPORTANT!	Position the main rotor so that a full pole face of the main rotor core is at the bottom Remove PMG of the stator bore if fitted.

The generators in this manual will be fitted with one of two different bearing arrangements. There may be two different arrangements on a two-bearing generator.

Removal of the bearing may be effected either after the rotor assembly has been removed or more simply by removal of endbracket (s).

Be sure to note the location of all components during removal to assist during the assembly process.

BEARING REPLACEMENT

Environment

Every effort must be made to establish a clean area around the generator when removing and replacing bearings. Contamination is a major cause of bearing failures.

Equipment

Suitable cleaning solvent
Bearing puller, two or three leg
Thin protective gloves
Lint free cleaning cloth
Induction heater.

Preparation

Remove the lubrication pipework if fitted .

Position the rotor so that the full pole face of the main rotor is
at the bottom of the stator bore.
Remove the end bracket, see 7.5.3.4 for procedure.

NOTES:
• It is not necessary to remove the rotor.
• Ensure that the bearing contact surface shows no sign of wear or corrosion prior to fitting the bearing.
• Never refit used bearings, Wave washer or 'O' rings.
• Never refit used bearings, grease flinger, wave washer or 'O' rings.
• Only the outer race should be used to transmit load during assembly (NEVER use the inner race).

REMOVAL OF REGREASABLE BEARINGS

The bearings are a press fit on the shaft and can be removed with standard tooling , i.e. 2 or 3 legged manual or hydraulic bearing pullers.

To remove bearings proceed as follows:

1. Remove 4 screws holding bearing cap.
2. Remove cap.
3. Non drive end remove wave washer and circlip (single bearing only).
4. Remove bearing cartridge housing complete with bearing (and grease f linger if fitted).
5. Remove bearing form cartridge.
6. Discard the old bearing 'O' rings and wave washer where fitted.

The bearing cap(s) and cartridge(s) must be thoroughly flushed out with clean solvent and-checked for wear or damage, before re-assembly. Damaged components should be replaced before refitting the bearing.

ASSEMBLY OF REASABLE BEARINGS

NOTE: Gloves must be worn at all tines when handling the bearings, grease and solvent.

1. Wipe clean the a ssembly surface, using cleaning solvent on lint free cloth.
2. Wipe clean: Bearing Cartridge. Wave Washer, Bearing Cap, greas flinger, all re-lubrication pipes and fittings (internal and external), Visually inspect all components after cleaning, for contamination.
3. Place all components on the clean assembly surface. Do not use an air line to blow off excess fluid .
4. Thoroughly clean the external surface of the grease gun nozzle using lint free cloth.

Bearing preparation

1. Remove the veering from its packaging.
2. Wipe off the preservative oil from the surface of the inner and outer rings using lint free cloth only.
3. Place the bearing on the clean assembly surface, with the bearing designation marking facing down.

Bearing Assembly (Lubrication, see TABLE 17)

Cartridge:
1. Apply the specified cartridge grease fill quantity to the back face of the bearing housing.
2. Apply a small amount of grease to the grooved sealing surface in the bearing housing.
3. Apply anti-fretting lubricant (MP14002-Kluber Altemp Q NB 50) to the beating housing circumference. Apply paste in a thin coherent layer by use of a lint free cloth (DO NOT rub in) (use clean protective gloves).
4. Non-drive end fit new 'O' Rings into the 'O' Ring grooves in the bearing housing circumfe-rence.

Bearing

1. Apply half the specified bearing grease fill quantity (see table 16) to the upper face of the bearing (opposite side to the bearing designation markings).
2. Thumb the applied grease into the bearing, ensuring good penetration into the raceways/-balls (use clean protective gloves).

Assemble Bearing into Cartridge

1. Heat the bearing cartridge to 25°C above ambient with an induction heater (Do not exceed 100°C)
2. With greased face of the bearing facing the cartridge bore, assemble the bearing into the bearing housing. Ensure the bearing outer race contacts the location shoulder.

Assemble Bearing onto Shaft

Bearing Cartridge
1. Heat the Bearing and Cartridge assembly to ao·c above ambient with an induction heater. (use induction heater,no other heat source is suitable)
2. Slide the Bearing and Cartridge assembly to over the shaft, pushing it firmly against the bearing seating shoulder.
3. Rotate the assembly (including inner race) 45°C in either direction, to provide correct alignment. The bearing must be held firmly in place until I s cool enough to positively locate.
NOTE: Ensure cartridge is at ambient temperature before assembling bracket.

Cap/ Flinger:

Apply the specified cap grease fill quantity to the I nside face of the cap (see table 16).

1. Fill the grease exhaust slot with grease.
2. Apply a small amount of grease to the grooved sealing surface in the cap.
3. Fit circlip. (single bearing only).
4. Heat flinger to 12o·c an place on shaft up to the bearing inner race. Hold firmly until positively located.
5. Place wave washer in cap, fit cap to bearing cartridge.

REMOVAL OF SEALED FORLIFE BEARINGS
With Bearing Cartridge

The bearings are a press fit on the shaft and can be removed with standard tooling, i.e. 2 or 3 egged manual or hydraulic bearing pullers.

To remove bearings proceed as follows:
1. Remove 4 screws holding bearing cap.
2. Remove cap.
3. At the end, remove wave washer and circlip (single bearing only).

4. Remove bearing cartridge housing complete with bearing.
5. Remove bearing from cartridge.
6. Discard the old bearing, 'O' rings and wave washer where fitted.

The bearing cap(s) and cartridge(s) must be thoroughly flushed out with clean solvent and checked for wear or damage, before re-assembly. Damaged components should be replaced before refitting the bearing.

Assembly of Sealed for life bearings with Cartridge

Pre - assembly, cleaning.

NOTE: Gloves must be worn at all times when handling the bearings, grease and solvent.
1. Wipe clean the assembly surface, using cleaning solvent on lint free cloth.
2. Wipe clean: Bearing Cartridge and bearing cap (internal and external). Visually inspect all components after cleaning, for contamination.
3. Place all components on a clean assembly surface. Do not use an air line to blow off excess fluid.
4. Thoroughly clean the external surface of the grease gun nozzle using lint free cloth.

Bearing preparation:

1. Remove the bearing from its packaging.
2. Wipe off the preservative oil from the surface of the inner and outer r ings using lint free cloth only.
3. Place the bearing on the clean assembly surface, with the bearing designation marking facing down.

Bearing Assembly

Cartridge:
1. Apply anti-fretting lubricant (MP 14002 kluber Altemp Q NB 50) to the bearing housing circumference. Apply paste in a thin coherent layer by use of a lint free cloth (DO NOT rub in)(use clean protective gloves).
2. Fit 'O' Rings into the 'O' Ring grooves in the bearing housing circumference. Assemble

Bearing into Cartridge
1. Heat the bearing cartridge to 25·c above the ambient temperature (with an induction heater, do not exceed 100°C) and assemble the new bearing into the cartridge.
Ensure that the bearing designation is visible after assembly.
2. With greased face of the bearing facing the cartridge bore, assemble the bearing into the bearing housing. Ensure the bearing outer race contacts the location shoulder.
NOTE: Only the outer race should be used to transmit load during assembly (NEVER use the inner race).

Assemble Bearing and Cartridge onto the shaft

1. Heat the Bearing and Cartridge assembly to ao·c above ambient. (use induction heater, no other heat source is suitable)
2. Slied the Bearing and Cartridge assembly over the shaft, pushing it firmly against the bearing seating shoulder.
3. Rotate the assembly (including inner race) 45 in either direction, go provide correct alignment. The bearing must be held firmly in place until it is cool enough to positively self locate.
4. Non drive end only fit circl ip (single bearing only) and wave washer.
5. Fit the bearing cap.
6. Rotate the bearing assembly on the shaft to check for free movement.

Note: Ensure cartridge is at ambient temperature before
assembling bracket.

7. Refit the end bracket and PMG where fitted.

8.5.3.4 MAIN ROTOR ASSEMBLY

Single Bearing Machine
NOTE: On single bearing machines, before removal from, or re-assembly to the prime mover, position the rotor, if possible, such that a fu ll pole face is at bottom dead centre.
1. Remove all access covers and terminal box lid.
2. Ensure that these leads are free to come away with the non-drive endbracket when removed.
3. Remove the 8 bolts holding the drive and adaptor to the frame.
4. With a rope sling around drive end adaptor, tap adaptor out of its spigot location; guide over fan and remove.
5. If the generator is fitted with a cartridge. Remove the 4 bolts retaining the end bearing cartridge in the non drive end endbracker (outer 4 bolts). (This includes all regreasable options)
6. Remove the 8 bolts securing the non drive end bracket to the frame.
7. Supporting the non-drive end bracket with a hoist, insert two M10 bolts in the two holes provided for 'jacking' purposes (on the end bracket horizontal centre line). Screw in the bolts until the end bracket spigot is clear of the locating recess, lower the whole assembly until the main rotor is resting in the stator bore. Still supporting the non drive eng bracket, tap the bracket off the non drive end bearing cartridge (taking care that the exciter stator does not foul exciter rotor windings) and remove.
8. To withdraw the rotor from the stator the stator the rotor must be supported by a rope at the drive end and eased out of the stator core until half the main rotor is protruding out of the stator. At this point it is safe to release the weight from the rope sling.
9. Tightly bind a rope sling around the rotor core, and supporting the non-drive end of the rotor, guide it clear of the stator.

Warning! ⚠	The rope sling may not be at the center of gravity of the rotor and guidance at the ends of the rotor is essential. THE FULL WELGHT OF THE ROTOR GIVEN IN THE TABLE BELOW MUST BE SUPPORTED BY THE CRANE AND SLING. If the rotor core is allowed to drop more than a few millimeters at this point, it will make contact with the stator windings and may damage them.

Maximum weight of the rotor assembly.

Table 13

RE-ASSEMBLY IS A REVERSAL OF THE ABOVE PROCEDURE.

Before assembly of a single bearing rotor into stator housing check that the drive discs are not damaged or cracked or showing any other signs of fatigue. Also check that holes in the discs for drive fixing screws are not elongated.

Damaged components must be replaced.

TWO BEARING MACHINES

NOTE:
Position rotor, if possible, such that a full pole face is at bottom dead center.
The procedure for removal of a two bearing rotor is similar to that outlined for single bearing machines with the exception of Steps 4 and 5 relating to the drive end adaptor.
For removal of this item proceed as follows:-
1. Remove the 8 bolts holding drive end adaptor to frame and 4 olts retaining bearing cartridge in drive end bracket (outer 4 bolts), if fitted./
2. With rope sling around the shaft extension, supporting the roto weight tap the drive end bracket spigot out of its locating recess and lower rotor assembly to rest in the stator bore.
3. Take the weight of the drive end bracket on the sling and tap the bracket off the drive end bearing cartridge. guide over the and remove.

Re-assembly is a reversal of the above procedure.

8.6 RETURNING TO SERVICE

After rectification of any faults found, remove all test connections and reconnect all control system leads. Restart the set and adjust VOLTS control potentiometer on AVR BY slowly turning clockwise until rated voltage is obtained. Refit all terminal box covers/access covers and reconnect heater supply.
Failure to refit all guards, Access covers and terminal box covers can result in personal injury or death.

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