

Technical Proposal of 500KW Syngas/Biomass Engine Generator

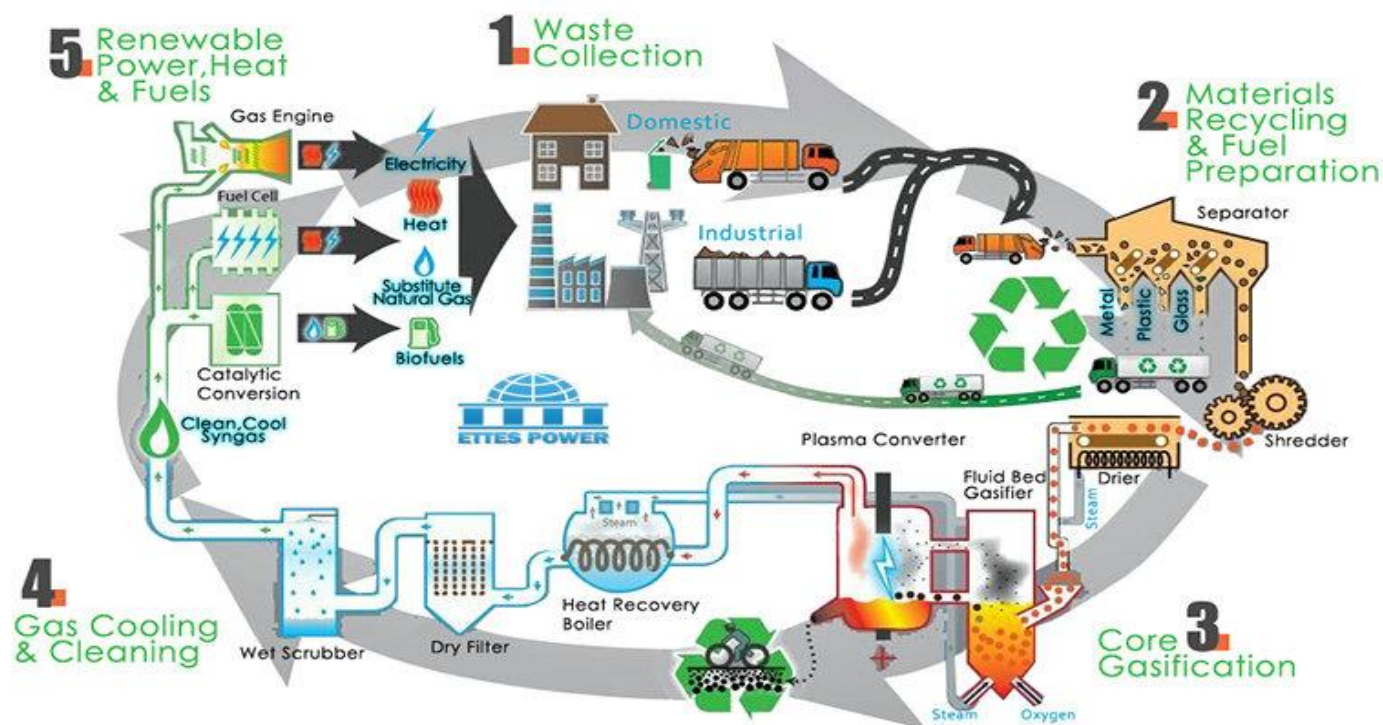
PART ONE: POWER PROJECT SUMMARY

Project Name: 500KW Low Speed Biomass Power Generating Plant

Project Scale: To Be Confirmed

Project Location: Italy/ Greece/ Ukraine/ Bulgaria/ Latvia/ Croatia/ Serbia/ South Africa/ Tanzania/ Thailand/ Philippines/ Indonesia/ Korea/ Chile/ Mexico/ Brazil (mainly involved countries for syngas/biomass power plants)

Project Contents: By using raw materials like municipal solid waste, wood chips, crop straws, saw dust, coconut shells, rice husks, palm kernel shell, coal powder and used tire, we can get syngas/biomass through gasification process. After filtering, de-hydrating, tar-removing and other necessary treatments, the syngas/biomass will be delivered to gas tank, and finally to gas engine for power generating. And at the same time, CHP System (heat collect boiler) can make heat recovery from exhaust gas to get hot water or steam, which can realize comprehensive and high-efficiency utilization of the power plant.



PART TWO: TECHNICAL FEATURES OF ETTES POWER BIOMASS ENGINES

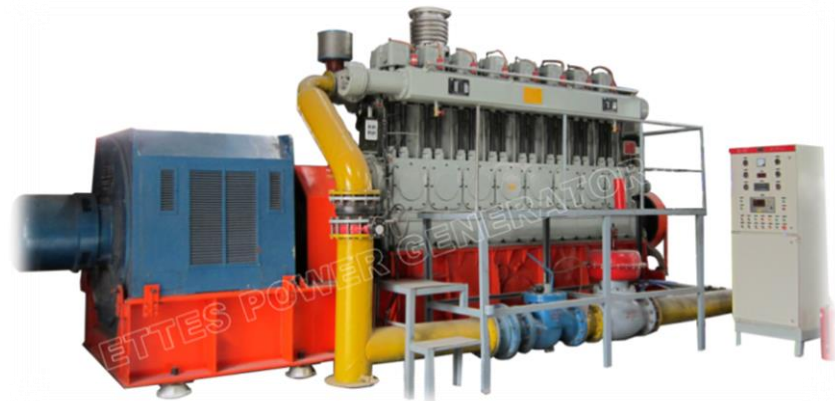
2.1 Unique Advantages of Ettes Power Low Speed Biomass Engines

Ettes Power Syngas/Biomass/Coal Gas Generator Set is driven by low speed 300 series engines, coupled with Siemens alternator, power ranging from 300kw upto 1000kw. The applicable fuel can be syngas including biomass, wood gas, Straw Gas and coal gas etc. Our syngas engines can work at reliable performance, easy for maintenance and much longer life-span Our generators enjoy hot markets in overseas markets including Italy, Russia, Ukraine, Latvia, Croatia, Serbia, South Africa, Tanzania, Philippines, Thailand, Inonesia, Korea and Japan etc.



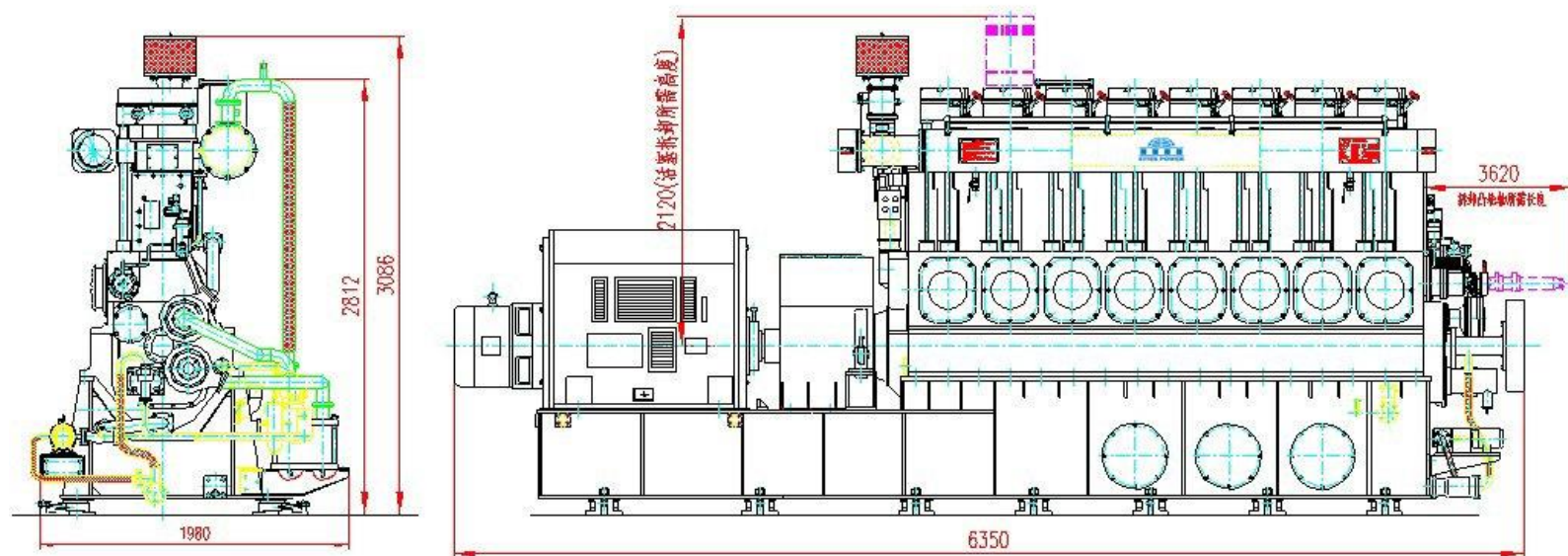
Based on Syngas/Biomass as fuel, the reasons why we suggest our 300 series low speed engines.

Syngas is far different with methane base gas (natural gas, biogas and Coalmine gas etc). Syngas is much more tricky, it is low in heat value, high in tar content and unstable in gas quality (TAR always raise problems of pipeline-blocking, cylinder-pollution and spark plug-jamming etc). So, there are few engines can be fired by syngas properly. However, our 300 series low speed engines can work at syngas smoothly. The key reasons are that our 300 series engines have unique and remarkable features & advantages as follows:



- **Cylinders Structure** in Line & Upright and Concise Layout, which means easy, simple and low cost in maintenance;
- **Large cylinder** (Bore × Stroke=300 × 380mm), **Long Stroke, Low Speed** and **Big displacement** 215L, which means big reserve power capacity and constant power output.
- **Low Engine Speed** at 500 or 600RPM, which means high reliability for continuous operation, sufficient combustion, low exhaust gas temperature and high heat efficiency; Low Engine Speed can reduce dramatically wearing of engine parts, prolong life span.
- **Naturally Aspirated** (no turbocharger and Intercooler), which means low failure rate and minimal downtime (Tar in syngas always block and damage turbocharger and intercooler);
- **Internal Mixing System** (for high hydrogen gas). Gas and air intake separately, then mixed in combustion room, which means no risk of backfire and knocking.
- **Strong Treatment and Resistance Ability Against TAR**, which means long term trouble free operation.
- **Low Noise**, low engine speed means lower noise, the noise level ≤ 100dB in working condition. By using silencer, the noise level can be ≤ 80dB.
- **CHP System** (Combined Heat and Power), making heat recovery from exhaust gas to get hot water or steam, which can realize comprehensive and high-efficiency utilization of the power plant.
- **Long Overhaul Time** of 60000 hours and lifecycle of 20-25 years, which secure constant economic benefits of your power plant.

2.2 Genset layout drawing



2.3 Genset has a complete safety control system (complying with the standard JB/T9583.1-1999) and has following safety devices:

- Low oil-pressure alarm and low oil-pressure engine stop;
- Over-speed alarm and engine stop;
- Engine cooling-water temperature high alarm;
- Lubrication oil temperature high alarm;
- Genset reserve power protection;
- Genset under-voltage protection;
- Genset over-current protection;
- All rotating parts are equipped with protective shield. In the switch cabinet, there is lightning arrester to prevent the genset from lightning strike.

PART THREE: MAIN ENGINE TECHNICAL PARAMETERS

3.1 Technical Specifications of Ettes Power 500kw Biomass Engine Generator Set

ITEM.	DESCRIPTION
Genset Model	EZ-625S
Rated Power	500kW
Rated Voltage	400V (Low Voltage of 415/440V/480V/690 and high voltage of 6.3kv,10.5kv are available)
Rated Current	902A
Rated Frequency	50HZ (60HZ is available)
Power Factor COSΦ	0.8 (lag)
Excitation Type	Brushless, Self-Excitation
Voltage Stationary Regulation Ratio (100%)	±2.5
Instant Voltage Regulation Ratio (%)	±15
Voltage Stable Time (%)	≤1.5s
Voltage Fluctuation Ratio (%)	≤0.5
Frequency Steady-state Regulation Ratio (%)	≤5 (0~5 adjustable)
Instant Frequency Regulation Ratio (%)	±10
Frequency Stable Time	≤7s
Phases and Connecting Methods	3 phases 4 wires
Biomass Engine Model	8300D/M-2
Engine Style	Water Cooled, Four stroke, spark plug ignition, naturally aspiration.
Cooling System	Heat Exchanger+Cooling Tower (Table Type Radiator is optional)
Cylinder No. and Arrangement	8 in Line
Cylinder bore	300mm
Stroke	380mm
Compression Ratio	9:1
Displacement	215L
Rated Rotation Speed	600RPM
Rated Engine Power	550kW



Rated Load Thermal Consumption	Around 11 MJ/kW·h
Oil Consumption	≤ 0.8 g/kW.h
Start Method	Compressed Air Start
Inlet Gas Temperature	≤40°C
Each Cylinder Exhaust-gas Temperature	≤550°C
Noise	100dB (≤ 80dB by Silencer)
Gas pressure Requirement	2~10kPa
Overhaul Time	Around 50000~60000 Hours
Life Span	20~25 years
Alternator	Siemens 1FC6 Series or Equal (Self Excited, Brushless, AVR, IP23, 50/60HZ, Both Low Voltage and High Voltage are available)
Genset Overall Size	6400×1600×2900 (LxWxH, mm)
Genset Gross Weight	22000kg

3.2 Requirements for lubrication oil and cooling water:

The biomass genset is equipped with complete lubrication oil system. Lubrication oil consumption is less than 0.8 g/kW.h;
 Lubrication oil specification: 40CD or 15W40CD (GB/T11123-1989) or SAE40;

Engine's high & low temperature cycle adopts softened water. Cooling water should be clean water with slightly alkaline, shall not contain corrosive substances, such as chloride, sulfate, or acid, etc. Detailed requirements are as follows:

Total Hardness (CaCO₃) ≤100ppm;

Chloride-ion Content <150mg/L;

PH Value 7~8.5

3.3 Biomass Quality Requirements

1). Before entering into engine, the biomass should be appropriate filtering, gas-liquid separation and pressure regulation. If the temperature is too high, it should be through cooling treatment, and make sure there is no liquid content in the gas.

2). Gas temperature ≤40°C, Gas pressure 2.5~10kpa,
 Pressure change rate ≤1kPa/min, Tar content ≤20mg/Nm³,
 H₂S content ≤50mg/Nm³, Impurities particle size ≤5μm,
 moisture content ≤20 mg/Nm³, Impurity content ≤30mg/Nm³,
 Heat value ≥4MJ/Nm³.

3.4 Ambient Environment requirement

The genset can run steadily and continuously at following environmental conditions: ambient temperature: -20°C~+40°C, relative humidity <90% (20°C), height above sea level ≤2500m.

In standard conditions (atmospheric pressure 100kPa, environment temperature: 25°C, air relative humidity 30%), the genset can work at full load of output power 500kW.

3.5 Brief introduction of genset main system

3.5.1 Gas system

The gas system is the equipments from biomass-storage tank to biomass engine, like air intake duct, pipe, valve, flame arrester, control equipment etc.

Clean biomass are delivered from biomass-storage tank to biomass main pipe, and then to branch pipe, butterfly valve, and finally biomass engine. For the purpose to ensure safe running of biomass genset, butterfly valves, emergency shut-off solenoid valve, dry-type fire arrester are installed in biomass transmission pipeline.

Following is biomass transmission route: biomass storage tank→main pipe→fire arrestor→butterfly valves→branch pipe→butterfly valves→biomass engine. In some projects, in order to fully guarantee the cleanness of biomass, basket-type filter will be installed.

3.5.2 Exhaust system

The exhaust system includes bellows expansion joint, exhaust pipe, muffler and muffler support. If with CHP or waste heat recovery system, for the purpose to avoid damage to muffler and heat recovery system by high exhaust pressure, explosion-proof valve will be installed on the exhaust pipe.

Following is the working order of the exhaust system: Gas generator set exhaust vent →expansion joint→ pipeline→explosion-proof valve (optional)→ CHP/waste heat recovery unit (optional) → pipe→ muffler → the air atmosphere.

Engine exhaust temperature is about 550°C, so the exhaust system components are made by high-temperature-resistant material. The exhaust pipe is hanged on the roof by hoop with hoisting wire rope and the muffler is installed on the muffler bracket.

The exhaust pipe sizes is DN300, and the engine exhaust pipe in the generator room shall be wrapped with two layers' insulations: the inner layer by aluminum silicate ceramic tube shell with thickness at 50mm, and the outer layer by galvanized iron with thickness at 0.4mm. After insulation, the surface temperature should not be over 60°C.

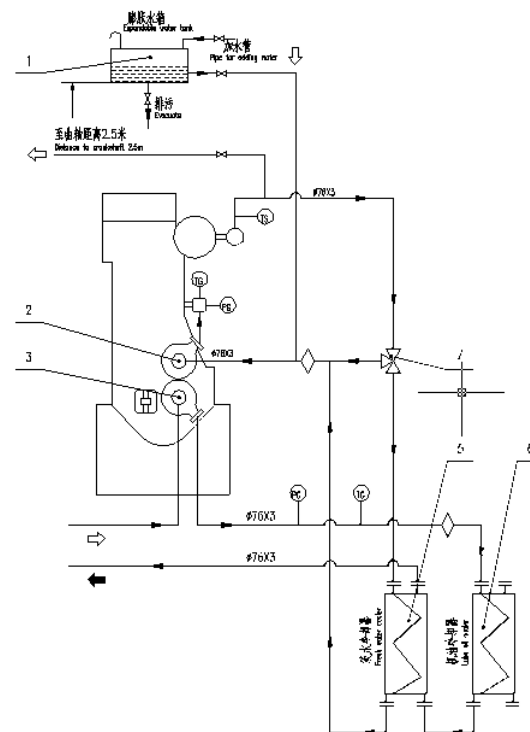
3.5.3 Cooling System

Regarding to cooling methods, gas engine is with open cooling as standard (closed water cooling of radiator is optional). In order to improve the corrosion-resistance performance of cylinder block and cylinder jacket, increase thermal efficiency, the engine cylinder and cylinder-head exhaust-pipes are cooled by fresh water. Lubrication oil cooler and fresh water coolers are cooled by water from cooling tower.

High temperature cycle (called inner cycle) is mainly to cool parts like the cylinder block, cylinder jacket, cylinder head, etc. Low temperature cycle (called outer cycle) is mainly through heat-exchanger to cool the lubrication oil and cooling water in the high temperature cycle; the water in the low temperature cycle is cooled by cooling tower, its water temperature is about 20-30°C. Cooling water for low temperature cycle is 60m³/h, through the heat changer, temperature is increased by 15°C. The inner cycle used softened water; the consumption rate for one genset is about 5kg per day.

As shown in the following drawing, low temperature water flow-line: cooling tower→fresh water pump→lub.oil cooler→fresh water cooler→cooling tower.

High temperature flow-line: fresh water pump→water inlet manifold→gas engine→heat-resistant water chamber of exhaust pipelines→fresh water cooler→fresh water pump.



Cooling System Schematic Diagram

- | | | |
|-------------------------|-----------------------|---------------------------|
| 1. Expansion Water Tank | 2. Fresh-water Pump | 3. Fresh-water Pump |
| 4. Thermolator | 5. Fresh-water Cooler | 6. Lubrication oil Cooler |



3.5.4 Starting System

Compressed air is used to start our biomass engine. The starting system mainly includes the air bottle, electromagnetic valve, the main starting valve and air distributor etc

The starting system working sequence is like this: air compressor→air bottle→check-valve →compressed air pipeline→biomass engine

3.5.5 Power Distribution System

Each genset has one switch cabinet to realize electricity transmission from genset to state-grid. This cabinets has genset protection functions in following circumstances: over-current, reverse-power, over-voltage, over-load, under-voltage, etc. Also, genset switch-on, break-brake, parallel connection, active and reactive power regulations can be achieved in this cabinet.

The switch cabinet is connected with cables, inlet cables from the bottom, and outlet cables from the top. After parallel operation with switch cabinet, the electricity produced by genset comes to the lower voltage side of step-up transformer. If it is high-voltage genset, there is no need of step-up transformer, the generator can generate 10.5kv and 6.3kv electricity and delivered to the state grid directly.

DC24V supplies 24V direct current to genset ignition system, alarm system, etc.

Power station switch cabinet is mainly used for distributing the electricity generated by power station, such as air compressor control, cooling tower blower control, cycling water pump control, softened water control and so on. At the same time, it can also satisfy the requirement of direct regulated power supply.

3.5.6 Genset Monitoring System

The genset monitoring system can provide the following monitoring parameters: Oil temperature, oil pressure, engine speed, water temperature; exhaust temperature of each cylinder; genset active power, reactive power, frequency, power factor; biomass inlet pressure and temperature; genset A phase voltage, B phase voltage, C phase voltage, A phase current, B phase current, C phase current

PART FOUR: GENSETS MANUFACTURE STANDARDS

4.1 The manufacture and inspection standards for generator set

GB/T2820—1997 Reciprocating internal combustion engine driven alternating current generator

GB/T1859—2000 Engine noise power level measured, quasi-power method

GB/T6702—2000 Reciprocating Internal Combustion Engine Performance

GB/T14024—1992 The measurement methods, allowing value and conduction interference for radio interference characteristics of internal combustion engine power plant

GB 3100—1993 International System of Units and their usage

IEC 60079 Electrical equipment for explosive gas atmospheres

ISO 3046 Reciprocating Internal Combustion Engine Performance

ISO 8178 Reciprocating internal combustion engine exhaust emission measurement ISO 8528, Reciprocating internal combustion engine driven AC generating sets JB/T9583.1-1999 Common technical requirements for gas generator set

Q /XNY 56001-2009 Common technical requirements for 300 series gas engine and generator set

Q /XNY 52001-2009 Factory test specifications for 300 series gas engine and generator set

ISO 9001:2008 Quality Control System

ISO14001 Environmental management System

CE Certificate for European Market

4.2 Genset raw materials standards

Q /ZC 56003-92-300 ductile iron crankshaft acceptance and technical conditions

Q /ZC 56005-89-300 niobium cylinder acceptance and technical conditions

Q /ZC 56013-89-300 pistons

Q /ZC 56069-2001-Engine Forged parts (connecting rods, the main bolts, etc.) Q /ZC 56044.1-2001 Gray cast iron parts of engine (body, base frame, etc.)

Q /ZC 56044.3-2005-Compacted graphite cast iron engines (cylinder head, etc.)

PART FIVE: STANDARD SUPPLY SCOPE

5.1 Supply Scope List (for each engine-genset)

No.	Name	Part No	Q'TY	Remarks
1	Gas engine	/	1set	8300D/M-2
2	Generator	/	1set	
3	Switch cabinet	/	1set	With parallel operation function
4	DC 24V stable electric source	/	1set	/
5	High elastic couplings	/	1set	/
6	Common foundation	/	1 pc	Put lubrication oil case into common foundation
7	Accessories, spare parts, tools, and special parts with engine	/	1set	/
8	Technical documents with engine	/	1 pc	/

Appendix No 1: Accessories Spare Part list (for each engine-genset)

序号 No.	名称 Name	代号 Part Code	数量 Q'TY.	备注 remarks
1	空气瓶 Air bottle	A0.5-3	1	/
2	空气压缩机 Air compressor	2ZF-0.34/30B	1	
3	淡水调温阀 Fresh water thermostatic valve	LZFT-65	1	仅闭式水冷机组用 Only used for closed water cooling system
4	淡水换热器 Fresh water cooler	BR0.23-15/S	1	
5	机油调温阀 Lub.oil thermostatic valve	LZFT-50	1	/
6	机油换热器 Lub. oil cooler	BR0.23-15/Y	1	/
8	机油滤清器 Lub.oil filter	CT01-10	1	/
9	电动预供油泵 Electric pre-supply pump	YCB1.0-0.6	1	/
10	卡套式焊接管接头 Sleeve style welding pipe joint	GB/T3747.1-2008 G6	10	/
11	卡套式直通管接头 Sleeve type welding pipe joint	GB/T3737.1-2008 G6	4	/
12	卡套式三通管接头 Sleeve type tee pipe joint	GB/T3745.1-2008 G6	2	/
13	卡套式压力表接头 Sleeve type pressure gauge joint	GB/T3751.1-2008 G6	2	/
14	压力表 Pressure gauge	Y-60Z (0~6MPa)	1	/
15	温度表 Thermometer	WSS-311 (0~100°C)	1	/
16	机旁控制柜 Standby control panel	JPX-02B	1	/
17	点火模块 Fire module	DISN800C	1	/
18	球阀 Spherical valve	Q41F-16C DN150	1	/
19	紧急切断电磁阀 Urgent cut-off electromagnetism valve	ZCRB-KES-DC24V DN150 PN16	1	/
20	膨胀节 Expansion joint	DN300	1	/
21	膨胀节法兰 Expansion joint flange	8L250-10-035	2	/
22	垫片 Gasket	8L250-10-036	2	/
23	排烟管变径接头 Change-diameter tube for exhaust pipe	500GFW-03-103	1	ø250×ø300
24	机油滤网 Oil filter	L250-02-200	1	/
25	滤网座 Filter holder	L250-02-033A	1	/
26	橡胶挠性软接头 Flexibility tie-in	DN65	2	仅闭式水冷机组用 Only used for closed water cooling System
27	垫片 Shim	DN25/PN16 GB/T9126.1-2000	6	/
28	垫片 Shim	DN40/PN16 GB/T9126.1-2000	8	/
29	垫片 Shim	DN50/PN16 GB/T9126.1-2000	8	/

30	垫片Shim	DN65/PN16 GB/T9126.1-2000	12	/
31	冷却器支架Bracket for cooler	400GFM-BJ12Y-03006 (L)	2	/
32		400GFM-BJ12Y-03006 (R)	2	/
33	吸油管Suck oil pipe	400GFM-BJ12Y-03004	1	/
34	发动机回水管Pipe for water return to engine	400GFM-BJ12Y-03005	1	/
35	机油滤器出油软管Flexibility pipe of lube oil filter	400GFM-BJ12Y-03010	1	/
36	机油软管Flexibility pipe of lube oil	400GFM-BJ12Y-03011	1	/
37	淡水软管Flexibility pipe of water	400GFM-BJ12Y-03014	1	/
38	机油进机软管Flexibility oil pipe to engine	400GFM-BJ12Y-03015	1	/

Appendix No 2: Accessories tools kits (One Set for Each Engine-Genset)

序号 No.	名称 Name	代号 Part Code	数量 Q'TY	备注 Remarks
1	飞轮螺栓螺母扳手 Nut spanner for flywheel bolt	300.90.001	1	/
2	拆卸主轴承下瓦用销子 Pin for removing lower main bearing	300.90.003	1	/
3	曲轴齿轮方孔套筒扳手 Square hole socket spanner for crankshaft gear	300.90.004	1	/
4	连杆螺母扳手Nut spanner, connecting rod	300.90.005	1	/
5	拉杆螺母扳手Nut spanner for pull rod	300.90.006	1	/
6	空气分配器圆螺母扳手 Round nut spanner for air distributor	300.90.008	1	/
7	凸轮轴圆螺母套筒扳手 Round nut socket spanner for camshaft	300.90.011	1	/
8	拆主轴承下瓦用销子 Pin for removing lower main bearing	300.90.024	1	/
9	凸轮轴齿轮拆卸器Puller for camshaft gear	300.90.100	1	/
10	装凸轮轴齿轮工具 Tools for installing camshaft gear	300.90.200	1	/
11	活塞销盖拉出器Piston pin cover puller	300.90.300	1	/
12	气缸套拆装工具 Tools for cylinder liner disassembling and installing	300.90.400	1	/
13	吊活塞工具Piston hoisting tools	300.90.500	1	/
14	活塞环导向套筒Piston rings guide sleeve	300.90.600	1	/
15	插销扳手Spanner wrench	300.90.700	1	/
16	水泵叶轮拆卸器Water pump impeller puller	300.90.1600	1	/
17	伞齿轮扳手Bevel gear spanner	300.90.1900	1	/
18	装气门锁夹工具 Tools for installing air valve locker	300.90.2100	1	/
19	气缸盖螺母扳手Spanner for cylinder head nut	300R.90.2700	1	/
20	转车工具Tool for rotating crankshaft	300.90.1700	1	每机一套 One Package for each genset
21	吊机工具Engine-hoisting tool	300.90.1800	1	每机一套 One Package for each genset