

SPECIFICATION FOR SERIES GENERATOR SET

*Model: 1GL Clip-on
(15Kw, 460V, 60Hz output)*

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1. General Description:

1.1 Structure

1GL generator set is designed for mounting to the upper front structure of an ISO reefer container. The design incorporates quick connections to the upper container corner castings. Additional attaching points on the container vertical structural members provide a secure mounting arrangement. It is a completely welded steel structural assembly designed to withstand minimum 3 g's acceleration forces in all directions. Components are secured to meet the requirements incident to use on ship, truck and railroad.

Forklift pockets are provided at the bottom of the generator set. Forklift pocket ends are close to prevent refrigeration unit damage.

Bumper is provided to protect unit during shipment. Document pouch is also provided on the panel backside.

The fuel tank design complies with the FHWA requirements.

The unit frame contains the water cooled engine and engine accessories, generator, battery, control box and gauges. A fuel tank of 410 liters (108gal) net capacity is integral to the frame.

1.2 Structural Frame and Integral Fuel Tank

The mechanical characteristics of the material used in frame and integral fuel tank:

$\sigma_s \geq 350\text{Mpa}$ $\sigma_b \geq 480\text{Mpa}$ $\delta_5 = 22\%$ $\text{AKV}(-20\text{ C}^\circ) \geq 27\text{J}$

The inner surface of the fuel tank is chemically cleaned and passivated, while the frame and outer surface of the fuel tank are primer coated with an epoxy ester chrome-free paint immediately after shot-blasting, and then finish coated with a high solids polyester baked-on enamel paint.

1.3 Panels and Doors

Metal-door, control box, receptacle box are primer coated with an epoxy ester chrome-free paint immediately after shot-blasting, and then finish coated with a high solids polyester baked-on enamel paint.

1.4 Hardware

All hardware and hinges are stainless steel or electroless nickel plated for maximum protection from salt water corrosion.

1.5 Dimensions

Width: 2310mm Height: 1100mm Depth: 660mm

1.6 Net weight

950 kg (oil and coolant are included)

1.7 Operation temperature range

-40 C° to +55 C° (-40°F to +131°F)

1.8 Alternator rating

15.0kW, 18.75kVA at 0.8 power factor

460 V, 3-phase

60Hz at 1800rpm.

1.9 Standard operating instruction is in English.

2. Engine:

2.2 Model: 4L22BD-RF

2.3 Technical specification of engine:

Type	Vertical, 4-cycle water-cooled diesel engine
Number of cylinders	4
Bore	85mm
Stroke	95mm
Total displacement	2.156L
Continuous output	21.0kw/1800rpm
Firing order	1-3-4-2
Direction of rotation	Counter clockwise (viewed from F.W)
Intake valve head clearance	0.25mm(cold)
Exhaust valve head clearance	0.25mm(cold)
Cooling system	Force-feed circulation radiator type cooling system
Coolant volume	8.0L
Coolant high temperature switch	97 C°, ±2 C°
Lubricating system	Forced lubrication with trochoid pump
Oil tank capacity	6L
Oil pressure	200kPa~450kPa at 1800rpm
Low oil pressure switch	80kPa ± 30kPa
Air cleaner type	Heavy-duty oil bath filter air cleaner
Starting system	Starting motor 12V 1.4kW
Starting aid	Air heater 12VDC, 500W
Charging generator	12V,14A

3. Engine fuel system:

3.1 Fuel Tank

Steel fuel tank is integrated in the frame, supplied with a drain valve at the bottom of the tank for purging contaminants and a fuel filler neck and a fuel level gauge, with net capacity of 410 liters

3.2 Components of fuel system:

- Fuel tank with capacity of 108 gal (410 liters)
- Primary filter with Water separator
- Spin-on fuel filter, as secondary filter
- Injection pump and mechanical governor
- Injection nozzles
- Fuel level gauge

3.4 Fuel option:

Use diesel fuel oil equivalent to or better than ISO 8217 DMA, BS 2869 Part 1 class A1 or Part 2 class A2 (Cetane Number: 45 min.).

4. Engine lubrication system:

4.1 Components of lubrication system:

- 6L oil pan
- Trochoid oil pump
- Oil filter
- Oil pressure gauge and sensors
- Low oil pressure switch (100±20kPa)

4.2 Oil option:

Engine oil should have properties of API classification CD or CF-4 grade. Use appropriate oil according to different seasons and regions.

Ambient Temperature	Models
-30~30C° (-22~86°F)	SAE 5W/30
-25~30C° (-13~86°F)	SAE 10W/30
-20~50C° (-4~122°F)	SAE 15W/40

5. Engine coolant system:

5.1 Components of coolant system:

- Coolant pump
- Thermostat
 Type: wax pellet type
 Valve opening temperature: 71 C° ±1.5 C°
 Full opening temperature: 85 C°
- Radiator
 Radiator is copper tubes with copper fins and dipped in corrosion resistant clear lacquer for protection from salt-water corrosion.
- Cooling fan
 Fan material: nylon-plastics
- Water temperature gauge and sensors
 High water temperature switch (97 C° ±2 C°)

5.2 Coolant option:

Engine cooling system topped with 55/45 mixture of antifreeze and water. Rating of -42°C.

6. Generator:

Manufacturer: SINO-AMERICA MARATHON

Model: RF-15

6.1 General

RF-15 three phase A.C. synchronous brushless generator is based on the technics of Marathon Electric CO. It is combined with diesel engine to make movable electrical power for container refrigeration system. RF-15 generator is of unique design, advanced construction, excellent performance, reliable operation, easy, small volume and light weight.

- 1) RF-15 generator is manufactured in accordance with NEMA ODP type (IP22). It consists of main generator, AC brushless exciter, rotating diode, auxiliary winding, terminal box, etc.
- 2) Class H insulation per NEMA MG-1-1.65, maximum temp rise:125 C°.
- 3) The frame is made of steel plate. The design of stator lamination is unique. 10 lead wires is supplied.
- 4) Main rotor use the single piece 4-pole salient pole lamination, coupled with die cast or welding damping winding, field winding to form a unirotor construction, the field winding is layer wound with thermo setting epoxy for high mechanical and electrical integrity.
- 5) Drive disc radial fan cooling method.
- 6) Laminations and wiring are protected against salt water with epoxy primers, epoxy impregnation (three times) and epoxy coating, the coating process is as follows:
 - I. Main rotor is coated with epoxy compound Sterling *V-300-20 (imported) and baked at 150 C° for 16 hours.
 - II. Main stator is dipped with Z30-14 polyester varnish three times and baked at 150 C° for 8 hours.
 - III. Exciter rotor and stator are dipped with Z30-14 polyester varnish two times and baked at 150 C° for 8 hours.
 - IV. Then coated the main stator with epoxy resin.
 - V. Finally spray the main stator, rotor and exciter stator, rotor with green epoxy coating.
- 7) Generator Rating:
15 kW, 18.75 kVA, 0.8 power factor or
RPM: 1800
Voltage: 460
Phases: 3
Frequency: 60 Hz
- 8) Dust-proof bearing, sealed and lubricated with synthetic hydrocarbon.

6.2 Generator function-voltage regulation

- 1) starting excitation
The initial excitation of the generator is supplied by permanent magnet steel which is mounted on exciter field.
- 2) Running excitation and control
The rectifier (6) is fed by an auxiliary winding (5) located in the stator. When starting the residual magnetism creates a current in the exciter armature (1). This current is rectified by the rotating diodes (2) and feeds the main field (3). The induced voltage in the auxiliary winding (5) is then used to increase the excitation

power via rectifier (6) to exciter field (7) so as to ensure a rapid and smooth build up of output voltage in the main stator winding (4).

- 3) Boosted output current during temporary over load periods such as motor or compressor start up.

The auxiliary winding (5) is triple-frequency harmonic winding. For temporary over loads (such as refrigeration unit start up), the excitation control system utilizes the auxiliary winding to handle the overload. When an overload occurs, the increase current flow from the alternator stator, which causes an immediate increase in the auxiliary winding current. This increased output boosts the output of the alternator to handle the temporary overload by exciter field.

7. Control system:

7.1 Components of control panel:

Engine hour meter, water temperature gauge, oil pressure gauge, charging ammeter
Preheat/start switch, on-off switch
Fault display lamps
safety stop control units

7.2 Unit control

1. **ON-OFF SWITCH:** The unit ON-OFF switch energizes the electrical system of the unit when in the ON position. In the OFF position, it de-energizes the fuel solenoid to stop the engine.
2. **PREHEAT/START SWITCH:** When pressed to PREHEAT, the PREHEAT/START switch energizes the air heater to aid in starting the diesel engine. When pressed to START, the PREHEAT/START switch energizes both the air heater and the starting motor. Hold the switch on START until the engine starts to fire and picks up speed. DO NOT release the switch from the START position prematurely when engine is extremely cold.
3. **ENGINE SHUTDOWN INDICATOR:** Indicates an over load, low oil pressure and high coolant temperature

7.3 Unit instrument

- 1) **AMMETER:** The ammeter indicates battery charging and discharging amperage during engine operation. The charging amperage varies according to the needs of the battery. The ammeter also indicates the amount of current draw by the air heater during preheat.
- 2) **HOURLMETER:** The engine hour-meter records the total hours that the engine is in operation so proper maintenance can be scheduled.
- 3) **OIL PRESSURE GAUGE:** The oil pressure gauge indicates engine oil pressure. Engine oil pressure should rise immediately on starting.
- 4) **ENGINE COOLANT TEMPERATURE GAUGE:** The engine coolant temperature gauge indicates the temperature of the engine coolant in the block.
- 5) **FUEL GAUGE:** A gauge mounted in the integral fuel tank indicates the level of diesel fuel in tank.

7.4 Unit protection device

1. **LOW OIL PRESSURE SWITCH:** Engine oil pressure shall rise immediately when

starting. A low oil pressure switch will ground, stop the engine and the low oil pressure shutdown indicator will light if oil pressure drops below 100 ± 20 kpa.

2. **ENGINE COOLANT HIGH TEMPERATURE SWITCH:** If the engine coolant temperature rises $97\text{ C}^\circ \pm 2\text{ C}^\circ$, the coolant high temperature switch will ground, stop the engine and the high temperature shutdown indicator will light.
3. **CIRCUIT BREAKERS:** A circuit breaker (CB1) is located behind generator terminal box face. It will trip, aux. connect ground and stop the engine if the 460 VAC power circuit overloads above 25 amps under operation and the overload shutdown indicator will light. Unit circuit breaker must be manually reset.

7.5 Protection Feature

- Safety stop control for engine low oil pressure
- Safety stop control for engine high coolant temperature
- Safety stop control for generator short circuit or over load

8. Auxiliary systems:

8.1 12VDC maintenance-free battery

Engine battery shall be maintenance-free with 625 cold cranking amps at -18 C° .

Cold Cranking Amps: 625Amps for 30 seconds at -18 C° (0°F)

Reserve capacity: 25Amps output for 160 min. at 27 C° (80°F)

Dimensions: 330 mm \times 173 mm \times 238 mm

Battery charging current is supplied by the DC charging generator .

8.2 ISO standard power cable receptacle

Electric power receptacle shall be designed in accordance with the C.E.E. standards and I.E.C. recommended specifications, including I.S.O, and to operate when the nominal voltage measured among phases is as below :

a) 60HZ; 400V min., 500V max.

b) 32 Amperes, 3 wire-4 pole, C.E.E. Earth contact position -3 h.

9. Mounting:

Two heavy-duty hand operated clamps on the upper corners, engage with the standard container corner castings.

Two bolts, attached to the unit, secure the lower corners to the container bolt receptacles.