



Underslung Reefer Generator

User Manual

Table of contents

Safety information	3
General safety notices	3
First aid	3
Operating precautions.....	3
Maintenance precautions	3
Unit hazard label identification.....	3
Special hazard statements.....	4
Product information	5
Specifications summary.....	5
Overview	5
Features.....	5
Views	6
External	6
Internal	7
Generator	8
Internal connections.....	9
Engine.....	10
General Specifications (Engine).....	12
Wiring diagram	14
Operating instructions.....	15
Mounting the Genset equipment	15
Standard mount.....	15
Quick Mount.....	16
Unmounting the Genset equipment.....	16
Standard unmount.....	16
Quick unmount	16
Starting and stopping instructions	16
Pre-start inspection.....	16
Starting Instructions	17
Post-start inspection.....	17
Stopping instructions.....	18
Sequence of operation warning	18
Standard Units	18

Safety information

General safety notices

The system belts, radiator fan, and electrical components present potential hazards during installation and servicing/maintenance. Only trained and qualified service personnel should install, repair, or service the Genset equipment. When working on the Genset equipment, observe all safety precautions and follow all the warnings and cautions mentioned below and also the hazard labels attached on the unit.

First aid

Always administer first aid or seek medical attention immediately for any injury, no matter how minor an injury may be.

Operating precautions

- Always wear safety glasses and hearing protection.
- Keep your hands, clothes, and tools away from the radiator fan and rotating belts.
- Wear the appropriate personal protective equipment for the work being undertaken.
- All circuit breakers and start-stop switches must be turned off and the negative battery terminal must be disconnected before performing work on the Genset equipment.
- Always work in pairs. Never work on the equipment alone.
- In case of severe vibration or unusual noise, stop the equipment and investigate.

Maintenance precautions

- Before performing any maintenance work on the Genset equipment, ensure that the power is turned off and the negative battery cable is disconnected.
- Do not bypass any electrical safety measures such as bridging an overload or using jumper wires. Only qualified service personnel should conduct system diagnostics and carry out any necessary repairs.
- In case of electrical fire, open circuit switch and extinguish with CO2 (never use water).
- Fuel tanks present explosion, fire, and rupture hazards even if liquid fuel has been drained. Do not attempt any repairs, especially repairs using flame, welder or torch, unless you have been properly trained and the tank has been emptied of liquid fuel and fuel vapors and the tank is properly ventilated.

Unit hazard label identification



Indicates an immediate hazard which WILL result in severe personal injury or death.



Indicates hazards or unsafe conditions which COULD result in severe personal injury or death.



Indicates potential hazards or unsafe practices which COULD result in minor personal injury, product, or property damage.

Special hazard statements

The following hazard statements are precautions that must be understood and applied during operation and maintenance of the Genset equipment.



- Beware of moving poly V-belt, belt driven components and hot exhaust components.
- Under no circumstances should ether or any other unauthorized starting aids be used in conjunction with the air intake heater.
- Beware of moving poly V-Belt and belt driven components.
- Beware of pinch points.
- Do not use gasoline to clean air cleaner parts.
- Do not direct water or steam into the openings of the Genset equipment. Do not allow any soap and water solutions to enter the alternator.
- High voltage (dielectric) testing must not be performed to the machine without first observing NEMA rules. The insulation of the Genset equipment winding may be safely checked by using a megger. A high megger reading indicates good insulation.



- When installing the battery or connecting a battery charger, observe the appropriate polarity and the terminal battery must be grounded. Reverse polarity may damage the charging system. When charging the battery of the Genset equipment, isolate the battery by disconnecting the negative battery terminal before the positive. After the battery has been charged, connect the positive battery terminal first, then the negative.
- Never pour cold water into a hot engine.
- Use only ethylene glycol, anti-freeze (with inhibitors) in system. Use of glycol by itself will damage the cooling system.
- Never open the radiator cap when the coolant is hot.
- Always cover the engine inlet tube while the air cleaner is being serviced.
- Do not under-fill or overfill the oil bath cups. Over-filling of cups causes loss of capacity; under-filling cups causes lack of filtering efficiency.
- Continued operation with failed shock mounts may result in engine or generator damage.

Product information

Specifications summary

Operating temperature range	-25°C to +55°C
Alternator set rating	15.0kW, 18.8kVA 380V @ 50HZ / 440 OR 460V @ 60HZ 3-phase 50HZ at 1500rpm or 60Hz at 1800rpm
Dimension	1536 x 1530 x 820 (Width x Height x Depth)
Weight	747
Fuel tank capacity	210

Overview

The Genset equipment is a self-contained and automatic diesel engine-powered unit that supplies electrical power to reefer containers. It consists of a diesel engine mounted in a structural steel frame that is directly connected to an alternating current generator. The engine is a vertical inline, four cylinder diesel manufactured by Kubota, while the generator is a 15 kW, brushless, dual bearing type. Once the unit is running, the voltage controller will read the voltage output of the generator and adjust accordingly, to keep the voltage within ISO limits.

Electrical controls are mounted in a control box with operating controls. Gauges are mounted on a control panel, which also serves as the control box cover. A deflector assembly and a windowed control box door protect the control panel.

Auxiliary engine equipment consists of the battery, solid state battery charging system, "spin-on" lube oil filter, fuel filter, and other necessary components for proper unit operation. The water pump and the radiator cooling fan are belt-driven from the engine crankshaft.

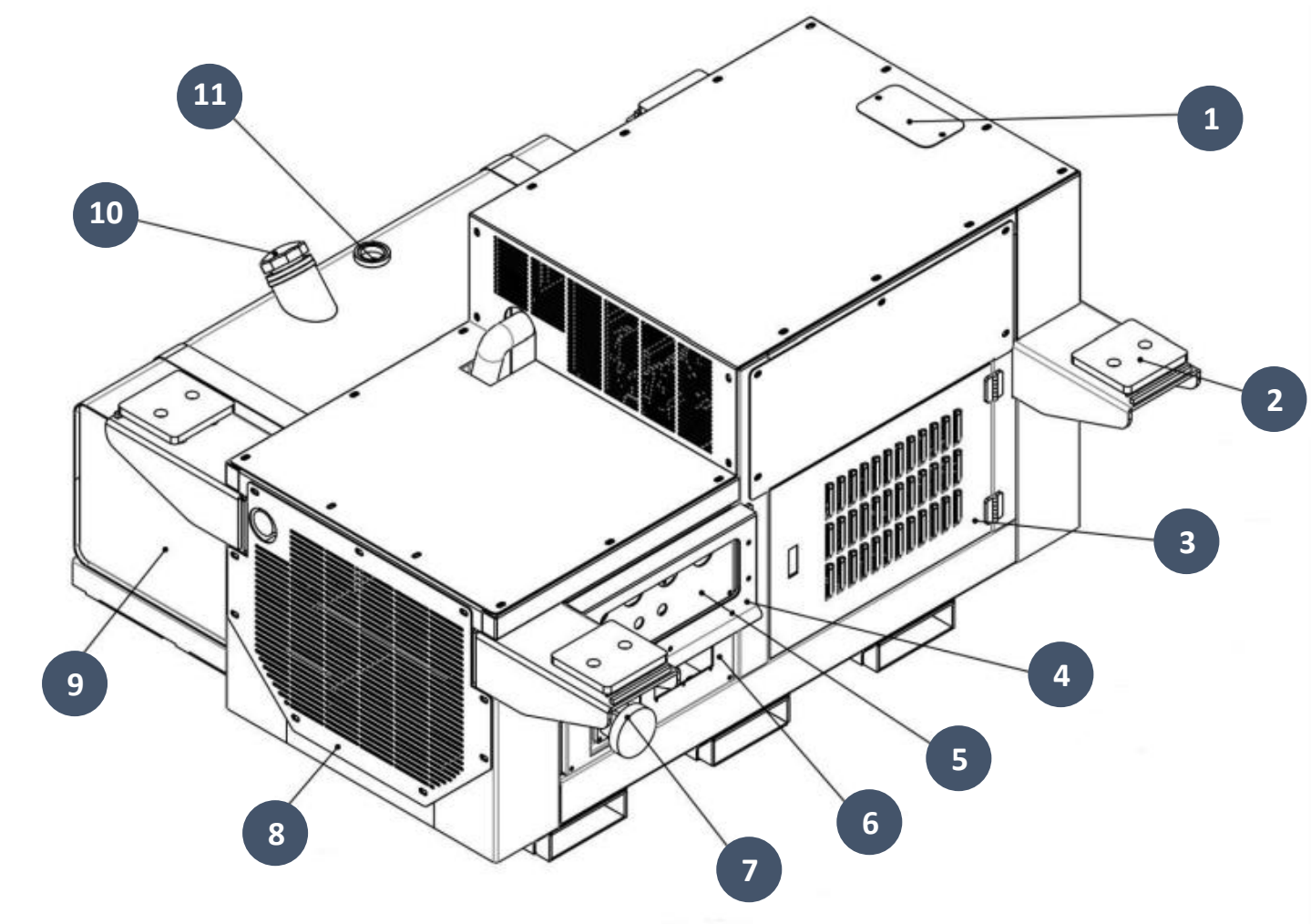
All references to engine are as viewed from the fly wheel end. The Genset equipment is available as a standard configuration, with an Auto Restart option or with Auto Restart and Low Coolant Sensor. The Auto Restart option automatically restarts the unit in the event of a unit shutdown. Auto Restart also offers built-in indicators that signal low oil pressure, high water temperature, over-speed, and other over-crank conditions.

Features

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

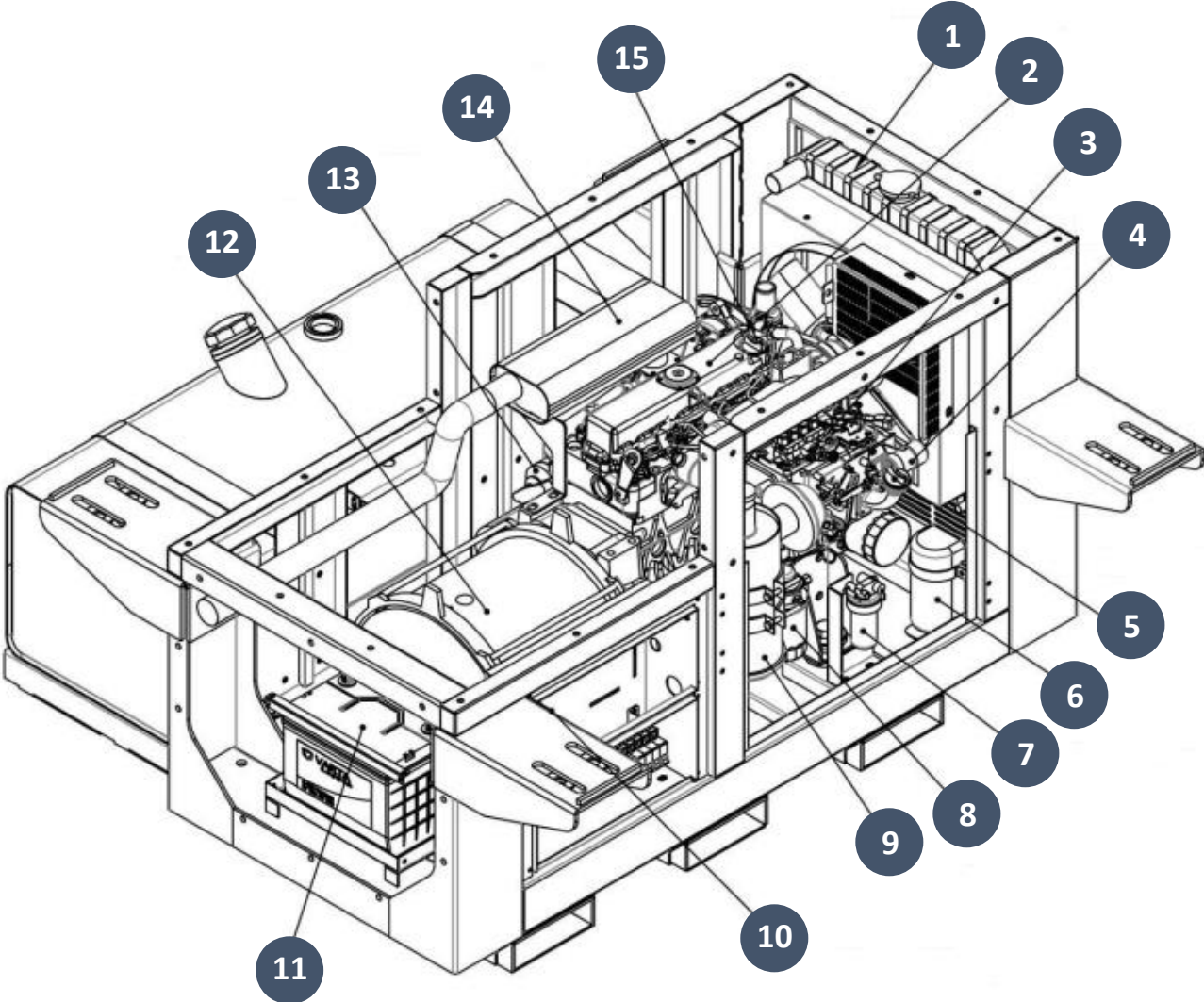
Views

External



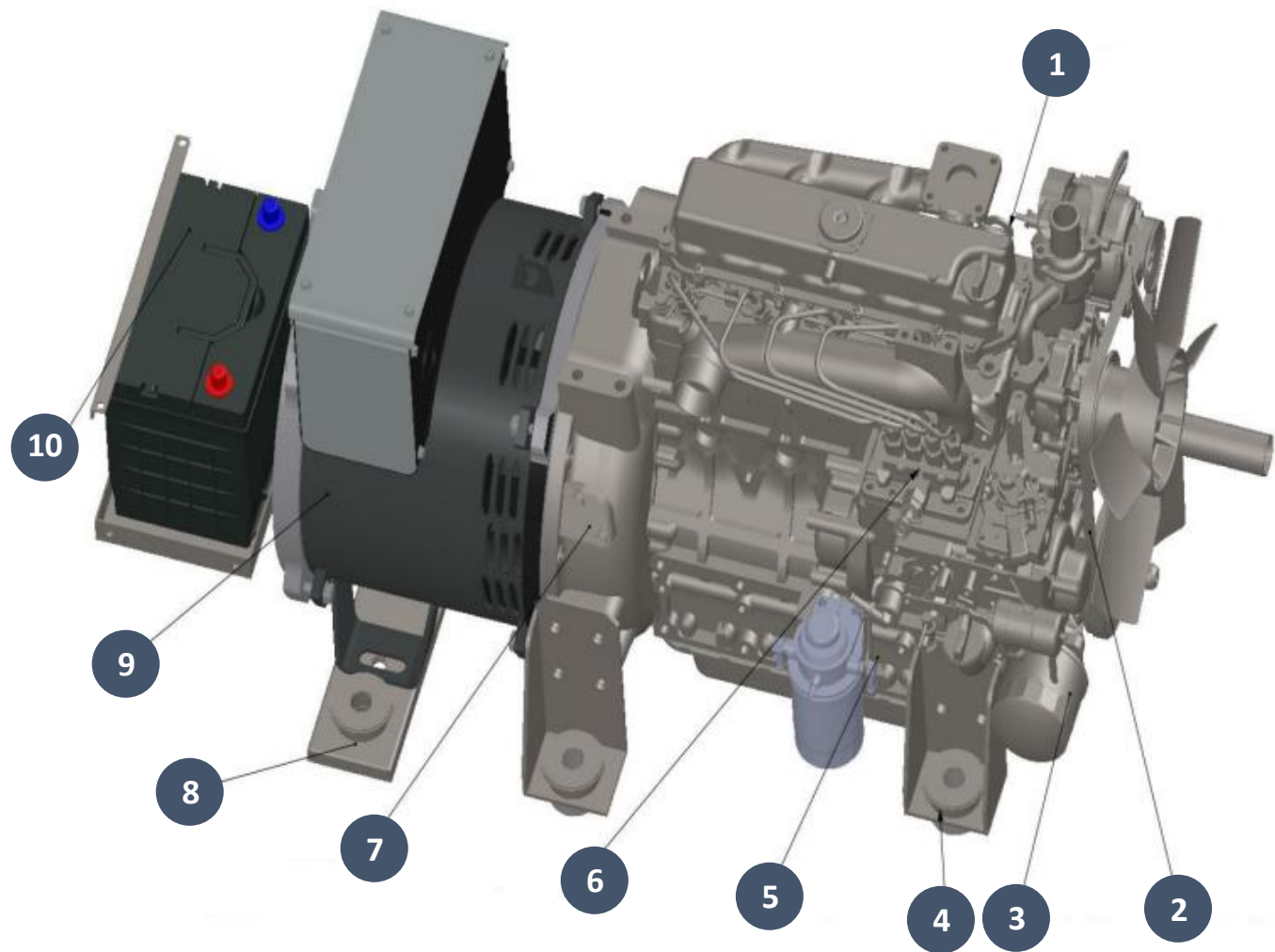
1. Whter cap	7. Circuit breaker
2. Fixed plate	8. Battery access panel
3. Access door	9. Tank
4. Control box protection door	10. Fuel cap
5. Control box	11. Fuel gauge
6. Fuel filter	

Internal



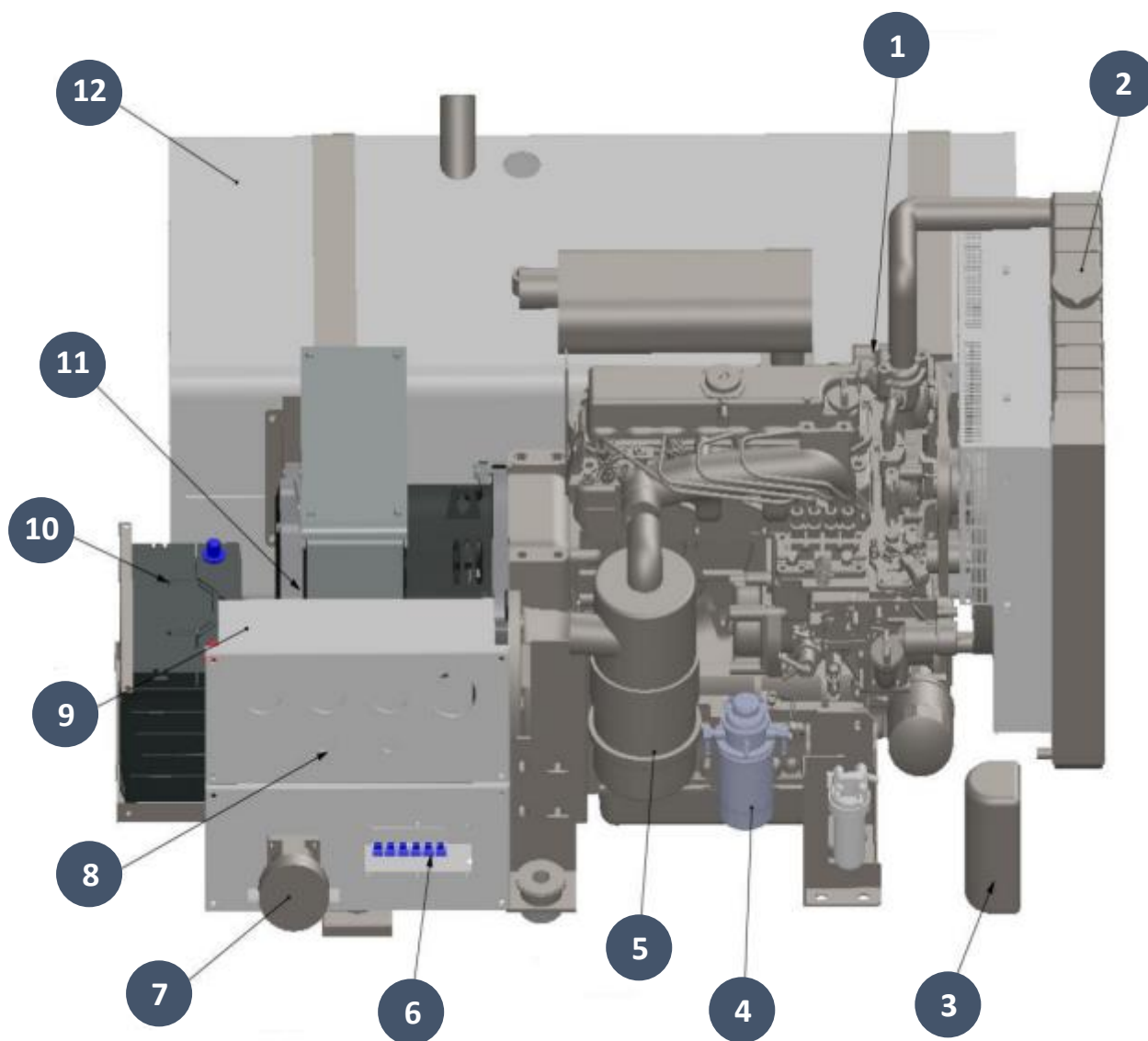
1. Radiator	9. Air cleaner
2. Engine injection pump	10. Solid state battery charger
3. Shutdown	11. Battery
4. Soleniod valve	12. Alternating current generator
5. Lube oil dip stick / fill cap	13. Starter motor
6. Coolant recovery bottle	14. Exhaust muffler
7. Oil-water separator	15. Water temperature sender
8. Fuel filter	

Generator



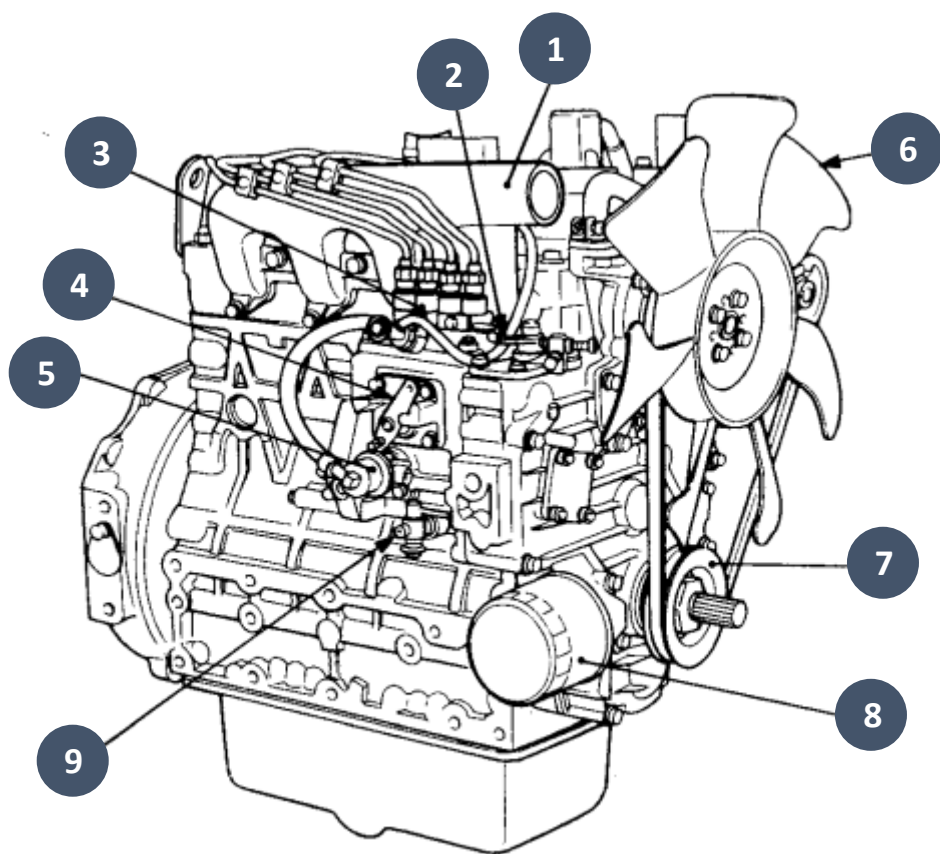
1. Oil pressure sender	6. Injector pump
2. V-belt	7. Flywheel access cover
3. Oil filter	8. Generator shockmount
4. Engine shockmount	9. Generator
5. Lube oil dipstick	10. Battery

Internal connections

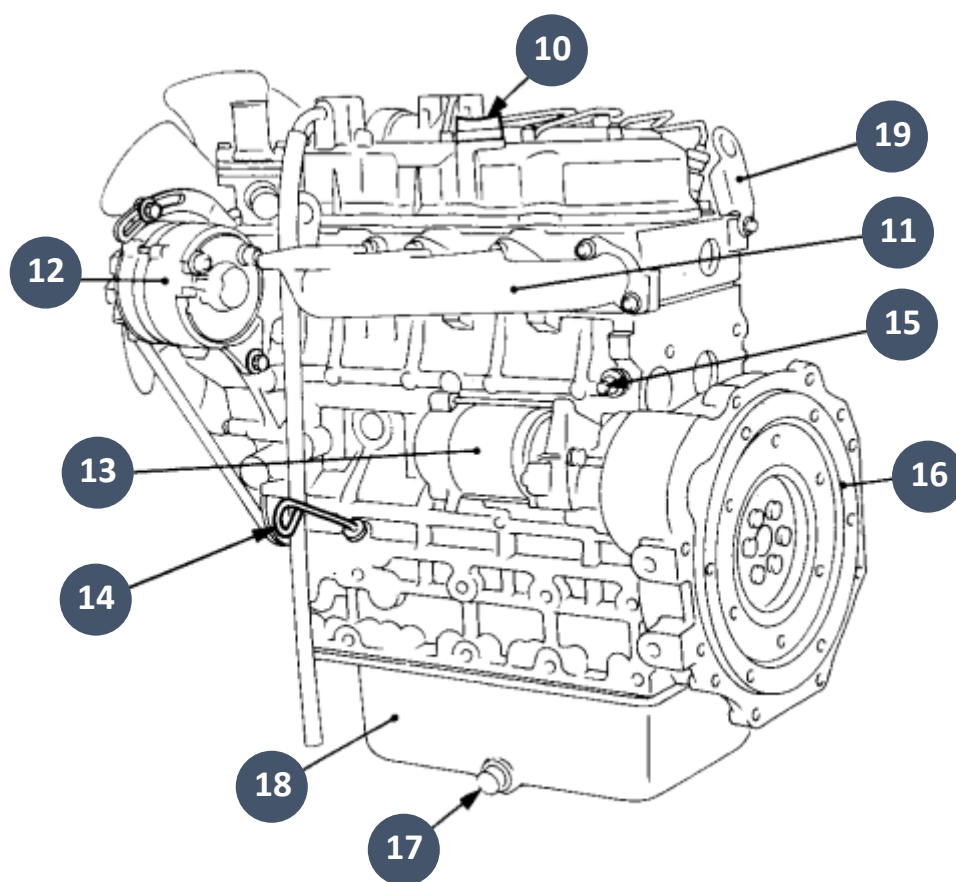


1. Water temperature sensor	7. Receptacle
2. Radiator	8. Controls
3. Coolant overview bottle	9. Receptacle box
4. Fuel filter	10. Battery
5. Air cleaner	11. Generator
6. Circuit breaker	12. Fuel tank

Engine



1. Intake manifold	6. Cooling fan
2. Speed control lever	7. Fan drive pulley
3. Injection pump	8. Oil filter cartridge
4. Engine stop lever	9. Water drain cock
5. Fuel feed pump	



10. Oil filter plug	16. Flywheel
11. Exhaust manifold	17. Oil drain plug
12. Alternator	18. Oil pan
13. Starter	19. Engine hook
14. Oil level gauge	
15. Oil pressure switch	

General Specifications (Engine)

MITSUBISHI CORPORATION ENGINE ENGINEERING DEPARTMENT

General Specification

Standard	All items, unless otherwise specified, are in accordance with JIS and maker's standards	
Model	Mitsubishi S4L2 S4L2-W461LTSH MHIET No. 31A00-02880 (1/2-CHG 0, 2/2-CHG 0)	
Regulations	EPA & CARB Tier4 certified Engine family ; *MVXL01.8EBA (* : Model year code) Engine model ; S4L2 Engine code ; S4L2-P18-2	
	CHINA Export Only	
Use	LIGHT TOWER	
Type	4 cycle water-cooled, vertical overhead valve, cylinder in line, swirl chamber type	
Number of cylinders	4	
Bore × Stroke	78mm × 92mm	
Piston displacement	1.758 liters	
Compression ratio	22 : 1	
Rotation	Anti-Clockwise rotation as viewed from flywheel side	
Firing order	1-3-4-2	
Engine weight(Dry)	Approx. 160kg	
Dimensions(Length)	Approx. 669mm	
(Width)	Approx. 442mm	
(Height)	Approx. 572mm	
Inclination(Continuous)	15°	
(Temporary)	30°(Max 30 min.)	
Fuel	ASTM diesel fuel oil No.2-D(JIS K2204 gas oil specification No.2 or 3)	
Lubricating oil	API classification service CF or CH-4 class	
Output(Without fan)	Spec.Rating	Rating at delivery
	Breaking in around 50hr	Breaking in around 0.25hr
	St-by; 18.4kW {25.0PS}/1800rpm	17.5kW {23.8PS}/1800rpm
	Prime; 17.0kW {23.1PS}/1800rpm	
	(With Fan St-by; 18.1kW {24.6PS}/1800rpm)	
	(With Fan Prime; 16.7kW {22.7PS}/1800rpm)	
Rating tolerance	±5% of nominal	
Fuel consumption (Without fan)	Approx. 250g/kW·h at St-by output.	263g/kW·h at St-by output.
Tolerance	±8%	
Idling engine speed	1800 rpm (Fixed at rated speed)	
Speed regulation	Isochronous control	
Rating conditions (Without fan)	ISO 15550	
	Total barometric pressure : 100kPa	
	Air temperature : 298K	
	Relative humidity : 30%	
Oil consumption	Approx. 0.1~0.3% of fuel consumption<Reference value> @ Full load, Rated speed	
Fuel injection timing	15°BTDC	
Mean effective pressure	0.70MPa {7.1kgf/cm ² } at St-by output	
Piston speed	5.5m/s at 1800rpm	

Fuel system

Fuel injection pump	In-Line type(ND-PFR M type)
Fuel injection nozzle	Throttle type
Governor	Electric type * Speed signal that is 120 pulses per one revolution is required. [the acceptable amplitude range is from 1 to 42 Vrms.]
Fuel filter	No
Fuel pump	No
Min. required fuel feeding head	100mm
Max.static head of leak pipe (return)	200mmHg

Lubricating system

Lubricating system	Forced circulation by trochoid pump
Lubricating oil filter	Filtering paper type, full flow
Oil pressure	0.29MPa~0.39MPa{3~4kgf/cm ² } at duty run 0.098MPa{1.0kgf/cm ² } min. at low idling
Oil capacity	Approx.6.0 liters (Oil pan 5.5 liters, high level,Oil filter etc. Approx. 0.5 liters, High~Low Approx. 1.8 liters)
Oil dipstick	Standard dipstick
Oil pressure switch	Yes
Oil pressure unit	No

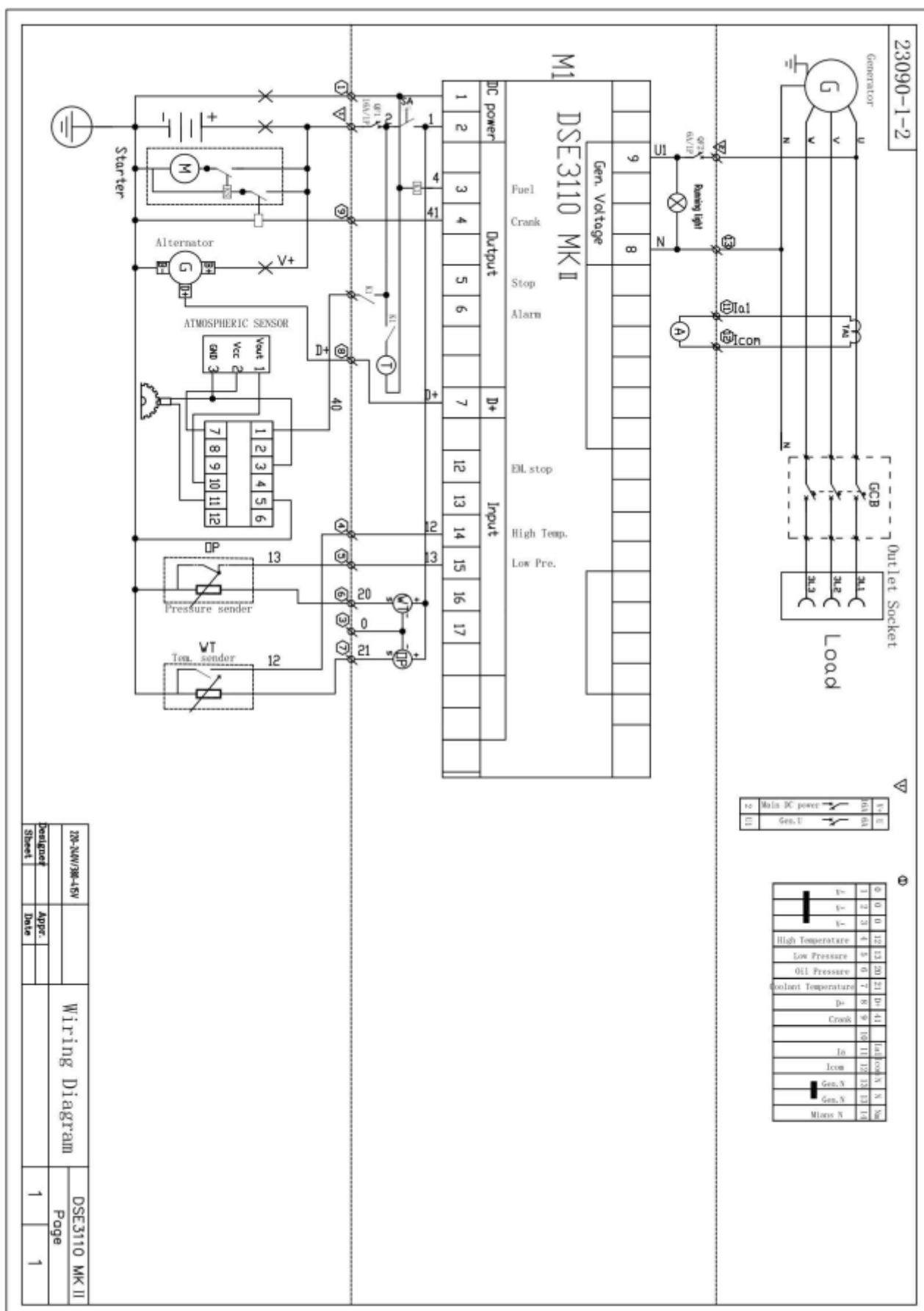
Cooling system

Cooling system	Forced circulation of fresh water by centrifugal pump with thermostat
Engine water capacity	Approx. 2.5 liters
Cooling fan	360mm diameter,6 blades, pusher
Water pump pulley	PCD 87mm
Pulley ratio	1.33(Crankpulley : Water pump pulley = 116 : 87)
Fan spacer	No
Water temp. switch	Yes
Thermo. Unit	No
Thermostat	Open at 76.5deg.C - full open at 90deg.C

Electrical system

Alternator	12V - 50A
Voltage regulator	IC type (Built in alternator)
Regulator set voltage	14.7 ±0.3V
Alternator pulley	PCD 65mm
Starting system	Electric starting
Starter motor	12V-2.0kW
Glow plug	10.5V,9.7A × 4
Engine shut off system	Mechanical included in the electronic governor system

Wiring diagram

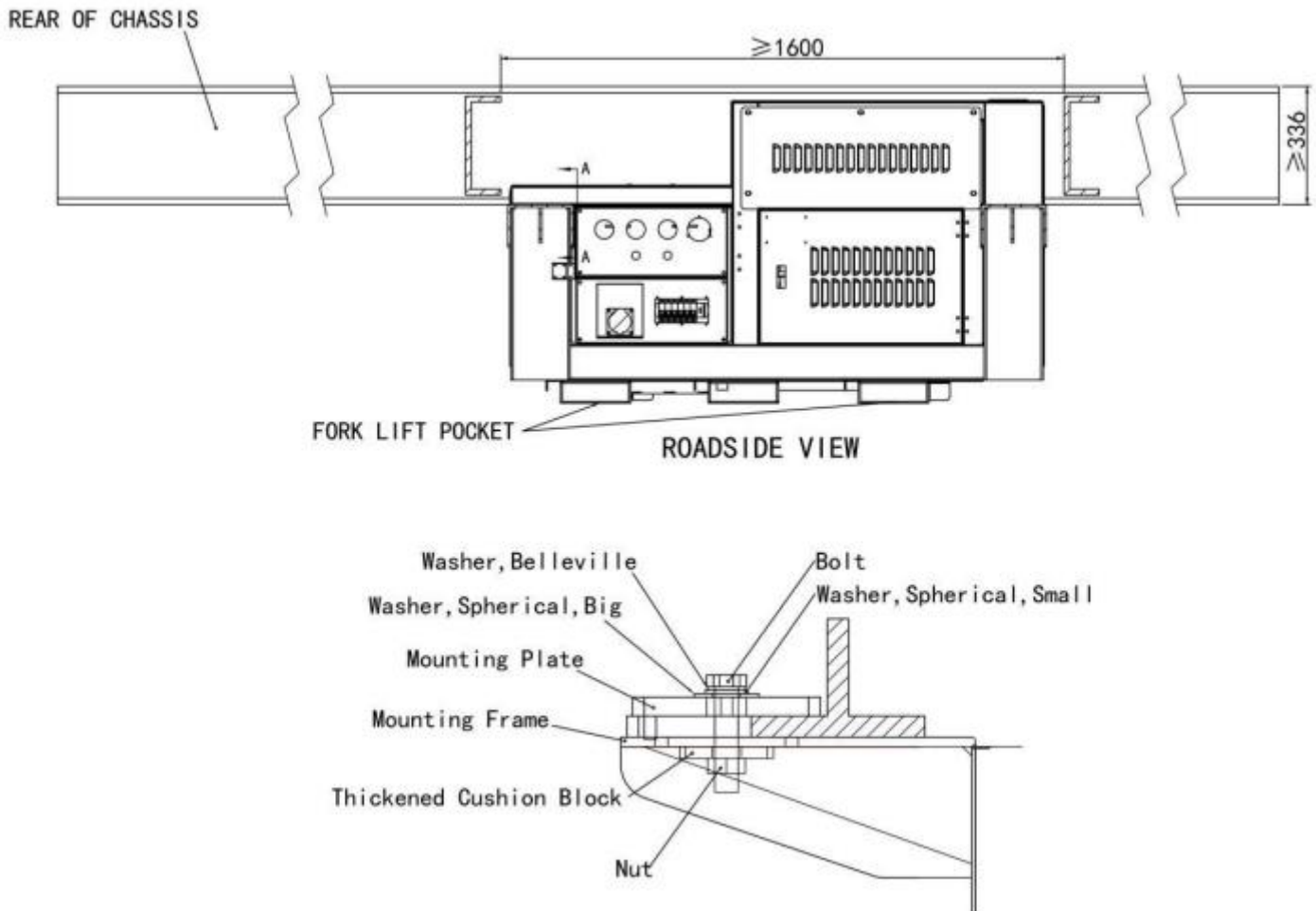


Operating instructions

Mounting the Genset equipment

The generator set is mounted under the center of the trailer chassis and is easily handled with a fork lift truck capable of handling 2,000 pounds. The fork lift pockets provided are accessible from either side. Mounting clamps are designed to be attached to outside I-beam flanges only. Maximum chassis width is 38 inches on center.

Standard mount



1. Loosen the mounting bolts sufficient to push mounting plates to the outermost position.
2. Place forks into fork lift pockets of generator set. Attach safety chain between unit and fork truck.
3. Center generator under chassis slide mounting plates fully onto chassis I-beams and torque mounting bolts to 80 - 90 ft-lbs (11.1 - 12.4 m-kp). Upon completion, remove safety chain before removing forks of fork lift truck from unit.

Quick Mount

1. Loosen mounting bolts sufficient to bring clamp to open position. To orient in open position, lift nut end of bolt out of slot. Clamp will fall open.
2. Place forks into fork lift pockets of generator. Attach safety chain between unit and fork truck.
3. Center the generator set in desired position under chassis.
4. Lift clamp in place, ensuring bolt is secured in slot.
5. Tighten bolt to 55 - 65 ft-lbs (7.6 - 9.0 m-kG).
6. Upon completion, remove safety chain before removing forks of fork lift truck from unit.

Unmounting the Genset equipment

Standard unmount

1. Disconnect the power cable from the generator (if connected).
2. With fork lift in position and safety chain attached, slide mounting plates back sufficiently to clear chassis.
3. Lower and remove generator.

Quick unmount

1. Disconnect power cable to unit (if connected).
2. With fork lift in position and safety chain attached, loosen mounting bolts, and lift end of bolts out of slot to orient clamps to open position.
3. Lower and remove the generator.

Starting and stopping instructions

Pre-start inspection

1. Check the engine lubrication and fuel filters, oil lines, and connections for leaks. If required, tighten connections and/or replace gaskets.
2. Check the engine lubricating oil level.
3. Check the poly V-belt for fraying or cracks.
4. Check radiator hoses for leaks and check radiator coolant level.
5. Check radiator coil and generator air intake screen for cleanliness. If required, clean using compressed air, reversing the normal air flow.
6. Check air cleaner for cleanliness and clean if necessary.
7. Check in-line fuel strainer and clean if necessary.
8. Drain water from fuel tank sump and filter bowl.
9. Check, and if required, tighten all hardware (brackets, etc.).
10. Ensure the main generator set circuit breaker (CB1) is in the OFF position. Connect the power cable to the refrigeration unit.

Starting Instructions

Before start up, ensure that both the Genset circuit breaker (CB1) and the refrigerated unit is turned OFF. After start up, run the Genset equipment for at least two minutes to allow the power source to stabilize before supplying power to the refrigerated unit. This eliminates the potential of any cold start transient spikes from reaching the refrigerated unit. Cold start transient spikes can potentially cause nuisance over voltage alarms on refrigerated units that are sensitive to electrical spikes or transients.

Standard Units

1. Make sure that CB-1 is in the OFF position.
2. Hook up the 460 volt cable from the refrigerated unit to the Genset receptacle.
3. Hold intake heater switch in the PREHEAT position. Suggested hold times for a cold engine are as follows:

COLD ENGINE PREHEAT TIMES	
Ambient temperature	Time
Above 10°C/50°F	Not required
-5°C to 10°C (23°F to 50°F)	5 seconds
Below -5°C/23°F	10 seconds
Continuous use shall not exceed 30 seconds	

4. With the heater switch held in the PREHEAT position, place the ignition switch in the START position.
5. After the engine has started, continue to hold the heater switch in the PREHEAT position until the engine develops sufficient oil pressure to close the oil pressure safety switch (approximately 5 seconds). When released, the heater switch will automatically return to the OFF position.
6. If the engine still cannot start running after the ignition switch is in the starting position for 8 seconds, please try to start again after an interval of 30 seconds. Do not keep the starting motor running for more than 15 seconds.

Post-start inspection

1. Allow the Genset unit to run for at least 2 minutes.
2. Turn on CB-1.
3. Check generator output with a volt meter, voltage output at start up with no load. Operation should be: 360- 460 Voltage - output may vary and fall with ISO specifications based on ambient.
4. Start refrigeration unit.
5. Run engine 10 minutes (check total time meter operation).
6. Listen for abnormal bearing noise (AC generator).
7. Check fuel lines, lube oil lines, filters, and exhaust system for leaks.

Stopping instructions

1. Place CB-1 in the OFF position.
2. Place the ignition switch in the OFF position.

Sequence of operation warning

Standard Units

To start the engine, the ignition switch (IGN) is held in the START position. With the switch in the START position, current flows to the start solenoid (SS). The starter motor turns over the engine resulting in pumping of fuel to the engine cylinders by the injection pump. This fuel is ignited by heat of compression; thus starting the engine. When the engine has developed sufficient oil pressure, the low oil pressure switch (LOP) Switch contacts open. The unit provides power to the safety relay (S).

After the engine is started and the start switch is released, the starter motor will stop starting. When the engine is running, the battery charger provides direct current to operate the control system and charge the battery.