# Service Manual

## Onan Generator Set for RV

HGLCA (Spec A)

English
Original Instructions
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# Service Manual

## QG7000i DF Generator Set for RV

# Content

# 1 Safety Precautions

**Thoroughly read the operator manual before operating the generator set. Safe operation and top performance can be obtained only when equipment is operated and maintained properly.**

The following symbols in this manual alert you to potential hazards to the operator, service person and equipment.

| ⚠ DANGER |
| --- |
| ***Alerts you to an immediate hazard which will result in severe personal injury or death..*** |

| ⚠ WARNING |
| --- |
| ***Alerts you to a hazard or unsafe practice which can result in severe personal injury or death.*** |

| ⚠ CAUTION |
| --- |
| ***Alerts you to a hazard or unsafe practice which can result in personal injury or equipment damage.*** |

When equipped with an integral or add-on Automatic Generator Starting System (AGS) control, exhaust carbon monoxide (CO), electric shock, and moving parts hazards are possible due to unexpected starting. Turn off AGS whenever performing maintenance or service, when the vehicle is stored between uses, is awaiting service, or is parked in a garage or other confined area.

## 1.1 General Precautions

- Keep ABC fire extinguishers handy.
- Make sure all fasteners are secure and torqued properly.
- Keep the generator set and its compartment clean. Excess oil and oily rags can catch fire. Do not store gear in the compartment it can restrict cooling air.
- Before working on the generator set, disconnect the negative (-) battery cable at the battery to prevent starting.
- Use caution when making adjustments while the generator set is running—hot, moving or electrically live parts can cause severe personal injury or death.
- When the generator is running, the muffler, oxygen sensor, cylinder head and other parts will produce a lot of heat, which may cause serious scald accidents. During inspection and maintenance, the generator should be shut down for 30 minutes to 1 hour, and the engine should be fully cooled before maintenance.
- Used engine oil has been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Benzene and lead in some gasolines have been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not to ingest, inhale or contact gasoline or its vapors.

- Do not work on the generator set when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.

## 1.2 Generator Set Voltage Is Deadly

- Disable the automatic generator set starting feature of an inverter-charger or other automatic starting device before servicing the generator set to avoid electric shock from unexpected starting.
- Generator set output connections must be made by a qualified electrician in accordance with applicable codes.
- The generator set must not be connected to the public utility or any other source of electrical power. Connection could lead to electrocution of utility workers and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry and stand on a dry wooden platform.

## 1.3 Engine Exhaust Is Deadly

- Learn the symptoms of carbon monoxide poisoning in this manual and never occupy the vehicle while the generator set is running unless the vehicle is equipped with a working carbon monoxide detector.
- The exhaust system must be installed in accordance with the generator set installation manual. Engine cooling air must not be used for heating the working or living space or compartment.
- Inspect for exhaust leaks at every startup and after every eight hours of running.
- Make sure there is ample fresh air when operating the generator set in a confined area.

## 1.4 Fuel is Flammable and Explosive

- Do not smoke or turn electrical switches ON or OFF where fuel fumes are present or in areas sharing ventilation with fuel tanks or equipment. Keep flame, sparks, pilot lights, arc-producing equipment and switches and all other sources of ignition well away.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.
- Leaks can lead to explosive accumulations of gas. LPG sinks when released and can accumulate inside housings and basements and other below-grade spaces. Prevent leaks and the accumulation of gas.

## 1.5 Battery Gas Is Explosive

- Wear safety glasses and do not smoke while servicing batteries.
- When disconnecting or reconnecting battery cables, always disconnect the negative (–) battery cable

first and reconnect it last to reduce arcing.

## 1.6 Moving Parts Can Cause Severe Personal Injury or Death

- Disable the automatic generator set starting feature of an inverter-charger or other automatic starting device before servicing the generator set to avoid unexpected starting and injury.
- Do not wear loose clothing or jewelry near moving parts such as PTO shafts, fans, belts and pulleys.
- Keep hands away from moving parts.
- Keep guards in place over fans, belts, pulleys, etc.

## 1.7 Button Battery Warning

The timer on the control panel of the generator set is equipped with a button battery. The packaging box of the product and the back of the timer are equipped with a button battery warning label, as shown below.

| | |
|---|---|
|  | This icon is a button battery warning label |
| Generator contains non-replaceable batteries CR2032 (3V). | Indicates the specification and status of the button battery. |
| ⚠ WARNING<br>• **INGESTION HAZARD:** This product contains a button cell or coin battery. • **DEATH** or serious injury can occur if ingested. • A swallowed button cell or coin battery can cause **Internal Chemical Burns** in as little as **2 hours.** • **KEEP** new and used batteries **OUT OF REACH of CHILDREN.** • **Seek immediate medical attention** if a battery is suspected to be swallowed or inserted inside any part of the body.  | Indicates the possible danger of button battery. |

# 2 Introduction

**⚠ WARNING**

***Hazardous Voltage***

***Contact with high voltages can cause severe electrical shock, burns, or death.***

***Make sure that only a trained and experienced electrician makes generator set electrical output connections, in accordance with the installation instructions and all applicable codes.***

**⚠ WARNING**

***Electrical Generating Equipment***

***Faulty electrical generating equipment can cause severe personal injury or death.***

***Generator sets must be installed, certified, and operated by trained and experienced persons in accordance with the installation instructions and all applicable codes.***

## 2.1 About This Manual

This is the service manual for the generator set models listed on the front cover. Read and carefully observe all of the instructions and precautions in this manual.

**⚠ WARNING**

***Improper service or replacement of parts can lead to severe personal injury or death and to damage to equipment and property. Service personnel must be trained and experienced to perform electrical and mechanical service.***

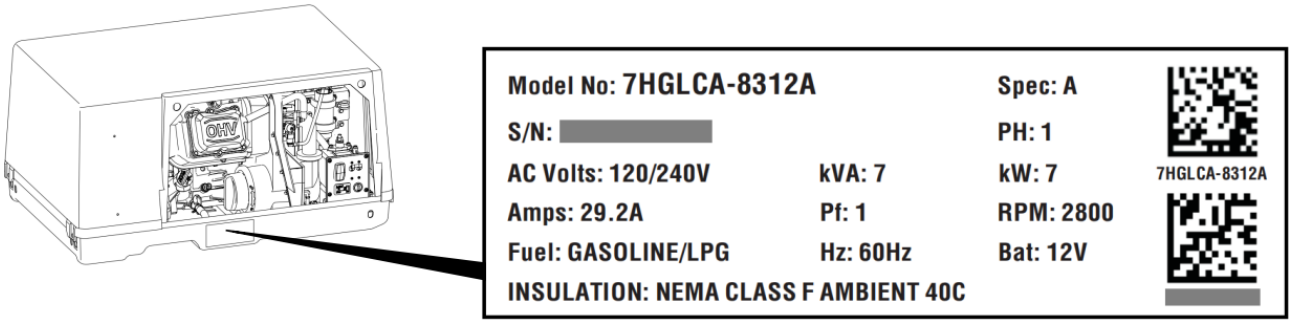
**⚠ WARNING**

***Unauthorized modifications or replacement of fuel, exhaust, air intake or speed control system components that affect engine emissions are prohibited by law in the State of California.***

See the installation manual for important recommendations concerning the installation and for a list of the installation codes and standards for safety which may be applicable.

See the parts manual for part identification numbers and required quantities and for exploded views of the generator set subassemblies. Genuine parts replacement parts are recommended for best results.

When contacting Manufacturer for parts and product information, be ready to provide the model and serial numbers on the generator set nameplate. Figure 1 illustrates the nameplate and its location. The numbers in the gray boxes are typical model and serial numbers. Every character in these numbers is significant. (The last character of the model number is the specification letter, which is important for obtaining the right parts.)




RECORD NUMBERS HERE

| |
|---|
| MODEL NUMBER: |
| SERIAL NUMBER: |

**FIGURE 1. NAMEPLATE LOCATION**

## 2.2 Related Literature

Before any attempt is made to operate the generator set, the operator should take time to read all of the manuals supplied with the generator set, and to familiarize themselves with the warnings and operating procedures.

| ⚠ CAUTION |
|---|
| ***A generator set must be operated and maintained properly if you are to expect safe and reliable operation. The Operator manual includes a maintenance schedule and a troubleshooting guide.*** ***The Health and Safety manual must be read in conjunction with this manual for the safe operation of the generator set:*** |

The relevant manuals appropriate to your generator set are also available, the documents below are in English:

- Operator Manual for RV Generator Set
- Installation Manual for RV Generator Set
- Generator Set Service Manual for RV Generator Set
- Recommended Spares List (RSL) for RV Generator Set
- Parts Manual for RV Generator Set

# 2.3 Specifications

## 2.3.1 Model Specifications

**TABLE 1. SPECIFICATIONS**

| Fuel type | **GASOLINE** | **LPG** |
|---|---|---|
| **GENERATOR:** Permanent Magnet, Inverter, Single Phase, Dual Voltage | | |
| Power | 7000 Watts | |
| Frequency[1] | 60 Hz | |
| Voltage | 120/240 Volts | |
| Current | 29.2 Amps | |
| Speed | 2800 RPM | |
| **FUEL CONSUMPTION:** | | |
| No Load | 1.4 l/h (0.4 gph) | 0.5 kg/h (1.1 lbs/h) |
| Half Load | 2.2 l/h (0.6 gph) | 1.2 kg/h (2.5 lbs/h) |
| Fuel Load | 3.4 l/h (0.9 gph) | 1.8 kg/h (3.8 lbs/h) |
| **ENGINE:** Single-Cylinder, Four-Stroke, Spark Ignited, OHV, Air-Cooled, Horizontal Shaft | | |
| Fueling Method | EFI[2] | Air Mixed With Fuel |
| Governor | ECU[3] | |
| Speed | 2200~2800 RPM | |
| Bore | 92 mm (3.62 in) | |
| Stroke | 82.5 mm (3.25 in) | |
| Displacement | 548 $cm^3$ (33.4 $in^3$) | |
| Compression Ratio | 8.5 : 1 | |
| Oil Capacity | 2.4 liters (2.5 qt) | |
| Intake Valve Lash (Cold) | 0.10 ~0.15mm (0.004in ~0.006in) | |
| Exhaust Valve Lash (Cold) | 0.15~0.20 mm (0.006in ~0.008 in) | |
| Spark Plug Gap | 0.6~0.7 mm (0.024~0.028 in) | |
| Spark Plug Torque | 25-30 Nm(18-22 ft-lbs) | |
| Ignition Timing | 19° BTDC, non-adjustable | |
| Magneto Air Gap | 0.7 mm(0.028 in) | |

| Fuel type | GASOLINE | LPG |
|---|---|---|
| **DC SYSTEM:** | | |
| Battery Voltage | 12 Volts | |
| Minimum Battery Rating | 450 CCA @ –18 °C (0 °F) | |
| **INSTALLATION:** | | |
| Exhaust O. D. | 31.75 mm (1.25 in) | |
| Fuel Supply Connection | 1/4 in. SAE J1231 Type 1 | - |
| Fuel vapor Connection | 5/16 in. SAE J1231 Type 1 | - |
| Minimum Free Air Inlet Area | 400 $cm^2$ (62 $in^2$) | |
| LPG Vapor Connection Pressure | - | 3/8-18 NPTF 228–330 mm (9–13 in) WC |
| Weight | 91 kg (201 lbs) | |
| Minimum Compartment Size (H x D x W)[3] | 450.4 mm x 588.7 mm x 878.8 mm (17.73 in x 23.18 in x 34.6 in) | |

1. 60 Hz models are listed by CSA.

2. Electronic Fuel Injection.

3. Electronic Control Unit.

4.See the Installation Manual for additional considerations when sizing the generator set compartment.

## 2.3.2 Torque Specifications

Mounting screws and nuts must be tightened to the specified torques in the following tables. All threads must be clean and lubricated with new engine oil before tightening. When tightening torques are not specified, tighten the screws and nuts according to **Table 3**. The grade numbers are indicated on top of the screw or bolt head.

**TABLE 2. TORQUE SPECIFICATIONS**

| | lb-ft | Nm |
|---|---|---|
| Spark Plugs | 18-22 | 25-30 |
| Connecting rod bolt | 13-15 | 18-20 |
| Cylinder head nut | 33-41 | 45-55 |
| Crankcase cover bolts | 18-22 | 25-30 |
| Alternator rotor nut | 81-96 | 110-130 |
| Alternator stator bolt | 18-22 | 25-30 |

| | lb-ft | Nm |
|---|---|---|
| Bolts of breather valve cover | 6-9 | 8-12 |
| Bolts of balance guide rail and box body | 18-22 | 25-30 |
| Cylinder head cover bolt | 6-9 | 8-12 |
| Valve lock nut | 5-7 | 7-10 |
| Rocker arm shaft bolt | 6-9 | 8-12 |
| Combined lock nut of oil drain pipe | 30-33 | 40-45 |
| Temperature sensor | 8-10 | 11-14 |
| Impeller fastening bolt | 6-9 | 8-12 |
| Bolts of fan cover and air guide cover | 6-9 | 8-12 |
| Bolts of Aluminum isolator brackets to Engine | 18-22 | 25-30 |
| Impeller disc bolt | 18-22 | 25-30 |
| Starting motor | 18-22 | 25-30 |
| Bolts of LPG control valve body and mounting bracket | 6-9 | 8-12 |
| Engine and base pan connecting bolt | 22-27 | 30-36 |
| Oxygen Sensor | 13-16 | 18-22 |
| Muffler and exhaust pipe connecting nut | 16-21 | 22-28 |
| Bolts of isolators to Base pan | 6-9 | 8-12 |
| Muffler to base pan connecting bolt | 16-21 | 22-28 |
| Battery ground bolt | 11-15 | 15-20 |
| LPG valve mounting bolts | 6-9 | 8-12 |
| Gasoline pump bolts | 6-9 | 8-12 |
| Bolts of controller and electronic controller ECU | 6-9 | 8-12 |

**TABLE 3. METRIC BOLT TORQUE SPECIFICATIONS - 8.8 GRADE**

| SIZE | lb-ft | Nm |
|---|---|---|
| M4 | 1.5-3 | 2-4 |
| M5 | 3-6 | 4-8 |
| M6 | 6-9 | 8-12 |
| M8 | 16-21 | 22-28 |
| M10 | 22-27 | 30-36 |
| M12 | 59-64 | 80-86 |

# 2.4 After Sales Services

Manufacturer offers a full range of maintenance and warranty services.

## 2.4.1 Maintenance

**⚠ WARNING**

***Electrical Generating Equipment***
***Incorrect operation and maintenance can result in severe personal injury or death.***
***Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.***

For expert generator set service at regular intervals, contact your local distributor. Each local distributor offers a complete maintenance contract package covering all items subject to routine maintenance, including a detailed report on the condition of the generator set. In addition, this can be linked to a 24-hour call-out arrangement, providing year-round assistance if necessary. Specialist engineers are available to maintain optimum performance levels from generator sets. Maintenance tasks should only be undertaken by trained and experienced technicians provided by your authorized distributor.

## 2.4.2 Warranty

For details of the warranty coverage for your generator set, refer to the Global Commercial Warranty Statement listed in the Related Literature section.

In the event of a breakdown, prompt assistance can normally be given by factory trained service technicians with resources to undertake all minor and many major repairs to equipment on site.

For further warranty details, contact your authorized service provider.

***NOTICE***

**Damage caused by failure to follow the manufacturer's recommendations will not be covered by warranty. Contact your authorized service provider.**

### 2.4.2.1 Warranty Limitations

For details of the warranty limitations for your generator set, refer to the warranty statement applicable to the generator set.

## 2.4.3 How to Obtain Service

For generator set parts, service, and literature, contact the nearest authorized Cummins Inc. distributor. You may go to the Internet site **power.cummins.com** for information on contacting our distributors worldwide.

### 2.4.3.1 In U.S. and Canada

Call +1-800-CUMMINSTM (1-800-286-6467) for the nearest Cummins Inc. distributor in the United States or Canada. Press 1 (option 1) to be automatically connected.

### 2.4.3.2 Outside U.S. and Canada

If you are outside U.S. and Canada, refer to **power.cummins.com** or send an email to ask.powergen@cummins.com.

### 2.4.3.3 Information To Have Available

- model number
- serial number
- date of purchase
- nature of the problem

# 3 Maintenance

## 3.1 Periodic Maintenance Schedule

**TABLE 4. PERIODIC MAINTENANCE SCHEDULE**

| MAINTENANCE PROCEDURE | MAINTENANCE FREQUENCY | | | | | |
|---|---|---|---|---|---|---|
| | Every Day or Every 8 Hours | After First 20 Hours | Every Month | Every 50 Hours | Every 150 Hours | Every 500 Hours |
| General Inspection | X | | | | | |
| Check Engine Oil Level | X | | | | | |
| Clean and Check Battery | | | X[3] | | | |
| Change Engine Oil | | X[1] | | | X[2, 3, 4] | |
| Replace Air Filter Element | | | | | X[2] | |
| Replace Spark Plug(s) | | | | | | X[5] |
| Replace Fuel Filter | | | | | | X[5, 6] |
| Adjust Valve Lash | | | | | | X[5, 6] |

1 - As a part of engine break-in, change the engine oil after the first 20 hours of operation.
2 - Service intervals of 150 hours to 167 hours are acceptable, perform more often when operating in dusty environments.
3 - Perform more often when operating in hot weather.
4 - Perform at least once a year.
5 - Perform sooner if engine performance deteriorates.
6 - Must be performed by a qualified mechanic (authorized Cummins Service Representative).
7 - Perform more often when operating in dusty environments.

## 3.2 Conducting General Inspections

Inspect the generator set before the first start of the day and after every eight hours of operation.

### 3.2.1 Oil Level

Check engine oil level (**Section 3.3**).

### 3.2.2 Exhaust System

**⚠ WARNING**

***Exhaust Gas Is Deadly***

***Do not operate the generator set if there is an exhaust leak or any danger of exhaust gases entering or being drawn into the vehicle.***

**⚠ WARNING**

***Do not park the vehicle in high grass or brush. Contact with the exhaust system can cause a fire.***

- Look and listen for exhaust system leaks while the generator set is running. Shut down the generator set if a leak is found; have it repaired before operating the generator set again.
- Look for openings or holes between the generator set compartment and vehicle cab or living space if the generator set engine sounds louder than usual. Have all such openings or holes closed off or sealed to prevent exhaust gases from entering the vehicle.
- Replace dented, bent or severely rusted sections of the tailpipe. Make sure the tailpipe extends at least 1 inch (25.4 mm) beyond the perimeter of the vehicle.
- Park the vehicle so that generator set exhaust gases disperse away from the vehicle. Barriers such as walls, snow banks, high grass and brush, and other vehicles can cause exhaust gases to accumulate in and around the vehicle.
- Do not operate power ventilators or exhaust fans while the vehicle is standing with the generator set running. The ventilator or fan can draw exhaust gases into the vehicle.
- Check all CO monitors to assure proper operation.

### 3.2.3 Fuel System

**⚠ WARNING**

***Gasoline and LPG are highly flammable and explosive, and can cause severe personal injury or death. Shut down the generator set and repair leaks immediately.***

- Check for leaks at the hose, tube and pipe fittings in the fuel supply and return systems while the generator set is running and while it is stopped. **Do not use a flame to check for LPG leaks.**
- Check the flexible fuel hose sections for cuts, cracks, and abrasions.
- Make sure the fuel line is not rubbing against other parts.
- Replace worn or damaged fuel line parts before leaks occur.
- If you smell gas, close the LPG container shutoff valve and have the generator set serviced before using it again.

### 3.2.4 Battery Connections

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting harder. See Maintaining the Battery and Battery Connections (**Section 3.5**).

### 3.2.5 Mechanical

**⚠ WARNING**

***Always wear safety glasses when using compressed air, a pressure washer or a steam cleaner to avoid severe eye injury.***

- Look for mechanical damage. Start the generator set. Look, listen and feel for any unusual noises and vibrations.
- Check the generator set mounting bolts to make sure they are secure.

- Check to see that the generator set air inlet and outlet openings are not clogged with debris or blocked.
- Clean accumulated dust and dirt from the generator set. Do not clean the generator set while it is running or still hot. Protect the alternator, air cleaner, control panel, and electrical connections from water, soap and cleaning solvents.

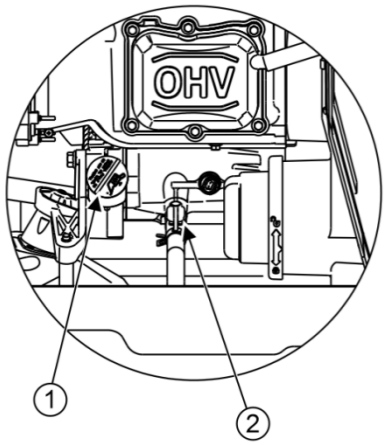
## 3.3 Checking Engine Oil Level

Park the vehicle on level ground and shut off the generator set before checking the engine oil level.

**⚠ WARNING**

***Crankcase pressure can blow hot engine oil out the fill opening causing severe burns. Always stop the generator set before removing the oil fill cap.***

1. Remove the oil fill cap and wipe oil off the dipstick as shown in the figure below.




| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Oil Fill Cap/Dipstick | 2 | Oil Drain Valve |

**FIGURE 2. OIL FILL/DIPSTICK AND DRAIN VALVE**

2. Reinsert without screwing in the dipstick. Remove the dipstick again to check oil level.
3. Add or drain oil as necessary. See Engine Oil Recommendations. Keep the oil level between the FULL and ADD marks. The oil fills slowly because it takes time for the air in the crankcase to escape. Recheck the level in a few minutes to make sure.

**⚠ CAUTION**

***Too much oil or too little load can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the Full and Add marks.***

4. Screw the oil fill cap back on securely.

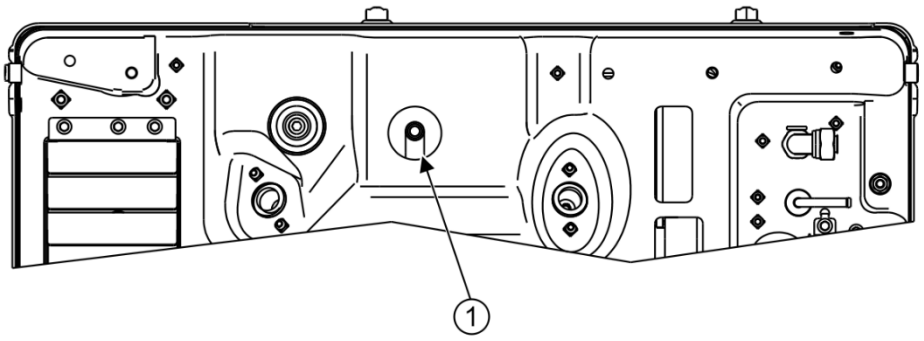
| NOTICE |
| --- |
| **Oil consumption beyond 1 ounce in 24 hours may be considered excessive for engines with greater than 400 hours of operation.** |

# 3.4 Changing Engine Oil

| ⚠ WARNING |
| --- |
| ***State and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Avoid skin contact and breathing of vapors. Use rubber gloves and wash exposed skin.*** |

Change oil more often in hot or dusty environments.

1. Place a pan underneath the oil drain hose, as shown in the figure below.




| No. | Description |
| --- | --- |
| 1 | Oil Drain Hole |

**FIGURE 3. DRAIN HOUSE (VIEW FROM BELOW THE GENERATOR SET FRONT EDGE)**

2. Run and then stop the engine when it is warm.

| ⚠ WARNING |
| --- |
| ***Crankcase pressure can blow hot engine oil out the fill opening causing severe burns. Always stop the generator set before removing the oil fill cap.*** |

3. Remove the oil fill cap.
4. Open the oil drain valve (Figure 2).
5. Let all oil drain from the engine.
6. Close the drain valve.
7. Refill with 2.7 qts (2.4 liters) of oil. See Engine Oil Recommendations. Check and add or drain oil as necessary.

**⚠ CAUTION**

***Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the Full and Add marks.***

***Oil fills very slowly. Take your time and check level often while filling. It takes time for the air in the crankcase to escape and allow oil to enter.***

8. Dispose of the used oil in accordance with local environmental regulations.

## 3.5 Maintaining the Battery and Battery Connections

**⚠ WARNING**

***Arcing at the battery terminals or light switch or other equipment or flames and sparks can ignite battery gas causing severe personal injury:***

- ***Ventilate the battery area before working on or near battery.***
- ***Wear safety glasses.***
- ***Do not smoke.***
- ***Switch the trouble light ON/OFF away from battery.***
- ***Do not disconnect battery cables while generator set is running or vehicle battery charging system is on.***
- ***Always disconnect the negative (-) cable first and reconnect it last.***

***Have the battery charging system serviced if DC system voltage is consistently low or high.***

1. Keep the battery case and terminals clean and dry, and the terminals tight.
2. Remove the battery cables with a battery terminal puller.
3. Make sure which terminal is positive (**+**) and which is negative (**-**) before making battery connections, always removing the negative (**-**) cable first and reconnecting it last to reduce arcing.

## 3.6 Replacing the Air Filter Element

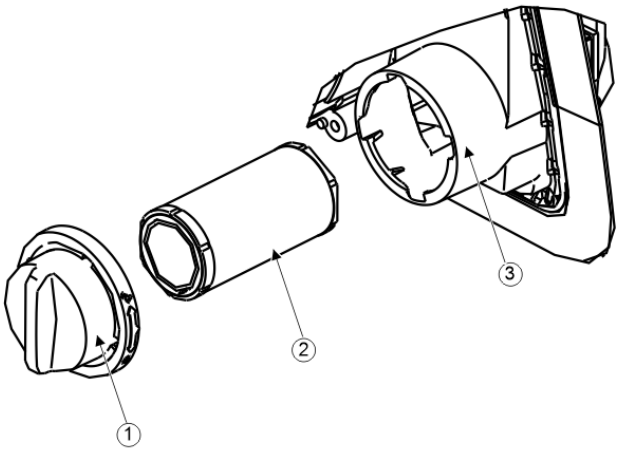
Air inflow will be affected and the power of engine will be reduced after the filter element of the air filter gets dirty. If the operation area is full of dust, the maintenance shall be conducted more frequently.

**⚠ WARNING**

***No filter cartridge or use of damaged filter cartridge may cause dusts to enter the engine and then cause the rapid erosion of the engine.***

1. Remove the front access cover.
2. Rotate and remove the air filter cover according to the instructions on the air filter.
3. Pull the air cleaner element out of the air cleaner housing.
4. Clean sealing surface of the air cleaner element and install the new air cleaner element into the housing.
5. Return the air filter cover to its original position and turn and tighten as indicated.

6. Re-install the front access cover.




| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Air Filter Cover | 3 | Air Filter Housing |
| 2 | Air Filter Element | | |

**FIGURE 4. REPLACING THE AIR FILTER ELEMENT**

# 3.7 Replacing Spark Plug

Refer to the Periodic Maintenance section for scheduled spark plug replacement. The generator set has one spark plugs, as shown in the figure below. The spark plugs must be in good condition for proper engine starting and performance. A spark plug that fouls frequently or has heavy soot deposits indicates the need for engine service. See the Troubleshooting section.

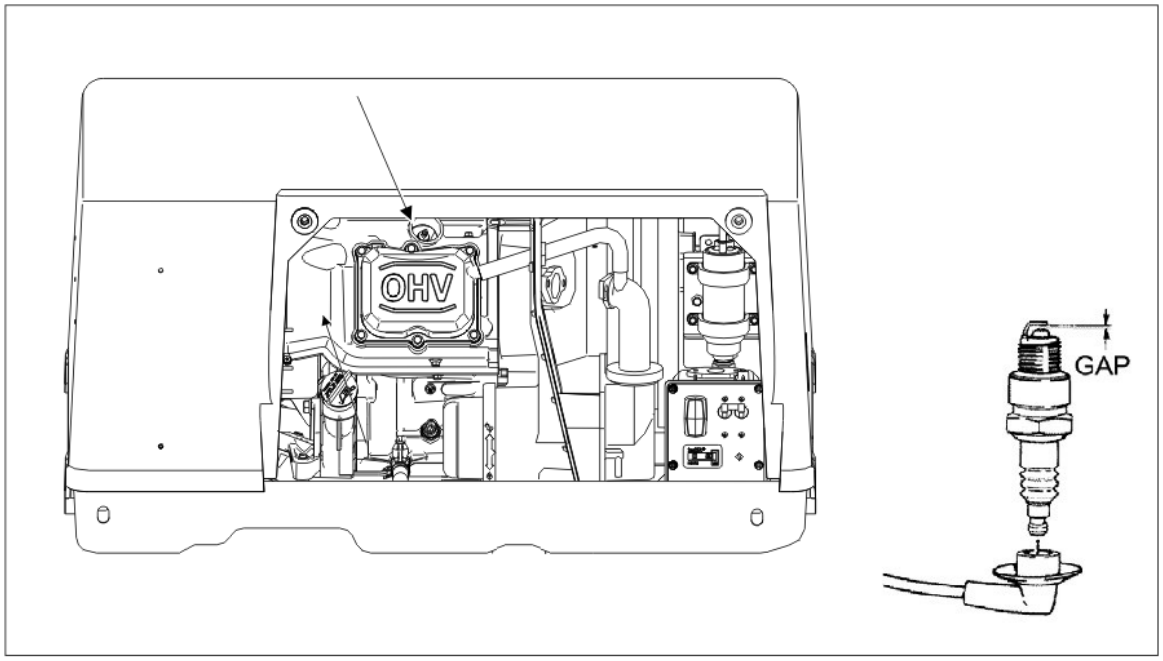



**FIGURE 5. SPARK PLUGS**

Always screw the spark plug in by hand, using a spark plug socket wrench to fully tighten the spark plug until the spark plug is pressed against the washer.

Spark plug torque: 25-30 N.m

## 3.8 Cleaning the Spark Arrestor

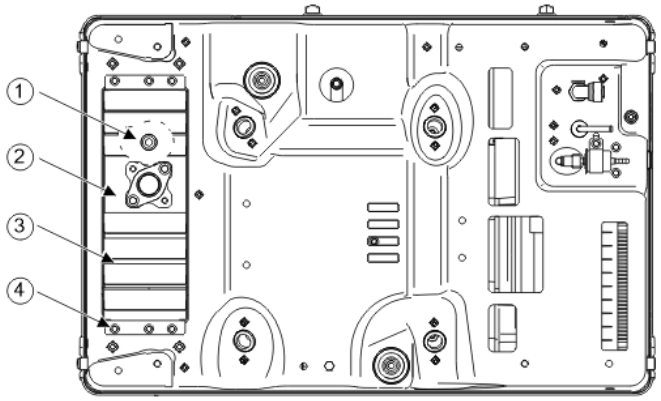
It may be necessary to clean out the spark arrester if the generator set is experiencing low power. Park the vehicle away from grass, brush or debris that could be ignited by sparks expelled during this procedure. The spark arrester meets U.S. Forest Service requirements.

**⚠ WARNING**

***A hot muffler can cause severe burns. Let the muffler cool down before removing or installing cleanout plugs or screens.***

A muffler is mounted inside the generator set. The cleanout plug is in the drum, but accessible from below, though not readily visible.

1. Remove the six screws from the blinds, then remove the blinds.
2. Remove the cleanout plug.
3. Start and load the generator set to near full power. Let the generator set run for about 5 minutes to expel the soot in the muffler.
4. Stop the generator set, allow the muffler to cool, and reinstall the plug.
5. Install the blinds back in place.




| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Cleanout plug | 3 | Blinds |
| 2 | Muffler | 4 | screws |

**FIGURE 6. SPARK ARRESTER CLEANOUT PLUG**

# 4 Preparing for Service

## 4.1 Troubleshooting

Refer to the Troubleshooting section before starting work on the generator set. Note that some problems have several possible causes.

## 4.2 Safety

There are hazards in servicing generator sets. Study *Safety Precautions* and become familiar with the hazards listed in **Table5**. Note the following safeguards and ways of avoiding hazards:

- ***Use personal protection:*** Wear appropriate protective safety equipment, such as safety shoes and safety glasses.
- Do not wear rings or jewelry and do not wear loose or damp clothing that might get caught in equipment or conduct electricity.
- ***Reduce the hazard:*** A safe, orderly workshop area and well-maintained equipment reduce the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working condition. Store flammable liquids in approved containers; away from fire, flame, spark, pilot light, switches, arc-producing equipment and other ignition sources. Keep the workshop clean and well-lighted and provide adequate ventilation.
- ***Develop safe work habits:*** Unsafe actions cause accidents with tools and machines. Be familiar with the equipment and know how to use it safely. Use the correct tool for the job and check its condition before starting. Comply with the warnings in this manual and take special precautions when working around electrical equipment. Do not work alone if possible and take no risks.
- ***Be prepared for an accident:*** Keep fire extinguishers and safety equipment nearby. Agencies such as the Red Cross and public safety departments offer courses in first aid, CPR and fire control. Take advantage of this information to be ready to respond to an accident. Learn to be safety-conscious and make safety procedures part of the work routine.

**TABLE 5. HAZARDS AND THEIR SOURCES**

| Hazard | Sources |
|---|---|
| Fire and Explosion | • Leaking or spilled fuel<br>• Hydrogen gas from battery<br>• Oily rags improperly stored<br>• Flammable liquids improperly stored |
| Burns | • Hot exhaust pipes<br>• Hot engine and generator surfaces<br>• Electrical shorts |
| Poisonous Gas | • Operating generator set where exhaust gases can accumulate |
| Electrical Shock (AC) | • Improper generator connections<br>• Faulty wiring<br>• Working in damp conditions<br>• Jewelry touching electrical components |
| Rotating Machinery | • Fan guards not in place |

| Hazard | Sources |
|---|---|
| Slippery Surfaces | • Leaking or spilled oil |
| Heavy Objects | • Removing generator set from vehicle<br>• Removing heavy components |

# 4.3 Special Tools

The following tools are required to service the generator set:

## 4.3.1 Engine Tools

- Torque wrench (0-111 lb-ft or 0-150 Nm)
- Inline spark tester
- Feeler gauge
- Leak down tester
- Spark plug gap gauge
- Cylinder compression tester
- Flywheel puller
- Cylinder compression tester
- Snap ring pliers
- Outside micrometer set (1-4 in)
- Telescoping gauge set (0.500-4.000 in)

## 4.3.2 Alternator Tools

- DVOM multi-tester
- Frequency meter
- OBD fault diagnosis instrument

# 4.4 Remove and Install the Generator Set

## 4.4.1 Removing the Generator Set Overview

Due to the wide variety of installations, it is not possible to provide specific procedures for removal. Contact the coach manufacturer or installer for their recommendations if it is unclear how the generator set is to be removed.

- **Below-Floor Mounting:**
  - Four M10x1.5, length 20mm bolts into the ends or bottom of the base (Figure 7) are used to secure the generator set to special brackets from the vehicle floor, frame, or to frame members underneath (Figure 7).
  - The area above the generator set should have a vapor-tight, fire-resistive barrier between the generator set and coach interior.
- **Above-Floor, Compartment Mounting:**
  - Four M10x1.5, length 20mm bolts into the bottom of the base (Figure 7) are used to secure the generator set to the floor of the compartment.
  - The compartment should have a vapor-tight, fire-resistive barrier that seals off the generator set from the coach interior.

## 4.4.2 Disconnecting the Generator Set

Disconnect battery, wiring, exhaust and fuel connections as follows before removing the generator set.

1. Disconnect all battery cables, negative (-) cable first, at the battery terminals.

> **⚠ WARNING**
>
> ***Arcing at battery terminals or light switch or other equipment or flames and sparks can ignite battery gas causing severe personal injury.***
>
> - ***Ventilate battery area before working on or near battery.***
> - ***Wear safety glasses.***
> - ***Do not smoke.***
> - ***Switch trouble light ON/OFF away from battery.***
> - ***Do not disconnect battery cables while the generator set is running or the vehicle battery charging system is on.***
> - ***Always disconnect the negative (-) cable first and reconnect it last.***

2. Disconnect the negative (-) and positive (+) battery cables at the generator set.
3. Disconnect the wiring connectors for remote control.
4. Disconnect the generator AC output wires and conduit from the junction box on the vehicle.
5. Disconnect the exhaust tail pipe.
6. Gasoline-fueled:
   a. Disconnect the fuel line(s) from the generator set.
   b. Securely plug the end of the fuel line to prevent leakage or an accumulation of explosive gasoline vapor.

7. **LPG-fueled:**
    a. Close the fuel shutoff valve(s) at the LPG container(s).
    b. Move the vehicle outside and away from below-grade spaces where LPG could accumulate.
    c. To purge most of the LPG from the fuel line and generator set, run the generator set (if it starts) until it runs out of fuel (LPG container valve closed).
    d. Disconnect the fuel line from the generator set.
    e. Plug the end of the hose to prevent fuel from escaping if someone inadvertently opens the shutoff valve(s) at the LPG container(s).

> **⚠ WARNING**
>
> ***Gasoline and LPG (liquefied petroleum gas) are flammable and explosive and can cause severe personal injury or death.***
>
> - ***Do not smoke.***
> - ***Keep flames, sparks, pilot lights, arc-producing and switching equipment, and all other sources of ignition away from the fuel tank and system, and areas sharing ventilation. Have an ABC fire extinguisher handy.***

> **⚠ WARNING**
>
> ***LPG is flammable and explosive and can cause asphyxiation. NFPA 58, Section 1.6 requires all persons handling LPG to be trained in proper handling and operating procedures.***
>
> ***LPG "sinks" and can accumulate in explosive concentrations. Before disconnecting the LPG fuel line, close the fuel shutoff valve(s) at the LPG container(s) and move the vehicle outside and away from pits, basements, and other below-grade spaces where LPG could accumulate.***

## 4.4.3 Removing the Generator Set

1. Park the vehicle on a level surface.
2. Put the transmission in PARK.
3. Lock the brakes.
4. Remove the ignition key. Do **not** move the vehicle during this procedure.

> **⚠ CAUTION**
>
> ***The underside of the generator set can be damaged by protruding objects. Always rest the generator set on a flat surface that has been cleared off. Always extend the lifting arms of a forklift beyond the base of the generator set to prevent them from protruding into the underside cover.***

Figure 7 illustrates the four lift-hook slots for generator set lifting. A lifting rig must spread the hook straps such that they do not crush or bend parts such as the control box, air filter and fuel lines while lifting. See the Specifications section regarding the weight of the generator set and make provisions accordingly for safe handling.

| ⚠ CAUTION |
| --- |
| ***Avoid tipping the front (service side) down while handling the generator set. Otherwise, engine oil could drain into and soak the air filter and cause hard starting and poor operation unless the filter is replaced.*** |

## 4.4.4 Installing the Generator Set

Generally, installation is the reverse of removal. Before installing the generator set, repair any damage to and seal all holes in the vapor-tight, fire-resistive barrier between the generator set and coach interior. Make sure all mounting bolts and brackets are secure and that all battery, AC output, control, exhaust, and fuel connections are proper and in good repair. Perform the service checklist before placing the generator set in service

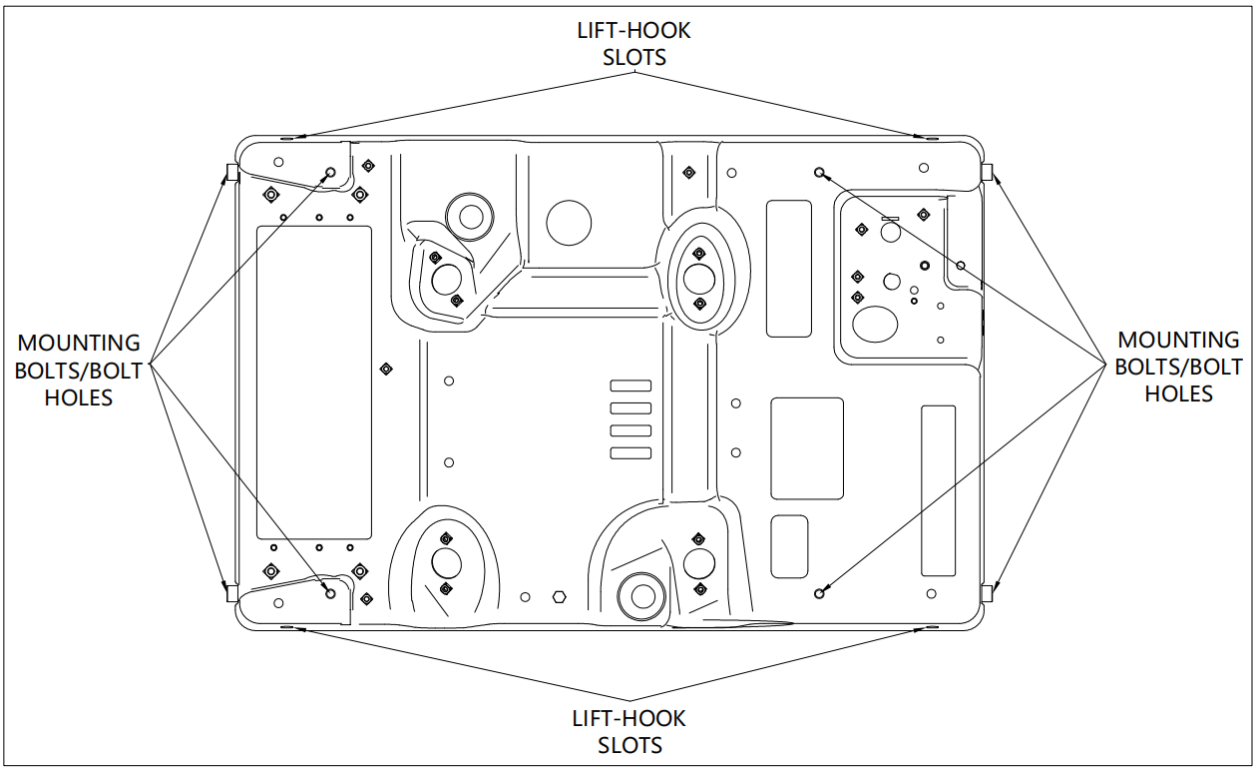



**FIGURE 7. GENERATOR SET LIFT-HOOK SLOTS (MOUNTING BOLT HOLES)**

# 4.5 Generator set housing

## 4.5.1 Disassembly

1.Rotate to open the two side cover locks and pull out the generator maintenance cover.

2.Remove the four mounting bolts to the frame base plate and remove the generator housing.

## 4.5.2 Installation

1.Do the reverse of the removal procedure, as shown in the removal section.

2. When installing, the sealing strip is around the bottom plate, and the edge is completely stuck in the groove. The opening of the sealing strip is located at both ends of the gas valve installation hole.

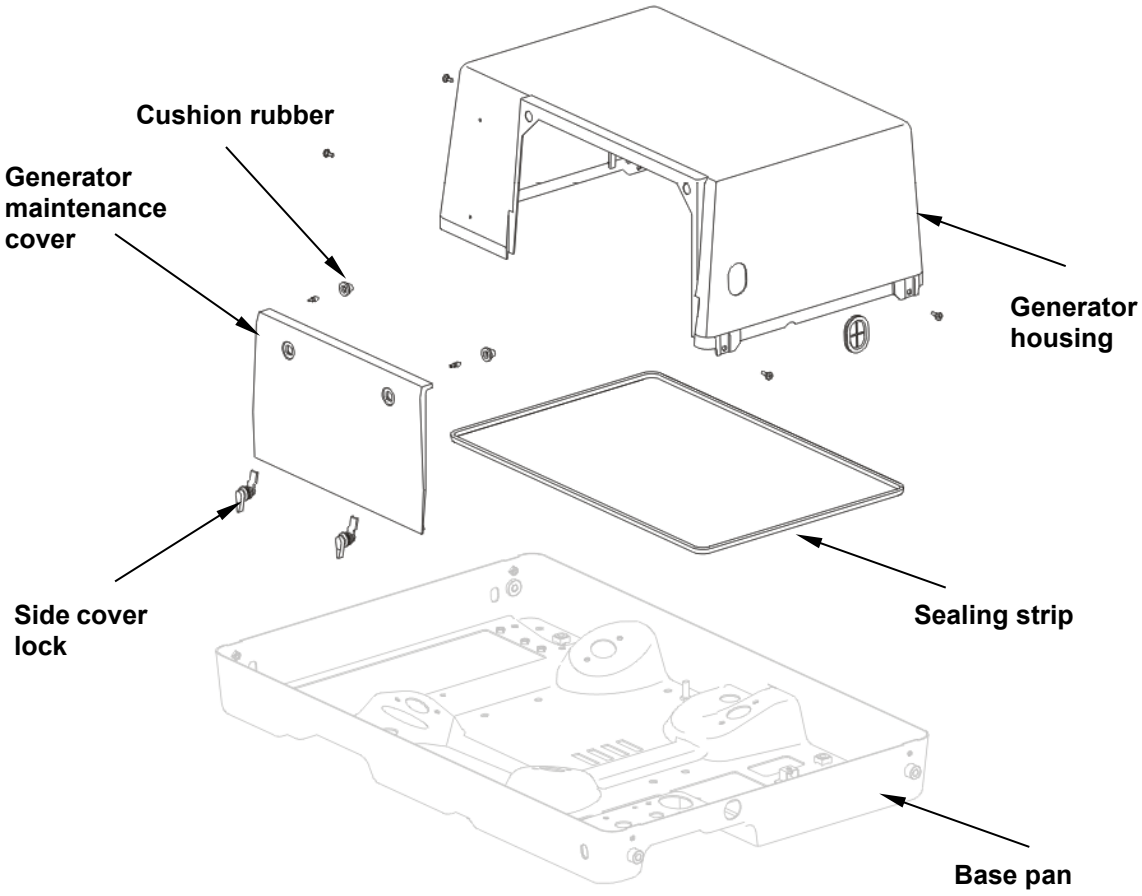



**FIGURE8. GENERATOR SET HOUSING**

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# 5 Control

## 5.1 Controller

Controller is an integrated microcontroller-based engine and generator set control . It provides all the control, monitoring and diagnostic functions required to operate the generator set. All connections to the controller are through connector on the side of the controller. Refer to the appropriate wiring diagrams and wiring harness drawings.

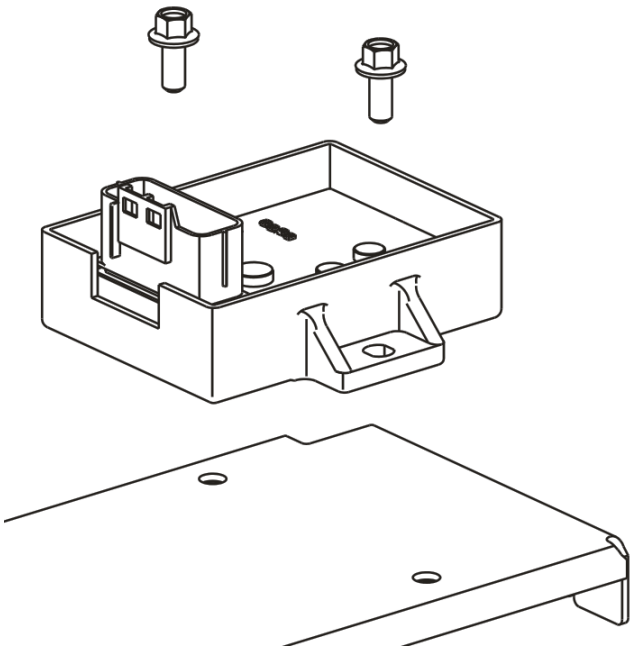


**FIGURE 9. CONTROLLER**

### 5.1.1 Major Functions of Controller

The figure below is a block diagram of controller functions.

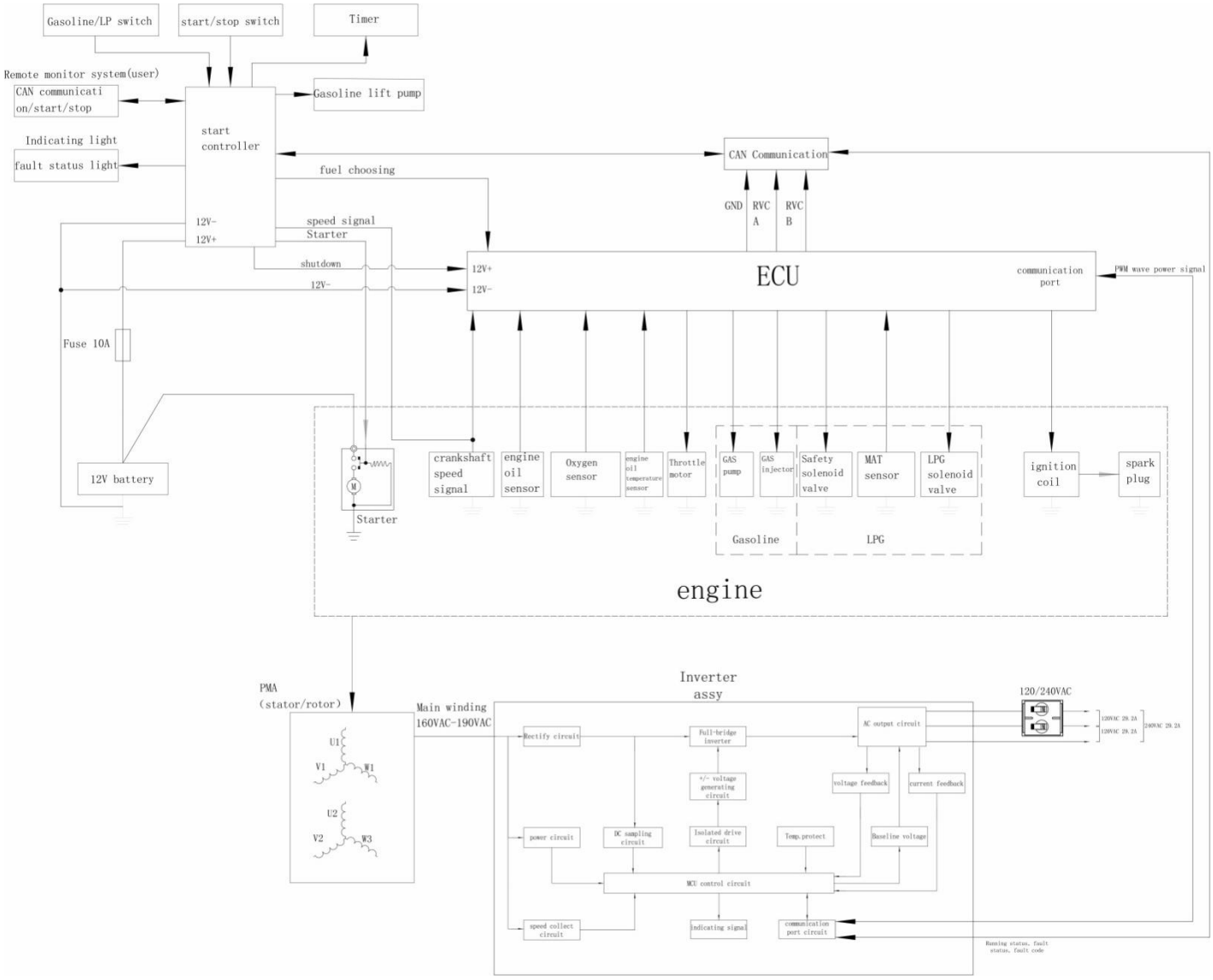



**FIGURE 10. CONTROLLER BLOCK DIAGRAM**

**Initialization:** Control initialization consists of checking memory (RAM, ROM, EEPROM) and generator set configuration.

**Fuel Prime (Gasoline Generator Sets):** Press and hold the stop switch for more than 3 seconds for lift pump to prime the fuel system.

**Startup:** Press and hold the start switch until the generator set starts. The controller:

1. ECU、The petrol pump is powered on.
2. The lift pump act for 1 second, and then start motor act after another 1 second.
3. The status indicator blinks at startup.
4. When the engine speed is detected to be greater than 1000 RPM at startup, turn off the output of the starting relay, make the status indicator light on, and turn on the timer function.

**Stop: Press the stop switch momentarily. The controller:**

1. Stop the power supply ECU.
2. Turn off the status indicator.

3. Writes session data (last fault, etc.) to non-volatile memory (NVM).
4. Sleeping mode after 5 minutes after power on for ECU but no other action Or shut down genset.

### 5.1.2 Controller Removal/Replacement

**Disassembly**

1.Remove the generator housing.

2.Remove the connector on the controller and the main cable by hand.

3.Remove the bolts connected with the fixed support bracket and remove the controller.

**Installation**

Reverse the removal procedure, as shown in the removal section.

### 5.1.3 Controller Inspection

When the power supply voltage exceeds 20±1V and continue for 5 seconds, fault 29 is reported. When the power supply voltage exceeds 22±1V, the module is over-voltage protected, and all outputs of the module are closed, shut down genset and need to reduce battery voltage to specification.

When the power is on, the indicator light on the controller will always be on, indicating that it is normal, otherwise it is abnormal.

## 5.2 Control Panel

The control panel components include a start-stop switch, a circuit breaker, a timer and a fuel transfer switch.

**Disassembly**

1.Remove the four screws and move the control panel assembly outward.

2.Disconnect the cable from the control panel and remove the control panel.

3.Remove the rear cover of the panel and the fixed support frame.

**Installation**

Reverse the removal procedure, as shown in the removal section.

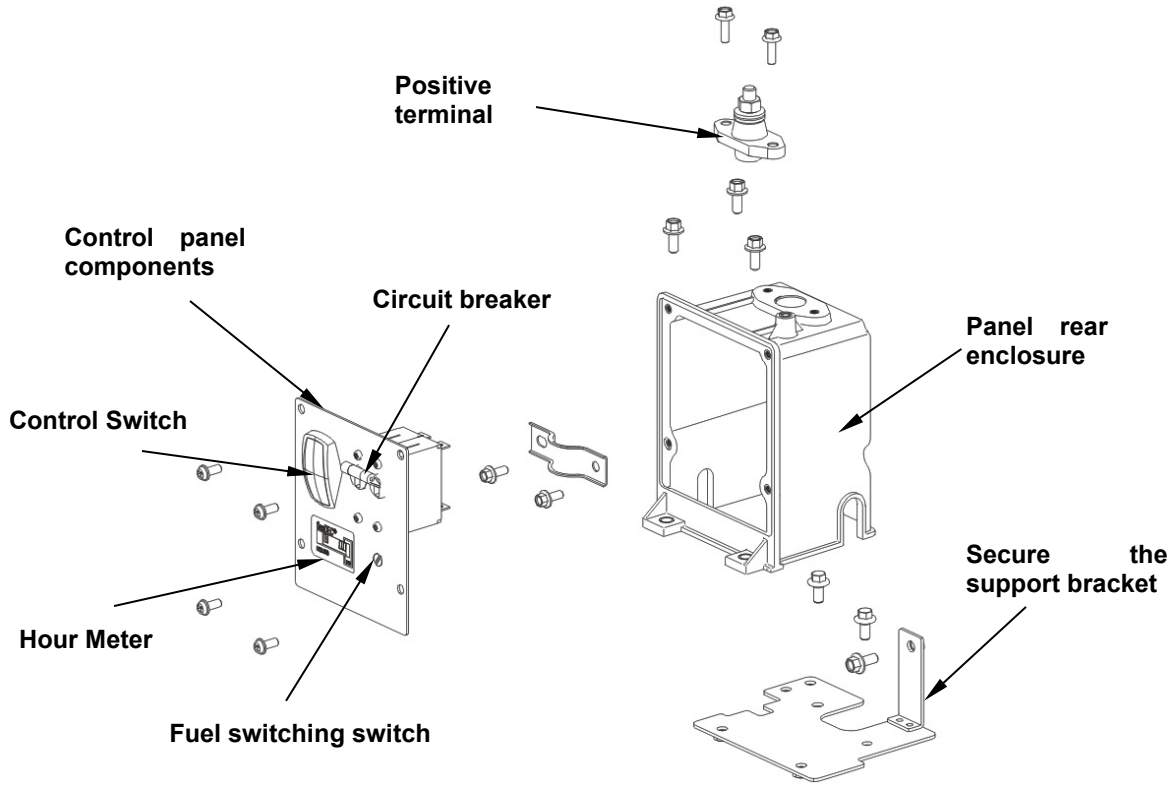
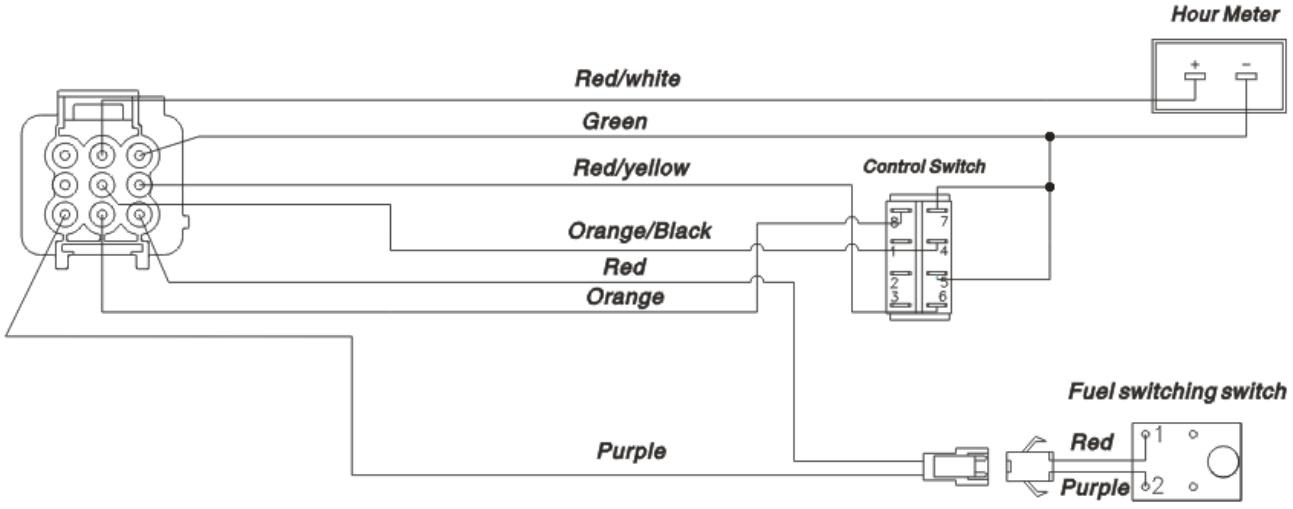



**FIGURE 11. CONTROL PANEL**




*Switch connection*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| *STOP* | ○ | —○ | | ○ | —○ | | | |
| *Mid-levelposition* | | | | | | | | |
| *START* | | ○ | —○ | | ○ | —○ | | |
| *Indicatolight(red)* | | | | | | | 12V- | 12V+ |

*Fuel switching switch*

| | 1 | 2 |
|---|---|---|
| *LPG* | ○ | —○ |
| *GAS* | | |

**FIGURE 12. CONTROL PANEL WIRING DIAGRAM**

## 5.2.1 Control Switch

The position of the start control switch is shown in the Figure 11 and Figure 12.

The switch can be pressed and reset flexibly without clamping stagnation. The contacts are in good contact.

Use a multimeter to check the continuity of the switch terminal at each position of the switch:

When the switch is in the STOP position, 1 is connected to 2 and 4 is connected to 5

When the switch is in the middle position, the lines are not connected

When the switch is in the START position, 2 is connected to 3 and 5 is connected to 6

Otherwise, replace the start control switch

## 5.2.2 Fuel transfer switch

The position of the fuel change-over switch is as shown in Figure 11 and Figure 12..

Disconnect the connecting plug and check the continuity between the terminals with a multimeter:

When the fuel switch is in the LGP position, 1 and 2 are connected;

When the fuel switch is in the GAS position, 1 and 2 are not connected;

Otherwise, replace the fuel switch position.

## 5.2.3 Hour Meter

The position of the timer is shown in Figure 11 and Figure 12, and the operating voltage range is 12 AC/DC to 270 AC/DC.

No display: check whether the circuit and plug are not connected;

If the display is garbled, inaccurate, and the timing error is greater than ± 0.1 hour/100 hours, replace the timer

## 5.2.4 Line Circuit Breakers

The line circuit breaker is located as shown.

1. Disconnect all wiring.
2. Check electrical resistance across the terminals of the circuit breaker.
3. Replace a circuit breaker that does not:
    - Reset, or
    - Close or open as the handle is turned ON and OFF.

# 5.3 Inverter components

The operation of the engine drives the motor components to output three-phase alternating current, which is converted into smooth direct current through the Inverter, and then stable alternating current is output through the relevant modules in the Inverter. The Inverter has the functions of short circuit, overload, over-temperature protection, etc.

**Disassembly**

1.Disconnect the connectors on the ECU and controller connectors by hand.

2.Remove the fixing bolts, ECU and controller

3.Remove the relevant fastening bolts, and remove the fixed support frame, Inverter mounting bracket, air deflector, etc.

4.Remove the input and output terminal connecting wires and communication interfaces of the Inverter, and remove the Inverter components.

**Installation**

Reverse the removal procedure, as shown in the removal section.

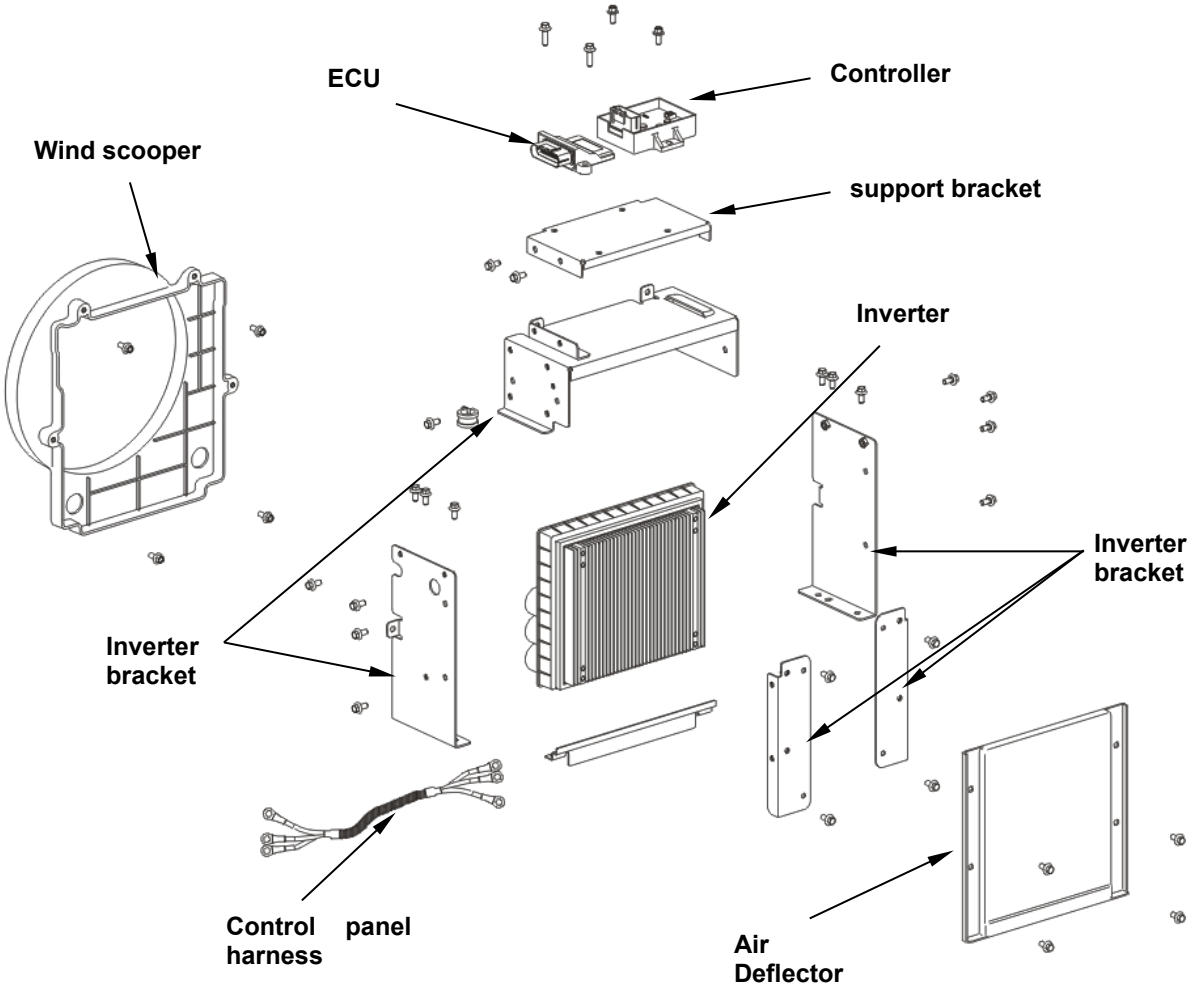



**FIGURE 13. INVERTER COMPONENTS**

**Test:**

Check that there is no color change on the wire on the Inverter, and there is no blister bulge on the resin filled on the Inverter. Check all electrical components on the Inverter.

There is no visible color change or damage to the connectors and wiring.

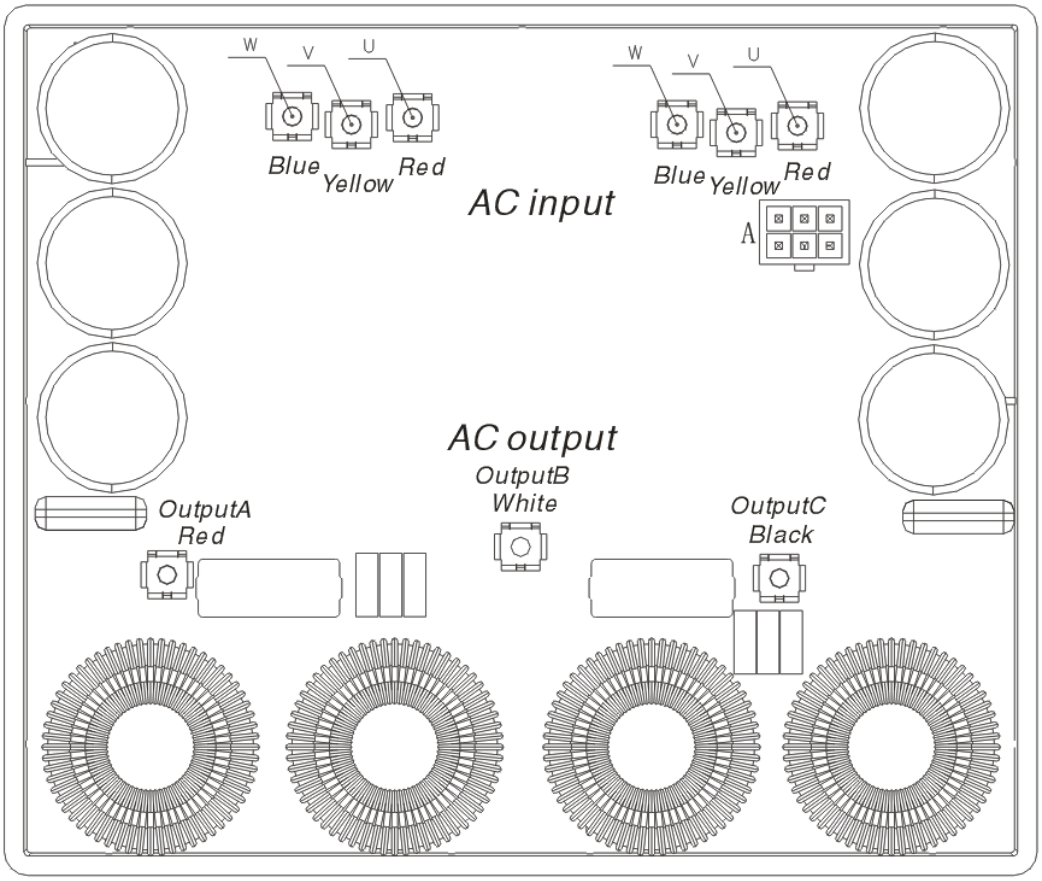



**FIGURE 14. INVERTER**

**Main parameters:**

1. Output voltage: AC 121V ± 0.5V (no-load), AC120V ± 0.5V (rated resistive load)
   AC 242V ± 0.5V (no load), AC 240V ± 0.5V (rated resistive load)
2. Rated output frequency: 60Hz ± 0.25HZ.
3. Rated output power: 7200VA Peak power: 9200 VA
4. Rated output current: 120V output (A-B): I/N = 30A
5. At 120 V output (B-C): I/N = 30A
6. 240 V output (A-C): I/N = 30A
7. Waveform distortion: under rated power, resistive load ≤ 2%, inductive and capacitive load of 0.8 power factor ≤ 3%, nonlinear load ≤ 6%

**Test:**

Check that there is no problem with the AC output of the motor components, and the output parameters of the Inverter are inconsistent. Replace the Inverter.

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# 6 Exhaust System

The generator set exhaust system must be gas-tight and prevent entry of exhaust gases into the vehicle interior.

**⚠ WARNING**

***Exhaust Gas Is Deadly***

***Keep exhaust gases from entering the vehicle. Do not terminate the exhaust tail pipe underneath the vehicle or closer than 6 inches (153 mm) to openings into the vehicle. Route the exhaust system such that it is protected from damage. Use approved materials only.***

## 6.1 Muffler, exhaust pipe

The muffler is a spark arrester type muffler that is US Forest Service Approved and meets code requirements. Failure to provide and maintain a spark arrester muffler can be in violation of the law. Contact a distributor for approved replacement exhaust parts.

**⚠ CAUTION**

***Unauthorized modifications or replacement of fuel exhaust, air intake, or speed control system components that affect engine emissions are prohibited by law.***

### 6.1.1 Disassembly

1. The muffler can be removed by removing the generator housing.
2. Remove 2 silencer and exhaust pipe bolts, and remove the silencer gasket.
3. Remove 4 mounting bolts of the muffler and the frame base plate, and take out the muffler from above.
4. Remove 2 connecting nuts between the exhaust pipe and the engine cylinder head, and remove the exhaust pipe and the muffler gasket.
5. Remove the mounting bolts of the muffler heat shield and the frame base plate, and remove the muffler heat shield.
6. Remove the 4 connecting bolts with the louver from the bottom plate of the rack, and remove the louver.
7. If necessary, remove the oxygen sensor from the exhaust pipe; remove the exhaust pipe from the muffler.

### 6.1.2 Installation

1. Reverse the removal procedure as shown in the removal section.
2. Replace the muffler gasket and exhaust port gasket with new ones during reinstallation.
3. Install the oxygen sensor at the corresponding position of the exhaust pipe. Torque: 18-22 N.m.
4. The damaged or deformed wind scooper and sealing strip shall be replaced immediately.

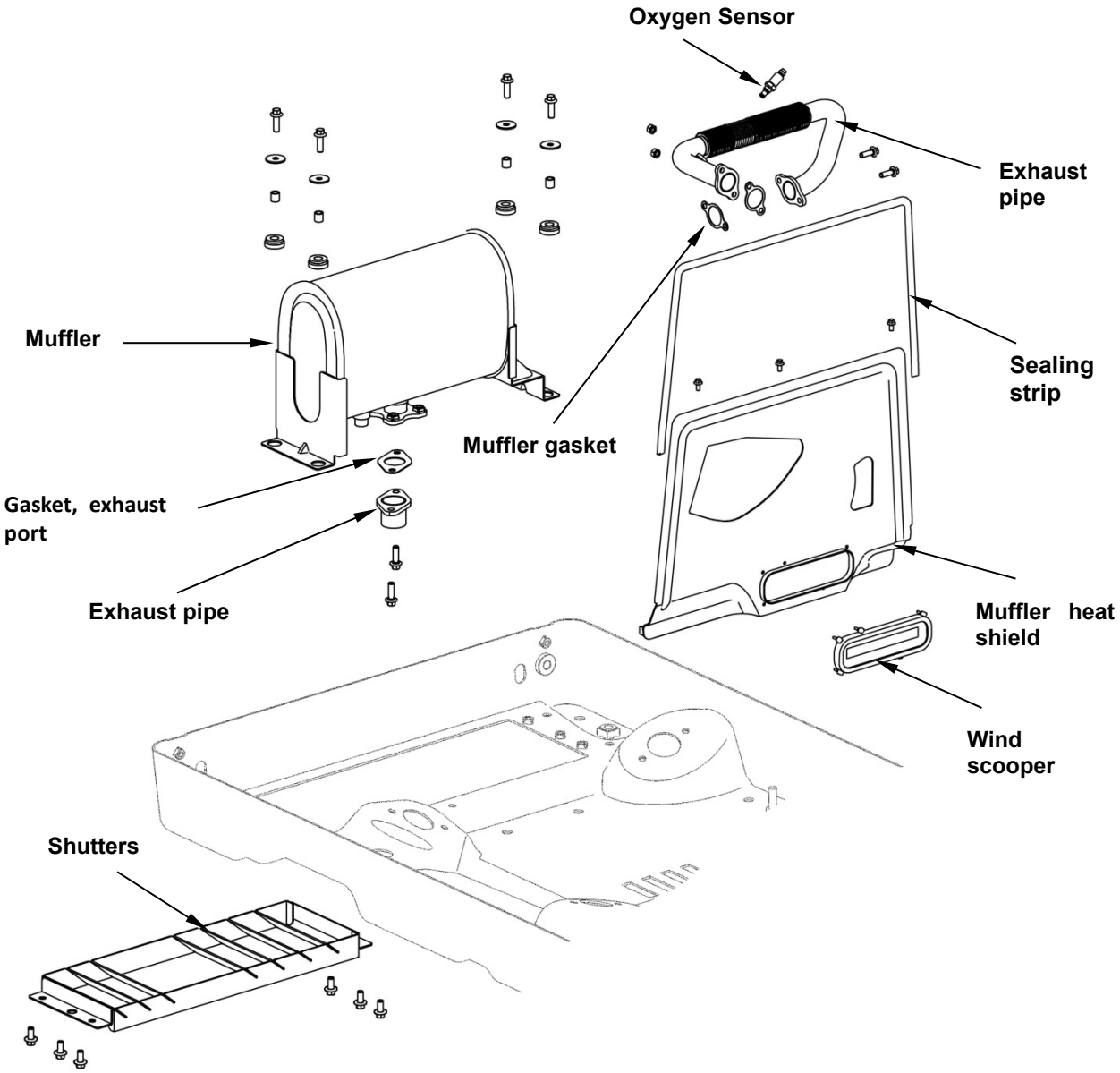



**FIGURE 15. EXHAUST SYSTEM**

## 6.2 Oxygen Sensor

Function: Collect the oxygen concentration signal in the engine exhaust

Inspection: Run the engine, when oxygen sensor fault code appears, first check whether the line connection is proper, see Chapter 10 fault code 85

## 6.3 Catalytic Converter

The catalytic converter employed in this system is a three-way, stainless steels honeycomb-type converter. A three-way converter has the following purposes:

- It reduces nitrous oxides into nitrogen and oxygen.
- It oxidizes unburned hydrocarbons and carbon monoxide into water and carbon dioxide.
- The stainless steels core allows for more versatility and prevents cracking as seen in ceramic type converters.

If the converter becomes clogged or coated with carbon, lead or oil, then the converter's efficiently is greatly reduced.

## 6.4 Tailpipe Installation

**⚠ WARNING**

***Beginning with Spec A EPA Phase 3 and CARB Tier 3 product incorporates a catalyst exhaust system which leads to subsequent higher exhaust gas temperatures and higher cooling air outlet temperatures. Due to these higher exhaust gas temperatures and higher cooling air outlet temperatures, the installer must review and follow all guidelines for the installation. Care must be taken to ensure that all installation requirements are met in Installation Review and Startup.***

The muffler is mounted inside the generator set and has a flange to which the tailpipe adapter (available from Manufacturer) is bolted or a collar to which the tailpipe is clamped or a short adapter bolted to its outlet flange.

**⚠ WARNING**

***Flexible pipe is not gas tight or durable and can cause exhaust gas leaks. Do not use flexible pipe for tailpipe.***

1. Use 18-gauge 1-3/8 inch ID aluminized steel tubing or material of equivalent heat and corrosion resistance for the tailpipe.
2. Support a tailpipe longer than 457 mm (1-1/2 ft) near its end and at intervals of 900 mm (3 ft) or less. Use automotive-type tailpipe hangers. Do not attach the hangers to combustible material such as wood.
3. Use U-bolt muffler clamps to connect sections of tailpipe. Overlapping pipe should be slotted.
4. Do not route the tailpipe closer than 114.3 mm (4.5 in) to fuel lines or fuel tanks.
5. Do not route the tailpipe closer than 76 mm (3 in) to combustible material (wood, felt, cotton, organic

fibers, etc.) unless it is insulated or shielded. The temperature rise (above ambient) on adjacent combustible material must not exceed 65 °C (117 °F).

6. Do not route the exhaust tailpipe underneath the oil drain.
7. Do not route the exhaust tailpipe under the air inlet, or in a way that it will restrict the air inlet/outlet.
8. To keep the tailpipe from being damaged, do not route it such that it protrudes into the approach or departure angles of the vehicle or below the axle clearance line.
9. Do not interconnect generator set and vehicle engine exhaust systems.
10. Do not terminate the tailpipe underneath the vehicle. Extend it a minimum of 25 mm (1 in) beyond the perimeter of the vehicle. Support the end of the tailpipe such that it cannot be pushed in and up under the skirt of the vehicle.
11. Do not terminate the tailpipe such that it is closer than 153 mm (6 in) to any opening, such as a door, window, vent, or unsealed compartment into the vehicle interior.

| ⚠ CAUTION |
| --- |
| ***Excessive back pressure can cause loss of performance and engine damage.*** |

12. Make sure the tailpipe system will not cause excessive back pressure. Exhaust back pressure cannot exceed 6 to 8 inches of water column (1/3 psi). Pressure is measured in the rear muffler outlet flange. measure the difference of the water in the water column. This difference should be 6 to 8 inches (1/3 psi).

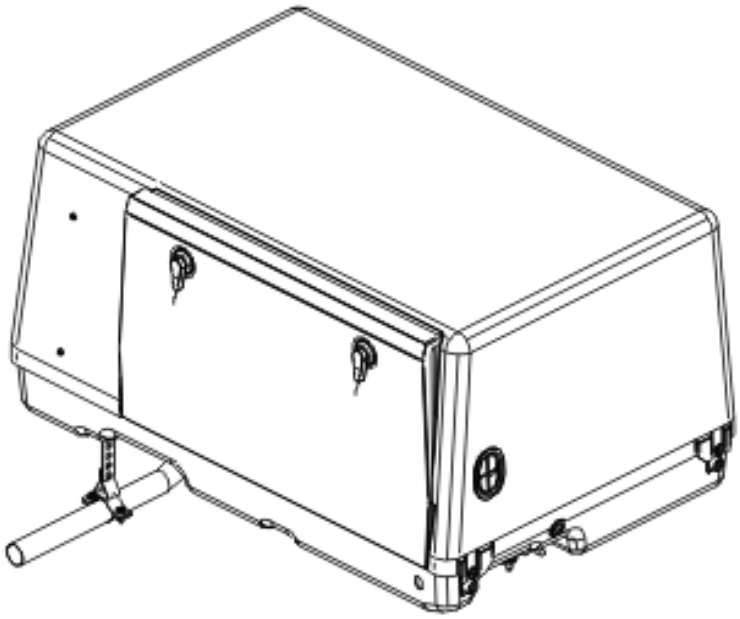


**FIGURE 16. TYPICAL TAILPIPE INSTALLATION**

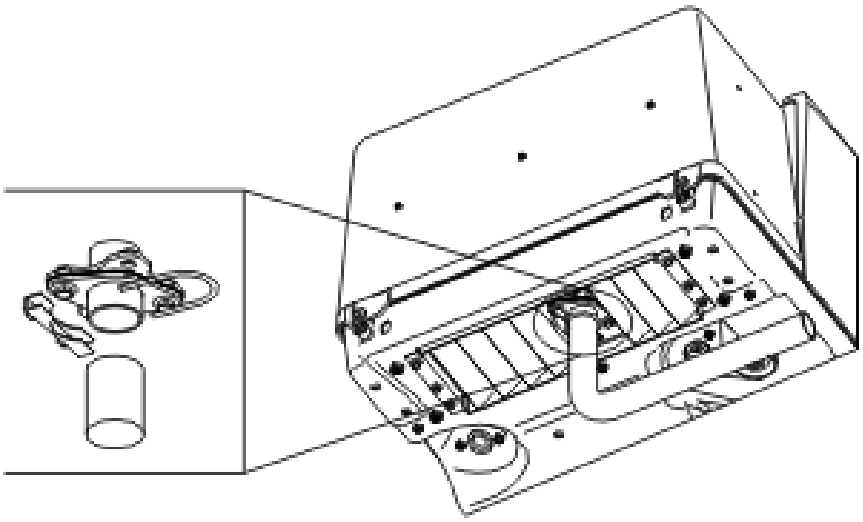
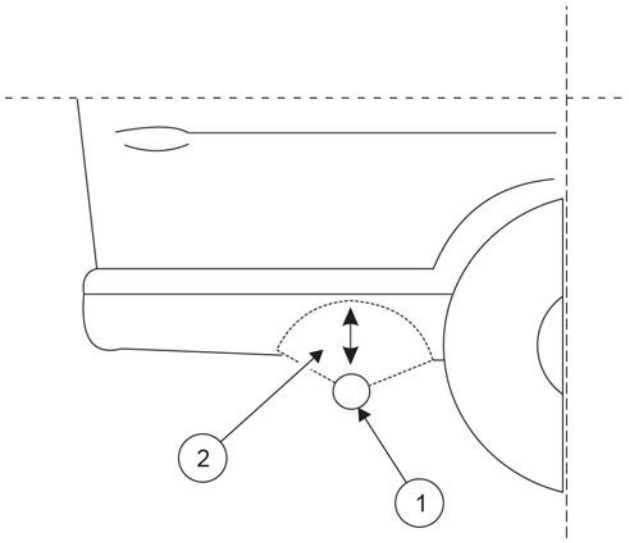
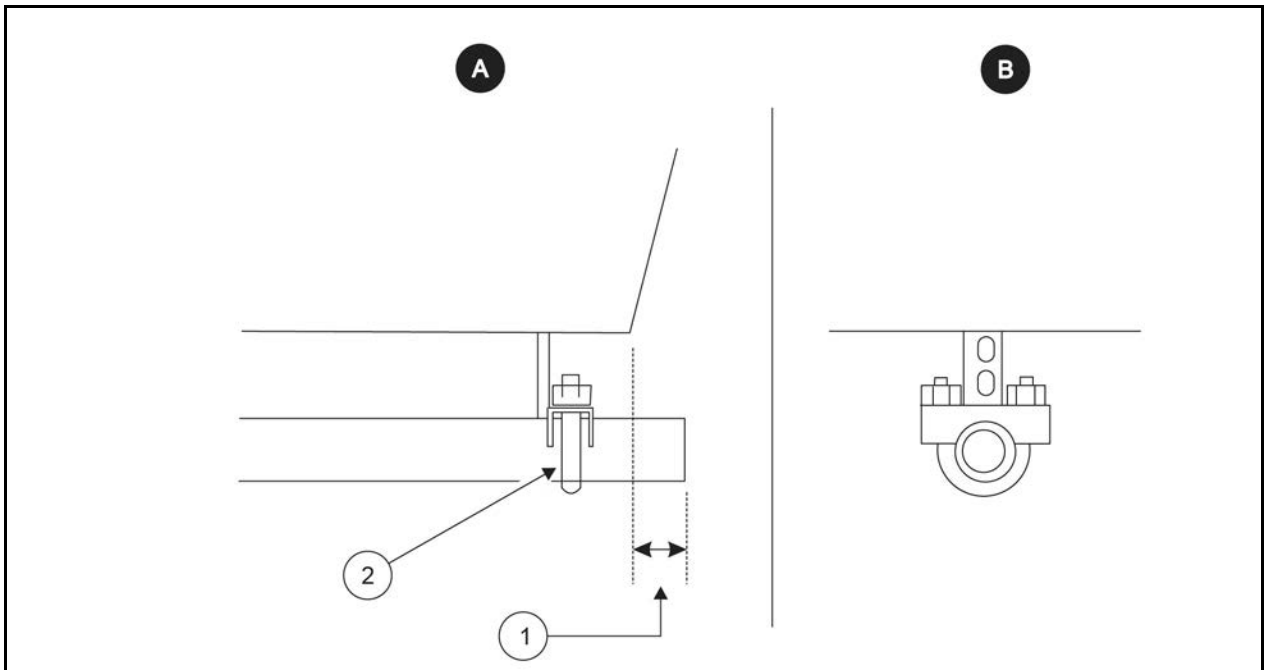


**FIGURE 17. EXHAUST TAILPIPE CONNECTIONS**




| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Tailpipe | 2 | 153 mm (6 in) |
| No opening into the vehicle interior may be closer than 153 mm (6 in) to the end of the tail pipe (within area 2, identified in this image). | | | |

**FIGURE 18. MINIMUM DISTANCES TO OPENINGS**




| No. | Description | No. | Description |
|---|---|---|---|
| A | Side view | 1 | 25 mm (1 inch) |
| B | Straight-on view | 2 | The last tailpipe hanger must be as close to the end as possible. |

**FIGURE 19. TERMINATING THE EXHAUST TAILPIPE**

## 6.5 Hot Air Recirculation Test

**⚠ WARNING**

***This product incorporates a catalyst exhaust system which leads to higher exhaust gas temperatures and higher cooling air outlet temperatures. The installer must review and follow all guidelines for the installation. Care must be taken to make sure that all installation requirements in this entire manual are met.***

A representative installation of the generator set must be tested to determine that the generator set will not overheat due to recirculation of hot air back into the generator set.

### 6.5.1 Test Method

**⚠ WARNING**

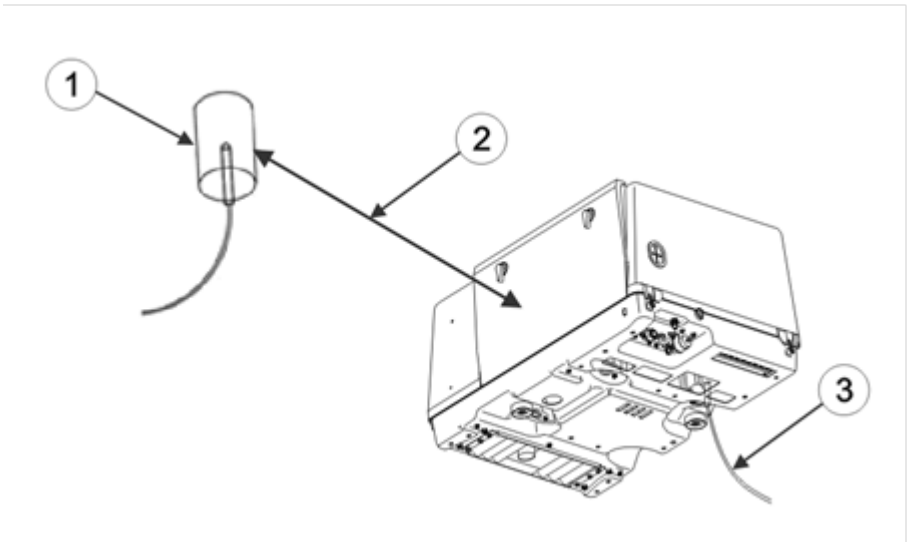
***EXHAUST GAS IS DEADLY! Do not operate the generator set when the vehicle is parked indoors or where exhaust can accumulate.***

1. Complete a representative installation.
2. Set up a load bank to run the generator set at rated full load.

3. Conduct the test at a location where the ambient air temperature will remain between 16 °C and 38 °C (60 °F and 100 °F).
4. Measure temperatures with thermocouples not heavier than 0.21 $mm^2$ (24 AWG).
    a. Measure generator set inlet air temperature with one thermocouple tied in the middle of the inlet air grille.
    b. Measure ambient air temperature with a shielded thermocouple within 1.2 m (4 ft) of the generator set and approximately the same height. Make sure the thermocouple will not be affected by warm air discharged from the generator set or by sunlight. Use 50.8 mm (2 in) diameter white PVC piping at least 152.4 mm (6 in) long as a thermocouple shield.
5. Close all compartment doors and run the generator set at full load for at least an hour. Record temperatures at 15 minute intervals until they stabilize. Temperature is considered stable when there is no change in 3 consecutive readings. The following table illustrates how the data can be arranged for recording and analysis.

**TABLE 6. TEMPERATURE DATA**

| THERMOCOUPLE LOCATION | TEMPERATURE °C (°F) | | | | |
|---|---|---|---|---|---|
| | Time of Reading | | | | |
| | | | | | |
| AMBIENT AIR | | | | | |
| INLET AIR | | | | | |




| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Ambient Air | 3 | Inlet Air |
| 2 | 1.2 m (4 ft) | | |

**FIGURE 20. THERMOCOUPLE LOCATIONS FOR HOT AIR RECIRCULATION TEST**

## 6.5.2 Test Results

Ideally, the air intake temperature should be as close to ambient as possible in all modes of operation: driving, parked, propulsion engine running and propulsion engine off.

- An installation with temperature rise over ambient exceeding 15 °C (27 °F) must be repaired/modified. These conditions will cause the generator set to have poor performance and accelerated wear.
- An installation with 10 °C – 15 °C (18 °F – 27 °F) rise over ambient will likely experience heat related issues including accelerated wear and possible fueling issues.
- An installation with 5 °C – 10 °C (9 °F – 18 °F) rise over ambient may not operate as intended in extremely warm conditions or at high loads.
- An installation with 0 °C – 5 °C (0 °F – 9 °F) rise over ambient should perform well in most conditions.

Other environmental effects (wind, parking location, location of obstructions near the generator set) can create undesirable performance due to temperature. This should be taken into consideration when installing the generator set with intent for common usage patterns.

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# 7 Fuel System

The electronic fuel injection system takes the electronic control unit (ECU) as the control center, uses various sensors installed on different parts of the engine to measure various working parameters of the engine, and accurately controls fuel injection, ignition and air intake through the set control program and calibration data, so that the engine can run smoothly under various working conditions. It meets the requirements of output power, low fuel consumption and guaranteed emission.

## 7.1 Gasoline Fuel System

See the operator manual for recommended fuels and the Specifications section for fuel consumption rates.

**⚠ WARNING**

***Gasoline is flammable and explosive and can cause severe personal injury or death — Do not smoke — Keep flames, sparks, pilot lights, switches, arc-producing equipment and all other ignition sources away from fuel, fuel components and areas sharing ventilation — Keep an ABC fire extinguisher handy.***

**⚠ CAUTION**

***Unauthorized modifications or replacement of fuel, exhaust, air intake or speed control system components that affect engine emissions are prohibited by law in the State of California.***

## 7.2 LPG Fuel System

**⚠ WARNING**

***LPG is flammable and explosive and can cause severe personal injury or death.***

- ***Do not smoke.***
- ***Keep flames, sparks, pilot lights, switches, arc-producing equipment and all other ignition sources away from fuel, fuel components and areas sharing ventilation.***
- ***Keep an ABC fire extinguisher handy.***

**⚠ WARNING**

***NFPA 58, Section 1.6 requires all persons handling LPG to be trained in proper handling and operating procedures.***

**⚠ CAUTION**

***Unauthorized modifications or replacement of fuel, exhaust, air intake or speed control system components that affect engine emissions are prohibited by law in the State of California.***

Before servicing a Low-Pressure (Vapor Withdrawal) LPG fuel system, check to see that the LPG container is at least half full. The problem may be that there is not enough LPG to provide the rate of vaporization necessary to meet generator set demand, especially on cold days and/or when the generator set is under full load.

# 7.3 Disassembly and assembly of fuel system

## 7.3.1 Disassembly

1. Disconnect the fuel pipe at the fuel filter and remove the fuel filter.
2. Disconnect the connecting pipe with the carbon canister, and remove the T-Joint, check valve, vent pipe, etc.
3. Remove the oil pipe assembly, and remove the gasoline pump and ECU from the mounting bracket of the Inverter.
4. Remove the fuel pipe assembly, Remove the high pressure gasoline pump from the bracket
5. Remove the LPG pipe, connect the bolts with the frame bottom plate, and remove the LPG control valve.
6. Remove the nuts at the connecting pipe of the air filter and the connecting pipe of the air filter.
7. Remove the LPG pipe, fuel pipe assembly and assembly plug connected with the throttle assembly, and take Out the throttle assembly.

## 7.3.2 Installation

1. Reverse the removal procedure as shown in the removal section.
2. Fuel pipe combination 、 breather tube and LPG pipe connection are not firm, and aging and cracking need to be replaced in time.
3. The carburetor gasket needs to be replaced during reassembly.

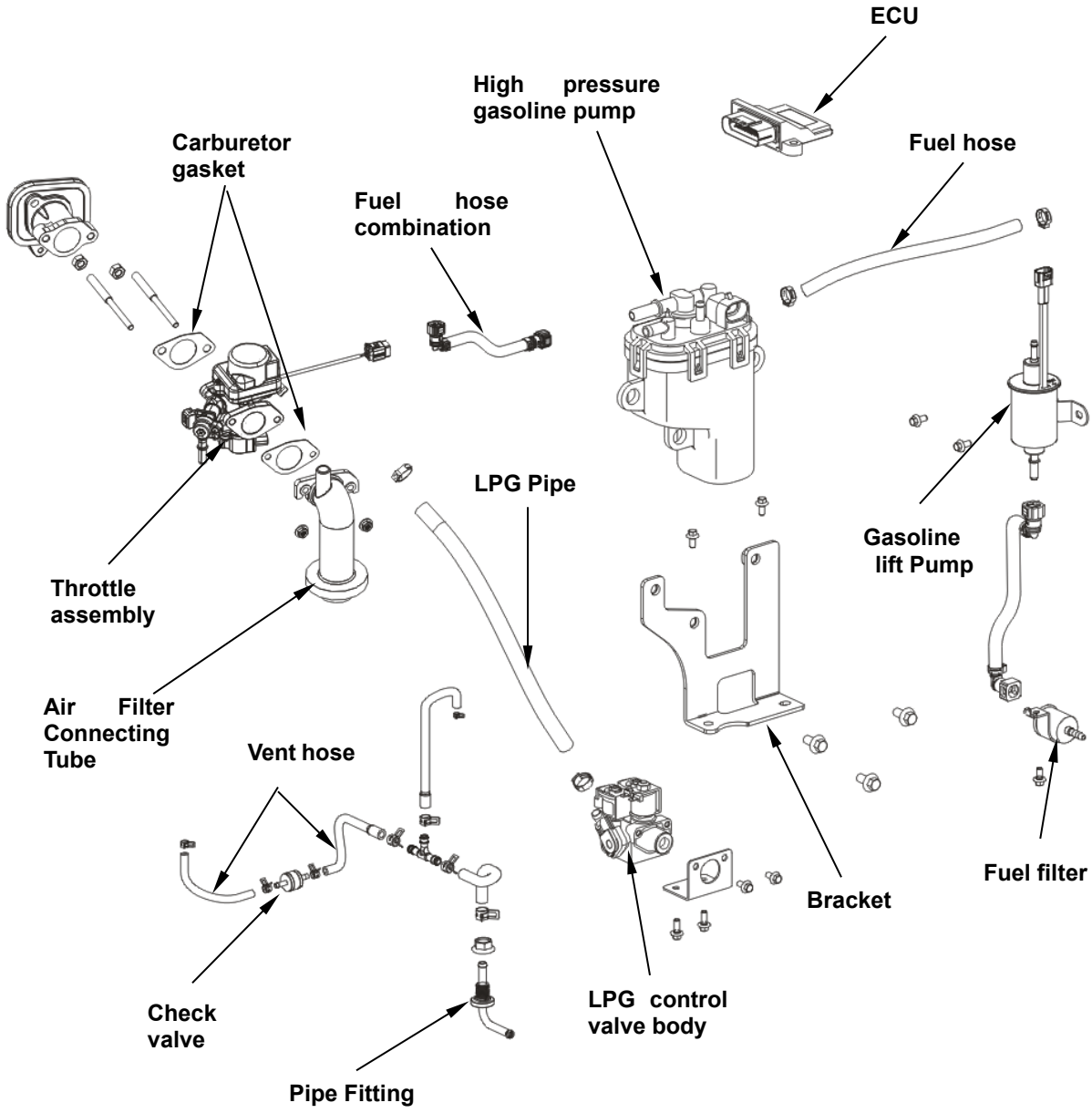


**FIGURE 21. FUEL SYSTEM**

# 7.4 Throttle combination

The throttle combination comprises a throttle body, a stepper motor, an end cover, a fuel injector, a fuel injector cap, a three-in-one sensor and other components. The amount of air entering the engine is determined by the throttle opening, which is measured by the throttle position sensor and fed back to the electronic controller

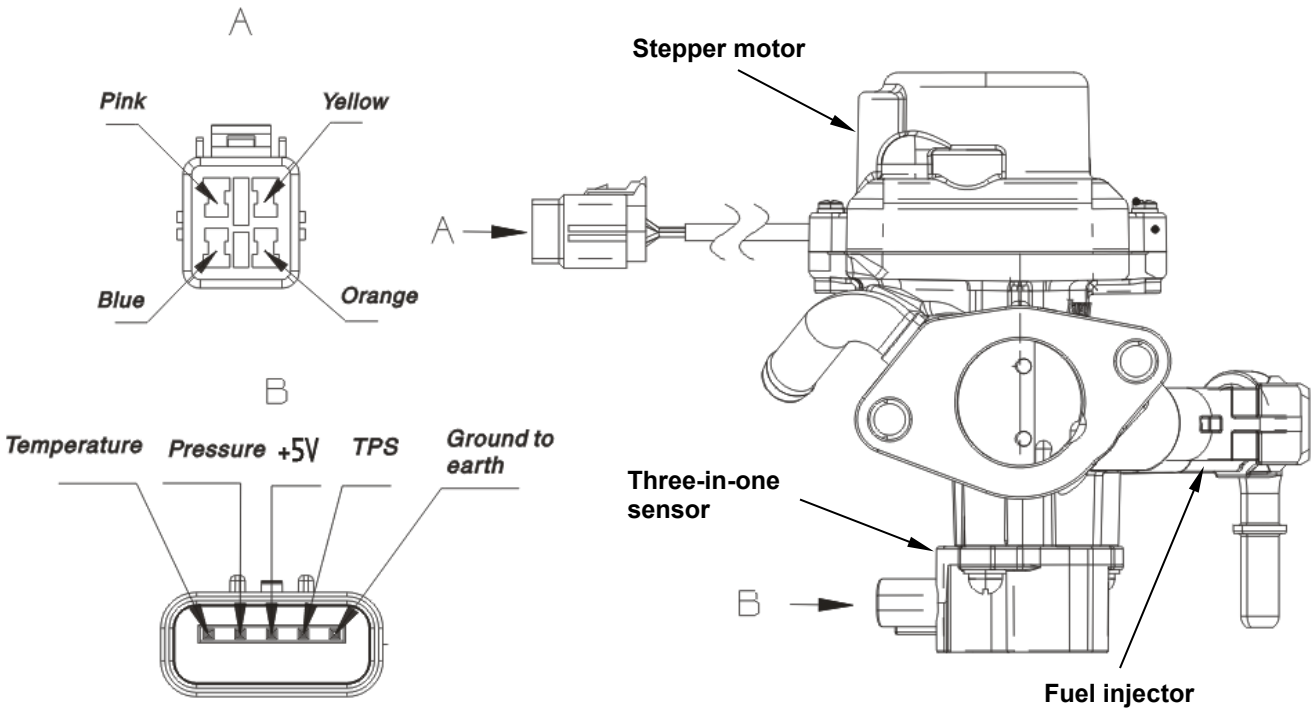


**FIGURE 22. THROTTLE COMBINATION**

## 7.4.1 Stepper motor

Function: Control the opening of the throttle plate and adjust the air intake of the engine

Inspection: 1. Check whether the appearance is complete.

2. Check the resistance between blue and yellow, pink and orange of the two windings, which is normally 25 ± 10% Ω.

## 7.4.2 Fuel injector

Function: Control the fuel injection amount

Inspection: 1. Check whether the appearance is complete.

2.Check whether the nozzle hole and filter screen are blocked.

3.Check the resistance between the two terminals of the fuel injector, which is normally 12 ± 5% Ω.

### 7.4.3 Three-in-one sensor

Function: It integrates three sensors of temperature, pressure and position, and can collect the intake air temperature, intake air pressure and throttle position signals of the engine.

Inspection: 1. Check whether the appearance is complete and whether the contact pin is deformed

2. Check the fault lamp or use fault diagnosis instrument to see if there are related faults such as air temperature, oil temperature and throttle position.

## 7.5 Electronic controller ECU

Function: Receives various engine speed, load and other signals to control fuel injection and control ignition

Inspection: 1. Check whether the appearance is complete and whether the contact pin is deformed

2. Check the fault lamp or use fault diagnosis instrument to see if there are related faults such as air temperature, oil temperature and throttle position, or ECU internal fault.

## 7.6 Fuel pumps

Function: Lift pump to lift fuel from fuel tank, and high pressure pump to provide high-pressure fuel to the fuel injector

Inspection: 1. Check whether the appearance is complete and whether there is fuel leakage.

2.Turn on the 12 V power supply and check whether the fuel pumps work.

## 7.7 LPG Control Valve

Main function is to control the LPG flow, including LPG control valve body, flow solenoid valve, safety solenoid valve, pressure sensor, etc.

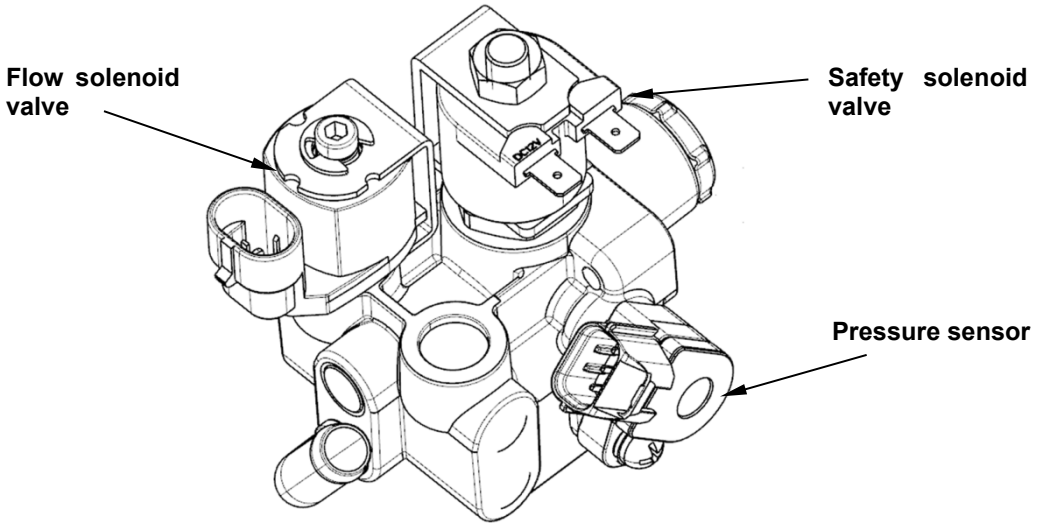


**FIGURE 23. LPG CONTROL VALVE**

## 7.7.1 Flow solenoid valve

Function: Precisely controls the amount of LPG for each cycle of the engine. Winding resistance is 3±0.2Ω.

Inspection: 1. Check whether the appearance is complete and whether the contact pin is deformed.

2.Turn on the 12 V power supply and check whether the solenoid valve act or not.

## 7.7.2 Safety solenoid valve

Function: Precisely controls the intake amount of gas for each cycle of the engine. Winding resistance is 19.5±1Ω.

Inspection: 1. Check whether the appearance is complete and whether the contact pin is deformed.

2. Turn on the 12 V power supply and check whether the solenoid valve act or not.

## 7.7.3 Pressure sensor

Function: collects LPG inlet pressure

Inspection: 1. Check whether the appearance is complete and whether the contact pin is deformed

2.Check faut display lamp or use fault diagnosis instrument to check pressure related faults

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# 8 Engine

## 8.1 Testing Compression/Leak down

Test engine compression and/or leak down to confirm whether the engine is worn. When the engine speed is 1200 rpm. Compression should fall between 174 and 203 psi.

## 8.2 Testing Crankcase Vacuum

Test crankcase vacuum to confirm whether the engine is worn or the breather valve is malfunction. When the engine speed is 2800 rpm, Vacuum should fall between 1 kpa and 3 kpa.

## 8.3 Removing and Installing Engine

The following image illustrates how the engine is mounted on the alternator/engine base.

### 8.3.1 Removal

1. Drain the engine oil because the generator set will be turned on its side to remove components.
2. Disconnect all electrical components and cables on the engine, such as motor output and Inverter connecting wires, oil temperature sensor, starting motor connecting wires, etc.
3. Remove the 2 fail safe bolts connected the engine base and base pan.
4. Remove the 4 bolts that connected the engine base and isolators
5. Move the engine out of the base pan.

### 8.3.2 Installation

1. Perform the reverse of the removal steps, as shown in the Removal section.
2. The deformation and cracking of the isolators shall be replaced in time.
3. The rubber ring on the fail safe bolts is aged and damaged, and needs to be replaced in time.
4. Tighten each connecting bolt to the specified torques

Engine to base pan bolt torque: 30-36 N.m.

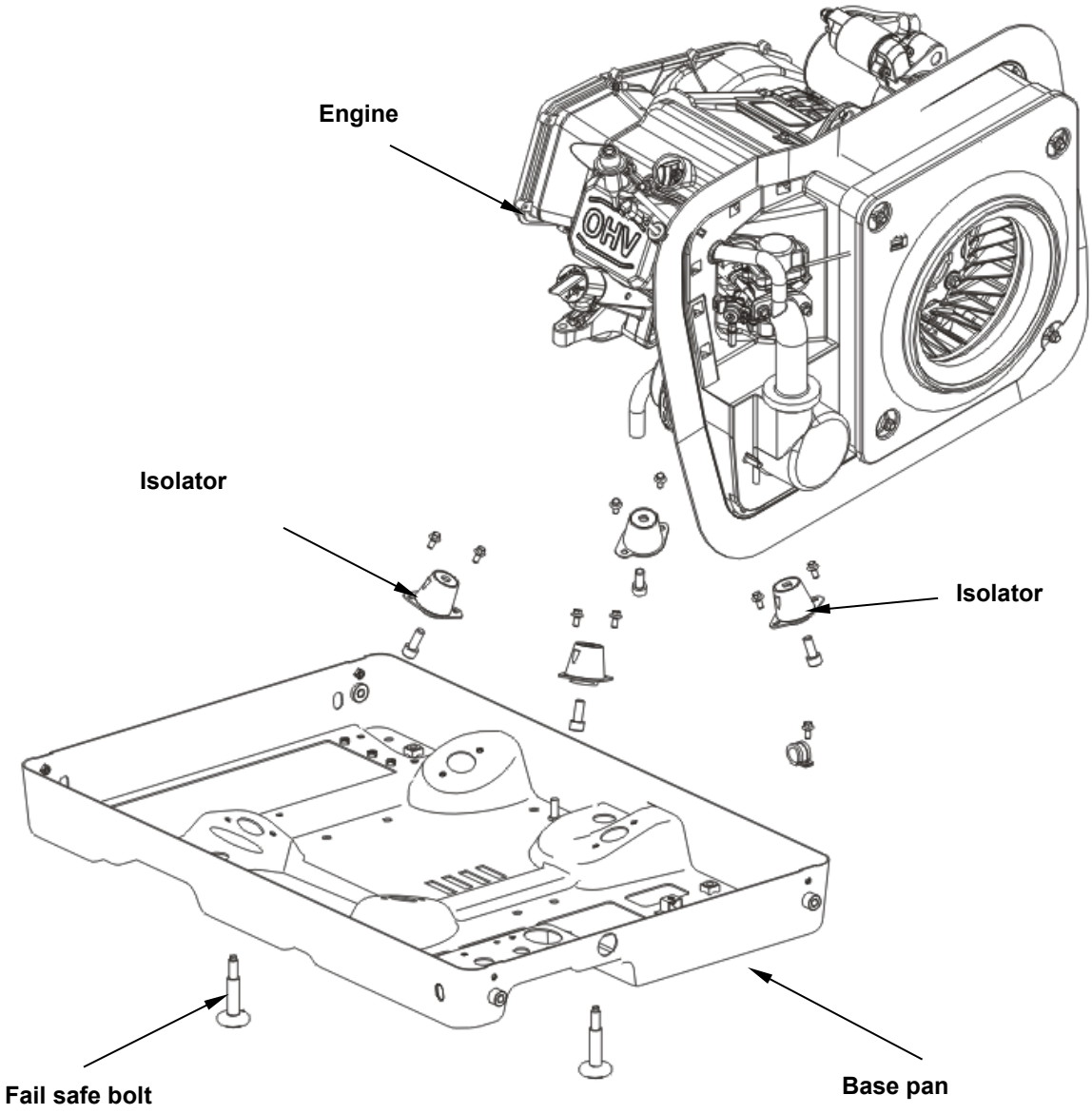


**FIGURE 24. ENGINE INSTALLATION**

# 8.4 Starter Motor

## 8.4.1 Starter Motor Replacement

- To remove the starter motor, disconnect all wiring and remove the two mounting screws.
- To install the starter motor, torque the mounting screws to 18.5-22 lb-ft (25-30 Nm) and the terminal nut to 6.5 lb ft (8 Nm).

## 8.4.2 Starter Motor Solenoid Replacement

**⚠ WARNING**

***This test involves high electrical currents, strong arcing and moving parts that can cause severe personal injury. Do not conduct this test near fuel tanks or when flammable vapors are present. Wear safety glasses. Keep fingers away from the pinion gear.***

The starter solenoid is separately replaceable. To determine whether the problem is in the solenoid or in the motor:

1. Secure the motor assembly in a vice after it has been removed from the generator set.
2. Using a heavy jumper cable, because of the large currents involved, connect the motor terminal on the solenoid (the one closest to the motor) to the positive (**+**) terminal on a 12 volt battery.
3. Using a heavy cable from the negative (**-**) terminal on the battery, briefly touch the mounting flange on the motor.
    - If the motor does not spin up quickly and smoothly, replace the motor/solenoid assembly.
    - If the motor does spin up quickly and smoothly, the motor is probably okay, replace the solenoid by disconnecting the motor lead from the solenoid terminal and removing the two solenoid mounting nuts.

***NOTICE***

**When installing a new solenoid, make sure the solenoid plunger engages the shift fork.**

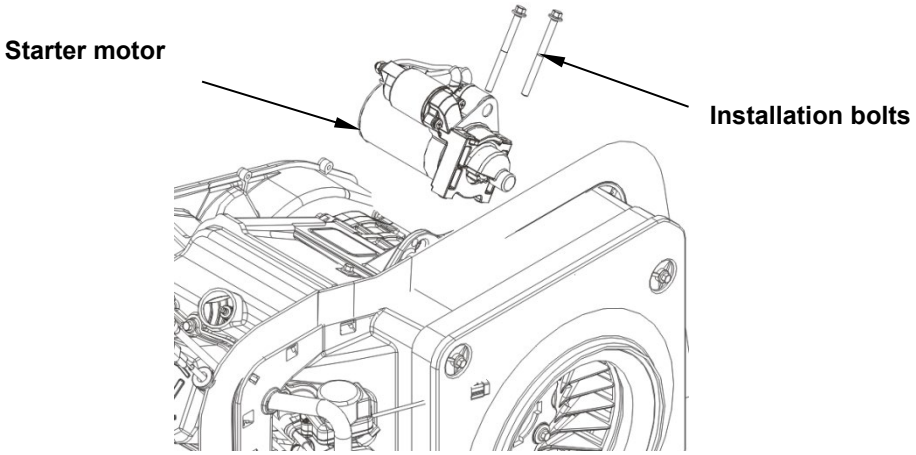


**FIGURE 25. STARTER MOTOR**

# 8.5 Fan housing, air guide housing

## 8.5.1 Fan housing and filter element

**Disassembly**

1. Rotate and remove the cover of the air filter housing, and move out the air filter element.
2. Remove the four fan shroud mounting bolts and remove the two fan shroud baffles.
3. Remove the four fan shroud assembly mounting bolts and remove the fan shroud assembly
4. Remove the brush from the slot of the fan cover part.

**Installation**

1. Reverse the removal procedure, as shown in the removal section.
2. During installation, check the filter element of the air filter, and clean or replace it in time if it is dirty or damaged
3. The brush shall be checked during installation, and the dirty and damaged brush shall be cleaned or replaced in time. Clip the brush into the slot of the fan housing component and install it in place.
4. Before installation, remove the dust from the fan shroud components and the fan shroud deflector.
5. Torque of mounting bolt: 8-12N.m

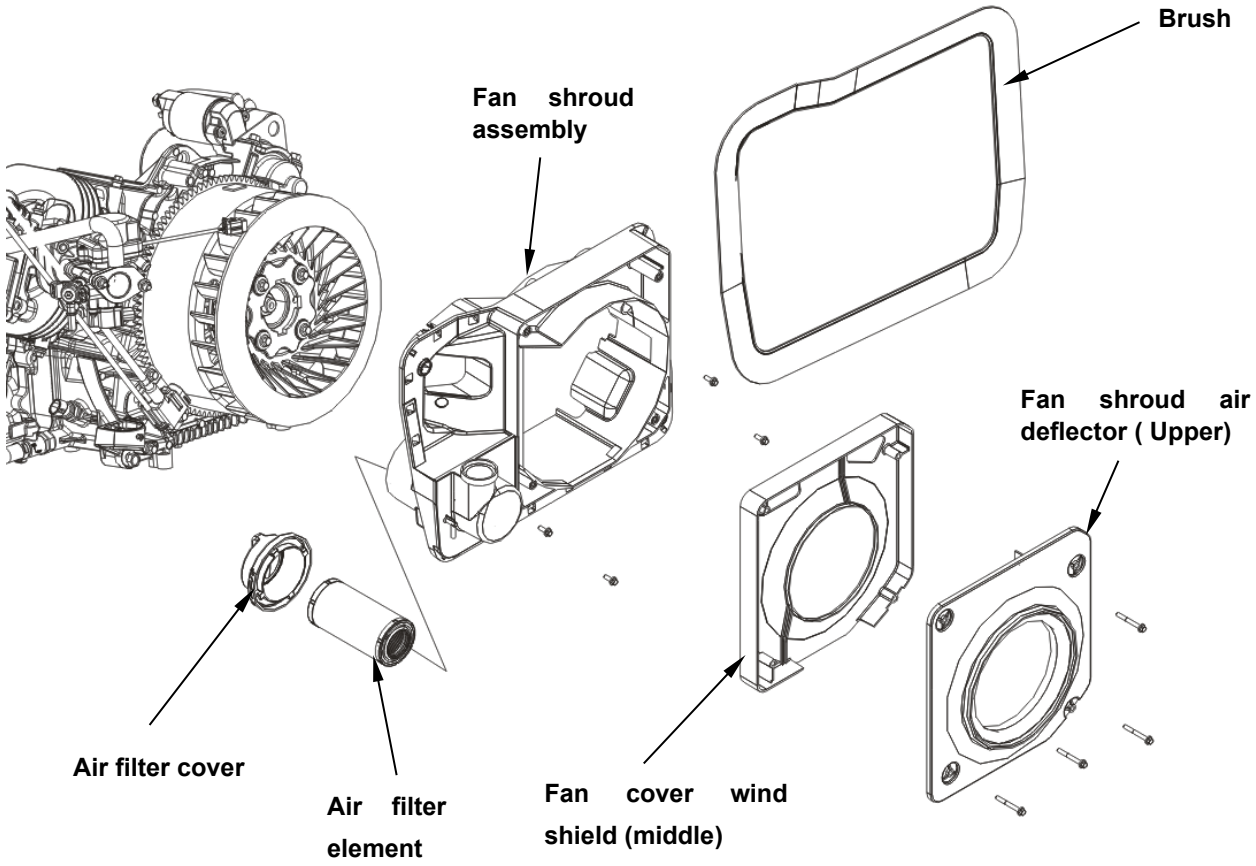


**FIGURE 26. FAN HOUSING AND FILTER ELEMENT**

## 8.5.2 Air deflector, impeller

**Disassembly**

1. Remove the four impeller mounting bolts and remove the impeller.

2. Remove the three air deflector mounting bolts and remove the air deflector.

3. Remove the connecting bolts between the impeller disc and the crankshaft, and remove the impeller disc.

**Installation**

1. Do the reverse of the removal procedure, as shown in the removal section.

2. Before installation, remove the dust in the air deflector and impeller, check whether the impeller fan blade is deformed or damaged, and then install it.

3. The impeller disc notch shall be aligned with the crankshaft for installation.

4. Bolt torque: Impeller disc fastening bolt: 25-30 N.m.

Impeller and air guide cover fastening bolts: 8-12 N.m.

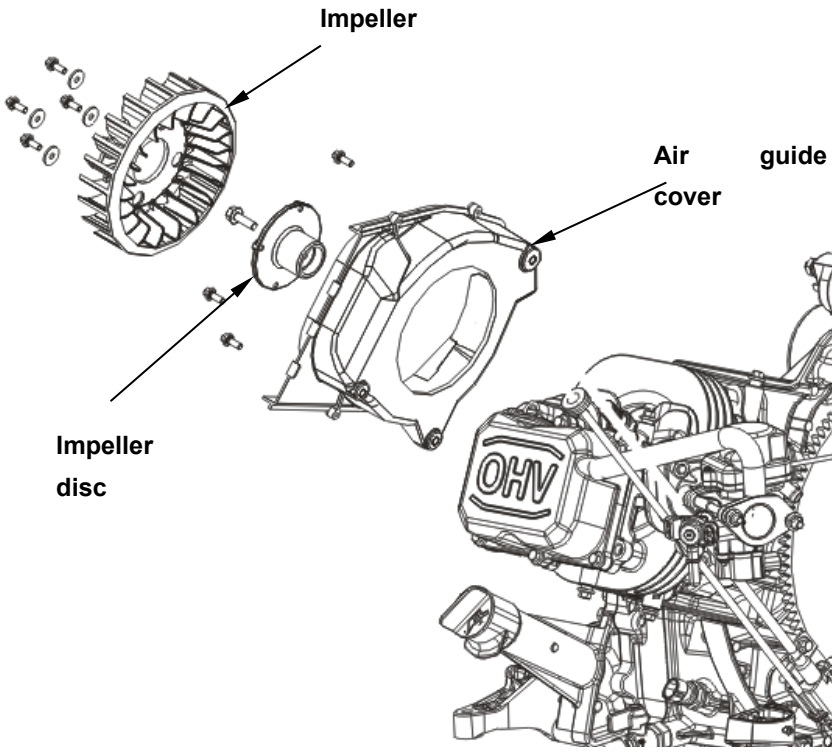


**FIGURE 27. AIR DEFLECTOR, IMPELLER**

## 8.5.3 Air deflector, engine deflector

**Disassembly**

1. Remove the mounting bolts and remove the air deflector from the cylinder head and the box.

2. Turn over the engine and remove the engine shroud from the bottom of the case.

**Installation**

1. Do the reverse of the removal procedure, as shown in the removal section.

2. Before installation, remove the dust on the deflector before installation.

3. Bolt torque: 8-12 N.m

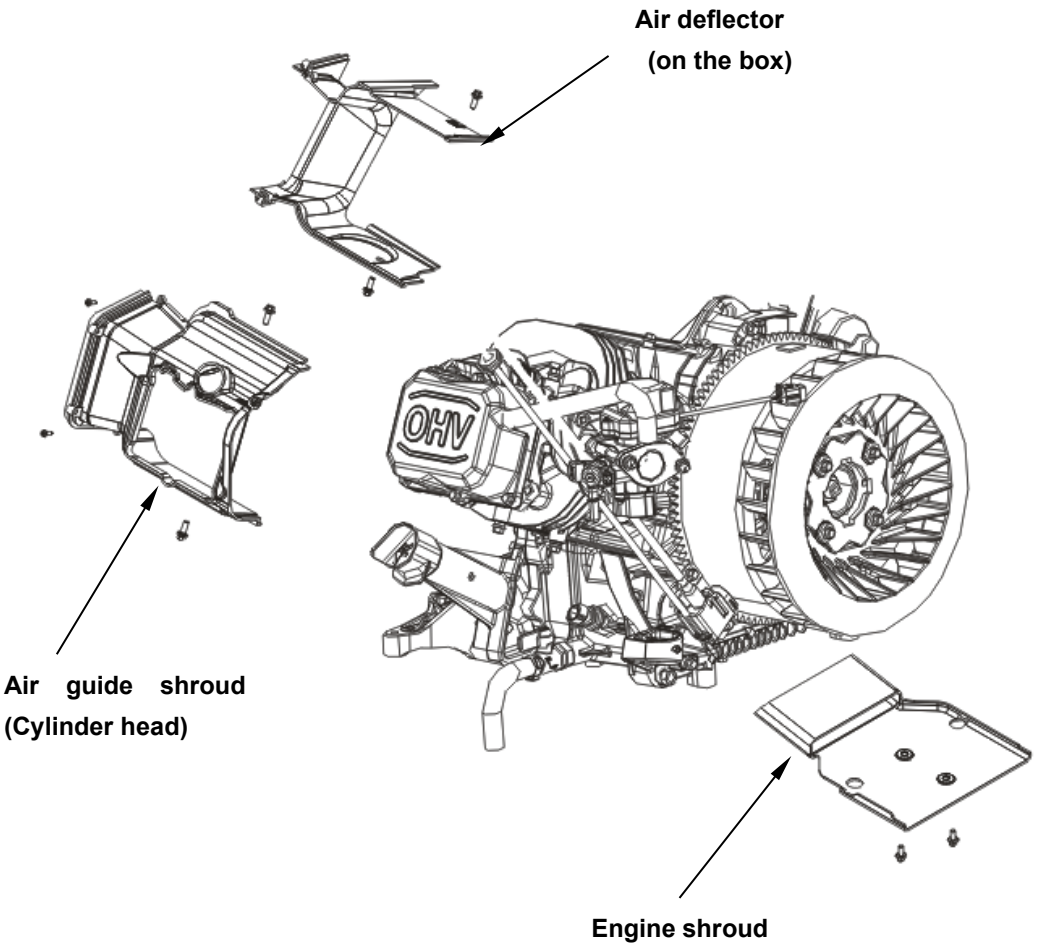


**FIGURE 28. AIR DEFLECTOR, ENGINE DEFLECTOR**

# 8.6 Motor components, ignition coil

**WARNING**

***Improper disassembly and assembly of motor rotors can cause damage to motor components and personal injury accidents. Please use special tools for disassembly and installation. When assembling rotor, use hand to hold outside surface of rotor, don't put fingers inside of rotor.***

**Disassembly**

1. Remove the impeller from the alternator rotor by removing the four mounting bolts.
2. Remove the fastening bolt of the ignition coil and remove the ignition coil from.
3. Remove the fastening nut of the alternator rotor with a special alternator rotor removal tool, and do not knock with a metal hammer.
4. Remove the alternator stator mounting bolts and remove the alternator stator.

**Installation**

1. Do the reverse of the removal procedure, as shown in the removal section.
2. When reassembling the ignition coil, adjust the clearance between the ignition coil trigger and the alternator rotor magnet.

   Tighten the ignition coil mounting bolts slightly.

   Insert the thickness gauge into the gap between the ignition coil trigger and the alternator rotor magnet steel.

   Press the ignition coil on the alternator rotor by hand and tighten the two bolts.

   Ignition coil trigger clearance: 0.3-0.4 mm
3. Bolt torque: Alternator stator fastening bolt 25-30N.m, alternator rotor fastening nut torque: 110-130 N.m.

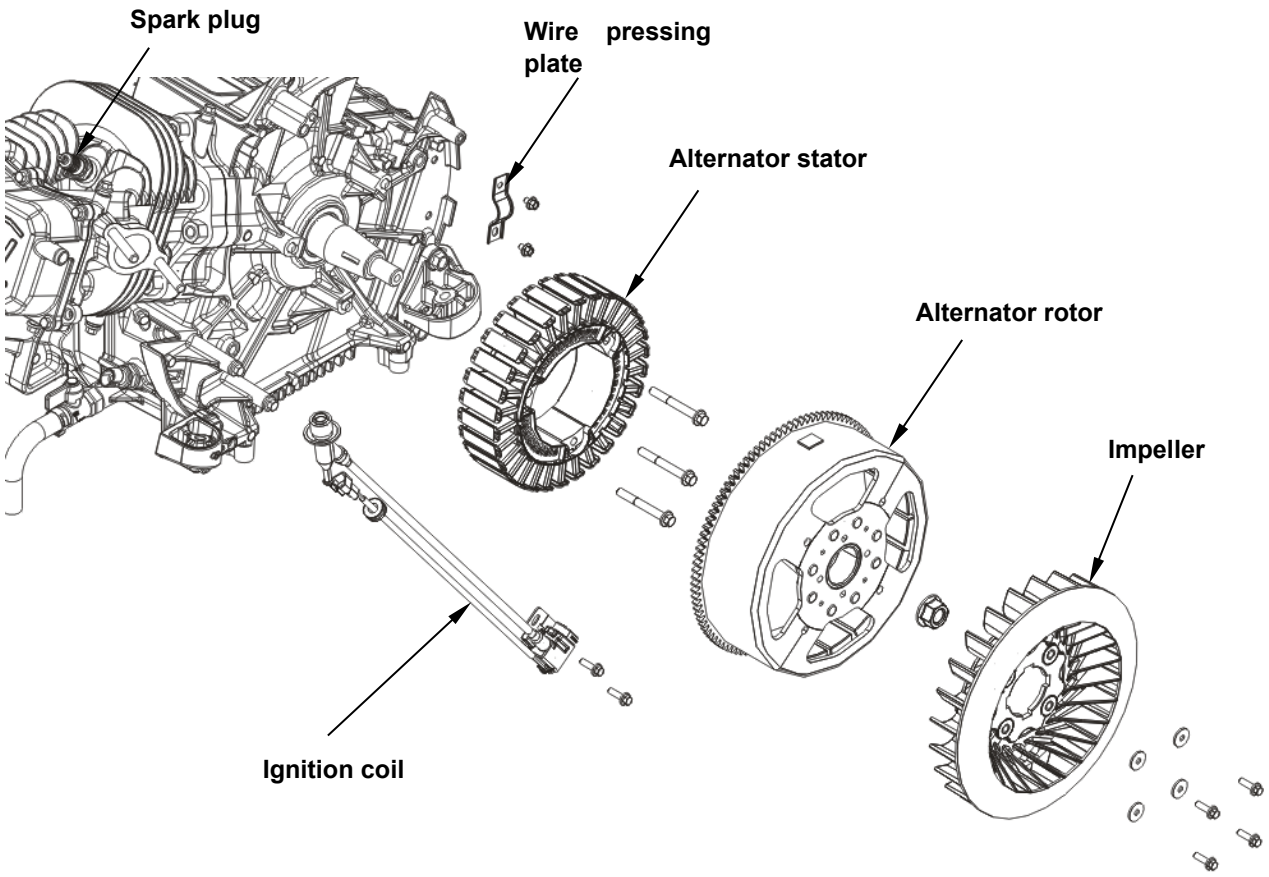


**FIGURE 29. ALTERNATOR COMPONENTS**

## 8.6.1 Ignition System

The ignition system consists of alternator rotor, ignition coil and spark plug.

If the engine does not start:

1. Secure the spark plug cables on the spark plugs if they have come off.
2. Remove and examine the spark plugs and replace, if necessary. Check and reset the gap to 0.024-0.028 inch (0.6-0.7 mm).
3. Conduct the spark check.
4. Replace faulty ignition coil/cable assemblies and set the air gaps.

### Spark Plugs

The spark plugs must be in good condition and have the proper gap for top engine performance.

Always screw the spark plug in by hand, using a spark plug socket wrench to fully tighten the spark plug until the spark plug is pressed against the washer.

Spark plug torque: 25-30 N.m.

If the engine misses or performance otherwise deteriorates, remove and examine the spark plugs for signs of the following problems

**SPARK PLUG PROBLEMS**

| Problem | Description |
|---|---|
| Light tan, gray or reddish deposits | Normal |
| spark plug fouled | Broken spark plug cable, low cylinder compression |
| Soot fouled | Wrong spark plug heat range (too cold), duty cycle too short for engine to reach normal operating temperature |
| Fuel fouled | Wrong spark plug heat range (too cold), faulty choke operation, overly rich fuel mixture, dirty air filter |
| Oil fouled | Malfunctioning crankcase breather, worn rings, worn valve guides or seals |
| Burned or overheated | Leaking intake manifold gaskets, lean fuel mixture |
| Worn | Spark plug service life used up. |

### Spark Check

1. Remove the spark plugs.
2. Reconnect the spark plug cables.
3. Ground the side electrodes to bare metal on the engine.

**⚠ WARNING**

***Gasoline and LPG are flammable and explosive and can cause severe personal injury or death. Make certain that no flammable fumes are present and that the area is well ventilated. Leave the generator set compartment door open for several minutes before performing this test.***

4. Do not touch the spark plug or cable during testing. Crank the engine and look for the spark across plug.
    - If the spark is weak or inconsistent across plug, replace the plug with a new one.
    - If the spark still is weak or inconsistent, Please check the ignition coil.

## Ignition coil

If the fire is weak or there is no fire, please check whether the product appearance is damaged or cracked, whether the potting glue is completely cured and free of sagging; whether the connector is loose or falls off; Check whether the high-voltage lead and the spark plug cap are firmly combined.

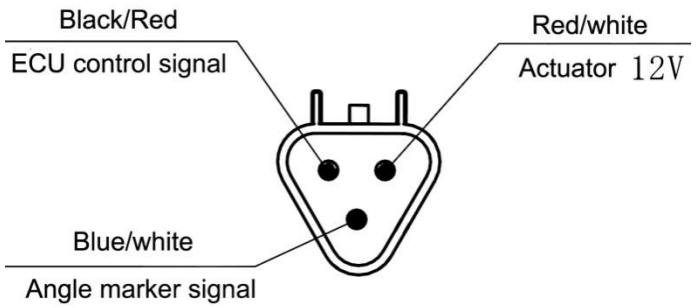


**FIGURE 30. IGNITION COIL PLUG**

Check the ignition coil resistance

Primary side resistance:

Use the multimeter probe to contact the black/red wire and the red/white wire respectively.

Measure the resistance on the primary side of the coil.

| | |
|---|---|
| Primary side resistance | 1.3±15% Ω |

Secondary side resistance

Use the multimeter probe to contact the high-voltage wire in the spark plug cap and the metal bracket respectively, and measure the resistance value of the secondary side of the coil.

| | |
|---|---|
| Secondary side resistance | 8.2±15% KΩ |

**Notice**

***Taking a measurement without removing the spark plug cap will result in a distorted reading.***

**Trigger**

Contact the multimeter probe with the blue/white wire and the metal bracket respectively, and measure the resistance value.

Trigger resistance value: (270 ± 20) Ω

If the trigger resistance is qualified, use the magnetic block marked with polarity to test the surface polarity of the iron core. If the surface polarity is N pole, it is qualified.

Otherwise, it is not qualified.

## 8.6.2 Alternator components

The engine drives the alternator rotor to rotate, so that the alternator stator winding cuts the magnetic induction line to generate electric energy and output three-phase alternating current

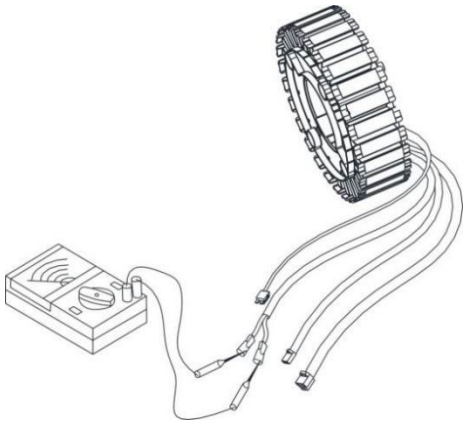

**FIGURE 31. STATOR DETECTION**

**Main parameters:**

1. Alternator output power: 8kW
2. Rated voltage of unit: 120/240V
3. Cold and hot voltage change: ≤ 25V
4. Main winding resistance (20 ℃): 0.4886Ω ± 20%
5. Insulation resistance: when tested with a 500V megohmmeter, the cold insulation resistance of each winding to the ground should be more than 5MΩ, the thermal insulation resistance should be more than 0.38 MΩ.

**Test:**

1. Check whether the parameters are consistent. If not, replace the motor stator or rotor.
2. Remove the alternator stator and alternator rotor from the engine and check whether the magnet steel and gear ring of the alternator rotor are damaged, deformed, loosened or broken, otherwise replace the electronic rotor.
3. Check whether there is obvious damage to the enameled wire and wire insulation of each winding of the alternator stator. If damaged, replace the stator

   Note: When removing and installing the stator, take care not to damage the winding enameled wire and the wire insulation.

# 8.7 Cylinder head, valve

## 8.7.1 Cylinder head

**Disassembly**

1. Remove the 2 hexagon nuts, and remove the intake pipe, carburetor gasket and heat insulation pad.
2. Remove the spark plug with the spark plug sleeve and remove the vent pipe.
3. Remove the fastening bolts of the cylinder head cover and remove the cylinder head cover.
   If necessary, further remove the breather tank cover and gasket from the cylinder head cover.

**Installation**

1. Reverse the removal procedure, as shown in the removal section.
2. Check the reed valve on the cover plate of the breather tank. It shall be adjusted or replaced if it is deformed or not tightly sealed.
3. Before installing the spark plug, check whether the electrode is excessively worn, clean it, and install it after adjustment.
4. During reassembly, each sealing gasket shall be replaced.

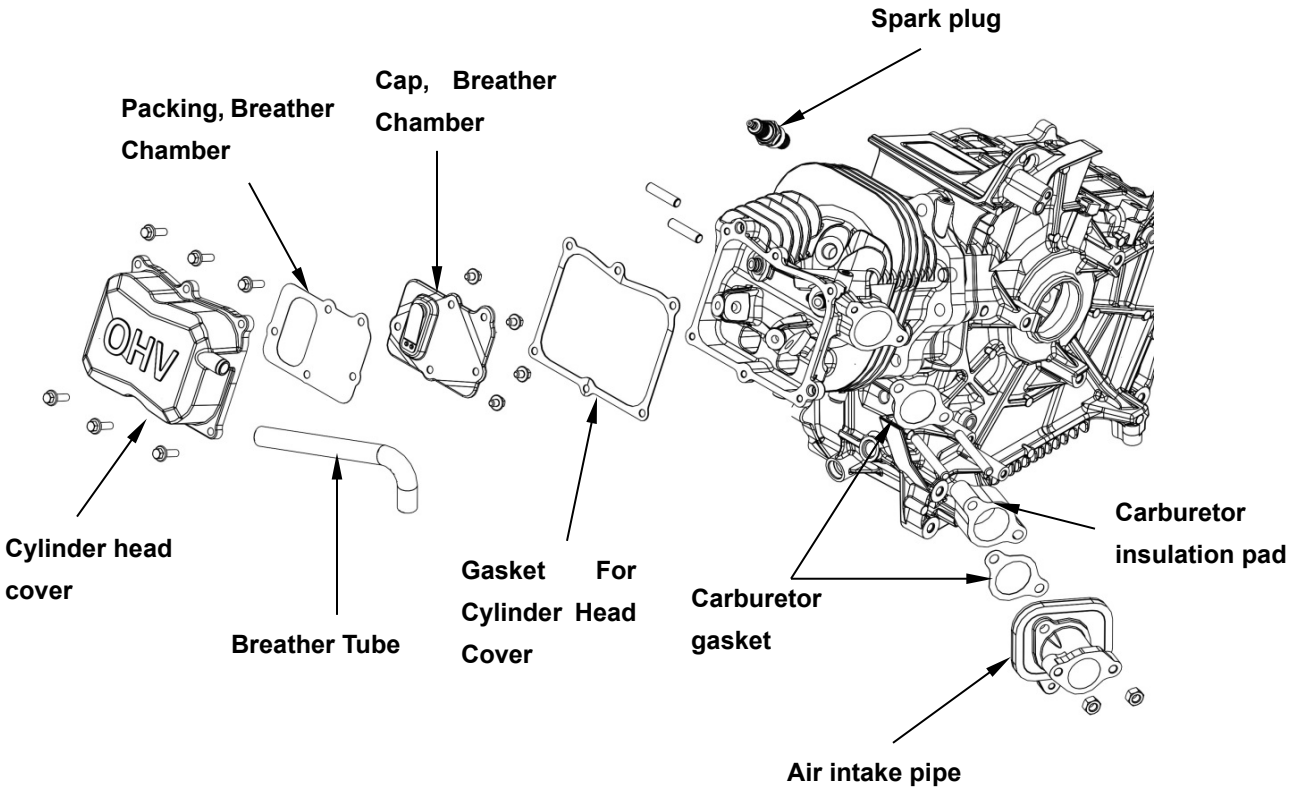


**FIGURE 32. CYLINDER HEAD**

## 8.7.2 Valve clearance adjustment

Valve lash is adjustable through the maintenance access opening on generator sets with enclosures.

| *NOTICE* |
| --- |
| **For accurate adjustments, valve lash must be adjusted when the engine is at room temperature.** |

1. Remove the spark plug to make it easier to turn the engine.
2. Remove the cylinder head cover and confirm the timing point:

2.1 Steps to confirm the timing point when the engine has been disassembled:

Turn the motor rotor and put the piston at the top dead center of the compression stroke. At this time, the two valves are completely closed. Insert the thickness gauge between the valve rocker arm and the valve. Clearance, measure the valve clearance.

2.2 Steps to confirm the timing without removing the generator from the RV:

Use a screwdriver to turn the motor rotor through the observation hole to make the exhaust valve spring in a compressed state, and insert the thickness gauge into the intake valve rocker arm and valve. Measure the clearance of the intake valve.

Continue to move the motor rotor, rotate the engine to compress the intake valve spring, and insert the thickness gauge into the clearance between the rocker arm of the exhaust valve and the valve. Measure the exhaust valve clearance.

3. Standard valve clearance: intake 0.10 ~ 0.15 mm

Exhaust 0.15 ~ 0.20 mm

4. If adjustment is necessary, proceed as follows:

4.1 Fix the valve adjusting screw with tools and loosen the valve lock nut with a wrench.

4.2 Rotate the valve adjusting screw to adjust to the specified valve clearance.

4.3 Fix the valve adjusting screw with tools and tighten the valve lock nut.

4.4 After tightening the lock nut, recheck the valve clearance.

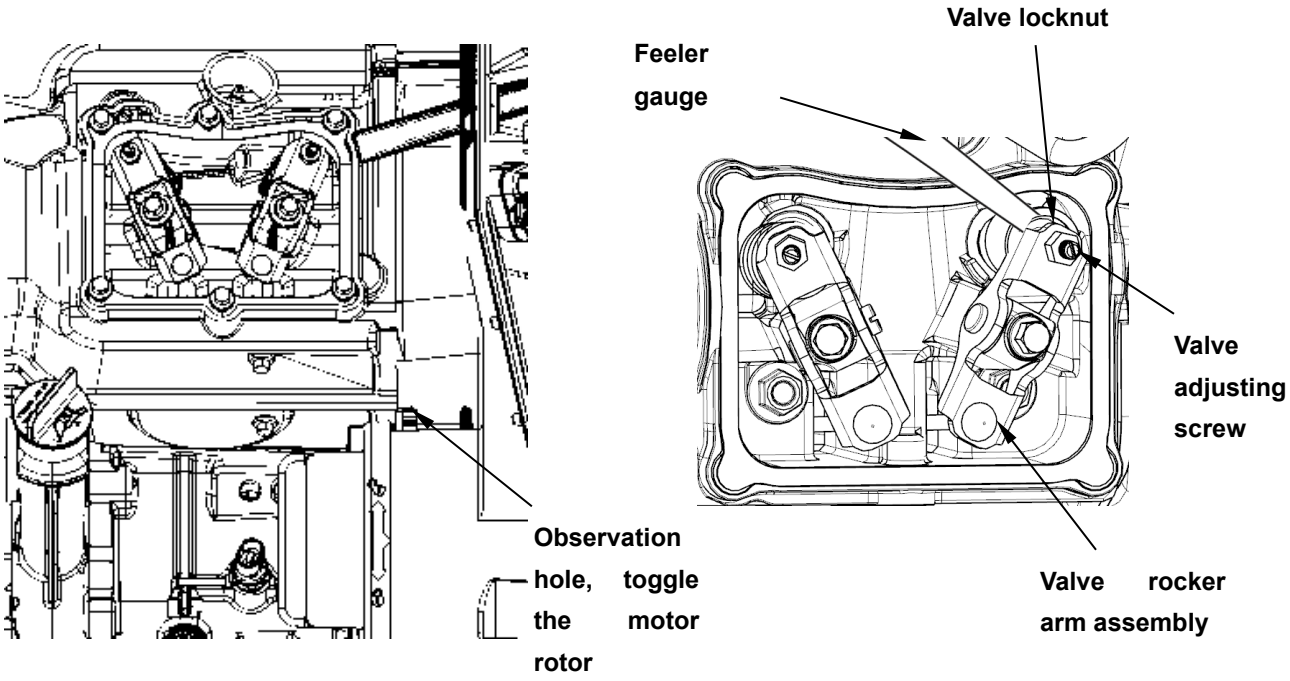


**FIGURE 33. VALVE CLEARANCE ADJUSTMENT**

## 8.8 Drain pipe assembly, temperature sensor

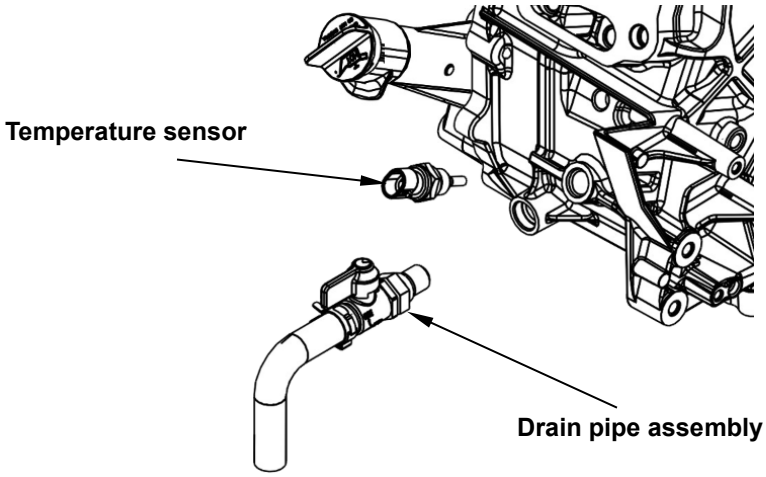


**FIGURE 34. DRAIN PIPE ASSEMBLY, TEMPERATURE SENSOR**

1. Apply a proper amount of sealant to the front thread of the oil drain pipe assembly, install it on the box, rotate the oil switch to the end, and check whether the O-ring is If not, tighten the oil switch by about 2 turns to make

the oil switch vertically upward. Oil drain bolt tightening torque: 40 ~ 45 N.m.

2. Install the temperature sensor on the box, tightening torque: 11 ~ 14 N. M.

3. Temperature sensor detection

Function: Collect the temperature of the engine

Detection: respectively contact the multimeter probes with the two contact pins, and measure the resistance value of the temperature sensor.

If the resistance value is not as specified, replace it

| Temperature ℃ | Minimum resistance Ω | Nominal resistance Ω | Maximum resistance Ω |
|---|---|---|---|
| -40 | 302200 | 361100 | 420000 |
| -25 | 115600 | 138100 | 160600 |
| 0 | 30700 | 33650 | 36600 |
| 25 | 9304 | 10000 | 10700 |
| 50 | 3269 | 3509 | 3754 |
| 60 | 2232 | 2401 | 2569 |
| 70 | 1560 | 1678 | 1795 |
| 80 | 1111 | 1195 | 1278 |
| 85 | 943 | 1015 | 1086 |
| 90 | 847.3 | 865.5 | 883.7 |
| 95 | 725 | 741.2 | 756 |
| 100 | 626.6 | 637.1 | 647.6 |
| 105 | 541 | 549.8 | 559 |
| 110 | 468 | 476.3 | 484 |
| 115 | 407 | 414 | 421 |
| 120 | 355 | 361.1 | 367 |
| 125 | 311 | 316.1 | 321 |
| 130 | 273 | 277.5 | 282 |
| 135 | 240 | 244.4 | 248 |
| 140 | 212 | 215.9 | 219 |
| 145 | 188 | 191.2 | 194 |
| 150 | 163.2 | 169.8 | 176.4 |

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# 9 Service Checklist

## 9.1 General

Before reinstalling the generator set, repair any damage to and seal all holes in the vapor-tight, fire- resistive barrier between the generator set and the coach interior.

After servicing or reinstalling a generator set, conduct the following checks and tests to determine that the generator set will operate safely and perform as required.

## 9.2 Mounting

Check for proper mounting and tighten all fasteners securely. Make sure the air inlet and outlet openings in the bottom of the generator set are not restricted in any way, and that there is access for changing the oil filter and draining oil.

## 9.3 Wiring

**⚠ WARNING**

***Batteries give off explosive gases that can cause severe personal injury — Do not smoke — Keep flames, sparks, pilot lights, switches, arc-producing equipment and all other ignition sources away.***

Make sure all AC output, control, ground and battery connections are tight and properly installed. Check wiring for cuts, cracks and abrasions and make sure it does not rub against anything that could cause damage.

## 9.4 Exhaust System

Make certain that the exhaust tail pipe terminates beyond the perimeter of the vehicle and not near vents or openable windows or doors. Test the on-board CO alarm(s). See the installation manual for important considerations concerning the installation of an exhaust system.

When the generator set is up and running, look and listen for leaks at all connections, welds, gaskets, and joints along the whole length of the exhaust system. Repair all leaks before putting the generator set in service.

# 9.5 Fuel System

Check flexible sections for cuts, cracks and abrasions and make sure they do not rub against anything that could cause damage. On models equipped with fuel injection, make sure proper connections have been made for a fuel return line all the way back to the fuel tank.

**⚠ WARNING**

***Gasoline is flammable and explosive and can cause severe personal injury or death.***

- ***Stop priming immediately if you smell gasoline or see fuel leaking, and clean up spilled fuel and ventilate area before starting the generator set or vehicle.***
- ***Do not smoke.***
- ***Keep flames, sparks, pilot lights, switches, arc-producing equipment and all other ignition sources away.***
- ***Keep an ABC fire extinguisher handy.***

**Gasoline Models:**

1. Recheck all fuel connections for tightness.
2. Prime the fuel system by holding the control switch at **STOP/PRIME** while checking for fuel line leaks.
3. Fix all leaks before starting the generator set.

**⚠ WARNING**

***LPG is flammable and explosive and can cause asphyxiation. NFPA 58, Section 1.6 requires all persons handling LPG to be trained in proper handling and operating procedures.***

**⚠ WARNING**

***LPG "sinks" and can accumulate in explosive concentrations. Before connecting or disconnecting the LPG fuel line, close the fuel shutoff valve(s) at the LPG container(s) and move the vehicle outside and away from pits, basements, and other below-grade spaces where LPG could accumulate.***

**LPG Models:**

1. Recheck all fuel connections for tightness.
2. Make sure proper connections have been made at the LPG container(s). A generator set equipped for low-pressure LPG (vapor withdrawal) must not be connected for high-pressure (liquid withdrawal), and vice versa.
3. For low-pressure LPG, check and adjust the LPG supply pressure to obtain 228 – 330 mm (9 – 13 inches) WC (water column) at all loads.
4. Fix all leaks before starting the generator set.

## 9.6 Startup

**⚠ WARNING**

***EXHAUST GAS IS DEADLY! Do not operate the generator set when the vehicle is indoors or where exhaust can accumulate.***

**⚠ CAUTION**

***Frequency-sensitive equipment such as VCRs, televisions, computers, etc., can be damaged by power line frequency variations. Some solid-state devices are powered whenever connected to an AC outlet even if the device is not in actual operation. For this reason, disconnect all devices that are voltage- or frequency-sensitive before attempting any governor adjustments. If disconnecting the devices is not possible, open the circuit breaker(s) at the distribution panel or at the generator set.***

1. Read the operator manual and perform the maintenance and pre-start checks instructed. Check the oil level and fill as necessary.
2. Make sure all frequency-sensitive equipment has been disconnected.
3. Start the generator set and Check engine speed.
4. Operate the generator set following all the instructions and safety precautions in the operator manual.
5. Check for fuel and exhaust leaks and unusual noises while the generator set is running under full and intermediate loads. Do not place the generator set in service until all fuel and exhaust leaks have been fixed and operation is satisfactory.

## 9.7 Output Check

Apply a full load to make sure the generator set can produce its full rated output. Use a load test panel to apply a progressively greater load until full load is reached.

## 9.8 Control

Stop and start the generator set several times at the generator set control and remote control (if equipped) to verify that it functions properly.

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# 10 Troubleshooting

## 10.1 Overview

**⚠ WARNING**

***Hot engine parts can cause severe burns. Always allow the engine to cool down before performing any maintenance or service.***

The following paragraphs provide fault code faults and symptom-based faults. If a problem is not resolved after taking the corrective actions suggested, contact a local dealer or distributor. See Section 2.4 on page 9.

**⚠ WARNING**

***Some generator set service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons with knowledge of fuels, electricity, and machinery hazards should perform generator set service. See the Safety Precautions section.***

***NOTICE***

**Maintaining engine oil level, keeping battery connections clean and tight, watching the fuel gauge, not overloading the generator set, etc. will prevent most shutdowns.**

***NOTICE***

**When the generator set and vehicle engine share a common fuel tank, the fuel dip tubes are usually arranged so that the generator set will run out of fuel first. Marking the generator set empty point on the fuel gauge will make it easier to tell when to stop the generator set before running it out of fuel.**

## 10.2 Fault Codes

The generator set control contains extensive diagnostics to detect shutdown faults and other faults. Following a fault shutdown or other faults, the control indicates the fault code by flashing the numeric code on the status indicator in the control switch.

The generator set fault codes divided into 1-digit and 2-digit faults codes, determine the fault code as follows:

- 1 flash indicates an engine temperature exceeded limit fault (Code 1 fault).
- 4 flashes indicates that cranking exceeded 15 seconds without the engine starting (Code 4 fault).
- The 2-digit code consists of two sets of flashes. The first set is of flashes represents the 10s digit of the code. After a brief pause, the second digit of the code flashes representing the unit digit of the code. This is followed by a long pause before repeating the flashing of the fault code.

  For example, Fault Code 36 appears as: blink-blink-blink—pause—blink-blink-blink-blink-blink- blink—long pause—repeat

The fault code stops flashing after 5 minutes. Pressing STOP/PRIME 3 times within 5 seconds causes the fault code to resume flashing.

| *NOTICE* |
| --- |
| **The last fault logged continue to flash even though the condition that caused the shutdown has been corrected.** |

## 10.2.1 Code 1- Engine Temperature Exceeded Limit

**Logic:** After the genset runs, the oil temperature exceeds 150 ℃

**Possible causes:** air in or out blocked, too little or too much of engine oil, temperature sensor, incorrect fuel type, oxygen sensor fail to cause too lean of fuel, air intake manifold bolt loose

**Diagnosis and solution:**

1. Check whether the air duct of the whole machine is blocked. If so, please clean it before starting the engine.
2. Check whether the engine oil type meets the requirements, and replace the engine oil with the correct amount and correct type if necessary.
3. Check whether the resistance of the temperature sensor meets the requirements, and replace the temperature sensor if necessary.
4. Check whether the fuel type is selected correctly, and replace the fuel if necessary.
5. Check whether the oxygen sensor is faulty and replace it if necessary.
6. Check whether air intake manifold bolt loose to cause lean fuel, repair or replace if necessary.

## 10.2.2 Code 4 - Over Crank Fault

**Logic:** Press start switch or use one touch start function, the longest crank will be 15 seconds. Any one crank attempt is not successful, generator set will alarm. Press the start key again to start again and succeed, then clear alarm. Press Stop switch, alarm will also be cleared.

**Possible causes:** no fuel, no or tool little oil, low battery voltage, ignition coil or spark plug fail, starting motor stuck, controller fail, ECU fail.

**Diagnosis and solution:**

1. Check whether the fuel tank is filled with fuel, whether the fuel pump works normally, whether the connection line is normal, whether the 12 V power supply of the fuel pump works.
   If fuel pump fails, replace the oil pump if necessary.
2. Check if oil level meet requirement, otherwise add or drain oil to make oil at between high and low level.
3. Check whether the battery starting voltage is lower than 8V, whether the battery power cable is connected Reliably. If fails, charge or replace the battery.
4. Check whether the igniter or spark plug works normally, whether the connecting wire is normal, whether the igniter discharges normally. If fails, replace the igniter or spark plug.

5. Check whether the starting motor works normally, whether the connecting wire is connected reliably, whether the motor is stuck or the speed is too low. If fails, replace the starting motor.
6. Check whether the light on the top surface of controller is on, or ECU works normally, and whether the connecting wire is connected reliably.
   If light on controller is off after power supply, then check controller and replace it if necessary
   If ECU fails, Replace ECU if necessary.

### 10.2.3 Code 6 - Low Oil Level

**Logic:** Oil level below minimum operating level, oil level sensor voltage signal is lower than 0.5V

**Possible causes:** oil level sensor, connecting wire, ECU

**Diagnosis and solution:**

1. Check oil and add oil to required level if necessary.
2. Check whether the connecting wire is short-circuit to the ground, and replace the connecting wire if necessary.
3. Check whether the oil level sensor is short-circuit, and if oil level meet spec., then possible cause is sensor fails, replace the oil level sensor if necessary.
4. Check whether ECU P13 and P27 are short-circuited, and replace ECU if necessary.

### 10.2.4 Code 12 - Output Over voltage

**Logic:** Output voltage is over 130V, then alarm and no power output but no shut down of genset

**Possible causes:** the inverter is abnormal

**Diagnosis and solution:**

1. Replace the inverter.

### 10.2.5 Code 13 - Output Under Voltage

**Logic:** 240V status and output voltage ≤216V, if continue 8s, then alarm. If 100ms continuous monitoring voltage below 60V, then shut off power output

120V status and output voltage ≤108V, if continue 8s, then alarm. If 100ms continuous monitoring voltage below 30V, then shut off power output

**Possible causes:** over load, the line connection is not reliable, the inverter is abnormal, alternator is abnormal

**Diagnosis and solution:**

1. Reduce power load.
2. Check whether the line connection is reliable.
3. Replace the inverter.
4. Replace the motor.

5. Check whether the engine speed meets the requirements.

| Speed (±100 rpm) | 2200 | 2350 | 2500 | 2650 | 2800 |
|---|---|---|---|---|---|
| Load（%） | 0 | 25% | 50% | 75% | 100% |

## 10.2.6 Code 14 – Output Over Frequency

**Logic:** if the output frequency of the generator set is more than 63 Hz, alarm and protection will no output but no genset shut down.

**Possible cause:** the inverter is abnormal

**Diagnosis and solution:**

1. Replace the inverter.

## 10.2.7 Code 15 – Output Under Frequency

**Logic:** if the output frequency of the generator set is less than 57Hz, alarm and protection will no output but no genset shut down.

**Possible cause:** the inverter is abnormal

**Diagnosis and solution:**

1. Replace the inverter.

## 10.2.8 Code 19 - Actuator Circuit Fault

**Logic:** The Stepper motor driver detected either of the following conditions: over temperature, shorted load (Stepper wires shorted to each other), short to ground, short to B+. Output current of step motor is over 2.3A

**Possible causes:** Throttle body sensor, stepper motor, connecting wire, ECU, throttle combination

**Diagnosis and solution:**

1. Check whether the connector of the three-in-one sensor and the stepper motor is loose or damaged, and repair or replace the connector if necessary.
2. Check whether throttle position sensor is open, short to ground, short to B+, otherwise, replace TPS.
3. Check whether the ECU P11 and P27 have 5V voltage, and replace the ECU if necessary.
4. Check whether stepper motor is open or over current, otherwise, replace stepper motor.
5. Check whether the throttle combination door plate and stepper motor are stuck, and repair or replace the throttle combination if necessary.

## 10.2.9 Code 25 - Alternator Over Voltage

**Logic:** DC rail voltage of inverter exceeded 250V, genset will be no output but don't shut down genset, need to restart for recovery

**Possible cause:** the inverter is abnormal, the motor is abnormal

**Diagnosis and solution:**

1. Replace inverter.
2. Replace alternator

## 10.2.10 Code 26 - Alternator Under Voltage

**Logic:** DC rail voltage of inverter is below 150V, genset will be no output but don't shut down genset, need to restart for recovery

**Possible causes:** the load is too large, connector loose, the generator output voltage is too low, the engine speed is too low, the inverter is abnormal, alternator is abnormal

**Diagnosis and solution:**

1. Reduce the load power.
2. Check whether the line connection is reliable.
3. Replace inverter.
4. Replace alternator.
5. Check whether the engine speed meets the requirements.

## 10.2.11 Code 27 - PMA Sense Lost

**Logic:** Unable to determine internal system frequency. Genset will be no output but don't shut down genset, need to restart for recovery

**Possible cause:** Abnormal inverter

**Diagnosis and solution:**

1. Re-start, if still no output, then change inverter

## 10.2.12 Code 29 - High Battery Voltage

**Logic:** when the one-button start module detects that the battery voltage is ≥ 20 V for 5 seconds, then alarm. And the controller will be no output and genset will shut down. Need to re-start for recovery.

**Possible cause:** The charger voltage is too high, and the battery does not meet the specifications.

**Diagnosis and solution:**

1. Disconnect the charger.
2. Check the open circuit voltage of the battery, and replace the battery if necessary.

## 10.2.13 Code 31 – Engine Over Speed

**Logic:** Engine speed greater than 3700 RPM, then alarm and shut down genset.

**Possible causes:** connecting wire, TPS, throttle combination, ECU

**Diagnosis and solution:**

1. Check whether the connecting wire and grounding wire are loose, and tighten them if necessary.
2. Check whether the three-in-one sensor is installed loosely and tighten it if necessary.
3. Replace the ECU

## 10.2.14 Code 34 - Inverter temperature Exceeded Limit

**Logic:** If the internal temperature of the inverter is ≥ 95 ℃, Genset will be no output but don't shut down genset, need to restart for recovery

**Possible cause:** air in or out blocked to cause the inverter cannot dissipate heat effectively, the inverter is abnormal

**Diagnosis and solution:**

1. Check whether the air duct of the whole machine is blocked. If so, please clean it before starting the engine.
2. Replace the inverter.

## 10.2.15 Code 36 - Abnormal Genset Shutdown

**Logic:** No other fault code occur, but genset abnormal shut down. Another logic, it's combined with ignition coil fault such as primary winding open circuit of ignition coil. Output current from ECU for ignition coil over 9A-11A

**Possible cause:** no fuel, connectors loose, Ignition coil failure, Controller or ECU failure.

**Diagnosis and solution:**

Read the fault code with OBD fault diagnosis instrument:

| Possible cause | J1939 | | Maintenance Notes (Follow the sequence below for check or repair) |
|---|---|---|---|
| | SPN | FMI | |
| No other fault code occur, but genset abnormal shut down | 110 | 2 | 1. Check fuel supply<br>2. Check whether connectors connected reliably<br>3. Check other abnormal items such as lift pump, IPM pump. |
| Primary winding open circuit of ignition coil | 1268 | 4 | 1. Check whether connector connected reliably<br>2. Check ignition coil per section 8.6.1, replace ignition coil if fails<br>3. Replace ECU<br>4. Replace the wiring harness |
| overcurrent from ECU for ignition coil | 1268 | 3 | |

## 10.2.16 Code 38 - Over Current (Field Overload)

**Logic:** output current ≥ 30.5A and alarm after 60 seconds. output current ≥ 35.4A and alarm after 15 seconds. Genset will be no output but don't shut down genset, need to restart for recovery

**Possible causes:** overload, wire loose, abnormal inverter

**Diagnosis and solution:**

1. Reduce power load.
2. Detect whether the output line is loose
3. Replace the inverter.
4. Replace the motor.

## 10.2.17 Code 43 - ECU Fault

**Logic**: Indicates the ECU has a problem.

**Possible causes:** ECU, connecting wire

**Diagnosis and solution:**

1. Check whether connector related loose, and replace the connecting wire if necessary.
2. Replace the ECU.

## 10.2.18 Code 45 - Speed Sense Lost

**Logic:** one-touch start module cannot detect the engine speed

**Possible causes: I**gnition coil, abnormal circuit connection or controller failure, flywheel fails.

**Diagnosis and solution:**

1. Replace the ignition coil.
2. Check whether the line connection is reliable, replace the wiring harness if necessary.
3. Replace the crankshaft sensor and flywheel.
4. Replace the controller.

## 10.2.19 Code 52 - Fuel Injector Or IPM Pump Circuit Fault

**Logic:** Fuel injector, fuel pump open circuit, short circuit, over current or over temperature

**Possible causes:** Connecting wire loose, high pressure fuel pump, fuel injector, ECU

**Diagnosis and solution:**

1. Check whether the fuel pump and fuel injector connectors are loose or damaged, and repair or replace them if necessary.
2. Read the fault code with OBD fault diagnosis instrument:

| Detailed Possible Causes | J1939 | | Maintenance Notes (Follow the sequence below for check or repair) |
|---|---|---|---|
| | SPN | FMI | |
| fuel pump output open circuit | 931 | 2 | 1.Replace the fuel pump;<br>2.Replace the ECU |
| fuel pump output current is over 3A-6A. | | | |
| fuel pump short circuit to ground | | | |
| Fuel pump driver in ECU temperature is over 155℃ - 185℃ | | | |
| injector output open circuit | 651 | 2 | 1.Replace the fuel injector<br>2.Replace the ECU |
| injector output current is over 1.6A-3A. | | | |
| injector short circuit to ground | | | |
| Injector driver in ECU temperature is over 155℃ - 185℃ | | | |

## 10.2.20 Code 53 - Oil Temperature Sensor Circuit Fault

**Logic:** Oil temperature sensor voltage signal is greater than 4.85 V or less than 0.05 V

**Possible causes:** oil temperature sensor open circuit or short circuit to 5V, 12V or short circuit to ground, connecting wire fails or connector loose, ECU fails

**Diagnosis and solution:**

1. Check whether there is resistance at both ends of the oil temperature sensor, and replace the sensor if necessary.
2. Check whether the oil temperature sensor end and ECU end of the connecting wire are connected, and replace the connecting wire if necessary.
3. Check whether the ECU pin is bent or broken, and replace the ECU if necessary.

## 10.2.21 Code 54 - MAT Sensor

**Logic:** Intake air temperature sensor voltage signals greater than 4.85 V or less than 0.05 V

Pressure sensor voltage is more than 4.8V or lower than 0.2V.

**Possible causes:** three-in-one sensor, connecting wire, ECU

**Diagnosis and solution:**

1. Check whether there is resistance between the temperature pin angle and the grounding pin angle in the three-in-one sensor, and replace the three-in-one sensor if necessary.
2. Check whether the temperature needle angle end and ECU end in the three-in-one sensor of the connecting wire are connected, and replace the connecting wire if necessary.
3. Check whether the ECU pin is bent or broken, and replace the ECU if necessary.

## 10.2.22 Code 57 - Over Prime Or Fuel Pressure Fault Or The LPG Solenoid Valve Fault

**Logic:** If the STOP key is used to pre-pump fuel for more than 3 minutes, then it alarm and stop pumping fuel.

LP pressure sensor voltage is more than 4.8V or lower than 0.2V

Open circuit or short circuit of the LP solenoid valve

**Possible cause:** Pre-pump oil exceeds the specified time, LP pressure failure, The LP solenoid valve is faulty

**Diagnosis and solution:**

Read the fault code with OBD fault diagnosis instrument:

| Detailed possible causes | J1939 | | Maintenance Notes (Follow the sequence below for check or repair) |
|---|---|---|---|
| | SPN | FMI | |
| Prime fuel for more than 3 minutes | 4083 | 8 | 1. Release STOP key to stop priming fuel |
| High LP pressure and voltage | 1390 | 2 | 1. Check LPG tank pressure whether between 9-13 inch water column (2.2-3.2Kpa), adjust or change LPG tank.<br>2. Replace LPG pressure sensor<br>3. Replace the ECU |
| Low LP pressure voltage | | | |
| LP solenoid Valve Open the circuit | 6181 | 2 | |

| | | | |
|---|---|---|---|
| LP solenoid valve Over current | | | 1. Check solenoid whether open or short circuit to ground, replace it if necessary<br>2. Check the wire connection, repair or replace if necessary<br>3. Check if solenoid current over 1.6-3A, replace solenoid.<br>4. If ECU driver temp is over 155-185 C degree, the ECU fails, replace it. |
| LP solenoid valve short circuit to ground | | 2 | |
| LP solenoid valve over heat | | | |

## 10.2.23 Code 73 - AC Output Circuit Fault

**Logic:** Short circuit between hot wire and hot wire. Short circuit between hot wire and neutral wire. Genset will be no output but don't shut down.

**Possible cause:** outside load short circuit, output wire short circuit, inverter fails

**Diagnosis and solution:**

1. Disconnect load, detect whether the outside load is short circuit
2. Detect whether the output line is short circuit., and replace the output line if necessary
3. Replace the inverter

## 10.2.24 Code 81 - Alternator Stator Circuit Fault

**Logic:** no output and genset no shut down, short circuit detected from alternator

**Possible cause:** alternator short circuit

**Diagnosis and solution:**

1. Replace the alternator

## 10.2.25 Code 85 - Oxygen Sensor Circuit Fault

**Logic:** Indicates that the oxygen sensor is not working properly

**Possible cause:** oxygen sensor, connecting wire, ECU

**Diagnosis and solution:**

1. Check whether the connector is loose or damaged, repair or replace it if necessary.
2. Replace the oxygen sensor
3. Check whether the ECU pin is bent or broken, and replace the ECU if necessary.

## 10.3 Symptom Based

Diagnosis of some problems involves observing system operation.

### 10.3.1 Status Indicator Not Working

Indicates that there could be faulty connections or no battery voltage.

#### A. Check Other Control Switch

Try the generator set control switch if the remote control switch start doesn't work, and vice versa.

#### B. Check Battery

1. Clean and tighten the positive (+) and negative (–) battery cable connections at the battery and at the generator set.
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.

### 10.3.2 Starting Batteries Run Down

Indicates problem with batteries, connections, charging system, or parasitic loads.

#### A. Check Battery

1. Clean and tighten the positive (+) and negative (–) battery cable connections at the battery and at the generator set.
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.

#### B. Battery Charging System

Install or service a battery charging system in the vehicle.

### 10.3.3 Starter Engages-Disengages

Indicates cranking voltage dips below 6 Volts.

#### A. Use Vehicle to Start Generator Set

Run the vehicle propulsion engine while trying to start the generator set—the battery charging alternator may be able to maintain starting voltage high enough to start the generator set.

#### B. Check Battery

1. Clean and tighten the positive (+) and negative (–) battery cable connections at the battery and at the generator set.
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.

### C. Change Battery Cables

Increase battery cable size or run parallel cables.

## 10.3.4 No Power—Generator Set Running, Status Light On

Indicates line circuit breaker is **OFF**, or tripped due to short circuit or overload.

### A. Check Line Circuit Breakers

1. Turn on or reset the line circuit breaker on the generator set.
2. Turn on or reset the line circuit breaker on the main distribution panel in the vehicle.

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# 11 Appendix A. Wiring Diagrams

## Table of Contents

## 11.1 Electrical Schematic drawing

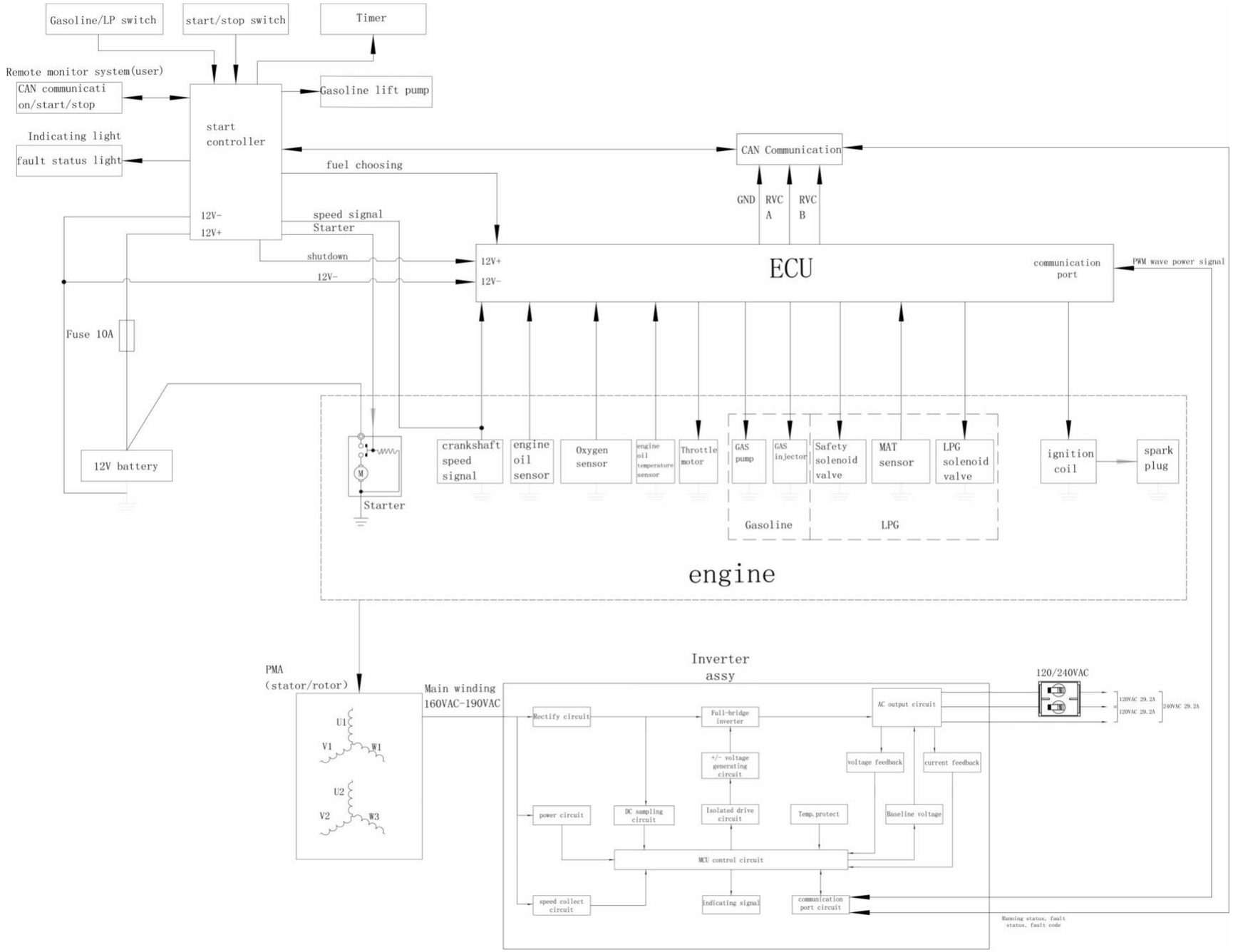


**Figure 35. Electrical Schematic**

## 11.2 Wiring Diagram

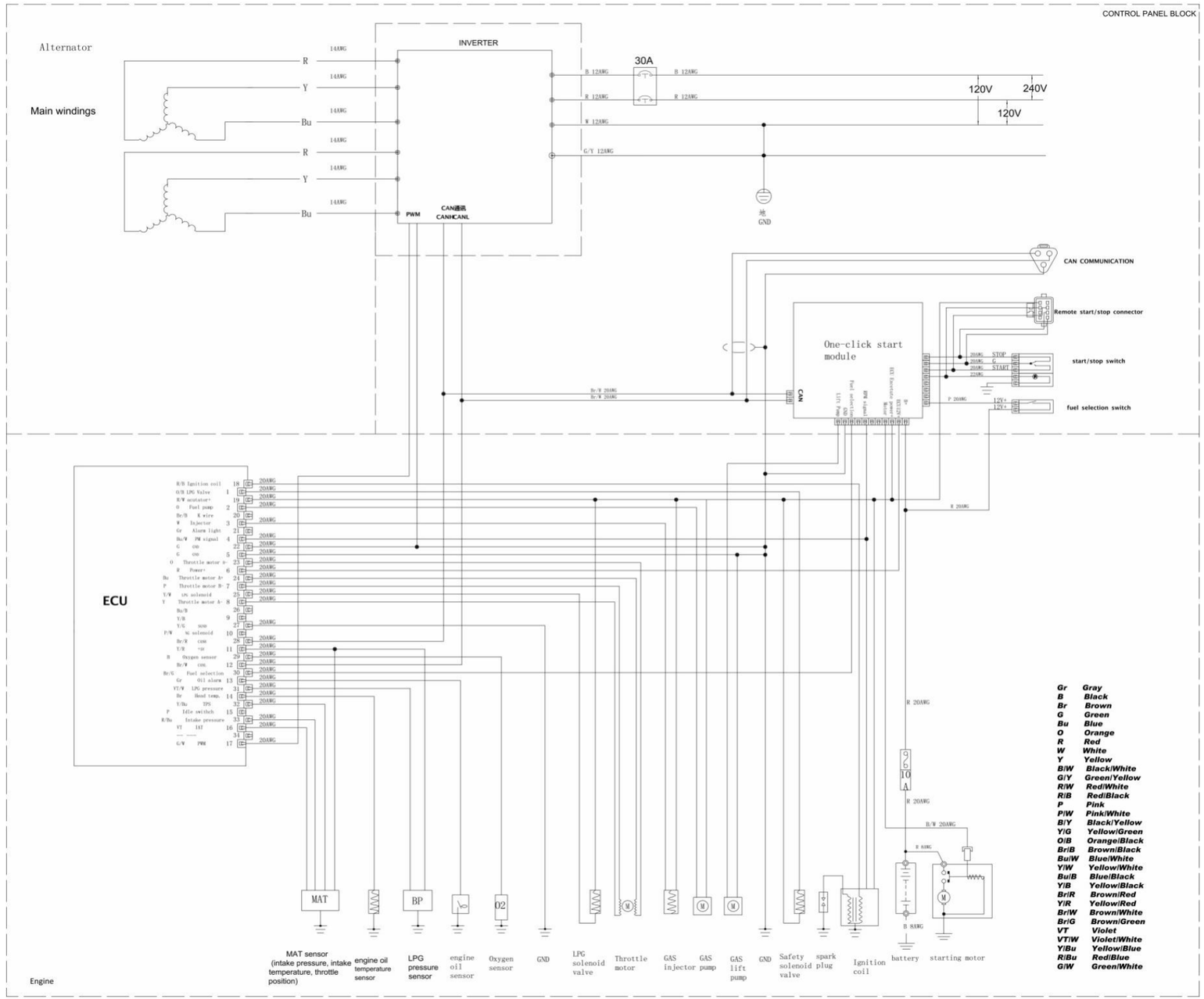


**Figure 36. Wiring Drawing**

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