



# **Service Manual**

## **Onan Generator Set for RV**

HDZAA (Spec A–E)



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# SAFETY PRECAUTIONS

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

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 that will result in severe personal injury or death.

**⚠ WARNING** alerts you to a hazard or unsafe practice that can result in severe personal injury or death.

**⚠ CAUTION** alerts you to a hazard or unsafe practice that 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.

## ENGINE EXHAUST IS DEADLY

- Inspect for exhaust leaks at every startup and after every eight hours of running.
- Learn the symptoms of carbon monoxide poisoning in the generator set Operator's Manual.
- Never sleep in the vehicle while the generator set is running unless the vehicle is equipped with a working carbon monoxide detector.
- Do not operate the generator set when the vehicle is parked in a confined space, such as a garage.
- The exhaust system must be installed in accordance with the generator set Installation Manual.

- Engine cooling air must not be used for heating the vehicle.

## GENERATOR VOLTAGE IS DEADLY

- Disable the automatic generator set feature (AGS) of an inverter-charger or other automatic starting device before servicing the generator set to avoid electric shock from an unexpected start.
- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The generator set must not be connected to shore power (utility). Back-feed to shore power can cause electrocution 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, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

## DIESEL FUEL IS COMBUSTIBLE

- 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 flames, sparks, pilot lights, arc-producing equipment and all other sources of ignition well away.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.

## MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

## **BATTERY GAS IS EXPLOSIVE**

- Wear safety glasses.
- Do not smoke.
- To reduce arcing when disconnecting or reconnecting battery cables, always disconnect the negative (-) battery cable first and reconnect it last.

## **FLAMMABLE VAPORS CAN BE IGNITED BY OPERATION OF COACH ELECTRICAL SYSTEMS AND CAUSE DIESEL ENGINES TO OVERSPEED**

- Stop the generator set before fueling the coach to reduce the risk of igniting flammable vapors.
- Do not operate the diesel-powered generator set where there are or can be flammable vapors created by fuel spills, gas leaks, etc. Flammable vapors drawn into a diesel engine air intake system can cause the engine to overspeed, which can result in fire, explosion and equipment damage. The owners and operators of the generator set are solely responsible for safe operation.

## **GENERAL PRECAUTIONS**

- Keep children away from the generator set.
- Do not use evaporative starting fluids. They are highly explosive.
- To prevent accidental or remote starting while working on the generator set, press the Stop button and disconnect the battery cables at

the batteries to prevent starting during maintenance and service. (Always disconnect negative [-] first and reconnect last to prevent sparks between tools and vehicle frame.)

- Keep the generator set and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Make sure all fasteners are secure and torqued properly.
- Do not work on the generator set when mentally or physically fatigued or after consuming alcohol or drugs.
- You must be trained and experienced to make adjustments while the generator set is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Keep multi-class ABC fire extinguishers readily at hand. Class A fires involve ordinary combustible materials such as wood and cloth. Class B fires involve combustible and flammable liquids and gaseous fuels. Class C fires involve live electrical equipment. See NFPA No. 10 (Portable Fire Extinguishers) or equivalent—BS EN 3-7:2004.
- Generator set installation and operation must comply with all applicable local, state and federal codes and regulations.

# 1. Introduction

## ABOUT THIS MANUAL

This is the Service Manual for the generator sets listed on the front cover.

**⚠WARNING** *This generator set is not a life support system. It can stop without warning. Children, persons with physical or mental limitations, and pets could suffer personal injury or death. A personal attendant, redundant power or alarm system must be used if generator set operation is critical.*

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

*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.*

## NAMEPLATE

Be ready to provide the generator set model and serial numbers on the nameplate when contacting Cummins for parts, service or information. Figure 1-1 illustrates typical model and serial numbers.

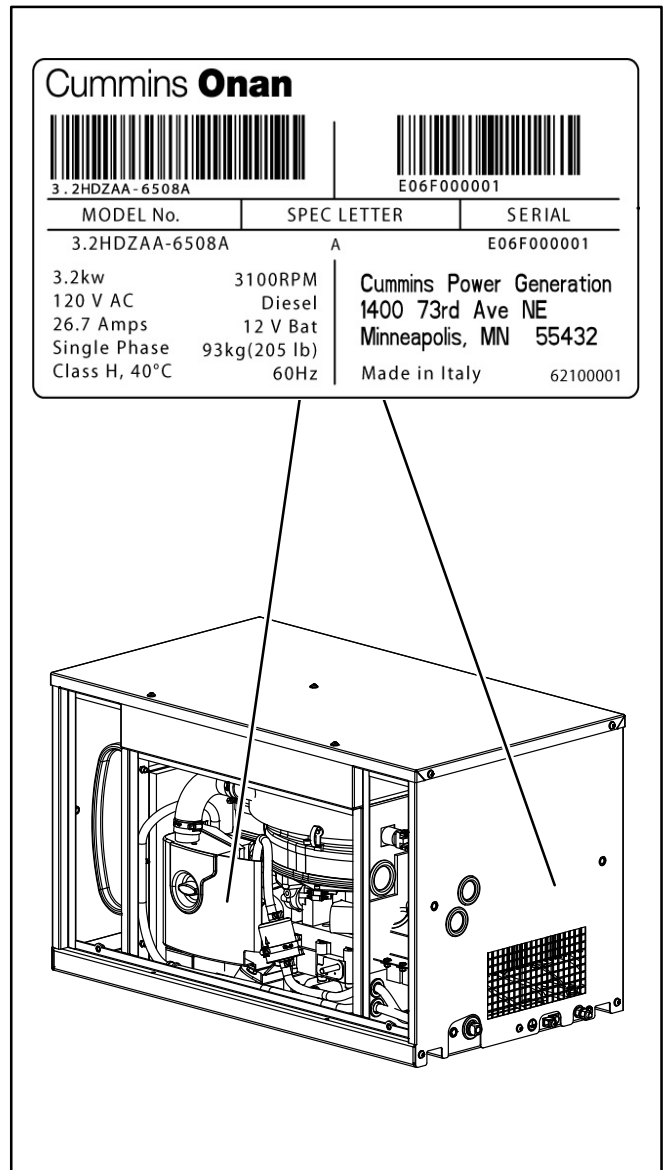
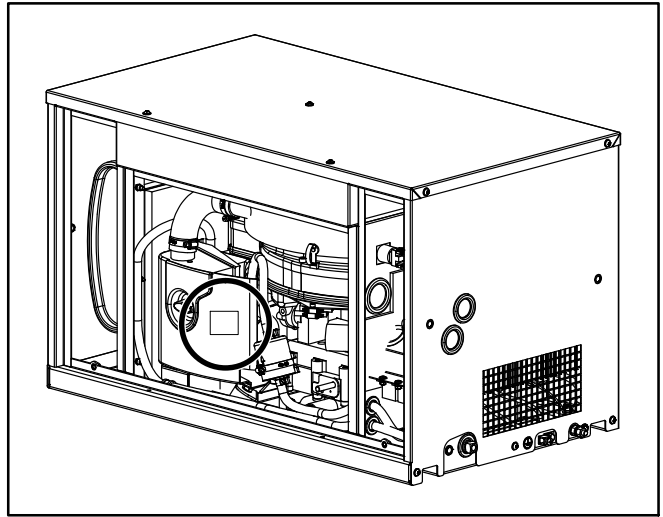


FIGURE 1-1. TYPICAL NAMEPLATE

## ENGINE EMISSIONS COMPLIANCE

The label that states compliance with applicable engine emissions regulations is located on the air cleaner cover as shown circled in Figure 1-2. Refer also to the FEDERAL EMISSION DESIGN AND DEFECT LIMITED WARRANTY FOR C. I. ENGINES (DIESELS) that was shipped in the same package as the Operator's Manual.



**FIGURE 1-2. EMISSIONS LABEL LOCATION**



## TYPICAL GENERATOR SET

Figure 1-3 illustrates a typical generator set showing connection points and maintenance access.

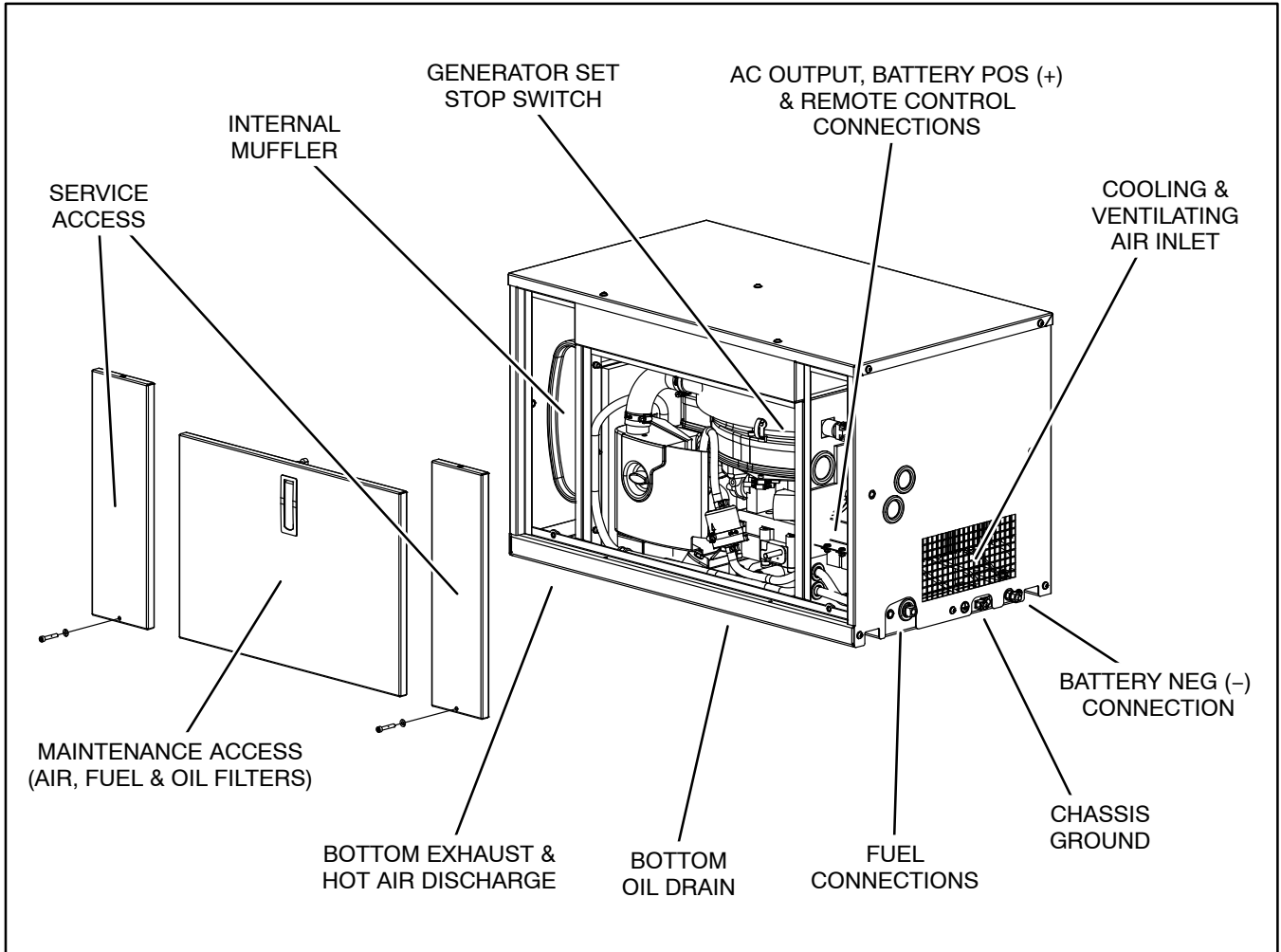


FIGURE 1-3. TYPICAL GENERATOR SET

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# 2. Operation

## RECOMMENDED FUEL

**⚠️WARNING** Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near fuel tanks or fuel-burning equipment or in areas sharing ventilation with such equipment. Keep flames, sparks, pilot flames, electrical arcs and switches and all other sources of ignition well away. Keep a multi-class ABC fire extinguisher handy.

High quality Grade 2-D diesel fuel is necessary for good performance and long engine life. Diesel fuels specified by ASTM D975 or EN 590 are recommended. Use Grade 1-D diesel fuel when ambient temperatures are below freezing. The fuel should have a Cetane number of at least 45 for reliable starting.

**Note:** Ultra Low Sulfur Diesel (ULSD) fuel that meets the ASTM D975 standard for lubricity is suitable for use with this generator set. The 1 to 2 percent less energy content of the fuel can have a slight effect on maximum engine power.

**Note:** B5 Bio-Diesel fuel that meets industry specifications and quality is suitable for use with this generator set.

## RECOMMENDED ENGINE OIL

Use API (American Petroleum Institute) performance Class **CH-4** or better engine oil or better. Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 2-1, choose the viscosity grade appropriate for the ambient temperatures expected until the next scheduled oil change. Multi-grade oils such as SAE 15W-40 are recommended for year-round use.

See Section 6. Specifications for oil capacity.

## STARTING BATTERIES

The generator set requires a 12 volt battery to power its control and starting circuits. Reliable generator set starting and starter service life depend upon adequate battery system capacity and maintenance.

See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 3-2) and Section 6. Specifications for minimum battery ratings.

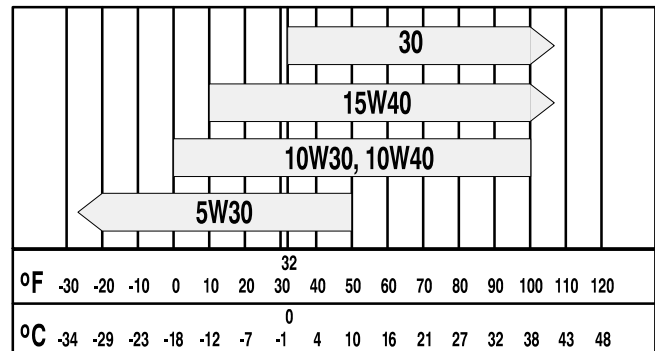


FIGURE 2-1. OIL VISCOSITY VS. TEMPERATURE

## STOP SWITCH

Press the stop switch (Figure 2-2) to stop the generator set or to prevent it from starting while performing maintenance and service. To allow the generator set to run, press the switch again. The switch

must stay in its “1” position for the generator set to run.

**Note: This is not a start switch. The generator set can only be started using the remote operator panel (p. 2-3).**

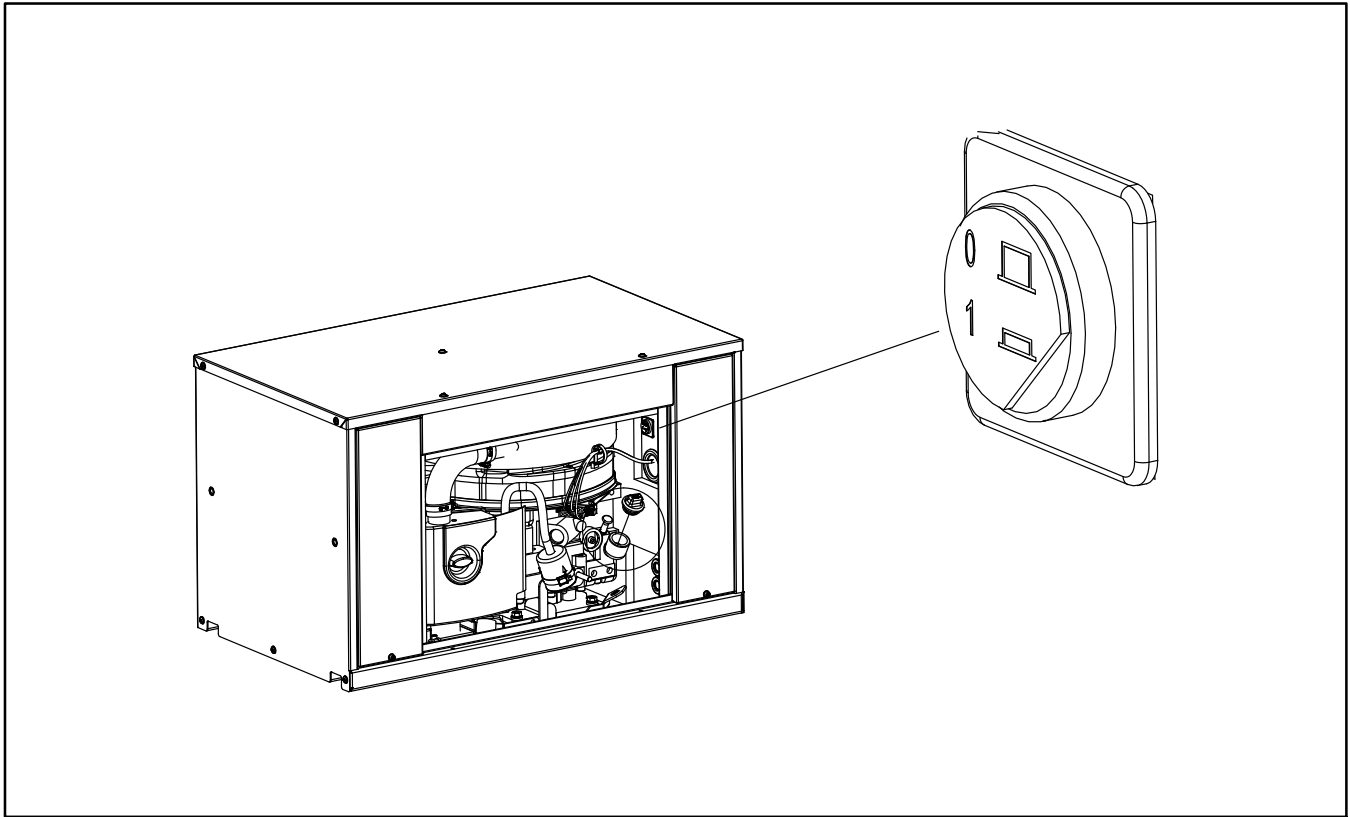


FIGURE 2-2. STOP SWITCH

## REMOTE OPERATOR PANEL

The remote operator panel (Figure 2-3) has the following features:

**Display ON / Gen OFF Button** – Press this button to wake the generator set and display screen prior to pressing the START button. This also starts the fuel pump, which will prime the fuel system for five minutes if the generator set does not start.

Press this button to stop the generator set.

**START Button** – To start the generator set, press and hold this button when “GEN OFF” appears on the display screen after having pressed the Display ON button.

**Display Screen** – The display screen displays generator set status, battery voltage, hours run and warning and shutdown messages (see *Section 5. Troubleshooting*).

**Low Oil Indicator Light** – This light warns that engine oil pressure is low or temperature is too high.

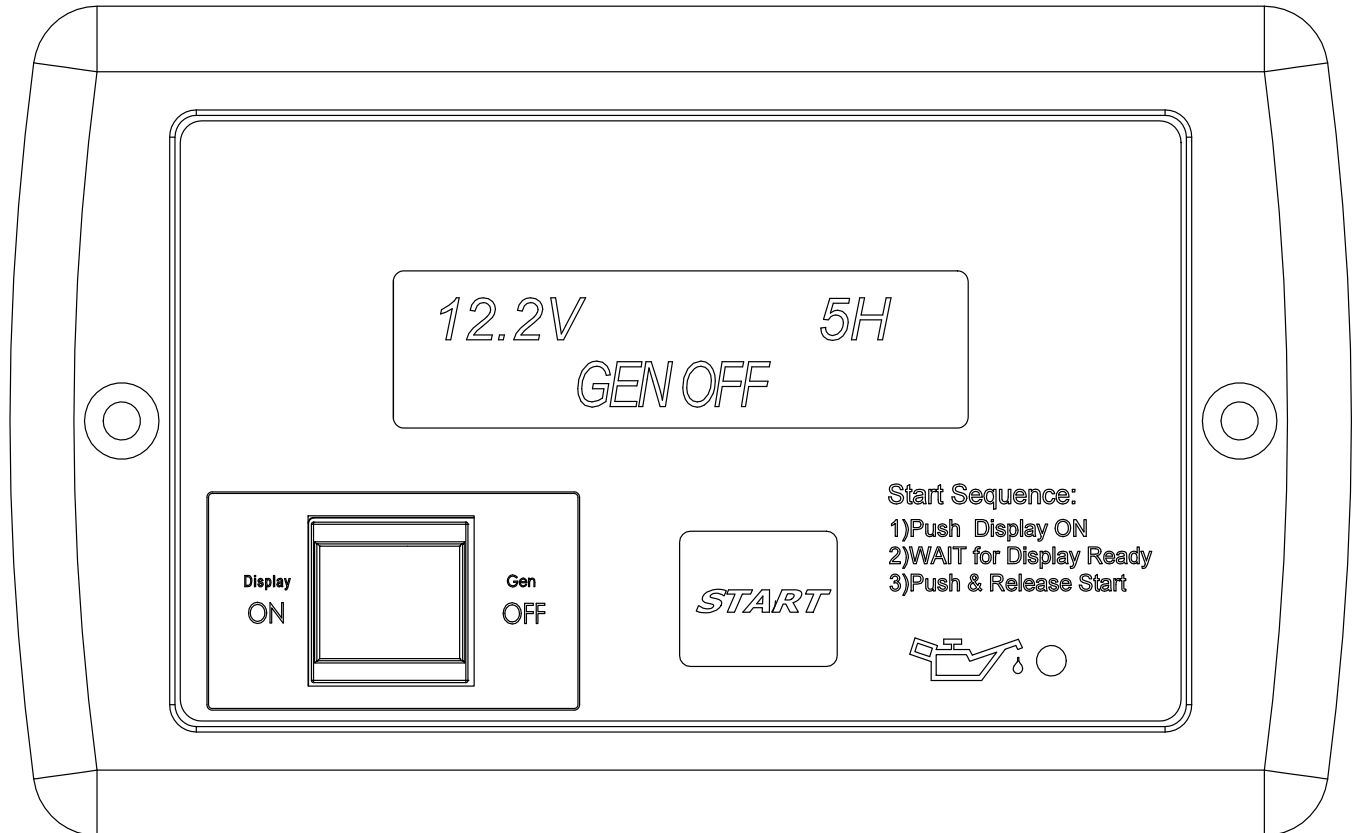


FIGURE 2-3. OPERATOR PANEL

## REMOTE CONTROL PANEL

Cummins offers three remote control kits as follows:

- Remote switch with status indicator light only (Figure 2-5).
- Remote switch with status indicator light and hour meter (Figure 2-6).
- Remote switch with status light indicator light and DC voltmeter (Figure 2-7).

The hour meter records genset operating time in hours. It cannot be reset. See the PERIODIC MAINTENANCE SCHEDULE (Page 3-1).

The DC voltmeter indicates whether voltage across the 12 VDC control system and battery is normal. If the indicator consistently stays above or below the normal zone, see MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (Page 3-1).

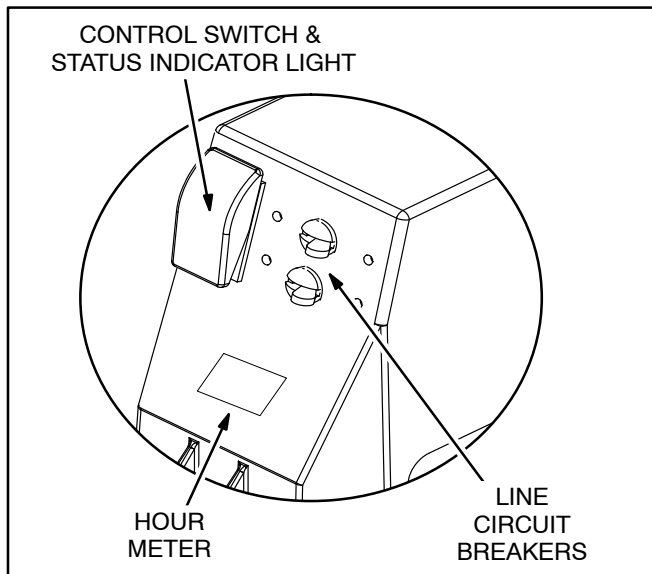


FIGURE 2-4. GENSET CONTROL PANEL

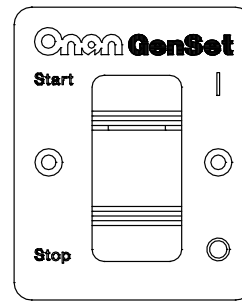


FIGURE 2-5. REMOTE SWITCH

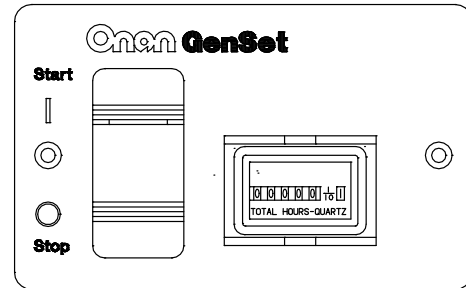


FIGURE 2-6. REMOTE SWITCH / HOUR METER

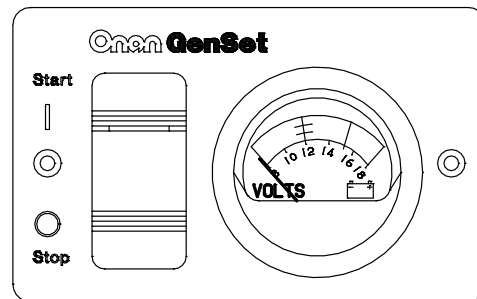


FIGURE 2-7. REMOTE SWITCH / DC VOLTMETER

**⚠WARNING** **EXHAUST GAS is deadly. All engine exhaust contains carbon monoxide; an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:**

- **Dizziness**
- **Headache**
- **Nausea**
- **Weakness and Sleepiness**
- **Vomiting**
- **Inability to Think Coherently**

**IF YOU EXPERIENCE ANY OF THESE SYMPTOMS, GET INTO FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the generator set and do not operate it until it has been inspected and repaired.**

**Never occupy the vehicle while the generator set is running unless the vehicle has a working carbon monoxide detector. The exhaust system must be installed in accordance with the generator set Installation Manual. Make sure there is ample fresh air when operating the generator set in a confined area.**

## PRE-START CHECKS

Before the first start of the day and after every eight hours of operation, inspect the generator set as instructed under GENERAL INSPECTION (p. 3-2). Keep a log of maintenance and the hours run and perform any maintenance that may be due. See Returning the Generator Set to Service (p. 2-8) if the vehicle has been in storage.

Before each start:

1. Make sure all vehicle carbon monoxide (CO) detectors are working.
2. Check for fuel and oil leaks and damage to the exhaust system.
3. To prevent overheating and to reduce fouling with dust and debris, make sure the generator set's normal ground clearance is not being reduced by sloping ground, curbs, logs or other objects. Repark the vehicle if necessary and/or

remove any objects blocking the air inlet or air outlet.

4. Turn off air conditioners and other large appliances.

## STARTING

1. Perform the PRE-START CHECKS.
2. Start the generator set at the remote operator panel.
  - A. Press and release the Display ON button.
  - B. **Wait** for "GEN OFF" to appear. If the generator set ran out of fuel and it is necessary to prime the fuel system, wait at least one minute before pressing the START button to allow the fuel pump to prime fuel.
  - C. Press and hold the START button until the generator set starts. The generator set will make up to three attempts to start. "GEN ON" will appear on the display screen when the generator set starts. "GEN WAIT" will appear during rest periods between start attempts.
3. Press the GEN OFF button to reset the control if the generator set does not start after three attempts. See *Section 5. Troubleshooting* if the generator set still does not start.
4. Let the generator set warm up a few minutes until it is running smoothly before connecting the vehicle electrical loads (appliances).
5. Check for fuel, oil and exhaust leaks. Stop the generator set immediately if there is leak and have it repaired.

## STOPPING

Run the generator set under no load for a few minutes to allow the engine to cool down and then press and release the Gen OFF button.

## LOADING THE GENERATOR SET

The generator set can power AC motors, air conditioners, AC/DC converters, battery chargers and other appliances. How much appliance load\* can be powered depends upon the generator set power rating. The generator set will shut down if the sum of the loads exceeds generator set power. See *Section 5. Troubleshooting*.

To avoid overloading the generator set and causing shutdowns, compare the sum of the loads of the appliances that are likely to be used at the same time to the power rating of the generator set. **It may be necessary to run fewer appliances at the same time—the sum of the loads must not be greater than generator set rating.**

The generator set may shut down due to overload when a large motor or air conditioner is started or cycles off and then on again, even though the sum of the loads is less than generator set rating. The reason for this is that a motor's startup load is much larger than its running load. **It may be necessary to run fewer appliances when large motors and air conditioners are cycling on and off.**

**TABLE 2-1. TYPICAL APPLIANCE LOADS**

| Appliance                  | Load (watts) |
|----------------------------|--------------|
| Air Conditioner            | 1400-2000    |
| Battery Charger            | Up to 3600   |
| DC Converter               | 300-900      |
| Refrigerator               | 600-1000     |
| Microwave Oven             | 1000-1500    |
| Electric Frying Pan or Wok | 1000-1500    |
| Electric Stove Element     | 350-1000     |
| Electric Water Heater      | 1000-1500    |
| Electric Iron              | 500-1200     |
| Electric Hair Dryer        | 800-1500     |
| Coffee Percolator          | 550-750      |
| Television                 | 200-600      |
| Radio                      | 50-200       |
| Electric Drill             | 250-750      |
| Electric Broom             | 200-500      |
| Electric Blanket           | 50-200       |

Maximum power decreases as altitude increases because air density decreases. For every 1000-foot (305 m) increase in elevation you can expect power to decrease approximately 3.5 percent. **It may be necessary to run fewer appliances at higher altitudes.**

**TABLE 2-2. POWER VS. ALTITUDE**

| Altitude<br>(Elevation above Sea Level) | Maximum Power                            |
|---|--|
| at/below 500 ft (152 m)                 | 3200 W (rated)                           |
| at 2500 ft (762 m)                      | 2980 W                                   |
| at 5500 ft (1676 m)                     | 2640 W                                   |
| above 5500 ft (1676 m)                  | 2640 W minus 112 W every 1000 ft (305 m) |

\* Appliance load and generator set power are measured in terms of watts (W) or kilowatts (kW), where 1 kilowatt (kW) = 1000 watts (W).



## RESETTING CIRCUIT BREAKERS

**Note:** The generator set does not have a power output circuit breaker.

If a circuit breaker in the main power distribution panel of the vehicle trips, either a circuit shorted or too many appliances were running.

If a circuit breaker trips, disconnect or turn off as many loads as possible and reset the circuit breaker. (Push the circuit breaker to **OFF** to reset it and then to **ON** to reconnect the circuit.) If the circuit breaker trips right away, either the electrical distribution system has a short or the circuit breaker is faulty. Call a qualified electrician.

If the circuit breaker does not trip right away, reconnect the appliances, one by one, up to a total load that does not overload the generator set.

Electrical appliances and tools must be used and maintained properly and be properly grounded to cause the line circuit breakers to trip when short circuits occur.

**⚠WARNING** *Short circuits in electrical appliances and tools can cause fire and electrical shock leading to severe personal injury or death. Read and follow the equipment and tool manufacturer's instructions and warnings regarding use, maintenance and proper grounding.*

## CONNECTING TO UTILITY POWER

A vehicle with provisions for connecting utility power must have an approved device to keep the generator set and utility from being interconnected. See the generator set Installation Manual for more information.

**⚠WARNING** *Interconnecting the generator set and the public utility can lead to electrocution of utility line workers, equipment damage and fire. Use an approved switching device to prevent interconnections.*

## OPERATING IN COLD WEATHER

Make sure the engine oil viscosity is appropriate for the cold ambient temperatures. See ENGINE OIL RECOMMENDATIONS (p. 2-1). Be sure to change the oil if a sudden drop in temperature occurs.

## OPERATING IN HOT WEATHER

Use diesel fuel appropriate for the ambient temperature.

Pay particular attention to the following items when operating the generator set in hot weather:

1. Make sure nothing blocks airflow to and from the generator set.
2. Make sure the engine oil viscosity is appropriate for the hot ambient temperatures. See ENGINE OIL RECOMMENDATIONS (p. 2-1).
3. Keep the generator set clean.
4. Perform maintenance due. See PERIODIC MAINTENANCE SCHEDULE (p. 3-1).

## OPERATING AT HIGH ALTITUDE

For the effect of altitude on maximum power, see LOADING THE GENERATOR SET (p. 2-6).

## OPERATING IN DUSTY ENVIRONMENTS

Pay particular attention to the following items when operating the generator set in dusty environments:

1. Do not let dirt and debris accumulate inside the generator set compartment. Keep the generator set clean.
2. Perform air cleaner maintenance more often. See PERIODIC MAINTENANCE SCHEDULE (p. 3-1).
3. Change engine oil more often. See PERIODIC MAINTENANCE SCHEDULE (p. 3-1).
4. Keep containers of engine oil that have been opened tightly closed to keep out dust.

## **BREAKING IN A NEW ENGINE**

Proper engine break-in on a new generator set or on one with a rebuilt engine is essential for top engine performance and acceptable oil consumption. See **LOADING THE GENERATOR SET** (p. 2-6).

Proper engine oil and oil level are especially critical during break-in because of the higher engine temperatures that can be expected. Change the oil if not appropriate for the ambient temperatures during break-in. See **ENGINE OIL RECOMMENDATIONS** (p. 2-1). Change the oil after the first 20 hours of operation.

## **EXERCISING THE GENERATOR SET**

Exercise the generator set at least 2 hours each month if use is infrequent. Run the generator set at approximately 1/2 rated power. See **LOADING THE GENERATOR SET** (p. 2-6). A single two hour exercise period is better than several shorter periods.

Exercising a generator set drives off moisture, re-lubricates the engine, replaces stale fuel and removes oxides from electrical contacts. The result is better starting, more reliable operation and longer engine life.

## **STORING THE GENERATOR SET**

Proper storage is essential for preserving top generator set performance and reliability when the generator set cannot be exercised regularly and will be idle for more than 120 days.

## **Storing the Generator Set**

1. Change the engine oil and attach a tag indicating oil viscosity. See **ENGINE OIL RECOMMENDATIONS** (p. 2-1).
2. Disconnect the battery cables (negative [-] cable first) from the starting battery and store the battery according to the battery manufacturer's recommendations. See **MAINTAINING THE BATTERY AND BATTERY CONNECTIONS** (p. 3-2).
3. Plug the exhaust tail pipe to keep out dirt, moisture, bugs, etc.
4. Close the fuel supply valve (if so equipped).

## **Returning the Generator Set to Service**

1. Check the oil tag on the generator set and change the oil if the viscosity indicated is not appropriate for the temperatures expected. See **ENGINE OIL RECOMMENDATIONS** (p. 2-1).
2. Reconnect the starting battery (negative [-] cable last). See **MAINTAINING THE BATTERY AND BATTERY CONNECTIONS** (p. 3-2).
3. Remove the plug from the exhaust tailpipe.
4. Change the air filter element if it is dirty (p. 3-6).
5. Open the fuel supply valve (if so equipped).
6. Inspect the generator set. See **GENERAL INSPECTION** (p. 3-2).

# 3. Periodic Maintenance

Periodic maintenance is essential for top performance and long generator set life. Use Table 3-1 as a guide for normal periodic maintenance. In hot and dusty environments some maintenance procedures should be performed more frequently, as indicated by the footnotes in the table.

Maintenance, replacement or repair of emission control devices and systems may be performed by any engine repair establishment or individual. How-

ever, warranty work must be completed by an authorized Cummins dealer.

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Push the Stop Switch Off and disconnect the battery cables at the batteries to prevent starting during maintenance and service. (Always disconnect negative [-] first and reconnect last to prevent sparks between tools and vehicle frame.)*

**TABLE 3-1. PERIODIC MAINTENANCE SCHEDULE**

| MAINTENANCE TASK  | FREQUENCY          |             |             |               |               |                | Page |
|---|--------------------|-------------|-------------|---------------|---------------|----------------|------|
|   | After First 20 Hrs | Every 8 Hrs | Every Month | Every 250 Hrs | Every 500 Hrs | Every 1000 Hrs |      |
| General Inspection  |                    | •           |             |               |               |                | 3-2  |
| Check Engine Oil Level  |                    | •           |             |               |               |                | 3-3  |
| Check Battery & Battery Connections <sup>1</sup>  |                    |             | •           |               |               |                | 3-2  |
| Change Engine Oil <sup>1, 2, 3</sup>  | •                  |             |             | •             |               |                | 3-4  |
| Replace Engine Air Filter <sup>2, 3</sup>   |                    |             |             |               | •             |                | 3-6  |
| Replace Fuel Filter <sup>3</sup>  |                    |             |             |               | •             |                | 3-8  |
| Adjust Engine Valve Lash <sup>4</sup>   |                    |             |             |               |               | •              | 4-6  |
| Clean the Oil Filter  |                    |             |             |               |               | •              | 3-5  |
| Check Fuel Injector Pressure <sup>4, 5</sup>  |                    |             |             |               |               | •              | 4-6  |
| 1. Perform more often when operating in hot weather.<br>2. Perform more often when operating in dusty conditions.<br>3. Perform at least once a year.<br>4. Must be performed by trained and experienced personnel (authorized Cummins service representatives).<br>5. EPA requirement. |                    |             |             |               |               |                |      |

## GENERAL INSPECTION

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

### Oil Level

Check engine oil level (Figure 3-1).

### 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.*

Look and listen for exhaust system leaks while the generator set is running. Shut down the generator set if a leak is found and 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 and make sure the tailpipe extends at least 1 inch (25.4 mm) beyond the perimeter of the vehicle.

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

Park the vehicle so that the generator set exhaust gases can 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.

### Fuel System

Check for leaks at hose, tube and pipe fittings in the fuel supply system while the generator set is running and while it is stopped. Check 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.

**▲WARNING** *Diesel fuel leaks can lead to fire. Do not operate the generator set if operation causes fuel to leak.*

### Mechanical

Look for mechanical damage and listen for unusual noises. Check the generator set mounting bolts.

To prevent overheating and to reduce fouling with dust and debris, make sure the generator set's normal ground clearance is not being reduced by sloping ground, curbs, logs or other objects. Repark the vehicle if necessary and/or remove any objects blocking the air inlet or air outlet.

## MAINTAINING THE BATTERY AND BATTERY CONNECTIONS

**▲WARNING** *Flames, sparks and arcing at battery terminals, light switches and other equipment can ignite battery gas causing severe personal injury—Ventilate battery area before working on or near battery—Wear safety glasses—Do not smoke—Switch work light ON or OFF away from battery—Stop generator set and disconnect charger before disconnecting battery cables—Disconnect negative (-) cable first and reconnect last.*

Refer to Table 3-1 for scheduled battery maintenance and follow the battery manufacturer's instructions. If battery (DC) voltage is consistently low or high, have the vehicle battery charging system serviced. (The generator set does not recharge the battery.) Always:

1. Keep the battery case and terminals clean and dry and the terminals tight.
2. Use a battery terminal puller to remove the cable clamps on post-type battery terminals.
3. Tighten threaded-stud battery terminals as recommended by the battery manufacturer.
4. 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.

## CHECKING ENGINE OIL LEVEL

**⚠ 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.*

To check engine oil level:

1. Park the vehicle on level ground, shut down the generator set and remove the front access door.

2. Pull out the oil dip stick, wipe it clean, reinsert it and pull it out again to check the oil level (Figure 3-1).

3. Add or drain oil as necessary. See RECOMMENDED ENGINE OIL (p. 2-1). Keep the oil level between the MIN / MAX marks.

**⚠ CAUTION** *Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the MIN / MAX marks.*

4. Reinsert the dipstick and secure the oil fill cap and front access door.

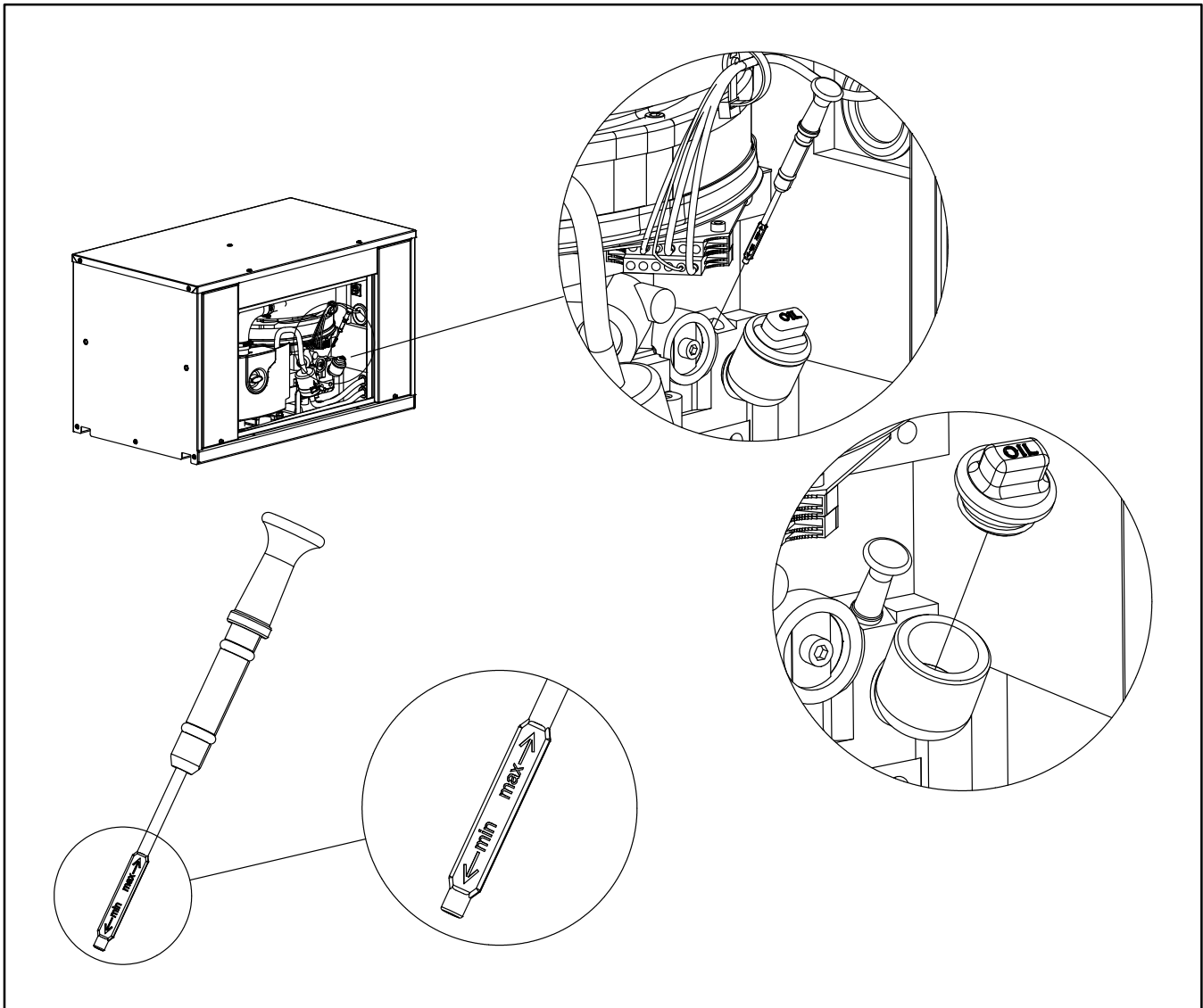


FIGURE 3-1. CHECKING ENGINE OIL LEVEL

## CHANGING ENGINE OIL

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Push the Stop Switch Off and disconnect the battery cables at the batteries to prevent starting during maintenance and service. (Always disconnect negative [-] first and reconnect last to prevent sparks between tools and vehicle frame.)*

Refer to Table 3-1 for scheduled engine oil change. Change oil more often in hot and dusty environments. To change engine oil:

1. Place a pail under the oil drain plug (Figure 3-2).
2. Remove the maintenance access door and the oil fill cap, unscrew the oil drain cap and drain all the oil from the engine. **Reinstall the oil drain cap securely.**
3. Refill with approximately 0.7 quarts of oil, check oil level (Figure 3-1) and secure the front access door.
4. Dispose of the used oil according to local environmental regulations.
5. Secure the front access door.

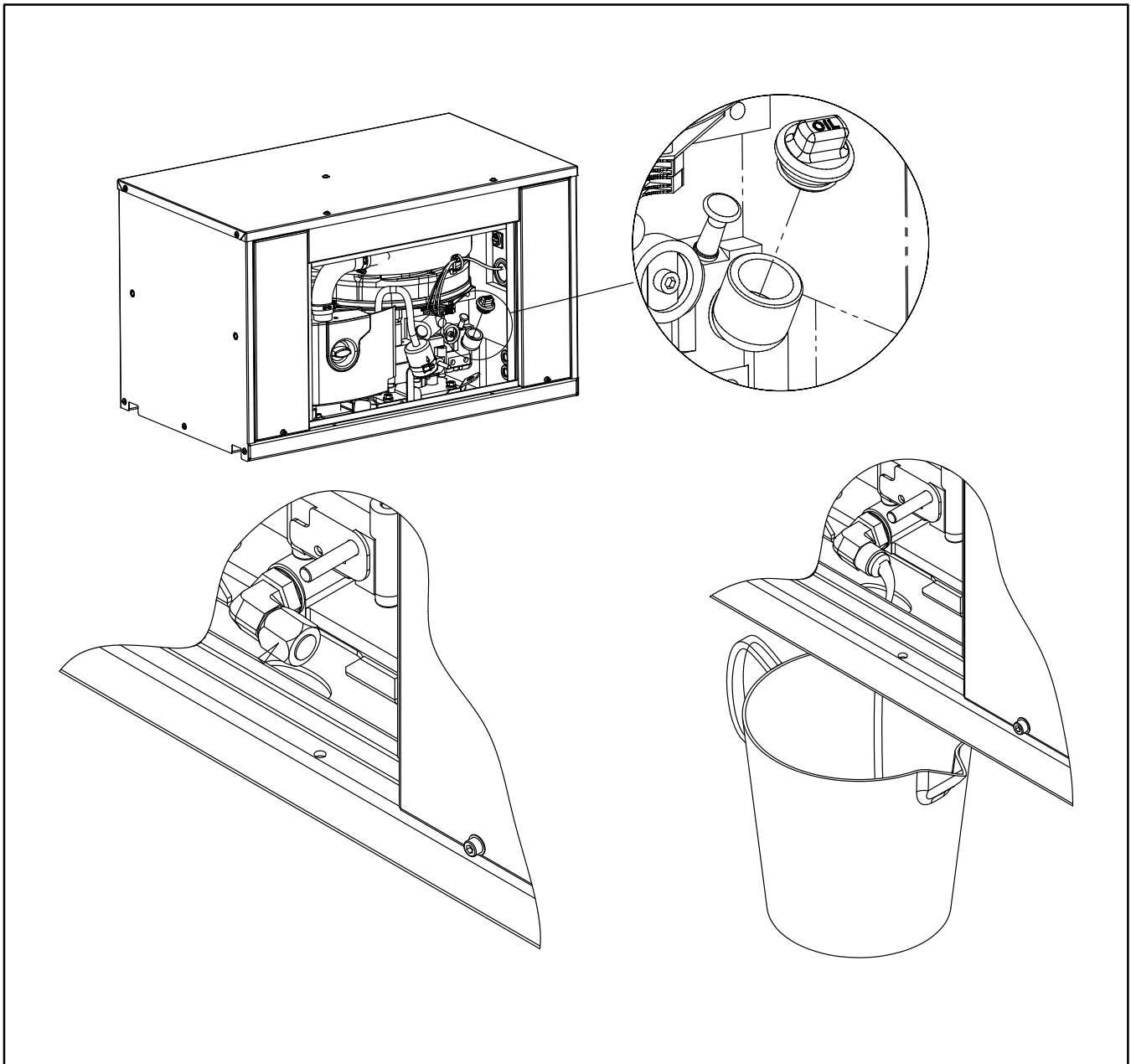


FIGURE 3-2. CHANGING ENGINE OIL

## CLEANING THE ENGINE OIL STRAINER

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Push the Stop Switch Off and disconnect the battery cables at the batteries to prevent starting during maintenance and service. (Always disconnect negative [-] first and reconnect last to prevent sparks between tools and vehicle frame.)*

**⚠WARNING** *Wear safety glasses when using compressed air to clean the oil strainer to protect your eyes from severe injury from flying debris.*

Refer to Table 3-1 for scheduled cleaning of the engine oil strainer. Clean the oil strainer more often in hot and dusty environments. The oil strainer is ac-

cessible through the front access door (Figure 3-3). To replace the oil strainer:

1. Remove the maintenance access door.
2. Loosen the center screw of the strainer (about five turns) and withdraw the strainer from the engine block.
3. Use compressed air to clean the strainer. Blow the debris from inside out.
4. Replace the O-rings or strainer if damaged.
5. Lubricate the O-rings with clean oil and insert the strainer until it stops.
6. Check for spring tension against the strainer and tighten the center screw.
7. Secure the front access door.

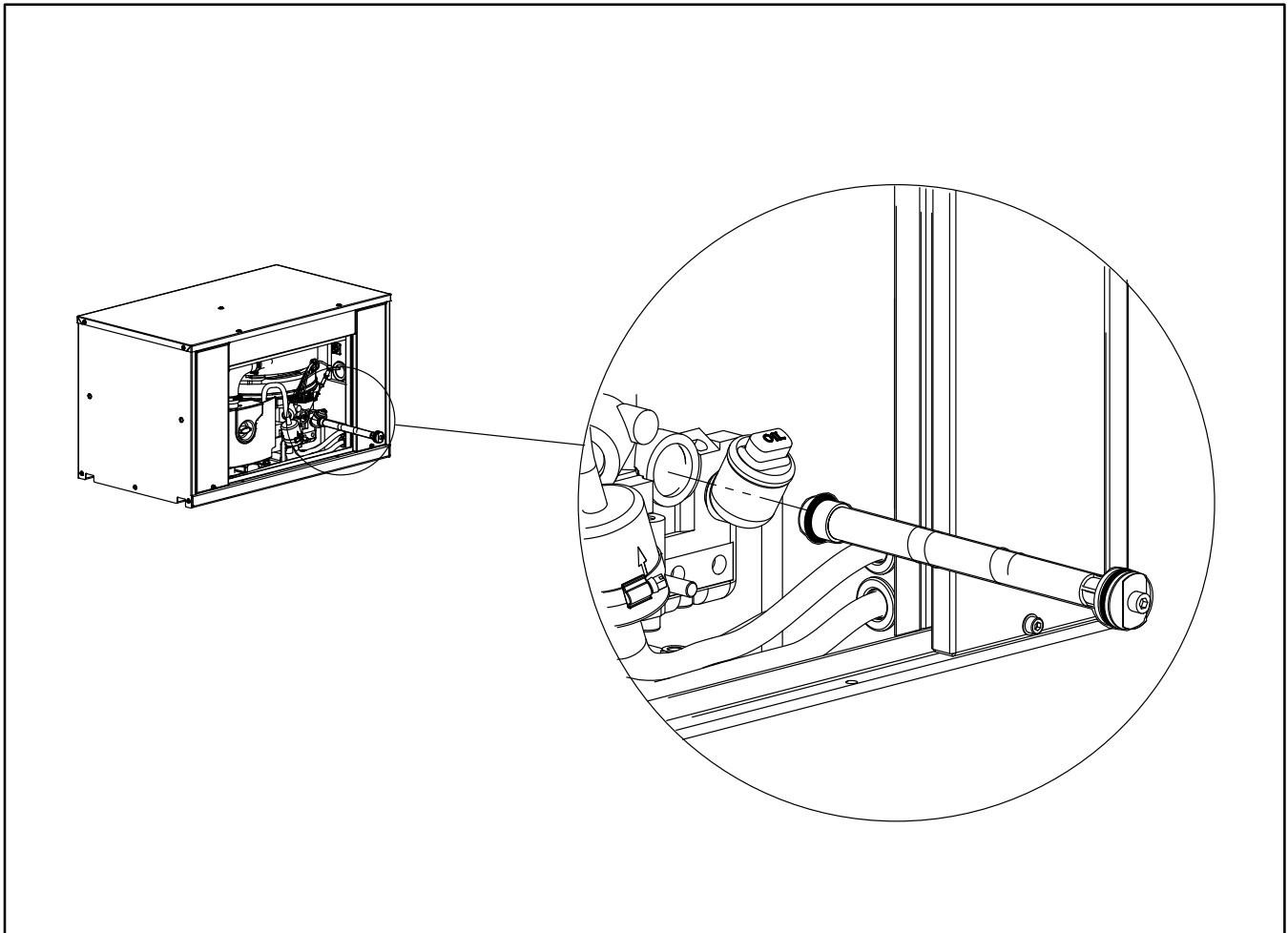


FIGURE 3-3. CLEANING ENGINE OIL STRAINER

## REPLACING THE AIR FILTER ELEMENT

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Push the Stop Switch Off and disconnect the battery cables at the batteries to prevent starting during maintenance and service. (Always disconnect negative [-] first and reconnect last to prevent sparks between tools and vehicle frame.)*

Refer to Table 3-1 for scheduled air filter replace-

ment. Replace it more often in dusty environments.

The air filter is accessible through the front access door (Figure 3-4). To replace the air filter:

1. Remove the filter cover
2. Unscrew the the knurled nut and remove the old filter element.
3. Clean dust and debris from the filter housing and install the new filter element.
4. Secure the front access door.

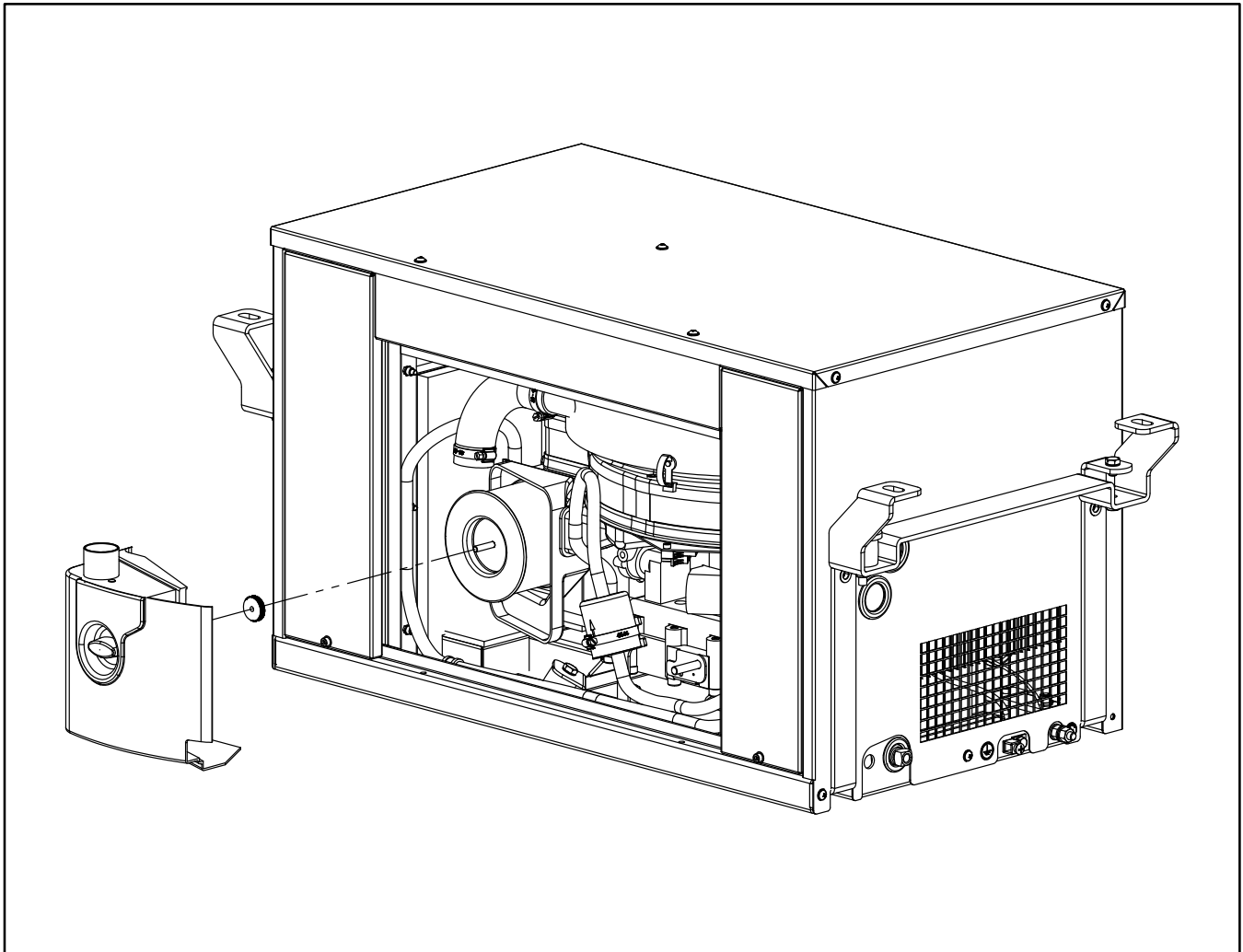


FIGURE 3-4. REPLACING THE AIR FILTER ELEMENT



## CLEANING THE SPARK ARRESTER

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 the cleanout plug.*

To clean the spark arrester:

1. Remove the cleanout plug on the bottom of the muffler.
2. Start the generator set and load it nearly to full power. Let the generator set run for about five minutes to expel the soot.
3. Stop the generator set, allow the muffler to cool down, and reinstall the cleanout plug.

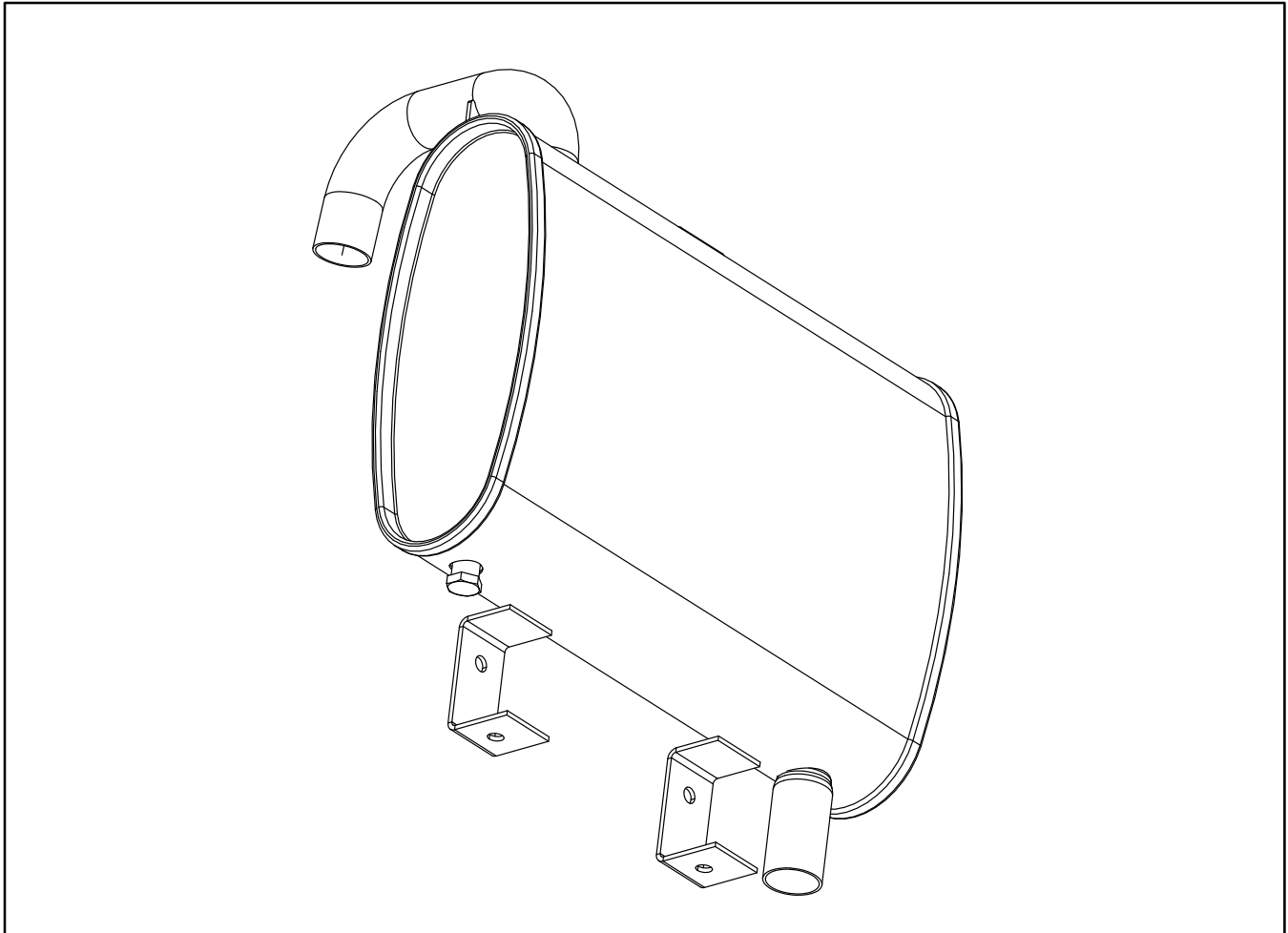


FIGURE 3-5. TYPICAL LOCATION OF SPARK ARRESTER CLEAN OUT PLUG ON BOTTOM OF MUFFLER

## REPLACING THE FUEL FILTER

See Table 3-1 for scheduled fuel filter replacement. A dirty fuel filter may be the cause of a failure to start.

**⚠WARNING** *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near diesel fuel tanks or equipment. Keep flames, sparks, pilot lights, electrical switches, arc-producing equipment and all other sources of ignition well away. Have a type ABC fire extinguisher ready to use.*

*Close any fuel line shutoff valve before disconnecting the fuel line from the filter.*

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Push the Stop Switch Off and disconnect the battery cables at the batteries to prevent starting during maintenance and service. (Always disconnect negative [-] first and reconnect last to prevent sparks between tools and vehicle frame.)*

**⚠CAUTION** *Dirt can damage the fuel system. Make sure to wipe dirt off the fuel hose fittings before disconnecting.*

The fuel filter is accessible through the front access door (Figure 3-6). To replace the fuel filter:

1. Have paper towels or rags ready to clean the two fuel hose fittings and absorb any fuel that spills.
2. Clean the two fuel hose fittings to keep dirt from entering the fuel hoses.
3. Loosen the two fuel hose clamps and the filter body clamp and replace the filter element. Make sure the arrow on the filter element points up in the direction of fuel flow.
4. Dispose of the fuel filter and paper towels or rags in accordance with local environmental regulations.
5. Secure the front access door.

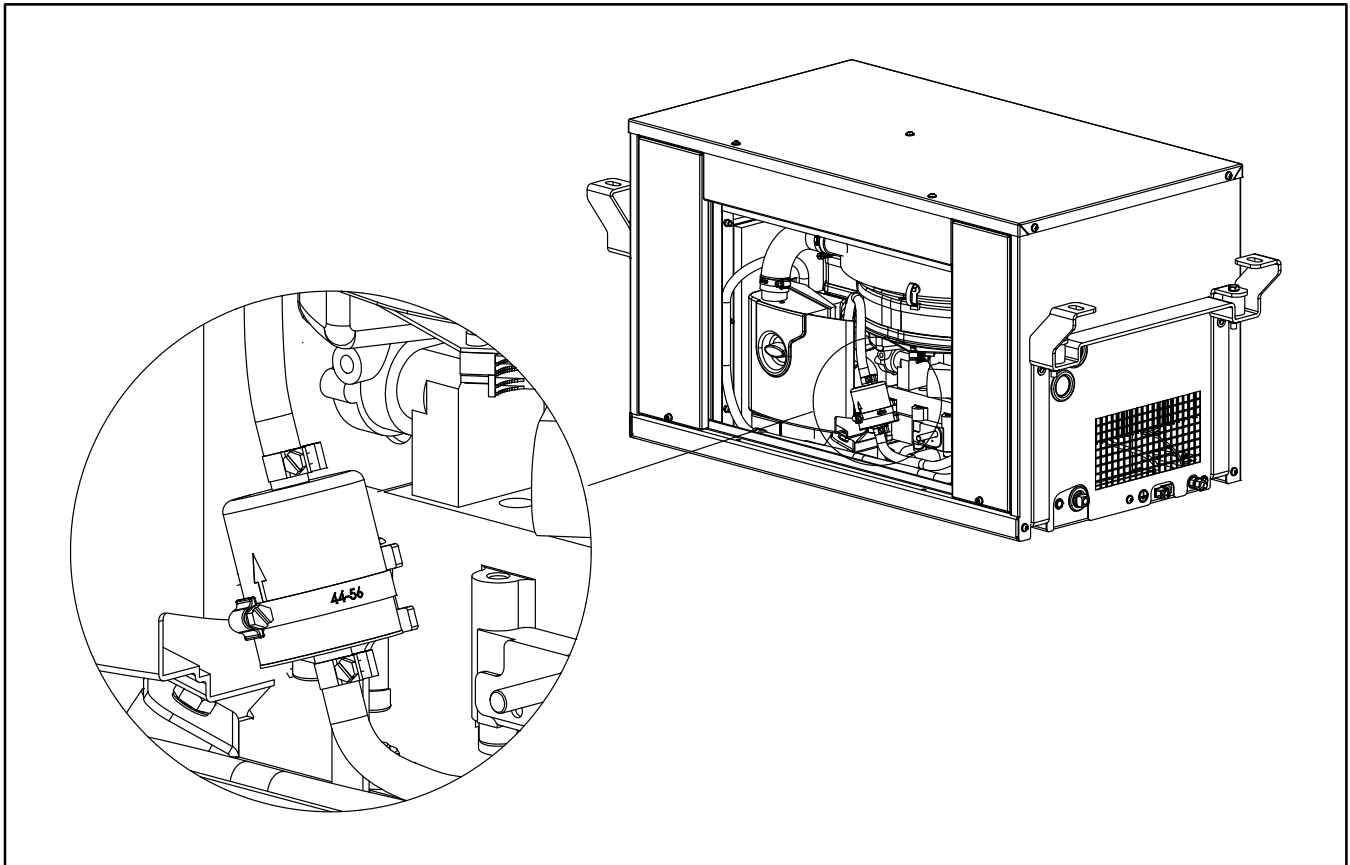


FIGURE 3-6. FUEL FILTER

# 4. Service

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## REMOVING GENERATOR SET

See *Section 5. Troubleshooting* to determine the probable cause of the problem before removing the generator set for service. The generator set is normally mounted on a supporting frame. Contact the vehicle manufacturer or installer if the best way to remove the generator set is not obvious.

**⚠️WARNING** *Accidental or remote starting can cause severe personal injury or death. Push the Stop Switch Off and disconnect the battery cables at the batteries to prevent starting during maintenance and service. (Always disconnect negative [-] first and reconnect last to prevent sparks between tools and vehicle frame.)*

**⚠️WARNING** *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near fuel tanks or fuel-burning equipment or in areas sharing ventilation with such equipment. Keep flames, sparks, pilot flames, electrical arcs and switches and all other sources of ignition well away. Keep a multi-class ABC fire extinguisher handy.*

### Disconnections

1. Disable the automatic generator set starting feature of an inverter-charger or other automatic starting device and disconnect the battery cables from the battery (negative [-] first) to keep the generator set from starting while working on it. Then disconnect the battery cables from the generator set.
2. Disconnect the remote control wiring harness connector at the generator set.
3. Disconnect the AC output leads at the generator set terminals.
4. Disconnect the exhaust tailpipe from the muffler.
5. Disconnect the supply and return fuel lines from the generator set.

### Removal from Vehicle

Make sure that the generator set is firmly supported before loosening any mounting bolts (Figure 4-1).

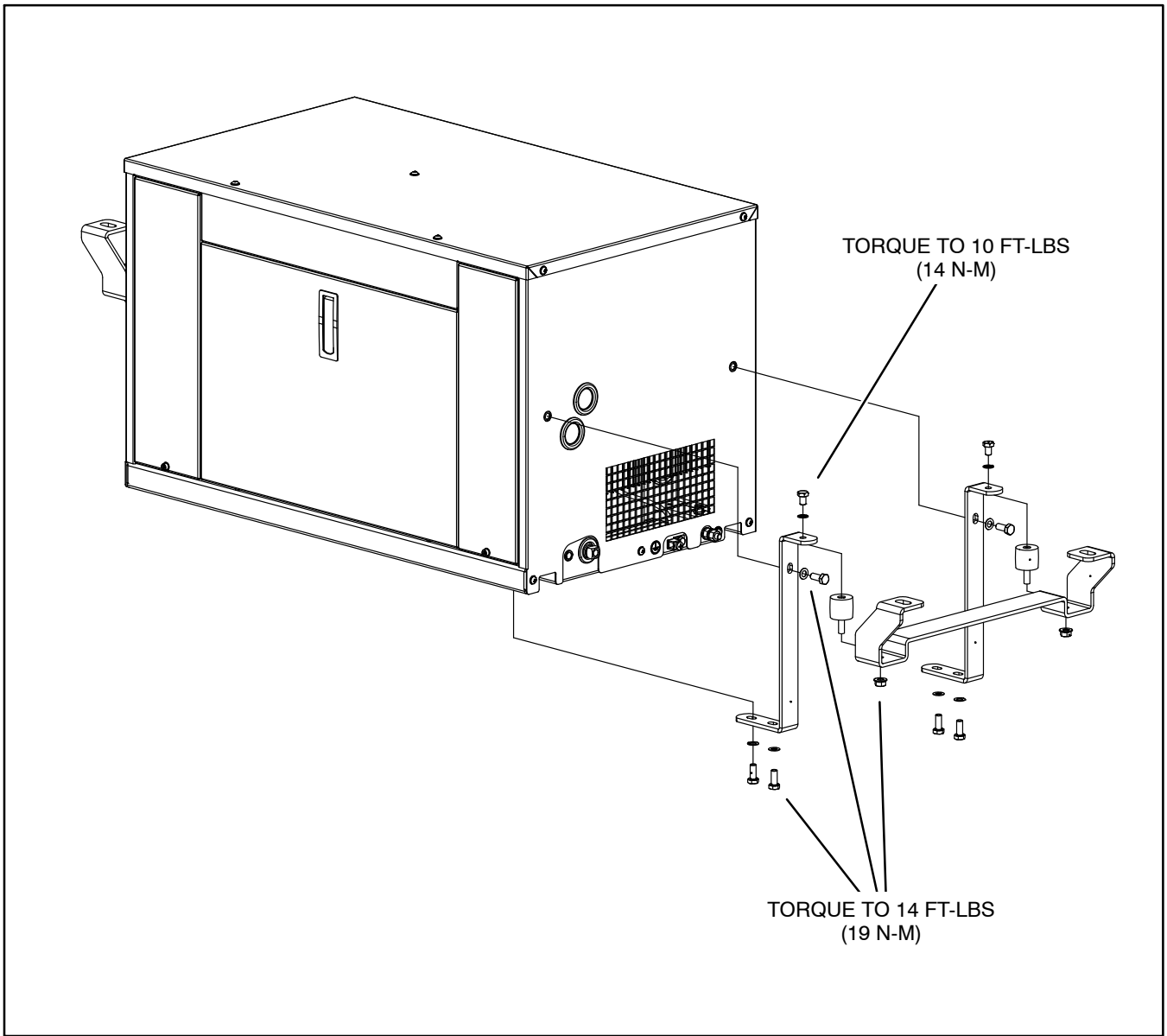
**⚠️WARNING** *Generator sets are heavy and can cause severe personal injury if dropped during removal. Use adequate lifting devices. Keep hands and feet clear while lifting.*

### Installation in Vehicle

Generally, installation is the reverse of removal and disconnection. *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 screws, 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 back in service (*Section 7. Service Checklist*).

**Note:** *It is critical for good vibration isolation that the four bolt holes in the vehicle frame line up accurately with the mounting holes in the generator set mounting brackets so that the vibration isolators do not have to be bent to line up with the holes in the vehicle frame.*

Secure the generator set to the vehicle structure with four (4) Grade 5 bolts of at least 3/8 inch diameter.



**FIGURE 4-1. GENERATOR SET MOUNTING BRACKETS AND VIBRATION ISOLATORS**

## REMOVING OUTER HOUSING

Remove the outer housing panels (Figure 4-2) to service or replace the starter, muffler, inverter and

internal AC and DC wiring. When reassembling the outer housing, tighten the housing screws to 27 in-lbs (3 N-m).

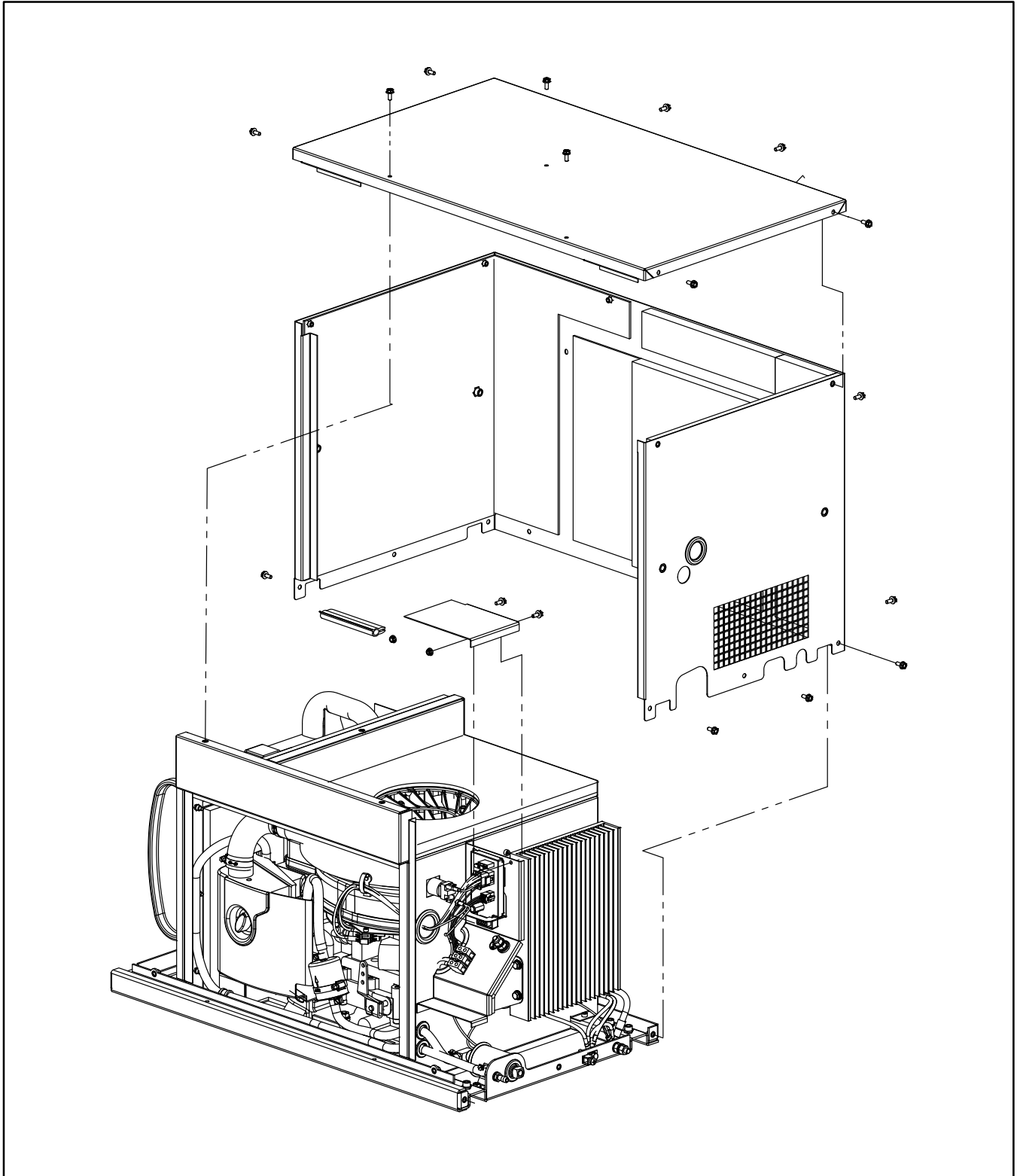


FIGURE 4-2. OUTER HOUSING

## INVERTER

The Inverter (Figure 4-3) inverts the main 3-Phase PMA (Permanent Magnet Alternator) output into 1-Phase, 60 Hz, 120 VAC output from the generator set. It also provides all generator set control functions. For connections see the wiring diagram on Page A-1.

The inverter has a microprocessor which monitors output power, engine speed, engine oil pressure, oil temperature, Inverter temperature and ambient temperature. Through the remote Operator Panel, it enables starting and stopping the generator set and provides status, maintenance, warning and fault messages. See *Section 5 . Troubleshooting*.

When remounting the inverter, tighten the isolator mounting screws to 8 ft-lbs (11 N-m).

## INTERNAL CONTROL PANEL

The internal control panel (Figure 4-3) is a connection point for the internal generator set control circuits. The 9-Pin connector is for B+ and engine circuits. The 10-Pin connector is for the Operator Panel. The 6-Pin connector is for the PMA battery charging auxiliary winding and for communications with the Inverter. For connections see the wiring diagram on Page A-1.

The control panel has a 30 amp automotive-type fuse to protect the control circuits if a component or connector shorts to ground.

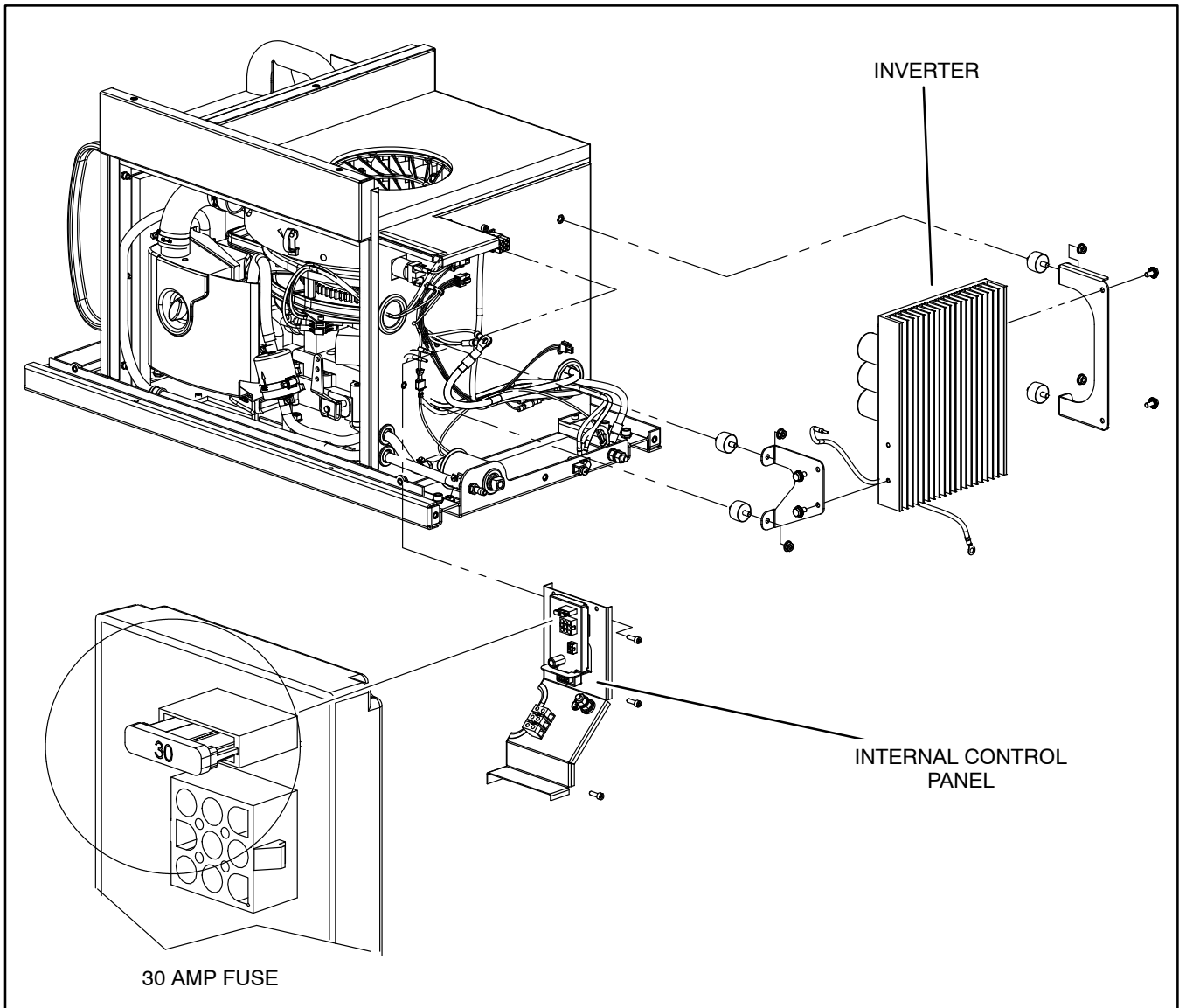
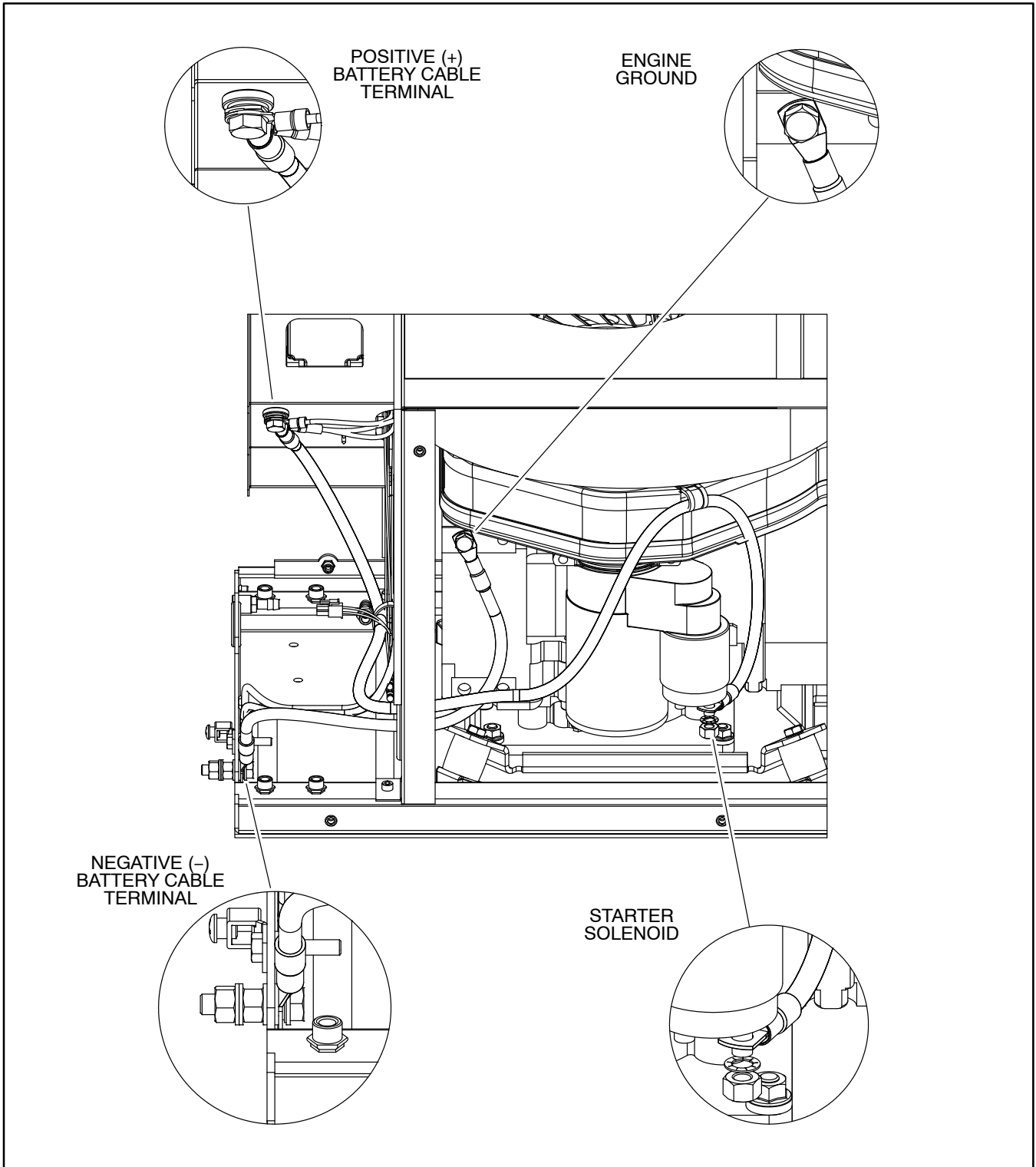


FIGURE 4-3. INVERTER

## DC CABLES

Route and clamp the DC cables as shown (Figure 4-4). Torque the terminal nuts to 10 ft-lbs (14 N-m).



**FIGURE 4-4. INTERNAL DC CABLES**

## FUEL SYSTEM

Figure 4-5 illustrates the fuel delivery system (transfer pump, filter and hoses). See the Engine Workshop Manual 983-0504 for fuel injection system service.

**⚠WARNING** *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near fuel tanks or fuel-burning equipment or in areas sharing ventilation with such equipment. Keep flames, sparks, pilot flames, electrical arcs and switches and all other sources of ignition well away. Keep a multi-class ABC fire extinguisher handy.*

### Fuel Transfer Pump

To test the fuel transfer pump, disconnect the fuel supply line at the engine and direct the end into a 1 gallon (4 liter) container. Press the Display ON button on the Operator Panel to prime fuel (five minutes). Press the Gen OFF button to stop priming before the container fills up. Replace the pump if it does not provide a steady flow of fuel after air has been bled from the system.

Flow must be at least .4 pints (200mL)/minute.

### Fuel Filter

See REPLACING THE FUEL FILTER (Page 3-8).

### Internal Fuel Hoses

When replacing the internal fuel hoses, make sure they are re-clamped and tied so as not rub on or be pinched by adjacent components.

## MUFFLER

Figure 4-5 illustrates the muffler assembly. When reassembling the muffler:

1. Tighten the exhaust clamp screws to 7.4 ft-lbs (10 N-m).
2. Tighten the exhaust flange nuts at the engine to 18-22 ft-lbs (25\_30 N-m). Make sure to use a new flange gasket.
3. Tighten the exhaust isolator screws to 13 ft-lbs (18 N-m).

## REMOVING ENGINE/PMA ASSEMBLY

See Engine Workshop Manual 983-0504 for servicing the engine—adjusting valve clearance (lash), servicing the fuel injection system, replacing the glow plug, overhauling the engine.

### Disassembly

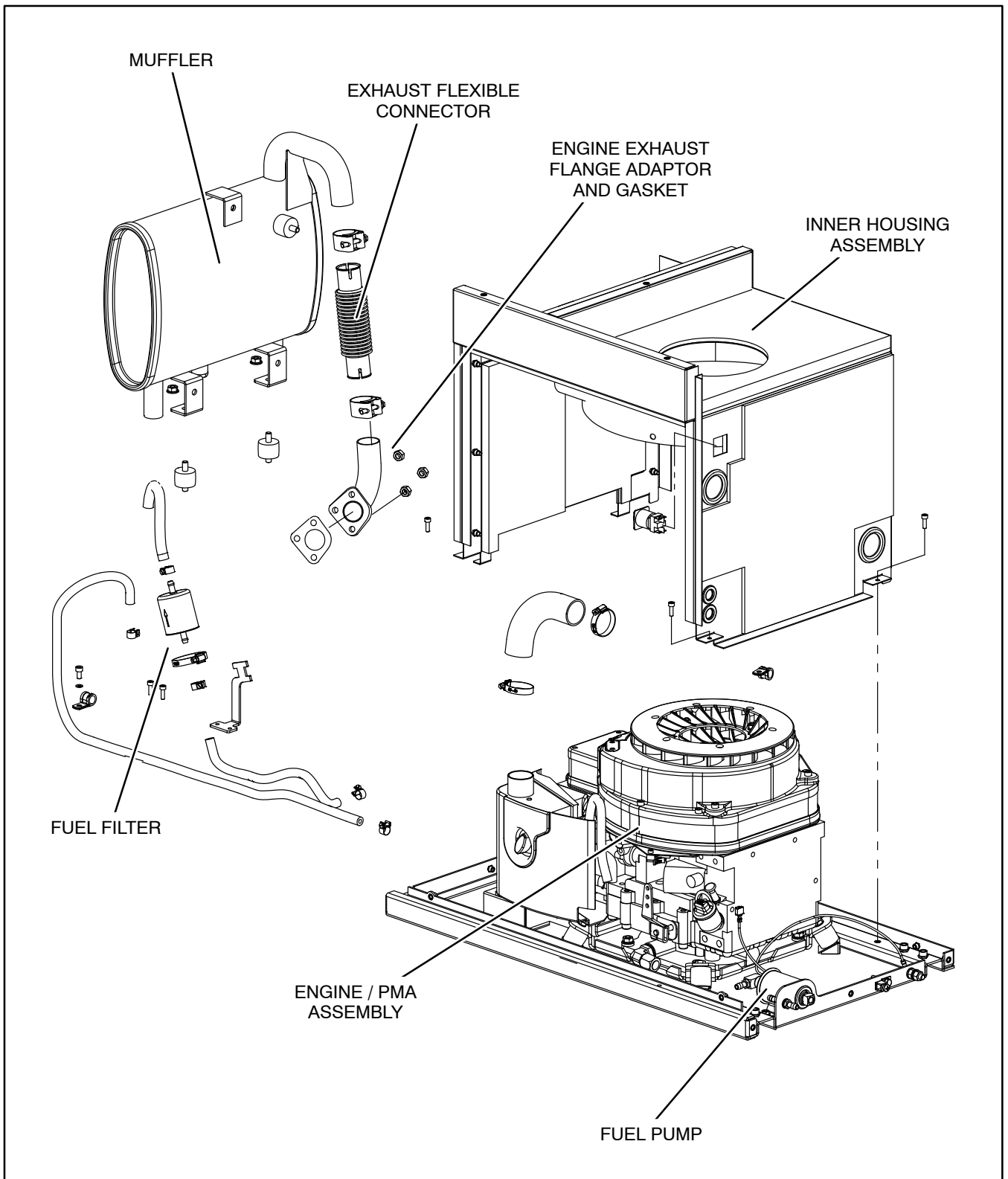
To remove the engine/PMA assembly (Figure 4-5) as an assembly:

1. Disconnect the DC cables (p. 4-5)
2. Disconnect the fuel lines.
3. Remove the outer housing (p. 4-3).
4. Remove the muffler.
5. Disconnect the AC wiring harnesses.
6. Remove the inner housing assembly.
7. Remove the Engine/PMA assembly from the four vibration isolator mounts (Figure 4-6).

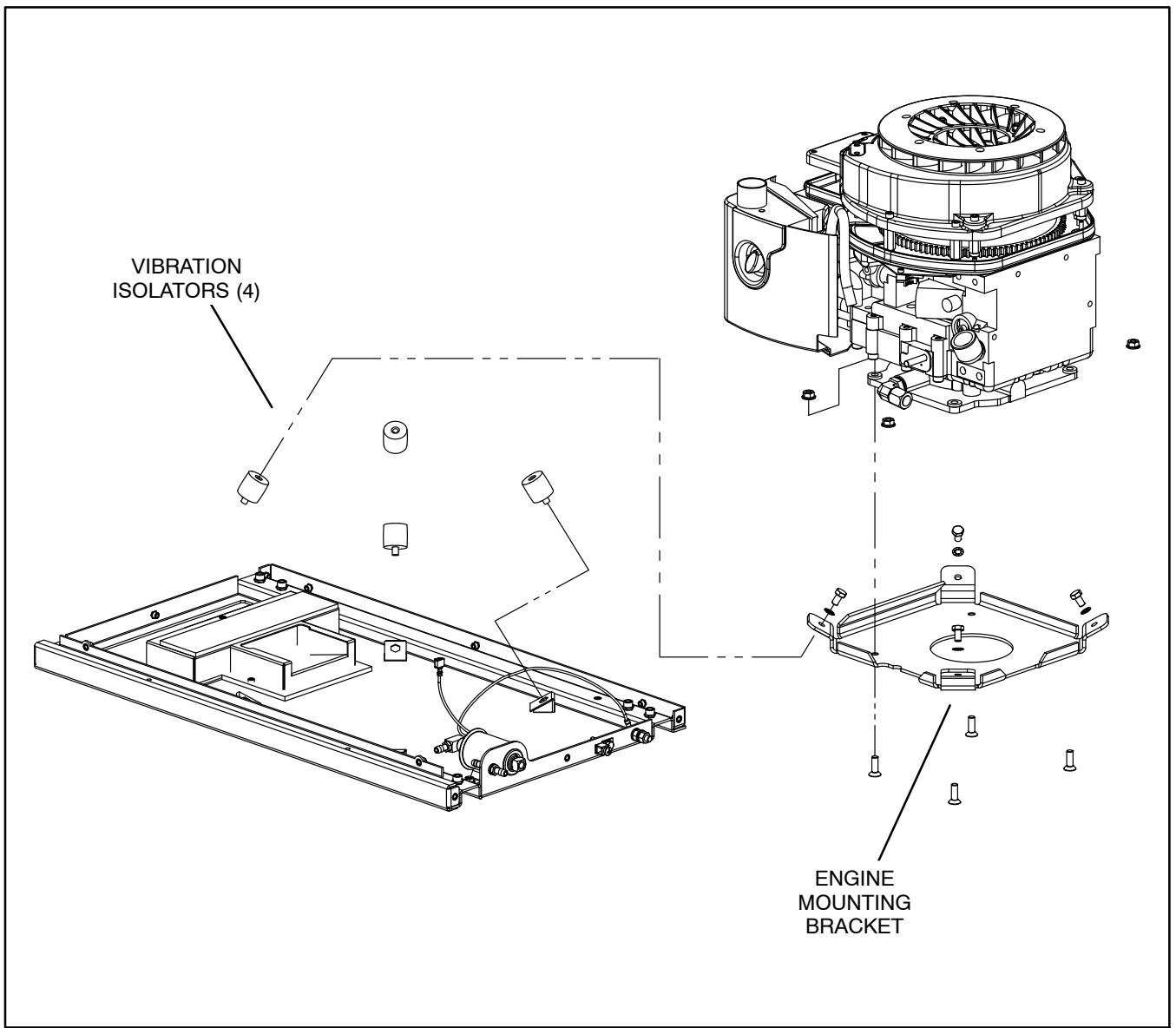
### Reassembly

1. Tighten the engine mounting bracket bolts (to engine) to 14 ft-lbs (19 N-m).
2. Tighten the engine mounting isolator bolts (to generator set base) to 10 ft-lbs (14 N-m).
3. Remount the muffler.
4. Reconnect the fuel lines.
5. Tighten the engine harness connector screws to 10.6 in-lbs (1.2 N-m).
6. Tighten the housing screws to 27 in-lbs (3 N-m).





**FIGURE 4-5. GENERATOR SET ASSEMBLY**



**FIGURE 4-6. ENGINE VIBRATION ISOLATORS**

## PMA

The PMA (Permanent Magnet Alternator) is mounted on top of the vertical-shaft engine (Figure 4-7). The permanent magnets rotate around the outside of the stator.

The stator has a three-phase main winding and two single-phase auxiliary windings. For connections see the wiring diagram on Page A-1.

### PMA Tests

Disconnect the 9-pin connector on the Inverter and measure main winding resistance between pins 1 and 2; 2 and 3; 3 and 1. Replace the stator if any winding is grounded or open or does not measure 1.1 ohms within 10 percent.

With the 9-pin connector disconnected from on the Inverter, measure auxiliary winding resistance between pins 4 and 9. Replace the stator if the winding is grounded or open or does not measure 0.3 ohms within 10 percent.

Disconnect the 6-pin connector from the Internal Control Panel and measure auxiliary winding resist-

ance between pins 2 and 3. Replace the stator if the winding is grounded or open or does not measure 0.3 ohms within 10 percent.

### Engine speed

To calculate engine speed, measure PMA Frequency,  $(\text{HZ} \times 60) / 9 = \text{Engine RPM}$ .

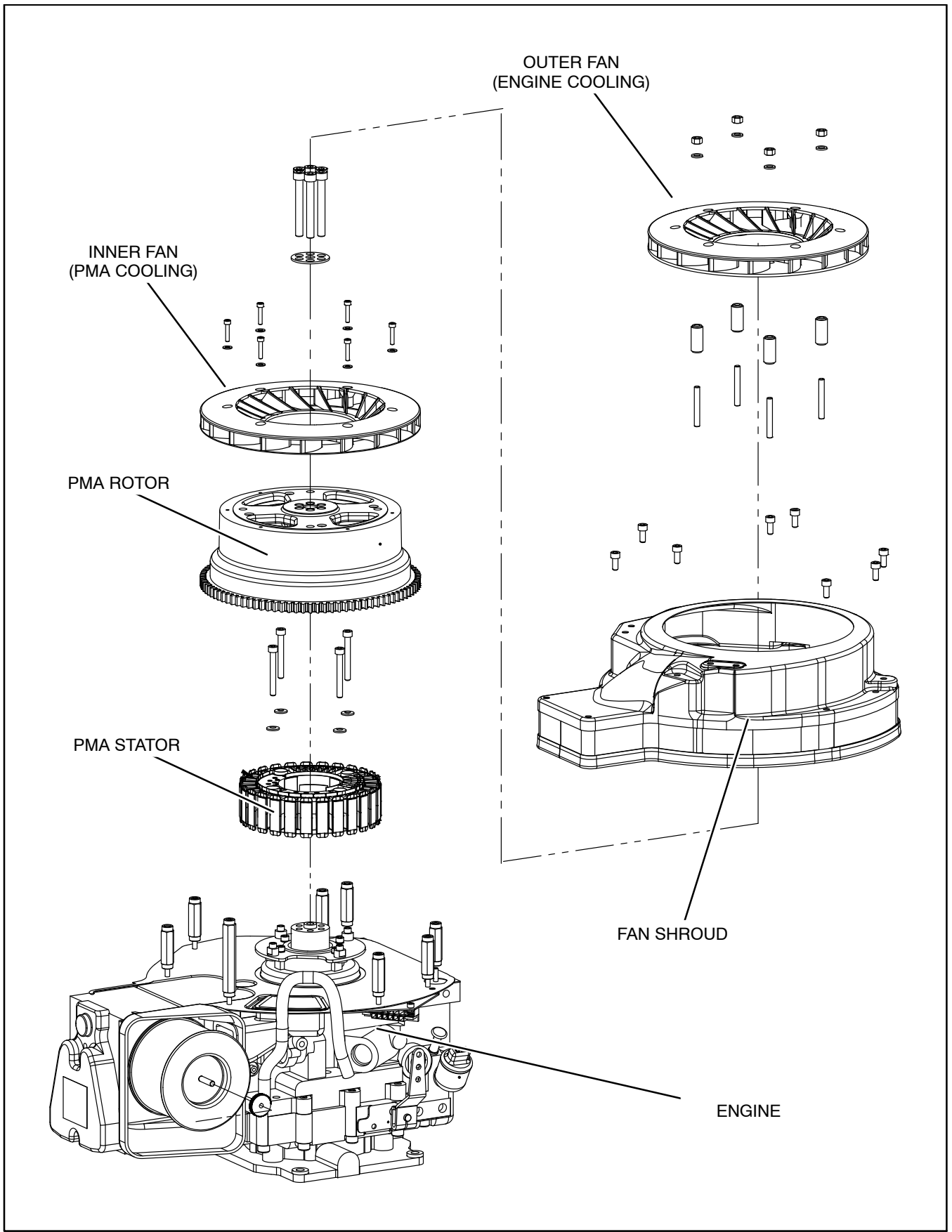
### Disassembly/Reassembly

**⚠ CAUTION** *Hitting the rotor or prying against it to remove it can break the magnets inside.*

See Service Manual, Engine Workshop 938-0504 for disassembly/Reassembly instructions.

### TORQUE SPECIFICATIONS:

| SIZE     | GRADE | N.m | Ft-Lb |
|----------|-------|-----|-------|
| M6 1.0   | 8.8   | 11  | 8     |
| M8 1.125 | 8.8   | 23  | 17    |
| M10 1.5  | 8.8   | 52  | 39    |
| M12 1.75 | 8.8   | 84  | 62    |



**FIGURE 4-7. PMA**

# 5. Troubleshooting

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**Note:** Most generator set shutdowns and failures to start can be avoided by performing periodic maintenance on schedule (TABLE 3-1. PERIODIC MAINTENANCE SCHEDULE) and by making sure that the generator set does not run out of fuel. In this regard it should also be noted that the vehicle manufacturer has probably arranged the fuel tank dip tubes such that the generator set will run out of fuel before the fuel gauge reads EMPTY, thus reserving fuel for the propulsion engine.

## STATUS MESSAGES

The Operator Panel displays the following status and periodic maintenance messages. Warning and Fault messages, once cleared, cannot be retrieved. To clear faults turn display off/on.

**Note:** Operator warning and fault messages, once cleared, cannot be retrieved.

**GEN OFF** Indicates that the generator set is off but ready to start.

**GEN ON** Indicates that the generator set is running.

**GEN START** If this message appears while pressing START, but the engine does not crank, check the stop switch inside the generator set (p. 2-2) and push it on.

**GEN CAL** This message appears during generator set start-up indicating that it is in calibration mode and not yet ready to produce AC output voltage. Wait a few seconds.

**RESTART GEN?** This message appears any time the generator set stops. Turn off and restart the generator set.

**GEN WAIT** The generator set is delaying the next start attempt to allow the starter motor to cool down. Or, more time is being allowed for engine preheating because the ambient temperature is below freezing. Try restarting when the message turns off.

**LOW BATTERY** Battery voltage is below the minimum value (9 VDC) necessary to start the generator set. Check battery connections and recharge or replace the battery.

## MAINTENANCE MESSAGES

**OIL CHANGE / CHECK OIL LEVEL** These messages appear every time the generator set hour counter reaches preset oil check/change intervals (check every 20 hours and then change the oil the first time at 50 hours and then every 250 hours). The generator set continues to run. Fill or change oil as necessary. The generator set must be running to reset the message. Hold START (green button) until the message clears. If not reset, the message will reappear after an hour of running.

## WARNING MESSAGES

**SHORT CIRCUIT** A connected appliance probably has a short circuit. AC output voltage is turned off but the engine is kept running to cool the generator set. Disconnect all appliances, press STOP to stop the engine and then restart the generator set. Reconnect appliances one by one to find out which one shorted and have it repaired or replaced.

## FAULT MESSAGES

### OIL TEMP-PRESS

**Possible Cause:** The engine lubricating oil temperature is too high or the pressure is too low. The oil pressure and temperature switches are connected in parallel. When the engine is at rest and cold, the pressure switch is closed and the temperature switch is open.

### Diagnosis/Repair—Low Oil Pressure:

1. Check Oil level and refill as necessary.
2. The oil pressure switch is normally closed (closes between 2.5 and 3.6 psi). Normal pressure is 36 psi at 3100 RPM. With the engine stopped, check for continuity to ground through the oil pressure switch. Replace if open.
3. If the oil pressure switch is opening, verify the connections between the engine harness and internal control board. Check for shorts to ground. To check if the switch is opening remove wire No. 4 (black) from the engine harness connector on the engine side of the connector. Start the generator set and verify that the switch is opening. If this test is performed without removing the wire from the harness, the

test meter may provide enough of a ground path to shut down the generator set.

4. If the switch does not open, one of 3 conditions exists: a) short to ground in the engine harness, b) faulty oil pressure switch, c) low engine oil pressure. Remove the oil pressure switch and test operation using a hand pump to apply appropriate pressure. Check harness for shorts to ground. Replace wiring and or switch as necessary. If the oil pressure circuit is okay, check the high oil temperature protection circuit.
5. The oil pressure switch is normally closed (closes between 2.5 and 3.6 psi). Normal pressure is 36 psi at 3100 RPM. With the engine stopped, check for continuity to ground through the oil pressure switch. Replace if open.
6. If the oil pressure switch is opening, verify the connections between the engine harness and internal control board. Check for shorts to ground. To check if the switch is opening remove wire No. 4 (black) from the engine harness connector on the engine side of the connector. Start the generator set and verify that the switch is opening. If this test is performed without removing the wire from the harness, the test meter may provide enough of a ground path to shut down the generator set.
7. If the switch does not open, one of 3 conditions exists: a) short to ground in the engine harness, b) faulty oil pressure switch, c) low engine oil pressure. Remove the oil pressure switch and test operation using a hand pump to apply appropriate pressure. Check harness for shorts to ground. Replace wiring and or switch as neces-

sary. If the oil pressure circuit is okay, check the high oil temperature protection circuit.

#### **Diagnosis/Repair—High Oil Temperature:**

1. Check for and remove blockages in the cooling air inlets and outlets.
2. Apply standard derates for elevation and temperature and reduce loads as needed.
3. The oil temperature switch is normally open (cold) and closes at 220° C (428° F).
4. Verify that the rise over ambient does not exceed 15° F (See Hot air recirculation test in the Installation Manual).
5. If engine appears to be cooling properly, remove the orange wire from the 9 pin connector on the internal control panel and start the generator set. Once running, check continuity to ground through this wire. There should be continuity while the engine is at rest through the oil pressure switch but not while the generator set is running. If the low oil pressure protection circuit is okay, a short to ground in this test indicates a faulty high oil temperature protection circuit.
6. If there is a short to ground when the generator set is running but engine temperature is relatively cool, remove the temperature switch and test using a hot plate to heat the switch to closing temperature. Replace the temperature switch if it does not close.
7. Check wiring for shorts to ground and repair as necessary.
8. If the low oil pressure and high oil temperature protection circuits are okay, service the engine lubricating oil pressure system. Refer to Engine Workshop Manual 983–0504.

## GENERATOR ALERT

**Possible Cause** There are three possible causes:

1. The Operator Panel in the vehicle must be able to communicate with the inverter in the generator set. If communication is interrupted this fault will likely occur when attempting to start the generator set.
2. Without power from the PMA auxiliary windings AC3 and AC4, the inverter will not be able to communicate with the Operator Panel. If the output frequency detected by the inverter is too high (engine speed greater than 4200rpm) the inverter will shut down the generator set. See PMA information in section 4–9 for engine speed calculation.
3. Faulty inverter.

**⚠ CAUTION** *Always perform stator check before replacing the inverter. Failure to do so will result in damage to the inverter.*

### Diagnosis/Repair:

1. Disconnect the vehicle AC wiring from the generator set and connect the generator set to a load bank. If the problem goes away check the vehicle AC wiring for shorts. Shorts to ground can cause an inverter communications fault.
2. Check for open wiring, shorts to ground, and bad crimps at the 2-pin connector on the inverter and at Pins 1 and 6 of the 6-pin connector on the internal control board.
3. Check for open wiring to ground and bad crimps at Pin 5 of the 6-pin connector on the internal control board.
4. Check for open wiring, shorts to ground, and bad crimps at Pins 1 and 4 of the 12-pin connector on the Operator Panel and for good connections at pins 7 and 10 of the 10-pin connector on the internal control board.
5. Check for open wiring, shorts to ground, and bad crimps at Pins 4 and 9 of the 9-pin connector on the inverter.
6. Check PMA winding connections to the internal control board and inverter. Refer to PMA tests (p. 4-9) and replace PMA stator if necessary.
7. Replace a faulty inverter.

**⚠ CAUTION** *Always perform stator check before replacing the inverter. Failure to do so will result in damage to the inverter.*

## OVER TEMPERATURE (INVERTER)

**Possible Cause** Inverter temperature detected to be over 70° C.

### Diagnosis/Repair:

1. Reduce loads.
2. Verify that the inverter heat sink is clean and that there is no air flow restriction or hot air recirculation.
3. After allowing generator and inverter too cool, start and run the generator set with no load. If it still shuts down on OVER TEMPERATURE, replace the inverter.
4. Verify that the inverter heat sink is clean and that there is no air flow restriction or hot air recirculation.
5. After allowing generator and inverter too cool, start and run the generator set with no load. If it still shuts down on OVER TEMPERATURE, replace the inverter.

**⚠ CAUTION** *Always perform stator check before replacing the inverter. Failure to do so will result in damage to the inverter.*

## OVERLOAD

**Possible Cause** Too many applications are connected, or the inverter is defective.

### Diagnosis/Repair:

1. Measure current draw. If it is greater than 32 amps, reduce the number of appliances connected in the coach and wait a few minutes for generator set to cool down. Press STOP to stop engine and restart the generator set.
2. If the generator set shuts down on 'Overload' condition, disconnect it from the coach and bench-test with a load-bank. If the generator set runs fine without shutting down, then the problem likely exists within vehicle wiring and/or appliances. In the event that it shuts down with no load connected, perform checks in Step 3.
3. Ensure stator is not damaged and has no shorts internally or to Ground on all Main and Auxiliary Windings. Test winding insulation re-

sistance with a Megger. Replace stator if necessary. If the stator is good, replace the inverter.

**▲ CAUTION** *Always perform stator check before replacing the inverter. Failure to do so will result in damage to the inverter.*

## LOW ENGINE POWER

**Possible Cause** Engine speed is below 2300 rpm

### Diagnosis/Repair:

1. Check that the engine stop lever is in its vertical (run) position (Figure 5-1). Refer to Engine Workshop Manual 983-0504 if the lever does not return to the run position after it has been pushed to stop the engine.
2. Reduce Loads: Disconnect AC output leads and connect to load bank. Test performance.
3. Check Fuel Flow: Verify fuel flow from lift pump it should be approximately 0.4 pints/minute (200 ml/minute) If flow is low check for kinked hoses and replace fuel filter as needed.
4. Check air flow (intake, exhaust) for restrictions: Remove exhaust and test, (spark arrester clean out may be needed).
5. Verify that the stop solenoid is operating correctly. Replace the solenoid if it does not pull in when 12 VDC is applied to its terminals.
6. Check the PMA winding connections at the internal control board and inverter. Refer to PMA tests (p. 4-9). Replace PMA stator if necessary.
7. The engine “wet-stacked” when run under no load. Run under approximately 3/4 rated load for approximately 30 minutes. If the problem persists, go to Step 8.
8. The injector is partially blocked. Check the spray pattern and replace as necessary. Refer to Engine Workshop Manual 983-0504.
9. The injector popping pressure is too Low. Check the popping pressure and replace as necessary. Refer to Engine Workshop Manual 983-0504.
10. The engine is worn. Refer to Engine Workshop Manual 983-0504.

## SYMPTOM DIAGNOSTICS

### DEAD OPERATOR PANEL

#### Possible Cause/Diagnosis/Repair

1. Verify that the battery is fully charged and that the connections are clean and tight.
2. Check for 12 VDC at Pin 12 of the 12-pin connector on the Operator Panel and for a good ground at Pin 1. (The Operator Panel requires at least 9 volts to function.) If there is no voltage:
  - A. Replace the 30 amp fuse on the internal control panel, if blown.
  - B. Check for 12 VDC at Pin 3 of the 10-pin connector on the internal control panel and for a good ground at Pin 10.
  - C. Check for 12 VDC at Pins 2, 3 and 6 of the 9-pin connector on the internal control panel and for a good ground at Pin 5 of the 6-pin connector.
  - D. Repair wiring and connectors as necessary.
3. Replace the internal control board if there is 12 VDC at at Pins 2, 3 and 6 of the 9-pin connector but 9 VDC or less at Pin 3 of the 10-pin connector.
4. Replace the Operator Panel if it does not wake up when if there is 12 VDC at Pin 12 of the 12-pin connector and a good ground at Pin 1.
5. Replace the internal control board if there is 12 VDC at at Pins 2, 3 and 6 of the 9-pin connector but 9 VDC or less at Pin 3 of the 10-pin connector.
6. Replace the Operator Panel if it does not wake up when if there is 12 VDC at Pin 12 of the 12-pin connector and a good ground at Pin 1.

### ENGINE CRANKS BUT DOES NOT START

**Note:** The generator will make up to three start attempts, cranking each time for 5 seconds and pausing for 2 seconds if necessary before the next crank. Gen Wait should appear on the display.

#### Possible Cause/Diagnosis/Repair

1. Clear the Gen Wait message from the Operator Panel by cycling it off and on. Try starting again.
2. Check the fuel level and fill as necessary.
3. Press the stop switch (p. 2-2) if it is not in its “1” position.
4. Replace the fuel if it is not of the specified grade or suitable for the ambient temperature (p 2-1).
5. Check Fuel flow from lift pump, should be approximately 0.4 pints/minute (200 ml/minute). Look for kinked hoses and replace fuel filter as need.



6. Verify that the fuel solenoid is getting 12V DC and clicks open when energized.
7. The cam to crank timing is off. Check Timing. Refer to Engine Workshop Manual 983-0504.
8. Valves not set properly: Check Valve lash. Refer to Engine Workshop Manual 983-0504.
9. The injector nozzle is blocked or locked. Remove the injector and check popping pressure and spray pattern. Refer to Engine Workshop Manual 983-0504.
10. The injection pump is stuck. Remove the high pressure injector line and crank the engine. Watch for fuel at delivery valve. Refer to Engine Workshop Manual 983-0504.
11. Engine compression is low—blown head gasket, bad injector seal, worn engine. Refer to Engine Workshop Manual 983-0504.
12. Check Fuel flow from lift pump, should be approximately 0.4 pints/minute (200 ml/minute). Look for kinked hoses and replace fuel filter as need.
13. Verify that the fuel solenoid is getting 12V DC and clicks open when energized.
14. The cam to crank timing is off. Check Timing. Refer to Engine Workshop Manual 983-0504.
15. Valves not set properly: Check Valve lash. Refer to Engine Workshop Manual 983-0504.
16. The injector nozzle is blocked or locked. Remove the injector and check popping pressure and spray pattern. Refer to Engine Workshop Manual 983-0504.
17. The injection pump is stuck. Remove the high pressure injector line and crank the engine. Watch for fuel at delivery valve. Refer to Engine Workshop Manual 983-0504.
18. Engine compression is low—blown head gasket, bad injector seal, worn engine. Refer to Engine Workshop Manual 983-0504.

## **ENGINE SPITS/SPUTTERS/EXHAUSTS WHITE SMOKE**

### **Possible Cause/Diagnosis/Repair**

1. Air in fuel system: Prime fuel system by turning on the display, lift pump should run for 5 minutes to prime system. If problem goes away check for air leaks with soapy water at fittings and hoses.
2. Bad Check Valve in return fuel line: Block of return line and test run. If problem goes away replace check valve.

## **ENGINE EXHAUSTS BLACK SMOKE**

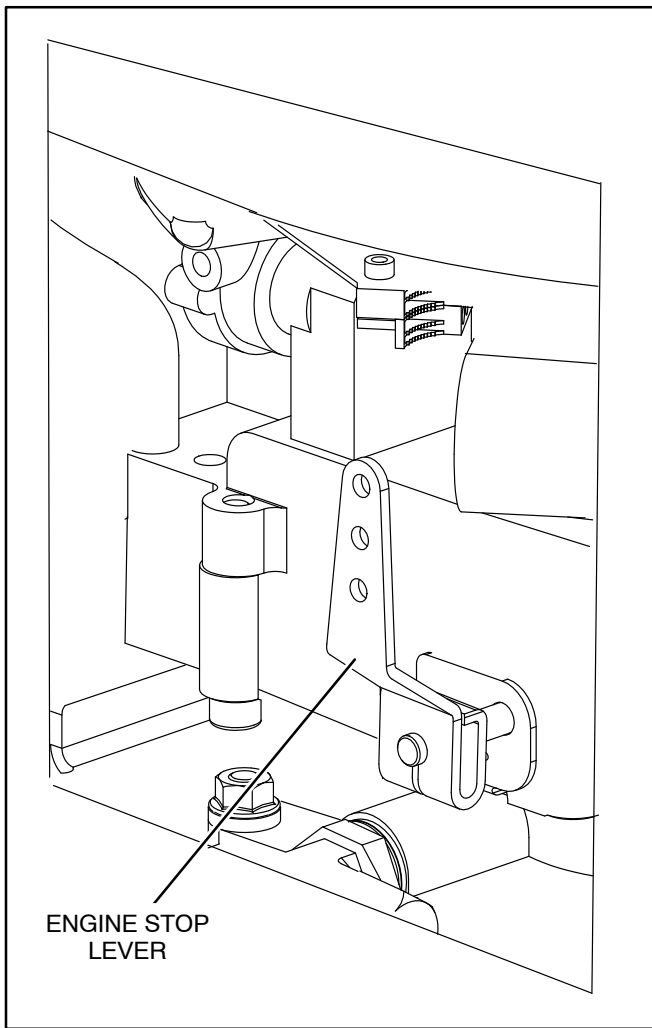
### **Possible Cause/Diagnosis/Repair**

1. The injector is partially blocked. Check the spray pattern and replace as necessary. Refer to Engine Workshop Manual 983-0504.
2. The injector popping pressure is too Low. Check the popping pressure and replace as necessary. Refer to Engine Workshop Manual 983-0504.

## **ENGINE WON'T STOP**

### **Possible Cause/Diagnosis/Repair**

1. Stop the engine by pushing the engine stop lever (Figure 5-1) all the way to the left.
2. Remove the fuel solenoid and apply 12V DC. Replace the solenoid if it does not function (click open).
3. Contact HATZ to readjust the idle adjustment screw.
4. Replacing the shutoff solenoid. Confirm the suction hole and starting slot positions are aligned. Refer to Engine Workshop Manual 983-0504 for the full procedure to do additional checks.



**FIGURE 5-1. ENGINE STOP LEVER**

## **SERVICE SCREENS**

### **Accessing Service Screens**

Generator service information can be accessed as follows:

1. Press Gen OFF
2. Hold down the START button and Display ON together.
3. Release both buttons when RV QD 3200 is displayed.
4. IMMEDIATELY press the START button 3 time. GEN OFF should be displayed. (Restart the procedure if the generator set tries to start.)
5. Press the START button again to start the generator set.
6. Once the generator set has started, press the START button to view the service screens.
7. Use the START button to navigate through the service screens.

### **Service Information**

The following generator service information is available on the service screens:

1. Battery voltage
2. Generator status
3. Inverter output AC voltage
4. Generator set running hours
5. Software version number
6. Load current draw
7. Load kW

# 6. Specifications

|   |  |
|---|--|
| <b>GENSET CONTROL:</b> Integrated Microprocessor-Based Engine and Generator Controller and AC Output Inverter |  |
| <b>GENERATOR:</b> Three-Phase, Permanent Magnet, 3100 RPM   |  |
| Power (@1.0 power factor)   | See Nameplate  |
| Voltage   | 120  |
| Frequency   | 60 Hz  |
| Number of Phases  | 1  |
| Current   | 26.7 amps  |
| <b>FUEL CONSUMPTION:</b>  |  |
| @ 1 kW  | 0.20 gph (0.76 lph)  |
| @ 2 kW  | 0.27 gph (1.03 lph)  |
| @ 3 kW  | 0.36 gph (1.37 lph)  |
| @ 3.5 kW  | 0.38 gph (1.44 lph)  |
| <b>ENGINE:</b> Single-Cylinder, Direct-Injection, Air-Cooled, 4-Stroke Diesel                                 |  |
| Bore  | 3.15 in (80 mm)  |
| Stroke  | 2.72 in (69 mm)  |
| Displacement  | 21 in <sup>3</sup> (347 cc)                                    |
| Compression Ratio   | 1:22   |
| Fuel Injection Timing (BTDC)  | 16°  |
| Fuel Nozzle Injection Pressure  | 2900±174 psi (200±12 bar)                                      |
| Cylinder Compression Test   | 290 to 319 psi (20 to 22 bar)                                  |
| Valve Lash: Intake & Exhaust (cold)   | 0.004 in (0.1 mm)  |
| Oil Capacity  | 1.1 quart (1.1 liter)  |
| <b>DC SYSTEM:</b>   |  |
| Nominal Battery Voltage   | 12 volts   |
| Minimum Battery Capacity<br>CCA (Cold Cranking Amps)  | 475 amps down to 0°F (-17°C)<br>650 amps down to -20°F (-29°C) |
| <b>WEIGHT (WET):</b> 205 lbs (93 kg)  |  |
| <b>SIZE (L x W x H):</b> 30.17 x 17.3 x 18.02 in (766.4 x 439.4 x 457.7 cm)                                   |  |
| <b>SOUND LEVEL:</b> 71 dB(A) @ 2 kw @10 ft (3 meters)   |  |

### LOAD ON ENGINE

- Operating the engine for a lengthy period off-load or at very low loads can affect its running

quality. We therefore recommend a minimum engine load of 15%.

- If operated at such low loads, it is best to operate the engine at a significantly higher load for a short period before switching it off.

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# 7. Service Checklist

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After servicing, inspect and test the installation to confirm that the generator set will operate as intended. Check each of the areas described below before putting the generator set into service.

## Housing

Check to see that all housing panels and access covers are in place and secure.

## Mounting

Examine all mounting bolts and supporting members to verify that the generator set is properly mounted. All fasteners should be tightened securely to prevent them from working loose when subjected to vibration.

## Lubrication

If the engine oil was drained, refill as required.

## Wiring

Verify that all wiring connections are tight and installed properly. Check each of these connections:

- Load wires
- Control wires
- Ground straps
- Battery cables

## Output Check

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

## Exhaust System

While the generator set is running inspect the entire exhaust system. Look and listen for leaks at all connections, welds, gaskets and joints. Also make sure

the exhaust pipe is not overheating adjacent materials or equipment. Do not run the generator set until all exhaust leaks have been repaired.

**⚠️WARNING** *Exhaust gas is deadly. The exhaust system must not leak and must discharge all exhaust away from the vehicle. Do not run the generator set until the exhaust leaks have been repaired.*

*The exhaust tailpipe must be supported by a hanger near the vehicle perimeter and terminate at least 1 inch outside the perimeter and at least 1 foot from doors and windows.*

## Fuel System

While the generator set is running, inspect the fuel supply and return lines, filter and fittings for leaks. Check flexible sections for cuts, cracks and abrasions and make sure they are not rubbing against anything that could cause leakage. Repair all fuel leaks immediately.

**⚠️WARNING** *Diesel fuel is combustible. Leaking fuel could lead to fire and to severe personal injury or death. Repair fuel leaks immediately.*

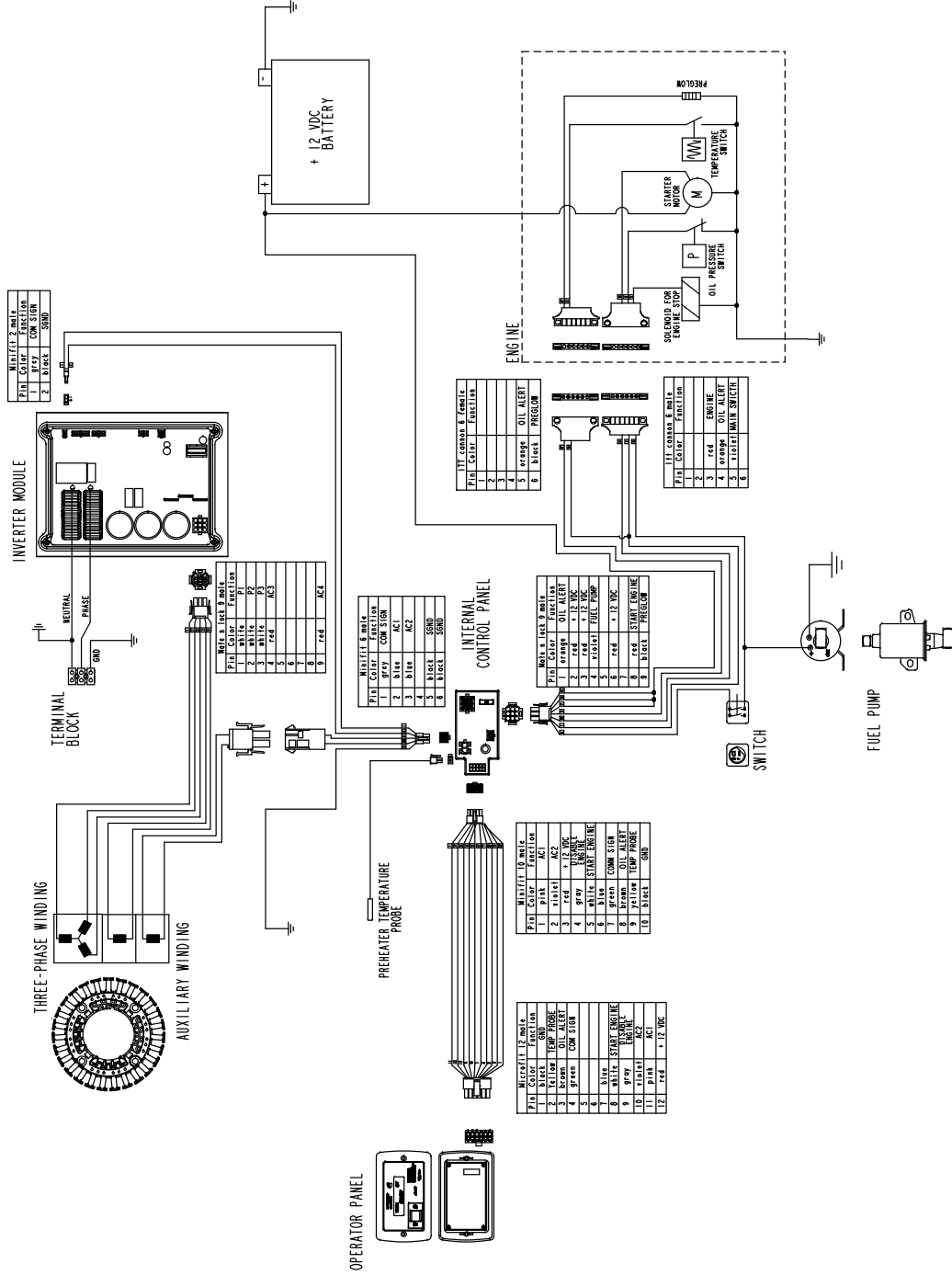
## Control

Stop and start the generator set several times at the Operator Panel in the vehicle to verify connections and proper operation.

## Mechanical

Stop the generator set and inspect it for leaking gaskets, loose fasteners, damaged components and interference with other equipment. Repair as necessary. Inspect the generator compartment and verify that there are no breaks or openings in the vapor-resistant barrier that separates the compartment from the vehicle interior. Seal openings as necessary. Make sure that all soundproofing material is in place.

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WIRING DIAGRAM

WIRING DIAGRAM







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