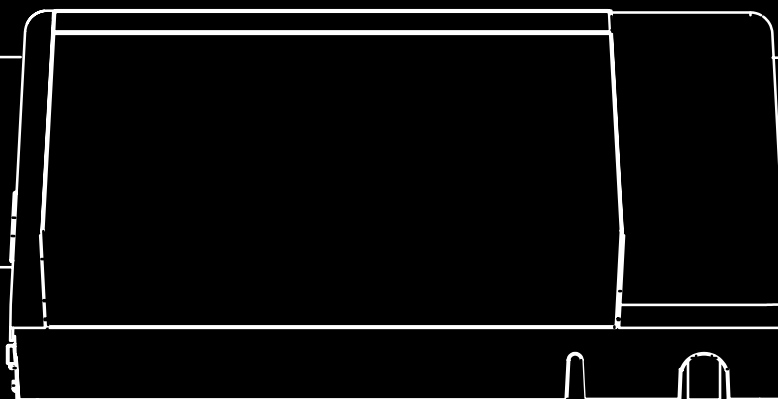


**Caution: This document contains mixed page sizes (8.5 x 11 or 11 x 17), which may affect printing. Please adjust your printer settings according to the size of each page you wish to print.**

# Onan *Mobile GenSet*

## Service Manual

HGJAA, HGJAB, HGJAC,  
HGJAD, HGJAE, HGJAF





## **WARNING:**



The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.



## **WARNING**



**Do not use this genset on a boat  
Such use may violate U. S. Coast Guard  
regulations and can result in  
severe personal injury or death from  
fire, electrocution, or  
carbon monoxide poisoning**

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# Safety Precautions

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Thoroughly read the **OPERATOR'S MANUAL** before operating the genset. 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.

Electricity, fuel, exhaust, moving parts and batteries present hazards which can result in severe personal injury or death.

## GENERAL PRECAUTIONS

- Keep ABC fire extinguishers handy.
- Make sure all fasteners are secure and torqued properly.
- Keep the genset and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Before working on the genset, disconnect the negative (–) battery cable at the battery to prevent starting.
- Use caution when making adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- 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 genset when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.

## GENERATOR VOLTAGE IS DEADLY!

- Generator output connections must be made by a qualified electrician in accordance with applicable codes.
- The genset 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.

## ENGINE EXHAUST IS DEADLY!

- Learn the symptoms of carbon monoxide poisoning in this manual and never sleep in the vehicle while the genset is running unless the vehicle is equipped with a working carbon monoxide detector.
- The exhaust system must be installed in accordance with the genset 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 genset in a confined area.

## 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. Natural gas rises when released and can accumulate under hoods and inside housings and buildings. LPG sinks when released and can accumulate inside housings and basements and other below-grade spaces. Prevent leaks and the accumulation of gas.

### **BATTERY GAS IS EXPLOSIVE**

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

tery cable first and reconnect it last to reduce arcing.

### **MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH**

- 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. Introduction

This is the service manual for the generator set (genset) 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 genset subassemblies. Genuine Onan® replacement parts are recommended for best results.

When contacting Onan for parts and product information, be ready to provide the model and serial numbers on the genset nameplate. Figure 7-1 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.)

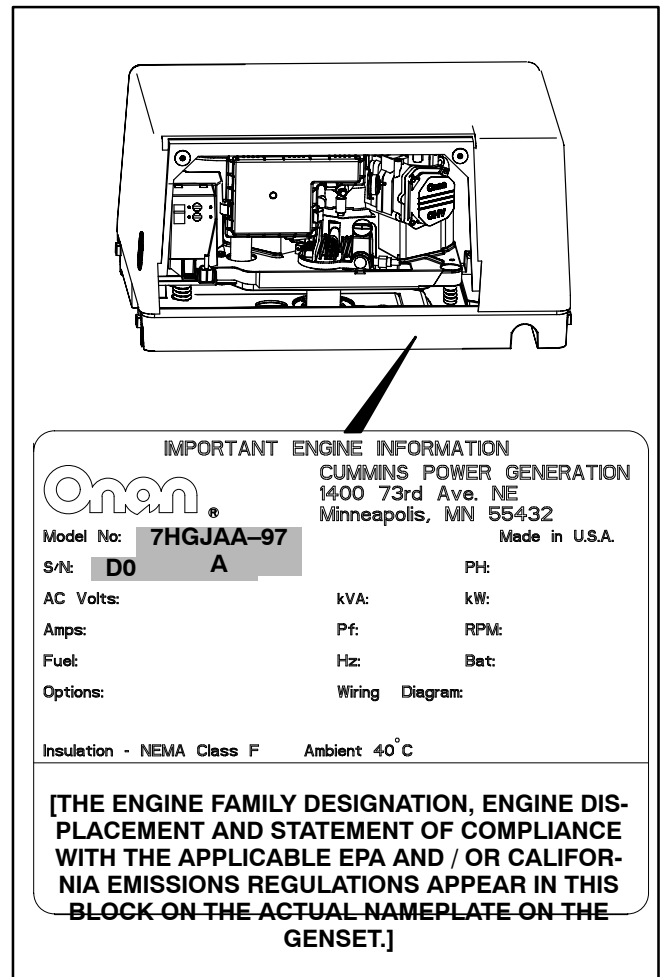


FIGURE 1-1. TYPICAL NAMEPLATE

## 2. Operation

### FUEL RECOMMENDATIONS

**⚠ WARNING** *Gasoline and LPG are highly flammable and explosive and can cause severe personal injury or death. Do not smoke or turn electrical switches ON or OFF where fuel fumes, tanks or equipment are present or in areas sharing ventilation. Keep flames, sparks, pilot lights, arc-producing equipment and switches and all other sources of ignition well away. Keep a type ABC fire extinguisher in the vehicle.*

#### Gasoline Models

Use clean, fresh unleaded gasoline having a minimum octane rating (Anti-Knock Index) of 87.

**⚠ CAUTION** *Do not use gasoline or gasoline additives containing methanol because methanol can be corrosive to fuel system components.*

*Avoid using leaded gasoline because of the extra engine maintenance that will be required.*

#### LPG Models

Use clean, fresh HD-5 grade liquified petroleum gas (LPG) or equivalent product consisting of at least 90 percent propane. Commercial liquified petroleum gas fuels may contain more than 2.5 percent butane which can result in poor fuel vaporization and poor engine starting in low ambient temperatures (below 32° F (0° C)).

Satisfactory performance on Low-Pressure LPG models requires that the LPG vapor be supplied at a pressure within the range indicated in Section 13. *Specifications.*

**⚠ WARNING** *High LPG supply pressure can cause gas leaks which can lead to fire and se-*

*vere personal injury or death. LPG supply pressure on Low-Pressure LPG models must be adjusted to Section 13. Specifications by trained and experienced personnel.*

### ENGINE OIL RECOMMENDATIONS

Use API (American Petroleum Institute) performance Class **SJ**, **SH** or **SG** engine oil, which may be in combination with performance Class CH-4, CG-4 or CF-4 (for example: SJ/CH-4). Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Table 2-1, choose the viscosity grade appropriate for the ambient temperatures expected until the next scheduled oil change.

Single-grade SAE 30 oil is preferable when temperatures are consistently above freezing. Multigrade oils are better when wide temperature variations are expected.

**TABLE 2-1. OIL VISCOSITY VS. TEMPERATURE**

EXPECTED AMBIENT TEMPERATURES	SAE VISCOSITY GRADE
32° F (0° C) and higher	30
10° F to 100° F (–12° C to 38° C)	15W-40 (OnaMax™)
0° F to 80° F (–18° C to 27° C)	10W-30 10W-40
–20° F to 50° F (–28° C to 10° C)	5W-30

### STARTING BATTERIES

The genset has a 12 volt, direct current (DC) engine cranking and control system. See Section 13. *Specifications* regarding minimum battery ratings for reliable genset cranking, especially in cold weather.

## GENSET CONTROL PANEL

The genset control panel (Figure 2-1) has the following features:

**Control Switch** – This switch is used to prime the fuel system, start and stop the genset and display the shutdown code. Hold the switch in its **START** position to crank and start the genset. Press the switch to its **STOP** position to stop the genset. Hold the switch in its **STOP/PRIME** position (starts priming in 2 seconds) to prime the fuel system (gasoline models only). See Section 11. *Troubleshooting* about displaying fault codes.

**Status Indicator Light** – This light is an LED (light emitting diode) in the control switch which blinks rapidly during cranking and comes on solid when the starter disconnects, indicating that the genset is running. If the genset shuts down abnormally, the light will blink a code to indicate the cause of the shutdown. See Section 11. *Troubleshooting*.

**Line Circuit Breaker** – The line circuit breaker protects the AC power leads connected to the genset from overloads and equipment short circuits.

**Hour Meter** – (Models HGJAD, HGJAE and HGJAF only) The hour meter records genset operating time in hours. It cannot be reset. See the Periodic Maintenance Schedule (Page 3-1).

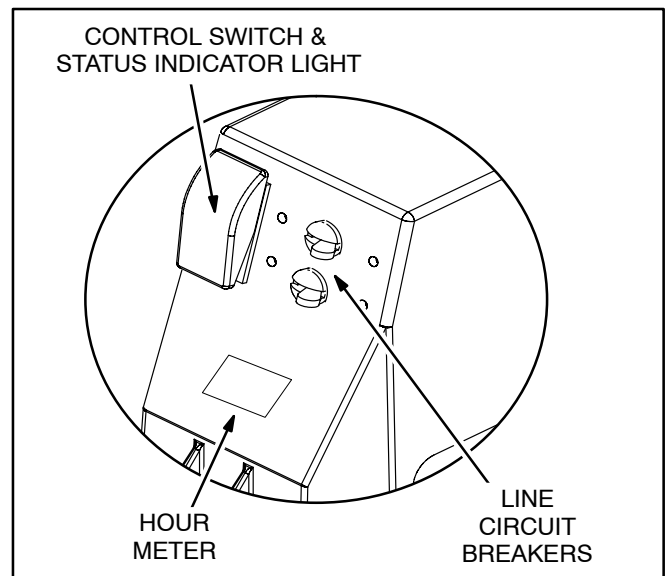


FIGURE 2-1. GENSET CONTROL PANEL

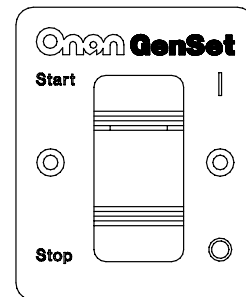


FIGURE 2-2. REMOTE SWITCH

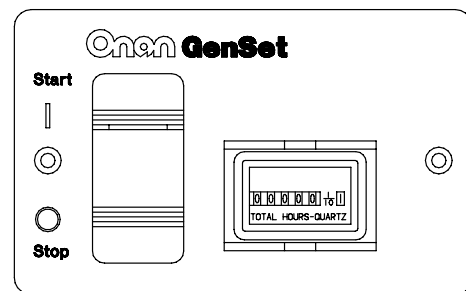


FIGURE 2-3. REMOTE SWITCH / HOUR METER

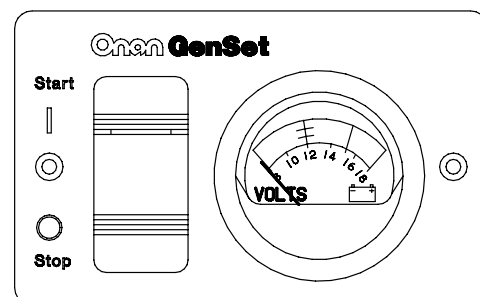


FIGURE 2-4. REMOTE SWITCH / DC VOLTMETER

## REMOTE CONTROL PANEL

Onan offers three remote control kits as follows:

- Remote switch with status indicator light only (Figure 2-2).
- Remote switch with status indicator light and hour meter (Figure 2-3).
- Remote switch with status indicator light and DC voltmeter (Figure 2-4).

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 3-5).

**⚠WARNING EXHAUST GAS IS DEADLY!**

**Exhaust gases contain carbon monoxide, an odorless, colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:**

- **Dizziness**
- **Throbbing in Temples**
- **Nausea**
- **Muscular Twitching**
- **Headache**
- **Vomiting**
- **Weakness and Sleepiness**
- **Inability to Think Clearly**

**IF YOU OR ANYONE ELSE EXPERIENCES ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the genset and do not operate it until it has been inspected and repaired.**

**Never sleep in the vehicle with the genset running unless the vehicle is equipped with a working carbon monoxide detector. Primary protection against inhaling carbon monoxide, however, is proper installation of the exhaust system, daily (every eight hour) inspection for visible and audible exhaust system leaks.**

## **CONDUCTING PRE-START CHECKS**

Before the first start of the day and after every eight hours of operation, inspect the genset as instructed under CONDUCTING GENERAL INSPECTIONS (Page 3-2). Keep a log of maintenance and the hours run and perform any maintenance that may be due.

Before each start:

1. Make sure all vehicle CO detectors are working.
2. Check for signs of fuel and exhaust leaks and for damage to the exhaust system.
3. To prevent overheating and to reduce fouling with dust and debris, make sure the genset'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 the air conditioner and other large appliances.
5. If the genset is equipped with an hydraulic pump, check and refill the oil reservoir as necessary.

## **PRIMING GASOLINE FUEL SYSTEMS**

If a gasoline genset ran out of fuel, prime the fuel system by holding the control switch at **STOP/PRIME** for 30 seconds. (The status indicator light will stay on solid while the pump is on.)

## **STARTING THE GENSET**

Start the genset from the genset control panel or remote control panel inside the vehicle (Page 2-2).

1. Push and hold the switch at **START** until the genset starts. The status indicator light on the switch flashes while cranking. It will come on solid when the starter disconnects, indicating that the genset is running. (Because the genset control has to "wake up," a slight delay might be noticed before anything seems to happen. On models with fuel injection, the delay could be up to 3 seconds to pressurize the fuel injectors.)
2. The genset control will discontinue cranking if the genset does not start within 30 seconds and will cause the status indicator light to blink Fault Code No. 4. Wait 5 seconds for the control to reset before trying again. See Section 11. *Troubleshooting* if the genset does not start after two or three tries.

**⚠CAUTION Do not risk burning out the starter motor by continued attempts to start. Find out why the genset is not starting and repair as necessary.**

3. For top performance and engine life, especially in colder weather, let the engine warm up for two minutes before connecting appliances.
4. Check for fuel and exhaust leaks. Stop the genset immediately if there is a fuel or exhaust leak and have it repaired.
5. Always secure the access cover after starting the genset at the genset control panel.

**⚠WARNING Operating the genset with the access cover off can lead to severe burns and overheating of components. Always secure the cover after starting the genset.**

## STOPPING THE GENSET

Turn off air conditioners and other large appliances and let the genset run for two minutes to cool down before stopping. This reduces backfiring and run-on. Then press the switch to **STOP** to stop the genset.

## RESTARTING THE GENSET

See Section 11. *Troubleshooting* if the genset shuts down abnormally.

## ENGINE ONLY OPERATION

(HGJAD, HGJAE, HGJAF only) – Shutdowns due to

generator failure are bypassed when the genset is restarted within one (1) minute. While operating in this mode, the status indicator lamp flashes at a high frequency. This feature allows the engine to run so that hydraulic systems powered by the engine can be operated though AC output has failed.

## GENSET LOCKOUT SWITCH

(HGJAD, HGJAE, HGJAF only) – The vehicle may be equipped with a genset lockout switch in the cab and/or boom bucket that can be used to prevent unauthorized starting of the genset. The switch(s) must be in their unlocked positions to start the genset.

### 3. Periodic Maintenance

Periodic maintenance is essential for top performance and long genset 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. Keeping a log of maintenance performed and hours run will help you keep

genset maintenance regular and provide a basis for supporting warranty claims.

Maintenance, replacement or repair of emission control devices and systems may be performed by any engine repair establishment or individual. However, warranty work must be completed by an authorized Onan dealer.

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

MAINTENANCE PROCEDURE	MAINTENANCE FREQUENCY							P a g e
	Every Day or Every 8 Hours	After First 20 Hours	Every Month	Every 50 Hours	Every 150 Hours	Every 450 Hours		
General Inspections	X							3-2
Check Engine Oil Level	X							3-3
Clean and Check Battery			X <sup>3</sup>					3-5
Clean Spark Arrestor				X				3-7
Change Engine Oil & Oil Filter		X <sup>1</sup>			X <sup>2, 3, 4</sup>			3-4
Replace Air Filter Element					X <sup>2</sup>			3-5
Replace Spark Plugs						X <sup>5</sup>		3-6
Clean Engine Cooling Fins						X <sup>2</sup>		—
Replace Fuel Filter						X <sup>5, 6</sup>		—
Adjust Valve Lash						X <sup>6</sup>		—
Clean or Replace Cylinder Heads						X <sup>6</sup>		—
1 – As a part of engine break-in, change the engine oil after the first 20 hours of operation. 2 – 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 trained and experienced mechanic (authorized Onan dealer).								

## CONDUCTING GENERAL INSPECTIONS

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

### Oil Level

Check engine oil level (Page 3-3).

### Exhaust System

Look and listen for exhaust system leaks while the genset is running. Shut down the genset if a leak is found and have it repaired before operating the genset again.

Look for openings or holes between the genset compartment and vehicle cab or living space if the genset 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.

Park the vehicle so that genset 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 genset running. The ventilator or fan can draw exhaust gases into the vehicle.

Check all CO monitors to assure proper operation.

**⚠️WARNING** **EXHAUST GAS IS DEADLY! Do not operate the genset 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.**

## Fuel System

Check for leaks at the hose, tube and pipe fittings in the fuel supply and return systems while the genset is running and while it is stopped. *Do not use a flame to check for LPG leaks.* 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.

If you smell gas, close the LPG container shutoff valve and have the genset serviced before using it again.

**⚠️WARNING** **Gasoline and LPG are highly flammable and explosive and can cause severe personal injury or death. Shut down the genset and repair leaks immediately.**

### 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 (Page 3-5).

### Mechanical

Look for mechanical damage. Start the genset and look, listen and feel for any unusual noises and vibrations.

Check the genset mounting bolts to make sure they are secure.

Check to see that the genset air inlet and outlet openings are not clogged with debris or blocked.

Clean accumulated dust and dirt from the genset. Do not clean the genset while it is running or still hot. Protect the generator, air cleaner, control panel, and electrical connections from water, soap and cleaning solvents.

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



## CHECKING ENGINE OIL LEVEL

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

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

1. Unscrew the oil fill cap and wipe oil off the dipstick (Figure 3-1). Screw the cap back on, remove it and check the oil level on the dip stick.
2. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (Page 2-1). 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 can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the FULL and ADD marks.*

3. Screw the oil fill cap back on securely.

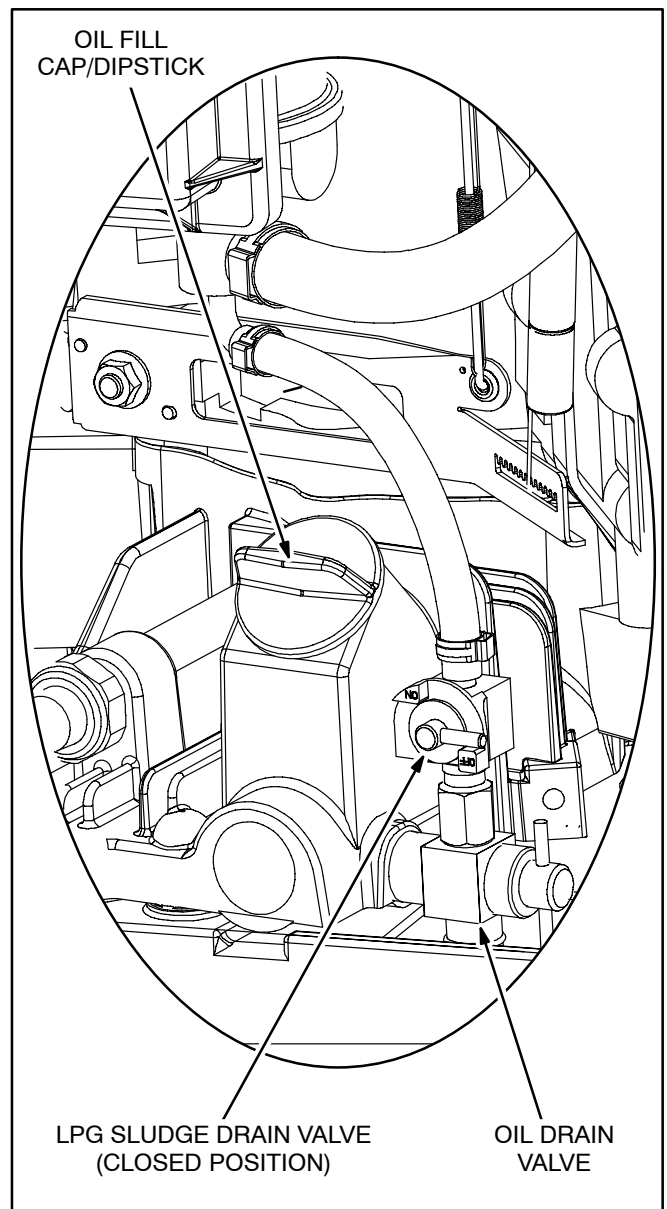


FIGURE 3-1. OIL FILL/DIPSTICK AND DRAIN VALVE

## CHANGING ENGINE OIL AND OIL FILTER

**⚠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.*

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

1. Place a pan underneath the oil drain hose and filter (Figure 3-2). 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 genset before removing the oil fill cap.*

2. Remove the oil fill cap, open the oil drain valve (Figure 3-1), let all oil drain from the engine and then close the drain valve.
3. **High Pressure LPG Gensets:** Drain the LPG system of accumulated sludge by opening the sludge drain valve (Figure 3-1). Oil-like sludge can migrate from the LPG supply system during operation, and if allowed to accumulate, can cause hard starting and rough running. The

sludge drains out through the engine oil drain hose. Make sure to re-close the valve to keep out dust and to keep the engine running smoothly.

4. Spin off the old oil filter and thoroughly wipe off the filter mounting surface. Remove the old gasket if it does not come off with the filter.
5. Apply a film of oil to the filter gasket and spin the new filter on by hand until the gasket just touches the mounting pad. Then turn it 1/2 to 3/4 turn—not more.
6. Refill with 2 quarts (1.8 l) of oil. See ENGINE OIL RECOMMENDATIONS (Page 2-1). 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.**

7. Dispose of the used oil and oil filter in accordance with local environmental regulations.

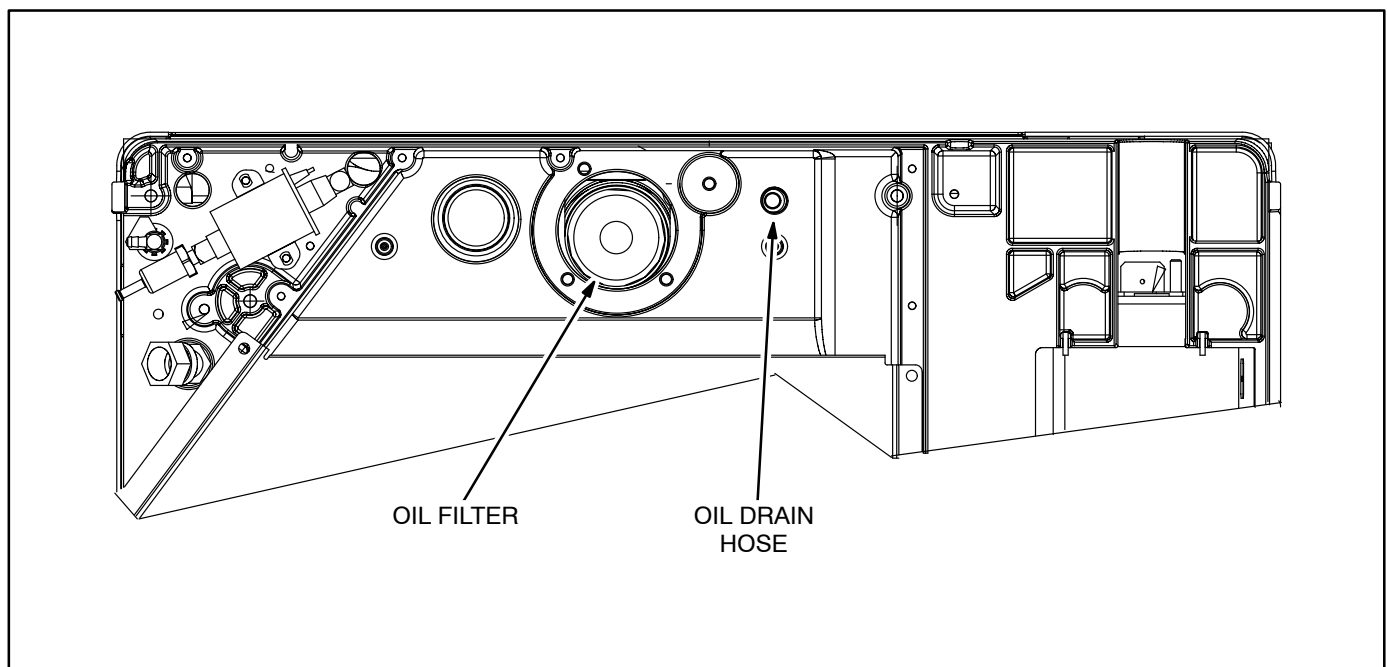


FIGURE 3-2. OIL FILTER AND DRAIN HOSE—VIEW FROM BELOW OF FRONT EDGE OF GENSET

## MAINTAINING BATTERY AND BATTERY CONNECTIONS

**⚠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 genset is running or vehicle battery charging system is on—Always disconnect negative (–) cable first and reconnect it last.*

Refer to Table 3-1 for scheduled battery maintenance, and follow the battery manufacturer's instructions. Have the battery charging system serviced if DC system voltage is consistently low or high. Always:

1. Keep the battery case and terminals clean and dry and the terminals tight.

2. Remove 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.

## REPLACING THE AIR FILTER ELEMENT

Refer to Table 3-1 for scheduled air filter element replacement. In dusty environments the filter element should be inspected and changed more frequently. To change the filter element (Figure 3-3):

1. Unlatch the three spring clips and rotate the cover out and away from the hooks on top. Remove the air filter element.
2. Wipe the filter element sealing surfaces clean and reassemble the air filter with a new filter element.

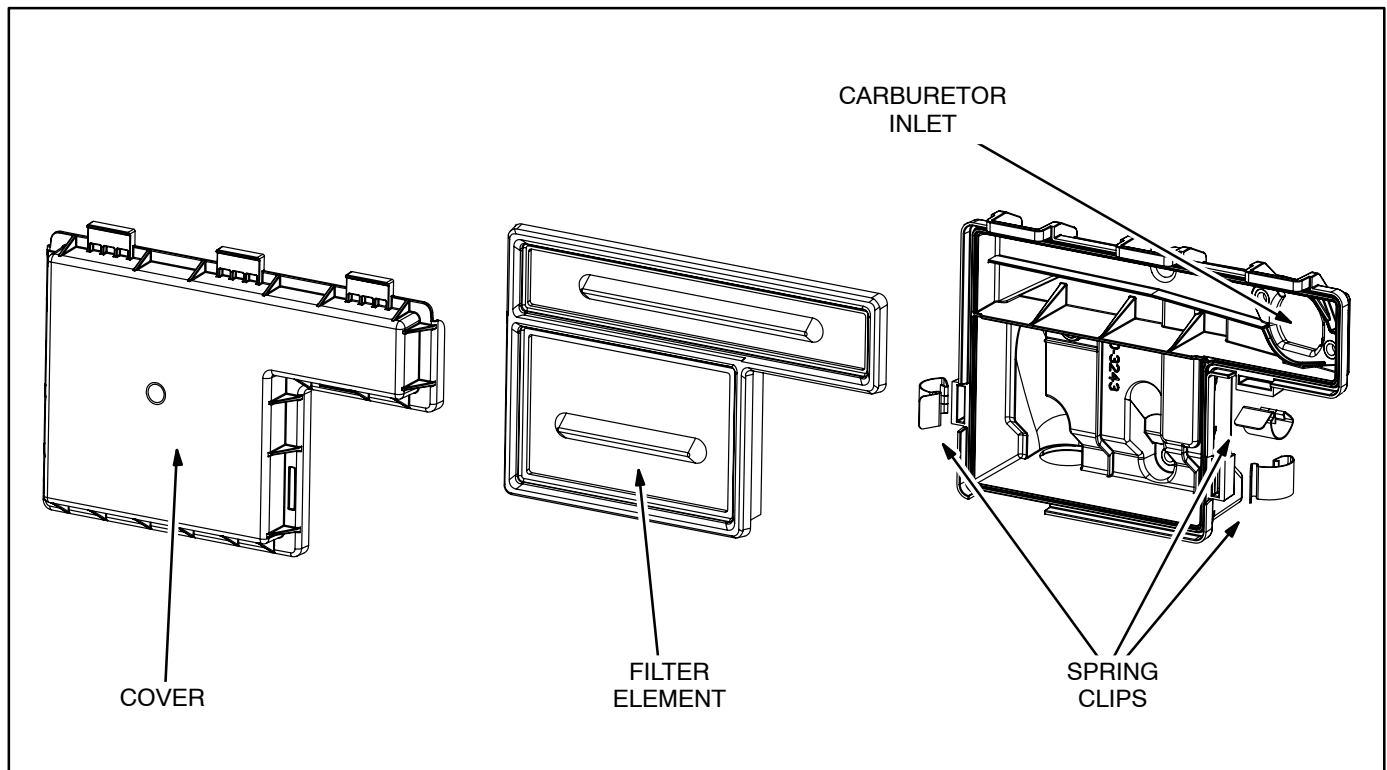


FIGURE 3-3. REPLACING THE AIR FILTER ELEMENT

## REPLACING SPARK PLUGS

Refer to Table 3-1 for scheduled spark plug replacement. (The genset has two spark plugs, Figure 3-4.) 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 indi-

cates the need for engine service. See Section 11. *Troubleshooting*.

To prevent cross threading, always thread a spark plug in by hand until it seats and then torque to 10 lbs-ft (13 N-m) if new, or to 18 lbs-ft (24 N-m) if being reused.

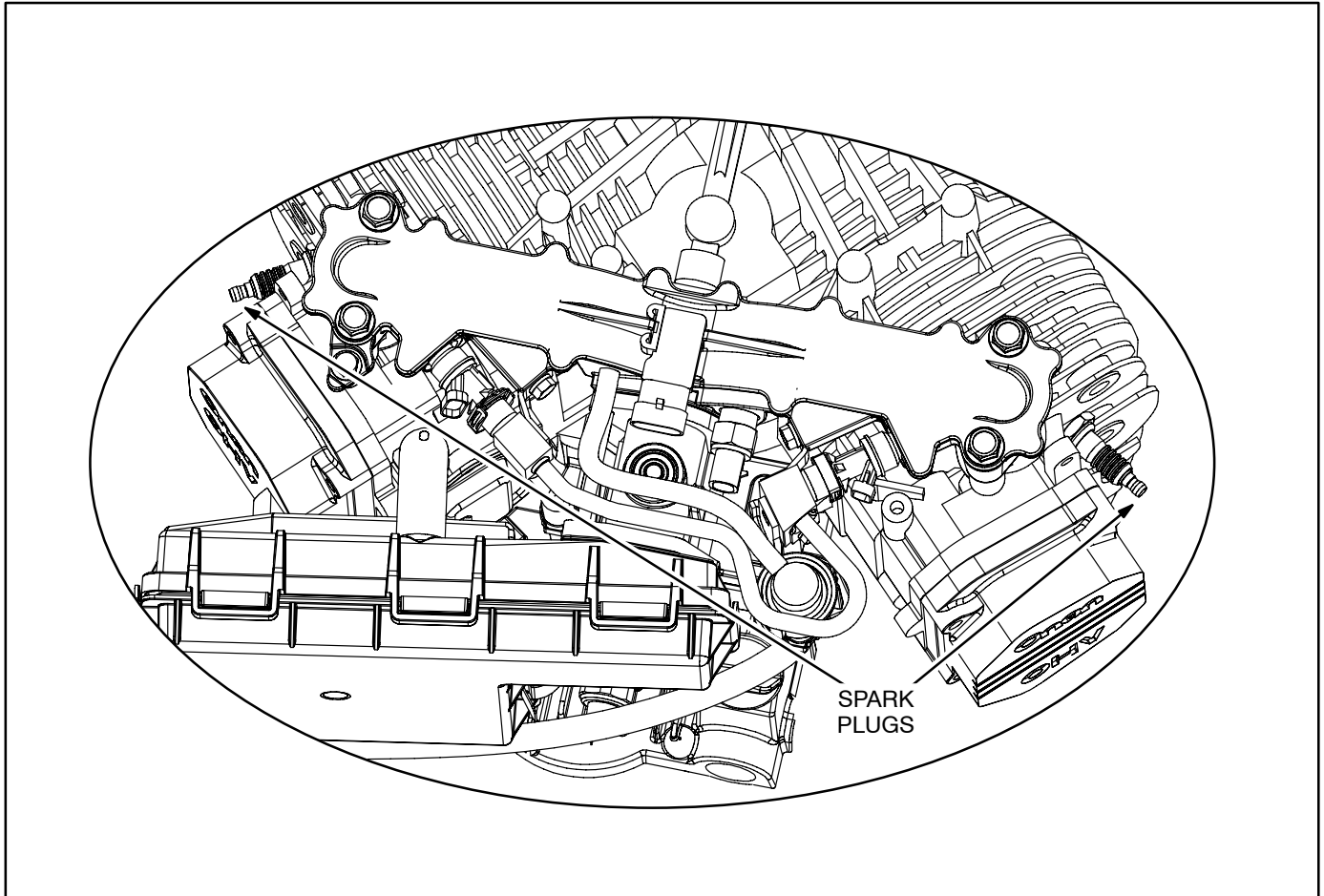


FIGURE 3-4. SPARK PLUGS

## CLEANING THE SPARK ARRESTOR

Refer to Table 3-1 for scheduled cleaning of the spark arrestor muffler. Cleaning is required for maximum genset performance. *Park the vehicle away from grass, brush or debris that could be ignited by sparks expelled during this procedure.*

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

**HGJAA & HGJAD:** A double-drum muffler is mounted inside the genset. The cleanout plug is in the top drum, but accessible from below, though not readily visible. In Figure 3-5 a portion of the lower drum is cut out so that the location of the plug is visible.

1. Locate the square-headed cleanout plug by hand and solidly seat a 7/16 inch, *eight point*, 3/8 inch drive socket wrench with 3 inch extension on the plug. Then add a swivel section and 6 inch extension and turn with a ratchet to remove the plug.
2. Start and load the genset to near full power. Let the genset run for about five minutes to expel the soot in the muffler.
3. Stop the genset, allow the muffler to cool down and then reinstall the plug.

**HGJAB & HGJAE:** See Figure 3-5 if double-drum or Figure 3-6 if single-drum. On a single-drum muffler the cleanout plug is accessible from below as shown in Figure 3-6.

1. Remove the plug with a 7/16 inch, *eight point* socket wrench.
2. Start and load the genset to near full power. Let the genset run for about five minutes to expel the soot in the muffler.
3. Stop the genset, allow the muffler to cool down and then reinstall the plug.

**HGJAC & HGJAF:** The muffler is externally mounted. If it has a clean out plug like the one shown in Figure 3-6, use the instructions for Series HGJAB as a guide. Alternatively, the end of the tail pipe may have a spark screen (Figure 3-7). If so, remove the screw that secures the spark screen, clean the screen with a wire brush and re-install it.

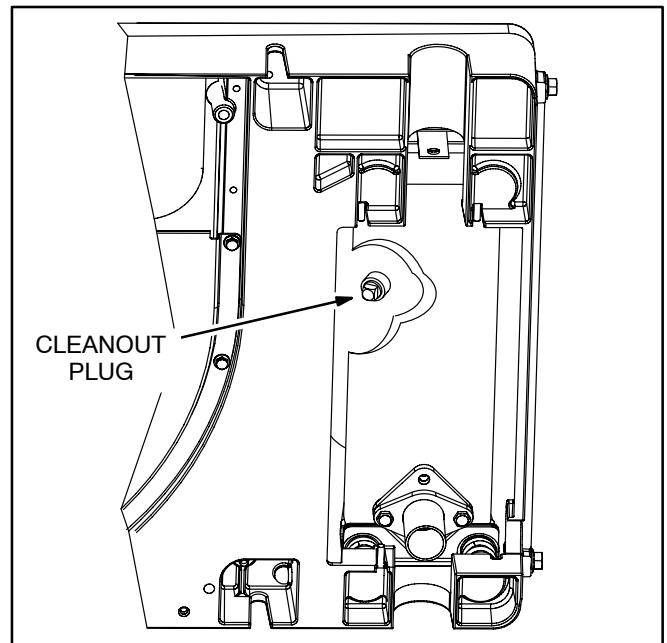


FIGURE 3-5. HJGAA & HGJAD CLEANOUT PLUG—VIEW FROM BELOW

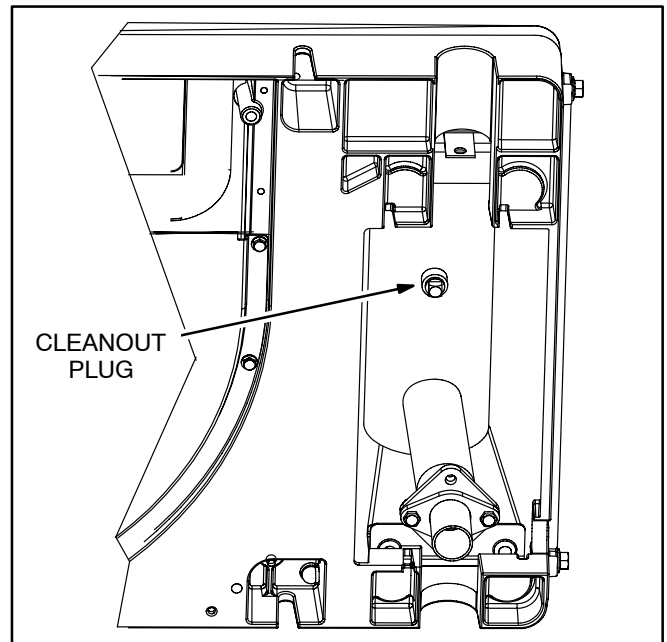


FIGURE 3-6. HJGAB & HGJAE CLEANOUT PLUG—VIEW FROM BELOW

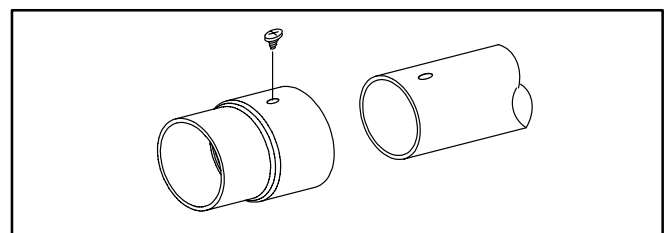


FIGURE 3-7. TYPICAL SPARK SCREEN

## 4. Preparing for Service

### TROUBLESHOOTING

Refer to Section 11. *Troubleshooting* before starting work on the genset. Note that some problems have several possible causes.

### SAFETY

There are hazards in servicing gensets. Study *Safety Precautions* and become familiar with the hazards listed in Table 4-1. 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 4-1. HAZARDS AND THEIR SOURCES

Fire and Explosion	<ul style="list-style-type: none"><li>• Leaking or spilled fuel</li><li>• Hydrogen gas from battery</li><li>• Oily rags improperly stored</li><li>• Flammable liquids improperly stored</li></ul>
Burns	<ul style="list-style-type: none"><li>• Hot exhaust pipes</li><li>• Hot engine and generator surfaces</li><li>• Electrical shorts</li></ul>
Poisonous Gas	<ul style="list-style-type: none"><li>• Operating genset where exhaust gases can accumulate</li></ul>
Electrical Shock (AC)	<ul style="list-style-type: none"><li>• Improper generator connections</li><li>• Faulty wiring</li><li>• Working in damp conditions</li><li>• Jewelry touching electrical components</li></ul>
Rotating Machinery	<ul style="list-style-type: none"><li>• Fan guards not in place</li></ul>
Slippery Surfaces	<ul style="list-style-type: none"><li>• Leaking or spilled oil</li></ul>
Heavy Objects	<ul style="list-style-type: none"><li>• Removing genset from vehicle</li><li>• Removing heavy components</li></ul>

### SPECIAL TOOLS

The following special tools are required to service the genset. See the Onan Tool Catalog.

#### Engine Tools

Torque wrench (0-75 lbs-ft or 0-100 N-m)  
Feeler gauge  
Leak down tester  
Spark plug gap gauge  
Cylinder compression tester  
Flywheel puller  
Snap ring pliers  
Cylinder ridge reamer  
Piston ring compressor  
Piston ring spreader  
Cylinder hone  
Valve seat cutter  
Valve spring compressor  
Piston groove cleaner  
Outside micrometer set (1-4 in.)  
Telescoping gauge set (0.500-4.000 in.)  
Hole gauge (0.300-0.400 in.)  
Plasti-Gage bearing clearance guide

## Generator Tools

Lead or dead-blow hammer  
VOM Multi-Tester  
Frequency Meter  
Load test panel and leads

## REMOVING THE GENSET

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 genset is to be removed.

**Below-Floor Mounting:** Four 3/8 inch bolts into the ends or bottom of the base (Figure 4-1) are used to secure the genset to special brackets from the vehicle floor or frame or to frame members underneath (Figure 4-1). *The area above the genset should have a vapor-tight, fire-resistive barrier between the genset and coach interior.*

**Above-Floor, Compartment Mounting:** Four 3/8 inch bolts into bottom of the base (Figure 4-1) are used to secure the genset to the floor of the compartment. *The compartment should have a vapor-tight, fire-resistive barrier that seals off the genset from the coach interior.*

### Disconnecting the Genset

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

1. Disconnect all battery cables (negative [–] first) at the battery(ies) 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 genset is running or vehicle battery charging system is on—Always disconnect negative (–) cable first and reconnect it last.*

2. Disconnect the negative (–) and positive (+) battery cables at the genset.
3. Disconnect the wiring connectors for remote control and remote fuel pump (fuel injection models).
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 Gensets:** Disconnect the fuel line(s) from the genset and securely plug the end of the fuel line to prevent leakage or an accumulation of explosive gasoline vapor.
7. **LPG-Fueled Gensets:** Close the fuel shutoff valve(s) at the LPG container(s) and move the vehicle outside and away from below-grade spaces where LPG could accumulate. To purge most of the LPG from the fuel line and genset, run the genset (if it starts) until it runs out of fuel (LPG container valve closed). Disconnect the fuel line from the genset and 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 (liquified 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 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.*

## Removing the Genset

Park the vehicle on a level surface, put the transmission in PARK, lock the brakes and remove the ignition key. Do not move the vehicle during this procedure.

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

Figure 4-1 illustrates the four lift-hook slots for genset 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 Section 13. *Specifications* regarding the weight

of the genset and make provisions accordingly for safe handling.

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

## INSTALLING THE GENSET

Generally, installation is the reverse of removal. *Before installing the genset, repair any damage to and seal all holes in the vapor-tight, fire-resistive barrier between the genset 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 genset in service (Section 12. *Service Checklist*).

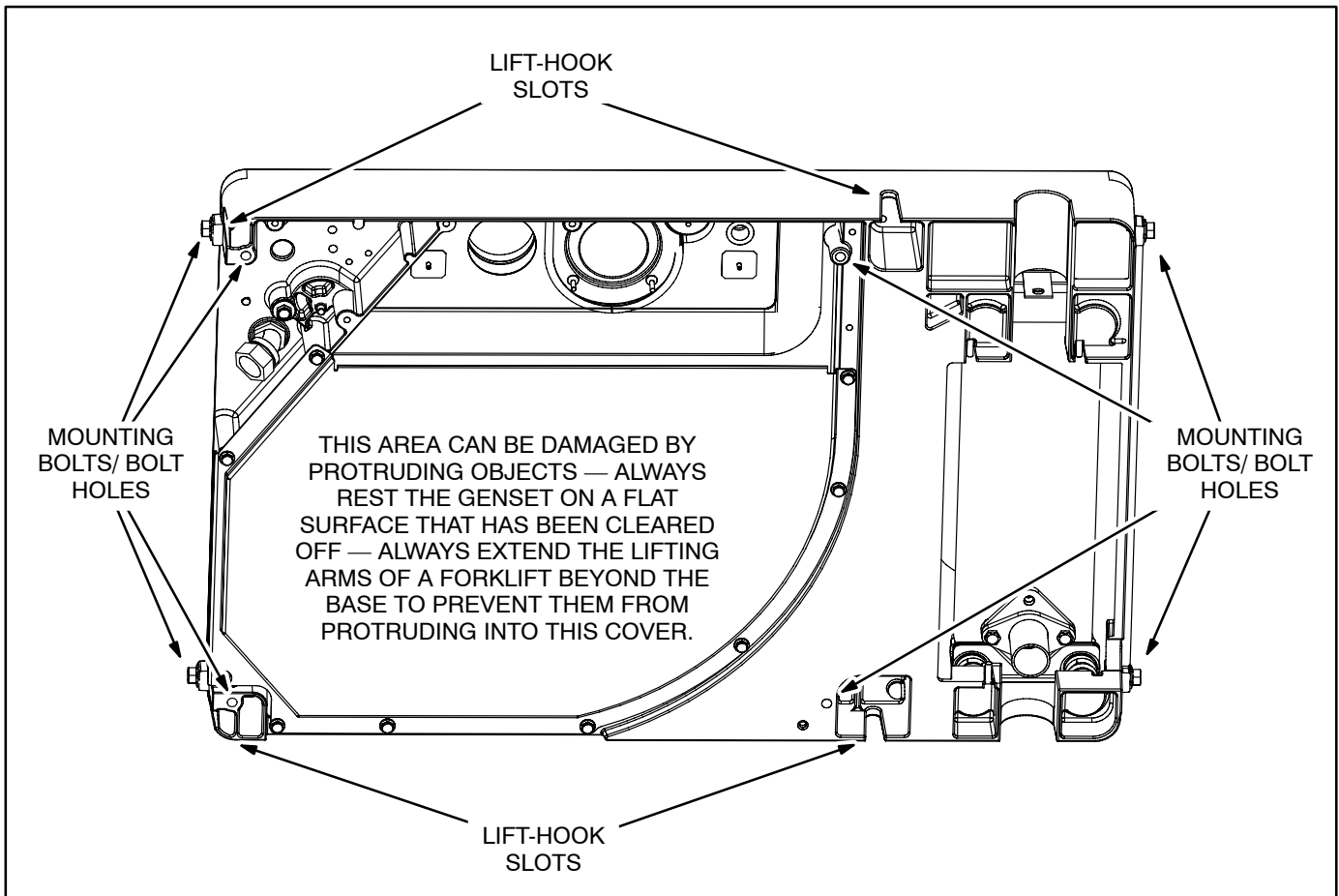


FIGURE 4-1. GENSET LIFT-HOOK SLOTS—MOUNTING BOLT HOLES—AREA THAT CAN BE DAMAGED

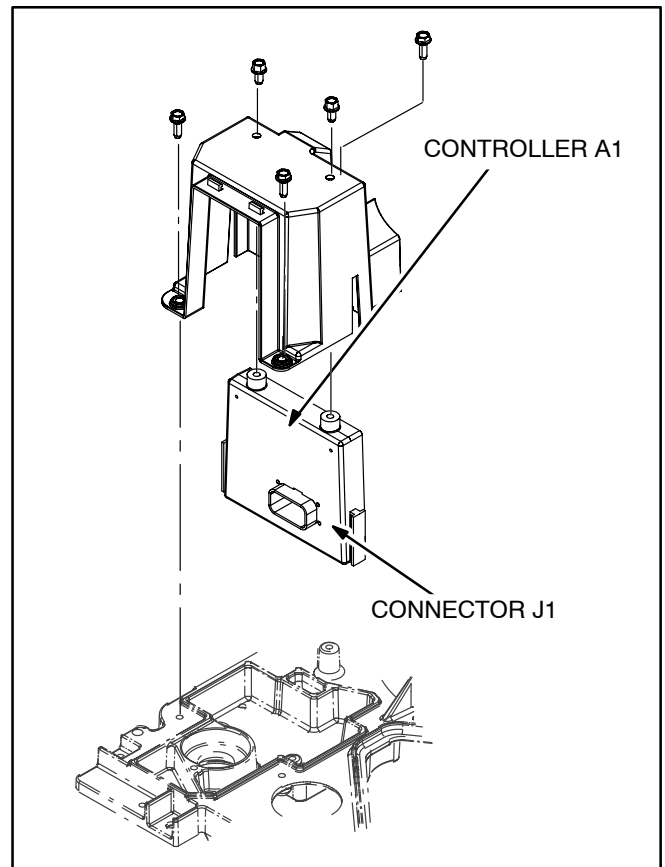


# 5. Control

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## CONTROLLER A1

Controller A1 is an integrated microcontroller-based engine and generator control (Figure 5-1). It provides all the control, monitoring and diagnostic functions required to operate the genset. All connections to the controller are through connector J1 on the side of the controller. Refer to the appropriate wiring diagrams and wiring harness drawings beginning with Page A-1.



**FIGURE 5-1. CONTROLLER A1**

## Major Functions of Controller A1

Figure 5-2 is a block diagram of controller functions.

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

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

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

1. Enables cranking.
2. Energizes the fuel pump E2 (gasoline models only).
3. Depending on model:
  - A. Enables fuel injection
  - B. Energizes the gasoline carburetor fuel cut-off solenoid E3 and choke heater
  - C. Energizes LPG fuel cutoff solenoid E3.
4. Flashes the field (F1-F2).
5. Flashes the status indicator light during cranking.
6. Disconnects the starter when engine speed is greater than 1300 rpm and turns the status indicator light on solid.
7. Turns on Switched B+ (remote pin J8-F).
8. Enables output voltage two seconds after operating speed is reached.
9. Turns off field flash.

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

1. Disables output voltage.
2. Deenergizes the fuel pump and fuel cutoff solenoid or fuel injectors.
3. Enables ignition kill.
4. Turns off the status indicator light.
5. Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM).
6. Removes processor power when idle 5 minutes (15 minutes, HGJAA & HGJAD).

**Note:** Stop takes precedence over Start if both present due to a faulty switch or other cause.

**Fuel Control:** See GASOLINE FUEL SYSTEM—SERIES HGJAA & HGJAD, Page 8-1.

**Voltage Control:** The controller maintains nominal AC output voltage during steady state operation by varying field current as load varies. In response to transient loads it lowers the voltage setpoint to allow engine recovery. Field power (DC) is supplied by the quadrature windings (AC) through the controller. For output voltage specifications see Table 8-1 (Page 8-1) for Series HGJAA & HGJAD and Table 8-3 (Page 8-19) for all other models.

**Fault Monitoring, Shutdown and Diagnostics:** See Section 11. *Troubleshooting*.

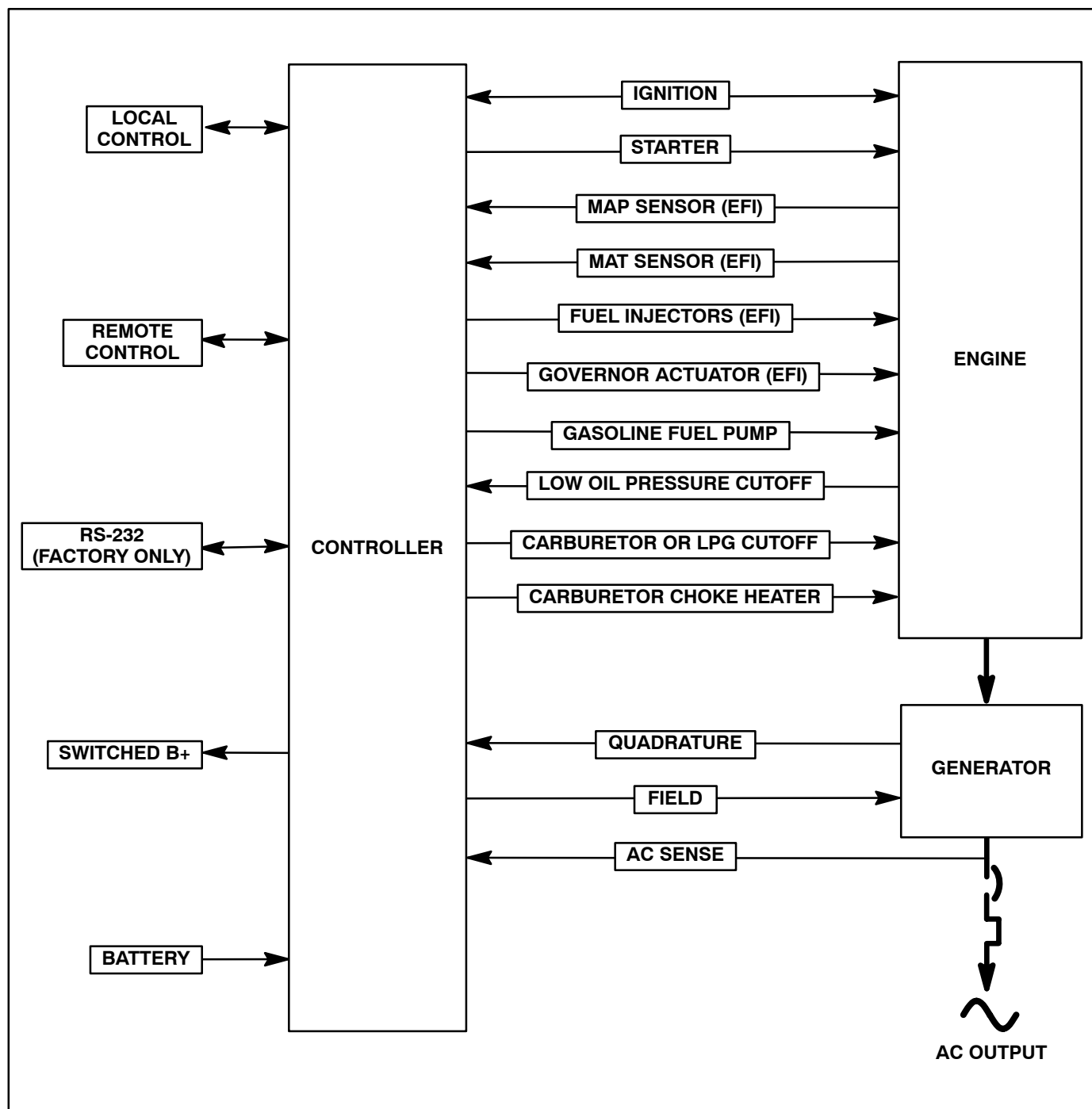


FIGURE 5-2. CONTROLLER A1 BLOCK DIAGRAM

## Controller A1 Removal / Replacement

To remove the controller, remove the two-piece enclosure, which is secured by four screws to the engine/generator base. *Make sure to remove the screw in back of the rear section of the enclosure.* Then remove the two screws that secure the controller to the rear section of the enclosure and slide it out. Use a small flat-bladed screwdriver to lever out the catch on connector P1/J1 (Figure 5-3), and pull the connector apart.

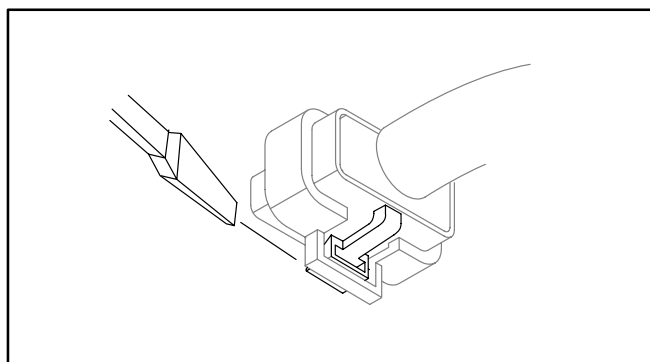


FIGURE 5-3. DISCONNECTING P1 / J1

## OTHER CONTROL COMPONENTS

### Control Switch S1

The control switch (Figure 5-4) is located as shown (Figure 5-5). Unsnap connector P9 from the back of the switch for access to its terminals. Replace the switch if it does not: close across terminals 2 and 3 when the switch is held in the Start position, close across terminals 1 and 2 when held in the Stop position, or the status indicator light does not light when 12 VDC is connected across terminals 7 (–) and 8 (+).

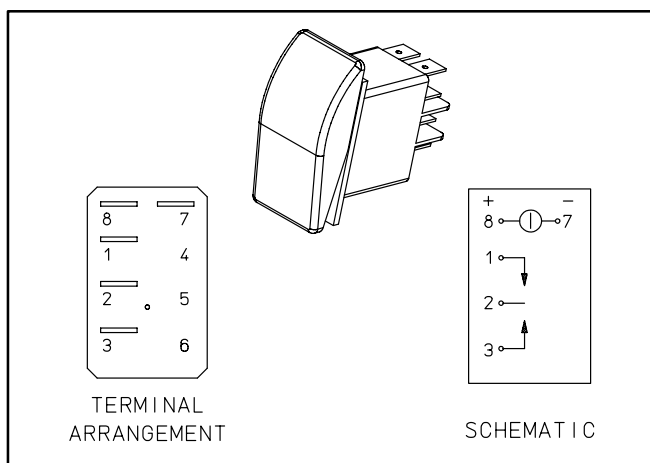


FIGURE 5-4. CONTROL SWITCH S1

### Line Circuit Breakers CB1, CB2, CB3

The line circuit breakers are located as shown (Figure 5-5). Disconnect all wiring and check electrical resistance across the terminals of each circuit breaker. Replace a circuit breaker that does not reset or that does not close or open as the handle is turned ON and OFF.

### Hour Meter

When the genset is so equipped, the hour meter is located as shown (Figure 5-5).

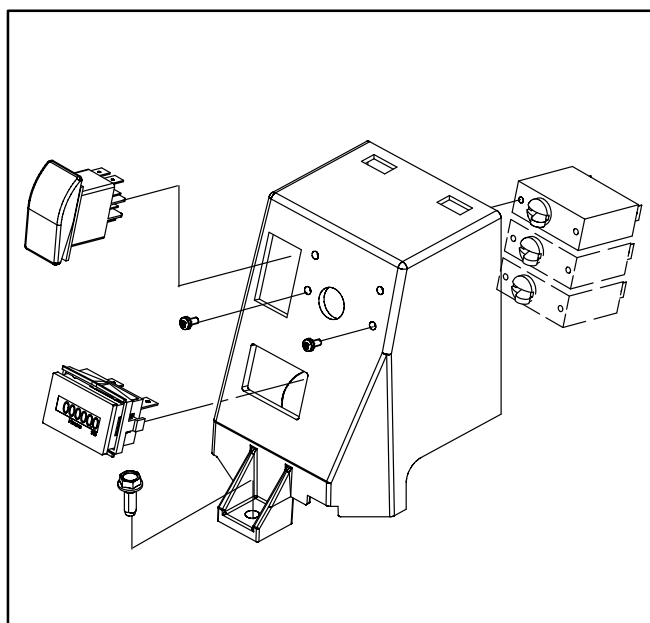


FIGURE 5-5. CONTROL SWITCH, LINE CIRCUIT BREAKERS, HOUR METER

### 3-Phase Voltage Sense Transformer

**Mounting:** The voltage sense transformer for 3-phase generators is mounted as shown (Figure 5-6). It is connected as shown on Page 6-6 to sense output voltage in L1.

**Testing:** Replace the transformer if resistance in either winding is not as specified in the schematic.

### Battery Charge Regulator VR

**Mounting:** When the genset is so equipped, the regulator and heat sink are mounted as shown on the engine-generator mounting base (Figure 5-7).

**Testing:** See Page 6-4 to test battery charge winding B1–B2. To test the regulator, remove the lead from terminal B+. If B1–B2 output is 15 to 20 VAC, but regulator output is less than 12.8 VDC, replace regulator VR.

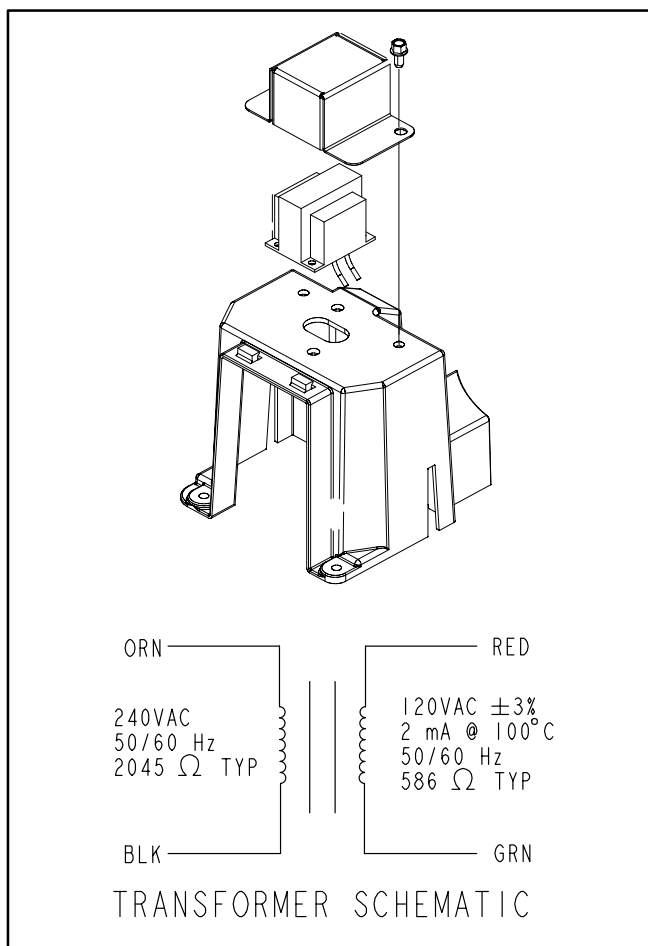


FIGURE 5-6. 3-PHASE VOLTAGE SENSE TRANSFORMER

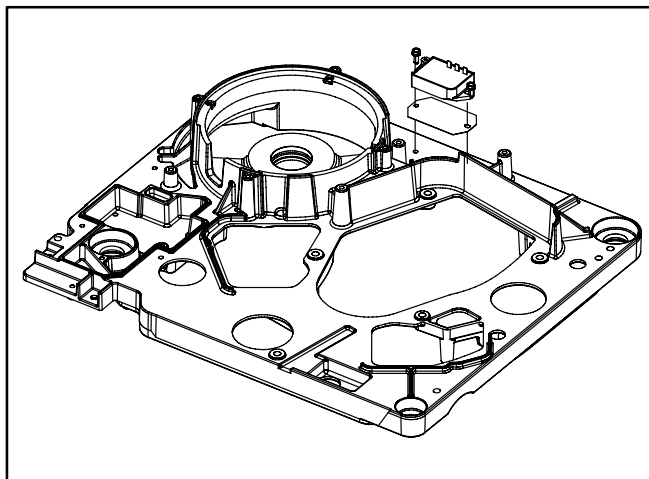


FIGURE 5-7. BATTERY CHARGE REGULATOR VR

## Wiring Harness Ground Screw

Secure the four (4) GND wiring harness eyelets (Page A-2 or A-4) to the base with the harness ground screw (Figure 5-8).

## Generator Neutral Ground Screw

For 2-Wire, 120 VAC gensets only (Figure 6-3, Page 6-6), secure generator leads T2 and T4, the green AC output lead and the two (2) white (L0 and L0) AC output leads to the base with the generator neutral ground screw (Figure 5-8).

## Bond Strap

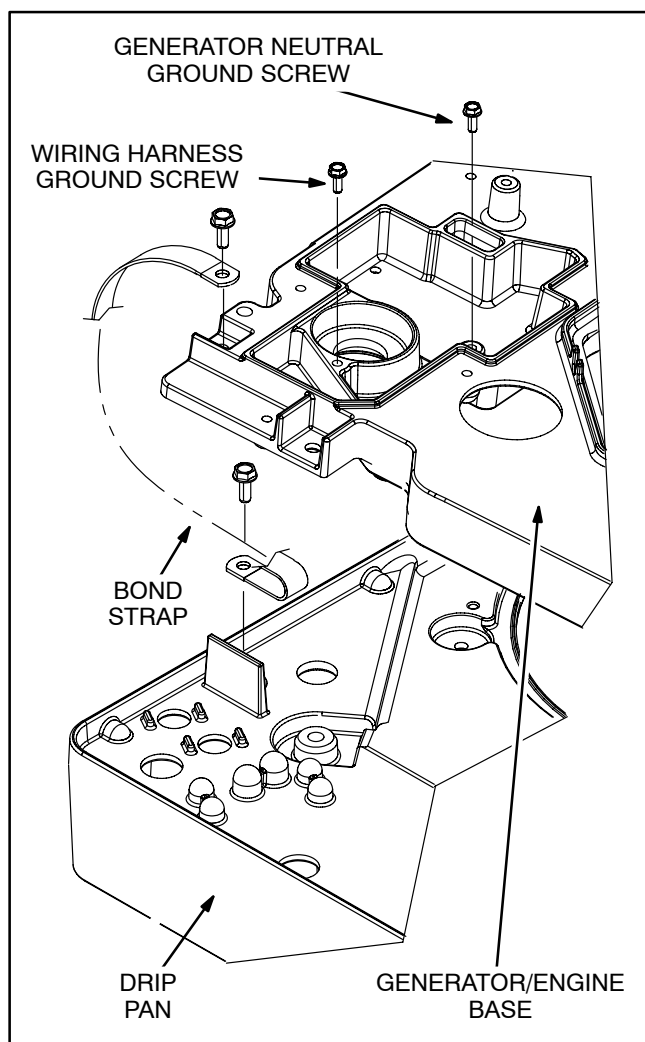
Connect the bond strap (Figure 5-8) between the generator/engine base and drip pan to carry control and cranking currents to battery negative (-). The negative battery cable terminal is on the bottom side of the drip pan (Figure 5-13).

## Remote Control Connector P2/J2

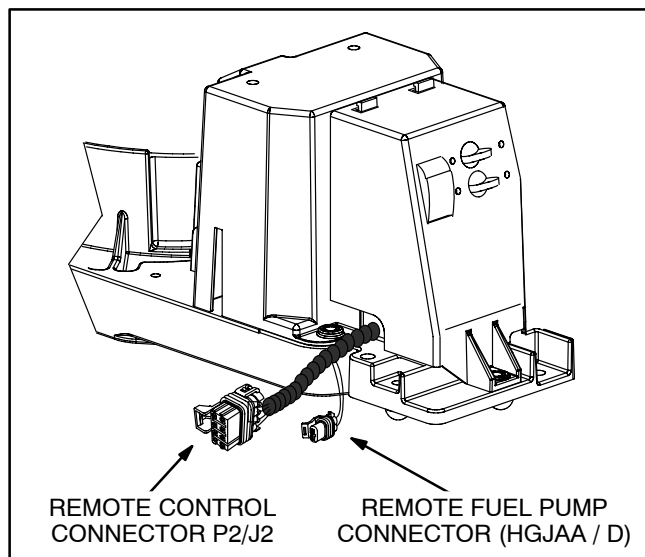
Figure 8-6 illustrates the sealed 8-pin connector for remote control.

## Fuel Pump Connector

Figure 8-6 illustrates the sealed 2-pin remote fuel pump connector for Models HGJAA and HGJAD. Models HGJAB, HGJAC, HGJAE and HGJAF gensets have, instead, two (2) separate quick-connects for connection directly to the leads of the mounted gasoline fuel pump (Page 8-11) or LPG shutoff solenoid (Page 8-14).



**FIGURE 5-8. BOND STRAP**



**FIGURE 5-9. REMOTE CONNECTORS**

Batteries

The genset has a 12 VDC, negative-ground engine control and cranking system. See Section 13. *Specifications* for the requirements for cranking batteries.

Battery Cables

If battery cables need to be replaced, size them according to Table 5-1. The current path between the genset and the negative (–) battery terminal must be able to carry full cranking current without causing excessive voltage drop. The path may be a full-length cable (Figure 5-10) or the vehicle frame (Figure 5-11). Note also that a genset grounding conductor, if provided, was probably required by code and must be reconnected to the grounding terminal (Figure 5-12).

***The genset mounting bolts are not considered adequate means for bonding the genset to the vehicle frame, either for the purpose of carrying cranking currents or for complying with requirements for genset/system grounding.***

When replacing battery cables route them away from fuel lines and hot engine exhaust components. Battery cables should be accessible for inspection and replacement, protected from damage and secured to prevent chafing due to vibration.

**⚠️WARNING** *Routing battery cables with fuel lines can lead to fire and severe personal injury or death. Keep battery cables away from fuel lines.*

TABLE 5-1 BATTERY CABLE SIZES FOR TEMPERATURES DOWN TO –20° F (–29° C)

TOTAL CABLE LENGTH* FEET (METERS)	CABLE SIZE AWG
0 to 10 (0 to 3)	2**
11 to 15 (3 to 4.5)	0
16 to 20 (4.5 to 6)	000

\* – Add the negative battery cable lengths with the positive battery cable lengths for the total.  
\*\* – A total length of up to 20 feet (6 meters) may be used in warmer climates or when battery capacity totals at least 1000 CCA (Cold Cranking Amps).

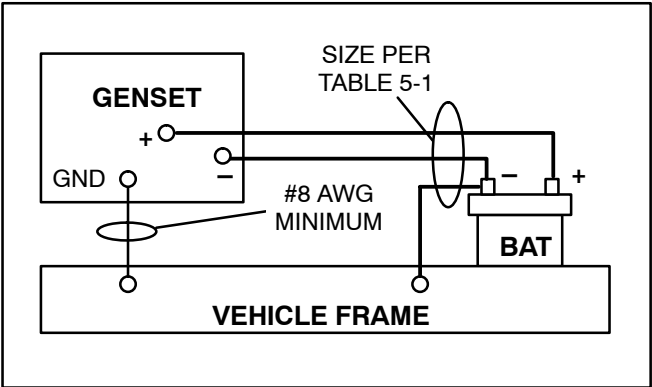


FIGURE 5-10. FULL-LENGTH CABLE FROM BATTERY NEGATIVE (–) TERMINAL

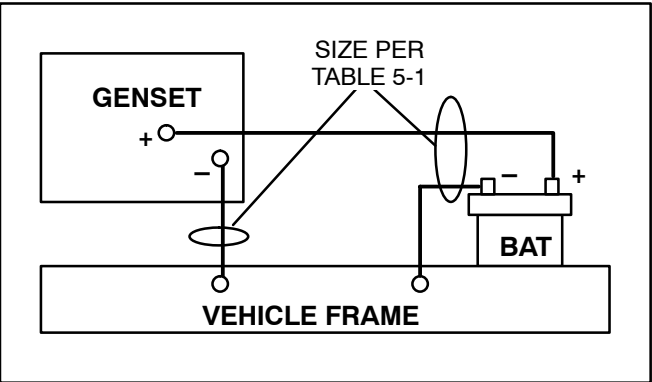


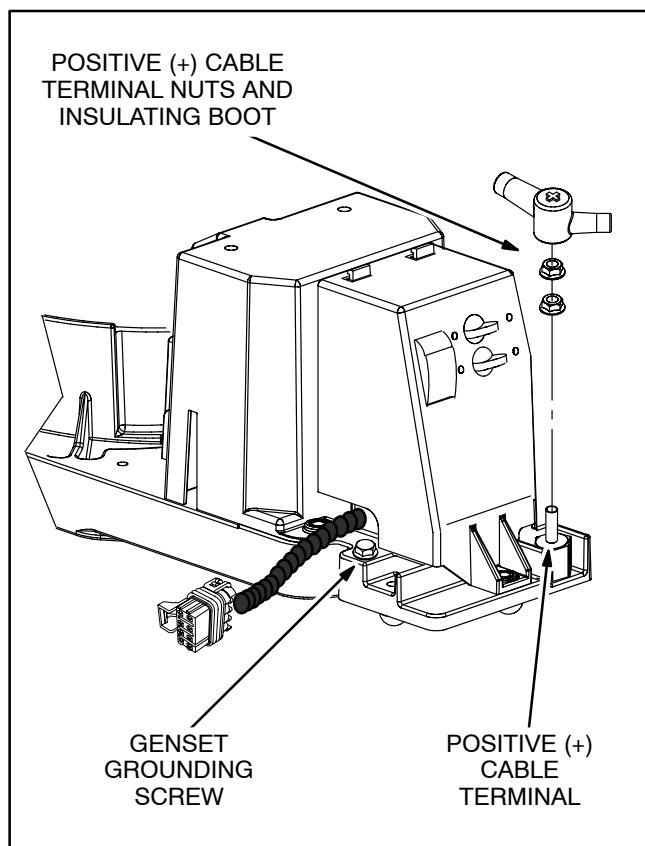
FIGURE 5-11. VEHICLE FRAME AS PATH FROM BATTERY NEGATIVE (–) TERMINAL

## Battery Cable Connections at Genset

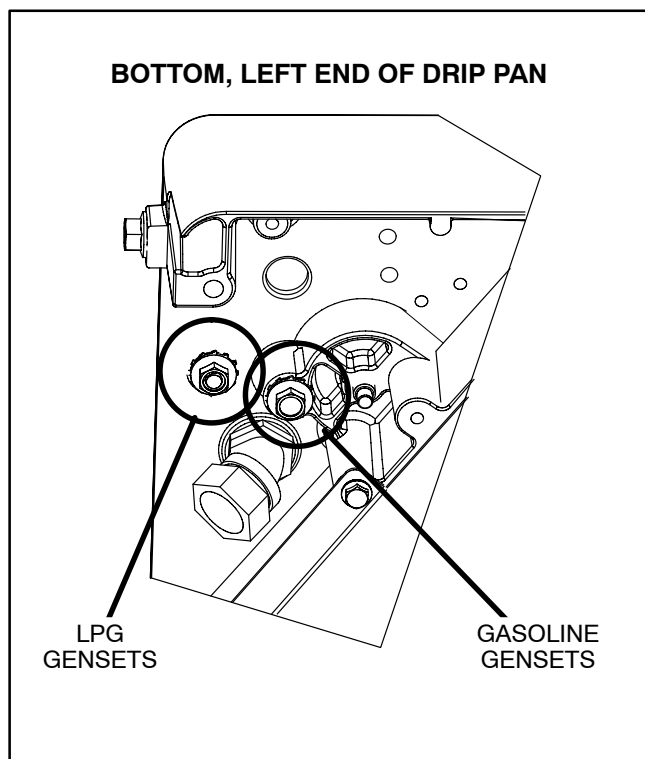
Terminate the battery cables with ring terminals sized for 5/16 inch screws and connect them to the genset as shown in Figures 5-12 and 5-13. Secure the insulating boot on the positive (+) terminal and tie it to the battery cable with a tie wrap.

### Genset (Equipment) Grounding Screw

When required (see Figure 5-10) connect the genset grounding screw (Figure 5-12) to the vehicle frame with a No. 8 AWG or larger stranded cable having a ring terminal sized for a 3/8 inch screw.



**FIGURE 5-12. POSITIVE (+) BATTERY CABLE TERMINAL & GENSET GROUNDING SCREW**



**FIGURE 5-13. NEGATIVE (-) BATTERY CABLE TERMINAL**



# 6. Generator

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## GENERATOR DESCRIPTION

These are vertical-shaft, 2-bearing, belt-driven, 2-pole, revolving field generators with brushes and slip rings (Figure 6-1). Output voltage is regulated by microcontroller-based genset controller A1 (Page 5-1).

### Stator

The stator consists of steel laminations with two or three sets of windings in the lamination slots. The main windings (T1–T2, etc.) power the connected loads and the quadrature windings (Q1–Q2) supply power for the generator field. Some models have battery charging windings (B1–B2). See the Figure 6-3 schematics.

### Rotor

The rotor consists of a shaft with steel laminations wrapped with field windings. A molded slip ring assembly is pressed on to supply field current to the rotor windings through the brush block assembly. The rotor shaft is supported on both ends by sealed ball bearings and is driven by a belt pulley.

### Genset Cooling Fan

The genset cooling fan (blower) is bolted to the generator drive pulley to cool generator and engine.

### Brush Block

Field current passes through the brush block which has two spring-loaded carbon brushes that make contact with the rotor slip rings.

### Voltage Regulator

Genset controller A1 maintains constant output voltage under varying load conditions by varying field current. Power for field excitation is supplied by the quadrature winding (Q1–Q2).

### Line Circuit Breakers

Line circuit breakers (CB1 / CB2 / CB3) are mounted on the control panel to protect the generator leads

and provide a means for disconnecting the generator from the load. See the Figure 6-3 schematics.

## Principle of Operation

During startup the controller enables field flashing by means of battery current for fast buildup of generator voltage as the engine accelerates to operating speed. During operation, the controller maintains nominal AC output voltage by varying field current in response to load. In response to transient loads, it lowers the voltage setpoint to allow engine recovery. The quadrature windings supply field power through the controller.

## GENERATOR SERVICE

The generator brush block, end bell and stator (Figure 7-2) can be removed from the top of the generator/engine base, leaving the rotor in place. It is necessary to remove the rotor drive pulley before the rotor can be pulled up out of the base. To remove the rotor drive pulley see Section 7. *Drive Belt System*.

### Stator Removal

1. Remove the two-piece control enclosure (Section 5. *Control*) and disconnect the stator leads from the line circuit breakers and neutral (grounded) terminal on the base.
2. Remove the brush block (Page 6-3).  
**⚠ CAUTION** *The brushes can be damaged if the brush block is not removed before removing the end bell.*
3. Remove the generator/engine bracket.
4. Remove the four generator through bolts.
5. Pull the generator end bell straight up.
6. Pull the stator assembly straight up, taking care not to damage rotor or stator windings.

### Stator Reassembly

Reassembly is the reverse of removal. Align the stator so that the leads exit through the slot in the base. Relubricate the bearing bore in the end bell with molybdenum disulfide paste or equivalent. Make sure the wave washer and O-ring are in place in the bearing bore. Torque the through bolts to 8 lb-ft (11 N-m).

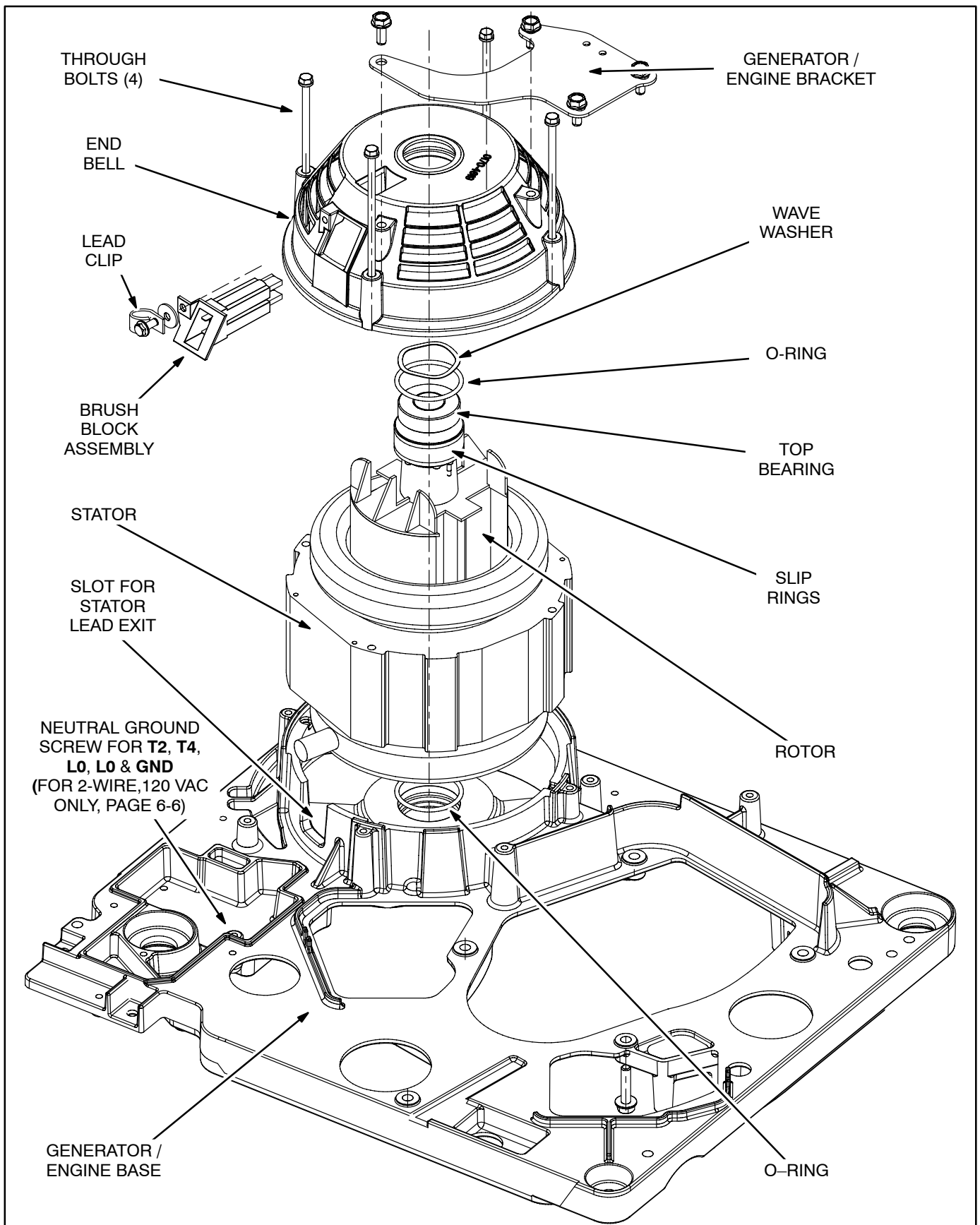


FIGURE 6-1. GENERATOR

## Rotor Removal

1. Remove the rotor drive pulley. See Section 7. *Drive Belt System*.
2. Remove the generator end bell.
3. Pull the rotor assembly straight up, taking care not to damage rotor or stator windings.

## Rotor Reassembly

Reassembly is the reverse of removal. Relubricate the bearing bores in the end bell and base with molybdenum disulfide paste or equivalent. Make sure the wave washer is in place in the end bell and that the O-rings are in place in top and bottom bearing bore grooves.

**For Spec A through C original rotors only**, use an adhesive when installing new bearings on the rotor shaft. Apply the adhesive to the shaft (Loctite 680 or equivalent) and primer (activator) to the bearing (Loctite 747 or equivalent).

After applying adhesive, if necessary, press each bearing on up to its shaft shoulder using a bench press.

**⚠ CAUTION** *Apply force only to the bearing inner race to avoid damage to the bearing.*

## BRUSHES AND SLIP RINGS

### Brush Block

Disconnect the field leads from the brush block (Figure 6-2), remove the mounting screw and withdraw the brush block from the generator end bell. Replace the brush block assembly if either brush is shorter than 7/16 inch (11 mm), binds in the brush block or is damaged in any way.

Reconnect the field leads, **F–** to the top terminal, and **F+** to the bottom terminal when reassembling. Make sure the leads pass through the lead clip (Figure 6-1) to prevent strain on the terminals.

### Slip Rings

Remove the brush block and inspect the slip rings for grooves, pits, or other damage. Use a Scotch Brite pad or commutator stone to remove light wear or corrosion.

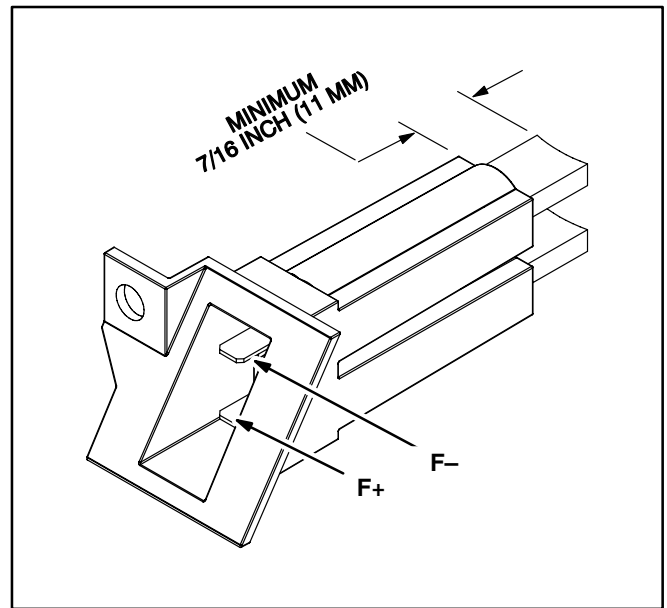


FIGURE 6-2. BRUSH BLOCK

## GENERATOR TESTING

### Rotor Tests

Test the rotor for grounded, open and shorted windings using an ohmmeter. First test at the brush block terminals. If the resistance is high, remove the brush block and test directly on the slip rings. Replace the brush block if a high resistance is due to the brushes.

**Ground Test:** Set the ohmmeter to the highest resistance scale, or use a megger. Touch one test prod to the rotor shaft and the other to one of the slip rings. Replace the rotor if the reading is less than one megohm (one million ohms) on a megger, or infinity on an ohmmeter.

**Winding Resistance Test:** Touch the slip rings with the meter test prods. Replace the rotor if resistance is not as specified in Table 6-1 or 6-2, as appropriate.

**TABLE 6-1. ROTOR—HGJAA, HGJAB, HGJAC**

RESISTANCE (OHMS) @ 77° F (25° C) ± 10%	
6.5-7.0 kW Gensets (95 mm Stack)	5.5 kW Gensets (80 mm Stack)
31.97	29.34

**TABLE 6-2. ROTOR—HGJAD, HGJAE, HGJAF**

RESISTANCE (OHMS) @ 77° F (25° C) ± 10%
31.97

### Stator Tests

Use an ohmmeter to test for grounded or open windings. Remove the control enclosure for access to the stator leads (Section 5. *Control*).

**Ground Test:** Set the ohmmeter to the highest resistance scale and then touch one test prod to the

stack and, in turn, the other to each stator lead. Replace the stator if any reading is less than one megohm (one million ohms) on a megger, or infinity on an ohmmeter.

**Open Winding Test:** Connect the ohmmeter test prods across each pair of winding leads. Replace the stator if any winding is open (zero ohms).

**Winding Resistance Test:** Use a meter (Wheatstone Bridge) having a precision down to 0.001 ohms to measure resistance across each pair of winding leads. Replace the stator if resistance is not as specified in Table 6-3 or 6-4, as appropriate.

**TABLE 6-3. STATOR—HGJAA, HGJAB, HGJAC**

WINDING	RESISTANCE (OHMS) @ 77° F (25° C) ± 10%	
	6.5-7.0 kW Gensets (95 mm Stack)	5.5 kW Gensets (80 mm Stack)
T1–T2, T3–T4	0.30	0.33
Q1–Q2	2.44	2.73

**TABLE 6-4. STATOR—HGJAD, HGJAE, HGJAF**

WINDING	RESISTANCE (OHMS) @ 77° F (25° C) ± 10%
120 V, 1-PH	
T1–T2	0.147
Q1–Q2	2.42
B1–B2	0.124
120/240 V, 1-PH	
T1–T4*	0.294
Q1–Q2	2.42
B1–B2	0.124
3-PH (DELTA)	
L1–L2, L1–L3, L2–L3	1.05
Q1–Q2	3.28
B1–B2	0.276
* – T2 and T3 must be connected for this test.	

## VOLTAGE ADJUSTMENTS—HGJAD, HGJAE, HGJAF

Voltage is adjusted by means of the control switch. Rapidly pressing the switch to **START** 6 times *during the first minute after startup* puts the genset controller into *voltage set mode*. The *amber* status indicator lamp will begin blinking once every second to confirm voltage set mode.

**Note:** If a fault shutdown occurs or the control switch is pressed to **STOP** during voltage set mode, voltage adjustments will not be stored in controller memory.

To adjust voltage:

1. Disconnect all generator loads and connect accurate meters to measure AC volts and frequency.

**⚠WARNING**     **HAZARDOUS VOLTAGE!**  
*Touching uninsulated live parts inside the genset or connected equipment can result in severe personal injury or death. For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and use tools with insulated handles.*

2. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds.
3. Rapidly press the control switch to **START** 6 times within 1 minute of start.

4. **To adjust voltage up**, press the control switch to **START** and release quickly. Each time the switch is released, voltage will rise approximately 0.6 volt.
5. **To adjust voltage down**, press the control switch to **START** and release in approximately 2 seconds. Each time the switch is released, voltage will drop approximately 0.6 volt.
6. Normal operation will resume in 20 seconds after the last adjustment, *which remains as the voltage set point until changed again.*

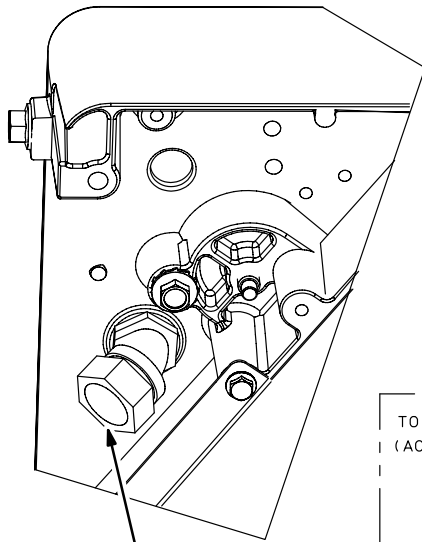
## GENERATOR CONNECTIONS

The genset is equipped with circuit breakers and 12 AWG leads for AC power output, which exit through a rain-tight 1/2 inch trade size conduit connector. See Figure 6-3 for the connection diagrams and the location of the conduit connector.

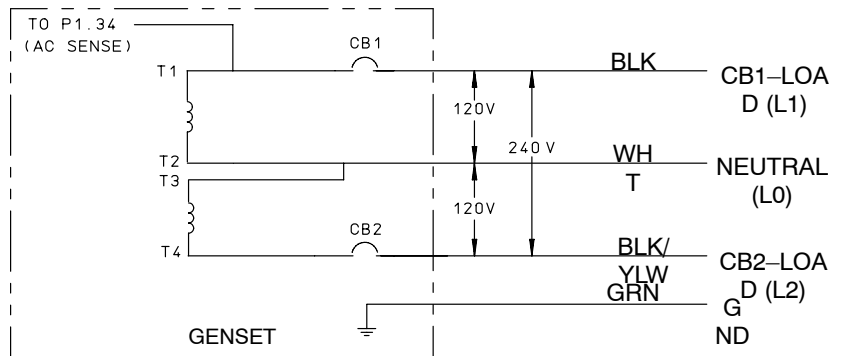
These gensets are not reconnectable for voltages other than stated on the nameplate.

*If the generator leads are replaced, their ampacity must be equal to or greater than the ampere rating marked on the genset circuit breakers. (Unless 125° C rated wiring is available, heavier gauge wiring may be required to obtain the required ampacity).*

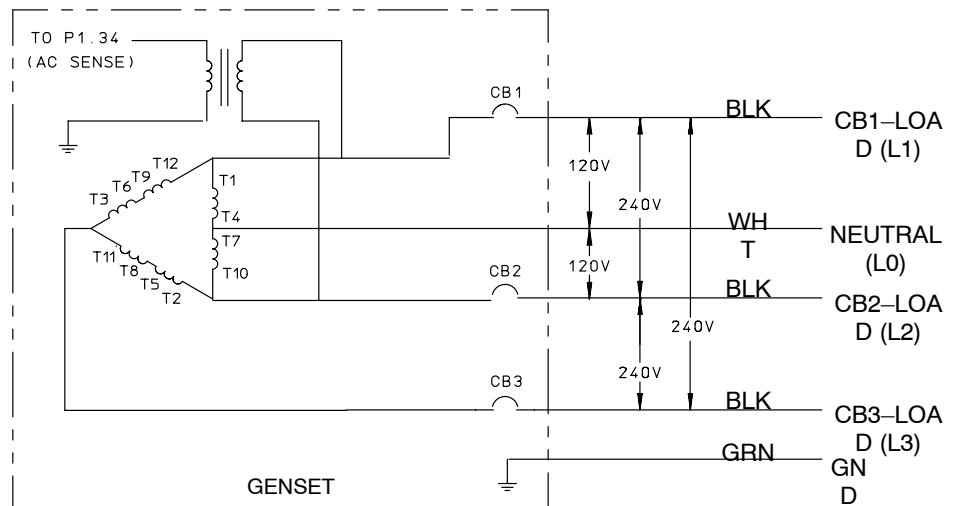
### STANDARD 3-WIRE— 100/200V, 115/230V, 120/240V <sup>1</sup>



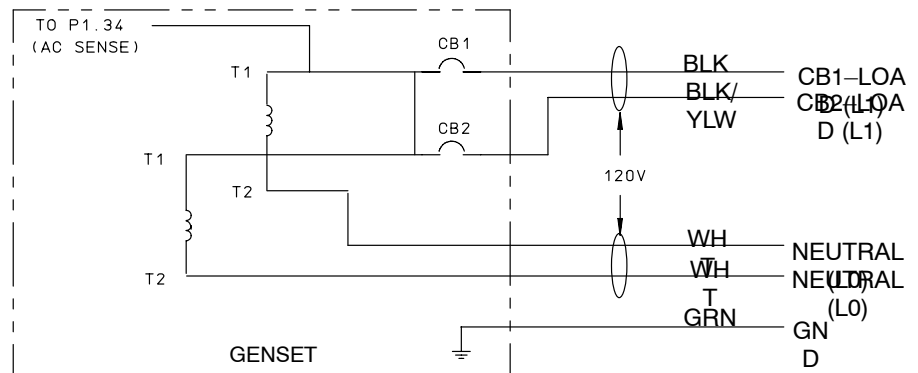
1/2 INCH CONDUIT  
CONNECTOR FOR AC  
LEADS—BOTTOM,  
LEFT END OF BASE



### 3-PHASE — 110/120V, 115/230V, 120/240V <sup>1</sup>



### "2-WIRE" — 100-120V <sup>1, 2</sup>



1. These are not reconnectable generators.
2. Because the two generator windings marked T1-T2 are in phase, the "neutral" conductors in the connected equipment, such as between a transfer switch and main distribution panel, must be sized to carry the sum of the currents.

FIGURE 6-3. CONNECTION DIAGRAMS AND AC LEAD OUTLET

## 7. Fan, Drive Belt, Flywheel, Ignition, Exhaust

The fan shroud (Figure 7-1) on the underside of the generator/engine assembly encloses the cooling fan, belt drive, flywheel, ignition coils (magnetos) and exhaust manifold.

### FAN, BELT, PULLEYS AND FLYWHEEL

The engine drives the generator by means of a 4-rib "Poly-Vee" belt (Figure 7-2). The engine pulley is coupled to the engine side of the flywheel, which is center-bolted and keyed to the engine crankshaft taper. The cooling fan and backplate are bolted directly to the generator pulley, which is center-bolted to the generator rotor shaft taper. The various generator/engine speed combinations tabulated in Section 13. *Specifications* are obtained by employing various pulley ratios.

The generator pulley must be removed to remove the generator rotor shaft and the flywheel assembly to remove the engine.

### Removing Fan and Generator Pulley

1. Remove the generator/engine assembly from the genset. See REMOVING / INSTALLING GENERATOR / ENGINE ASSEMBLY, Section 9. *Engine*.
2. Remove the eight fan shroud bolts and remove the fan shroud (Figure 7-1).
3. Remove the three bolts securing the fan (blower) and its back plate (Figure 7-2) and remove them from the pulley.
4. Block the generator pulley and remove the center bolt. Use a wheel puller to break the pulley free of the generator shaft taper. Three M6 bolt tapping are provided on the face for pulling.
5. Turn the belt tensioner away from the belt with a 1/2 inch socket driver and block it there while lifting off the generator pulley.

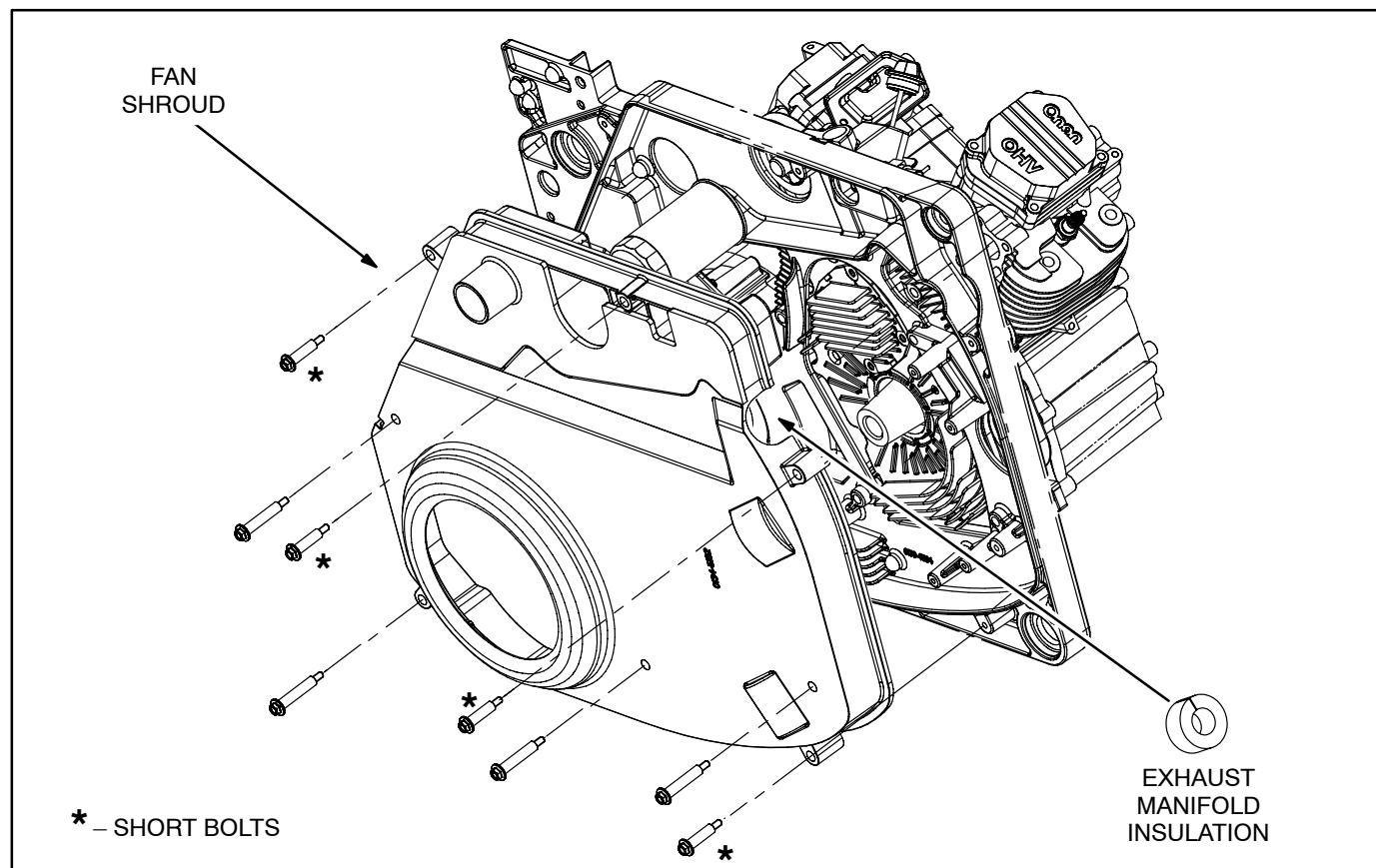


FIGURE 7-1. FAN SHROUD

## Removing Flywheel and Engine Pulley

1. Remove the generator/engine assembly from the genset. See REMOVING / INSTALLING GENERATOR / ENGINE ASSEMBLY, Section 9. *Engine*.
2. Remove the eight fan shroud bolts and remove the fan shroud (Figure 7-1).
3. Remove the two ignition coils. See IGNITION COILS in this section.
4. Remove the four nuts in the face of the flywheel that secure the pulley coupling to the flywheel (Figure 7-2). (Otherwise, it will be necessary to remove the generator pulley to seat the belt back on both pulleys.)
5. Block the flywheel from turning and remove the center bolt. Use a wheel puller to break the flywheel free of the crankshaft taper. Two M10 bolt tappings are provided on the face for pulling.
6. Secure the crankshaft taper key so that it will not fall out.
7. Turn the belt tensioner away from the belt with a 1/2 inch socket driver and block it there while lifting off the flywheel.

## Removing Tensioner Pulley

First remove the fan and generator pulley (Page 7-1) so that the belt tensioner arm assembly can swing over and relieve the spring tension, and then remove the center bolt.

## Reassembling Pulleys and Flywheel

Install the belt tensioner assembly if it has been removed. Torque the center bolt to 20 lb-ft (27 N-m). Turn the belt tensioner away from the belt with a

1/2 inch socket driver and block it there while seating the belt on the pulleys.

***If only the generator pulley has been removed and the belt is still around the engine pulley,*** wrap the belt around the generator pulley and install the pulley on its shaft. Check to see that the belt is properly seated in its grooves in both pulleys. Secure the fan and its backplate. Torque the generator pulley center bolt to 45 lb-ft (61 N-m). Torque the fan bolts to 8 lb-ft (11 N-m).

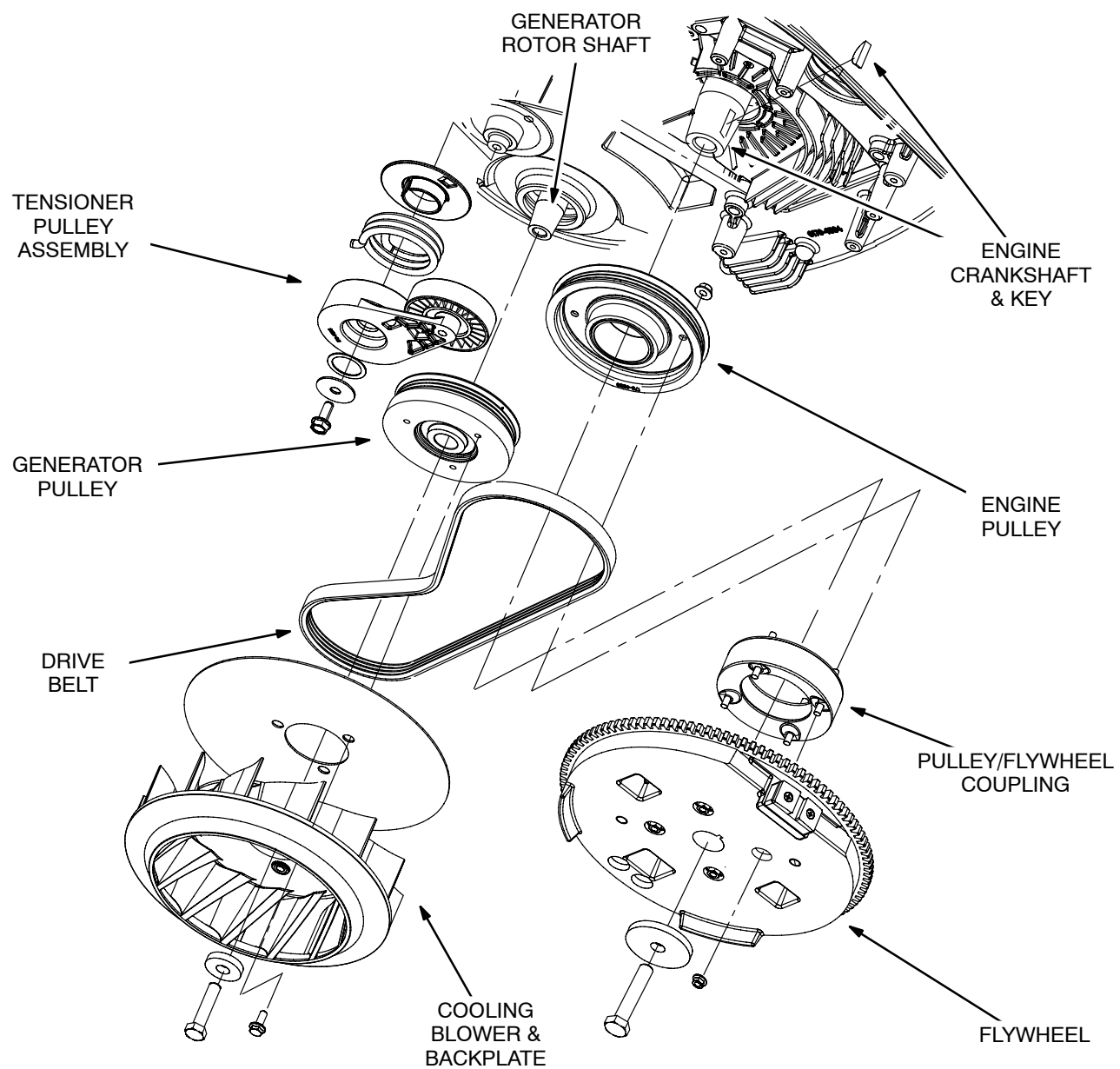
***If only the engine pulley have been removed and the belt is still around the generator pulley:***

1. Unless the engine pulley and flywheel are apart, remove the four nuts in the face of the flywheel that secure the pulley coupling to the flywheel and pull the pulley and flywheel apart.
2. Wrap the belt around the engine pulley and lay the pulley around the crankshaft.
3. Make sure the key is in the crankshaft and line up the flywheel with the key and the four bolts in the pulley coupling. Thread on the four coupling nuts and the center bolt and washer. Check to see that the belt is properly seated in its grooves in both pulleys. Torque the coupling nuts to 5 lb-ft (6 N-m). Torque the flywheel center bolt to 60 lb-ft (81 N-m).

***If both pulleys have been removed,*** assemble the engine pulley and flywheel if they have been taken apart, wrap the belt around the engine pulley, install the flywheel and then install the generator pulley.

Reinstall the ignition coils and set the air gaps (IGNITION COILS in this section) if the flywheel has been removed. Install the fan shroud, making sure the exhaust manifold insulation (Figure 7-1) is in place. Note that the fan shroud bolts are of two lengths. Torque the fan shroud bolts to 8 lb-ft (11 N-m).





**FIGURE 7-2. BELT DRIVE**

## IGNITION SYSTEM

The ignition system consists of the flywheel magnet and two ignition coil assemblies (magnetos) with integral spark plug cables and boots (Figure 7-3) and two spark plugs.

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 0.025 inch (0.06 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.

To prevent cross threading, always thread a spark plug in by hand until it seats and then torque to 10 lbs-ft (13 N-m) if new, or to 18 lbs-ft (24 N-m) if being reused.

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

**Light tan, gray or reddish deposits** – Normal

**One 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, reconnect the spark plug cables and 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 genset compartment door open for several minutes before performing this test.*

2. Do not touch the spark plug or cable during testing. Crank the engine and look for spark across each plug. If spark is weak or inconsistent across either plug, replace the plug with a new one. If spark still is weak or inconsistent, see Ignition Coils (Magnetos).

## Ignition Coils (Magnetos)

**Ignition Coil Resistance Test:** If spark is weak or inconsistent across either spark plug, check ignition coil resistance between a good ground on the engine and each spark plug cable terminal. Replace an ignition coil assembly if its electrical resistance exceeds the maximum specified in Table 7-1.

**TABLE 7-1. IGNITION COIL RESISTANCES**

	MINIMUM*	MAXIMUM*
LEFT (No. 1 Cyl)	13,700 Ohms	33,000 Ohms
RIGHT (No. 2 Cyl)	11,500 Ohms	27,000 Ohms
* – Meter polarity is critical. Connect positive (+) lead to ground.		

**Removal:** If spark is weak or inconsistent across either spark plug and/or coil resistance is high or low, remove the ignition coil assembly as follows:

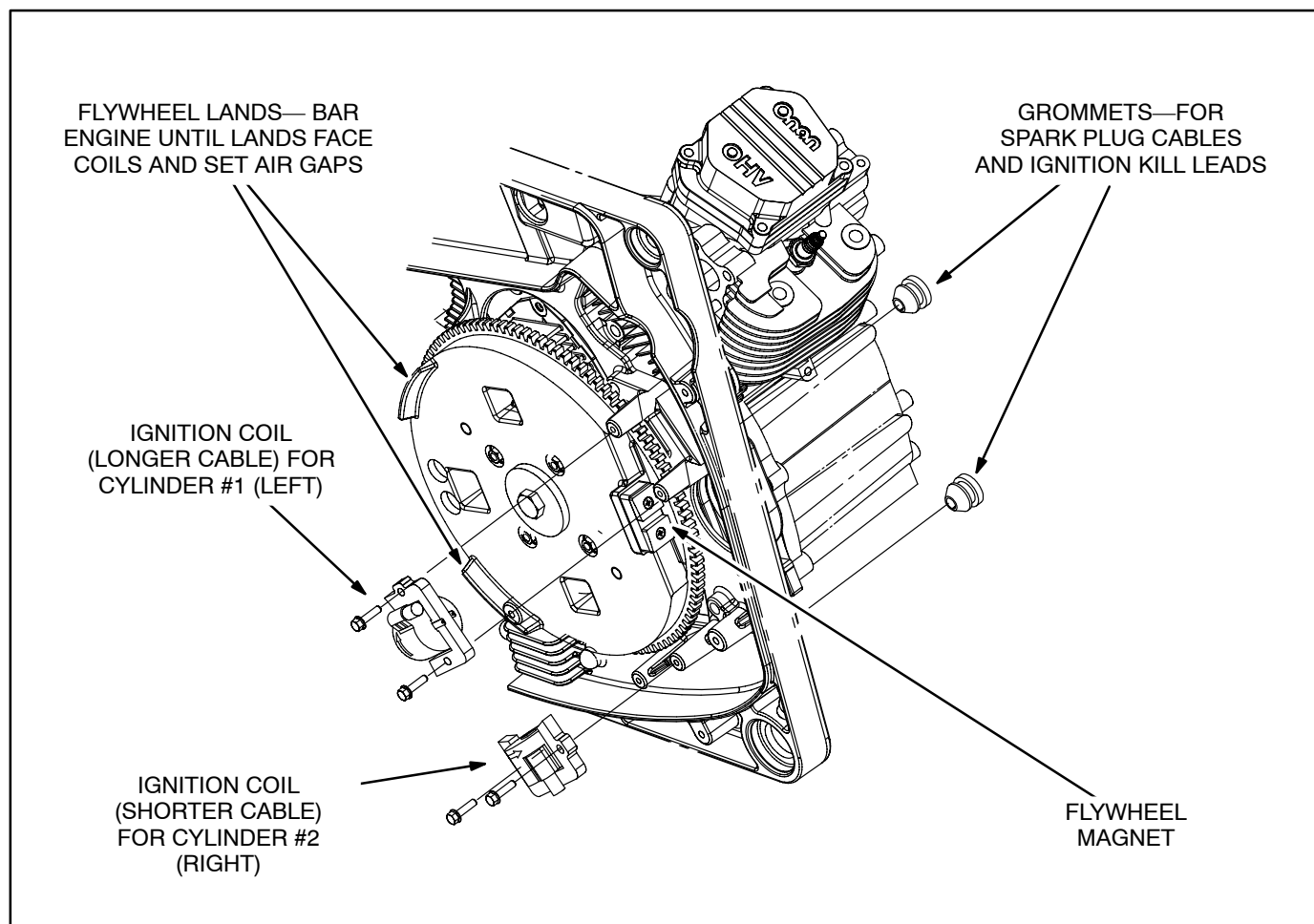
1. Remove the generator/engine assembly from the genset. See REMOVING / INSTALLING

GENERATOR / ENGINE ASSEMBLY, Section 9. *Engine*.

2. Remove the eight fan shroud bolts and remove the fan shroud (Figure 7-1).
3. Disconnect the ignition kill lead at the coil terminal, pull the spark plug cable through the grommet in the base and remove the two ignition coil mounting screws.

**Installation:** is the reverse of assembly. Set the air gaps. *Note in Figure 7-3 the location of the coil assembly that has the longer spark plug cable, which goes to cylinder No. 1 (left, or generator side of engine).*

**Setting Air Gaps:** To set the air gaps bar the engine until the lands on the flywheel directly face the coils. Place a 0.012 inch (0.03 mm) thick feeler gauge between the coil and the land on the flywheel, hold the coil tight up against the feeler gauge and land and torque the two mounting bolts to 5 lb-ft (7 N-m).



**FIGURE 7-3. IGNITION COILS (MAGNETOS)**

## EXHAUST SYSTEM

The genset 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 (Figures 7-8, 7-9 and 7-10). Use approved materials only.***

**⚠ 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.***

Failure to provide and maintain an approved spark arresting exhaust system can be a violation of the law. Liability for damage, injury and warranty ex-

pense due to the modification of the exhaust system or to use of unapproved parts is the responsibility of the person performing the modification or installing the unapproved parts. Contact an Onan dealer for approved exhaust system parts.

### Removing Exhaust Manifold

1. Remove the generator/engine assembly from the genset. See REMOVING / INSTALLING GENERATOR / ENGINE ASSEMBLY, Section 9. *Engine*.
2. Remove the eight fan shroud bolts and remove the fan shroud (Figure 7-1).
3. Remove the two flange bolts in each of the two exhaust outlet flanges and remove the manifold (Figure 7-4).

### Installing Exhaust Manifold

Installation is the reverse of removal. Always install new flange gaskets when reinstalling the exhaust manifold and torque the flange nuts to 20 lb-ft (26 N-m).

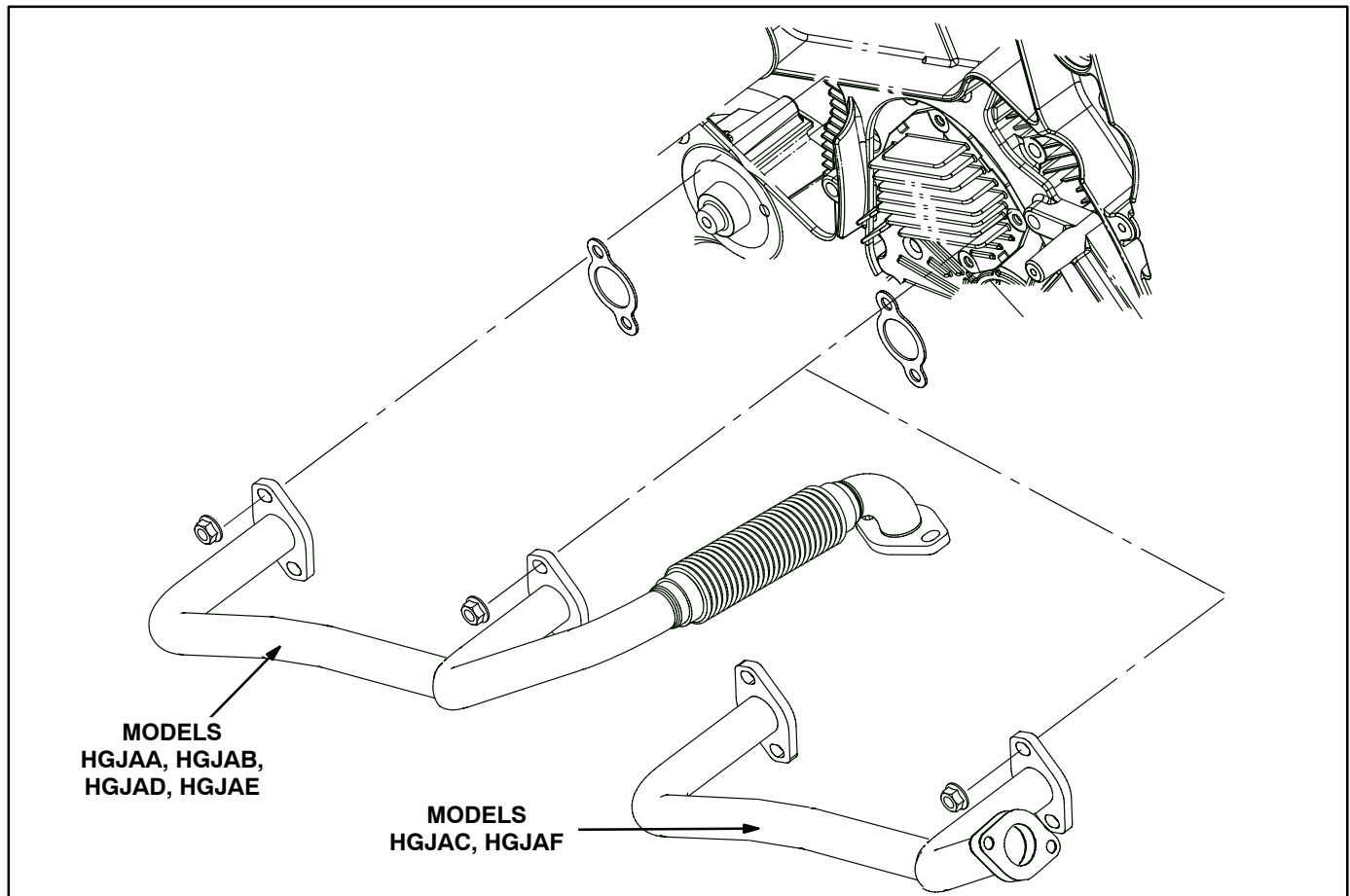


FIGURE 7-4. EXHAUST MANIFOLD

## HGJAA, HGJAB, HGJAD, HGJAE Mufflers

Always install new flange gaskets when reinstalling a muffler and torque the flange nuts to 10 lb-ft (13 N-m).

The muffler (Figure 7-5) is mounted inside the gen-set enclosure. It is USDA approved as a spark ar-

resting muffler and meets RVIA EA-1 construction requirements. The Model HGJAB muffler has the same inlet and outlet flange locations but has only one drum.

See Exhaust Tail Pipe in this section regarding materials, clamps, support, routing and termination of the tailpipe.

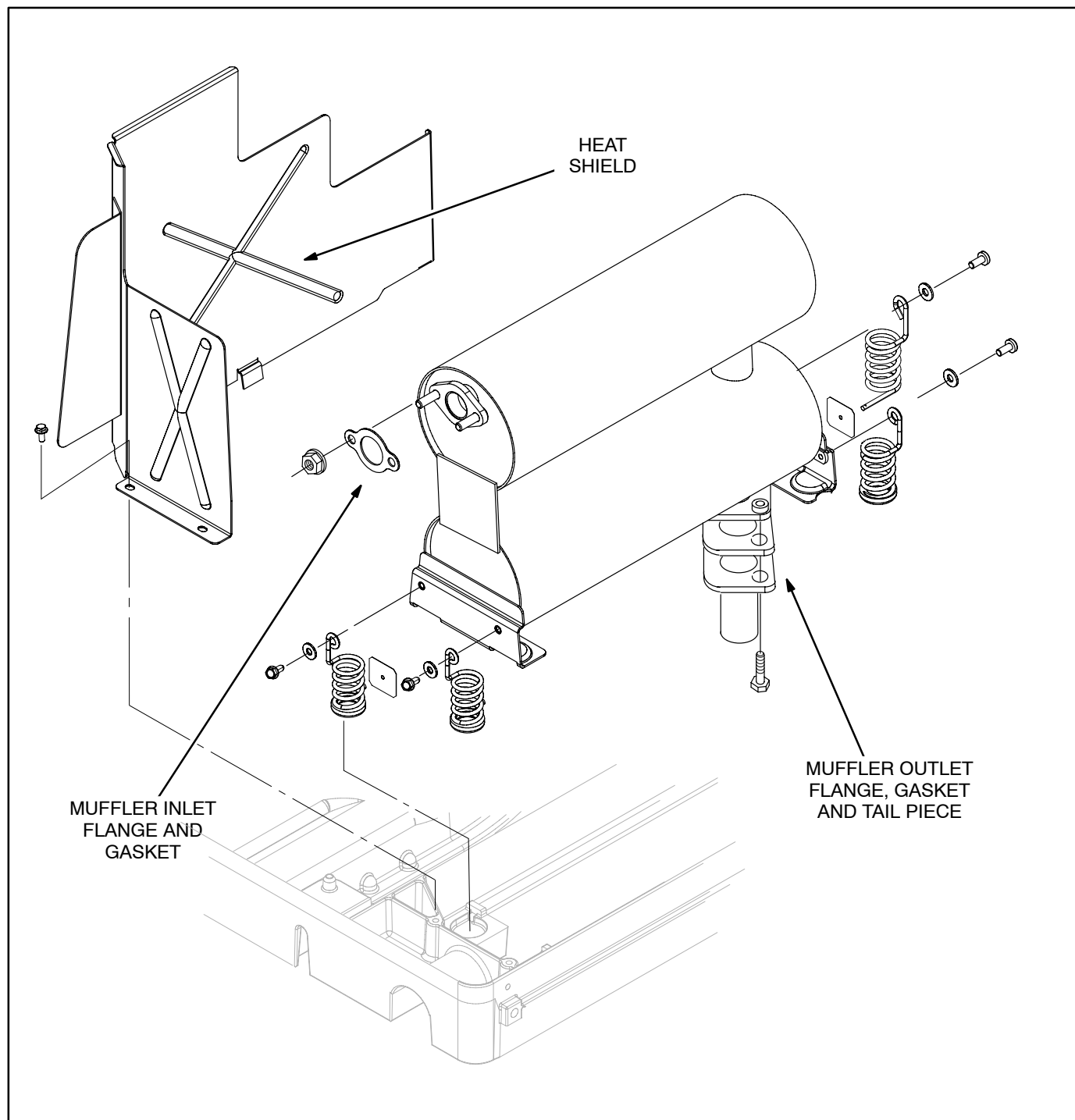


FIGURE 7-5. MODEL HGJAA, HGJAB, HGJAD, HGJAE MUFFLER

## HGJAC, HGJAF Mufflers

Always install new flange gaskets when reinstalling a muffler and torque the flange nuts to 10 lb-ft (13 N-m).

The muffler is side or bottom mounted and is provided in kit form with gasket and mounting hardware (Figure 7-6). The mufflers meet RVIA EA-1

construction requirements and the USDA approved spark arresting screen is for mounting on the end of the tail pipe. Follow the instructions in the kit when mounting a replacement muffler.

See Exhaust Tail Pipe in this section regarding materials, clamps, support, routing and termination of the tailpipe.

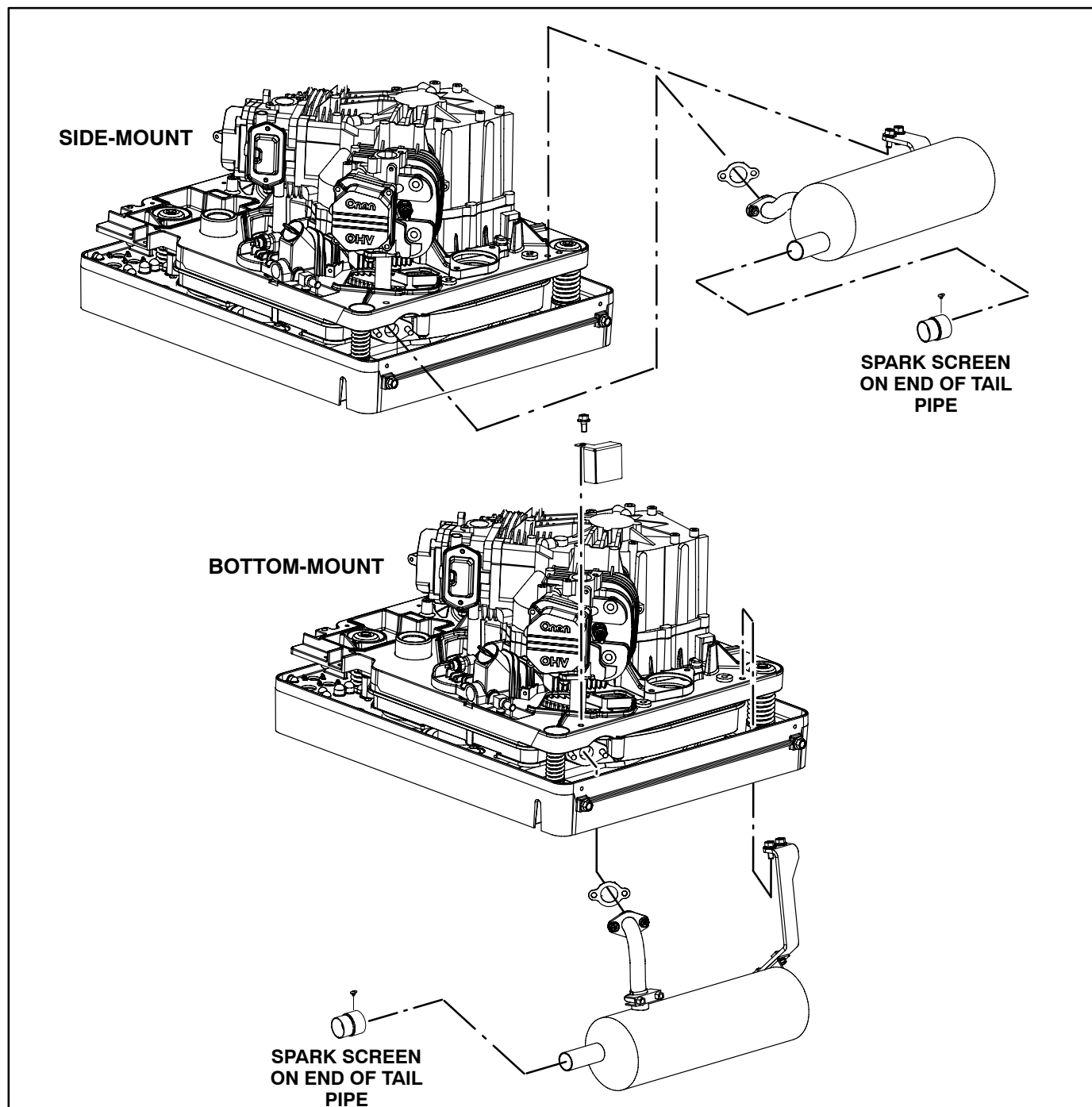


FIGURE 7-6. MODEL HGJAC, HGJAF MUFFLER

## Exhaust Tail Pipe

The exhaust tail pipe is customer supplied.

1. Use 16-gauge 1-3/8 inch O. D. aluminized steel tubing or material of equivalent heat and corrosion resistance for the tail pipe. Do not use flexible pipe, which is neither gas tight nor durable. Clamp the tail pipe to the muffler outlet with a U-bolt muffler clamp (available from Onan). Support a tail pipe longer than 1-1/2 feet (457 mm) near its end and at intervals of 3 feet (900 mm) or less. Use automotive-type tail pipe hangers (available from Onan). Do not attach the hangers to combustible material such as wood.
2. Use U-bolt muffler clamps (available from Onan) to connect sections of tail pipe. Overlapping pipe should be slotted (Figure 7-7).
3. Do not route the tail pipe near fuel lines or fuel tanks.
4. Do not route the tail pipe closer than 3 inches (76 mm) to combustible material (wood, felt, cotton, organic fibers, etc.) unless it is shielded. The temperature rise (above ambient) on adjacent combustible material must not exceed 117°F (65°C).
5. Do not route the exhaust tail pipe underneath the oil drain or air inlet such that it will restrict genset cooling air.

**⚠WARNING** *A hot exhaust tail pipe can ignite oil drain spills causing severe personal injury or death. Do not route the exhaust tail pipe underneath the oil drain.*

6. To keep the tail pipe 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 (Figure 7-8).

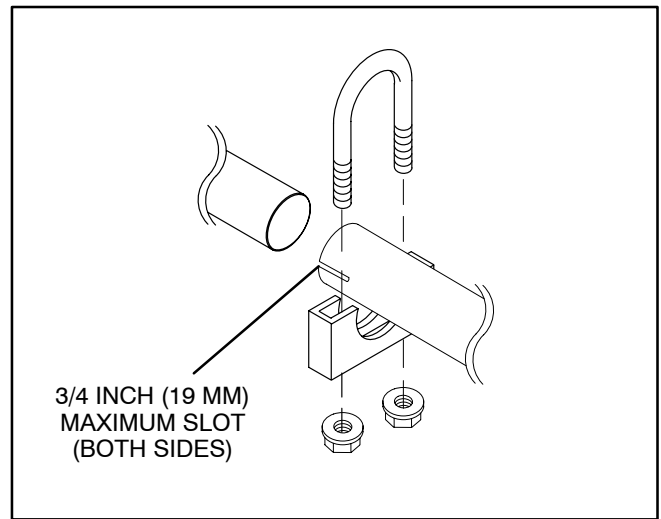


FIGURE 7-7. EXHAUST TAIL PIPE CONNECTIONS

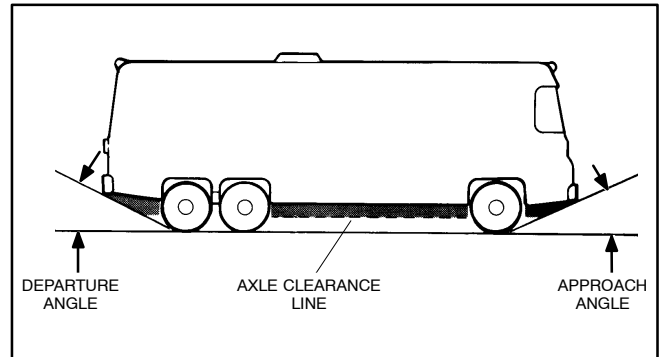


FIGURE 7-8. VEHICLE CLEARANCES

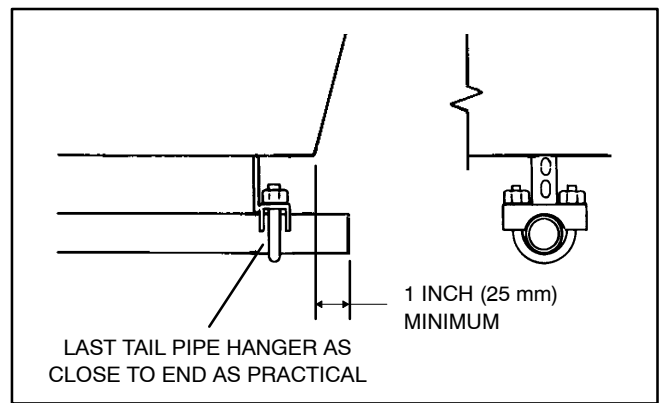
7. Do not terminate the tail pipe underneath the vehicle. Extend it a minimum of 1 inch (25 mm) beyond the perimeter of the vehicle (Figure 7-9). *Support the end of the tail pipe such that it cannot be pushed in and up under the skirt of the vehicle.*
8. Do not interconnect genset and vehicle engine exhaust systems.

**⚠ CAUTION** *Interconnecting engine exhaust systems will lead to migration of exhaust condensate and soot into the idle engine, causing damage.*

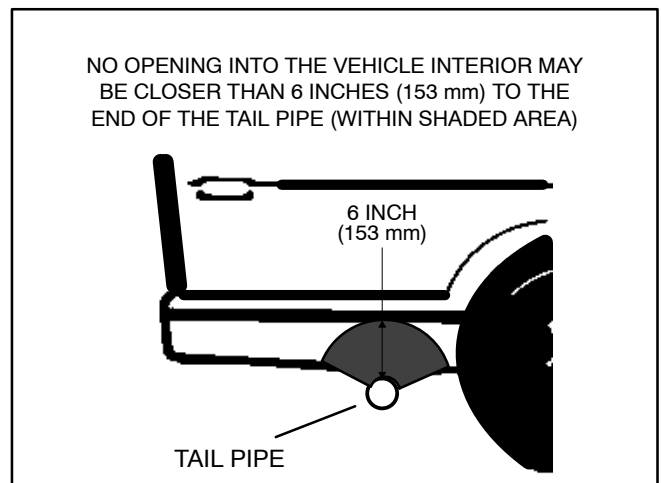
9. Do not terminate the tail pipe such that it is closer than 6 inches (153 mm) to any opening, such as a door, window, vent or unsealed compartment, into the vehicle interior (Figure 7-10).
10. Make sure a tail pipe deflector will not cause excessive back pressure or interfere with removing the spark arresting screen.

**⚠ CAUTION** *Excessive back pressure can cause engine damage.*

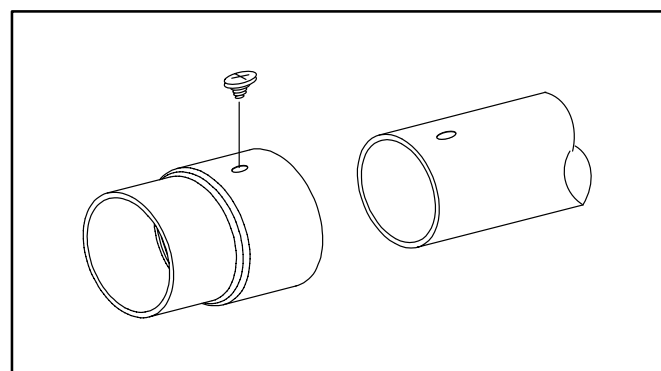
11. The spark arresting screen in the kit fits snugly on the end of 1-3/8 O. D. pipe. Push the spark arresting screen on to the end of the tailpipe all the way to the shoulder and secure it with a stainless steel sheetmetal screw through the hole provided (Figure 7-11).



**FIGURE 7-9. TERMINATING THE EXHAUST TAIL PIPE**



**FIGURE 7-10. MINIMUM DISTANCES TO OPENINGS**



**FIGURE 7-11. SPARK ARRESTING SCREEN**



# 8. Fuel System

## GASOLINE FUEL SYSTEM—HGJAA & HGJAD

See the Operator's Manual for recommended fuels and Section 13. *Specifications* 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.*

### Operation

These genset models are equipped with sequential, multi-port fuel injection (Figure 8-1). A remote high-pressure fuel pump (Figure 8-8) supplies fuel to the genset. The fuel rail pressure regulator maintains a constant fuel pressure differential across the injectors (43.5 psi [300 kPa] nominal). The genset controller (Section 5, *Control*):

1. Monitors and governs AC output frequency (Table 8-1) as load varies by means of the throttle, which regulates the mass of air inducted each engine cycle.
2. Monitors absolute intake manifold air pressure (MAP) to determine engine load and modify the calculations of inducted air mass.
3. Monitors absolute intake manifold air temperature (MAT) to modify the calculations of inducted air mass.
4. Monitors the ignition pulses to determine fuel injector timing.
5. Energizes the fuel injectors. Injector fuel delivery is proportional to pulse width, which the

controller calculates on the basis of MAP and MAT to provide the desired air fuel ratio (AFR).

6. Enriches AFR during cranking, warm-up and heavy load transients for good starting and performance.

TABLE 8-1 VOLTAGE / FREQUENCY / DROOP

Voltage			Frequency (Hz)	
Rated Voltage (60 Hz)	Max No Load	Min Full Load	No Load	Droop
120	125	115	60.5/59.5	N/A
240	250	230	60.5/59.5	N/A

### Removing Throttle Body

The throttle body can be removed without removing the genset enclosure. Referring to Figure 8-1, remove the throttle body as follows:

1. Disconnect the fuel supply hose at the outlet of the fuel filter and the return fuel hose at the outlet to the fuel pressure regulator.
2. Disconnect the leads to the throttle body, MAP and MAT sensors and fuel injectors.
3. Remove the air filter cover and filter element and remove the two support screws in the back of the filter enclosure as well as the two throttle body mounting nuts.
4. Pull away the air filter enclosure and throttle body.
5. Avoid removing the throttle body through studs from the intake manifold. Otherwise, they will have to be replaced with new studs having factory-applied thread sealant.

### Removing Intake Manifold

Remove the genset enclosure and perform Steps 1 through 3 of Removing Throttle Body. (Do not loosen the throttle body mounting nuts if the air filter, throttle body and manifold are to be removed as an assembly.) Then remove the intake manifold bolts and pull away the assembly.

## Reassembly

Reassembly is the reverse of disassembly. Always use new gaskets when reassembling. Note the marking on the gasket between the air filter enclosure and the throttle body as to which way is up and which side is out.

Torque the intake manifold bolts to 19 lb-ft (26 N-m).

If a throttle body through stud came out, replace it with a new stud having factory-applied thread seal-

ant. Clean the threads in the manifold of the old sealant. Torque the stud to 5.5 lb-ft (7 N-m).

Make sure the air intake fits through the opening in the base and that the engine breather tube is connected between the air filter enclosure and the cylinder head. To prevent damage to the air filter enclosure, first tighten the two (2) throttle body mounting nuts (left first) to 4.5 lb-ft (6 N-m) and then tighten the two (2) support screws.

See Fuel Connections regarding proper hose clamps and crimping tools when reconnecting fuel hoses.

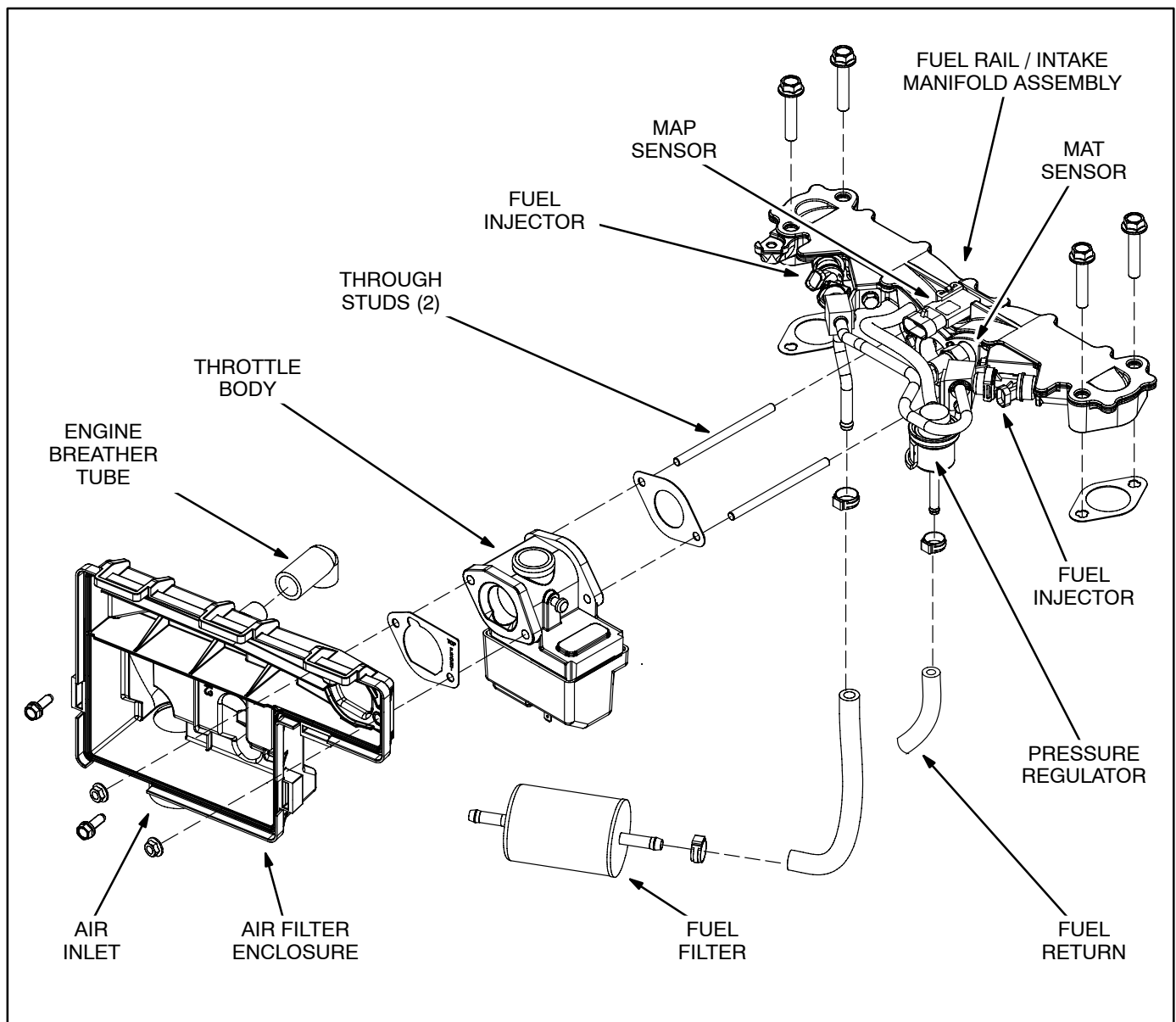


FIGURE 8-1. FUEL INJECTION SYSTEM—SERIES HGJAA & HGJAD

## Fuel Rail and Injectors

The rail-injector-regulator assembly (Figure 8-2) is flexible enough to remove as an assembly from the intake manifold. All of the components shown except for the intake manifold and MAP sensor are removeable without removing the genset enclosure. *Thoroughly clean the outside of the assembly before disassembly and be careful not to let dirt enter fuel system components while disassembled..*

Remove the throttle body (Figure 8-1), disconnect the vacuum hose and remove the two mounting screws. All joints have O-ring seals. To pull an injec-

tor from the fuel rail, gently pry apart the two sides of the clip on the injector. Replace an injector if electrical resistance is not approximately 12.5 ohms.

When reassembling, apply light motor oil (sparingly) to the O-ring seals on the ends of the fuel injectors. Push the injectors on by hand until they snap securely in place on the fuel rail. Make sure the fuel rail brackets line up with and seat firmly against the machined bosses on the manifold. Tighten the mounting screws to 75 lb-in (8.4 N-m).

Make sure to reconnect the vacuum hose. Push the ends on dry all the way up the hose barbs.

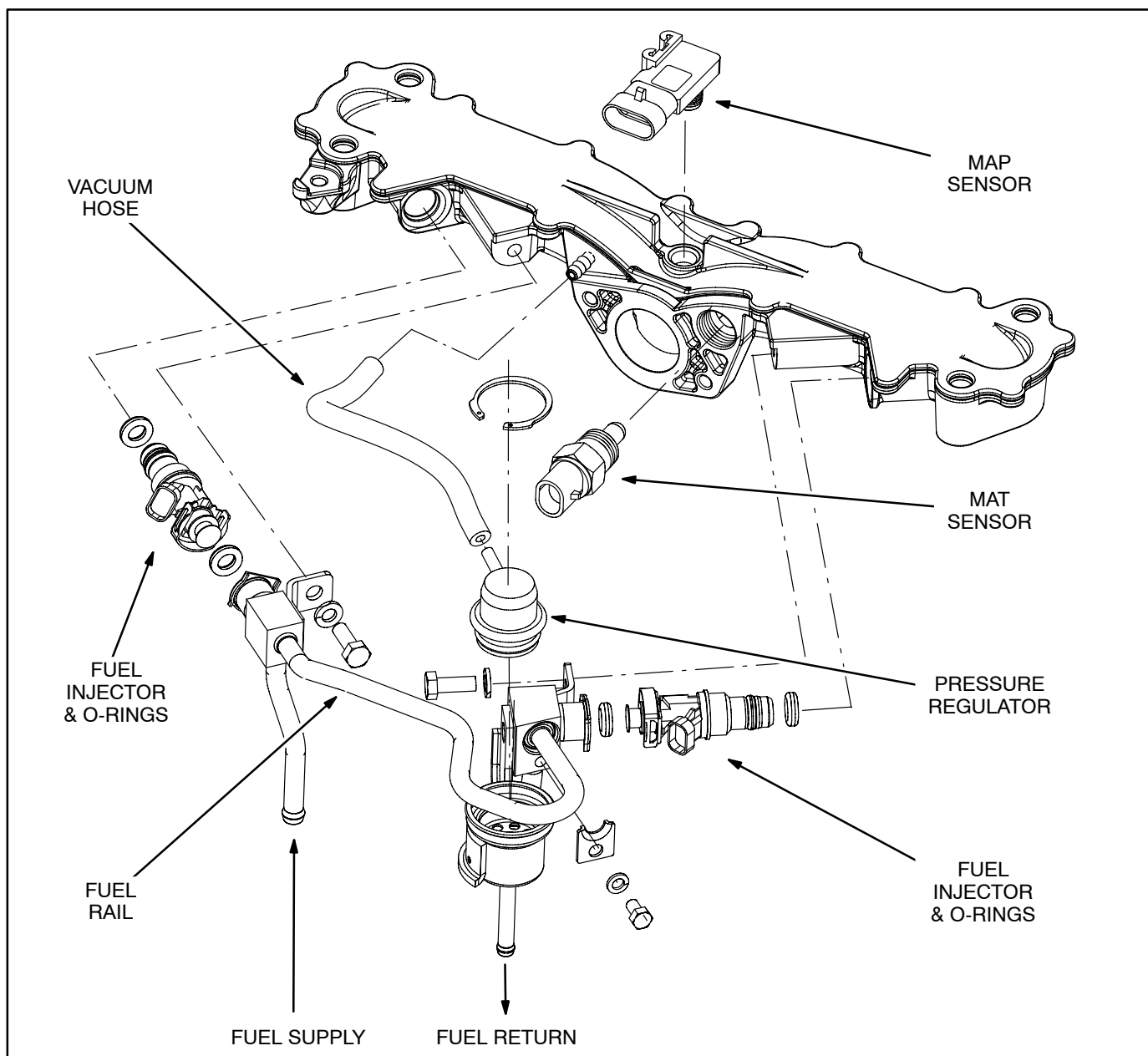


FIGURE 8-2. FUEL RAIL / INTAKE MANIFOLD ASSEMBLY

## Fuel Pressure Regulator

The fuel pressure regulator body (Figure 8-2) is removeable from the rail assembly by disconnecting the vacuum hose and removing the circlip.

Apply light motor oil (sparingly) to the two O-ring seals when reassembling.

The manifold vacuum hose is connected to the back of the regulator diaphragm to maintain a constant fuel pressure differential across the fuel injectors as intake manifold pressure varies. Make sure to reconnect the vacuum hose. Push the ends on dry all the way up the hose barbs.

## MAT Sensor

Check electrical resistance across the two terminals of the MAT sensor (Figure 8-2). Replace the sensor if resistance is not 2600 to 3000 ohms. To remove the sensor, remove the throttle body (Page 8-1), disconnect the wiring harness and unthread it from the manifold.

When reinstalling the sensor apply Teflon thread coating to the threads of the sensor. Turn it in until just two threads are left.

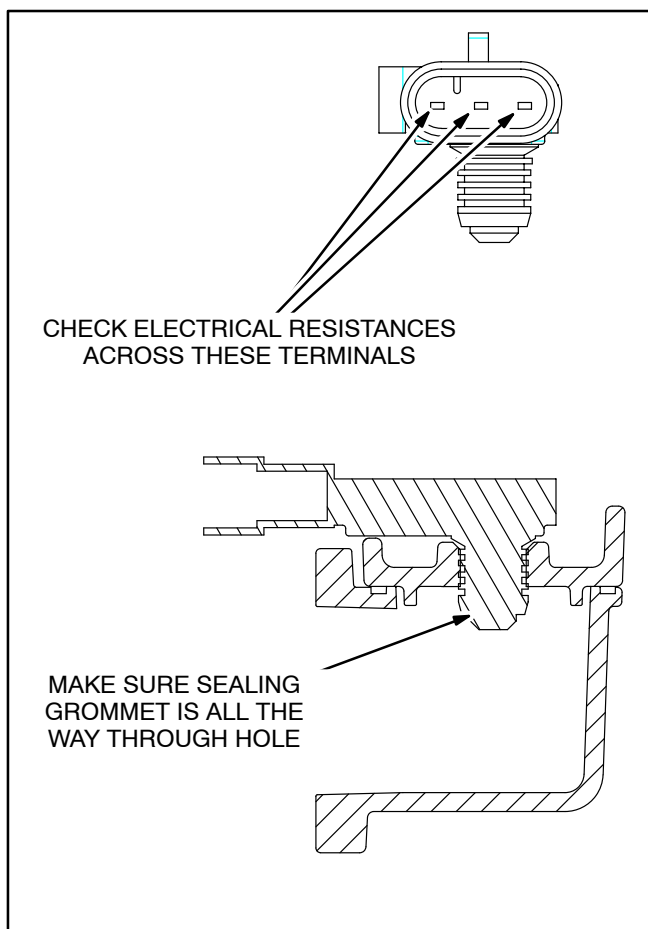
## MAP Sensor

The genset enclosure must be removed to remove the MAP sensor, which is pulled straight up to remove it from the intake manifold (Figure 8-2). To check electrical resistances across the pins indicated in Figure 8-3, remove the connector. To determine the letter designation of a pin, check the marking on the corresponding connector lead. Replace the sensor if any reading is out of specification (Table 8-2).

**TABLE 8-2 MAP SENSOR RESISTANCES**

PINS	KILO-OHMS @ Room Temperature & Pressure	CONNECTION
A-C	4.0-4.2	GND-5V
A-B	91-101	GND- $V_{out}$
B-C	91-97	$V_{out}$ -5V

When reinstalling the sensor, apply light motor oil (sparingly) to the the sealing grommet and push it in by hand. Make sure the grommet is all the way through the hole so that it will not come out (Figure 8-3).



**FIGURE 8-3. MAP SENSOR**

## Throttle Body / Governor Actuator

The throttle body and governor actuator are one assembly (Figures 8-4 and 8-5). The throttle plate is mounted on the same ball bearing-mounted shaft as the actuator rotor. The actuator stator is energized by a pulse width modulated signal from the genset controller, which monitors frequency and recalculates the pulse width—and therefore throttle position—necessary to maintain rated frequency as load varies. The torsion spring opposes the rotor.

Do not attempt to readjust the idle screw (Figure 8-5), which was set and sealed at the factory.

**Checking Throttle Plate Action:** If the genset does not start, remove the air filter and observe the throttle plate while cranking. The throttle plate should close against the idle stop when deenergized, open fully while cranking and modulate smoothly while running. If the throttle does not function, connect its terminals to a 12 volt battery with jumpers. If the throttle opens fully, the problem is probably in the control circuit, not the throttle body.

**Checking Stator Winding Continuity:** If the throttle does not open, disconnect the wiring at the stator terminals, check for electrical resistance and replace the stator if it is not between 4.5 and 5.5 ohms.

**Replacing Stator:** To remove the stator assembly from the throttle body, remove the snap-on cover, torsion spring and the four mounting screws. When reassembling, make sure that the mating bosses are properly aligned before tightening the four stator screws. Torque the four stator screws to 18 lb-in (2 N-m). Then press the torsion spring onto the flat on the end of the throttle shaft and catch the spring hook in the slot in the coil bobbin (Figure 8-4).

**Replacing Throttle Body:** Replace the throttle body if there is any looseness, play or binding in the throttle shaft or if the factory seal on the idle screw has been broken. When pressing the rotor and retention ring onto the shaft of the throttle body, support the end of the shaft as shown (Figure 8-5) to avoid damage to the bearings and throttle plate. Then assemble stator, torsion spring, snap-on cover and dust cap to the body.

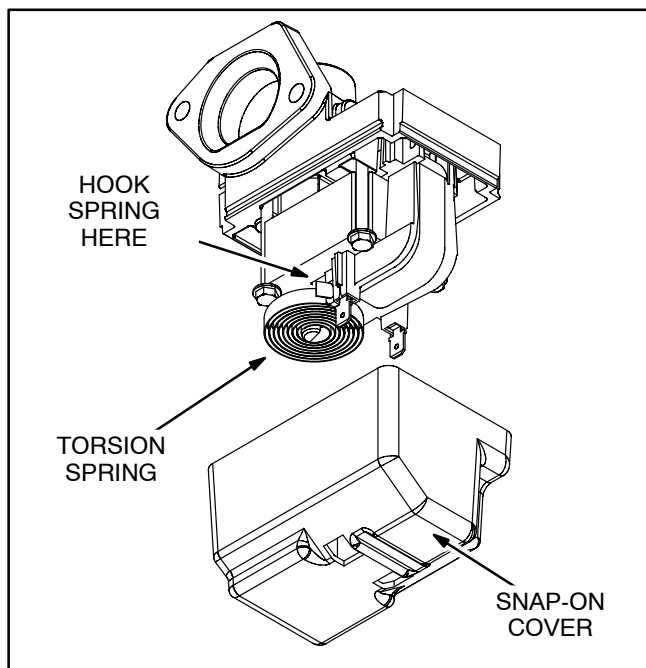


FIGURE 8-4. THROTTLE BODY / GOVERNOR ACTUATOR

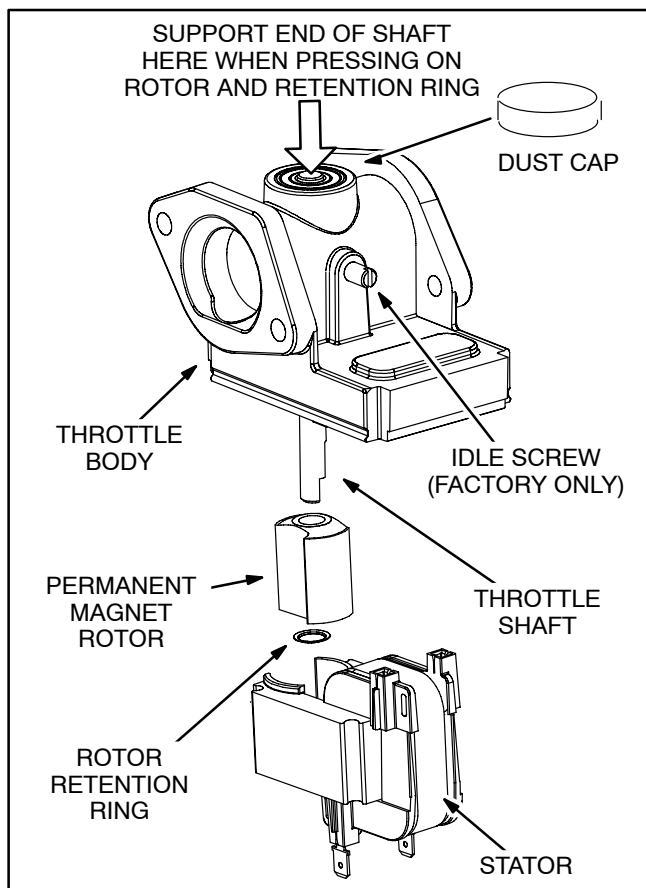


FIGURE 8-5. ACTUATOR ROTOR & STATOR

## Remote Fuel Pump

Figure 8-8 illustrates the remote fuel pump kit for Model HGJAA. The Model HGJAD kits include fill neck adaptors for fuel supply and return connections at the tank and are specific to each make and model of vehicle. The right kit must be used. Follow the instructions in the kit when replacing a pump assembly. Figure 8-6 illustrates the 2-pin remote pump wiring connector and in-line fuse and Figure 8-7 the fuel supply and return fittings at the genset.

**⚠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.*

**Fuel Pump Flow Test:** Disconnect the fuel return line at a convenient point between the genset and supply tank and be prepared to collect the fuel in a gallon container. Prime the genset for exactly one (1) minute taking care not to spill any fuel. The whole fuel system, exclusive of the injectors, is probably in good working order if fuel flow is approximately 1 quart (0.9 liter) per minute and fuel pressure is approximately 45 psi. A much higher fuel pressure indicates a blockage in the fuel system. **Make sure to reconnect the fuel return line.**

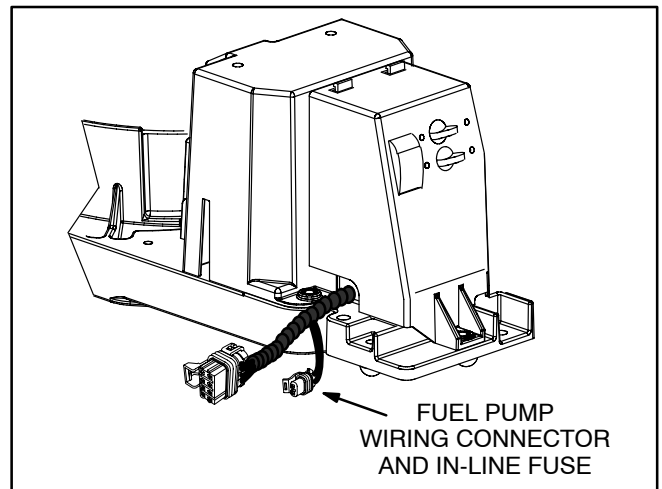


FIGURE 8-6. FUEL PUMP WIRING CONNECTOR

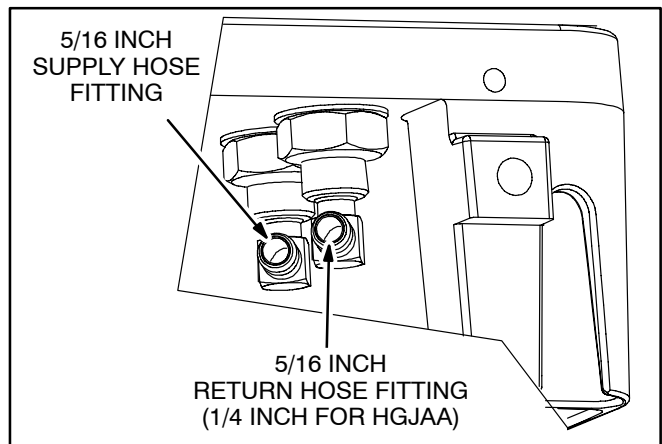


FIGURE 8-7. FUEL FITTINGS

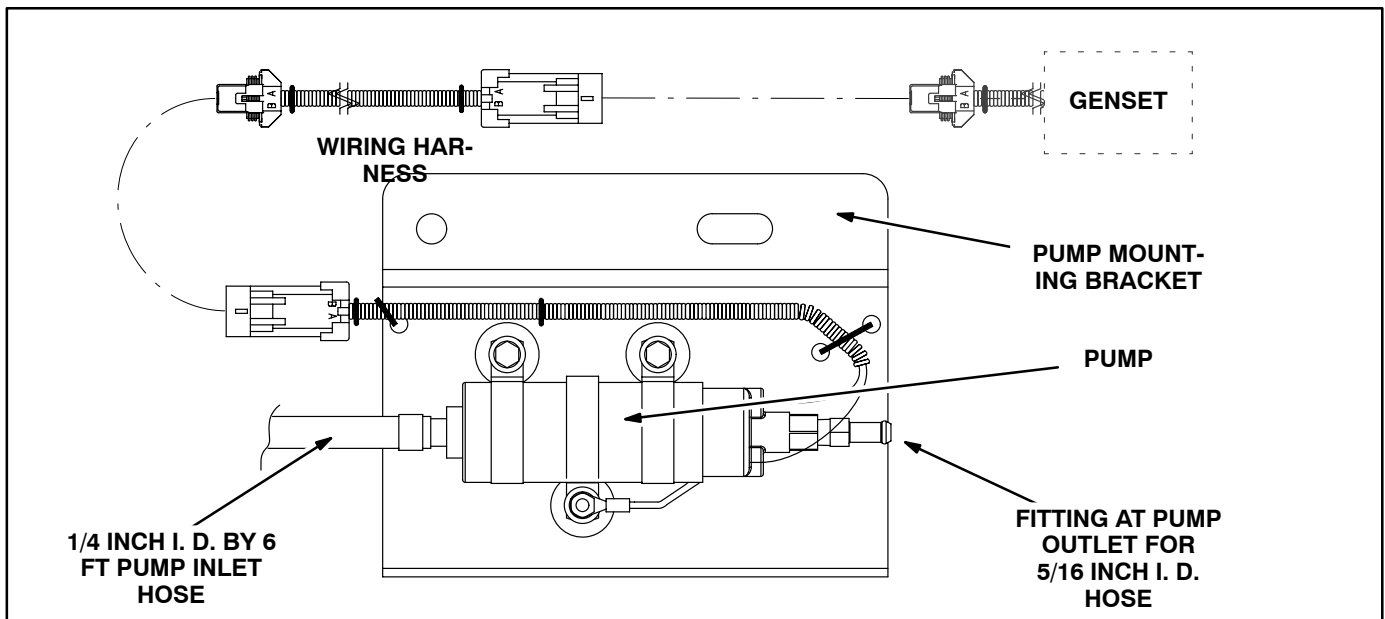


FIGURE 8-8. REMOTE FUEL PUMP—HGJAA

## Fuel Connections

**⚠ CAUTION** *When connecting fuel hoses, only use soap-free lubricants such as WD40, which runs through fuel without leaving residues that can clog fuel jets.*

A fuel return line to the supply tank must be provided.

Genset and propulsion engine fuel supply and return lines must not be interconnected.

The maximum fuel pump lift is 36 inches (914 mm).

The genset fuel pickup should be terminated higher in the supply tank than the propulsion engine pickup to keep from running the vehicle out of fuel.

*Do not change or remove the fuel fill tube, fill limiter vent, vapor canister, vapor lines, filler cap or any other part of the fuel system without the express approval of the vehicle chassis manufacturer. Modifications must conform with applicable sections of the Code of Federal Regulations, Title 49, and other standards.*

**Fuel Line Materials for Model HGJAD:** Replace fuel hose clamps, hose and tubing as necessary with the following materials. Good connections are required to prevent fuel leakage under pump pressure.

- **Tubing:** Use 5/16 inch O. D. ( $\pm 0.003$  inch) welded and drawn Type 304L stainless or AISI 1008–1010 low carbon steel tubing of 0.028 inch minimum wall thickness. The tubing must meet requirements for 150 psi operating pressure (Ref. ASTM A 539–99) and have corrosion resistance equal to or better than hot-dipped zinc galvanization.
- **Hose Beads:** Use suitable tooling to form tubing ends into SAE J1231 Type 1 or Type 3 double-flare hose beads—**required** for all tubing and fittings.
- **Flexible Hose:** Use 5/16 in I. D. SAE J30R9 hose.

- **Hose Clamps:** Use stainless steel stepless ear clamps. Onan P/N 0503-1951-13, Oetiker P/N 16700013 or equivalent are **required**.

**Fuel Line Materials for Model HGJAA:** Use the same materials for the line between the pump and genset as for Model HGJAD. Use the following materials for the supply line between the tank and pump and for the return line between genset and tank.

- **Tubing:** Use 1/4 inch O. D. ( $\pm 0.003$  inch) welded and drawn Type 304L stainless or AISI 1008–1010 low carbon steel tubing of 0.028 inch minimum wall thickness. The tubing must meet requirements for 150 psi operating pressure (Ref. ASTM A 539–99) and have corrosion resistance equal to or better than hot-dipped zinc galvanization.
- **Hose Beads:** Use suitable tooling to form tubing ends into SAE J1231 Type 1 or Type 3 double-flare hose beads—*recommended* for all tubing and fittings for fuel return.
- **Flexible Hose:** Use 1/4 in I. D. SAE J30R7 hose or better.
- **Hose Clamps:** Use stainless steel stepless ear clamps. Onan P/N 0503-1951-08, Oetiker P/N 16700008 or equivalent are *recommended*.

**Fuel Line Routing:** If it is necessary to replace fuel lines, route the supply and return lines side-by-side along bulkheads and frame members such that they are protected, *and at or above the top of the fuel tank to reduce siphoning if a line breaks or a hose comes off*. The entire length of a fuel line must be visible for inspection and accessible for replacement.

Support fuel lines to restrain movement and prevent chaffing or contact with sharp edges, electrical wiring and hot exhaust parts.

**⚠ WARNING** *Electric arcs can ignite gasoline leading to severe personal injury or death. Do not run wiring and fuel lines together.*

## GASOLINE FUEL SYSTEM—HGJAB, HGJAC, HGJAE, HGJAF

See the Operator's Manual for recommended fuels and Section 13. *Specifications* 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.*

### Operation

Gasoline and combustion air are mixed in the proper ratio in the carburetor (Figure 8-9) for good starting and good performance over the entire load range. The mechanical governor (Page 8-20) operates the throttle in the carburetor to maintain constant engine speed (within a range of 5 percent) as load varies.

### Removing Carburetor

The carburetor can be removed without removing the genset enclosure. Referring to Figure 8-9, remove the carburetor as follows:

1. Disconnect the fuel hose at the carburetor.
2. Disconnect the governor linkage (Page 8-19).
3. Disconnect the leads to the choke heater and fuel cutoff valve (Figure 8-10).
4. Remove the air filter cover and filter element and remove the two support screws in the back

of the filter enclosure as well as the two carburetor mounting nuts.

5. Pull away the air filter enclosure and carburetor. Drain as much of the fuel in the float bowl by turning the carburetor upside down over a waste fuel container.
6. Avoid removing the carburetor through studs from the intake manifold. Otherwise, they will have to be replaced with new studs having factory-applied thread sealant.

### Removing Intake Manifold

Remove the genset enclosure and perform Steps 1 through 4 of Removing Carburetor. (Do not loosen the carburetor mounting nuts if the air filter, carburetor and manifold are to be removed as an assembly.) Then remove the intake manifold bolts and pull away the assembly.

### Reassembly

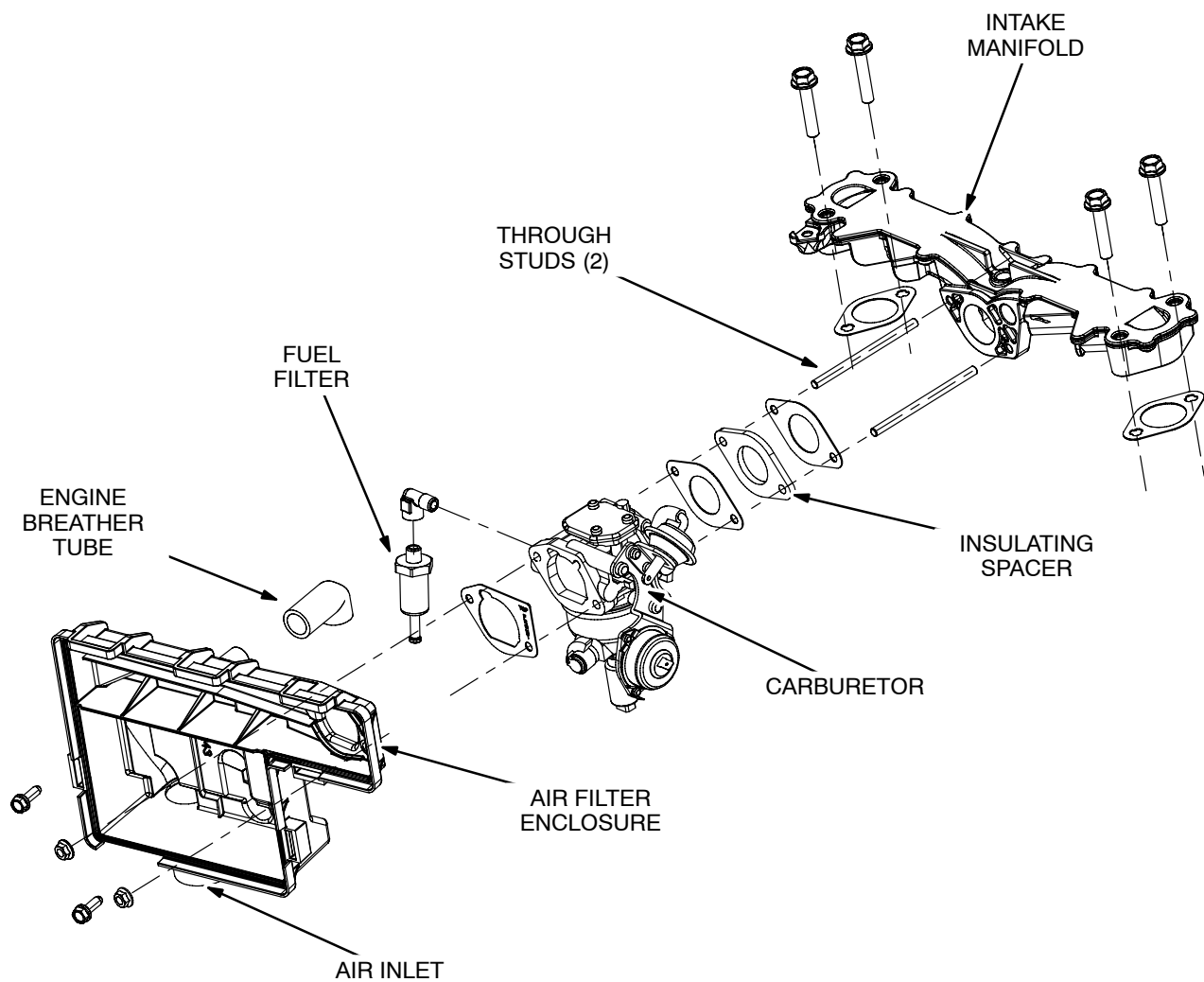
Reassembly is the reverse of disassembly. Always use new gaskets when reassembling. Note the marking on the gasket between the air filter enclosure and the carburetor as to which way is up and which side is out.

Torque the intake manifold bolts to 19 lb-ft (26 N-m).

If a carburetor through stud came out, replace it with a new stud having factory-applied thread sealant. Clean the threads in the manifold of the old sealant. Torque the stud to 5.5 lb-ft (7 N-m).

Make sure the air intake fits through the opening in the base and that the engine breather tube is connected between the air filter enclosure and the cylinder head. To prevent damage to the air filter enclosure, first tighten the two (2) carburetor mounting nuts (left first) to 4.5 lb-ft (6 N-m) and then tighten the two (2) support screws.





**FIGURE 8-9. GASOLINE CARBURETOR AND INTAKE MANIFOLD ASSEMBLY**

## Carburetor

The carburetor (Figure 8-10) is not likely to cause problems and should be replaced only after all other problems have been eliminated (see Section 11. *Troubleshooting*). The carburetor fuel mixture adjustments are sealed at the factory. See Page 8-20 to connect the throttle link and to adjust the idle (throttle) stop screw.

## Automatic Choke

The automatic choke is operated by a bi-metal/heater assembly and a vacuum breaker assembly (Figure 8-10). Conduct the following checks and adjustments before replacing a carburetor/choke assembly:

1. Apply 12 VDC across the heater terminals. The choke should open fully in 2 to 3 minutes.
2. Check the heater alignment marks and realign if out of alignment. The choke should be closed at temperatures below 70° F (21° C). It may be partly open above 70° F (21° C), but should close almost completely when vibrated (engine cranked).
3. The vacuum breaker diaphragm must not leak under a vacuum of 30 inches Hg (100 kPa). It should not take a vacuum greater than 2.4 inches Hg (8 kPa) to open the choke fully. At a vacuum of 1 inch Hg (3.2 kPa) the choke plate should be at the angle shown (Figure 8-10). If necessary, bend the link at the point shown, using two pliers.

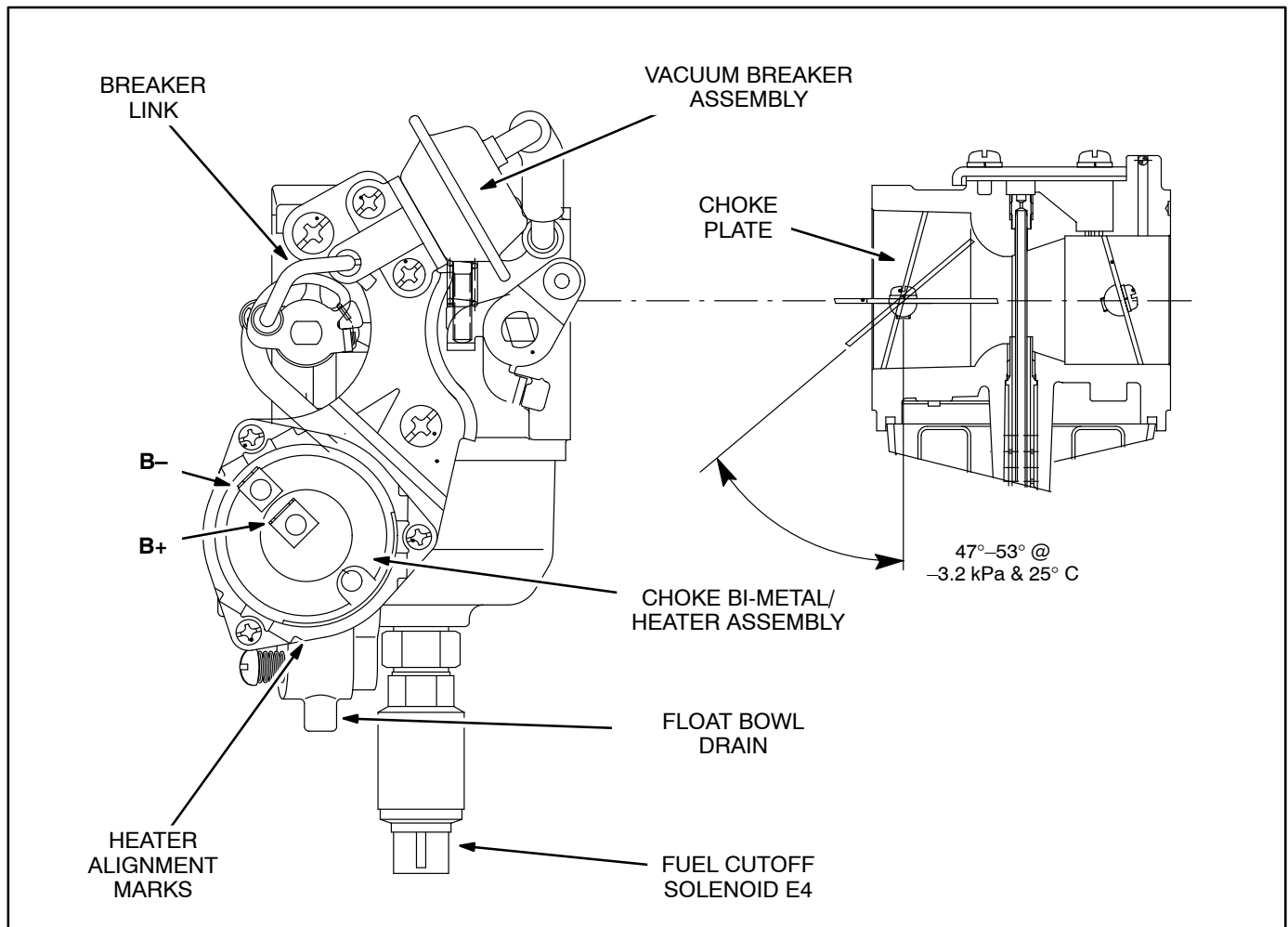


FIGURE 8-10. CARBURETOR / CHOKE ASSEMBLY

## Fuel Cutoff Solenoid E4

The fuel cutoff solenoid is threaded into the bottom of the carburetor float bowl (Figure 8-10). If the engine does not start because it is not getting fuel, but fuel can be drained from the carburetor float bowl, the solenoid probably is not opening and should be replaced. To remove and replace the cutoff solenoid:

1. Remove the carburetor.
2. Using a 15 mm wrench on the float bowl adapter (brass) and a 13 mm wrench on the solenoid, remove and discard the solenoid and aluminum washer.
3. When installing the new solenoid, use a new washer and torque it to 8 lb-ft (10 N-m). Make sure the float bowl adapter does not turn.
4. Reassemble all the parts that were removed.

## Fuel Filters

Two identical fuel filters are provided, one at the inlet to the pump (Figure 8-11) and the other at the carburetor inlet fitting (Figure 8-9). Replace both filters at the interval recommended in the Operator's Manual, or sooner if performance indicates that the filters are clogged. Use an 11/16-inch deep socket to remove the filters. Thread a replacement filter on by hand and then 1 to 1-1/2 turns more.

## Fuel Pump

An electric fuel pump (Figure 8-11) supplies fuel to the carburetor. Test the pump as follows if the gen-set does not start, starves for fuel or floods with fuel:

1. Check the fuel tank and fill as necessary.
2. Disconnect the fuel hose at the carburetor and connect a fuel pressure gauge accurate enough to read in the 2.5 to 4 psi (17 to 27 kPa) range.
3. Prime the fuel system (hold control switch at Stop/Prime) while observing the gauge. The

pressure should hold constant between 2.5 to 4 psi (17 to 27 kPa), or drop off very slowly.

4. If there is no pressure, tap the pump body with a screw driver handle to free the piston from fuel deposits. If there is no response, replace it with an Onan-supplied pump.

**⚠WARNING** *Do not substitute an automotive electric fuel pump for the Onan-supplied fuel pump. The output pressure from an automotive pump is much higher and can cause carburetor flooding or fuel leakage, creating a fire hazard.*

5. If the pressure is above or below the 2.5 to 4 psi (17 to 27 kPa) range, check fuel pressure at the inlet to the pump, with and without the vehicle propulsion engine running. Pressure higher than 4 psi (27.5 kPa) can cause flooding past the needle and float assembly in the carburetor. A lift of more than 3 feet (-1.3 psi) will prevent the pump from delivering enough fuel. Reinstall the fuel line, as necessary, if inlet pressure does not fall in the -1.3 to 1.5 psi range.

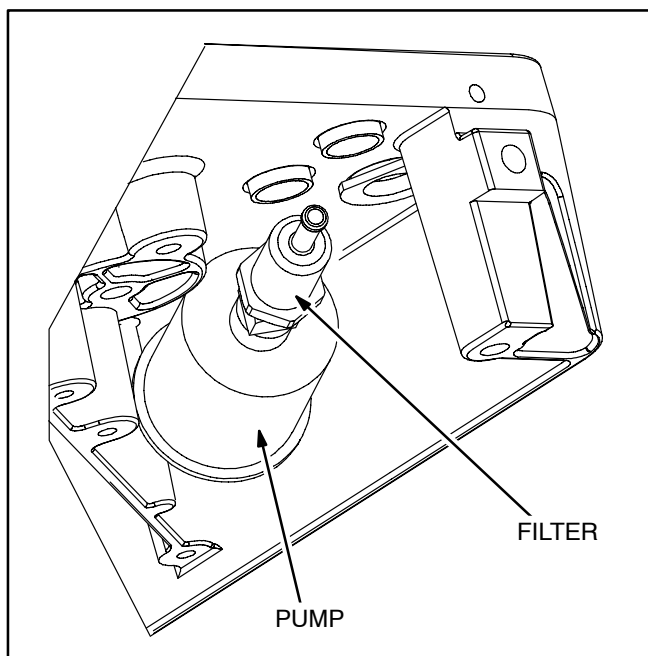


FIGURE 8-11. FUEL PUMP AND FILTER

## Fuel Connections

**⚠ CAUTION** *When connecting fuel hoses, only use soap-free lubricants such as WD40, which runs through fuel without leaving residues that can clog fuel jets.*

Onan recommends a separate fuel pickup tube or a separate fuel tank for the genset. The genset must never be connected to the **fuel supply line** of the vehicle engine—either to a high-pressure system (pump in tank), which can overpressurize the genset fuel system, or to a vacuum system (pump on engine), which can cause the genset to starve for fuel. Some vehicle chassis manufacturers allow connections to the **fuel return line** on high pressure fuel systems. Contact the vehicle chassis manufacturer for approval. Fuel line pressure at the point where the genset is connected must not exceed 1-1/2 psi under any condition.

**⚠ WARNING** *Excessive fuel pressure can flood the genset causing a fire. Genset fuel supply line pressure must not exceed 1-1/2 psi under any condition.*

The maximum fuel pump lift is 36 inches (914 mm).

The genset fuel pickup should be terminated higher in the supply tank than the propulsion engine pickup to keep from running the vehicle out of fuel.

*Do not change or remove the fuel fill tube, fill limiter vent, vapor canister, vapor lines, filler cap or any other part of the fuel system without the express approval of the vehicle chassis manufacturer. Modifications must conform with applicable sections of the Code of Federal Regulations, Title 49, and other standards.*

**Fuel Line Materials:** Replace fuel hose clamps, hose and tubing as necessary with the following materials. Good connections are required to prevent fuel leakage.

- **Tubing:** Use 1/4 inch O. D. ( $\pm 0.003$  inch) welded and drawn Type 304L stainless or AISI 1008–1010 low carbon steel tubing of 0.028 inch minimum wall thickness. The tubing must meet requirements for 150 psi operating pressure (Ref. ASTM A 539–99) and have corrosion resistance equal to or better than hot-dipped zinc galvanization.
- **Hose Beads:** Use suitable tooling to form tubing ends into SAE J1231 Type 1 or Type 3 double-flare hose beads—*recommended* for all tubing and fittings for fuel return.
- **Flexible Hose:** Use 1/4 in I. D. SAE J30R7 or hose or better.
- **Hose Clamps:** Use stainless steel stepless ear clamps. Onan P/N 0503-1951-11, Oetiker P/N 16700011 or equivalent are *recommended*.

**Fuel Line Routing:** If it is necessary to replace the fuel line, route the fuel line along bulkheads and frame members such that they are protected, *and at or above the top of the fuel tank to reduce siphoning if a line breaks or a hose comes off*. The entire length of a fuel line must be visible for inspection and accessible for replacement.

Support fuel lines to restrain movement and prevent chaffing or contact with sharp edges, electrical wiring and hot exhaust parts.

**⚠ WARNING** *Electric arcs can ignite gasoline leading to severe personal injury or death. Do not run wiring and fuel lines together.*

## LPG FUEL SYSTEM—HGJAB, HGJAC, HGJAE, HGJAF

*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 genset demand, especially on cold days and/or when the genset is under full load.*

**⚠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.*

### Operation

LPG and combustion air are mixed in the proper ratio in the mixer (Figure 8-12) for good starting and good performance over the entire load range. The demand regulator on Low-Pressure LPG Models (Figure 8-13) or the converter on High-Pressure LPG Models (Figure 8-15) meters LPG to the mixer in proportion to venturi vacuum. The mechanical governor (Page 8-20) operates the throttle in the mixer to maintain constant engine speed (within a range of 5 percent) as load varies.

### Removing Mixer

The mixer can be removed without removing the genset enclosure. Referring to Figure 8-12, remove the mixer as follows:

1. Disconnect the fuel hose at the mixer or at the demand regulator.

2. Disconnect the governor linkage.
3. Remove the air filter cover and filter element and remove the two support screws in the back of the filter enclosure as well as the two mixer mounting nuts.
4. Pull away the air filter enclosure and mixer.
5. Avoid removing the mixer through studs from the intake manifold. Otherwise, they will have to be replaced with new studs having factory-applied thread sealant.

The mixer is not likely to cause problems and should be replaced only after all other causes have been eliminated (see Section 11. *Troubleshooting*). The mixer fuel mixture adjustments are sealed at the factory. See Page 8-20 to connect the throttle link and to adjust the idle (throttle) stop screw.

### Removing Intake Manifold

Remove the genset enclosure and perform Steps 1 through 3 of Removing Mixer. (Do not loosen the mixer mounting nuts if the air filter, mixer and manifold are to be removed as an assembly.) Then remove the intake manifold bolts and pull away the assembly.

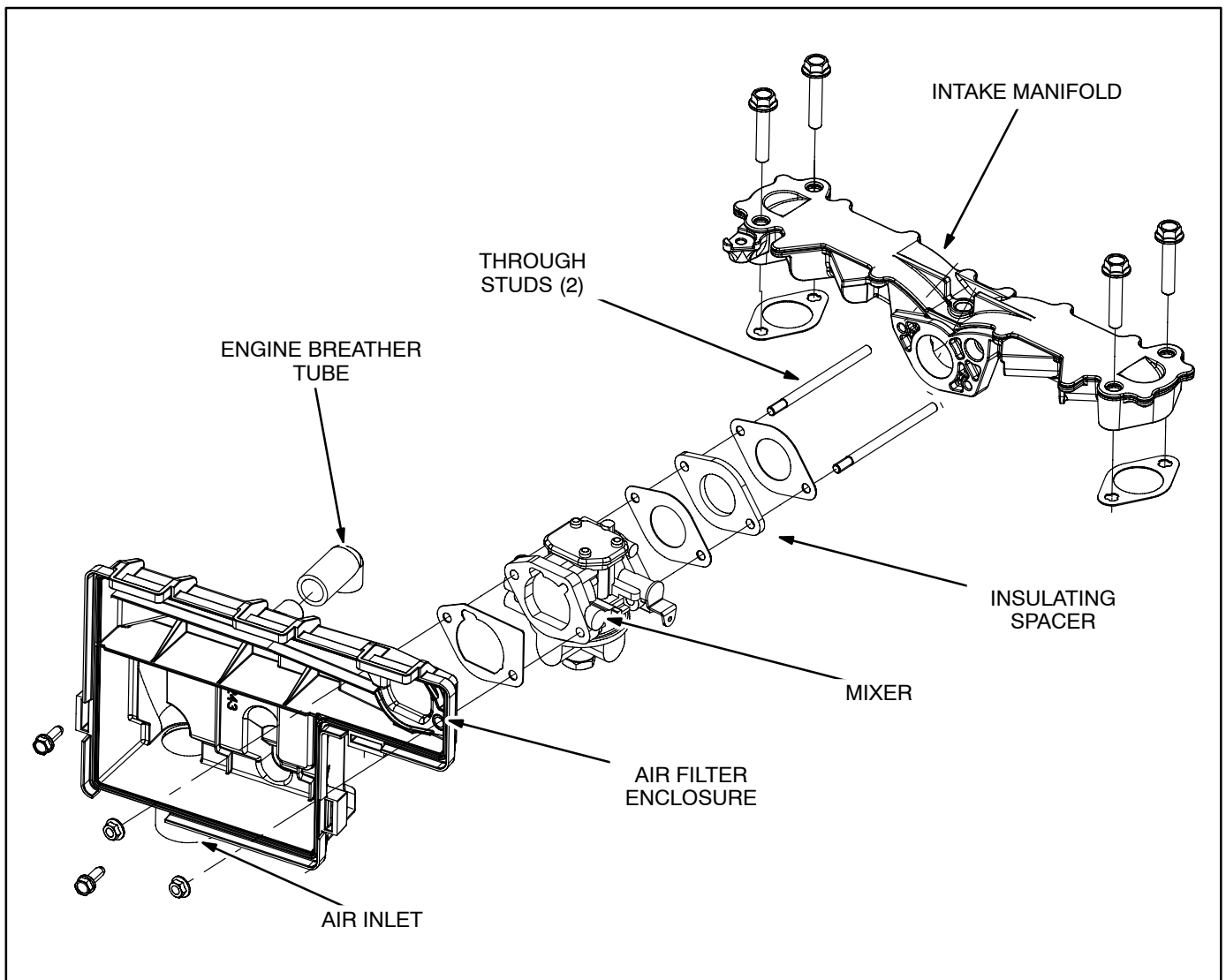
### Reassembly

Reassembly is the reverse of disassembly. Always use new gaskets when reassembling. Note the marking on the gasket between the air filter enclosure and the mixer as to which way is up and which side is out.

Torque the intake manifold bolts to 19 lb-ft (26 N-m).

If a mixer through stud came out, replace it with a new stud having factory-applied thread sealant. Clean the threads in the manifold of the old sealant. Torque the stud to 5.5 lb-ft (7 N-m).

Make sure the air intake fits through the opening in the base and that the engine breather tube is connected between the air filter enclosure and the cylinder head. To prevent damage to the air filter enclosure, first tighten the two (2) mixer mounting nuts (left first) to 4.5 lb-ft (6 N-m) and then tighten the two (2) support screws.



**FIGURE 8-12. LPG MIXER AND INTAKE ASSEMBLY**

## Low-Pressure LPG Demand Regulator

*Low-Pressure LPG Models* have a demand regulator that meters fuel to the carburetor (Figure 8-13). It is usually not the cause of fuel system problems. All other possible fuel system problems should first be checked out. Then conduct a lock-off pressure test as follows before replacing a demand regulator.

Replace the demand regulator only if lock-off pressure is not within the range of 0.20 to 0.35 inches WC (5.1 to 8.9 mm).

**Lock-Off Pressure Test:** Lock-off pressure is determined by pressurizing the back (vent) side of the regulator diaphragm to simulate carburetor venturi vacuum:

1. Connect the regulator inlet (Figure 8-13) to a source of air pressure regulated to 11 inches WC (28 cm).
2. Disconnect the hose from the carburetor at the regulator outlet. The soap bubble will be placed on the hose barb at the regulator
3. "T" in two hoses to the end of the regulator vent hose (3/8 inch I. D.). Use one hose to measure pressure by connecting it to an inclined manometer that reads 0 to 2 inches WC

(0 to 50 mm) and the other to provide the test pressure.

4. Attach a soap bubble to the hose barb at the regulator outlet. While reading the pressure indicated by the manometer and watching the soap bubble, blow lightly into the hose being used to pressurize the regulator. Regulator lock-off pressure is the minimum pressure that will cause air to flow through the regulator, as indicated by the expanding soap bubble. (At first the soap bubble may expand due to diaphragm movement but will stop expanding if air is not flowing through the regulator.)

**CAUTION** *If this is a bench test of the regulator, make sure the diaphragm is in a vertical plane (as in the genset), otherwise the weight of the diaphragm will cause erroneous readings of lock-off pressure.*

**Vent Hose:** Make sure to reconnect the regulator vent hose to the vent bug screen in the drip pan (Figure 9-14). The regulator is vented to this location to prevent variations in compartment air pressure from affecting fueling and to vent LPG outside the genset compartment if the diaphragm develops a leak.

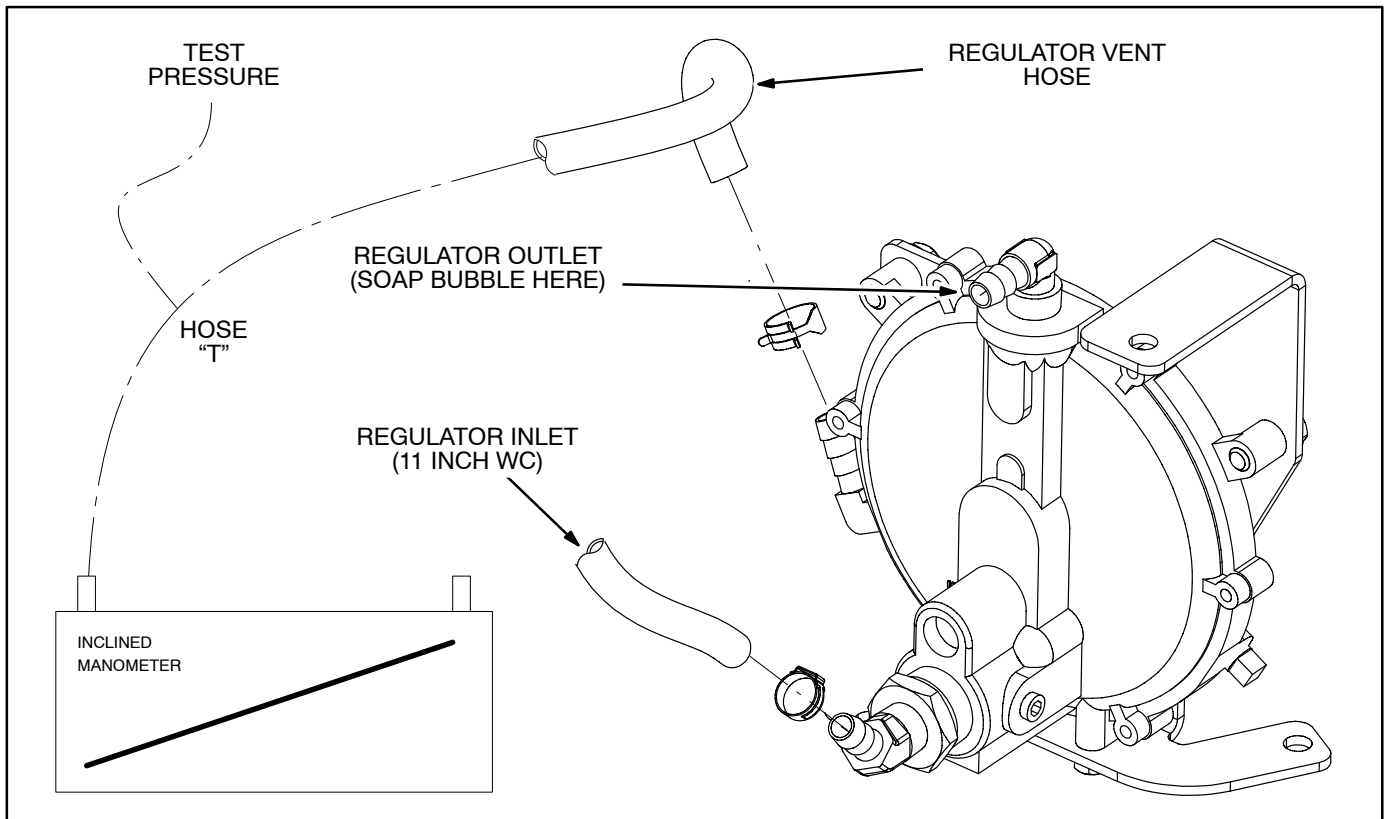


FIGURE 8-13. LOW-PRESSURE LPG LOCK-OFF PRESSURE TEST

## Testing Low-Pressure LPG Shutoff E4

**Test for Leakage:** If there is a smell of gas when the genset is not running, or any other reason to suspect that the valve (Figure 8-14) is leaking, connect the inlet of the valve to a source of air pressure regulated to not more than 14 inches WC (35 cm) and disconnect the outlet hose. Replace the solenoid if it leaks. Use a soap bubble to check for leakage.

**Test for Operation:** Disconnect the solenoid leads from the genset wiring harness and connect them to a 12 volt battery while the source of air pressure is still connected. Replace the solenoid if it does not open.

## Cleaning Low-Pressure LPG Filter

Remove the filter at the inlet to the solenoid (Figure 8-14), if provided, and clean off debris from the filter and iron filings from the magnet. Torque the filter back on to 25 lb-ft (34 N-m).

## Low-Pressure LPG Supply Connections

**LPG Tank Connections:** Low-Pressure LPG genset Models must be connected to the vapor withdrawal fitting on the LPG tank. The tank must have a manual shutoff valve and 2-stage pressure regulator adjusted to deliver 9-13 inches WC (23-33 cm) pressure at the genset. Figure 9-14 shows the supply fitting on the genset.

**⚠WARNING** *High LPG supply pressure can cause gas leaks which can lead to fire and severe personal injury or death. LPG supply pressure must be adjusted to Specifications by qualified personnel.*

**Fuel Line Materials and Routing:** If it is necessary to replace the fuel lines, use approved fuel line materials of 3/8-inch I. D. for runs up to 3 feet (0.9 m) and 1/2-inch I. D. for runs up to 15 feet (4.6 m).

Route gas lines away from hot exhaust parts and electrical wiring, provide support and protection to prevent chaffing, kinking and pinching and make sure they are accessible throughout for inspection and replacement.

**⚠WARNING** *Electric arcs can ignite LPG leading to severe personal injury or death. Do not run wiring and fuel lines together.*

**Appliance Fuel Lines:** Do not connect the genset fuel supply line to any appliance fuel supply line. The genset can draw fuel away from other appliances and cause a flame out. To prevent the possibility of flameout, the fuel supply system must be designed to deliver sufficient fuel for normal operation of the genset and other appliances at the expected temperature conditions. It may be necessary to use a separate fuel tank for the genset if sufficient fuel cannot be supplied with a single tank system.

**⚠WARNING** *The flameout of an unvented LPG appliance can lead to explosive accumulations of gas inside the vehicle and the danger of severe personal injury or death. Do not connect the genset fuel supply line to any vehicle appliance supply line.*

**Testing for Gas Leaks:** Upon completing service, fill the LPG tank and test every joint and fitting in the LPG supply system using an approved method, such as soap bubbles.

**⚠WARNING** *Testing for gas leaks with a flame can cause a fire or explosion that can lead to severe personal injury or death. Use approved methods only.*

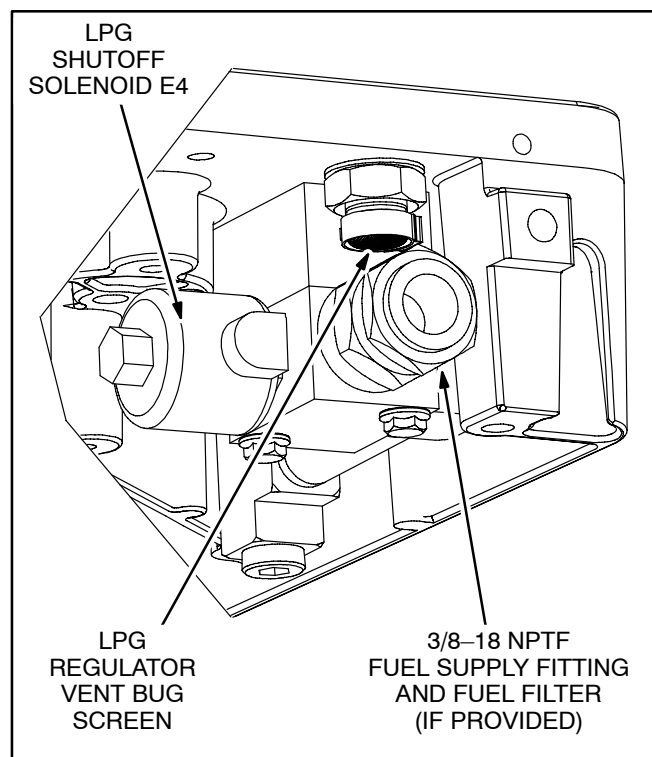


FIGURE 8-14. LOW-PRESSURE LPG FITTING



## High-Pressure LPG Converter (Regulator)

*High-Pressure LPG Models* have a converter (liquid to vapor) that also meters fuel to the carburetor (Figure 8-15). It is usually not the cause of fuel system problems. All other possible fuel system problems should first be checked out before replacing it.

### Testing High-Pressure LPG Shutoff E4

**Test for Leakage:** If there is a smell of gas when the

genset is not running, or any other reason to suspect that the valve (Figure 8-15) is leaking, remove the solenoid and connect the inlet of the valve to a source of compressed air (200 psi maximum). Replace the solenoid if it leaks. Use a soap bubble to check for leakage.

**Test for Operation:** Connect to a 12 volt battery while the source of air pressure is still connected. Replace the solenoid if it does not open.

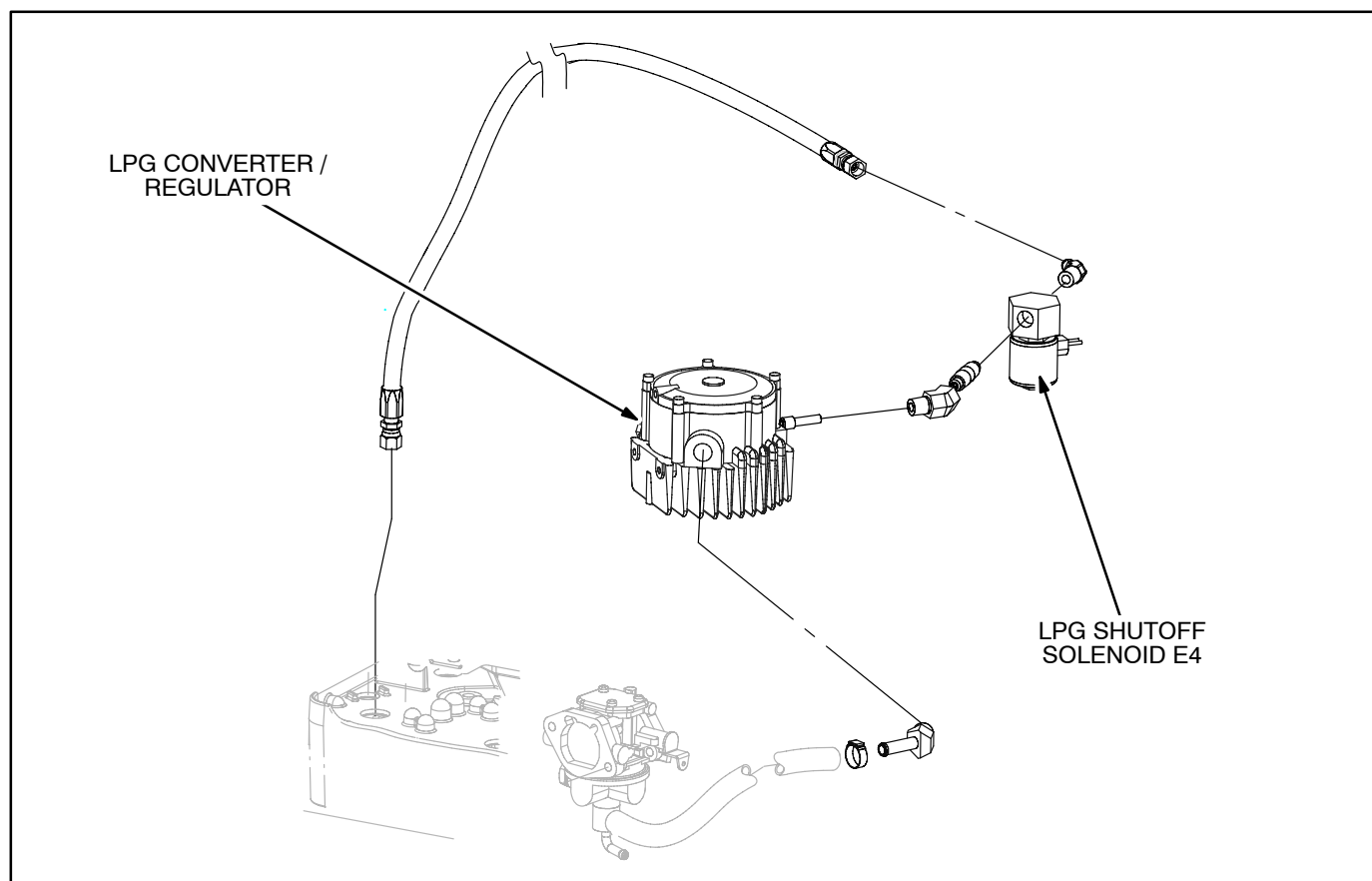


FIGURE 8-15. HIGH-PRESSURE LPG COMPONENTS

## Cleaning High-Pressure LPG Filter

Remove the filter at the genset supply inlet (Figure 8-16) and clean off debris from the filter and iron filings from the magnet. Torque the filter back on to 25 lb-ft (34 N-m).

## High-Pressure LPG Supply Connections

**LPG Tank Connections:** High-Pressure LPG genset Models must be connected to the liquid withdrawal fitting on the LPG tank. Use the Standard for the Storage and Handling of Liquified Petroleum Gases (NFPA No. 58) as a guide for the installation of a High-Pressure LPG fuel system (Figure 8-17). Figure 8-16 shows the supply fitting on the genset.

**Fuel Line Materials and Routing:** Connect the genset to the LPG supply line with flexible hose that is non-conductive between its end fittings so that the fuel line cannot become an alternative path for cranking currents. The hose must be Listed for **350 psi working pressure** and **LP-Gas** or **Propane**.

Route gas lines away from hot exhaust parts and electrical wiring, provide support and protection to prevent chaffing, kinking and pinching and make sure they are accessible throughout for inspection and replacement.

**⚠WARNING** *Electric arcs can ignite LPG leading to severe personal injury or death. Do not run wiring and fuel lines together.*

**Testing for Gas Leaks:** Upon completing the installation, fill the LPG tank and test every joint and fitting in the LPG supply system using an approved method, such as soap bubbles.

**⚠WARNING** *Testing for gas leaks with a flame can cause a fire or explosion that could lead to severe personal injury or death. Use approved methods only.*

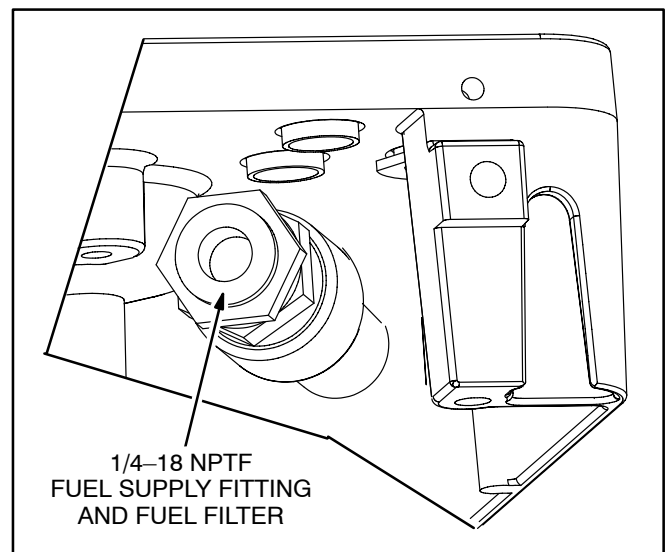


FIGURE 8-16. HIGH-PRESSURE LPG FITTING

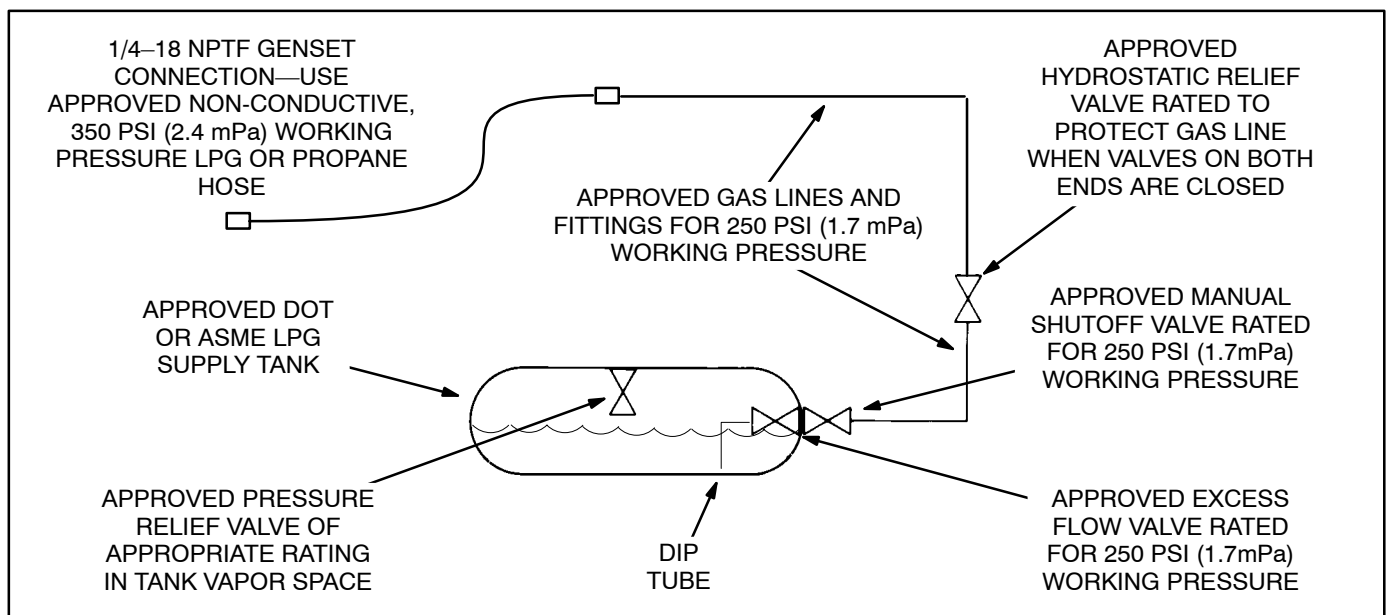


FIGURE 8-17. TYPICAL HIGH-PRESSURE LPG SUPPLY SYSTEM (LIQUID WITHDRAWAL)

## MECHANICAL GOVERNOR—HGJAB, HGJAC, HGJAE, HGJAF

The mechanical governor (Figure 8-18) operates the throttle plate in the carburetor or mixer to maintain constant engine speed (within a range of 5 percent) as load varies. See Page 9-14 regarding the internal governor parts.

See Table 8-3 for rated voltage and frequency versus allowable voltage range and droop (the difference between No-Load frequency and Full-Load frequency).

**TABLE 8-3 VOLTAGE / FREQUENCY / DROOP**

Rated Voltage	Voltage		Frequency	
	Max No Load	Min Full Load	No Load	Droop
<b>60 HERTZ GENSETS</b>				
<b>100</b>	108	93	63/62	2–4
<b>120</b>	125	112	63/62	2–4
<b>200</b>	216	186	63/62	2–4
<b>240</b>	250	224	63/62	2–4
<b>50 HERTZ GENSETS</b>				
<b>100</b>	108	93	52.5/51.5	2–4
<b>200</b>	216	186	52.5/51.5	2–4
<b>220</b>	238	205	52.5/51.5	2–4
<b>230</b>	249	215	52.5/51.5	2–4
<b>240</b>	250	224	52.5/51.5	2–4

Before making governor adjustments, check for other causes of hunting or excessive droop, such as binding governor linkage, fouled spark plugs, improper valve lash, and dirty fuel filters.

**⚠ CAUTION** *Voltage/frequency-sensitive equipment such as VCRs, televisions, computers, etc. may 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 which are voltage or frequency-sensitive before attempting any carburetor/governor adjustments. If disconnecting the devices is not possible, open the circuit breaker(s) at the distribution panel or at the genset, if so equipped.*

Accurate governor adjustments require a variable load bank of up to 7 kW capacity and accurate meters for measuring frequency (within 0.3%), voltage (within 0.5%) and output current (AC).

## Assembling Governor Linkage

Reassemble the throttle link and its tension spring if they have not been assembled as shown in Figure 8-18. The easiest way is to hook both ends of link and spring while the governor arm is detached. *Hook the tension spring below the throttle link in the throttle lever so that it can pull down on the bottom of the hole while the throttle link can push up on the top of the hole without interfering with each other.*

To detach the governor arm, remove the governor shaft nut by turning it **clockwise** and then pull the arm away from the shaft hub. To reattach the arm, see Resetting Governor Arm.

## Resetting Governor Arm

Anytime the carburetor or governor linkage has been disturbed by disassembly and reassembly, it will be necessary to reset the governor arm on the governor shaft, as follows (see Figure 8-18):

1. Loosen the governor shaft nut by turning it **clockwise** and remove the arm.
2. Use a battery terminal puller or equivalent tool to break the taper fit of the shaft in the arm hub.
3. Reattach arm and hub, making sure the two pins and holes engage, and thread the shaft nut on **counterclockwise**. Check for free rotation of the arm around the shaft and let the governor spring take up all play in the linkage. The linkage must push the throttle up against the wide open throttle stop.
4. Torque the shaft nut to 8 lb-ft (11 N-m), **counterclockwise**. (By design, tightening counterclockwise takes up play between the internal governor parts.)
5. Gently push the governor arm down and check for binding, rubbing against adjacent parts, interference with wiring and looseness.

## Adjusting Governor

Adjust the governor as follows (see Figure 8-18):

1. Warm up the genset for at least 5 minutes at 1/2 to 3/4 rated load. The choke must be completely open. Adjust frequency as close as possible to the appropriate Table 8-3 value with the speed adjusting nut to keep the genset from shutting down (most likely on Fault 14—Overfrequency or Fault 15—Underfrequency). Restart in 5 seconds if it shuts down.

2. When the engine is warm remove all loads and adjust the idle (throttle) stop screw to obtain 51 to 53 Hz on a 60 Hz genset or 41 to 43 Hz on a 50 Hz genset, holding down the throttle lever with your finger.
3. Let the throttle lever go and recheck and re-adjust No-Load frequency (speed), as necessary, to Table 8-3. Bump the governor arm to see that frequency stabilizes.
4. Connect rated load. If droop is greater than specified in Table 8-3, move the governor spring hook one or two notches towards the governor shaft and recheck frequency and droop. Repeat the procedure as necessary. If droop is less than specified, or the genset hunts, move the spring hook one or two notches away from the governor shaft and recheck frequency and droop. Repeat the procedure as necessary.
5. The governor must not hunt. Check for hunting under the following loading sequence:
  - A. No-Load • 3/4-Load • No-Load • 1/2-Load • No-Load • 1/4-Load • No-Load.
6. See Section 11. *Troubleshooting* if output voltage does not fall within the range specified in Table 8-3.
7. Check for binding, interference with wiring and rubbing against adjacent parts. Reset the governor arm if governor performance does not improve.

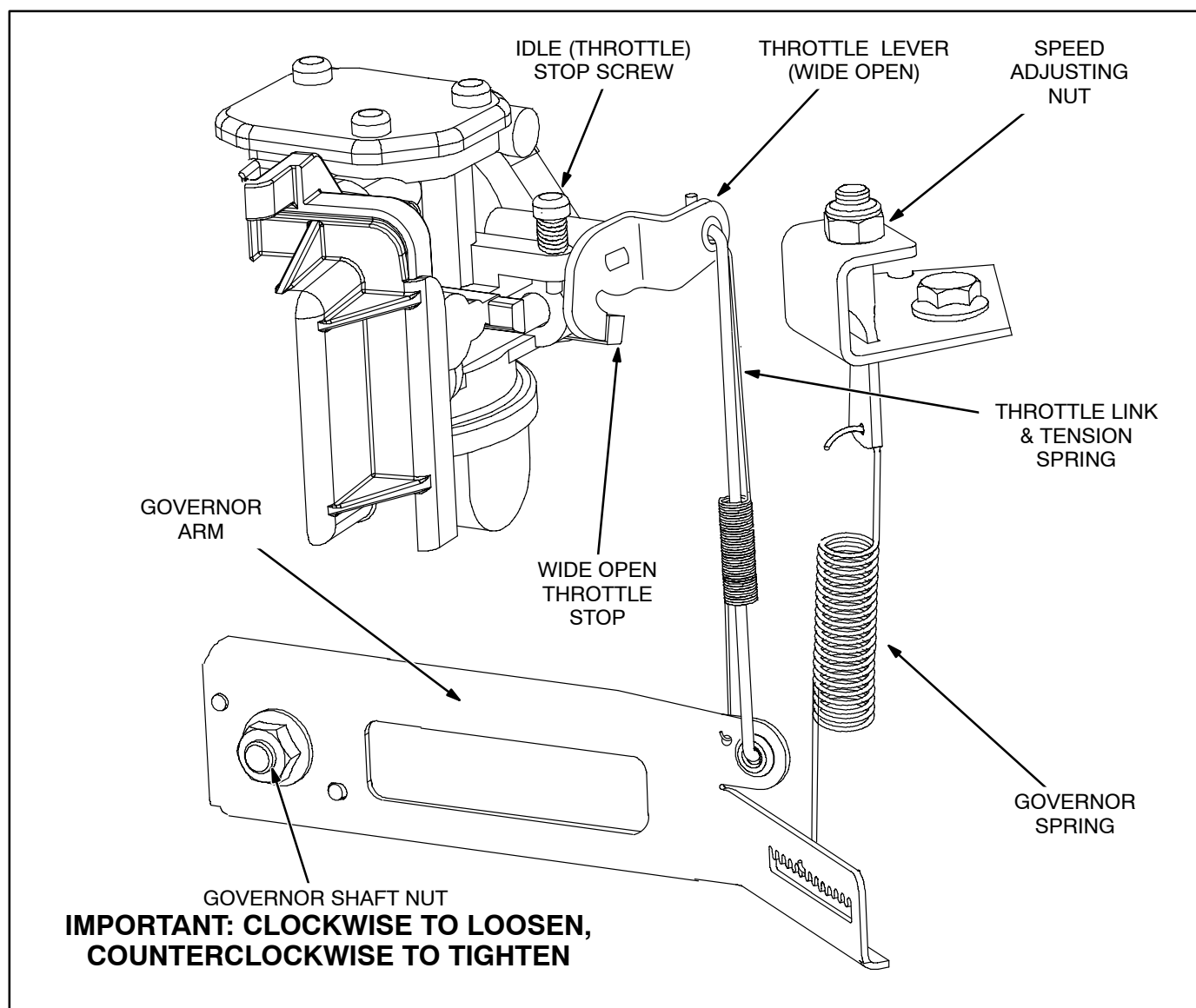


FIGURE 8-18. MECHANICAL GOVERNOR

# 9. Engine

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## TESTING COMPRESSION / LEAKDOWN

Test engine compression and / or leakdown to confirm whether the engine is worn. Compression should fall between 153 and 188 psi and not vary between cylinders by more than 10 percent.

## TESTING CRANKCASE VACUUM

Test crankcase vacuum to confirm whether the engine is worn or the breather valve is malfunctioning. Vacuum should be 7 to 10 inches of water column as measured through a tap in the oil fill cap.

## REMOVING AND INSTALLING GENERATOR / ENGINE ASSEMBLY

Figure 9-1 illustrates how the engine is mounted on the generator/engine base. The flywheel, exhaust manifold and mounting bolts are accessible for removal on the bottom side of the base.

### Removal

Remove the generator/engine assembly from the genset, and then the engine, drive belt, exhaust manifold or ignition coils (magnetos) from the generator/engine assembly.

1. Drain the engine oil because the genset will be turned on its side to remove components.
2. Remove the two-piece control enclosure (Section 5. *Control*) and disconnect the AC output leads from their terminals on the circuit breakers and base.
3. Disconnect the grounding strap at the generator/engine base.
4. Disconnect fuel pump or fuel solenoid leads.
5. Disconnect the fuel lines at the engine (at the fuel filter outlet [supply] and pressure regulator

[return] on EFI models, or at the carburetor or LPG regulator on other models).

6. For Models HGJAA, HGJAB, HGJAD and HGJAE disconnect the engine exhaust outlet at the muffler flange and remove the heat shield between the muffler and engine. For Models HGJAC and HGJAF, remove the muffler.
7. If the engine is to be separated from the base, disconnect all wiring from the engine:
  - A. Spark plug cables (two)
  - B. Ignition kill (two)
  - C. Starter motor and solenoid
  - D. Low oil pressure cutoff switch
  - E. On EFI models, the governor actuator, fuel injector and MAP and MAT sensors, and on models with carburetors, the choke heater and fuel cutoff.
8. If the engine is to be separated from the base, remove the generator/engine bracket and loosen or remove the cylinder shroud screws.

**⚠ CAUTION** *1) To prevent possible damage, do not rest the generator/engine assembly on its fan shroud. 2) Place blocks under the assembly when it is rested upside-down so that the weight will not bear on the choke pulloff diaphragm (gasoline carburetors).*

9. Remove the two fail-safe bolts. With assistance, lift the generator/engine assembly off its four mounting springs and rest it upside-down. (Four 3/8–16 holes, one in each corner, are provided for lifting and support.)

### Installation

Installation is the reverse of removal. Torque the fail-safe bolts to 38 lb-ft (51 N-m). Check that the assembly floats freely on its springs and does not make contact with the drip pan.

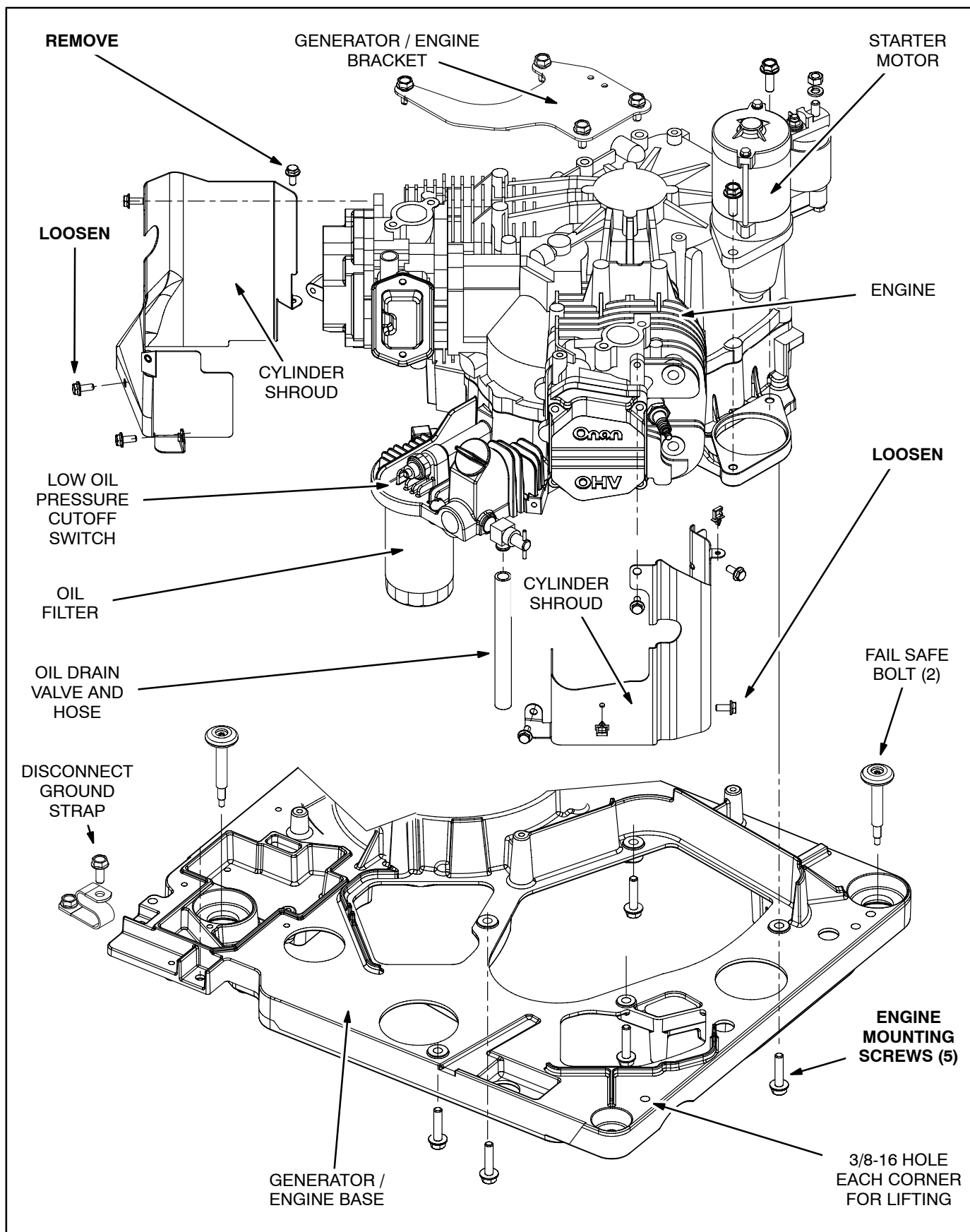


FIGURE 9-1. ENGINE

## REMOVING AND INSTALLING ENGINE

### Removal

1. Unless it has already been performed, disconnect all wiring from the engine, remove the generator/engine bracket and loosen or remove the cylinder shroud screws shown in Figure 9-1.
2. Remove the ignition coils, flywheel and exhaust manifold (Section 7. *Fan, Drive Belt, Flywheel, Ignition, Exhaust*).
3. Remove the five screws securing the engine to the generator/engine base and lift off the base.

### Installation

Installation is the reverse of removal. Torque the engine mounting screws to 20 lb-ft (27 N-m). Torque the cylinder shroud screws to 8 lb-ft (11 N-m).

## STARTER MOTOR

### Replacing Starter Motor

To remove the starter motor (Figure 9-1), disconnect all wiring and remove the two mounting screws. Follow instructions in the starter motor kit if the starter is to be repaired. When installing a starter motor, torque the mounting screws to 20 lb-ft (27 N-m) and the terminal nut to 6.5 lb ft (8 N-m).

### Replacing Starter Motor Solenoid

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

**⚠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.*

1. Secure the motor assembly in a vice after it has been removed from the genset.
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.
  - A. *If the motor does not spin up quickly and smoothly*, replace the motor/solenoid assembly.
  - B. *If the motor does spin up quickly and smoothly*, the motor is probably okay: replace the solenoid.
  - C. The solenoid is removeable by disconnecting the motor lead from the solenoid terminal and removing the two solenoid mounting nuts. When installing a new solenoid, make sure the solenoid plunger engages the shift fork.
  - D. The solenoid is removeable by disconnecting the motor lead from the solenoid terminal and removing the two solenoid mounting nuts. When installing a new solenoid, make sure the solenoid plunger engages the shift fork.

## ADJUSTING VALVE LASH

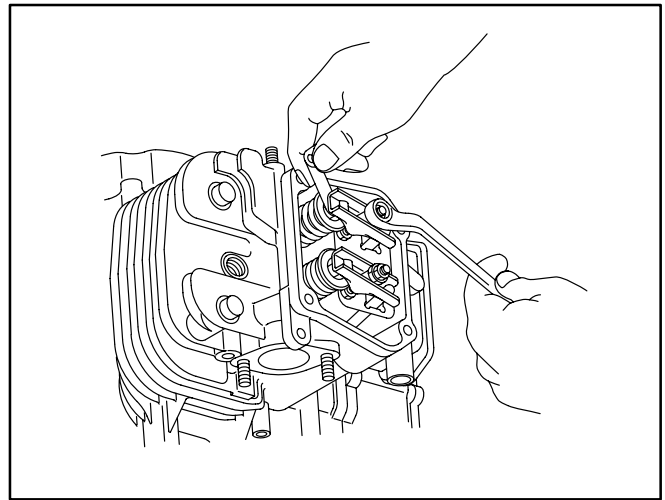
Valve lash is adjustable through the maintenance access opening on gensets with enclosures. Access to Cylinder No. 1 requires removal of the air filter enclosure. See Page 8-1, 8-8 or 8-13, depending on fuel system.

**Note: For accurate adjustments, valve lash must be adjust when the engine is at room temperature.**

Adjust valve lash (Figure 9-2) for all valves to 0.004 inch (0.01 mm). Torque the adjustment lock nuts to 6.5 lb-ft (8.5 N-m) and recheck lash.

The following procedure is recommended, noting that the intake valves are the upper ones and the exhaust valves the lower ones and that Cylinder No. 1 is to the left (generator side) and Cylinder No. 2 to the right:

1. Remove the spark plugs so that the engine is easier to turn over.
2. Use a socket wrench on the generator pulley nut to turn the engine. Remove the snap-in cover in the access hole in the drip pan. Always turn clockwise so that the nut does not loosen.
3. Remove the valve covers. Have rags in place to catch the oil that spills out.
4. Turn the engine until the Cylinder No. 2 intake valve (top) is at maximum lift. Then adjust Cylinder No. 1 intake valve lash.
5. Turn the engine until the Cylinder No. 2 exhaust valve (bottom) is at maximum lift. Then adjust Cylinder No. 1 exhaust valve lash.
6. Turn the engine until the Cylinder No. 1 intake valve (top) is at maximum lift. Then adjust Cylinder No. 2 intake valve lash.
7. Turn the engine until the Cylinder No. 1 exhaust valve (bottom) is at maximum lift. Then adjust Cylinder No. 2 exhaust valve lash.
8. Secure the valve covers using new gaskets. Torque the cover screws to 5.5 lb-ft (8 N-m).
9. Replace the spark plugs and pulley nut cover.



**FIGURE 9-2. ADJUSTING VALVE LASH**



## CYLINDER HEADS AND VALVES

The cylinder heads are removeable after the intake and exhaust manifolds have been removed. See Page 8-1, 8-8 or 8-13 regarding removal of the intake manifold. See Page 7-6 regarding removal of the exhaust manifold.

### Removal and Disassembly

To remove the heads from the crankcase, and valves from the heads:

1. Remove the valve covers for access to two of the four head bolts. Have rags in place to catch the oil that spills out.
2. Remove the four head bolts and pull away the head.
3. If the valves are to be removed, place the head on a flat surface and push down on the valve spring retainers, remove the collets and disassemble.
4. Clean the parts thoroughly. Check head flatness, spring free length, valve seat angle and contact width, valve stem diameter and valve width against DIMENSIONS AND CLEARANCES (Page 9-15) and replace parts as necessary. Replace burned, pitted or bent valves.

### Reassembly and Installation

Reassembly and installation are the reverse of disassembly and removal. Note the following:

1. Lap each valve in place until a uniform ring shows around the face of the valve.
2. Apply oil to the valve stems and install new valve stem seals.
3. Check the head dowel pins and replace if necessary.
4. Install new head gaskets and torque the head bolts in three steps as follows:

Tightening Torques		
Step 1	Step 2	Step 3
7.2 lb-ft (9.8 N-m)	14.5 lb-ft (19.6 N-m)	24.6-30.4 lb-ft (33.3-41.2 N-m)

5. Assemble the push rods and rocker arms (Page 9-6) and adjust valve lash (Page 9-4).

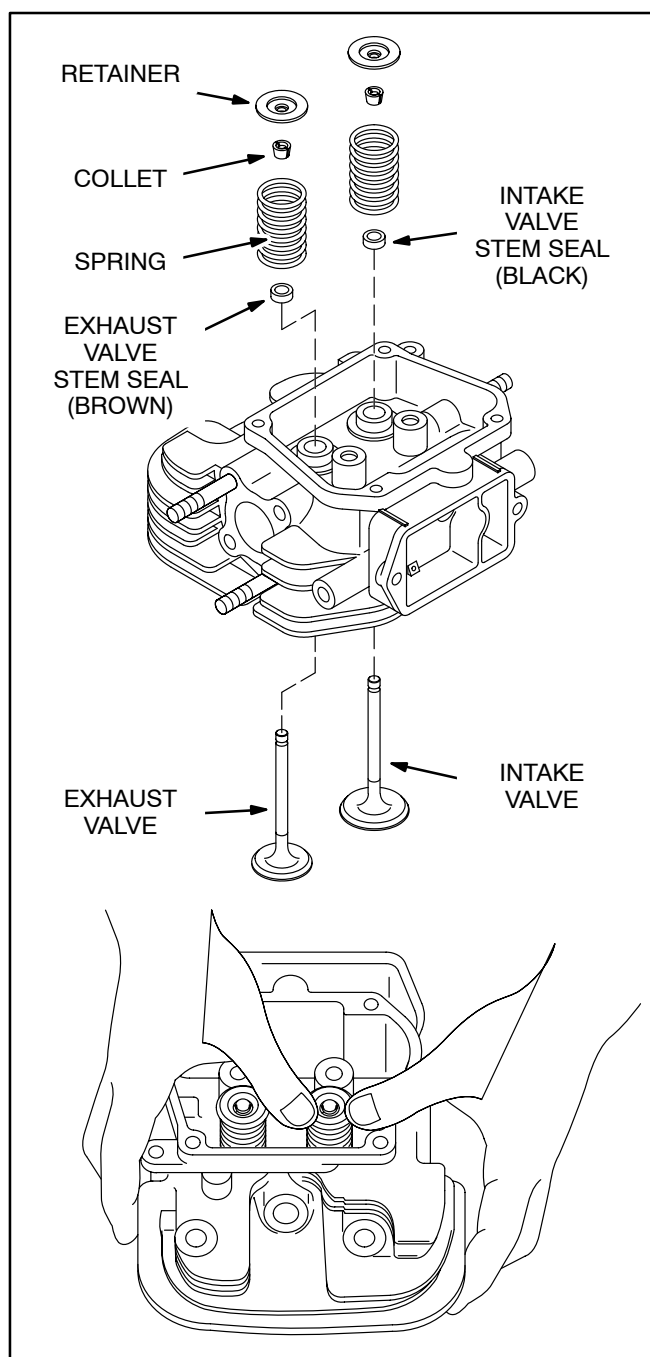


FIGURE 9-3. CYLINDER HEAD AND VALVES

## Rocker Arms and Push Rods

After the heads have been assembled to the crankcase the push rods and rocker arms can be assembled loosely as shown in Figure 9-4. Oil the rocker arms and pivots. Insert the push rods into the hollows in the tappets in the crankcase. Adjust valve lash.

## Breather Valve

The engine breather is located on the Cylinder No.1 head and consists of a leaf valve (Figure 9-5). The valve maintains a partial vacuum in the crankcase and provides some separation of crankcase gases and oil. The crankcase gases are routed to the air intake for burning in the combustion chambers. Remove, clean and examine the parts and replace as necessary. Re-install the reed valve so that it opens out. Do not tighten the cover screws to more than 3 lb-ft (4 N-m), or the gaskets may be damaged.

Make sure to reconnect the tube between the breather outlet and the back of the air filter.

## CRANKCASE ASSEMBLY

### Disassembly

After removing the engine from the base (Page 9-3), turn it on its back and remove the main bearing cover screws. Gently tap the cover with a soft-faced hammer to loosen it. If the crank and pistons are to come out, remove the cylinder heads (Page 9-5). Remove the camshaft and tappets and then the pistons and connecting rods and finally the crankshaft. Mark each part so that it can be re-assembled with its mating parts.

### Assembly

Before reassembling the crankcase (Figure 9-6), clean all parts thoroughly and check each against DIMENSIONS AND CLEARANCES (Page 9-15). Replace or machine parts as necessary. Replace all gaskets with new. Liberally oil all rotating and sliding parts as they are being assembled. Reassemble the crankcase in the sequence of numbered steps that follow, beginning on (Page 9-8)

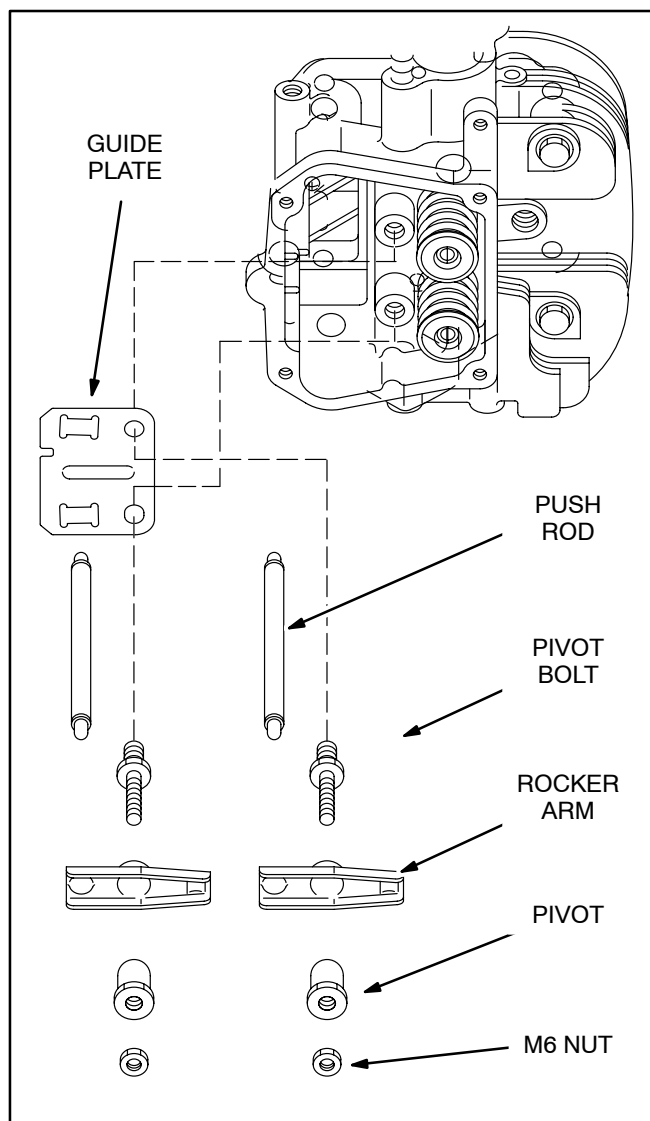


FIGURE 9-4. ROCKER ARMS AND PUSH RODS

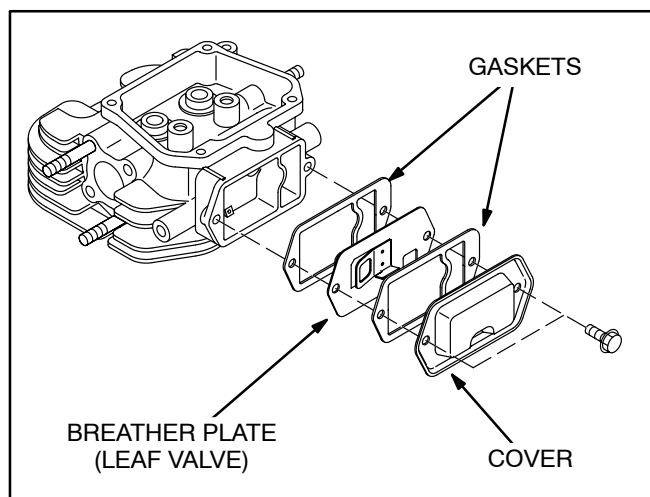


FIGURE 9-5. ENGINE BREATHER VALVE

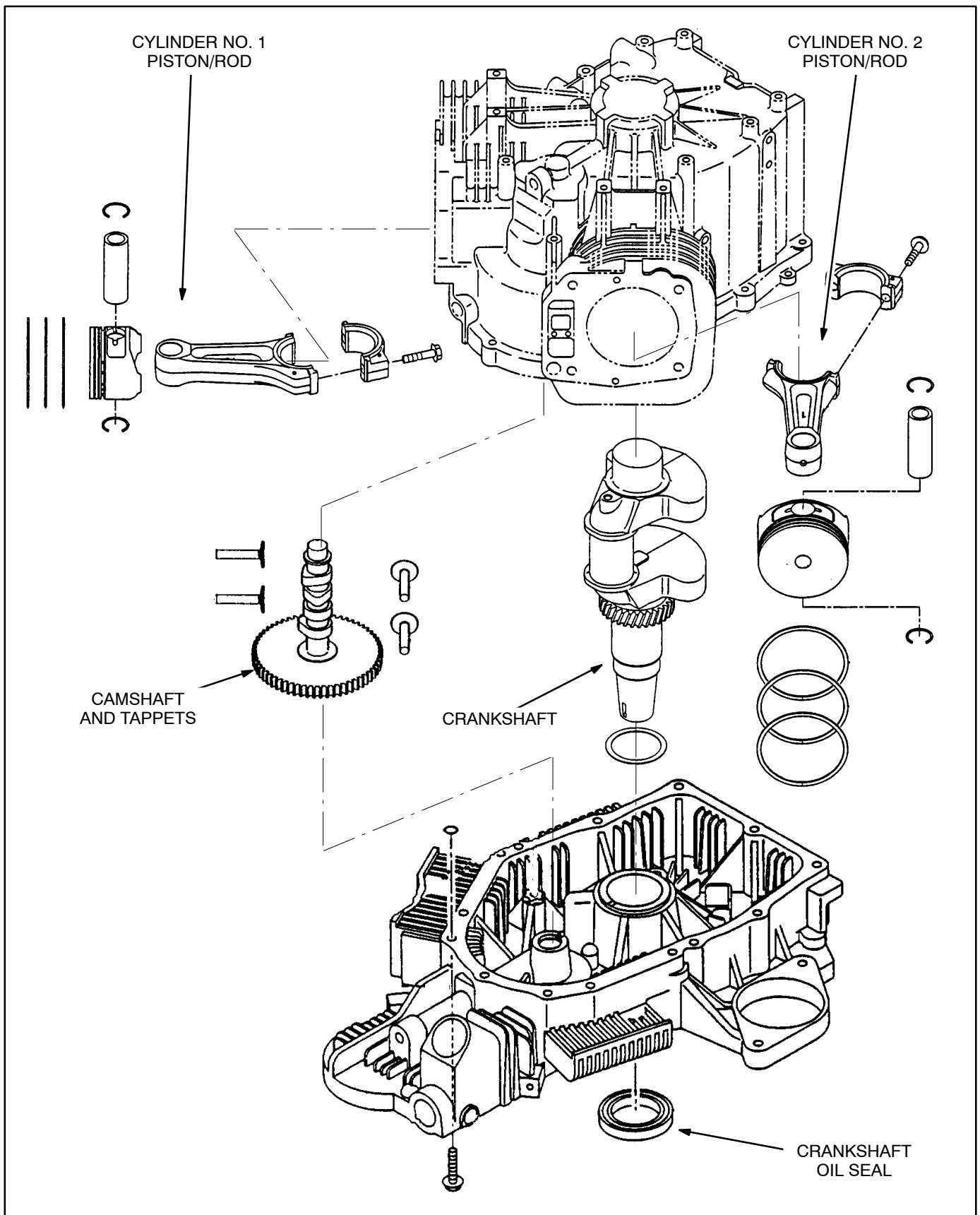


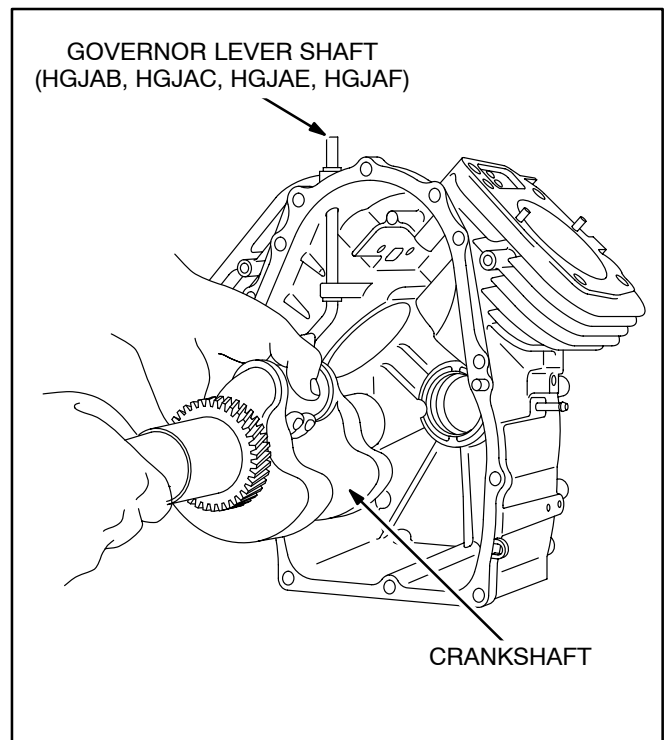
FIGURE 9-6. CRANKCASE ASSEMBLY

## Crankshaft

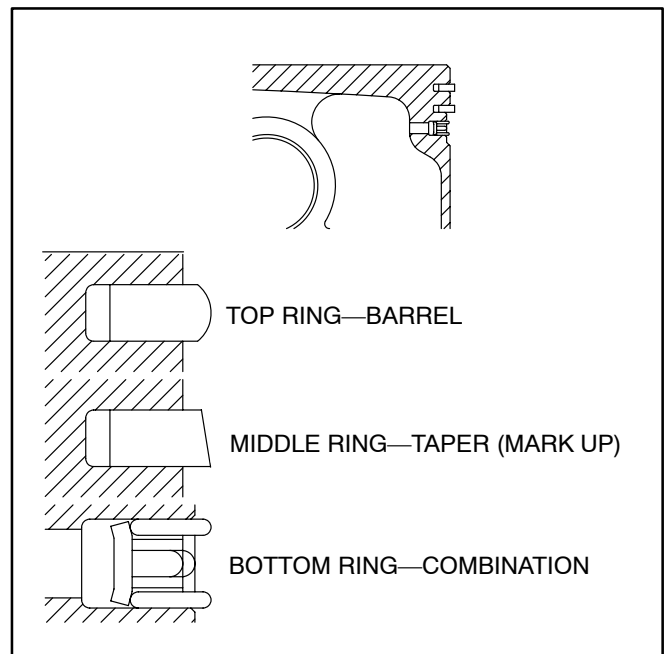
On Models HGJAB, HGJAC, HGJAE and HGJAF install the governor lever and then the crankshaft (Figure 9-7).

## Piston Rings

Install the oil ring (bottom) first, then the middle ring and last the top (Figure 9-8). The top ring can be installed either side up. The middle ring has a punch mark on the side that must be up.



**FIGURE 9-7. INSTALLING CRANKSHAFT**



**FIGURE 9-8. PISTON RINGS**

## Piston / Connecting Rod Assembly

Assemble the pistons and connecting rods using both circlips to hold the piston pin in the piston. Note that one connecting rod is marked “1” and the other “2” (Figure 9-9). Assemble in the respective cylinder with the markings on the main bearing cover side.

When installing the connecting rod caps, make sure the alignment marks register (Figure 9-10). Torque the cap bolts to 16.3-19.9 lb-ft (22.1-27 N-m). Check for free movement of piston and connecting rod by turning the crankshaft slowly.

## Camshaft and Tappets

Reinstall the tappets in their original bores. Push them in fully to avoid damage during camshaft installation. Install the camshaft and line up the timing marks with the crankshaft gear (Figure 9-11).

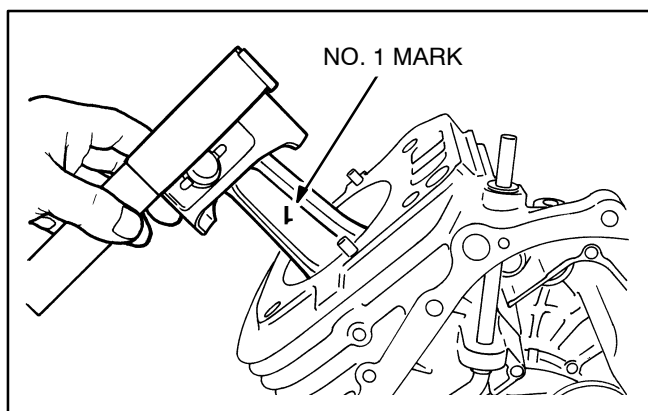


FIGURE 9-9. INSTALLING PISTON / ROD

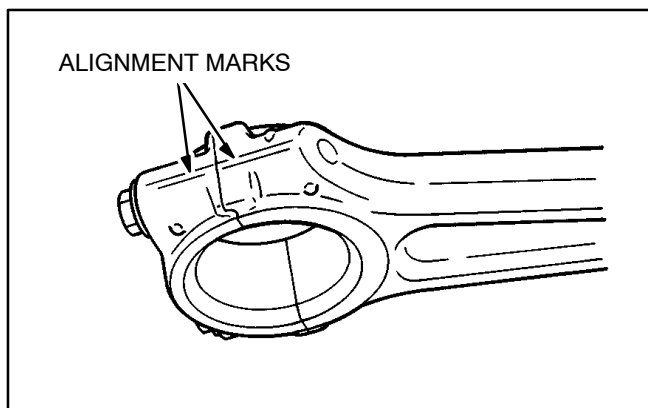


FIGURE 9-10. ROD ALIGNMENT MARKS

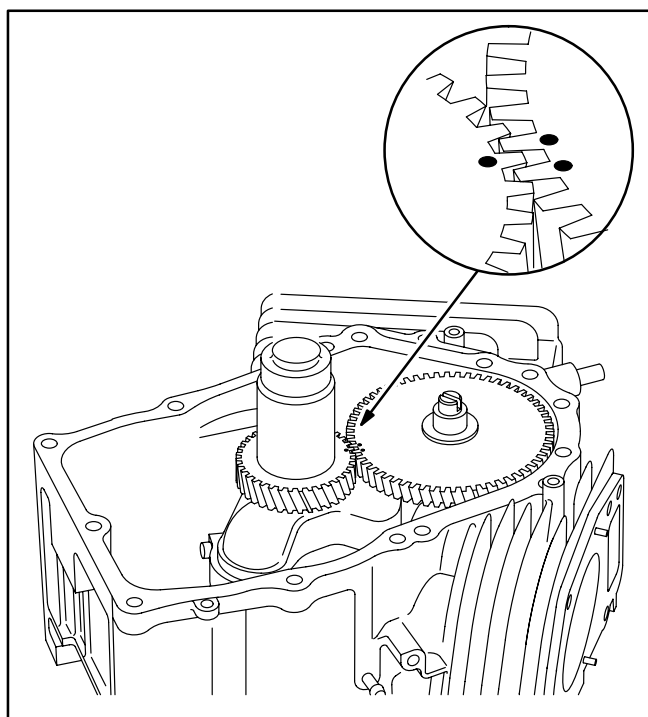


FIGURE 9-11. TIMING MARKS

## Crankshaft End Play

Check and adjust crankshaft end play with spacer shims. Three thicknesses are available: 0.6, 0.8 and 1.0 mm (0.024, 0.031 and 0.039 inch). To pick the best shim:

1. Measure and record the A and B distances (Figure 9-12). Figure 9-13 shows a method for determining the B distance. B is equal to Reading 1 minus Reading 2.
2. The thickness of the compressed gasket is 0.014 inch (0.36 mm). Thus:
3.  $A + 0.014 \text{ inch} - B = \text{Clearance (inch)}$   
[ $A + 0.36 \text{ mm} - B = \text{Clearance (mm)}$ ]
4. Thus, to obtain an end play of 0.008 inch (0.2 mm):
5.  $\text{Clearance (inch)} - 0.008 \text{ inch} = \text{Shim Thickness (inch)}$   
[ $\text{Clearance (mm)} - 0.2 \text{ mm} = \text{Shim Thickness (mm)}$ ]

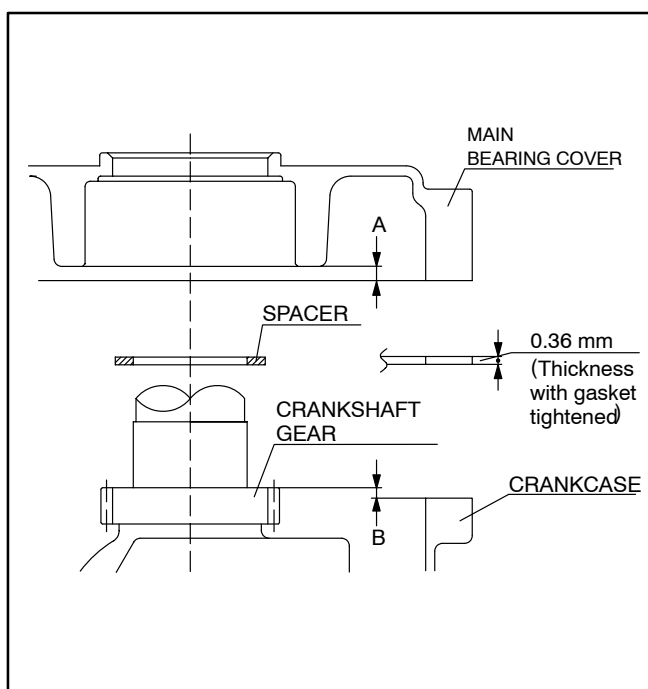


FIGURE 9-12. CRANKSHAFT END PLAY

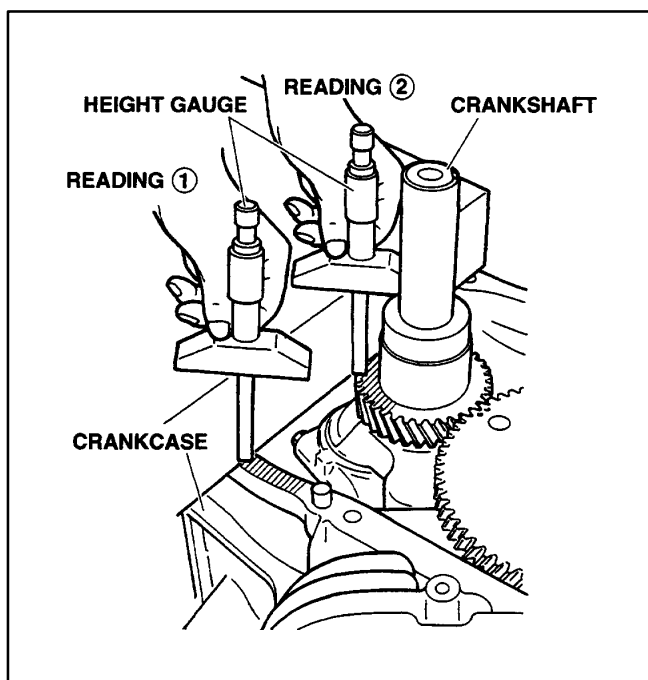


FIGURE 9-13. CRANKSHAFT END PLAY

## Crankshaft Oil Seal

Press a new crankshaft oil seal into the main bearing cover to a depth of 0.020 to 0.060 inches (0.5 to 1.5 mm) below the surface.

**⚠ CAUTION** *Pressing the oil seal in too far will result in an oil leak.*

If the crankshaft has been grooved or has nicks or scratches where the oil seal touches the crankshaft, it is recommended that a "Speedi-Sleeve" be installed. See **PSB 686** for "Speedi-Sleeve" use and installation instructions.

## Main Bearing Cover

Install a seal guide over the crankshaft to protect the crankshaft oil seal. On Models HGJAB, HGJAC, HGJAE and HGJAF make sure the governor gear (Page 10-1) has been installed.

Use a new cover gasket and 3-Bond or an RTV adhesive sealant equivalent to Dow Corning 732.

Make sure both O-rings (187-6239) are in place, one at each oil return hole from the block.

Lubricate the oil seal lip and gently guide the cover on over the crankshaft to prevent damaging the oil seal, making sure that the governor gear meshes with the camshaft gear. If necessary, poke a thin rod through the gap between crankcase and cover to turn the governor gear slightly so that the teeth mesh.

Torque the cover screws to 16.2-16.9 lb-ft (22-23 N-m).

**Note: Replace all cover screws that are not imprinted with the number "9" with Onan Part Number 800-6361. These are newer, stronger screws necessary for securing the cover tighter to prevent oil leaks.**

## Lubricating Oil Pump

The crankshaft and camshaft journals are pressure lubricated, while the cylinders and valve system are lubricated by the oil mist in the crankcase. The oil pump is driven by the camshaft through a coupling on the end of the camshaft. A full-flow oil filter and low oil pressure cutoff switch are mounted externally (Figure 9-1).

**Low Oil Pressure Switch:** The genset controller will blink Fault Code No. 2—Low Oil Pressure if there is a loss of oil pressure (less than 17 psi). Nominal oil pressure is 43 psi. See Section 11. *Troubleshooting*.

**Removing Oil Pump:** To remove the oil pump for service (Figure 9-14), it will be necessary to remove the flywheel but not to remove the engine from the base. See Section 7. *Fan, Drive Belt, Flywheel, Ignition, Exhaust* to remove the flywheel. Then remove the four mounting screws and remove the pump components (Figure 9-15).

**Reinstalling Oil Pump:** Clean, service and replace pump parts as necessary (Figure 9-15) and relubricate before installing. Make sure the shaft engages the end of the camshaft properly.

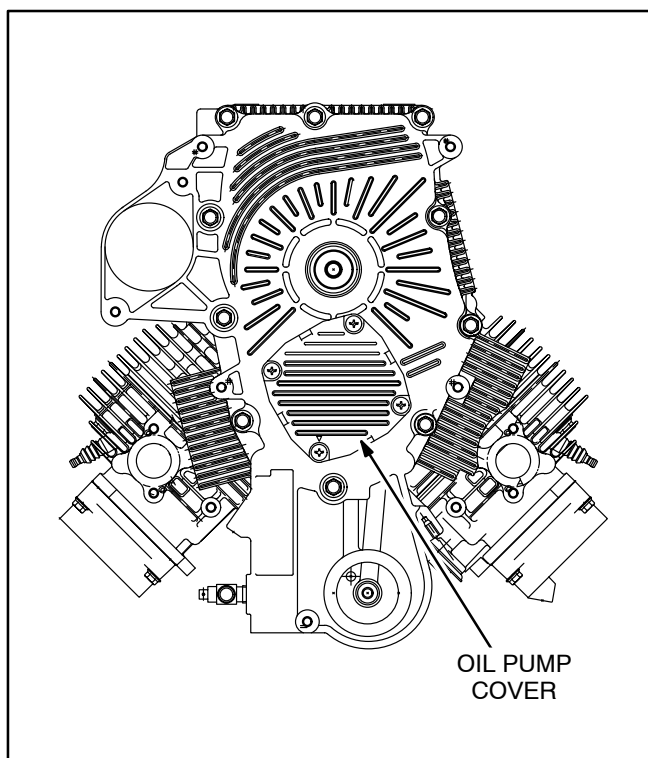


FIGURE 9-14. OIL PUMP COVER (ENGINE BOTTOM)

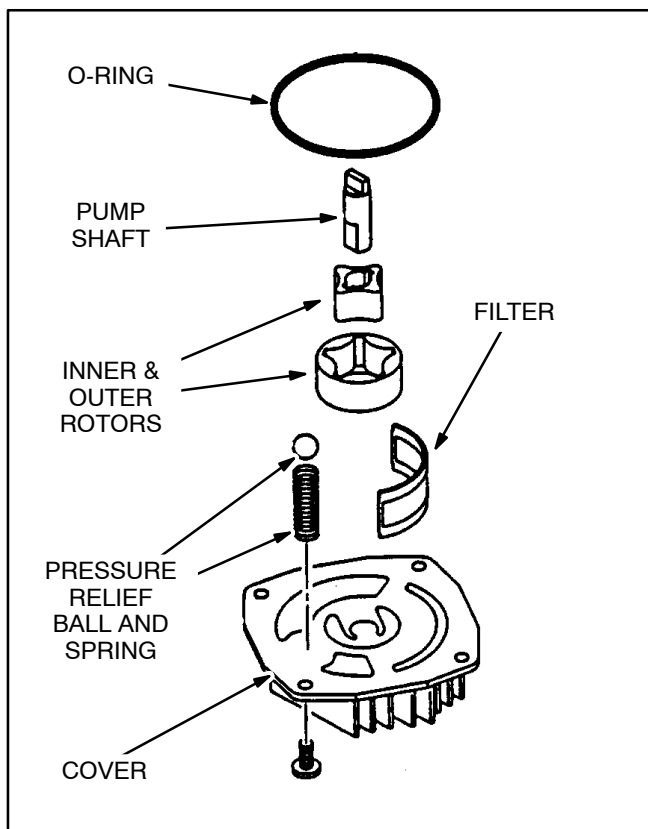
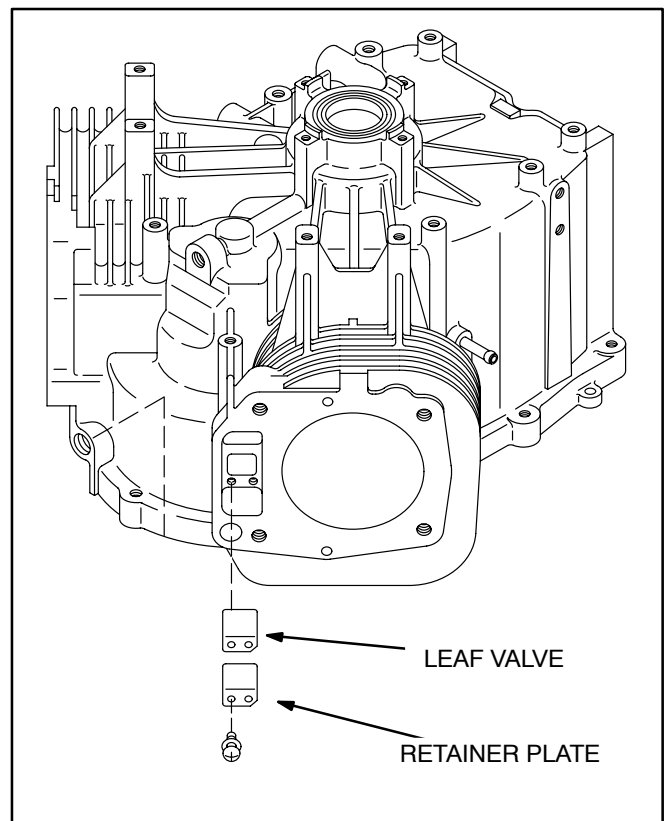


FIGURE 9-15. OIL PUMP



## Oil Control Leaf Valves

A leaf valve is secured by two screws and a retainer plate in the push rod compartment along side each cylinder (Figure 9-16). The valves control the mist of crankcase gases and oil that pass through the heads lubricating the valve system. The oil drops out and returns to the crankcase through passages in the heads and crankcase while the breather valve (Page 9-6) prevents accumulation of the crankcase gases.



**FIGURE 9-16. OIL CONTROL LEAF VALVES**

## Mechanical Governor—HGJAB, HGJAC, HGJAE, HGJAF

The internal components of the mechanical governor are accessible when the main bearing cover is removed. The governor gear assembly rotates on a shaft projecting from the bearing cover and snaps in place in the groove in the shaft (Figure 10-1). It is driven by the camshaft gear. The governor lever is carried in the crankcase and protrudes out the side (Figure 9-17), where the governor arm is attached (Page 8-20). The governor sleeve (Figure 10-1) pushes up on the paddle of the governor lever shaft (Figure 9-17). It opposes, in proportion to engine speed, the force of the external governor spring (Page 8-20).

Be careful when assembling the main bearing cover to the crankcase that the governor and camshaft gears mesh properly. If necessary, poke a thin rod through the gap between crankcase and cover to turn the governor gear slightly so that the teeth mesh.

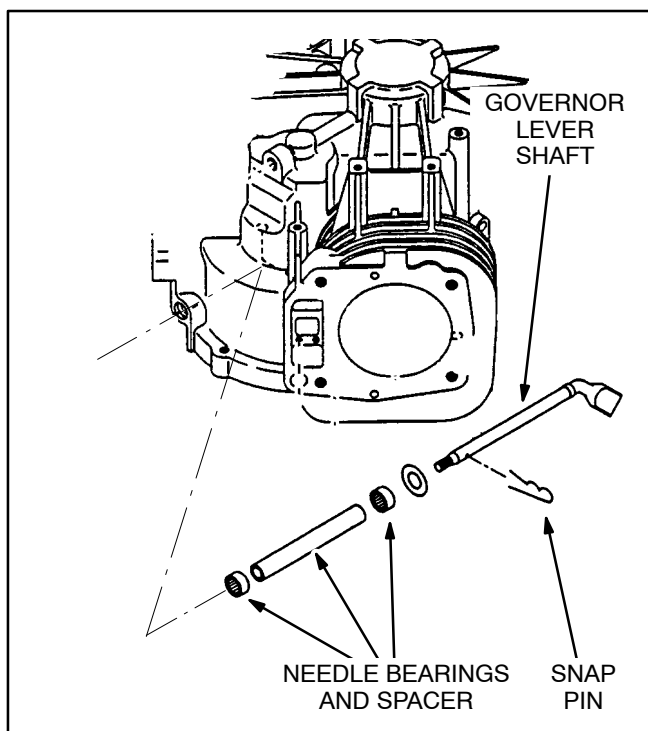


FIGURE 9-17. GOVERNOR LEVER

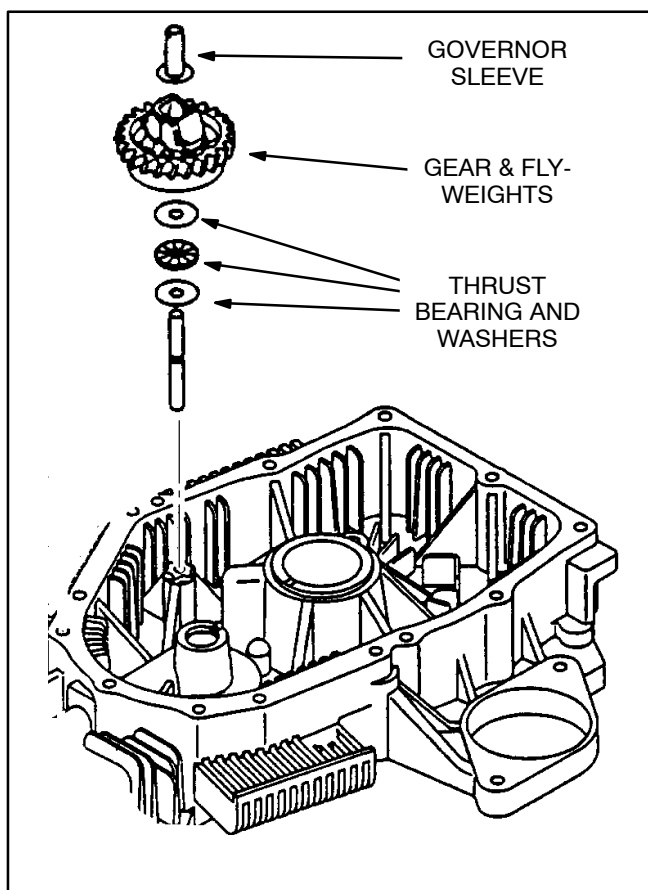
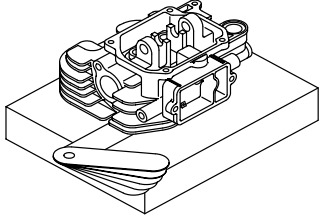
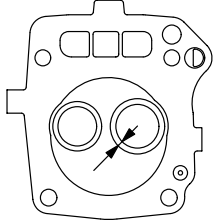
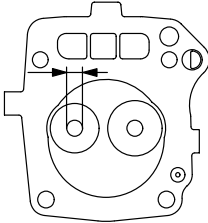
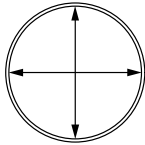
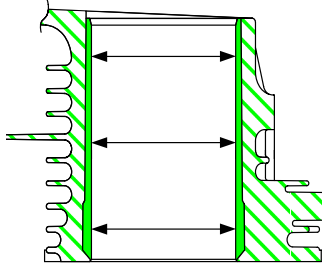
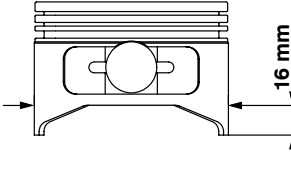
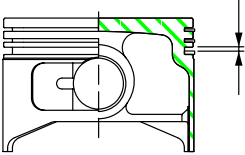
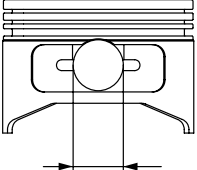
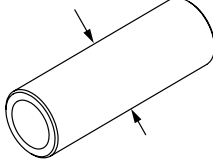
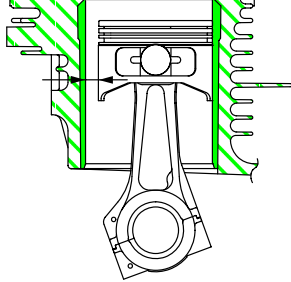
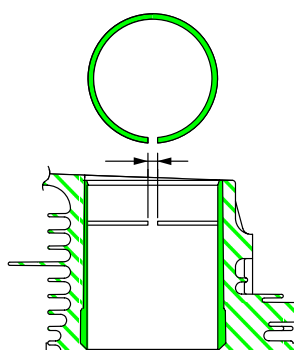
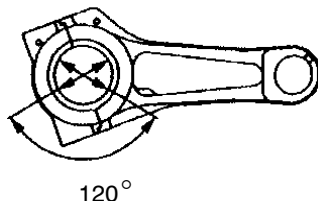
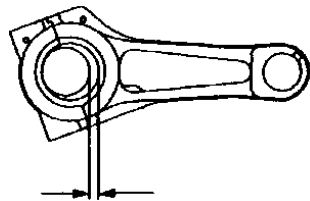
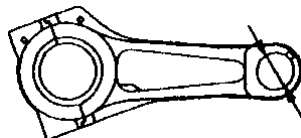
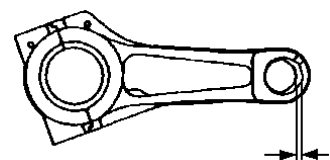
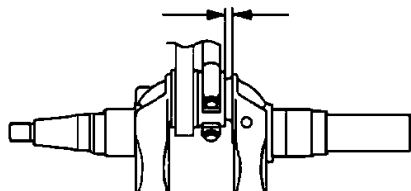


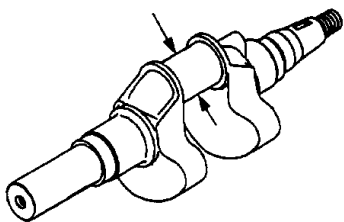
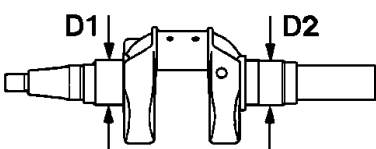
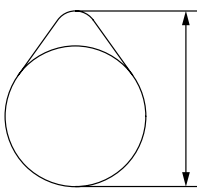
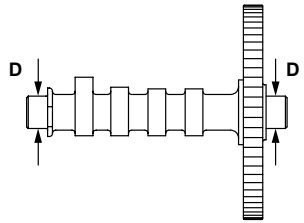
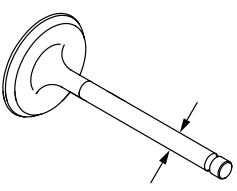
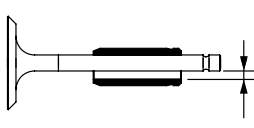
FIGURE 9-18. GOVERNOR GEAR

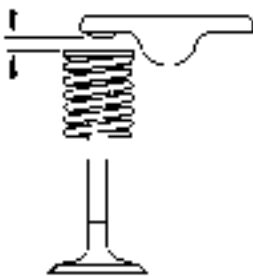
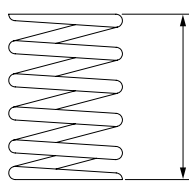
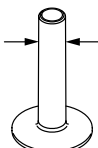
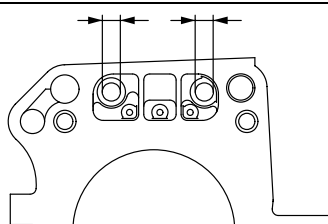
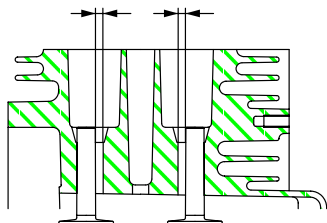
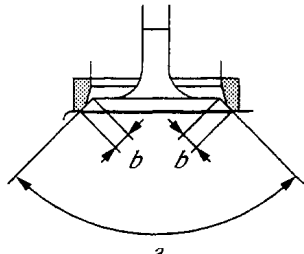
## DIMENSIONS AND CLEARANCES

ITEM		STANDARD inches (mm)	MAXIMUM inches (mm)
<b>Cylinder Head</b>			
Flatness		0.002 or less (0.05 or less)	0.004 (0.1)
Valve seat contact width		Intake/ Exhaust 0.028 – 0.039 (0.7 – 1.0)	0.079 (2.0)
Valve guide inside diameter		0.2376 – 0.2383 (6.035 – 6.053)	0.242 (6.15)
<b>Cylinder</b>			
Inside diameter		STD	Rebore when the difference between the max. and min. of diameter reaches 0.004 (0.1)
		1st Reboring	3.159 – 3.160 (80.250 – 80.269)
		2nd Reboring	3.169 – 3.170 (80.500 – 80.519)
		Roundness after reboring	0.004 (0.01)
		Cylindricity after reboring	0.0006 (0.015)

ITEM		STANDARD inches (mm)	MAXIMUM inches (mm)
<b>Piston</b>  Piston size (at skirt in thrust direction) 	STD	3.148 – 3.149 (79.968 – 79.988)	3.145 (79.878)
	1st outer diameter	3.158 – 3.159 (80.218 – 80.238)	3.155 (80.128)
	2nd outer diameter	3.168 – 3.169 (80.468 – 80.488)	3.164 (80.378)
Ring groove side clearance 	Top	0.0002 – 0.0035 (0.05 – 0.09)	0.006 (0.15)
	2nd	0.0012 – 0.0028 (0.03 – 0.07)	0.006 (0.15)
	Oil Ring	0.0022 – 0.0069 (0.057 – 0.175)	0.006 (0.15)
Piston pin hole 		0.8262 – 0.8269 (20.989 – 21.002)	0.8281 (21.035)
Piston pin outer diameter 		0.8264 – 0.8268 (20.991 – 21.000)	0.8251 (20.960)
Clearance between piston and cylinder at skirt area 		0.0005 – 0.0020 (0.012 – 0.051)	0.0098 (0.25)

ITEM		STANDARD inches (mm)	MAXIMUM inches (mm)	
Piston <i>(continued)</i>		Top 2nd	0.0079 – 0.0157 (0.2 – 0.4)	0.0591 (1.5)
	Oil Ring	0.0079 – 0.0276 (0.2 – 0.7)	0.0591 (1.5)	
Connecting Rod				
Large end inner diameter		1.5354 – 1.5361 (39.000 – 39.016)	1.5394 (39.100)	
Clearance between crankpin and inner diameter		0.0012 – 0.0024 (0.030 – 0.060)	0.0079 (0.2)	
Small end inner diameter		0.8272 – 0.8277 (21.010 – 21.023)	0.8299 (21.080)	
Clearance between piston pin and inner diameter		0.0004 – 0.0013 (0.010 – 0.032)	0.0047 (0.12)	
Large end side clearance		0.0039 – 0.0157 (0.1 – 0.4)	0.0394 (1.0)	

ITEM		STANDARD inches (mm)	MAXIMUM inches (mm)
<b>Crankshaft</b>			
Crankpin outer diameter		1.5337 – 1.5343 (38.956 – 38.970)	1.5315 (38.90)
Journal diameter		D1: 1.77102 – 1.77165 (44.984 – 45.000) D2: 1.77110 – 1.77154 (44.986 – 44.997)	_____
End Play		0.005 – 0.012 (0.127 – 0.305)	
<b>Camshaft</b>			
Cam height (internal and external)		1.4213 – 1.4291 (36.1 – 36.3)	1.4154 (35.95)
Journal outer diameter "D"		0.7861 – 0.7866 (19.967 – 19.980)	0.7854 (19.950)
<b>Valve</b>			
Valve stem outer diameter		Intake 0.2350 – 0.2356 (5.970 – 5.985)	0.2303 (5.85)
		Exhaust 0.2346 – 0.2352 (5.960 – 5.975)	0.2303 (5.85)
Clearance between valve stem and valve stem guide		Intake 0.0022 – 0.0033 (0.050 – 0.083)	0.0118 (0.30)
		Exhaust 0.0024 – 0.0037 (0.060 – 0.093)	0.0118 (0.30)

ITEM		STANDARD inches (mm)	MAXIMUM inches (mm)
<b>Valve</b> <i>(continued)</i>  Valve clearance	  Intake/ Exhaust Measured Cold	0.0034 – 0.0045 (0.085 – 0.115)	
<b>Valve spring</b>  Free length		1.5551 (39.5)	—
<b>Tappet</b>  Outer stem diameter		0.03528 – 0.3533 (8.960 – 8.975)	0.3516 (8.93)
Inner guide diameter		0.3543 – 0.3549 (9.00 – 9.015)	0.3575 (9.08)
Tappet guide clearance		0.0010 – 0.0022 0.025 – 0.055)	0.0059 (0.15)
<b>Valve seat angle</b>  Cut angle (a) Contact width (b)		a: 90° b: 0.028 – 0.039 (0.7 – 1.0)	0.079 (2.0)

# 10. Hydraulic Pump

The optional hydraulic pump, when provided, is mounted atop the engine (Figure 10-1). See Section 13. *Specifications* regarding hose fittings, fluid specifications and inlet conditions.

## INSTALLING THE HYDRAULIC PUMP

When installing the pump, apply molybdenum disulfide paste or equivalent to the shaft spline and torque the two flange screws to 20 lb-ft (26 N-m). Do not start the genset before the hydraulic pump has been connected to the hydraulic system and filled with oil.

**⚠ CAUTION** *Running the genset without oil in the hydraulic pump will destroy the pump.*

**⚠ CAUTION** *The slightest amount of dirt in an hydraulic system can damage precisely machined internal components. Keep dirt out:*

- *Thoroughly clean the outside of a fitting or cap before disconnecting or removing it.*
- *Keep all openings in components and hoses capped with proper JIC caps until just before making connections.*
- *Thoroughly flush hoses before connecting.*
- *Regularly replace the oil filter.*
- *Never reuse hydraulic fluid that has been drained from a system.*

## CONNECTING HYDRAULIC HOSES

**⚠ WARNING** *The high pressure spray from a leak or fitting in a hydraulic line can penetrate the skin, leading to possible blood poisoning — Wear safety glasses — Shut down the genset before loosening or tightening fittings — Do not delay getting proper medical attention if exposed to high pressure oil spray.*

When connecting hoses and starting up the system:

1. Consider that hoses shrink slightly in length and expand slightly in diameter under pressure.
2. There must be enough slack in the connected hoses to prevent strain due to movement of the pump.

3. Support, restrain and protect hydraulic hose as necessary to prevent chaffing.
4. Do not bend hose tighter than the hose manufacturer recommends.
5. Use wide-sweep 90-degree fittings.
6. Always use two wrenches when tightening hydraulic fittings.
7. Install an SAE Class 4 filter (10 micron) in the system.
8. The system oil reservoir should be above the pump and the hose from the pump should slope up to the reservoir.
9. To fill the pump, first fill the reservoir and crank the engine with the spark plug cables disconnected from the spark plugs to prevent the engine from starting. Replenish oil in the reservoir as necessary.
10. The installed system must not cause pump inlet conditions to exceed *Specifications*.

**⚠ CAUTION** *Continuing to run or load a noisy pump can destroy it. Purge the air before continuing.*

11. The hydraulic system has air in it as long as there continues to be sharp metallic noise. Run the genset for a few seconds at a time until all air has been purged.

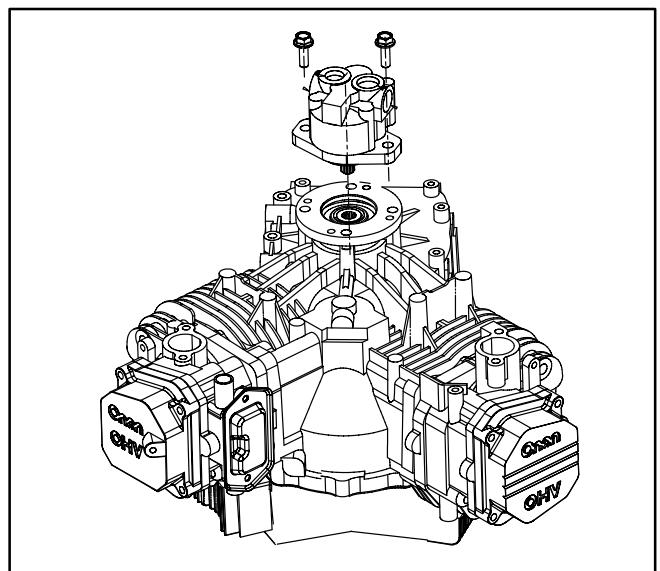


FIGURE 10-1. HYDRAULIC PUMP



# 11. Troubleshooting

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

The Fault Codes are listed in numerical order along with step-by-step corrective actions. Refer to the appropriate wiring diagram and harness drawings beginning on Page A-1.

First note the following:

- Maintaining engine oil level, keeping battery connections clean and tight, watching the fuel gauge, not overloading the genset, etc. will prevent most shutdowns.
- When the genset and vehicle engine share a common fuel tank the fuel dip tubes are usually arranged so that the genset will run out of fuel first. Marking the genset empty point on the fuel gauge will make it easier to tell when to stop the genset before running it out of fuel.

## FAULT CODES

The genset controller provides extensive diagnostics by causing the status indicator light on the Control Switch to blink in coded fashion. Following a fault shutdown, the indicator light will repeatedly blink 2, 3 or 4 blinks at a time.

- **Two blinks** indicates a low oil pressure fault.
- **Three blinks** indicates a service fault. Press **Stop** once to cause the two-digit, second-level fault code to blink. (Pressing **Stop** again will stop the blinking.) The two-digit code consists of 1, 2, 3, 4 or 5 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the fault code number. For example, **Fault Code No. 36** appears as:

blink-blink-blink—*pause*—blink-blink-blink-blink-blink-blink—  
*long pause*—repeat

- **Four blinks** indicates that cranking exceeded 30 seconds without the engine starting.
- **Note: Fault Code Nos. 3 and 4 are first level faults. Avoid interpreting them as second-level Fault Code Nos. 33 and 44, which have purposely not been assigned as fault codes.**

**Restoring Fault Code Blinking** – The fault code stops blinking after five minutes (15 minutes, Series HGJAA & HGJAD). Press **Stop** three times within five seconds to restore blinking. ***Note that the last fault logged will blink even after the condition that caused the shutdown has been corrected.***

## GENSET STARTS OR STOPS WITHOUT COMMAND – NO FAULT CODE

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** To start or stop – control receives ground at start or stop input on control, DC voltage drops below 9V and controller de-energizes (shuts down in sleep mode)

**Possible Cause:** Low battery voltage, shorted harness connection, faulty start/stop switch, Auto Gen Start (AGS) is enabled

### Diagnosis and Repair:

1. Check last fault and record.
2. Measure battery voltage at battery and genset.
3. Inspect battery connections and cables for cleanliness, tightness and damage: clean, tighten and repair connections and cables as necessary.
4. Check electrolyte level and hydrometer reading in maintenance type batteries: replace electrolyte and recharge or replace battery as necessary.
5. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
6. Reconnect P1 connector and test run genset for symptom: repair or replace pins in connector as necessary.
7. Measure battery voltage at genset while attempting to start from local or remote switch: recharge or replace battery if voltage drops below 9 VDC, test and service genset battery charger if so equipped, increase battery cable size or run parallel cables.
8. Measure battery voltage and check for charger increase while genset is running.
9. Measure for continuity change across start/stop switch between neutral and start position and neutral and stop position at switches and at connector P1: reconnect or repair connections, replace switches as necessary.
10. Measure for continuity from start and stop inputs to ground at switches and at connector P1: Repair or replace damaged harness.
11. Determine if AGS is installed and enabled (AGS will command start and stop based on its own settings): disable AGS or explain AGS function to customer (see PSB-666).

## NO RESPONSE – STATUS INDICATOR LIGHT DEAD

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** To start – control receives ground via start/stop switch to start or stop input on control

**Possible Cause:** Low/No battery voltage, poor battery connection, faulty battery, open harness connection, faulty start/stop switch, faulty LED

### Diagnosis and Repair:

1. Measure battery voltage at battery, at genset and at connector P1: reconnect, clean, repair and replace connections as necessary.
2. Measure battery voltage at genset while attempting to start or prime from local or remote switch: recharge or replace battery if voltage drops below 9 VDC, test and service genset battery charger if so equipped, increase battery cable size or run parallel cables.
3. Measure for continuity change across start/stop switch between neutral and start position and neutral and stop position at switches and at connector P1: reconnect or repair connections, replace switches as necessary.
4. Test switches LED by energizing with 12 VDC: replace switches as necessary.
5. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
6. Reconnect P1 connector and test run genset for start and prime operation: replace control as necessary.

## STARTING BATTERIES RUN DOWN

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Low/No battery voltage

**Possible Cause:** Battery connections, battery, charging system, excessive cranking, excessive priming

### Diagnosis and Repair:

1. Measure battery voltage at battery and genset.
2. Inspect battery connections and cables for cleanliness, tightness and damage: clean, tighten and repair connections and cables as necessary.
3. Check electrolyte level and hydrometer reading in maintenance type batteries: replace electrolyte and recharge or replace battery as necessary.
4. Verify battery charger is on and check operation.
5. Measure battery voltage and check for charging increase while genset is running.
6. Check last fault and record: troubleshoot as necessary.
7. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
8. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
9. Measure for continuity change across start/stop switch between neutral and stop position at switches and P1 connector: replace switches as necessary or disconnect external stop device if so equipped.
10. Measure for voltage at fuel pump while genset is not running or being primed: replace control as necessary.

## STARTER ENGAGES – DISENGAGES

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Cranking voltage dips below 6 VDC: microprocessor aborts start attempt

**Possible Cause:** Battery connections, battery, charging system, start/stop switches, engine compression

### Diagnosis and Repair:

1. Measure battery voltage at battery and genset.
2. Inspect battery connections and cables for cleanliness, tightness and damage: clean, tighten and repair connections and cables as necessary.
3. Check electrolyte level and hydrometer reading in maintenance type batteries: replace electrolyte and recharge or replace battery as necessary.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Measure battery voltage at genset while attempting to start from local or remote switch: recharge or replace battery if voltage drops below 9 VDC, test and service genset battery charger if so equipped, increase battery cable size or run parallel cables.
7. Measure battery voltage and check for charger increase while genset is running.

## NO AC POWER – GENSET RUNNING, STATUS LED ON STEADY OR FLASHING RAPIDLY

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Genset control in normal or Engine Run Only mode

**Possible Cause:** Circuit breakers, Engine Run Only mode due to faulty generator

### Diagnosis and Repair:

1. Status light on – Measure AC output at genset circuit breaker: reset or turn on genset circuit breaker, diagnose faulty loads as necessary
2. **HGJAD, E, F Models** – (Rapid flashing status light – Engine Run Only mode)
  - A. Remove connector P1 from control and re-install and try to start genset: inspect, repair or replace P1 connector pins as necessary.
  - B. While running in Engine Run Only mode externally excite field with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
  - C. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - D. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - E. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - F. Check brush alignment per PSB-682a.

## GENSET CRANKS BUT DOES NOT START – NO FAULT CODE

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Fault codes are based on time lapse between events

**Possible Cause:** Not holding start switch long enough to cause fault

### Diagnosis and Repair:

1. Check and record last fault code.
2. Crank genset and hold switch until control stops cranking and displays fault code (approximately 30 seconds): troubleshoot fault code and reference last fault code recorded above if necessary.

## GENSET RUNS BUT STOPS WHEN SWITCH IS RELEASED – NO FAULT CODE

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Fault codes are based on time lapse between events

**Possible Cause:** Not holding start switch long enough to cause fault

### Diagnosis and Repair:

1. Check and record last fault code.
2. Start genset and hold switch until control shuts down and displays fault code (approximately 30 seconds): troubleshoot fault code and reference last fault code recorded above if necessary.

## LOW OIL PRESSURE FAULT – FAULT CODE 2

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Continuous ground at control for oil pressure input

**Possible Cause:** Low/high oil level, faulty switch, faulty oil pressure relief valve, fault oil pump

### Diagnosis and Repair:

1. Verify that Last Fault is FC 2: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure oil level: add or drain oil as necessary.
3. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
4. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
5. Measure continuity change across start/stop switch between rest and under simulated pressure: replace switch as necessary.
6. **HGJAB, C** – Measure continuity between ground and P1-13: repair or replace harness as necessary.  
**HGJAA, D, E, F** – Measure continuity between ground and P1-6: repair or replace harness as necessary.
7. Measure oil pressure with mechanical gauge: repair or replace relief valve and oil pump as necessary.

## SERVICE CHECK FAULT – FAULT CODE 3

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Single-Digit Fault to indicate shutdown due to a Two-Digit Fault

**Possible Cause:** Any Two-Digit Fault Code

### Diagnosis and Repair:

1. Verify that Last Fault is FC 3: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. While LED is flashing three times press stop once (1 second duration): trouble shoot Two-Digit Fault Code.

## OVERCRANK – FAULT CODE 4

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Controller unable to sense genset frequency after 30 seconds of holding start switch

**Possible Cause:** Faulty switch, faulty external start command, fuel supply, air fuel mixture, exhaust system, wire connections, starter, ignition system

### Diagnosis and Repair:

1. Verify that Last Fault is FC 4: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure for continuity change across start/stop switch between neutral and start position at switches and P1 connector: replace switches as necessary or disconnect external start device if so equipped.
3. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
4. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
5. Verify engine rotation manually: repair engine damage as necessary.
6. Measure DC voltage at starter during start attempt: repair wire connections, replace start solenoid and starter as necessary.
7. Check air filter cleanliness; replace air filter as necessary.
8. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
9. **All Gasoline Models**
  - A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
  - B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
  - C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.

**10. All Gasoline Carburetor Models**

- A. Verify carburetor altitude setting: readjust as necessary.
- B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
- C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
- D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

**11. All Gasoline EFI Models**

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

**12. Propane Models**

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
13. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
14. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
15. Measure DC voltage from ignition kill lead greater than 1 VDC: repair or replace leads, pins or magnetos as necessary.
16. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
17. Test Magnetos:
- A. Disconnect Connector P1.
  - B. Connect positive(+) meter lead to chassis ground.
  - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
  - D. **HGJAB, C** – Measure continuity to negative lead at pin P1-15 and P1-20: replace magnetos as necessary.
18. Measure spark plug gap: set gap or replace spark plugs as necessary.
19. Verify ignition spark condition.
20. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
21. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
22. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
23. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
24. Check brush alignment per PSB-682a.
25. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## OVERVOLTAGE – FAULT CODE 12

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Instantaneous Fault – AC voltage S1–S2 greater than 150 VAC

Delayed Fault – AC voltage S1–S2 greater than 138 VAC, but less than 150 VAC for 3 continuous minutes

**Possible Causes:** Genset loads, Inverter/Charger, wire connections, AC sense transformer, windings

### Diagnosis & Repair:

1. Verify that Last Fault is FC 12: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure AC voltage.
3. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
4. Cycle loads to determine if a particular load causes fault: diagnose faulty load as necessary.
5. Determine Inverter/Charger battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
6. Verify balanced loads in 120/240 VAC applications: balance loads within 10 percent line-to-line as required.
7. **HGJAD only** – Run genset in Engine Run Only mode and externally excite field F1–F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
8. **Non EFI** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420–0603 and Instruction Sheet R1098.
9. Remove connector P1 from control and re-install and try to start genset: inspect, repair or replace P1 connector pins as necessary.
10. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
11. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
12. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
13. Check brush alignment per PSB-682a.
14. Dealers contact Distributor for technical support, Distributors contact factory for technical support.



## UNDERVOLTAGE – FAULT CODE 13

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** AC voltage S1–S2 less than 108 VAC for 5 continuous seconds

**Possible Causes:** Genset loads, Inverter/Charger, wire connections, generator drive system, windings, AC sense transformer, windings

### Diagnosis & Repair:

1. Verify that Last Fault is FC 13: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure AC voltage.
3. Measure AC voltage in and out of sense transformer (if so equipped): repair wire connection, replace sense transformer as necessary.
4. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
5. Cycle loads to determine if a particular load will cause fault: diagnose faulty load as necessary.
6. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
7. Verify balanced loads in 120/240 VAC applications: balance loads within 10 percent line-to-line as required.
8. **HGJAD only** – Run genset in Engine Run Only mode and externally excite field F1–F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
9. **Non EFI** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420–0603 and Instruction Sheet R1098.
10. Remove connector P1 from control and re-install and try to start genset: inspect, repair or replace P1 connector pins as necessary.
11. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
12. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
13. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
14. Check brush alignment per PSB-682a.
15. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## OVERFREQUENCY – FAULT CODE 14

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Instantaneous Fault – Frequency greater than 70Hz

Delayed Fault – Frequency greater than 66Hz, but less than 70Hz, for 3 continuous seconds

**Possible Causes:** Genset loads, Inverter/Charger, engine governor function, fuel supply, air fuel mixture, exhaust system, choke, demand regulator, carburetor, generator drive system, generator windings, ignition, wire connections

### Diagnosis & Repair:

1. Verify that Last Fault is FC 14: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure AC current while running genset with vehicle loads: identify faulty or short cycling loads.
3. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
4. Measure genset load capability with shop load bank (derate for altitude and temperature as necessary).
5. Measure genset frequency and droop while running.
6. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
7. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
8. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
9. Check all grounds and neutral leads for looseness at battery, genset, inverter/converter; run genset on separate battery: tighten or replace terminals and leads as necessary.
10. Check air filter cleanliness; replace air filter as necessary.
11. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
12. Verify P1-29 (HGJAD, E, F Models; unused Hz select option prior to 2004) is not grounded: remove lead termination, tape and isolate.
13. **HGJAD only** – Run genset in Engine Run Only and externally excite field F1-F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
14. **Non EFI** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420-0603 and Instruction Sheet R1098.
15. **All Gasoline Models**
  - A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
  - B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
  - C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.

**16. All Gasoline Carburetor Models**

- A. Verify carburetor altitude setting: readjust as necessary.
- B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
- C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
- D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

**17. All Gasoline EFI Models**

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

**18. Propane Models**

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
19. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
20. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
21. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
22. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
23. Check brush alignment per PSB-682a.
24. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
25. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
26. Test Magnetos:
- A. Disconnect Connector P1.
  - B. Connect positive(+) meter lead to chassis ground.
  - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
  - D. **HGJAB, C** – Measure continuity to negative lead at pin P1-15 and P1-20: replace magnetos as necessary.
27. Measure spark plug gap: set gap or replace spark plugs as necessary.
28. Verify ignition spark condition.
29. Inspect spark plug cables, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
30. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.
31. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## UNDERFREQUENCY – FAULT CODE 15

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Carburetor Models – Frequency less than 54Hz for 30 continuous seconds

EFI Models – Frequency less than 54Hz for 8 continuous seconds

**Possible causes:** Genset loads, Inverter/Charger, engine governor function, fuel supply, air fuel mixture, exhaust system, choke, demand regulator, carburetor, generator drive system, generator windings, ignition, wire connections

### Diagnosis & Repair:

1. Verify that Last Fault is FC 15: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure AC current while running genset with vehicle loads: identify faulty or short cycling loads.
3. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
4. Measure genset load capability with shop load bank (derate for altitude and temperature as necessary).
5. Measure genset frequency and droop while running.
6. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
7. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
8. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
9. Check air filter cleanliness; replace air filter as necessary.
10. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
11. **HGJAD only** – Run genset in Engine Run Only and externally excite field with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
12. **Non EFI only** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420-0603 and Instruction Sheet R1098.
13. **All Gasoline Models**
  - A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
  - B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
  - C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.
14. **All Gasoline Carburetor Models**
  - A. Verify carburetor altitude setting: readjust as necessary.
  - B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
  - C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
  - D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

## 15. All Gasoline EFI Models

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

## 16. Propane Models

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
- 17. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
  - 18. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 19. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 20. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 21. Check brush alignment per PSB-682a.
  - 22. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
  - 23. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
  - 24. Test Magnetos:
    - A. Disconnect Connector P1.
    - B. Connect positive(+) meter lead to chassis ground.
    - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
    - D. **HGJAB, C** – Measure continuity to negative lead at pin P1-15 and P1-20: replace magnetos as necessary.
  - 25. Measure spark plug gap: set gap or replace spark plugs as necessary.
  - 26. Verify ignition spark condition.
  - 27. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
  - 28. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.
  - 29. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## FUEL PUMP FAULT – FAULT CODE 17

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Only Active Prior to 2001 – Open fuel pump circuit at control

**Possible Causes:** Wire connections, harness leads, faulty fuel pump

### Diagnosis & Repair:

1. Verify that Last Fault is FC 17: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Verify fuel pump operation in prime mode, if pump operates fault condition has been cleared verify harness connections, no further troubleshooting.
3. **HGJAA, D** Check continuity across fuse F1.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector, prime genset to verify pump operation and test run genset for fault occurrence.
6. Measure continuity between E2 fuel pump leads; replace terminals or fuel pump as necessary.
7. Measure voltage between fuel pump E2 + and ground while priming; replace terminals, harness leads or control as necessary.

## GOVERNOR ACTUATOR (EFI ONLY) – FAULT CODE 19

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Shorted or open connection between governor leads after pressing start

**Possible causes:** Wire connections, P1-17, governor actuator

### Diagnosis & Repair:

1. Verify that Last Fault is FC 19: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
3. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
4. P1-17 open to ground on EFI Models: ground lead as required for carburetor configuration.
5. Verify actuator function by applying DC voltage to terminals: replace actuator as necessary.
6. Measure resistance between actuator terminals; repair or replace connections as necessary, replace governor actuator.
7. Measure continuity between P1-28 and actuator lead; repair or replace terminals and leads as necessary.
8. Measure DC voltage at actuator while starting: replace controller as necessary.

## GOVERNOR ACTUATOR OVERLOAD (EFI ONLY) – FAULT CODE 22

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Only active Prior to 2001 – Maximum governor output (PWM) for 10 continuous seconds

**Possible causes:** Genset loads, Inverter/Charger, wire connections, fuel supply, air fuel mixture, exhaust system, governor actuator, ignition system

### Diagnosis & Repair:

1. Verify that Last Fault is FC 22: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure AC current while running genset with vehicle loads: identify faulty or short cycling loads or reduce vehicle loads as necessary.
3. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
4. Measure genset load capability with shop load bank (derate for altitude and temperature as necessary).
5. Measure AC frequency and droop while running.
6. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
7. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
8. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
9. Check air filter cleanliness; replace air filter as necessary.
10. Check intake manifold and gaskets for air leaks: tighten fasteners and replace gaskets and manifold as necessary.
11. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
12. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.
13. Verify actuator function by applying DC voltage to terminals: replace actuator as necessary.
14. Check throttle body for binding; inspect spring for dirt and debris: clean spring, replace throttle body as necessary.
15. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
16. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
17. Test Magnetos:
  - A. Disconnect Connector P1.
  - B. Connect positive(+) meter lead to chassis ground.
  - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
  - D. **HGJAB, C** – Measure continuity to negative lead at pin P1-15 and P1-20: replace magnetos as necessary.
18. Measure spark plug gap: set gap or replace spark plugs as necessary.
19. Verify ignition spark condition.
20. Inspect spark plug cables, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
21. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## OIL PRESSURE SWITCH FAULT – FAULT CODE 23

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Only Active Prior to 2001 – Continuous open on oil pressure switch input before cranking

**Possible Causes:** Wire connections, faulty switch

### Diagnosis & Repair:

1. Verify that Last Fault is FC 23: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Verify harness lead is connected to switch: repair or replace terminal as necessary.
3. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per: insert, repair or replace pins as necessary.
4. Reconnect P1 connector and test run genset for fault occurrence.
5. Measure continuity to ground at switch and through harness at P1 connector: replace switch, repair or replace harness as necessary.

## VOLTAGE SENSE LOST – FAULT CODE 27

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** No Sense Voltage (0 VAC across S1–S2) for 1 continuous second after start disconnect

**Possible Causes:** Genset loads, Inverter/Charger, VAC sense transformer, engine governor function, fuel supply, choke, demand regulator, carburetor, generator windings, ignition, wire connections, temperature

### Diagnosis & Repair:

1. Verify that Last Fault is FC 27: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure AC voltage.
3. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Check air filter cleanliness; replace air filter as necessary.
7. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
8. **HGJAD only** – Run genset in Engine Run Only and externally excite field with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
9. **Non EFI only** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420–0603 and Instruction Sheet R1098.



#### **10. All Gasoline Models**

- A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
- B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
- C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.

#### **11. All Gasoline Carburetor Models**

- A. Verify carburetor altitude setting: readjust as necessary.
- B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
- C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
- D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

#### **12. All Gasoline EFI Models**

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

#### **13. Propane Models**

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
- 14. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
  - 15. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 16. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 17. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 18. Check brush alignment.
  - 19. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
  - 20. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.

21. Test Magnetos:

- A. Disconnect Connector P1.
- B. Connect positive(+) meter lead to chassis ground.
- C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1–4 and P1–5: replace magnetos as necessary.
- D. **HGJAB, C** – Measure continuity to negative lead at pin P1–15 and P1–20: replace magnetos as necessary.

22. Measure spark plug gap: set gap or replace spark plugs as necessary.

23. Verify ignition spark condition.

24. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.

25. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.

26. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## HIGH BATTERY VOLTAGE – FAULT CODE 29

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** DC voltage to controller greater than 19 VDC when pressing start or stop

**Possible Causes:** Incorrect battery configuration, wire damage, faulty charger, control

### Diagnosis & Repair:

- 1. Verify that Last Fault is FC 29: Yes, continue diagnosis; No, troubleshoot actual last fault.
- 2. Measure DC voltage at battery, genset and connector P1: reconnect battery or repair wiring as necessary.
- 3. Measure DC voltage with battery charger on: reduce boost charge rate or diagnose faulty charger as necessary.
- 4. If genset shares batteries with propulsion engine, check for fault using shop battery (voltage spike may cause fault): diagnose fault or voltage spikes from propulsion engine charging system.
- 5. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
- 6. Reconnect P1 connector and test run genset for fault occurrence: replace controller.

## OVERSPEED FAULT (HGJAD, E, F MODELS ONLY) – FAULT CODE 31

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** 5kW Engine Run Only mode –Engine RPM via ignition pulse greater than 2880rpm

7kW Engine Run Only mode –Engine RPM via ignition pulse greater than 3360rpm

**Possible Causes:** Engine governor function, fuel supply, air fuel mixture, exhaust system, choke, demand regulator, carburetor, generator drive system, ignition, wire connections

### Diagnosis & Repair:

1. Verify that Last Fault is FC 31: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure genset frequency and droop while running.
3. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Check air filter cleanliness; replace air filter as necessary.
7. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
8. **HGJAD only** – Run genset in Engine Run Only and externally excite field F1–F2 with 12 VDC or 24 VDC and measure AC frequency.
9. **Non EFI** – If the genset will not stay running measure AC frequency using Break-Out Tool 420–0603 and Instruction Sheet R1098.
10. **All Gasoline Models**
  - A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
  - B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
  - C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.
11. **All Gasoline Carburetor Models**
  - A. Verify carburetor altitude setting: readjust as necessary.
  - B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
  - C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
  - D. Inspect carburetor butterfly for binding: replace carburetor as necessary.
12. **All Gasoline EFI Models**
  - A. Inspect throttle body for binding or damage: replace as necessary.
  - B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

### 13. Propane Models

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
- 14. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
  - 15. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
  - 16. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
  - 17. Test Magnetos
    - A. Disconnect Connector P1.
    - B. Connect positive(+) meter lead to chassis ground.
    - C. Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
  - 18. Measure spark plug gap: set gap or replace spark plugs as necessary.
  - 19. Verify ignition spark condition.
  - 20. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
  - 21. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.
  - 22. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## LOW CRANKING SPEED SENSE – FAULT CODE 32

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

### Logic:

Prior to 2003 – quadrature frequency less than 1.7Hz for 2 continuous seconds after pressing start.

After 2003 – quadrature frequency less than 1.7Hz for 12 continuous seconds after pressing start

Model HGJAD – quadrature frequency less than 1.7Hz & Engine RPM 0 for 12 continuous seconds after pressing start

**Possible Causes:** Cylinder at TDC, fuel supply, air fuel mixture, exhaust system, starter, choke, demand regulator, carburetor, generator drive system, generator windings, ignition, wire connections

### Diagnosis & Repair:

1. Verify that Last Fault is FC 32: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure battery voltage at battery and genset: recharge or replace battery as necessary.
3. Verify engine rotation manually: repair engine damage as necessary.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Measure DC voltage at starter during start attempt: repair wire connections, replace start solenoid and starter as necessary.
7. Check air filter cleanliness; replace air filter as necessary.
8. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
9. **HGJAD only** – Run genset in Engine Run Only and externally excite field F1–F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
10. **Non EFI** – Verify genset operation and outputs with Break-Out Tool 420-0603 and Instruction Sheet R1098.
11. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
12. **All Gasoline Models**
  - A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
  - B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
  - C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.
13. **All Gasoline Carburetor Models**
  - A. Verify carburetor altitude setting: readjust as necessary.
  - B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
  - C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
  - D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

#### 14. All Gasoline EFI Models

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

#### 15. Propane Models

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
16. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
17. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
18. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
19. Test Magnetos
- A. Disconnect Connector P1.
  - B. Connect positive(+) meter lead to chassis ground.
  - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
  - D. **HGJAB, C** – Measure continuity to negative lead at pin P1-15 and P1-20: replace magnetos as necessary.
20. Measure spark plug gap: set gap or replace spark plugs as necessary.
21. Verify ignition spark condition.
22. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
23. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.
24. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

### FAULT CODE 33 – FAULT CODE 33

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Single-Digit Fault to indicate shutdown due to Two-Digit Fault Code

**Possible Cause:** Fault Code 3 interpreted as a non-assigned Fault Code 33

#### Diagnosis & Repair:

- 1. Verify that Last Fault is FC 3 Yes, continue diagnosis; No, troubleshoot actual last fault.
- 2. While LED is flashing three times press stop once (1 second duration): trouble shoot Two-Digit Fault Code.

## CONTROL CARD FAILURE – FAULT CODE 35

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** EEPROM (programming variables) error during self test

**Possible Causes:** Faulty program

### Diagnosis & Solution:

1. Verify that Last Fault is FC 35: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Replace control.

## GENSET STOPPED WITHOUT FAULT CONDITION – FAULT CODE 36

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** RPM less than 500 and Sense Voltage S1–S2 at 0 VAC when no other fault condition occurred

**Possible Causes:** Auto Gen Start (AGS), fuel supply, air fuel mixture, exhaust system, loads, Inverter/Charger, choke, demand regulator, carburetor, generator drive system, generator windings, ignition, wire connections

### Diagnosis & Repair:

1. Verify that Last Fault is FC 36: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Verify whether AGS stopped genset: Yes, disable AGS or explain AGS function to customer (see PSB-666); No, continue diagnosis.
3. Verify engine rotation manually: repair engine damage as necessary.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Check air filter cleanliness; replace air filter as necessary.
7. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
8. Measure AC current while running genset with vehicle loads: identify faulty or short cycling loads.
9. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
10. Measure genset load capability with shop load bank.
11. **HGJAD only** – Run genset in Engine Run Only and externally excite field F1–F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
12. **Non EFI** – Verify genset operation and outputs with Break-Out Tool 420-0603 and Instruction Sheet R1098.
13. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.

**14. All Gasoline Models**

- A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
- B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
- C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.

**15. All Gasoline Carburetor Models**

- A. Verify carburetor altitude setting: readjust as necessary.
- B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
- C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
- D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

**16. All Gasoline EFI Models**

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

**17. Propane Models**

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
- B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
- C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
- D. Verify clear vent hose.
- E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
- F. Check genset fuel lines for damage: replace fuel line as required.
- G. Measure regulator lock off pressure.

18. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.

19. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.

20. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.

**21. Test Magnetos**

- A. Disconnect Connector P1.
- B. Connect positive(+) meter lead to chassis ground.
- C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
- D. **HGJAB, C** – Measure continuity to negative lead at pin P1-15 and P1-20: replace magnetos as necessary.

22. Measure spark plug gap: set gap or replace spark plugs as necessary.

23. Verify ignition spark condition.

24. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.

25. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.

26. Dealers contact Distributor for technical support, Distributors contact factory for technical support.



## INVALID SET CONFIGURATION – FAULT CODE 37

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Configuration is determined by ratio of quadrature frequency / ignition speed

**Possible Causes:** Wire connections, windings, ignition system, drive belt slippage, generator drive system

### Diagnosis & Repair:

1. Verify that Last Fault is FC 37: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Alternating FC 37 and FC 47: Magneto gap to wide: reset magneto gap, retest.
3. **HGJAD only** – Run genset in Engine Run Only and externally excite field with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
4. **Non EFI only** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420–0603 and Instruction Sheet R1098.
5. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
6. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
7. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
8. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
9. Check brush alignment per PSB-682a.
10. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
11. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
12. Test Magnetos
  - A. Disconnect Connector P1.
  - B. Connect positive(+) meter lead to chassis ground.
  - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1–4 and P1–5: replace magnetos as necessary.
  - D. **HGJAB, C** – Measure continuity to negative lead at pin P1–15 and P1–20: replace magnetos as necessary.
13. Measure spark plug gap: set gap or replace spark plugs as necessary.
14. Verify ignition spark condition.
15. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
16. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## FIELD OVERLOAD (OVERVOLTAGE) – FAULT CODE 38

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Field voltage (F1–F1) greater than 150 VDC for 10 continuous seconds

**Possible Causes:** Loads, Inverter/Charger, windings, fuel supply, governor system

### Diagnosis & Repair:

1. Verify that Last Fault is FC 38: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure F1–F2 DC voltage.
3. Measure AC current while running genset with vehicle loads: identify faulty or short cycling loads.
4. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
5. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
6. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
7. Measure genset load capability with shop load bank (derate for altitude and temperature as necessary).
8. Measure genset frequency and droop while running.
9. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
10. Check air filter cleanliness; replace air filter as necessary.
11. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
12. **All Gasoline Models**
  - A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
  - B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
  - C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.
13. **All Gasoline Carburetor Models**
  - A. Verify carburetor altitude setting: readjust as necessary.
  - B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
  - C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
  - D. Inspect carburetor butterfly for binding: replace carburetor as necessary.
14. **All Gasoline EFI Models**
  - A. Inspect throttle body for binding or damage: replace as necessary.
  - B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

## 15. Propane Models

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
- 16. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
  - 17. **HGJAD only** – Run genset in Engine Run Only and externally excite field F1–F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
  - 18. **Non EFI** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420–0603 and Instruction Sheet R1098.
  - 19. Remove connector P1 from control and re-install and try to start genset: inspect, repair or replace P1 connector pins as necessary.
  - 20. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 21. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 22. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  - 23. Check brush alignment per PSB-682a.
  - 24. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.
  - 25. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## GENERATOR ROTOR FAULT – FAULT CODE 41

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Only Active After 2003 – Field Voltage F1–F2 at 0 VDC and Sense Voltage S1–S2 at 0 VAC for 1 continuous second

**Possible Causes:** Loads, windings, fuel supply

### Diagnosis & Repair:

1. Verify that Last Fault is FC 41: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure F1–F2 DC voltage.
3. Measure AC current while running genset with vehicle loads: identify faulty or short cycling loads.
4. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
5. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
6. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
7. Measure genset load capability with shop load bank (derate for altitude and temperature as necessary).

#### 8. All Gasoline Models

- A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
- B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
- C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.

#### 9. All Gasoline Carburetor Models

- A. Verify carburetor altitude setting: readjust as necessary.
- B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
- C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
- D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

#### 10. All Gasoline EFI Models

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

#### 11. Propane Models

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
- B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD–5 grade Propane.
- C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
- D. Verify clear vent hose.

- E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
12. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
  13. **HGJAD only** – Run genset in Engine Run Only and externally excite field F1–F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output
  14. **Non EFI** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420–0603 and Instruction Sheet R1098.
  15. Remove connector P1 from control and re-install and try to start genset: inspect, repair or replace P1 connector pins as necessary.
  16. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  17. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  18. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
  19. Check brush alignment per PSB-682a.
  20. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.
  21. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## PROCESSOR FAULT – FAULT CODE 42

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** ROM (programming variables) error during self test

**Possible Causes:** Faulty program

### Diagnosis & Solution:

1. Verify that Last Fault is FC 42: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Replace control.

## PROCESSOR FAULT – FAULT CODE 43

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** RAM (programming variables) error during self test

**Possible Causes:** Faulty program

### Diagnosis & Solution:

1. Verify that Last Fault is FC 43: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Replace control.

## SPEED SENSE FAULT – FAULT CODE 45

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** While running quadrature frequency dropped to 0Hz for 1 continuous second

**Possible Causes:** Auto Gen Start (AGS), fuel supply, air fuel mixture, exhaust system, loads, Inverter/Charger, choke, demand regulator, carburetor, generator drive system, generator windings, ignition, wire connections

### Diagnosis & Repair:

1. Verify that Last Fault is FC 45: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Verify whether AGS stopped genset: Yes, disable AGS or explain AGS function to customer (see PSB-666); No, continue diagnosis.
3. Verify engine rotation manually: repair engine damage as necessary.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Check air filter cleanliness; replace air filter as necessary.
7. Check for blocked or damaged exhaust system: repair or replace exhaust components as necessary.
8. Measure AC current while running genset with vehicle loads: identify faulty or short cycling loads.
9. Determine battery charge rate (typical default is 80 percent): if adjustable reduce to 30 percent.
10. Measure genset load capability with shop load bank (derate for altitude and temperature as necessary).
11. **HGJAD only** – Run genset in Engine Run Only and externally excite field F1–F2 with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
12. **Non EFI** – Verify genset operation and outputs with Break-Out Tool 420-0603 and Instruction Sheet R1098.
13. Measure genset frequency and droop while running.
14. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
15. **All Gasoline Models**
  - A. Vapor lock may occur in high ambient temperatures: operate in ambients at less than 120°F; verify proper installation to prevent air recirculation; correct as necessary.
  - B. Measure steady DC voltage at fuel pump while genset is cranking: repair wiring as necessary.
  - C. Try to start genset on shop fuel supply: verify tank level and fuel line condition in vehicle.

#### 16. All Gasoline Carburetor Models

- A. Verify carburetor altitude setting: readjust as necessary.
- B. Verify choke operation, setting, linkage, vacuum pull off assembly and sustain valve: readjust, repair or replace as necessary.
- C. Measure fuel pump pressure/flow: replace fuel filter or fuel pump as necessary.
- D. Inspect carburetor butterfly for binding: replace carburetor as necessary.

#### 17. All Gasoline EFI Models

- A. Inspect throttle body for binding or damage: replace as necessary.
- B. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.

#### 18. Propane Models

- A. When ambient temperatures are less than 40°F vapor-withdrawal Propane tanks should be at least half full to provide proper vaporization rate.
  - B. Propane having more than 2.5 percent Butane will not vaporize in ambients at less than 32°F; use HD-5 grade Propane.
  - C. Measure steady DC voltage at fuel solenoid while genset is running; repair wiring as necessary.
  - D. Verify clear vent hose.
  - E. Run genset on shop fuel supply; verify tank level and fuel line condition in vehicle.
  - F. Check genset fuel lines for damage: replace fuel line as required.
  - G. Measure regulator lock off pressure.
19. Check governor, actuator, linkage and spring for debris, damage and looseness: readjust and repair as necessary.
20. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
21. Test Magnetos
- A. Disconnect Connector P1.
  - B. Connect positive(+) meter lead to chassis ground.
  - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1-4 and P1-5: replace magnetos as necessary.
  - D. **HGJAB, C** – Measure continuity to negative lead at pin P1-15 and P1-20: replace magnetos as necessary.
22. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
23. Measure spark plug gap: set gap or replace spark plugs as necessary.
24. Verify ignition spark condition.
25. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
26. Measure temperature of air intake and temperature rise across genset; remove blockage or prevent air recirculation.
27. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## IGNITION FAULT – FAULT CODE 47

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

### Logic:

HGJAB, C – No ignition signal at P1–15 for 1 continuous second

HGJAA – No ignition signal at P1–5 for 1 continuous second

HGJAD, E, F prior to 2004 – No ignition signal at P1–5 for 1 continuous second

HGJAD, E, F after 2004 in Engine Run Only mode only – No ignition signal at P1–5 for continuous second

**Possible Causes:** Wire connections, windings, ignition system, generator drive system

### Diagnosis & Repair:

1. Verify that Last Fault is FC 47: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Alternating FC 47 and FC 37: Magneto gap too wide: reset magneto gap, retest.
3. Test Magnetos
  - A. Disconnect Connector P1.
  - B. Connect positive(+) meter lead to chassis ground.
  - C. **HGJAA, D, E, F** – Measure continuity to negative lead at pin P1–4 and P1–5: replace magnetos as necessary.
  - D. **HGJAB, C** – Measure continuity to negative lead at pin P1–15 and P1–20: replace magnetos as necessary.
4. **HGJAD only** – Run genset in Engine Run Only and externally excite field with 12 VDC or 24 VDC and measure main and quadrature winding AC output.
5. **Non EFI only** – If the genset will not stay running measure genset frequency, quadrature winding and main winding voltages using Break-Out Tool 420–0603 and Instruction Sheet R1098.
6. Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response: repair damaged generator drive system as necessary.
7. Measure field, quadrature and main winding resistance: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
8. Measure field, quadrature and main winding resistance to ground: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
9. Measure field, quadrature and main winding resistance to each other: clean slip rings, replace brushes, repair harness and replace rotor or stator as necessary.
10. Check brush alignment per PSB-682a.
11. Verify that spark plug cables are secure on spark plugs: reconnect or replace as necessary.
12. Inspect ignition kill leads in harness and at connector P1: repair or replace lead, terminal or pins as necessary.
13. Measure spark plug gap: set gap or replace spark plugs as necessary.
14. Verify ignition spark condition.
15. Inspect spark plug lead, kill lead terminal at magneto and measure magneto air gap: replace terminals, set gap or replace magnetos as necessary.
16. Dealers contact Distributor for technical support, Distributors contact factory for technical support.



## FIELD SENSE FAULT – FAULT CODE 48

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Controller unable to sense field voltage

**Possible Causes:** Faulty control

### **Diagnosis & Solution:**

1. Verify that Last Fault is FC 48: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Replace control.

## PROCESSOR FAILURE – FAULT CODE 51

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Processor error

**Possible Causes:** Faulty control

### **Diagnosis & Solution:**

1. Verify that Last Fault is FC 51: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Replace control.

## FUEL INJECTOR FAULT – FAULT CODE 52

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Open or shorted fuel injector

**Possible Causes:** P1–17, wire connections, fuel injector

### **Diagnosis & Solution:**

1. Verify that Last Fault is FC 52: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure P1–17 open to ground on EFI set: ground lead as required for carburetor configuration.
3. Inspect connector at injectors for looseness and damage, repair or replace connector as necessary.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Measure for continuity between P1–23 – INJ1 and P1–35 – INJ2: repair or replace harness as necessary.
7. Measure for continuity to ground from P1–23, P1–35, INJ1 and INJ2: repair or replace harness as necessary.
8. Replace injector.
9. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## MAT SENSOR FAULT – FAULT CODE 54

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** MAT sender input greater than 300K ohms

**Possible Causes:** P1–17, wire connections, MAT sender

### Diagnosis & Solution:

1. Verify that Last Fault is FC 54: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure P1–17 open to ground on EFI set: ground lead as required for carburetor configuration.
3. Inspect connector at sender for looseness and damage, repair or replace connector as necessary.
4. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
5. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
6. Measure for continuity across harness between P1–25 – MAT(A) and P1–20 – MAT(B): repair or replace harness as necessary.
7. Measure resistance of MAT: Replace sender as necessary.
8. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## MAP SENSOR FAULT – FAULT CODE 56

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** MAP sensor input less than 50kPa at start

**Possible Causes:** P1–17, ambient pressure/altitude, wire connections, MAP sender, wide open throttle (WOT) during start

### Diagnosis & Solution:

1. Verify that Last Fault is FC 56: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Measure P1–17 open to ground on EFI set: ground lead as required for carburetor configuration.
3. Verify ambient pressure greater than 50kPa: change altitude.
4. Inspect connector at sender for looseness and damage: repair or replace connector as necessary.
5. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB–676: insert, repair or replace pins as necessary.
6. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
7. Measure for continuity across harness between P1–31 – MAP(A), P1–22 – MAP(B) and P1–30 – MAP(C): repair or replace harness as necessary.
8. Measure resistance on sender between MAP(A), MAP(B) and MAP(C): replace sender as necessary.
9. Measure fuel pump pressure/flow: replace fuel filter, pressure regulator or fuel pump as necessary.
10. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

## OVERPRIME FAULT – FAULT CODE 57

**⚠WARNING** *Some genset 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 genset service. See Safety Precautions.*

**Logic:** Genset priming: 3 consecutive minutes

**Possible Causes:** Wiring harness, faulty switch, AGS

### Diagnosis & Repair:

1. Verify that Last Fault is FC 57: Yes, continue diagnosis; No, troubleshoot actual last fault.
2. Check for an object holding switch in stop position: remove object.
3. Disconnect genset control P1 connector, verify P1 pins are fully inserted and inspect pin condition per PSB-676: insert, repair or replace pins as necessary.
4. Reconnect P1 connector and test run genset for fault occurrence: repair or replace pins in connector as necessary.
5. Measure for continuity change across start/stop switch between neutral and stop position at switches and P1 connector: replace switches as necessary or disconnect external stop device if so equipped.
6. Dealers contact Distributor for technical support, Distributors contact factory for technical support.

# 12. Service Checklist

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## GENERAL

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

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

## MOUNTING

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

## 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.

## 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 genset 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 genset in service.

## 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 genset 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:** Recheck all fuel connections for tightness and then prime the fuel system by holding the control switch at **STOP/PRIME** while checking for fuel line leaks. Fix all leaks before starting the genset.

**⚠️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:** Recheck all fuel connections for tightness. Make sure proper connections have been made at the LPG container(s). A genset equipped for Low-Pressure LPG (vapor withdrawal) must not

be connected for high-pressure (liquid withdrawal), and vice versa. For Low-Pressure LPG, check and adjust LPG supply pressure to obtain 9–13 inches (228–330 mm) WC (water column) at all loads. Fix all leaks before starting the genset.

## STARTUP

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

Read the Operator's Manual and perform the maintenance and pre-start checks instructed. *Check the oil level and fill as necessary.*

**⚠ 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 genset.***

If the genset is equipped with a mechanical governor and frequency adjustments have yet to be made, make sure all frequency sensitive equipment has been disconnected. Start the genset and adjust the governor as necessary (see Section 8. *Fuel System*).

Operate the genset following all the instructions and safety precautions in the Operator's Manual. Check for fuel and exhaust leaks and unusual noises while the genset is running under full and intermediate loads. Do not place the genset in service until all fuel and exhaust leaks have been fixed and operation is satisfactory.

## OUTPUT CHECK

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

## CONTROL

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

# 13. Specifications

	GASOLINE MODELS					
	7.0 HGJAA	7.0 HGJAB	7.0 HGJAC	5.5 HGJAA	5.5 HGJAB	5.5 HGJAC
GENERATOR: 2-Pole Revolving Field, 2-Bearing, Self-Excited, 1-Phase, Vertical Shaft, Capped Digital Voltage Regulation						
Power	7000 watts			5500 watts		
Frequency	60 Hertz			60 Hertz		
Voltage	120 volts			120 volts		
Current	58.3 amp			45.8 amp		
Speed	3600 rpm			3600 rpm		
FUEL CONSUMPTION:						
No load	0.43 gph (1.6 l/h)	0.43 gph (1.6 l/h)	0.43 gph (1.6 l/h)	0.34 gph (1.3 l/h)	0.35 gph (1.3 l/h)	0.35 gph (1.3 l/h)
Half load	0.70 gph (2.7 l/h)	0.73 gph (2.8 l/h)	0.73 gph (2.8 l/h)	0.58 gph (2.2 l/h)	0.60 gph (2.3 l/h)	0.60 gph (2.3 l/h)
Full load	1.13 gph (4.3 l/h)	1.22 gph (4.6 l/h)	1.22 gph (4.6 l/h)	0.89 gph (3.4 l/h)	0.95 gph (3.6 l/h)	0.95 gph (3.6 l/h)
ENGINE: Air-Cooled, 4-Cycle Spark-Ignited, OHV, 90° V Twin Cyl, Vertical Shaft						
Fueling Method	SFI <sup>1</sup>	Carburetor	Carburetor	SFI <sup>1</sup>	Carburetor	Carburetor
Governor	Digital	Mechanical	Mechanical	Digital	Mechanical	Mechanical
Speed	2880 rpm			2400 rpm		
Bore	3.15 in (80 mm)			3.15 in (80 mm)		
Stroke	2.56 in (65 mm)			2.56 in (65 mm)		
Displacement	39.8 in <sup>3</sup> (653 cc)			39.8 in <sup>3</sup> (653 cc)		
Comp. Ratio	8.0 : 1			8.0 : 1		
Cyl. Comp. Test	153-188 psi			153-188 psi		
Oil Capacity	2.0 quart (1.8 l)			2.0 quart (1.8 l)		
Valve Lash (Cold)	0.004 in (0.10 mm), Intake & Exhaust			0.004 in (0.10 mm), Intake & Exhaust		
Spark Plug	18–25 lbs-ft (23–32 N-m)			18–25 lbs-ft (23–32 N-m)		
Ignition Timing	20° BTDC, non-adjustable magneto			20° BTDC, non-adjustable magneto		
Magneto Air Gap	0.012 in (0.3 mm)			0.012 in (0.3 mm)		
Spark Plug Gap	0.025 in (0.6-0.7 mm)			0.025 in (0.6-0.7 mm)		
DC SYSTEM:						
Battery Voltage	12 volts			12 volts		
Min. Battery CCA	450 @ 0° F (–18° C)			450 @ 0° F (–18° C)		
INSTALLATION:						
Exhaust O. D.	1-1/4 in			1-1/4 in		
Max. Exhaust Back Pressure	–	–	35 in (889 mm) WC	–	–	35 in (889 mm) WC
Fuel Supply Connection	5/16 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1	5/16 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1
Fuel Return Connection	1/4 in. SAE J1231 Type 1	–	–	1/4 in. SAE J1231 Type 1	–	–
Noise dB(A) <sup>2</sup>	66	67	75	66	67	75
Weight	290 lb (132 Kg)	290 lb (132 Kg)	239 lb (107 Kg)	279 lb (127 Kg)	279 lb (127 Kg)	228 lb (104 Kg)
Compartment (H x D x W) <sup>3</sup>	HGJAA/HGJAB: 17.2 in x 23.2 in x 34.6 in (438 mm x 589 mm x 879 mm) HGJAC: 16.5 in x 22.8 in x 27.9 in (420 mm x 579 mm x 709 mm)					
1.Sequential Multiport Fuel Injection 2.Measurements @ 10 ft (3 m) in a typical RV installation, under an 4 kW load. 3.With 1/2 in. clearances. See the Installation Manual for additional considerations when sizing the genset compartment.						

	LPG MODELS					
	6.5 HGJAA	6.5 HGJAB	6.5 HGJAC	5.5 HGJAA	5.5 HGJAB	5.5 HGJAC
<b>GENERATOR:</b> 2-Pole Revolving Field, 2-Bearing, Self-Excited, 1-Phase, Vertical Shaft, Capped Digital Voltage Regulation						
Power	6500 watts			5500 watts		
Frequency	60 Hertz			60 Hertz		
Voltage	120 volts			120 volts		
Current	54.2 amp			45.8 amp		
Speed	3600 rpm			3600 rpm		
<b>FUEL CONSUMPTION:</b>						
No load	2.2 lbs/h (1.0 kg/h)	2.2 lbs/h (1.0 kg/h)	2.2 lbs/h (1.0 kg/h)	1.8 lbs/h (0.8 kg/h)	1.8 lbs/h (0.8 kg/h)	1.8 lbs/h (0.8 kg/h)
Half load	3.9 lbs/h (1.8 kg/h)	3.9 lbs/h (1.8 kg/h)	3.9 lbs/h (1.8 kg/h)	3.3 lbs/h (1.5 kg/h)	3.3 lbs/h (1.5 kg/h)	3.3 lbs/h (1.5 kg/h)
Full load	5.3 lbs/h (2.4 kg/h)	5.3 lbs/h (2.4 kg/h)	5.3 lbs/h (2.4 kg/h)	4.6 lbs/h (2.1 kg/h)	4.6 lbs/h (2.1 kg/h)	4.6 lbs/h (2.1 kg/h)
<b>ENGINE:</b> Air-Cooled, 4-Cycle Spark-Ignited, OHV, 90° V Twin Cyl, Vertical Shaft						
Fueling Method	Air/Fuel Mixer			Air/Fuel Mixer		
Governor	Mechanical			Mechanical		
Speed	2880 rpm			2400 rpm		
Bore	3.15 in (80 mm)			3.15 in (80 mm)		
Stroke	2.56 in (65 mm)			2.56 in (65 mm)		
Displacement	39.8 in <sup>3</sup> (653 cc)			39.8 in <sup>3</sup> (653 cc)		
Comp. Ratio	8.0 : 1			8.0 : 1		
Cyl. Comp. Test	153-188 psi			153-188 psi		
Oil Capacity	2.0 quart (1.8 l)			2.0 quart (1.8 l)		
Valve Lash (Cold)	0.004 in (0.10 mm), Intake & Exhaust			0.004 in (0.10 mm), Intake & Exhaust		
Spark Plug	18–25 lbs-ft (23–32 N-m)			18–25 lbs-ft (23–32 N-m)		
Ignition Timing	20° BTDC, non-adjustable magneto			20° BTDC, non-adjustable magneto		
Magneto Air Gap	0.012 in (0.3 mm)			0.012 in (0.3 mm)		
Spark Plug Gap	0.025 in (0.6-0.7 mm)			0.025 in (0.6-0.7 mm)		
<b>DC SYSTEM:</b>						
Battery Voltage	12 volts			12 volts		
Min. Battery CCA	450 @ 0° F (–18° C)			450 @ 0° F (–18° C)		
<b>INSTALLATION:</b>						
Exhaust O. D.	1-1/4 in			1-1/4 in		
Max. Exhaust Back Pressure	–	–	35 in (889 mm) WC	–	–	35 in (889 mm) WC
LPG Vapor: Connection Pressure	3/8–18 NPTF 9-13 in (228-330 mm) WC			3/8–18 NPTF 9-13 in (228-330 mm) WC		
LPG Liquid: Connection Pressure	1/4–18 NPTF Tank Pressure			1/4–18 NPTF Tank Pressure		
Noise dB(A) <sup>1</sup>	66	67	75	66	67	75
Weight	290 lb (132 Kg)	290 lb (132 Kg)	239 lb (107 Kg)	279 lb (127 Kg)	279 lb (127 Kg)	228 lb (104 Kg)
Compartment (H x D x W) <sup>2</sup>	HGJAA/HGJAB: 17.2 in x 23.2 in x 34.6 in (438 mm x 589 mm x 879 mm) HGJAC: 16.5 in x 22.8 in x 27.9 in (420 mm x 579 mm x 709 mm)					
1.Measurements @ 10 ft (3 m) in a typical RV installation, under an 4 kW load. 2.With 1/2 in. clearances. See the Installation Manual for additional considerations when sizing the genset compartment.						

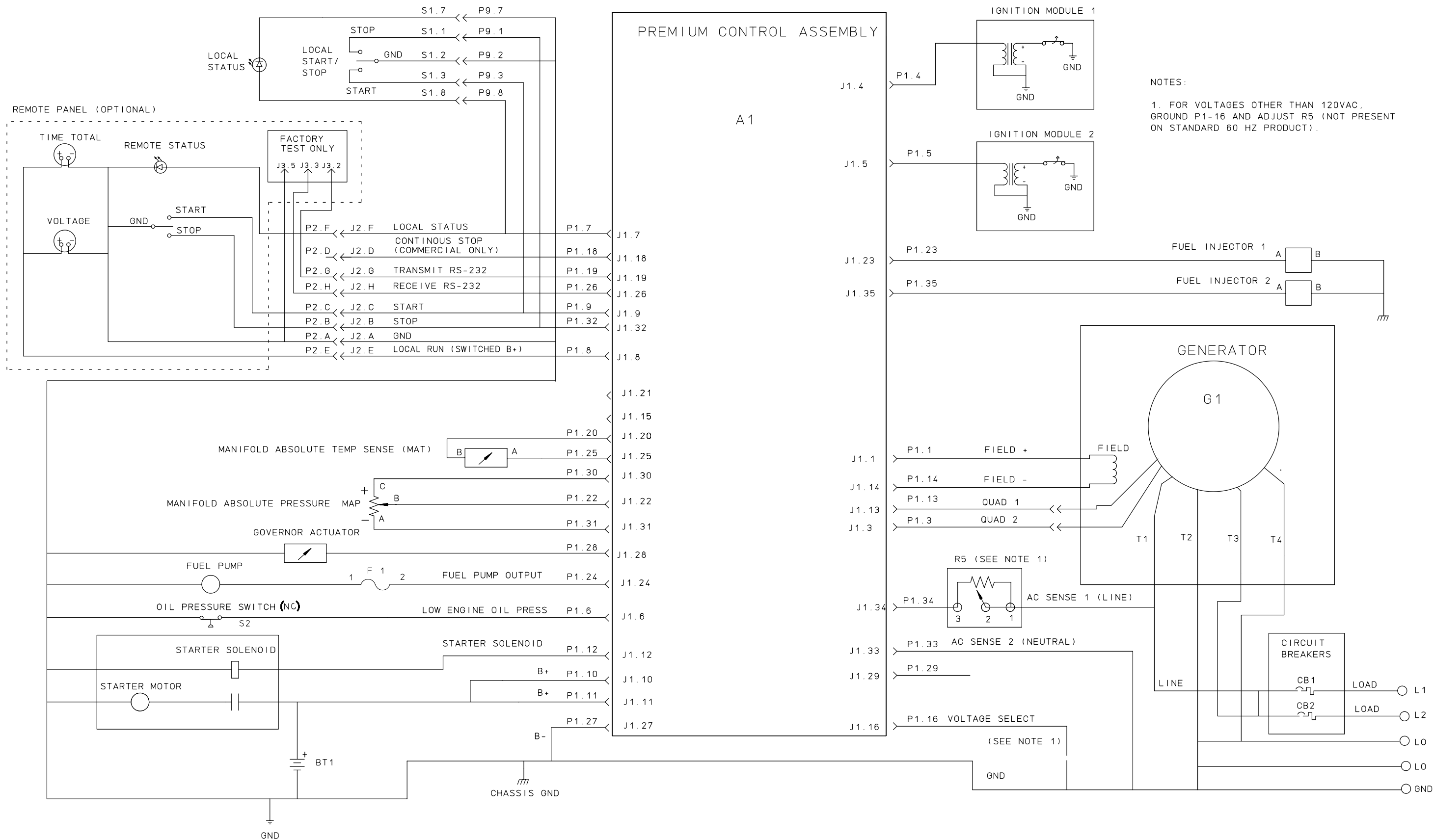
	GASOLINE MODELS					
	7.0 HGJAD	7.0 HGJAE	7.0 HGJAF	5.5 HGJAD	5.5 HGJAE	5.5 HGJAF
GENERATOR: 2-Pole Revolving Field, 2-Bearing, Self-Excited, 1-Phase, Vertical Shaft, Capped Digital Voltage Regulation						
Power (1.0 PF) <sup>1</sup>	7000 watts			5500 watts		
Frequency	60 Hertz			60 Hertz		
1-Ph, 4-Wire V/A	120 / 240 Volts, 29.2 Amps			120 / 240 Volts, 22.9 Amps		
1-Ph, 2-Wire V/A	120 Volts, 58.3 Amps			120 Volts, 45.8 Amps		
3-Ph V/A	120 / 240 Volts, 16.8 Amps			120 / 240 Volts, 12 Amps		
Speed	3600 rpm			3600 rpm		
FUEL CONSUMPTION:						
No load	0.43 gph (1.6 l/h)	0.43 gph (1.6 l/h)	0.43 gph (1.6 l/h)	0.34 gph (1.3 l/h)	0.35 gph (1.3 l/h)	0.35 gph (1.3 l/h)
Half load	0.70 gph (2.7 l/h)	0.73 gph (2.8 l/h)	0.73 gph (2.8 l/h)	0.58 gph (2.2 l/h)	0.60 gph (2.3 l/h)	0.60 gph (2.3 l/h)
Full load	1.13 gph (4.3 l/h)	1.22 gph (4.6 l/h)	1.22 gph (4.6 l/h)	0.89 gph (3.4 l/h)	0.95 gph (3.6 l/h)	0.95 gph (3.6 l/h)
ENGINE: Air-Cooled, 4-Cycle Spark-Ignited, OHV, 90° V Twin Cyl, Vertical Shaft						
Fueling Method	SFI <sup>2</sup>	Carburetor	Carburetor	SFI <sup>2</sup>	Carburetor	Carburetor
Governor	Digital	Mechanical	Mechanical	Digital	Mechanical	Mechanical
Speed	2880 rpm			2400 rpm		
Bore	3.15 in (80 mm)			3.15 in (80 mm)		
Stroke	2.56 in (65 mm)			2.56 in (65 mm)		
Displacement	39.8 in <sup>3</sup> (653 cc)			39.8 in <sup>3</sup> (653 cc)		
Comp. Ratio	8.0 : 1			8.0 : 1		
Cyl. Comp. Test	153-188 psii			153-188 psii		
Oil Capacity	2.0 quart (1.8 l)			2.0 quart (1.8 l)		
Valve Lash (Cold)	0.004 in (0.10 mm), Intake & Exhaust			0.004 in (0.10 mm), Intake & Exhaust		
Spark Plug	18–25 lbs-ft (23–32 N-m)			18–25 lbs-ft (23–32 N-m)		
Ignition Timing	20° BTDC, non-adjustable magneto			20° BTDC, non-adjustable magneto		
Magneto Air Gap	0.012 in (0.3 mm)			0.012 in (0.3 mm)		
Spark Plug Gap	0.025 in (6-7 mm)			0.025 in (6-7 mm)		
HYDRAULIC PUMP:	Fixed-displacement gear pump—1.8 gpm @ 2500 psi			Fixed-displacement gear pump—1.6 gpm @ 2500 psi		
DC SYSTEM:						
Battery Voltage	12 volts			12 volts		
Battery Charging	10 amps regulated			10 amps regulated		
Min. Battery CCA	450 @ 0° F (–18° C)			450 @ 0° F (–18° C)		
INSTALLATION:						
Exhaust O. D.	1-1/4 in			1-1/4 in		
Max. Exhaust Back Pressure	–	–	35 in (889 mm) WC	–	–	35 in (889 mm) WC
Fuel Supply Connection	5/16 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1	5/16 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1	1/4 in. SAE J1231 Type 1
Fuel Return Connection	5/16 in. SAE J1231 Type 1	–	–	5/16 in. SAE J1231 Type 1	–	–
Hydraulic Fluid	Transmission or Petroleum-Based Hydraulic Fluid—Operating Viscosity: 80-1000 SSU—Maximum Start-Up Viscosity: 4000 SSU			Transmission or Petroleum-Based Hydraulic Fluid—Operating Viscosity: 80-1000 SSU—Maximum Start-Up Viscosity: 4000 SSU		
Hydraulic Pump Inlet Conditions	Not to exceed 5 in Hg Vacuum or 20 psi Pressure			Not to exceed 5 in Hg Vacuum or 20 psi Pressure		
Hydraulic Pump Connections Outlet Inlet	3/4-16 UNF-2B SAE 7/8-14 UNF-2B SAE			3/4-16 UNF-2B SAE 7/8-14 UNF-2B SAE		
Noise dB(A) <sup>3</sup>	66	67	75	66	67	75
Weight	290 lb (132 Kg)	290 lb (132 Kg)	239 lb (107 Kg)	279 lb (127 Kg)	279 lb (127 Kg)	228 lb (104 Kg)
Compartment (H x D x W) <sup>4</sup>	HGJAD/HGJAE: 17.2 in x 23.2 in x 34.6 in (438 mm x 589 mm x 879 mm) HGJAF: 16.5 in x 22.8 in x 27.9 in (420 mm x 579 mm x 709 mm)					
1. A genset with an hydraulic pump is rated with the pump idle. 2. Sequential Multiport Fuel Injection 3. Measurements @ 10 ft (3 m) in a typical installation, under an 4 kW load. 4. With 1/2 in. clearances. See the Installation Manual for additional considerations when sizing the genset compartment.						



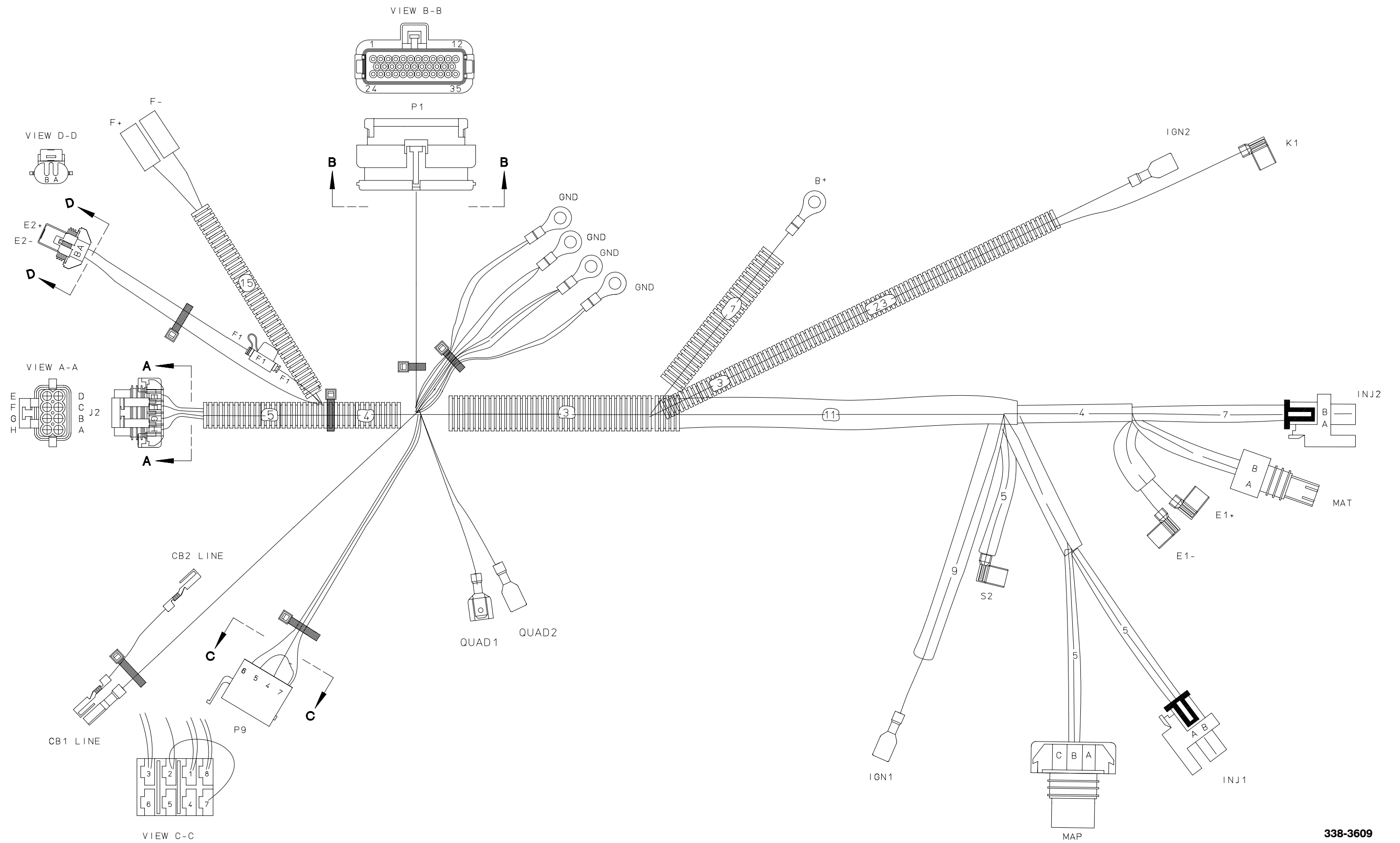
	LPG MODELS			
	6.5 HGJAE	6.5 HGJAF	5.5 HGJAE	5.5 HGJAF
GENERATOR: 2-Pole Revolving Field, 2-Bearing, Self-Excited, 1-Phase, Vertical Shaft, Capped Digital Voltage Regulation				
Power (1.0 PF) <sup>1</sup>	6500 watts		5500 watts	
Frequency	60 Hertz		60 Hertz	
1-Ph, 4-Wire V/A	120 / 240 Volts, 27 Amps		120 / 240 Volts, 22.9 Amps	
Speed	3600 rpm		3600 rpm	
FUEL CONSUMPTION:				
No load	2.2 lbs/h (1.0 kg/h)	2.2 lbs/h (1.0 kg/h)	1.8 lbs/h (0.8 kg/h)	1.8 lbs/h (0.8 kg/h)
Half load	3.9 lbs/h (1.8 kg/h)	3.9 lbs/h (1.8 kg/h)	3.3 lbs/h (1.5 kg/h)	3.3 lbs/h (1.5 kg/h)
Full load	5.3 lbs/h (2.4 kg/h)	5.3 lbs/h (2.4 kg/h)	4.6 lbs/h (2.1 kg/h)	4.6 lbs/h (2.1 kg/h)
ENGINE: Air-Cooled, 4-Cycle Spark-Ignited, OHV, 90° V Twin Cyl, Vertical Shaft				
Fueling Method	Air/Fuel Mixer		Air/Fuel Mixer	
Governor	Mechanical		Mechanical	
Speed	2880 rpm		2400 rpm	
Bore	3.15 in (80 mm)		3.15 in (80 mm)	
Stroke	2.56 in (65 mm)		2.56 in (65 mm)	
Displacement	39.8 in <sup>3</sup> (653 cc)		39.8 in <sup>3</sup> (653 cc)	
Comp. Ratio	8.0 : 1		8.0 : 1	
Cyl. Comp. Test	153-188 psi		153-188 psi	
Oil Capacity	2.0 quart (1.8 l)		2.0 quart (1.8 l)	
Valve Lash (Cold)	0.004 in (0.10 mm), Intake & Exhaust		0.004 in (0.10 mm), Intake & Exhaust	
Spark Plug	18–25 lbs-ft (23–32 N-m)		18–25 lbs-ft (23–32 N-m)	
Ignition Timing	20° BTDC, non-adjustable magneto		20° BTDC, non-adjustable magneto	
Magneto Air Gap	0.012 in (0.3 mm)		0.012 in (0.3 mm)	
Spark Plug Gap	0.025 in (6-7 mm)		0.025 in (6-7 mm)	
HYDRAULIC PUMP:	Fixed-displacement gear pump—1.8 gpm @ 2500 psi		Fixed-displacement gear pump—1.6 gpm @ 2500 psi	
DC SYSTEM:				
Battery Voltage	12 volts		12 volts	
Battery Charging	10 amps regulated		10 amps regulated	
Min. Battery CCA	450 @ 0° F (–18° C)		450 @ 0° F (–18° C)	
INSTALLATION:				
Exhaust O. D.	1-1/4 in		1-1/4 in	
Max. Exhaust Back Pressure	–	35 in (889 mm) WC	–	35 in (889 mm) WC
LPG Vapor: Connection Pressure	3/8–18 NPTF 9-13 in (228-330 mm) WC		3/8–18 NPTF 9-13 in (228-330 mm) WC	
LPG Liquid: Connection Pressure	1/4–18 NPTF Tank Pressure		1/4–18 NPTF Tank Pressure	
Hydraulic Fluid	Transmission or Petroleum-Based Hydraulic Fluid—Operating Viscosity: 80-1000 SSU—Maximum Start-Up Viscosity: 4000 SSU		Transmission or Petroleum-Based Hydraulic Fluid—Operating Viscosity: 80-1000 SSU—Maximum Start-Up Viscosity: 4000 SSU	
Hydraulic Pump Inlet Conditions	Not to exceed 5 in Hg Vacuum or 20 psi Pressure		Not to exceed 5 in Hg Vacuum or 20 psi Pressure	
Hydraulic Pump Connections Outlet Inlet	3/4-16 UNF-2B SAE 7/8-14 UNF-2B SAE		3/4-16 UNF-2B SAE 7/8-14 UNF-2B SAE	
Noise dB(A) <sup>2</sup>	67	75	67	75
Weight	290 lb (132 Kg)	239 lb (107 Kg)	279 lb (127 Kg)	228 lb (104 Kg)
Compartment (H x D x W) <sup>3</sup>	HGJAD/HGJAE: 17.2 in x 23.2 in x 34.6 in (438 mm x 589 mm x 879 mm) HGJAF: 16.5 in x 22.8 in x 27.9 in (420 mm x 579 mm x 709 mm)			
1. A genset with an hydraulic pump is rated with the pump idle. 2. Measurements @ 10 ft (3 m) in a typical installation, under an 4 kW load. 3. With 1/2 in. clearances. See the Installation Manual for additional considerations when sizing the genset compartment.				

# 14. Torque Specifications

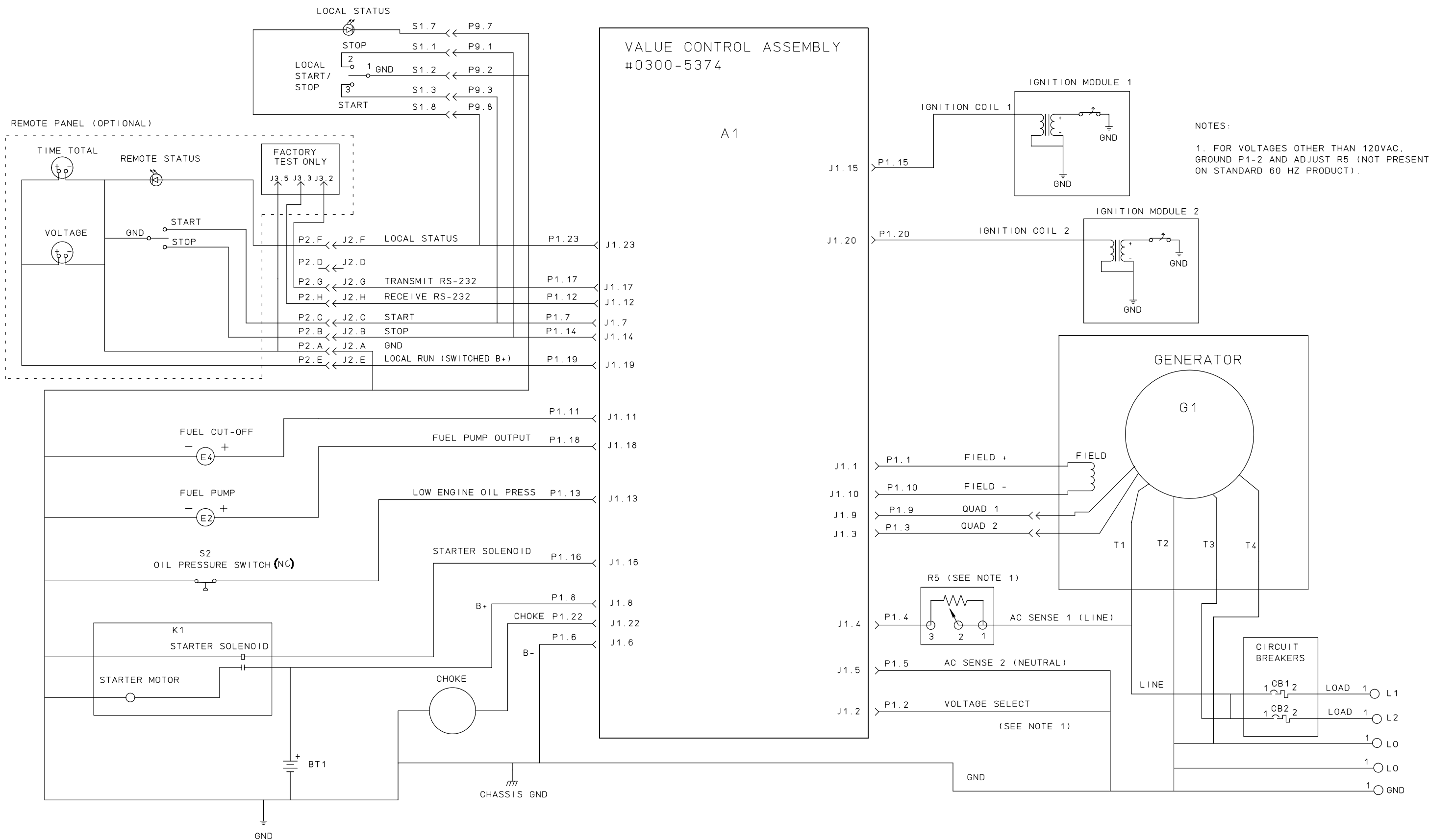
	lb-ft*	N-m *
Spark Plugs	10 (New), 18 (Reused)	13 (New), 24 (Reused)
Genset Mounting Screws	35	48
Generator Through Bolts	8	11
Belt Tensioner Center Bolt	20	26
Generator Pulley Center Bolt	45	61
Fan Screws	8	11
Flywheel to Pulley Coupling Nuts	5	6
Flywheel Center Bolt	60	81
Magneto Mounting Screws	5	7
Exhaust Manifold Flange Nuts	20	26
Fan Shroud Screws	8	11
Muffler Flange Nuts	10	13
Intake Manifold Bolts	19	26
Throttle Body / Carburetor / Mixer Mounting Nuts	4.5	6
Fuel Rail Mounting Screws (EFI)	75 lb-inch	8.4
Throttle Body Stator Screws (EFI)	18 lb-inch	2
LPG Inlet Filter	25	34
Governor Arm Shaft Nut ( <b>Counterclockwise</b> )	8	11
Generator / Engine Assembly Fail Safe Bolts	38	51
Engine Mounting Screws	20	26
Cylinder Shroud Screws	8	11
Starter Motor Mounting Screws	20	26
Starter Terminal Nut	6.5	8
Valve Lash Adjustment Lock Nuts	6.5	8
Valve Cover Screws	5.5	8
Cylinder Head Bolts (Three equal increments)	24.6-30.4	33.3-41.2
Engine Breather Valve Cover Screws	3	4
Connecting Rod Cap Bolts	16.3-19.9	22.1-27.0
Crankcase Cover Screws	16.2-16.9	22-23
Hydraulic Pump Mounting Flange Bolts	20	26
* – Use engine oil as a lubricant for all threads except when otherwise specified.		



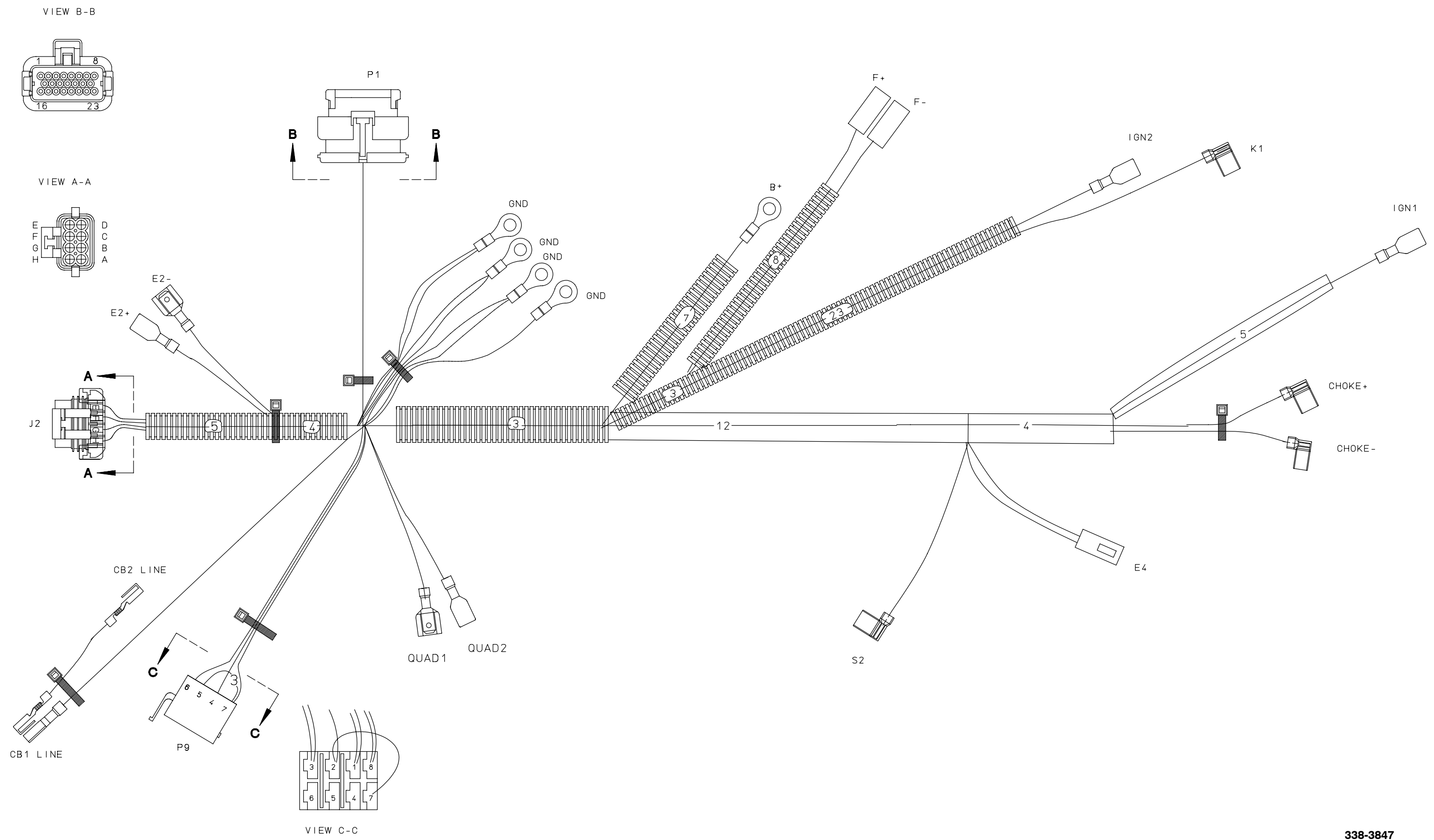
WIRING DIAGRAM—HGJAA



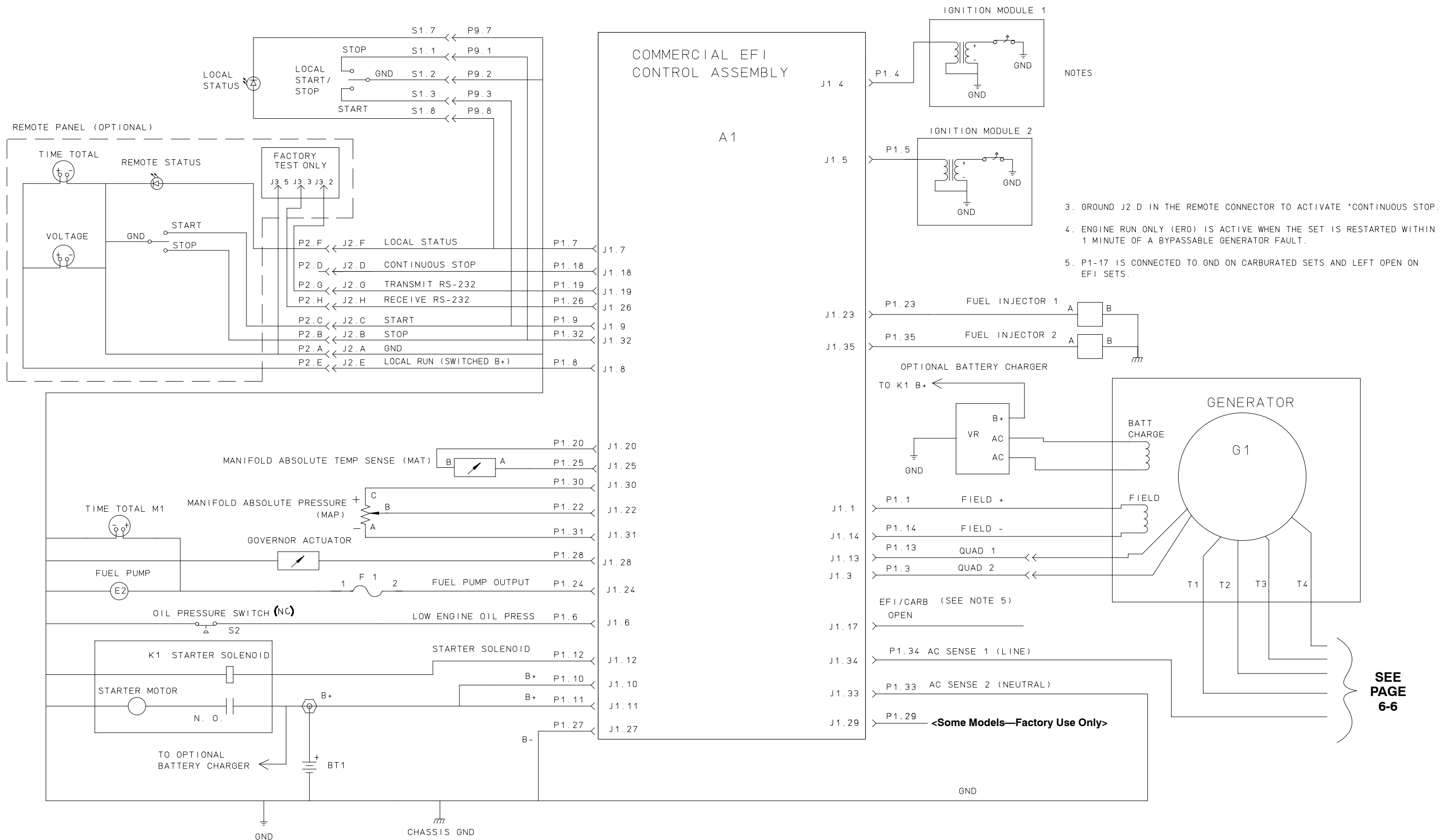
WIRING HARNESS—HGJAA



WIRING DIAGRAM—HGJAB/HGJAC

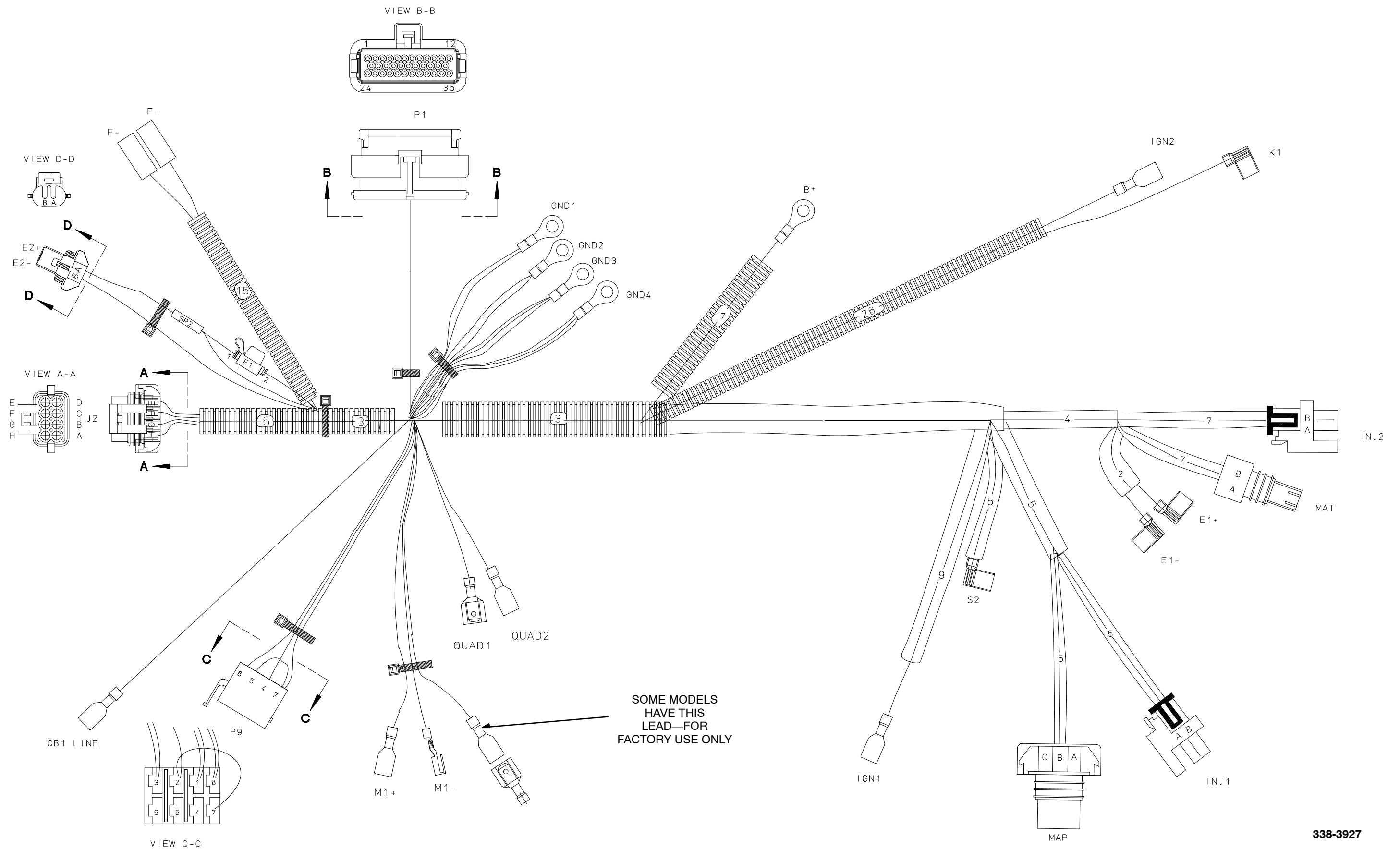


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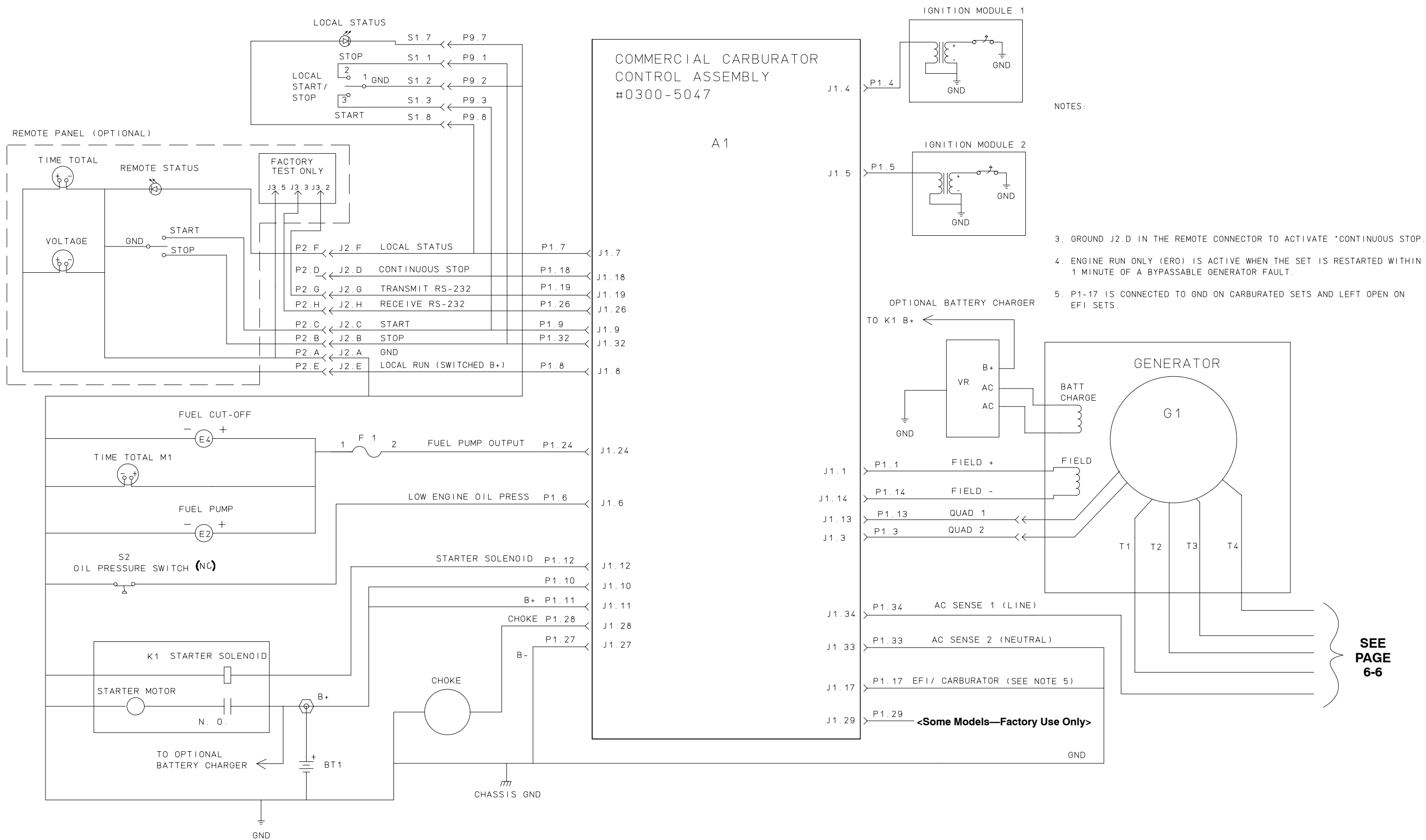
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WIRING DIAGRAM—HGJAD



WIRING HARNESS—HGJAD





WIRING DIAGRAM—HGJAE & HGJAF





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