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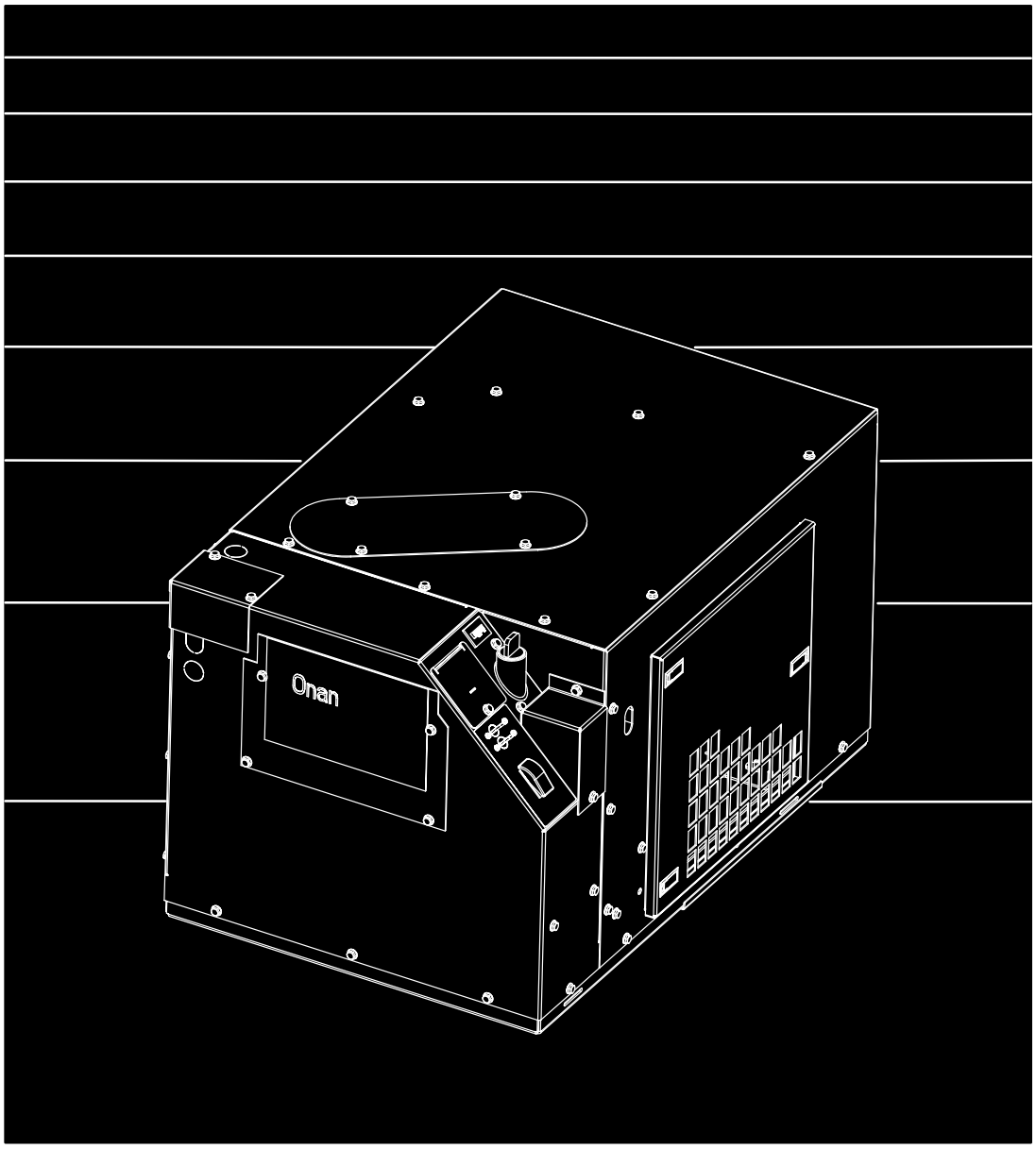
Onan Mobile GenSet

Service Manual

HDKBA, HDKBB



Printed in U.S.A.

981-0535
10-02

California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and 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

Supplement: 981-1049
Date: 09/04
Insert with-

Manual Number (Date):	981-0173 (08/04)	981-0174 (08/04)	981-0540 (08/04)
	981-0170 (11/03)	981-0171 (11/03)	981-0526D (02/04)
	981-0166B (06/03)	981-0167B (06/03)	981-0535 (10/02)
	981-0161 (08/89)	981-0522B (07/99)	

Purpose: These instructions supplement the instructions for filling the engine cooling system found in the *Periodic Maintenance* sections of the Operator's and Service Manuals listed above.

⚠WARNING ***To prevent severe burns from hot coolant under pressure, carefully observe all of the Safety Precautions and Instructions in the Manual for handling and filling coolant.***

Instructions: Use a funnel when filling the cooling system through the fill opening (Figure 1) to prevent coolant from entering the vent hose and blocking the escape of air as the system fills. The system *will seem full when it actually is not* if the air cannot escape through the vent hose. If the vent hose does get blocked, pinch the overflow hose and blow the vent hose clear.

⚠CAUTION ***Coolant trapped in the vent hose will prevent the system from filling to its capacity, which can lead to serious engine damage.***

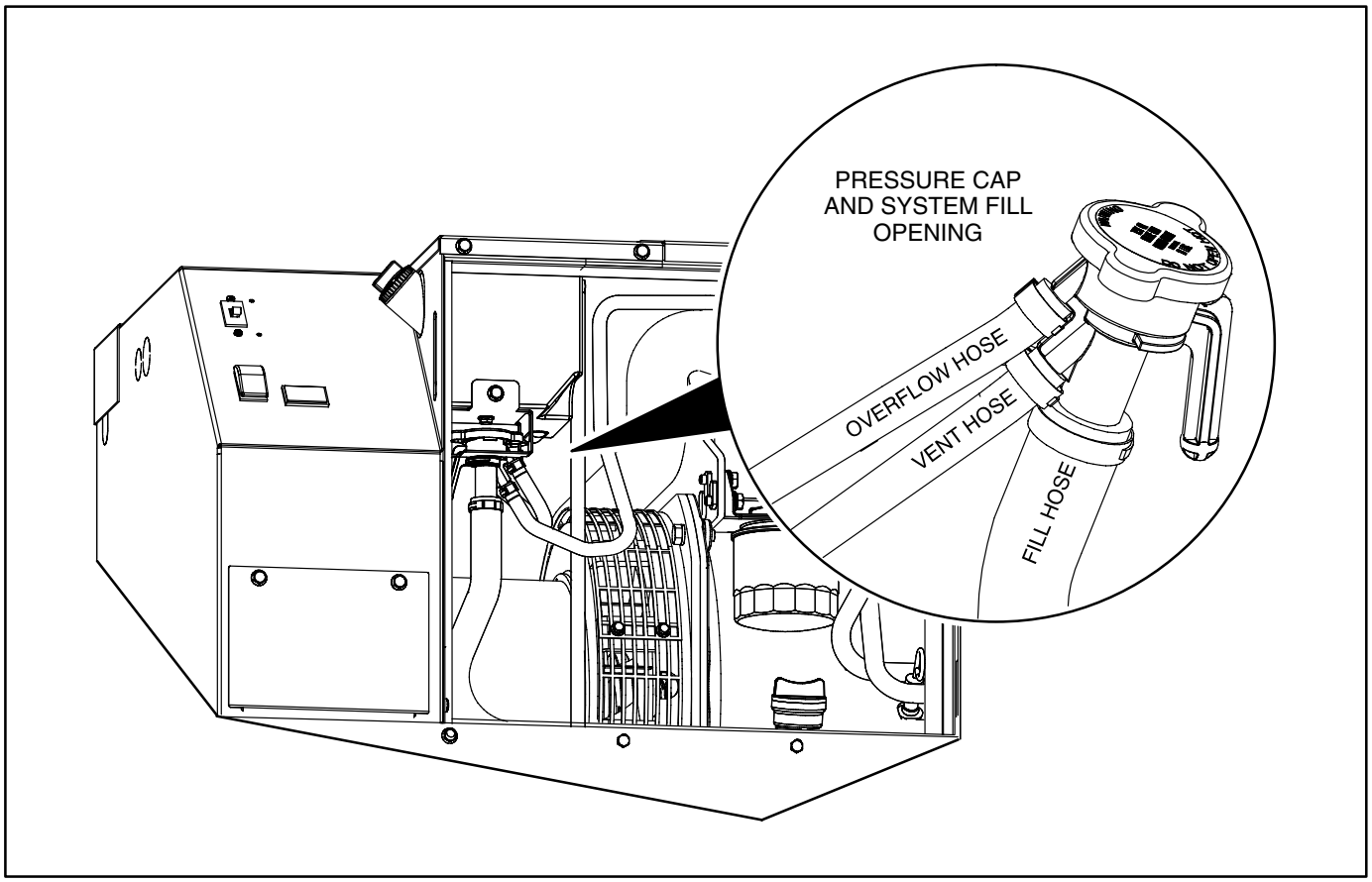


FIGURE 1. TYPICAL COOLANT FILL OPENING WITH CONNECTED FILL, OVERFLOW AND VENT HOSES

Table of Contents

Safety Precautions

Thoroughly read the OPERATOR'S MANUAL before operating the genset. Safe operation and top performance can only be obtained 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 children away from the genset.
- Do not use evaporative starting fluids. They are highly explosive.
- To prevent accidental or remote starting while working on the genset, disconnect the negative (**-**) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray out and cause severe burns.
- 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.
- Make sure all fasteners are secure and torqued properly.
- Do not work on the genset when mentally or physically fatigued or after consuming alcohol or drugs.
- You must be trained and experienced to make 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 U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to the public utility or any other source of electrical power. Back-feed could lead to electrocution of utility personnel and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

ENGINE EXHAUST IS DEADLY

- Learn the symptoms of carbon monoxide poisoning in this manual.
- 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 working or living spaces or compartments.
- Make sure there is ample fresh air when operating the genset in a confined area.

DIESEL FUEL IS COMBUSTIBLE

- Do not smoke or turn electrical switches ON or OFF where fuel fumes are present or in areas sharing ventilation with fuel tanks or equipment. Keep flames, sparks, pilot lights, arc-producing equipment and all other sources of ignition well away.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.

BATTERY GAS IS EXPLOSIVE

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

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, and other moving parts.

FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. ***Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak, etc.*** The owners and operators of the genset are solely responsible for operating the genset safely.

Mobile-6

1. Introduction

ABOUT THIS MANUAL

This is the service manual for the generator sets (gensets) 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 qualified 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 1-1 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.)

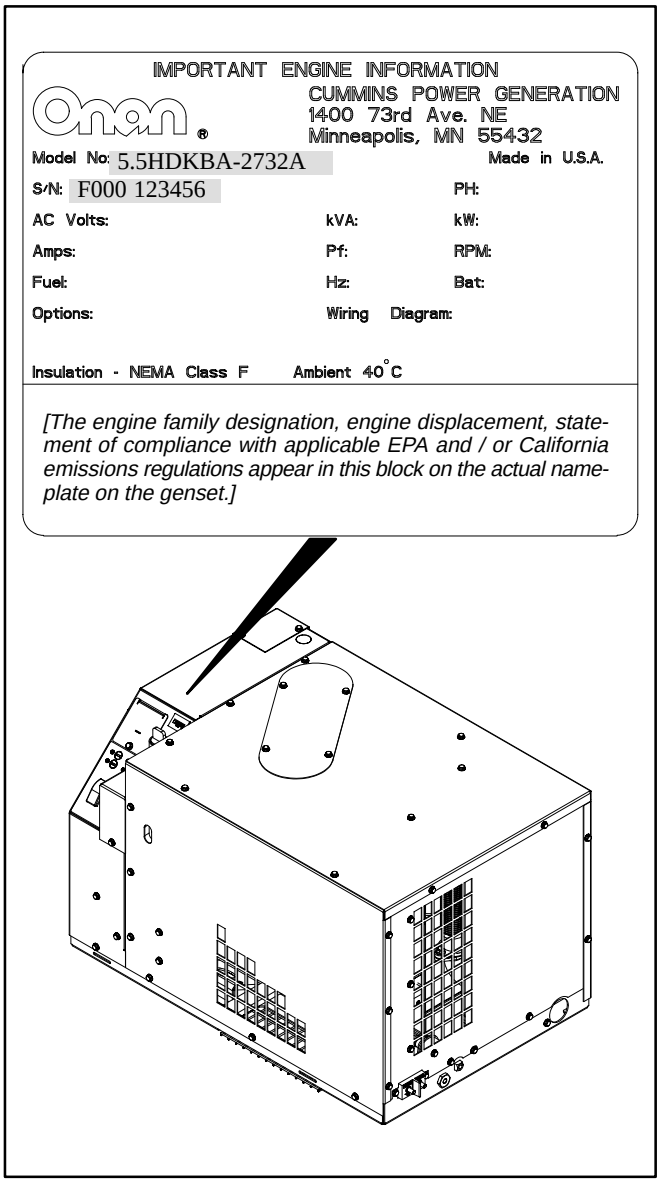


FIGURE 1-1. TYPICAL NAMEPLATE

FUEL RECOMMENDATIONS

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

Use clean, fresh No. 2 diesel fuel (ASTM 2-D) when the outdoor ambient temperature is above freezing, and No. 1 diesel fuel (ASTM 1-D) when below freezing. The fuel should have a Cetane number of at least 45 for reliable starting.

ENGINE OIL RECOMMENDATIONS

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

STARTING BATTERIES

The genset requires a 12 volt battery to power its control and starting circuits. Reliable genset starting and starter service life depend upon adequate battery system capacity and maintenance. See Section 11. *Specifications* for battery requirements and Section 3. *Periodic Maintenance* for battery care.

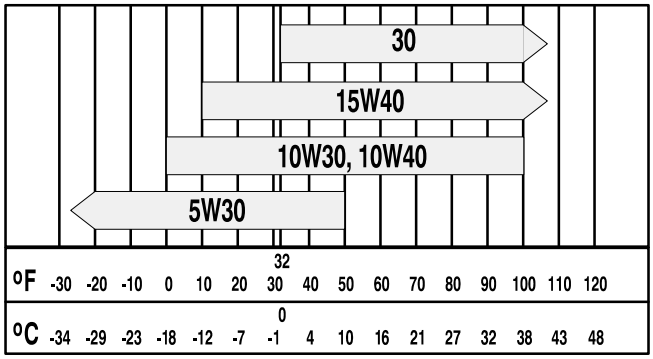


FIGURE 1-2. OIL VISCOSITY VS. TEMPERATURE

2. Operation

OPERATOR'S CONSOLE

The console (Figure 2-1) has the following features:

Control Switch - This switch is used to start and stop the genset, prime the engine fuel system and restore the fault code (blinking status light).

Status Light - This is an LED (light emitting diode) in the control switch which blinks rapidly during preheat and cranking. After the genset starts up, this light stays on continuously, indicating that the genset is running and that the starter has disconnected. If the genset shuts down, this light blinks in coded fashion to indicate the nature of the fault shutdown (see Section 9. *Troubleshooting*).

(Rapid blinking before cranking starts indicates that the glow plugs are preheating the combustion chambers. The controller automatically varies the time based on engine temperature.)

Line Circuit Breakers - The line circuit breakers protect the AC power leads connected to the genset.

Coolant Pressure Cap - The coolant pressure cap is under the access plate. Fill coolant here when refilling the system.

Coolant Recovery Tank - The recovery tank is mounted inside the genset and provides for coolant expansion. The coolant level is visible through the sight hole on the front of the genset. The fill cap is under the access cover. Replenish the normal loss of coolant here.

Oil Fill Cap and Dipstick - Check and fill engine oil.

REMOTE CONTROL PANEL

The vehicle probably has a control panel inside the vehicle for remote control of the genset, which may have an hour meter or DC voltmeter.

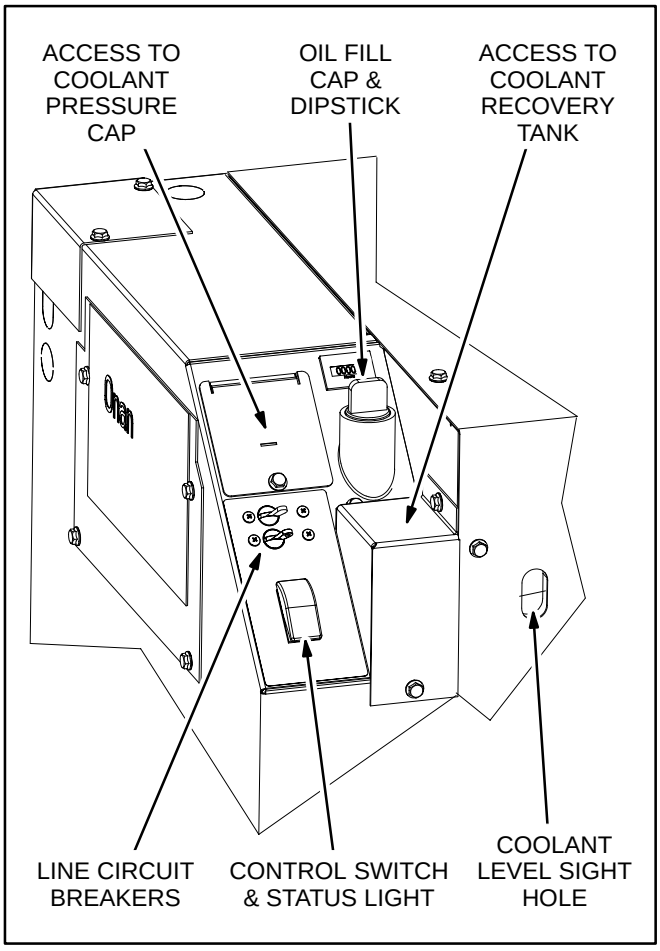


FIGURE 2-1. OPERATOR'S CONSOLE

⚠WARNING ***EXHAUST GAS IS DEADLY!***

All engine exhaust contains carbon monoxide; an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:

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

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

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

PRIMING THE FUEL SYSTEM

The fuel system should be primed after replacing the fuel filter or running the genset out of fuel. To prime the fuel system hold the control switch down in its **Stop** position for at least 1 minute (starts in 2 seconds).

STARTING THE GENSET

Start the genset from the genset control panel or remote control panel inside the vehicle.

1. Push and hold the switch at **START** until the genset starts. The status indicator light on the switch flashes during preheat and cranking. It will come on solid when the starter disconnects, indicating that the genset is running. (Depending on how cold it is, preheat can take up to 15 seconds, extending the time that the light blinks.)

   ⚠CAUTION ***Excessive cranking can overheat and damage the starter motor. Do not crank for more than 30 seconds at a time. Wait at least 2 minutes before trying again.***

2. See Section 9. *Troubleshooting* if the genset does not start after several tries.
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, exhaust and coolant leaks. Stop the genset immediately if there is a fuel, exhaust or coolant leak and have it repaired.

STOPPING THE GENSET

Turn off air conditioners and other large appliances and let the genset run for two minutes to cool down. Then push the switch to **STOP**.

3. Periodic Maintenance

Periodic maintenance is essential for good 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.

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 OPERATION	MAINTENANCE FREQUENCY						
	Every Day	After First 50 Hours	Every Month	Every 150 Hours	Every 500 Hours	Every 1000 Hours	Page
General Inspection	•						3-2
Check Engine Oil Level	•						3-3
Check Engine Coolant Level	•						3-9
Clean and Check Battery			•[2]				3-5
Clean Spark Arrestor				•[3]			3-6
Change Engine Oil and Oil Filter		•		•[1, 2, 3]			3-4
Replace Engine Air Filter					•[1, 3]		3-5
Replace Fuel Filter					•[3]		3-7
Check Coolant Anti-freeze Protection					•[3]		3-8
Flush Coolant System						•[4]	3-8
Replace Coolant Pressure Cap						•[4]	3-8
Replace Engine V-belt (Coolant Pump)						•[5, 6]	8-11
Replace Coolant Hoses and Thermostat						•[5, 6]	8-10
Adjust Engine Valve Lash						•[5, 6]	8-1
Service Fuel Injectors						•[5, 6]	8-1
Check Generator Bearings, Drive Belt, Belt Tensioner & Drive Coupling						•[5, 6]	7-1

1 - Perform more often when operating in dusty conditions.
2 - Perform more often when operating in hot weather.
3 - Perform at least once a year.
4 - Perform at least once every two years.
5 - Perform at least once every five years.
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).

Engine Coolant System

⚠ CAUTION ***Operating the genset when coolant level is low can cause serious engine damage.***

Check the coolant level and look for coolant leaks around the bottom of the genset and on the ground below. Minor leaks that can be replenished by daily additions of coolant to the recovery tank should be repaired by a qualified service technician as soon as possible. Larger leaks are cause for shutting down the genset until it can be repaired.

Exhaust System

⚠ 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.***

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.

Check all CO monitors to assure proper operation.

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

Park the vehicle so that the genset exhaust gases can disperse away from the vehicle. Barriers such as walls, snow banks, high grass and brush and other vehicles can cause exhaust gases to accumulate in and around the vehicle.

Do not operate power ventilators or exhaust fans while the vehicle is standing with the genset running. The ventilator or fan can draw exhaust gases into the vehicle.

Fuel System

Check for leaks at hose, tube and pipe fittings in the fuel supply system while the genset is running and while it is stopped. Check flexible fuel hose sections for cuts, cracks, and abrasions. Make sure the fuel line is not rubbing against other parts. Replace worn or damaged fuel line parts before leaks occur.

⚠ WARNING ***Diesel fuel leaks can lead to fire. Do not operate the genset if operation causes fuel to leak.***

Prime the fuel system if the genset ran out of fuel.

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 and listen for unusual noises. Check the genset mounting bolts.

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.

CHECKING ENGINE OIL LEVEL

Park the vehicle on level ground and shut off the genset before checking 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 plug.***

1. Pull the plug and dipstick out of the oil fill neck (Figure 3-1). The plug may be difficult to pull straight out. It is easier if you tilt the plug in its socket while pulling out. Wipe off the dipstick and thread it back into the fill neck and seat the plug, which snaps into its socket. Remove the plug and dipstick again and check the oil level on the dip stick.

2. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (Page 1-2). Keep the oil level between the high and low beads on the end of the dipstick, as shown. It is not necessary to add oil between oil changes if the oil has not dropped more than 1/3 of the way between the high and low beads. A full quart (0.9 liter) can be added if the oil level is at the lower bead.

   ⚠CAUTION ***Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the high and low beads on the dipstick.***

3. Secure the oil fill plug, which snaps into its socket.

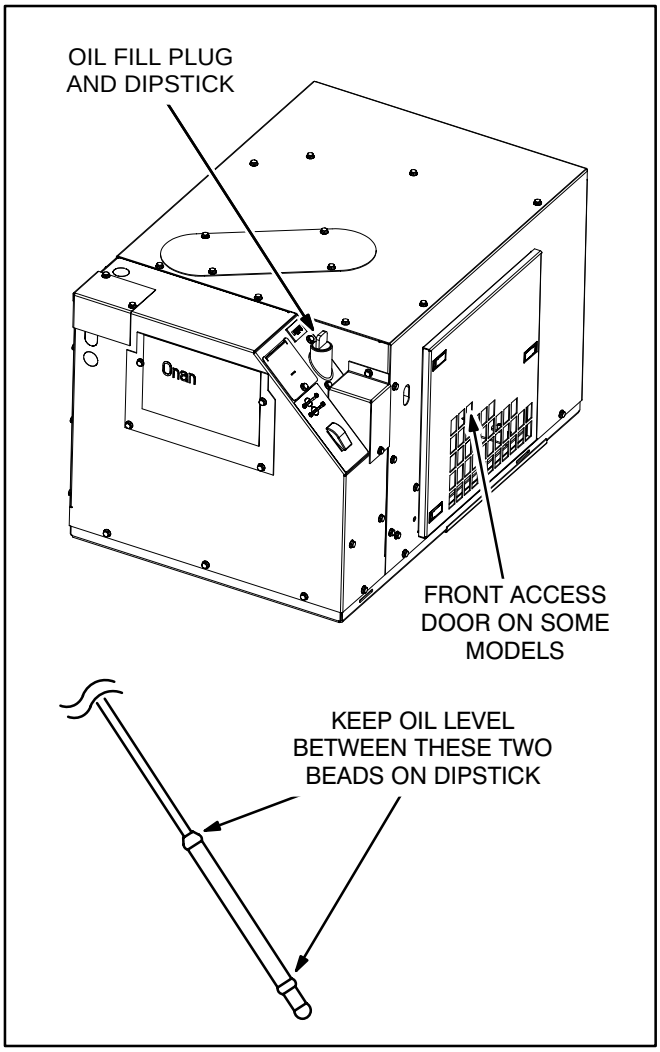


FIGURE 3-1. OIL FILL NECK AND DIPSTICK

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.***

See Table 3-1 for scheduled engine oil change. Change oil more often in hot and dusty environments.

1. Run the genset until warm and shut it off.
2. Pull the oil fill plug and dipstick (Page 3-3) out a couple of inches (50 mm) so that the oil will drain faster.
3. Depending on the installation, remove the bottom maintenance access cover (Figure 3-2) or front access door (Figure 3-1) and place a pan under the oil drain outlet.
4. Open the drain valve or remove the plug and drain all the oil from the engine.
5. ***Close the drain valve or secure the plug***.
6. Spin off the oil filter canister and clean the filter mounting surface on the engine block. Remove the old gasket if it remains.
7. Make sure the gasket is in place on the new filter and apply a thin film of clean oil to the gasket. Spin the new filter on until the gasket just touches the block. Turn it an additional 1/2 to 3/4 turn. Do not over tighten.
8. Refill with 2 quarts (1.9 liters) of oil and check the level (Page 3-3).
9. Secure the maintenance access cover.
10. Dispose of the used oil and oil filter according to local environmental regulations.

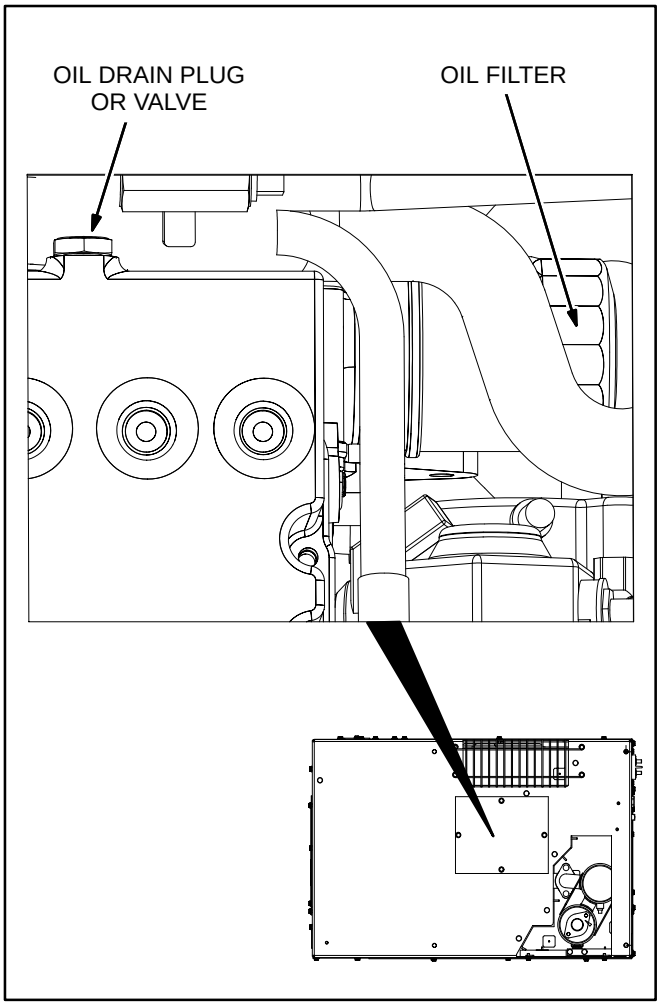


FIGURE 3-2. OIL DRAIN PLUG AND OIL FILTER

MAINTAINING THE BATTERY AND BATTERY CONNECTIONS

⚠WARNING ***Arcing at battery terminals or in light switches or other equipment, and flames or 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 work light ON or OFF away from battery—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (-) cable first and reconnect last.***

See Table 3-1 for scheduled maintenance. 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 remove 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.

Depending on the installation, remove the protective grille below the air filter (Figure 3-3) or the front access door (Figure 3-1). Then unscrew the two (2) wingnuts and pull away the housing support frame, housing and filter element.

Turn the wingnuts hand tight when installing the new filter element.

Note: The filter housing and its support frame fit only one way (one corner has been trimmed). Turn the assembly all the way around if it does not fit and try again.

Replace the bottom protective grille or the access door.

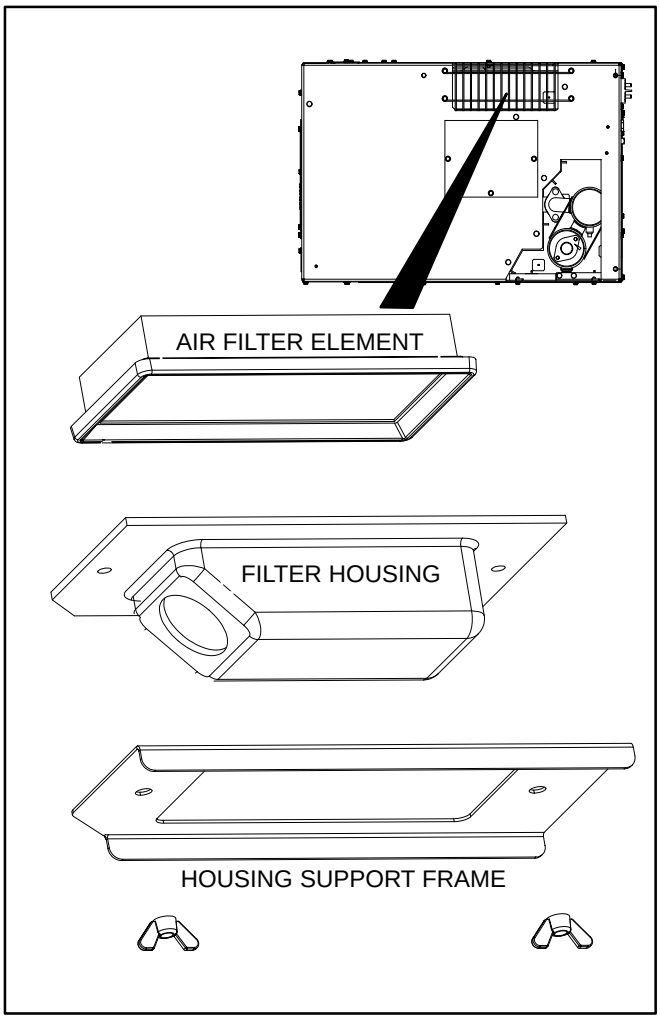


FIGURE 3-3. AIR FILTER

CLEANING THE SPARK ARRESTOR

Refer to Table 3-1 for scheduled cleaning of the spark arrestor muffler (which meets U.S. Forest Service requirements). Cleaning is required for maximum genset performance.

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

The muffler is mounted inside the genset housing. The spark arrestor cleanout plug is located on the side of the muffler and is accessible through the bottom (Figure 3-4). Clean out the muffler as follows:

1. Remove the cleanout plug (7/16 inch square head) from the muffler.
2. Start the genset and load it nearly to full power. Let the genset run for about five minutes to expel the soot.
3. Stop the genset, allow the muffler to cool down and reinstall the cleanout plug.

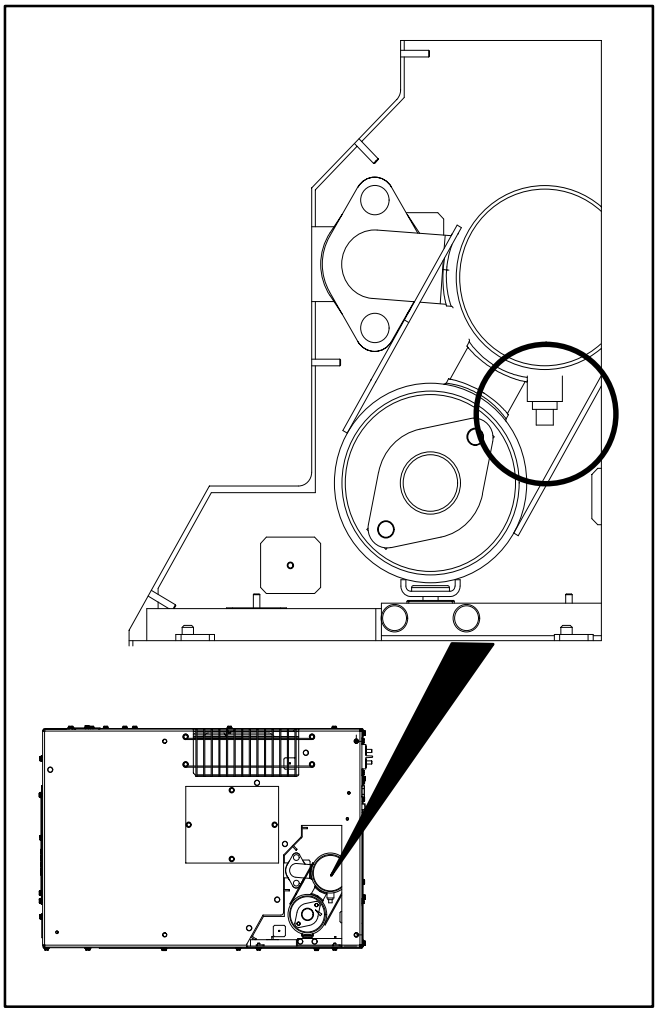


FIGURE 3-4. SPARK ARRESTOR CLEANOUT PLUG

REPLACING THE FUEL FILTER

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

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

See Table 3-1 for scheduled fuel filter replacement. A dirty fuel filter may be the cause of a failure to start. Depending on the installation, the fuel filter is accessible through the bottom maintenance access cover (Figure 3-5) or front access door (Figure 3-1) and inner cover.

⚠ CAUTION ***Wipe dirt off the fuel hose fittings at the fuel filter before disconnecting the hoses so as to keep dirt out of the fuel system.***

Removing the Fuel Filter: Take care to spill as little fuel as possible when disconnecting the filter from the fuel line. Close any shut off valve in the fuel line. Wipe dirt off the fuel hose fittings at the filter.

To remove the filter, disconnect the two fittings at the filter. *Use two flarenut wrenches on each fitting so as not to round the corners or stress the fittings.* Then remove the filter mounting nut and two (2) bracket mounting screws. Dispose of the fuel filter according to local regulations.

Installing the Fuel Filter: Secure the bracket to the new filter. The filter and its bracket fit properly only one way.

Loosely secure the filter and bracket to the base with the two mounting screws and re-connect the fuel fittings. Take care not to crossthread the fuel fittings. Thread them in by hand and tighten one flat past seating. Finally, tighten the bracket and bracket mounting screws and replace the access cover(s).

Prime the fuel system by holding the control switch down in its **Stop** position for at least 1 minute after replacing the fuel filter. Priming is necessary to displace the air in the new filter and fill it with fuel.

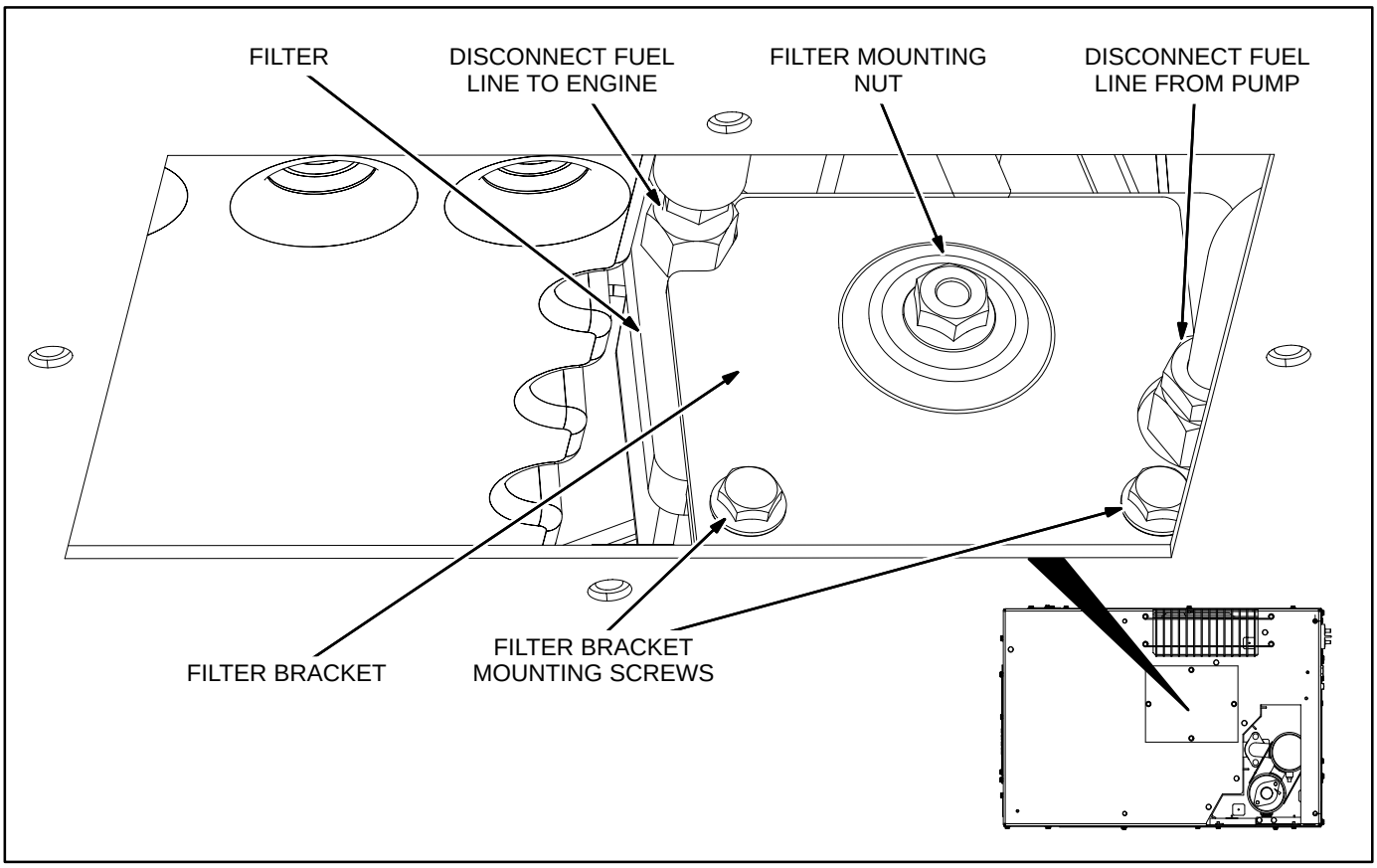


FIGURE 3-5. FUEL FILTER

CHANGING COOLANT

Refer to Table 3-1 for scheduled maintenance. The engine cooling system is filled with a 50/50 mixture of ethylene glycol anti-freeze and water when the genset leaves the factory, which is suitable for temperatures down to -34° F (-37° C).

Recommended Coolant Mixture

Use the best quality ethylene glycol antifreeze solution available. It should be fully formulated with rust inhibitors and coolant stabilizers. Use fresh water that is low in minerals and corrosive chemicals. Distilled water is best. The cooling system has a 3.1 quart (2.9 L) capacity.

Pressure Cap

Replace the pressure cap (Figure 3-8) every two years (seals deteriorate and leak). Proper cooling system pressure (14 psi) is essential for optimal engine cooling and minimal coolant loss.

Draining the Cooling System

⚠WARNING ***Hot coolant spray can cause severe burns. Let the engine cool before releasing the pressure cap or removing the drain cap.***

Let the engine cool before removing the pressure cap. Relieve any remaining pressure by turning the pressure cap slowly, without pushing down. When the pressure has been relieved, push down on the cap, turn it the rest of the way and withdraw it. Then open the radiator drain cock which is accessible through the bottom access cover (Figure 3-6) and drain the coolant into a suitable container.

⚠WARNING ***Ethylene glycol antifreeze is considered toxic. Dispose of it according to local regulations for hazardous substances.***

Clean and flush the cooling system before refilling. Radiator cleaning chemicals are available at local auto parts stores. Follow the instructions for cleaning and flushing that come with the cleaning solution.

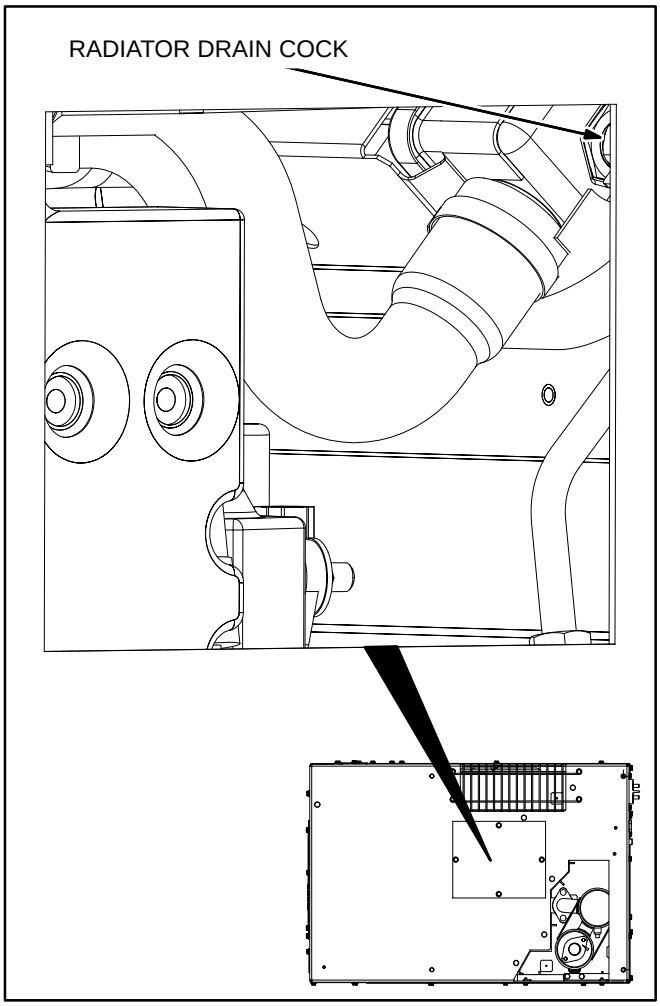


FIGURE 3-7. ENGINE COOLING SYSTEM

Refilling the Cooling System

Close the radiator drain cock and fill the system with coolant through the fill opening. Pull the hose connected to the pressure cap assembly out as far as it will go. When the coolant level reaches the fill opening, start and operate the genset for a few minutes and shut it down. Add more coolant if necessary and secure the pressure cap.

Fill the recovery tank with coolant mixture to the COLD mark.

Coolant Level Check

Check coolant level in the recovery tank (Figure 3-8) before the first startup of each day and fill to the COLD mark if necessary.

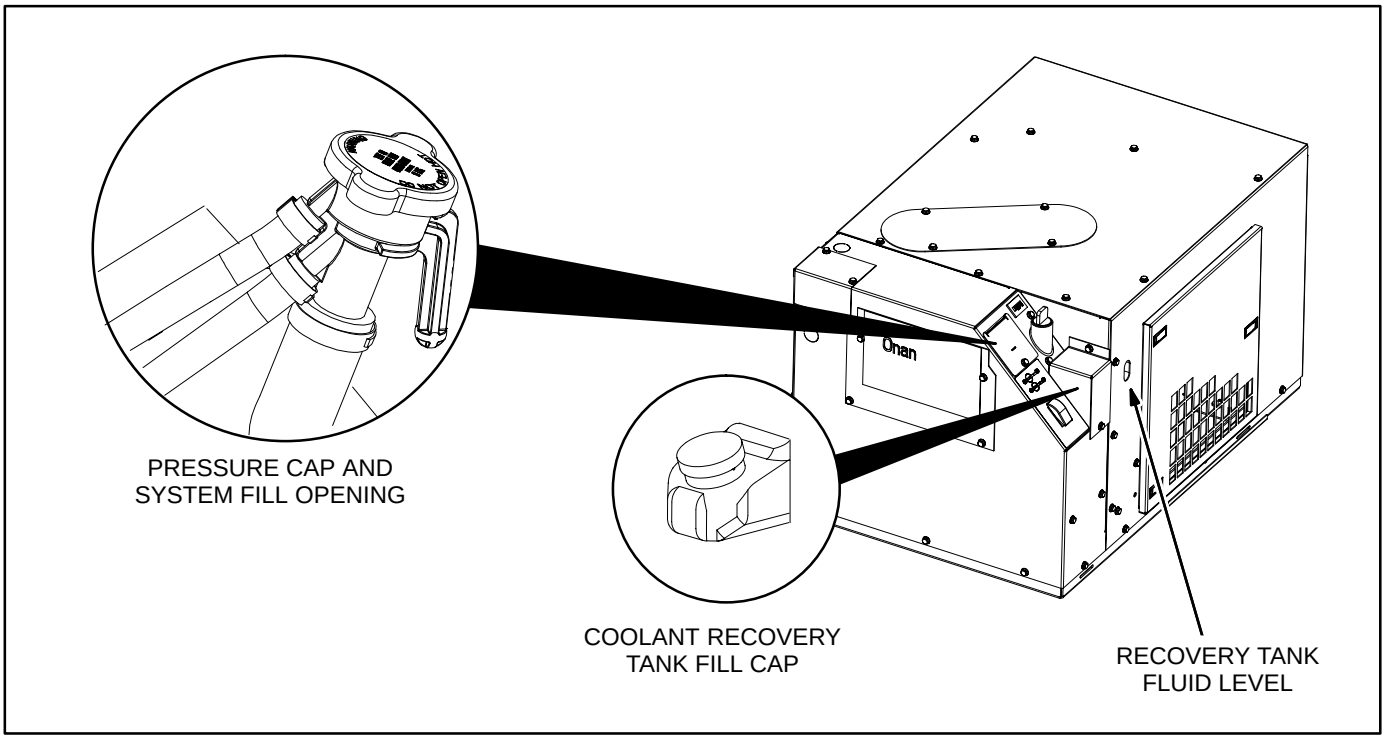


FIGURE 3-8. ENGINE COOLING SYSTEM PRESSURE CAP AND RECOVERY TANK

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4. Preparing for Service

SPECIAL TOOLS

The following tools are necessary for servicing the genset:

Torque wrench: 0-75 lbs-ft (0-100 N-m)

Tachometer

Digital multi-meter: AC and DC Voltage, Ohms

Load test panel and leads

SAFETY

Hazards and Their Sources

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	• Leaking or spilled fuel • Hydrogen gas from battery • Oily rags improperly stored • Flammable liquids improperly stored
Burns	• Hot exhaust pipes • Hot engine and generator surfaces • Electrical shorts
Poisonous Gas	• Operating genset where exhaust gases can accumulate
Electrical Shock (AC)	• Improper generator connections • Faulty wiring • Working in damp conditions • Jewelry touching electrical components
Rotating Machinery	• Fan guards not in place
Slippery Surfaces	• Leaking or spilled oil
Heavy Objects	• Removing genset from vehicle • Removing heavy components

Testing the Genset Inside a Building

Make sure there is ample fresh air when operating the genset inside a building to prevent carbon monoxide asphyxiation.

⚠WARNING ***EXHAUST GAS IS DEADLY! Engine exhaust must be vented outside if the genset is operated inside a building.***

REMOVING / INSTALLING GENSET

See Section 9. *Troubleshooting* to determine the probable cause of the problem before removing the genset for service. The genset is normally mounted in a special compartment on the floor of the vehicle or on a supporting frame. Contact the vehicle manufacturer or installer if the best way to remove the genset is not obvious.

Disconnections

1. Disconnect the negative (**-**) battery cable *from the battery* and then disconnect the battery cables from the genset.

   ⚠WARNING ***Sparks and high current could cause fire and other damage to the battery, battery cables and vehicle if the loose ends of cables connected to the battery touch. Always disconnect the negative (-) battery cable from the battery before disconnecting the battery cables from the genset.***

2. Disconnect the remote control wiring harness connector at the genset.
3. Disconnect the AC output leads at the genset terminals.
4. Disconnect the exhaust tailpipe from the muffler flange.
5. Disconnect the supply and return fuel lines from the genset.

   ⚠WARNING ***Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke if you are near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other sources of ignition well away.***

Removal from Vehicle

Make sure that the genset is firmly supported before loosening any mounting bolts. There are four bolt holes in the skid-base for securing the genset to the floor or supporting frame. The two lifting eyes are accessible through the access opening in the top panel of the genset. Lift the genset with both lifting eyes when using a hoist.

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

Installation in Vehicle

Generally, installation is the reverse of removal and disconnection. *Before installing the genset, repair any damage to and seal all hoes in the vapor-tight, fire-resistive barrier between the genset and coach interior.* Make sure all mounting screws, and brackets are secure and that all battery, AC output, control, exhaust and fuel connections are proper and in good repair. Perform the service checklist before placing the genset in service (Section 10. *Service Checklist*).

Use four Grade 5 screws (3/8-16 UNC) to secure the genset to the floor or frame. The screws must protrude at least 1/2 inch (10 mm) but not more than 1 inch (25 mm) into the base, as measured from the bottom surface of the base. Torque the screws to 35 lb-ft (41 N-m).

REMOVING / INSTALLING GENSET HOUSING PANELS

⚠WARNING ***Do not operate the genset without the housing panels secure in place. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. The housing is also required for proper genset cooling.***

See Figure 4-1. The housing consists of five removable panels. The front (service) panel may also include a removable service door secured by latches.

Note the fan inlet baffles (Figure 4-1). To line up the baffle screw holes with the holes in the front panel, remove the air inlet grille on the bottom side of the base and reach in by hand to move the baffles into alignment with the screw holes.

⚠CAUTION ***Make sure to reinstall the fan inlet baffles, which are necessary for proper genset cooling.***

When reassembling, torque the panel screws to 8 lb-ft (11 N-m).

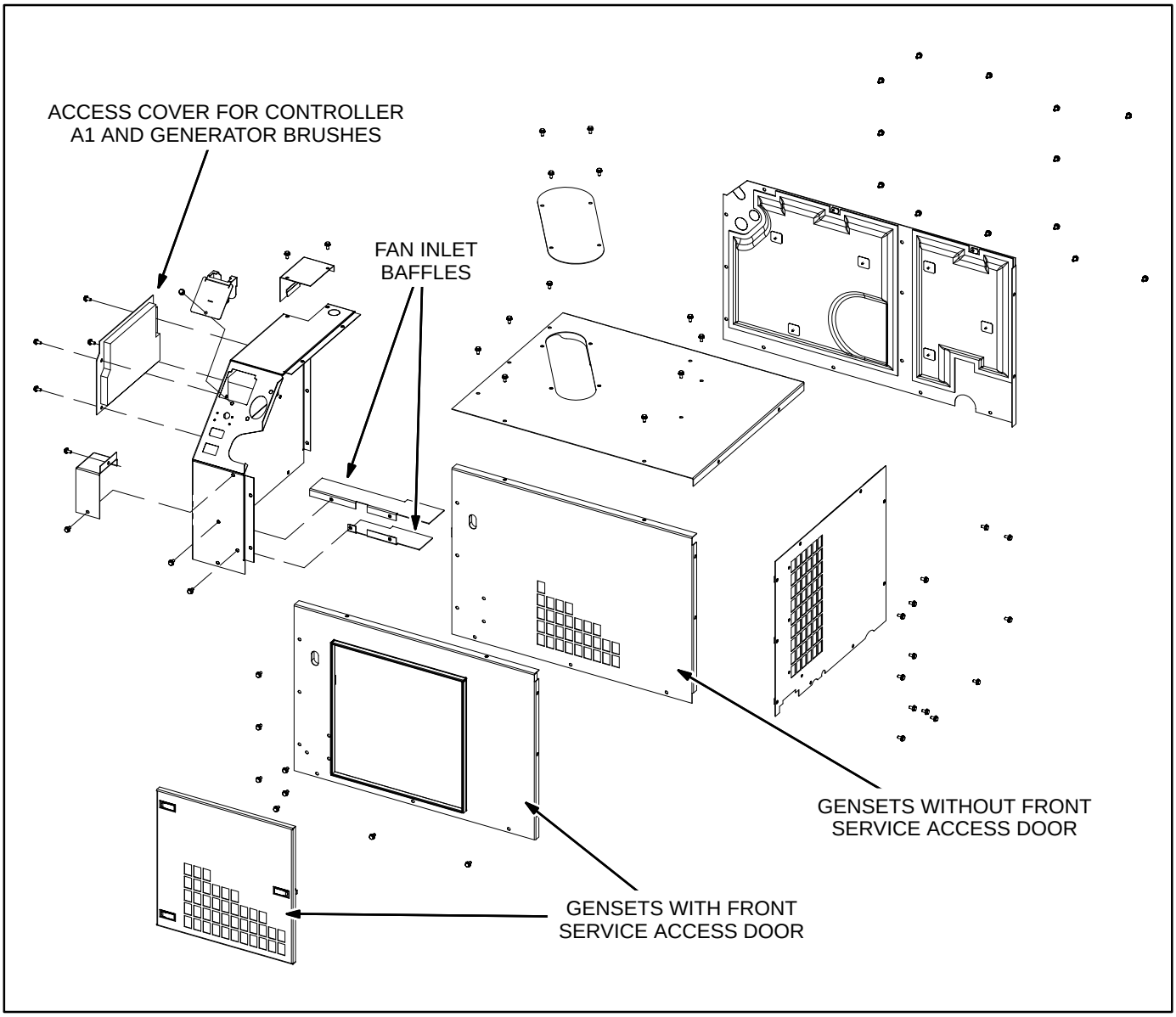

FIGURE 4-1. THE GENSET HOUSING PANELS AND THEIR MOUNTING SCREWS

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5. Control System

OVERVIEW

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. Refer to the wiring diagram (Page A-1) and wiring harness drawing (Page A-3).

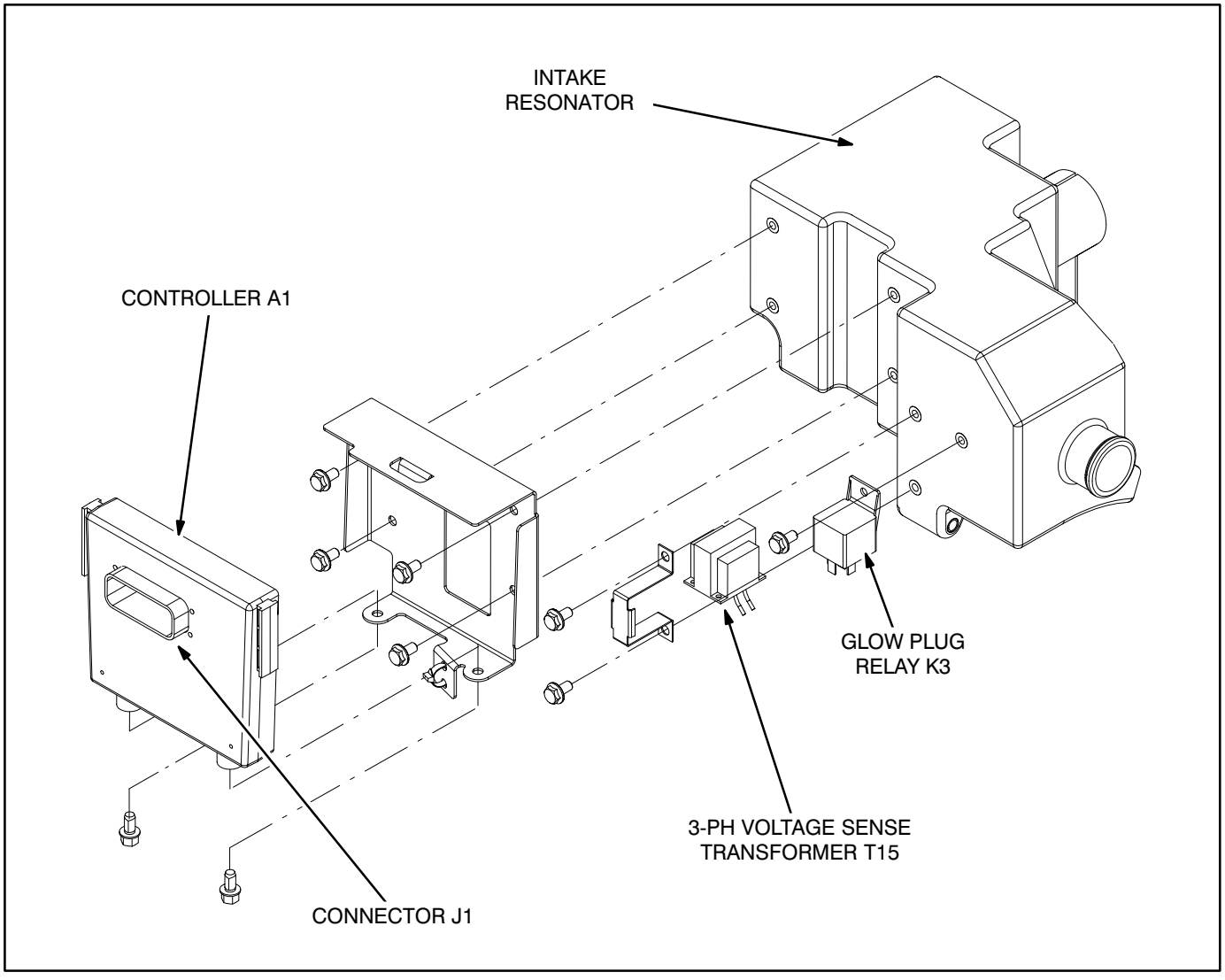

FIGURE 5-1. CONTROLLER A1

CONTROLLER A1

Major Functions

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: Press and hold the control switch at **STOP (Prime)** for more than 3 seconds to cause fuel pump E5 to prime the fuel system.

Startup: Press and hold the control switch at **START (Preheat)** until the genset starts. The controller:

1. Energizes fuel lift pump E5.
2. Energizes the glow plugs (two) during pre-heat and cranking. The duration of pre-heat prior to cranking is engine temperature dependent, but does not exceed 15 seconds.
3. Enables the status lamp to blink rapidly.
4. Enables some fault detection.
5. Enables cranking. The maximum allowed duration of cranking is engine temperature dependent and varies between 20 and 30 seconds.
6. Enables field flash (F1-F2).
7. Energizes governor actuator A12 (full rack).
8. Disconnects the starter (B1) at 800 rpm.
9. When operating speed is reached:
    A. Enables output voltage.
    B. Turns off field flash.
    C. Turns on status lamp.
    D. Enables Switched B+ (J1-8).
    E. Enables complete fault detection.

Stop: Touch the control switch to **STOP (Prime)**. The controller:

1. Disables output voltage.
2. Deenergizes the fuel lift pump and governor actuator.
3. Turns off the status lamp.
4. Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM).
5. Removes processor power when idle 5 minutes.

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

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 is supplied by the quadrature windings (Q1-Q2).

Fuel Control: The controller maintains nominal frequency as load varies by modulating the pulse width of the current energizing governor actuator A12, which moves the fuel rack.

Voltage Adjustments: See ADJUSTING VOLTAGE (Page 6-5).

Frequency Adjustments: See ADJUSTING FREQUENCY (Page 6-5).

Fault Monitoring, Shutdown and Diagnostics: See Section 9. *Troubleshooting*.

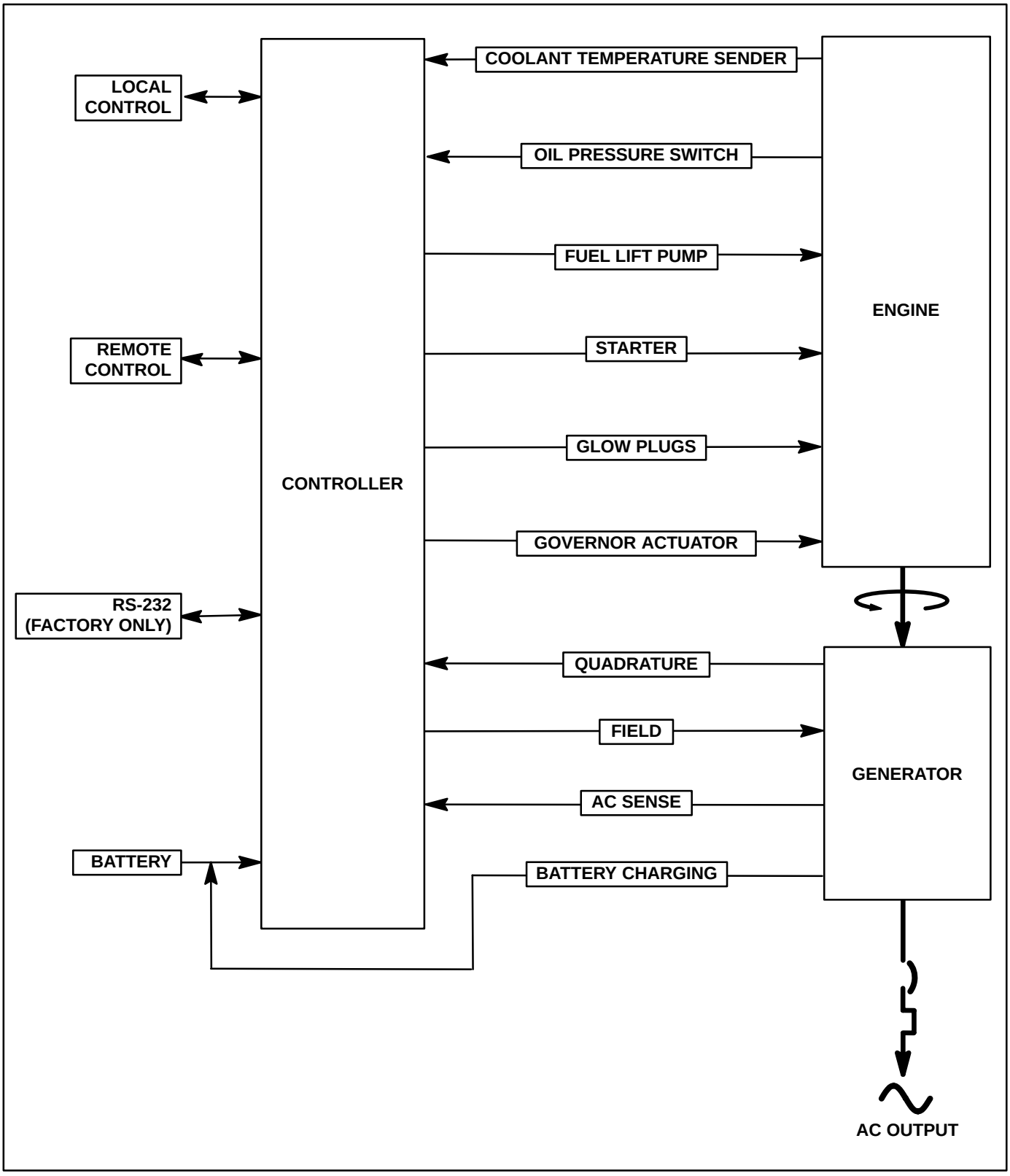

FIGURE 5-2. CONTROLLER A1 BLOCK DIAGRAM

Controller A1 Removal / Replacement

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

The controller is mounted on the intake resonator and is accessible through the access panel on the left end of the enclosure. Use a small flat-bladed screwdriver to lever out the catch on connector P1/J1 and pull the connector apart (Figure 5-3).

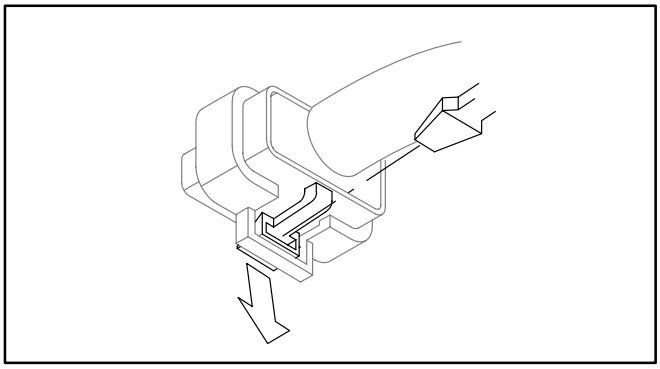

FIGURE 5-3. DISCONNECTING P1 / J1

CONTROL SWITCH S1

The switch is mounted on the control panel (Figure 5-4). Unsnap connector P9, which is accessible through the access panel on the left end of the enclosure, 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 or close across terminals 1 and 2 when held in the Stop position, or the status indicator light does light when 12 VDC is connected across terminals 7 (**-**) and 8 (**+**). See Figure 5-5.

LINE CIRCUIT BREAKERS CB1, CB2, CB3

The line circuit breakers are mounted on the control panel and are accessible through the access panel on the left end of the enclosure (Figure 5-4). 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 M1

The hour meter (when the genset is so equipped) is mounted on the control panel and is accessible through the access panel on the left end of the enclosure (Figure 5-4).

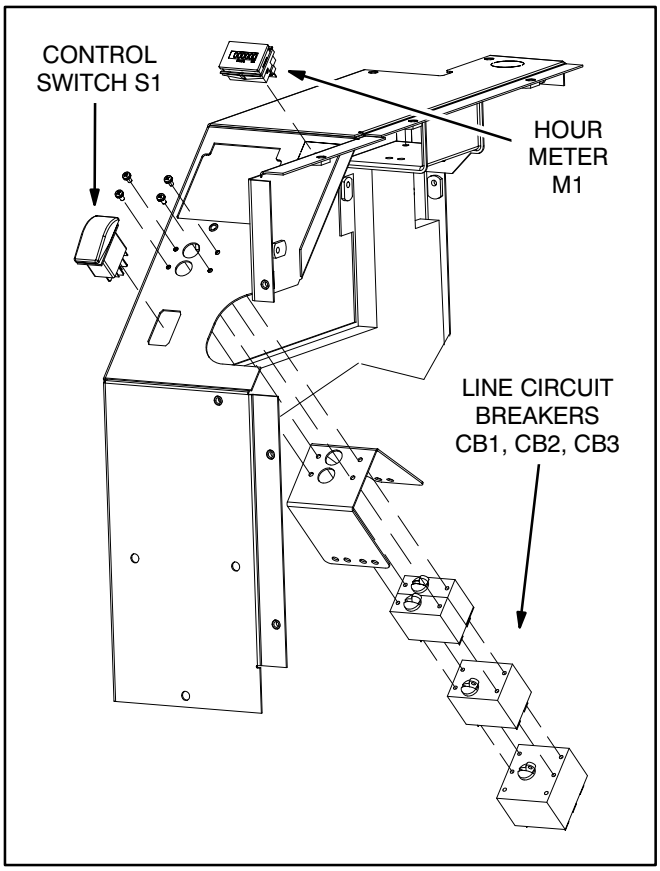

FIGURE 5-4. CONTROL SWITCH, LINE CIRCUIT BREAKERS, HOUR METER

GLOW PLUG RELAY K3

The glow plug relay is mounted in its wiring socket on the intake resonator (Figure 5-1). Pull the relay out to test it. Apply 12 VDC across terminals 85-86. Replace the relay if the contacts across terminals 30-87 (NO) do not open and close.

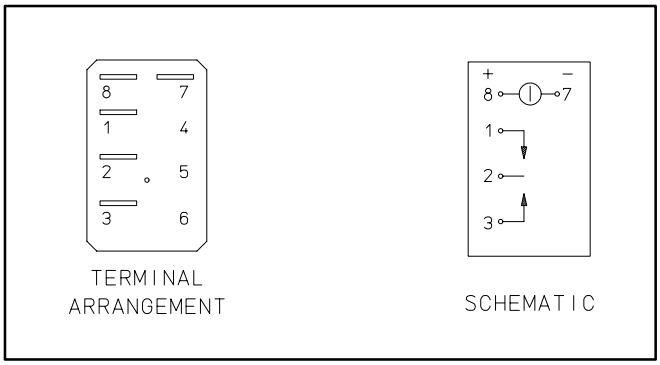

FIGURE 5-5. CONTROL SWITCH S1

3-PHASE VOLTAGE SENSE TRANSFORMER T15

Mounting: The voltage sense transformer for 3-phase generators is mounted on the intake resonator (Figure 5-1). It is connected as shown on Page A-2 to sense output voltage in L1.

Testing: Replace the transformer if resistance in either winding is not as specified in the schematic (Figure 5-6).

BATTERY CHARGE REGULATOR AVR1

Mounting: The regulator and heat sink are mounted as shown on the engine-generator adaptor and are accessible when the top or back panel is removed (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.

DC CONTROL FUSE F1

This is a 30 amp mini-bayonet fuse in the wiring harness near the starter solenoid (Page A-3). It is accessible from below through the access panel in the base.

OIL PRESSURE SWITCH S2

See Page 8-5.

COOLANT TEMPERATURE SENDER E4

See Page 8-5.

FUEL PUMP E2

See Page 8-8.

STARTER MOTOR B1

See Page 8-11.

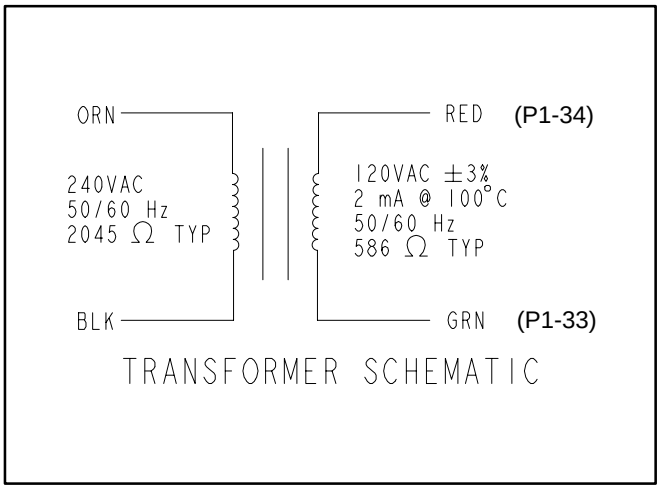

FIGURE 5-6. 3-PHASE VOLTAGE SENSE TRANSFORMER T15

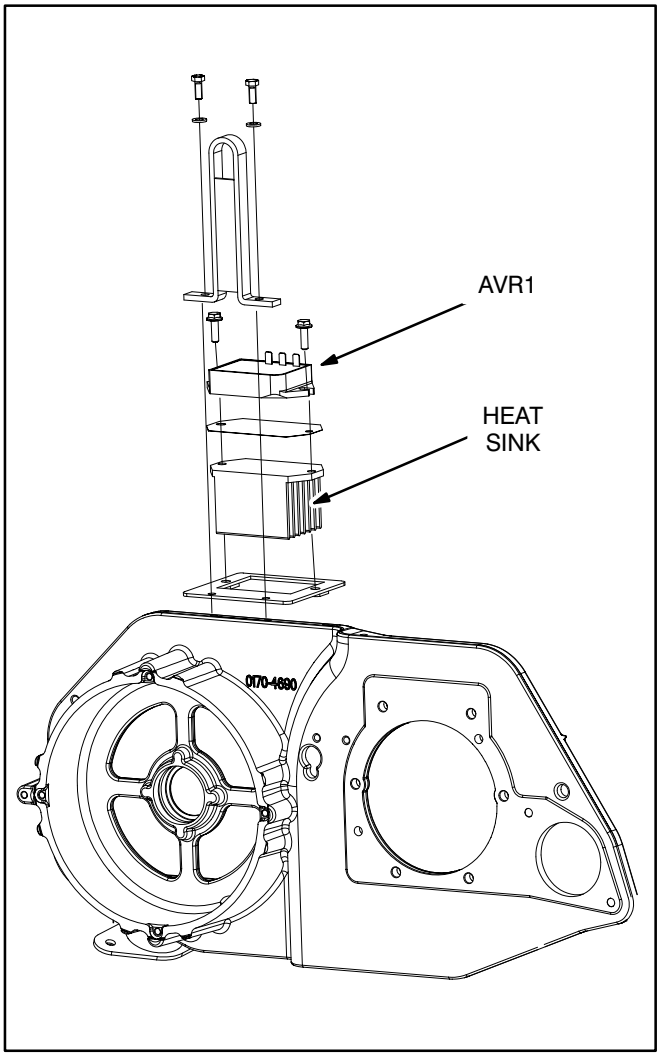

FIGURE 5-7. BATTERY CHARGE REGULATOR AVR1

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6. Generator

OVERVIEW

These are belt-driven, 2-bearing, 2-pole (3600 rpm), 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.) are for powering the connected loads. The quadrature windings (Q1-Q2) are for field excitation. Some models have battery charge windings (B1-B2).

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. The drive belt pulley and fans are center-bolted to the tapered rotor ends.

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

Principle of Operation: During startup genset controller A1 flashes the field with 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 for engine recovery.

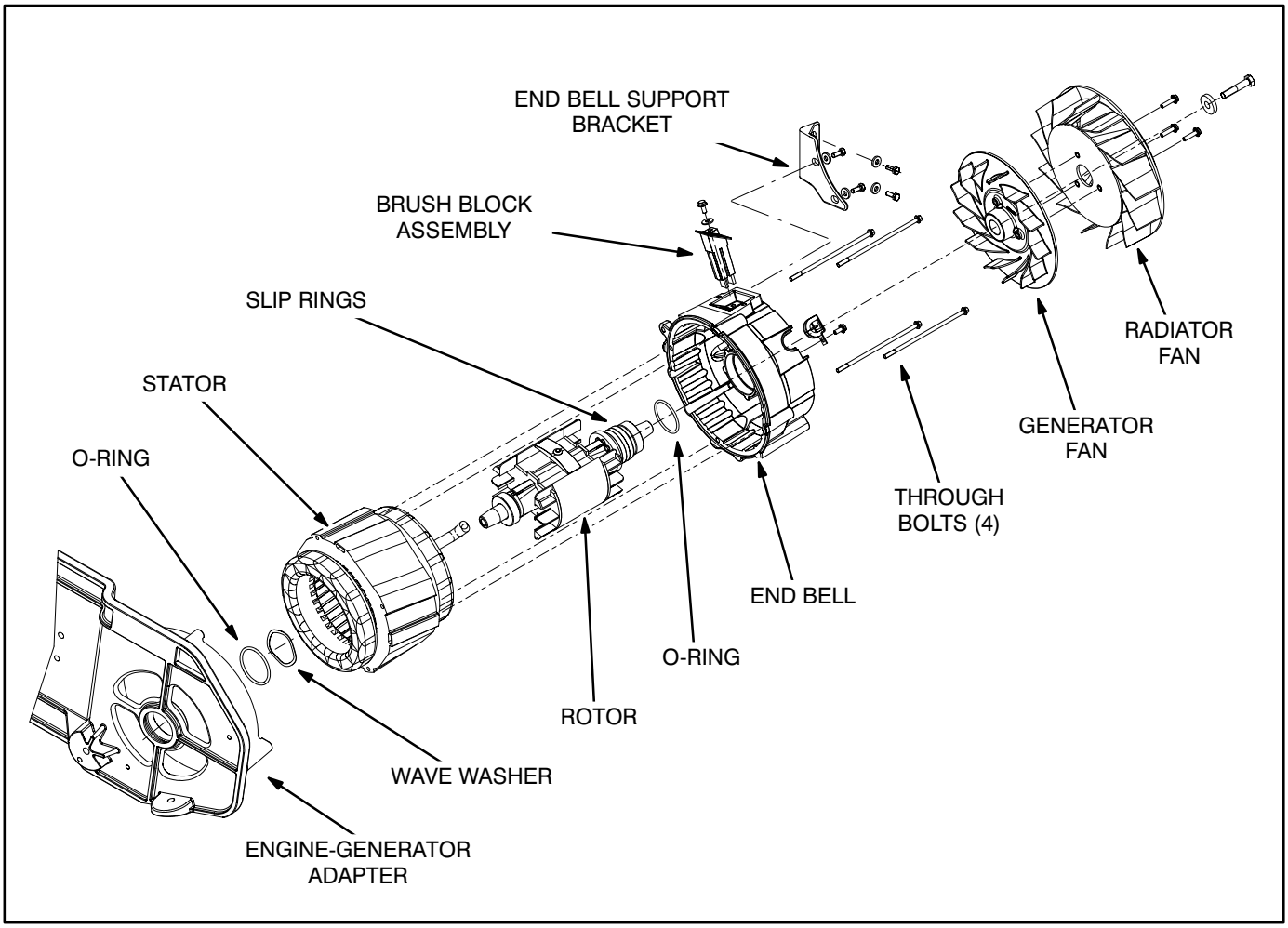

FIGURE 6-1. GENERATOR

SERVICING THE GENERATOR

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Stator Removal

1. Disconnect the generator leads inside the AC outlet box and remove all enclosure panels.
2. Remove the brush block (Figure 6-1).

   ⚠CAUTION ***The brushes can be damaged if the brush block is not removed before removing the end bell.***

3. Remove the fan hub bolt and fan. (To keep the rotor from turning while loosening the fan bolt, hold the pulley bolt with a wrench.) To pull the fan off the shaft taper, secure a three-point wheel puller to the three holes in the fan hub with M6 or 1/4 inch self-tapping screws.
4. Remove the end bell support bracket from the engine bracket and the end bell (4 bolts).
5. Scribe a line across the adapter, stator laminations and end bell to make realignment easier during reassembly.
6. Block the stator so that it does not fall against the rotor, and then remove the four generator through bolts.
7. Pull the generator end bell straight out. Examine the bearing bore and replace the end bell if it is scored or otherwise damaged by the bearing.
8. Pull the stator assembly straight out, taking care not to damage rotor or stator windings.
9. Block the rotor to support its hanging weight to prevent damage to the adapter and bearing.

Stator Reassembly

Reassembly is the reverse of removal. Note the following:

1. Loosen the end bell support bracket bolts, if not already removed, so that the bracket does not interfere with proper stator and end bell alignment.
2. Align the stator and end bell with the line scribed on them during disassembly.
3. Relubricate the bearing bore in the end bell with molybdenum disulfide paste (Onan PN 524-0118 or equivalent).
4. Make sure the O-ring is in place in the bearing bore.
5. Torque the stator through bolts and end bell bracket bolts to 8 lb-ft (11 N-m) and the fan hub bolt to 45 lb-ft (61 N-m). (To keep the rotor from turning while tightening the fan bolt, hold the pulley bolt with a wrench.)

Rotor

To remove the rotor, remove the stator and then the drive pulley (Page 7-2) and pull the rotor straight out to the front. Catch the wave washer so that it can be reused. When reassembling, lubricate the bearing bores in the end bell and adapter with molybdenum disulfide paste (Onan PN 524-0118 or equivalent). Make sure the wave washer is in place in the engine-generator adaptor and that the O-rings are in place in the bearing bore groves in both ends.

Use an adhesive when installing new bearings on the rotor shaft. Apply the adhesive to the shaft (Locktite 680 or equivalent) and primer (activator) to the bearing (Locktite 747 or equivalent). 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.***

SERVICING BRUSHES AND SLIP RINGS

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Brush Block

Access: Remove the access panel on the left end of the enclosure for access to the brush block.

Service: 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-** (black) to the outside terminal, and **F+** (red) to the inside terminal.

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.

TESTING FIELD FLASH

Field flash can be tested by measuring output voltage while cranking with the governor actuator leads (Page 8-2) disconnected to keep the engine from starting. If output voltage increases at least 1 volt while cranking, the whole field excitation system—controller, brushes, slip rings and rotor—are probably in working order and the problem lies elsewhere. See Section 9. *Troubleshooting*.

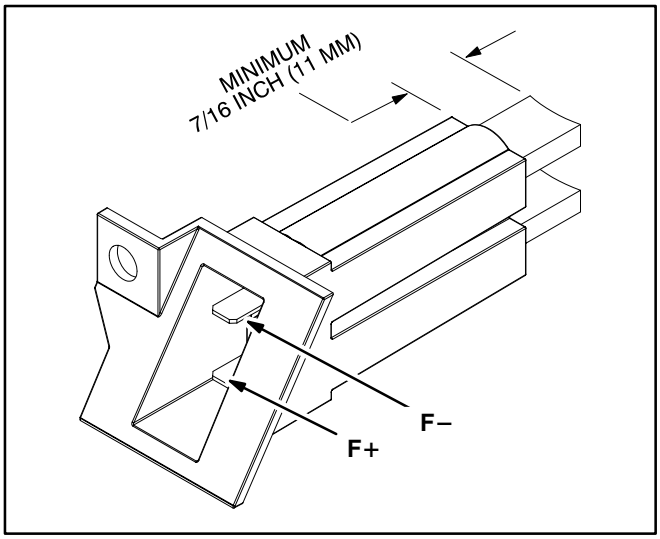

FIGURE 6-2. BRUSH BLOCK

TESTING GENERATOR WINDINGS

Testing the Rotor

Field Resistance Test: Remove the access panel on the left end of the enclosure for access to the brush block and connector P1 (controller A1). Disconnect field leads F1 and F2 from controller A1 by pulling connector P1 and measure resistance across pins 1 and 14. If resistance is not as specified in Table 6-1:

1. Check for and repair faulty field leads.
2. Service brush block and slip rings (Page 6-3).
3. Check rotor resistance across the slip rings. Replace the rotor if resistance is not as specified.

Ground Test: Using a megger or the highest scale on a digital ohmmeter, measure resistance between the rotor and either slip ring. Replace the rotor if its winding has less than one megohm resistance to ground.

TABLE 6-1. ROTOR WINDING RESISTANCE

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

Testing the Stator

Disconnect T1, T2, T3 and T4 from the terminals in the output box. Disconnect B1 and B2 from charging regulator AVR1. Disconnect Q1 and Q2 from controller A1 by pulling connector P1 (Pins 3 and 13).

Open Winding Test: Measure resistance across each winding lead pair (Table 6-2). Replace the stator if any winding is open (zero ohms).

Winding Resistance Test: Use a meter (Wheatstone Bridge) having 0.001 ohm precision to measure resistance across each winding lead pair (Table 6-2). Replace the stator if resistance in any winding is not as specified.

Ground Test: Using a megger or the highest scale on a digital ohmmeter, measure resistance between the stack and each stator lead. Replace the stator if any winding has less than one megohm resistance to ground.

TABLE 6-2. STATOR WINDING RESISTANCES

WINDING	RESISTANCE (OHMS) @ 77° F (25° C) ± 10%
120/240 VAC, 60 Hz	
T1-T2, T3-4	0.612
Q1-Q2	2.42
B1-B2	0.124
120 VAC, 60 Hz	
T1-T2, T3-4	0.153
Q1-Q2	2.42
B1-B2	0.124
230 VAC, 50 Hz	
T1-T2, T3-4	0.692
Q1-Q2	2.89
B1-B2	0.112
3-Ph, 400 VAC, 50 Hz	
T1-T2, T1-T3, T2-T3	0.35
Q1-Q2	3.28
B1-B2	0.418
3-Ph, 240 VAC, 60 Hz	
T1-T2, T1-T3, T2-T3	0.97
Q1-Q2	2.73
B1-B2	0.303

RECONNECTING THE GENERATOR

Reconnect the generator properly for the application. See Page A-2.

ADJUSTING FREQUENCY

If it is necessary to change the output frequency for the application, remove the access cover on the left end of the genset. Find the leads marked **J8 HZ**, **60 HZ** and **50 HZ** in the wiring harness (Page A-3). Connect **60 HZ** or **50 HZ** to **J8 HZ**, as appropriate, and secure the access cover (4 screws).

ADJUSTING VOLTAGE

Output voltage may need to be readjusted for the application, especially if it was necessary to change the frequency and/or reconnect the generator (Page A-2). Recheck generator reconnections and reconsider whether frequency needs to be changed before attempting voltage adjustments.

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. The *green* status indicator lamp will remain on. The controller resumes normal operating mode 20 seconds after the last adjustment.

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 10 seconds.

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 1 second. 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. The last adjustment will be retained by the controller.

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7. Drive System

OVERVIEW

The engine drives the generator by means of a 6-rib “Poly-Vee” belt (Figure 7-1). The drive pulley is mounted on the engine flywheel by means of a flexible coupling. The generator pulley is center-bolted to the tapered end of the rotor shaft. The pulley must be removed to remove the generator rotor from the engine-generator adapter.

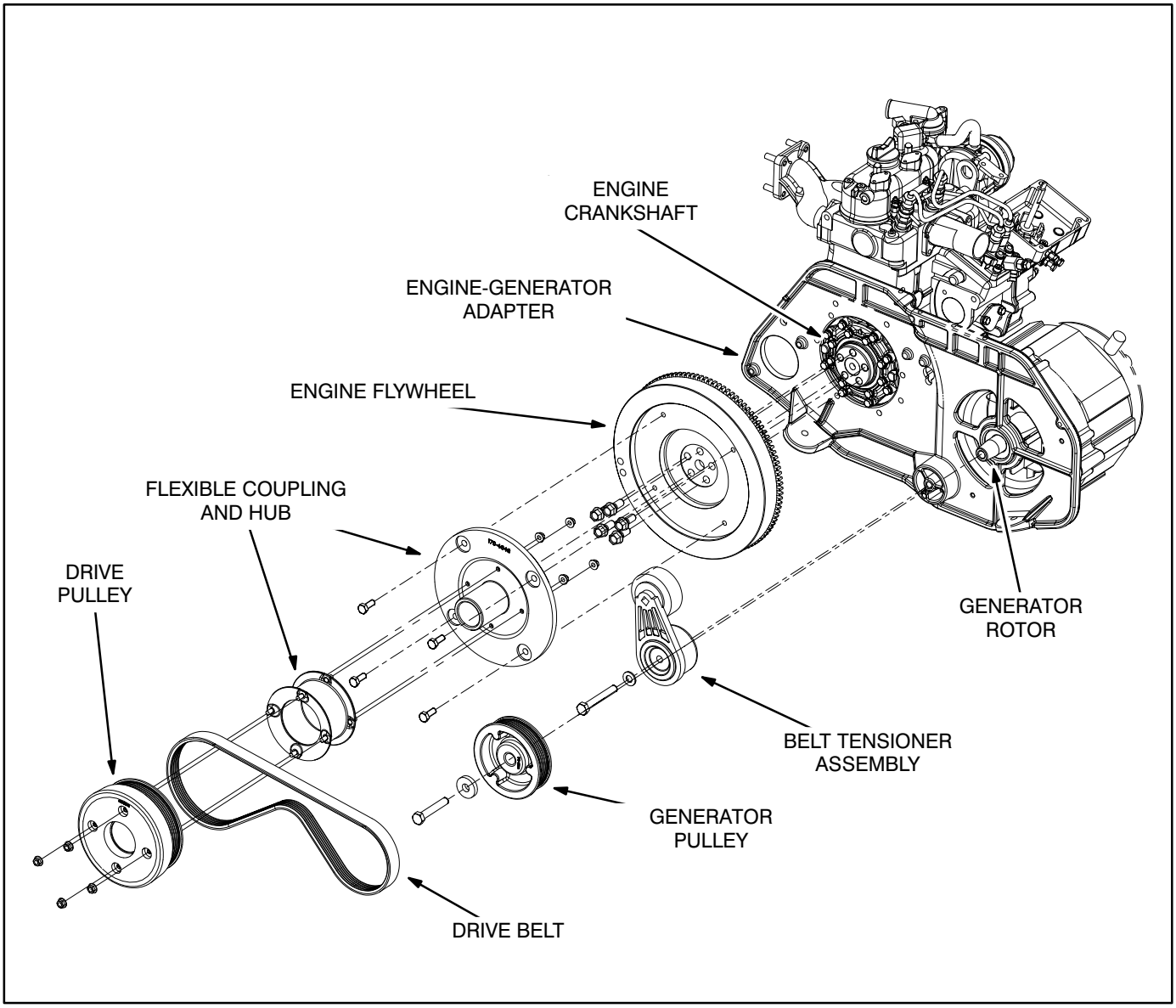

FIGURE 7-1. GENERATOR DRIVE

INSPECTING DRIVE AND BEARINGS

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Remove the back panel (Page 4-1) to inspect the drive and bearings:

1. Pivot the belt tensioner away from the belt with a 3/8 inch drive and remove the belt. Examine the belt for cracks, worn spots and other signs of deterioration. Replace the belt if necessary or if it has been in service 5 years or 2000 hours.
2. Remove the drive pulley and coupling as an assembly from the flywheel and then the pulley from the coupling. Examine the coupling for wear and deterioration and replace it if necessary. Examine the two split-sleeve bearings in the pulley hub for wear and scoring and replace them if necessary.

   When reassembling, torque the coupling nuts to 8 lb-ft (12 N-m) and the 4 hub-to-flywheel bolts to 21 lb-ft (29 N-m).
3. Spin the idler pulley. Replace the bearing if it does not spin smoothly or is noisy. Replace the idler assembly if it does not pivot smoothly from one end of its travel to the other.
4. Spin the generator pulley by hand to determine if there is any noise, looseness or grinding. Check for side-to-side and up-and-down looseness of the bearing. If necessary, disassemble the generator (Page 6-2) to determine the cause of the looseness or noise. Replace the rotor assembly if it is evident that either bearing has spun on the shaft. Replace the end bell or adapter if it is evident that the bearing has spun in the bore. Replace the bearings if they have been in service 5 years or 2000 hours.

SERVICE

Generator Pulley

Remove the belt and pulley center bolt and use a claw-type wheel puller to break the pulley free of the generator shaft taper. (To keep the rotor from turning while loosening the pulley bolt, hold the fan bolt with a wrench.) Torque the center bolt to 45 lb-ft (60 N-m) when reassembling.

Tensioner Pulley Assembly

Spin the idler pulley. Replace the bearing if it does not spin smoothly or is noisy. Replace the idler assembly if it does not pivot smoothly from one end of its travel to the other. Torque the center pivot bolt 45 lb-ft (60 N-m).

Drive Pulley and Coupling

Remove the drive pulley and coupling as an assembly from the flywheel. Then, if necessary, remove the 4 coupling nuts on each end to disassemble the coupling from the hub and the pulley. Examine the coupling for wear and deterioration and replace it if necessary. Examine the two split-sleeve bearings in the pulley hub for wear and scoring and replace them if necessary.

Torque the coupling nuts to 8 lb-ft (12 N-m) and the 4 hub-to-flywheel bolts to 21 lb-ft (29 N-m).

Flywheel

Remove the drive pulley and coupling as an assembly for access to the flywheel mounting bolts. Scribe a line across crankshaft and flywheel to make realignment easier when reassembling. ***The flywheel will only go on one way because the bolts are not quite evenly spaced. Proper alignment is necessary to preserve engine balance and timing mark.***

Torque the 5 mounting bolts to 42 lb-ft (56 N-m) when remounting the flywheel.

Engine-Generator Adapter

To remove the adapter, first remove the engine-generator assembly from its mounting on the three vibration isolators, the generator (Page 6-2) from the adapter and the flywheel from the engine. Torque the 6 mounting bolts to 21 lb-ft (29 N-m) when reassembling.

8. Engine

MAJOR ENGINE SERVICE

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Refer to engine Workshop Manual 981-0536 for major engine service, setting fuel injection timing, replacing glow plugs, cleaning the crankcase breather assembly and replacing the coolant pump.

Note: To preserve the high-idle speed setting, do not disturb the lock wires on the governor adjusting screws (Page 8-4) when removing the actuator base for engine service.

FUEL INJECTION TIMING MARKS

Remove the back panel for access. Note that the timing marks (Figure 8-1) line up at 19° BTDC.

ADJUSTING VALVE LASH

Remove the top panel for access. Do not use the fuel injection timing marks (Figure 8-1) when adjusting valve lash. That could lead to misadjustments.

Adjust valve lash when both valves are closed at TDC for the power stroke (every other revolution). To locate this position for either cylinder, rotate the engine clockwise (looking from the front) until the intake valve push rod (Figure 8-2) just stops moving down (valve closed). Then turn the engine half a turn more and set lash for both valves (intake and exhaust) at 0.0059-0.0073 inch (0.145-0.185 mm). Repeat this procedure for the other cylinder.

GLOW PLUGS

Refer to engine Workshop Manual 981-0536 when replacing the glow plugs).

Note: If a glow plug does not come out after unscrewing it, or the end has broken off, it will be necessary to remove the engine head. Glow plugs can swell if preheat voltage is greater than 14 volts, such as when a battery booster is used for starting.

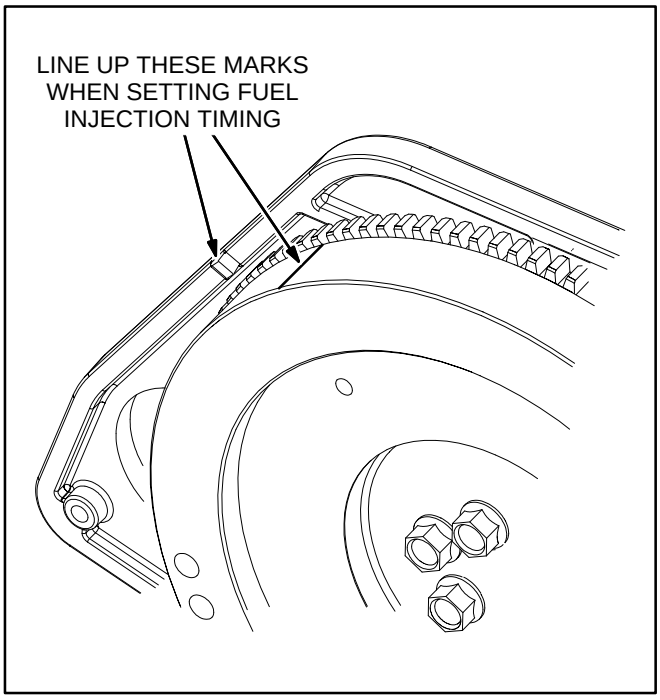

FIGURE 8-1. FUEL INJECTION TIMING MARKS

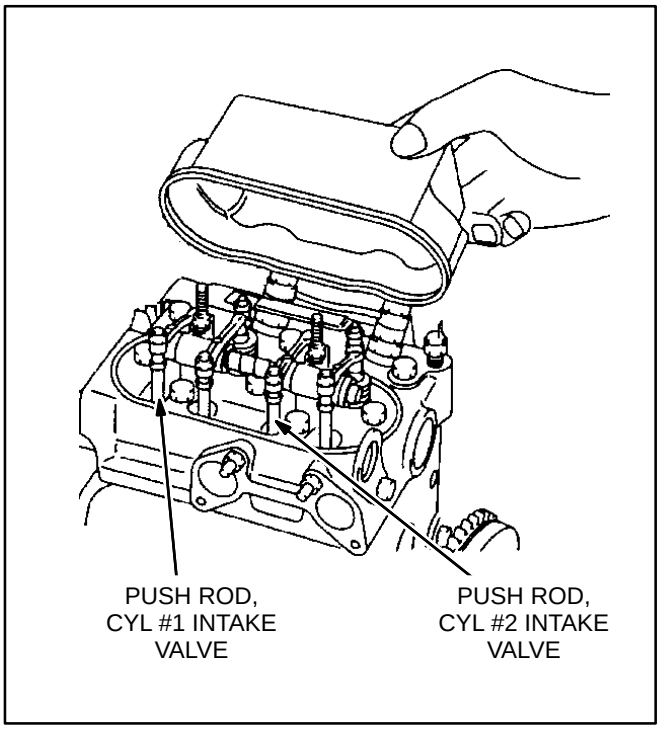

FIGURE 8-2. ROCKER ARMS AND PUSH RODS

GOVERNOR ACTUATOR

The position of the rotor in governor actuator A12 (Figure 8-3) is determined by the modulated pulse width of the current supplied by controller A1.

Assembly / Disassembly

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Stator: Remove the front and top panels for access. To remove the stator, disconnect the 2 actuator leads and remove the cover and 4 stator screws. Pry out the leg of the return spring with a screwdriver. (Be prepared to catch the spring if it flies off.) Lift off the bearing carrier and stator.

⚠WARNING ***The spring can fly off and cause severe eye injury. Wear safety glasses.***

Stator reassembly is the reverse of disassembly. The bearing carrier must seat squarely in the stator. Torque the stator screws to 24 lb-in (2.7 N-m).

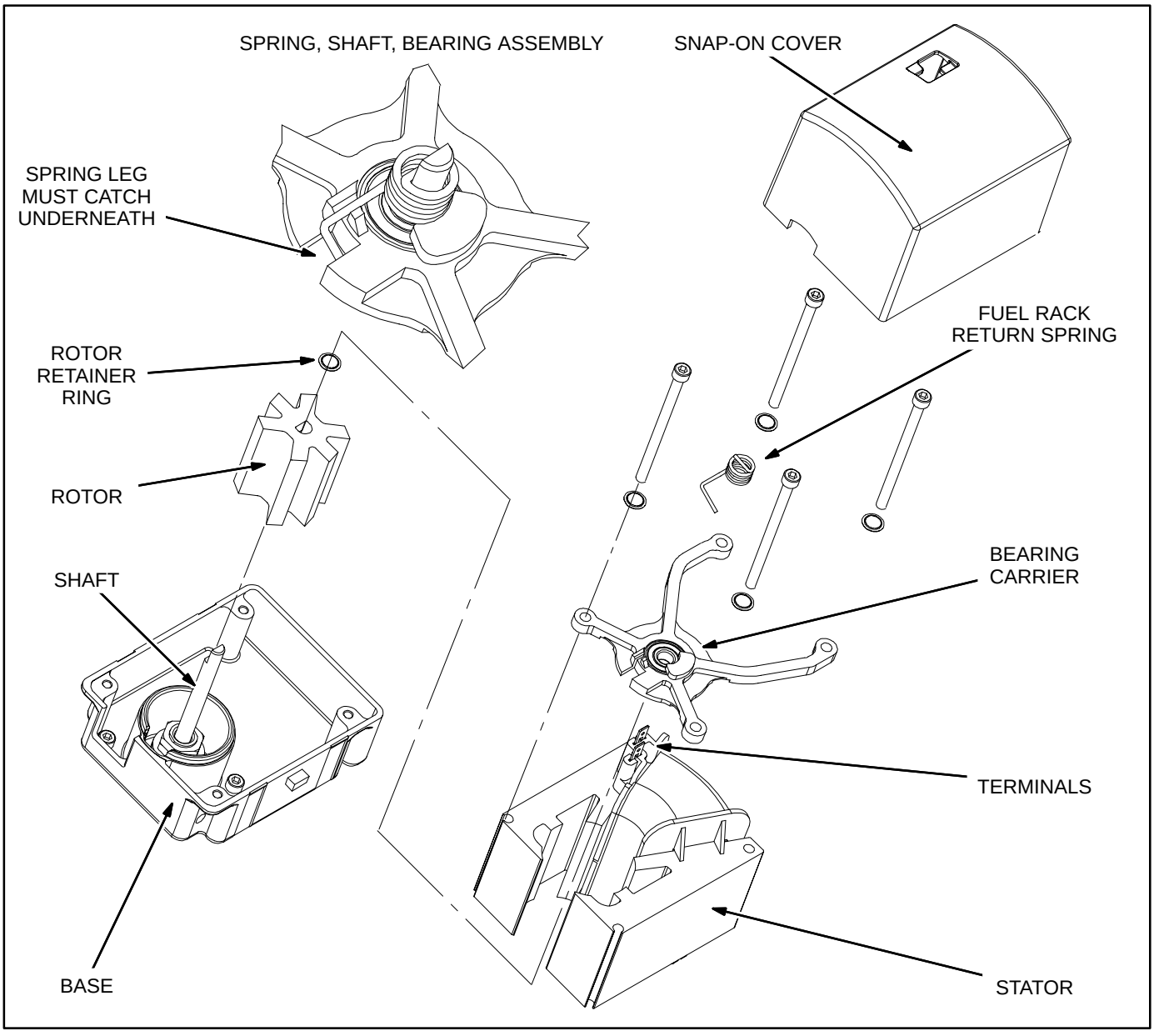

FIGURE 8-3. GOVERNOR ACTUATOR

Replace the return spring if it is worn. This spring returns the fuel rack to the no-fuel position. Push the spring on over the flat on the shaft and pry the leg into its slot (Figure 8-3). The leg below the knee must catch underneath and the spring must be pushed down as far as it will go.

⚠ CAUTION ***The genset may not stop reliably if the fuel rack return spring is not assembled properly.***

Use wire ties to secure the cover.

Rotor: The rotor can be pried off the shaft after the bearing carrier has been removed.

Use a new retainer ring when reassembling. Note that the ring is concave (dished). Push the dished side up against the rotor to keep it in place on the shaft.

Base: See engine Workshop Manual 981-0536 if it is necessary to remove the actuator base or replace internal engine governor parts. The stator must be removed for access to the screws that secure the base to the engine.

Note: To preserve the existing high-idle speed adjustment, do not disturb the lock wires on the adjusting screws on the governor actuator base (Page 8-4) when removing it from the engine for engine service.

Adjusting Speed Control Lever Stop

The actuator speed control lever stop (Figure 8-4) must be adjusted whenever a different actuator base assembly is installed. The stop screw, rather than the fuel rack control lever, must stop the speed control linkage when the fuel rack is driven to the no-fuel position.

Note: To adjust the stop, the rotor need not be on the shaft, but the end of the shaft must be supported by the bearing carrier.

1. Remove the front and top panels for access to the adjusting screw.
2. Loosen the stop screw locknut and back the screw out a few turns. (Top one in the group of three.)
3. Turn the stop screw in until it just makes contact and set the locknut.

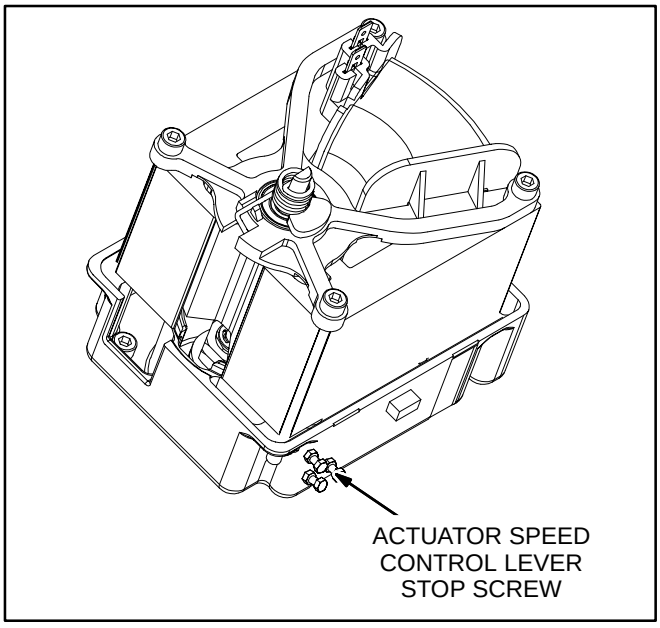

FIGURE 8-4. SPEED CONTROL LEVER STOP

Adjusting High-Idle Speed

⚠WARNING ***This adjustment involves operating the genset with enclosure panels removed that guard against moving parts that can cause severe personal injury or death. Keep your hands away from the engine belt and pulleys.***

High-idle speed (Figure 8-5) must be checked each time an actuator base is reinstalled or replaced.

For an initial adjustment when installing a new base, (to make sure the engine stops when the actuator is deenergized), turn the high-idle speed adjusting screw in until the head of the screw is 3/4 inch (19 mm) from the base (Figure 8-5).

Note: Be prepared, if necessary, to clamp off the supply *and the return* fuel lines to stop the engine.

1. Adjust the speed control lever stop (Page 8-4).
2. For this test, measure engine speed with a strobe or injector clamp-on type tachometer.
3. Remove the front and top panels for access to the speed adjusting screw.
4. Disconnect the actuator leads and connect a 12 volt battery to the actuator terminals *using a battery switch*. (The battery will hold the governor mechanism against the high speed stop and allow the engine to run after shutdown—probably Code No. 15.)

   ⚠CAUTION ***The actuator could overheat if the battery is left on more than 10 minutes.***
5. When ready, switch the battery on, start the genset, measure engine speed (rpm) *and stop the engine by switching off the battery.*
6. Readjust high-idle speed, as follows, if not between 3300 and 3400 rpm:
   A. Loosen the lock nuts on the two bottom screws and back out the clamping screw.
   B. To increase speed, turn the speed adjusting screw in 1 turn (clockwise). To decrease speed, turn it out 1 turn (counterclockwise).
7. Repeat Steps 5 and 6 until high-idle speed is between 3300 and 3400 rpm. Set the lock nut.
8. Run the clamping screw in by hand until snug, back it out 1-1/2 turns and set the lock nut.

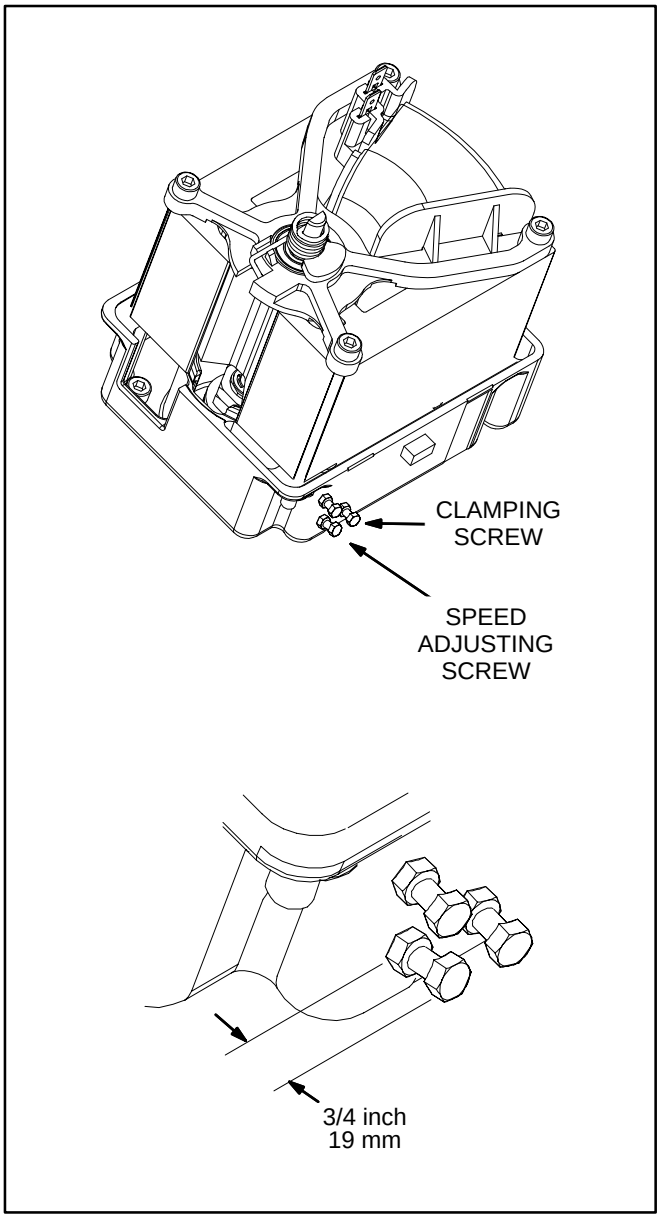

FIGURE 8-5. HIGH-IDLE SPEED SCREW

COOLANT TEMPERATURE SENDER E4

Remove the top or back panel for access to the sender (Figure 8-6). Use thread sealant and engage at least two threads when reassembling.

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Replace the sender if resistance is not approximately 800 ohms at room temperature or does not decrease rapidly when immersed in boiling water.

LOW OIL PRESSURE SWITCH S2

Remove the top or back panel for access to the switch (Figure 8-6). Use thread sealant and engage at least two threads when reassembling.

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Replace the sender if it is not open when the engine is not running (zero pressure). Replace it if it does not close when the engine is running and known to have normal oil pressure.

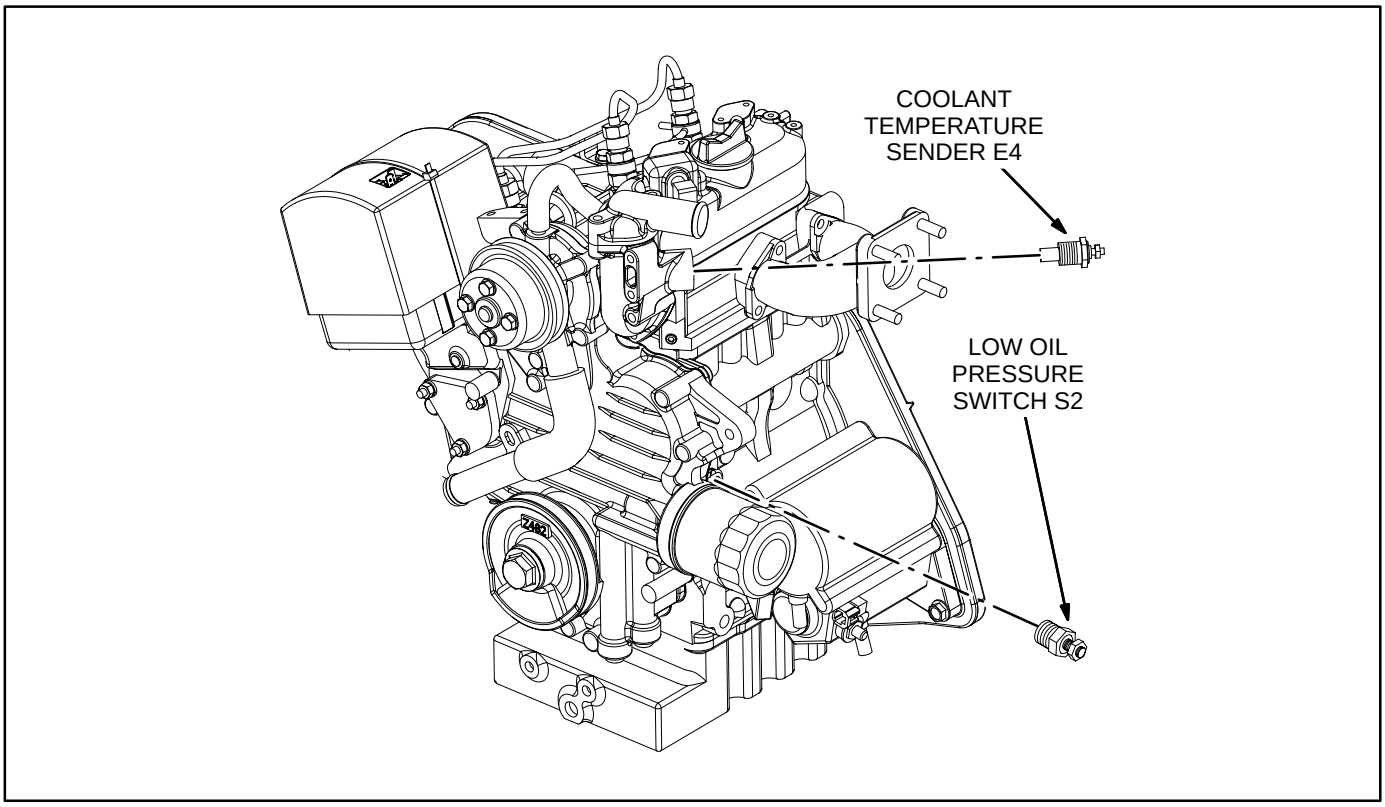

FIGURE 8-6. ENGINE SENSORS

AIR INTAKE SYSTEM

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Figure 8-7 illustrates the air intake system. Remove the top and front panels for access. Apply soap solution to the rubber sleeve on the engine intake manifold so that the collar of the resonator will slide on easily.

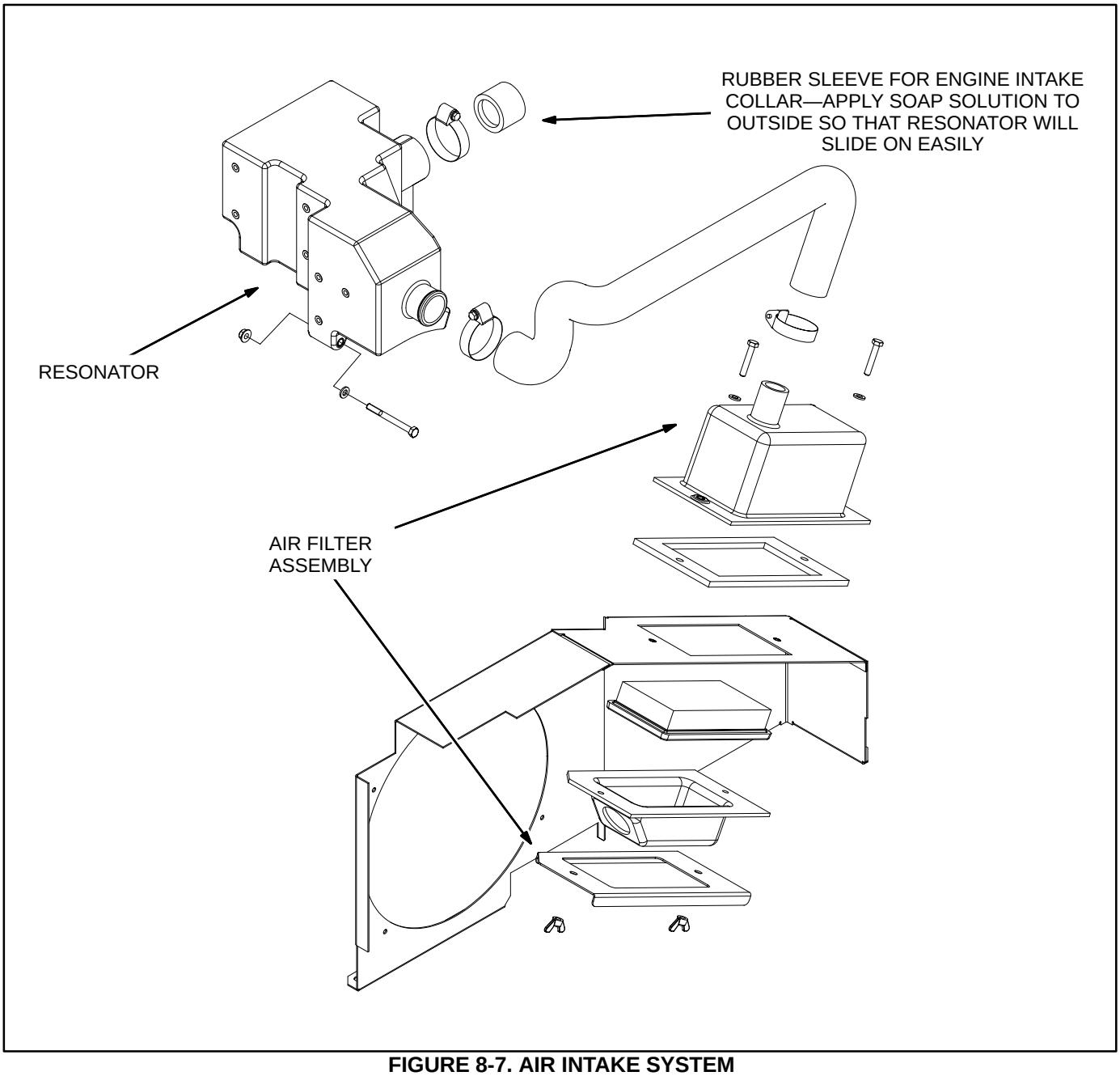

FIGURE 8-7. AIR INTAKE SYSTEM

MUFFLER

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Figure 8-8 illustrates the muffler assembly. Remove the top and right end panels for access.

Use new flange gaskets when reassembling. Torque all flange nuts to 21 lb-ft (29 N-m). Torque the isolator mount nuts to 8 lb-ft (11 N-m).

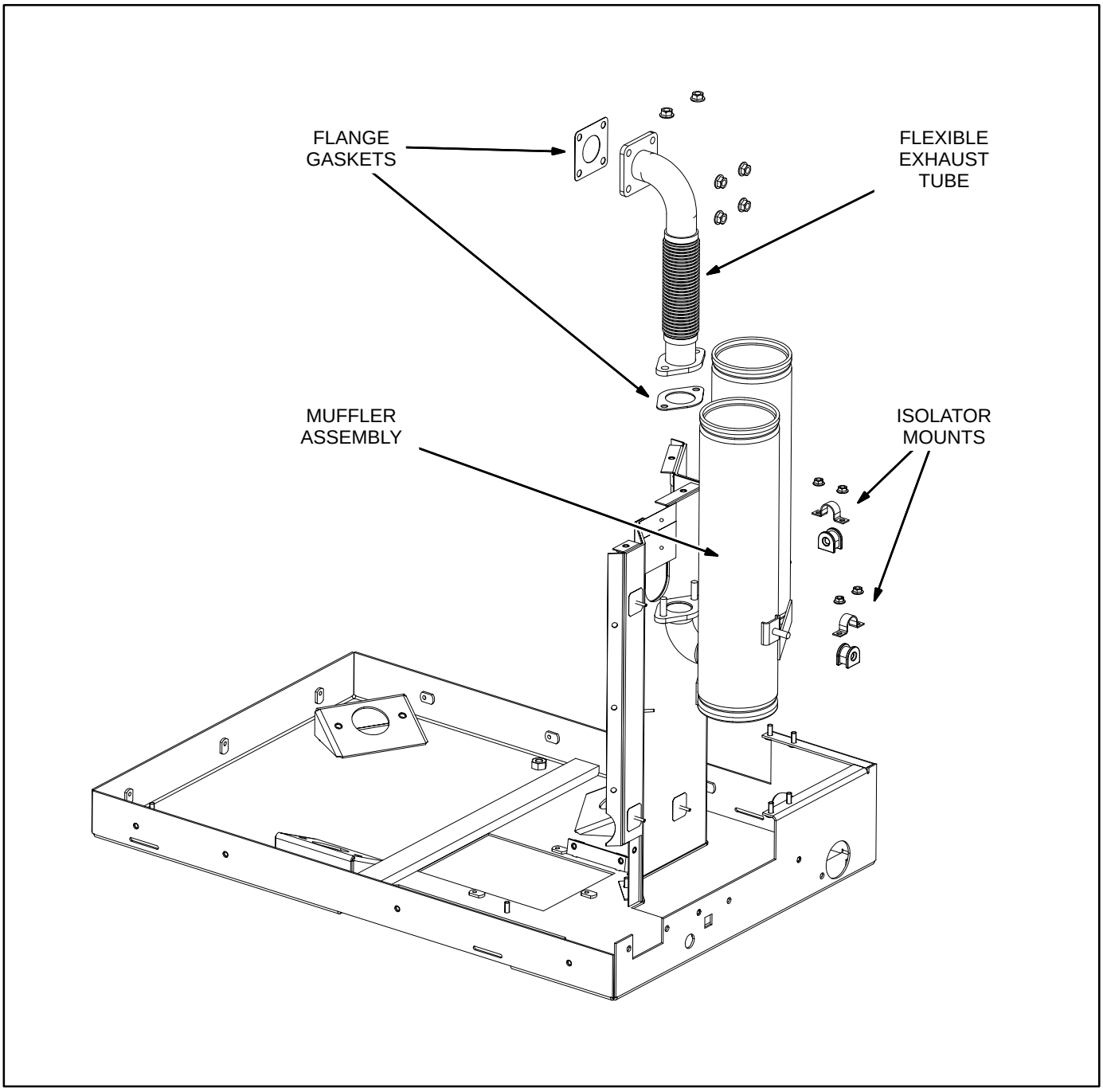

FIGURE 8-8. MUFFLER SYSTEM

FUEL SYSTEM

Figure 8-9 illustrates the fuel system as assembled for delivering fuel to and from the fuel injection system. See the engine Workshop Manual (981-0536) for fuel injection system service.

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

Fuel Delivery Test:

1. Disconnect the fuel return hose from the line to the supply tank and point the end into a quart (1 liter) container or larger.
2. Prime the genset by pushing the Start/Stop switch to **STOP (Prime)** and holding it there for exactly 1 (one) minute. Flow should not be less than 0.4 pints (200 ml) per minute.
3. If flow is less than specified:
   A. Replace the fuel filter (Page 3-7).
   B. Look for other restrictions in the fuel supply system and repair any restrictions to fuel flow.
   C. Look for air bubbles or long gaps when fuel is not being delivered. This would indicate loose fuel fittings or a cracked fuel filter body. Repair as necessary.
   D. Replace the fuel pump.

Fuel Lift Pump

Remove the right side panel for access.

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Fuel Filter

See REPLACING THE FUEL FILTER (Page 3-7)

Internal Fuel Hoses

When replacing the internal fuel hoses (Figure 8-9) make sure they are reclamped and tied as illustrated and will not rub on or be pinched by adjacent components.

Thread Sealant and Fuel Line Fittings

The fuel line between the fuel pump and the fuel filter has flare fittings (Figure 8-9). Always use two flare nut wrenches when loosening or tightening a flare fitting. ***Do not use any type of thread sealant on a flare fitting.***

The connections for fuel supply and return that extend through the side of the drip pan are pipe thread fittings. For these fittings use *liquid-type* pipe thread sealant Listed as suitable for diesel fuel. Apply the sealant sparingly to the male threads only.

⚠CAUTION ***Excess liquid-type pipe thread sealant or pieces of Teflon-type pipe thread sealant can plug the engine fuel system. Apply liquid-type pipe thread sealant sparingly to the male threads only. Do not use Teflon tape.***

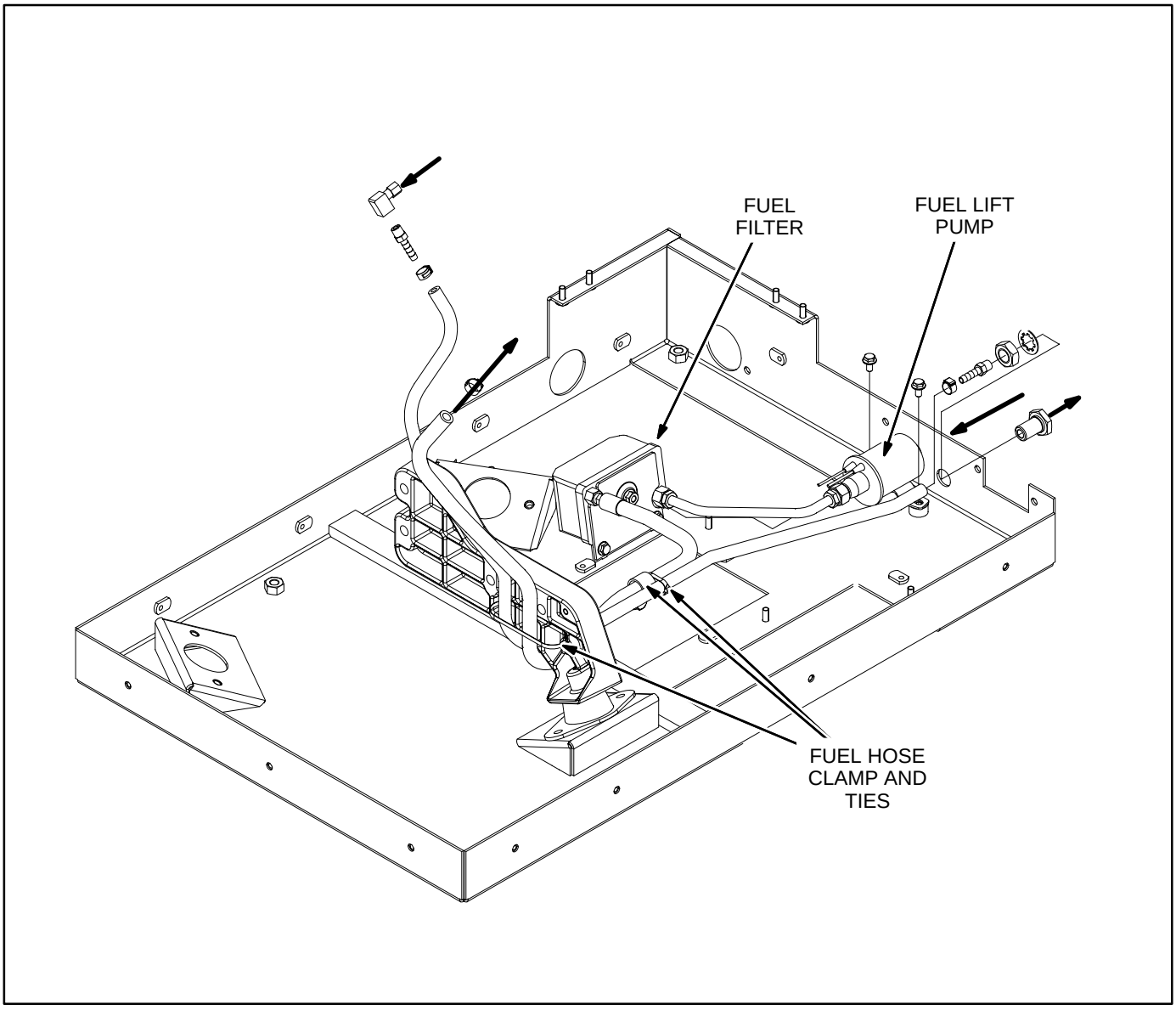

FIGURE 8-9. FUEL SYSTEM

COOLING SYSTEM

The genset has a liquid cooled engine. The centrifugal blower on the end of the generator pulls cooling air in through the air inlet in the bottom of the genset and pressurizes the enclosure, which is baffled to force all of the air out through the radiator (Figure 8-10).

See CHANGING COOLANT (Page 3-8) regarding maintenance of the cooling system. See the engine Workshop Manual (981-0536) regarding coolant pump and thermostat service. See COOLANT PUMP BELT (Page 8-11) regarding belt service.

Remove the front and top panels for access to the radiator, which is mounted by three (3) screws on each side to the adjoining panels.

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

When reassembling the cooling system:

- Make sure the system fill hose is in front of the lifting eye so that it can be pulled out far enough to fill the system.
- The vent line is tied to run along the top of the air intake hose (Page 8-6) to keep it from sagging and trapping air.
- The fill hose is tied to the top of the engine bracket.

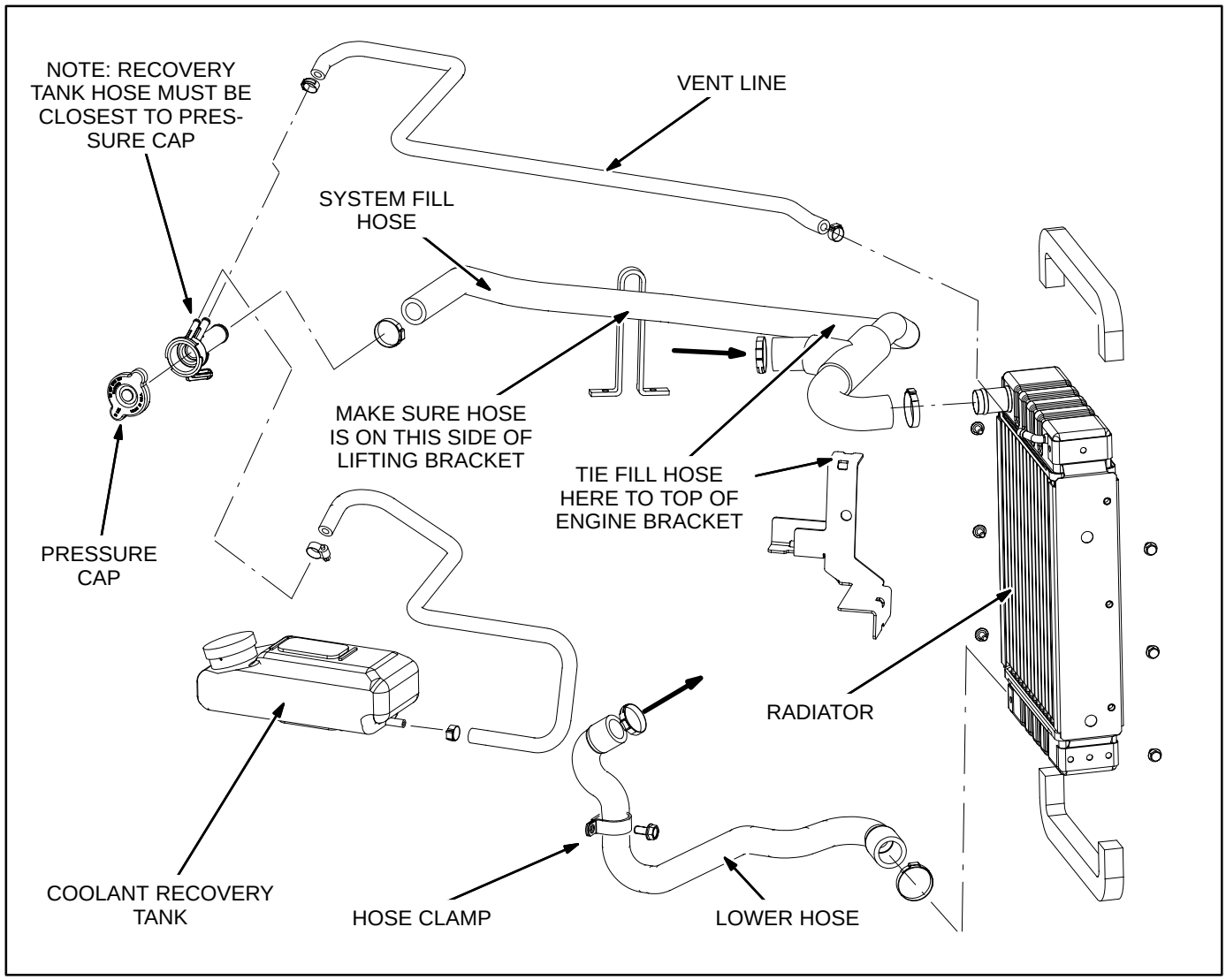

FIGURE 8-10. COOLING SYSTEM

COOLANT PUMP BELT

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Since there is no means to adjust belt tension, it is critical that the correct replacement belt be used. (Figure 8-11). (Belt tension increases slightly as the engine runs and is sufficient for the relatively light pump load.)

⚠CAUTION ***Using the wrong coolant pump drive belt can lead to engine overheating.***

Remove the top panel for access when replacing the coolant pump belt. Start the new belt in the grove of the top pulley and as far a possible (by hand) in the grove of the bottom pulley. Continue by barring the engine in the direction that will wind the belt on all the way.

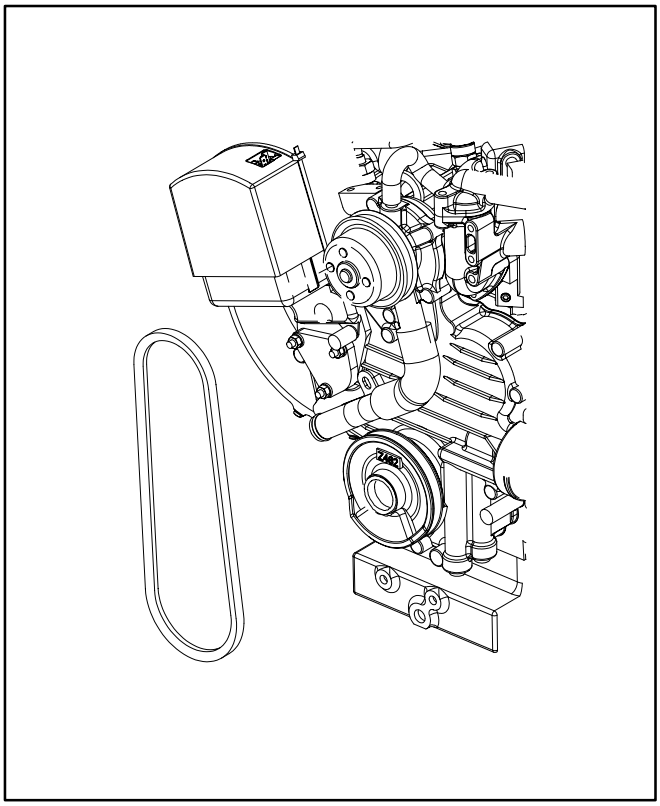

FIGURE 8-11.COOLANT PUMP BELT

STARTER

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable at the battery to prevent the engine from starting.***

Starter Removal and Replacement: The starter motor (Figure 8-12) is accessible for removal and installation through the access opening in the the base pan. Parts are available for rebuilding the starter. Torque the mounting screws to 29 lb-ft (39 N-m). Make sure starter B+ is connected to genset B+.

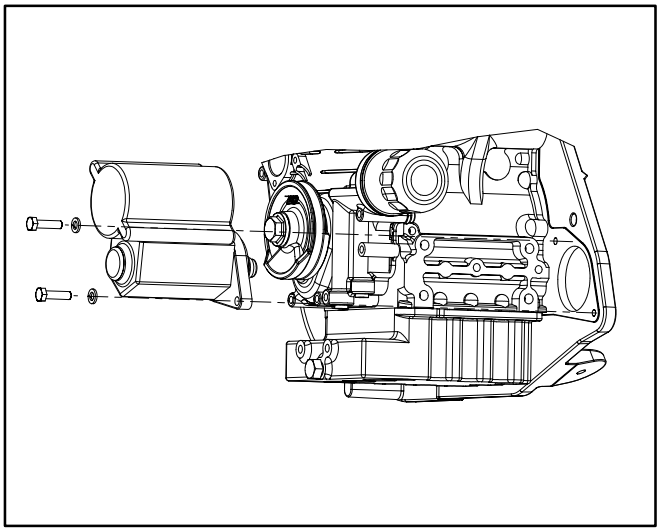

FIGURE 8-12. STARTER MOTOR

FLYWHEEL

See *Flywheel* on Page 7-2.

ENGINE-GENERATOR ADAPTOR

See *Engine-Generator Adaptor* on Page 7-2.

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9. Troubleshooting

TABLE 9-1 lists the shutdown codes in numerical order along with step-by-step corrective actions. First note the following:

- Maintaining engine oil and coolant levels, keeping battery connections clean and tight, watching the fuel gauge, not overloading the genset, keeping the air inlet and outlet openings clear, 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.

SHUTDOWN CODES

The genset controller provides extensive diagnostics by causing the status indicator light on the Control Switch to blink in a coded fashion. Following a fault shutdown, the indicator light will repeatedly blink 1, 2, 3 or 4 blinks at a time.

- **One blink** indicates shutdown due to high engine temperature.
- **Two blinks** indicates shutdown due to a loss of engine oil pressure.
- **Three blinks** indicates a service fault. Press **Stop** once to cause the two-digit, second-level shutdown 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 shutdown code number. For example, **shutdown code No. 36** appears as:

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

- **Four blinks** indicates that cranking exceeded a preset time (20 seconds if ambient temperature is above 32° F[0° C], 30 seconds if below) without starting.
- **Note: shutdown code Nos. 3 and 4 are first level faults. Avoid interpreting them as second-level shutdown code Nos. 33 and 44, which have not been assigned as shutdown codes.**

Restoring shutdown code Blinking - The shutdown code stops blinking after five minutes. Press **Stop** three times within three seconds to restore blinking. ***Note that the last fault logged will blink, even after the condition that caused the shutdown has been corrected.***

TABLE 9-1 . TROUBLESHOOTING

⚠ WARNING ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

NO RESPONSE—DEAD STATUS INDICATOR LIGHT

(Poor connections, faulty wiring or dead battery)

Corrective Action: (*Refer to Pages A-1 and A-3 when tracing wiring and connectors below.*)

1. Try the local genset control switch (S1) if the remote control switch (S11) does not work, and vice versa. If neither works, go to Step **2**. If one switch works but not the other, go to Step **5**.
2. Clean and tighten the positive (**+**) and negative (**-**) battery cable terminals at the battery and genset.
3. Remove the access cover on the bottom side (Page 3-4) and replace fuse F1 if blown.
4. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
5. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Check for B**+** at Pins 10 and 11. If there is no B**+**, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
6. While P1 is disconnected, check for continuity between Pin 27and B**-** (ground). If open, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
7. While P1 is disconnected, check operation of the local and remote control switches (S1, S11). Start should close Pin 9 to B**-** (ground). Stop should close Pin 32 to B**-** (ground). If the circuit does not close, check for missing, bent or corroded pins and faulty wiring and repair the appropriate circuit as necessary.
8. Replace controller A1 (Page 5-4).

THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

(The battery, battery connections or charging system are in marginal condition)

Corrective Action:

1. Clean and tighten the positive (**+**) and negative (**-**) battery cable connections at the battery and at the genset.
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
3. Service the vehicle battery charging system or the genset battery charger (Page 5-5).

THE STARTER ENGAGES AND DISENGAGES

(Cranking voltage dips below 6 volts because of low battery charge or poor connections)

Corrective Action:

1. Have the vehicle propulsion engine running while trying to start the genset. (The battery charging alternator may be able to maintain starting voltage high enough to get the genset started.)
2. Clean and tighten the positive (**+**) and negative (**-**) battery cable connections at the battery and at the genset.
3. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.

TABLE 9-1 . TROUBLESHOOTING (CONT.)

⚠ **WARNING** ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

THERE IS NO POWER WHEN THE GENSET IS RUNNING

(A line circuit breaker is OFF, tripped or malfunctioning)

Corrective Action:

1. Reset or turn ON the line circuit breaker on the genset.
2. Reset or turn ON any other circuit breaker in the power supply system.

THE GENSET WILL NOT STOP RUNNING (THE RUN LIGHT IS OFF)

(The governor mechanism is stuck or binding)

Corrective Action:

1. Close the fuel supply valve, if provided, or squeeze off the fuel supply line.
2. Remove the top housing panel (Page 4-3) and the cover on the governor actuator (Page 8-2). Reattach the governor leads and observe the actuator rotor while cranking. The rotor should rotate smoothly through about 1/2 inch (12 mm). If it does not, push the actuator rotor by hand (clockwise) to check for binding in the governor mechanism. It should rotate smoothly and return smoothly. If it binds or catches, remove the bearing carrier and stator and look for signs of physical contact between rotor and stator and service as necessary. If there are no signs of contact, remove the governor base. Replace the base or service the internal engine governor mechanism, as necessary (Page 8-1).

HIGH TEMPERATURE FAULT—CODE NO. 1

(First-level fault code—engine coolant temperature exceeded 230° F [110° C])

Corrective Action:

1. Check the engine coolant level and add coolant as necessary. (Page 3-8).
2. Check for and remove any objects blocking the air inlet or outlet openings in the bottom and sides of the genset.
3. Flush the coolant system to remove coolant passage fouling (Page 3-8).
4. Replace the engine thermostat, which might not be opening fully (Page 8-10).
5. Test coolant sender E2 (Page 5-5) and replace if necessary.

⚠ WARNING ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

LOW OIL PRESSURE FAULT—CODE NO. 2

(First-level fault code—the low oil pressure cutoff switch is open)

Corrective Action: (*Refer to Pages A-1 and A-3 when tracing wiring and connectors below.*)

1. Check the engine oil level and add oil as necessary (Page 3-3).
2. Drain the excess oil if the oil level is above the Full mark on the dipstick. (The oil will foam if the level is too high and result in possible loss of oil pressure.)
3. Remove the access cover on the bottom side and tighten the terminal on pressure switch S2 (Page 8-5), if loose.
4. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Check continuity between Pin 6 and the terminal on pressure switch S2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
5. Replace the switch with a gauge, ground the switch wire (to keep engine running) and start the engine. *Shut down the engine immediately if there is no oil pressure.*
   A. If engine oil pressure is less than 14 psi (98 kPa), service the oil lubricating system (Page 8-1).
   B. If engine oil pressure is at least 14 psi (98 kPa), replace oil pressure switch S2.
6. Replace controller A1 (Page 5-4).

SERVICE CHECK—CODE NO. 3

(First-level fault code—a second-level fault occurred)

Corrective Action: Check the second-level fault code by momentarily pressing Stop. The second-level fault will be one of the following in this table.

⚠ WARNING ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

OVERCRANK FAULT—CODE NO. 4

(First-level fault code—Cranking without starting exceeded 20 to 30 seconds, depending on ambient)

Corrective Action: (*Refer to Pages A-1 and A-3 when tracing wiring and connectors below.*)

1. Check the fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
2. Check for fuel (air) leaks at all fuel fittings and tighten as necessary. Prime the engine fuel system by holding the control switch at **Stop** for one minute.
3. Check the engine air filter (Page 3-5) and remove any blockage.
4. Check for mechanical damage.
5. Replace the fuel filter (Page 3-7).
6. Conduct a fuel pump flow test and service as necessary (Page 8-8).
7. Inspect and service the glow plugs (Page 8-1) as follows:
   A. If loose, tighten the glow plug terminals.
   B. Check for B**+** at the glow plug terminals during cranking. If there is no B**+**, remove glow plug relay K3 from its socket and test for proper operation (Page 5-4). Replace if necessary. Also check for B**+** at relay socket terminal 30, for continuity between terminal 87 and the glow plugs and for continuity between terminal 86 and B**-** (ground). Clean and tighten connections and replace wiring as necessary.
   C. Check for B**+** at relay socket terminal 85 while cranking. If there is no B**+**, disconnect connector P1 from controller A1 (Page 5-1) and check for missing, bent or corroded pins and faulty wiring and repair as necessary. If the wire and connections are good, replace controller A1.
   D. Remove the glow plug bus bar and check for electrical continuity between each glow plug terminal and B**-** (ground). Replace any open glow plug (Page 8-1).
8. Remove the top housing panel (Page 4-3) and the cover on the governor actuator (Page 8-2). Reattach the governor leads and observe the actuator rotor while cranking. The rotor should rotate smoothly through about 1/2 inch (12 mm). If it does not, apply 12 VDC to the actuator terminals and observe whether the rotor rotates smoothly. If it does not, go to Step A. If it does, go to Step C.
   A. Check resistance across the actuator terminals with an accurate digital ohmmeter. If resistance is not between 1.7 and 2.8 ohms, replace the actuator stator.
   B. Push the actuator rotor by hand (clockwise) to check for binding in the governor mechanism. It should rotate smoothly and return smoothly. If it binds or catches, remove the bearing carrier and stator and look for signs of physical contact between rotor and stator and service as necessary. If there are no signs of contact, remove the governor base. Replace the base or service the internal engine governor mechanism, as necessary (Page 8-1).
   C. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Measure resistance between Pin 28 and A12+ and between Pin 29 and A12-. If either lead is open, check for missing, bent or corroded pins or faulty wiring and repair as necessary.
   D. Replace controller A1 (Page 5-1).
9. Service the engine (Page 8-1).

⚠ WARNING ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

OVERVOLTAGE FAULT—CODE NO. 12

(The controller is not able to regulate to rated voltage)

Corrective Action:

1. Push the line circuit breaker to OFF, start the genset and measure output voltage. If output voltage is normal, the problem is in the circuits external to the genset. If there is no voltage, test for grounded field, stator or quadrature windings (Page 6-4). Replace a stator or rotor that has faulty windings.
2. Replace controller A1 (Page 5-1).

UNDERVOLTAGE FAULT—CODE NO. 13

(The controller is not able to regulate to rated voltage)

Corrective Action:

1. Push the line circuit breaker to OFF, start the genset and measure output voltage. If output voltage is normal, go to Step **2**. If output voltage is low, go to Step **3**.

2. Reduce the number of connected appliances, especially when air conditioners and battery chargers are running.

3. Service the brushes and slip rings as necessary (Page 6-3) and test the generator field, stator and quadrature windings for opens and shorts (Page 6-4). Replace a stator or rotor that has faulty windings.

4. Replace controller A1 (Page 5-1).

OVERFREQUENCY FAULT—CODE NO. 14

(The controller is not able to regulate to rated frequency)

Corrective Action:

1. Check for a tripped genset circuit breaker, reset it if necessary, and run with fewer connected loads. (A breaker tripping under load can cause frequency to overshoot.)
2. Check for fuel (air) leaks at all fuel fittings and tighten as necessary. Prime the engine fuel system by holding the control switch at **Stop** for one minute. (Air bubbles can disrupt frequency.)
3. Remove the top housing panel (Page 4-3) and the cover on the governor actuator (Page 8-2). Reattach the governor leads and observe the actuator rotor while cranking. The rotor should rotate smoothly through about 1/2 inch (12 mm). If it does not, apply 12 VDC to the actuator terminals and observe whether the rotor rotates smoothly. If it does not, go to Step A. If it does, go to Step C.
   A. Check resistance across the actuator terminals with an accurate digital ohmmeter. If resistance is not between 1.7 and 2.8 ohms, replace the actuator stator.
   B. Push the actuator rotor by hand (clockwise) to check for binding in the governor mechanism. It should rotate smoothly and return smoothly. If it binds or catches, remove the bearing carrier and stator and look for signs of physical contact between rotor and stator and service as necessary. If there are no signs of contact, remove the governor base. Replace the base or service the internal engine governor mechanism, as necessary (Page 8-1).
   C. Replace controller A1 (Page 5-1).

⚠ WARNING ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

UNDERFREQUENCY FAULT—CODE NO. 15

(The controller is not able to regulate to rated frequency)

Corrective Action:

1. Turn OFF the line circuit breaker. If the genset now runs, run it with fewer connected loads, especially those with high motor starting loads such as air conditioners.
2. Check the fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
3. Check for fuel (air) leaks at all fuel fittings and tighten as necessary. Prime the engine fuel system by holding the control switch at **Stop** for one minute. (Air bubbles can disrupt frequency.)
4. Check the engine air filter (Page 3-5) and remove any blockage.
5. Check for mechanical damage.
6. Replace the fuel filter (Page 3-7).
7. Conduct a fuel pump flow test and service as necessary (Page 8-8).
8. Remove the top housing panel (Page 4-3) and the cover on the governor actuator (Page 8-2). Reattach the governor leads and observe the actuator rotor while cranking. The rotor should rotate smoothly through about 1/2 inch (12 mm). If it does not, apply 12 VDC to the actuator terminals and observe whether the rotor rotates smoothly. If it does not, go to Step A. If it does, go to Step C.
   A. Check resistance across the actuator terminals with an accurate digital ohmmeter. If resistance is not between 1.7 and 2.8 ohms, replace the actuator stator.
   B. Push the actuator rotor by hand (clockwise) to check for binding in the governor mechanism. It should rotate smoothly and return smoothly. If it binds or catches, remove the bearing carrier and stator and look for signs of physical contact between rotor and stator and service as necessary. If there are no signs of contact, remove the governor base. Replace the base or service the internal engine governor mechanism, as necessary (Page 8-1).
   C. Replace controller A1 (Page 5-1).
9. Readjust high idle speed (Page 8-4).
10. Service the fuel injectors and injection pump as necessary (Page 8-1).
11. Check fuel injection timing (Page 8-1).

GOVERNOR ACTUATOR FAULT—CODE NO. 19

(The controller sensed that the actuator circuit is either open or shorted)

Corrective Action:

1. Remove the top housing panel (Page 4-3) and reconnect the leads at the governor actuator, if loose. Polarity does not matter.
2. Check resistance across the actuator terminals with an accurate digital ohmmeter. If resistance is not between 1.7 and 2.8 ohms, replace the actuator stator.
3. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Measure resistance between Pin 28 and A12+ and between Pin 29 and A12-. If either lead is open, check for a missing, bent or corroded pin or faulty wiring and repair as necessary.

⚠ WARNING ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

GOVERNOR OVERLOAD FAULT—CODE NO. 22

(The duration of operation at or near full-duty cycle was beyond the design limit)

Corrective Action:

1. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2. Check for fuel (air) leaks at all fuel fittings and tighten as necessary. Prime the engine fuel system by holding the control switch at **Stop** for one minute.
3. Replace the engine air filter (Page 3-5) and clean the spark-arrest muffler (Page 3-6).
4. Replace the fuel filter (Page 3-7).
5. Conduct a fuel pump flow test and service as necessary (Page 8-8).
6. Readjust high idle speed (Page 8-4).
7. Remove the top housing panel (Page 4-3) and the cover on the governor actuator (Page 8-2). Reattach the governor leads and observe the actuator rotor while cranking. The rotor should rotate smoothly through about 1/2 inch (12 mm). If it does not, apply 12 VDC to the actuator terminals and observe whether the rotor rotates smoothly. If it does not, go to Step A. If it does, go to Step C.
   A. Check resistance across the actuator terminals with an accurate digital ohmmeter. If resistance is not between 1.7 and 2.8 ohms, replace the actuator stator.
   B. Push the actuator rotor by hand (clockwise) to check for binding in the governor mechanism. It should rotate smoothly and return smoothly. If it binds or catches, remove the bearing carrier and stator and look for signs of physical contact between rotor and stator and service as necessary. If there are no signs of contact, remove the governor base. Replace the base or service the internal engine governor mechanism, as necessary (Page 8-1).
   C. Replace controller A1 (Page 5-1).
8. Service the fuel injectors and injection pump as necessary (Page 8-1).
9. Check fuel injection timing (Page 8-1).

TEMPERATURE SENDER FAULT—CODE NO. 24

(The controller sensed that the sender circuit is either open or shorted)

Corrective Action: (*Refer to Pages A-1 and A-3 when tracing wiring and connectors below.*)

1. Remove the access cover on the bottom side and tighten the terminal on coolant temperature sender E4 (Page 8-5), if loose.
2. Test the resistance of sender E4 at room temperature and in boiling water (Page 8-5). Replace if faulty.
3. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Check continuity between Pin 21 and ring terminal E4-1. If there is no continuity, check for missing, bent or corroded pins or faulty wiring and repair as necessary.

TABLE 9-1 . TROUBLESHOOTING (CONT.)

⚠ **WARNING** ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

AC VOLTAGE SENSE FAULT—CODE NO. 27

(The controller was unable to sense output voltage)

Corrective Action: (*Refer to Pages A-1 and A-3 when tracing wiring and connectors below.*)

1. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Check continuity between Pin 33 and Pin 34. If open, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
2. On 3-phase gensets, test voltage sense transformer T15 (Page 5-5).
3. Service the brushes and slip rings as necessary (Page 6-3) and test the generator field, stator and quadrature windings for opens and shorts (Page 6-4). Replace a stator or rotor that has faulty windings.
4. Replace controller A1 (Page 5-1).

HIGH BATTERY VOLTAGE FAULT—CODE NO. 29

(The controller sensed battery system voltage greater than 19 volts)

Corrective Action:

1. Check battery bank connections and reconnect, if necessary, so that the 12 volt batteries serving the genset are connected in parallel (12 volt) rather than in series (24 volt).
2. Select a lower external battery boost charge rate.

LOW CRANKING SPEED FAULT—CODE NO. 32

(Cranking speed less than 100 rpm [2.5 Hz, generator] for more than 12 seconds)

Corrective Action:

1. Have the vehicle propulsion engine running while trying to start the genset. (The battery charging alternator may be able to maintain starting voltage high enough to get the genset started.)
2. Clean and tighten the positive (**+**) and negative (**-**) battery cable connections at the battery and at the genset.
3. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
4. Replace engine oil with oil of proper viscosity for ambient temperatures. (High oil viscosity can slow down cranking speed.)

CONTROL CARD FAULT—CODE NO. 35

(Microprocessor EEPROM error during self-test)

Corrective Action: Replace controller A1 (Page 5-1).

⚠ WARNING ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

ENGINE STOPPED FAULT—CODE NO. 36

(The genset stopped without a command from the controller)

Corrective Action:

1. Check the fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
2. Check for fuel (air) leaks at all fuel fittings and tighten as necessary. Prime the engine fuel system by holding the control switch at **Stop** for one minute.
3. Check the engine air filter (Page 3-5) and remove any blockage.
4. Check for mechanical damage.
5. Replace the fuel filter (Page 3-7).
6. Conduct a fuel pump flow test and service as necessary (Page 8-8).
7. Check for an open field or open or grounded quadrature circuit (Page 6-4) and service as necessary.
8. Remove the top housing panel (Page 4-3) and the cover on the governor actuator (Page 8-2). Reattach the governor leads and observe the actuator rotor while cranking. The rotor should rotate smoothly through about 1/2 inch (12 mm). If it does not, apply 12 VDC to the actuator terminals and observe whether the rotor rotates smoothly. If it does not, go to Step A. If it does, go to Step C.
   A. Check resistance across the actuator terminals with an accurate digital ohmmeter. If resistance is not between 1.7 and 2.8 ohms, replace the actuator stator.
   B. Push the actuator rotor by hand (clockwise) to check for binding in the governor mechanism. It should rotate smoothly and return smoothly. If it binds or catches, remove the bearing carrier and stator and look for signs of physical contact between rotor and stator and service as necessary. If there are no signs of contact, remove the governor base. Replace the base or service the internal engine governor mechanism, as necessary (Page 8-1).
   C. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Measure resistance between Pin 28 and A12+ and between Pin 29 and A12-. If either lead is open, check for missing, bent or corroded pins or faulty wiring and repair as necessary.
   D. Replace controller A1 (Page 5-1).
9. Service the engine (Page 8-1).

FIELD OVERLOAD FAULT—CODE NO. 38

(Field voltage exceeded 150 VDC)

Corrective Action:

1. Reduce the number of air conditioners running at the same time (and other appliances that cause low power factor).
2. Have the air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause very low power factor.)
3. Service the brushes and slip rings as necessary (Page 6-3) and test the generator field, stator and quadrature windings for opens and shorts (Page 6-4). Replace a stator or rotor that has faulty windings.

TABLE 9-1 . TROUBLESHOOTING (CONT.)

⚠ **WARNING** ***Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.***

SHORTED ROTOR FAULT—CODE NO. 41

(The rotor circuit is shorted to ground)

Corrective Action: (*Refer to Pages A-1 and A-3 when tracing wiring and connectors below.*)

1. Remove the access cover on the left side and disconnect connector P1 from controller A1 (Page 5-1). Check for continuity between Pin 1 or 14 and B**-** (ground). Repair or replace wiring, brushes and slip rings (Page 6-3) or rotor (Page 6-4), as necessary, if the rotor is shorted to ground.
2. Replace controller A1 (Page 5-1).

PROCESSOR FAULT—CODE NO. 42

(Microprocessor ROM error during self-test)

Corrective Action: Replace controller A1 (Page 5-1).

PROCESSOR FAULT—CODE NO. 43

(Microprocessor RAM error during self-test)

Corrective Action: Replace controller A1 (Page 5-1).

SPEED SENSE FAULT—CODE NO. 45

(Controller unable to sense quadrature frequency)

Corrective Action:

1. Check the fuel level and fill as necessary. Then prime the engine fuel system by holding the control switch at **Stop** for one minute and try restarting.
2. Service the brushes and slip rings as necessary (Page 6-3) and test the generator field, stator and quadrature windings for opens and shorts (Page 6-4). Replace a stator or rotor that has faulty windings.

OVERPRIME FAULT—CODE NO. 57

(Prime mode exceeded 3 minutes)

Corrective Action: Check for and remove any object that may be holding either control switch (remote or local) in the prime (stop) position.

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10. Service Checklist

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 onboard 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.

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

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, perform the maintenance and pre-start checks instructed and follow all of its instructions and safety precautions. 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.

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11. Specifications

	60 Hz Models	50 Hz Models
GENSET CONTROLLER: Integrated Microprocessor Based Engine and Generator Controller		
GENERATOR: Two-Bearing, Two-Pole Rotating Field, “Poly-Vee” Belt Drive		
Power (@1.0 PF)	5500 W	5000 W
RPM	3600	3000
Voltage	120V 1-Ph, 120/240V 1-Ph, or 120/240V 3-Ph	115/230V 1-Ph or 230/400V 3-Ph
Current	45.8A, 22.9A, or 13.2A	23.9A or 7.2A
Circuit Breakers	25A, 25A, or 15A	25A or 8A
FUEL CONSUMPTION:		
No-load Half-load Full-load	0.25 gph (0.93 lph) 0.41 gph (1.57 lph) 0.66 gph (2.51 lph)	0.21 gph (0.78 lph) 0.34 gph (1.31 lph) 0.55 gph (2.09 lph)
ENGINE: 2-Cylinder In-Line, Water-Cooled, Indirect-Injection, 4-Stroke Cycle Diesel		
RPM	2880	2400
Bore	2.64 in (67 mm)	
Stroke	2.68 in (68 mm)	
Displacement	29.23 in^3 (479 cc)	
Compression Ratio	23 : 1	
Fuel Injection Timing (BTDC)	18°-20 °	
Injection Order	1-2	
Fuel Nozzle Injection Pressure	1991 psi (13.73 mPa)	
Valve Lash: Intake & Exhaust (cold)	0.0059 - 0.0073 inch (0.145 - 0.185 mm)	
Oil Capacity (with filter)	2 quart (1.9 liter)	
Cooling System Capacity	2.3 quart (2.2 liter)	
DC SYSTEM:		
Nominal Battery Voltage	12 volts	
Minimum Battery Capacity CCA (Cold Cranking Amps)	475 amps down to 0° F (-17° C) 650 amps down to -20° F (-29° C)	
Fuse F1 (control, start and glow plug circuits)	30 amp mini-bayonet	
WEIGHT: 400 lbs (181 kg)		
SIZE (L x W x H): 34.5 x 22.4 x 20.3 in (846 x 549 x 498 mm)		
SOUND LEVEL: 68 dB(A) @ 10 ft (3m)		

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12. Torque Specifications

	lb-ft*	N-m *
Genset Mounting Screws	35	48
Generator Through Bolts	8	11
Belt Tensioner Center Bolt	20	26
Generator Pulley Center Bolt	45	61
Fan Bolts	8	11
Flywheel to Pulley Coupling Nuts	5	6
Flywheel Center Bolt	60	81
Exhaust Manifold Flange Nuts	20	26
Muffler Flange Nuts	10	13
Intake Manifold Bolts	19	26
Engine Mounting Bolts	20	26
Starter Motor Mounting Bolts	20	26
Starter Terminal Nut	6.5	8
* - Use engine oil as a lubricant for all threads except when otherwise specified.		

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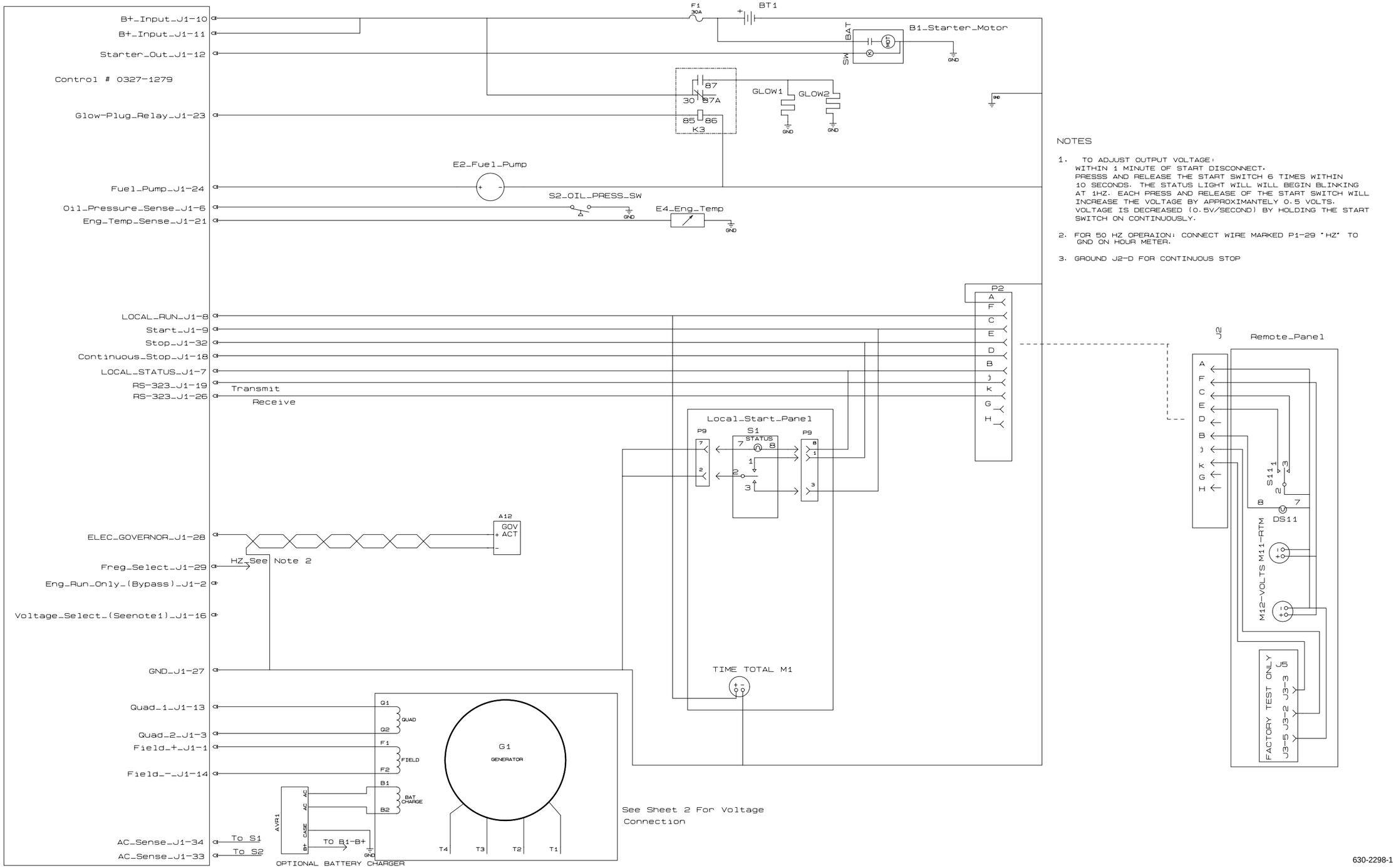
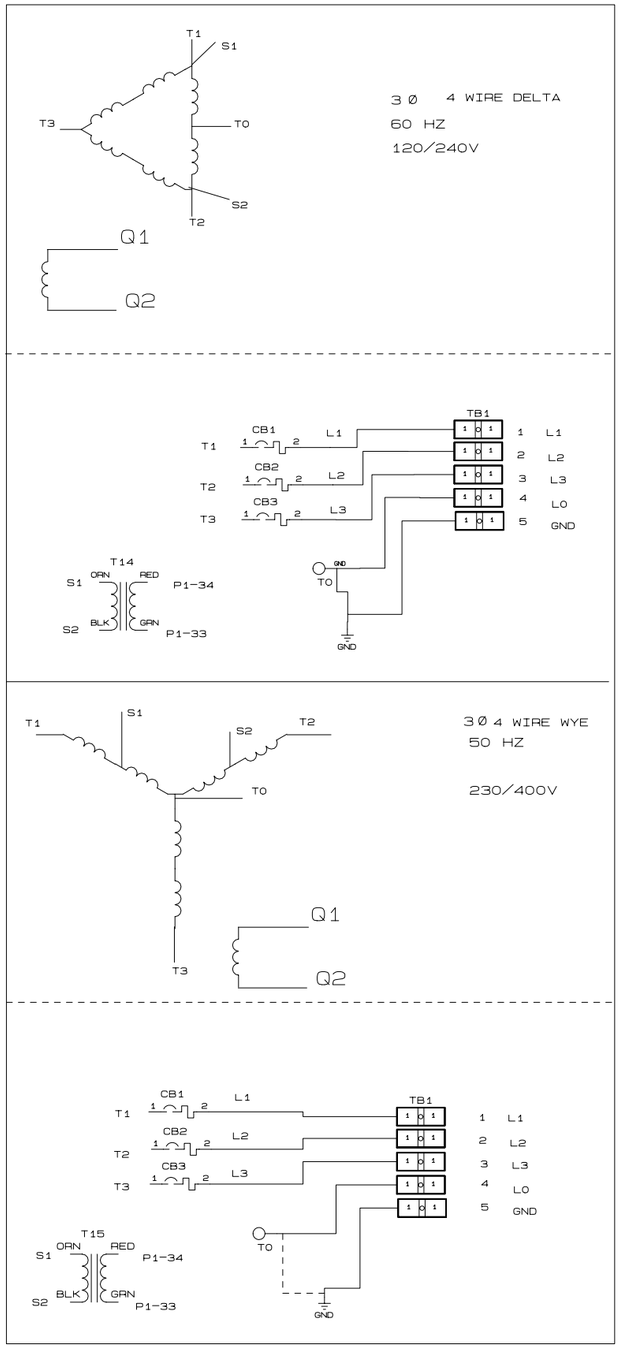


NOTES

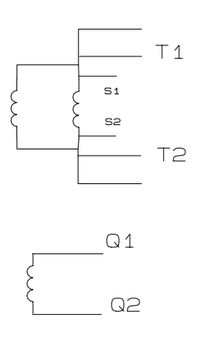
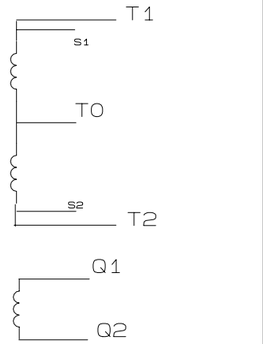
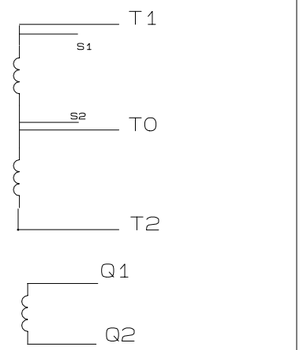
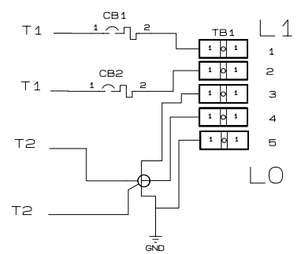
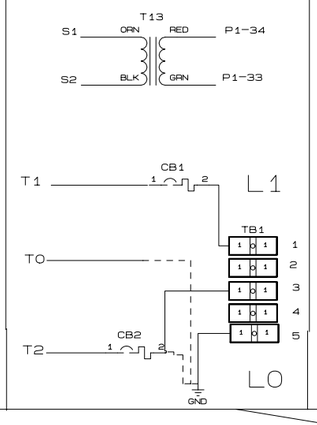
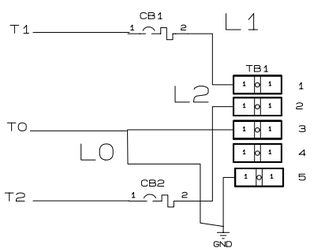
1. TO ADJUST OUTPUT VOLTAGE:
   WITHIN 1 MINUTE OF START DISCONNECT.
   PRESSS AND RELEASE THE START SWITCH 6 TIMES WITHIN 10 SECONDS. THE STATUS LIGHT WILL WILL BEGIN BLINKING AT 1HZ. EACH PRESS AND RELEASE OF THE START SWITCH WILL INCREASE THE VOLTAGE BY APPROXIMANTELY 0.5 VOLTS. VOLTAGE IS DECREASED (0.5V/SECOND) BY HOLDING THE START SWITCH ON CONTINUOUSLY.
2. FOR 50 HZ OPERAION: CONNECT WIRE MARKED P1-29 "HZ" TO GND ON HOUR METER.
3. GROUND J2-D FOR CONTINUOUS STOP

630-2298-1

DC WIRING DIAGRAM



3 Ø Generator Reconnection

	A	B	C	HZ
VOLTAGE	120		120/240	60
		230		50
SCHEMATIC				
DIAGRAM				

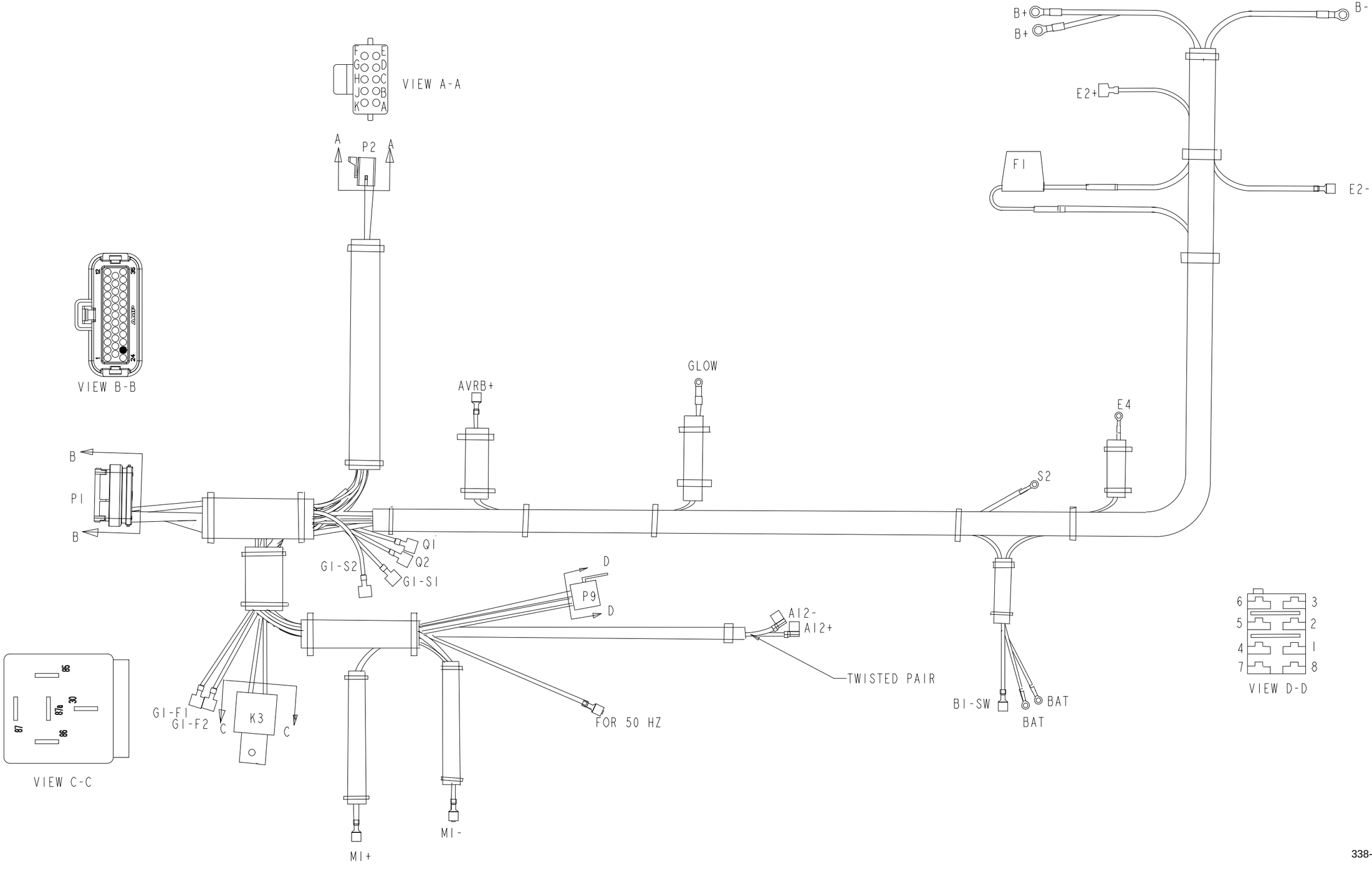
TO CONNECTED TO GND ON GROUNDED NEUTRAL
T2 CONNECTED TO GND OTHERWISE.
BOTH CANNOT BE CONNECTED TO GND OR TOGETHER.

1 Ø Generator Reconnection

630-2298-2

GENERATOR CONNECTION DIAGRAM

A-2



338-4092

DC WIRING HARNESS

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