Service Manual

Onan Generator Set for Commercial Mobile

HDKBA (Spec A–D)
HDKBB (Spec A–J)
HDKBC (Spec D–J)

English
Original Instructions
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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.

Only trained and experienced service personnel with knowledge of fuels, electricity and machinery hazards shall remove, dismantle and dispose of the generator set. See service manual.

Some generator set installation procedures present hazards that can result in severe personal injury or death. Only trained and experienced personnel with knowledge of fuels, electricity and machinery hazards should perform generator set installation procedures.

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

⚠ DANGER ***Used to alert you to an immediate hazard which will result in severe personal injury or death.***

⚠WARNING ***Used to alert you to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠ CAUTION ***Used to alert 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.
- 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-purpose fire extinguishers handy. Multipurpose fire extinguishers are used for fires that involve ordinary combustible and flammable liquid fuels and gaseous fuels; live electrical equipment. (US and Canada: Ref. NFPA No. 10)
- Generator set installation and operation must comply with all applicable local, state and federal codes and regulations.
- Generator set with a sound shield shall not be run with the service doors removed/missing.
- Engine components can be hot and cause severe burns. Hot coolant under pressure can spray and cause severe burns.

- Use personal protective equipment when servicing the generator set such as gloves, safety glasses, etc.

THE HAZARDS OF CARBON MONOXIDE

WARNING ***Engine−driven generators can produce harmful level of carbon monoxide that can injure or kill you.***

ONLY YOU CAN PROTECT YOURSELF FROM CO POISONING!

- Watch constantly for people near the exhaust of the generator set while it is running.
- Make sure exhaust cannot enter the living quarters through a window, vent or door.
- Make sure all CO detectors or audible alarms are working properly.
- Pay attention to the signs of CO poisoning.
- Check the exhaust system for corrosion, obstruction and leaks each time you start the generator set and every eight hours if you run it continuously.

GENERATOR VOLTAGE IS DEADLY

- Disable the automatic genset starting feature (AGS) of an inverter−charger or other automatic starting device before servicing the genset.
- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.

WARNING ***Interconnecting the generator set and shore power can lead to electrocution or utility line workers, equipment damage and fire. use an approved switching device 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

- Inspect for exhaust leaks at every startup and after every eight hours of running.
- Learn the symptoms of carbon monoxide poisoning n the genset Operator's Manual.
- Never sleep in the vehicle while the genset is running unless the vehicle is equipped with a working carbon monoxide detector.
- Do not operate the genset when the vehicle is parked in a confined space, such as a garage.
- Disable the automatic genset starting feature (AGS) of an inverter−charger or other automatic starting device before storing the vehicle or parking it in a garage or other confined space.
- The exhaust system must be installed in accordance with the genset Installation Manual.
- Engine cooling air must not be used for heating the vehicle.

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.

GASOLINE IS FLAMMABLE AND EXPLOSIVE

- Because this generator set is an *Ignition Protected* device, no substitutes are permitted for the parts listed in the *Critical Parts Index* of the generator set Parts Catalog. They must be purchased from Onan and be installed in accordance with the generator set Service Manual by those who are trained and experienced in marine generator set service.

BATTERY GAS IS EXPLOSIVE

- Wear splash−proof safety glasses.

- Do not smoke or permit flames or sparks to occur near the battery at any time.
- 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

⚠WARNING ***Do not operator a diesel–powered generator set where a flammable vapor environment can be created by fuel spill, leak, etc.***

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. The owners and operators of the genset are solely responsible for operating the genset safely.

SUBSTANCE HAZARDOUS TO HEALTH

Generator sets use substances, and emit and create wastes that can cause health risks. Generator set operators must use appropriate personal protective equipment (such as clothing, gloves, protective glasses/goggles, and respiration equipment) when exposed to fuel, oil, coolant, wet batteries, grease, cleaning agents, or other substances exposed to lungs, eyes, or skin. Use appropriate containers for transport, storage, and disposal of waste substances. Follow local regulations for disposal and recycling.

ANTIFREEZE (FLEETGUARD – ES COMPLEAT/EG PREMIX)

This antifreeze is also known as an ethylene glycol based coolant; summer coolant; coolant additive. It is purple coloured, viscous liquid, with a mild chemical odour, is soluble in water and harmful. It contains ethylene glycol, and diethylene glycol. Ethylene glycol is a potentially hazardous constituent.

The substance has a boiling point of 107° C, and a flash point of 121° C.

It is used as an engine coolant additive, and can be found in engine cooling systems, and heat exchangers. Installers, operators and maintainers are likely to encounter this substance.

HAZARDOUS REACTIONS

Ethylene glycol is combustible when exposed to heat or flame and can react vigorously with oxidants. Moderate explosive hazard in form of vapour when exposed to heat or flame. Hazardous products resulting from combustion or decomposition include carbon monoxide, carbon dioxide and acrid smoke. Self–contained breathing apparatus must be worn in the event of fume build up.

Avoid strong oxidizing agents – incompatible with sulfuric acid, nitric acid, caustics and aliphatic amines.

It may cause neurological signs and symptoms, and kidney damage. It is also a skin and eye irritant.

Very toxic in particulate form upon inhalation. Harmful if swallowed, lethal dose for humans reported to be 100ml.

PROTECTIVE MEASURES

Refrain from eating, drinking or smoking when using the product. Adopt a high standard of personal hygiene. In case of skin contact, wash immediately with soap and water.

Ensure good ventilation and avoid heat sources. Avoid breathing mist, if there is a risk of vapour, or particulate, use a suitable organic vapour mask.

Eye protection, gloves, overalls, impervious apron should be used. Avoid contamination inside the gloves. If overalls become contaminated, discontinue use and clean thoroughly.

STORAGE/TRANSPORT

Store and transport only in correctly marked containers. Keep containers closed when not in use. Keep cool, out of sunlight, away for naked flames and strong acids, do not freeze. Store well away from food–stuffs and drinking water. Take special care to avoid discharge into drains, sewers and water–courses.

Contain leak/spill with sand, earth or non–combustible, absorbent material to prevent entry of substance into drainage/sewerage system, water–courses and land. Eliminate all ignition sources, use plastic shovel to transfer to suitable container and dispose of unwanted or absorbed substance through and authorised contractor to a licensed site.

EMERGENCY ACTION

- Fire
  Extinguishing media: CO_2, alcohol resistant foam, dry powder, or water spray.
  Fire fighters to use self contained breathing apparatus. Keep fire exposed containers cool. Prevent run–off from entering waterways, drains and drinking water supplies.

- Ingestion
  Toxic by ingestion. If swallowed induce vomiting only under the advice of a Doctor or poison control centre. Delayed treatment may result in fatality.
- Inhalation (of vapour)
  Remove from further exposure. In case of irritation to lungs or throat, seek medical advice.
- Aspiration (inhalation of liquid)
  Obtain immediate medical assistance.
- Eyes
  Flush copiously with water or preferably eye−wash solution for at least five minutes. Seek medical advice.
- Skin
  Wash thoroughly with soap and water, and seek medical attention if irritation develops. Change clothing if necessary and wash before re−use.
- Spillage
  Soak−up using an absorbent material and dispose of this as directed under Storage/Transport.

GAS OIL

This product is also known as Red Diesel, Fuel Oil, and type A1 or A2. It can be pale red or a clear liquid with a characteristic mild odour. It contains catalytically cracked oil, petroleum distillates, quinizarin, and gas oil maker dye red. The catalytically cracked oil and petroleum distillates are potentially hazardous constituents.

The substance has an initial boiling point of 180°C, a flash point greater than 56°C, and a vapour pressure less than 0.7mm Hg at 20°C and has negligible solubility in water.

It is used as a fuel for off−road diesel powered vehicles and stationary engines, and can be found in fuel tanks, pipes and injection systems. The substance should not be used for any other purpose without contacting the manufacturer or supplier. Installers, operators and maintainers are likely to encounter this substance.

HAZARDOUS REACTIONS

This liquid is flammable. Avoid smoking, heat sources, such as welding and naked flames, sparks and static electricity build−up. Thermal decomposition products are hazardous, containing CO_X, NO_X and SO_X compounds.

The vapour is explosive. High vapour concentrations can cause respiratory irritation, dizziness, nausea, and loss of consciousness. Excessive and prolonged exposure to the mist can cause chronic inflammatory reaction of the lungs and a form of pulmonary fibrosis.

Avoid strong oxidising agents, e.g. chlorates which may be use in agriculture.

Gas oil is slightly irritating to the skin and has a de−fatting action. Toxicity following single exposure to high level of gas oil is of low order. Prolonged, repeated skin contact may de−fat the skin resulting in possible skin irritation and dermatitis. In some cases warty, cancerous growths have occurred.

PROTECTIVE MEASURES

Ensure good ventilation and avoid heat sources. Observance of good housekeeping rules will ensure general safety. Do not smoke. Avoid breathing mist.

When working on, or testing, injection equipment, special care is required to avoid perforation of skin by high pressure fuel. Use eye protection in the event of suspected high pressure leak.

Adopt a high standard of personal hygiene. In the case of skin contact, wash well with soap and water.

Use glove and overalls, and eye protection goggles if there is a risk of splashing. Use oil impervious gloves and avoid contamination inside the gloves. If overalls become contaminated, discontinue use and clean thoroughly. Contaminated clothing should be removed, soaked with water, and laundered before re−use.

No special respiratory precautions are necessary in normal use.

DO NOT use as a solvent for removing dirt/grease etc, from skin.

STORAGE/TRANSPORT

Store and transport only in correctly marked containers. Keep containers closed when not in use. Keep cool, out of sunlight and away from naked flames. Electrical continuity is required between the transport and storage vessels during product transfer.

Contain leak/spill with sand, earth or other suitable material, and prevent entry of substance into drainage/sewerage system, water−courses and land. Dispose of unwanted or absorbed substance through an authorised contractor to a licensed site.

Inform local and fire authorities should the product reach waterways, drains etc.

EMERGENCY ACTION

- Fire
  Extinguishing media:
  Large fire − Foam/water fog. Never use water jet.
  Small fire − foam/dry powder, AAAF, CO_2, sand, earth.
  Avoid making sparks. Fire fighters to use self−contained breathing apparatus. Keep fire exposed containers cool, using water fog/spray. Prevent run−off from entering waterway, drains and drinking water supplies.
- Ingestion
  Do not induce vomiting. Wash the mouth out with water, and send to hospital immediately.
- Inhalation (of vapour)
  Remove from further exposure. Obtain medical assistance immediately.
- Aspiration (inhalation of liquid)
  If, following ingestion of gas oil, vomiting occurs, there is danger of aspiration into the lungs. This would cause intense local irritation and chemical pneumonitis that can be fatal. Obtain immediate medical assistance.
- Eyes
  Irrigate copiously with water or preferably eye−wash solution for at least five minutes. If irritation persists seek medical advice.
- Skin
  Wash thoroughly with soap and water. Change clothing if necessary.
  If high pressure injection has occurred prompt surgical attention is required.
- Spillage
  Absorb using sand, earth or other suitable material. Dispose of unwanted or absorbed flammable material as directed under Storage/Transport.

LUBRICATION OIL − PREMIUM BLUE E 15W40

Also known as oil, lube oil, sump oil, new oil is dark, viscous liquid with a slight, characteristic odour. The base oil contains: distillates (petroleum), solvent−dewaxed heavy paraffinic. It is not classified as dangerous according to Directive 1999/45/EC and its amendments, and is not classified according to the EU regulations.

It has a boiling point greater than 150°C, a flash point Open Cup of 220°C (Cleveland), and is insoluble in cold water.

It is used in engine lubricant oil systems, sump pan and filters, make−up tanks and piping systems as a lubrication oil for use in wide range of diesel engines operating under severe conditions. Installers, operators and maintainers are likely to encounter this product.

HAZARDOUS REACTIONS

This product is stable although slightly re−active with oxidising agents. Results of decomposition are carbon oxides (CO, CO_2) and water.

Although harmful if swallowed or aspirated (breathed in), repeated or prolonged exposure is not known to aggravate medical conditions.

Used oil may contain harmful combustion by−products and unburnt fuel that will cause skin reactions as detailed for fuel. Particular care must be taken if oil form a severely overheated engine is handled − use impervious gloves, lab coat and safety glasses.

Do not breathe vapour/spray.

PROTECTIVE MEASURES

Ensure good ventilation and avoid heat sources.

Adopt a high standard of personal hygiene. In case of skin contact, wash thoroughly with soap and water.

Use safety glasses, impervious gloves and lab coat. Avoid contamination inside the gloves. If overalls become contaminated, discontinue use and clean thoroughly.

No special respiratory precautions are necessary in normal use. Do not breathe vapour/spray when handling hot materials.

STORAGE/TRANSPORT

Store and transport only in correctly marked containers. Keep containers tightly sealed when not in use. Keep in a cool, well ventilated area, out of sunlight and away from naked flames. Store well away from food−stuffs and drinking water.

Wear splash goggles, full suit, boots and gloves. Absorb leak/spill with an inert material and dispose of unwanted or absorbed substance through an authorised contractor to a licensed site. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

EMERGENCY ACTION

- Fire
  Extinguishing media:
  Large fire − Use water spray, fog or foam. Do not use water jet.
  Small fire − Use dry chemical powder or CO_2
  Fire−fighters to use self contained breathing apparatus and full turnout gear. Keep fire exposed containers cool.
- Ingestion
  Do not induce vomiting, Obtain medical advice immediately.
- Inhalation (of vapour)
  Remove from further exposure. Obtain medical attention.
- Aspiration (inhalation of liquid)
  Obtain immediate medical assistance.
- Eyes
  Flush copiously with water or preferably eye−wash solution for at least fifteen minutes. Obtain medical advice.
- Skin
  Wash thoroughly with soap and water. Obtain medical advice if irritation develops. Change clothing if necessary and wash before re−use.
- Spillage
  Absorb with an inert material and dispose of this as directed under Storage/Transport.

GENERATOR SET WARNING LABELS

Warning signs are provided on the generator set at or near the point of risk. To avoid injury, always take the necessary precautions – as indicated on the sample signs shown below:

	Caution or Warning indicates a risk of personal injury.
	Caution or Warning of Temperature Hazard. Indicates a risk of personal injury from high temperature.
	Caution or Warning of High Voltage Hazard. Indicates a risk of personal injury from electric shock or electrocution.
	Caution or Warning of Engine Coolant Pressure Hazard. Indicates a risk of personal injury from hot pressurized engine coolant.
	Caution or Warning. Indicates to read Operator Manual for additional information.
	Caution or Warning of No Step. Indicates a risk to personal injury or equipment damage from stepping on equipment.
	Caution or Warning of Combustion or Explosion Hazard. Indicates a risk of personal injury from explosion.
	Caution or Warning of Belt and Rotating Part Hazard. Indicates a risk of personal injury from entanglement in moving parts.
	Caution or Warning of Chemical (ingestion or burn) Hazard. Indicates a risk of personal injury or asphyxiation from poisonous fumes or toxic gases.
	Caution or Warning of High Voltage or Current Source Hazard. Indicates a risk of personal injury from electrical shock or electrocution.
	Caution or Warning of Fan and Rotating Part Hazard. Indicates a risk of personal injury from entanglement in moving parts.

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.)

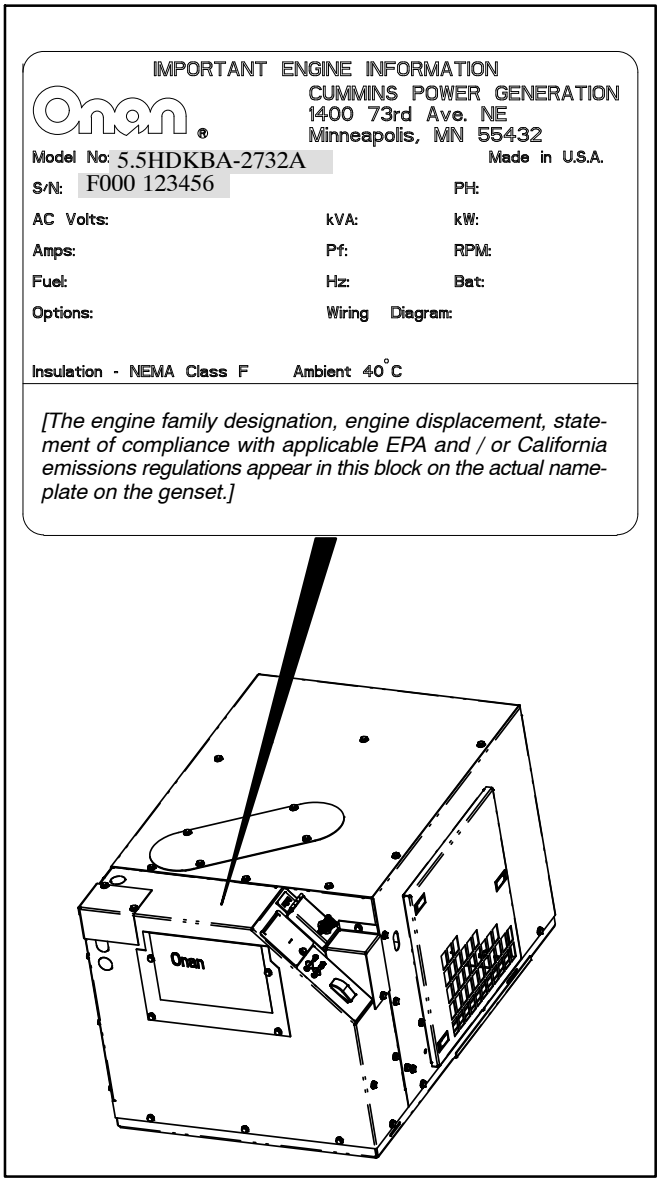

FIGURE 1-1. TYPICAL NAMEPLATE

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.***

High quality diesel fuel is necessary for good performance and long engine life.

The specifications for the type and sulfur content (ppm, % weight) of the diesel fuel used must comply with all emissions regulations applicable in the areas where the genset is to be operated.

Diesel fuels meeting ASTM D975 or EN 590 specifications are recommended. Use Grade 1-D diesel fuel where ambient temperatures are below 14° F (–10° C). A minimum Fuel Cetane Rating of 45 is recommended. Where ambient temperatures are below –4 F (–20° C), or the elevation is above 5000 ft (1500 m), a minimum Cetane Rating of 50 is recommended.

Current US EPA regulations for Non-Road engines limit diesel fuel sulfur content to a maximum of 500 ppm (0.05% weight). Therefore, use Grade 2-D S500 or 2-D S15 diesel fuel. Where ambient temperatures are below 14° F (–10° C), use Grade 1-D S500 or 1-D S15 diesel fuel. Note that beginning in year 2010, US EPA regulations for Non-Road engines will limit diesel fuel sulfur content to a maximum of 15 ppm (0.0015% weight).

Do not use diesel fuel having a sulfur content greater than 10,000 ppm (1.0% weight).

Diesel fuel must meet the ASTM D975 standard for lubricity and pass a minimum load level of 3100 grams as measured by ASTM D6078, or maximum scar diameter of 0.45 mm as measured by ASTM D6079 or ISO 12156–1.

BIO–DIESEL FUELS B5 – B20

B5 bio–diesel fuel that meets industry specifications and quality is suitable for use with this generator set.

Bio–Diesel Above B5 and up to B20 Bio–Diesel Blends

The following must be verified before using bio–diesel blends up to B20:

- The generator set is Spec F or higher.
- The vehicle propulsion engine is capable of using B20 when sharing the same fuel tank.
- The OEM has installed B20 compatible fuel line from fuel tank to generator set.
- The OEM has installed a water separator in the fuel line just before the generator set.

Approved Bio–Diesel Fuel:

- For bio–diesel blends above the B5 and up to B20, Onan generator sets by Cummins. requires that the fuel meet the specifications outlined in ASTM D7467. The bio–diesel component of this fuel blend must meet ASTM D6751 or EN14214 and the petroleum diesel component must meet ASTM D975.
- Blended bio–diesels fuels should be bought pre–blended and not made by customers.

Bio–Diesel Properties:

- Bio–diesel has poor oxidation stability which can accelerate fuel oxidation. Fuel oxidation will reduce generator performance. This effect is accelerated at increased ambient temperatures.
- Bio–diesel properties change at low ambient temperatures (below 23°F/–5°C). Necessary precautions must be taken when operating the generator with bio–diesel blends in low ambient temperatures, such as a fuel heater, hose insulation, or additional anti–gel fuel additives.
- Bio–diesel fuel blends are an excellent medium for microbial growth. Microbes cause fuel system corrosion and premature filter plugging. The effectiveness of all commercially available conventional anti–microbial additives, when used in bio–diesel, is not known. Consult your fuel and additive supplier for assistance.

⚠WARNING It is highly recommended that specific market applications are avoided or exercised with extra care due to some of the properties of bio−diesel fuel blends such as cold weather operation, long term storage, material incompatibilities and other effects on engine operating characteristics. Such applications that should use standard fuels include applications that will experience seasonal usage, storage for periods exceeding 90 days, and extreme temperatures or humidity.

Storage Requirements:

- If using bio−diesel for seasonal applications (stored more than 90 days), the generator must be purged before storage by running the engine on pure diesel fuel meeting ASTM D975 for a minimum of 30 minutes.

Warranty Coverage:

Onan generator sets by Cummins Warranty covers failures that are a direct result of defects in material or factory workmanship. Generator damage, service issues and/or performance issues determined by Onan generator sets by Cummins to be caused by bio−diesel fuel blends not meeting the specifications outlined in the applicable Installation, Operator, and Service Manuals are not considered to be defects in material or workmanship and may affect your generator's warranty.

ENGINE OIL RECOMMENDATIONS

Oil Performance Class

Use API (American Petroleum Institute) classified engine oils according to the following guidelines:

Emissions-Regulated Areas: It is mandatory to use CF, CF−4, CG−4, CH−4 or CI−4 class oil with low sulfur fuel (sulfur content less than 500 ppm, 0.05% weight) or ultra low sulfur fuel (sulfur content less than 15 ppm, 0.0015% weight).

Non-Regulated Areas: CF class oil is recommended when using high sulfur fuel—sulfur content between 500 ppm (0.05% weight) and 5000 ppm (0.5%weight). If CF−4, CG−4, CH−4 or CI−4 class oil is used, the oil and oil filter must be changed twice as often as specified in the PERIODIC MAINTENANCE SCHEDULE (Page 3−1).

Non-Regulated Areas: Use CF, CF−4, CG−4, CH−4 or CI−4 class oil when using high sulfur fuel—sulfur content between 5000 ppm (0.5% weight) and 10,000 ppm (1.0% weight). The oil and oil filter must be changed twice as often as specified in the PERIODIC MAINTENANCE SCHEDULE (Page 3−1).

Oil Viscosity

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.

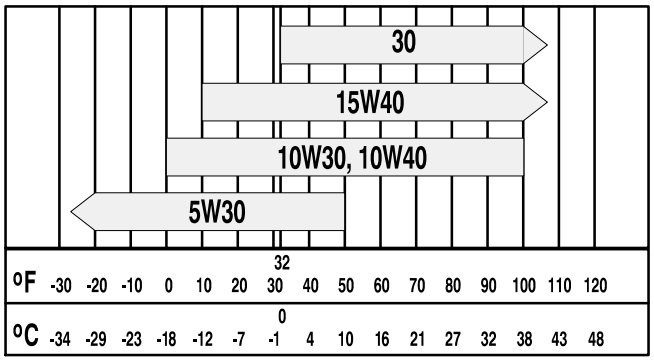

FIGURE 1-2. OIL VISCOSITY VS. TEMPERATURE

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.

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 Access – 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.

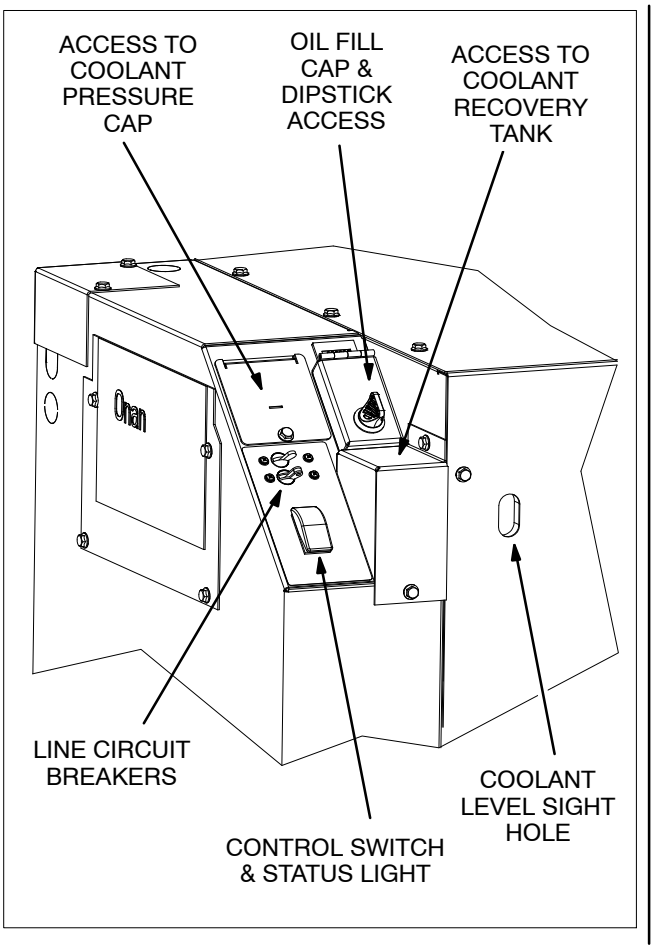

FIGURE 2-1. OPERATOR'S CONSOLE

⚠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***
- ***Nausea***
- ***Vomiting***
- ***Headache***
- ***Weakness and Sleepiness***
- ***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 occupy 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.

⚠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.***

1. Visually inspect for fuel, exhaust and coolant leaks. Do not start the genset if there is fuel, exhaust or coolant leak and have it repaired.
2. 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.)
3. See Section 9. *Troubleshooting* if the genset does not start after several tries.
4. For top performance and engine life, especially in colder weather, let the engine warm up for two minutes before connecting appliances.

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				•[3,6]			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, 7]		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]	8-12
Replace Coolant Hoses and Thermostat						•[5, 6]	8-11
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).
7 – Perform every 250 hours when using B20 Bio–diesel fuel.

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

⚠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 or drain.***

⚠ 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.***

⚠ CAUTION ***Do not operate generator with Oil Fill Access Cover open. Always ensure the cover is closed and latched before operating the generator.***

1. Open the Oil Fill Access Cover to locate the dipstick and oil fill location (Figure 3-1). Twist the dipstick cap approximately 1/4 turn counterclockwise and pull to remove the dipstick from the Oil Fill Tube. Wipe off the dipstick and insert it back into the Oil Fill Tube. Remove the dipstick again and check the oil level on the dipstick cable.
2. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (Page 1-3). 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. Approximately 1 pint (0.4 liter) can be added if the oil level is at the lower bead.
3. Insert the Dipstick into the Oil Fill Tube and twist the dipstick cap clockwise to secure it. Close and latch the Oil Fill Access Cover.

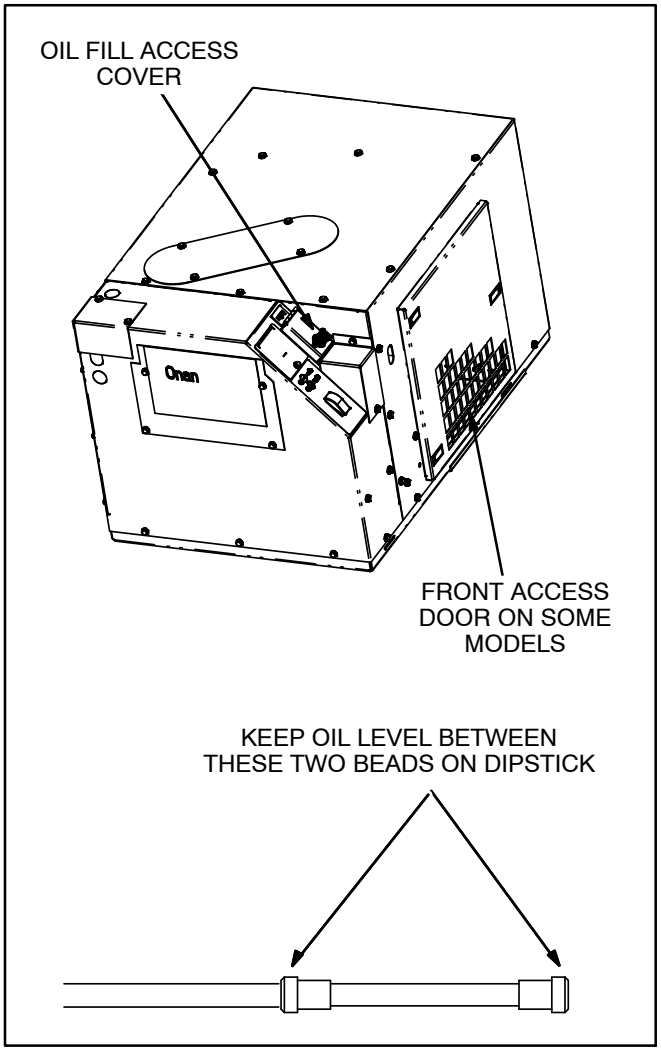

FIGURE 3-1. OIL FILL NECK AND DIPSTICK

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.

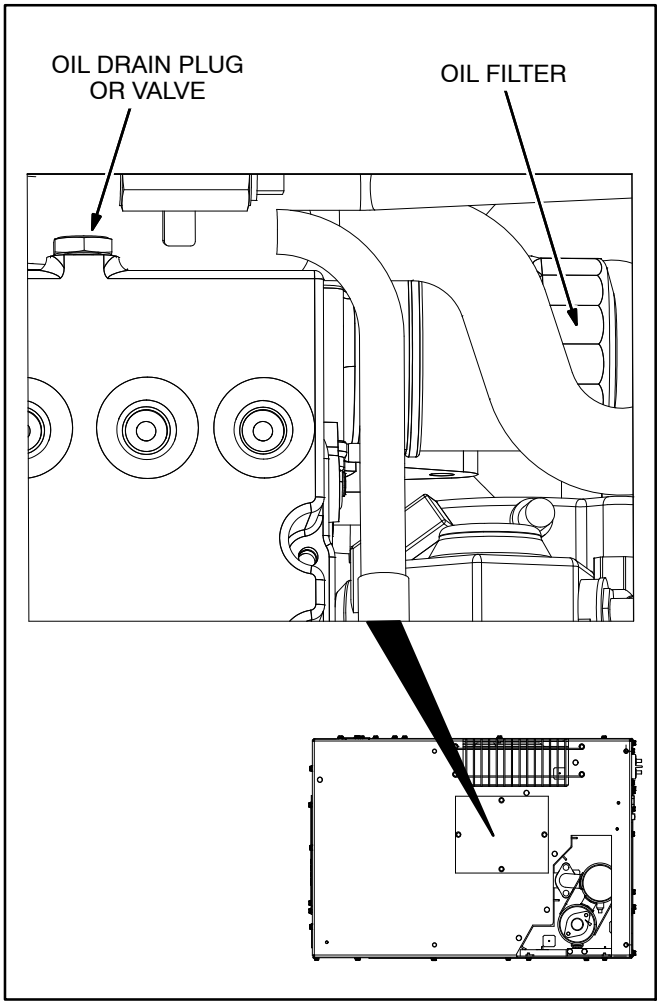

FIGURE 3-2. OIL DRAIN PLUG AND OIL FILTER

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.

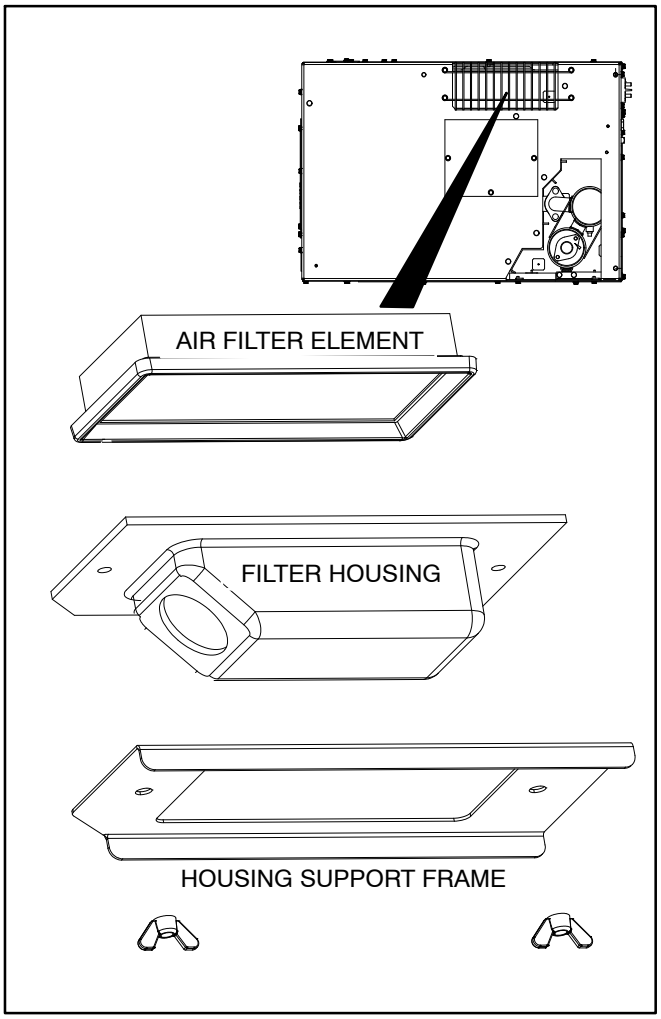

FIGURE 3-3. AIR FILTER

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.

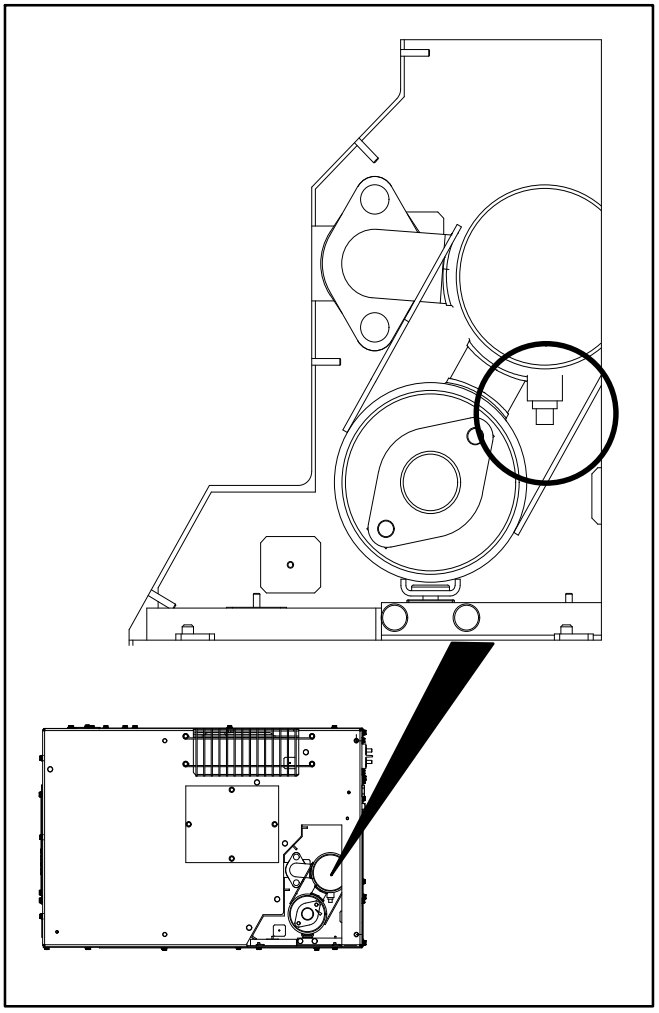

FIGURE 3-4. SPARK ARRESTOR CLEANOUT PLUG

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.

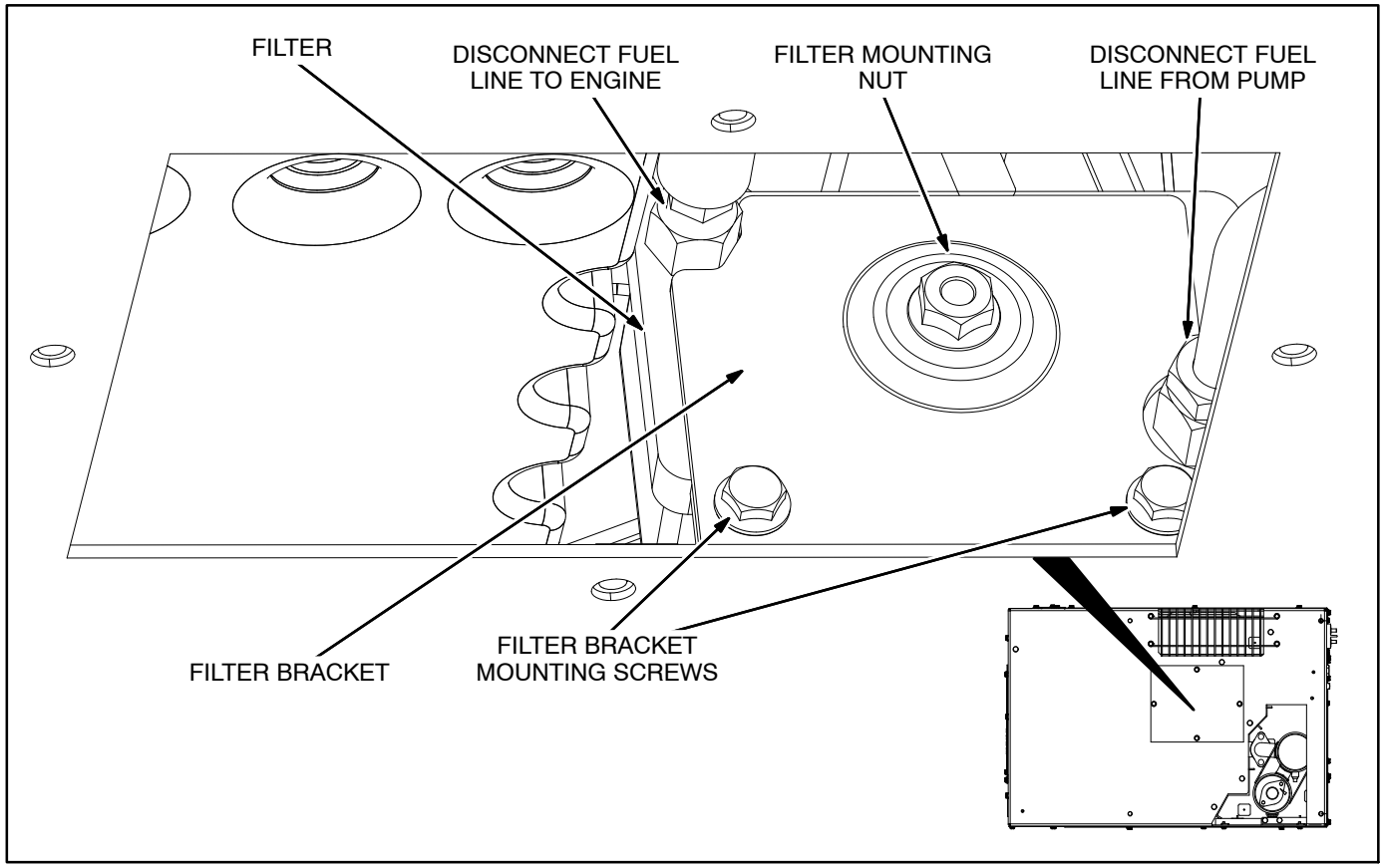

FIGURE 3-5. FUEL FILTER

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.

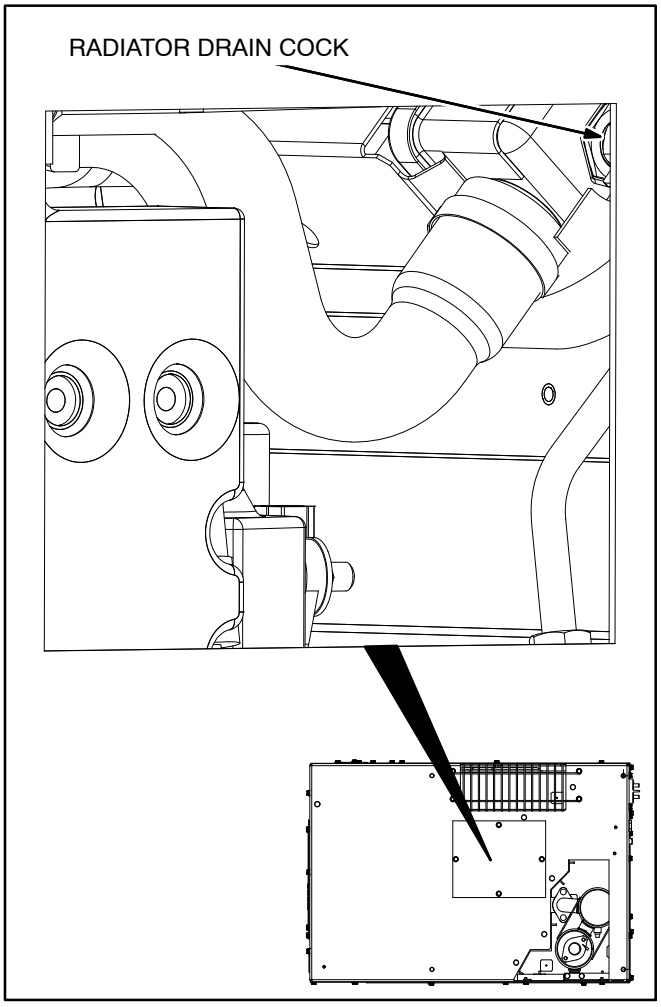

FIGURE 3-7. ENGINE COOLING SYSTEM

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.

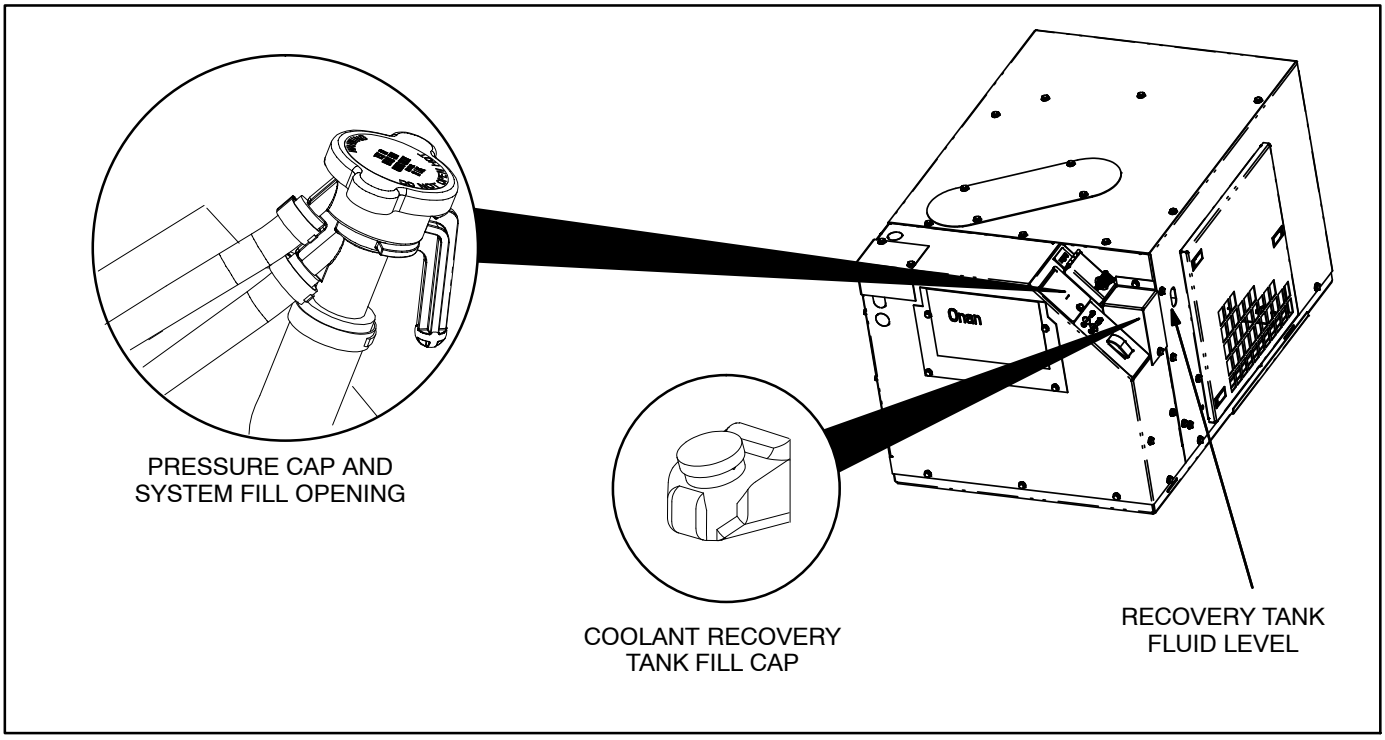

FIGURE 3-8. ENGINE COOLING SYSTEM PRESSURE CAP AND RECOVERY TANK

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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).

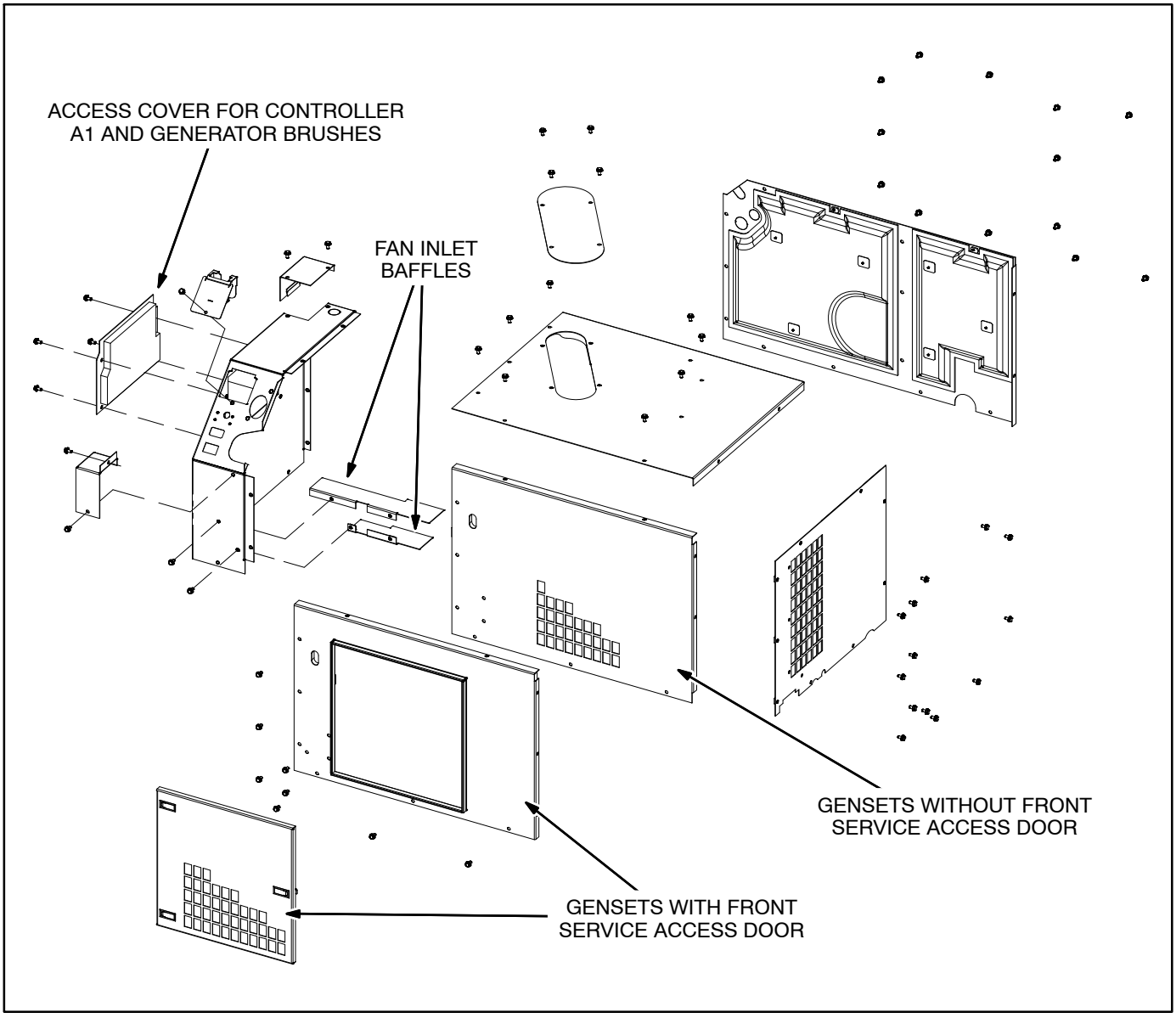

FIGURE 4-1. THE GENSET HOUSING PANELS AND THEIR MOUNTING SCREWS

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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).

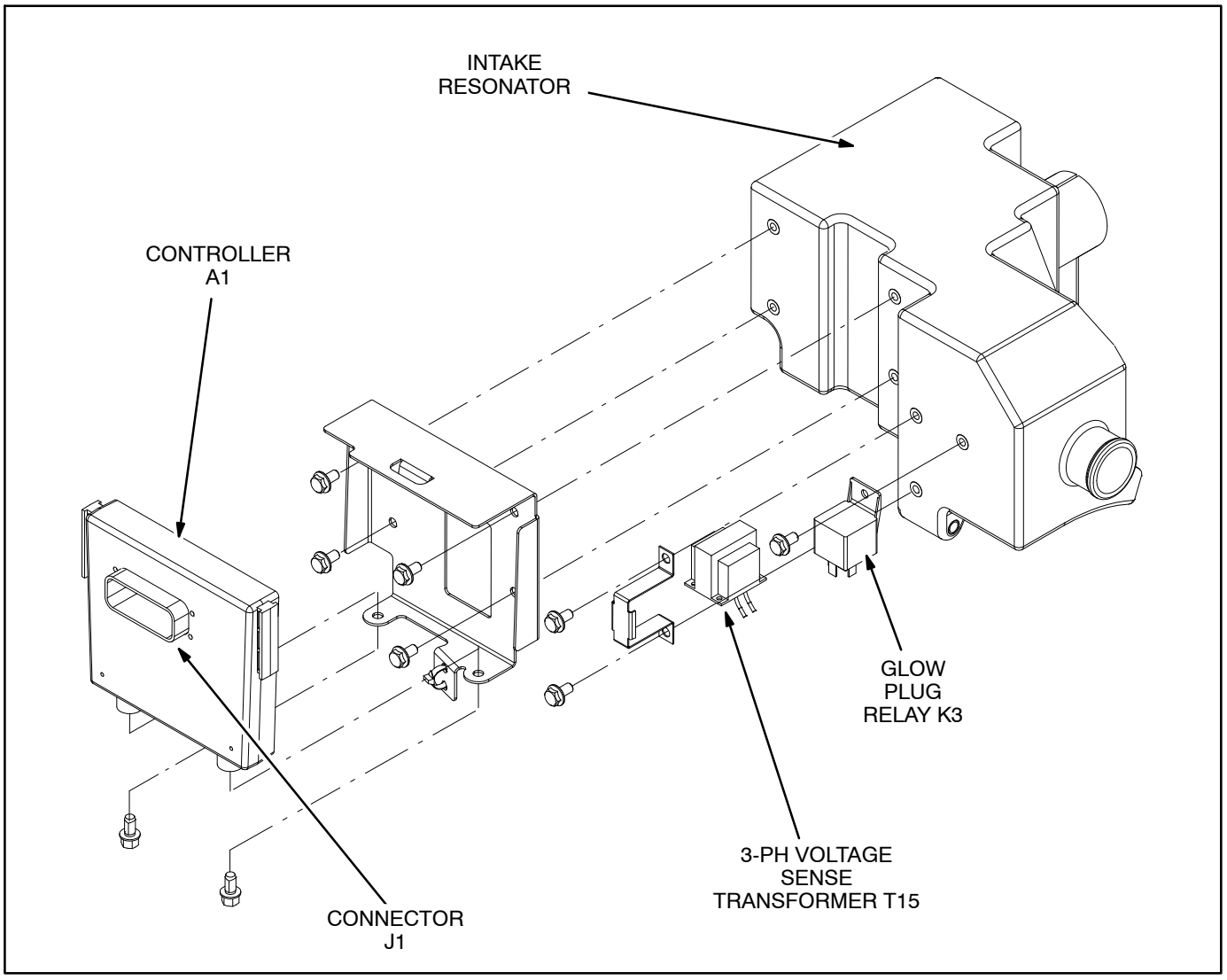

FIGURE 5-1. CONTROLLER A1

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 6-6).

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

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

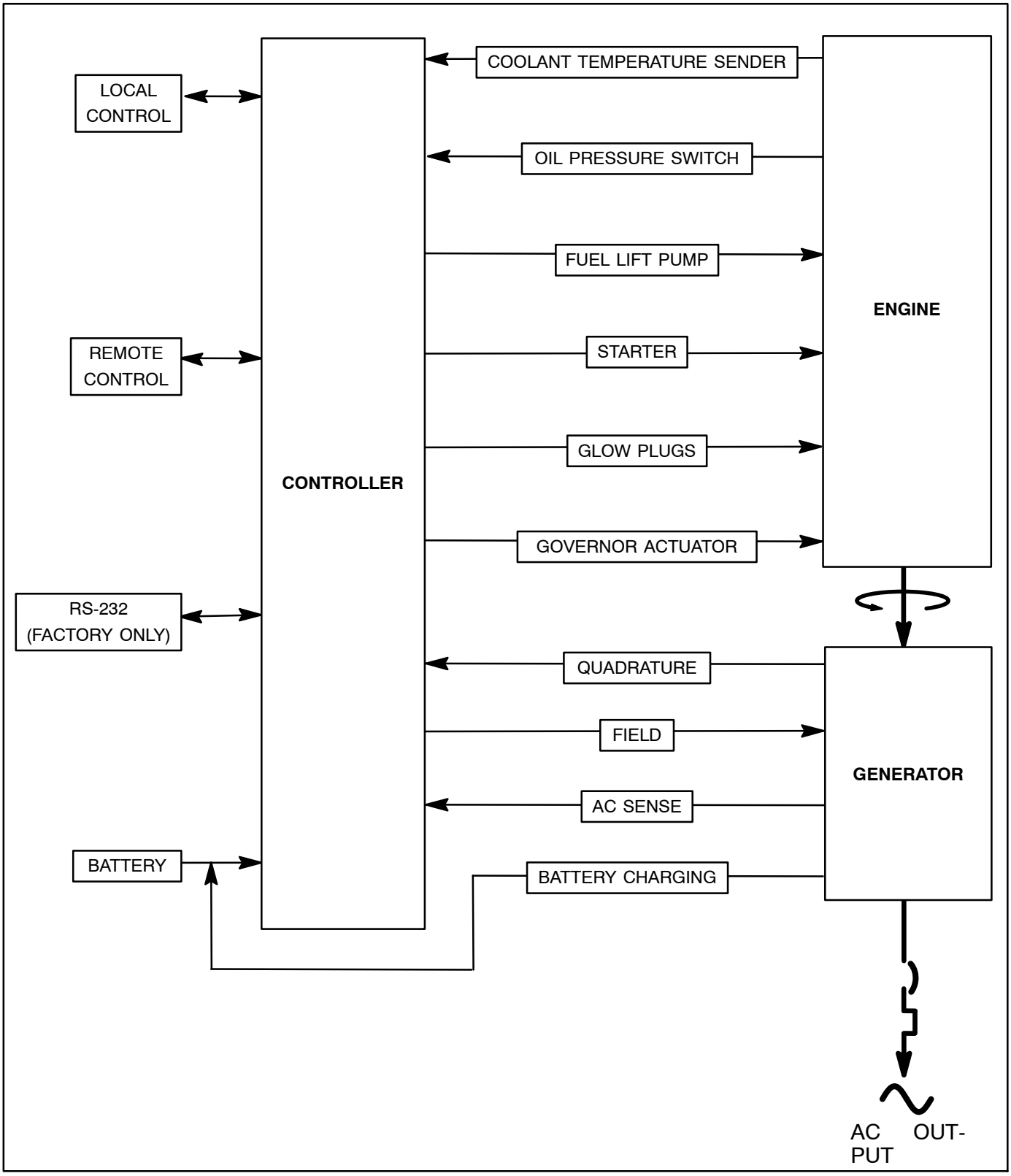

FIGURE 5-2. CONTROLLER A1 BLOCK DIAGRAM

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).

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).

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.

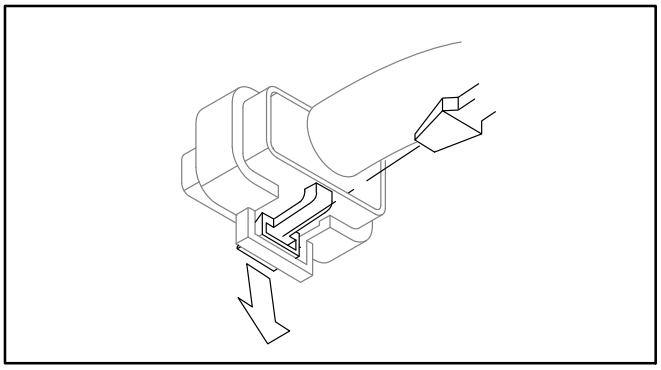

FIGURE 5-3. DISCONNECTING P1 / J1

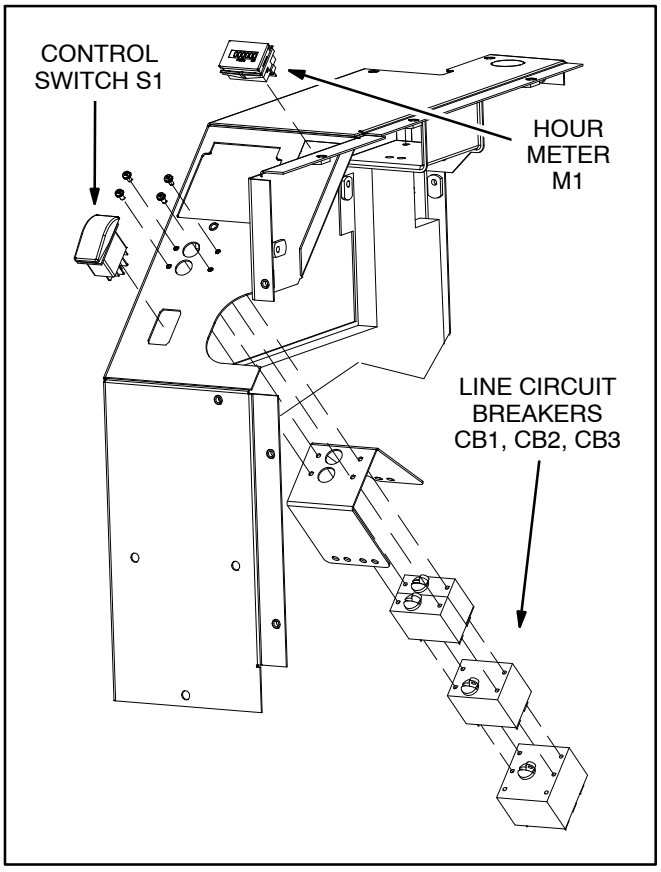

FIGURE 5-4. CONTROL SWITCH, LINE CIRCUIT BREAKERS, HOUR METER

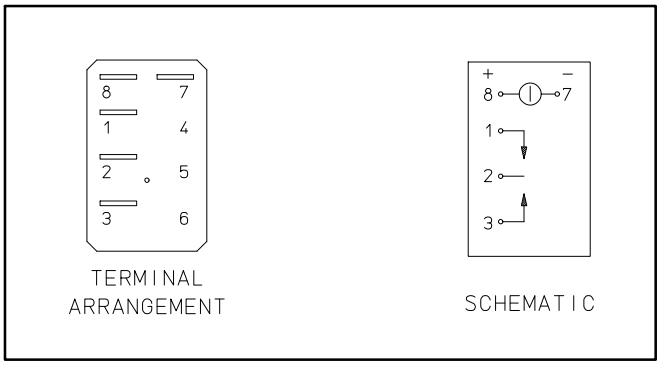

FIGURE 5-5. CONTROL SWITCH S1

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 8-6.

COOLANT TEMPERATURE SENDER E4

See Page 8-6.

FUEL PUMP E2

See Page 8-9.

STARTER MOTOR B1

See Page 8-12.

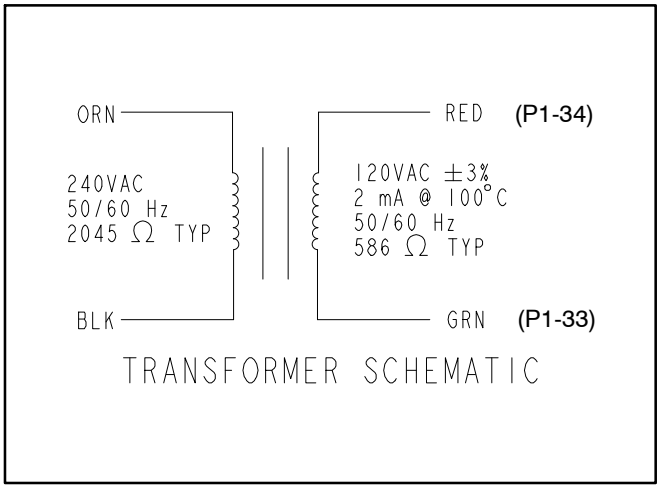

FIGURE 5-6. 3-PHASE VOLTAGE SENSE TRANSFORMER T15

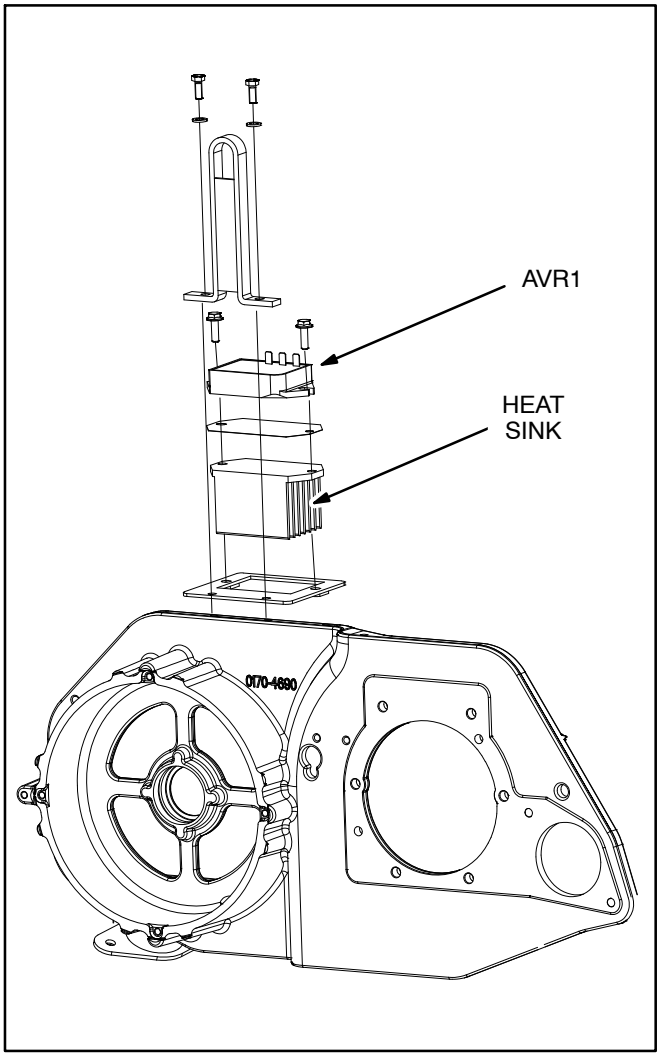

FIGURE 5-7. BATTERY CHARGE REGULATOR AVR1

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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.

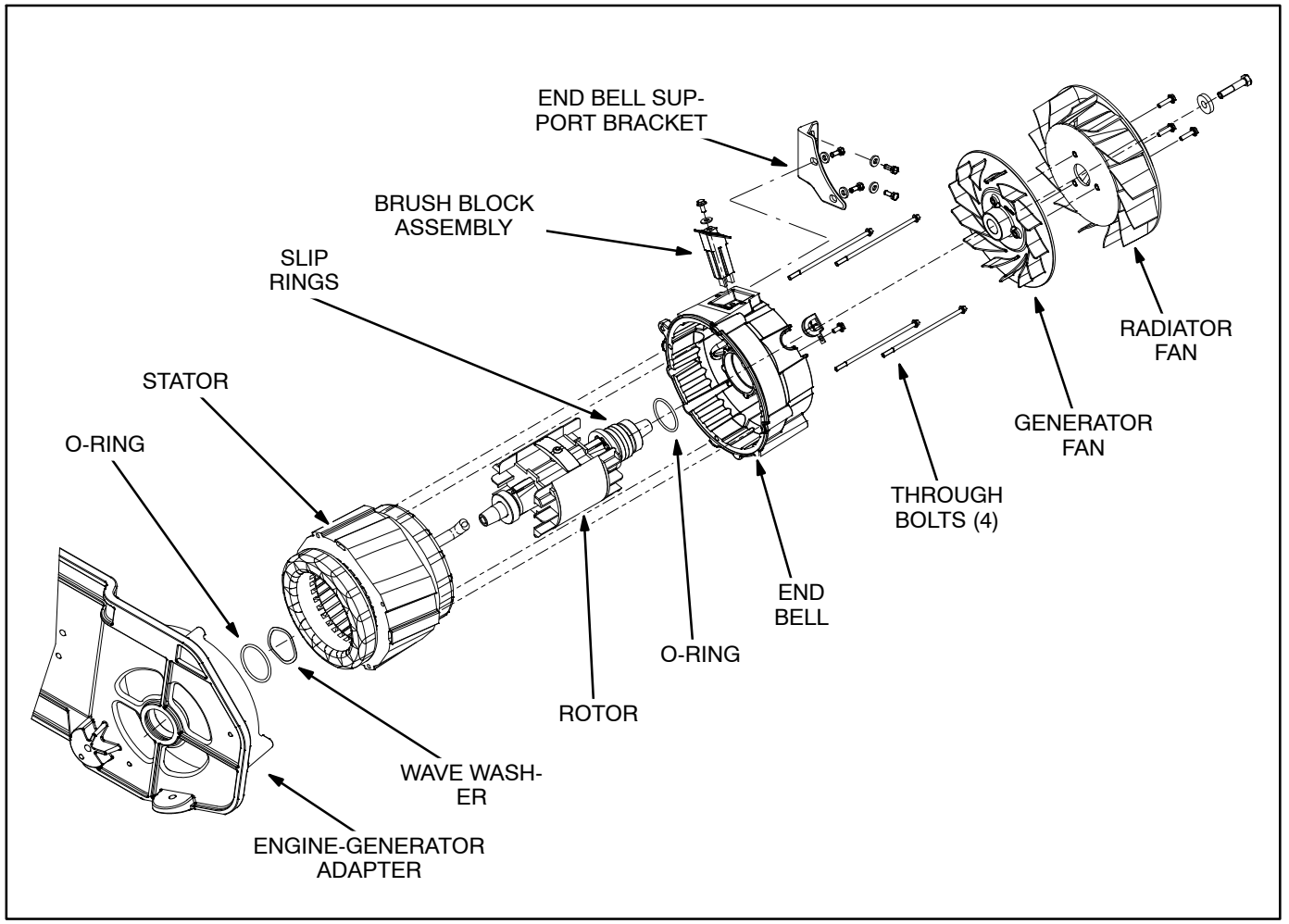

FIGURE 6-1. GENERATOR

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.

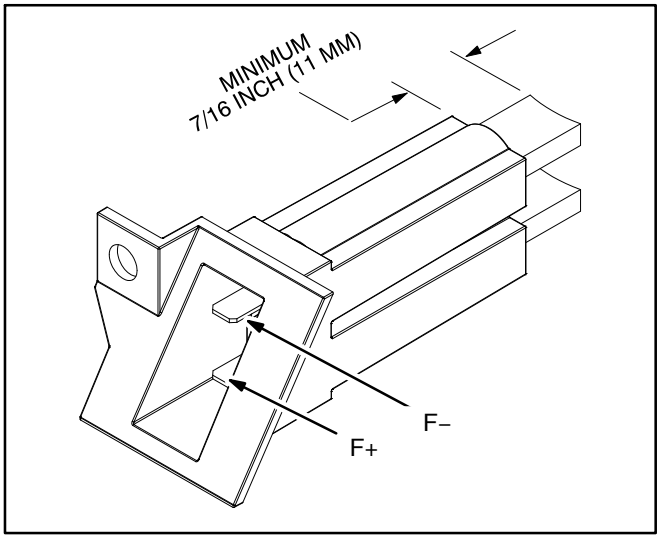

FIGURE 6-2. BRUSH BLOCK

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*.

TESTING GENERATOR WINDINGS

Testing the Rotor

Notice: **There is a consumer alternator service strategy change starting with HDKBB Spec H to J and HDKBC Spec H to J alternators/serialized alternators. See below for more information.**

Beginning with HDKBB and HDKBC, the rotor (A) and stator (B) will no longer be orderable as individual service parts. Going forward there will be one part number for the complete alternator assembly (C). See the following table.

TABLE 1-1. SERVICE STRATEGY CHANGE SUMMARY

	Before – Spec H Alternators	After – Starting with Spec J Alternators
Rotor	A	C (Alternator Assembly)
Stator	B	

TABLE 1-2. SERVICE STRATEGY CHANGE SUMMARY

	Before – Spec H Alternators	After – Starting with Spec J Alternators
Rotor Fail	Replace with A	Replace C (Alternator Assembly)
Stator Fail	Replace with B	

The new (Spec J) may have slightly different characteristics, but the overall form, fit, function, and performance will be the same as that of existing alternators. New spec alternators will be backwards compatible with old spec generator set models. However, the new spec and old spec alternator parts are not interchangeable. If a rotor or stator fails in the existing alternator, the entire alternator must be replaced with the new (Spec J) alternator assembly.

Wiring connections and labels will remain the same as the old spec alternators.

Each new spec alternator is serialized. The serial number sticker will be located on the stator and rotor.

New spec alternators may have different cold resistive (R) values depending on model (see the following Table).

Bearings and slip rings will not be individually replaceable on the new spec alternators.

TABLE 1-3. STATOR WINDING RESISTANCES

RESISTANCE (OHMS) ± 10% At 77° F (25° C)			
	A053M356	**A053R511**	**A053L824**
Main Winding T1 – T0	x	.17	.3
Main Winding T2 – T0	x	2	.3
Main Winding T1 – T2	.81	x	x
Main Winding T3 – T4	x	x	x
Quad Winding Q1 – Q2	2.29	.1	1.9 ± .3
Charging Winding B1 – B2	.11	.1	.09 ± .03
Rotor Winding F1 – F2	28 ± .5	28 ± .5	29.8 ± 3

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 the table:

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 and stator assembly 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 and stator assembly if its winding has less than one megohm resistance to ground.

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. Replace the rotor and stator assembly 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. Replace the rotor and stator assembly 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 rotor and stator assembly if any winding has less than one megohm resistance to ground.

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.

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.

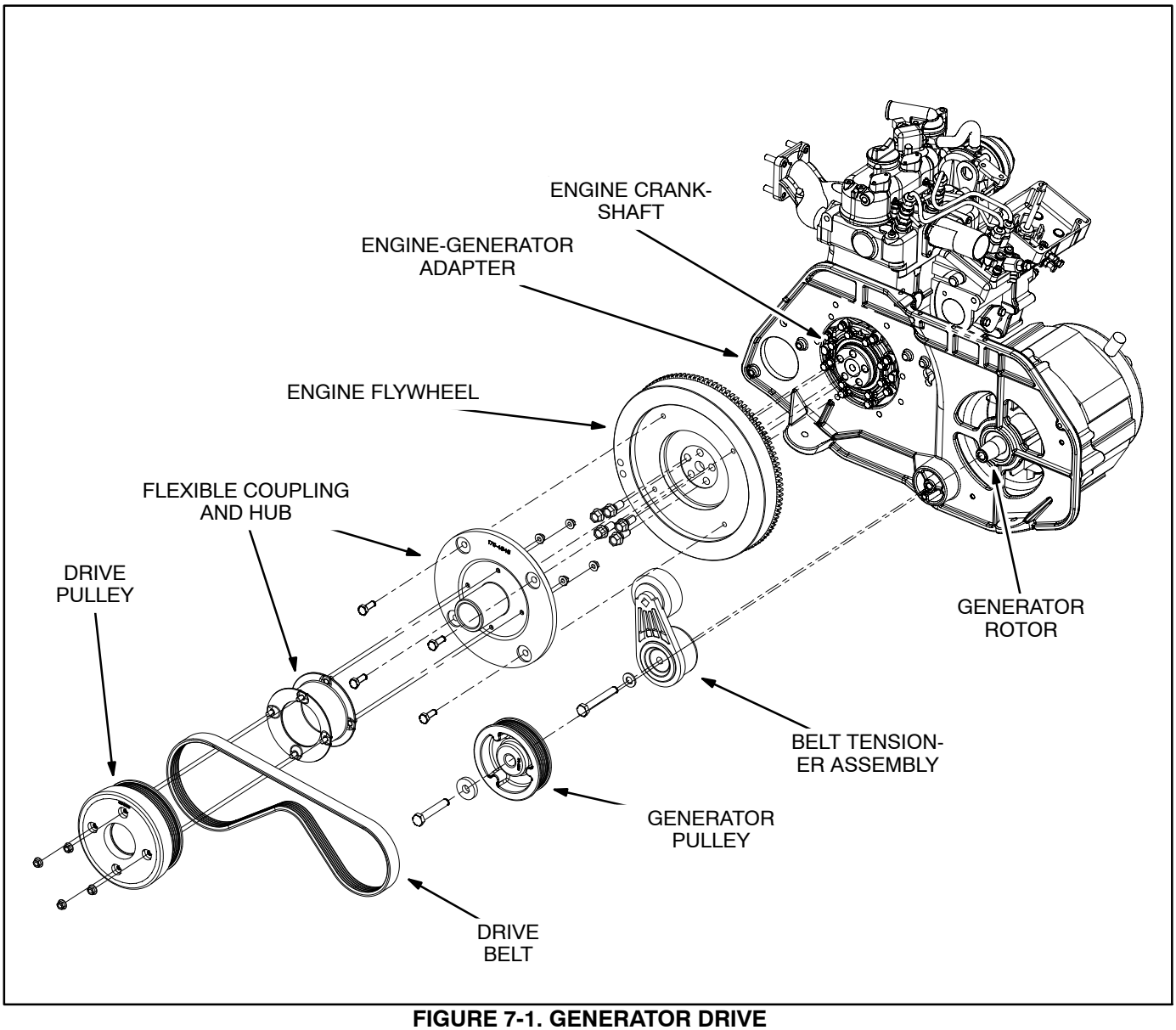

FIGURE 7-1. GENERATOR DRIVE

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 981-0514 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 981-0514 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.

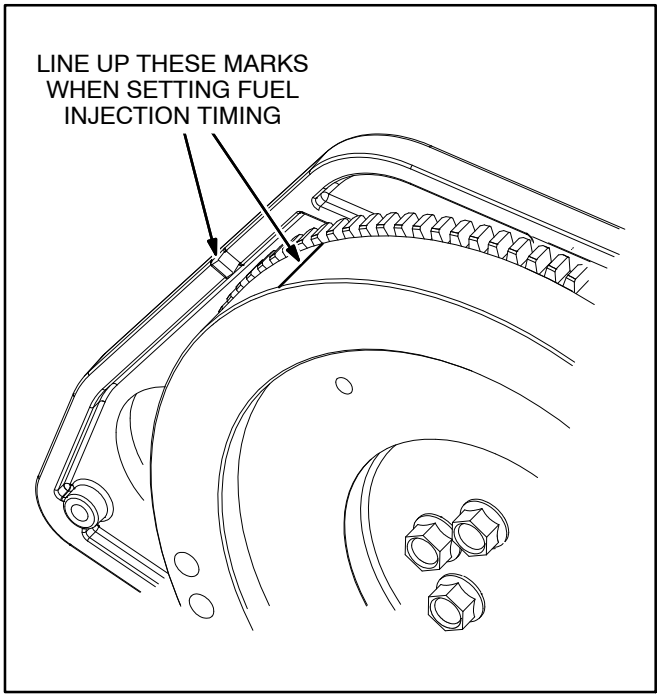

FIGURE 8-1. FUEL INJECTION TIMING MARKS

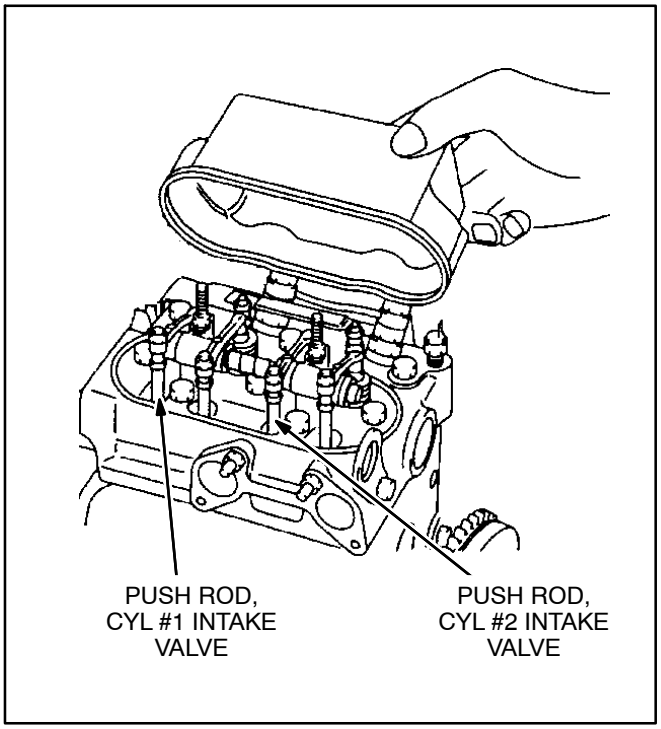

FIGURE 8-2. ROCKER ARMS AND PUSH RODS

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).

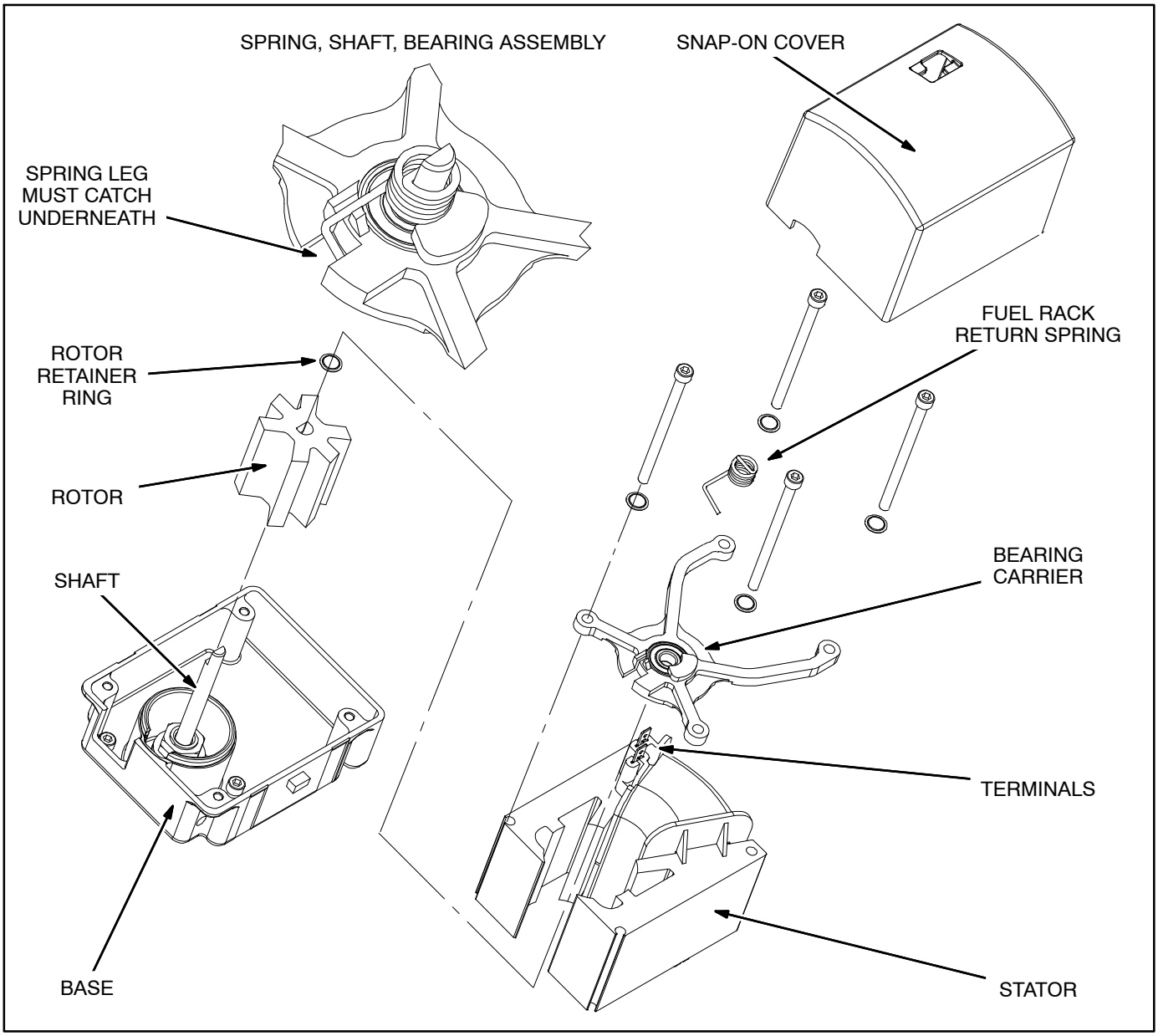

FIGURE 8-3. GOVERNOR ACTUATOR

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 981-0514 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.

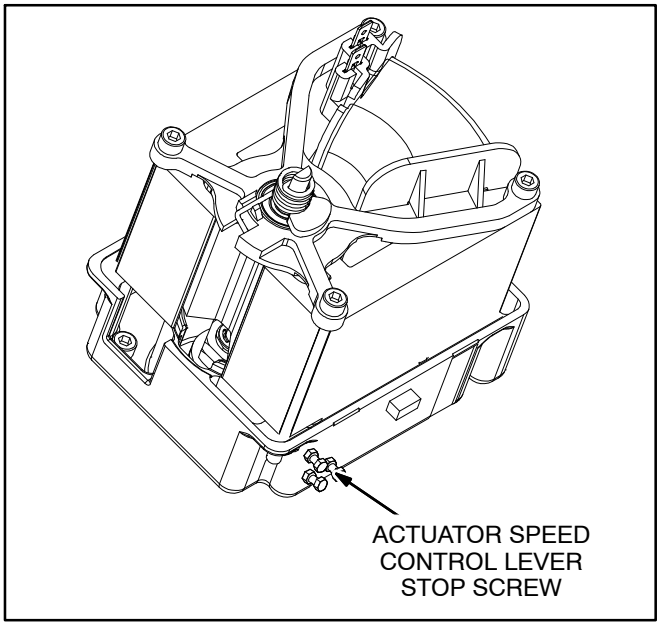

FIGURE 8-4. SPEED CONTROL LEVER STOP

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 resistor between the two leads with a resistence between 1.7–2.8 ohms (This resistor is required to keep the genset from shutting down on fault code 19, Governor Actuator Circuit Open or Shorted, while governor adjustments are being completed.).
5. Connect a 12 volt battery to the actuator terminals using a battery disconnect switch (The battery will hold the governor mechanism against the high speed stop and allow the engine to run after shutdown.).

   ⚠CAUTION ***The actuator could overheat if the battery is left on more than 10 minutes.***
6. When ready, switch the battery on, start the genset, measure engine speed (rpm) *and stop the engine by switching off the battery.*
7. 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).
8. Repeat Steps 6 and 7 until high-idle speed is between 3300 and 3400 rpm. Set the lock nut.
9. Run the clamping screw in by hand until snug, back it out 1-1/2 turns and set the lock nut.

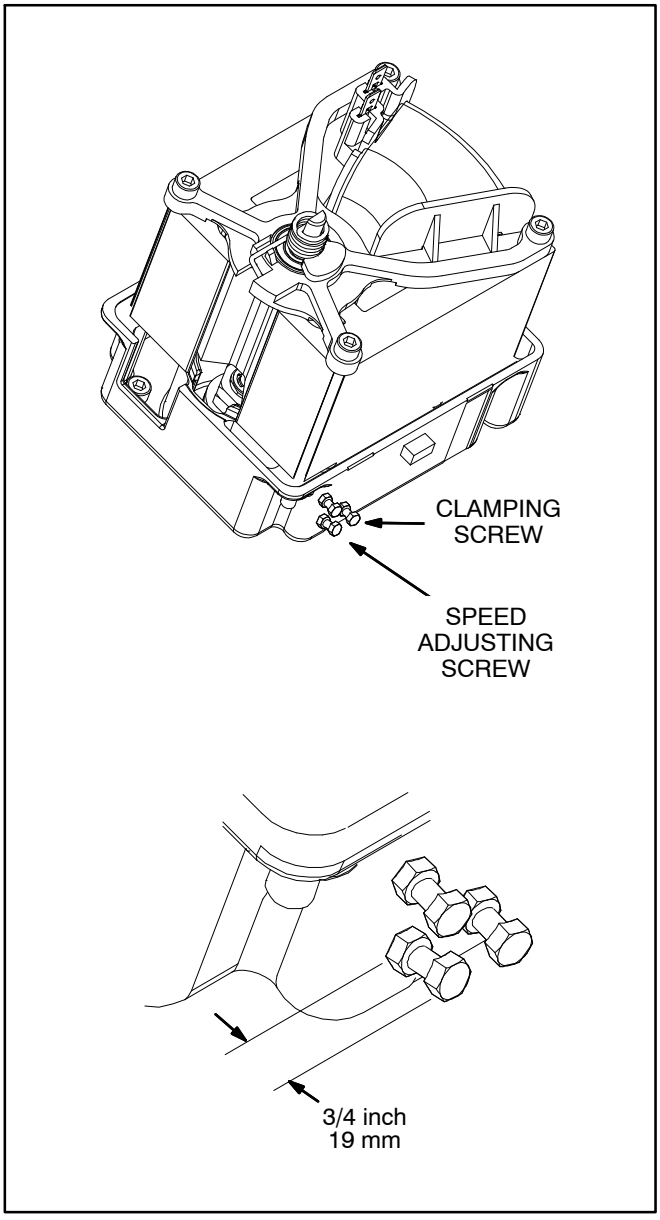

FIGURE 8-5. HIGH-IDLE SPEED SCREW

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.

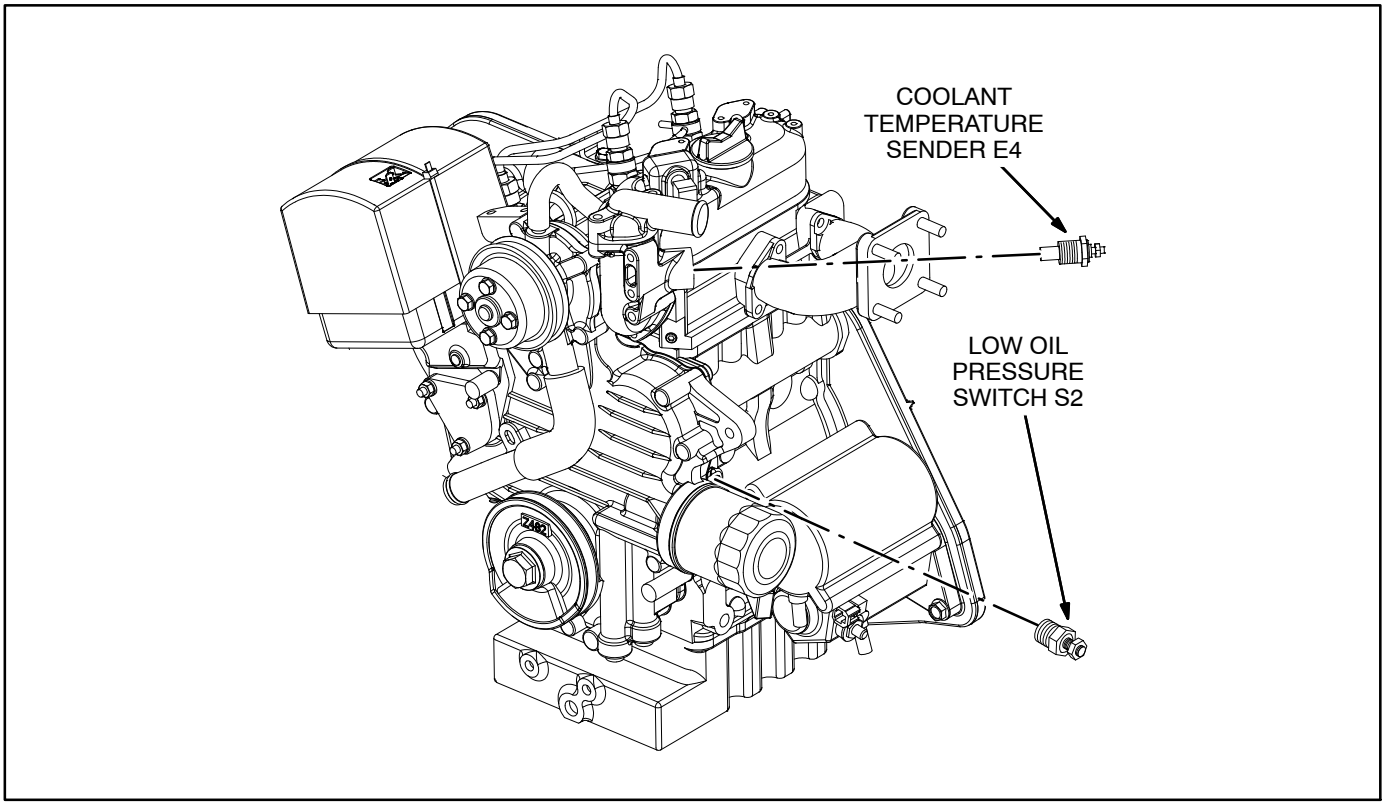

FIGURE 8-6. ENGINE SENSORS

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.

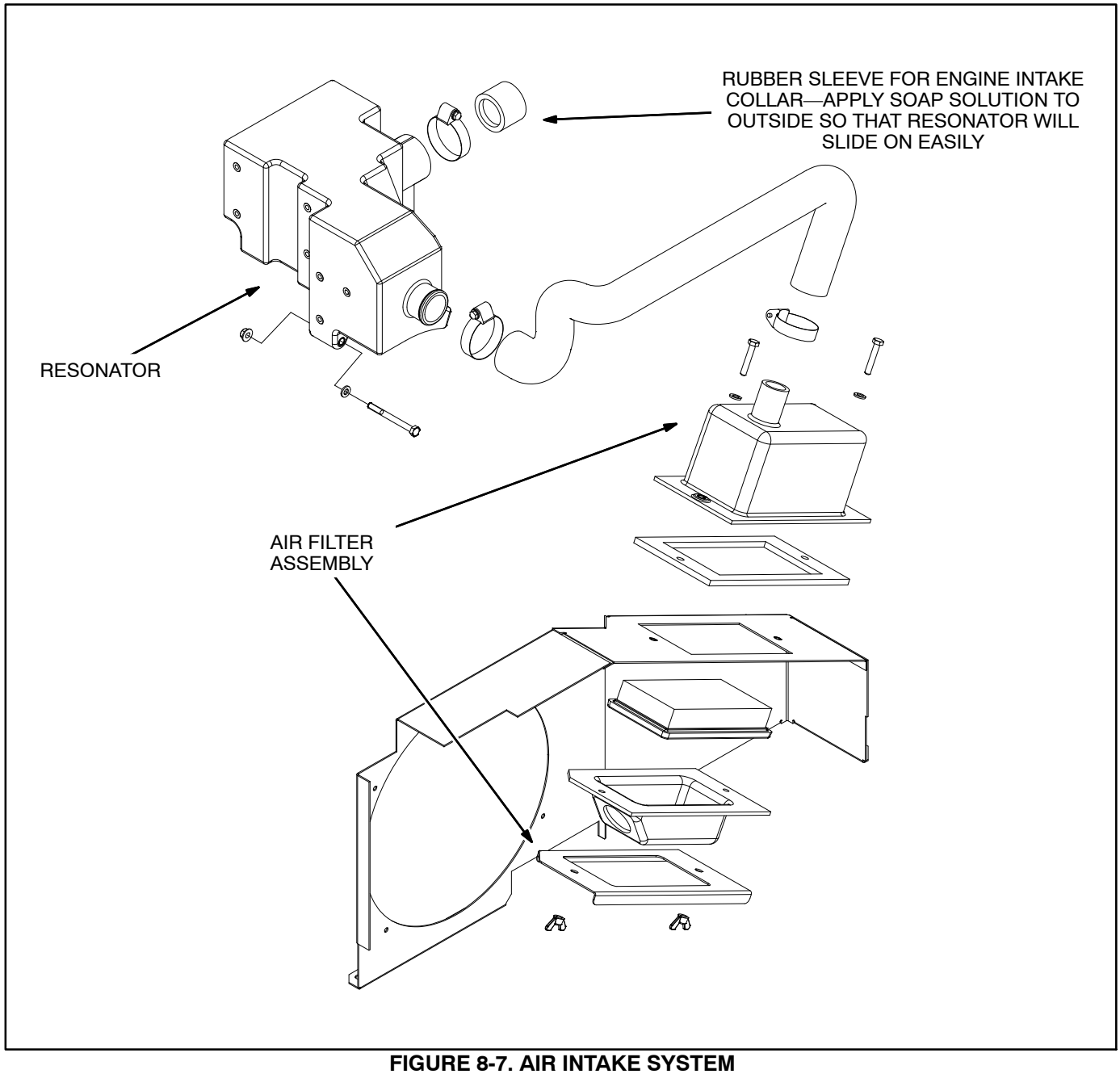

FIGURE 8-7. AIR INTAKE SYSTEM

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).

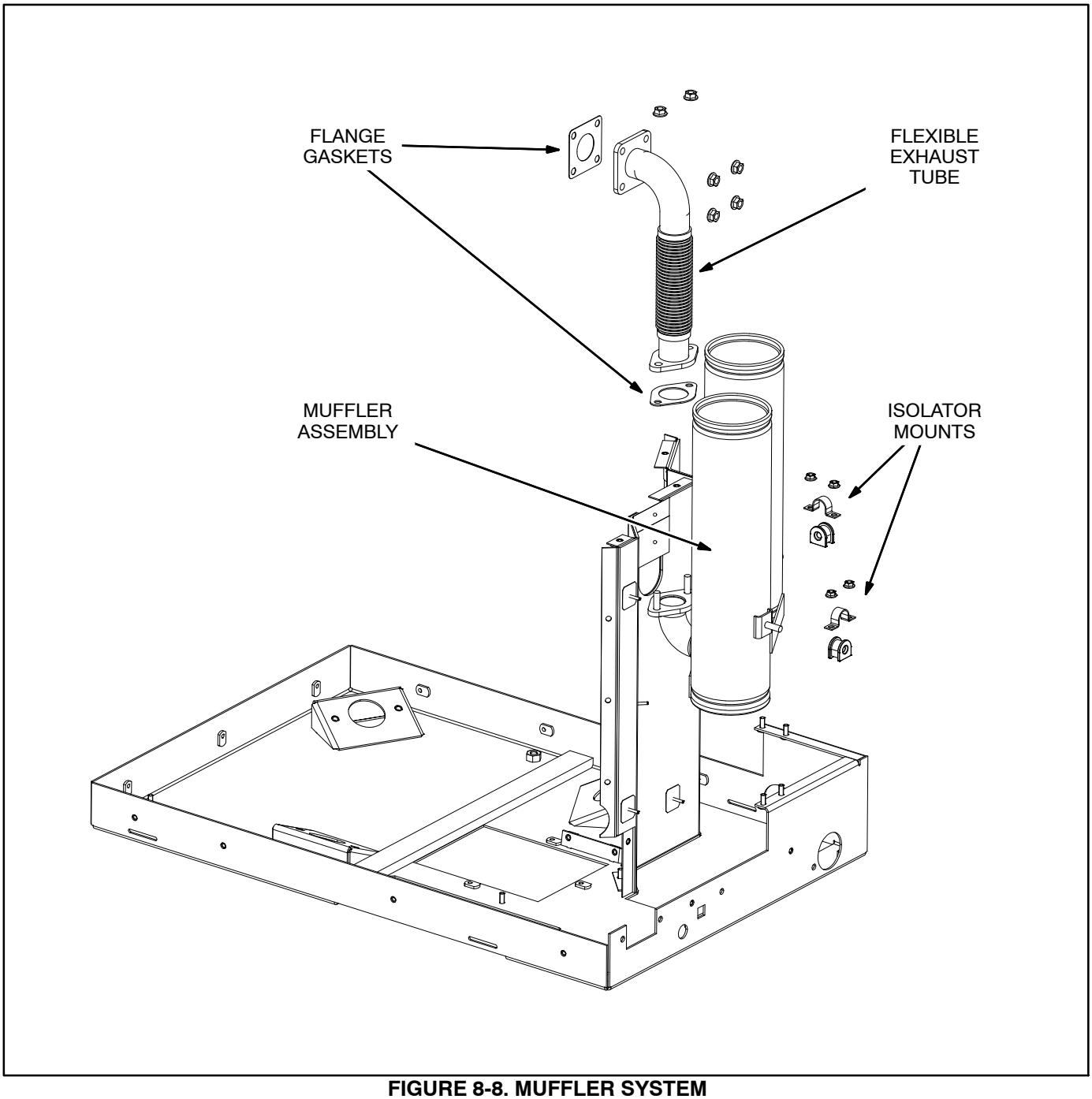

FIGURE 8-8. MUFFLER SYSTEM

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 (981-0514) 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.***

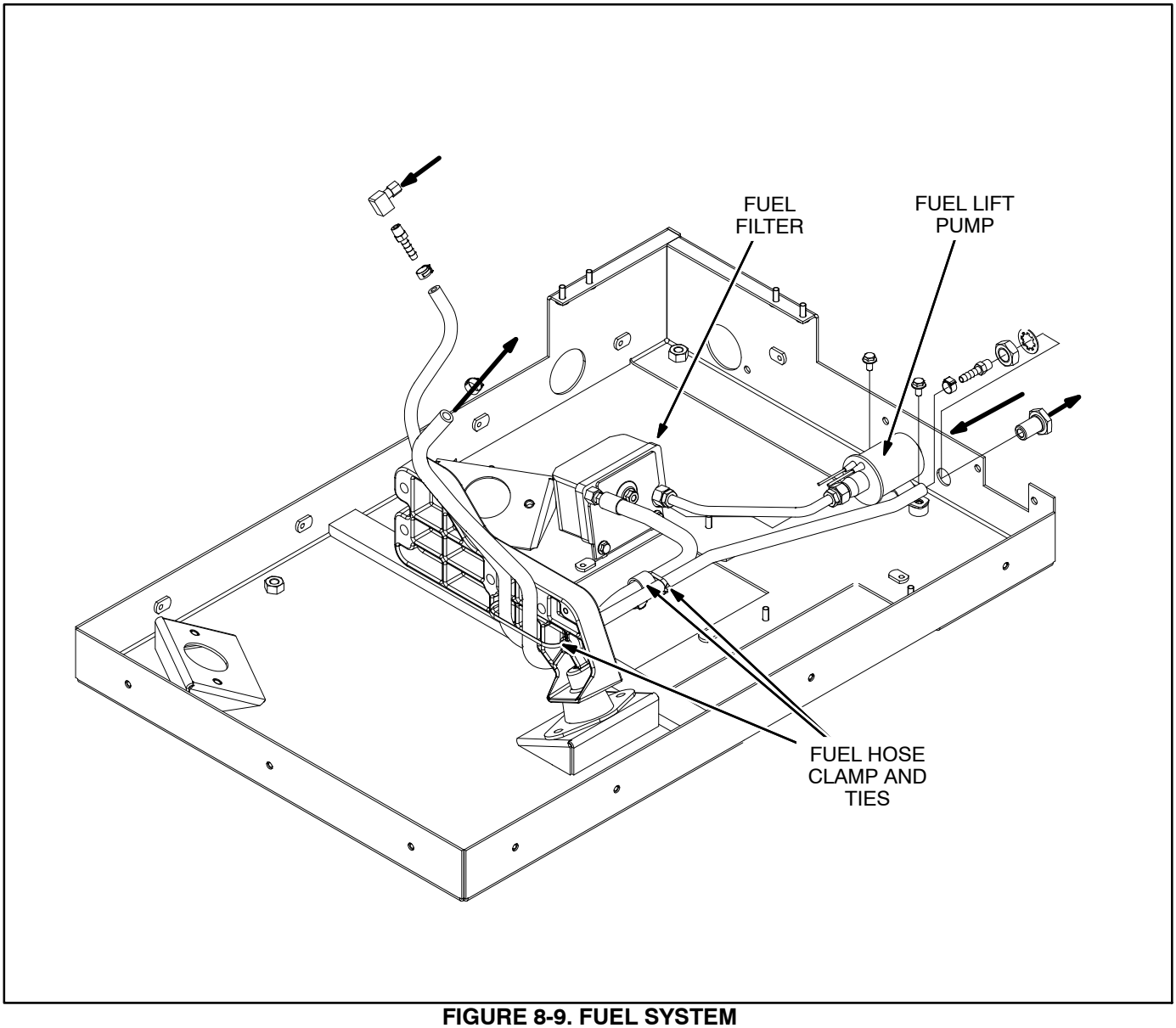

FIGURE 8-9. FUEL SYSTEM

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 (981-0514) regarding coolant pump and thermostat service. See COOLANT PUMP BELT (Page 8-12) 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 8-7) to keep it from sagging and trapping air.
- The fill hose is tied to the top of the engine bracket.

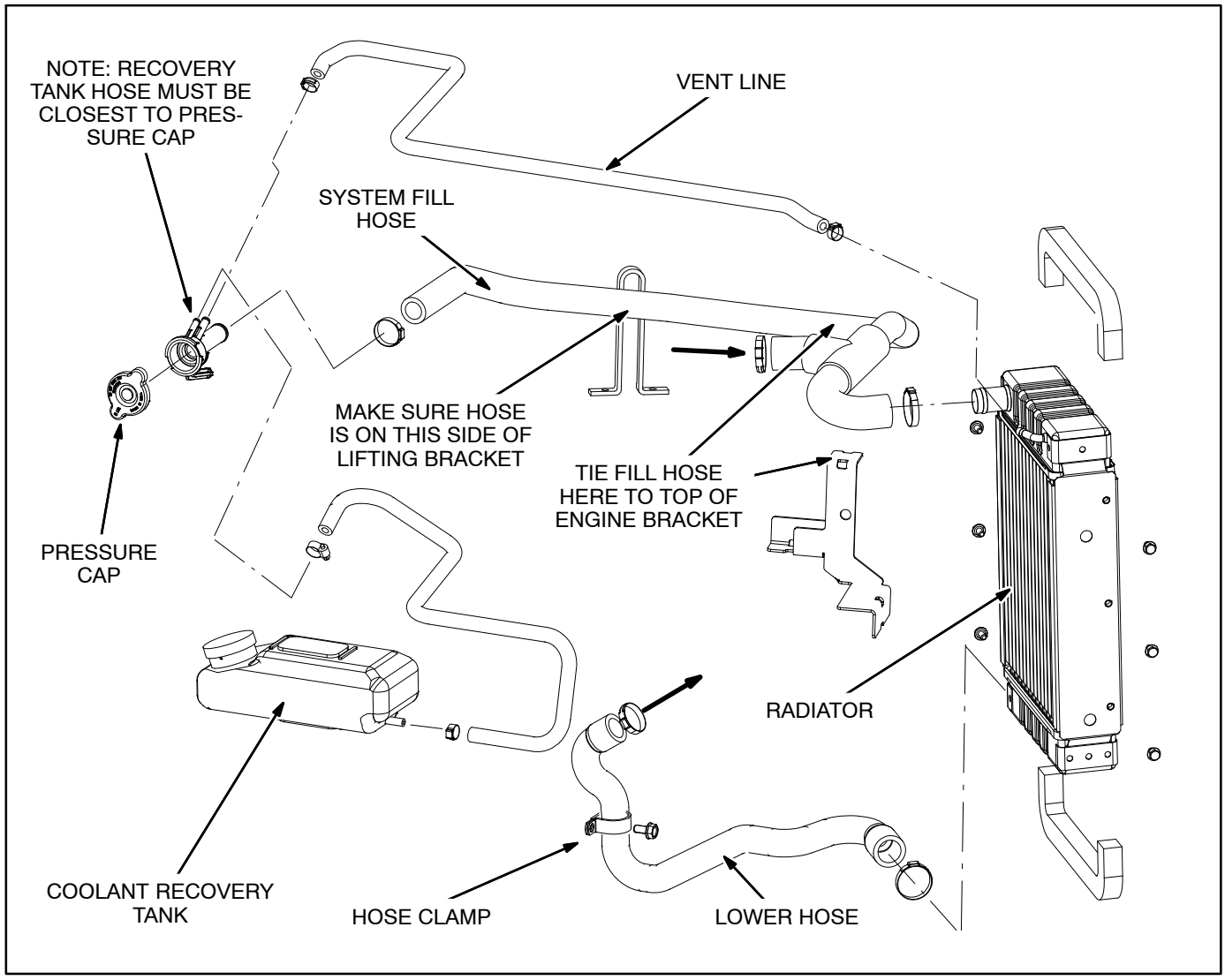

FIGURE 8-10. COOLING SYSTEM

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.

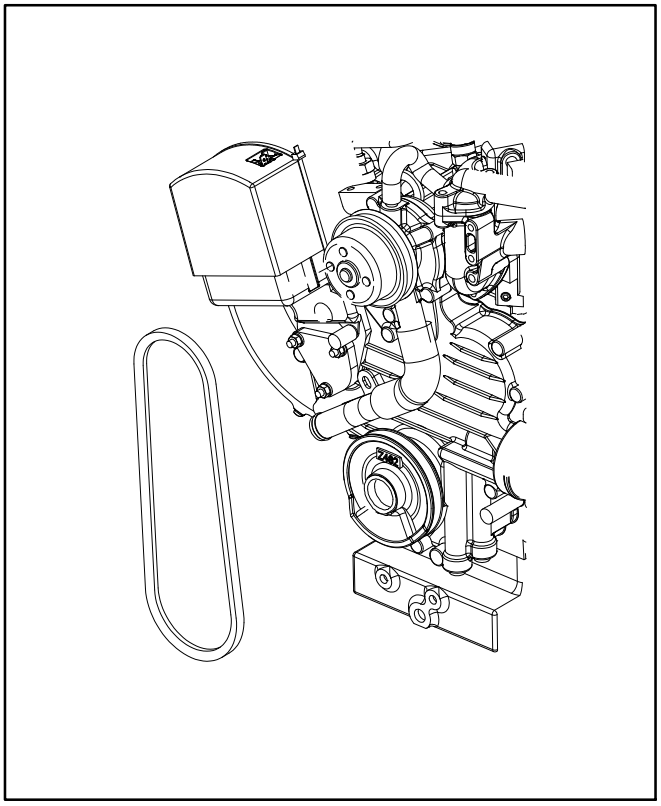

FIGURE 8-11.COOLANT PUMP BELT

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 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+.

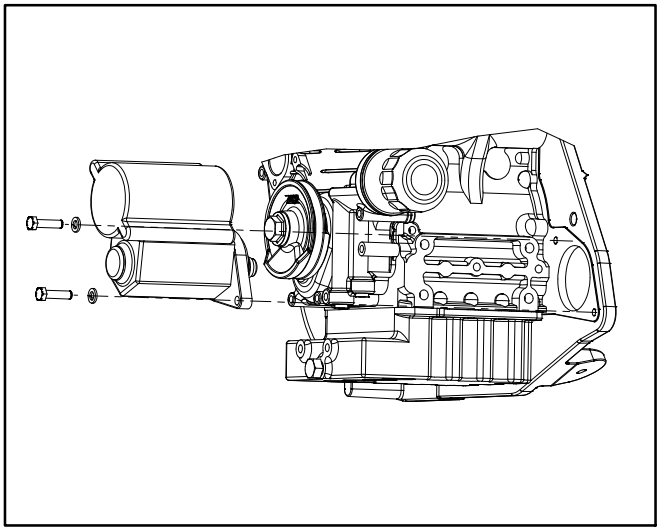

FIGURE 8-12. STARTER MOTOR

FLYWHEEL

See *Flywheel* on Page 7-2.

ENGINE-GENERATOR ADAPTOR

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

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.

FAULT CODES

The genset controller provides extensive diagnostics by causing the status indicator light on the Control Switch to blink in a coded fashion. Proper procedure for obtaining the last recorded fault code:

1. To wake the control: Press and hold the STOP/Prime button until the indicator light illuminates (3–4 seconds). Then release.

2. Press the STOP/Prime button 3 times within 5 seconds to display the first level shutdown fault code. The indicator light will repeatedly blink 1, 2, 3,or 4 blinks at a time:

- **1 Blink**: indicates shutdown due to high engine coolant temperature. For example:
  blink–––*long pause*–––blink–––*long pause*–––repeat
- **2 Blinks**: indicates a low oil pressure fault. For Example:
  blink–blink––*long pause*––blink–blink––*long pause*––repeat
- **3 Blinks**: indicates a service fault. For example:
  blink–blink–blink–*long pause*–repeat
- **4 Blinks**: indicates that cranking exceeded 30 seconds without the engine starting. For example:
  blink–blink–blink–blink–*long pause*–repeat
- **Note: Fault Code Nos. 1, 2, 3, and 4 are first level faults. Pay close attention to the pause sequence to avoid interpreting first level faults as second level Fault Codes Nos. 11, 22, 33, or 44.**

Press STOP/Prime once more to cause the two–digit, second–level fault to blink. (Pressing STOP/Prime again will stop the blinking.) The two–digit code consists of 1, 2, 3, 4, or 5 blinks, a short pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks represents the ones digit of the fault code number. The second set of blinks for the ones digit will blink slightly slower than the tens digit. For example, Fault Code No. 36 appears as:

blink–blink–blink–*short pause*–blink–blink–blink–blink–blink–blink–*long pause*–repeat

- **Note: Generator systems equipped with an AutoGen Start of AGS feature may experience shutdowns with no Fault Codes. This is because the AutoGen Start control is sending the generator control a signal that is sensed as a normal shutdown signal.**

Because different fault logics are used on different products, refer to the appropriate product's service manual to translate the blink code shutdown fault. Each fault will have a description of the shutdown reason and a list of step by step corrective actions.

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.

⚠ 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. Flush the coolant system to remove coolant passage fouling (Page 3-8).
2. Check the engine coolant level and add coolant as necessary (Page 3-8).
3. Check for and remove any objects blocking the air inlet or outlet openings in the bottom and sides of the genset.
4. Check for hot air recirculation. Conduct rise over ambient test if necessary.
5. Check condition of belts and hoses and replace if necessary.
6. Reduce load if necessary. Apply all non–applicable deratings. Derate for high ambient tempera–tures, and high altitudes. Remember the genset rating is an intermittent rating.
7. Test set at full load minus applicable derates. See example calculations below.
8. Test the engine thermostat, to see if it is opening fully (Page 8-11) and replace if necessary.
9. Test coolant sender E4 (Page 8-6) and replace if necessary.

HDKBA, HDKBB power output decreases 3.5% for each 1,000 feet above and altitude of 500feet. Power output decreases by 1% for each 10°F above 85°F. Ratings are at intermittent power output. Continuous ratings are 90% of intermittent. The genset can handle the rated load intermittently. When loads are continuous they should never exceed 90% of nameplate rating.

Example calculation power at operating altitude: 4,500 feet (4,000 feet above rated generator altitude) multiply 3.5% x 4 (4,000 ft) = 14% power reduction. Then multiply 0.14 x generators power rating. ex: 5,500 x 0.14 = 770 watts at altitude.

⚠ 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 switch is closed (grounded))

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 8-6), 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, isolate the switch wire from ground (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 8-9).
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)

Fault occurs when alternator output frequency exceeds 110% of nominal frequency (66Hz for 60Hz Models and 55Hz for 50Hz Models) for more than 2.5 sec or instantaneously when frequency exceeds 117% of nominal frequency (70Hz for 60Hz models and 58Hz for 50Hz models).

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 8-9).
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 27 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 8-9).
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 8-6), if loose.
2. Test the resistance of sender E4 at room temperature and in boiling water (Page 8-6). 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.

⚠ 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.
3. Verify ground at P1–27

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 8-9).
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. Conduct hot air recirculation test (Refer to Installation Manual).
10. 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.***

INVALID SET CONFIGURATION FAULT – CODE NO. 37

(If continuous 'Stop' input is connected to Ground or if MAT sensor input is not Open. Logic is checked at every Start or Prime attempt.)

Corrective Action:

1. Check for any 'open' wire connections for continuous Stop and MAT sensor and repair accordingly.

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.

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).

⚠ 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.***

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.

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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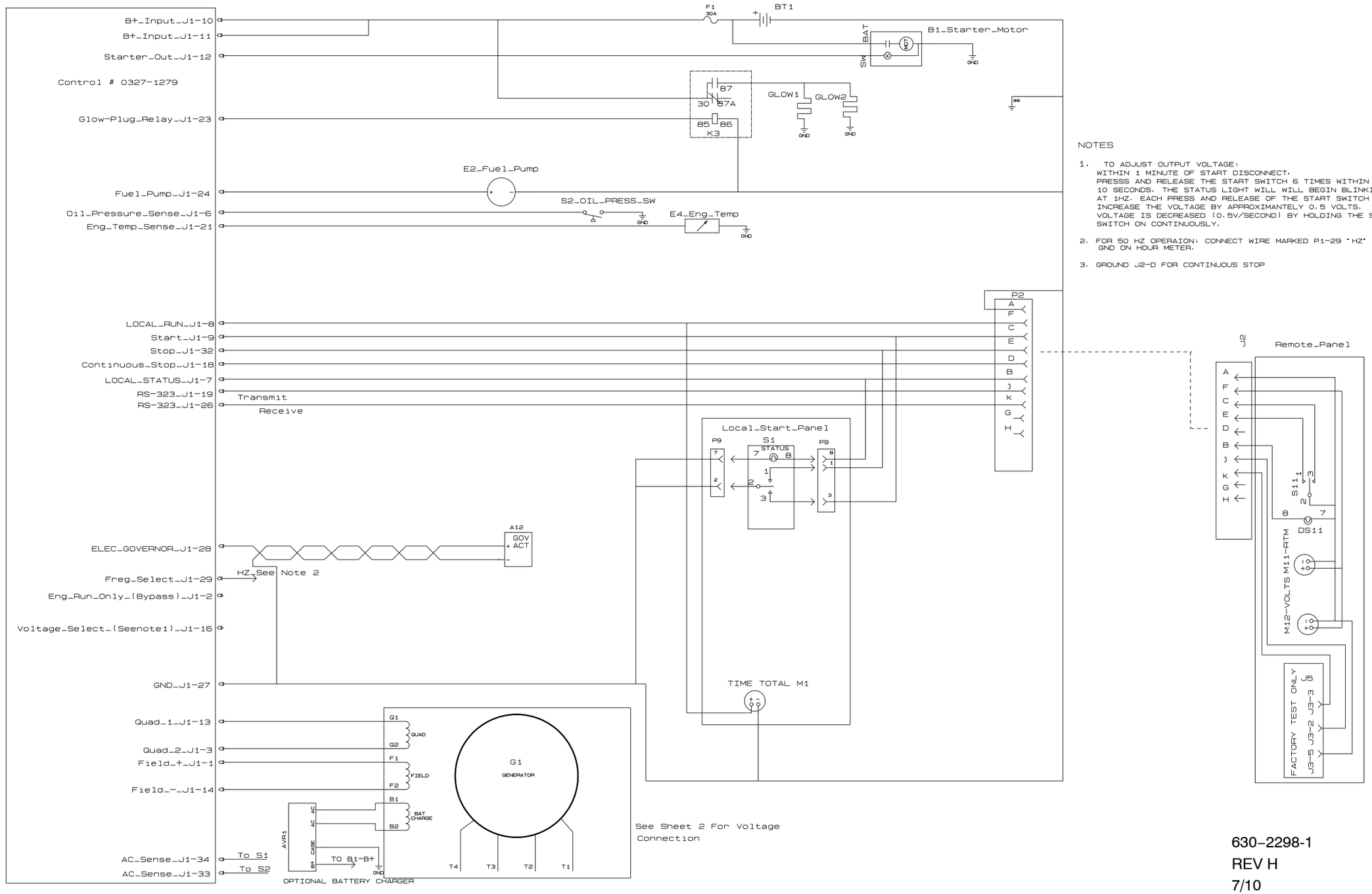
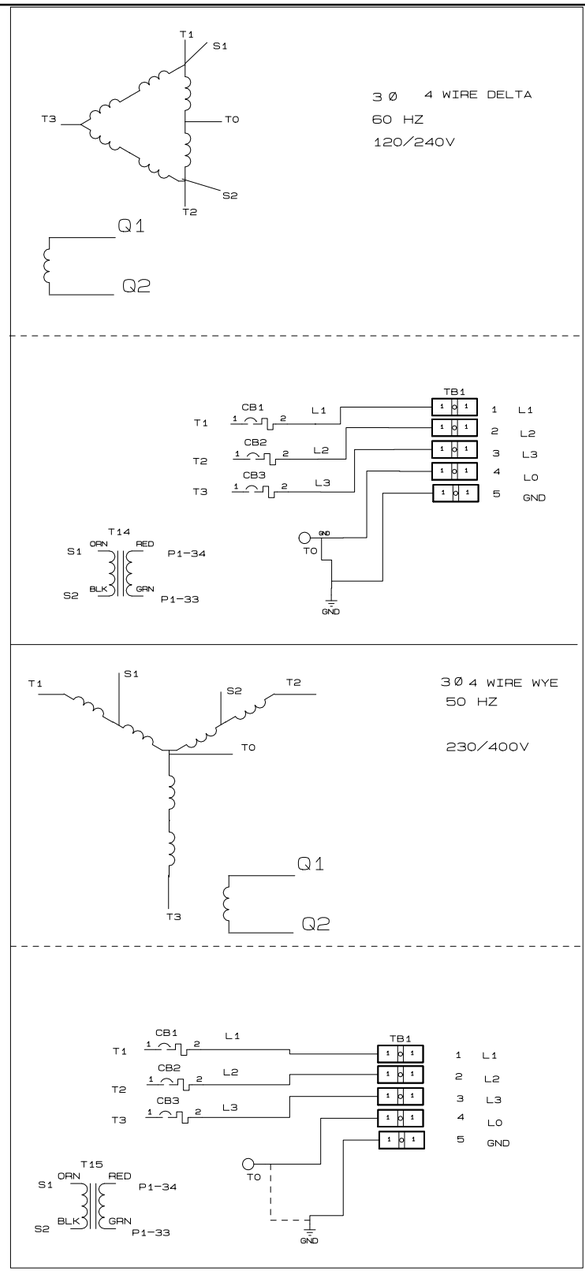


DC WIRING DIAGRAM



3 Ø Generator Reconnection

	A	B	C	HZ
VOLTAGE	120		120/240	60
		230		50
SCHEMATIC	T1, S1, S2, T2, Q1, Q2	T1, S1, T0, S2, T2, Q1, Q2	T1, S1, S2, T0, T2, Q1, Q2	
DIAGRAM	T13 (ORN, RED, BLK, GRN, P1-34, P1-33); CB1, CB2, TB1, L1, L2, LO, GND			

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
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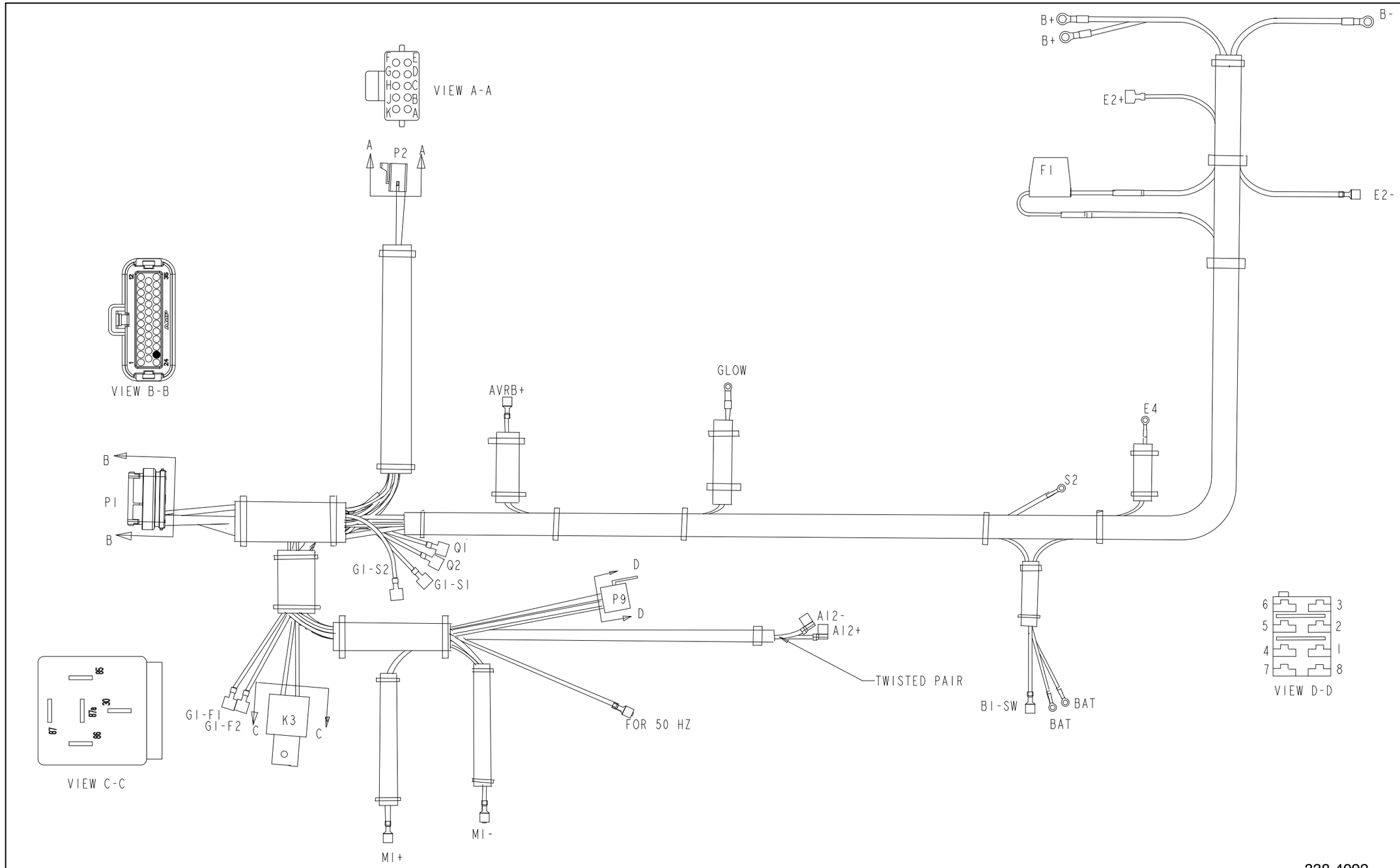
GENERATOR CONNECTION DIAGRAM



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DC WIRING HARNESS

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