

Cummins **Onan**



# Service Manual

## RV Generator Set

HDKCA (Spec A–E)

HDKCB (Spec A–E)

HDKCC (Spec A–E)

HDKCD (Spec A–E)

HDKCG (Spec A–E)

**California**

**Proposition 65 Warning**

**Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.**

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# SAFETY PRECAUTIONS

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**Thoroughly read the OPERATOR'S MANUAL before operating the genset. Safe operation and top performance can 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 personnel 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.

***Used to alert you to a lethal hazard which you must take steps to prevent severe personal injury or death, as when you are in the vicinity of High Voltage equipment.***

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

***⚠ CAUTION Used to alert you to a hazard or unsafe practice that 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 generator set.
- 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. Multi-purpose fire extinguishers are used for fires that involve ordinary combustible materials such as wood and cloth; combustible and flammable liquid fuel and gaseous fuels; live electrical equipment (North America or US: ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.
- Generator sets with a sound shield shall not be run with the service doors remove/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 performing periodic maintenance operations such as gloves, safety glasses, etc.

## THE HAZARD 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.

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

### **ENGINE EXHAUST IS DEADLY**

- Inspect for exhaust leaks at every startup and after every eight hours of running.
- Learn the symptoms of carbon monoxide poisoning in the 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 in a confined space, such as a garage.
- Disable the automatic genset starting feature 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 working or living spaces or compartments.

### **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**

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

### **FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED**

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. ***Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak,***



*etc.* The owners and operators of the genset are solely responsible for operating the genset safely.

## 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 lung, 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.

## 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 from 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<sub>2</sub>, 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

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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<sub>x</sub>, NO<sub>x</sub> and SO<sub>x</sub> 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 used 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<sub>2</sub>, 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 ma-

terial. 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<sub>2</sub>) 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 from 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<sub>2</sub>  
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:

	<p>Caution / Warning. Indicates a risk of personal injury.</p>
	<p>Caution / Warning of Temperature Hazard. Indicates a risk of personal injury from high temperature.</p>
	<p>Caution / Warning of High Voltage Hazard. Indicates a risk of personal injury from electric shock/electrocution.</p>
	<p>Caution / Warning. Indicates a risk of personal injury from equipment that may be subject to automatic starting or remote starting.</p>
	<p>Caution / Warning. Indicates to read Operator manual for additional information.</p>
	<p>Caution / Warning of Belt and Rotating Part Hazard. Indicates a risk of personal injury from entanglement in moving parts.</p>
	<p>Caution / Warning of Pressure Hazard. Indicates a risk of personal injury from pressurized fluids.</p>

# 1. Introduction

## ABOUT THIS MANUAL

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

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

**⚠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.*

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

## NAMEPLATE

Be ready to provide the genset model and serial numbers on the nameplate when contacting Onan for parts, service or information. Figure 1-2 illustrates the nameplate and its location. The gray boxes illustrate where to look for the model and serial numbers.

FIGURE 1-1.

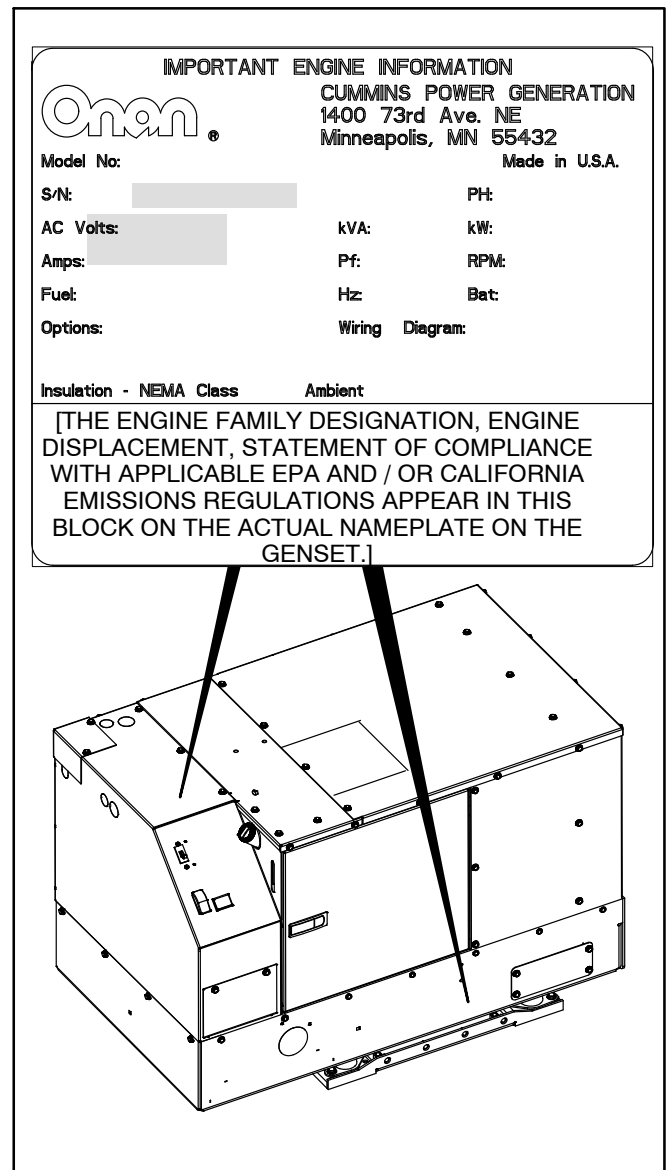


FIGURE 1-2. TYPICAL NAMEPLATE

## TYPICAL GENSET

Figure 1-3 illustrates the fuel, battery, remote control and AC output connection points, the flow of

cooling and ventilating air and the maintenance and service access panels of a typical genset. Not shown are the combustion air inlet and oil drain openings in the base.

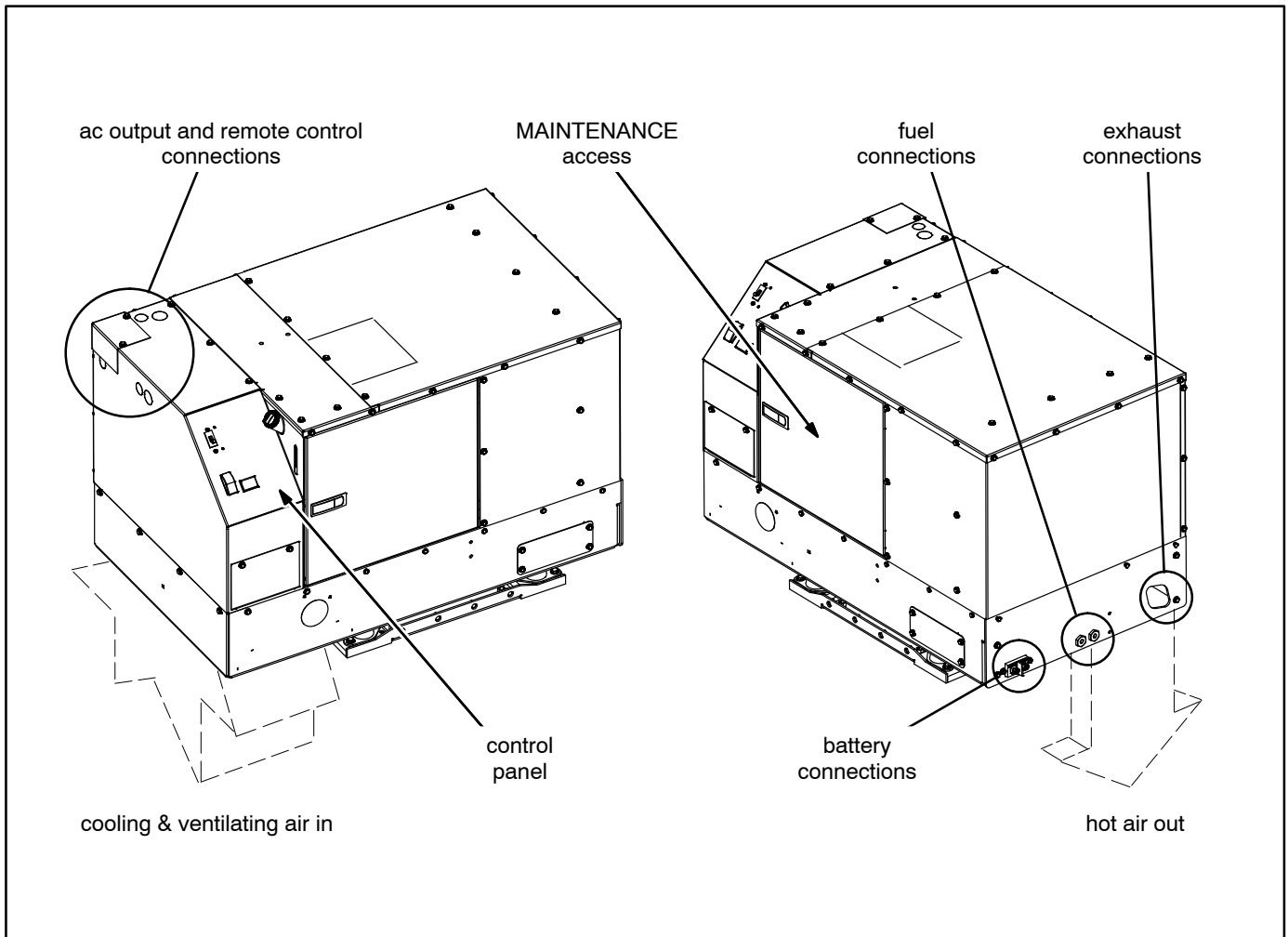


FIGURE 1-3. TYPICAL GENSET

# 2. Operation

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## RECOMMENDED FUEL

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

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

## 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:

- For model HDKCA, HDKCB, or HDKCG generator set is at Spec E or higher.
- For model HDKCC or HDKCD, generator set is at Spec D 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:

- Bio-diesel meeting either ASTM D6751 or EN14214. Fuel meeting either ASTM D6751 or EN14214 can be blended with an acceptable diesel fuel meeting ASTM D975, meeting ASTM D975 up to 20 percent volume concentration (B20).
- 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 increases 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 60 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:

Cummins Onan 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 Cummins Onan 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

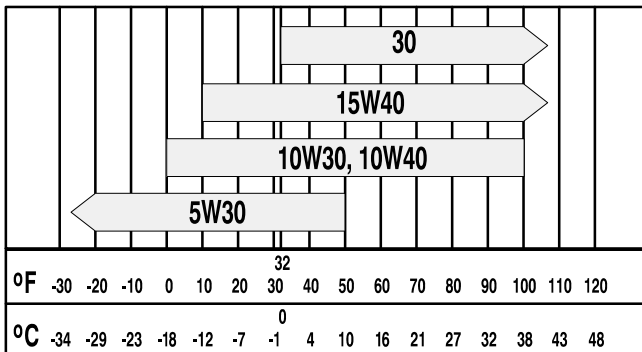
Use API (American Petroleum Institute) classified engine oils according to the following guidelines:

- 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 3-2).
- 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 3-2)

See *Section 14. Specifications* for oil capacity.

### Oil viscosity

Look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 2-1, choose the viscosity grade appropriate for the ambient temperatures expected until the next scheduled oil change. Multi-grade oils such as SAE 15W-40 are recommended for year-round use.



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

## RECOMMENDED COOLANT

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.

See *Section 14. Specifications* for coolant capacity.

## 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 MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (Page 3-6) and *Section 14. Specifications* for minimum required battery ratings.



## CONTROL PANEL

The control panel (Figure 2-2) 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 Lamp** – This is a lamp in the control switch that blinks rapidly during preheat and cranking. It stays on continuously while the genset is running. If the genset shuts down, it will blink a numerical code to indicate the nature of the fault shutdown (see *Section 12. Troubleshooting*).

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

**Line Circuit Breaker(s)** – The line circuit breakers protect the AC power leads connected to the genset.

**Coolant Recovery Tank Fill Cap** – The recovery tank provides for coolant expansion. Replenish the normal loss of coolant by filling here.

**Hour Meter** – The hour meter records the total running time of the genset. It cannot be reset.

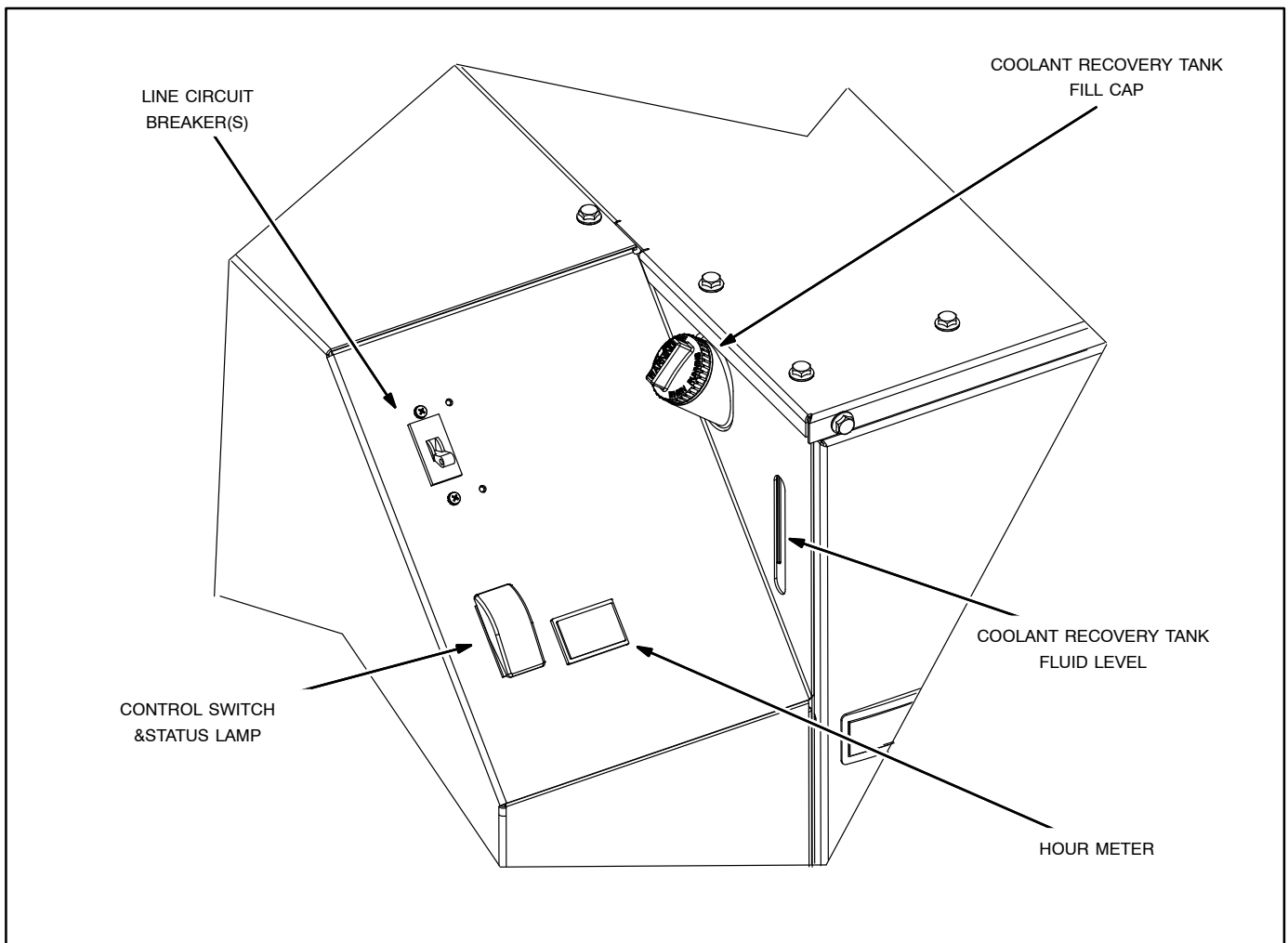


FIGURE 2-2. CONTROL PANEL

## REMOTE CONTROL PANELS

There probably is a remote genset control panel inside the vehicle. Onan offers three remote control kits as follows:

- Remote switch / status lamp (Figure 2-3).
- Remote switch / status lamp and hour meter (Figure 2-4).
- Remote switch / status lamp and DC voltmeter (Figure 2-5).

The DC voltmeter indicates whether voltage across the 12 VDC control system and battery is normal. If the indicator consistently stays above or below the normal zone, see MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 3-6).

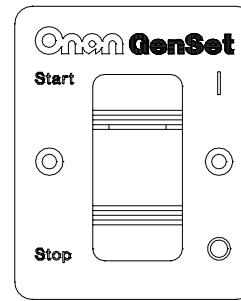


FIGURE 2-3. REMOTE SWITCH

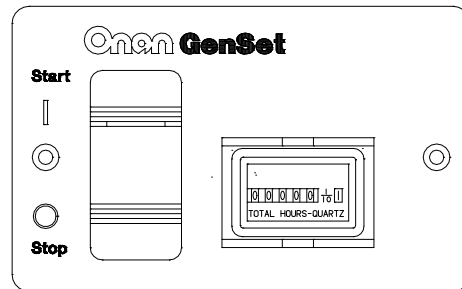


FIGURE 2-4. REMOTE SWITCH / HOUR METER

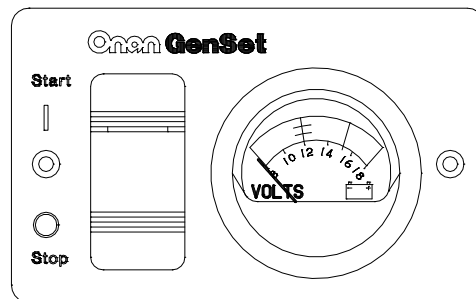


FIGURE 2-5. REMOTE SWITCH / DC VOLTMETER

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

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

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

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

## PRE-START CHECKS

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

Before each start:

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

4. Turn off air conditioners and other large appliances.

## 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 half a minute.

## MANUAL STARTING

The genset can be started and stopped from the genset control panel or from a remote panel.

1. Perform the PRE-START CHECKS, prime the fuel system if necessary, and turn off the air conditioners and other large electrical loads.
2. Visually inspect for fuel, exhaust and coolant leaks. Do not start the genset if there is a fuel, exhaust or coolant leak and have it repaired.
3. Push and hold **Start** until the genset starts. The status lamp will come on when the genset starts and will stay on while it runs. While starting it will blink rapidly indicating preheating and cranking. (Depending on how cold it is, preheating can take up to 15 seconds, extending the time that the lamp blinks.)

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

4. See *Section 12. Troubleshooting* if the genset does not start after several tries.
5. Let the genset warm up a few minutes until it is running smoothly before connecting the vehicle electrical loads (appliances).

## MANUAL STOPPING

Run the genset under no load for a few minutes to allow the engine to cool down and then push and release **Stop**.

## AUTOMATIC STARTING AND STOPPING

The vehicle may be equipped with an inverter-charger or other automatic genset starting device. Always follow the instructions and safety precautions provided by the manufacturer of the automatic starting device when enabling automatic genset starting.

**⚠WARNING** **EXHAUST GAS is deadly. MOVING PARTS and ELECTRICITY can cause severe personal injury or death. To reduce exposure to these hazards, always disable automatic genset starting before:**

- **Sleeping in vehicle, unless vehicle has a working CARBON MONOXIDE detector**
- **Parking vehicle in garage or confined space**
- **Parking vehicle for storage**
- **Servicing genset**
- **Servicing batteries**
- **Servicing electrical appliances**
- **Fueling vehicle**

## LOADING THE GENSET

The genset can power AC motors, air conditioners, AC/DC converters, battery chargers and other appliances. How much appliance load\* can be powered depends upon the genset power rating. The genset will shut down or its circuit breakers will trip if the sum of the loads exceeds genset power. See *Section 12. Troubleshooting*.

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

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

Maximum power decreases as altitude increases because air density decreases. For every 1000-foot (305 m) increase in elevation you can expect power to decrease approximately 3.5 percent. Table 2-2 shows the results of typical calculations. ***It may be necessary to run fewer appliances at higher altitudes.***

TABLE 2-1. TABLE 2-2. POWER VS. ALTITUDE

Elevation above Sea Level	Maximum Power
at/below 500 ft (152 m)	12,000 W (rated)
at 2500 ft (762 m)	11,280 W
at 5500 ft (1676 m)	10,200 W
above 5500 ft (1676 m)	10,200 W minus 360 W every 1000 ft (305 m)

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

## RESETTING CIRCUIT BREAKERS

If a circuit breaker in the main power distribution panel of the vehicle or on the genset (Figure 2-2) trips, either a circuit shorted or too many appliances were running. Note that the genset will continue to run after a circuit breaker trips.

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

If the circuit breaker does not trip, reconnect the appliances, one by one, up to a total load that does not overload the genset or cause the circuit breaker to trip. If a circuit breaker trips right away when an appliance is connected, the appliance probably has a short.

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

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

## CONNECTING TO UTILITY POWER

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

**⚠WARNING** *Interconnecting the genset and the public utility (or any other power source) can lead to electrocution of utility line workers,*

*equipment damage and fire. Use an approved switching device to prevent interconnections.*

## OPERATING IN COLD WEATHER

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

## OPERATING IN HOT WEATHER

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

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

## OPERATING AT HIGH ALTITUDE

For the effect of altitude on maximum power, see LOADING THE GENSET (Page 2-6).

## OPERATING IN DUSTY ENVIRONMENTS

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

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

## BREAKING IN A NEW ENGINE

Proper engine break-in on a new genset or on one with a rebuilt engine is essential for top engine performance and acceptable oil consumption. Run the genset at approximately 1/2 rated power for the first 2 hours and then at 3/4 rated power for 2 more hours. See **LOADING THE GENSET** (Page 2-6).

Proper engine oil and oil level are especially critical during break-in because of the higher engine temperatures that can be expected. Change the oil if not appropriate for the ambient temperatures during break-in. See **ENGINE OIL RECOMMENDATIONS** (Page 2-2). Check oil level twice a day or every 4 hours during the first 24 hours of operation and change the oil and oil filter after the first 50 hours of operation.

## EXERCISING THE GENSET

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

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

## STORING THE GENSET

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

### Storing the Genset

1. Disable the automatic genset starting feature of an inverter-charger or other automatic starting device.

**⚠WARNING** ***CARBON MONOXIDE is deadly and can accumulate to dangerous levels in***

***garages and other confined spaces. Disable the automatic genset starting feature of an inverter-charger or other automatic starting device before storing the vehicle.***

2. Push the genset line circuit breaker OFF (Page 2-7).
3. Change the engine oil and attach a tag indicating oil viscosity. See **ENGINE OIL RECOMMENDATIONS** (Page 2-2).
4. Disconnect the battery cables (negative [-] cable first) from the starting battery and store the battery according to the battery manufacturer's recommendations. See **MAINTAINING THE BATTERY AND BATTERY CONNECTIONS** (Page 3-6).
5. Plug the exhaust tail pipe to keep out dirt, moisture, bugs, etc.
6. Close the fuel supply valve (if so equipped).

### Returning the Genset to Service

1. Check the oil tag on the genset and change the oil if the viscosity indicated is not appropriate for the temperatures expected. See **ENGINE OIL RECOMMENDATIONS** (Page 2-2).
2. Reconnect the starting battery (negative [-] cable last). See **MAINTAINING THE BATTERY AND BATTERY CONNECTIONS** (Page 3-6).
3. Remove the plug from the exhaust tailpipe.
4. Change the air filter element if it is dirty (Page 3-6).
5. Open the fuel supply valve (if so equipped).
6. Inspect the genset. See **GENERAL INSPECTION** (Page 3-3).
7. Push the genset line circuit breaker ON (Page 2-7) when the genset is ready to power appliances.
8. Enable the automatic genset starting feature of an inverter-charger or other automatic starting device following the device manufacturer's instructions and safety precautions.

# 3. Periodic Maintenance

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

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

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

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

**⚠WARNING** *Only authorized and competent personnel who are familiar with the equipment and its operation should carry out maintenance.*

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

MAINTENANCE TASK	FREQUENCY							Page
	After First 50 Hrs	Every Day	Every Month	Every 250 Hrs	Every 500 Hrs	Every 800 Hrs	Every 1500 Hrs	
General Inspection		•						3-3
Check Engine Oil Level		•						3-4
Check Engine Coolant Level		•						3-11
Check Battery & Battery Connections			•					3-6
Change Engine Oil & Oil Filter <sup>1, 2, 3</sup>	•			•				3-4
Check V-Belt Tension <sup>4, 7</sup>				•				8-1
Clean Spark Arrestor <sup>3</sup>				•				3-8
Replace Engine Air Filter <sup>2</sup>					•			3-6
Replace Fuel Filter <sup>9</sup>					•			3-9
Adjust Engine Valve Lash <sup>7</sup>						•		9-1
Flush Coolant System <sup>6</sup>							•	3-11
Replace Coolant Pressure Cap <sup>6</sup>							•	3-11
Replace V-Belts & Coolant Hoses <sup>6,7</sup>							•	8-1
Check Fuel Injector Pressure <sup>7,8</sup>							•	9-1
Check Generator Slip Rings/ Brushes <sup>2,7</sup>						•		-
Replace Generator Bearing <sup>7</sup>							•	-

1. Perform more often when operating in hot weather.  
 2. Perform more often when operating in dusty conditions.  
 3. Perform at least once a year.  
 4. Tighten or replace the belt.  
 5. Perform at least once every two years.  
 6. Perform at least once every five years.  
 7. Must be performed by trained and experienced personnel (authorized Onan service representatives).  
 8. EPA requirement.  
 9. Perform every 250 hours when using B20 Bio-diesel fuel.



## GENERAL INSPECTION

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

### Oil Level

Check engine oil level (Figure 3-1).

### Engine Coolant System

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

Check the engine 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.

**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 3-6).

### Mechanical

Visually inspect genset for mechanical damage. For generator sets with a sound shield, install service doors before running the generator set to listen for unusual noises. Check the genset mounting bolts. Check to see that the generator set air inlet and outlet openings are not clogged with debris or blocked. Keep the generator set compartment clean.

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

**⚠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.*

**⚠WARNING** *Engine components (drains, filters, hoses, etc.) will be hot and can cause severe burns. The use of protective gloves is recommended.*

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

**⚠WARNING** *Do not run the genset with the maintenance access covers off. Contact with hazardous moving parts and hot exhaust manifolds can cause severe personal injury.*

1. Park the vehicle on level ground, shut down the genset and remove the front access door.
2. Pull out the oil dip stick, wipe it clean, reinsert it and pull it out again to check the oil level (Figure 3-1).
3. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (Page 2-2). Keep the oil level between the FULL and ADD marks.

**⚠CAUTION** *Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the FULL and ADD marks.*

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

## 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 vapors. Use rubber gloves and wash exposed skin.*

**⚠WARNING** *Engine components (drains, filters, hoses, etc) will be hot and can cause severe burns. The use of protective gloves is recommended.*

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Discon-*

*nect the negative (-) cable at the battery to prevent starting while working on the genset.*

**⚠WARNING** *Do not run the genset with the maintenance access covers off. Contact with hazardous moving parts and hot exhaust manifolds can cause severe personal injury.*

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

1. Park the vehicle on level ground and set the parking break.
2. Run the generator set until it is warm and shut-down the generator set.
3. Place a pan large enough to hold the full oil capacity of the engine under the oil drain plug (Figure 3-1).

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

4. Remove the front access door and remove the oil fill cap.
5. Remove the oil drain plug using the appropriate size socket and breaker bar. Allow all the oil to drain from the engine.
6. Reinstall the oil drain plug and torque to 32 lb-ft (44 Nm) (Page 13-1).
7. Spin off the oil filter and drain off oil.
8. Thoroughly wipe off the filter mounting surface and remove the old gasket if it does not come off with the oil filter.
9. Make sure the new gasket is in place on the new oil filter and apply a thin film of clean oil to the gasket. Spin the new filter on by hand until the gasket just touches the mounting surface and turn the filter an additional 1/2 to 3/4 turn. Do not over tighten.

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

10. Refill with oil. See ENGINE OIL RECOMMENDATIONS (Page 2-2) Check the oil level and add or drain oil as necessary.
11. Screw the oil cap on securely and reinstall the front access door.

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

## Replacing Oil Lines

**⚠WARNING** *Pressure in the Oil System can cause forceful ejection of fittings, which could result in personal injury. Remove pressure before attempting to disconnect.*

1. Follow Changing Engine Oil and Oil Filter steps 1 through 7.
2. Clean area around fittings with a clean cloth.

3. Disconnect oil lines. Beginning Spec C, Oil lines are attached using an STC fitting (STC-06). FF90213-06 STC release tool is required for disconnection. Insert tool behind release sleeve and pull hose free from the assembly. Do not pry on the fitting with the tool.

4. Connect new lines. Beginning Spec C Lines are attached using STC connectors. Press STC fitting into mating connector until you feel a solid stop. Verify connection by pulling back parallel to the connection.

5. Continue Changing Engine Oil and Filter instruction from step 8.

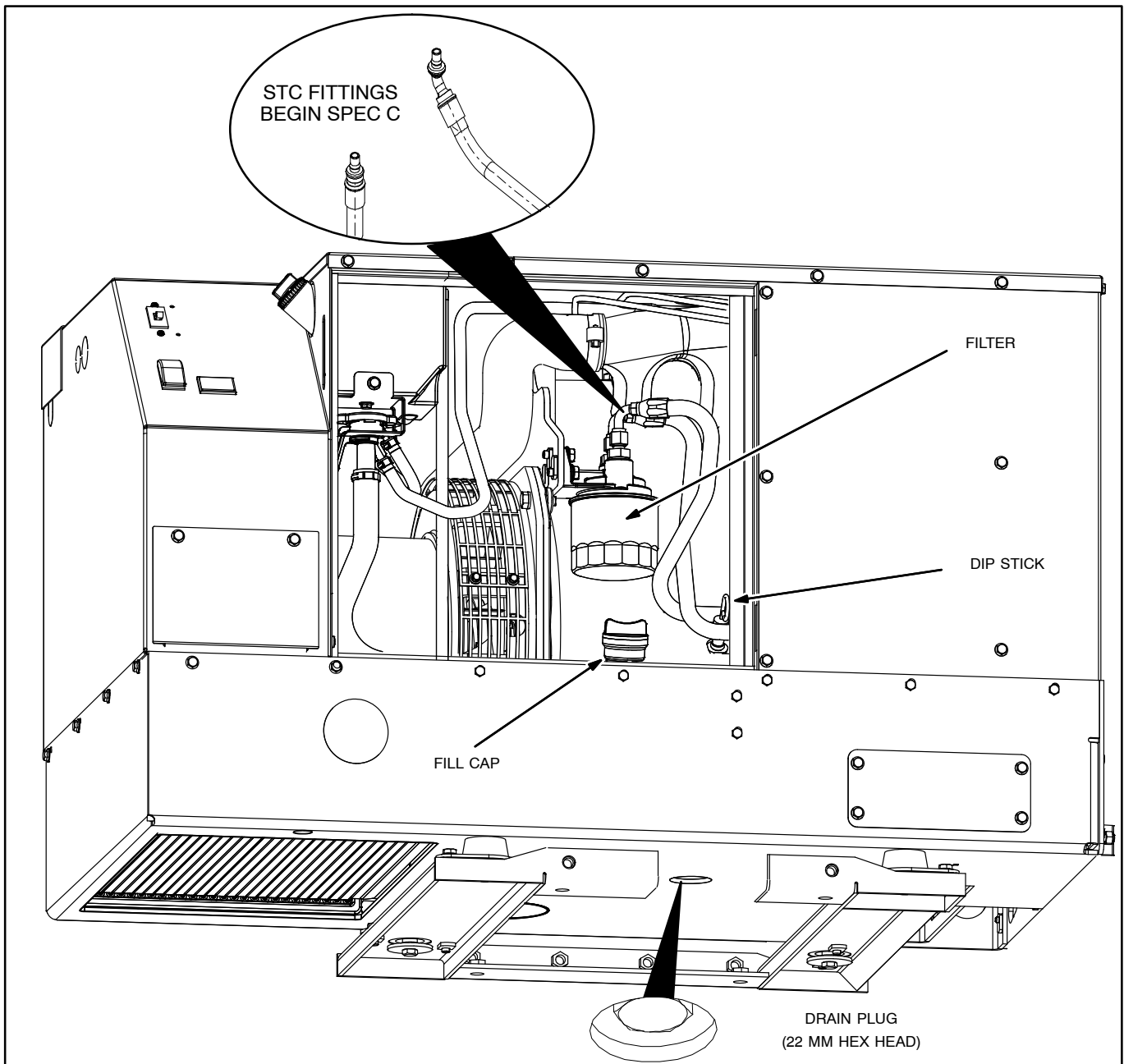


FIGURE 3-1. ENGINE OIL MAINTENANCE

## 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.*

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

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

## REPLACING THE AIR FILTER ELEMENT

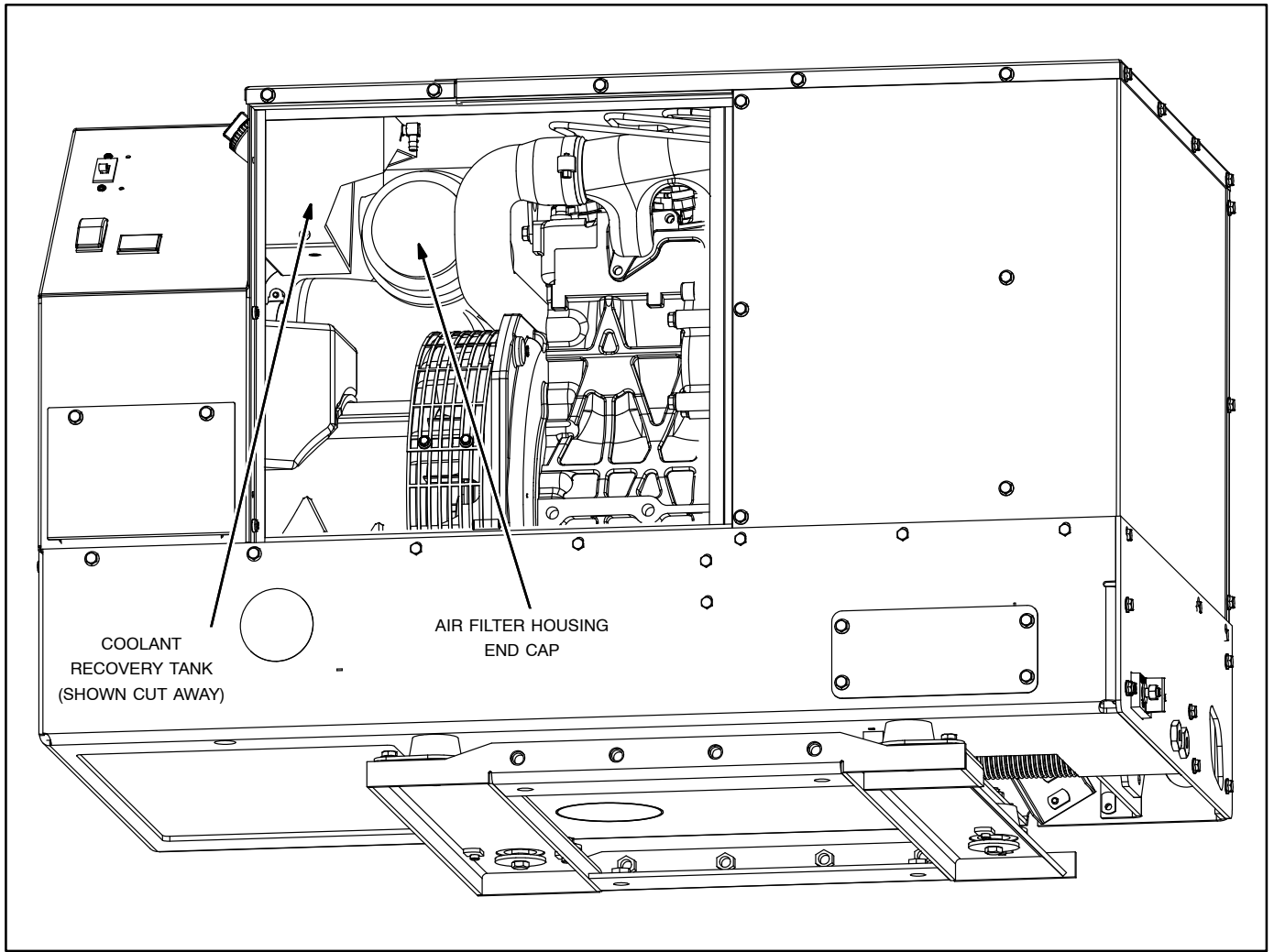
**⚠WARNING** *Engine components (drains, filters, hoses, etc) will be hot and can cause severe burns. The use of protective gloves is recommended.*

**⚠WARNING** *Do not run the genset with the maintenance access covers off. Contact with hazardous moving parts and hot exhaust manifolds can cause severe personal injury.*

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

Refer to Table 3-1 for scheduled air filter replacement. Replace it more often in dusty environments.

The air filter is accessible through the front access door (Figure 3-2). Loosen the three screws that secure the coolant recovery tank to the housing top panel and move it out of the way. Loosen the two screws that secure the air filter housing to the housing top panel so that the spring clips that secure the filter housing end cap can be unlatched. Remove the end cap and replace the filter element. Secure the filter housing, coolant tank and access door.



**FIGURE 3-2. REPLACING THE AIR FILTER ELEMENT**

## 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 (Figure 3-3). The spark arrestor cleanout plug is located on the side of the muffler and is accessible by removing the top enclosure panel. Clean out the muffler as follows:

1. Remove the top enclosure panel.
2. Remove the cleanout plug from the muffler. Secure the top enclosure panel before running the genset. With the cover in place there will be enough air flow to cool the engine properly and carry the soot out of the compartment.
3. Start the genset and load it nearly to full power. Let the genset run for about five minutes to expel the soot.
4. Stop the genset, allow the muffler to cool down, reinstall the cleanout plug and secure the top panel.

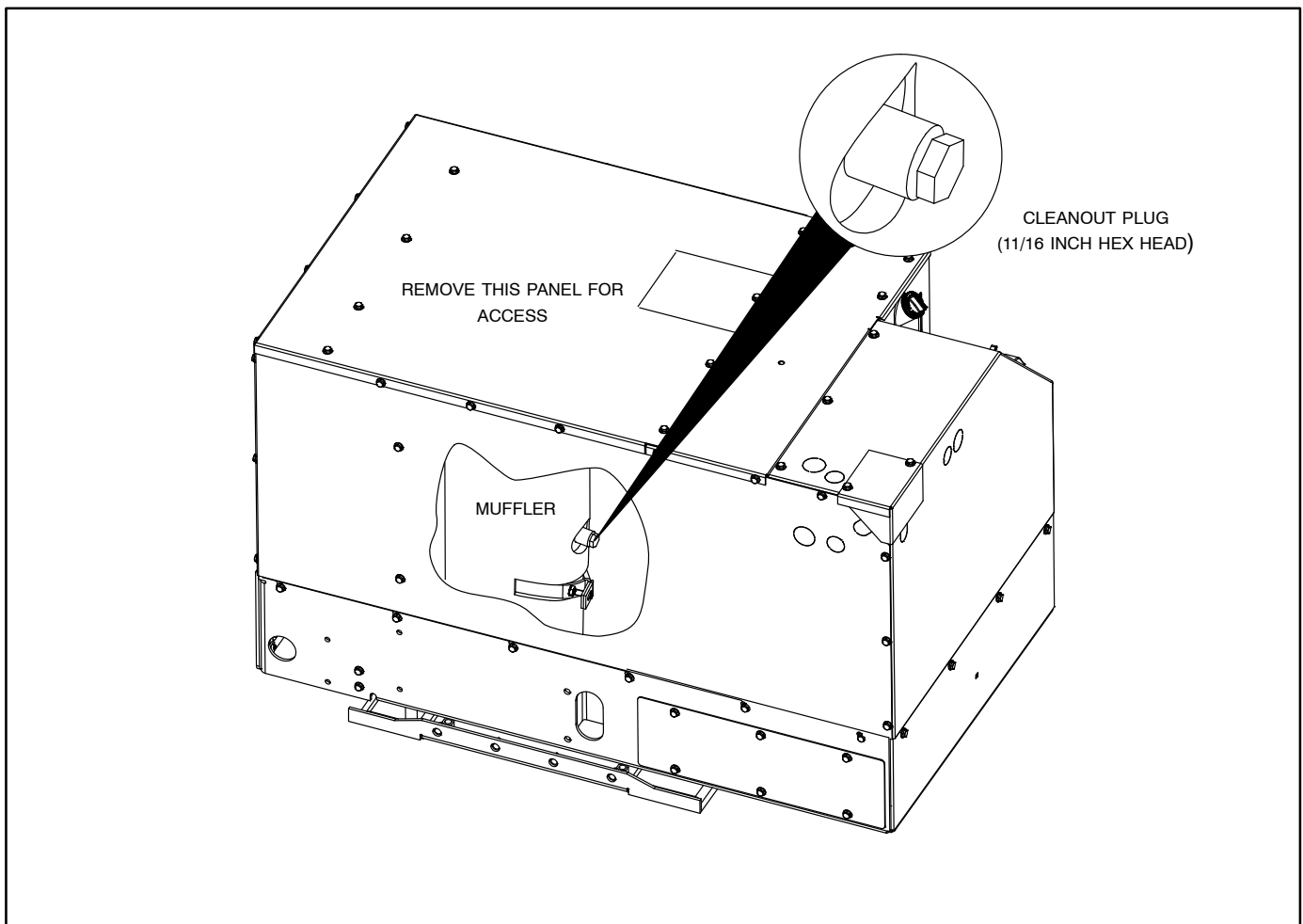


FIGURE 3-3. SPARK ARRESTOR CLEANOUT PLUG

## REPLACING THE FUEL FILTER

See Table 3-1 for scheduled fuel filter replacement. A dirty fuel filter may be the cause of a failure to start. The fuel filter is accessible through the front access door (Figure 3-4).

**⚠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.*

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

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

**⚠WARNING** *Engine components (drains, filters, hoses, etc) will be hot and can cause severe burns. The use of protective gloves is recommended.*

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Discon-*

*nect the negative (-) cable at the battery to prevent starting while working on the genset.*

## Removing the Fuel Filter

Disconnect the two fittings at the filter and remove the mounting nut. Apply a wrench on the filter fitting as well as on the flare nut so as not to stress the fitting. Flare nut wrenches should be used on the flare nuts so as not to round the corners on the nuts. Dispose of the fuel filter according to local regulations. (Note: Filter removal will be easier if the filter mounting bracket screws are removed.)

**⚠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.*

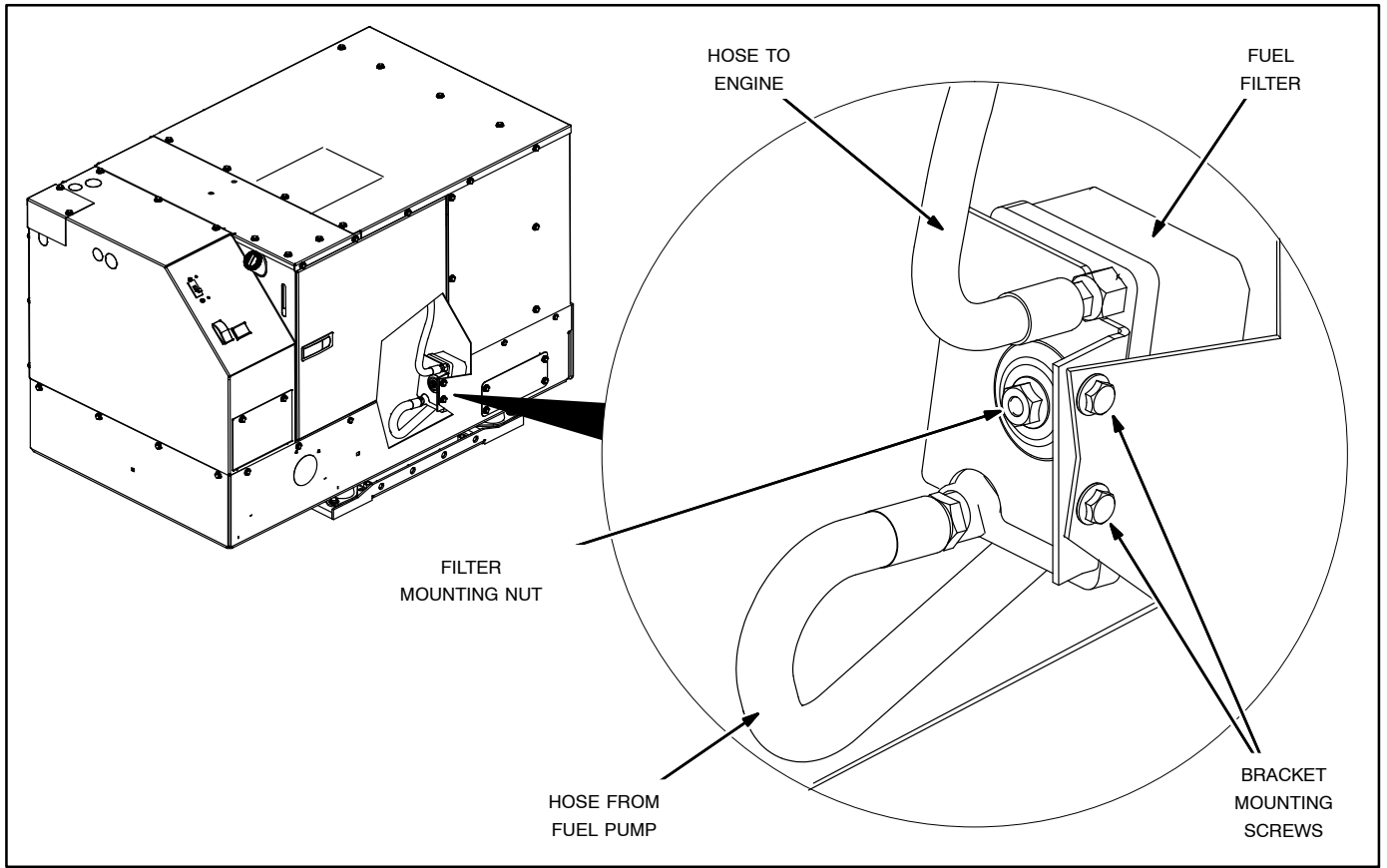
## Installing the Fuel Filter

Rotate the filter half a turn around its mounting stud if the fittings interfere with the bracket. It only fits one way.

Connect the fuel fittings before tightening the filter mounting nut. Take care not to crossthead the fuel fittings. Thread them in by hand and *tighten one flat past seating with two wrenches.*

Prime the fuel system for half a minute to fill the new filter with fuel.

Secure the access door.



**FIGURE 3-4. FUEL FILTER**



## MAINTAINING THE COOLANT SYSTEM

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

See RECOMMENDED COOLANT (Page 2-2).

### Pressure Cap

Replace the pressure cap (Figure 3-5) every two years (seals deteriorate and leak). Proper cooling system pressure (14 psi) is essential for optimal engine cooling and minimal coolant loss.

### Draining and Cleaning Cooling System

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

**▲WARNING** *Engine components (drains, filters, hoses, etc) will be hot and can cause severe burns. The use of protective gloves is recommended.*

**▲WARNING** *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

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

remove the coolant drain plug (Figure 3-5) 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.*

Flush and clean 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.

### Refilling Cooling System

Install the coolant drain plug *using pipe thread sealant*. Tighten it just enough so that it does not leak when the genset is running and has warmed up. Pull the hose connected to the pressure cap assembly out as far and as high as it will go and fill the system with coolant. 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.

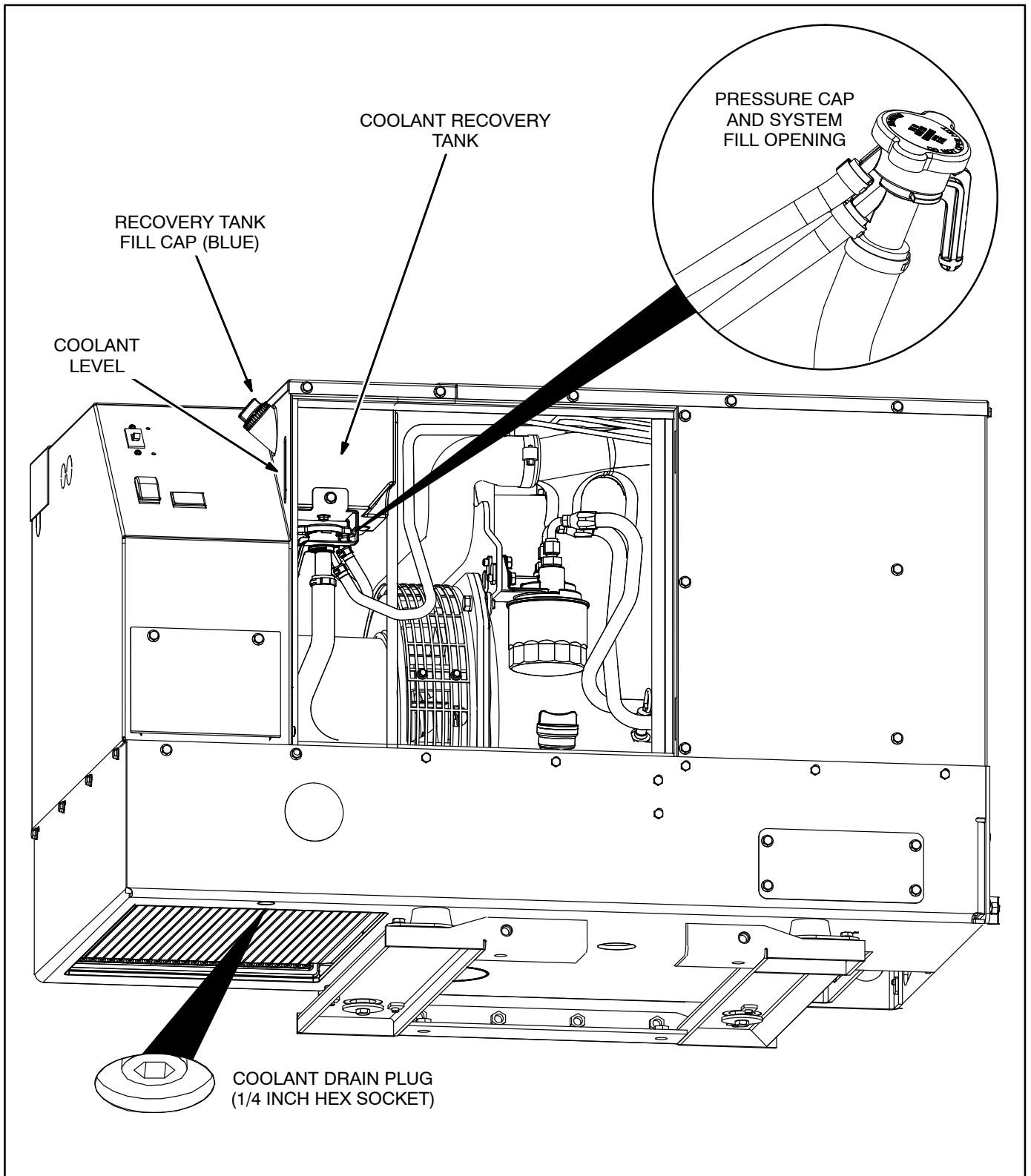
Fill the recovery tank with coolant mixture to the COLD mark.

**▲WARNING** *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

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

### Coolant Level Check

Check coolant level in the recovery tank (Figure 3-5) before the first startup of each day and fill to the COLD mark if necessary.



**FIGURE 3-5. ENGINE COOLING SYSTEM**

# 4. Preparations 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 4-2. 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. TABLE 4-2. HAZARDS AND THEIR SOURCES

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

### 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 12 . 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. Disable the automatic genset starting feature of an inverter-charger or other automatic starting device and disconnect the negative (-) battery cable *from the battery* to keep the genset from starting while working on it. Then disconnect the battery cables from the genset.

**⚠WARNING** *Accidental or remote starting can cause severe personal injury or death. Disable the automatic starting feature of an inverter-charger or other automatic starting device and disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

***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 lifting eye is accessible through the access opening in the top panel of the genset.

**⚠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 holes 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 15. Service Checklist*).

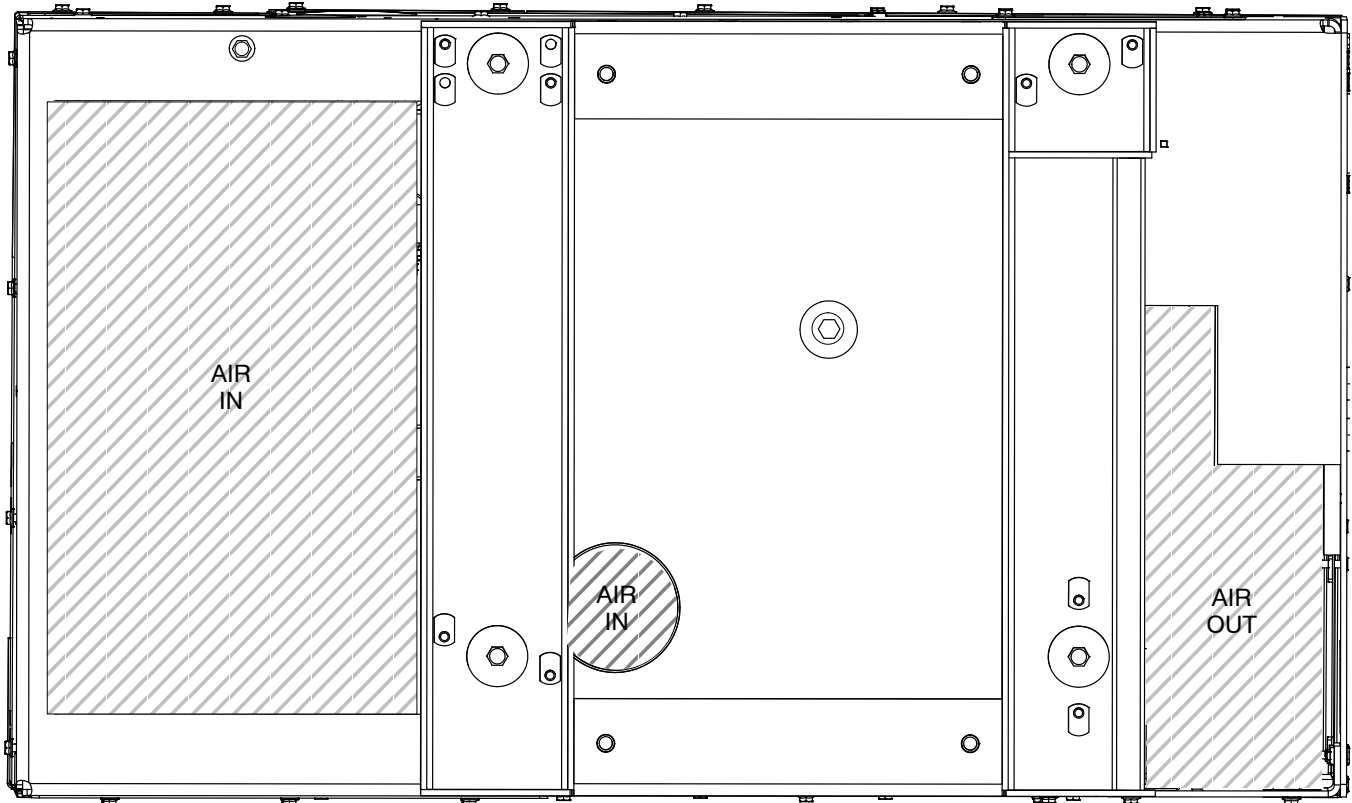
Use four Grade 5 screws (3/8-16 UNC) to secure the genset to the floor or frame. The screws must protrude at least 1/2 inch (10 mm) but not more than 1 inch (25 mm) into the base, as measured from the bottom surface of the base. Torque the screws to 35 lb-ft (41 N-m).

## TEST STAND

When testing and servicing the genset on a workbench or test stand make sure the openings in the skid-base shown in Figure 4-1 (shaded areas) are free and clear. Also, make sure there is ample fresh air when operating the genset.

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

**⚠ CAUTION** *Restricting the air inlet and outlet openings could lead to damage to the genset due to overheating.*



**FIGURE 4-1. AIR INLET AND OUTLET OPENINGS IN BOTTOM (SHADED AREAS)**

## DISASSEMBLING / REASSEMBLING HOUSING AND MOUNTING SYSTEM

### Disassembling Housing

**⚠ WARNING** *Do not operate the genset without the housing panels secured 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 4-2. The housing consists of removable panels. The front and top panels include removable service doors secured by latches or screws.

Remove all the screws around the perimeter of each panel and pull the panel away. Note the sets of two and of three screw holes in the top panel which are circled. These are for the screws that secure the air cleaner housing and the coolant recovery tank, respectively. Remove these screws before lifting the top panel away.

**⚠ CAUTION** *The panel screws are all the same length. Do not substitute longer screws to mount the air cleaner housing or recovery tank. Longer screws can cause damage by bottoming before becoming tight.*

Because of overlapping flanges, the top panel must be removed to remove the side panels and put back last.

To remove the end panel on the generator end of the genset:

1. Cut the wire-tie that secures the wiring harnesses to the panel.

2. Remove the two output terminal block mounting screws to free the output cables from the panel—preferable to loosening the terminal screws.
3. Loosen the screws that secure the circuit breakers to the operator's console and pull the circuit breakers and attached wiring away.
4. Disconnect the leads at the terminals on the control switch and hour meter.
5. Remove the mounting screws to free auxiliary relays K1, K2 and K3 (p. 11-5)
6. Disconnect the two air intake hoses from the air intake resonator box.
7. Remove all attachment screws and pull the panel away.

### Reassembling Housing

Reassembly is the reverse of disassembly. To make sure that all of the panel screw holes will line up, wait to tighten the screws until all of the panels and screws are in place.

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

**Note:** **Note:** When securing the side service door frame to the panel on its right, the frame and panel should touch metal-to-metal. Pull the sound absorbing insulation back a little, if necessary, so that it is not pinched between the panel and frame. That way the insulation covers the slots in the door frame which would otherwise let some noise out.

### Reassembling Mounting System

When reassembling, torque the vibration isolator center and mounting screws according to torque specifications (p. 13-1).

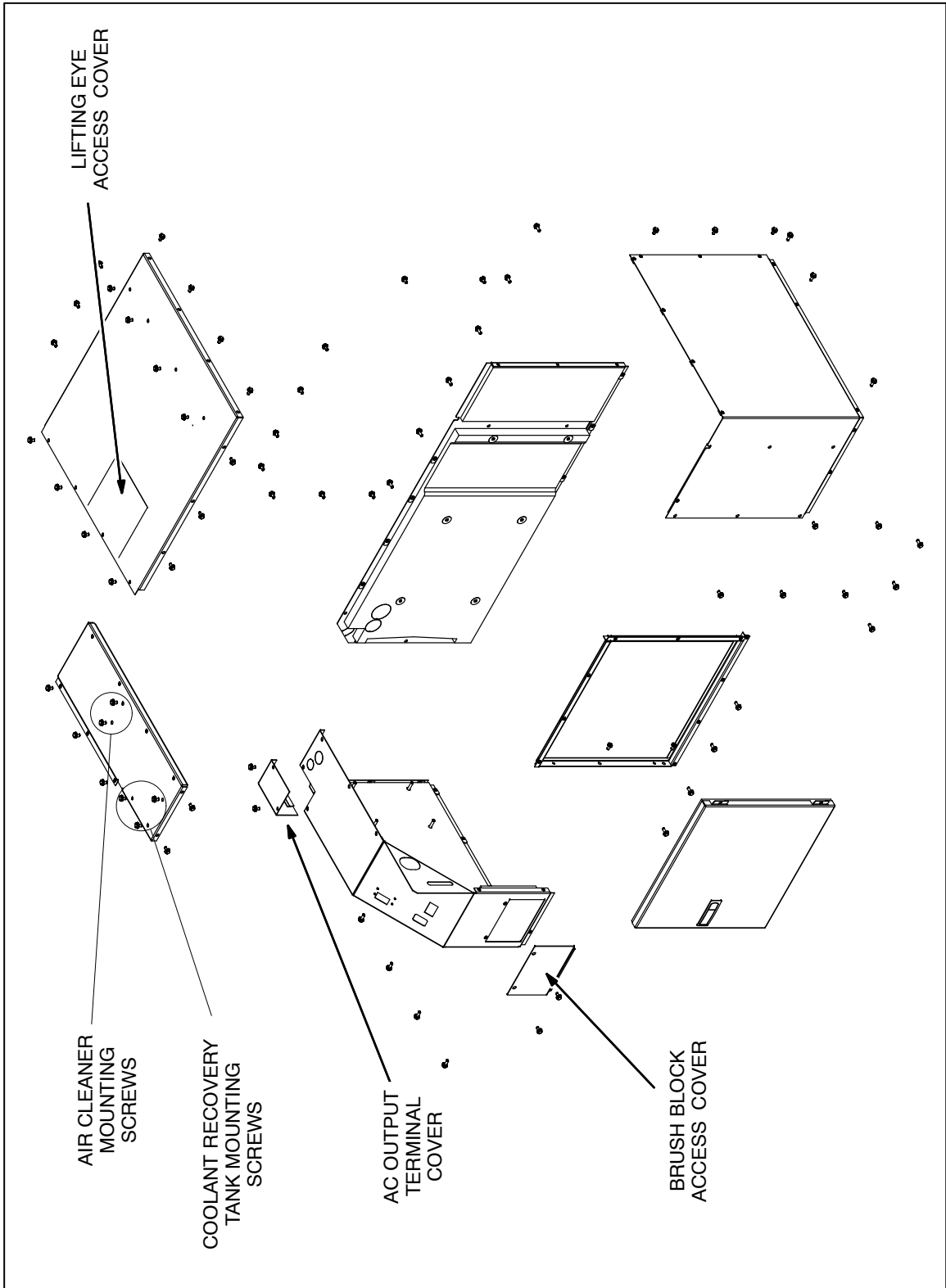


FIGURE 4-2. HOUSING PANELS

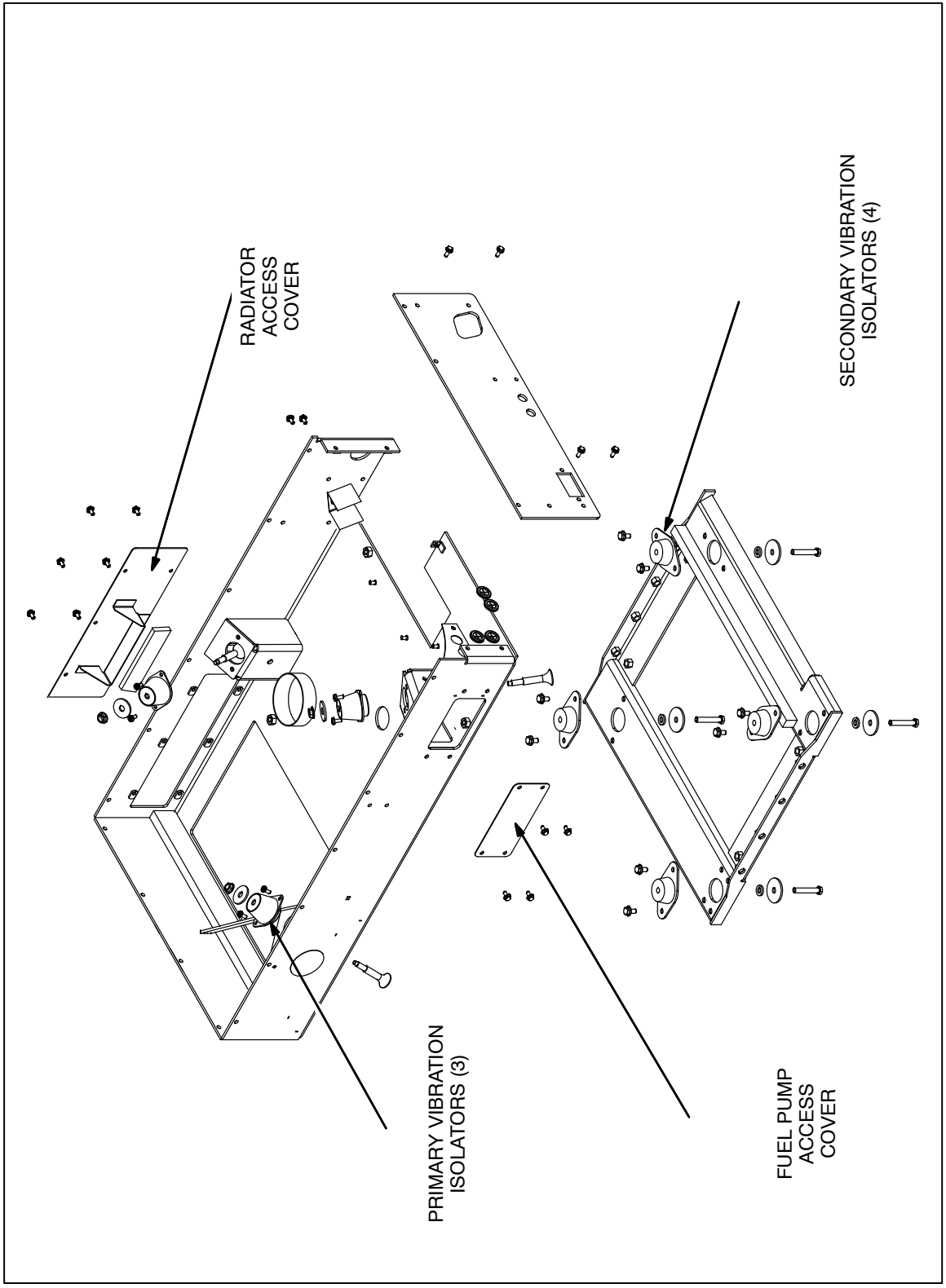


FIGURE 4-3. MOUNTING SYSTEM



# 5. Fuel System

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

Figure 5-1 shows the components of the fuel system up to the connections at the engine.

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

**⚠CAUTION** *Always wipe dirt off fuel fittings before disconnecting them to keep dirt from entering the fuel system.*

## FUEL INJECTION SYSTEM

See Engine Workshop Manual 981-0541 regarding fuel injection system service.

## FUEL FILTER

The fuel filter is mounted on a bracket on the side of the base and is accessible through the front access door. See Page 3-9 regarding fuel filter replacement.

## FUEL PUMP

### Fuel Flow Test

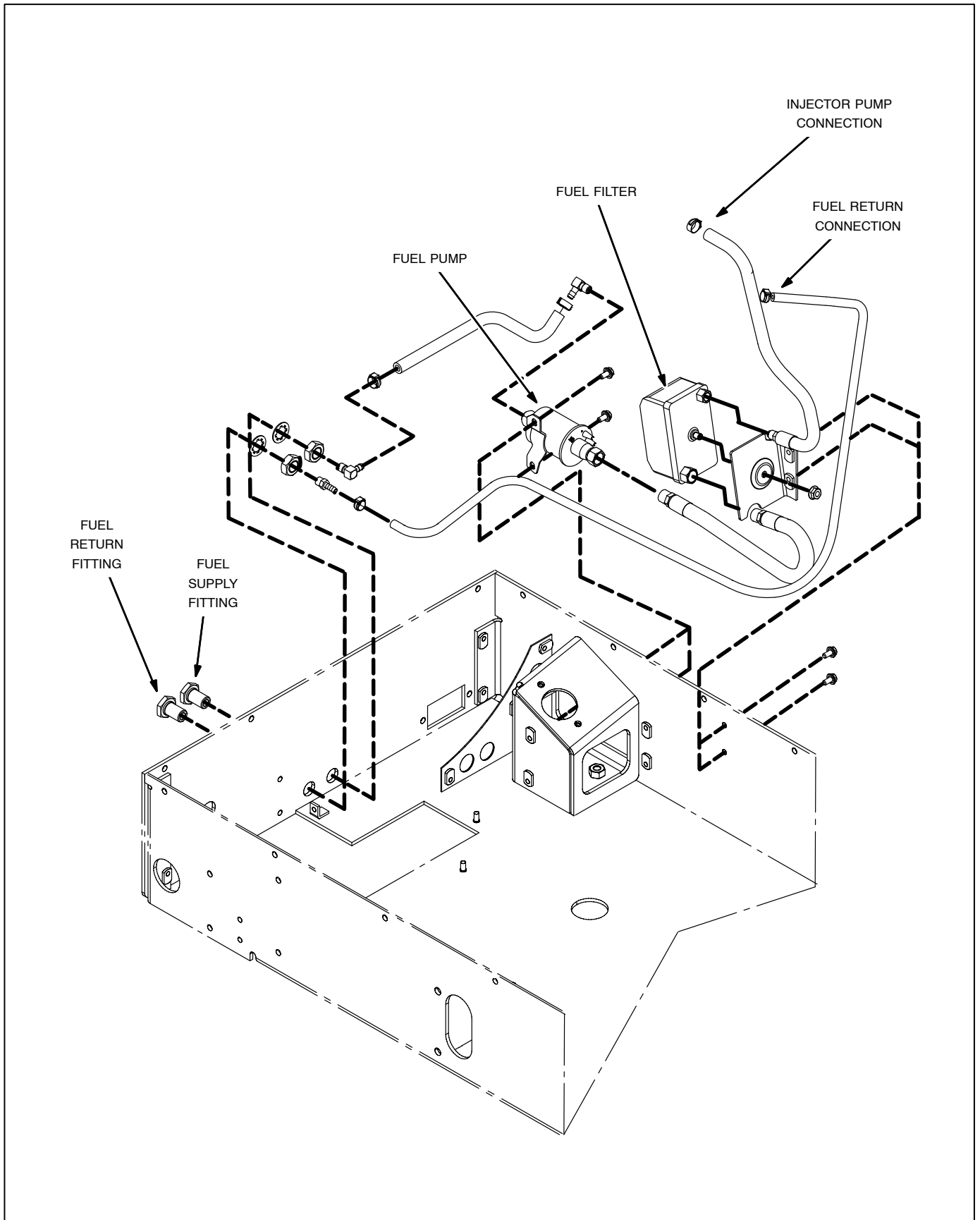
1. Disconnect the fuel return hose from the line to the supply tank and point the end into a quart (1 liter) or larger container that has volume graduations.
2. Prime the genset by pushing the Start/Stop switch to **STOP** and holding it there for the duration of the test. Flow should not be less than 200 ml (0.4 pints) per minute.
3. If flow is less than specified, replace the fuel filter. If that does not help, look for other restrictions in the fuel system. Last, replace the fuel pump. The pump is not serviceable.

### Removal and Installation

The fuel pump is mounted inside the engine mounting tower in the base and is accessible by removing the cover on the side of the base (Figure 4-3).

Before connecting the fuel lines to the pump, loosen the fuel filter so that there is enough hose length to make connections.

Connect the fittings on both ends of the fuel line by hand before tightening either. Use flare-nut wrenches to tighten the fittings so as not to round the corners on the nuts and two wrenches at each fitting so as not to stress the pump or filter. Tighten each fitting one flat past seating.



**FIGURE 5-1. FUEL SUPPLY AND RETURN SYSTEM**

## 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 was manufactured after April 2011.
- 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:

- Bio-diesel meeting either ASTM D6751 or EN14214. Fuel meeting either ASTM D6751 or EN14214 can be blended with an acceptable diesel fuel meeting ASTM D975, meeting ASTM D975 up to 20 percent volume concentration (B20).
- Use bio-diesel fuel blends within 6 months of its manufacture.

#### 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 increases 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 60 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:

Cummins Onan 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 Cummins Onan 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.

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# 6. Air Intake System

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

Remove the top and back housing panels for ac-

cess (p. 4-4). To reassemble the air intake system, refer to Figure 6-1.

**⚠CAUTION** *Do not cut the engine intake air tubes to make them “fit better.” Their lengths are critical for proper noise attenuation.*

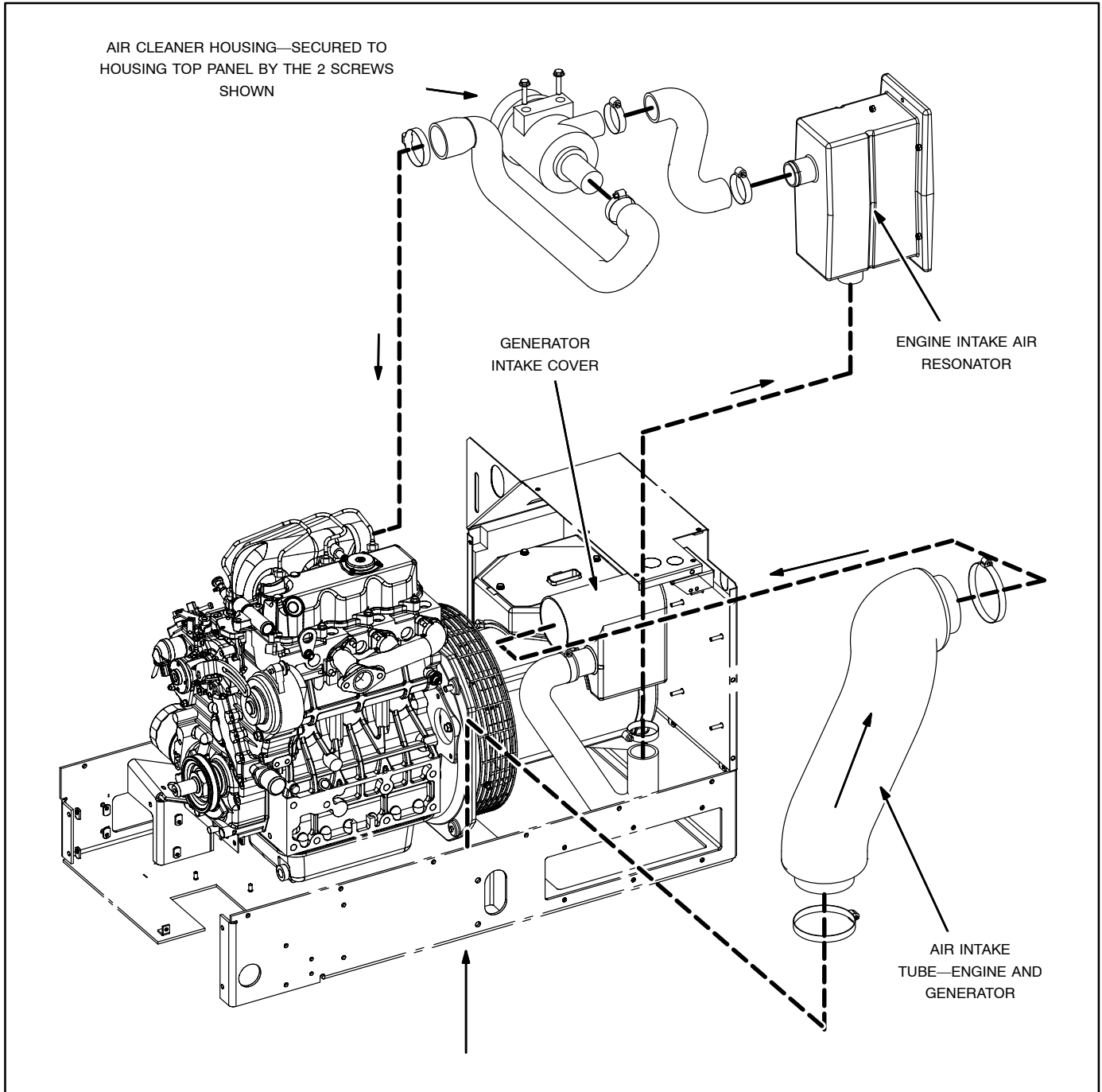


FIGURE 6-1. AIR INTAKE COMPONENTS

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# 7. Exhaust System

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

The muffler is bolted directly to the outlet flange of the engine exhaust manifold and a flexible, corrugated stainless steel tube is bolted to the muffler outlet flange (Figure 7-1). The flange on the other end of the flexible tube is bolted to a bracket on the base assembly (Figure 8-1).

Flanged tailpipe adaptors are available for tailpipe connections out the end, back or bottom of the genset. See the Installation Manual for important safety warnings and instructions regarding the routing and termination of the tailpipe (not supplied by Onan).

Always use new flange gaskets when connecting exhaust system components.

See Page 3-8 regarding spark arrestor cleaning.

To remove the muffler:

1. Disconnect the negative (-) battery cable *from the battery* to prevent the genset from starting

and remove the top and back housing panels (p. 4-4).

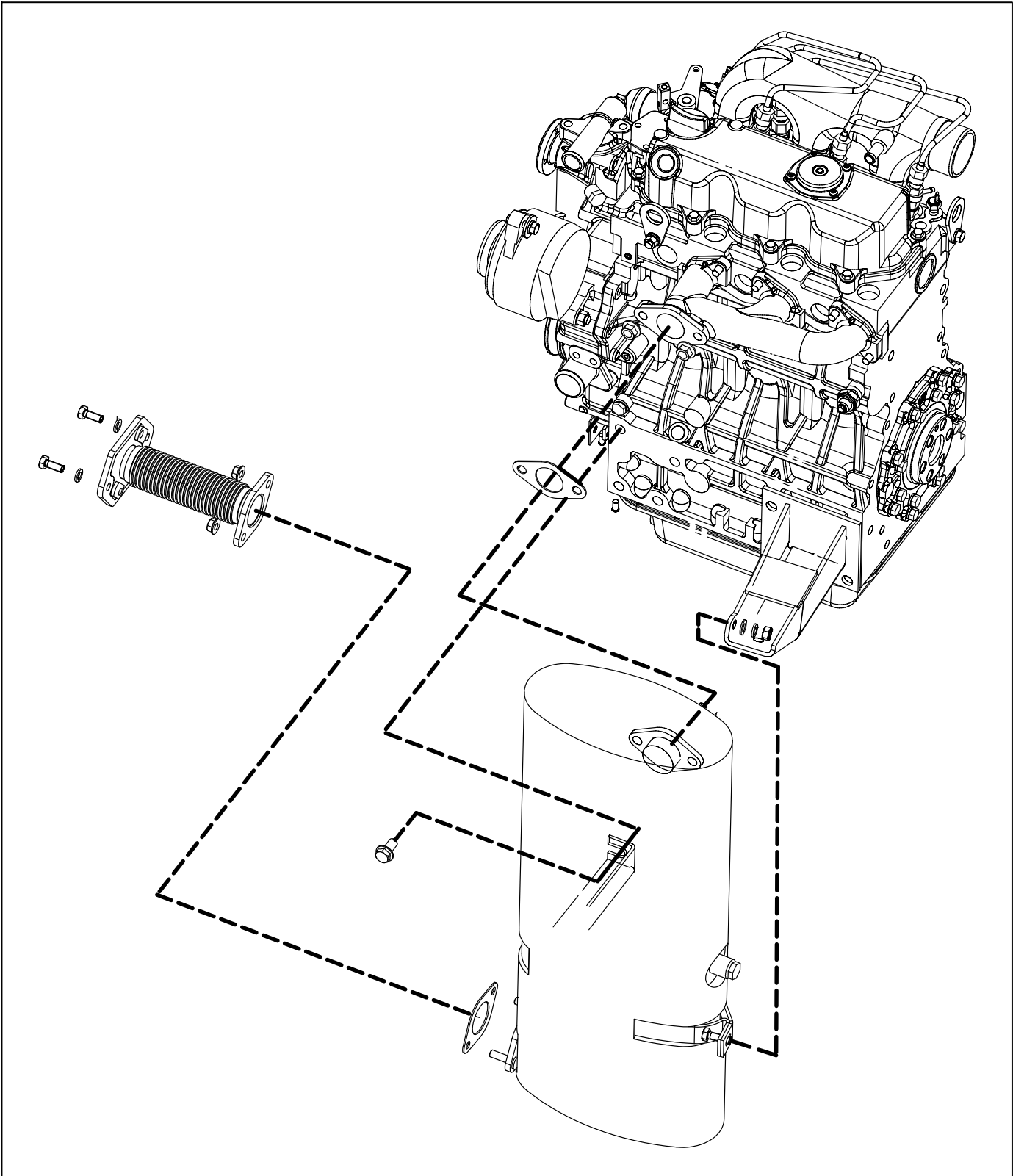
2. Disconnect the exhaust tail pipe and remove the flanged tail pipe adaptor.
3. Remove the flange screws on both ends of the flexible tube and withdraw the tube out the end of the genset.

**⚠ CAUTION** *The flexible tube is fragile. Take care not to bend or twist it.*

4. Remove the screws from the 2 muffler support brackets and the muffler manifold flange and withdraw the muffler.

Installation of the muffler is the reverse of removal. Use new flange gaskets for the tail pipe adaptor, flexible tube and muffler. Tighten all screws and nuts according to specifications (p. 13-1).

**⚠ WARNING** *Exhaust gas is deadly. The exhaust system must not leak. Liability for injury, death, damage and warranty expense due to the use of an unapproved muffler or due to modifications becomes the responsibility of the person installing the unapproved muffler or performing the modifications. Use Onan approved exhaust system parts.*



**FIGURE 7-1. MUFFLER ASSEMBLY**



# 8. Engine Cooling System

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

Refer to Figure 8-1 to reassemble the cooling system components.

The genset has a liquid-cooled engine with integral, belt-driven coolant pump. The radiator is mounted horizontally in the base of the genset. The system drain plug is on the radiator end tank. The coolant recovery tank is mounted on the underside of the top housing panel.

The centrifugal blower (fan) is driven by a two-belt, two-stage drive system. The primary belt drives the coolant pump and battery charging alternator. The coolant pump pulley has two belt groves. The outer belt groove drives the fan pulley (coupling) that spins freely on bearings on the end of the crankshaft. The fan is mounted on the coupling with a spacer.

The fan pulls cooling air up through the radiator and across all of the components inside the housing. The warm air is discharged out the bottom opening in the right end of the base.

See Page 3-11 regarding periodic cooling system maintenance and Page 9-3 regarding the coolant temperature sender.

## THERMOSTAT AND PUMP

See Engine Workshop Manual 981-0541 for coolant thermostat and pump service.

## RADIATOR

To remove the radiator:

1. Disconnect the negative (-) battery cable *from the battery* to prevent the genset from starting.
2. Let the genset cool down and then drain the cooling system (p. 3-11).

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

3. Remove the radiator access cover on the back of the base (Figure 4-3).
4. Disconnect the two radiator hoses and withdraw the radiator out the side opening in the base.

Installation of the radiator is the reverse of removal. Replace the foam sealing strips around the opening in the base if they are damaged. Tighten all screws according to specifications (p. 13-1).

## FAN

**Fan:** To remove the fan:

1. Remove the top and end housing panels (p. 4-4).
2. Remove the four fan hub bolts and withdraw the fan and spacer.

**⚠️CAUTION** *The fan (blower wheel) is fragile. Do not brace against it when loosening or tightening the hub bolts.*

**Fan Coupling:** If it is necessary to replace the fan coupling (pulley) from the end of the crankshaft, use a 1/2 inch socket wrench drive to remove it.

Installation is the reverse of removal. Tighten all screws according to specifications (p. 13-1).

## FAN BELT

### Primary Belt Tension

Remove the top genset housing panel (p. 4-4). Adjust tension so that deflection is 8-10 mm (0.3-0.4 inch) midway between the alternator and pump pulleys when a force of 10 kg (22 pounds) is applied.

### Secondary Belt Tension

The secondary belt has a spring tensioner (Figure 9-1).

### Belt Replacement

Remove the fan and then install the new belt(s) and adjust tension.

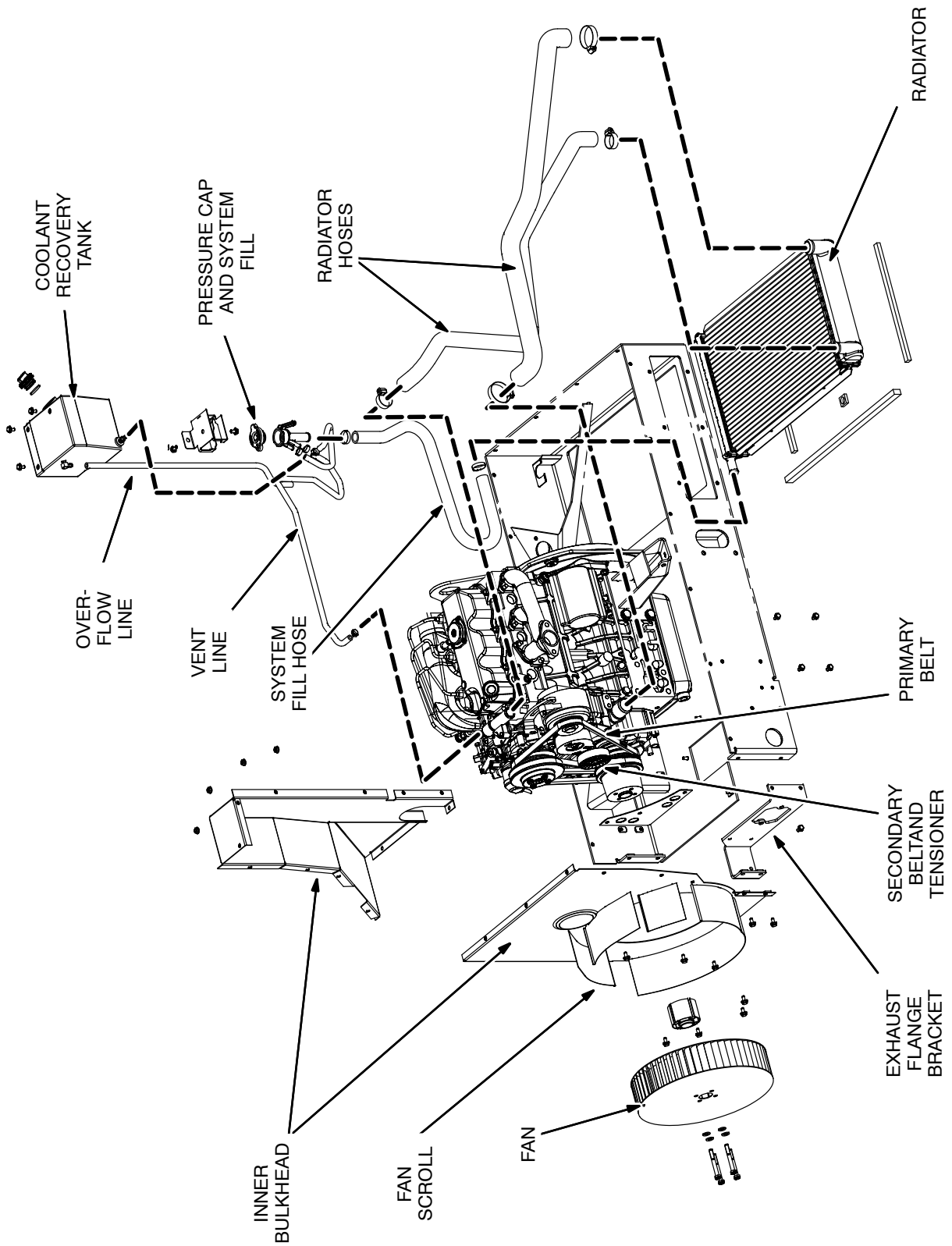


FIGURE 8-1. ENGINE COOLING SYSTEM

# 9. Engine and Accessories

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

## ENGINE

See Engine Workshop Manual 981-0541 for servicing the engine proper: adjusting valve clearance (lash), servicing the fuel injection system, replacing the glow plugs, cleaning the crankcase breather assembly, replacing the coolant thermostat and pump and overhauling the engine.

### Removal

The engine-generator-muffler assembly and wiring harnesses can be removed as an assembly from the genset if it is necessary to remove either the engine (Figure 9-1) or the generator (Figure 10-1). To do so:

1. Remove all of the housing panels except the inner bulkhead (p. 4-4), leaving the wiring harnesses attached to the engine-generator assembly.
2. Drain the cooling system, disconnect the radiator and vent hoses from the engine.

3. Remove the blower (fan) assembly (p. 8-1).
4. Remove the radiator (p. 8-1) for access to the bolt head of the generator isolation mount.
5. Disconnect the generator cooling air tube from the generator (p. 6-1).
6. Disconnect the battery cables and base grounding strap from the engine.
7. Disconnect the wiring harness lead to the fuel pump.
8. Disconnect the supply and return fuel hoses at the engine (p. 5-2).
9. Disconnect the flexible connector from the muffler outlet flange (p. 7-2).
10. Attach a hoist of sufficient capacity to the lifting eye, take up the slack and remove the center bolts of the three isolation mounts. Lift the engine-generator\_muffler assembly away.

### Installation

Installation is the reverse of removal. Make sure the air seal ring is in place around the oil drain hole in the base to keep air from bypassing the radiator. (The engine-generator compartment is under a partial vacuum.) Tighten all screws to specifications (p. 13-1).

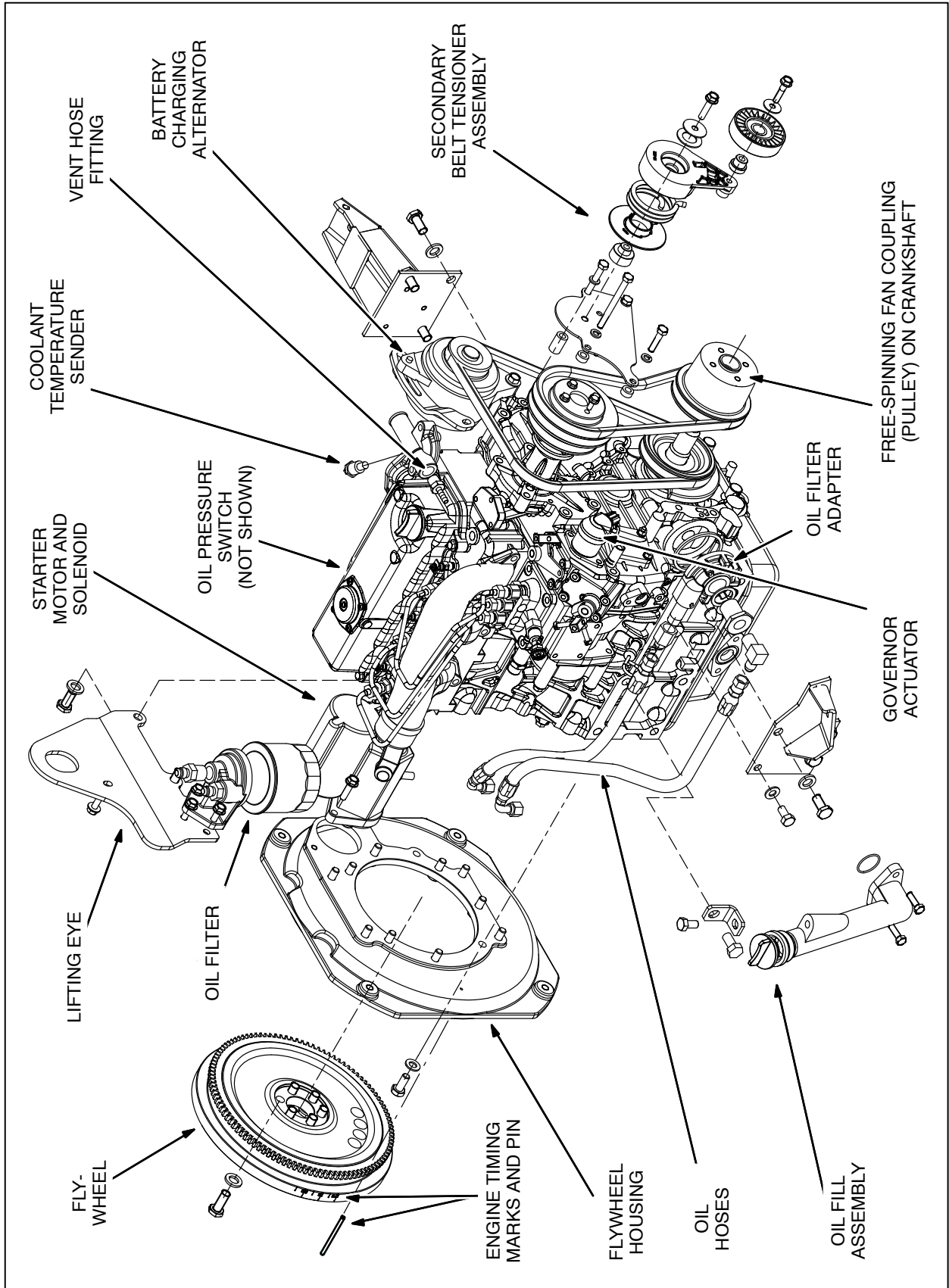


FIGURE 9-1. ENGINE AND ACCESSORIES

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

## ENGINE SENSORS

The engine is equipped with a coolant temperature sender and low oil pressure cutout switch (Figure 9-1). The associated fault codes (Section 12. Troubleshooting) are as follows:

- **No. 1** - Engine Over Temperature
- **No. 2** - Low Oil Pressure
- **No. 24** - Faulty Engine Temperature Sender

### Coolant Temperature Sender

The sender is accessible for replacement by removing the top housing panel (p. 4-4). Replace the sender if resistance is not approximately 1300 ohms in ice water, 700 ohms at room temperature or 57 ohms in boiling water. Use thread sealant and engage at least two threads when reassembling.

### Oil Pressure Switch

The switch is accessible for replacement by removing the top housing panel (p. 4-4). Replace the switch if it is not closed (ground continuity at the ter-

minal) when the engine is not running or if the switch does not open when oil pressure rises to 14 psi (96 kPa).

## BATTERY CHARGING ALTERNATOR

The battery charging alternator is accessible for service by removing the top housing panel (p. 4-4). Adjust fan belt tension and tighten the mounting bolts according specifications (p. 13-1) when reassembling.

## STARTER MOTOR

The starter motor is accessible for service by removing the top housing panel (p. 4-4). Tighten the mounting bolts according specifications (p. 13-1) when reassembling.

## GLOW PLUGS

Refer to engine Workshop Manual 981-0541 when replacing the glow plugs, which are accessible for service by removing the top housing panel.

**Note: 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.**

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

## GOVERNOR ACTUATOR

The governor actuator (Figure 9-3) is removable by removing the housing end panel (Figure 4-2) and the fan and inner bulkhead (Figure 8-1). Remove the actuator from the engine block (2 screws). When reassembling, make sure the O-ring seal is in place and that the push rod goes through the internal guide hole. Replace the actuator if:

- Electrical resistance across its terminals is not 2 to 4 ohms.
- The plunger does not pull in smoothly when **B+** (12 VDC) is applied across its leads.
- The plunger does not move in and out smoothly when pushed in by hand.

## HIGH-IDLE SPEED

Reset high-idle speed if the stop screw seals have been broken or internal governor parts have been replaced or are worn. To reset high-idle speed:

1. Remove the governor actuator to allow operation at full fuel rack, but leave it connected to keep Fault No. 19 from preventing Start. Plug the opening to keep oil from splashing out.
2. Disconnect the fuel pump and power it directly with a 12 volt battery to keep the engine running when Fault No. 12 or 14 occurs.

**⚠WARNING** *These adjusting screws are in close proximity to rotating belts and pulleys that can cause severe personal injury. Be very careful not to get your hands near the pulleys and belts while making the adjustments.*

3. Disconnect all loads from the genset to protect them from overfrequency and start the genset. Adjust the stop screws (Figure 9-3) to obtain 67.3-68.3 Hertz (2019-2049 rpm). **TO STOP THE ENGINE**, disconnect the fuel pump from the battery.
4. Seal the adjusting threads with paint.
5. Re-install all of the components that were removed or disconnected.

FIGURE 9-2.

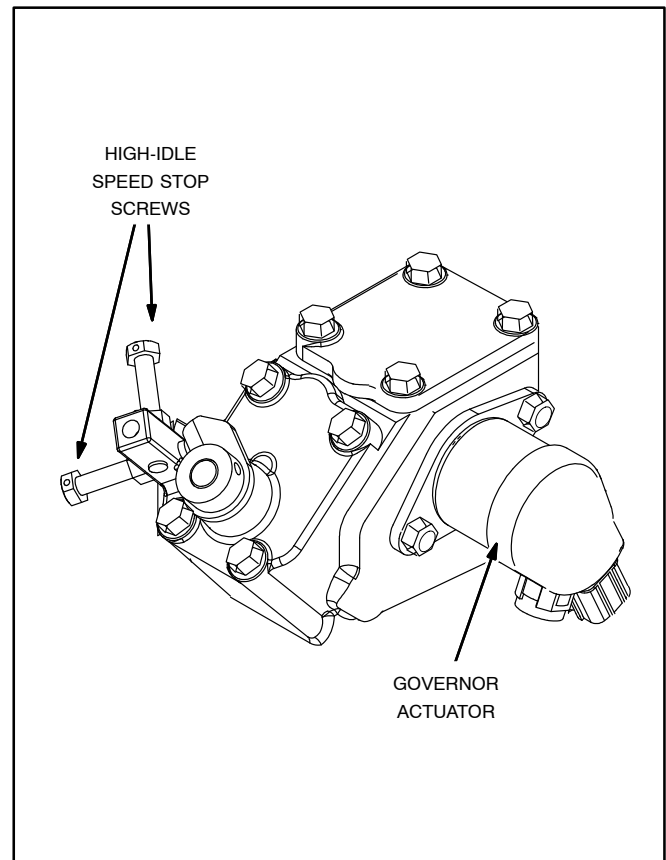


FIGURE 9-3. GOVERNOR ACTUATOR AND HIGH-IDLE SPEED STOP SCREW

# 10. Generator

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

## GENERATOR WINDING TESTS

### Testing Winding Insulation Resistance

**Testing for Winding-to-Winding and Winding-to-Ground Shorts:** A digital ohmmeter can be used (highest scale) as a preliminary check for a grounded Stator, Quadrature or Field Winding or for a short between Stator (Main) and Quadrature windings. The meter should indicate infinite resistance.

*A 500 VDC megger is recommended for finding winding-to-winding or winding-to-ground shorts. Resistance between windings or to ground should be not be less than 1 megohm.*

**Testing Stator Windings with a Megger:** A 500 VDC megger is recommended for testing Stator Winding insulation resistance. Disconnect **T2** and **T3** from the grounding screw on the engine mounting bracket (p. 16-5) to isolate the windings from ground, and separate the two parts of generator connector **P3/J3** to isolate the control board from the DC test voltage. Apply one side of the DC test voltage to both windings (connect to either end) and the other side to a good generator ground (stator laminations) for 10 minutes and record resistance values at one minute and at 10 minutes.

A resistance value of at least 5 megohms should be obtained for a new stator with dry windings. The polarization index (the ratio of the resistance reading at 10 minutes to the reading at one minute) should also be at least 2. For a genset that has been in service, the resistance value should not be less than 1 megohm, nor the polarization index less than 2.

If the readings are low, or the genset has been in storage for a long time in a high-humidity environment, the test should be repeated after the windings have been dried. The most effective way of drying the stator windings, if the genset is operable, is to run it under full load for at least one hour.

### Testing Winding Resistance

Use a **Digital Ohmmeter** to check for open or shorted Main (Stator), Quadrature or Field Windings. Use a **Wheatstone Bridge** having a precision of at least 0.001 ohm to measure Stator Winding resistance.

Replace a rotor or stator that has winding resistances outside Table 10-1 tolerances.

**Stator Windings:** Check Stator Winding resistance across the AC output terminal block: **TB2-1—TB2-3** and **TB2-2—TB2-3**. Make sure circuit breaker **CB1/CB2** is ON.

If resistance is within Table 10-1 tolerances, the whole AC output circuit is probably sound.

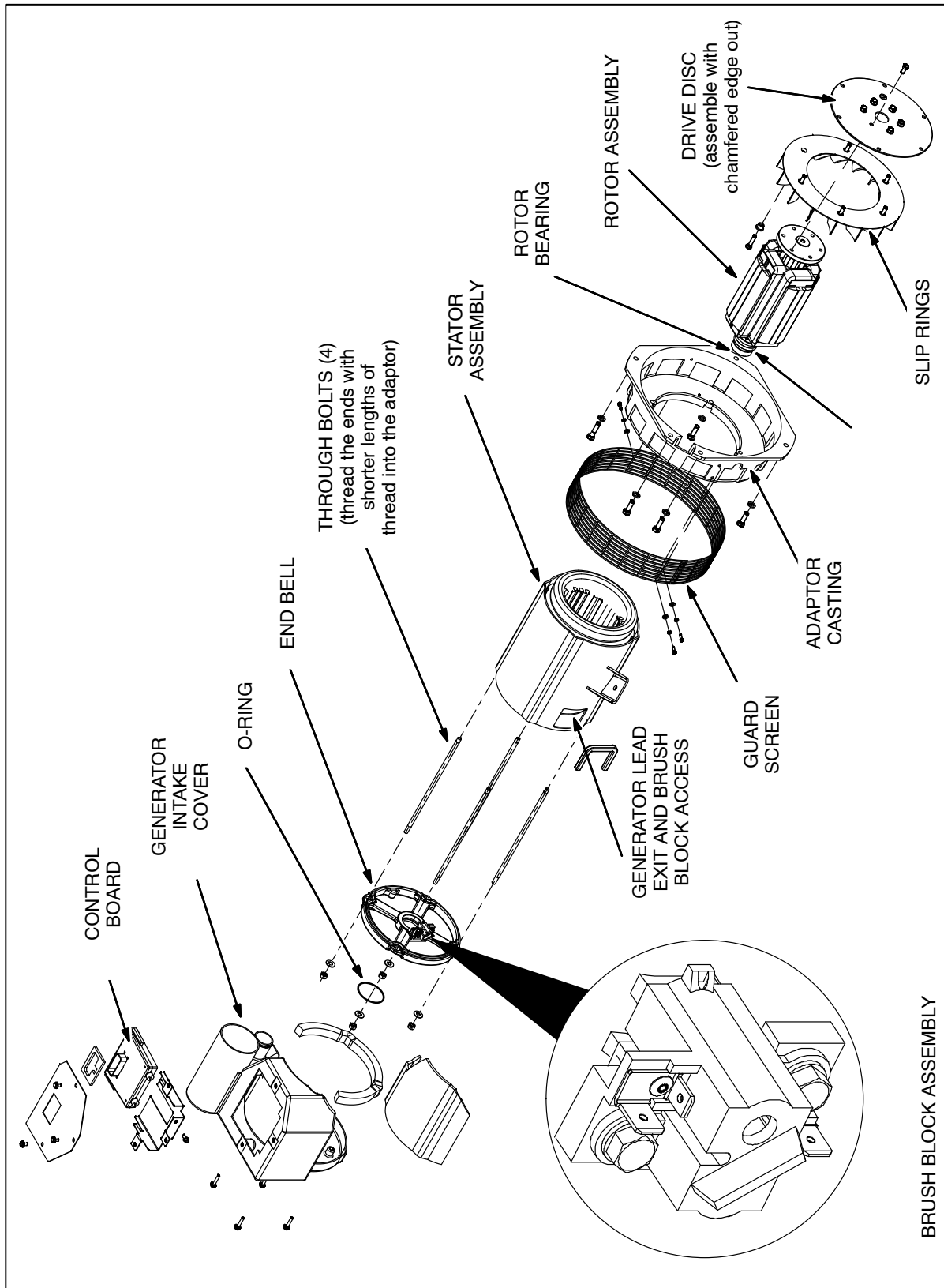
If resistance is high, check resistance directly across the winding leads, which are connected at **CB1/CB2** and at the grounding screw on the generator mounting bracket (p. 16-5). Service as necessary by tightening connections or servicing the generator, AC harness (p. 16-5) or circuit breakers (p. 11-5).

**Field and Quadrature Windings:** Separate the two parts of generator connector **P3/J3** for access to the field windings (**P3-7—P3-8**) and quadrature windings (**P3-3—P3-6**). Resistance must within Table 10-1 tolerances. If field resistance is high, first service the brushes and slip rings (p. 10-3) and repeat the test. Then, if necessary, service the rotor.

**TABLE 10-1. WINDING RESISTANCES**

WINDING	RESISTANCE (OHMS) @ 70°F (21°C)	
	HDKCA, HDKCC, HDKCG	HDKCB, HDKCD
T1-T2, T3-T4	0.197-0.241	0.178-0.218
Q1-Q60 (P3-3 to P3-6)	1.99-2.42	1.89-2.31
Rotor (P3-7 to P3-8)	19.4	22.5

Note: Even though winding resistance may be within the tolerances of this Table, replace the Rotor or Stator if winding-to-winding or winding-to-ground resistance (winding **insulation** resistance) is less than 1 megohm. (An ohmmeter must indicate an *open circuit* or *infinite resistance* between windings or between any winding and ground.)



**FIGURE 10-1. GENERATOR**



## GENERATOR SERVICE

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

### Brushes and Slip Rings

**Access:** Remove the brush block access cover (Figure 10-2) for access to the brush block assembly and slip rings.

**Checking for Wear:** Check brush wear by marking off a piece of wire at 1 inch (25 mm) and inserting it into each of the two holes in the top of the brush block from which the pig tails exit. Replace the brush if the wire can be inserted more than 1 inch (25 mm). (Make sure the wire rests on top of the brush and not on part of the spring.)

**Cleaning Up Slip Rings:** If the slip rings are grooved or pitted, try cleaning them up with a commutator stone while cranking the engine. (Connect the starter motor directly to a battery and the starter solenoid to a remote start switch.) The rotor will have to be removed if the slip ring assembly has to be replaced.

**Replacing Brush Block:** When replacing the brush block assembly, center the brushes on the slip rings before tightening the two mounting screws. Make sure to reconnect the lead marked **F1** to the outboard brush and the lead marked **F2** to the inboard brush.

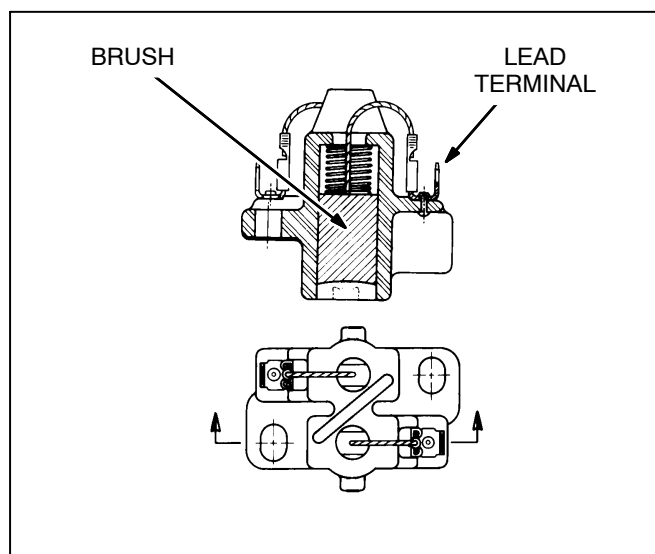


FIGURE 10-2. BRUSH BLOCK ASSEMBLY

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

### Removing the Generator

Remove the engine-generator assembly as an assembly from the genset (p. 9-1) and then remove the generator from the engine, as follows:

1. Remove the air inlet assembly (Figure 10-1).
2. Disconnect the generator leads attached to the grounding screw on the generator mounting bracket (Page 16-5) and separate the two parts of generator connector **P3/J3**.
3. Remove the brush block assembly or lift the brushes and insert a wire to keep the brushes up and out of the way while disassembling and reassembling the generator.
4. Loosen the four through bolt nuts and remove the end bell and stator assemblies.

**Note: Note:** Any time the end bell assembly is removed, the O-ring located in the bearing bore must be replaced.

5. Remove the adaptor casting from the flywheel housing and then the rotor from the flywheel.

### Installing the Generator

Installation is the reverse of removal. Tighten all nuts and bolts according to specifications (Page 13-1) and note the following:

1. Make sure the chamfered edge of the drive disc faces the flywheel.
2. Make sure the ends of the through bolts with the shorter lengths of thread are threaded into the adaptor casting.
3. Make sure the O-ring is in place in the bearing bore of the end bell.
4. Relubricate the bearing bore with molybdenum desulfide or an equivalent grease. Cover the bearing bore with a thin layer of grease, covering both the O-ring and the metallic surface.
5. Before securing the air inlet adaptor assembly, make sure the brush block assembly is in place (Brushes and Slip Rings) and that the wire holding up the brushes has been removed.

## Replacing the Rotor Bearing

Use a gear puller if it is necessary to remove the rotor bearing. If the slip ring assembly is being replaced, install the new assembly before pressing on the bearing. Press a new rotor bearing on flush with the end of the rotor. Apply Loctite #680 adhesive to the shaft and Loctite #747 activator to the bearing mating surface.

## Replacing the Slip Ring Assembly

Remove the rotor bearing and unsolder the two field leads if it is necessary to remove the slip ring assembly. Press a new slip ring assembly on making sure the key is in place and soldered the field leads to the slip ring assembly.

## ADJUSTING VOLTAGE

The controller has a **voltage set mode** that is enabled by rapidly pressing **START** 6 times *during the first minute after startup*. To adjust voltage:

1. Disconnect all genset loads and connect accurate meters to measure AC output voltage.

**⚠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 **START** 6 times. The status lamp will start to blink once a second to confirm that the controller is in voltage adjust mode.
4. **To adjust voltage up**, press **START** and release quickly. Each time **START** is released, voltage will increase approximately 0.6 volt.
5. **To adjust voltage down**, press the control switch to **START** and release in approximately 1 second. Each time **START** is released, voltage will decrease approximately 0.6 volt.
6. Normal operation will resume in 20 seconds after the last adjustment. The last adjustment will be saved by the controller.

**Note: Voltage adjustments will not be saved if a fault shutdown occurs or STOP is pressed while in voltage set mode.**

# 11. Control

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

## CONTROL BOARD (CONTROLLER)

The Control Board is an integrated microprocessor-based engine and generator control that provides all the control, monitoring and diagnostic functions required to operate the genset.

### Control Board

**Location and Mounting:** Refer to Figure 11-1 for control board location and mounting and to Pages 16-3 and 16-4 for the control wiring schematic and harness drawings. The control board is

accessible for replacement through the front access door.

**Connector:** A single connector (P1/J1) is used for all connections between the control board and harness. When separating the connector, use a small flat-bladed screwdriver to lever out the catch.

**⚠ CAUTION** *Makeshift meter test probes used for testing Control Board connections during troubleshooting can damage pin sockets by spreading or dislodging the contact wiper arms, resulting in an open or intermittent electrical connection. Use a mating pin (PN 323-1605) or a test probe that is 0.045 inches in diameter. Replace damaged pin sockets (PN 323-1614-01). Make sure the pin sockets are fully seated and can't be pulled out.*

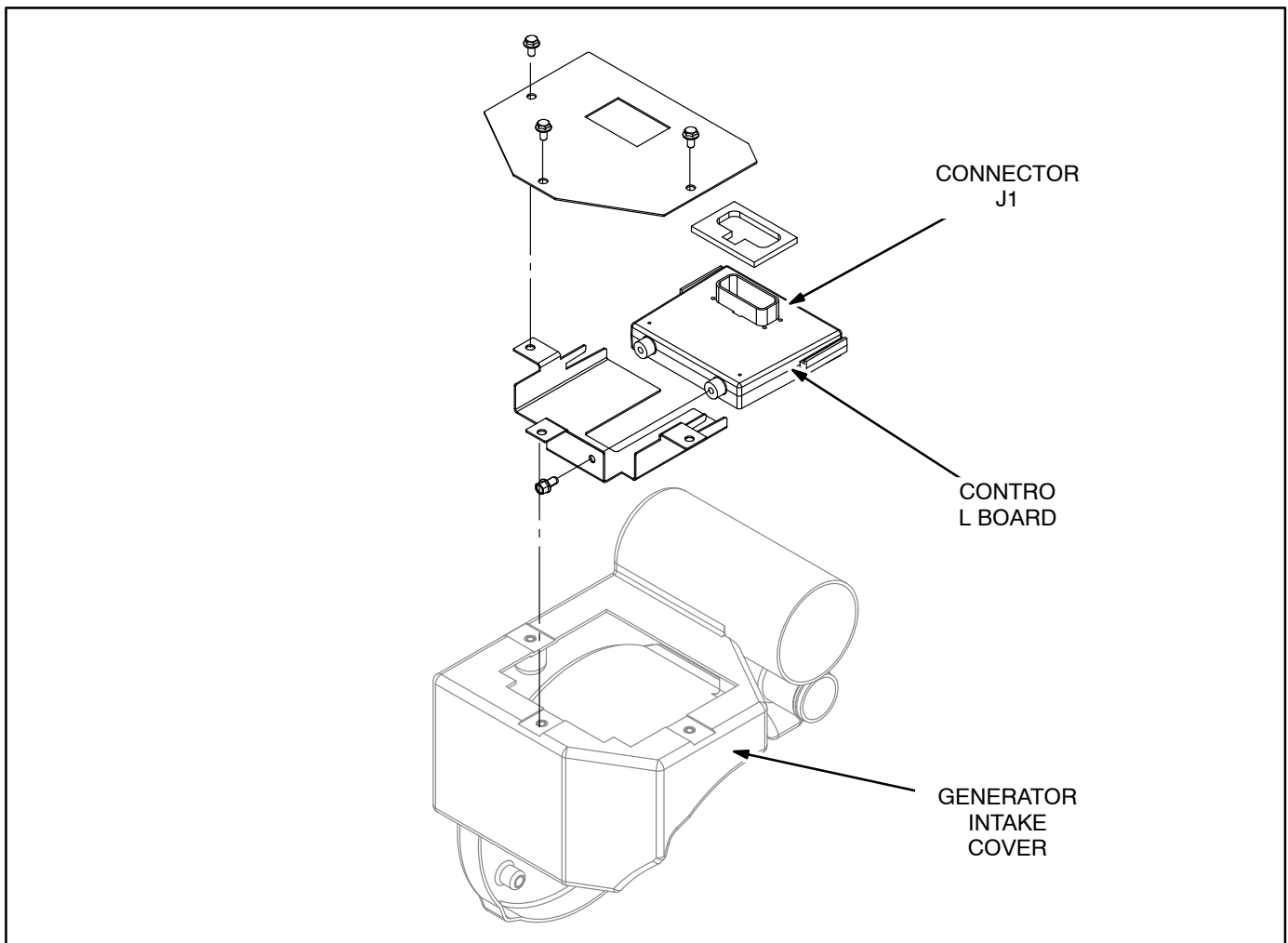


FIGURE. 11-1 CONTROL BOARD

## Major Controller Functions

Figure 11-2 is a block diagram of Controller functions.

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

**Fuel Priming:** Press and hold the control switch at **STOP (Prime)** for more than 3 seconds to cause fuel pump E2 to prime the fuel system.

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

1. Energizes fuel lift pump E2.
2. Energizes the glow plugs (3) 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 for up to 35 seconds.
6. Enables field flash (F1-F2).
7. Energizes governor actuator E1 (full rack).
8. Disconnects the starter 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.

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

**Controlling Voltage:** The Controller maintains nominal AC output voltage as load varies by varying field voltage. In response to transient loads, it lowers the voltage setpoint to allow engine recovery. Field power is supplied by the quadrature windings (Q1-Q2). See ADJUSTING VOLTAGE (p. 10-4).

**Controlling Fuel:** The Controller positions the fuel rack to maintain nominal frequency as load varies by sending a pulse-width-modulated square-wave signal (PWM) to governor actuator E1. It determines frequency by sensing the zero crossings of the quadrature winding output. When the actuator is not energized, its spring-loaded plunger holds the fuel rack in the no-fuel position.

**Fault Monitoring, Shutdown and Diagnostics:** See Section 12. Troubleshooting.

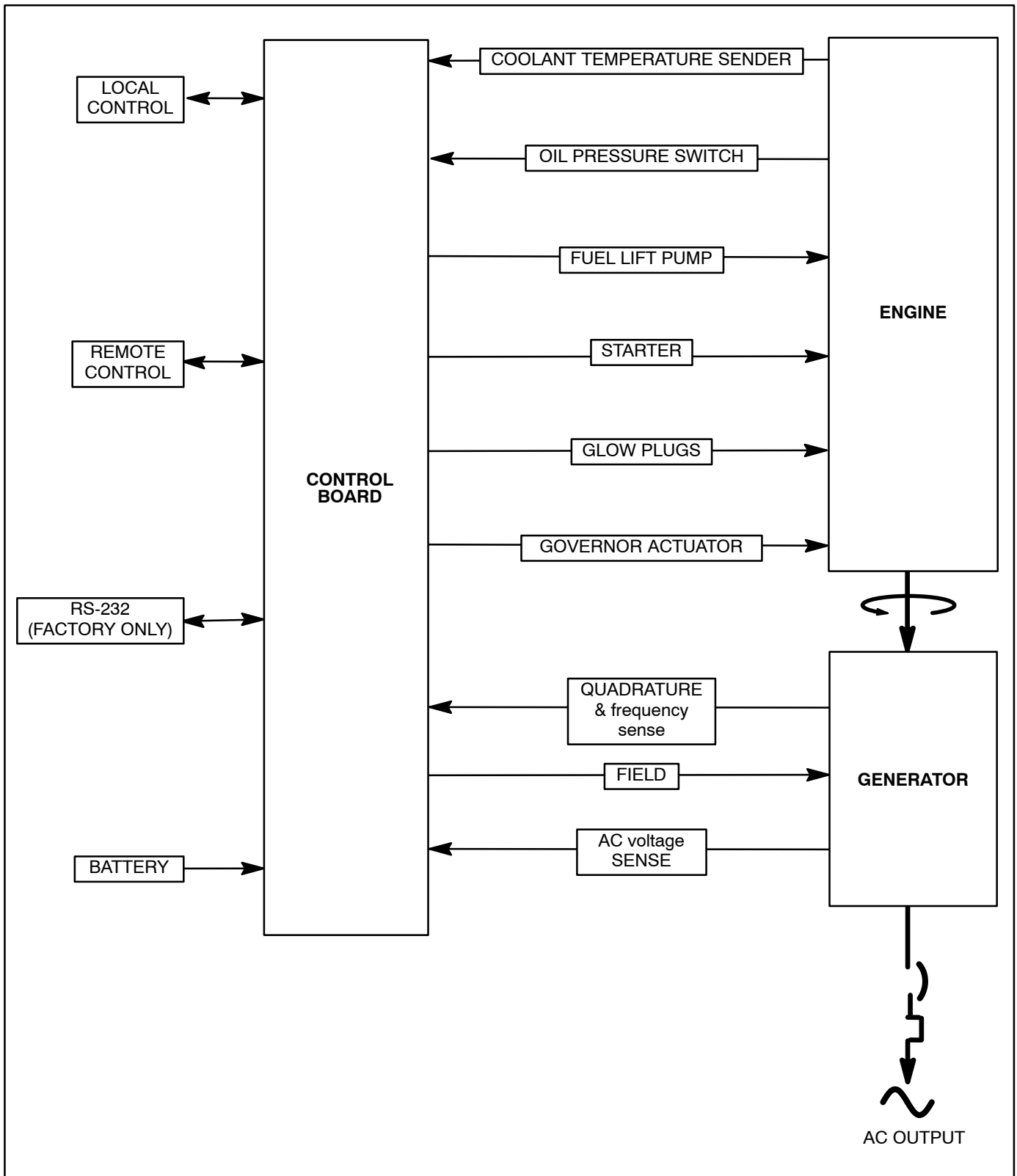


FIGURE 11-2. CONTROL BLOCK DIAGRAM

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

## LOCAL AND REMOTE CONTROL SWITCHES

Refer to Pages 16-3 and 16-4 for the control wiring schematic and harness drawings.

### Control Switch Tests

**Local Control Switch S1:** Switch S1 is mounted on the control panel (Figure 11-3). Unsnap connector **P9**, which is accessible through the front access door. Referring to Figure 11-4, replace the switch if:

- The switch does not close across terminals **2** and **3** when held in the Start position
- The switch does not close across terminals **1** and **2** when held in the Stop position
- The status indicator light does light when 12 VDC is connected across terminals 7 (-) and 8 (+).

**Remote Control Switch:** Disconnect remote control connector **J8/P8** and test a remote control switch (customer supplied) in the same manner as switch S1 and repair as necessary.

### Wiring Harness Tests

If the control switches are good but the Start / Stop circuit still does not work, test the wiring harness between the control switches and control board.

Disconnect **P1** from the control board (p. 11-1).

- **P1-9** should close to **P1-27** when the local or remote switch is held in its Start position.
- **P1-32** should close to **P1-27** when the local or remote switch is held in its Stop position.

Replace broken or missing wires and bent or corroded terminals.

### HOUR METER

The hour meter (Figure 11-3) is mounted on the control panel and is accessible for replacement through the front access door. It cannot be reset.

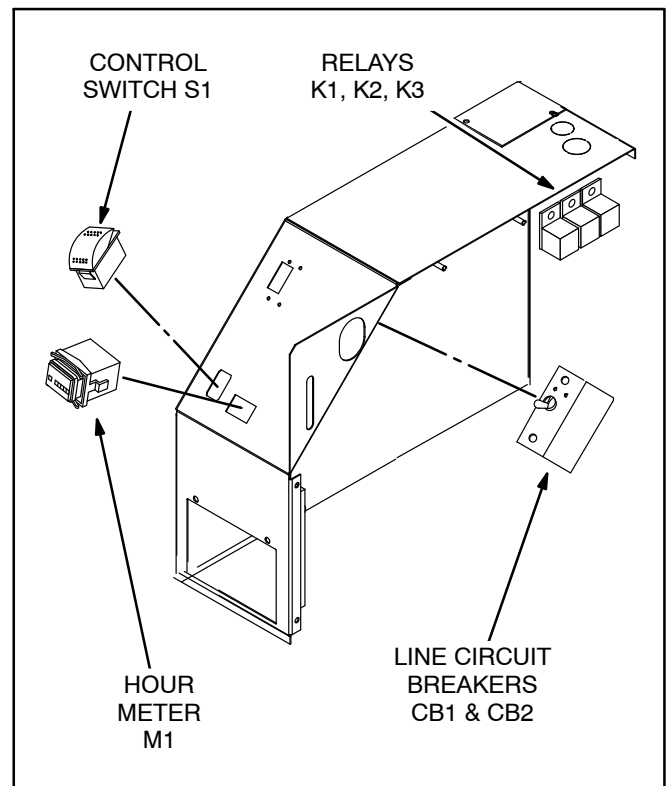


FIGURE 11-3. CONTROL COMPONENTS

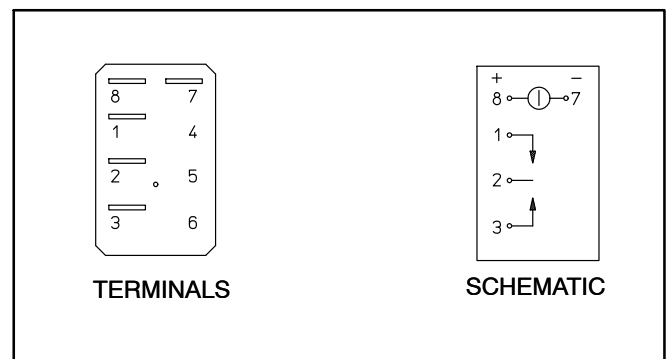


FIGURE 11-4. CONTROL SWITCH S1

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

## LINE CIRCUIT BREAKERS CB1, CB2

The line circuit breakers (Figure 11-3) are mounted on the control panel and are accessible for replacement through the front door. 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.

## RELAYS K1, K2, K3

These relays are secured in a row above the intake resonator (Figure 11-3) and are accessible for replacement by removing the top enclosure panel. To test a relay, apply 12 VDC across terminals 85–86 (Figure 11-5). Replace the relay if 30–87a (NO) does not close or 30–87 (NC) does not open, or either does not return to its normal position when power is removed.

See Page 16-3 for relay function.

## VOLTAGE SENSE TRANSFORMER TX1

The voltage sense transformer is mounted in the top of the intake resonator (Figure 11-6) and is accessible for replacement by removing the top enclosure panel. Disconnect all four leads and check electrical resistance across the primary and secondary windings. Replace the transformer if the resistance of either winding is not as specified in the schematic.

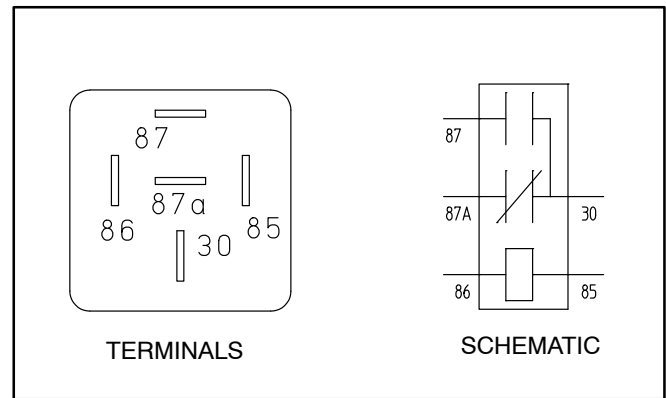


FIGURE 11-5. RELAYS

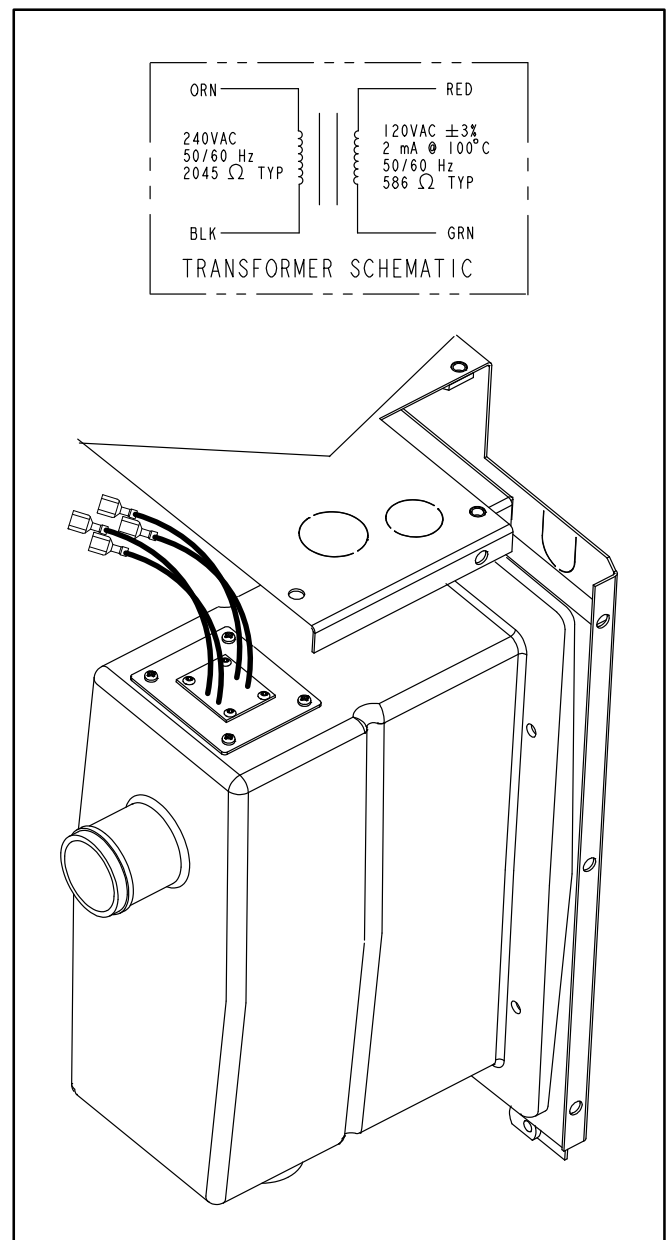


FIGURE 11-6. VOLTAGE SENSE TRANSFORMER

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# 12. Troubleshooting

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## TROUBLESHOOTING WITH TABLE 12-1

To aid troubleshooting the genset controller causes the status indicator light to blink the numeric code assigned to the fault that caused shutdown. For a brief description of the fault and step-by-step corrective action, refer to TABLE 12-1. TROUBLESHOOTING, which lists the fault codes in numerical order.

**Note:** Many genset shutdowns can be avoided by performing periodic maintenance on schedule (TABLE 3-1. PERIODIC MAINTENANCE SCHEDULE) and by *not* running the genset out of fuel. Note that when the genset and propulsion engine draw from the same fuel tank, the fuel dip tubes are usually arranged so that the genset will run out of fuel first. By marking the genset empty point on the fuel gauge, it will be easier to tell when the genset may run 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.

- **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 bystep corrective actions.

## RESTORING FAULT CODE BLINKING

The fault code stops blinking after five minutes. Press **Stop** three times within three seconds to restore fault code blinking.

**Note:** **Note:** The last fault logged will blink even though the condition that caused the shutdown may have been corrected.

TABLE 12-1. 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 AT CONTROL SWITCH

(Faulty switch, poor or missing connections, dead battery)

**Corrective Action:** *Refer to Pages 16-3, 16-4 and 16-5, as appropriate.*

10. Try the genset (local) control switch if there is no response at the remote control switch, and vice versa.
  - If there is no response at either remote or local switch, go to Step 11.
  - If there is no response at the remote switch but at the local, go to Step 12.
  - If there is no response at the local switch but at the remote, go to Step 15.
11. Check for 12 VDC across genset battery cable terminal block **TB1**. **If there is no voltage**, service as necessary by cleaning and tightening battery cable connections, recharging or replacing the battery or replacing damaged or missing battery cables. **If there is voltage** across **TB1**, but no response at either remote or local switch, go first to Step 12. , and then, if necessary, also to Step 15.
12. Disconnect harness connector **P8** from the remote circuits. Check for **B+** (12 VDC) at **P8-C** (Start) and at **P8-E** (Stop) and for ground continuity at **P8-A** (Ground). If there is **B+** and ground continuity, service the remote switch and harness (p. 11-4). If not, go to Step 13.
13. Disconnect harness connector **P1** from the control board (p. 11-1) and check for **B+** at **P1-10** and for ground continuity at **P1-27**. If there is **B+** and ground continuity, go to Step 14. If not, go to Step 18.
14. Check for wiring continuity in the harness between connectors **P8-C** and **P1-9** (Start), **P8-E** and **P1-32** (Stop), **P8-B** and **P1-7** (Status), **P8-F** and **P1-8** (Run) and **P8-A** and **P1-27** (Ground). Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board (p. 11-1) if the genset still does not start.
15. Disconnect harness connector **P9** from control switch S1 (p. 11-4). Check for **B+** (12 VDC) at **P9-3** (Start) and at **P9-1** (Stop) and for ground continuity at **P9-2** (Ground). If there is **B+** and ground continuity, test control switch S1 and replace if necessary (p. 11-4). If not, go to Step 16.
16. Disconnect harness connector **P1** from the control board (p. 11-1) and check for **B+** at **P1-10** and for ground continuity at **P1-27**. If there is **B+** and ground continuity, go to Step 17. If not, go to Step 18.
17. Check for wiring continuity in the harness between connectors **P9-3** and **P1-9** (Start), **P9-1** and **P1-32** (Stop), **P9-8** and **P1-7** (Status), **P9-7** and **P1-27** (Status Ground) and **P9-2** and **P1-27** (Start/Stop Ground). Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board (p. 11-1) if the genset still does not start.
18. Remove the top housing panel (p. 4-4) and check that both harness connectors labeled **B1-BAT** are secure on the starter solenoid terminal, that **GND** is secure on the chassis ground and that there is wiring continuity in the harness between connectors **P1-10** and **B1-BAT** and between connectors **P1-27** and **GND**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board (p. 11-1) if the genset still does not start.
19. Remove the top housing panel (p. 4-4) and replace broken or missing cables between **TB1** and the engine. Tighten loose connections.

TABLE 12-1. 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.*

### THE STARTER ENGAGES AND DISENGAGES

(Low cranking voltage)

**Corrective Action:**

1. Have the vehicle propulsion engine running while trying to start the genset. Its charging alternator may be able to maintain a high enough battery terminal voltage to start the genset.
2. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables.

### THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

(Marginal battery, battery connections or charging system)

**Corrective Action:** *Refer to Pages 16-3, 16-4 and 16-5, as appropriate.*

1. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables.
2. **Models HDKCA and HDKCB** – The genset starting battery is recharged by the vehicle engine or separate battery charger. Service as required.
3. **Models HDKCC, HDKCD, and HDKCG** – These models have a feature whereby genset battery charging alternator **G1** (p. 9-3) can be disabled, via relay **K1** (p. 11-5), by connecting **B+** to remote connector pin **P8-D**. Service the vehicle engine or separate battery charger if depended upon for recharging the genset starting battery. If genset battery charging alternator **G1** is not disabled, continue with Step 4.
4. Remove the top housing panel (p. 4-4) and check for wiring continuity in the harness between charging alternator **G1** and starter solenoid terminal **B+ (BAT)**. Repair as necessary.
5. Check for proper operation of relay **K1** and replace if necessary (p. 11-5).
6. Check for wiring continuity in the harness between connectors **G1-VR** and **K1-87a**. Repair as necessary.
7. Disconnect harness connector **P1** from the control board (p. 11-1). Check for wiring continuity in the harness between connectors **P1-24** and **K1-30**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out.
8. Replace battery charging alternator **G1** (p. 9-3).

### NO AC POWER WHEN GENSET IS RUNNING

(A Circuit Breaker is OFF, tripped or malfunctioning or there are poor AC harness connections)

**Corrective Action:** *Refer to Pages 16-3, 16-4 and 16-5, as appropriate.*

1. Reset or turn ON genset circuit breaker **CB1**.
2. Reset or turn ON any other circuit breaker in the AC power supply system.
3. Check voltage at genset AC output terminal block **TB2** when the genset is running. If there is approximately 120 VAC across **TB2-1** and **TB2-3** and across **TB2-2** and **TB2-3**, repair or reconnect the wiring between the genset and the main vehicle distribution panel. If there is no voltage, go to Step 4.
4. Check for proper **AC** harness connections and repair as necessary (p. 16-5).
5. Test each circuit breaker and replace if necessary (p. 11-5).

TABLE 12-1. 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.*

**ENGINE OVER TEMPERATURE—CODE NO. 1**

(During normal operation engine coolant temperature exceeded 239° F [115° C] for 10 seconds)

**Corrective Action:**

1. Check engine coolant level, add coolant as necessary and repair any leaks.
2. Check for and remove any objects blocking the air inlet or outlet openings in the bottom of the genset and clean out dirt fouling the radiator passages.
3. Run fewer appliances at the same time to keep down engine temperature. (Note that high altitude and high ambient temperature decrease engine cooling capacity.)
4. Look for loose or broken fan belts and readjust or replace as necessary (p. 8-1).
5. Check for air leaks in the housing as a result of missing or loose housing panels and access covers, including the access cover for the AC terminals (Figure 4-2).
6. If loose, reconnect wiring harness connector **E3-1** to engine coolant temperature sender E3 (p. 9-3). (The Controller interprets a loose lead touching ground as high temperature.)
7. Replace the coolant thermostat, which might not be fully opening. See Engine Workshop Manual 981-0541.
8. Test temperature sender E3 and replace if necessary (p. 9-3).

**LOW OIL PRESSURE—CODE NO. 2**

(During normal operation engine oil pressure dropped to less than 14 psi for 3 seconds—switch closed)

**Corrective Action:**

1. Check engine oil level, add oil as necessary and repair any leaks.
2. Drain the excess oil if the level is above Full on the dipstick. If the level is too high the crankshaft can whip the oil into foam, which the pump can't pump.)
3. Test low oil pressure cutoff switch S2 and replace if necessary (p. 9-3).
4. Service the engine. See Engine Workshop Manual 981-0541.

**SERVICE CHECK—CODE NO. 3**

(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.

TABLE 12-1. 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.*

**OVER CRANK—CODE NO. 4**

(First-level fault code—Cranking time exceeded 35 seconds)

**Corrective Action:** *Refer to Pages 16-3, 16-4 and 16-5, as appropriate.*

1. Check fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
2. Prime the engine fuel system for one minute (p. 2-5). If the fuel pump does not operate, check for loose wiring harness connectors **E2-1** and **E2-2** and reconnect them to the pump. If they were found connected, disconnect them and power the pump directly with a 12 volt battery. Replace the fuel pump if it does not operate. If the pump operates, disconnect **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-24** and **E2-1** and for ground continuity at connector **E2-2**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fuel pump still does not operate.
3. Check the engine air filter and remove any blockage (p. 3-6).
4. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
5. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime.
6. Replace the fuel filter (p. 3-9).
7. Conduct a fuel flow test and service as necessary (p. 5-1).
8. If loose, reconnect wiring harness connector **HR-1** to the glow plug bus bar. If it was found connected, check for **B+** on the glow plug bus bar while cranking. **If there is B+**, remove the glow plug bus bar and check for electrical continuity between each glow plug terminal and ground. Replace all three glow plugs if any glow plug is open (p. 9-3). **If there is no B+**, check for proper operation of glow plug relay **K3** (p. 11-5). If the relay functions properly, check for wiring continuity in the harness between connectors **HR1** and **K3-87** and for ground continuity at **K3-86**. If good, disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-23** and **K3-85** and between **P1-10** and **K3-30**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if there still is no **B+** at the glow plug bus bar during cranking.
9. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4). (The engine cannot start if the actuator fails to pull in its spring-loaded plunger.)
10. Service the fuel injectors and injection pump (p. 9-1).
11. Service the internal engine governor mechanism (p. 9-1).
12. Service a worn engine (p. 9-1).

**OVER VOLTAGE—CODE NO. 12**

(After voltage regulation was enabled Output Voltage jumped to more than 150 VAC [125% of rated] for 75 milliseconds or to more than 138 VAC [115% of rated] for 3 seconds)

**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 and service a grounded or shorted main, field or quadrature windings (p. 10-1) or grounded or shorted voltage sense transformer (p. 11-5).
2. Replace the control board (p. 11-1).

TABLE 12-1. 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.*

**UNDER VOLTAGE—CODE NO. 13**

(After voltage regulation was enabled Output Voltage fell to less than 108 VAC [90% of rated] for 5 seconds)

**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 and service a grounded or shorted main, field or quadrature windings (p. 10-1) or grounded or shorted voltage sense transformer (p. 11-5).
2. Replace the control board (p. 11-1).

**OVER FREQUENCY—CODE NO. 14**

(After the starter was engaged Frequency jumped to more than 70 Hz for 40 milliseconds or to more than 66 Hz for 6 seconds)

**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 genset frequency to overshoot.)
2. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime. (Air bubbles can disrupt frequency.)
3. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
4. Check high-idle speed and readjust if necessary (p. 9-4).
5. Replace the control board (p. 11-1).
6. Service the internal engine governor mechanism according to Engine Workshop Manual 981-0541.

**UNDER FREQUENCY—CODE NO. 15**

(During normal operation Frequency fell to less than 54 Hz for more than 8 seconds)

**Corrective Action:**

1. Push the line circuit breaker to OFF and restart the genset. If the genset now runs, run it with fewer connected loads, especially those with high motor starting loads such as air conditioners.
2. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime. (Air bubbles can disrupt frequency.)
3. Replace the engine air filter and clean the spark-arrest muffler (p. 3-6).
4. Replace the fuel filter (p. 3-9).
5. Conduct a fuel flow test and service as necessary (p. 5-1).
6. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
7. Check high-idle speed and readjust if necessary (p. 9-4).
8. Replace the control board (p. 11-1).
9. Service the fuel injectors and injection pump (p. 9-1).
10. Check fuel injection timing (p. 9-1).
11. Service the internal engine governor mechanism (p. 9-1).
12. Service a worn engine (p. 9-1).

TABLE 12-1. 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.*

### **ACTUATOR SHORTED OR OPEN—CODE NO. 19**

(At startup the Controller sensed an open or shorted governor actuator/harness)

**Corrective Action:** *Refer to Pages 16-3, 16-4 and 16-5, as appropriate.*

1. If loose, reconnect wiring harness connectors **E1-1** and **E1-2** to the governor actuator. If they were found connected, disconnect the wiring harness and measure electrical resistance across the actuator leads. Replace the actuator if resistance is not 2.8 to 2.9 ohms.
2. Disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-28** and **E1-1** and for ground continuity at connector **E1-2**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fault still occurs.

### **ACTUATOR OVERLOAD—CODE NO. 22**

(Due to connected overload or low engine performance, the Controller maintained the governor actuator at full-duty cycle—maximum pulse-width-modulated square-wave signal [PWM]—for 60 consecutive seconds)

**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 all fuel fittings for fuel and air leaks and tighten as necessary. Reprime.
3. Replace the engine air filter and clean the spark-arrest muffler (p. 3-6).
4. Replace the fuel filter (p. 3-9).
5. Conduct a fuel flow test and service as necessary (p. 5-1).
6. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
7. Check high-idle speed and readjust if necessary (p. 9-4).
8. Service the fuel injectors and injection pump (p. 9-1).
9. Check fuel injection timing (p. 9-1).
10. Service the internal engine governor mechanism (p. 9-1).
11. Service a worn engine (p. 9-1).

### **FAULTY ENGINE TEMPERATURE SENDER—CODE NO. 24**

(After 10 minutes of normal operation the Controller checked for and sensed an open temperature sender/harness)

**Corrective Action:**

1. If loose, reconnect wiring harness connector **E3-1** to engine coolant temperature sender **E3** (p. 9-3).
2. Test the temperature sender and replace if necessary (p. 9-3).
3. Disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **P1-21** and **E3-1**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out. Replace the control board if the fault still occurs.

TABLE 12-1. 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.*

**VAC SENSE LOST—CODE NO. 27**

(The Controller lost VAC sensing during normal voltage regulation when the field was functioning normally and frequency was at least 40 Hz)

**Corrective Action:** *Refer to Pages 16-3, 16-4 and 16-5, as appropriate.*

1. Disconnect harness connector **P1** from the control board (p. 11-1) and check for electrical resistance between pins **P1-33** and **P1-34**, which should be approximately 586 ohms (**TX1** secondary winding, p. 11-5). Go to Step 2. if the secondary circuit of voltage sense transformer **TX1** is good. If not, disconnect the four harness leads from **TX1** and test the transformer. Replace the transformer if either winding is faulty. If the transformer is good, check wiring continuity in harness leads **P1-33—TX1-RED** and **P1-34—TX1-GRN**. Repair or replace components as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out.
2. Make sure the line circuit breaker (**CB1/CB2**) is OFF, disconnect the four harness leads from **TX1** and test the transformer. Replace the transformer if either winding is faulty. If the transformer is good, check electrical resistance between harness leads **TX1-S1** and **TX1-S2**, which should be approximately twice the individual winding resistances in Table 10-1 (**T1-T2 + T3-T4**). If not, check wiring continuity in harness leads **CB1-LINE—TX1-S1** and **CB2-LINE—TX1-S2** and for proper connections of both sense leads and generator leads to the line terminals on **CB1** and **CB2**. Repair, reconnect or replace components as necessary.
3. Replace the control board (p. 11-1).

**HIGH BATTERY VOLTAGE—CODE NO. 29**

(During startup the Controller sensed that battery system voltage was greater than 19.2 volts for 5 milliseconds or greater than 19.2 volts for 1 second will running)

**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 battery booster charge rate.
3. Verify ground at P1-27



TABLE 12-1. 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.*

**LOW CRANKING SPEED SENSE—CODE NO. 32**

(The Controller could not detect cranking speed [quadrature zero crossings] for 12 seconds)

**Corrective Action:**

1. Have the vehicle propulsion engine running while trying to start the genset. Its charging alternator may be able to maintain a high enough battery terminal voltage to start the genset.
2. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables.
3. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
4. Remove the top housing panel (p. 4-4) and check for wiring continuity in the harness between connectors **SW** (starter solenoid) and **K2-87** (starter pilot relay) and between **K2-30** and **B+ (BAT)** (starter solenoid). Repair as necessary.
5. Check for proper operation of starter pilot relay K2 and replace if necessary (p. 11-5).
6. Disconnect harness connector **P1** from the control board (p. 11-1) and check for wiring continuity in the harness between connectors **J1-12** and **K2-85** and for ground continuity at connector **K2-86**. Repair as necessary. Make sure connector pin sockets are not damaged or corroded and that they are fully seated and can't be pulled out.
7. Service or replace the starter motor assembly (p. 9-3).
8. Replace the control board (p. 11-1).

**EE CHECKSUM FAULT—CODE NO. 35**

(During startup the genset Controller detected an EE memory error)

**Corrective Action:** Replace the control board (p. 11-1)

**GENSET STOPPING WITHOUT FAULT CONDITION—CODE NO. 36**

(The Controller declared this fault because engine speed fell below 1000 RPM for 0.5 seconds, though not by Controller action)

**Corrective Action:**

1. Check fuel level and refill as necessary. (Note: The genset fuel pickup is probably higher than the vehicle engine fuel pickup.)
2. Prime the engine fuel system for one minute (p. 2-5).
3. Check all fuel fittings for fuel and air leaks and tighten as necessary. Reprime.
4. Check the engine air filter and remove any blockage (p. 3-6).
5. Replace the fuel filter (p. 3-9).
6. Conduct a fuel flow test and service as necessary (p. 5-1).
7. Remove the governor actuator, test it for proper operation and replace if necessary (p. 9-4).
8. Replace the control board (p. 11-1).
9. Service the engine (p. 9-1).

TABLE 12-1. 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.*

**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—CODE NO. 38**

(During normal voltage regulation Field Voltage exceeded 180 VAC for 10 seconds)

**Corrective Action:**

1. Reduce the number of air conditioners running at the same time, and other appliances that cause low power factor. (The lower the power factor of a motor or compressor, the more current it draws per kilowatt. The genset Controller, in turn, must boost field voltage to meet the higher demand for current imposed by low power factor.)
2. Have the air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause a very low power factor.)
3. Test the generator field and stator windings and service as necessary (p. 10-1).

**GENERATOR ROTOR SHORT—CODE NO. 41**

(While flashing the field the Controller sensed that the rotor circuit was shorted to ground)

**Corrective Action:**

1. Disconnect Generator connector **J3/P3** and check for a short to ground at **P3-7** and at **P3-8** (p. 10-1). Service or replace brushes, slip rings and rotor as necessary.
2. Replace the control board (p. 11-1).

**ROM FAULT—CODE NO. 42**

(During startup the genset Controller detected a ROM memory error)

**Corrective Action:** Replace the control board (p. 11-1)

**RAM FAULT—CODE NO. 43**

(During startup the genset Controller detected a RAM memory error)

**Corrective Action:** Replace the control board (p. 11-1)

**SPEED SENSE LOST—CODE NO. 45**

(After start disconnect the Controller lost speed sense [quadrature zero crossings] for 0.25 seconds)

**Corrective Action:**

1. Disconnect Generator connector **J3/P3** and check for open and shorted field (**P3-7—P3-8**) and quadrature (**P3-3—P3-6**) windings (p. 10-1). Service or replace brush block, slip rings, rotor or stator as necessary.
2. Replace the control board (p. 11-1).

TABLE 12-1. 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.*

**LOSS OF FIELD SENSE—CODE NO. 48**

(The field sense circuit on the Controller circuit board failed during normal voltage regulation)

**Corrective Action:** Replace the control board (p. 11-1)

**OVERPRIME—CODE NO. 57**

(The local or remote control switch was held in the Prime position for more than 3 minutes)

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

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# 13. Bolt Torques

	lb-ft	N-m
Housing Panel Screws	7-9	10-12
Intake Air Hose Clamp Screws	7-9	10-12
Intake Air Resonator Mounting Screws	6-12 lb-inch	0.7-1.4
Radiator Access Plate Screws	7-9	10-12
Fuel Pump and Fuel Filter Bracket Mounting Screws	7-9	10-12
Fuel Fittings at Pump and Fuel Filter—One Flat passed finger tight.	–	–
Exhaust Assembly Flange Screws and Nuts	16-20	22-28
Battery Cable Terminal Block Terminal Nuts	6.7-8.3	9-11
Battery Cable Terminal Block Mounting Screws	7-9	10-12
Starter Solenoid Terminal Nuts	4.4-8.7	5.9-11.8
AC Output Terminal Block Terminal Screws	12-14 lb-inch	1.4-1.6
AC Output Terminal Block Mounting Screws	20-22 lb-inch	2.2-2.5
Circuit Breaker Terminal Screws	12-14 lb-inch	1.4-1.6
Circuit Breaker Mounting Screws	12-14 lb-inch	1.4-1.6
Vibration Isolator Mounting Screws	7-9	10-12
Primary Vibration Isolator Center Bolt*	43-53	58-72
Secondary Vibration Isolator Center Bolt*	27-30	37-41
Generator Drive Disc to Flywheel Bolts*	24-32	33-44
Generator Drive Disc to Rotor Bolts*	19-21	25-29
Generator Through Bolt Nuts*	20-25	28-34
Generator to Flywheel Housing Bolts*	39	52
Flywheel Housing Mounting Bolts*	30-40	41-55
Flywheel Mounting Bolts*	65-80	88-108
Starter Mounting Bolts*	18-22	24-30
Engine Mounting Bracket Bolts*	36-43	48-58
Engine Lifting Bracket Bolts*	18-22	24-30
Engine Oil Drain Plug*	32	44
Fan Spacer Bolts*	18-22	24-30
Free-Spinning Fan Coupling (Pulley)*	103-118	137-157
M6 Engine Bolts Except When Otherwise Specified*	5.8-6.9	7.9-9.3
M8 Engine Bolts Except When Otherwise Specified*	13.0-15.2	17.7-20.6
M10 Engine Bolts Except When Otherwise Specified*	28.9-33.3	39.2-45.1
M12 Engine Bolts Except When Otherwise Specified*	46.3-53.5	62.8-72.6
Oil Filter Adapter Mounting Nut	40-50	–
Remote Oil Line Fittings	24-26	–
Remote Oil Filter Elbow — One Full Turn Past Hand Tighten	–	–

\* – Use engine oil as a thread lubricant.

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# 14. Specifications

<b>MODEL:</b>	<b>HDKCA</b>	<b>HDKCB</b>
<b>GENSET CONTROL:</b> Integrated Microprocessor-Based Engine and Generator Controller		
<b>GENERATOR:</b> Single-Bearing, 4-Pole Rotating Field, 1800 RPM		
Power (@1.0 power factor)	10,000 W	12,500 W
Voltage	120 / 240	120 / 240
Frequency	60 Hz	60 Hz
Number of Phases	1	1
Current	41.7 amps per leg	52.1 amps per leg
Line Circuit Breaker	2-pole, 45 amp	2-pole, 50 amp
<b>FUEL CONSUMPTION:</b>		
No-load	0.11 gph (0.41 lph)	0.11 gph (0.41 lph)
Half-load	0.48 gph (1.82 lph)	0.48 gph (1.82 lph)
Full-load	1.01 gph (3.8 lph)	1.2 gph (4.54 lph)
<b>ENGINE:</b> 3-Cylinder In-Line, Water-Cooled, Indirect-Injection (IDI), 4-Stroke Cycle Diesel		
Bore	3.43 in (87 mm)	
Stroke	3.64 in (92.4 mm)	
Displacement	100.5 in <sup>3</sup> (1,647 cc)	
Compression Ratio	22.6 : 1	
Fuel Injection Timing (BTDC)	14.50° (Spec A-B)	14.25° (Begin Spec C)
Firing Order	1-3-2	
Fuel Nozzle Injection Pressure	1991 psi (13.731 mPa)	
Cylinder Compression Test	370 psi (2.55 mPa) minimum	
Valve Lash: Intake & Exhaust (cold)	0.0071 to 0.0087 in (0.18 to 0.22 mm)	
Oil Capacity (with filter)	5.9 quart (5.6 liter)	
Cooling System Capacity	6.6 quart (6.2 liter)	
<b>DC SYSTEM:</b>		
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)	
Battery Recharging	Installer must provide for battery charging	
<b>WEIGHT:</b>	792 lbs (359 kg)	816 lbs (370 kg)
<b>SIZE (L x W x H):</b> 41.4 x 24.5 x 27 in (105 x 62 x 68.6 cm)		
<b>SOUND LEVEL:</b> 68 dB(A) @ 10 ft (3m) & 54 dB(A) @ 50 ft (15m)—in “free field site” @ half load		

**SPECIFICATIONS**

<b>MODEL:</b>	<b>HDKCC (60Hz)</b>	<b>HDKCC (50Hz)</b>	<b>HDKCD</b>	<b>HDKCG</b>
<b>GENSET CONTROL:</b> Integrated Microprocessor-Based Engine and Generator Controller				
<b>GENERATOR:</b> Single-Bearing, 4-Pole Rotating Field, 1800 RPM				
Power (@1.0 power factor)	10,000 W	8,000 W	12,000 W	10,000 W
Voltage	120 / 240	115/230	120 / 240	120 / 240
Frequency	60 Hz	50 Hz	60 Hz	60 Hz
Number of Phases	1	1	1	1
Current	41.7 amps per leg	34.8 amps per leg	50 amps per leg	41.7 amps per leg
Line Circuit Breaker	2-pole, 45 amp	2-pole, 35 amp	2-pole, 50 amp	2-pole, 45 amp
<b>FUEL CONSUMPTION:</b>				
No-load	0.11 gph(0.41 lph )	0.11 gph(0.41 lph )	0.11 gph(0.41 lp )	0.11 gph(0.41 lph )
Half-load	0.48 gph(1.82 lph )	0.3 gph(1.25 lph )	0.48 gph(1.82 lp )	0.48 gp(1.82 lph )
Full-load	1.01 gph(3.80 lph )	0.82 gph(3.1 lph )	1.20 gph(4.54 lp )	0.82 gph(3.1 lph )
<b>ENGINE:</b> 3-Cylinder In-Line, Water-Cooled, Indirect-Injection (IDI), 4-Stroke Cycle Diesel				
Bore	3.43 in (87 mm)			
Stroke	3.64 in (92.4 mm)			
Displacement	100.5 in <sup>3</sup> (1,647 cc)			
Compression Ratio	22.6 : 1			
Fuel Injection Timing (BTDC)	14.50° (Spec A–B)		14.25° (Begin Spec C)	
Firing Order	1–3–2			
Fuel Nozzle Injection Pressure	1991 psi (13.731 mPa)			
Cylinder Compression Test	370 psi (2.55 mPa) minimum			
Valve Lash: Intake & Exhaust (cold)	0.0071 to 0.0087 in (0.18 to 0.22 mm)			
Oil Capacity (with filter)	5.9 quart (5.6 liter)			
Cooling System Capacity	6.6 quart (6.2 liter)			
<b>DC SYSTEM:</b>				
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)			
Maximum Regulated Charging Current	20 amps			
<b>WEIGHT:</b>	816 lbs (370 kg)	816 lbs (370 kg)	816 lbs (370 kg)	816 lbs (370 kg)
<b>SIZE (L x W x H):</b> 41.4 x 24.5 x 27 in (105 x 62 x 68.6 cm)				
<b>SOUND LEVEL:</b> 68 dB(A) @ 10 ft (3m) & 54 dB(A) @ 50 ft (15m)—in “free field site” @ half load				



# 15. Service Checklist

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

## Housing

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

## Mounting

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

## Lubrication

If the engine oil was drained, refill as required.

## Cooling System

If the engine coolant was drained, refill as required.

## Wiring

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

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

## Output Check

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

## Exhaust System

While the genset is running inspect the entire exhaust system. Look and listen for leaks at all con-

nections, welds, gaskets and joints. Also make sure the exhaust pipe is not overheating adjacent materials or equipment. Do not run the genset until all exhaust leaks have been repaired.

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

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

## Fuel System

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

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

## Control

Stop and start the genset several times at the control panel on the genset and at the remote control board (if provided) to verify that they work properly.

## Mechanical

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

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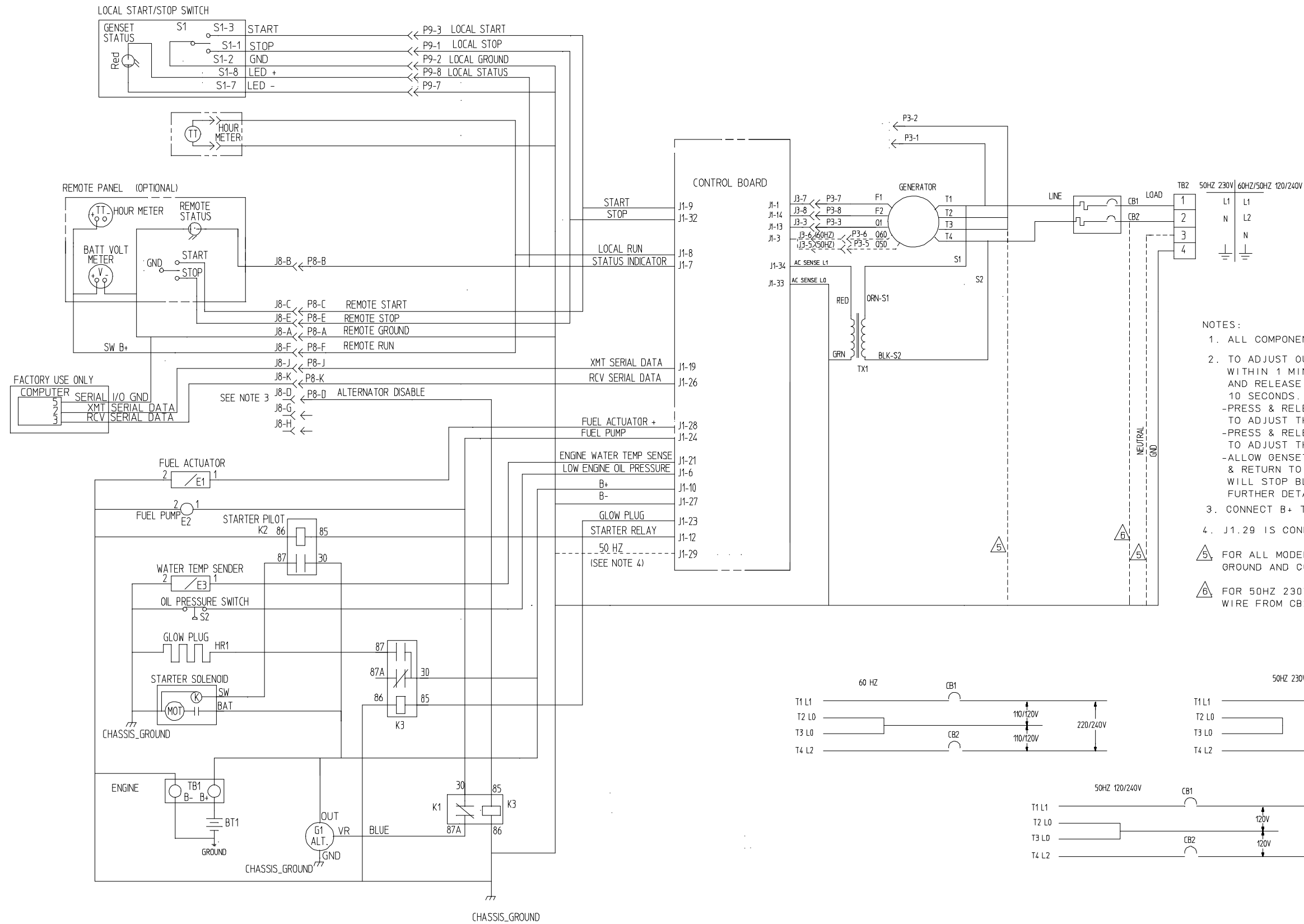
# 16. Diagrams

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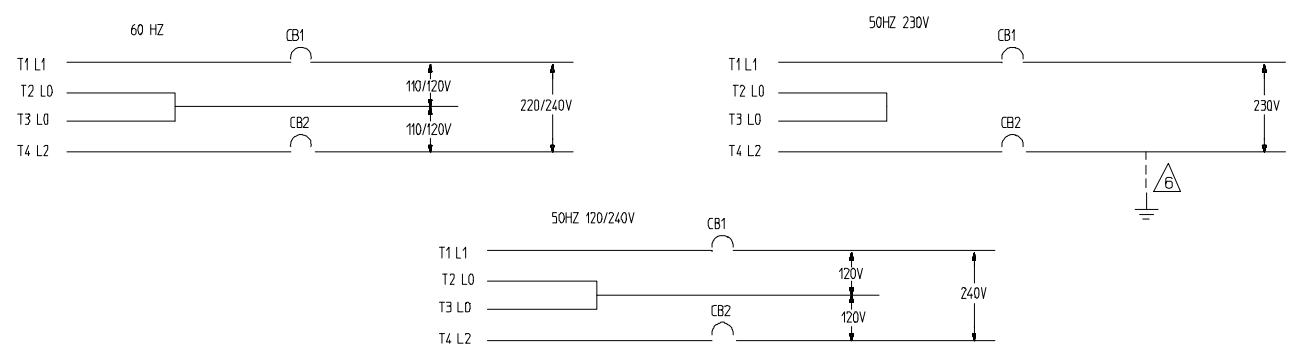
This section consists of the schematic and connection wiring diagrams referenced in the text. The following drawings are included.

- Page 16-3, CONTROL SCHEMATIC
- Page 16-4, CONTROL WIRING HARNESS
- Page 16-5, AC WIRING HARNESS

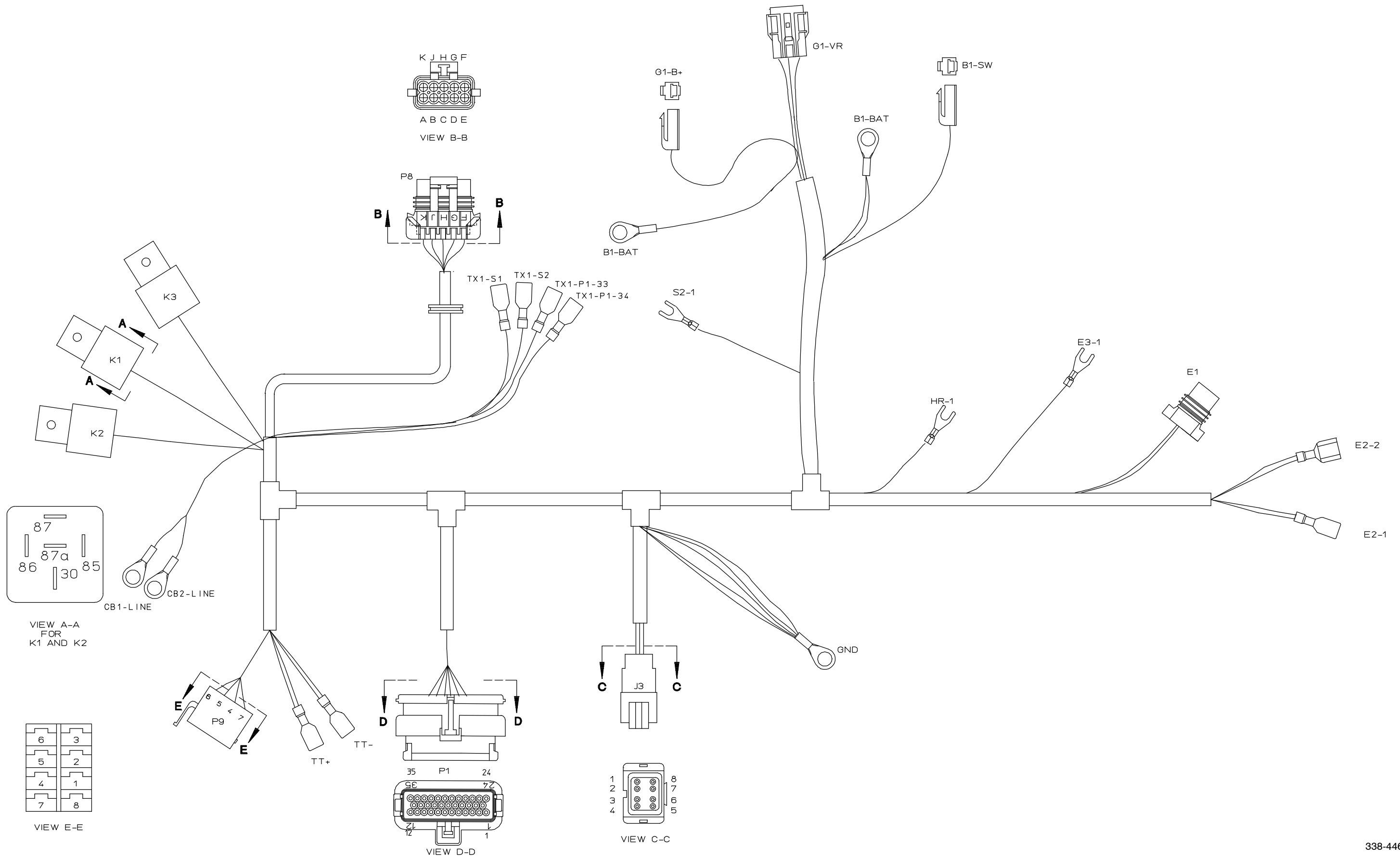
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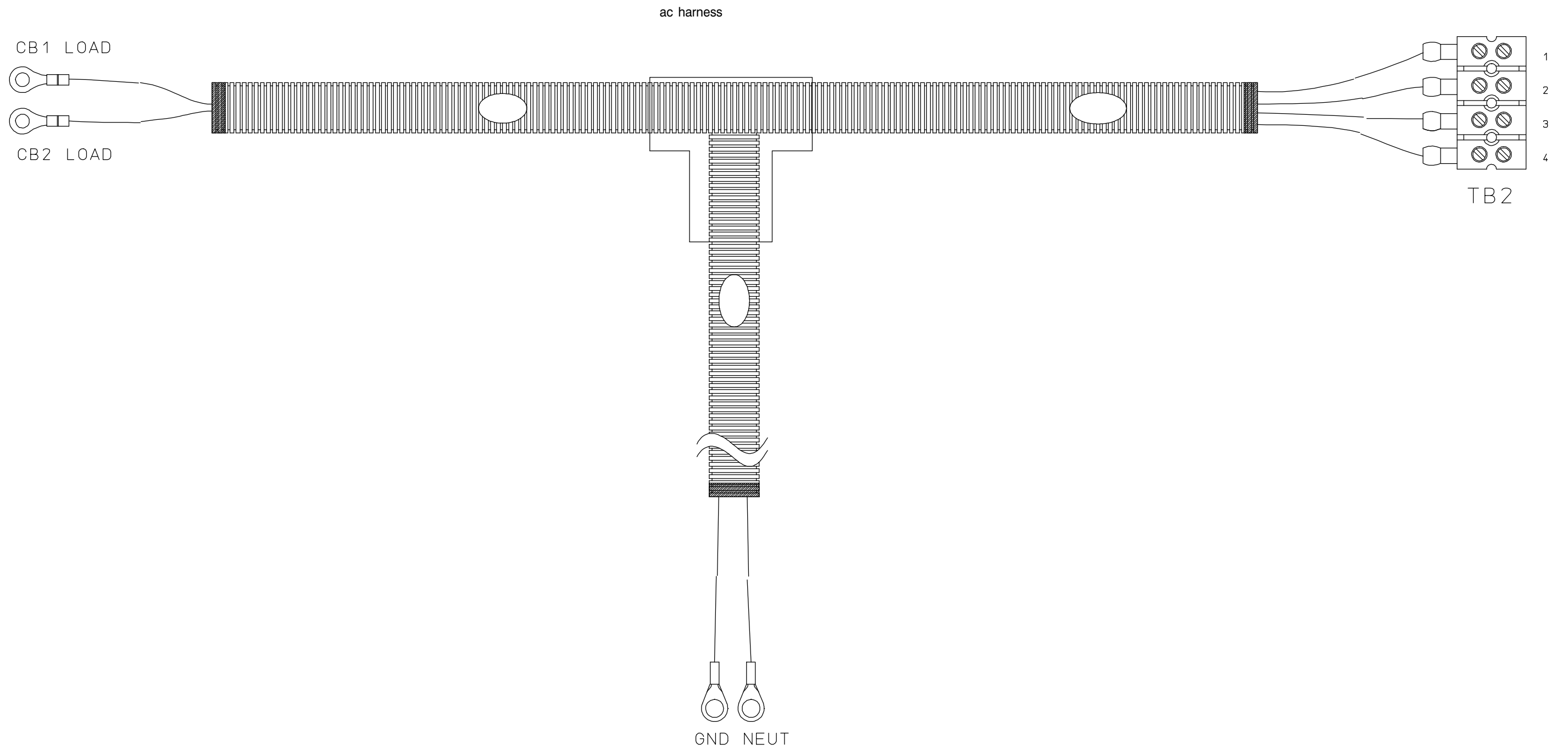
- NOTES:
- ALL COMPONENTS SHOWN IN DE-ENERGIZED STATE.
  - TO ADJUST OUTPUT VOLTAGE: WITHIN 1 MINUTE OF START DISCONNECT. PRESS AND RELEASE THE START SWITCH 6 TIMES WITHIN 10 SECONDS. THE STATUS LIGHT WILL BEGIN BLINKING -PRESS & RELEASE THE START BUTTON QUICKLY (<0.5 SEC) TO ADJUST THE VOLTAGE UP 0.5V. -PRESS & RELEASE THE START BUTTON LONGER (>1 SEC) TO ADJUST THE VOLTAGE DOWN 0.5V. -ALLOW GENSET TO RUN FOR 20 SEC TO SAVE SETTINGS & RETURN TO NORMAL OPERATION. THE STATUS LIGHT WILL STOP BLINKING. SEE THE SERVICE MANUAL FOR FURTHER DETAILS.
  - CONNECT B+ TO J8-D TO DISABLE ALTERNATOR
  - J1.29 IS CONNECTED TO GROUND ON 50 HZ UNITS ONLY.
- ⚠️ FOR ALL MODELS EXCEPT 50HZ230V, CONNECT NEUTRAL TO GROUND AND CONNECT T3 AND T2 TO GROUND.
- ⚠️ FOR 50HZ 230V MODEL, CONNECT RING TERMINAL LEAD WIRE FROM CB2 LOAD SIDE TO GROUND.



**CONTROL SCHEMATIC**



**CONTROL WIRING HARNESS**



**AC WIRING HARNESS**

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