Cummins Onan

Service Manual

Generator Set

HDKAW (Spec A–B)

English
Original Instructions

3-2013

A028W414 (Issue 8)

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.

Table of Contents

SECTION **PAGE**

SECTION **PAGE**

SAFETY PRECAUTIONS

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

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

⚠ DANGER ***alerts you to an immediate hazard that will result in severe personal injury or death.***

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

⚠ CAUTION ***alerts you to a hazard or unsafe practice that can result in personal injury or equipment damage.***

When equipped with an integral or add–on Automatic Generator Starting System (AGS) control, exhaust carbon monoxide (CO), electric shock, and moving parts hazards are possible due to unexpected starting. Turn off AGS whenever performing maintenance or service, when the vehicle is stored between uses, is awaiting service, or is parked in a garage or other confined area.

ENGINE EXHAUST IS DEADLY

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

GENERATOR VOLTAGE IS DEADLY

- Disable the automatic genset starting feature (AGS) of an inverter-charger or other automatic starting device before servicing the genset to avoid electric shock from an unexpected start.
- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to shore power (utility). Back-feed to shore power can cause electrocution and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

DIESEL FUEL IS COMBUSTIBLE

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Disable the automatic genset starting feature (AGS) of an inverter-charger or other automatic starting device before servicing the genset to avoid unexpected starting.
- 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.

BATTERY GAS IS EXPLOSIVE

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

FLAMMABLE 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.

GENERAL PRECAUTIONS

- Keep children away from the genset.
- Do not use evaporative starting fluids. They are highly explosive.
- To prevent accidental or remote starting while working on the genset, disconnect the negative (–) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray out and cause severe burns.
- Keep the genset and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Make sure all fasteners are secure and torqued properly.
- Do not work on the genset when mentally or physically fatigued or after consuming alcohol or drugs.
- You must be trained and experienced to make adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi-class ABC fire extinguishers readily at hand. Class A fires involve ordinary combustible materials such as wood and cloth. Class B fires involve combustible and flammable liquids and gaseous fuels. Class C fires involve live electrical equipment. See NFPA No. 10 (Portable Fire Extinguishers) or equivalent—BS EN 3-7:2004.
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.

THIS PAGE IS INTENDED TO BE BLANK

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 Cummins Onan for parts, service or information. Figure 1-1 illustrates the nameplate and its location. The gray boxes illustrate where to look for the model and serial numbers.

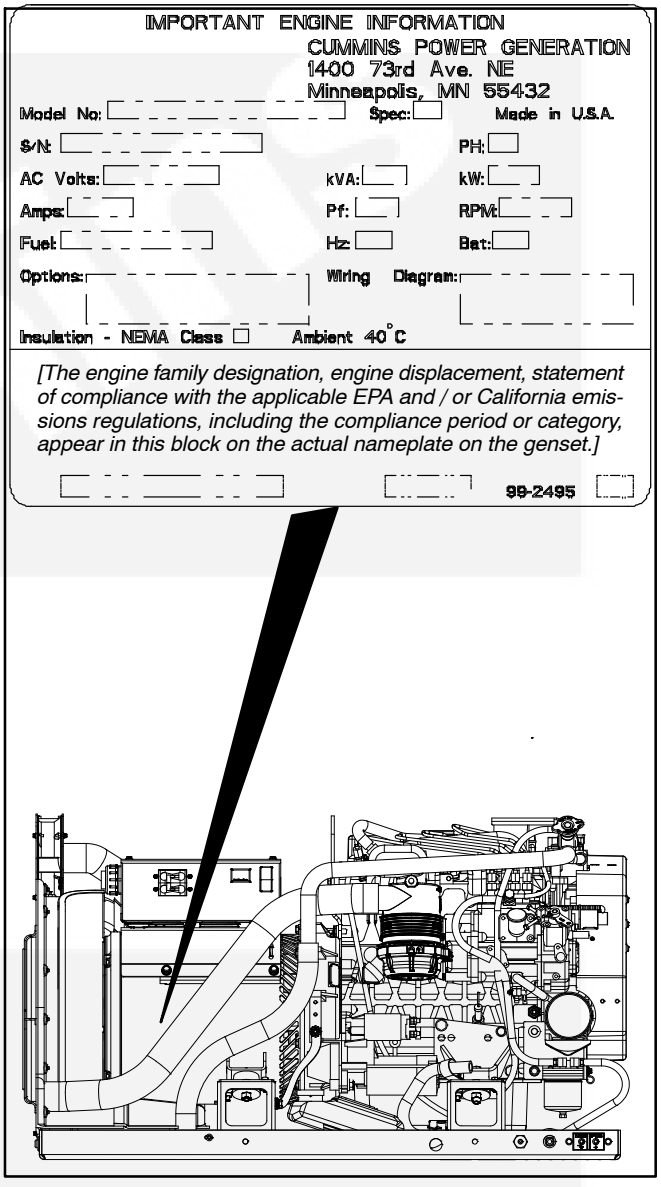


FIGURE 1-1. TYPICAL NAMEPLATE

ENGINE EMISSIONS COMPLIANCE

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

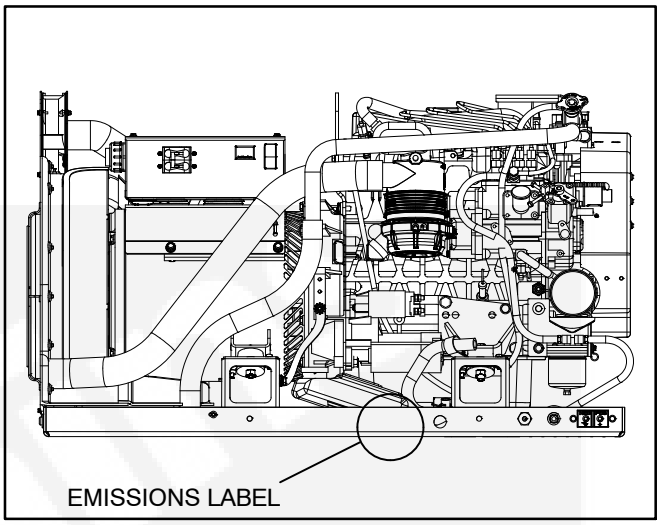


FIGURE 1-2. EMISSIONS LABEL LOCATION

TYPICAL GENSET

Figures 1-3 and 1-4 illustrate the location of key operating features such as the fuel and battery connection points, control panel switches, hour meter, the coolant and oil fill locations, and other operating component locations.

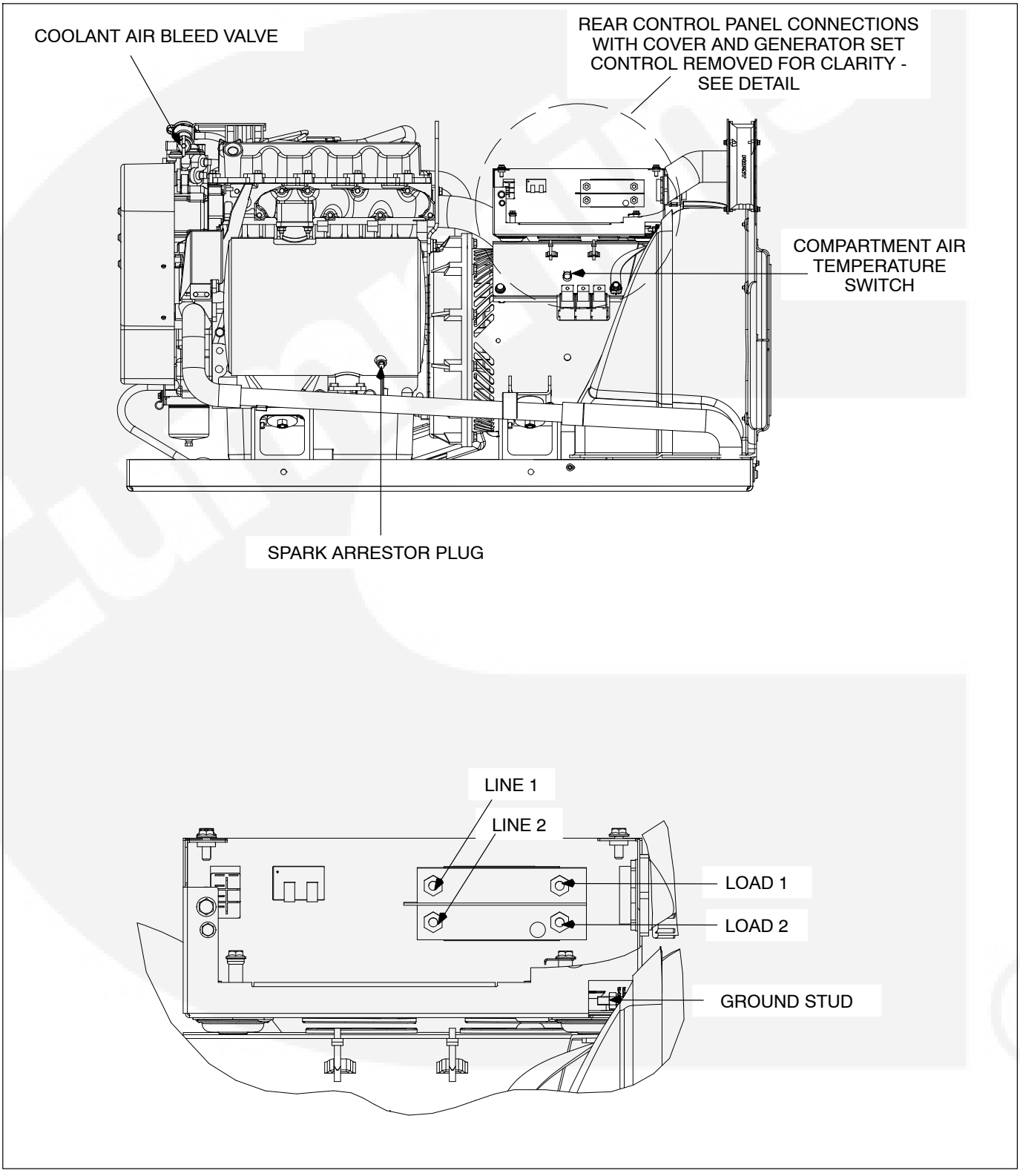


FIGURE 1-3. GENSET COMPONENT LOCATIONS

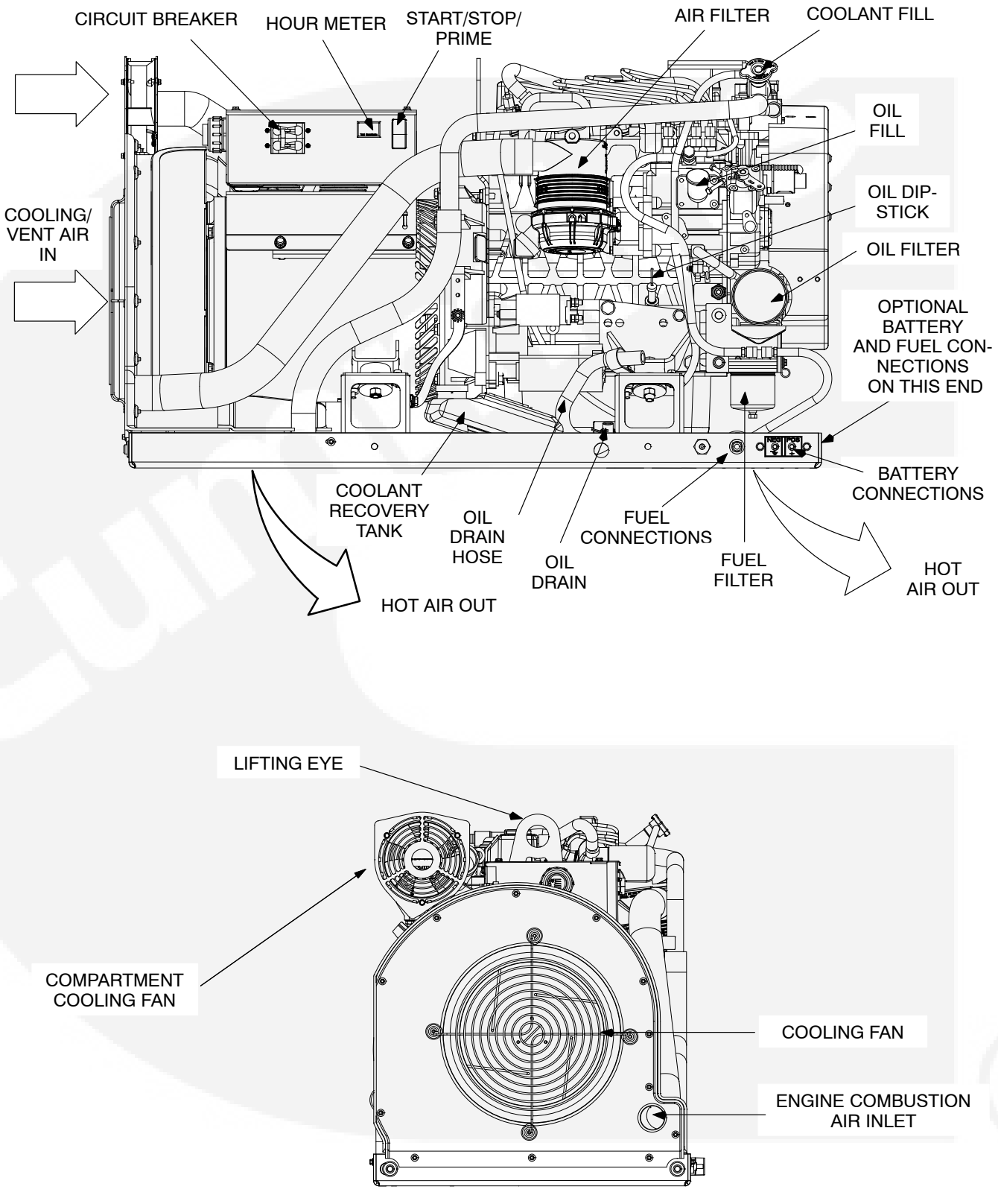


FIGURE 1-4. GENSET COMPONENT LOCATIONS

2. Operation

FUEL RECOMMENDATIONS

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

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

- The specifications for the type and sulfur content (ppm, % weight) of the diesel fuel used must comply with all emissions regulations applicable in the areas where the genset is to be operated.
- Diesel fuels meeting ASTM D975 or EN 590 specifications are recommended. Use Grade 1-D diesel fuel where ambient temperatures are below 14° F (–10° C). A minimum Fuel Cetane Rating of 45 is recommended. Where ambient temperatures are below –4° F (–20° C), or the elevation is above 5000 ft (1500 m), a minimum Cetane Rating of 50 is recommended.
- Current US EPA regulations for Non-Road engines limit diesel fuel sulfur content to a maximum of 500 ppm (0.05% weight). Therefore, use Grade 2-D S500 or 2-D S15 diesel fuel. Where ambient temperatures are below 14° F (–10° C), use Grade 1-D S500 or 1-D S15 diesel fuel. Note that beginning in year 2010, US EPA regulations for Non-Road engines will limit diesel fuel sulfur content to a maximum of 15 ppm (0.0015% weight).
- Do not use diesel fuel having a sulfur content greater than 10,000 ppm (1.0% weight).
- Diesel fuel must meet the ASTM D975 standard for lubricity and pass a minimum load level of 3100 grams as measured by ASTM D6078, or maximum scar diameter of 0.45 mm as measured by ASTM D6079 or ISO 12156–1.

BIO–DIESEL FUELS B5 – B20

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

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

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

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

Approved Bio–Diesel Fuel:

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

Bio–Diesel Properties:

- Bio–diesel has poor oxidation stability which can accelerate fuel oxidation. Fuel oxidation will reduce generator performance. This effect is accelerated at increased ambient temperatures.
- Bio–diesel properties change at low ambient temperatures (below 23°F/–5°C). Necessary precautions must be taken when operating the generator with bio–diesel blends in low ambient temperatures, such as a fuel heater, hose insulation, or additional anti–gel fuel additives.
- Bio–diesel fuel blends are an excellent medium for microbial growth. Microbes cause fuel system corrosion and premature filter plugging. The effectiveness of all commercially available conventional anti–microbial additives, when

used in bio−diesel, is not known. Consult your fuel and additive supplier for assistance.

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

Storage Requirements:

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

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

- **Emissions-Regulated Areas:** It is mandatory to use CF, CF−4, CG−4, CH−4 or CI−4 class oil with low sulfur fuel (sulfur content less than 500 ppm, 0.05% weight) or ultra low sulfur fuel (sulfur content less than 15 ppm, 0.0015% weight).
- **Non-Regulated Areas:** CF class oil is recommended when using high sulfur fuel—sulfur content between 500 ppm (0.05% weight) and 5000 ppm (0.5%weight). If CF−4, CG−4, CH−4 or CI−4 class oil is used, the oil and oil filter must be changed twice as often as specified in the PERIODIC MAINTENANCE SCHEDULE (page 3-1).
- **Non-Regulated Areas:** Use CF, CF−4, CG−4, CH−4 or CI−4 class oil when using high sulfur fuel—sulfur content between 5000 ppm (0.5% weight) and 10,000 ppm (1.0% weight). The oil and oil filter must be changed twice as often as specified in the PERIODIC MAINTENANCE SCHEDULE (page 3-1).

Oil Viscosity

Look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 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.

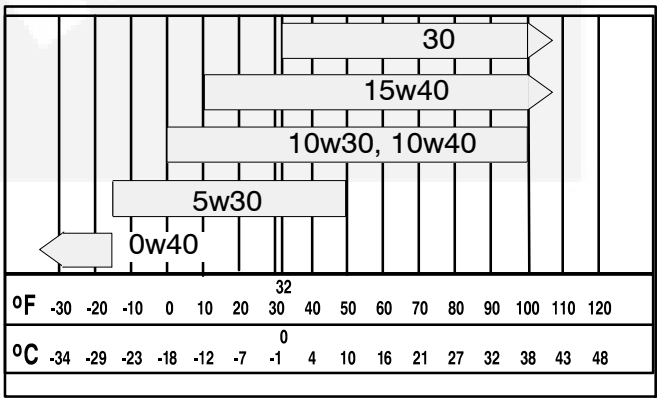


FIGURE 2-1. OIL VISCOSITY VS. TEMPERATURE

COOLANT RECOMMENDATIONS

Use the best quality ethylene glycol antifreeze solution available. It should be fully formulated with rust inhibitors and coolant stabilizers and mixed with fresh (distilled) water that is low in minerals and corrosive chemicals. A 50/50 mixture is recommended for all climates and is suitable for temperatures down to −34° F (−37° C).

⚠CAUTION ***Do not use any other type of coolant in the generator set, or the generator set may be damaged. Use only ethylene glycol.***

See *Section 10. Specifications* for coolant capacity.

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

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 3-4) and *Section 10. Specifications* for minimum required battery ratings.

CONTROL OPERATION

In order to perform software updates to the control board, you will need InPower Onan installed on your computer and a service tool harness (338−4840). To perform updates.

1. Disconnect the P8 plug to disconnect the operator panel while performing software updates.
2. Connect the service tool harness to the computer and the P8 connector.
3. Open InPower Onan and connect to the control. Perform necessary updates.
4. Disconnect the service tool harness and reconnect the operator panel harnessP8 connector .

STOP / START OPERATION

Start Control

The starter should only **engage** when the following conditions have been met:

- The stop input to the control is not active. Stop overrides start.
- The alternator frequency is less than 1 Hz. There is also a lock−out timer which prevents start attempts within 3 seconds after the end of the previous attempt.

The starter should only **disengage** when:

- The start button is released, or
- Generator speed is greater than the start disconnect speed (1100 RPM), or
- The stop button is pressed.

Start Sequence

The control software performs, in order, the following as part of the **start** sequence:

- Control performs a system's check by looking at the following:

  -Control configuration − Identify genset (50 / 60 Hz)

  -Battery voltage

  -Engine coolant temperature used to deter mine glow plug glow times

  -Actuator circuit open / shorted
- Glow plug preheat is activated as needed, depending upon temperature
- Status light flashes during preheat
- Left pump energized
- Governor actuator to full duty cycle
- Starter is engaged
- Flash status light to signal engine is cranking
- Enable field flash
- Look for frequency pulses. Command starter to disengage and turn the starter off at start disconnect speed (1100 RPM)

Run Sequence

During a **Run** sequnce:

- The load post load time (automatically shuts the plugs off when time expires)
- The governor actuator regulates engine speed
- The control begins automatic voltage regulation
- The status indicator remains on steady

Stop Sequence

The control software performs the following as part of the **Stop** sequence:

- Disables the voltage regulator
- Disables the fuel solenoid and the electronic governor (0% duty cycle)
- Turns off the Run output
- Stores usage data

Switch Handling

There is a three−position momentary switch that is hard wired to the generator. It configures the state of the generator to Start, Stop / Prime, and Off. The switch is tied to a momentary power latch that allows for the control to enter sleep mode.

The control enters sleep mode if there is inactivity for 5 minutes. It draws less then 3mA from the battery. This limit allows the control to remain connected to the battery for a long period of time without drawing down the battery.

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 8. 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.

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

REMOTE CONTROL PANEL

A remote genset control panel can be installed inside the vehicle. Three control panel kits are available:

- Remote switch / status lamp
- Remote switch / status lamp and hour meter
- Remote switch / status lamp and DC voltmeter

The DC voltmeter indicates whether voltage across the 12 VDC control system and battery is normal. If the indicator consistently stays above or below the normal zone, see MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (page 3-4).

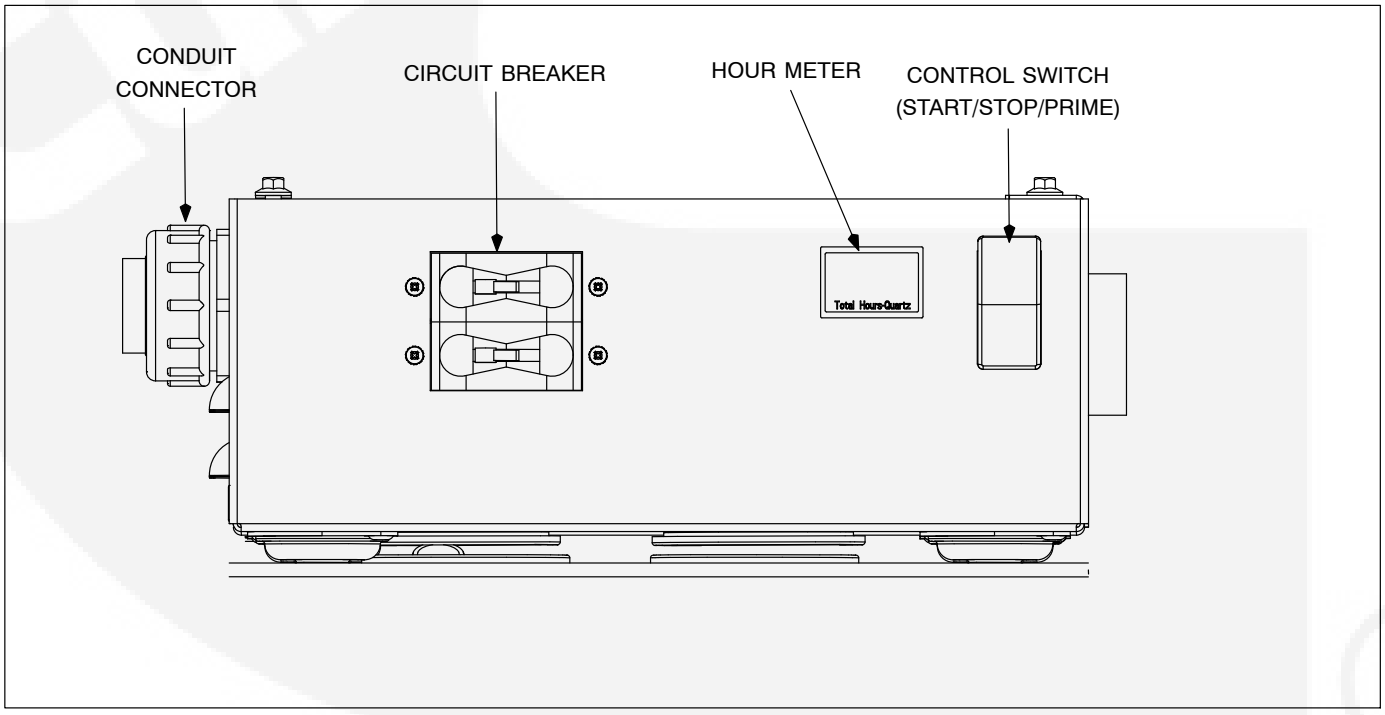


FIGURE 2-2. CONTROL PANEL

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

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

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

Never 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 (page 3-2). Keep a log of maintenance and the hours run and perform any maintenance that may be due. See Returning the Genset to Service (page 2-8) if the vehicle has been in storage.

Before each start:

1. Make sure all vehicle carbon monoxide (CO) detectors are working.
2. Check for fuel, oil and coolant 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 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.
5. Make sure that nothing is stored in the area around the generator set, and make sure that nothing is interfering with generator set operation.

PRIMING THE FUEL SYSTEM

The fuel system should be primed after replacing the fuel filter or running the genset out of fuel. To prime the fuel system, hold the control switch down in its **Stop** position for at least half a minute. (Shutdown Code No. 57, Overprime, occurs after 3 minutes of holding the switch down. See *Section 8. Troubleshooting.*)

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. 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.***
3. See *Section 8. Troubleshooting* if the genset does not start after several tries.
4. Let the genset warm up for a few minutes until it is running smoothly before connecting the vehicle electrical loads (appliances).
5. Check for fuel, oil, coolant and exhaust leaks. Stop the genset immediately if there is a leak and have it repaired.

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 (AGS). 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 the rated genset power. See *Section 8. Troubleshooting*.

To avoid overloading the genset and causing shutdowns, compare the sum of the loads of the appliances that are likely to be used at the same time to the power rating of the genset. Use Table 2-1 or the ratings on the appliances themselves (if so marked) to obtain the individual appliance loads. ***It may be necessary to run fewer appliances at the same time—the sum of the loads must not be greater than genset power 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 the 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. Maximum power also decreases as ambient temperature increases. For every 1000-foot (305 m) increase in elevation, expect the power to decrease approximately 3.5 percent. For every 10°F (5.5° C) increase in ambient temperature above 85° F (29.4° C), expect the power to decrease approximately 1 percent. See Table 2-2. ***It may be necessary to run fewer appliances at higher altitudes.***

TABLE 2-1. TYPICAL APPLIANCE LOADS

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

TABLE 2-2. POWER VS. ALTITUDE

Altitude (Elevation above Sea Level)	Maximum Power (60 Hz)
at/below 500 ft (152 m)	20,000 W (genset rating)
at 2500 ft (762 m)	18,600 W
at 5500 ft (1676 m)	16,500 W
above 5500 ft (1676 m)	16,500 W minus 700 W every 1000 ft (305 m)

TABLE 2-3. POWER VS. TEMPERATURE

Temperature	Maximum Power (60 Hz)
85° F (29.4° C)	20,000 W (genset rating)
95° F (35° C)	19,800 W
105° F (40.6° C)	19,600 W
122° F (50° C) or greater	19,260 W minus 200 W every 10° F (5.5° C)

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

TABLE 2-4. POWER VS TEMPERATURE AND ALTITUDE

Temperature and Altitude	Maximum Power (60 Hz)
85° F at/below 500 ft	20,000 W (genset rating)
95° F at 2500 ft	18,400 W
105° F at 2500 ft	18,200 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 to 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 3-1).

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 3-1).
3. Change engine oil more often. See PERIODIC MAINTENANCE SCHEDULE (page 3-1).
4. Keep containers of engine oil that have been opened tightly closed to keep out dust.

BREAKING IN A NEW ENGINE

Proper engine break-in on a new 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 to OFF (page 2-7).
3. 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 3-4).
4. Change the engine oil and attach a tag indicating oil viscosity. See ENGINE OIL RECOMMENDATIONS (page 2-2).
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 3-4).
3. Remove the plug from the exhaust tailpipe.
4. Replace the air filter element if it is dirty (page 3-4).
5. Open the fuel supply valve (if so equipped).
6. Inspect the genset. See GENERAL INSPECTION (page 3-2).
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

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. However, warranty work must be completed by an authorized Cummins 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.***

TABLE 3-1. PERIODIC MAINTENANCE SCHEDULE

MAINTENANCE TASK	FREQUENCY								
	After First 50 Hrs	Every Day	Every Month	Every 250 Hrs	Every 500 Hrs	Every 800 Hrs	Every 1500 Hrs	Every 3000 Hrs	Page
General Inspection		•							3-2
Check Engine Oil Level		•							3-2
Check Engine Coolant Level		•							3-7
Check Battery & Battery Connections[1]			•						3-4
Change Engine Oil & Oil Filter[1, 2, 3, 8]	•				•				3-3
Clean Spark Arrestor[3]				•					3-5
Replace Engine Air Filter[2, 3]				•					3-4
Replace Fuel Filter[3, 9]				•	•				3-6
Adjust Engine Valve Lash[6]						•			–
Flush Coolant System[4]							•		3-7
Replace Coolant Pressure Cap[4]							•		3-7
Check V-Belt & Coolant Hoses[5, 6] Replace as necessary				•					3-9
Check Fuel Injector Pressure[6, 7]							•		–
Replace Generator Bearing[6]								•	–

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. Perform at least once every two years.
5. Perform at least once every five years.
6. Must be performed by trained and experienced personnel (authorized Cummins Onan service representatives).
7. EPA requirement.
8. Perform every 75 hours when using high sulfur fuel. See ENGINE OIL RECOMMENDATIONS (page 2-2).
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 runs out of fuel.

Battery Connections

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting more difficult. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (page 3-4).

Mechanical

Look for mechanical damage and listen for unusual noises. Check the genset mounting bolts for any signs of wear.

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.***

1. Park the vehicle on level ground, and shut down the genset.
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.

CHANGING ENGINE OIL AND OIL FILTER

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

1. Run the genset until warm and shut it off.
2. Remove the oil fill cap, and disconnect the oil drain hose. Then, open the oil drain valve, or remove the plug from the oil pan (according to your generator set). Finally, drain all the oil from the engine into a suitable container. ***Reinstall the oil drain hose securely, and close the oil drain valve or reinsert the oil drain plug*** (Figure 3-1).
3. Spin off the oil filter canister and clean the filter mounting surface on the engine block. Remove the old gasket if it remains.
4. Make sure the gasket is in place on the new filter and apply a thin film of clean oil to the gasket. Spin the new filter on until the gasket just touches the block. Turn it an additional 1/2 to 3/4 turn. Do not overtighten.
5. Refill with 10 quarts (9.5 liters) of oil, check oil level (Figure 3-1).
6. Dispose of the used oil and oil filter according to local environmental regulations.

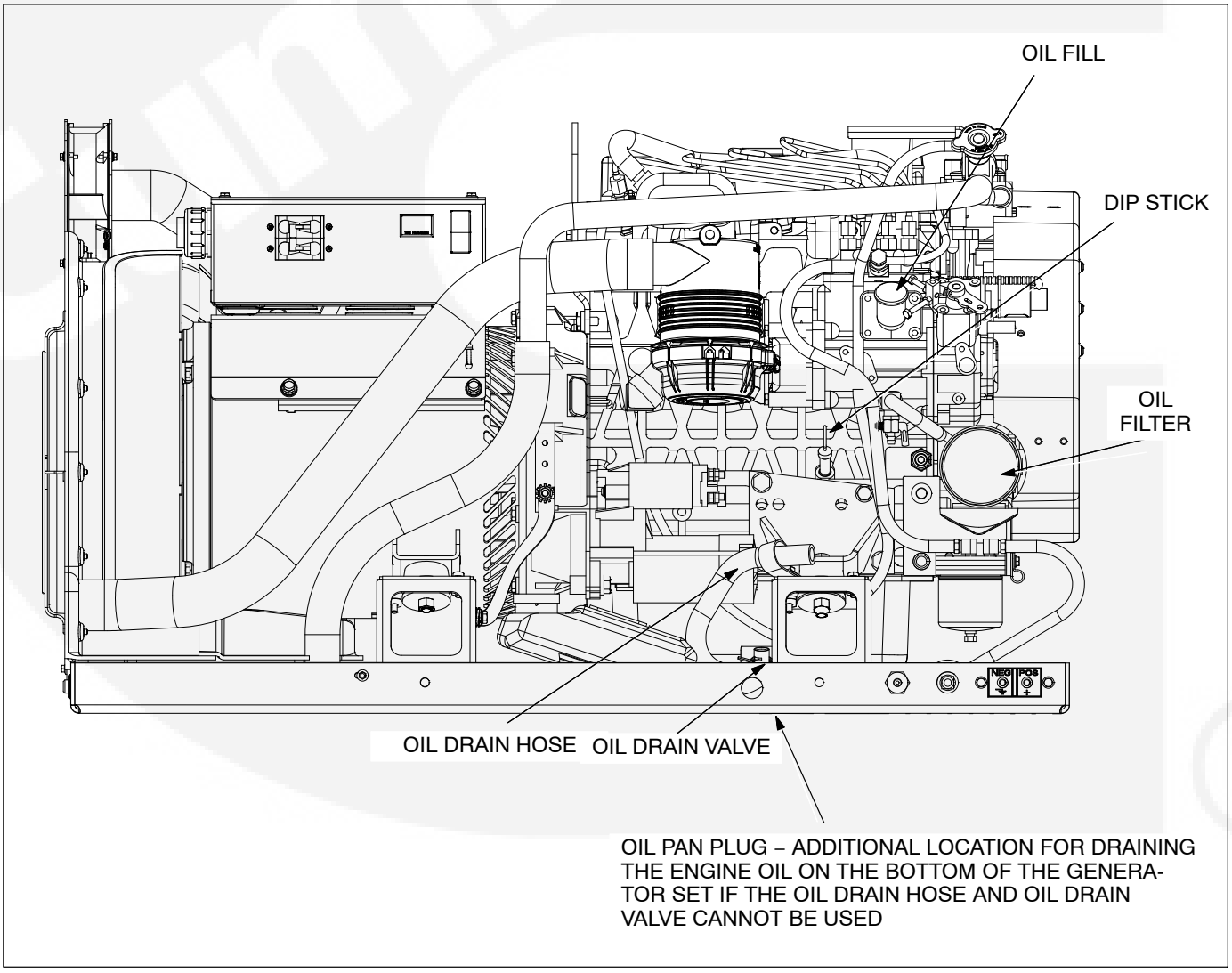


FIGURE 3-1. ENGINE OIL MAINTENANCE

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

Refer to Table 3-1 for scheduled air filter replacement. Replace it more often in dusty environments. The air filter is located on the side of the engine as shown in Figure 3-2.

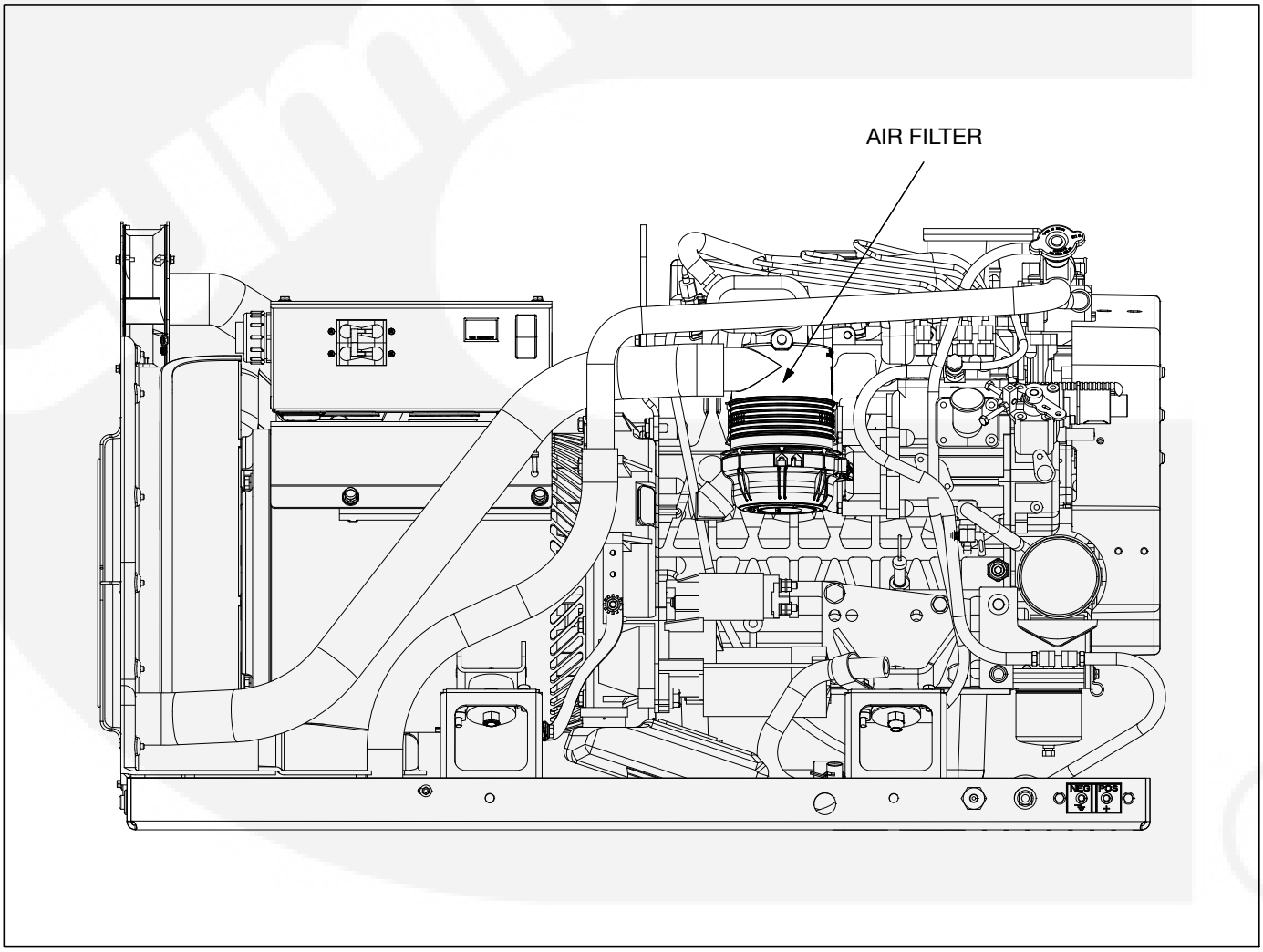


FIGURE 3-2. REPLACING THE AIR FILTER ELEMENT

CLEANING THE SPARK ARRESTOR

Refer to Table 3-1 for scheduled cleaning of the spark arrestor (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 spark arrestor cleanout plug is located on the side of the muffler (Figure 3-3). Clean out the spark arrestor as follows:

1. Remove the 1/4" NPT cleanout plug from the muffler.
2. Start the genset and load it nearly to full power. Let the genset run for about five minutes to expel the soot.
3. Stop the genset, allow the muffler to cool down, reinstall the cleanout plug.

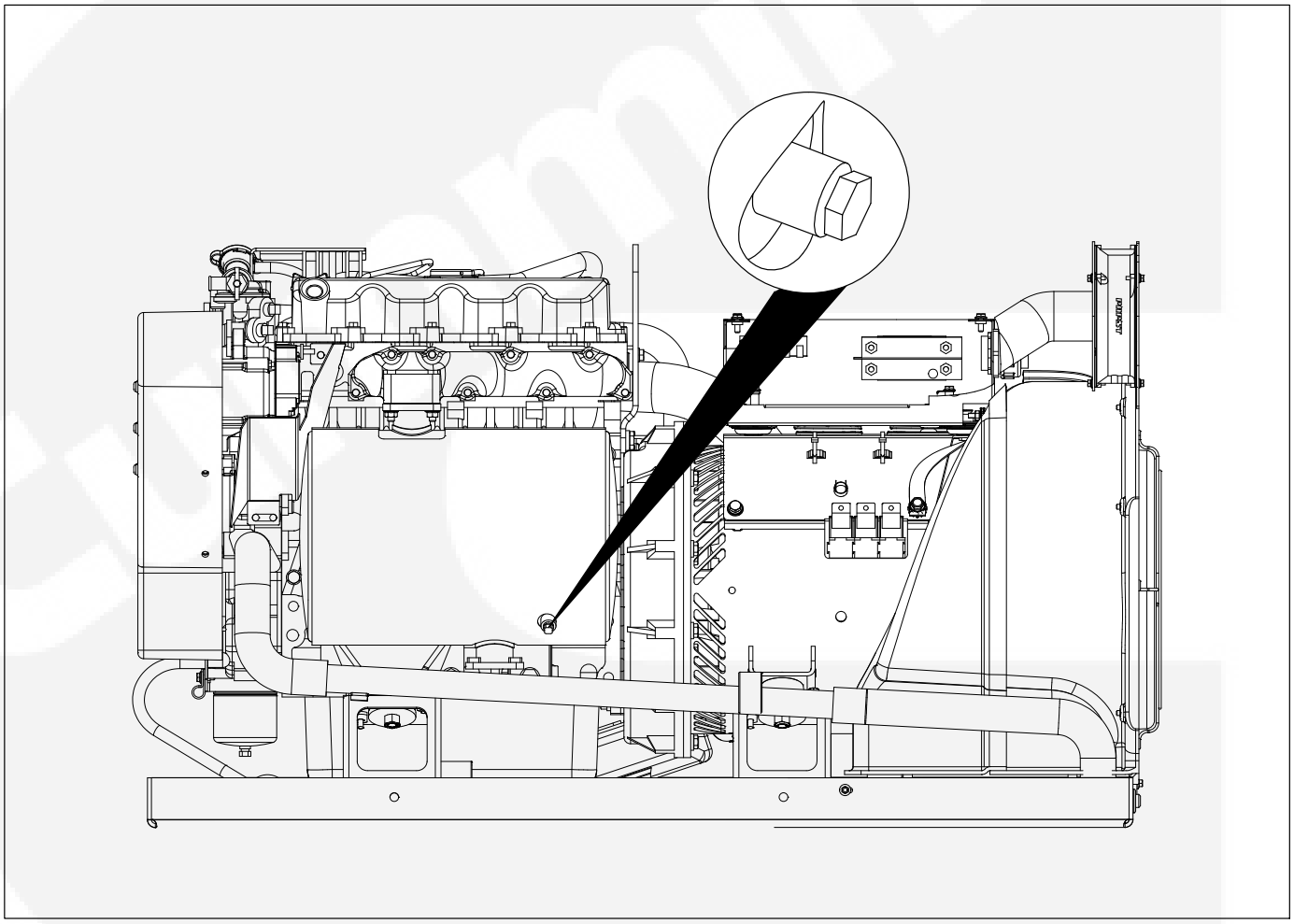


FIGURE 3-3. SPARK ARRESTOR CLEANOUT PLUG

DRAINING/REPLACING THE FUEL FILTER

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

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

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.

Keep dirt, water and other contaminants from entering the fuel system and corroding or clogging fuel injection components.

Replacing the Fuel Filter

See Table 3-1 for scheduled fuel filter replacement. Replace the fuel filter if the engine lacks power.

1. Disconnect the negative (–) cable at the battery to prevent the engine from starting, and close any fuel supply and return valves.

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (–) cable at the battery to prevent the engine from starting.***

2. Spin off the old filter with a filter wrench, and dispose of it in accordance with local environmental regulations.
3. Clean the contact surface on the filter base, lubricate the new filter gasket, and spin the new filter on hand tight.
4. Prime the engine for at least 30 seconds to fill the new filter (page 2-5). Run the generator set and check for leaks. Tighten the filter by hand, if necessary.

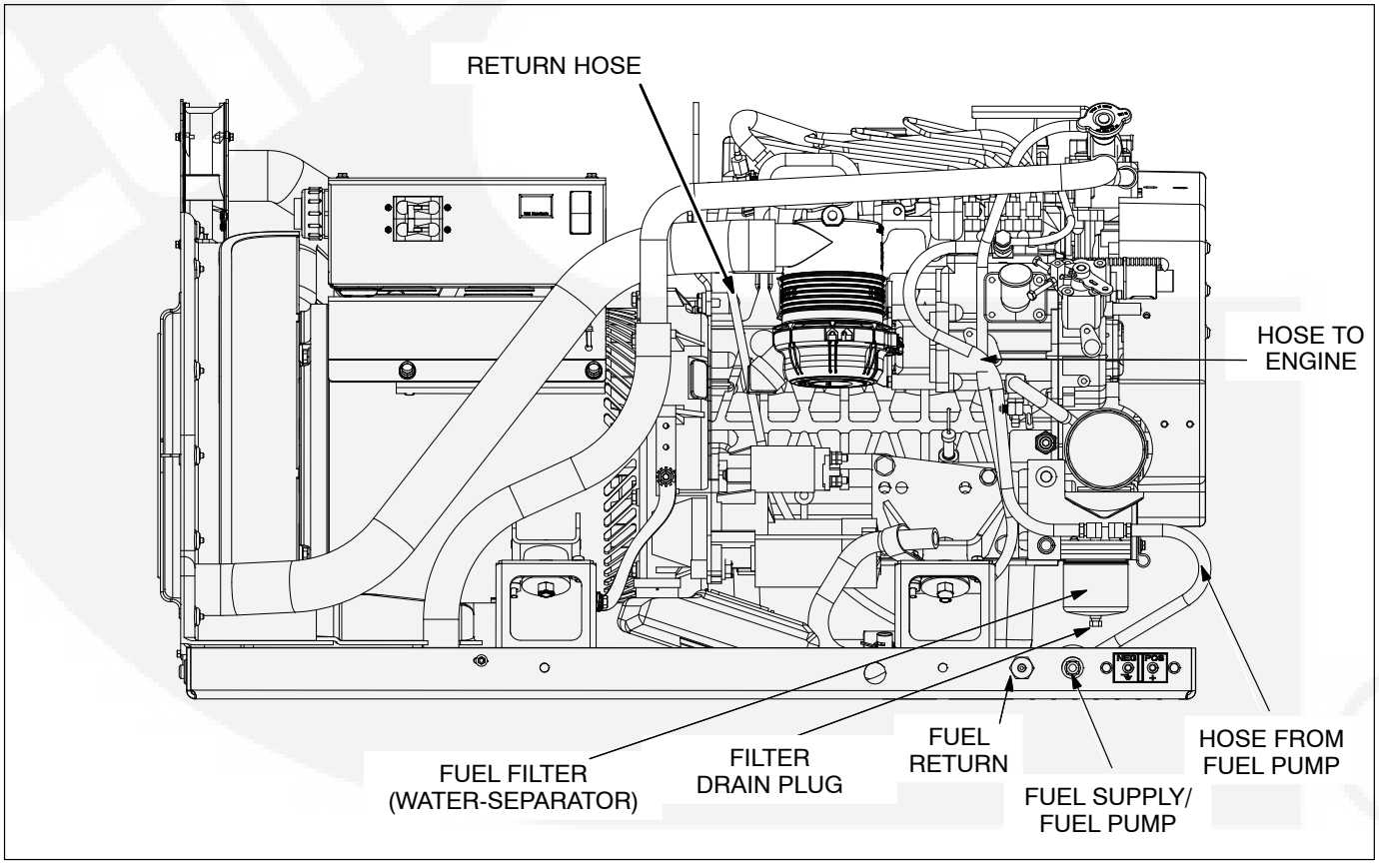


FIGURE 3-4. FUEL FILTER

MAINTAINING THE ENGINE COOLING SYSTEM

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

Recommended Coolant

See COOLANT RECOMMENDATIONS (page 2-2).

Pressure Cap

Replace the pressure cap (Figure 3-5) every two years (seals deteriorate and leak). Proper cooling system pressure (13 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 plug.***

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 in the radiator *using pipe thread sealant*. Tighten it just enough so that it does not leak when the genset is running and has warmed up.

Open the air bleed valve located in the engine thermostat housing. Fill the system using a funnel to prevent coolant from entering the overflow bottle hose. Once coolant begins to bleed out of the air bleed valve, close the air bleed valve and add coolant until it reaches the fill opening. Also, fill the recovery tank to the COLD mark, then install the pressure cap. Add more coolant if necessary after the generator set has run for a few minutes.

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 with Recommended Coolant.

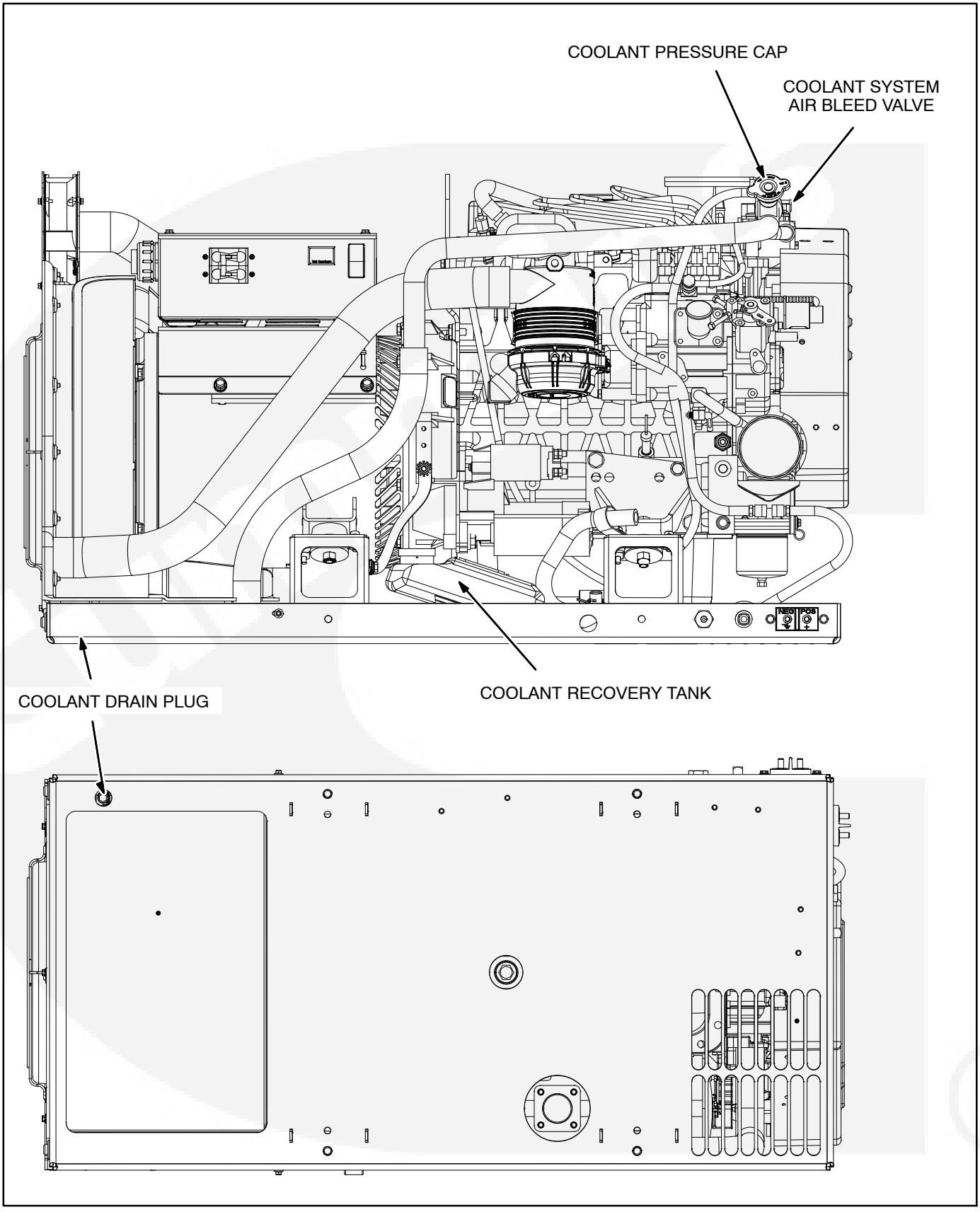


FIGURE 3-5. ENGINE COOLING SYSTEM

ADJUSTING V-BELT TENSION

The V-belt drives the battery charging alternator and coolant pump (Figure 3-6). See Table 3-1 for scheduled inspection or replacement. Adjust belt tension as follows:

1. Disconnect the negative (–) cable at the battery to prevent the engine from starting.

   ⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (–) cable at the battery to prevent the engine from starting.***

2. Remove the belt guard.
3. Loosen the alternator pivot bolt first and then the adjusting bracket bolt on top.
4. Pivot the alternator out to tighten belt tension. Hold tension by tightening the tension adjusting bolt and then check tension by applying 20 pounds (10 kg) to the middle of the pulley span. Belt tension is correct when deflection is 3/8 inch (10 mm). Tighten the alternator bolts when tension is correct.
5. Tighten the bolts, secure the belt guard or enclosure and reconnect the battery cables, negative (–) last.

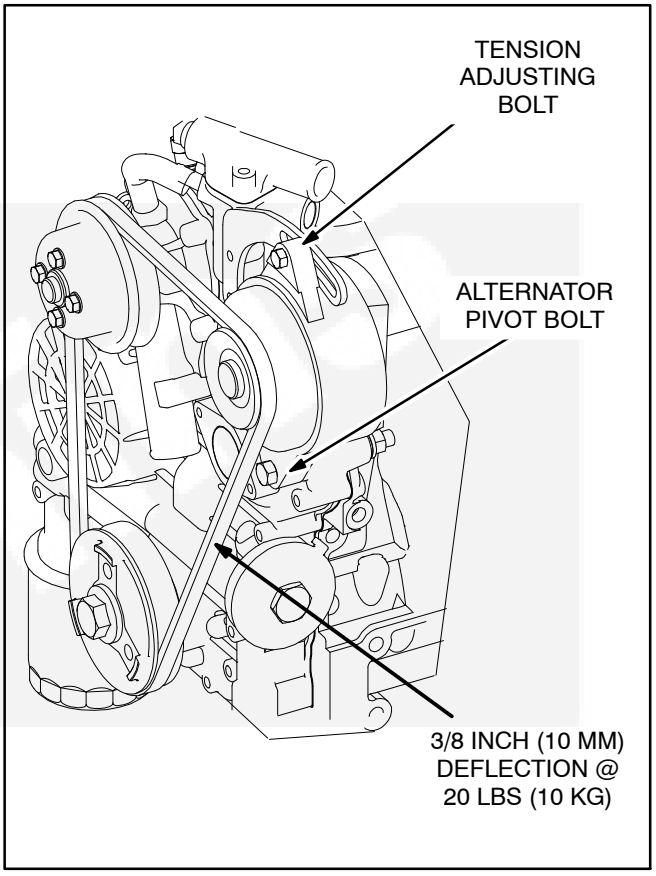


FIGURE 3-6. ADJUSTING V-BELT TENSION

REPLACING THE THERMOSTAT

See Table 3-1 for scheduled replacement. Referring to Figure 3-7, replace the thermostat as follows:

1. Disconnect the negative (–) cable at the battery to prevent the engine from starting, let the engine cool and remove the front and back access doors if the generator set has an enclosure.

   ⚠WARNING ***ACCIDENTAL OR REMOTE STARTING can cause severe personal injury or death. Disconnect the negative (–) cable from the battery to prevent the engine from starting.***

   HOT COOLANT is under pressure and can cause severe burns when loosening the pressure cap. Let the engine cool before loosening the pressure cap.

2. Remove the coolant pressure cap.
3. Remove the two thermostat housing bolts and pull off the housing, thermostat and gasket. The hose does not need to come off.
4. Clean off the gasket area and install the new thermostat and gasket. Apply Three Bond 1215 liquid sealant or equivalent to the top side of the gasket.
5. Replenish any lost coolant, secure the pressure cap, and reconnect the battery cables, negative (–) last.

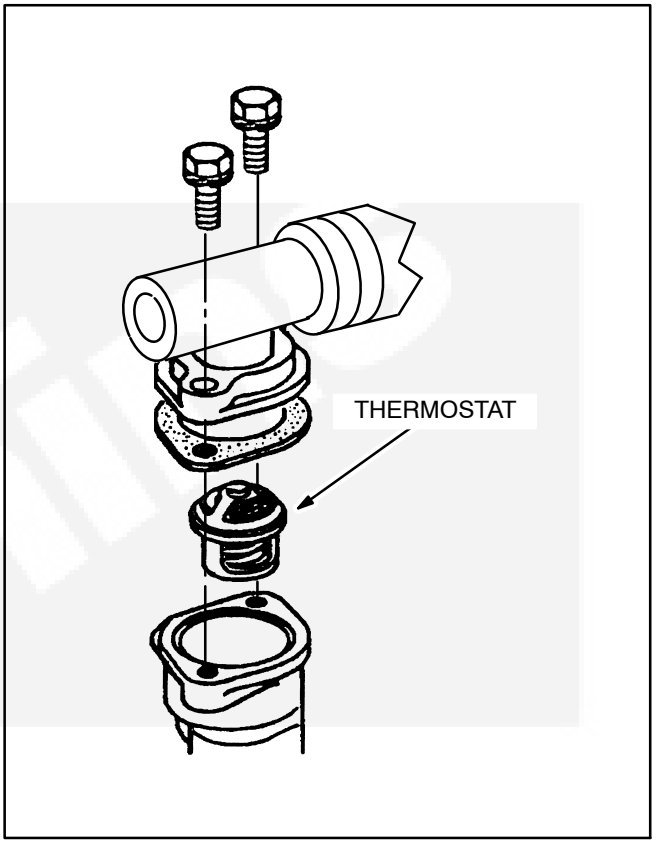


FIGURE 3-7. TYPICAL THERMOSTAT

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 (load bank)

SAFETY

Hazards and Their Sources

There are hazards in servicing gensets. Study *Safety Precautions* and become familiar with the hazards listed in Table 4-1. Note the following safeguards and ways of avoiding hazards:

- ***Use personal protection:*** Wear appropriate protective safety equipment, such as safety shoes and safety glasses.

  Do not wear rings or jewelry and do not wear loose or damp clothing that might get caught in equipment or conduct electricity.
- ***Reduce the hazard:*** A safe, orderly workshop area and well-maintained equipment reduce the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working condition. Store flammable liquids in approved containers; away from fire, flame, spark, pilot light, switches, arc-producing equipment and other ignition sources. Keep the workshop clean and well-lit 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 do not take any risks.
- ***Be prepared for an accident:*** Keep fire extinguishers and safety equipment nearby. Agencies such as the Red Cross and public safety departments offer courses in first aid, CPR and fire control. Take advantage of this information to be ready to respond to an accident. Learn to be safety-conscious and make safety procedures part of the work routine.

TABLE 4-1. HAZARDS AND THEIR SOURCES

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

Testing the Genset Inside a Building

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

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

REMOVING / INSTALLING GENSET

See *Section 8. 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 near the top 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 11. 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 (Air-Out areas) are free and clear. Also, make sure there is ample fresh air when operating the genset. Support the generator set at the indicated locations.

⚠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.***

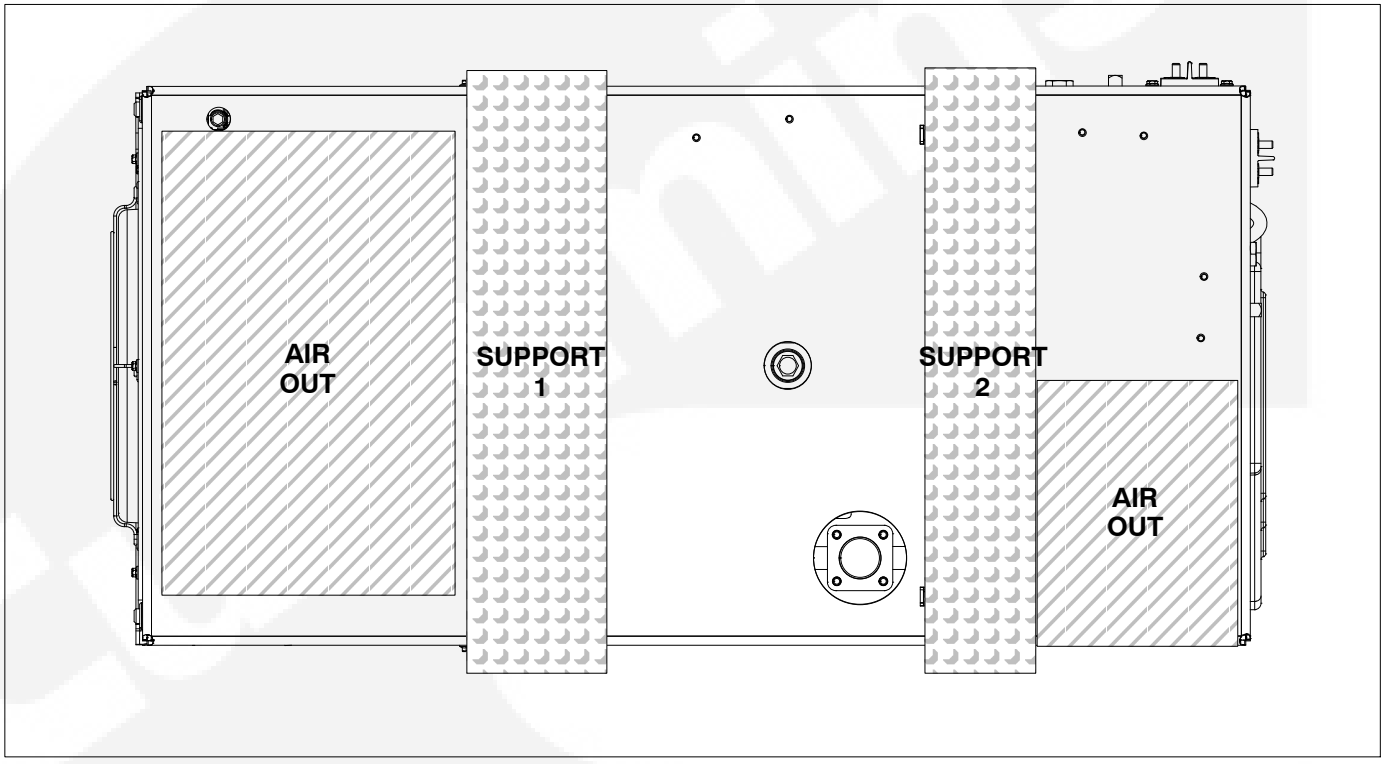


FIGURE 4-1. AIR OUTLET OPENINGS IN BOTTOM (SHADED AREAS)

REASSEMBLING MOUNTING SYSTEM

When reassembling, torque the vibration isolator center and mounting screws according to torque specifications (page 9-1).

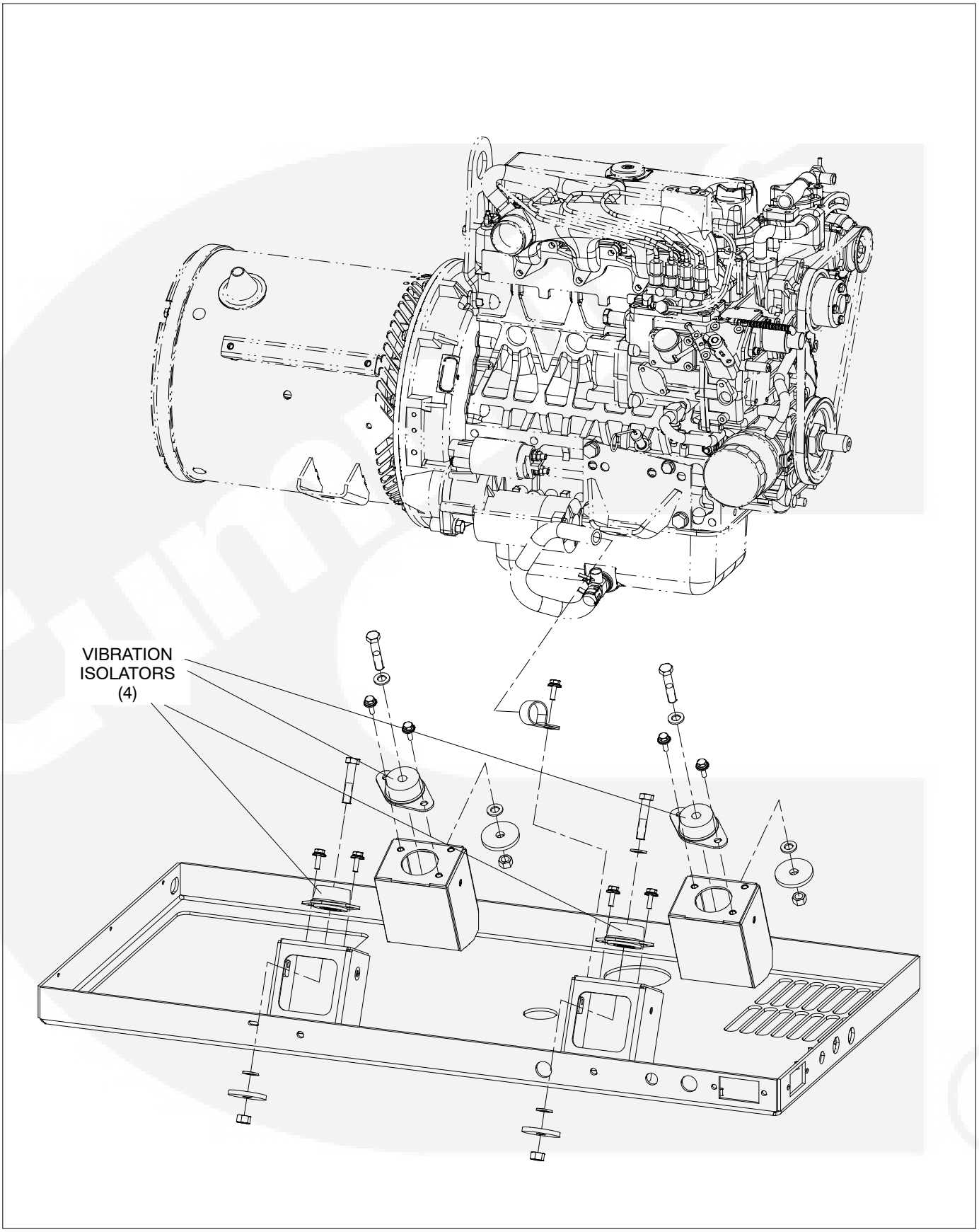


FIGURE 4-2. MOUNTING SYSTEM

5. Engine and Accessories

MAJOR ENGINE SERVICE

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

See the Engine Workshop Manual 981-0551 for major engine service procedures. See *Specifications* (Section 10) in this manual to identify the engine model number for the generator set.

When remounting the engine torque the vibration isolator through bolts to 56–68 lb-ft (76–92 N-m).

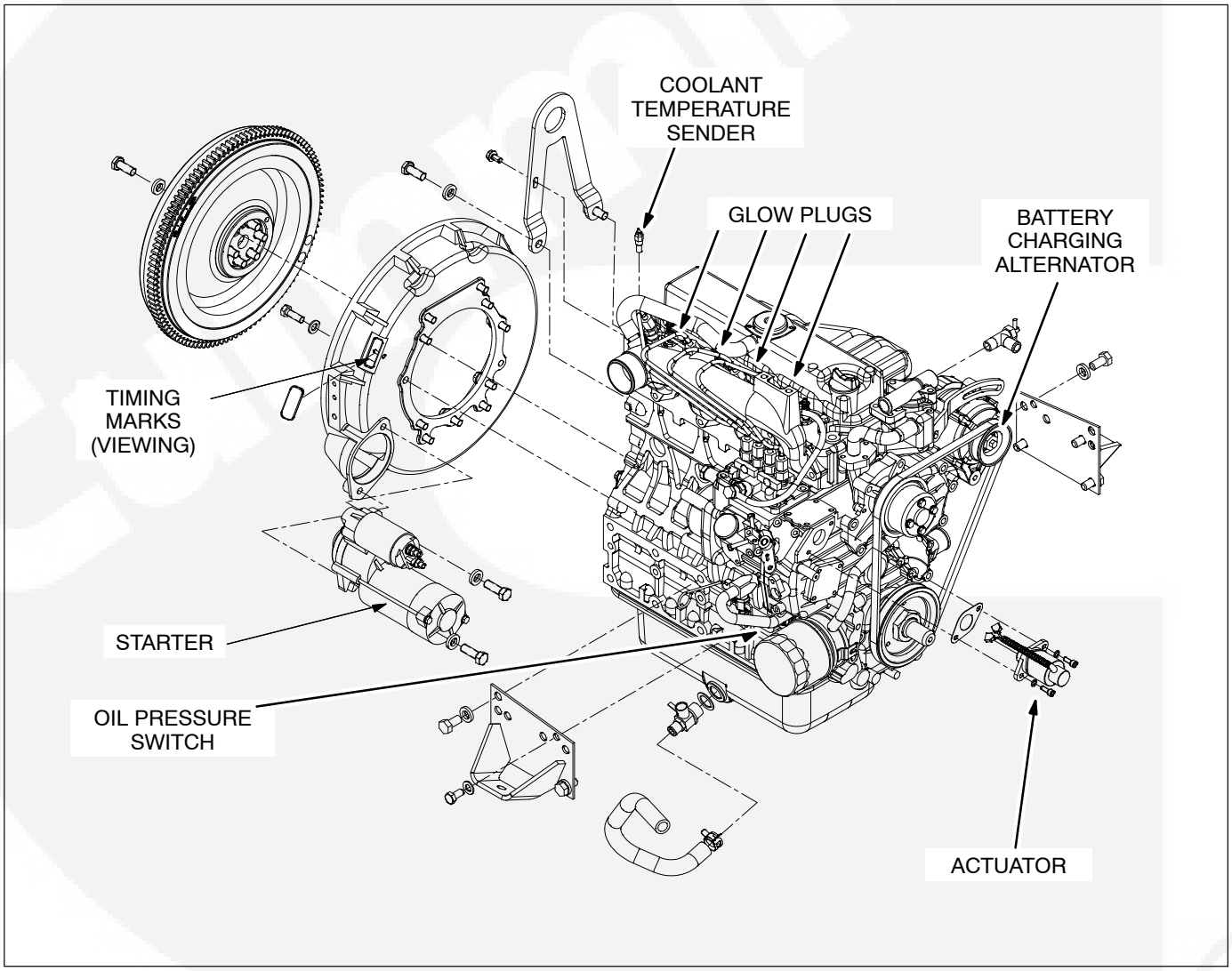


FIGURE 5-1. ENGINE COMPONENTS

ENGINE SENSORS

Engine Oil Pressure Switch

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

The oil pressure sender is threaded into the side of the block or a manifold (Figure 5-1). Use thread sealant and engage at least two full threads when installing.

Engine Coolant Temperature Sender

The engine coolant temperature sender is located at the top of the engine block (Figure 5-1). Use thread sealant and engage at least two full threads when installing. In isolated-ground applications, the sender has two terminals.

The sensor resistance varies by temperature, as indicated in Table 5-1.

TABLE 5-1. COOLANT TEMPERATURE SENSOR RESISTANCE BY TEMPERATURE

Temperature		Resistance
°C	°F	Ohms
38	100	450±45
66	150	158.2±15.8
93	200	64.3±6.4
104	219	46.6±2.3
121	250	29.3±2.9
149	300	15.0±2.2

GOVERNOR ACTUATOR

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

The generator set controller modulates the pulse width of the current it sends to governor actuator A12 (Figure 5-1), which positions the engine fuel rack accordingly.

If troubleshooting indicates that the actuator might be malfunctioning, disconnect its two leads and remove the actuator. Replace the actuator if the plunger does not move smoothly when pushed in or the internal spring does not return it smoothly. If the plunger moves smoothly without binding, apply battery voltage (12 volts) and observe the plunger. Replace the actuator if the plunger does not pull in all the way and stay in while power is applied.

The coil in the actuator has a resistance of 5.3±0.3 ohms.

Reinstall the actuator with a new flange gasket. Torque the two mounting screws to 7–9 lb-ft (9.5–12.2 N-m).

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 a start. Plug the opening to keep oil from splashing out.
2. Disconnect the fuel pump, and power it directly witha 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 generator set to protect them from overfrequency*, and start the generator set. Adjust the stop screws to obtain 67.3–68.3 Hz (2019–2049 rpm). **TO STOP THE ENGINE**, disconnect the fuel pump from the battery.

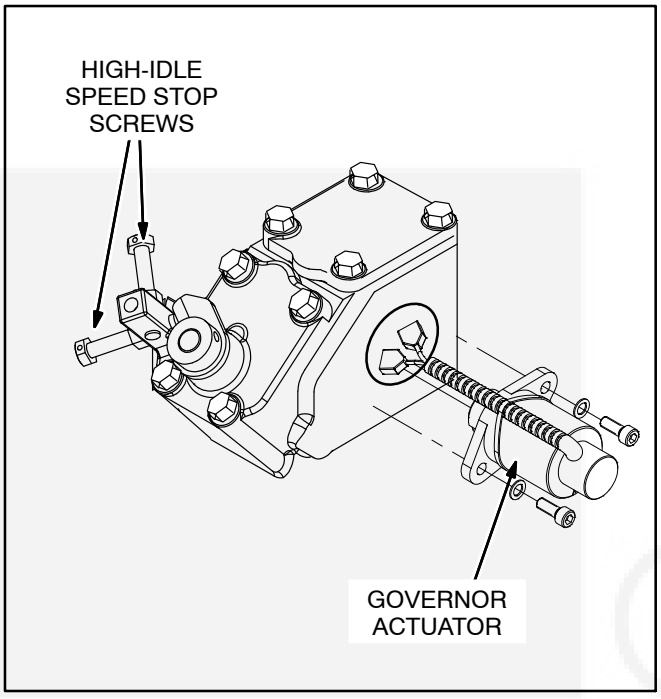


FIGURE 5-2. COOLANT SUPPLY TUBE

4. Seal the adjusting threads with paint.
5. Re-install all of the components that were removed or disconnected.

GLOW PLUGS

Refer to the Engine Workshop Manual when replacing the glow plugs (Figure 5-1).

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 the nominal 12 volts, such as when a battery booster is used for starting.

STARTER

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. Before servicing the starter, disconnect the negative (–) cable at the battery to prevent the engine from starting.***

The starter motor is bolted to the flywheel housing (Figure 5-1). See the Engine Workshop Manual for service or replacement. Parts are available for rebuilding the starter. Torque the mounting bolts to 31–38 lb-ft (42–51.5 N-m).

BATTERY CHARGING ALTERNATOR

See page 3-9 to adjust or replace the alternator V-Belt (Figure 5-1). See the Engine Workshop Manual for service or replacement.

TIMING MARKS

The flywheel has timing marks to help set the timing of the injection system. You can see the timing marks by removing the plug and looking through the hole indicated in Figure 5-1. See the engine workshop manual for the appropriate injection timing settings.

FUEL SYSTEM

⚠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.***

Figure 5-3 illustrates how the fuel system is assembled for delivering fuel to and from the fuel injection system. See the engine Workshop Manual for fuel injection system service.

Fuel Filter

See DRAINING / CHANGING FUEL FILTER (page 3-6) regarding fuel filter maintenance.

Fuel Pump Test

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

First service all of the fuel filters in the system and repair any restrictions to fuel flow. If fuel delivery still appears to be weak, test for pump delivery as follows:

1. Disconnect the fuel return hose from the line to the supply tank and point the end into a container of known volume, such as a 1 or 2 liter (quart) bottle.
2. Prime the generator set by pushing the Start/Stop switch to STOP(Prime) and holding it there for the duration of the test. It should not take longer than 1.5 minutes to fill a 1 liter container (2/3 liter per minute).
3. Replace the pump if flow is less than specified.

Fuel Fittings

The generator set has a bulkhead fitting on the return end. For this fitting, use *liquid-type* pipe thread sealant Listed as suitable for diesel fuel. Apply the sealant sparingly to the male threads only.

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

Fuel Hose

Replace worn or damaged fuel hose with 5/16 in. I.D. SAE J30R9 fuel hose. The manufacturer must possess a CARB executive order.

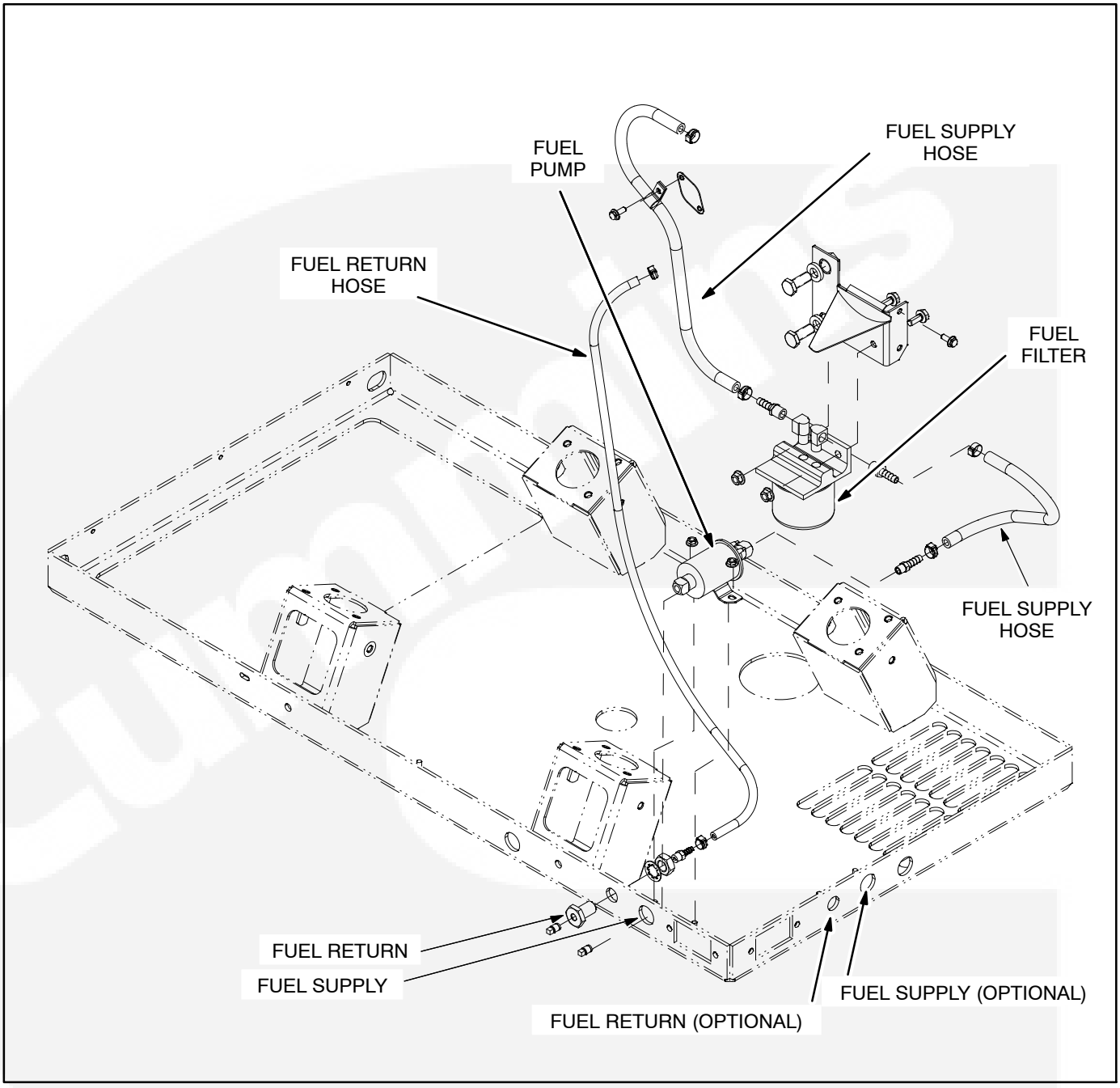


FIGURE 5-3. TYPICAL FUEL SYSTEM

EXHAUST SYSTEM

Because of the clearance between the muffler and the coolant supply tube on the generator set, it may be difficult to remove the muffler. When servicing the muffler, it is suggested that you follow these steps to avoid damaging the studs on the exhaust manifold.

1. Remove the coolant supply tube fastener. See Figure 5-4.
2. Loosen the screw in the coolant supply tube bracket attached to the tube. See Figure 5-4.
3. Rotate the tube outward at the pivot point of the fastener on the bracket attached to the coolant tube.

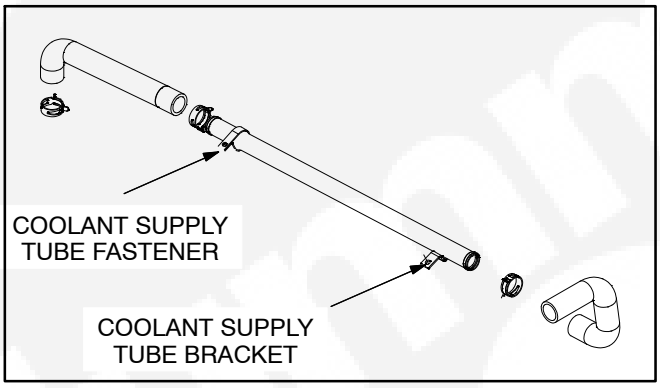


FIGURE 5-4. COOLANT SUPPLY TUBE

SAE J1939 CAN CONNECTION

The generator set controller can communicate over a CAN (controlled area network) datalink. The main use of this datalink is to provide information to an existing CAN datalink, for example, to provide information to a remote operator panel.

CAN communications is based on the SAE J1939 communication protocol. The CAN datalink is based on a main trunk (no more than 40 meters long and 30 devices) that is terminated by 120-ohm resistors on each end. Stubs (no longer than 1 meter) extend from the main trunk to each module in the bus.

The connection between the generator set controller and the CAN datalink is shown in Figure 5-5.

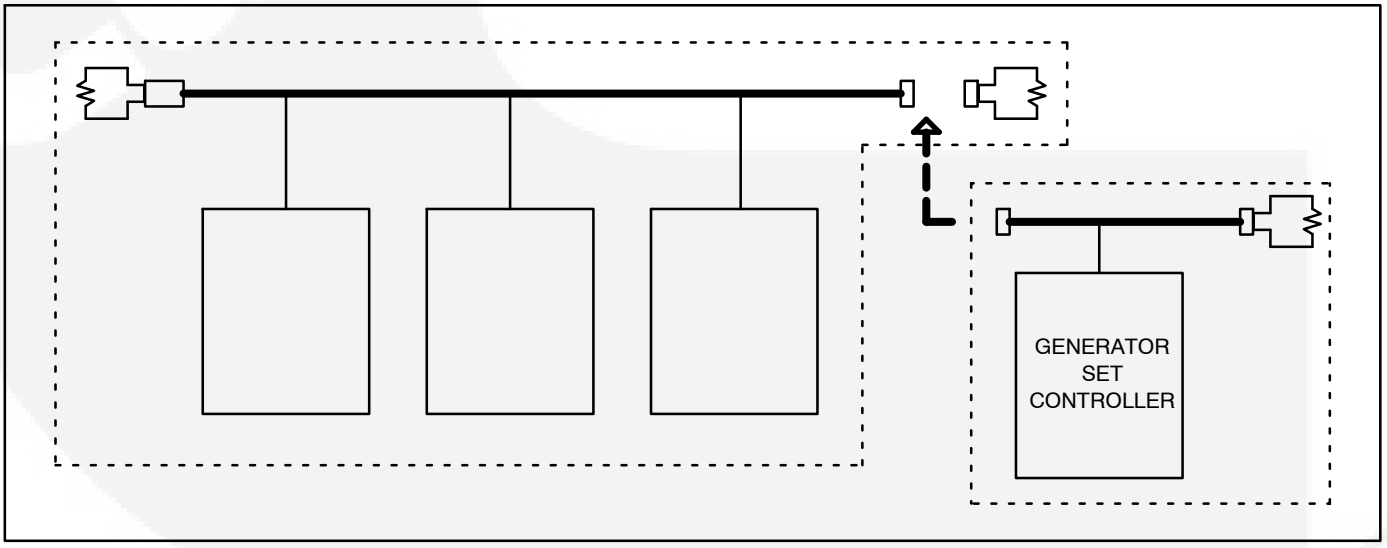


FIGURE 5-5. CAN DATALINK

Pin Connections

The SAE J1939 pin connections for the generator controller are identified in Table 5-2.

TABLE 5-2. SAE J1939 PIN CONNECTIONS

Description	Pin
CAN A	P8-D
CAN B	P8-G
CAN Shield	P8-H

In order to connect to the CAN datalink, a terminating resistor of 120 ohms is required at each end of the CAN datalink. This is not included on the control board or in the remote harness.

CAN Datalink Signals

The CAN datalink carries a series of 1's and 0's in each message. Figure 5-6 and Table 5-3 show how the generator set controller distinguishes between 1's and 0's.

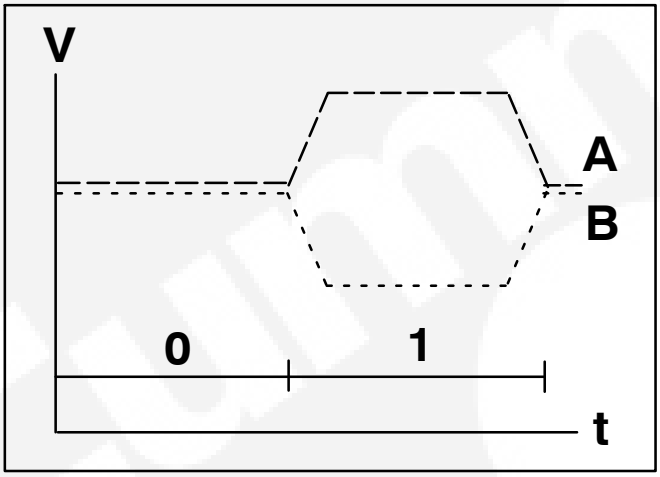


FIGURE 5-6. CAN DATALINK VOLTAGE DIFFERENTIALS

TABLE 5-3. CAN DATALINK VOLTAGE DIFFERENTIALS

SIGNAL	0	1
J1939 High (+)	2.5 V	3.5 V
J1939 Low (–)	2.5 V	1.5 V
Voltage Differential	0 V	2 V

The CAN datalink transmits 0's and 1's at 250 KBaud, or 250 kilobits per second. Hence, it is possible for the voltages on J1939 High (+) and J1939 Low (–) to change 250,000 times per second.

Figure 5-7 and Figure 5-8 show some examples of good and bad signals on a high-resolution oscilloscope. The bad signal is caused by termination problems (no termination, wrong termination, or bad termination).

FIGURE 5-7. CAN DATALINK: GOOD SIGNAL

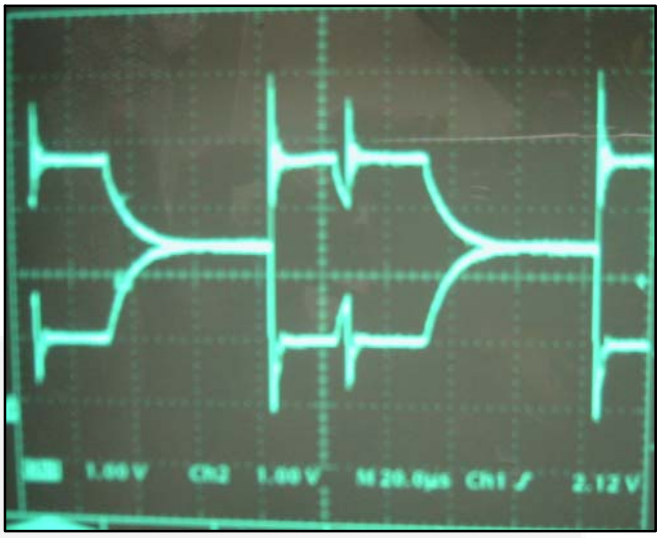


FIGURE 5-8. CAN DATALINK: BAD SIGNAL

SAE J1939 Broadcasts

The source address of the generator controller is 234. Instruments will not display any messages from the generator controller if the instruments do not recognize this address.

The controller supports the SAE J1939 broadcasts identified in Table 5-4 (broadcast data) and in Table 8-1 (fault codes). Use the PCan tool to monitor these broadcasts. The controller does not receive SAE J1939 messages.

TABLE 5-4. SAE J1939 BROADCASTS

Description	PGN	SPN
Claim Address*	60928	
DM1	65226	
Engine temperature (coolant temperature)	65262	110
AC output frequency (in place of engine speed)	65030	2436
AC output voltage	65030	2444
Battery voltage	65271	168
Genset hours*	65253	247
Software part number, software version*	65242	
DM2*	65227	
Genset faults	Full list of fault codes identified in Section 8	
* These messages are only broadcasted on request.		

The genset has a low oil pressure switch, not a sender, so it cannot provide oil pressure in SAE J1939 broadcasts. It does broadcast fault code 2 (Low Oil Pressure Fault) instead.

THIS PAGE LEFT INTENTIONALLY BLANK

6. Generator

OVERVIEW

The Cummins Onan YD series AC generators are two-bearing, 1800-rpm, 60-Hertz units.

A centrifugal blower on the front end of the rotor shaft circulates the generator cooling air which is drawn in through the cooling air inlet, over the rotor, and discharged through the outlet slots at the blower end. See Figure 6-1.

The end bell and stator housing are attached by four through-studs which pass through the stator assembly. The brushless exciter stator mounts in the end bell while the exciter rotor and its rotating rectifier assemblies mount on the rotor shaft.

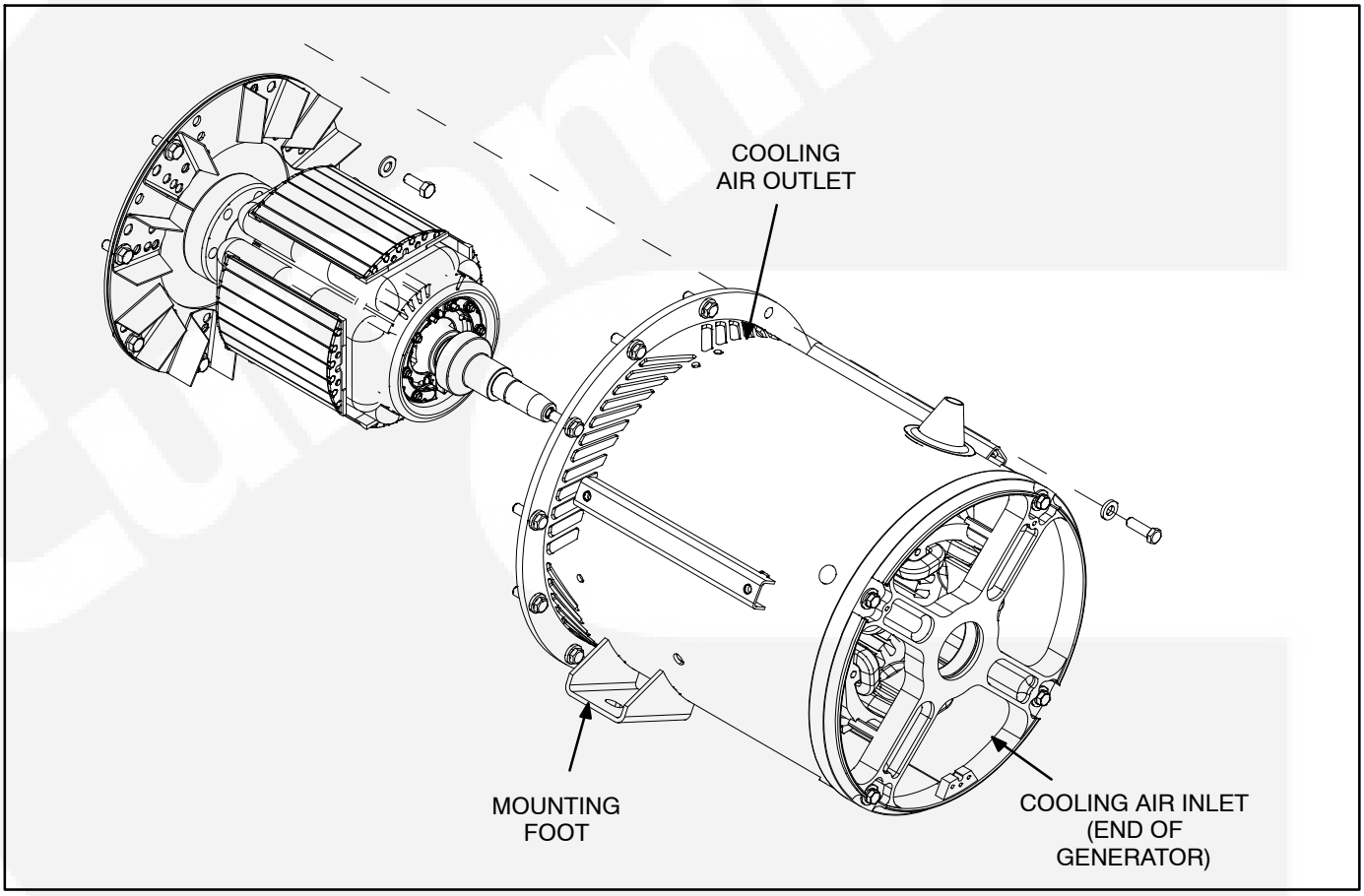


FIGURE 6-1. GENERATOR

TESTS

Testing Rotating Rectifiers

Two different rectifier assemblies make up the rotating rectifier bridge assembly (see Figure 6-2). Test each diode on the rectifier assemblies with an ohm meter using negative and positive polarities:

- Connect one test lead to the F1+ stud, connect the other lead to diodes CR1, CR2, and CR3 sequentially, and record the resistance value of each rectifier.
- Connect one test lead to the F2– stud, connect the other lead to diodes CR4, CR5, and CR6 sequentially, and measure the resistance value of each rectifier.
- Reverse the ohmmeter leads from the preceding steps, and repeat the resistance measurements: F1+ stud to CR1 through 3, and F2– to CR4 through 6.

- All resistance values should read high for one test and low for the other test. If any reading is high or low for both tests, the rectifier assembly is defective.

Note: Use 23 to 26 inch-lbs (2.6 to 2.9 N•m) torque when replacing nuts for F1+ and F2–, and diodes CR1 through CR6.

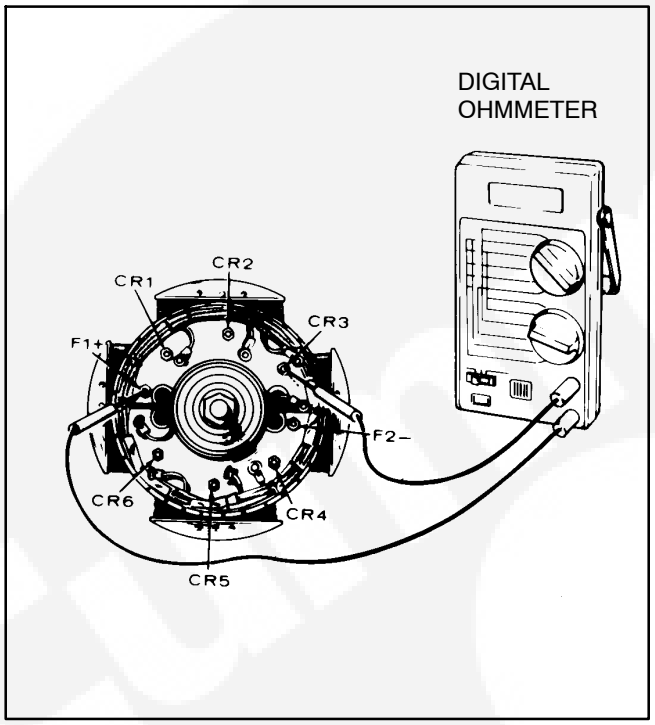


FIGURE 6-2. TESTING ROTATING RECTIFIERS

Testing Exciter Stator

Test the exciter stator for open or shorted windings, and grounds, as follows (see Figure 6-3).

Open or shorted windings:

- Disconnect F1+ and F2– exciter field leads from terminal block in generator end bell, and measure the resistance between them. The resistance should measure 12.4 ohms ± 10% at 77° (25° C).

Grounds:

- Connect the ohmmeter between either field lead and exciter stator laminations.
- Set the ohmmeter to the highest resistance range. Resistance must read one megohm or greater.

Note: The preferred test is with a megger or insulation resistance meter that applies 500 VDC or more to the test leads. Readings should be 100,000 ohms or greater.

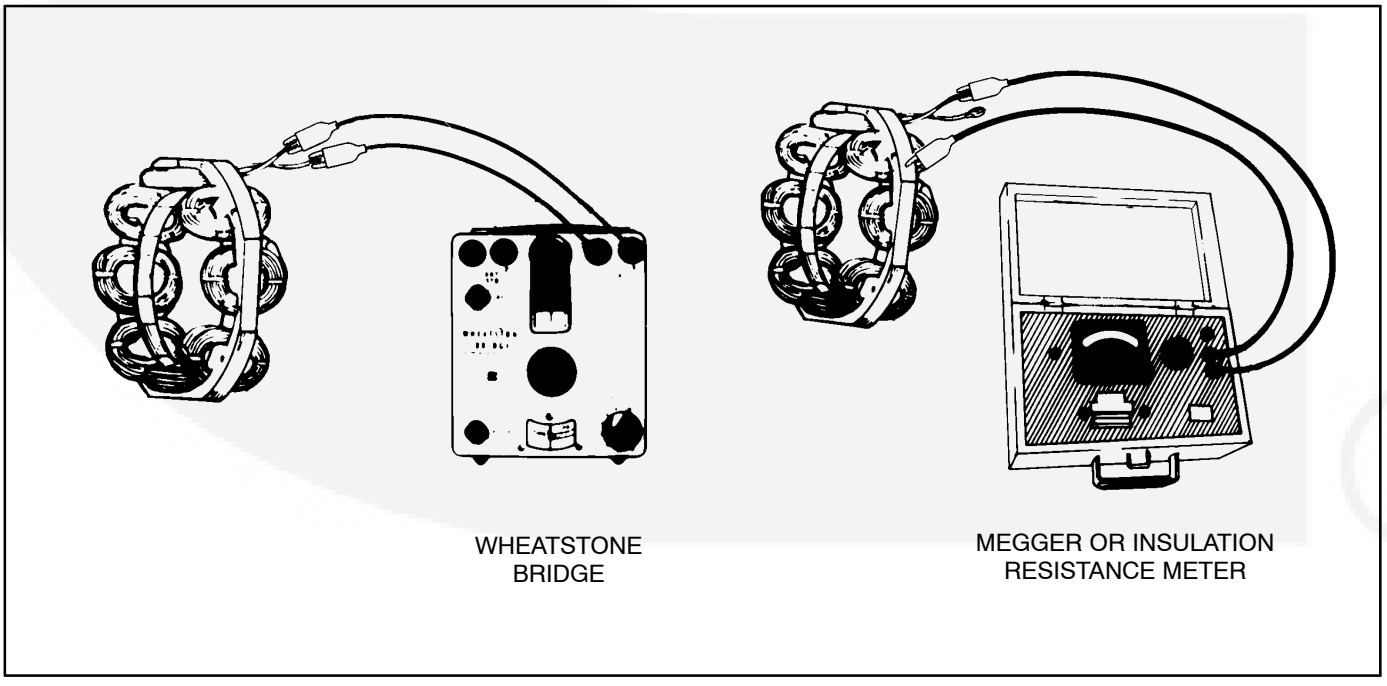


FIGURE 6-3. TESTING WINDINGS RESISTANCE

Testing the Exciter Rotor

Test the exciter rotor for open, shorted windings, or grounds (see Figure 6-4):

- Disconnect the main rotor field leads which connect to the rotating rectifier assemblies at F1+ and F2–.
- Disconnect lead wires from diodes CR1 through CR6.
- Using a Wheatstone bridge or digital ohmmeter, measure between exciter lead pairs T1–T2, T2–T3, and T1–T3. Resistance should measure 645 milliohms ± 10% at 77° (25° C).

Test the exciter rotor for grounds.

- With all generator leads disconnected from diodes CR1 through CR6, measure between any diode lead and exciter rotor laminations.
- The reading should be greater than one megohm.
- A reading less than one megohm indicates defective ground insulation.

Note: The preferred test is with a Megger or insulation resistance meter that applies 500 VDC or more. Be sure all exciter leads are disconnected from the diodes. Readings should be 100,000 ohms or greater.

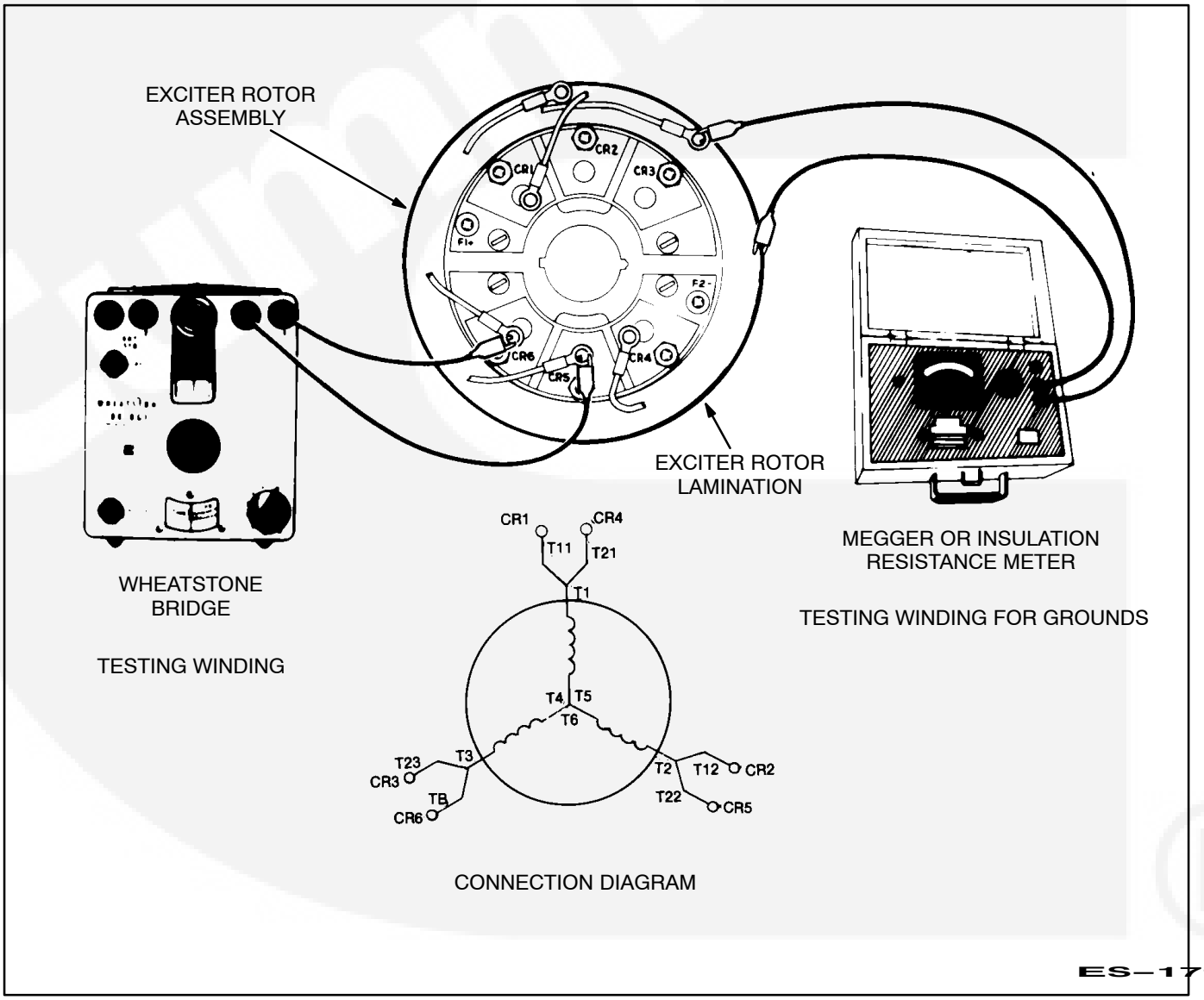


FIGURE 6-4. TESTING THE EXCITER ROTOR

Testing the Generator Stator

Using the proper test equipment, test the stator for grounds, opens, and shorts in the windings (Figure 6-5).

Test for grounds:

Note: Some generators have ground connections to the frame. Check the wiring diagram. All stator leads must be isolated for testing.

- Use a megger or insulation resistance meter which applies 500 VDC or more to the test leads.
- Test each stator winding for a short to the laminations.
- A reading less than 100,000 ohms indicates a questionable stator.
- Thoroughly dry the stator and retest.

Test the stator for open or shorted windings:

- Use an accurate instrument for this test such as a Kelvin bridge or digital ohmmeter.
- For single-phase stators, measure between T1–T2 and T3–T4.
- Resistance values at 77° (25° C) are listed in Table 6-1 (lead length between 0 and 15 feet).
- If any windings are shorted, open, or grounded, replace the stator assembly.
- Before replacing the assembly, check the leads for broken wires or insulation.

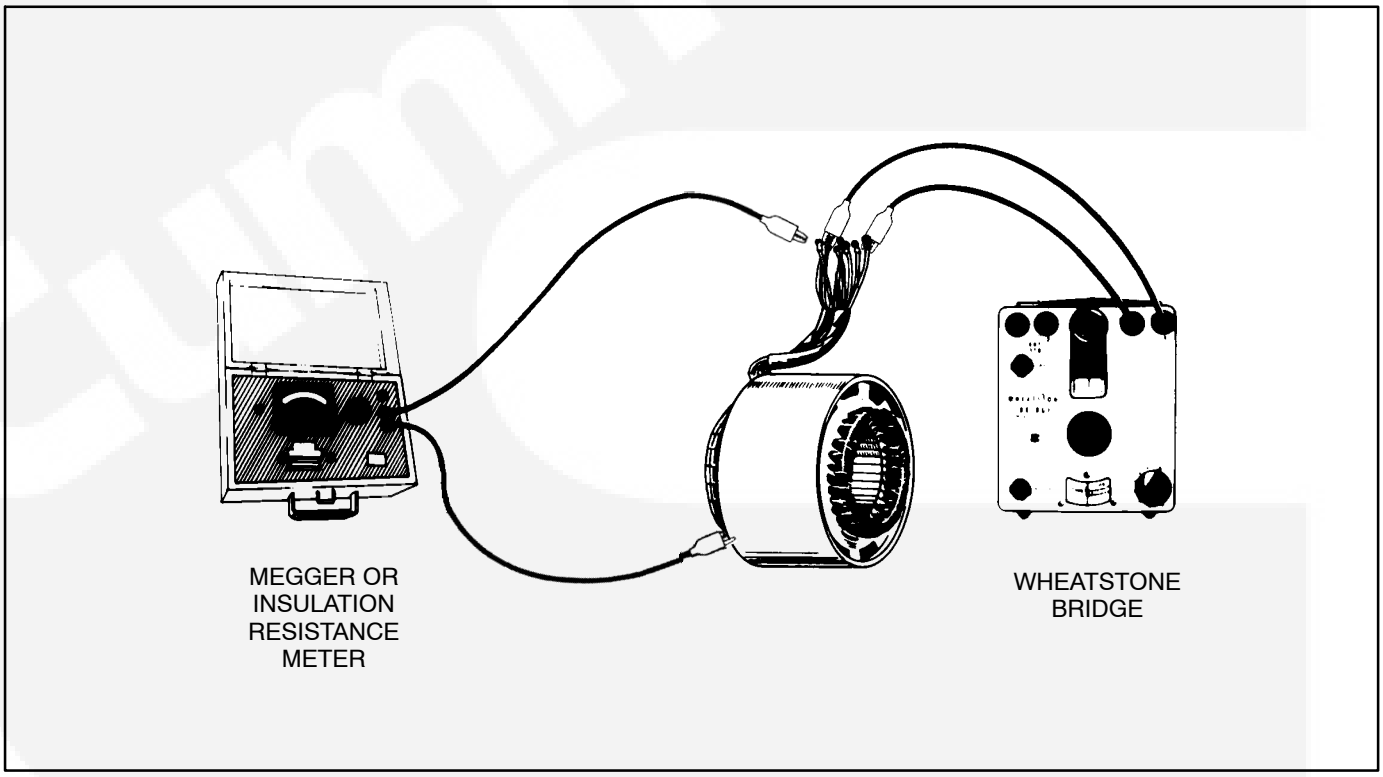


FIGURE 6-5. TESTING THE GENERATOR STATOR

TABLE 6-1. STATOR RESISTANCE VALUES

Single Phase kW Rating	Resistance (ohms ± 5%)
20	.075 ± .083

Testing the Generator Rotor

For these measurements, use a megger or insulation resistance meter which applies 500 VDC or more to the test leads.

Test for grounds:

- Remove rotor leads F1+ and F2– from the rotating rectifier assemblies.
- Connect test leads between F1+ and the rotor shaft. Meter should read 100,000 ohms or greater.
- If the measurement value is less than 100,000 ohms, the rotor is questionable.
- Thoroughly dry the rotor and retest.

- Replace a grounded rotor with a new identical part.

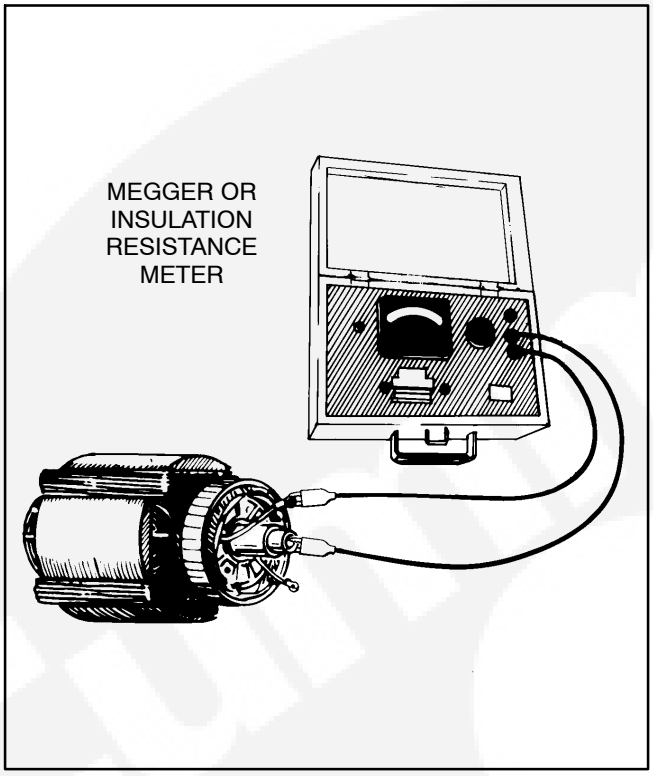


FIGURE 6-6. TESTING WINDINGS RESISTANCE

Test for open or shorted windings:

- Remove rotor leads F1+ and F2– from the rotating rectifier assemblies.
- Using an ohmmeter, measure the resistance between F1+ and F2– (see Figure 6-7).
- Refer to the Rotor Resistance Values Table for the appropriate resistance values at 77°F (25°C).
- Replace a defective rotor with a new, identical part.

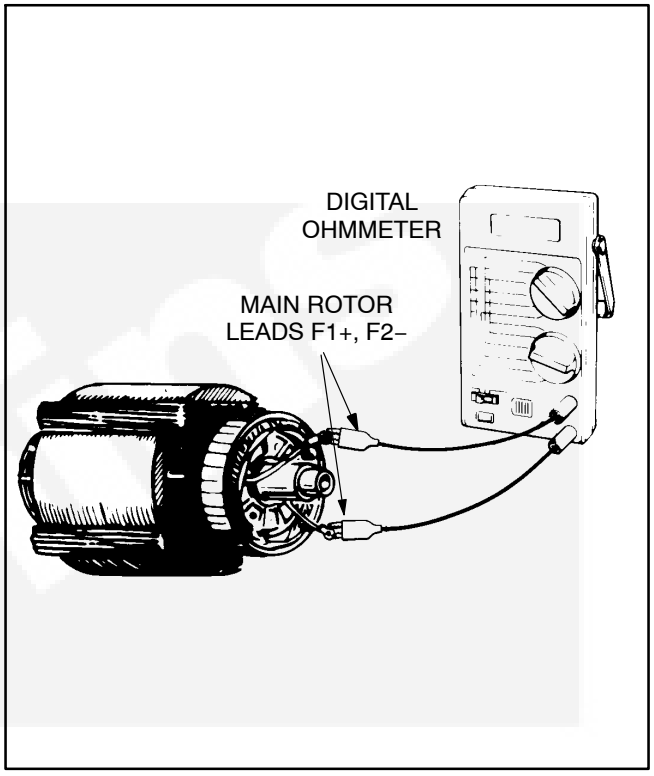


FIGURE 6-7. TESTING WINDINGS RESISTANCE

REPLACING THE BEARINGS

The generator is heavy. Use the appropriate tools and procedures to remove it from the generator set.

⚠WARNING ***Accidentally dropping the generator can damage it and cause severe personal injury and death. The hoist, straps and chains must have sufficient capacity and be attached properly so that the load cannot shift.***

Before starting, disconnect the starting battery cables (negative [–] first) to make sure the set will not start while working on it.

⚠WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).***

Generator Removal

- Disconnect alternator output leads and exciter F1 and F2 leads.
- Remove the generator from the vehicle.

Alternator Disassembly

Position the alternator with the end bell facing up which facilitates a safer and easier assembly and

disassembly. Refer to Figure 6-8 for an exploded view of the alternator with parts identification.

- Remove nuts from the rotor through studs.
- Remove the end bell by tapping upward around the joint and separating it from the stator assembly.
- Remove four stator through-studs with a vise grip.
- Using a safe lifting device, stator handling tongs, or chain and lift hooks, lift stator assembly from gear case adapter. If necessary, lift unit off the bench about one inch and tap adapter housing with a soft faced hammer to free stator from adapter.

⚠ CAUTION ***Do not set stator down on open end, top or bottom. Stator weight can damage the windings.***

- While stator is still on lift tongs or hooks, revolve stator to horizontal position and set it on its side.
- Remove the air baffle by loosening four locking screws.

Note: A rope sling is the most suitable device for handling rotors.

- Remove the rotor and fan by using a soft-faced hammer to tap on the adapter while holding the rotor assembly about one inch above the bench with a hoist and rope sling.

⚠ CAUTION ***Use care to prevent damage to the fan blades. Broken blades will throw the fan out of balance and reduce the air flow rate.***

- If it is necessary to replace a damaged fan, support the rotor assembly horizontally and remove the fan from the rotor with a gear puller.
- Hold the rotor in a suitable clamp and loosen the nut on the rotor through-stud bolt.
- If required, remove the bearing with a gear puller and accessory crutch (if available) from the rotor through stud.
- Clamp the alternator rotor in a fixed vertical or horizontal position to remove or install the rotor lock nut. The lock nut is torqued to 130–150 ft. lb. (176–203 N•m).
- If bearing, shaft, or oil seal replacement is required, hold gear case upright and tap drive pinion and shaft through gear case.
- With a vise grips, remove rotor through-stud from the drive pinion shaft.
- Remove the snap ring from the bearing on the drive pinion shaft.
- Press the bearing from the drive pinion shaft if bearing replacement is required.

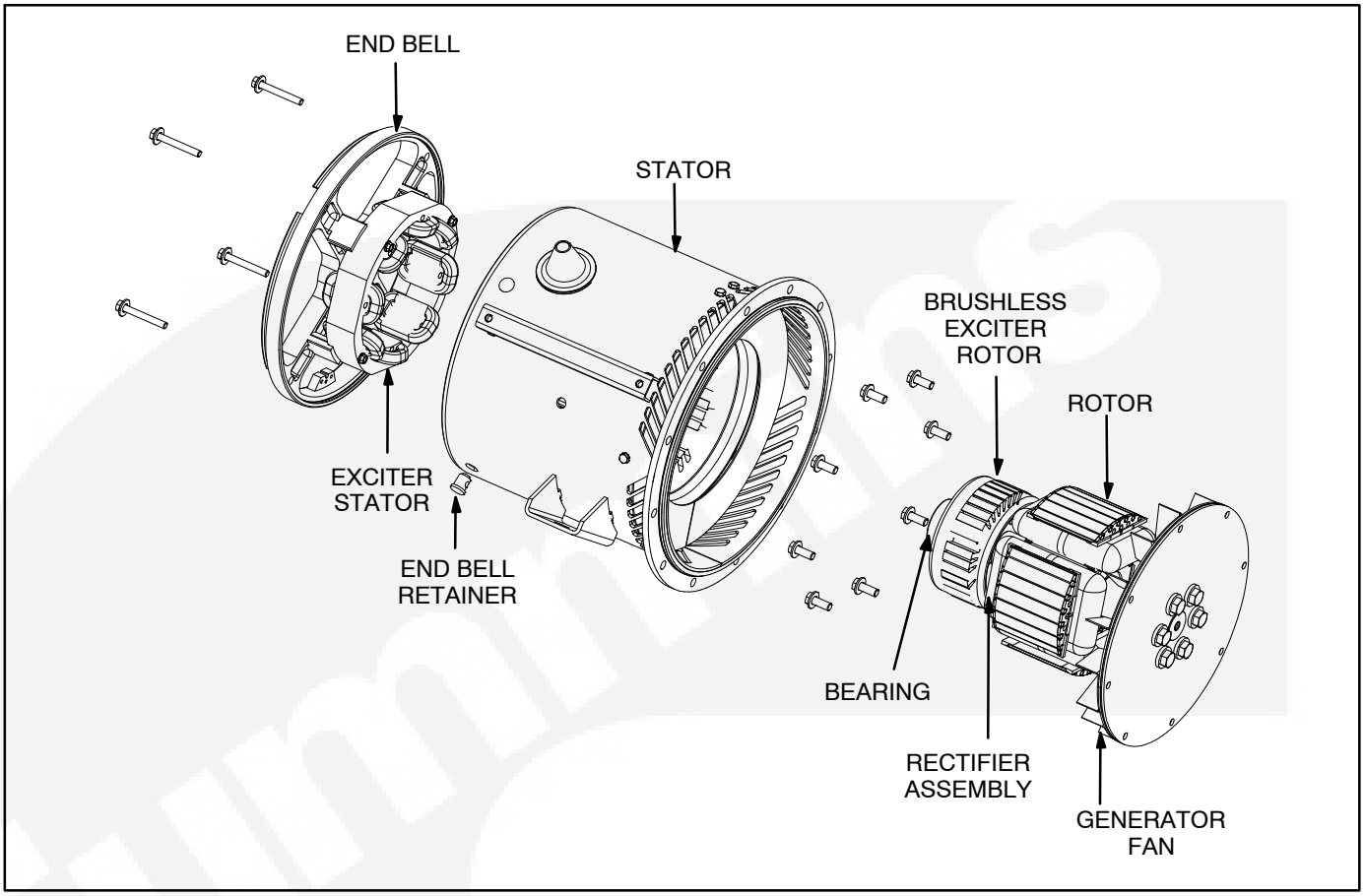


FIGURE 6-8. ALTERNATOR PARTS IDENTIFICATION

Alternator Assembly

Assemble alternator components in reverse order from disassembly using the following additional instructions.

- Clean and inspect mating surfaces.
- Coat mating area between alternator bearing and end bell bearing hole with a thin film of Molykote or equivalent lubricant.
- Install rotor through-stud in drive pinion shaft, if it was removed.
- Install the rotor and fan assembly on the adapter.
- Guide the key slot in the fan onto the key in the drive pinion shaft. A raised line on the fan body casting indicates the location of the key slot inside. The drive shaft and key can be seen through the air outlet in the adapter.
- If they were removed, install the exciter rotor and shaft bearing.
- Torque the shaft nut against the exciter rotor to 130 to 150 ft. lbs. (176 to 203 N•m).

⚠ CAUTION ***Use care to prevent damage to the fan blades. Broken blades will throw the fan out of balance and reduce the air flow rate.***

- Install two stator through-studs in the adapter for aligning the stator assembly over the rotor.
- Install the baffle ring.
- Install the remaining two stator through-studs in the adapter.
- Install the stator and end bell. Torque the nuts on the through-studs to 19 to 21 ft. lbs. (26 to 28 N•m).
- Torque the rotor through-stud nut to 55 to 60 ft. lbs (75 to 81 N•m).
- Install the mounting feet and the control box.
- Connect the alternator output and control leads according to the appropriate wiring diagram.
- Replace the end bell cover.
- Replace the reconnect box cover.

THIS PAGE LEFT INTENTIONALLY BLANK

7. 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.***

OVERVIEW

See Figure 7-2 and Figure 7-3 for an illustration of the generator set control components.

Generator Control

General: The generator control is an integrated microcontroller-based engine and generator control. It provides all the control, monitoring and diagnostic functions required to operate a generator set.

Connections: Fan and compartment air temperature switch connections are through connector J2. Other DC control connections to the control are through connector J1. Refer to Table 7-1 below and the appropriate wiring diagrams and wiring harness drawings beginning on Page A-1.

TABLE 7-1. J1 AND J2 CONNECTIONS

PIN	I/O	DESCRIPTION
J1-1	Output	Field–
J1-2	Input	Quad1
J1-3	Input	Quad2
J1-4	N/A	Not used
J1-5	Input	Genset start
J1-6	Input	Low oil pressure
J1-7	Output	Status light
J1-8	Input	B+
J1-9	Input	B+
J1-10	N/A	Not used
J1-11	Output	Starter solenoid; B+ output
J1-12	N/A	Not used
J1-13	Output	Field+
J1-14	N/A	Not used
J1-15	N/A	Not used
J1-16	N/A	Not used
J1-17	N/A	Not used
J1-18	N/A	Not used
J1-19	Both	RS-485 A; communications
J1-20	Both	CAN A
J1-21	Both	CAN B
J1-22	Both	CAN GND
J1-23	Output	Fuel actuator; pulse-width modulated
J1-24	Output	Fuel pump; B+ output
J1-25	Output	Hour meter; B+ output
J1-26	Both	RS-485 B; communications
J1-27	Input	B–
J1-28	Output	Glow plug
J1-29	N/A	Not used

PIN	I/O	DESCRIPTION
J1-30	N/A	Not used
J1-31	N/A	Not used
J1-32	Input	Genset stop
J1-33	Input	Must be closed
J1-34	Input	Generator Voltage Sense S1
J1-35	Input	Generator Voltage Sense S2
J2-3	Output	Fan output
J2-4	Input	Temperature switch

Software Updates: To update the control software:

1. Connect the InPower Onan service tool harness (PN 0338-4840) to remote connector P8.
2. Connect InPower Onan and update the software.

Control Switch

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

Line Circuit Breaker

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.

Compartment Air Temperature Switch

The compartment air temperature switch (Figure 7-3) has normally-closed contacts. The contacts open when the temperature rises above 180°F±5°F. The contacts close again when the temperature falls below 165°F±5°F.

Note: Make sure you use a compartment temperature switch with a color code (Figure 7-1) that is red.

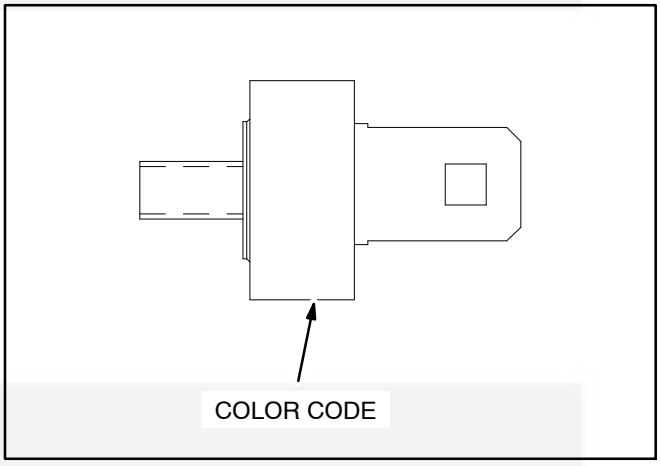


FIGURE 7-1. COMPARTMENT TEMPERATURE SWITCH

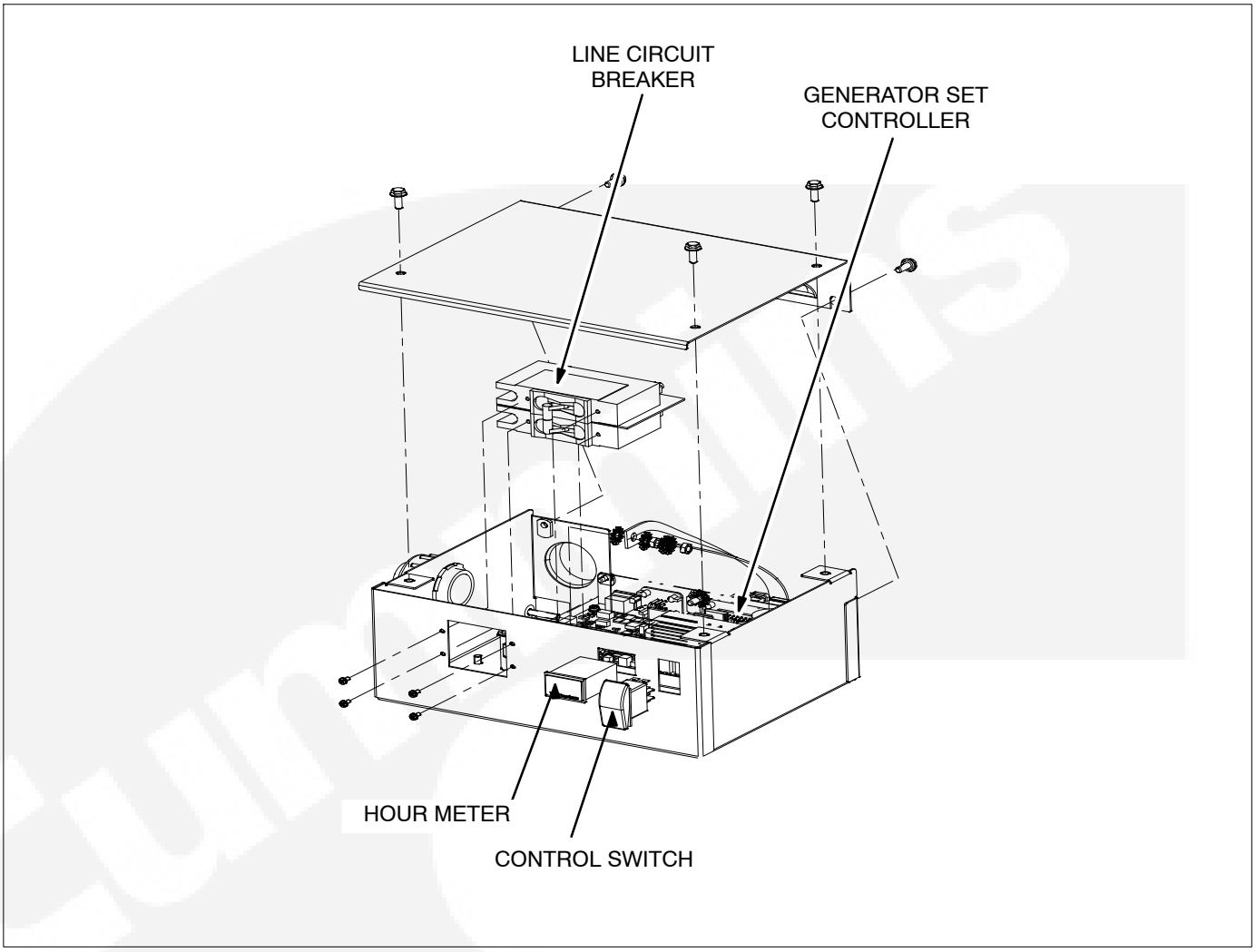


FIGURE 7-2. CONTROL COMPONENTS (FRONT VIEW)

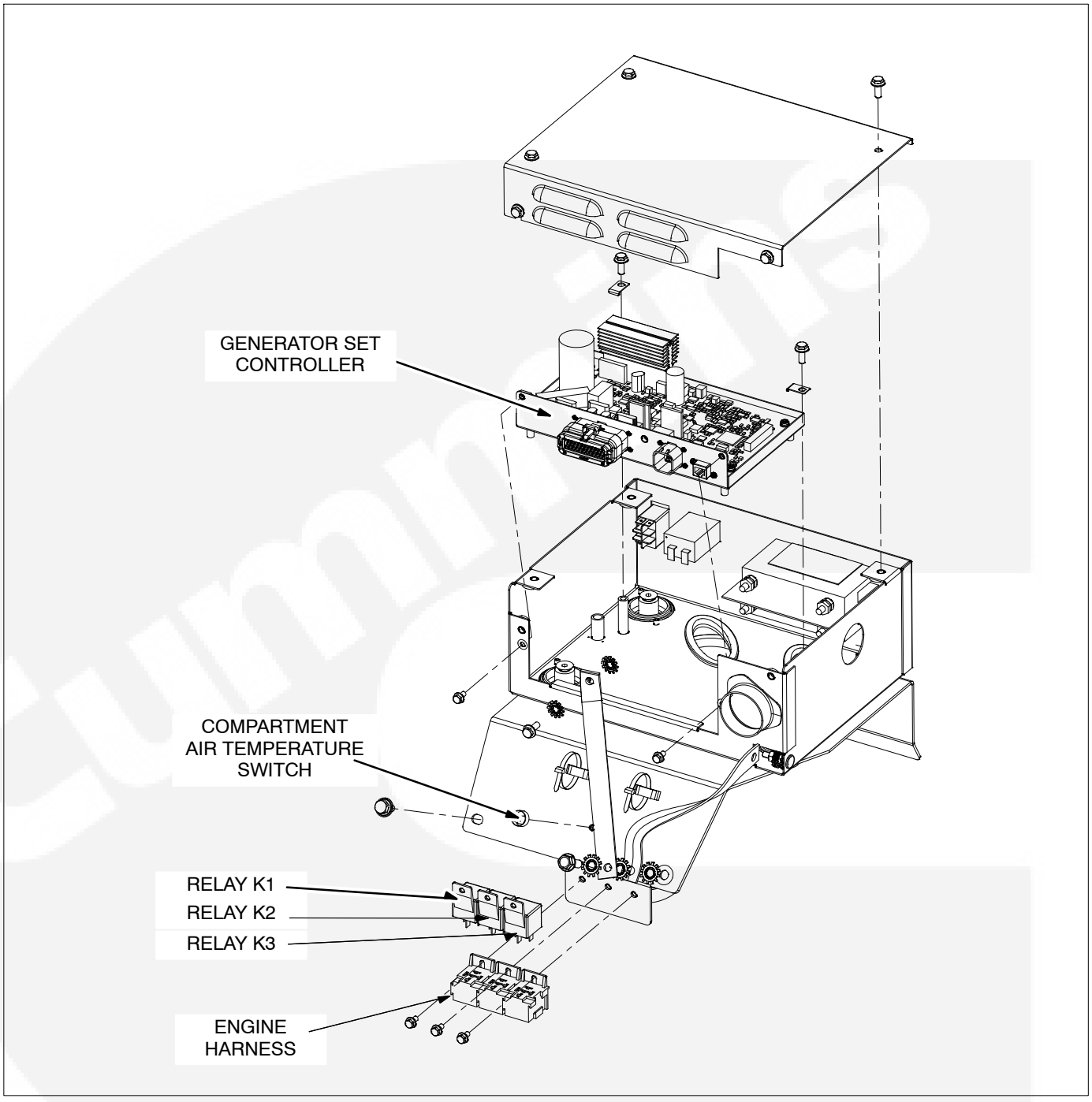


FIGURE 7-3. CONTROL COMPONENTS (BACK VIEW)

8. Troubleshooting

DIAGNOSTICS FEATURES OF THE GENERATOR

Use the table of symptoms and fault codes to diagnose a shutdown. If you are unable to resolve the problem after taking the corrective actions suggested, contact an authorized Cummins dealer.

Operator Panel

If a fault shutdown occurs the FAULT status lamp on the Operator panel will come on and the LCD screen will remote panel the description of the Fault, the Fault Number, and the hour in total generator running time when the Fault occurred.

Status Indicator Light on Control Switch

The generator causes the status indicator light on the Control Switch to flash the *first-level* diagnostic fault code when a fault occurs. The status indicator light will repeatedly flash 1, 2, 3, 4 or 9 flashes at a time.

- **One flash** indicates shut down due to high temperature.
- **Two flashes** indicate shutdown due to a loss of engine oil pressure.
- **Three flashes** indicate a service fault. Press **Stop** once to cause the two-digit, *second-level* shutdown code to flash. (Pressing **Stop** again will stop the flashing.) The two-digit code consists of 1, 2, 3, 4 or 7 flashes, a brief pause, and then 1 to 9 flashes. The first set of flashes represents the tens digit and the second set of flashes the units digit of the shutdown code number. For example, Fault Code No. 24 appears as: **flash–flash — pause — flash–flash–flash–flash — long pause — repeat**.
- **Four flashes** indicate that cranking exceeded a preset time (20 seconds if ambient temperature is above 32 °F[0 °C], 30 seconds if below) without starting.

Note: Fault Codes 33 and 44 have not been assigned so as to avoid the confusion of wrongly interpreting Fault Codes 3 and 4, which are first-level faults.

Restoring Fault Code Flashing

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

Note: The last fault logged will flash, even after the condition that caused the shutdown has been corrected.

FAULT CODES

The generator can generate the fault codes listed in Table 8-1.

TABLE 8-1. SUPPORTED FAULT CODES

FAULT NUMBER	FAULT NAME	J1939 SPN	J1939 SPN DESCRIPTION	J1939 FMI	J1939 FMI DESCRIPTION
1	High Engine Coolant Temperature	110	Eng Coolant Temp	0	Data Valid – Above Normal – Most Severe
2	Low Oil Pressure	100	Eng Oil Pressure	1	Data Valid – Below Normal – Most Severe
3	Service Engine	––	––	––	––
4	Over Crank	1675	Eng Starter Mode	14	Special Instructions
12	Over voltage	2444	Line-to-Neutral AC RMS Voltage	0	Data Valid – Above Normal – Most Severe

FAULT NUMBER	FAULT NAME	J1939 SPN	J1939 SPN DESCRIPTION	J1939 FMI	J1939 FMI DESCRIPTION
13	Under voltage	2444	Line-to-Neutral AC RMS Voltage	1	Data Valid – Below Normal – Most Severe
14	Over Frequency	2436	AC Frequency – Average	0	Data Valid – Above Normal – Most Severe
15	Under Frequency	2436	AC Frequency – Average	1	Data Valid – Below Normal – Most Severe
19	Actuator Short/ Open	51	Throttle position	2	Data Erratic, Intermittent or Incorrect
22	Actuator overload	51	Throttle position	0	Data Valid – Above Normal – Most Severe
27	AC Output sense lost	2444	Line-to-Neutral AC RMOS Voltage	4	Voltage Below Normal or Shorted to Low Source
29	High battery voltage	168	Electrical Potential (Voltage)	0	Data Valid – Above Normal – Most Severe
32	Starter Fault	1675	Eng Starter Mode	8	Abnormal Requency or Pulse Width or Period
35	EE Checksum fault	234	Software Identification	13	Out of Calibration
36	Mechanical Fault	190	Engine Speed	11	Root Cause Not Known
43	RAM Failure	234	Software Identification	13	Out of Calibration
45	Speed Sense Lost	190	Engine Speed	2	Data Erratic, Intermittent or Incorrect
57	Over Prime	1440	Fuel Flow Rate 1	14	Special Instructions
76	High Ambient Temperature	171	Ambient Air Temperature	0	Data Valid – Above Normal – Most Severe

TROUBLESHOOTING PROCEDURES

⚠WARNING ***Some generator 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 generator service.***

Refer to the following lists of faults and their possible causes and corrective actions to diagnose and repair a fault. Dealers, contact an authorized Cummins Distributor if you are unable to resolve the problem after taking the corrective actions suggested. Distributors, contact the factory if you are unable to resolve the problem.

Most shutdowns can be prevented by maintaining engine oil and coolant levels, keeping battery connections clean and tight, keeping the air inlet and outlet openings clear, watching the fuel gauge, and by not overloading the generator.

THE STARTER ENGAGES AND DISENGAGES

Possible Cause:

Battery voltage, battery condition, wire connections

Logic:

Cranking voltage dips below 6 volts.

Corrective Action:

- Clean and tighten the battery cable connections at the battery and at the generator.
- Recharge or replace the batteries. Refer to the battery manufacturer's recommendations.
- Clean and tighten the starter cable connections inside the generator.

THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

Possible Cause:

Battery charge system, battery condition, parasitic load

Logic:

Low or no battery voltage.

Corrective Action:

- Clean and tighten the battery cable connections at the battery and at the generator.
- Recharge or replace the batteries. Refer to the battery manufacturer's recommendations.
- Locate the DC parasitic load and repair as necessary.

THERE IS NO POWER WHEN THE GENERATOR IS RUNNING

Possible Cause:

Circuit Breaker

Logic:

Generator is running with no AC output.

Corrective Action:

- Reset or turn ON the line circuit breaker on the generator.
- Reset or turn ON any other circuit breaker in the power supply system.
- If there is no voltage, test circuit breaker CB1, and replace if necessary (page 7-2).
- Check for and tighten the top starter motor mounting bolt to secure generator lead T2 to GND.
- Check the connection of generator lead T1 to CB1-1 and repair as necessary.

THE GENERATOR WILL NOT STOP RUNNING (RUN LIGHT OFF)

Possible Cause:

Governor Actuator

Logic:

The governor mechanism is stuck or binding.

Corrective Action:

- Close the fuel supply valve, if provided, or squeeze off the fuel supply line.
- Inspect and service the governor actuator as necessary (page 5-2).
- Service the internal engine governor mechanism in accordance with the Engine Workshop Manual.

THE GENERATOR WILL NOT STOP RUNNING (RUN LIGHT ON)

Possible Cause:

Faulty wiring, control switch or remote panel.

Logic:

Control does not sense ground for stop command.

Corrective Action:

- Try stopping with the control switch inside the generator (page 2-4).
- Disconnect the remote control harness at the generator (page 2-4).
- Close the fuel supply valve, if provided, or squeeze off the fuel supply line.
- Disconnect P1 from the control board and P8 from the remote panel and check for continuity between P1-32 and P8-E. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect P1 from the control board and P9 from control switch S1 on the generator control panel and check for continuity between P1-32 and P9-1. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary. If there is continuity, test and replace switch S1 (page 7-2) as necessary.

THE GENERATOR RUNS BUT THERE IS PERSISTENT, AUDIBLE ENGINE SURGING

Possible Cause:

Fuel leaks, restrictions or air bubbles, failed rotating rectifier, cycling loads, misadjusted or faulty governor.

Logic:

Generator control adjusting to monitored input variables.

Corrective Action:

- Verify the condition under no load and full load condition utilizing a consistent non-cycling load such as a load bank.
- Check all fuel fittings for fuel and air leaks and tighten as necessary.
- Replace the fuel filters (page 3-6).
- Conduct a fuel pump test (page 5-3).
- Test and service the rotating rectifier as necessary (page 6-1).
- Remove the governor actuator, test it for proper operation and replace if necessary (page 5-2).
- Service the internal engine governor mechanism in accordance with the Engine Workshop Manual.
- Check high-idle speed and readjust if necessary.
- Service the engine in accordance with the Engine Workshop Manual.

HIGH TEMPERATURE FAULT – CODE NO. 1

Possible Cause:

Blower fan, thermostat, temperature sender, air trapped in cooling system, cooling system failing, water pump.

Logic:

First-level fault code; engine coolant temperature exceeded 230° F (110° C) for 2–3 seconds while running or 1minute upon startup.

Corrective Action:

- Check the engine coolant level and add coolant as necessary (page 3-7).
- Check for and remove any objects blocking the air inlet or outlet openings of the generator.
- Purge the coolant system of air (page 3-7).
- Flush the coolant system to remove coolant passage fouling (page 3-7).
- Tighten the terminal on temperature sensor E3 if loose (page 5-2).
- Disconnect P1 from the control board and check for continuity between J1-31 and E3. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Test coolant sender E3 and replace if necessary (page 5-2).
- Replace the engine thermostat, which might not be opening fully, in accordance with the Engine Workshop Manual.

LOW OIL PRESSURE FAULT – CODE NO. 2

Possible Cause:

Low/High oil level, faulty switch, faulty oil pressure relief valve, faulty oil pump

Logic:

First-level fault code; the low oil pressure cutoff switch opened for 3 seconds or more after oil pressure has closed the switch for 3 seconds or longer.

Corrective Action:

- Check the engine oil level and add oil as necessary (page 3-2).
- Drain excess oil if the level is above the Full mark on the dipstick. (The oil will foam if the level is too high and result in possible loss of oil pressure.)
- Tighten the terminal on pressure switch S2 if loose (page 5-1).
- Disconnect P1 from the control board and check for continuity between J1-6 and S2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Connect manual pressure gauge in place of oil pressure switch and verify oil pressure is 7 psi or greater.
- Check for a faulty switch or engine oil lubrication system and service accordingly (page 5-1).

SERVICE CHECK – CODE NO. 3

Possible Cause:

Any two digit fault code

Logic:

Single–digit fault to indicate shutdown due to a two–digit fault.

Corrective Action:

Check the *second-level* fault code by momentarily pressing Stop. Troubleshoot the two–digit fault code given.

OVERCRANK FAULT – CODE NO. 4

Possible Cause:

Faulty switch, fuel supply, wire connections, starter

Logic:

First-level fault code; cranked for 35 sec without the generator starting with the oil pressure switch closed.

Corrective Action:

- Check the fuel level and refill as necessary. (Note: The generator fuel pickup is probably higher than the vehicle engine fuel pickup.)
- Check for fuel (air) leaks at all fuel fittings and tighten as necessary.
- Check the engine air filter (page 3-4) and remove any blockage.
- Conduct a fuel pump test (page 5-3).
- Replace the fuel filters (page 3-6).
- Inspect and service the glow plugs as necessary (page 5-3).
- Inspect and service the governor actuator as necessary (page 5-2).
- Check for mechanical damage.
- Service the internal engine governor mechanism in accordance with the Engine Workshop Manual.
- Conduct cylinder compression tests (dry and wet) and service a worn engine in accordance with the Engine Workshop Manual.

OVERVOLTAGE FAULT – CODE NO. 12

Possible Cause:

Generator set loads, wire connections, generator windings

Logic:

Output voltage exceeded 115 percent of nominal for more than 3 seconds or spiked to 125 percent for less than a second.

Corrective Action:

- Verify that Last Fault is fault code 12: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Turn OFF the generator circuit breaker. If the generator now runs, the problem may be in one of the loads. Cycle the loads to determine which one it is and have it repaired.
- Measure and verify AC voltage at the customer connection block and at pins J1-34 and J1-35.
- Measure and verify AC frequency while changing engine rpm to determine if a frequency response matches engine rpm response.
- Verify balanced loads in 120/240 VAC applications: balance loads within 10 percent line-to-line as required.
- Disconnect J3 from P3 and check for continuity between P3-6 to L2 and P3-1 to L1. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect J1 from the control board and check for continuity between J1-34 to L1 and J1-35 to L2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Measure field, quadrature and main winding resistance: repair harness and replace rotor or stator as necessary.

- Measure field, quadrature and main winding resistance to ground: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to each other: repair harness and replace rotor or stator as necessary.
- Dealers contact Distributor for technical support, Distributors contact factory for technical support.

UNDERVOLTAGE FAULT – CODE NO. 13

Possible Cause:

Generator set loads, wire connections, generator windings

Logic:

Output voltage dropped below 90 percent of nominal for more than 5 seconds and current is less than 100 percent.

Corrective Action:

- Verify that Last Fault is fault code 13: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Turn OFF the generator circuit breaker. If the generator now runs, run with fewer connected loads.
- Measure and verify AC voltage at the customer connection block and at pins J1-34 and J1-35.
- Measure and verify AC frequency while changing engine rpm to determine if frequency response
- Verify balanced loads in 120/240 VAC applications: balance loads within 10 percent line-to-line as required.
- Disconnect J3 from P3 and check for continuity between P3-6 to L2 and P3-1 to L1. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect J1 from the control board and check for continuity between J1-34 to L1 and J1-35 to L2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Measure field, quadrature and main winding resistance: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to ground: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to each other: repair harness and replace rotor or stator as necessary.
- Dealers contact Distributor for technical support, Distributors contact factory for technical support.

OVERFREQUENCY FAULT – CODE NO. 14

Possible Cause:

Generator set loads, inverter/charger, engine governor, fuel supply, generator windings, wire connections

Logic:

Frequency exceeded 66 Hz for more than 6 seconds or spiked to 70 Hz for less than a second.

Corrective Action:

- Verify that Last Fault is fault code 14: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Check for a tripped generator circuit breaker, reset if necessary, and run with fewer connected loads. (A breaker tripping under load can cause frequency to overshoot.)

- Check for fuel (air) leaks at all fuel fittings and tighten as necessary. (Air bubbles can disrupt frequency.)
- Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response.
- Disconnect J1 from the control board and check for quadrature resistance between J1-2 and J1-3. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect J3 from P3 and check for continuity between J3-3 to J1-2 and J3-4 to J1-3. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Reconnect J1 and J3 connectors and test run genset for fault occurrence: repair or replace pins in connector as necessary.
- Check all grounds and neutral leads for looseness at battery & genset: tighten or replace terminals and leads as necessary.
- Check governor actuator and fuel rack for debris, damage, and looseness: readjust and repair as necessary.
- Measure field, quadrature and main winding resistance: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to ground: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to each other: repair harness and replace rotor or stator as necessary.
- Dealers contact Distributor for technical support, Distributors contact factory for technical support.

UNDERFREQUENCY FAULT – CODE NO. 15

Possible Cause:

Generator set loads, engine governor, fuel supply, generator windings, wire connections

Logic:

Frequency dropped below 54 Hz for more than 8 seconds.

Corrective Action:

- Verify that Last Fault is fault code 15: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Turn OFF the generator circuit breaker. If the generator now runs, run with fewer connected loads.
- Check the fuel level and refill as necessary. (Note: The generator fuel pickup is probably higher than the vehicle engine fuel pickup.)
- Check for fuel (air) leaks at all fuel fittings and tighten as necessary. (Air bubbles can disrupt frequency.)
- Check the engine air filter (page 3-4) and remove any blockage.
- Replace the fuel filters (page 3-6).
- Conduct a fuel pump test (page 5-3).
- Disconnect J1 from the control board and check for quadrature resistance between J1-2 and J1-3. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect J3 from P3 and check for continuity between J3-3 to J1-2 and J3-4 to J1-3. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Reconnect J1 and J3 connectors and test run genset for fault occurrence: repair or replace pins in connector as necessary.
- Check all grounds and neutral leads for looseness at battery & genset: tighten or replace terminals and leads as necessary.
- Check governor actuator and fuel rack for debris, damage, and looseness: readjust and repair as necessary.
- Measure field, quadrature and main winding resistance: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to ground: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to each other: repair harness and replace rotor or stator as necessary.
- Service the internal engine governor mechanism in accordance with the Engine Workshop Manual.
- Conduct cylinder compression tests (dry and wet) and service a worn engine in accordance with the Engine Workshop Manual.

GOVERNOR ACTUATOR FAULT – CODE NO. 19

Possible Cause:

Wire connections, governor

Logic:

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

Corrective Action:

- Verify that Last Fault is fault code 19: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Verify the actuator leads are securely connected at the governor actuator.
- Disconnect J1 from the control board and check for continuity between J1-23 and E1-1 and between Ground and E1-2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Inspect and service the governor actuator as necessary (page 5-2).

GOVERNOR OVERLOAD FAULT – CODE NO. 22

Possible Cause:

Generator set loads, inverter/charger, wire connections, fuel supply, governor actuator

Logic:

The actuator was at full-duty cycle for 10 seconds.

Corrective Action:

- Verify that Last Fault is fault code 22: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Reduce the number of appliances running at the same time.
- Check for fuel (air) leaks at all fuel fittings and tighten as necessary.
- Replace the engine air filter (page 3-4).
- Replace the fuel filters (page 3-6).
- Conduct a fuel pump test (page 5-3).
- Inspect and service the governor actuator and leads as necessary (page 5-2).
- Service the internal engine governor mechanism in accordance with the Engine Workshop Manual.
- Conduct cylinder compression tests (dry and wet) and service a worn engine in accordance with the Engine Workshop Manual.

AC VOLTAGE SENSE FAULT – CODE NO. 27

Possible Cause:

Generator set loads, inverter/charger, generator windings, wire connections

Logic:

The voltage sense signal was less than 5 VAC and frequency greater than 40 Hz.

Corrective Action:

- Verify that Last Fault is fault code 27: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Measure and verify AC voltage at the customer connection block and at pins J1-34 and J1-35.
- Disconnect J3 from P3 and check for continuity between P3-6 to L2 and P3-1 to L1. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect J1 from the control board and check for continuity between J1-34 to L1 and J1-35 to L2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.

HIGH BATTERY VOLTAGE FAULT – CODE NO. 29

Possible Cause:

Incorrect battery configuration, wire damage, faulty charger

Logic:

Battery system voltage was greater than 19.2 volts for 1 second.

Corrective Action:

- Verify that Last Fault is fault code 29: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Check battery bank connections and reconnect, if necessary, so that the 12 volt batteries are connected in parallel (12 volt) rather than in series (24 volt).
- Select a lower battery booster charge rate on vehicle's inverter/charger if applicable.
- Check all ground leads for looseness at battery & genset: tighten or replace terminals and leads as necessary.
- Connect the generator to a separate known good battery and while running the genset, verify the output voltage of the DC charge alternator. If the voltage goes above the threshold, replace the DC alternator.

STARTING FAULT – CODE NO. 32

Possible Cause:

Fuel system, starter, governor actuator, exhaust system, generator windings, battery condition, wire connections

Logic:

Cranking speed less than 2.5 Hz for more than 3 seconds.

Corrective Action:

- Verify that Last Fault is fault code 32: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Verify engine oil is of proper viscosity for the ambient temperatures. (High oil viscosity can slow down cranking speed.)
- Clean and tighten the battery cable connections at the battery and at the generator.
- Recharge or replace the batteries. Refer to the battery manufacturer's recommendations.
- Verify the starter and starter wiring to verify the starter is functional when generator is trying to start.
- Disconnect genset control J1 connector, verify J1-2 and J1-3 pins are fully inserted and inspect pin condition per PSB 676: insert, repair or replace pins as necessary.
- Disconnect J3 from P3 and check for continuity between P3-3 to Q1 and P3-4 to Q2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect J1 from the control board and check for continuity between J1-2 to Q1 and J1-3 to Q2. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Test the generator field, stator and quadrature windings for opens and shorts (page 6-1). Replace a stator or rotor that has faulty windings.
- Service the generator engine starter in accordance with the Engine Workshop Manual.

CONTROL CARD FAULT – CODE NO. 35

Possible Cause:

Control card

Logic:

Microprocessor EEPROM error during self-test.

Corrective Action:

- Verify that Last Fault is fault code 35: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Update the control calibration using InPower.
- Replace the control board (page 7-1).

GENERATOR STOPPED WITHOUT FAULT CONDITION – CODE NO. 36

Possible Cause:

Fuel supply, generator set loads, inverter/charger, governor actuator

Logic:

The generator stopped without a command from the controller.

Corrective Action:

- Verify that Last Fault is fault code 36: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Check the fuel level and refill as necessary. (Note: The generator fuel pickup is probably higher than the vehicle engine fuel pickup.)
- Check for fuel (air) leaks at all fuel fittings and tighten as necessary.
- Check the engine air filter (page 3-4) and remove any blockage.
- Conduct a fuel pump test (page 5-3).
- Replace the fuel filter (page 3-6).
- Check for mechanical damage of engine or alternator.
- Inspect and service the governor actuator as necessary (page 5-2).
- Verify the engine runs rough or smokes: Yes, conduct cylinder compression tests (dry and wet) and service a worn engine in accordance with the Engine Workshop Manual.
- Service the internal engine governor mechanism in accordance with the Engine Workshop Manual.

PROCESSOR FAULT – CODE NO. 43

Possible Cause:

Control card

Logic:

Microprocessor RAM error during self-test.

Corrective Action:

- Verify that Last Fault is fault code 43: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Update the control calibration using InPower.

- Replace the control board (page 7-1).

SPEED SENSE FAULT – CODE NO. 45

Possible Cause:

Fuel supply, governor, actuator, generator windings, wire connections

Logic:

Controller unable to sense quadrature frequency.

Corrective Action:

- Verify that Last Fault is fault code 45: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Measure quadrature winding resistance at stator leads (J1-2 and J1-3) and at J1 connector.
- Measure AC frequency while changing engine rpm to determine if frequency response matches engine rpm response.
- Disconnect J1 from the control board and check for quadrature resistance between J1-2 and J1-3. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Disconnect J3 from P3 and check for continuity between J3-3 to J1-2 and J3-4 to J1-3. If there is no continuity, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
- Reconnect J1 and J3 connectors and test run genset for fault occurrence: repair or replace pins in connector as necessary.
- Measure field, quadrature and main winding resistance: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to ground: repair harness and replace rotor or stator as necessary.
- Measure field, quadrature and main winding resistance to each other: repair harness and replace rotor or stator as necessary..
- Dealers contact Distributor for technical support, Distributors contact factory for technical support.

OVER PRIME – CODE NO. 57

Possible Cause:

Wire harness, faulty switch, auto gen start, wiring harness

Logic:

Generator is off but priming circuit continuously active for 3 minutes or more.

Corrective Action:

- Verify that Last Fault is fault code 57: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Disconnect P1 from the control board and P8 from the remote panel and check for a constant ground signal between P1-32 and P8-E. If there is a constant ground signal, bent or corroded pins and faulty wiring and repair as necessary. If there is no continuity, test and replace remote panel switch (page 2-4) as necessary.
- Disconnect P1 from the control board and P9 from control switch S1 on the generator control panel and check for a constant ground signal between P1-32 and P9-1. If there is a constant ground signal, bent or corroded pins and faulty wiring and repair as necessary. If there is no continuity, test and replace switch S1 (page 7-2) as necessary.

ALTERNATOR OVER TEMP – CODE NO. 76

Possible Cause:

DC fan, blower fan, temperature sender, wiring harness

Logic:

Temperature at generator alternator is greater than 180 degrees (F).

Corrective Action:

- Verify that Last Fault is fault code 76: Yes, continue diagnosis; No, troubleshoot actual last fault.
- Verify the genset enclosure for clear intake and exhaust air openings.
- Verify the temperature at the back side of the alternator within the genset.
- Verify the temperature sensor resistance between J2-4 and ground. Replace as necessary.
- Measure the temperature sensor wiring between J2-4 and temperature sensor for continuity. Repair or replace as necessary.
- Dealers contact Distributor for technical support, Distributors contact factory for technical support.

THIS PAGE LEFT INTENTIONALLY BLANK

9. Bolt Torques

	lb-ft	N-m
Cooling Fan Guard Screws	20–25 in-lb	2.3–2.8
Cooling Fan Plate Screws	20–25 in-lb	2.3–2.8
Cooling Fan Hub Screw	36–44	49–60
Cooling Fan Screws	7–9	9.5–12.2
Compartment Cooling Fan Hose Clamp Screws	20–25 in-lb	2.3–2.8
Scroll Housing Screws	4.4–5.2	6–7
Coolant Hose Screws	15–19	20–25.7
Water Tube Bracket Screws	27.3–33	37–44.7
Radiator Duct Bracket Screws	15–19	20–25.7
Alternator End Bell Screws	4.4–5.2	6–7
Skid Mounting Scerws	7–9	9.5–12.2
Flywheel Scerws	56–68	76–92
Engine Adapter Screws	27–33	37–44.7
Lifting Bracket Screw	56–68	76–92
Lifting Bracket Flange Screw	15–19	20–25.7
Water Sender	8–12	11–16
Terminal Nut on Water Sender	6–8 in-lb	0.7–0.9
Starter Mounting Screws	31–38	42–51.5
Engine Mount Alternator-side Screw	56–68	76–92
Engine Mount Fan-Belt-side Screw	27–33	37–44.7
Engine Oil Drain Valve	31–38	42–51.5
Governor Actuator Mounting Screws	7.2–9.3	9.8–12.6
Air Filter Bracket Engine Mounting Screws	15–19	20–25.7
Air Filter Mounting Screws	8–12	11–16
Intake Resonator Clamp Screws	25–30 in-lb	2.8–3.4
Air Hose Clamp Screws	25–30 in-lb	2.8–3.4
Fuel Hose Loop Clamp Screw	7.2–9.3	9.8–12.6
Fuel Filter Bracket Engine Mounting Screws	56–68	76–92
Fuel Filter Bracket Fuel Filter Mounting Screws	15–19	20–25.7
Fuel Filter Bracket Side Mounting Screws	7.2–9.3	9.8–12.6
Fuel Pump Nuts	7.2–9.3	9.8–12.6
Fuel Hose Fitting Nut	22.1–29.5	30–40
Generator Mounting Screws	27–33	37–44.7
Silencer Underneath Mounting Screw	56–68	76–92
Silencer Top Mounting Nuts	15–19	20–25.7
Heat Shield Screws and Nuts	15–19	20–25.7
Vibration Isolator Center Mounting Screws	56–68	76–92
Vibration Isolator Side Mounting Screws	15–19	20–25.7

	lb-ft	N-m
Control Cover Screws	7.2–9.3	9.8–12.6
Control Box Generator Lead Screws	7.2–9.3	9.8–12.6
Control Box Circuit Breaker Mounting Screws	1.2–1.5	1.6–2.0
Control Box Saddle Screws	17.7–19.2	24–26
Ground Strap Screws and Nuts	17.7–19.2	24–26
Starter Battery Screws	7.2–9.3	9.8–12.6
Battery Harness Skid Mounting Screws	7.2–9.3	9.8–12.6
Control Card Bottom Mounting Screws	7.2–9.3	9.8–12.6
Control Box Relay Mounting Screws	4.4–5.2	6–7
Control Card Side Mounting Screws (to Back of Control Box)	4.4–5.2	6–7
Control Saddle Alternator Mounting Screws	17.7–19.2	24–26
Temperature Switch	2–3	2.7–4.1
Fan Belt Guard Brackets Engine Mounting Screws	17.7–21.4	24–29
Fan Belt Guard Mounting Screws	3.0–3.6	4.2–4.8

10. Specifications

⚠ CAUTION ***Do not convert the generator set from 60 Hz to 50 Hz. Attempting to do so will damage the equipment.***

MODEL:	**HDKAW**
GENERATOR SET CONTROL: Integrated Microprocessor-Based Engine and Generator Controller	
GENERATOR: Single-Bearing, 4-Pole Rotating Field	
Power (@1.0 power factor)	20,000 W
Voltage	120 / 240
Frequency	60 Hz
Number of Phases	1
Current	83.3 amps per leg
Line Circuit Breaker	2-pole, 85 amp
FUEL CONSUMPTION:	
No-load Half-load Full-load	0.54 gph (2.04 lph) 1.12 gph (4.24 lph) 1.95 gph (7.39 lph)
ENGINE: 4-Cylinder In-Line, Water-Cooled, Indirect-Injection (IDI), 4-Stroke Cycle Diesel	
Model	V2403
Bore	3.43 in (87 mm)
Stroke	4.03 in (102.4 mm)
Displacement	148.53 in^3 (2,434 cc)
Compression Ratio	24.3 : 1
Fuel Injection Timing (BTDC)	13.5° ± 15°
Firing Order (Clockwise Rotation)	1–3–4–2
Fuel Nozzle Injection Pressure	1991 psi (13.73 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)	10 quart (9.5 liter)
Cooling System Capacity	7.8 quart (7.4 liter)
DC SYSTEM:	
Nominal Battery Voltage	12 volts
Minimum Battery Capacity CCA (Cold Cranking Amps)	650 amps down to 0°F (–17°C) 875 amps down to –10°F (–23°C) 1000+ amps down to –20° F (–29°C)
Maximum Regulated Charging Current	40 amps
WEIGHT:	890 lbs (404 kg)
SIZE (L x W x H): 48.9 x 23.6 x 29.7 in (1241 x 600 x 708 mm)	

MODEL:	HDKAW
SOUND LEVEL:	
60 Hertz Models	81.9 dB(A) @ 10 ft (3m) before installation @ full load

11. Service Checklist

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.

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 connections, 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.***

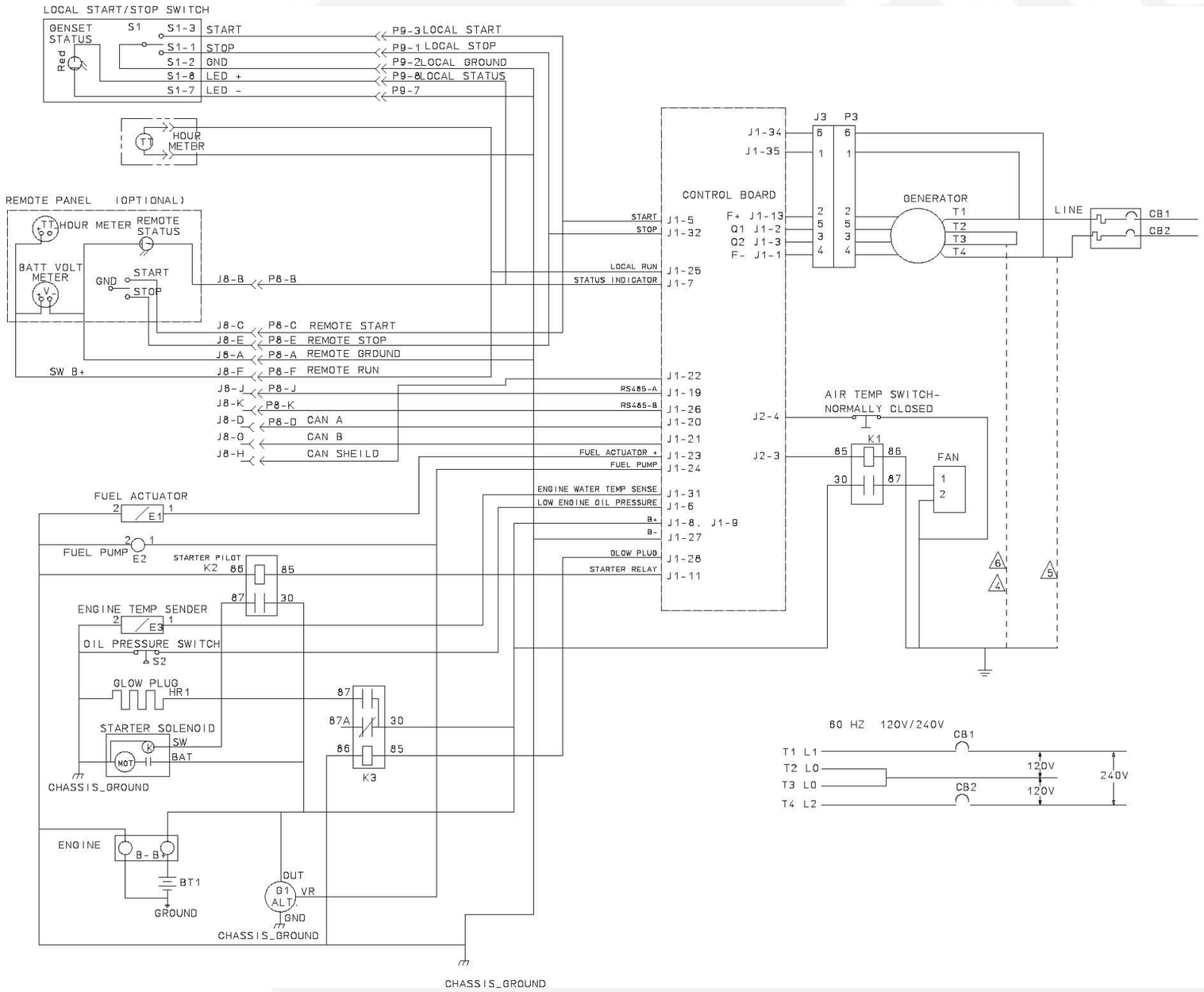
Control

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.

THIS PAGE LEFT INTENTIONALLY BLANK



NOTES:

1. ALL COMPONENTS SHOWN IN DE-ENERGIZED STATE.

2. 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.

3.

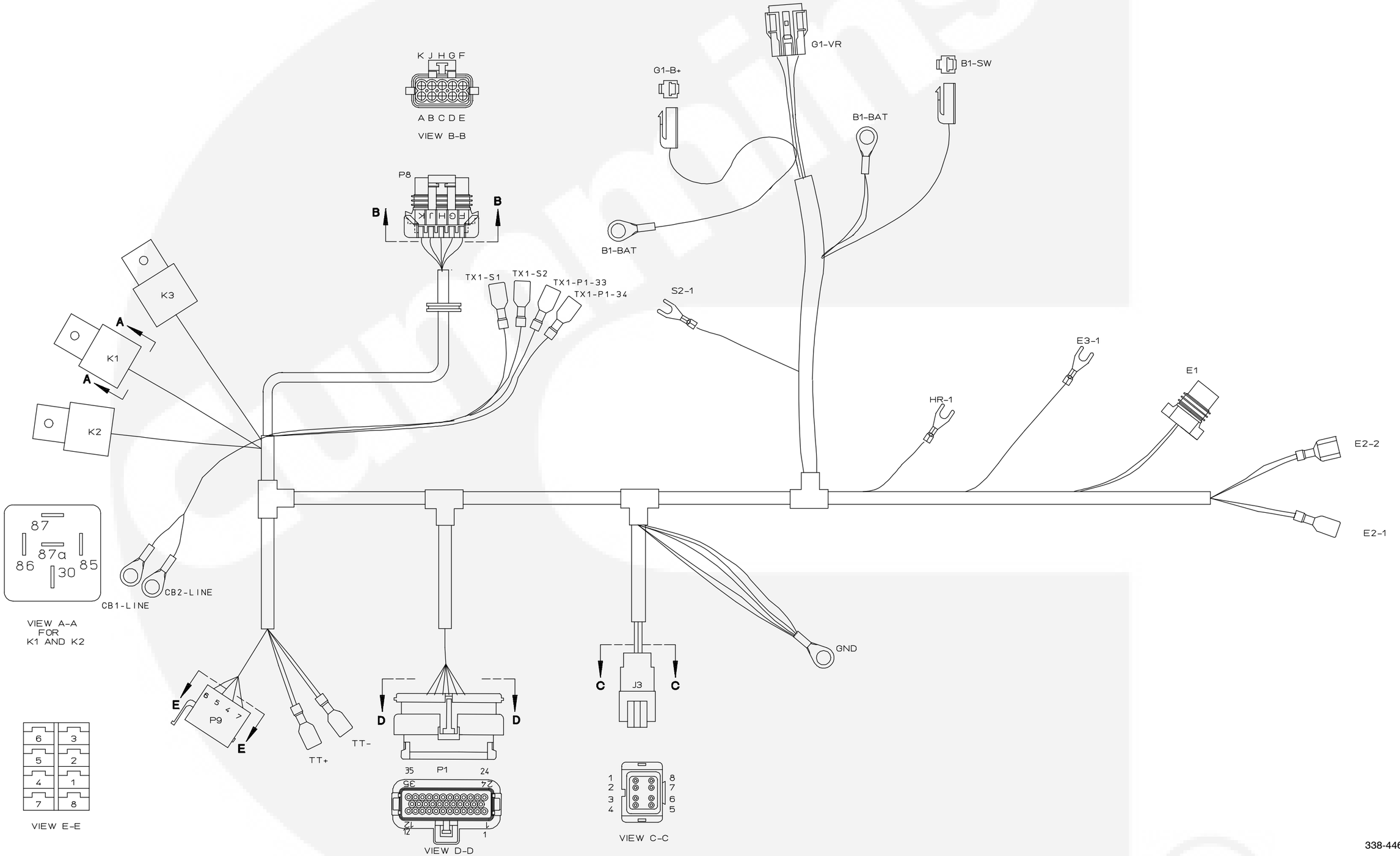
4. FOR ALL MODELS EXCEPT ISOLATED NEUTRAL, CONNECT GENERATOR LEADS T3 AND T2 TO CONTROL BOX GROUND.

5. FOR ISOLATED NEUTRAL CONNECTIONS, CONNECT RING TERMINAL OF LEAD A026J474 FROM CB2 LINE SIDE TO CONTROL BOX GROUND.

6. FOR ISOLATED NEUTRAL, INSTALL ISOLATED POST 0332-2370 TO STUD ON CONTROL BOX A026F554 AND TORQUE TO 9.8 - 12.6Nm. CONNECT T2 AND T3 TO ISOLATED POST WITH FASTENER 0821-0008 AND TORQUE TO 9.8 - 12.6 Nm.

No. A026E150 sh 1 of 1
Rev. E
Modified 05/10

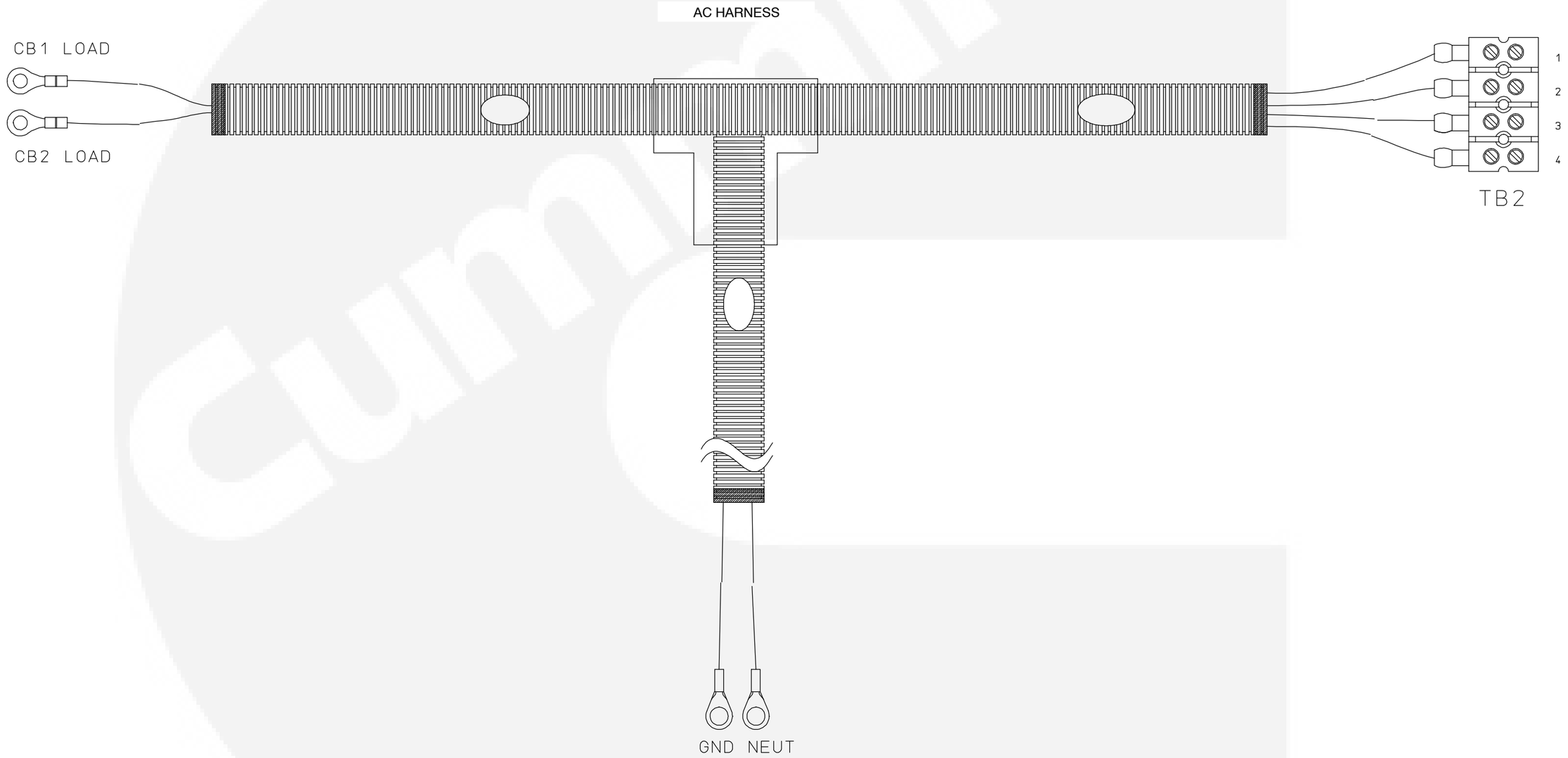
CONTROL SCHEMATIC



338-4461

CONTROL WIRING HARNESS

A-2

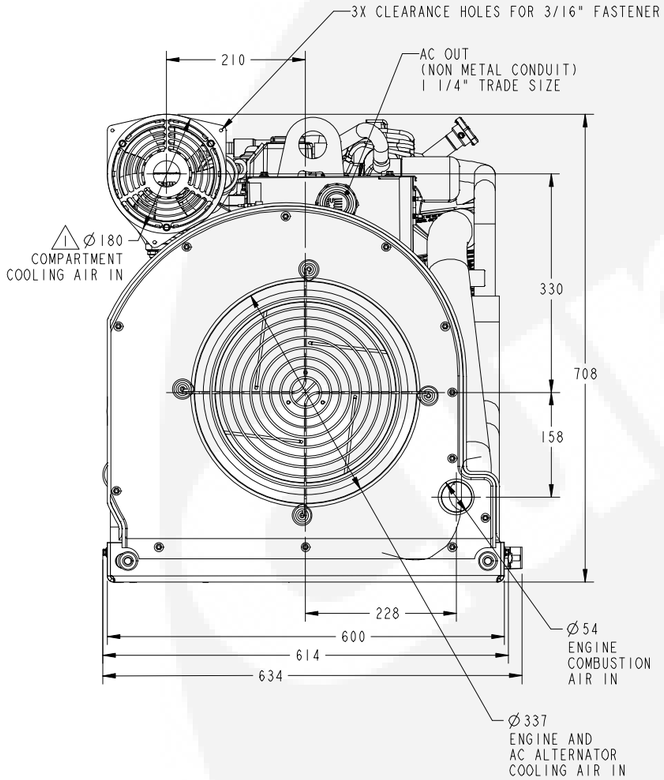


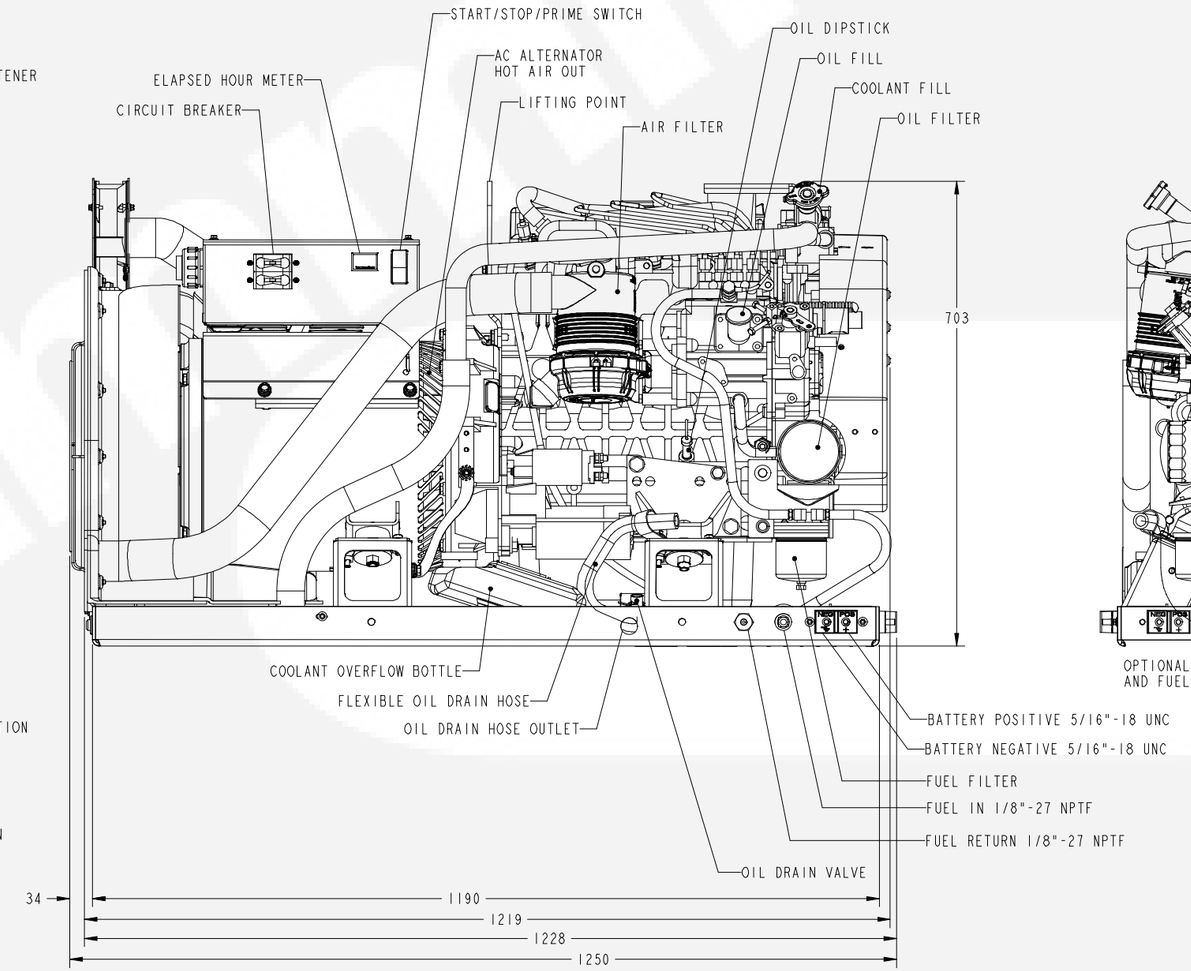
AC WIRING HARNESS

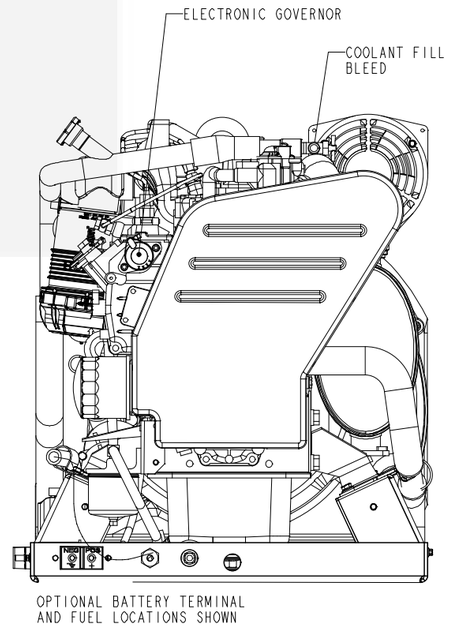
A-3

NOTES:

1. COMPARTMENT COOLING FAN KIT INSTALLED AT TIME OF GENERATOR SET INSTALLATION.





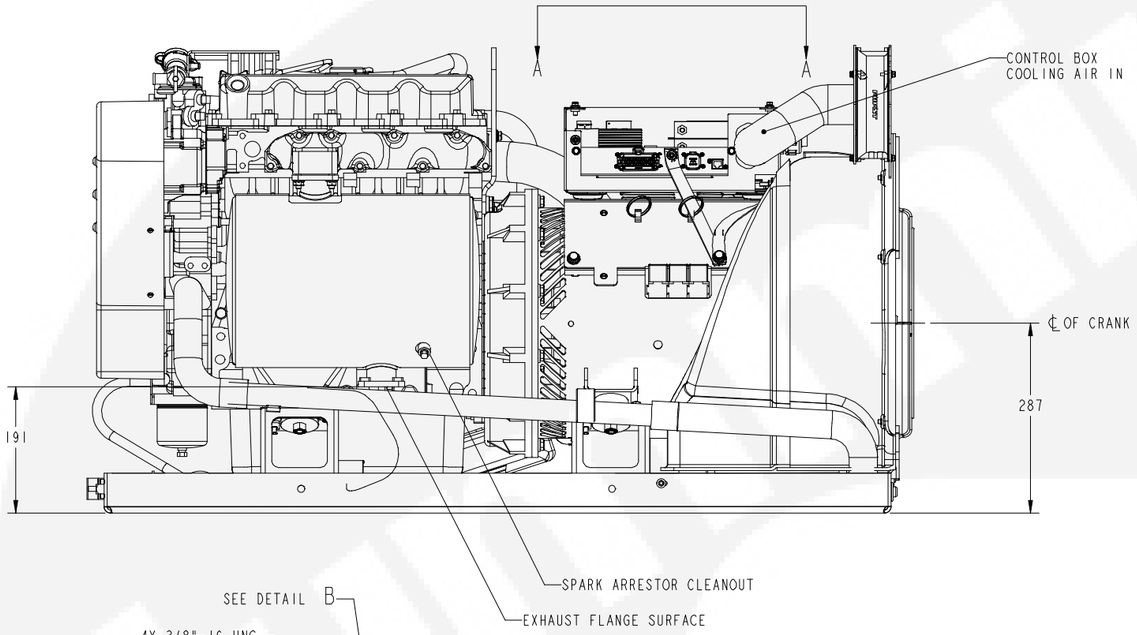


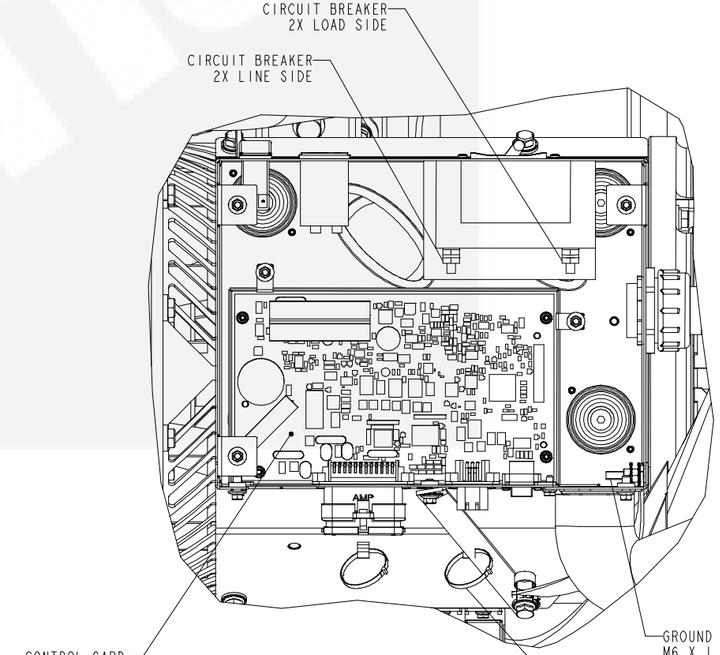
OPTIONAL BATTERY TERMINAL
AND FUEL LOCATIONS SHOWN

No. A026K862 sh 1 of 2
Rev. B
Modified 17/09

OUTLINE DRAWING

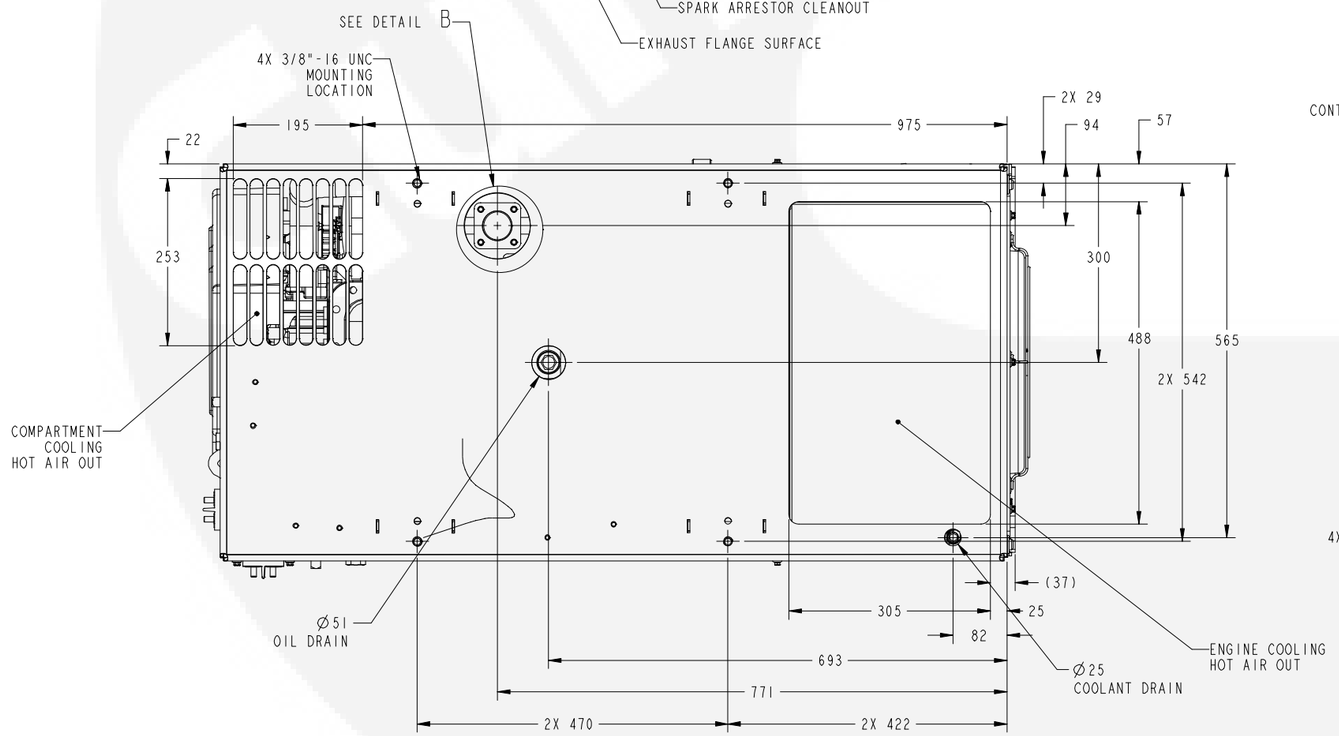
A-4

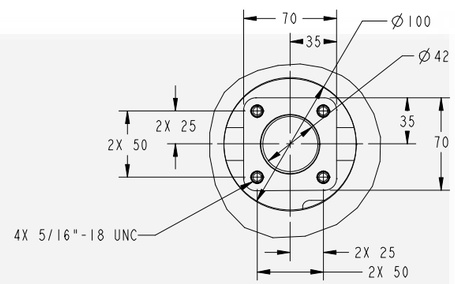




VIEW A-A
SCALE 1/2

ISOLATED POST FOR
50 HZ 230 VAC AND
50 HZ GROUND WIRE
NOT SHOWN FOR CLARITY





DETAIL B
SCALE 1/2

No. A026K862 sh 2 of 2
Rev. B
Modified 17/09

THIS PAGE IS INTENDED TO BE BLANK

Cummins **Onan**

Cummins Power Generation
1400 73rd Ave. NE
Minneapolis, MN 55432 USA

Phone 1 763 574 5000
Toll-free 1 800 888 6626
Fax 1 763 574 5298
Email www.cumminsonan.com/contact
www.cumminsonan.com