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Service Manual

MDDCA	MDDCB	MDDCC
MDDCD	MDDCE	MDDCF
MDDCG	MDDCH	MDDCJ

California

Proposition 65 Warning

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

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SAFETY PRECAUTIONS

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

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

GENERAL PRECAUTIONS

- Keep children away from the genset.
- Do not use evaporative starting fluids. They are highly explosive.
- Do not step on the genset when entering or leaving the generator room. Parts can bend or break leading to electrical shorts or to fuel, coolant or exhaust leaks.
- To prevent accidental or remote starting while working on the genset, always 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, drip pan and compartment clean. Oily rags can catch fire. Gear stowed in the compartment can restrict cooling.
- Make sure all fasteners are secure and properly torqued.
- 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. (ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to shore power. 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.

ENGINE EXHAUST IS DEADLY

- Never sleep in the boat while the genset is running unless the boat is equipped with properly working carbon monoxide detectors.
- The exhaust system must be installed in accordance with the genset Installation Manual and be free of leaks.
- Make sure the bilge is adequately ventilated with a power exhauster.
- Inspect for exhaust leaks at every startup and after every eight hours of operation.
- For more information about carbon monoxide poisoning see the American Boat and Yacht Council (ABYC) publication TH-22—*Educational Information About Carbon Monoxide*.

DIESEL FUEL IS COMBUSTIBLE

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

BATTERY GAS IS EXPLOSIVE

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not wear loose clothing or jewelry near moving parts such as PTO shafts, fans, belts and pulleys.
- Keep hands away from moving parts.
- Keep guards in place over fans, belts, pulleys, and other moving parts.

FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, possibly resulting in fire, explosion, severe personal injury or 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 safely operating the genset.

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.*

Operation, Periodic Maintenance and Troubleshooting provide the instructions necessary for operating the genset and maintaining it at top performance. The owner is responsible for performing maintenance in accordance with the PERIODIC MAINTENANCE SCHEDULE (p. 4-1). This manual also includes genset specifications and information regarding compliance with emissions regulations.

See the Parts Manual for part identification numbers and required quantities. Genuine Onan® replacement parts are recommended for best results.

MODEL IDENTIFICATION

Be ready to provide the genset model and serial numbers on the nameplate when contacting Onan for parts, service and product information. Figure 1-1 illustrates the nameplate and its location on the side of the control box. Every character in these numbers is significant. (The last character of the model number is the specification letter, which is important for obtaining the right parts.)

⚠ WARNING *Improper service or replacement of parts can lead to severe personal injury or death and to damage to equipment. Service personnel must be trained and experienced in performing electrical and mechanical service.*

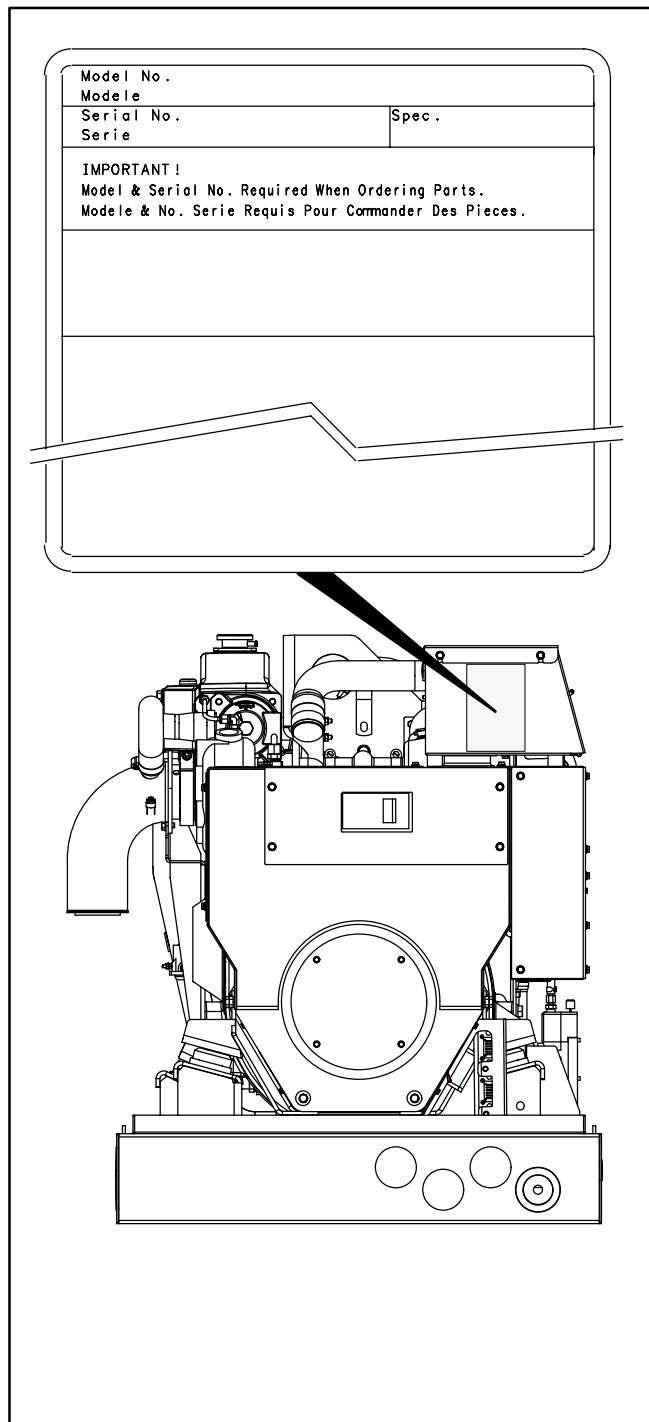


FIGURE 1-1. TYPICAL NAMEPLATE

U. S. FEDERAL EMISSIONS LABEL

The label that states compliance with applicable EPA emissions regulations is located on the side of the valve cover (Figure 1-2). Refer also to the FED-

ERAL EMISSION DESIGN AND DEFECT LIMITED WARRANTY FOR C. I. ENGINES (DIESELS) that was shipped in the same package as the genset Operator's Manual.

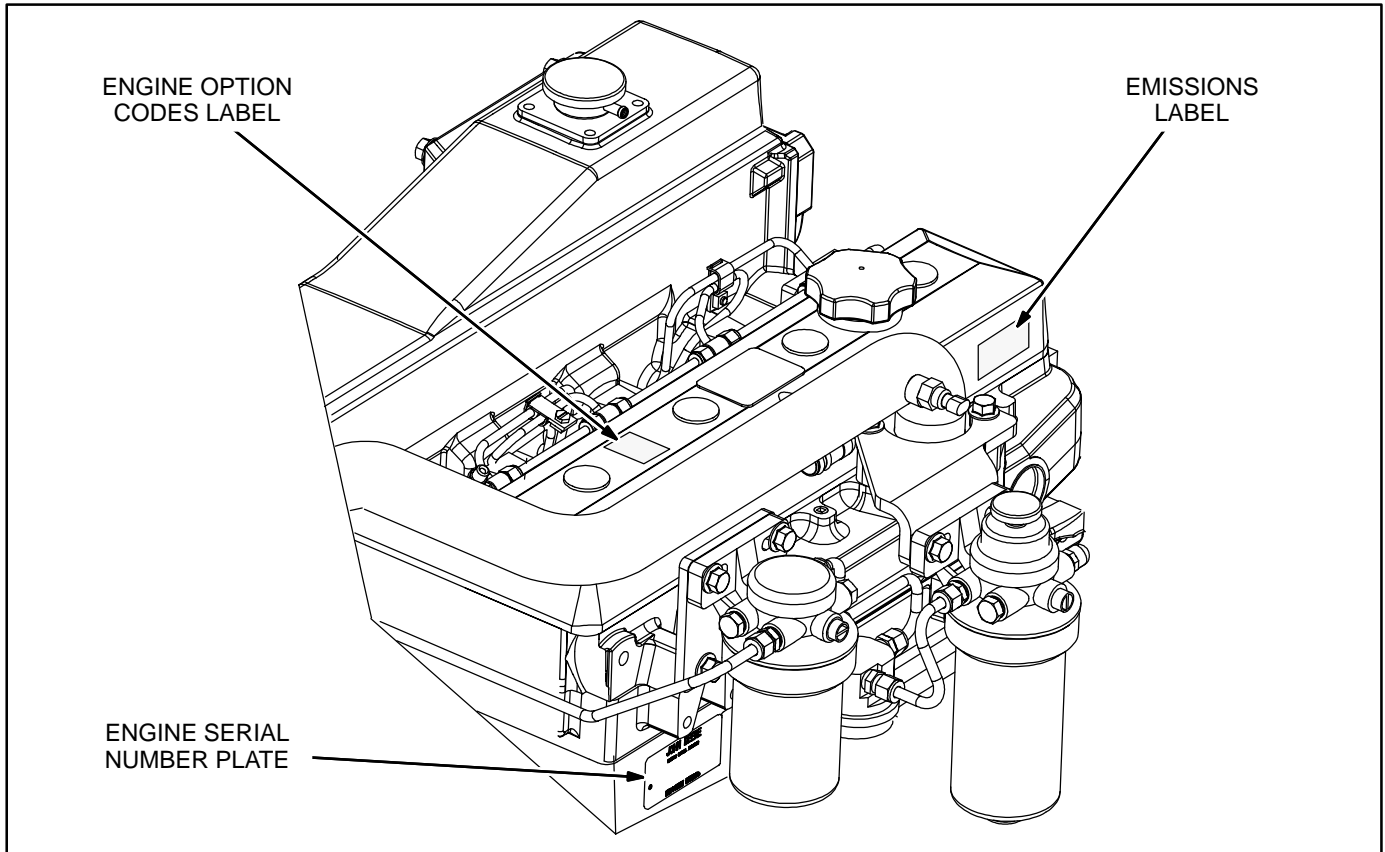


FIGURE 1-2. ENGINE LABELS

2. Genset Control Panel

LOCAL CONTROL PANEL

The genset control panel either has an e-Series Digital Display or a control switch with status lamps. A genset equipped for operation in parallel with other

gensets will have a single/parallel operation selector switch. It may also have a manual voltage regulator. If the genset has a housing, remove the front panel for access to the selector switches and manual voltage adjusting knob. See Figure 2-1.

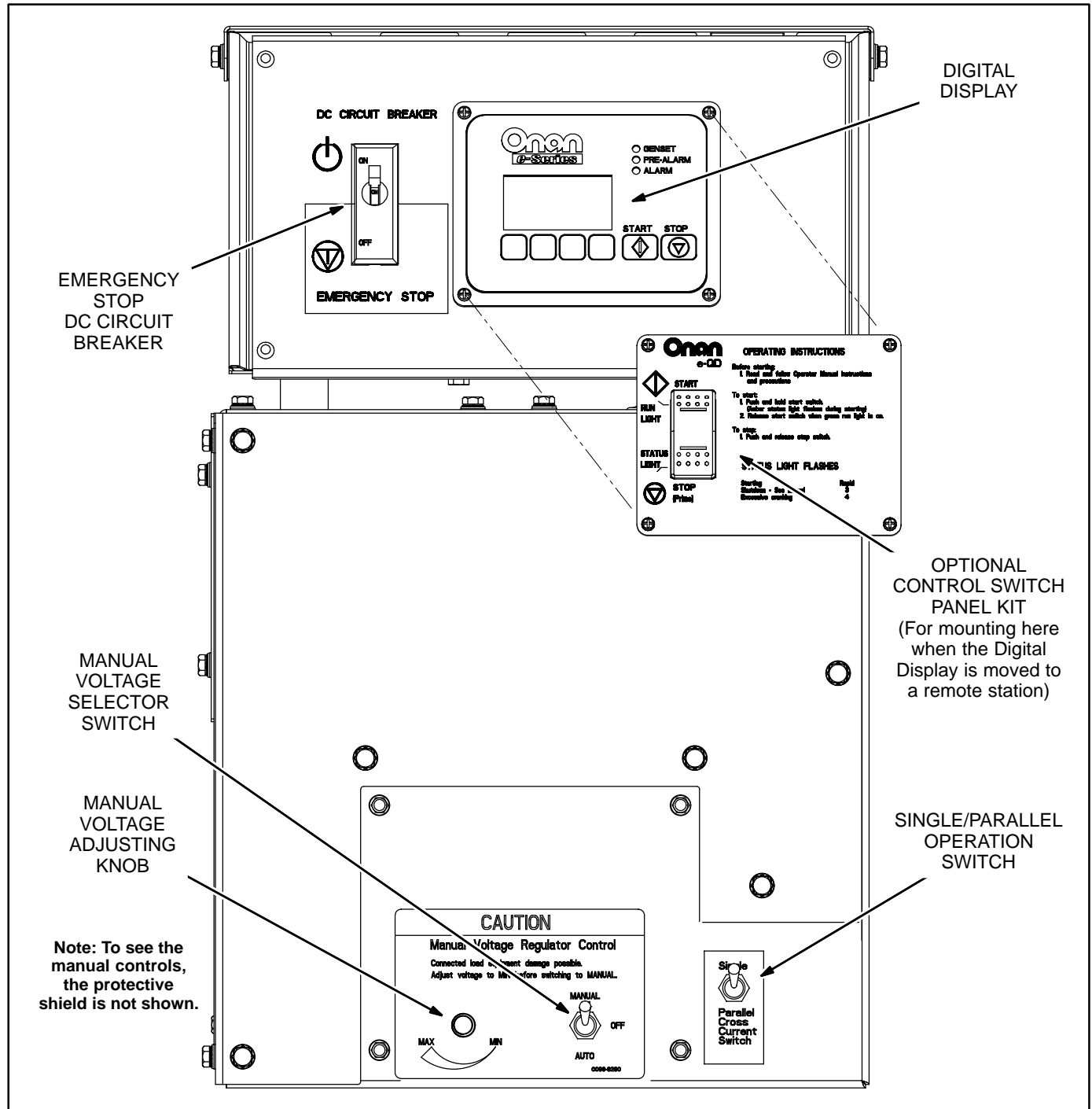


FIGURE 2-1. GENSET CONTROL PANEL

EMERGENCY STOP SWITCH

This is a 20 amp circuit breaker that protects the genset control circuits from shorts to ground. Push the red handle down to stop the genset.

CONTROL SWITCH

Control Switch: This switch is used to start and stop the genset and prime fuel (if the genset is equipped with an auxiliary electric fuel pump).

- *Push and Hold* **START** until the genset starts (green lamp comes on).

- *Push and Release* **STOP (Prime)** to stop the genset.
- *Push and Hold* **STOP (Prime)** to prime the fuel system (amber lamp comes on in 2 seconds to indicate priming).

Status Lamps: The control switch has two status lamps. The *amber* status lamp comes on during priming, blinks rapidly during cranking and goes out when the engine is up to speed. If the genset shuts down abnormally, this lamp will slowly blink a numerical code to indicate the cause of shutdown. See *Section 8. Troubleshooting*. The *green* status lamp comes on to indicate that the genset is running.

DIGITAL DISPLAY

The e-Series Digital Display has an LCD screen with 4 navigation buttons, 3 status lamps, a START button and a STOP button (Figure 2-2).

Turning On the Display

Touch any button to turn on the Display, which will initialize and attempt to establish communications with the genset controller. All connected Displays will turn on automatically when the genset is started at any station. They will all turn off 5 minutes after the genset has received a normal command to stop. They will stay on indefinitely until a fault shutdown is cleared by touching any button on any Display.

Start Button

Starting the Genset: *Push and Hold START* until the genset starts. The GENSET status lamp blinks while the engine is cranking. It comes on when the genset starts and stays on while it runs. The status displayed on the LCD changes from *Starting* to *Running* (Figure 2-3). See STARTING THE GENSET (p. 3-3).

Stop Button

Stopping the Genset: *Push and Release STOP*. The GENSET status lamp will go out. The status displayed on the LCD will change from *Running* to *Stopped* (Figure 2-3). See STOPPING THE GENSET (p. 3-4).

Priming the Fuel System: *Push and Hold STOP*. The GENSET status lamp will blink. The status displayed on the LCD will change to *Priming* in 2 seconds (Figure 2-3). See PRIMING THE FUEL SYSTEM (p. 3-3).

Genset Status Lamps

GENSET – This status lamp (green) blinks while the engine is cranking or the fuel system is being primed. It stays on while the genset is running.

PRE-ALARM – This status lamp (amber) comes on when an engine Pre-Alarm condition exists (p. 2-7). It blinks rapidly while the genset is running in fault bypass mode (p. 2-10) or voltage adjust mode (p. 6-15).

ALARM – This status lamp (red) blinks during fault shutdown (p. 2-5).

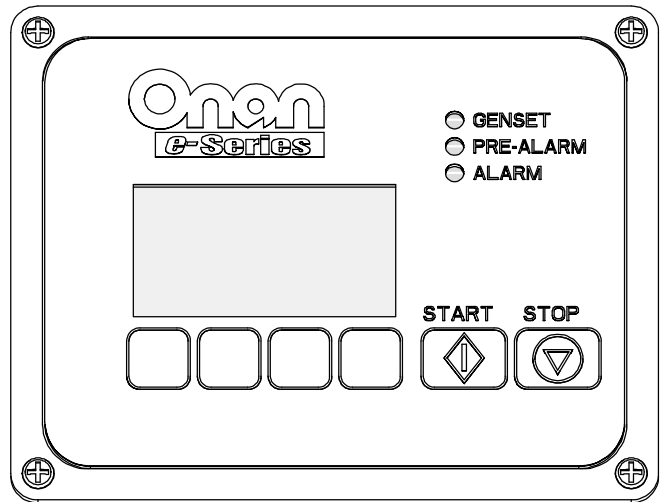


FIGURE 2-2. DIGITAL DISPLAY

Genset Status

Genset status is displayed on 4 screen pages (Figure 2-3). GEN STATUS PG1 appears when the Display is turned on. Press the double arrows [↔] to toggle between the 4 screen pages.

The *Status* line on PG1 will display the word *Prim-ing*, *Starting*, *Running*, *Stopped*, *Volt Adj.* or *Fault Override*. The rest of the lines on the 4 status screen pages display AC output voltage, AC frequency, percentage of full load in 10 percent increments (bar graph), engine coolant temperature, engine oil pressure, engine RPM, engine air intake manifold temperature, fuel temperature, fuel rate (consumption), starting battery voltage and total genset running time.

Note: The total time on the master hour meter in the genset control box (Page 5-4) prevails if the total time on the e-Series Digital Display is different. See **Configuring Replacement Genset Controller** (p. 2-9) to reset the Digital Display to match the master hour meter.

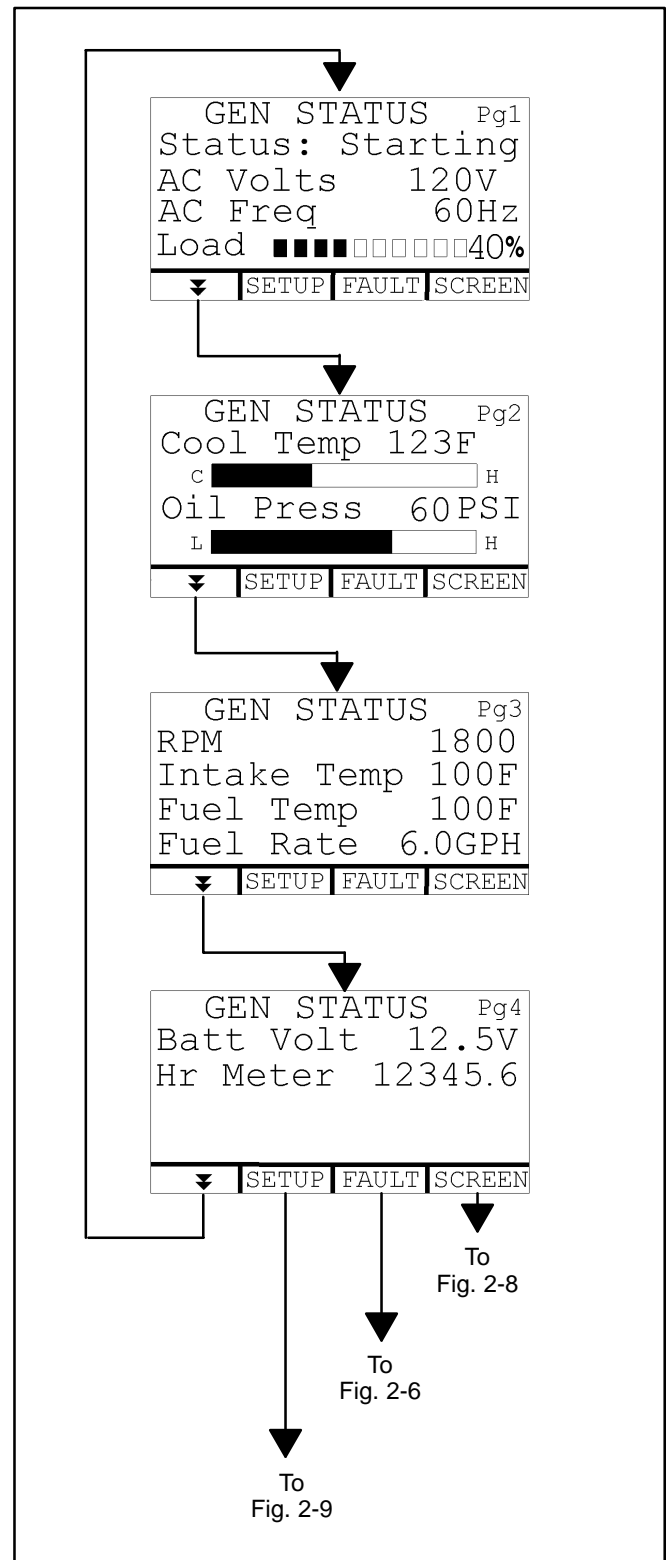


FIGURE 2-3. TYPICAL GENSET STATUS SCREENS

Fault Screen

When Fault Occurs: If a fault shutdown occurs the ALARM status lamp will blink and the LCD screen will display the Fault Number, a description of the Fault and the hour in total genset running time when the Fault occurred (Figure 2-4). Refer to TABLE 8-1. TROUBLESHOOTING GENSET FAULTS to diagnose and correct the problem.

The e-Series Digital Display will display the fault indefinitely. Touch any button to clear the fault. The display will turn off in 5 minutes after the fault has been cleared.

Engine Fault—No. 16: If this fault occurs, press the INFO button (which appears only for this fault) to display the engine FAULT INFO screen for a description of the engine fault (Figure 2-5). If this fault occurs see TABLE 8-2. TROUBLESHOOTING ENGINE FAULT—NO. 16.

The SPN and FMI numbers displayed on the FAULT INFO screen are the diagnostic code numbers used in the SAE J1939 engine data network protocol supported by the genset.

Press [◀BACK] to go back to the GEN STATUS screen.

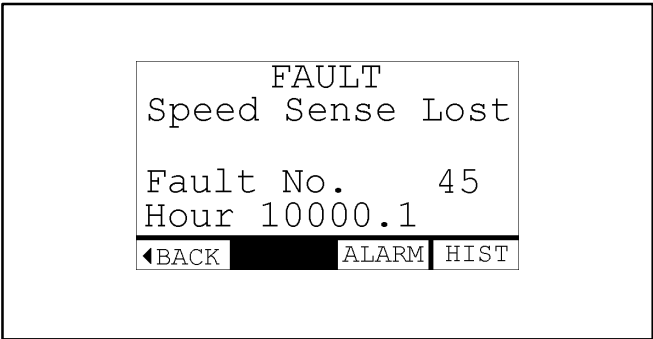


FIGURE 2-4. TYPICAL FAULT SCREEN

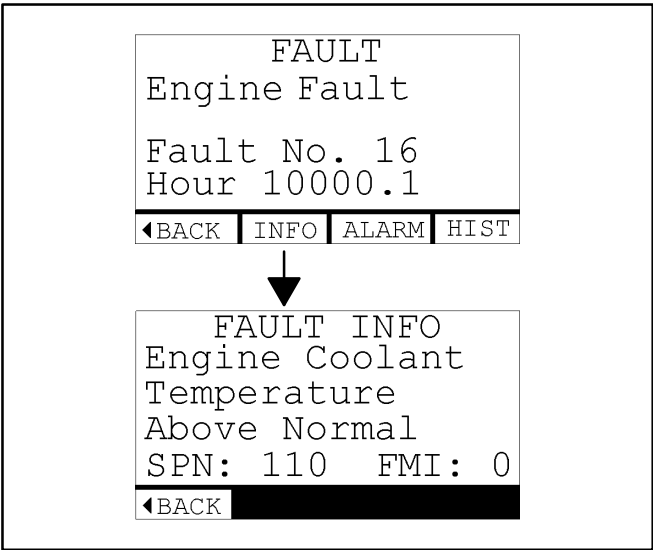


FIGURE 2-5. TYPICAL ENGINE FAULT SCREENS

Fault History

To display any of the last five faults, press the FAULT button on any GEN STATUS screen. Then press the HIST button on the FAULT screen (Figure 2-6).

The FAULT HISTORY screen will display the last Fault Number, a description of the Fault and the hour in total genset running time when the fault occurred. Press the double arrows [↕] to toggle between the last 5 faults. If there are no faults, the FAULT HISTORY screen will display *No Stored Faults*.

Press [↶BACK] to go back to GEN STATUS.

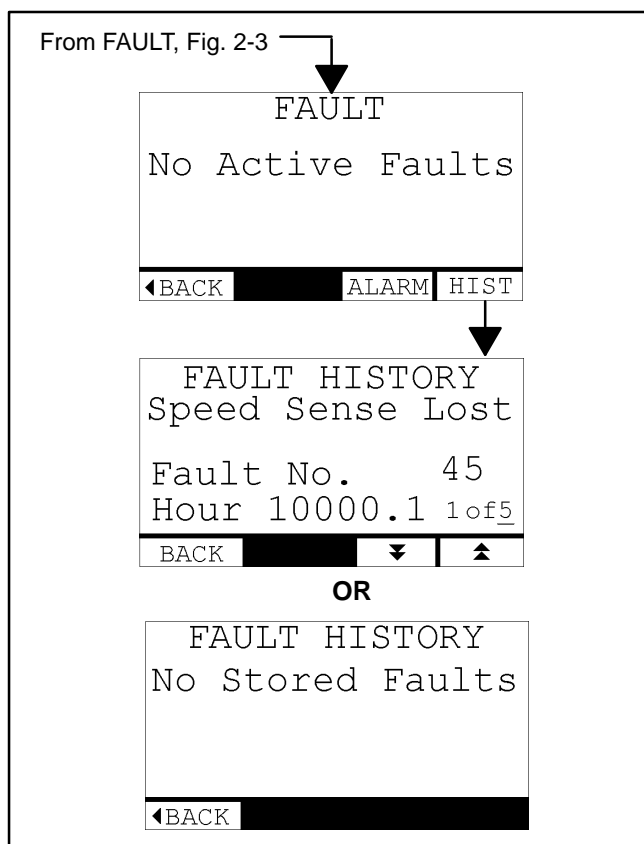


FIGURE 2-6. FAULT HISTORY

Engine Pre-Alarms

The PRE-ALARM status lamp will start to blink as certain engine running conditions approach their limits for engine shutdown. To display information about the pre-alarm condition, press the FAULT button on any GEN STATUS screen. Then press the ALARM button to display the PRE-ALARM screen (Figure 2-7).

The PRE-ALARM screen will display a brief description of the condition and the SPN and FMI numbers, which are the diagnostic code numbers used in the SAE J1939 engine data network protocol supported by the genset.

Refer to TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARMS to diagnose and correct the problem.

Press [◀BACK] to go back to GEN STATUS.

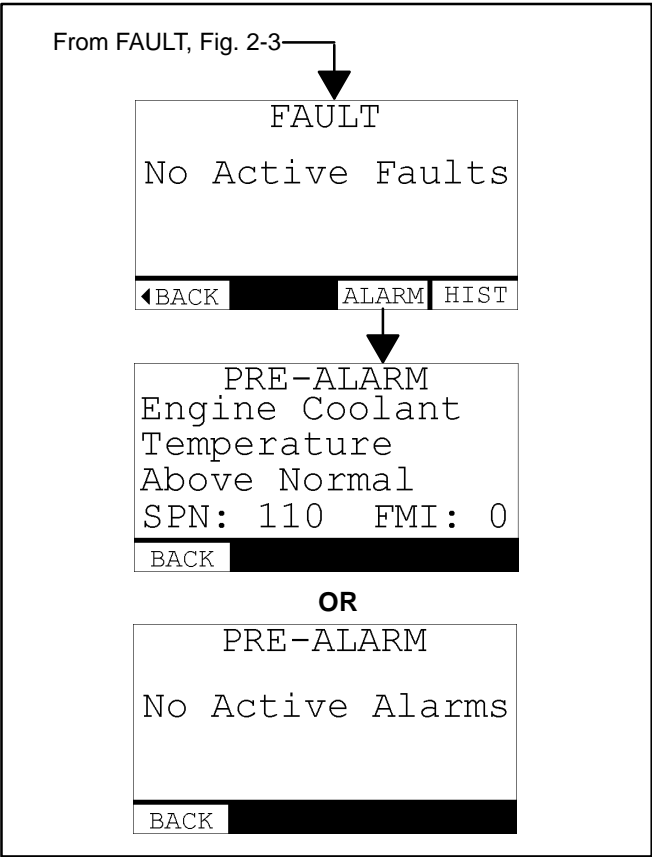


FIGURE 2-7. ENGINE PRE-ALARMS

Brightness and Contrast

To adjust the brightness and contrast of the LCD screen and status lamps, go to the SCREEN ADJUST screen by pressing SCREEN on any GEN STATUS screen. Press NEXT to select *Brightness* or *Contrast*. Increase or decrease the selected item by pressing the increase-decrease buttons [◀ ▶]. See Figure 2-8. (“Contrast” applies only to the LCD screen.)

Press [◀BACK] to save the settings and go back to GEN STATUS.

Display Setup

Go to the SETUP screen by pressing SETUP on any GEN STATUS screen. Press the up-down arrows [▼ ▲] to select *Display Setup* and press ENTER. See Figure 2-9.

Units: To change the units of measure on the GEN STATUS screens, press NEXT to select Units. Then press the up-down arrows [▼ ▲] to toggle between Metric and SAE units.

Press [◀BACK] to save the selection and go back to GEN STATUS.

AC Voltmeter Calibration: To calibrate the Display Voltmeter, press NEXT to select AC Voltmeter Calibration. Then press the up-down arrows [▼ ▲] to increase or decrease the voltage displayed to correspond to an accurate AC output voltmeter (line-to-line or line-to-neutral, as desired).

Press [◀BACK] to save the selection and go back to GEN STATUS.

Note: This procedure does not change AC output voltage. See *To Adjust Voltage Using Digital Display* (p. 6-15).

Genset and Display Information

Go to the SETUP screen by pressing SETUP on any GEN STATUS screen. Press the up-down arrows [▼ ▲] to select *Genset Info* or *Display Info* and press ENTER. See Figure 2-9. This information may be requested by the service technician.

Keep pressing [◀BACK] to get back to GEN STATUS.

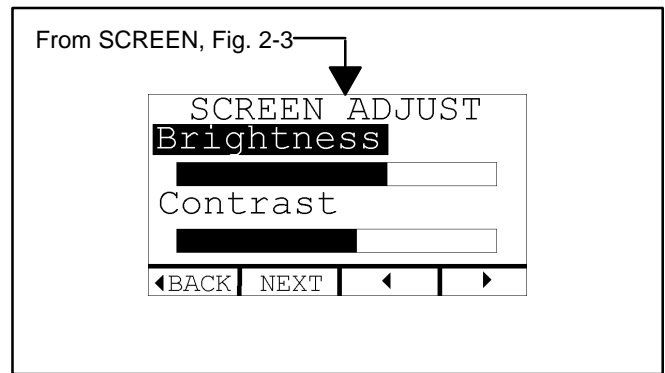


FIGURE 2-8. SCREEN BRIGHTNESS & CONTRAST

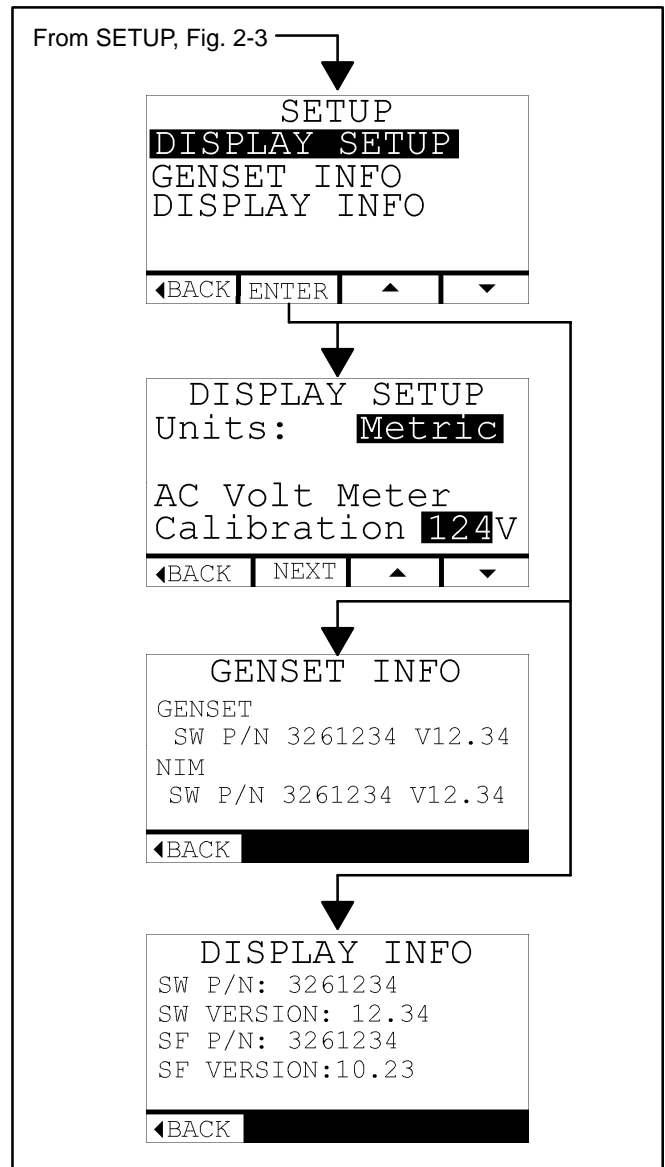


FIGURE 2-9. SETUP, GENSET & DISPLAY INFO

Configuring a Replacement Genset Controller

A replacement genset controller must be configured to match the genset configuration. Otherwise, an INVALID GENSET CONFIGURATION—CODE NO. 37 shutdown will occur at startup (p. 8-7). Also, the Digital Display hour meter should be reset to match the master hour meter (p. 5-5).

Setting Configuration: Stop the genset and then press STOP 6 times to display the configuration screen (Figure 2-10). Press NEXT to select *Genset Config*. Press the up-down arrows [▼ ▲] to select the configuration number marked on the genset nameplate. Also see Table 2-1.

Press [◀BACK] to save the selection and get back to GEN STATUS.

Resetting Digital Display Hour Meter: Press NEXT to select *Set Hour Meter*. Then press the up-down arrows [▼ ▲] to match the number of hours on the master hour meter (p. 5-5).

Press [◀BACK] to save the selection and get back to GEN STATUS.

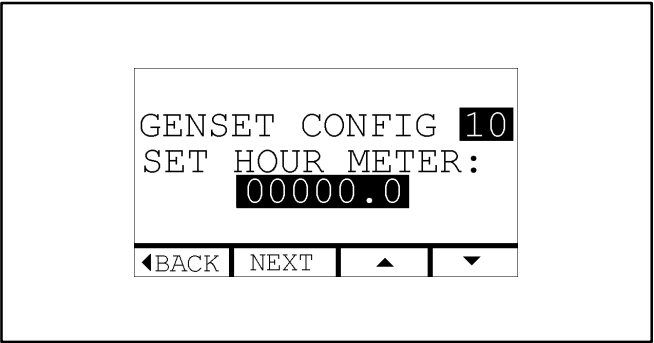


FIGURE 2-10. CONFIGURING CONTROLLER AND SETTING HOUR METER

TABLE 2-1. GENSET CONFIGURATION NUMBERS

GENSET MODEL	CONFIGURATION NUMBER
MDDCA & MDDCF—1-Phase	27
MDDCA & MDDCF—3-Phase	34
MDDCB & MDDCG—1-Phase	28
MDDCB & MDDCG—3-Phase	35
MDDCC—1-Phase	29
MDDCC—3-Phase	36
MDDCD & MDDCH—1-Phase	31
MDDCD & MDDCH—3-Phase	37
MDDCE & MDDCJ—1-Phase	32
MDDCE & MDDCJ—3-Phase	38

SINGLE / PARALLEL GENSET OPERATION SWITCH

A PMG-excited generator is designed for paralleling applications. A current transformer (CT) is provided to detect reactive current so that excitation can be regulated between the generators. The switch shorts the CT circuit for single generator operation. See Figure 2-1.

Parallel Operation

To prepare the gensets for parallel operation, push the switch on **each** genset to **Parallel** (down).

⚠ WARNING *The generator could overheat from high reactive currents if the switch is left in the Single operation position during parallel generator operation.*

Single Operation

To prepare a genset for single operation, push the switch to **Single** (up).

⚠ CAUTION *Voltage regulation could be unstable if the switch is left in the Parallel operation position during single generator operation.*

MANUAL VOLTAGE CONTROL

AUTO POSITION: The manual voltage control switch must be in **AUTO** for normal, automatic voltage regulation. See Figure 2-1.

OFF POSITION: When the switch is **OFF** there will be no field current to build up AC output voltage.

MANUAL POSITION: You must be trained and use proper voltage metering to manually control AC output voltage. Always turn the voltage adjusting rheo-

stat fully counterclockwise to **MIN** before turning the switch to **MANUAL**.

⚠ CAUTION *Improper manual voltage control can lead to equipment damage. You must be trained and use proper voltage metering. Always turn the voltage adjusting rheostat fully counterclockwise (MIN) before turning the switch to MANUAL.*

REMOTE CONTROL AND MONITORING

Remote e-Series Digital Displays and Control Switches

The boat may be equipped with several remote genset control stations having either an e-Series Digital Display or control switch.

SAE J1939 Data Link

The boat may be equipped to monitor genset operation on an integrated monitoring system through the SAE J1939 data connector in the genset control box.

Fault Bypass Switch

⚠ CAUTION *Damage to the genset as a result of bypassing fault shutdown protection is not covered under Warranty.*

The boat may be equipped with a switch to bypass genset fault shutdown. This feature is available for applications that require the genset to be kept running to supply a critical load, *regardless of possible damage to the genset.*

The PRE-ALARM status lamp blinks rapidly while the genset is running in fault bypass mode (p. 2-3).

3. Operation

FUEL

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

High quality Grade 2-D diesel fuel is necessary for good performance and long engine life. Diesel fuels specified by EN 590 or ASTM D975 are recommended. Use Grade 1-D diesel fuel if the fuel tank is exposed to temperatures below 40° F (5° C).

The Cetane number should not be less than 45 and sulfur content not more than 0.5 percent (by weight). Where fuel is exposed to cold ambient temperatures, use fuel that has a cloud point (temperature at which wax crystals begin to form) at least 10° F (6° C) degrees below the lowest expected fuel temperature.

Fuel lubricity should 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.

ENGINE OIL

Use API (American Petroleum Institute) Service Category **CH-4** engine oil or better after the first 100 hours of engine break-in. See CARE OF NEW OR RE-BUILT ENGINE (p. 3-5) for oil to use during break-in.

Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 3-1, 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.

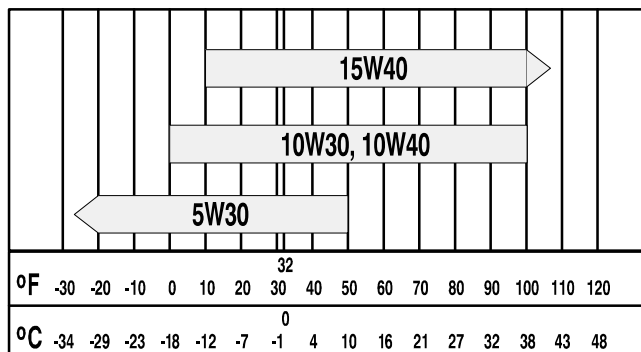


FIGURE 3-1. OIL VISCOSITY VS. TEMPERATURE

ENGINE COOLANT

Use the best quality ethylene glycol antifreeze solution available. It should be a fully formulated low-silicate coolant for heavy-duty engines meeting the ASTM D6210 specification. A 50/50 mixture of water and ethylene glycol is recommended to provide protection down to -34° F (-37° C).

Use fresh water that is low in minerals and corrosive chemicals for the coolant mixture. Distilled water is best.

See Section 9. Specifications regarding coolant capacity.

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

BATTERIES

Reliable genset starting and starter service life depend upon adequate battery system capacity and maintenance. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 4-4) and Section 9. Specifications.

FIRE EXTINGUISHER PORT

A genset with an enclosure has a fire extinguisher port accessible by breaking through the circle on the warning label located as shown in Figure 3-2. ***Make sure that the nozzle of the fire extinguisher that will be used in the event of fire is smaller than the circle so that it will fit through the port.*** The fire extinguisher must be of the gaseous type.

In the event of fire:

1. DO NOT open the genset enclosure.
2. Shut down engines, generators and blowers.
3. Break through the circle on the label with the nozzle and discharge the full contents of the fire extinguisher.

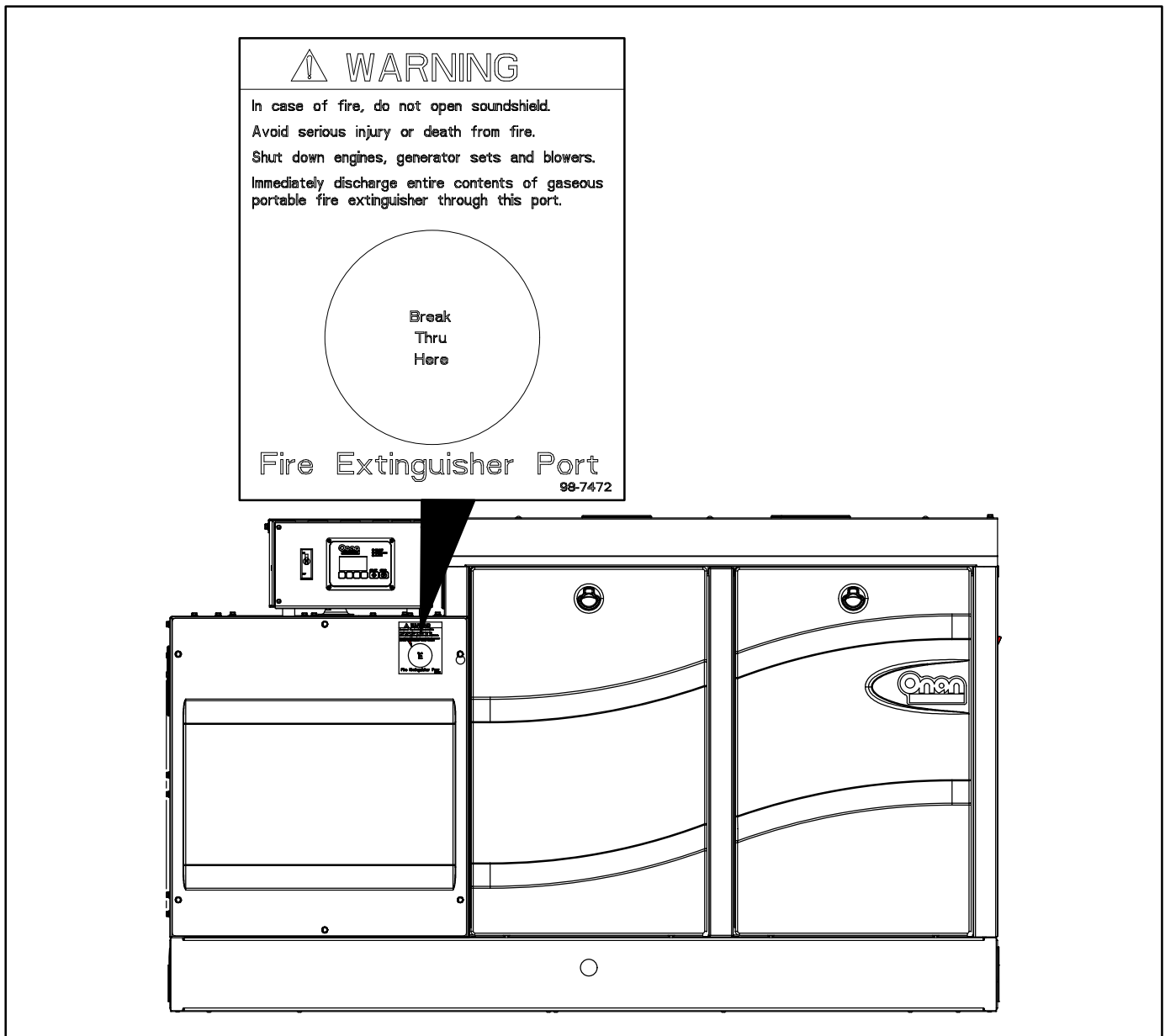


FIGURE 3-2. FIRE EXTINGUISHER PORT

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

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

GET EVERYONE OUT INTO FRESH AIR IMMEDIATELY IF ANYONE EXPERIENCES ANY OF THESE SYMPTOMS. Seek medical attention if symptoms persist. Never sleep in the boat when the genset is running unless the cabin has a working carbon monoxide detector.

Look over the entire exhaust system and listen for leaks each time you start up the genset and after every eight hours of operation. Shut down the genset immediately if there is a leak. Do not run the genset until the leak has been repaired. The exhaust system must be installed in accordance with the genset Installation Manual.

PRE-START CHECKS

Inspect the genset before the first start of the day and after every eight hours of operation as instructed under GENERAL INSPECTION (p. 4-4). Keep a log of maintenance and the hours run and perform any maintenance that may be due. See Returning the Genset to Service (p. 3-5) if the boat has been in storage. Before each start:

1. Make sure all CO detectors on board are working properly.
2. Check for swimmers that might be exposed to the engine exhaust.
3. Disconnect all electrical loads and disengage the PTO (if so equipped).

PRIMING THE FUEL SYSTEM

The fuel system should be primed after replacing fuel filters or running the genset out of fuel. Prime using the priming lever on the engine-mounted pump (p. 4-7). If equipped with an electric auxiliary pump, *Push and Hold STOP* on the e-Series Digital Display or **STOP (Prime)** on the control switch for at least 30 seconds.

STARTING THE GENSET

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

1. *Push and Hold **START*** on the e-Series Digital Display or control switch until the genset starts. The genset status lamp blinks when the engine is cranking and comes on and stays on when the genset starts and runs. The status displayed on the e-Series Digital Display changes from *Starting* to *Running* (Figure 2-3).
2. For longer engine life, let the engine warm up for two minutes before connecting air conditioners and other large electrical loads or engaging the PTO.
3. Check for water, coolant, fuel and exhaust leaks. Stop the genset immediately if there is a leak. Repair fuel leaks immediately.
4. Monitor genset status using the e-Series Digital Display (p. 2-4). Perform maintenance or service as necessary if the Display indicates a **Pre-Alarm** condition (p 2-3).
5. ***If the genset fails to start***, cranking will discontinue in 20 to 60 seconds, depending on ambient temperature. The e-Series Digital Display and/or control switch status lamp will indicate Fault Code No. 4. See *Section 8. Troubleshooting* if the genset does not start after several tries.

⚠CAUTION ***Excessive cranking can burn out the starter or flood the muffler and engine (exhaust flow during cranking is too low to expel water from a wet exhaust system). Find out why the genset does not start and make necessary repairs.***

6. ***If the genset shuts down***, the e-Series Digital Display and/or control switch status lamp will indicate the numeric fault code. See *Section 8. Troubleshooting*.

STOPPING THE GENSET

Disconnect all electrical loads and disengage the PTO (if so equipped) to let the genset run without load and cool down. After 2 minutes *Push* and *Release* **STOP** on the e-Series Digital Display or control switch. The genset status lamps will go out.

⚠ CAUTION *“After Boil” can force large amounts of coolant out through the pressure cap and coolant recovery tank. Always let the engine cool down before stopping the genset. Check for loss of coolant after every emergency stop or fault shutdown. Refill and clean up as necessary.*

EMERGENCY STOP

Push the **EMERGENCY STOP SWITCH** down to **OFF** (p. 2-2). After all necessary repairs have been made, push the switch to **ON** so that the genset can be operated.

LOADING THE GENSET

How much equipment load can be powered depends upon the genset power rating. The genset will shut down or its AC output circuit breakers (if so equipped) will trip if the sum of the loads exceeds genset power or circuit breaker rating.

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

The PTO can take full engine power on gensets so equipped. The boat builder may have made provisions to automatically disconnect all or most electrical loads when the PTO is engaged. ***It may be necessary to run fewer electrical loads—or none at all—when the PTO is engaged.***

The genset is rated at standard barometric pressure, humidity and temperature (ref. ISO 3046). Either low barometric pressure (high altitude) or high

ambient temperature will decrease engine power. ***It may be necessary to run fewer loads under such conditions.***

NO-LOAD OPERATION

Keep no-load operation to a minimum. During no-load operation cylinder temperatures drop to the point where fuel does not burn completely causing fuel wetting and white smoke. It is best to run the genset at 1/4 to 3/4 load.

RESETTING LINE CIRCUIT BREAKERS

If a genset or AC distribution panel circuit breaker trips, either a circuit shorted or too many loads were connected. Note that the genset will continue to run after a line circuit breaker trips.

If a circuit breaker trips, disconnect or turn off as many loads as possible and reset the circuit breaker. 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 loads one-by-one up to a total load that does not overload the genset or cause circuit breakers to trip. A circuit probably has a short if the circuit breaker trips right away when it is connected.

Electrical equipment 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 equipment can cause fire and electrocution. Electrical equipment and its grounding must be maintained properly to protect against short circuits.***

CONNECTING TO SHORE POWER

When provisions have been made for connecting shore power, the boat must have an approved device to keep the genset and shore power from being interconnected.

⚠ WARNING ***Backfeed to shore power can cause electrocution or damage to equipment. Use an approved device to prevent the genset from being interconnected with shore power.***

COLD TEMPERATURE OPERATION

Do not let raw water freeze in the heat exchanger during cold weather when the genset is not operating. Freezing water can damage the raw water tubes in the heat exchanger. Engine coolant, but not raw water, is protected from freezing. If freezing temperatures are expected, see Protecting the Heat Exchanger From Freezing During Storage (p. 4-16). Also drain the muffler.

CARE OF NEW OR RE-BUILT ENGINE

The genset is shipped from the factory with engine break-in oil. During break-in use API Service Category **CE**, **CD** or **CC** oil. Avoid no-load operation as much as possible during break-in.

Change the oil and oil filter after the first 50 hours of operation (p. 4-6).

▲CAUTION *Using normally specified CH-4 or equivalent oils will not allow a new or re-built engine to break-in properly.*

EXERCISING THE GENSET

Exercise the genset at least 1 hour every month if use is infrequent. Run the genset at 1/4 to 3/4 load. A single exercise period is better than several shorter periods. Exercising a genset drives off moisture, re-lubricates the engine, uses up fuel before it becomes stale and removes oxides from electrical contacts. The result is better starting, longer engine life and greater reliability.

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. Disconnect the genset by turning off the line circuit breaker on the genset (if so equipped) or AC distribution panel.
2. Change the engine oil and filter and attach a tag indicating oil viscosity. See ENGINE OIL RECOMMENDATIONS (p. 3-1).

3. Crank the engine several revolutions but do not let it start. This will fill the oil passages with the new oil.
 4. Disconnect the battery cables (negative [-] cable first) from the starting battery and store the battery according to the battery manufacturer's recommendations. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 4-4).
 5. Check coolant level and add as necessary (p. 4-11). Test the coolant mixture if freezing temperatures are possible and change if necessary.
- ▲WARNING** *Hot coolant is under pressure and can cause severe burns when loosening the pressure cap. Let the engine cool before loosening the pressure cap.*
6. If freezing temperatures are expected, see Protecting the Heat Exchanger From Freezing During Storage (p. 4-16). Also drain the muffler.
 7. Disengage a PTO clutch if so equipped.
 8. Loosen or remove the serpentine belt (p. 4-14).
 9. Clean and lightly oil parts that can rust.

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 (p. 3-1).
2. Reconnect the starting battery (negative [-] cable last). See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 4-4).
3. Replace the raw water pump impeller if it was installed more than a year ago (p. 4-13).
4. Service the air filter element if it is dirty (p. 4-10).
5. Re-install the serpentine belt (p. 4-14).
6. Perform the maintenance required (p. 4-1), conduct the pre-start checks and prime the fuel system.
7. Start and run the genset.
8. Reconnect the genset by turning on the line circuit breaker on the genset (if so equipped) or AC distribution panel.

4. Periodic Maintenance

Periodic maintenance is essential for top performance and long genset life. Use Table 4-1 as a guide for normal periodic maintenance. Figures 4-1 and 4-2 illustrate the service points.

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

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

⚠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 4-1. PERIODIC MAINTENANCE SCHEDULE

MAINTENANCE OPERATION	MAINTENANCE FREQUENCY								
	After First 50 Hrs	Every Day / 8 Hrs	Monthly	Yearly	Every 350 Hrs	Every 700 Hrs	Every 1050 Hrs	Every 2100 Hrs	Page
General Inspection ¹		•							4-4
Check Engine Oil Level		•							4-5
Drain Water from Fuel Filter			•						4-9
Inspect Battery and Battery Connections ²			•						4-4
Inspect Siphon Break				•	•				4-11
Change Engine Oil and Oil Filter	•			•	•				4-6
Inspect Serpentine Belt and Tensioner ³				•	•				4-14
Replace CCV Filter ⁴				•	•				4-9
Replace Fuel Filters				•	•				4-8
Inspect Air Filter ⁵				•		•			4-10
Inspect Zinc Anodes				•	•				4-16
Inspect Raw Water Impeller ⁸				•			•		4-13
Replace Coolant, Pressure Cap & Thermostats ⁶								•	4-11
Adjust Engine Valve Lash ⁹								•	–
Replace Fuel Injectors ⁹								•	–
Inspect Generator Bearing ^{7, 9}				•					–

1 – Includes inspection of Oil Level, Coolant Level, Fuel System, Exhaust System, Batteries and Battery Connections.

2 – See battery manufacturer's recommendations.

3 – Inspect tensioner and belt for slippage, cracking and wear and replace as necessary.

4 – Shut down engine for 2 minutes every 24 hours to allow for auto drainage of crankcase oil.

5 – Clean and oil if restriction is greater than 25 inches (635 mm) WC. The air cleaner housing has a 1/4 inch NPT gauge tap.

6 – Replace every 2 years.

7 – Replace every 5 years.

8 – Replace every 1050 hours.

9 – Must be performed by a qualified mechanic (authorized Onan dealer).

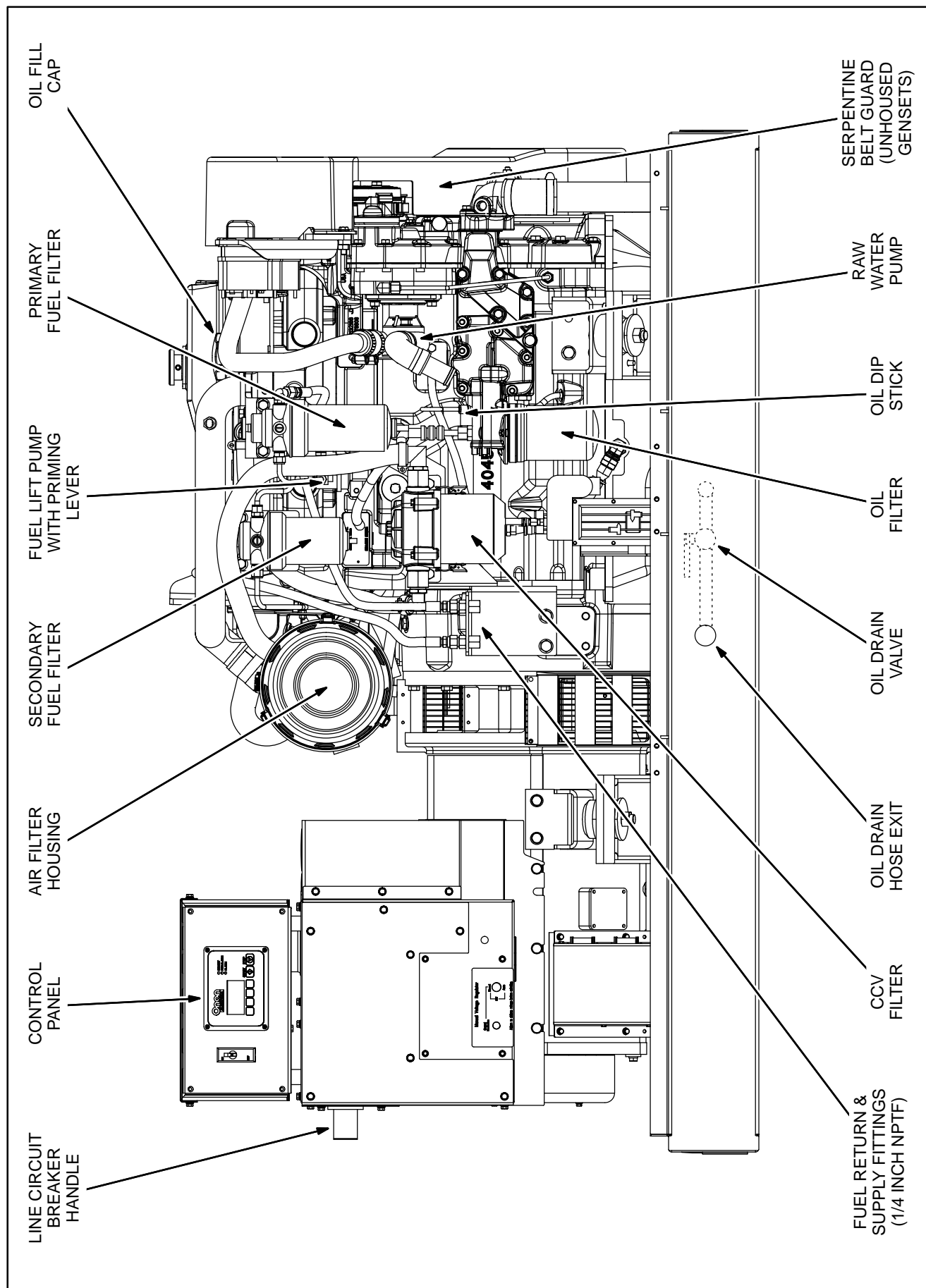


FIGURE 4-1. TYPICAL SERVICE SIDE (4-CYLINDER MODEL—REPRESENTATIVE ALSO OF 6-CYLINDER MODELS)

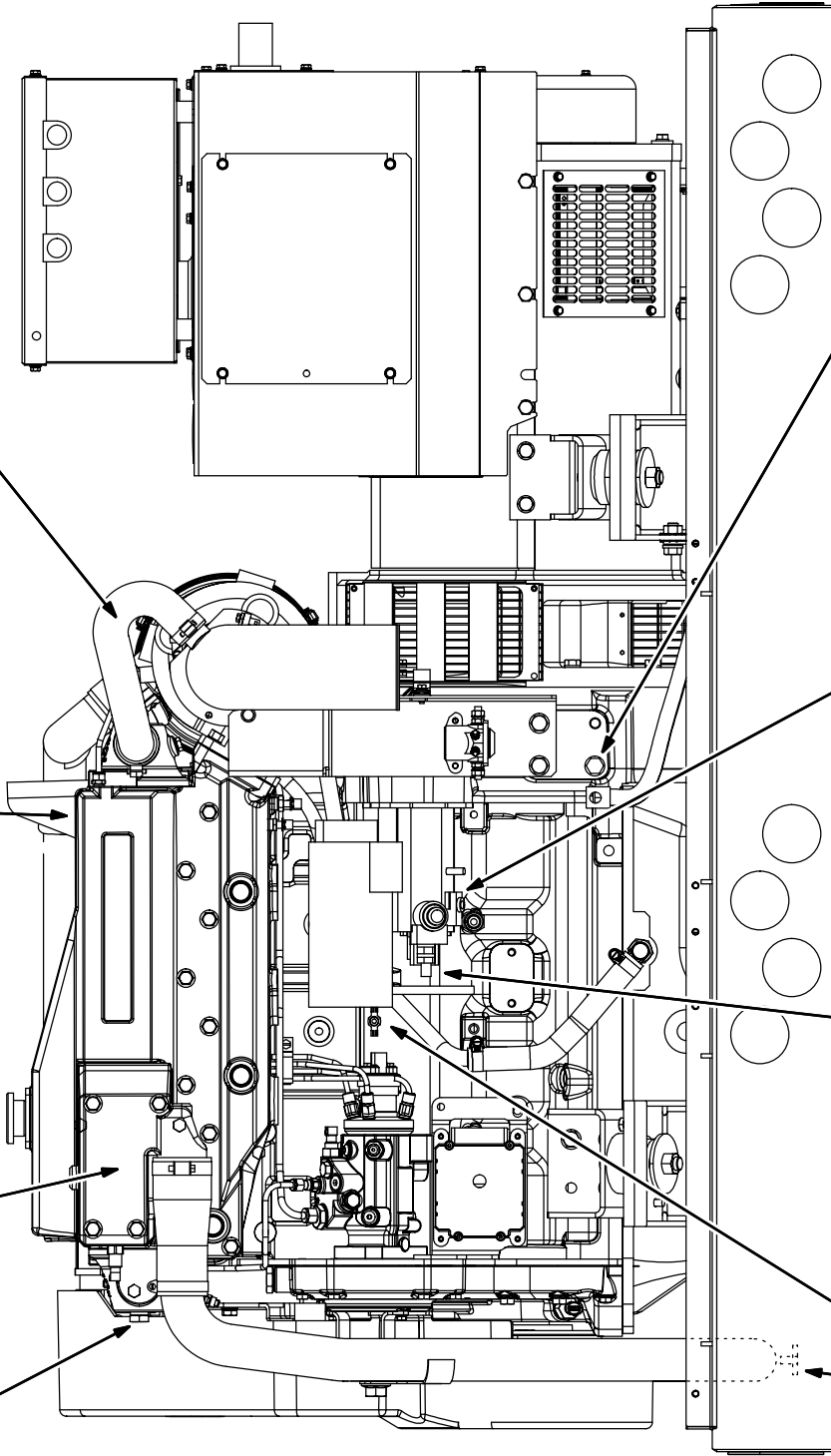
RAW WATER HOSE BETWEEN REAR END CAP OF HEAT EXCHANGER AND WATER-EXHAUST MIXER ELBOW (INSTALLATION MAY REQUIRE SIPHON BREAK—SEE INSTALLATION MANUAL)

COOLANT FILL VENT COCK (ON TOP OF HEAD NEXT TO LIFTING EYE)

COOLANT PRESSURE CAP AND FILL NECK

COOLANT THERMOSTAT HOUSING

ZINC ANODE IN HEAT EXCHANGER END CAP (BOTH ENDS)



BATTERY (+) CONNECTION
M12 STUD (NON-ISOLATED GROUND)
M10 STUD (ISOLATED GROUND)

BATTERY (-) CONNECTION
FOR ISOLATED-GROUND
M10 STUD

BATTERY (-) CONNECTION FOR NON-ISOLATED
GROUND & GENSET GROUND (VESSEL BOND)
M12 SCREW

COOLANT
DRAIN COCKS

FIGURE 4-2. TYPICAL NON-SERVICE SIDE (4-CYLINDER MODEL—REPRESENTATIVE ALSO OF 6-CYLINDER MODELS)

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 (p. 4-5).

Exhaust System

Inspect the exhaust system for leaks and loose hose clamps at the exhaust manifold, exhaust elbow, muffler, water separator and hull fittings. Replace damaged sections of exhaust hose.

Check that all CO monitors are working properly.

⚠️WARNING ***EXHAUST GAS IS DEADLY! Do not operate the genset until all exhaust leaks have been repaired.***

Fuel System

Check for leaks at hose, tube and pipe fittings in the fuel supply and return systems while the genset is running and while it is stopped. Check flexible fuel hose for cuts, cracks, abrasions and loose hose clamps. Make sure fuel lines do not rub against other parts. Replace worn or damaged fuel line parts before leaks occur. Replace hose with with USCG TYPE A1 or ISO 7840-A1 fuel hose.

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

⚠️WARNING ***Fuel leaks can lead to fire. Repair leaks immediately. Do not run the genset if it causes fuel to leak.***

Coolant Level

Check coolant level in the recovery tank and if necessary refill to COLD when the engine is cold or to HOT when it is running. The recovery tank is designed to maintain coolant level, not to fill the system. If the tank is empty, check for and repair any coolant leaks and refill the system through the fill neck on the engine. See Refilling the Cooling System (p. 4-12). Use the recommended antifreeze mixture (p. 3-1).

Raw Water System

Clean out the sea water strainer if necessary and make sure the sea cock is open for genset operation. Also, when a water/exhaust separator is pro-

vided (see Installation Manual), open the sea cock for the water drain hose.

Check for and replace hoses that leak or are damaged.

Battery Connections

See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS.

Mechanical

Monitor generator set status using the e-Series Digital Display (p. 2-4).

Look for mechanical damage and listen for unusual noises when the genset is running. Check the genset mounting bolts. Check to see that the genset air inlet and outlet openings are not clogged with debris or blocked. Keep the genset compartment clean.

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 4-1 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.

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting harder. Always:

1. Keep the battery case and terminals clean and dry and the terminals tight.
2. Remove battery cables with a battery terminal puller.
3. Make sure which terminal is positive (+) and which is negative (–) before making battery connections. Always remove the negative (–) cable first and reconnect it last to reduce arcing. Refer to Figure 4-2 for battery cable connections at the genset.

CHECKING ENGINE OIL LEVEL

⚠ WARNING *U. S. federal and state 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.*

⚠ CAUTION *Too little oil can cause severe engine damage. Too much oil can cause high oil consumption.*

Shut off the genset and check the oil level with the dip stick (Figure 4-3). Add or drain oil as necessary. Add 1 quart (0.9 liters) when the level falls to the ADD mark. Drain oil if the level is above the cross-hatch area.

See ENGINE OIL RECOMMENDATIONS (p. 3-1).

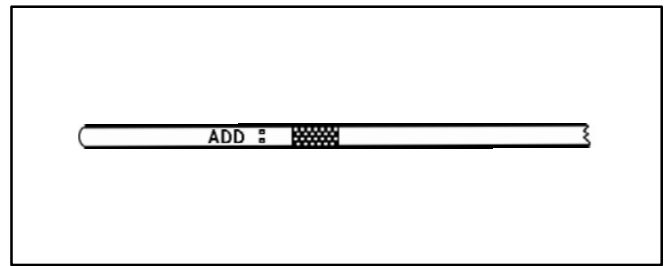


FIGURE 4-3. OIL LEVEL DIP STICK

CHANGING ENGINE OIL AND FILTER

⚠WARNING *U. S. federal and state agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Avoid skin contact and breathing of vapors. Use rubber gloves and wash exposed skin.*

Refer to Table 4-1 for scheduled engine oil change.

1. Run the genset under load until it is up to operating temperature. Then stop it and disconnect the negative (–) battery cable at the battery.

⚠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. Have a suitable container ready and open the drain valve (Figure 4-1). Follow the instructions for an oil pump-out system if provided.
3. Close the oil drain valve.
4. Unscrew the oil filter element (Figure 4-4) using a suitable filter wrench and discard the filter.
5. Wipe the two O-ring sealing surfaces clean.
6. Oil the two O-ring seals and threads of the new filter element.
7. Make sure the notches in the dust seal and filter header mate properly.
8. Hand tighten the filter firmly against the dust seal. DO NOT USE A FILTER WRENCH AND DO NOT TURN IT FARTHER THAN HAND TIGHT.
9. Refill the engine with the proper type and amount of engine oil. See ENGINE OIL RECOMMENDATIONS (p. 3-1) and Section 9. Specifications. Check the oil level and add or drain oil as necessary.
10. Dispose of the used oil and oil filter according to local environmental regulations.

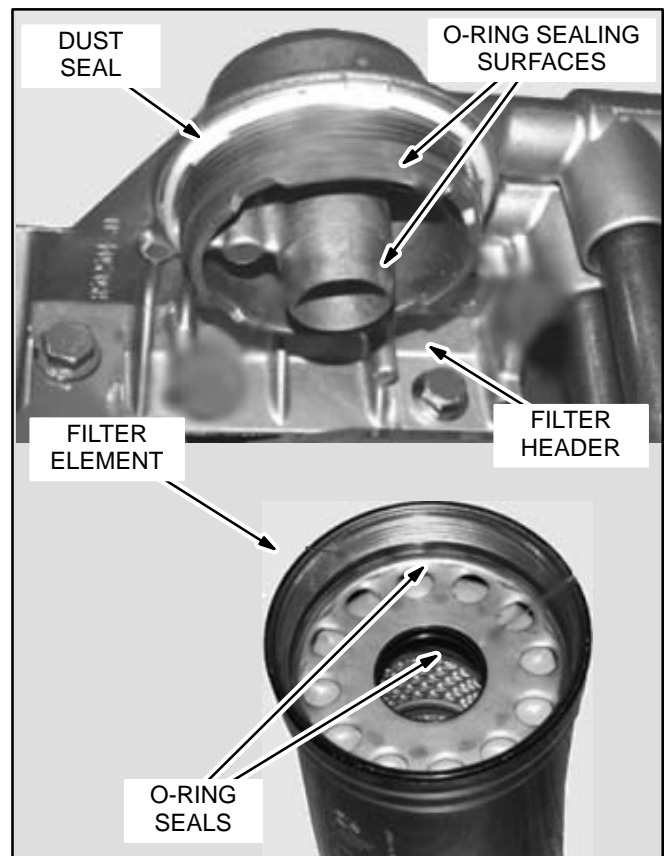


FIGURE 4-4. OIL FILTER

PRIMING THE 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 close at hand.

Priming with Mechanical Fuel Pump

The engine is equipped with a cam-driven mechanical pump with a manual priming lever that is pushed up and down to pump fuel (Figure 4-5). If the priming lever cannot be pushed down, crank the engine over once to turn the internal cam lobe to the low side and thus free up the lever.

Before priming, loosen the secondary filter vent to allow air to escape while priming. Close the vent when the filter is full.

Priming with Optional Electric Fuel Pump

If the genset is equipped with a supplementary electric fuel pump, *Press and Hold* the control switch or Digital Display **Stop/Prime** button to fill the fuel lines and filters. The fuel pump starts in about 2 seconds.

If both filters need to be filled, loosen both filter vents (Figure 4-5) to allow air to escape while priming. Close the primary filter vent when the primary filter is full and the secondary filter vent when its filter is full.

BLEEDING THE INJECTOR LINES

It may be necessary after replacing parts or running out of fuel to bleed the air trapped in the fuel lines between the injection pump and nozzles. To bleed air from the fuel line, loosen the connection at the injection nozzle (Figure 4-6) using two open-end wrenches to avoid damaging the nozzle assembly. Then crank the engine, without letting it start, until fuel free of bubbles flows out of the loosened connection. Retighten the connection to 20 lb-ft (27 N-m). If necessary, repeat the procedure for the remaining nozzles.

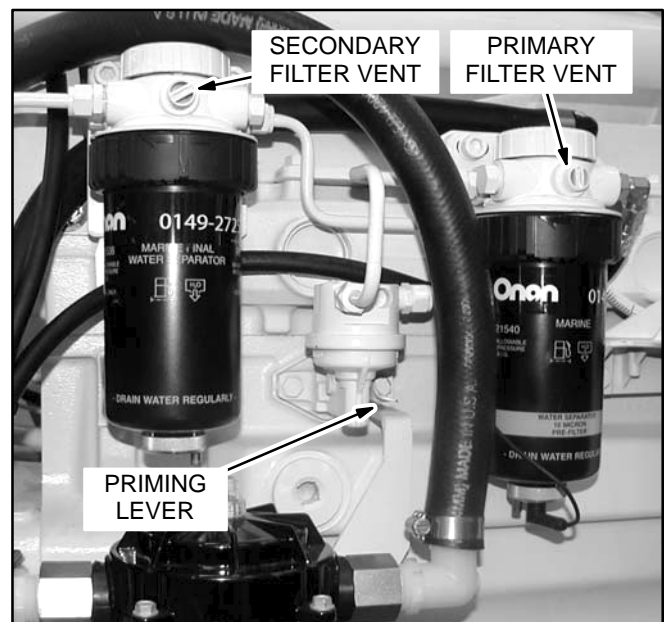


FIGURE 4-5. PRIMING FUEL



FIGURE 4-6. BLEEDING INJECTOR LINES

REPLACING THE FUEL FILTERS

⚠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 close at hand.

See Table 4-1 for scheduled filter change. The gen-set has a primary and a secondary fuel filter. The primary filter has a water separator and sensor (Figure 4-7). Check for up-stream filters which may also need to be replaced.

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

To replace the fuel filters:

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. Disconnect the water sensor.
3. Clean the area surrounding each filter assemblies to keep debris out of the fuel system and drain the fuel in each filter into a suitable container by loosening its vent and drain screws. Dispose of the water, sediment and fuel in accordance with local environmental regulations.
4. Firmly grasp each filter retaining ring, lift it up and rotate it counterclockwise 1/4 turn (as viewed from below). Remove the ring with its filter element.
5. Install the new filters, properly indexing the raised locators with the mounting base slots.
6. Install the retaining rings, making sure the dust seals are in place. Hand tighten about 1/3 turn until it audibly snaps (clicks) into its detent.
7. Reconnect the water sensor.

Note: If the boat has an “isolated ground” system, check with the boat builder as to whether or not to connect the water sensor, which uses a very small non-isolated current to detect the level of water collected in the fuel filter.

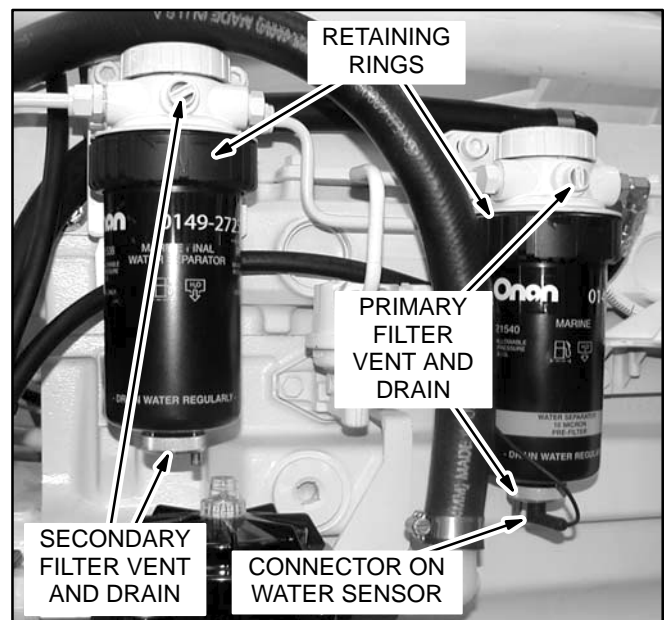


FIGURE 4-7. PRIMARY AND SECONDARY FUEL FILTERS

DRAINING WATER FROM THE FUEL FILTER

Drain water and sediment more often than scheduled (Table 4-1) if fuel quality is poor or condensation cannot be avoided or when a WATER IN FUEL WARNING is being displayed. Check for up-stream filters which may also need to be replaced.

1. Disconnect the water sensor connector (Figure 4-7). Loosen the vent and drain screws and drain the water and sediment into a suitable container (about 1/2 cup or 120 ml).
2. Close the drains and reconnect the water sensor connector.

Note: If the boat has an “isolated ground” system, check with the boat builder as to whether or not to connect the water sensor, which uses a very small non-isolated current to detect the level of water collected in the fuel filter.

3. Dispose of the water, sediment and fuel in accordance with local environmental regulations.

REPLACING THE CCV FILTER ELEMENT

Refer to Table 4-1 for scheduled CCV (Crankcase Vent) filter element replacement. Replace the filter whenever the red service indicator in the filter header pops up.

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 CCV housing and withdraw the filter element and discard it.
3. Install the new filter element making sure the inner and outer O-ring seals seat properly.
4. Reset the red service indicator if it popped up by unscrewing the clear plastic cap, pushing the indicator back down and re-installing the cap.

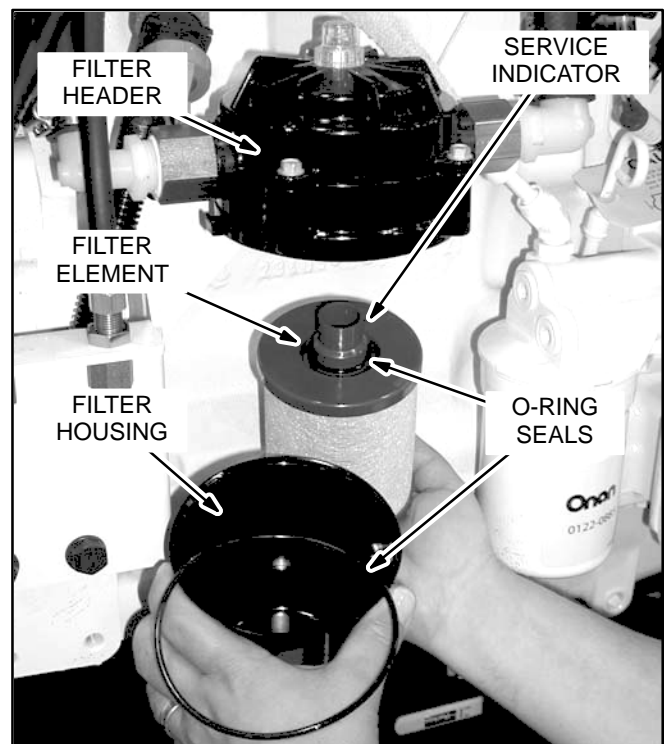


FIGURE 4-8. CCV FILTER ELEMENT

REPLACING THE AIR FILTER ELEMENT

The engine is equipped with a washable air filter element (Figure 4-9). Refer to Table 4-1 for scheduled air filter element cleaning. Inspect and clean the element more often in dusty environments. To service the filter element:

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. Release the end cap latches and withdraw the filter element.
3. Replace the filter element if the filter media or rubber seals are damaged.

⚠CAUTION *Fuels, solvents, cleaners and detergents can damage the filter media and rubber seals. Only use hot soapy water to clean the filter element.*

4. Wash the filter element in hot soapy water and let it dry thoroughly.
5. Oil the filter element with a suitable air filter oil.
6. Reinstall the filter element.

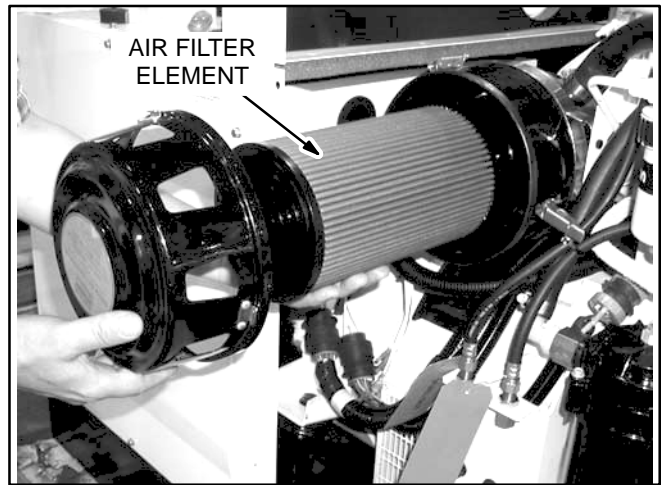


FIGURE 4-9. AIR FILTER ELEMENT

MAINTAINING THE ENGINE COOLING SYSTEM

Refer to Table 4-1 for scheduled maintenance.

Cooling System Overview

The engine is cooled by a pressurized, closed-loop liquid cooling system. Coolant is pumped through passages in the engine block, head, exhaust manifold and turbocharger housing. The exhaust manifold also serves as the engine coolant reservoir. The engine coolant is cooled by a keel cooler or by a heat exchanger mounted inside the exhaust manifold.

Keel Cooler: A keel cooler, when provided, is part of the pressurized, closed-loop liquid cooling system through which the coolant flows.

Heat Exchanger: When a heat exchanger is mounted inside the exhaust manifold, raw water (the floatation water) is pumped through tubes in the heat exchanger to cool the engine coolant. The water is then passed through a hose into the exhaust-water mixer to cool the exhaust gases. The raw water is expelled from the boat along with the exhaust gases. See Page 4-16.

Recommended Coolant Mixture

See ENGINE COOLANT (p. 3-1) for recommendations.

Replenishing Normal Coolant Loss

Check coolant level in the recovery tank before the first startup of each day and if necessary refill to

COLD when the engine is cold or to HOT when it is running. The recovery tank is designed to maintain coolant level, not to fill the system. If the tank is empty, check for and repair any coolant leaks and refill the system through the fill neck on the engine.

Pressure Cap

Replace the pressure cap every two years (seals deteriorate and leak). Proper cooling system pressure (10 psi) is essential for optimal engine cooling and minimal coolant loss.

Coolant Hoses

Check for and replace hoses that leak or are damaged.

Siphon Break

See Table 4-1 for scheduled maintenance. A siphon break is installed when the siphon point at the exhaust-water mixer is below the water line. If of a spring-loaded valve design, check for free movement of the plunger. Replace the device if the plunger does not move freely or the body is encrusted with deposits from leakage past the valve seat. If of the bleed-vent type, check that the vent hose is properly connected on both ends. If the vent is connected to a through-hull fitting, check for normal water flow whenever the engine is running. See the Installation Manual for more information regarding siphon break installation.

⚠ WARNING *Engine damage due to flooding as a result of failing to install or maintain a required siphon break is not covered by Warranty.*

Draining and Cleaning Cooling System

Have towels and containers ready to wipe up, collect and properly dispose of the coolant. Disconnect the negative (–) cable at the battery to prevent the engine from starting and let the engine cool before removing the pressure cap.

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

Remove the pressure cap and open the block and crossover tube drain cocks (Figure 4-2). Drain the coolant into suitable containers for disposal in accordance with the local regulations for hazardous substances.

Drain or flush a keel cooler in accordance with the manufacturer's instructions.

Use radiator cleaning chemicals to clean and flush the cooling system before refilling with fresh coolant. Follow the cleaner manufacturer's instructions.

⚠CAUTION *Filling a hot engine with cold water can cause cracks in the manifold, head and block. Follow the manufacturer's instructions for cleaning and flushing.*

Refilling Cooling System

Close the block and crossover tube drain cocks (Figure 4-2) and open the coolant fill vent cock located by the lifting eye (Figure 4-10). Fill the system through the engine fill neck. The system will fill only as fast as air can escape. Close the vent cock when coolant comes out and continue filling up to the rim of the fill neck. Start and run the engine for a minute or two to dislodge air pockets. Stop the engine and refill coolant to the rim of the fill neck. Repeat the procedure until the engine can be run for at least 10 minutes without the coolant level dropping. Secure the pressure cap and refill the recovery tank up to the HOT mark.

⚠CAUTION *Low coolant level can cause severe engine damage. Make sure the system is full.*

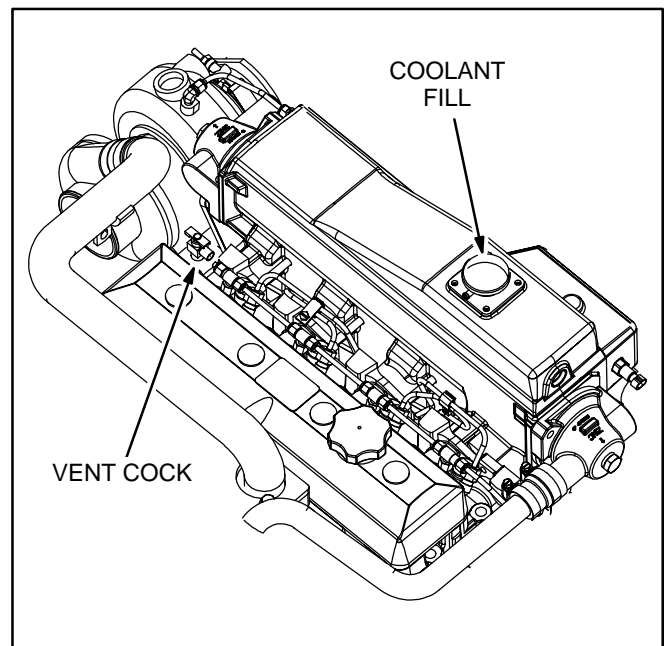


FIGURE 4-10. COOLANT FILL VENT COCK

Replacing the Raw Water Pump Impeller

See Table 4-1 for scheduled replacement. Referring to Figure 4-11, replace the impeller as follows:

1. Close the sea cock.
2. 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.*

3. Remove the impeller cover and gasket using a short flat-bladed screwdriver.
4. Use an impeller removal tool to pull the impeller out of the pump. *It will be necessary to check for and cleanout pieces of the impeller from the heat exchanger if vanes have broken off.*
5. Install the new impeller. It helps to twist the impeller clockwise (the way it turns) while squeezing it into the housing.
6. To provide initial lubrication and better pump suction before water reaches the pump, wet the inside of the pump and impeller with water, soap solution or a silicone lubricant.

⚠CAUTION *Do not lubricate the impeller with grease or oil or other petroleum products because they known to chemically attack the impeller material.*

7. Secure the cover using a new gasket.
8. *If the sea water strainer is above the water line fill it for faster priming.*
9. Open the sea cock, reconnect the battery cables (negative [–] last) and start the genset. The genset will shut down within 8 seconds if there is no raw water flow. Fault Code No. 7 (p. 8-4) will be declared. If it shuts down, find out why, remove any blockage and restart the genset.

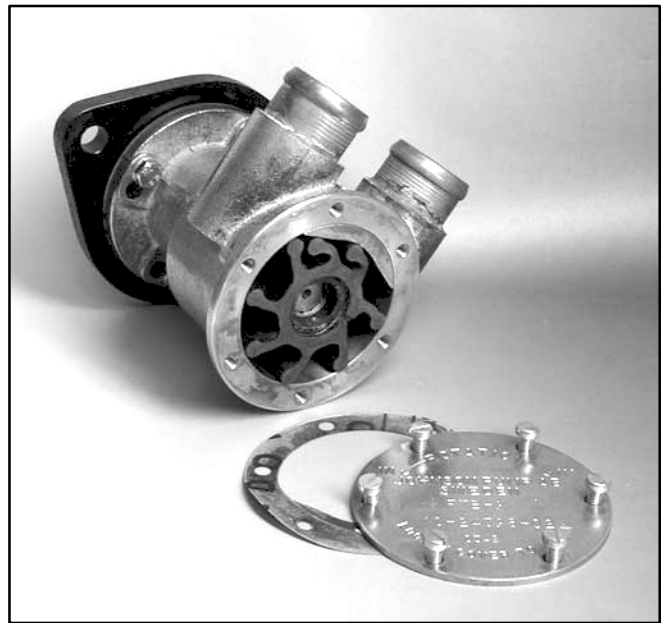


FIGURE 4-11. RAW WATER PUMP

Replacing the Serpentine Belt

The serpentine belt drives the battery charging alternator and coolant pump. See Table 4-1 for scheduled inspection or replacement.

Replacing the Belt: Referring to Figure 4-12, replace the belt 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 or enclosure end panel.
3. If the genset is so equipped, disconnect the PTO shaft. See *Disconnecting PTO Shaft*.
4. Relieve belt tension by rotating the tensioner pulley arm counterclockwise and remove the belt. Use a 15 mm wrench on the pulley center screw to rotate the arm.
5. Check the belt tensioner, idler, alternator and coolant pump pulleys for smooth rotation and the arm for smooth operation throughout the arc of its travel between end stops. Have components repaired or replaced as necessary.
6. Install the belt making sure each “V” is in its proper groove in each pulley.
7. Check the position of the tensioner arm. It should be about midway between its end stops. If it is near or touching either end stop, the belt is too long or too short. Replace the belt as necessary.
8. Replace the belt guard or enclosure end panel.

Disconnecting PTO Shaft: Referring to Figure 4-13, remove the 4 shaft flange screws and the 4 radial coupling screws and slide the shaft away from the crankshaft pulley far enough to let the belt through. When reassembling, tighten the flange screws to 54 lb-ft (75 N-m) and the radial coupling screws to 170 lb-ft (225 N-m).

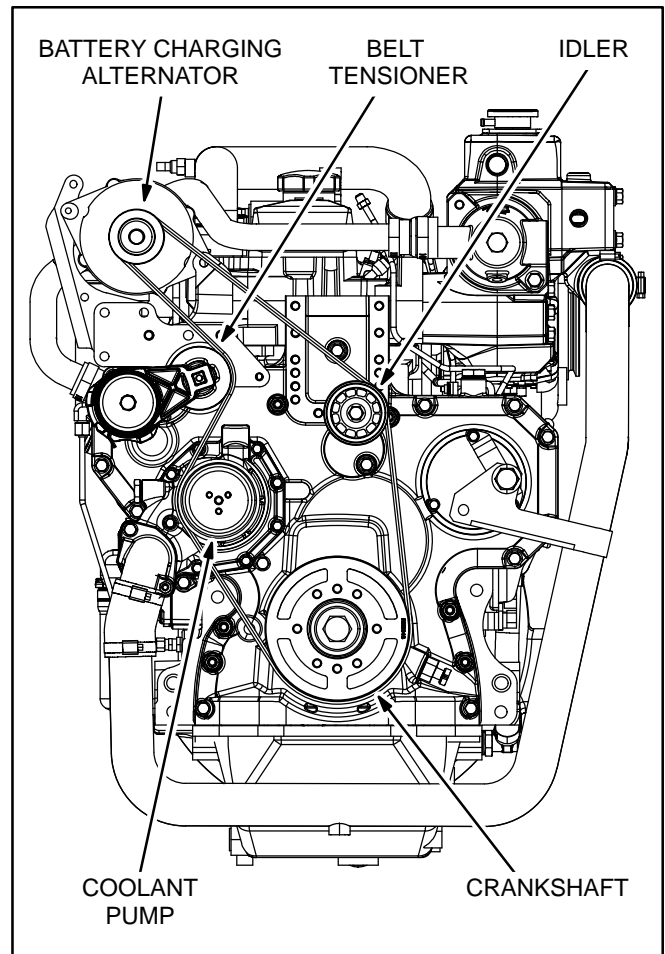


FIGURE 4-12. SERPENTINE BELT

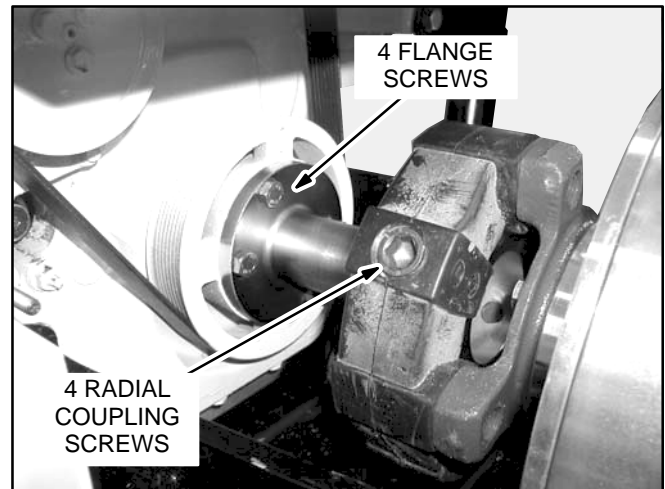


FIGURE 4-13. PTO SHAFT

Replacing the Thermostats

See Table 4-1 for scheduled replacement. *The two thermostats (Figure 4-14) are a matched pair and must be replaced as a pair.* Replace the thermostats as follows:

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

⚠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 rear door if the genset has an enclosure.
3. Remove the coolant pressure cap after letting the engine cool down.
4. Drain enough coolant so that it does not spill out when the thermostat housing is loosened.
5. Remove the four thermostat housing screws and pull off the housing and gasket.
6. Clean off the gasket area.
7. Replace the two thermostats. Make sure location and orientation are as shown.
8. Secure the thermostat housing using a new gasket.
9. Replenish any lost coolant and secure the pressure cap and rear door.

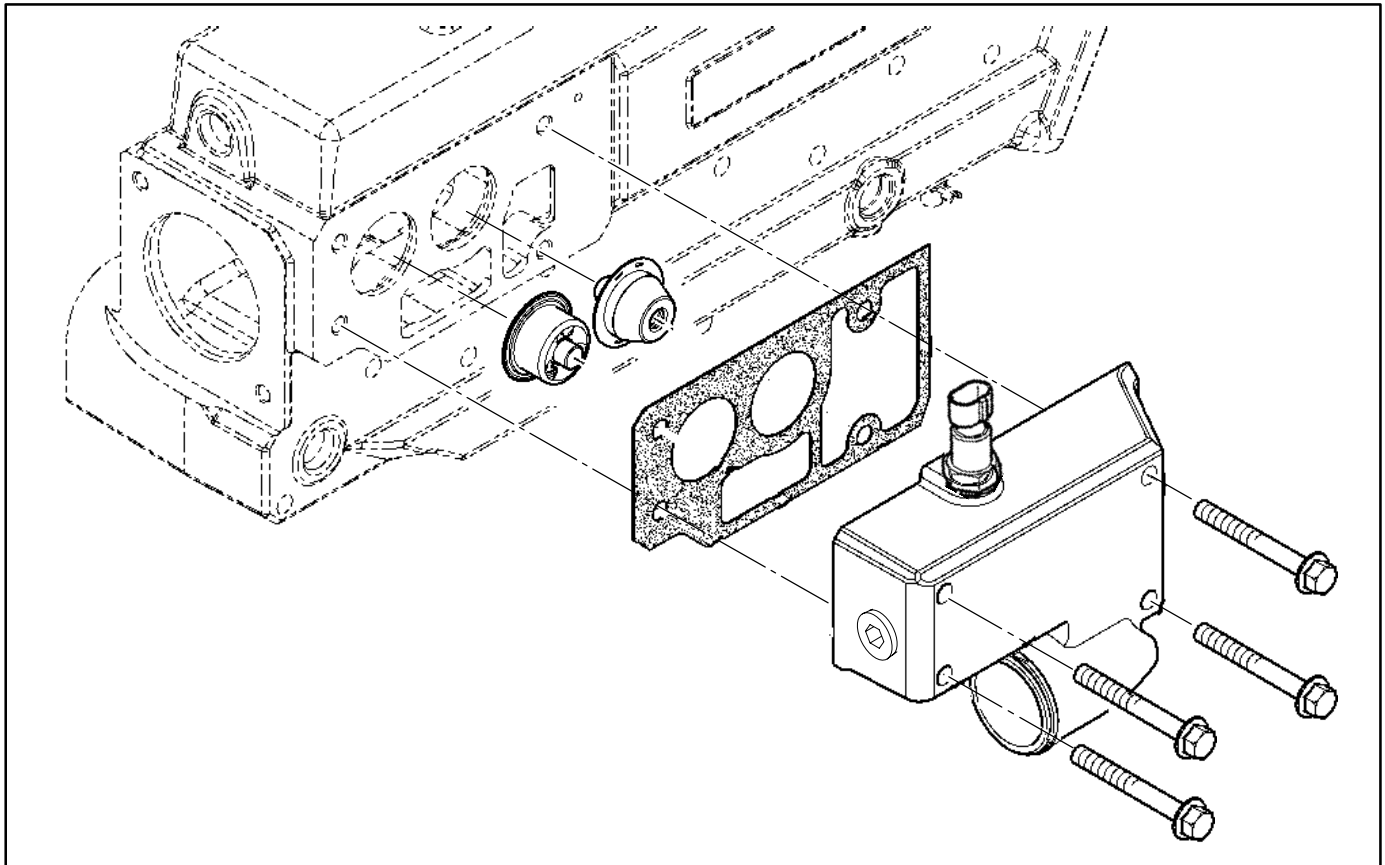


FIGURE 4-14. COOLANT THERMOSTATS

Removing, Cleaning and Inspecting the Heat Exchanger

See Table 4-1 for scheduled maintenance. Clean the raw water tubes of the heat exchanger (Figure 4-15) if the engine keeps shutting down due to above normal engine coolant temperature. Refer to TABLE 8-2. TROUBLESHOOTING ENGINE FAULT CODE NO. 16 or TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARM CONDITIONS.

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 rear doors and the top and end panels if the genset has an enclosure.
3. Drain enough coolant so that it does not spill out when the heat exchanger is withdrawn.
4. Disconnect the connector on the raw water flow switch on the front end cap.
5. Disconnect the raw water hoses from the front and rear end caps.
6. Remove the front end cap and heat exchanger.
7. Remove the rear end cap.
8. Inspect the heat exchange and clean it thoroughly. Use a 3/16 inch (4.76 mm) diameter brass rod to clean the full length of each tube.
9. Inspect the zinc anodes and replace if necessary.
10. Inspect the O-rings and replace if necessary.
11. Have the heat exchanger core pressure tested if you think it might be defective. Replace it if necessary.

Installing the Heat Exchanger

1. Lubricate the 4 O-rings (2 each end) with multi-purpose grease. Install the small O-ring in the bore groove of the end cap and the larger O-ring in the face groove.

2. Install the rear end cap and mounting screws leaving a 1/4 inch (6 mm) gap. Make sure the hose barb points the right way.
3. Install the front end cap with the heat exchanger properly seated in the bore. Make sure the hose barb points the right way.
4. Evenly tighten the front end cap screws until the end cap touches the housing.
5. Evenly tighten the rear end cap screws until the end cap touches the housing.
6. Tighten the end cap mounting screws to 18 lb-ft (24 N-m).
7. Reconnect the hoses and switch connector.

Protecting Pump, Heat Exchanger and Muffler from Freezing

Freezing water can damage the pump, heat exchanger and muffler. Engine coolant, but not raw water, is protected from freezing.

To protect the pump and heat exchanger during storage in freezing weather, it is recommended that the residual raw water in the heat exchanger be displaced by pumping a 60/40 solution of Propylene Glycol and water through it. To do this, connect the raw water pump to a container of the solution by means of a short hose and crank the engine. Shut the engine down immediately if it starts. About 1/2 gallon (2 liters) is required. Solutions formulated for this purpose are available from Marine and RV service centers.

Drain the muffler to protect it from freezing.

⚠WARNING *Ethylene Glycol is considered toxic. Do not use it to protect the raw water passages in the heat exchanger because it will be expelled into the environment when the genset is started.*

Zinc Anodes

See Table 4-1 for scheduled maintenance. If either plug is less than 5/8 inch (16 mm) long or less than 3/16 inch (5 mm) in diameter, replace both plugs. Use thread sealant when installing a zinc plug. See Figure 4-15.

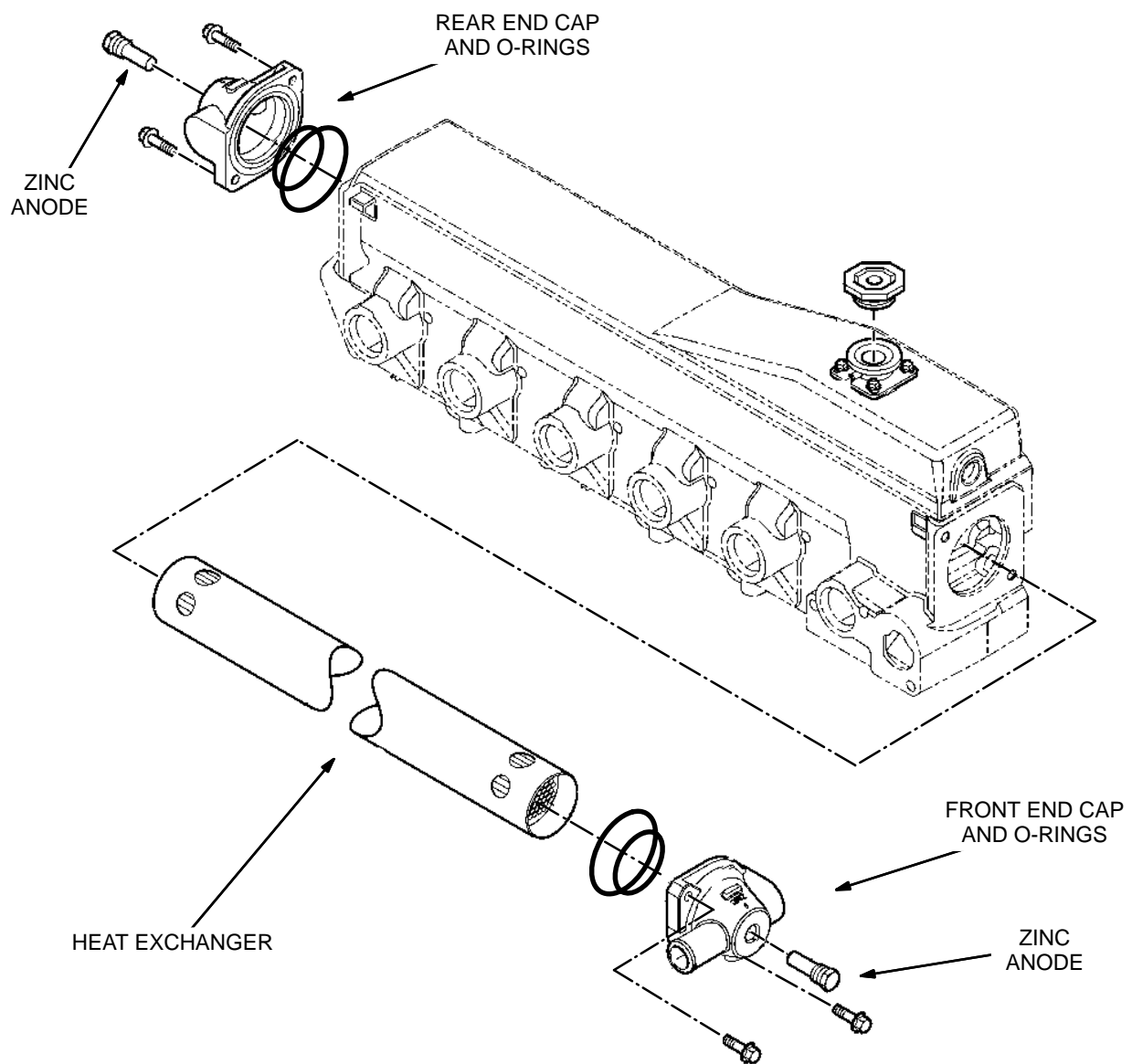


FIGURE 4-15. HEAT EXCHANGER AND ZINC ANODES

5. Genset 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

Figure 5-1 illustrates the location and mounting of the genset control board and Figure 5-3 the components inside the control box. The control board has a microprocessor-based controller that provides all the control, monitoring and diagnostic functions required to operate the genset. The genset controller talks to the engine control module (ECM), which is engine mounted (p. 7-1), through the Network Interface Module (NIM) mounted in the control box (Figure 5-3).

Up to three Onan e-Series Digital Displays (Figure 5-3) may be connected to the genset. The NIM has a connector for external SAE J1939 data link connections to an integrated boat monitoring system.

Gensets equipped for parallel operation have a separate voltage regulator (p. 6-11).

Figure 5-2 is a control block diagram. Pages A-1 through A-6 are the control schematic and wiring harness drawings.

CONTROL BOARD

Configuring Replacement Controller

See Page 2-9 for instructions on how to configure a replacement controller for the genset.

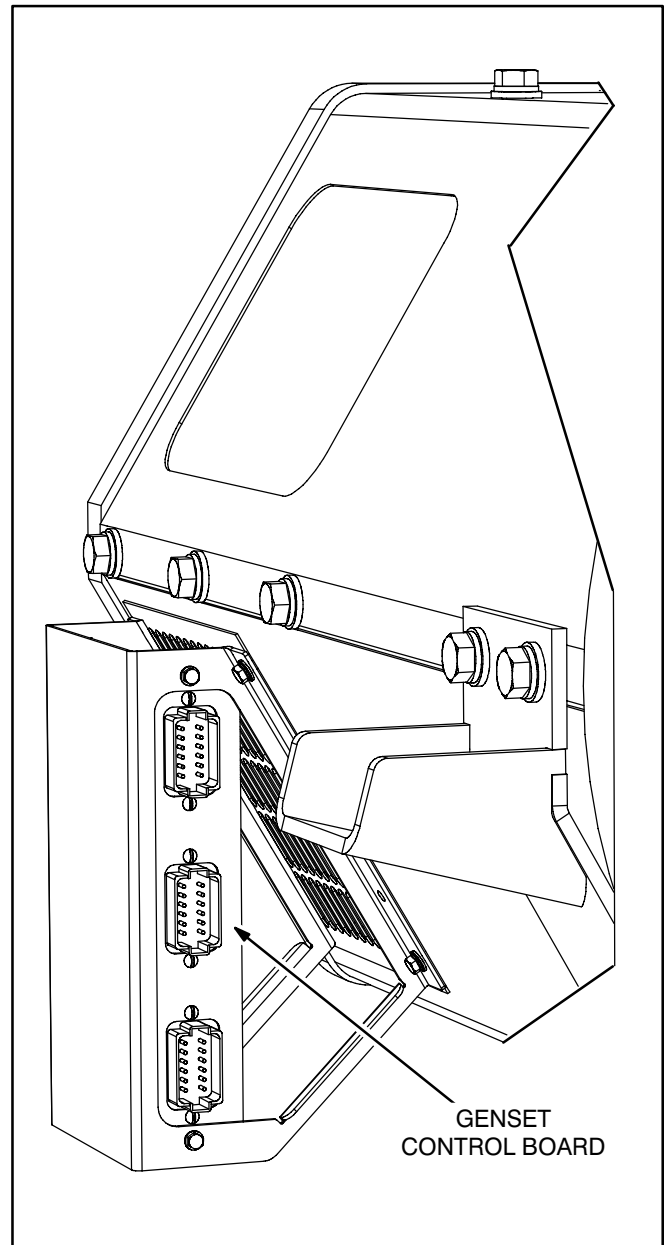


FIGURE 5-1. GENSET CONTROL BOARD

Control Board Connectors

Three connectors (**P1/J1**, **P2/J2**, **P3/J3**) are used for all connections between the control board and wiring harness (Figure 5-1). When separating the connector, use a small flat-bladed screwdriver to lever out the catch.

⚠ CAUTION *Makeshift meter test probes used for testing Control Board connections during troubleshooting can damage pin sockets by spreading or dislodging the contact wiper arms, resulting in an open or intermittent electrical connection. Use a mating pin (PN 323–1491) or a test probe that is 0.045 inches in diameter. Replace damaged pin sockets (PN 323–1492). Make sure the pin sockets are fully seated and cannot be pulled out.*

Major Controller Functions

Refer to the control block diagram (Figure 5-2).

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

Fuel Priming: The fuel priming function can be used if the genset is equipped with an electric fuel lift pump. See PRIMING THE FUEL SYSTEM (p. 3-3).

Starting: See STARTING THE GENSET (p. 3-3).
The Controller:

1. Energizes the fuel lift pump, if so equipped
2. Enables the status lamp to blink rapidly
3. Enables run relay K6 to power the ECM and NIM and wake the boat monitoring system
4. Enables start relay K7 to signal the ECM to crank the engine
5. Enables some fault detection
6. Enables field flash, except when PMG excited
7. Disables start relay K7 to signal the ECM to discontinue cranking
8. When operating speed is reached:
 - A. Enables output voltage, except when PMG excited
 - B. Turns off field flash
 - C. Turns on status lamp
 - D. Enables Switched B+ (J1-8)
 - E. Enables complete fault detection

Stopping: See STOPPING THE GENSET (p. 3-4).
The Controller:

1. Disables run relay K6
2. Disables output voltage, except when PMG excited
3. Deenergizes the fuel lift pump, if so equipped.
4. Turns off the status lamp
5. Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM)
6. Removes processor power when idle 5 minutes

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

Voltage Regulation—Quad Winding Excited

Generators: The Controller maintains nominal AC output voltage as load varies by varying field voltage. In response to transient loads, it lowers the voltage setpoint to allow engine recovery. Field power is supplied by the quadrature windings (Q1-Q2). See ADJUSTING VOLTAGE (p. 6-15).

Voltage Regulation—PMG Excited Generators:

The voltage regulating function of the Controller is disabled. AC output voltage is regulated by a separate AVR. See Page 6-11. Field power is supplied by the PMG.

Controlling Fuel: The Controller allows the ECM to control fueling to maintain nominal frequency (speed) as load varies.

Fault Monitoring, Shutdown and Diagnostics:
See Section 8. Troubleshooting.

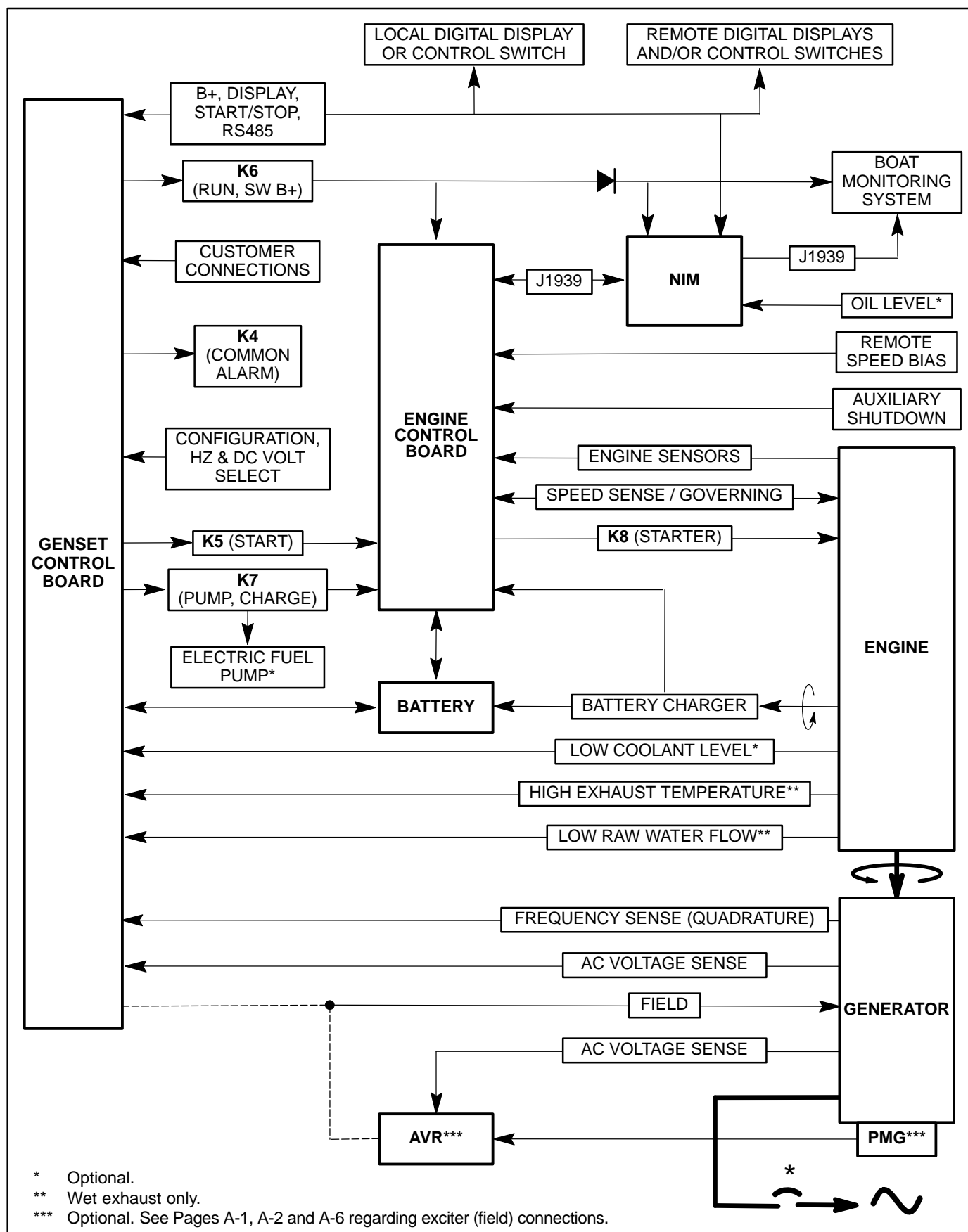


FIGURE 5-2. CONTROL BLOCK DIAGRAM

CONTROL BOX

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

Figure 5-3 illustrates the components inside the

control box. See Pages A-1, A-4 and A-5 for connections to components inside the box.

DIGITAL DISPLAY

Either a Digital Display or control switch panel may be mounted on the control box (Figure 5-3). See DIGITAL DISPLAY (p. 2-3) regarding function. Up to three Digital Displays may be connected in the system. See Pages A-1 and A-4 for connections.

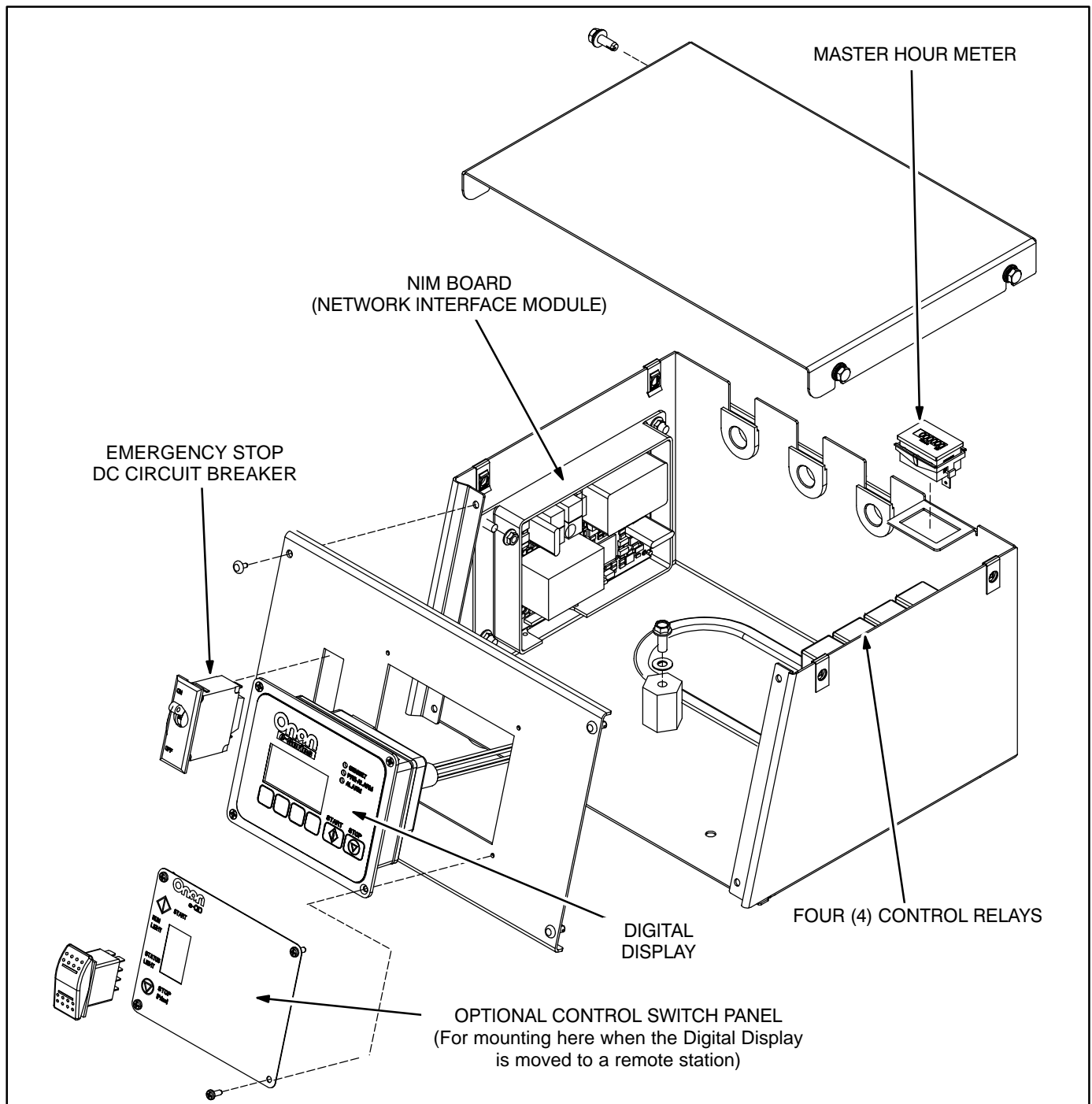


FIGURE 5-3. CONTROL BOX COMPONENTS

LOCAL / REMOTE CONTROL SWITCHES

See Pages A-1 and A-4 for local or remote control switch connections. Referring to Figure 5-4, replace a switch if:

- The switch does not close across connector pins **2** and **3** when held in the **Start** position
- The switch does not close across connector pins **1** and **2** when held in the **Stop** position
- The green run lamp does not light when 12 VDC is connected across connector pins **1(-)** and **6 (+)**.
- The amber status lamp does not light when 12 VDC is connected across connector pins **1(-)** and **5 (+)**.

CONTROL RELAYS K1, K2, K3, K4

These relays are located and mounted as shown in (Figure 5-3). To test a relay, apply 12 VDC across terminals 85–86 (Figure 5-5). Replace the relay if 30–87 (NO) does not close or 30–87a (NC) does not open, or either does not return to its normal position when power is removed.

See Page A-1 for relay function.

MASTER HOUR METER

The master hour meter is located and mounted as shown in (Figure 5-3). See Page 2-9 for instructions on how to synchronize run time on a replacement controller with the master hour meter.

EMERGENCY STOP CIRCUIT BREAKER

The circuit breaker is located and mounted as shown in (Figure 5-3). Replace a circuit breaker that does not open or close or reset.

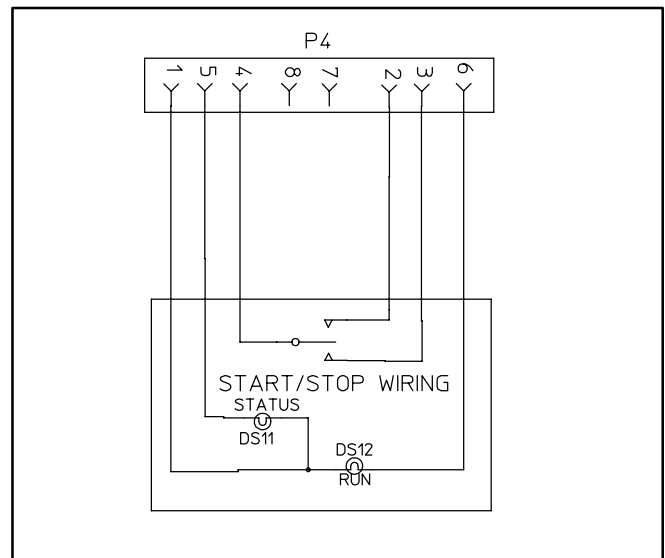


FIGURE 5-4. CONTROL SWITCH SCHEMATIC

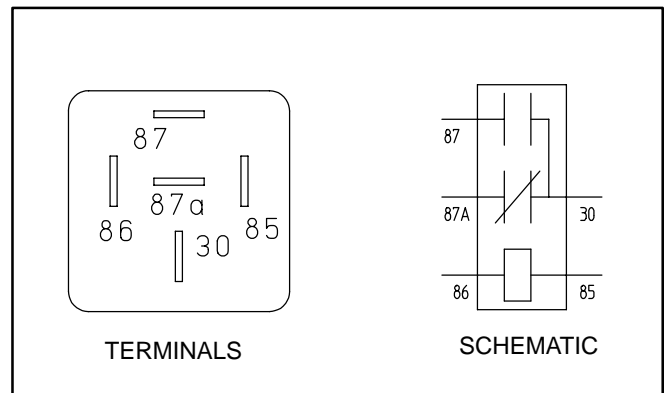


FIGURE 5-5. CONTROL RELAYS

NETWORK INTERFACE MODULE (NIM)

The NIM board is located and mounted as shown in (Figure 5-3) and is connected as shown on Page A-1. It has five jumpers to configure the board for the specific application (Figure 5-6). Make sure a replacement board is configured the same as the old one.

1. Jumper **W1** has no function at this time.
2. Jumper **W2** is cut for these genset models.
3. Jumpers **W3** and **W4** are used to assign the J1939 network address of the genset in a multiple-genset installation. To assign an address, cut the jumpers as scheduled in Table 5-1.

TABLE 5-1. J1939 ADDRESSES

JUMPER W3	JUMPER W4	ADDRESS
Not Cut	Not Cut	234
Not Cut	Cut	158
Cut	Not Cut	179
Cut	cut	203

4. Cut Jumper **W5** if the bus termination resistor on this NIM board is not required to terminate the network bus.

Note: Onan Publication D-3315, *Supported Messages on SAE J1939* is the basis for the software interface between the genset controller and the remote boat monitor.

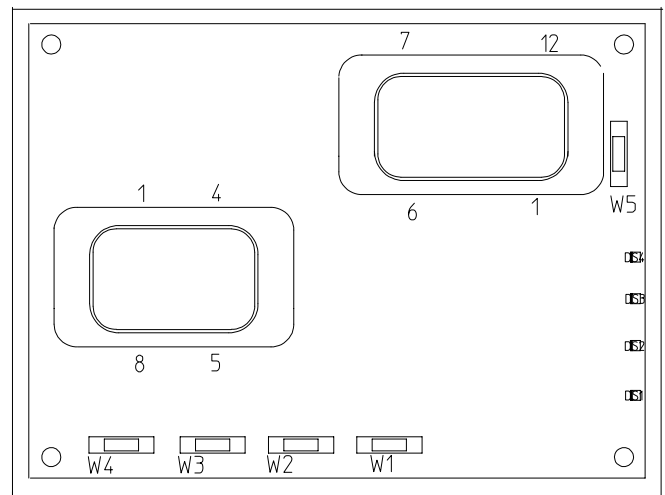


FIGURE 5-6. NIM CONFIGURATION JUMPERS

6. Generator

TESTS TO DETERMINE WHETHER GENERATOR OR REGULATOR IS FAULTY

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

Use the following procedure to isolate AC output problems to the generator or the voltage regulator.

1. Throw the line circuit breaker **OFF** and shut down the genset.

⚠CAUTION ***This test involves unregulated excitation of the generator. To prevent damage to the generator due to overcurrent, make sure that all loads have been disconnected from the power output terminals of the generator and that all faults have been cleared.***

2. Jumper Pins 6 and 7 on connector P12 in the control box to bypass genset fault shutdown so that the genset will continue to run during the test. (The boat builder may have connected a switch for fault bypass operation that can be switched ON for the test.)

⚠CAUTION ***Do not run this test in fault bypass mode until all engine fault shutdown and pre-alarm conditions have been serviced. Otherwise engine damage could result that is not covered by Warranty.***

3. Remove the side access cover of the control housing to access the exciter stator leads (**X** and **XX**). Disconnect the **X** and **XX** leads from the AC harness (quick connect type connectors).

4. Prepare to measure output voltage across the generator terminals while the genset is running.
5. Bring two jumpers from a 12 volt battery for connection to the exciter stator **X** (Field +) and **XX** (Field -) leads.
6. Connect the jumper from the positive (+) post of the battery to the **X** lead. Be prepared to connect the jumper from the negative (-) post of the battery to the **XX** lead. If one of the 12 volt cranking batteries is used, bring the jumpers from the battery connected on the grounded side of the system to avoid inadvertently imposing 24 volts on the system.
7. Check polarity again. Polarity must be correct or this test will be inconclusive because the induced and residual magnetic polarities in the exciter stator will be opposed.
8. Start the genset and connect the jumper from the battery negative (-) terminal to the **XX** lead.
9. The generator circuitry is probably okay if rated output voltage or higher is obtained and the voltages for all phases are balanced when the exciter is powered by a 12 volt battery. (Normal excitation voltage ranges from approximately 10 VDC at no-load to approximately 40 VDC at full-load.)
10. If the voltages are unbalanced, troubleshoot the main stator first. If the voltages are uniformly low, troubleshoot the exciter and field circuits first.
11. When testing has been completed, restore fault protection by switching OFF the fault bypass switch or removing the jumper between Pins 6 and 7 on connector P12. Make sure the status screen on the Digital Display does not continue to display "Fault Override" when finished with the work.

⚠CAUTION ***Damage to the genset as a result of bypassing fault shutdown protection is not covered under Warranty.***

TESTING THE GENERATOR

These tests can be performed without removing the generator. Before starting tests, disconnect the negative (–) cable from the battery to make sure the engine will not start while performing these tests.

⚠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.*

Exciter Stator

Testing Winding Resistance: Measure winding resistance with a Wheatstone bridge or digital ohmmeter (Figure 6-1). Replace the stator if winding resistance is not as specified by Table 6-1.

Testing Winding Insulation Resistance: Disconnect the exciter stator leads **X** and **XX** from their connectors in the AC harness and isolate them from ground. Using an ohmmeter, measure resistance between either lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm (1,000,000 ohms).

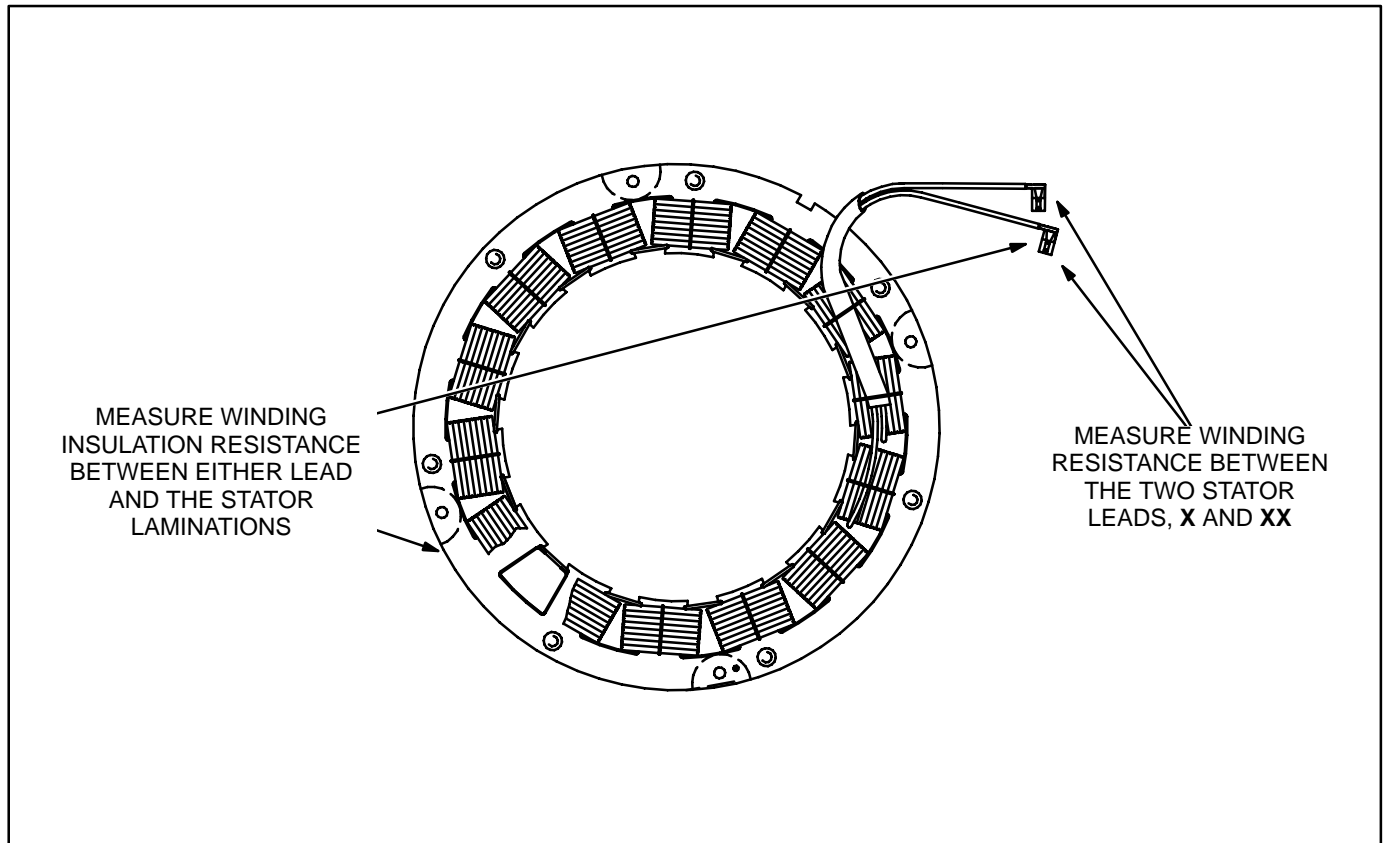


FIGURE 6-1. TESTING THE EXCITER STATOR

Exciter Rectifier Bridge (Rotating Rectifier Assembly)

The exciter rectifier bridge is mounted on the exciter rotor, inboard, facing the main rotor (Figure 6-2). It consists of a positive plate and a negative plate, split diametrically. Each carries three diodes, three terminal posts for connecting exciter rotor leads to the diode pigtails and a terminal for the main rotor (generator field) lead. A surge suppressor is connected across the two plates to prevent transient voltages that could damage the diodes.

Testing Diodes: Disconnect the diode pigtails from the terminal posts. Using an ohmmeter, measure electrical resistance between each diode pigtail and the plate on which the diode is mounted. Reverse the meter test probes and repeat the tests. The electrical resistance across each diode should be high in

one direction and low in the other. If the resistance is high or low in both directions, replace the diode.

Replacing Diodes: Make sure the replacement diode is of the correct polarity. Disconnect the pigtail from the terminal post and unscrew the old diode. Apply heat-sink compound under the head of the diode. Make sure the compound does not get on the threads. Torque the diodes to 36 to 42 lb-in (4 to 4.8 N-m) and the pigtail terminals to 24 lb-in (2.7 N-m) when reassembling.

Surge Suppressors Testing and Replacement: Remove the suppressor. Replace the suppressor if it appears to have overheated or if ohmmeter readings indicate less than infinite resistance (end of scale) in both directions. Torque the terminals to 24 lb-in (2.7 N-m) when reassembling.

CAUTION Layers of dust can cause diodes to overheat and fail. Brush dust off regularly.

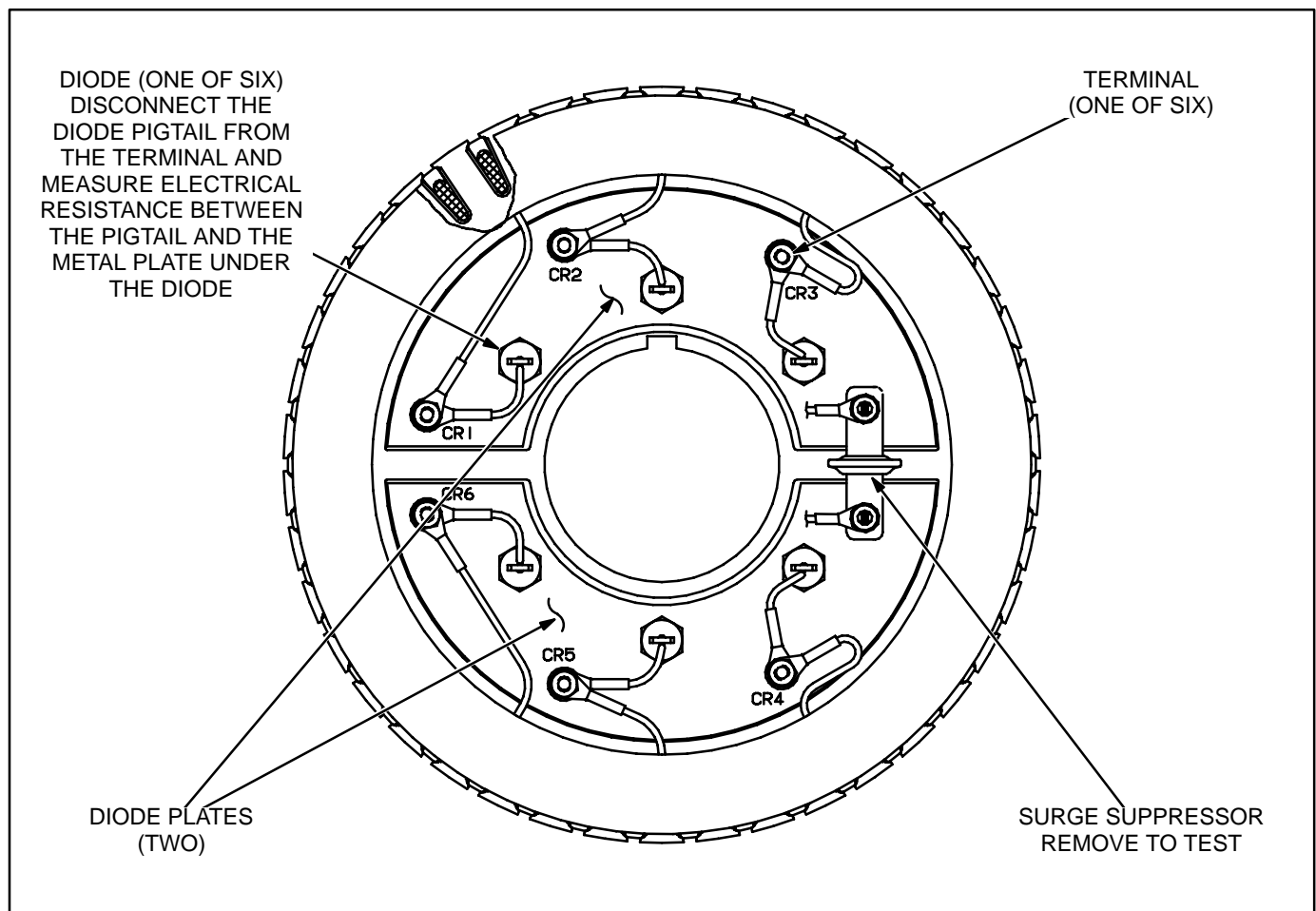


FIGURE 6-2. TESTING THE ROTATING RECTIFIER ASSEMBLY

Exciter Rotor

Testing Winding Resistance: Disconnect the six rotor winding leads from the terminal posts on the rectifier assembly (Figure 6-3). With a Wheatstone bridge, measure electrical resistance across each pair of rotor windings: **U** (CR1 or CR4) and **V** (CR2 or CR5), **V** (CR2 or CR5) and **W** (CR3 or CR6), **W** (CR3 or CR6) and **U** (CR1 or CR4). See the winding

schematic. Replace the whole rotor shaft assembly if the resistance of any winding is not as specified in Table 6-1.

Testing Winding Insulation Resistance: Using an ohmmeter, measure the resistance between any rotor winding lead or the terminal to which it is connected and the rotor laminations. Replace the whole rotor shaft assembly if insulation resistance is less than 1 megohm.

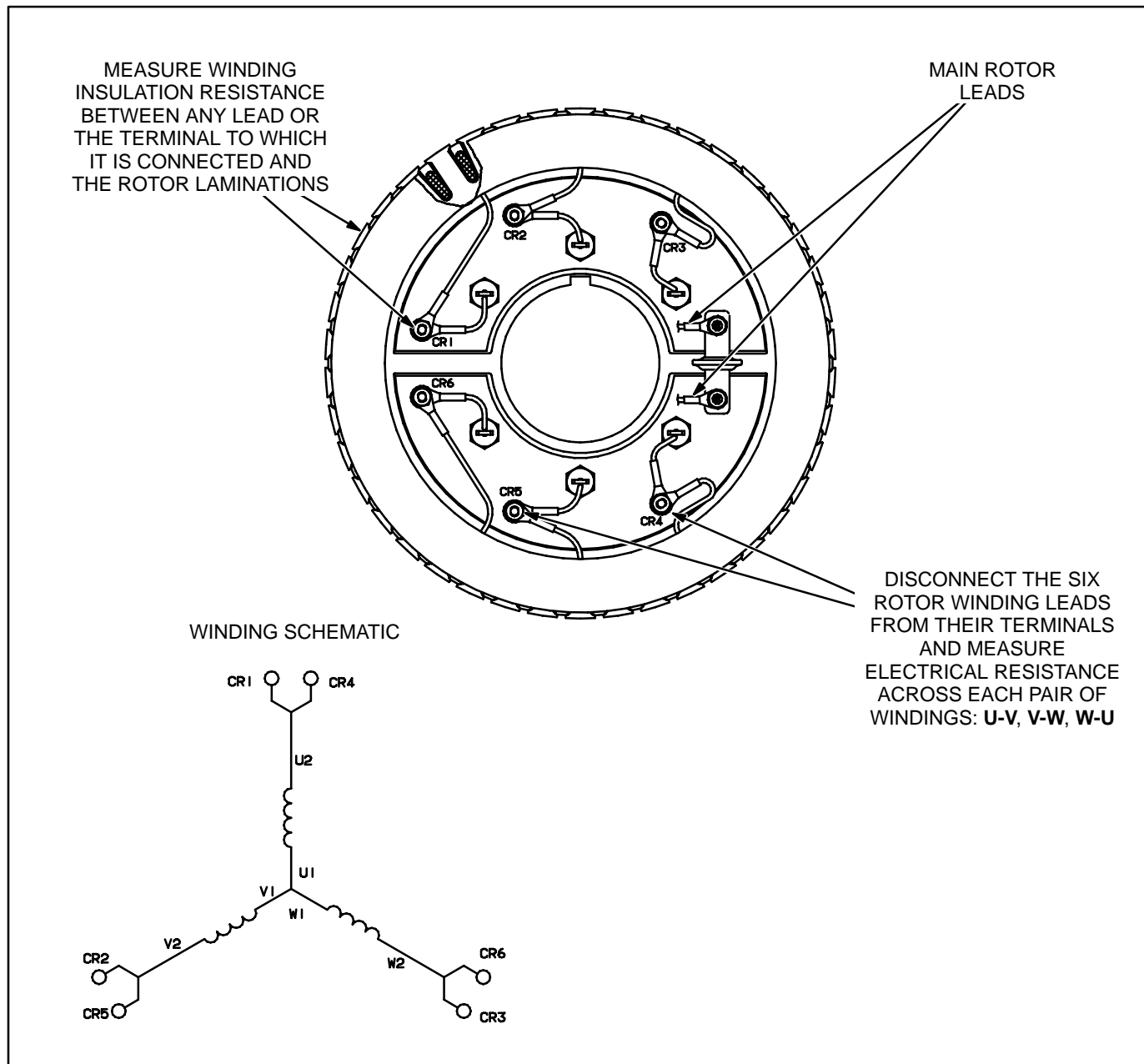


FIGURE 6-3. TESTING THE EXCITER ROTOR

Main Rotor (Generator Field)

Testing Winding Resistance: Disconnect the two leads of the main rotor from the terminals on the rotating rectifier assembly (Figure 6-4). Measure electrical resistance between the two leads with a Wheatstone bridge or digital ohmmeter. Replace the rotor if the resistance is not as specified in

Table 7-1. Connect the rotor leads and torque the terminals to 24 lb-in (2.7 N-m) when reassembling.

Testing Winding Insulation Resistance: Using an ohmmeter, measure the resistance between either lead of the main rotor windings, or the terminal to which it is connected, and the main rotor laminations. Replace the rotor if insulation resistance is less than 1 megohm.

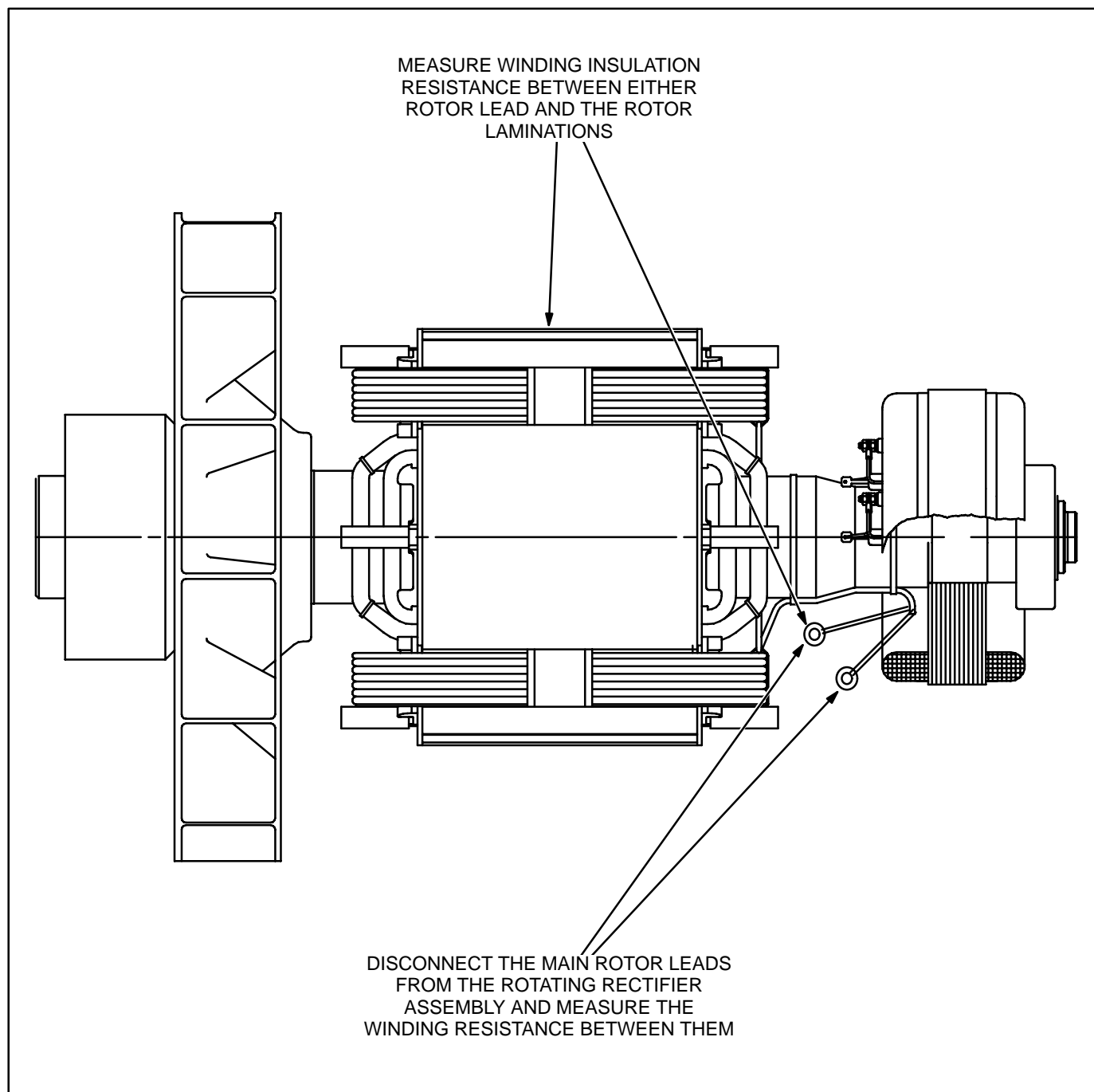


FIGURE 6-4. TESTING THE MAIN ROTOR

Main Stator

Testing Winding Resistance: Measure electrical resistance across each pair of stator leads (U1-U2, U5-U6, V1-V2, V5-V6, W1-W2 and W5-W6) with a Wheatstone bridge having at least 0.001 ohm precision. Replace the stator if the resistance of any winding is not as specified in Table 6-1.

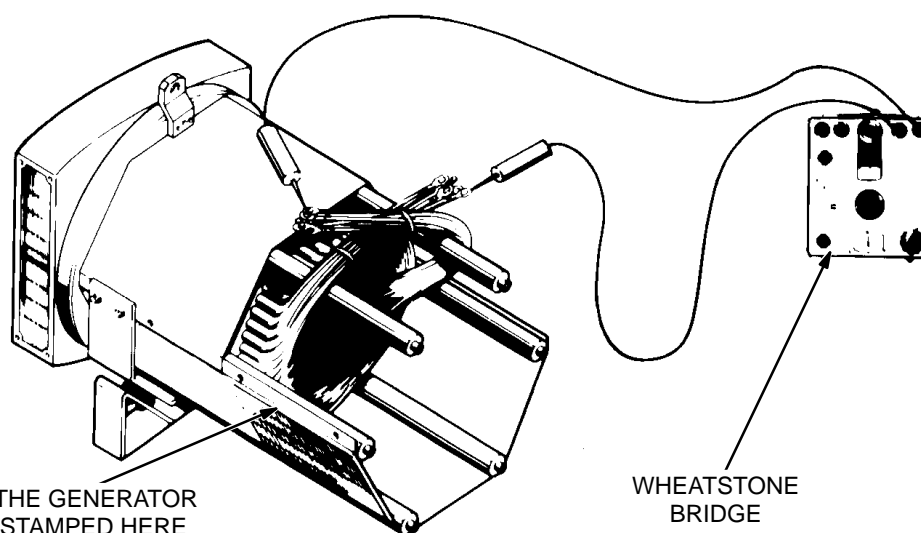
Alternatively, winding resistance can be measured line-to-line at the generator terminals (U-V, V-W, W-U) on "star" connected generators. On a 600 volt generator, line-to-line resistance should be twice the table value (two winding elements in series). On a "series star" connected generator, line-to-line re-

sistance should be four times the table value (four winding elements in series). On a "parallel star" connected generator, line-to-line resistance should be the same as the table value (two gensets of two winding elements in series). Single phase only windings can be measured at W-V and should be twice the table value.

Testing Winding Insulation Resistance: Disconnect all stator leads and winding taps from their respective terminals and make sure the ends do not touch the generator frame. Using an ohmmeter, measure electrical resistance between any stator lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm.

TABLE 6-1. GENERATOR STATOR AND ROTOR WINDING RESISTANCES

GENERATOR PART NUMBER	MAIN WINDING RESISTANCE OHMS ^{1, 2}	QUADRATURE WINDING RESISTANCE OHMS ¹	MAIN ROTOR WINDING RESISTANCE OHMS (± 10%) ¹	EXCITER ROTOR WINDING RESISTANCE OHMS (± 10%) ¹	EXCITER STATOR WINDING RESISTANCE OHMS (± 10%) ¹
4-Lead Generators (Single-Phase)					
3096-04	0.0368–0.0333	0.296–0.328	0.80	0.180	19.5
3097-02	0.0252–0.0228	0.565–0.624	1.20	0.180	19.5
3097-03	0.0179–0.0162	0.543–0.600	1.31	0.180	19.5
3097-04	0.0137–0.0124	0.459–0.507	1.50	0.210	19.5
12-Lead Generators (Three-Phase)					
3096-08	0.0530–0.0480	0.538–0.595	0.67	0.180	19.5
3096-09	0.0341–0.0309	0.453–0.501	0.80	0.180	19.5
3097-07	0.0310–0.0280	0.574–0.635	1.11	0.180	19.5
3097-09	0.0163–0.0147	0.466–0.515	1.31	0.210	19.5



1. If high, recheck winding resistance after the windings have cooled to room temperature.
2. The main windings are probably good if some of the resistances fall outside the range but are all within 10 percent of each other.

GENERATOR DISASSEMBLY

Removing the Generator Output Box

1. Before starting, disconnect the negative (–) cable from the battery to make sure the genset will not start while working on it.

⚠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 sound shield if the genset is so equipped. See Page 6-16 for instructions on how to remove the internal air baffle.
3. Disconnect the AC line cables and conduit. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
4. If the genset has a mounted line circuit breaker, disconnect the cables to the circuit breaker. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
5. Disconnect the output box grounding strap.
6. Disconnect the remote control wiring and conduit. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
7. Disconnect the engine wiring harness connectors.
8. Disconnect all generator control leads (winding taps) from connections in the output box. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
9. Loosen the three output box mounting bolts on each side of the generator and remove the output box.

Removing the Generator

1. The rotor must be carried inside the stator when the generator is withdrawn from the engine because the drive discs alone cannot support the weight of the rotor. Bar the engine until one of the four poles of the rotor points straight down so that the rotor will rest on the face of the pole

when the generator is withdrawn. (Use John Deere flywheel rotating tool JDE81-1.)

⚠CAUTION *Use the engine barring tool that is available. Using the rotor fan blades to bar the engine will damage the blades.*

2. Attach a lifting eye on each end of the generator using two M10 screws for each lifting eye (Figure 6-5).
3. Take up hoist slack and remove the two through bolts securing the generator to the rubber isolation mounts (p. 7-23).
4. Raise the generator end approximately one inch (12 mm) and securely block the engine under the flywheel housing. Lower the generator slightly so that the blocks carry most of the weight.
5. Remove the bolts securing the generator drive discs to the flywheel.
6. Loosen all the bolts securing the generator adaptor casting to the flywheel housing. Adjust the hoist to carry the full weight of the generator, remove the bolts and pull the generator away.

Removing the Rotor

1. Remove the generator adaptor casting on the drive disc end and the end plate on the bearing end.
2. Using a hoist of sufficient capacity, cinch a lifting strap on the drive end of the rotor. Lift the bearing end of the rotor by hand and push it towards the drive end of the generator until half the width of the rotor core protrudes from the stator. Release the weight of the rotor and re-cinch the lifting strap around the middle of the rotor core. Withdraw the rotor until it is free of the stator, guiding it by hand on both ends to prevent contact with the stator windings.
3. Rest the rotor in a cradle, solidly supporting it on two pole faces—not on the drive discs, fan or exciter rotor.
4. Remove the retaining clip if the rotor shaft bearing is to be removed.

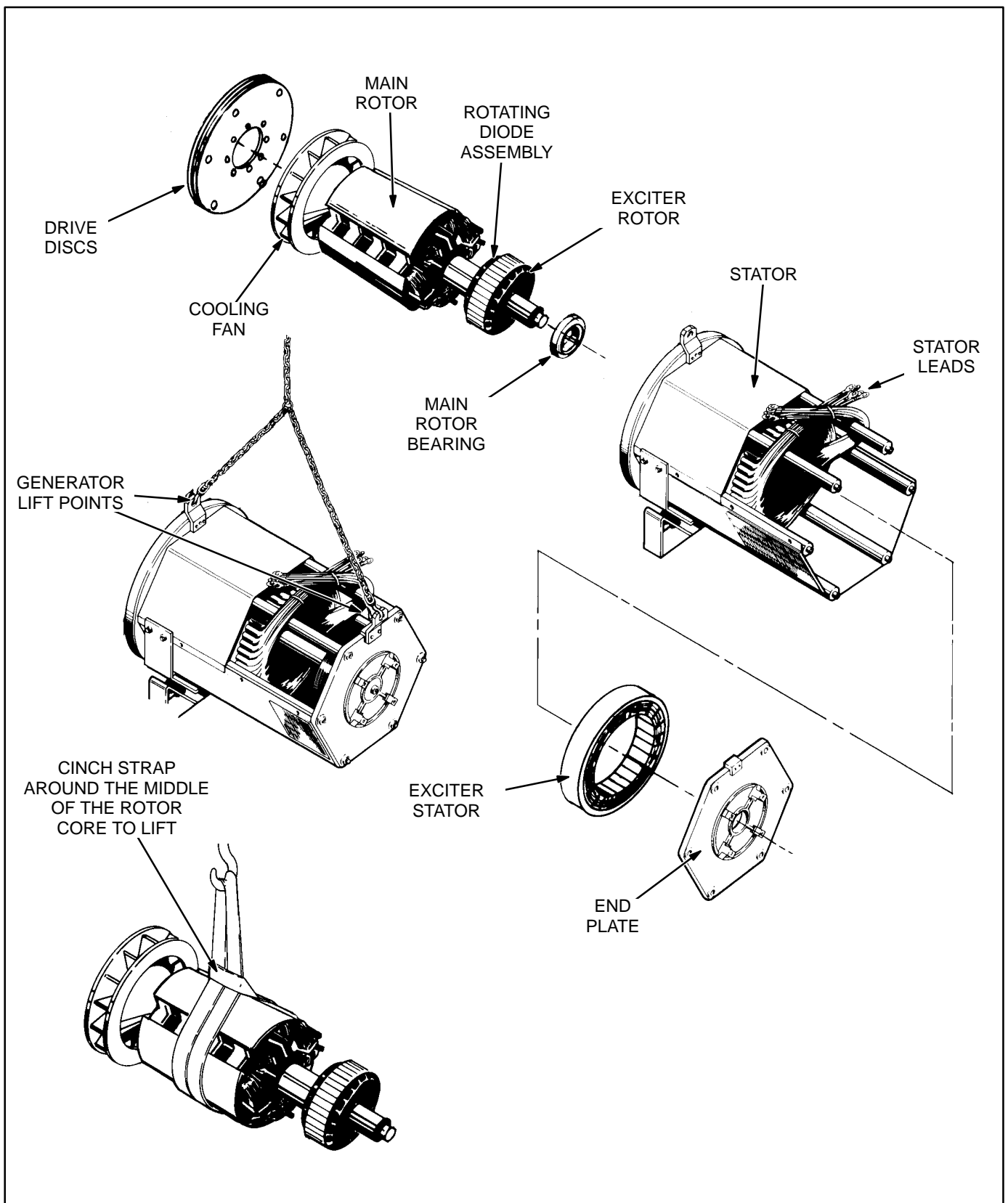


FIGURE 6-5. GENERATOR ASSEMBLY

GENERATOR REASSEMBLY

Reassembling is the reverse of disassembling. Note the following.

1. Apply force to the inner race of the rotor bearing when pressing it onto the shaft, otherwise, it will be damaged. Be sure to secure the retaining clip.
2. The drive disc-to-rotor bolts should be torqued to 160 lb-ft (230 N-m). Make sure the bolt washers face the drive discs with rounded edges toward the discs.
3. The exciter stator mounting screws should be torqued to 7 lb-ft (10 N-m).
4. Make sure the rubber O-ring is in place in the bearing bore in the generator endplate.
5. The generator end plate mounting bolts should be torqued to 25 lb-ft (34 N-m).
6. The generator-to-adaptor bolts should be torqued to 40 lb-ft (55 N-m).
7. The adaptor-to-engine bolts should be torqued to 35 lb-ft (48 N-m). These bolts should be torqued before the drive disc is bolted to the flywheel (Step 8).
8. The drive disc-to-flywheel bolts should be torqued to 47 lb-ft (62 N-m). Make sure the bolt washers face the drive discs with rounded edges toward the discs. If necessary, gently pry the rotor fan up using a piece of lumber so that the drive discs line up with the locating bore in the face of the flywheel and slip in.
9. The vibration isolator center bolts should be torqued to 165 lb-ft (245 N-m).
10. Re-install the sound shield if the genset is so equipped. See Page 6-16 for instructions on how to re-install the internal air baffle.
11. Reconnect the generator as required (p. A-3).

SERVICING THE PMG

The following is applicable if the generator is equipped with a PMG (permanent magnet) exciter.

Testing

1. Jumper Pins 6 and 7 on connector P12 in the control box to bypass genset fault shutdown so that the genset will continue to run during the test. (The boat builder may have connected a switch for fault bypass operation that can be switched ON for the test.)

⚠ CAUTION *Do not run this test in fault bypass mode until all engine fault shutdown and pre-alarm conditions have been serviced. Otherwise engine damage could result that is not covered by Warranty.*

2. Disconnect PMG leads **PMG 2**, **PMG 3** and **PMG 4** from their connectors in the AC harness. (AC harness quick connect terminals are located inside control housing.)
3. Start the genset and let speed stabilize.
4. Measure voltage across lead pairs **PMG 2 & PMG 3**, **PMG 3 & PMG 4** and **PMG 4 & PMG 2**. Voltage should be at least 150 VAC for 50 Hz gensets and at least 180 VAC for 60 Hz gensets, and should be approximately the same for each set of leads. If the voltages are low or uneven, check all the leads and connections and repair as necessary before disassembling the PMG.
5. Stop the genset and measure electrical resistance across lead pairs **PMG 2 & PMG 3**, **PMG 3 & PMG 4** and **PMG 4 & PMG 2** with a Wheatstone bridge or digital ohmmeter. Each winding should have a resistance of approximately 4.4 ohms.
6. *When testing has been completed, restore fault protection by switching OFF the fault bypass switch or removing the jumper between Pins 6 and 7 on connector P12.*

⚠ CAUTION *Damage to the genset as a result of bypassing fault shutdown protection is not covered under Warranty.*

Disassembling the PMG

1. Before starting, disconnect the negative (-) cable from the battery to make sure the genset will not start while working on it.

⚠ 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 PMG cover and disconnect the leads at the connector.
3. Remove the bolts and clamps that secure the PMG stator to the generator frame and carefully pull away the stator.

The rotor is magnetic and will attract the stator. Hold the stator firmly so that the windings are not damaged by striking the stator support lugs.

4. Remove the rotor center bolt and pull away the rotor. The rotor is magnetic and will attract iron filings. Put it in a clean plastic bag until it is re-mounted. Do not take it apart or it will lose its magnetism. Also, if the dowel pin in the end of the shaft is loose, stow it in a safe place until it is time to reassemble the PMG.

Reassembling the PMG

Reassembling is the reverse of disassembling. Torque the rotor center bolt to 40 lb-ft (54 N-m). The stator leads must be at 12 o'clock.

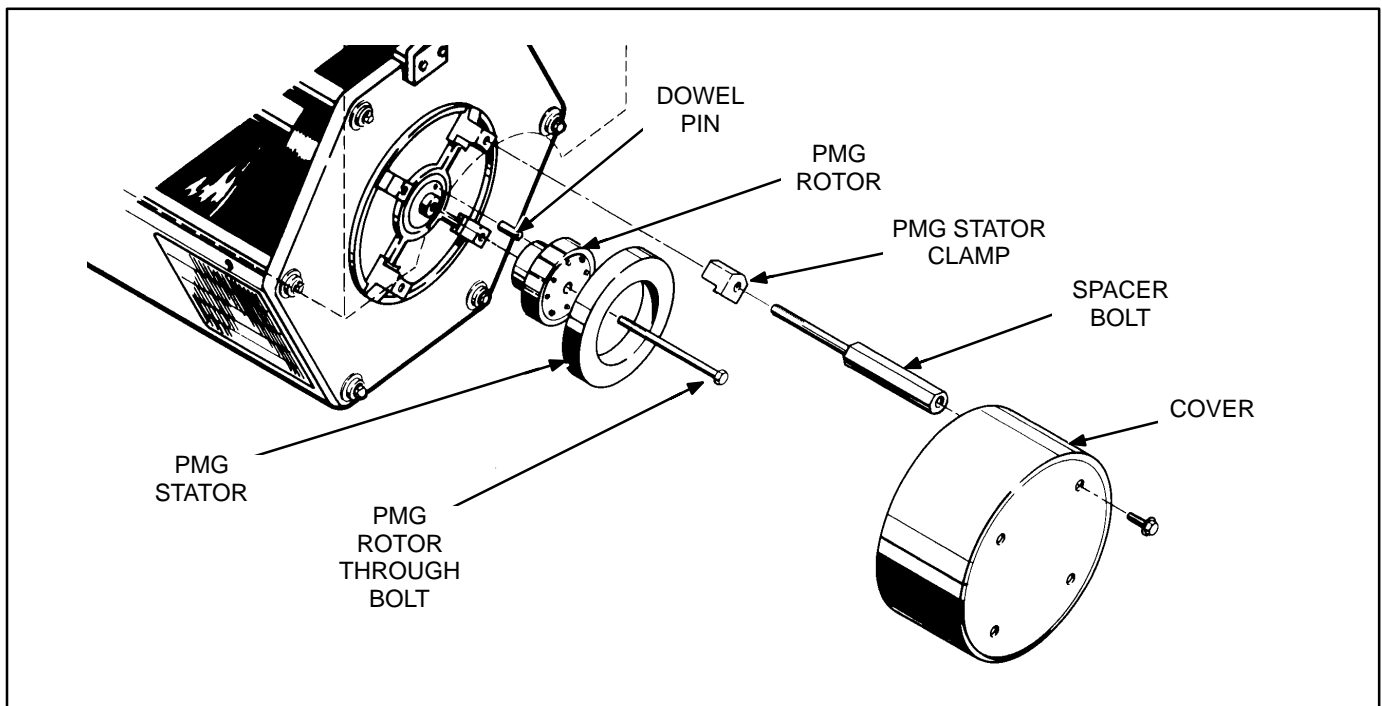


FIGURE 6-6. PMG ASSEMBLY

VOLTAGE REGULATOR—PMG EXCITED GENERATORS

Automatic Voltage Regulator (AVR)

To Adjust Voltage: See ADJUSTING VOLTAGE—PMG EXCITED GENERATORS (p. 6-13).

Location and Mounting: Figure 6-7 illustrates the location and mounting of the AVR used for PMG excitation. See Pages A-1, A-2, A-3 and A-6 for AC Sense and Field connections.

Note: The voltage regulating function of the genset controller must be disabled. Make sure J16 is connected to P16 in the regulator harness (p. A-6). Also see Note 7 on Page A-1.

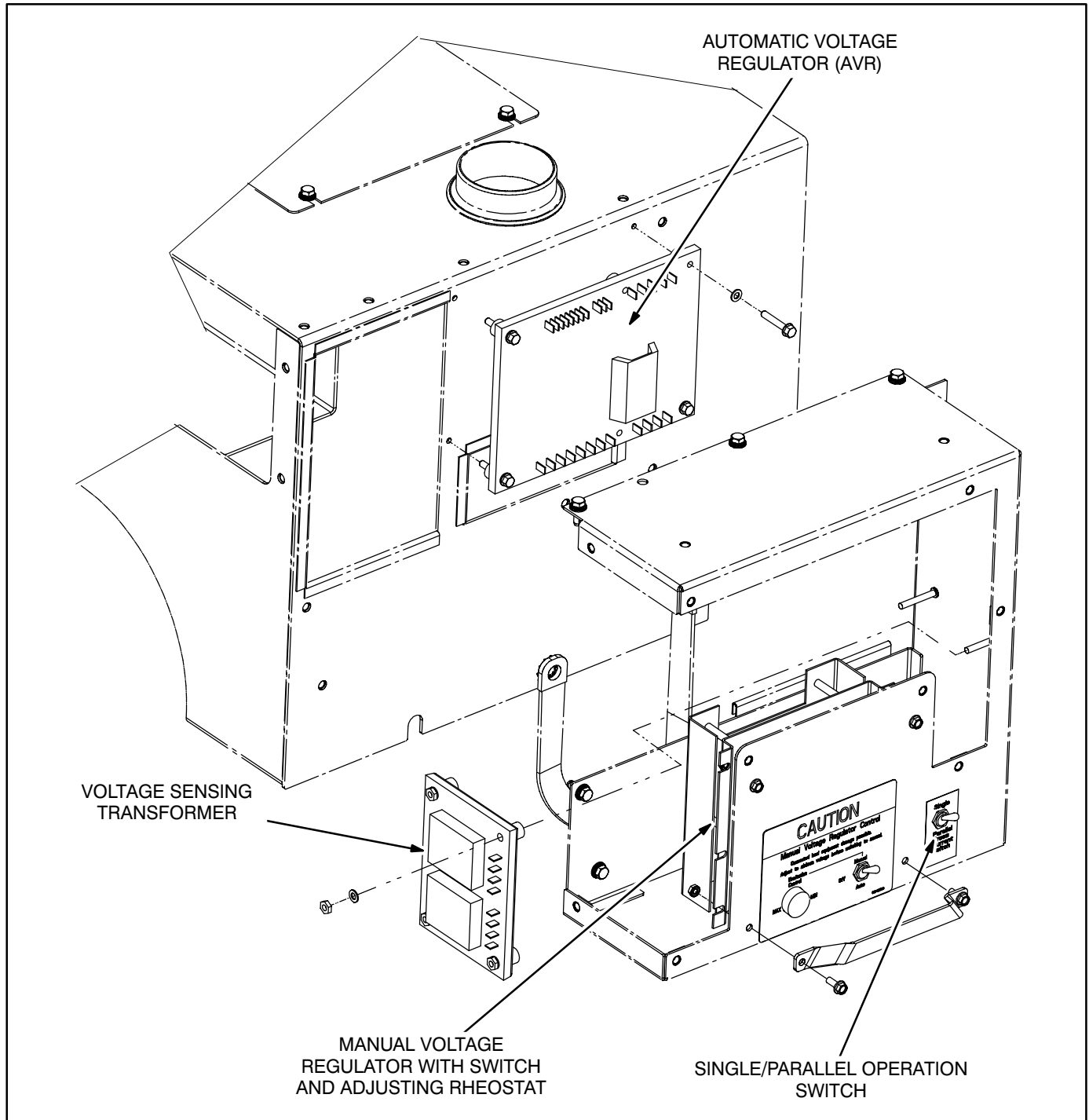


FIGURE 6-7. AUTOMATIC AND MANUAL VOLTAGE REGULATORS USED FOR PMG EXCITATION

To Replace AVR: When replacing an AVR, make sure the configuration jumpers are on the right terminals (Figure 6-9).

- **Voltage Trim Jumper** – Jumper is required across terminals **1** and **2** to get the full range of voltage adjustment

- **KW Range Selection Jumper** –

For Models MDDCE and MDDCJ, jumper terminals **B** and **C**

For all other models, jumper terminals **A** and **C**

- **Frequency Selection Jumper** –

For **60 Hz** Models, jumper **1** and **3**

For **50 Hz** Models, jumper **2** and **3**

Isolation Transformer T30

Figure 6-8 illustrates the terminals and schematic of the voltage sensing isolation transformer windings. See Page A-2 regarding connections. Check for electrical continuity across each winding pair: Input **8-7** and **7-6** and Output **8-7** and **7-6**. Replace a transformer with an open winding.

Manual Voltage Regulator (Optional)

Figure 6-7 illustrates the location and mounting of the manual voltage regulator used for PMG excitation. See Page A-2 regarding connections.

To test for a faulty manual voltage regulator, disconnect the field and PMG leads from it and connect them directly to the AVR. If the AVR can regulate voltage properly when the manual regulator is bypassed, but not when it is in the circuit, the manual regulator is faulty and should be replaced.

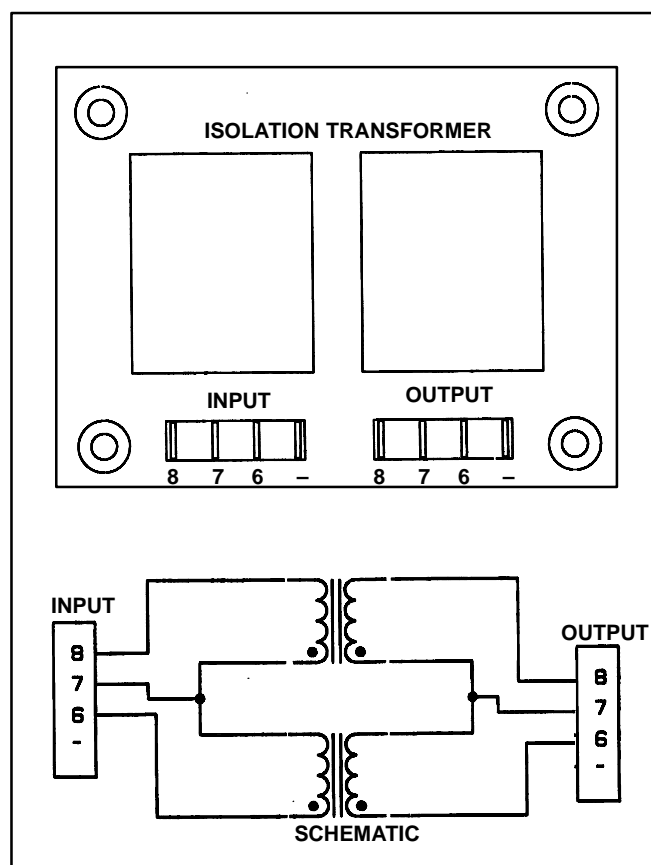


FIGURE 6-8. ISOLATION TRANSFORMER T30

ADJUSTING VOLTAGE—PMG EXCITED GENERATORS

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

To Adjust Voltage

Refer to Figure 6-9.

1. If the genset has a sound shield enclosure, remove the front access panel below the control box.
2. Remove the voltage regulator access cover.
3. Push the Single/Parallel Operation Switch up to SINGLE. The switch is located below the voltage regulator access opening.
4. Start the genset and let voltage and frequency stabilize. Make sure all loads have been disconnected.
5. Using a small flat-bladed screwdriver, turn the *Voltage Trimmer* clockwise to increase voltage or counterclockwise to decrease voltage.

To Adjust Reactive Droop Compensation

This procedure applies only to gensets being set up for paralleling. Refer to Figure 6-9.

1. Check for correct droop CT connections and polarity, especially if the generator has been re-connected (p. A-2 and A-3).
2. Adjust voltage in accordance with the preceding procedure.
3. Push the Single/Parallel Operation Switch down to PARALLEL. The switch is located below the voltage regulator access opening.
4. Start the genset and connect at least 1/2 rated load.
5. Measure voltage at the voltage regulator terminals to which the droop CT leads are connected. You may expect less than 5 VAC.
6. Multiply the reciprocal of the voltage measured in Step 5 ($1 \div \text{VAC}$) by 100. This value is the percentage of full rotation required of the *Voltage Droop Trimmer*.

Example Calculation: If 1.4 VAC was measured in Step 5, the trim required is:

$$(1 \div 1.4) \times 100 = 71\% \text{ of full rotation.}$$

7. Turn the *Voltage Droop Trimmer* fully counterclockwise to zero and then clockwise the percentage of full rotation determined in Step 6 (approximately).

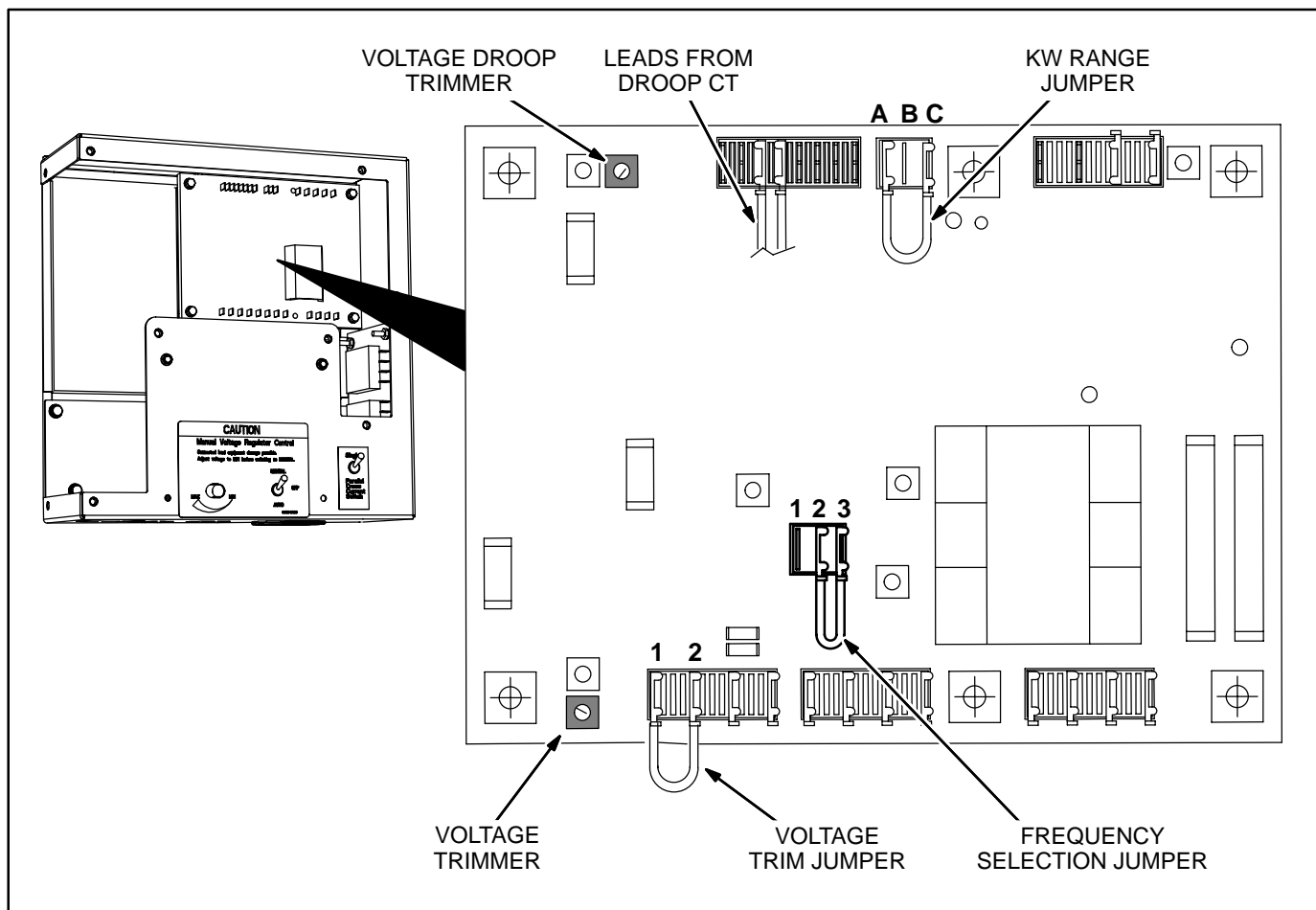


FIGURE 6-9. VOLTAGE REGULATOR ON PMG-EXCITED GENERATORS

ADJUSTING VOLTAGE—QUAD WINDING EXCITED GENERATORS

The generator is excited by the quadrature windings through the genset controller (Figure 5-1) which regulates AC output voltage. See pages A-1 and A-3 for AC Sense, Quad and Field connections.

To Adjust Voltage Using Digital Display

Note: The GEN STATUS screen will not display AC Voltage while the genset is in voltage adjust mode. The line for displaying the voltage is filled in as shown in Figure 6-10. A separate voltmeter is required for voltage adjustment.

1. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds. Make sure all loads have been disconnected.
2. Rapidly press **START** 6 times *during the first minute after startup* to put the genset controller into *voltage adjust mode*. The green status lamp will blink rapidly and the Display will change Status from *Running* to *Volt Adj* (Figure 6-10).
3. **To adjust voltage up**, press and quickly release **START**. Voltage will increase approximately 0.6 volts each press and release.
4. **To adjust voltage down**, press and hold **START** for about 1 second. Voltage will decrease approximately 0.6 volts each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the Display to change Status from *Volt Adj* to *Running* and then press **STOP** to stop the genset and save the adjustment.
6. Restart the genset and check voltage.

To Adjust Voltage Using Control Switch

1. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds. Make sure all loads have been disconnected.
2. Rapidly press **START** 6 times *during the first minute after startup* to put the genset controller into *voltage adjust mode*. The amber status lamp will begin blinking about once every second to indicate the change to voltage adjust mode. The green status lamp will remain on.
3. **To adjust voltage up**, press and quickly release **START**. Voltage will increase approximately 0.6 volts each press and release.
4. **To adjust voltage down**, press and hold **START** for about 2 second. Voltage will decrease approximately 0.6 volts each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the amber lamp to stop blinking and then press **STOP** to stop the genset and save the adjustment.
6. Restart the genset and check voltage.

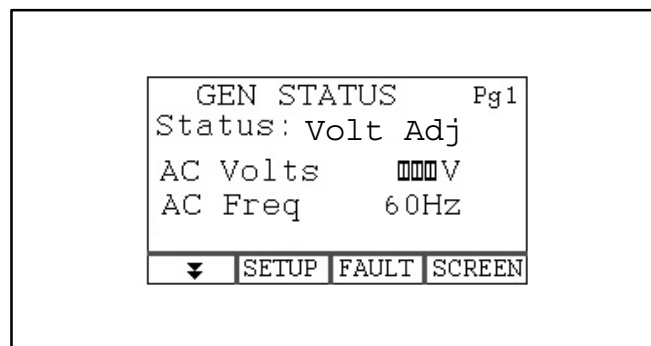


FIGURE 6-10. VOLTAGE ADJUSTMENT SCREEN

REMOVING/INSTALLING INTERNAL AIR BAFFLE OF SOUND SHIELD

When removing a generator it will be necessary to remove the sound shield if the genset is so equipped. The internal air baffle fits closely around the generator making it necessary to move components out of the way in order to push the baffle on or off down the length of the generator (Figure 6-11).

Removal

1. Remove the DC control box and its four mounts (and mount stiffener rings) and swing the control box down over the end of the generator so that the air baffle can be pushed on over the end of the generator.
2. Disconnect the 3 controller connectors and remove the controller and bracket (4 screws).
3. Disconnect any wiring to components inside the AC control box and remove the box (8 screws).
4. The hole in the air baffle matches the cross-section of the generator and outlet box. Push the air baffle down the length of the generator until it clears the end.

Installation

1. Installation is the reverse of assembly.
2. Push the air baffle down the length of the generator up to the skid crossmember. The weld nut tabs along the top edge of the baffle must point as shown in Figure 6-11. Secure the baffle to the crossmember with 3 screws.
3. Make sure to reconnect the ground bonding strap.

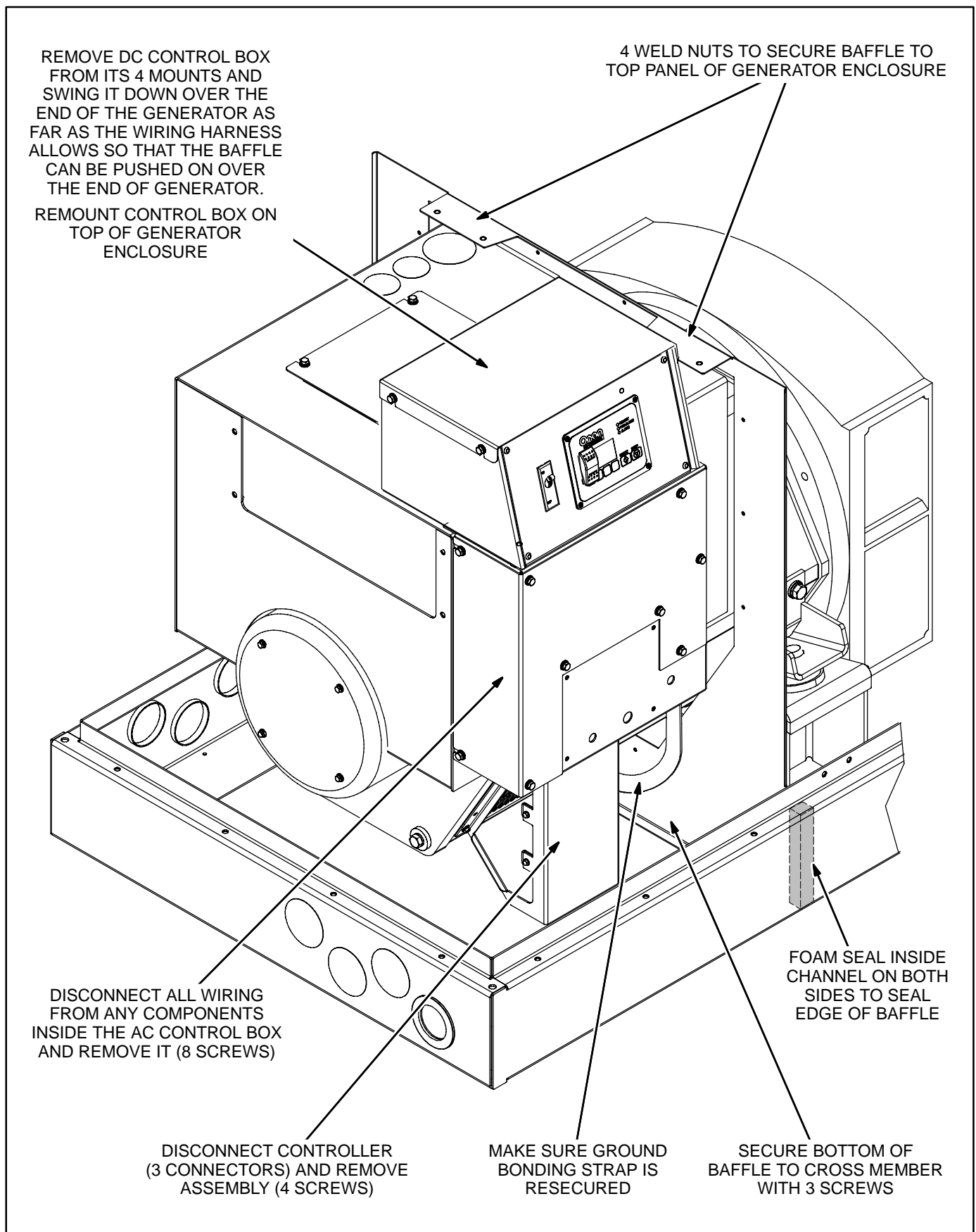


FIGURE 6-11. COMPONENTS TO BE MOVED OUT OF WAY TO INSTALL AIR BAFFLE

7. Engine and Accessories

ENGINE

For engine service beyond that covered in this section, call an authorized John Deere service representative. Figure 1-2 illustrates where the engine serial number plate and options code label are located on the engine. Information on these labels will be requested before the service call is made.

ECM AND ENGINE SENSORS

Figure 7-1 illustrates the engine, ECM (Engine Control Module) and sensors connected to the ECM

through the engine wiring harness. See TABLE 8-2. TROUBLESHOOTING ENGINE FAULT CODE NO. 16 and TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARMS for the associated engine diagnostics.

See Figures 7-2 through 7-4 for the engine sensors connected through the genset wiring harness (Pages A-1 and A-5) and TABLE 8-1. TROUBLESHOOTING GENSET FAULTS for the associated diagnostics.

Also see the control block diagram in Figure 5-2.

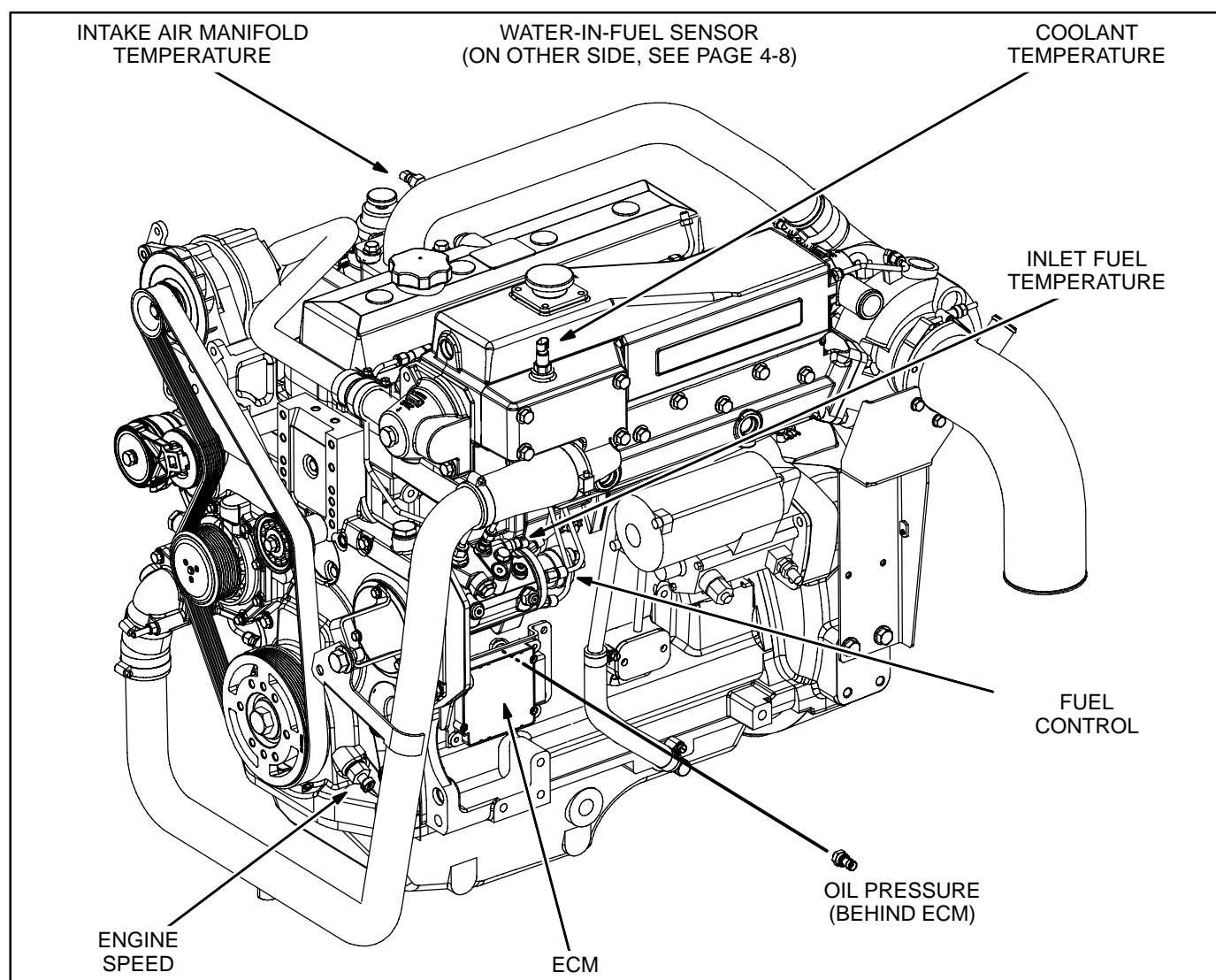


FIGURE 7-1. ENGINE WITH ECM AND ENGINE SENSORS

⚠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.*

HIGH EXHAUST TEMPERATURE SWITCH

The high exhaust temperature switch is provided on models having wet exhaust. The switch is secured to the side of the water / exhaust mixer (Figure 7-2).

For connections see Pages A-1 and A-5.

LOW COOLANT LEVEL SWITCH (OPTIONAL)

When provided, this switch is threaded into the coolant reservoir (Figure 7-3). Use thread sealant when remounting the switch.

For connections see Pages A-1 and A-5.

RAW WATER FLOW SWITCH

This switch is provided on models having a heat exchanger.

The raw water flow switch is threaded into a “T” fitting on the front end cap of the heat exchanger (Figure 7-3). Use thread sealant and engage at least two full threads when installing.

Check continuity across the switch terminals while blowing into it (1 psi). Replace the switch if it does not open and close.

For connections see Pages A-1 and A-5.

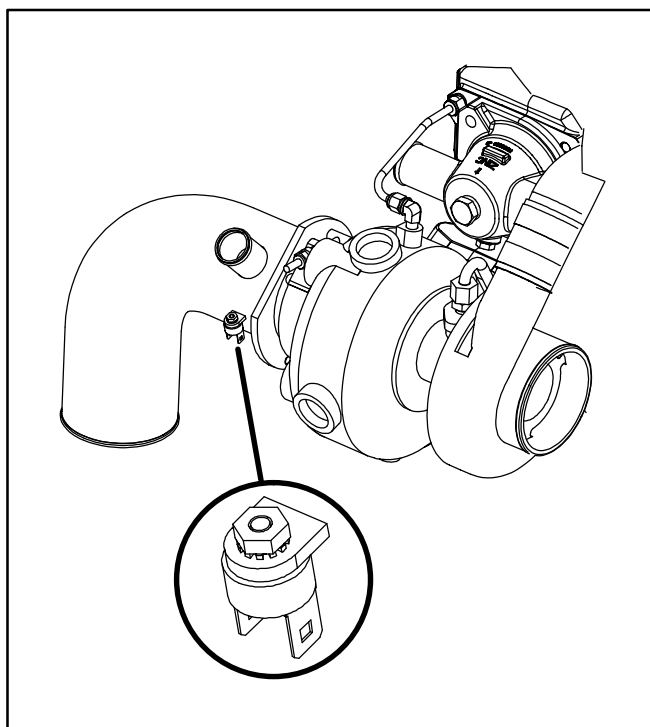


FIGURE 7-2. HIGH EXHAUST TEMPERATURE SWITCH

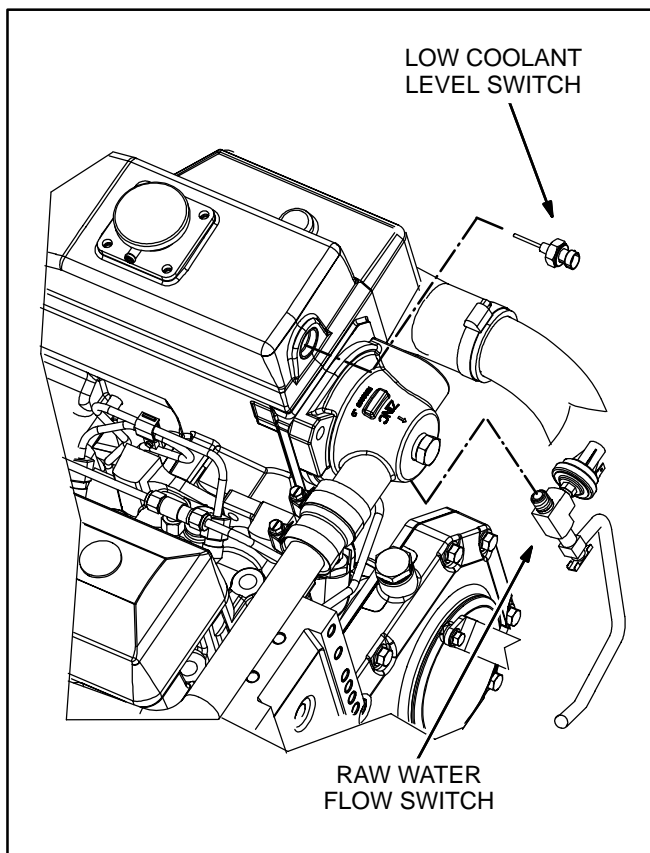


FIGURE 7-3. LOW COOLANT LEVEL AND RAW WATER FLOW SWITCHES

⚠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.*

LOW / HIGH OIL LEVEL GAUGE

If necessary, readjust the oil level gauge as follows:

1. Add or drain oil as necessary so that the level indicated on the dip stick is as illustrated in Figure 7-4.
2. To make sure the engine will start, adjust the gauge level indicators so that the left indicator (high oil level) is well above the oil level in the gauge and the right indicator (low oil level) well below.
3. Start the genset and adjust the left level indicator down into the oil. The genset should shut down on Code No. 6-OIL LEVEL HIGH OR LOW. Reset the control and adjust the level indicator up well out of the oil.
4. Repeat the Step 3 procedure with the right indicator. The genset should shut down on Code No. 6-OIL LEVEL HIGH OR LOW when the right level indicator rises above the oil level in the gauge.
5. Make necessary repairs or reconnections if the genset does not shut down when either high or low oil level is simulated (Steps 3 and 4). For connections see Pages A-1 and A-5.
6. Stop the genset and allow oil to drain back into the oil pan. Check the oil level on the dip stick again and add or drain oil as necessary.
7. Adjust the high oil level indicator (left) to 1/4 inch (6 mm) above the oil level in the gauge and the low oil level indicator (right) to 1-1/4 inch (31 mm) below.

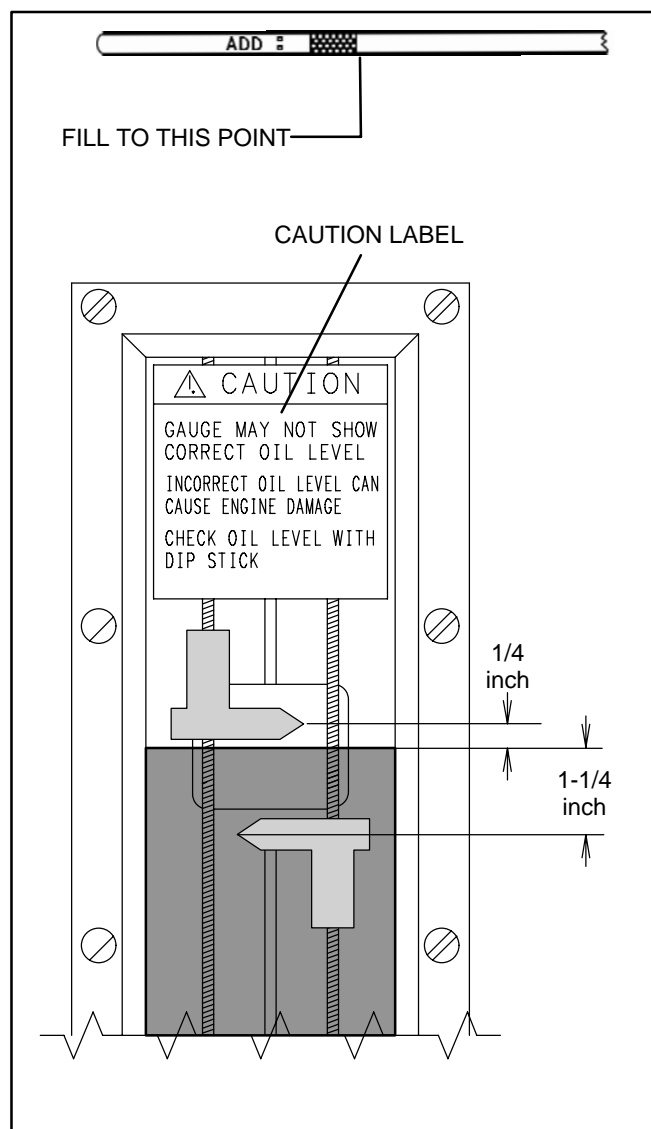


FIGURE 7-4. ADJUSTING OIL LEVEL GAUGE

⚠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.*

STARTER AND START SOLENOID

Figure 7-5 illustrates starter and start solenoid K8 installation. For connections to the starter and solenoid terminals shown, see the wiring schematic on Page A-1.

To test the start solenoid and starter, first service the battery as necessary and clean and tighten connections. Then remove the two engine harness leads

(red) from start solenoid K8 and apply battery voltage across terminals 85 and 86. The engine should crank normally. If nothing happens:

1. Check for battery voltage across terminals 30 and 87. Replace the solenoid if it does not close across terminals 30 and 87 when energized.
2. Replace the starter if it does not crank when battery voltage is applied.
3. Call an authorized John Deere service representative if the start solenoid and starter function normally but the engine does not crank under ECM control.

When replacing a starter, torque the starter motor cap screws (3) to 75 N-m (54 lb-ft).

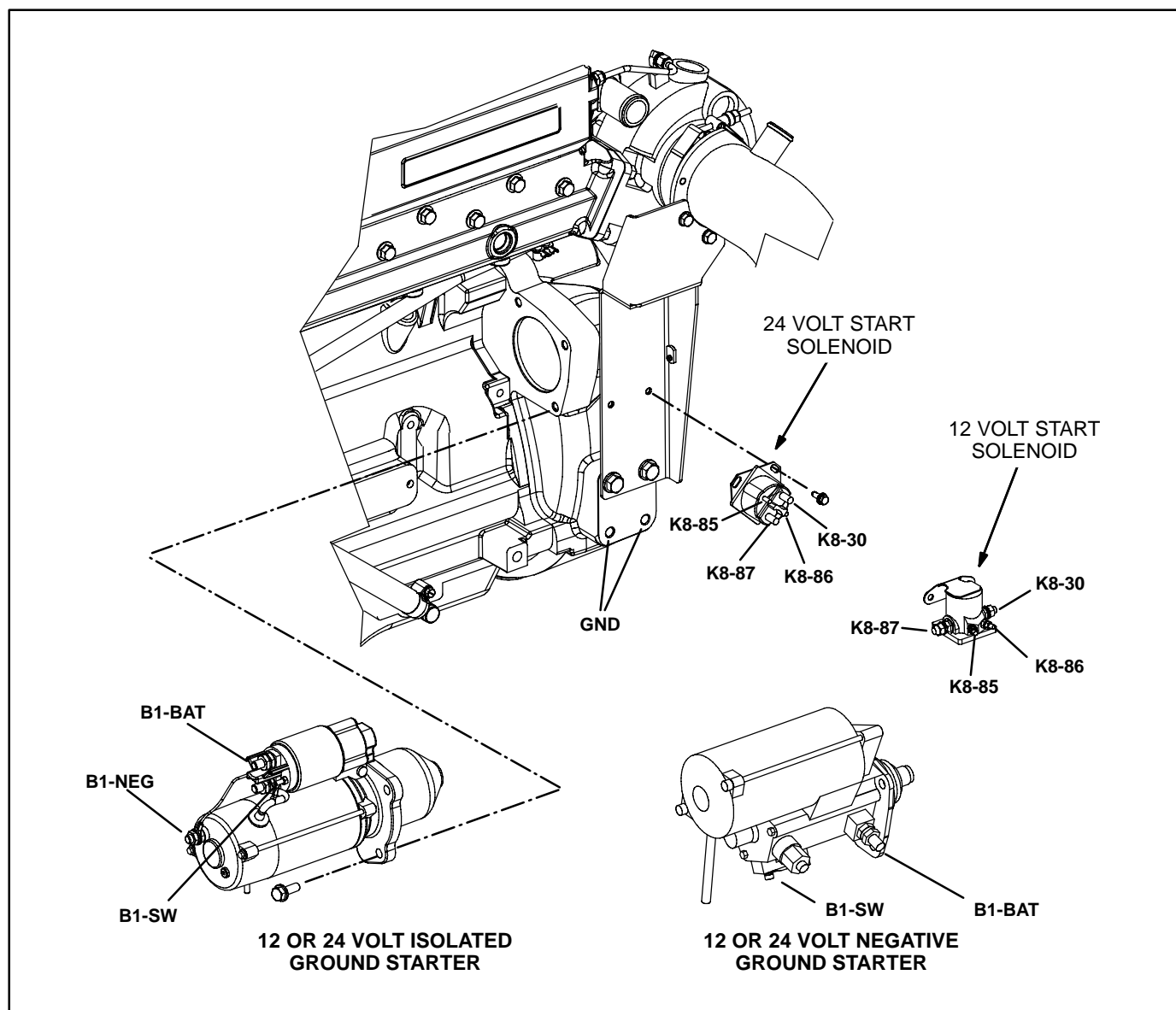


FIGURE 7-5. TYPICAL STARTER INSTALLATIONS

⚠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.*

BATTERY CHARGING ALTERNATOR

Before replacing the alternator, check the output cable for soundness and tight connections on both ends (terminal on back of alternator and B+ terminal

on starter solenoid) and that the sense lead from the engine harness is connected.

To remove the alternator (Figure 7-6), disconnect it from the output lead and engine harness lead, remove the belt using a 1/2 inch drive ratchet on the belt tensioner and remove the bracket screw and hinge bolt. Note the locations of the spacer washers and bushings for reassembly.

If the front mounting plate was removed, note the screws to tighten first and the respective torques.

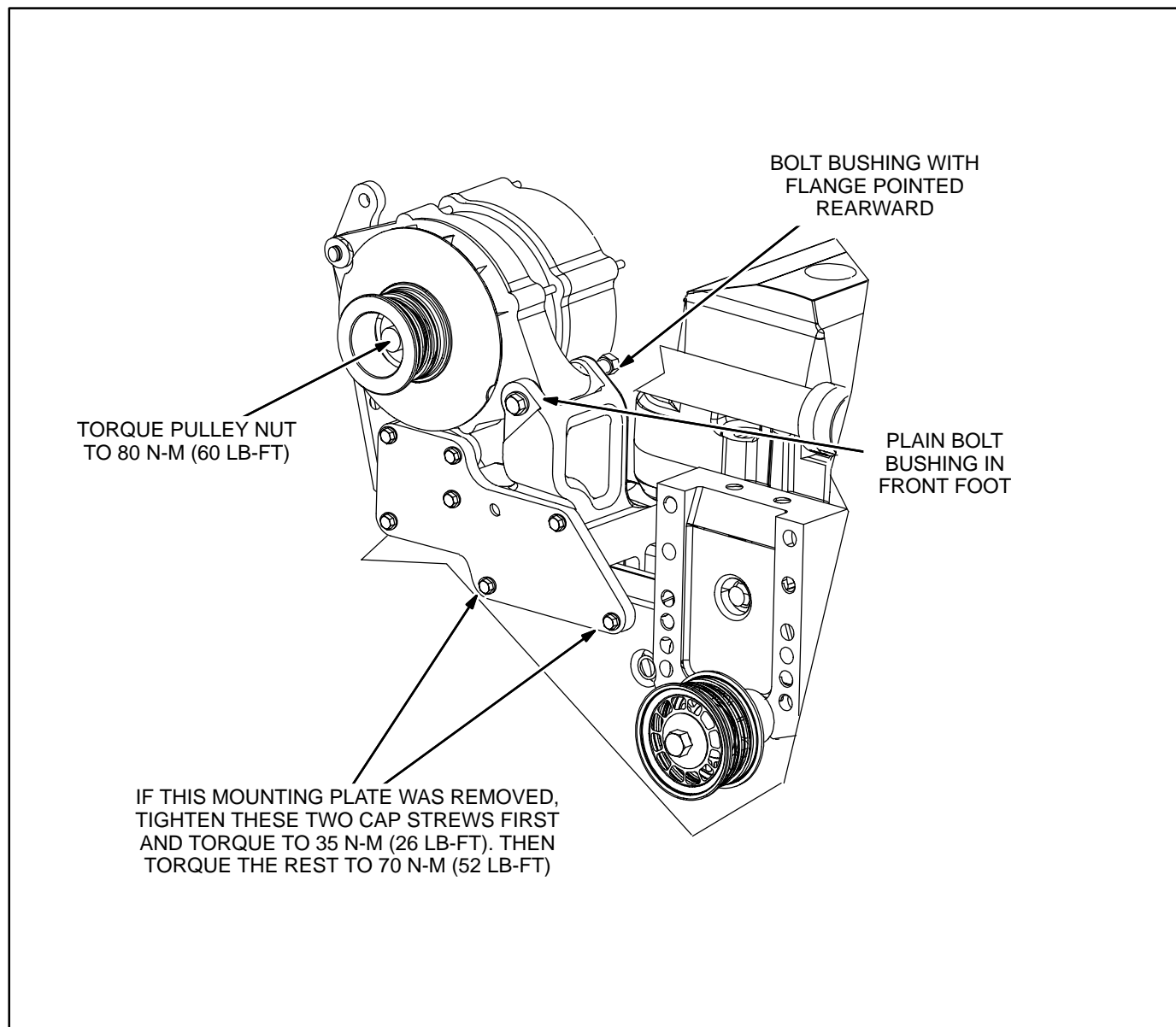


FIGURE 7-6. BATTERY CHARGING ALTERNATOR

⚠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.*

ELECTRIC FUEL PUMP (OPTIONAL)

To test the pump (Figure 7-7), disconnect its outlet hose from the genset fuel inlet fitting and connect it to a pressure gauge. *Push and Hold STOP (Prime)* to prime the fuel system (the amber lamp comes on in 2 seconds to indicate priming). Replace the pump if the gauge indicates less than 69 kPa (20 psi).

⚠CAUTION *Use a backup wrench when connecting or disconnecting fuel lines to prevent damage to the fittings.*

For connections see Pages A-1 and A-5.

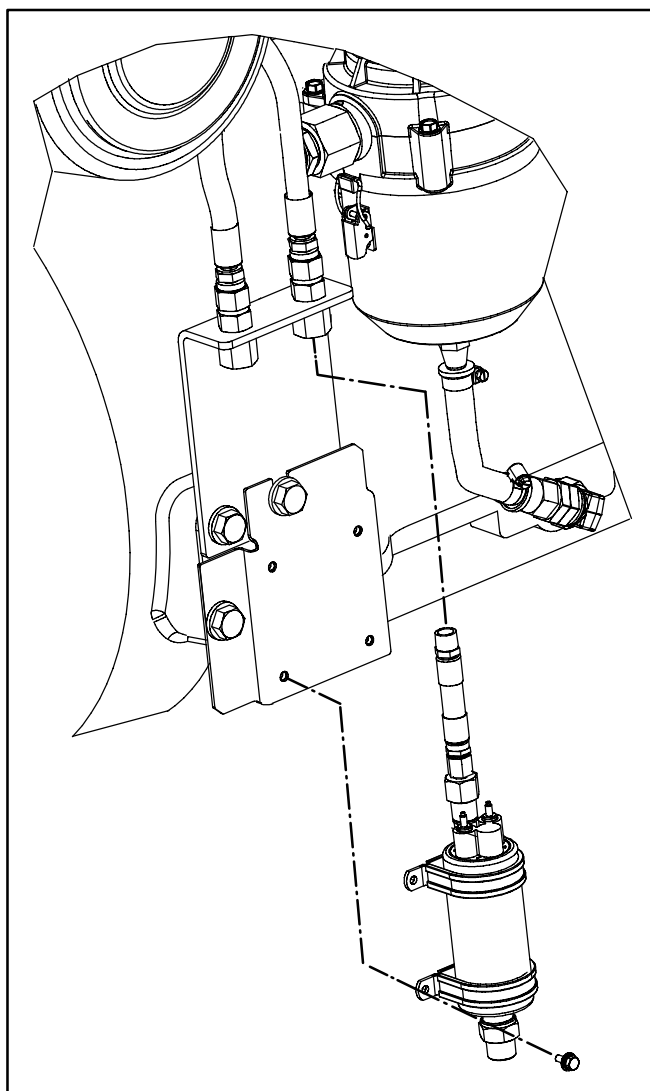


FIGURE 7-7. ELECTRIC FUEL PUMP

⚠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.*

MECHANICAL FUEL PUMP

Vacuum/Pressure Tests

1. Disconnect and cap the fuel lines.

⚠CAUTION *Use a backup wrench when connecting or disconnecting fuel lines to prevent damage to the fittings.*

2. Connect a vacuum/pressure gauge to the inlet.
3. Push the priming lever all the way down and release. The gauge should indicate the same value each time and very slowly return to zero. If not, the pump is defective.
4. Connect the gauge to the outlet.
5. Push the priming lever all the way up and release. The gauge should initially indicate 28 to 41 kPa (4 to 6 psi) and very slowly return to zero. If not, the pump is defective.

Leakage Test

Connect a source of compressed air regulated to not more than 140 kPa (20 psi) to the inlet fitting. Plug the outlet and submerge the pump in clean diesel fuel. Replace the pump if there are any air bubbles.

Removing Pump

1. Disconnect and cap the fuel lines.

2. Remove the two cap screws and withdraw the pump (Figure 7-8). Cover the opening in the block to keep out debris.
3. Inspect the pump lever for wear. Replace the pump if the face is worn flat or concave.

Note: The pump is driven by a push rod that rides on an eccentric camshaft lobe. It can only be removed by removing the cylinder head.

Installing Pump

1. Install the pump with the pumping lever resting on top of the push rod. Use a new O-ring. Apply LOCKTITE® 242 to the screw threads and torque to 30 N-m (22 lb-ft).
2. Apply LOCKTITE® 242 to the fuel fittings and reconnect the fuel lines. ***Do not allow the sealant to get into the fuel system.***
3. Bleed air as instructed on Page 4-7.

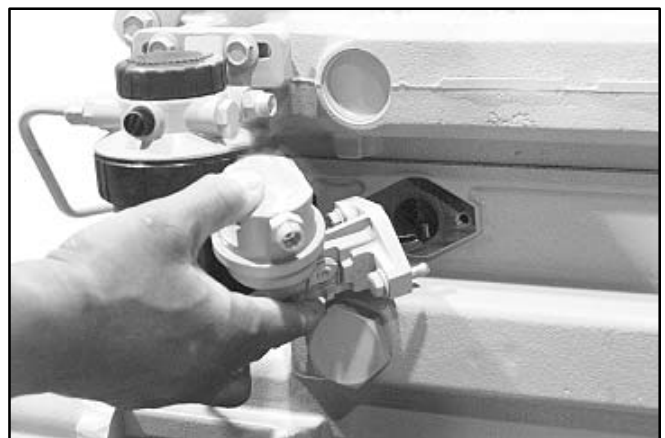


FIGURE 7-8. MECHANICAL FUEL PUMP

⚠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.*

ADJUSTING VALVE LASH

Valve lash must be checked and adjusted when the engine is COLD. Readjust to the specified Setting in Table 7-1 if valve lash falls outside the Acceptable Range.

TABLE 7-1. VALVE LASH SPECIFICATION (COLD)

	INTAKE	EXHAUST
Acceptable Range	0.31 to 0.38 mm (0.012 to 0.015 in)	0.41 to 0.48 mm (0.016 to 0.019 in)
Setting	0.36 mm (0.014 in)	0.46 mm (0.018 in)

Note: Inspect the valve tips and rocker arm contact pads for wear. Check all parts for excessive wear, breakage and cracks. Replace parts that show visible damage. Rocker arms that are unusually loose should be inspected more thoroughly for damage.

1. Remove the rocker arm cover (Figure 7-9).
2. Move the CCV bracket out of the way for access to the engine rotation tool and timing pin holes (Figure 7-10). If it is necessary to disconnect the fuel lines, make sure the appropriate fuel valves are closed.

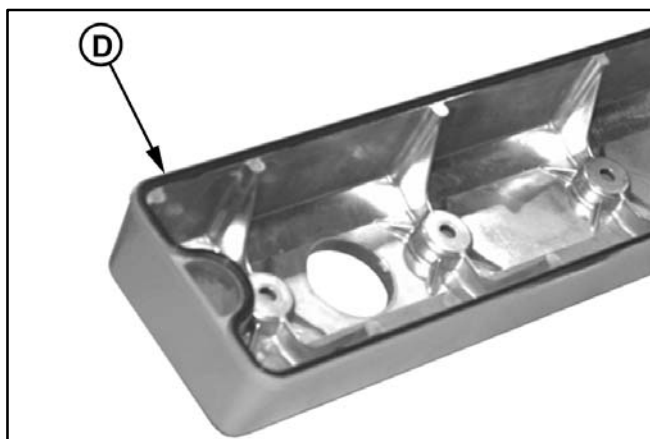


FIGURE 7-9. ROCKER ARM COVER

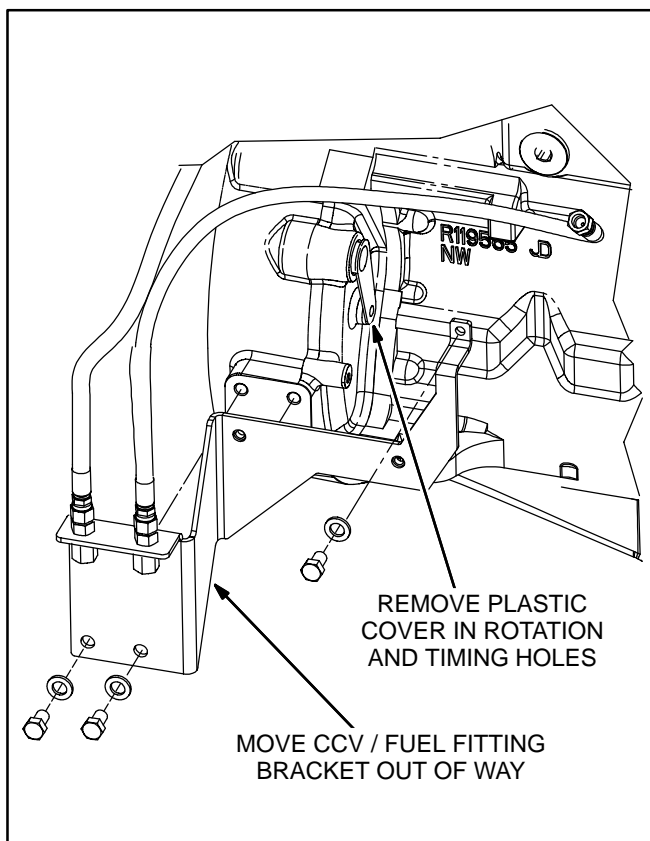


FIGURE 7-10. ACCESS TO ENGINE ROTATION AND TIMING PIN HOLES IN FLYWHEEL HOUSING

3. Using flywheel rotating tool JDE81-1 rotate the engine flywheel in the running direction (clockwise viewed from the front) until the No. 1 cylinder is at TDC on the compression stroke. Insert timing pin tool JDG1571 in the flywheel.

Note: If the No. 1 cylinder rocker arms are loose, the No. 1 cylinder is at TDC on compression. If they are tight, rotate the engine one full revolution. This is position (B) in Figures 7-11 and 7-12.

4. Check valve lash at each of the rocker arms the arrows point to in position (B) in Figure 7-11 or 7-12, as appropriate. Readjust each valve as instructed in Step 6, if necessary.
5. To check the rest of the valves, rotate the engine one full revolution and lock the flywheel with the timing pin. This is position (C). Check each rocker arm an arrow points to and readjust as instructed in Step 6, if necessary.
6. To adjust a valve, loosen rock arm adjusting screw jam nut (A), Figure 7-13. Turn the adjusting screw until the feeler gauge slips with a slight drag. Hold the adjusting screw from turning with a screwdriver and tighten the jam nut to 27 N-m (20 lb-ft). Recheck lash and readjust as necessary.
7. Reinstall the rocker arm cover. Replace cover sealing ring (D), Figure 7-9, if necessary.
8. Secure the CCV bracket and fuel lines and open any fuel valves that were closed.

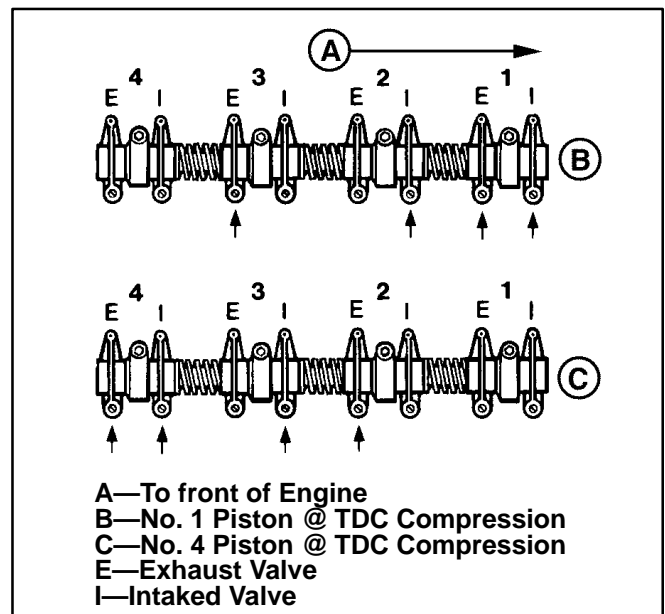


FIGURE 7-11. 4-CYLINDER ENGINES

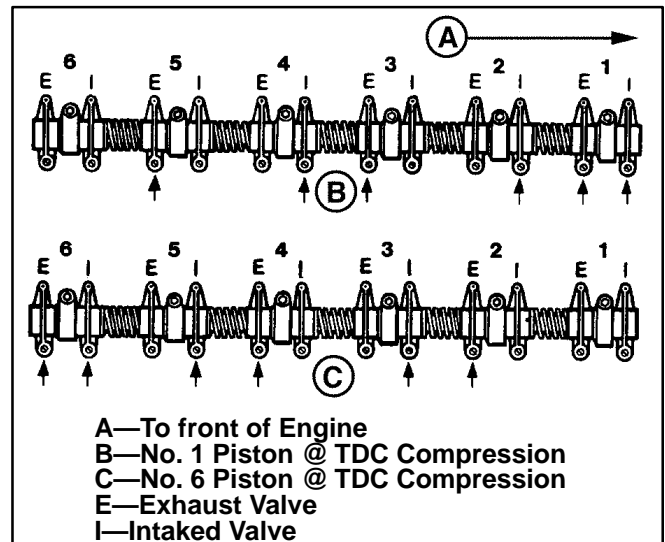


FIGURE 7-12. 6-CYLINDER ENGINES

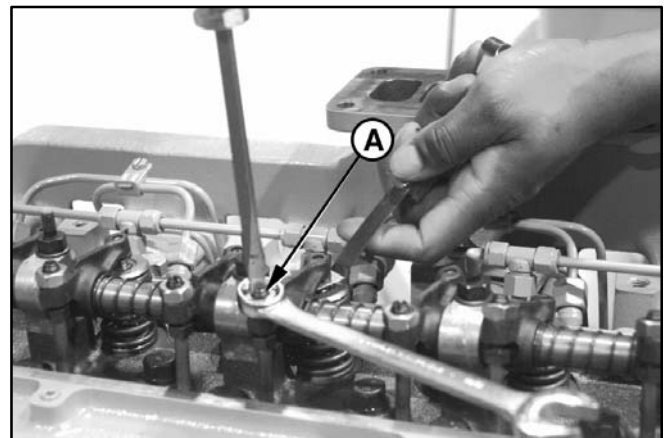


FIGURE 7-13. SETTING SCREW JAM NUT

⚠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.*

REPLACING FUEL INJECTION NOZZLES

Removing Injection Nozzle

Before removal, thoroughly remove all dirt from the cylinder head around the fuel injection nozzles. Clean with compressed air to prevent dirt from entering the cylinders. Plug the bore in the cylinder head after each nozzle has been removed. Cap fuel line openings as soon as they are disconnected.

Immediately fit protective caps over the nozzle tips and the line connections to avoid handling damage and getting debris in the fuel system.

Do not bend the fuel delivery lines, as this could affect their durability. When loosening a fuel pressure line, hold the male union of the nozzle line stationary with a backup wrench.

1. Loosen tube nuts (A), Figure 7-14, at each nozzle to remove the leak-off lines and T-fittings as an assembly.
2. Disconnect the fuel injection line from the nozzle using a backup wrench on the nozzle connection as shown in Figure 7-15.
3. Remove the cap screw that secures the nozzle in the cylinder head nozzle bore.
4. Pull the injection nozzle out of the cylinder head using nozzle pulling tool JDG1515-1, (A) in Figure 7-16.

⚠CAUTION *Do not use screwdrivers, pry bars or the like as they could damage the injection nozzle beyond repair.*

5. Clean the injection nozzle bore using nozzle bore cleaning tool JDE39, (A) in Figure 7-17. Blow debris from the hole with compressed air and plug the hole to prevent entry of debris.

⚠CAUTION *To prevent dulling the cleaning tool, always turn it clockwise even while pulling it from the bore.*

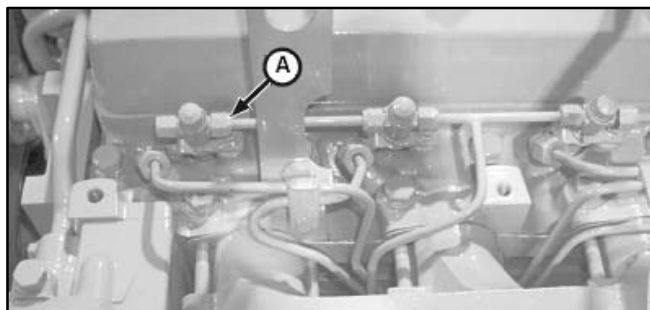


FIGURE 7-14. LOOSENING FUEL LEAK-OFF LINES

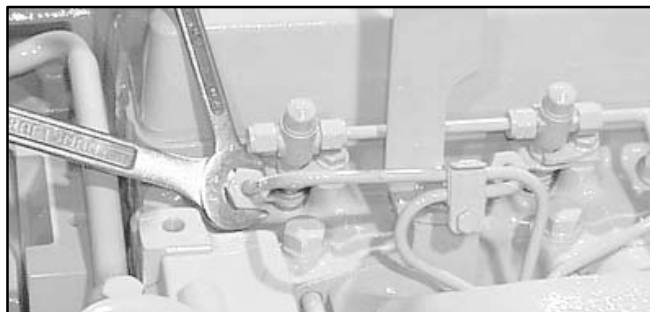


FIGURE 7-15. LOOSENING FUEL INJECTION LINES

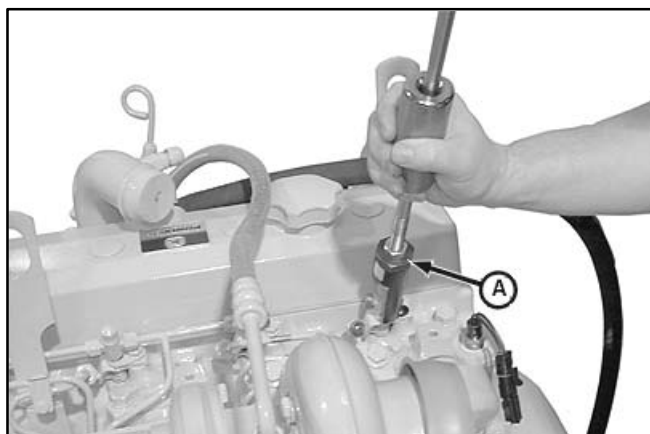


FIGURE 7-16. REMOVING INJECTION NOZZLE

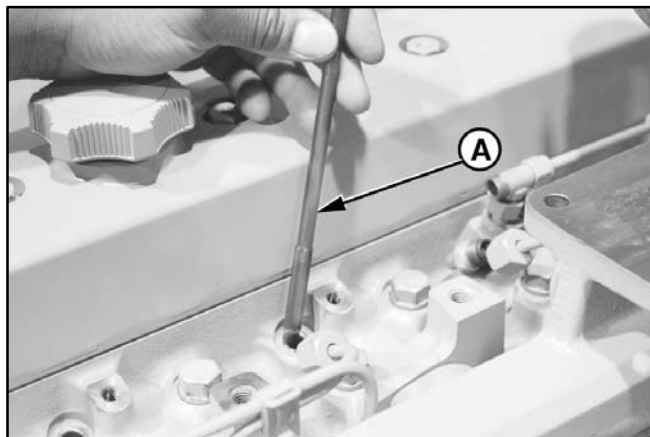


FIGURE 7-17. CLEANING INJECTION NOZZLE BORE

Installing Injection Nozzle

1. Clean the nozzle bore in the cylinder head if that has not been done (p. 7-10).
2. Install the nozzle assembly in the cylinder head bore using a slight twisting motion as the nozzle is seated in the bore (Figure 7-18).
3. Align the nozzle clamp and install the cap screw. Do not tighten the screw yet.
4. Connect the fuel pressure line to the nozzle. Leave the connection slightly loose until air is bled from the system.
5. Tighten the nozzle hold-down clamp screw to 40 N-m (30 lb-ft).
6. Install the leak-off assembly. Torque the nuts to 5 N-m (3.7 lb-ft) (44 lb-in).
7. Bleed air as instructed on Page 4-7.



FIGURE 7-18. INSTALLING INJECTION NOZZLE

⚠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.*

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

COOLANT PUMP

Removing Pump

1. Drain the coolant.
2. Remove the belt guard or front of sound enclosure.
3. Remove the serpentine belt (p.).
4. Remove the pump inlet elbow (Figure 7-19).
5. Remove the pump (Figure 7-20).
6. Remove the pulley from the pump.

Installing Pump

1. Clean the mating gasket surfaces.
2. Install the coolant pump insert in the pump kit, if necessary. Follow the instructions in the kit.
3. Install the pump with a new gasket. Torque the cap screws to 16 N-m (12 lb-ft).
4. Install the pulley. Torque the cap screws to 15 N-m (11 lb-ft).
5. Using a new O-ring seal, install the inlet elbow. Torque the cap screws to 35 N-m (26 lb-ft).
6. Refill the system with coolant (p. 4-12).

Note: Clean and flush the coolant system whenever replacing the pump or timing gear cover. See Page 4-12.

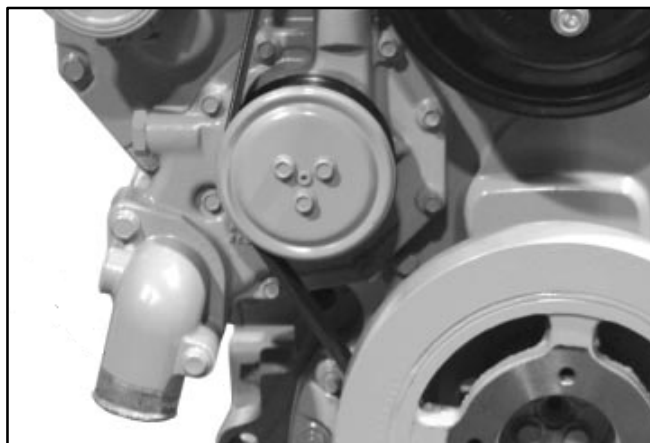


FIGURE 7-19. PUMP AND INLET ELBOW



FIGURE 7-20. COOLANT PUMP

⚠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.*

AUXILIARY DRIVE

The engine is equipped with the auxiliary drive only when a raw water pump is provided.

To remove the drive and pump as a unit, disconnect the oil line and remove the two cap screws. Look for cracks in the housing and for worn or damaged bearings, gears and splines. Replace if necessary.

When installing an auxiliary drive, use a new gasket, torque the cap screws to 95 N-m (70 lb-ft) and reconnect the oil line.

RAW WATER PUMP

The engine is equipped with a raw water pump only on models with wet exhaust or wet exhaust and heat exchanger.

See Page 4-13 for instructions on how to replace the impeller.

Remove the two cap screws to remove the pump. Look for cracks in the housing, worn or damaged bearings and signs of water leakage. Replace if necessary.

When installing a pump, use a new gasket and torque the cap screws to 55 N-m (41 lb-ft).

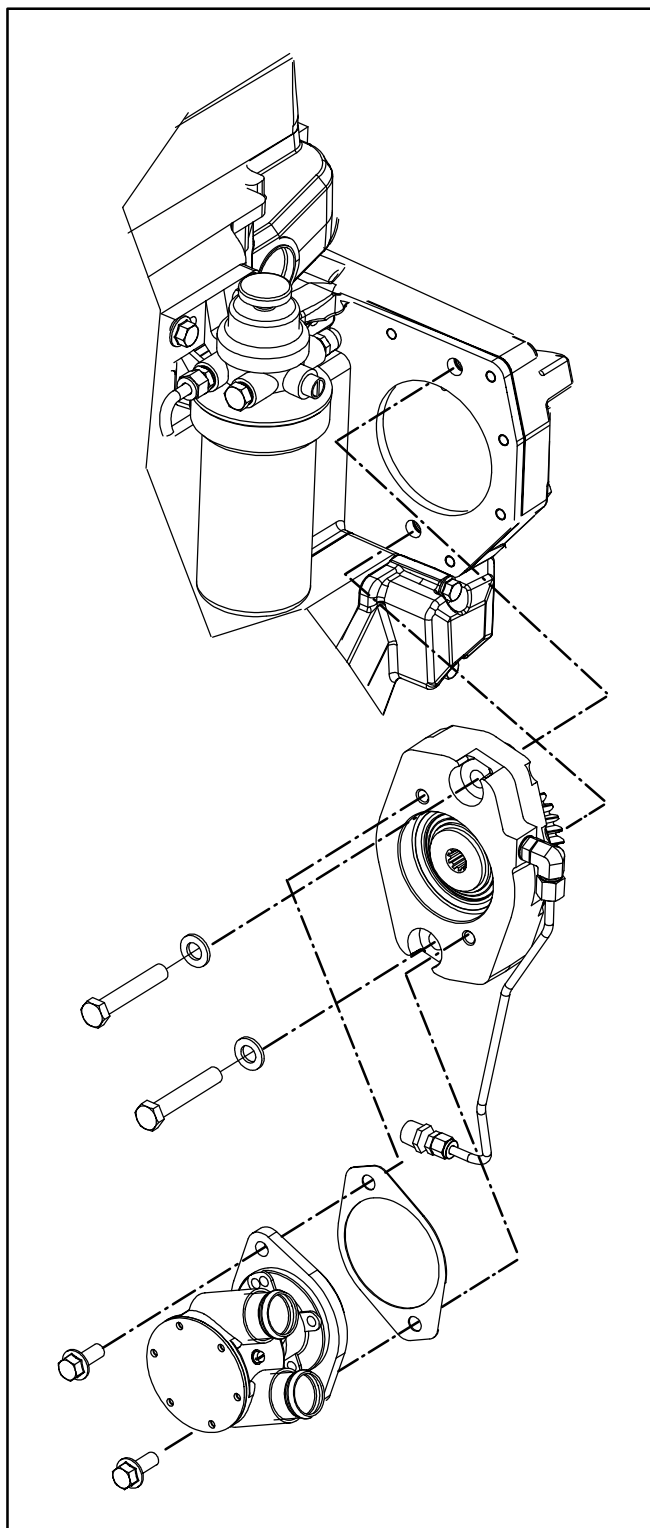


FIGURE 7-21. AUXILIARY DRIVE AND RAW WATER PUMP

⚠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.*

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

TIMING GEAR COVER GASKET

Removing Timing Gear Cover

1. Remove the serpentine belt (p. 4-14).
2. Drain engine oil and coolant.
3. Remove the oil pan (p. 7-15).
4. Remove the battery charging alternator and bracket.
5. Disconnect the coolant return tube or hose from the pump inlet.
6. Remove the engine speed sensor (p. 7-1).
7. Remove the auxiliary drive, if so equipped (p. 7-13), or the close off plate.
8. Remove the crankshaft pulley or pulley/damper (p. 7-18).
9. Remove the stud nuts and cap screws around the border of the timing gear cover (Figure 7-22).

Installing Cover and Gasket

1. Drive the crankshaft oil seal out of the cover (p. 7-18).
2. Clean the cylinder block and cover gasket surfaces.
3. Clean the timing gear cover in solvent and dry with compressed air.
4. Inspect the cover for cracks and damage. Make sure the bore for the crankshaft oil seal is clean and free of nicks.
5. Install the new gasket and cover. Apply **LOCTITE® 592** pipe sealant to the capscrews and studs and torque to 35 N-m (26 lb-ft).
6. Install a new crankshaft oil seal (p. 7-19).
7. Reassemble all of the other components that were removed.

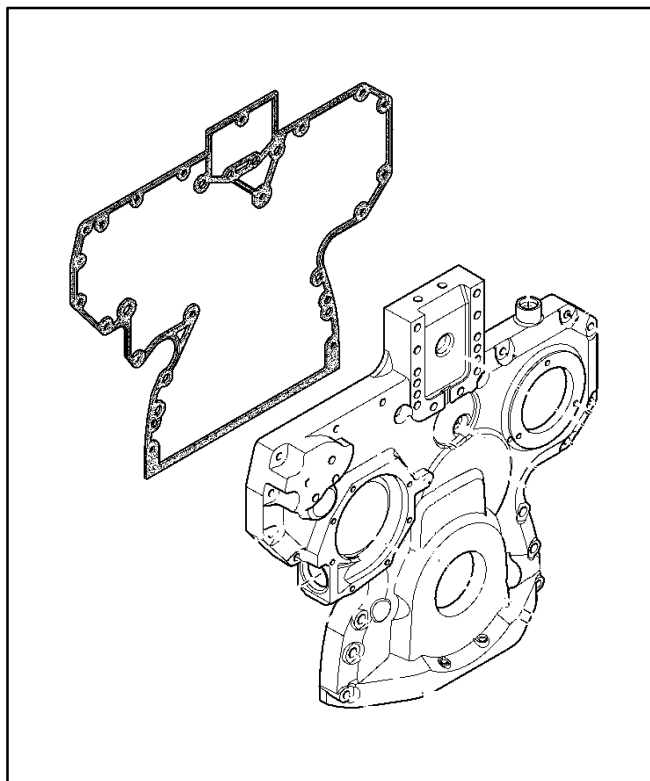


FIGURE 7-22. TIMING GEAR COVER AND GASKET

⚠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.*

OIL PAN GASKET

Apply LOCTITE® Flexible Form-In-Place Gasket on the oil pan rail as shown in Figure 7-23 in the four corners where the timing gear cover and flywheel housing meet the cylinder block.

Install the oil pan and new gasket and tighten the cap screws to 35 N-m (26 lb-ft). See Figure 7-24.

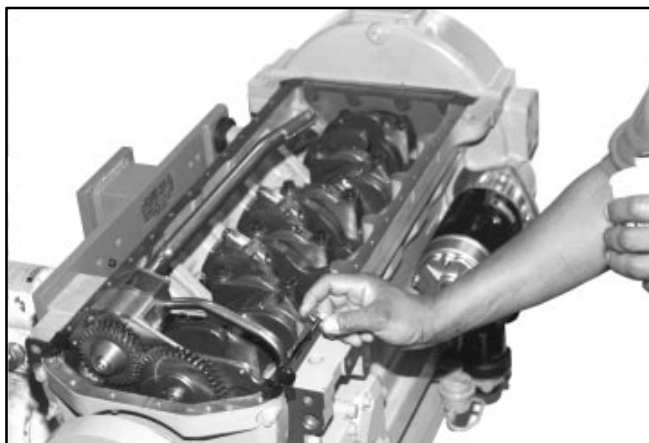


FIGURE 7-23. OIL PAN RAIL

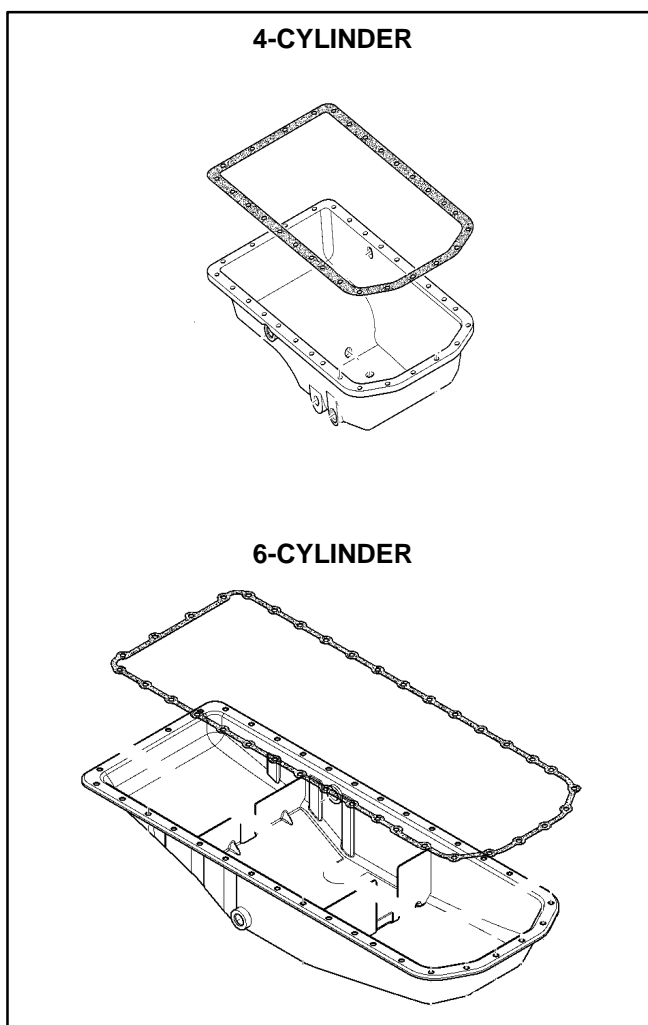


FIGURE 7-24. OIL PAN AND GASKET

OIL COOLER

⚠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.*

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

Removing the Oil Cooler

Refer to Figure 7-25.

1. Drain the engine coolant by removing the drain plug on the oil cooler housing.
2. On 6-cylinder engines remove the oil filter header and pull the tubes out of the cover of the oil cooler.

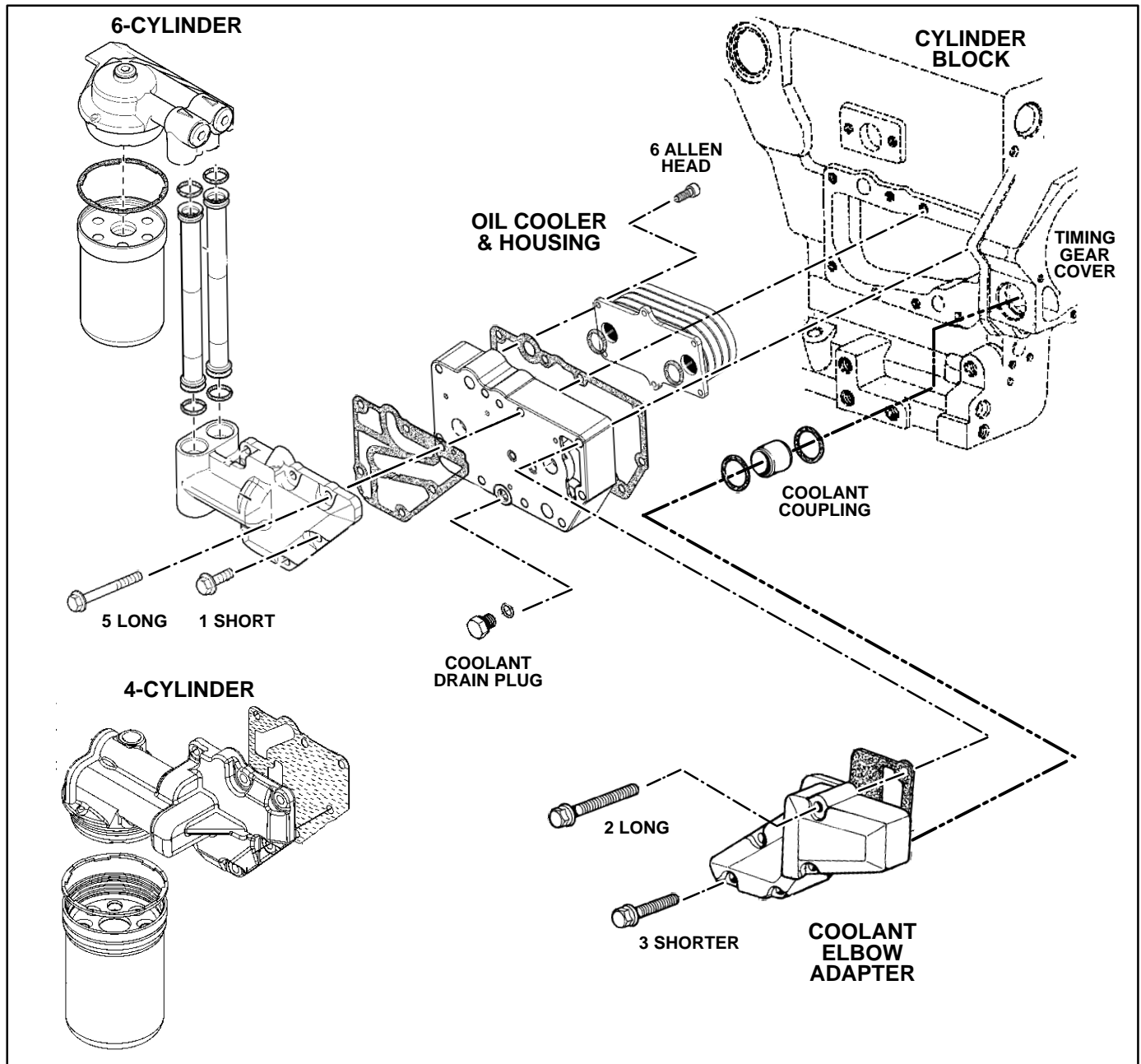


FIGURE 7-25. OIL COOLER ASSEMBLY

3. Remove the coolant elbow adapter and coupling.
4. Remove the oil cooler housing.
5. Remove the oil cooler from the housing.
6. Inspect the core of the oil cooler for damage, plugging or leakage which would allow oil and coolant to mix.
7. Back flush the oil cooler to clean all debris from the core.
8. If leakage is suspected, pressure test the oil cooler in liquid with compressed air regulated to 140 to 170 kPa (20 to 25 psi). Replace the cooler if there are air bubbles. Hold the pressure for at least 30 seconds.
9. Inspect the inside of the oil cooler housing (Figure 7-26). Remove the O-rings (A) and inspect the surface finish of the O-ring grooves. If ridges are discernible with a finger nail, replace the oil cooler housing. Do not attempt to repair the oil cooler or housing.

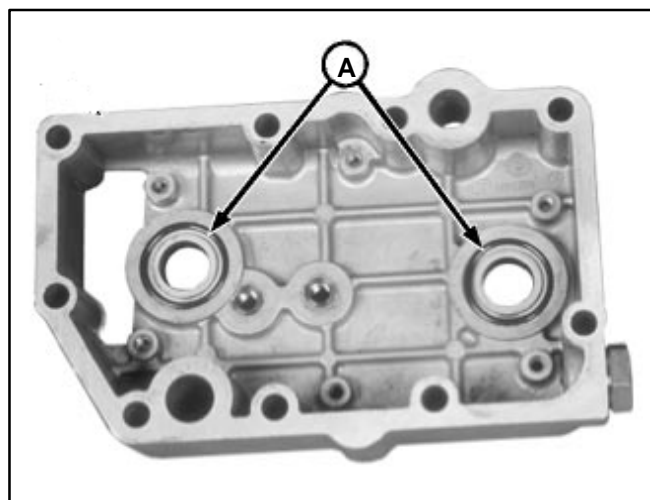


FIGURE 7-26. OIL COOLER HOUSING

Installing the Oil Cooler

1. Install new O-rings lubricated with clean engine oil.
2. Install the cooler in its housing. Apply LOCK-TITE® 242 Thread Lock and Sealer to the six Allen head cap screws and thread them in by hand to secure the core in the housing. Torque the screws to 12 N-m (106 lb-in) in the sequence shown in Figure 7-27.
3. Re-install all of the components removed using new gaskets and O-rings. Torque the housing and adapter elbow cap screws to 35 N-m (26 lb-ft).
4. Install the coolant drain plug and torque to 5 N-m (60 lb-in).
5. Refill the cooling system (p. 4-12).

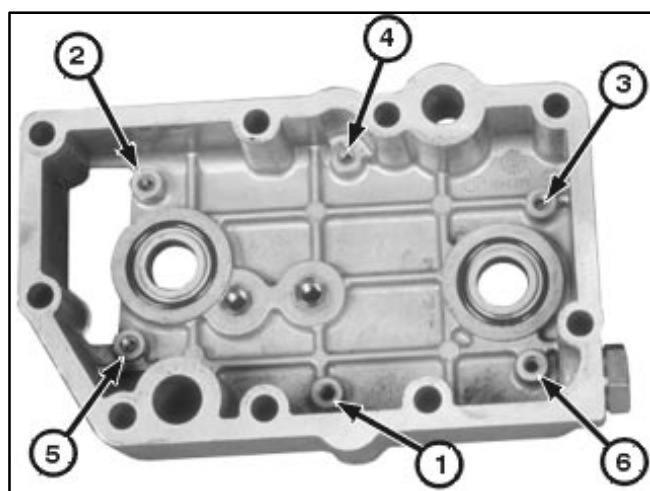


FIGURE 7-27. TORQUE SEQUENCE

⚠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.*

FRONT CRANKSHAFT OIL SEAL

Removing the Front Oil Seal

1. Remove the pulley (4-cylinder) or pulley/damper (6-cylinder). See Figure 7-28.

⚠CAUTION *The vibration damper could be damaged if a jaw type puller is used to remove it or it is dropped or struck with a hammer. For removal, use a heavy duty puller secured to the auxiliary mounting holes (B).*

The damper could suddenly release when the cap screw is removed. Be prepared to catch it safely to avoid injury or damage to the damper.

- A. Insert timing pin tool JDG1571 into the fly-wheel.
 - B. Remove cap screw and washer (A) that secure the damper to the crankshaft.
 - C. install a thread protector in the nose of crankshaft and secure a heavy duty puller to the pulley or damper using the auxiliary mounting holes (B). Remove the pulley or pulley/damper.
2. Center punch the oil seal at 12 o'clock and drill a 1/8 in (3 mm) hole (Figure 7-29).
 3. Remove the oil seal using seal remover tool JD719 (Figure 7-30).

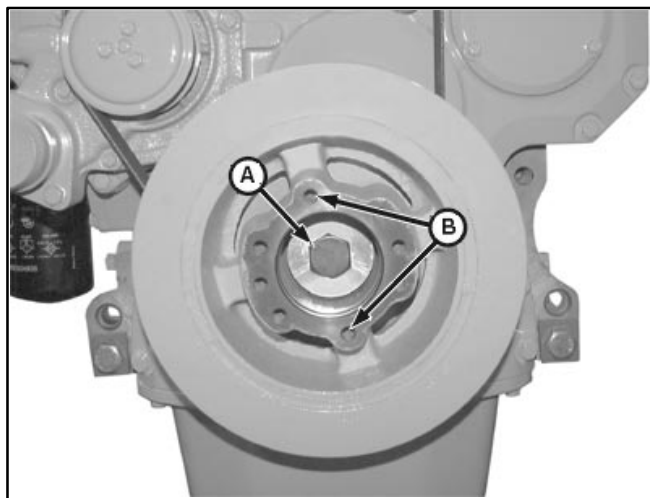


FIGURE 7-28. PULLEY / VIBRATION DAMPER

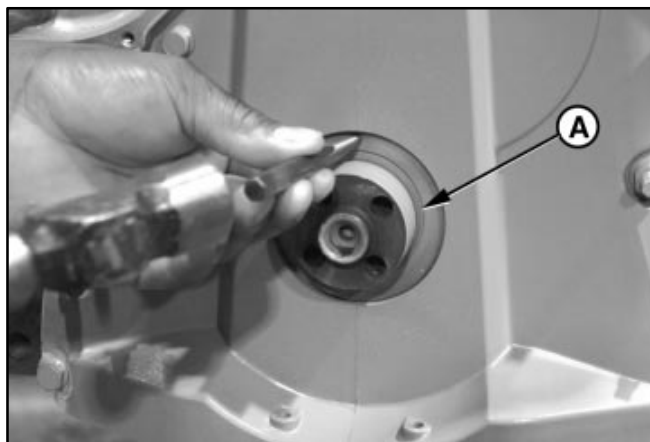


FIGURE 7-29. REMOVING OIL SEAL

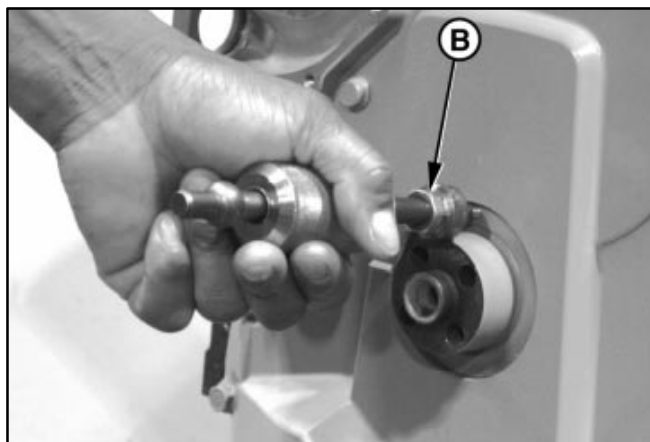


FIGURE 7-30. REMOVING OIL SEAL

Installing the Front Oil Seal

1. Clean and inspect the seal bore in the timing gear cover (Figure 7-31). Check for nicks and burrs. Use a medium-grit emery cloth to smooth rough areas.

▲ CAUTION For proper sealing, the OD of the crankshaft and wear sleeve **MUST BE** cleaned with Brake Kleen, Ignition Cleaner, or equivalent and dried prior to installing the seal.

2. Install forcing screw tool JDG954-8 (A) into the nose of the crankshaft until it bottoms.
3. Secure adapter tool JDG954-7 (B) with nut (C).

▲ CAUTION For proper sealing, do not allow oil to contact the coating on the OD of the seal.

4. Apply a light coating of clean engine oil to the lips of the seal and position the seal on the crankshaft flange. (The spring-loaded side of the seal goes into the timing gear cover first.)
5. Place installer tool JDG954-1 (D) over the adapter. Place guide sleeve tool JDG954-6 (E) over the installer and seal. See Figure 7-32.
6. Install the washer and nut onto the adapter and tighten the nut until seal (F) is flush with the face of the timing gear cover. See Figure 7-33.
7. Install pulley or pulley/damper, as follows:

- A. Clean the nose of the crankshaft using LOCKTITE® 7649 clean and cure primer.
- B. Apply a light 2 to 3 mm (0.79 to 0.118 in) bead of LOCKTITE® 680 retaining compound around the leading edge of the crankshaft nose (Figure 7-34). Place the pulley or pulley/damper on the nose of the crankshaft.
- C. Dip the mounting cap screw in clean SAE 30 oil and secure the pulley or pulley/damper with the cap screw and washer. Torque the screw to 500 N-m (369 lb-ft).
- D. Remove the timing pin from the flywheel.

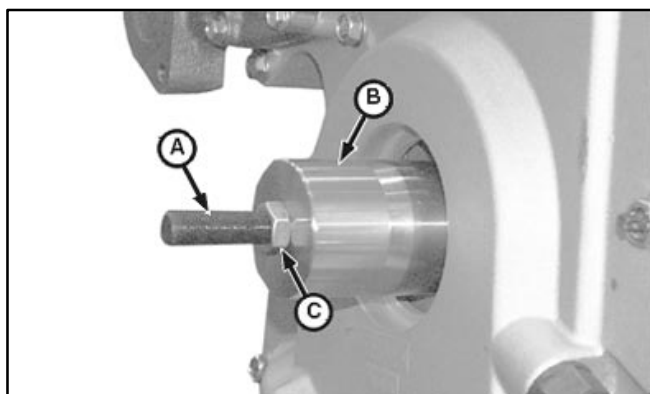


FIGURE 7-31. INSTALLING OIL SEAL

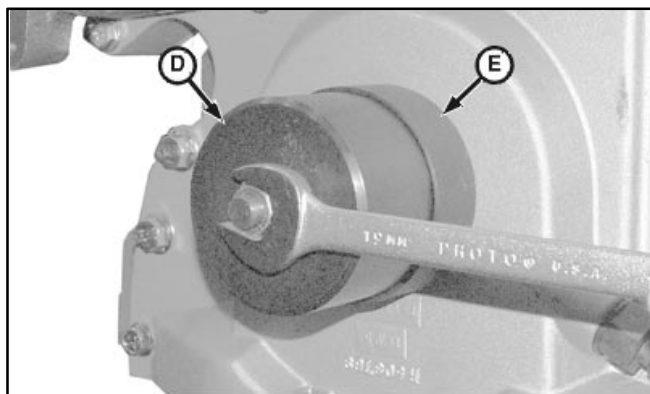


FIGURE 7-32. INSTALLING OIL SEAL

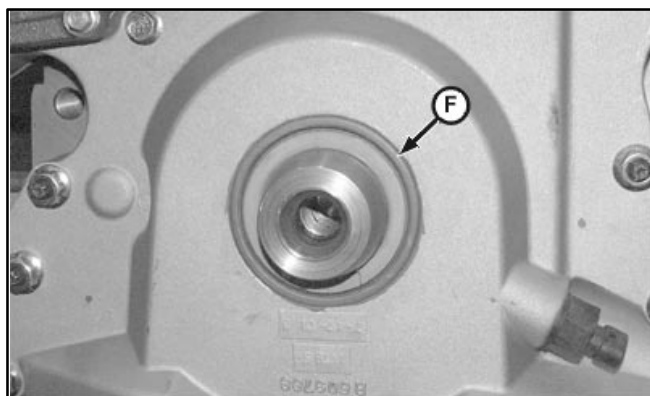


FIGURE 7-33. INSTALLED OIL SEAL

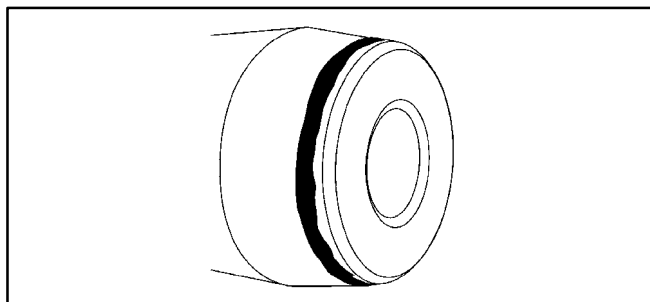


FIGURE 7-34. NOSE OF CRANKSHAFT

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

The flywheel is heavy. Suitable means must be used for lifting to prevent personal injury.

REAR CRANKSHAFT OIL SEAL

Removing the Rear Oil Seal

1. Separate the engine and generator. See ENGINE / GENERATOR MOUNTING (p. 7-23).
2. Remove the flywheel.

Note: Discard the old flywheel cap screws when the flywheel is removed and obtain new cap screws for reassembly.

- A. Remove two cap screws and install guide studs (A). See Figure 7-35.
 - B. Remove the rest of the cap screws.
 - C. Pry the flywheel off the crankshaft. Alternatively, insert a punch through the timing pin hole and tap on it to drive the flywheel from the crankshaft.
3. Adjust the forcing screw (A) on seal remover tool JDG698A so that it centers the tool on the crankshaft flange. See Figure 7-36. Using the slots in the seal remover tool as a template, mark three locations on the seal casing where screws should be installed to remove the seal.
 4. Center punch and drill three 3/16 in (4 mm) holes where marked (Figure 7-37).

Note: The holes must be drilled near the outer edge of the seal case. The screws will pull the seal against the wear ring, removing both pieces.

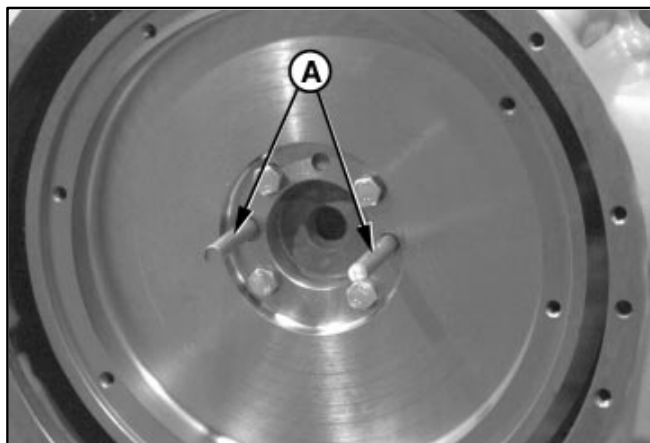


FIGURE 7-35. FLYWHEEL

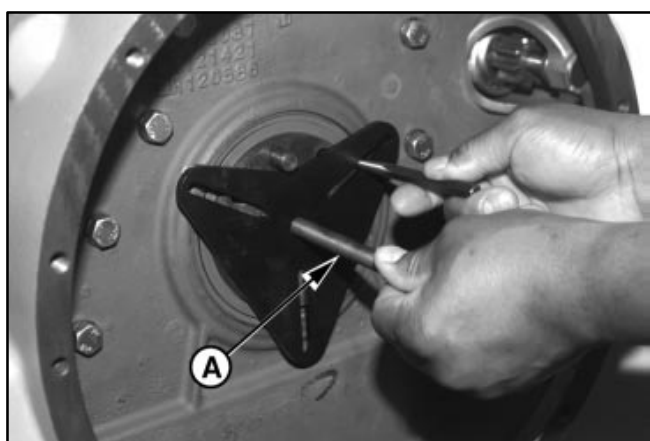


FIGURE 7-36. MARKING EXTRACTION SCREW LOCATIONS



FIGURE 7-37. CENTER PUNCHING AND DRILLING EXTRACTION SCREW HOLES

5. Position the tool on the the crankshaft. Thread three 2-1/2 in (62 mm) long sheet metal screws with washers (B) through the slots of the tool and into the holes drilled in the seal casing (Figure 7-38).
6. Tighten the forcing screw until the seal is removed.

Installing the Rear Oil Seal

Note 1: The rear oil seal (A) and wear sleeve (B) are fabricated as a non-separable part. See Figure 7-39.

Note 2: To avoid contamination with dirt, do not remove the seal/wear plate assembly from its plastic bag until just ready to install it.

Note 3: Lubricants of any kind used during installation can cause premature failure of the seal.

Note 4: Install the seal with the open side and wear sleeve ID chamfer towards the engine. Reversing the seal will result in oil leakage because crankshaft rotation with respect to the oil seal grooves will be wrong.

1. Thoroughly clean the OD of the crankshaft flange and bore in the flywheel housing with cleaning solvent, acetone or other suitable cleaner such as Brake Kleen or Ignition Cleaner and Drier. See Figure 7-40.
2. Look for nicks and burrs on the wear ring surface and bore in the flywheel housing. If necessary, use polishing cloth to remove them. Finish cleaning by wiping with a clean rag.

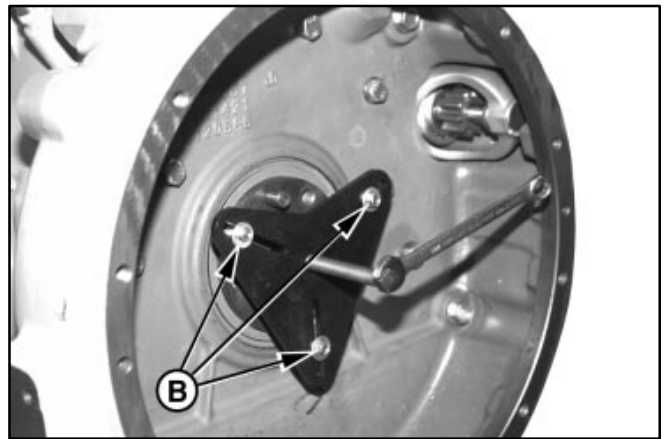


FIGURE 7-38. REMOVING REAR OIL SEAL

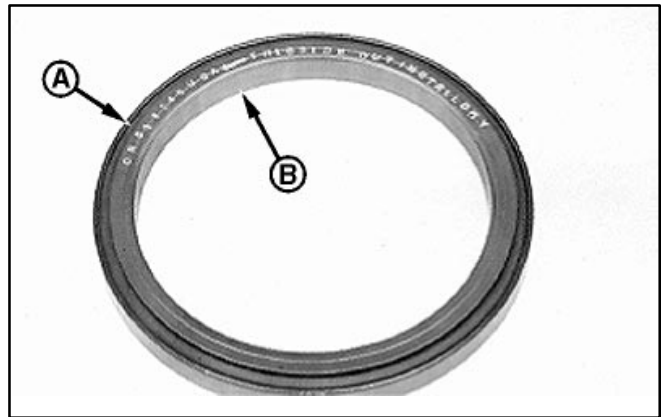


FIGURE 7-39. REAR OIL SEAL

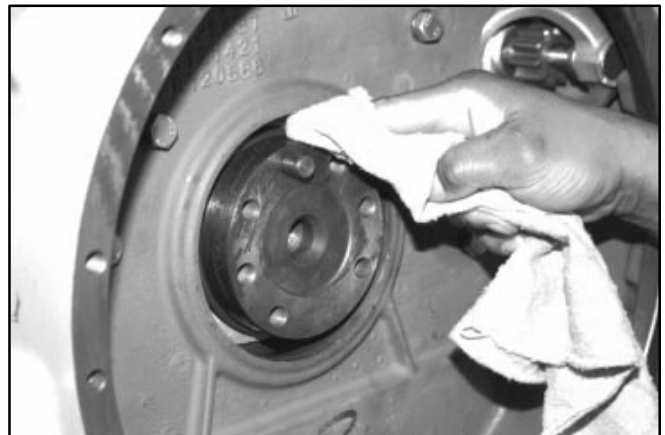


FIGURE 7-40. CLEANING CRANKSHAFT FLANGE AND FLYWHEEL HOUSING BORE

3. Referring to Figure 7-41, install pilot JT30041A (A) from seal/wear plate installer tool set JT30040B using two 38 mm (1-1/2 in) socket-head cap screws (B). Thread in both cap screws until they touch the base of the pilot and then back them off 1/2 turn.

4. To line up pilot JT30041A with the crankshaft, slide driver tool JT30042 on over the pilot until it bottoms. See (A) in Figure 7-42. Then tighten the two pilot cap screws (B) and remove the driver.

5. Handling the seal carefully, start the seal (B) over the pilot and crankshaft flange with the open side towards the engine. See Figure 7-42.

Note: Discard the seal and get a new one if the wear sleeve surface is scratched or gouged or contaminated with sealant (liquid).

6. Slide driver tool JT30042 (A) back onto the pilot up against the seal. Using a thrust washer and screw, drive it all the way until it bottoms. See Figure 7-42.

7. Remove the driver and pilot and check that the seal is properly positioned and square in the flywheel housing bore.

8. Re-install the flywheel **using new capscrews**.

⚠WARNING *The flywheel is heavy. Suitable means must be used for lifting to prevent personal injury.*

A. Re-install the guide studs (A) used in removing the flywheel. See Figure 7-43.

B. Start the cap screws. Do not tighten until the guide studs have been removed and all cap screws have been started. Tighten the capscrews to 138 N-M (102 lb-ft).

9. Reassemble the genset. See ENGINE / GENERATOR MOUNTING (p. 7-23).

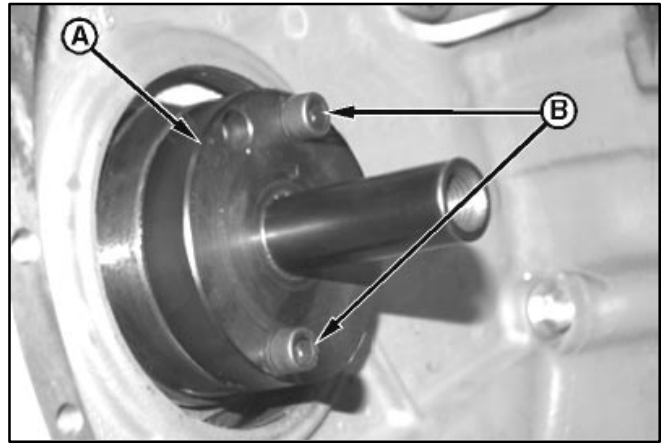


FIGURE 7-41. REAR OIL SEAL INSTALLER TOOL

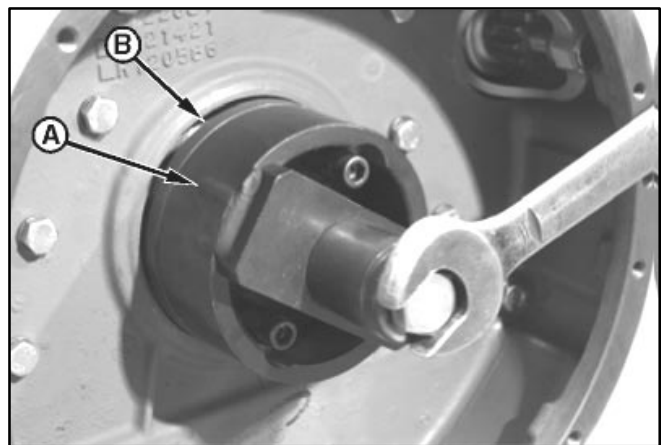


FIGURE 7-42. INSTALLING REAR OIL SEAL

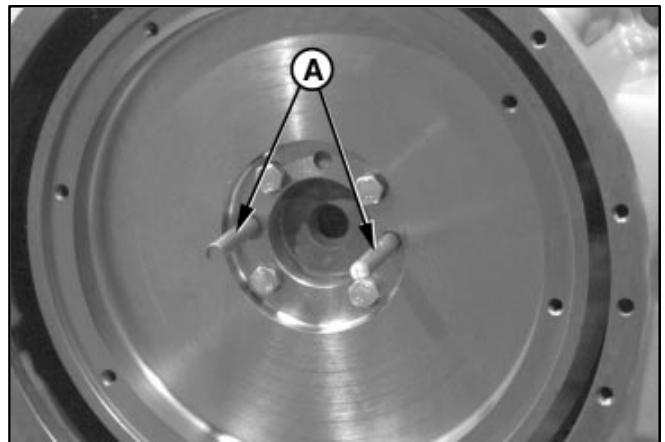


FIGURE 7-43. FLYWHEEL

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

ENGINE / GENERATOR MOUNTING

See Removing the Generator (p. 6-7) if it is neces-

sary to separate the engine and generator or to remove either from the skid (Figure 7-44).

Torque the mounting screws as specified in Figure 7-44.

Make sure to reconnect the skid bonding strap to the genset grounding point on the engine flywheel housing when reassembling.

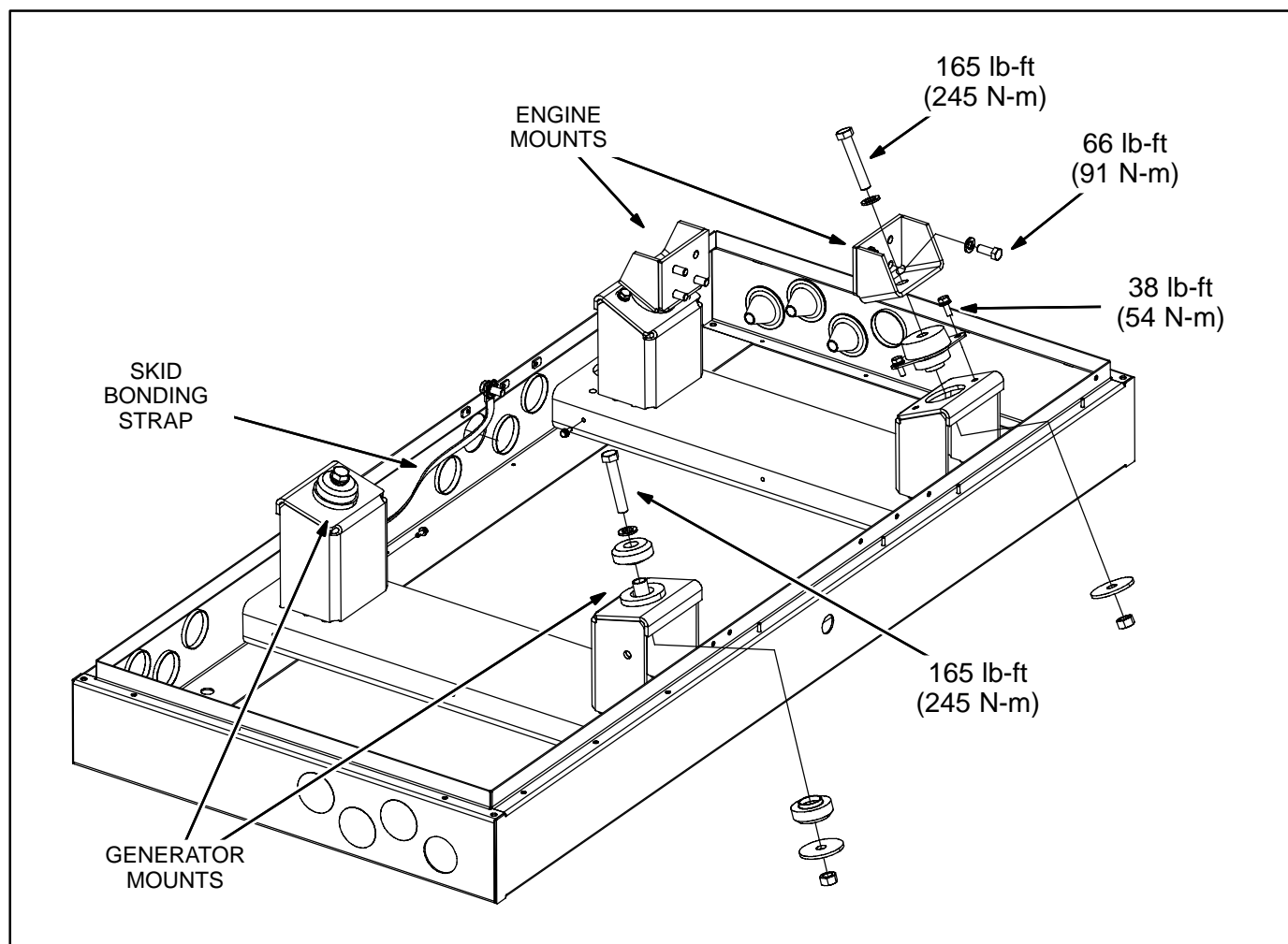


FIGURE 7-44. SKID AND VIBRATION ISOLATOR MOUNTS

⚠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.*

PTO ASSEMBLY

Clutch Assembly

The clutch assembly is secured in the PTO bracket with eight 3/8-16 screws. Torque the screws as specified (Figure 7-45).

The clutch drive plate is secured to the clutch with four 7/16-14 screws. Torque the screws as specified (Figure 7-46).

The clutch leads should exit from the top of the clutch assembly.

PTO Bracket and Coupler

The PTO bracket is secured to the front of the engine with 4 screws. Torque the screws as specified (Figure 7-46).

To assemble the drive coupler:

1. Slide the drive coupler over the drive adapter and secure the adapter to the crankshaft with 4 flange screws and torque the screws as specified.
2. Loosely secure the drive coupler to the drive adapter with the 4 radial M16 bolts.
3. Insert the 4 rounded-head bolts into the coupler and thread them into the clutch drive plate. It may be necessary to tighten the radial bolts to line up the clutch drive bolts with the holes in the drive plate.
4. Torque the 8 coupler bolts as specified when all of the bolts are seated.

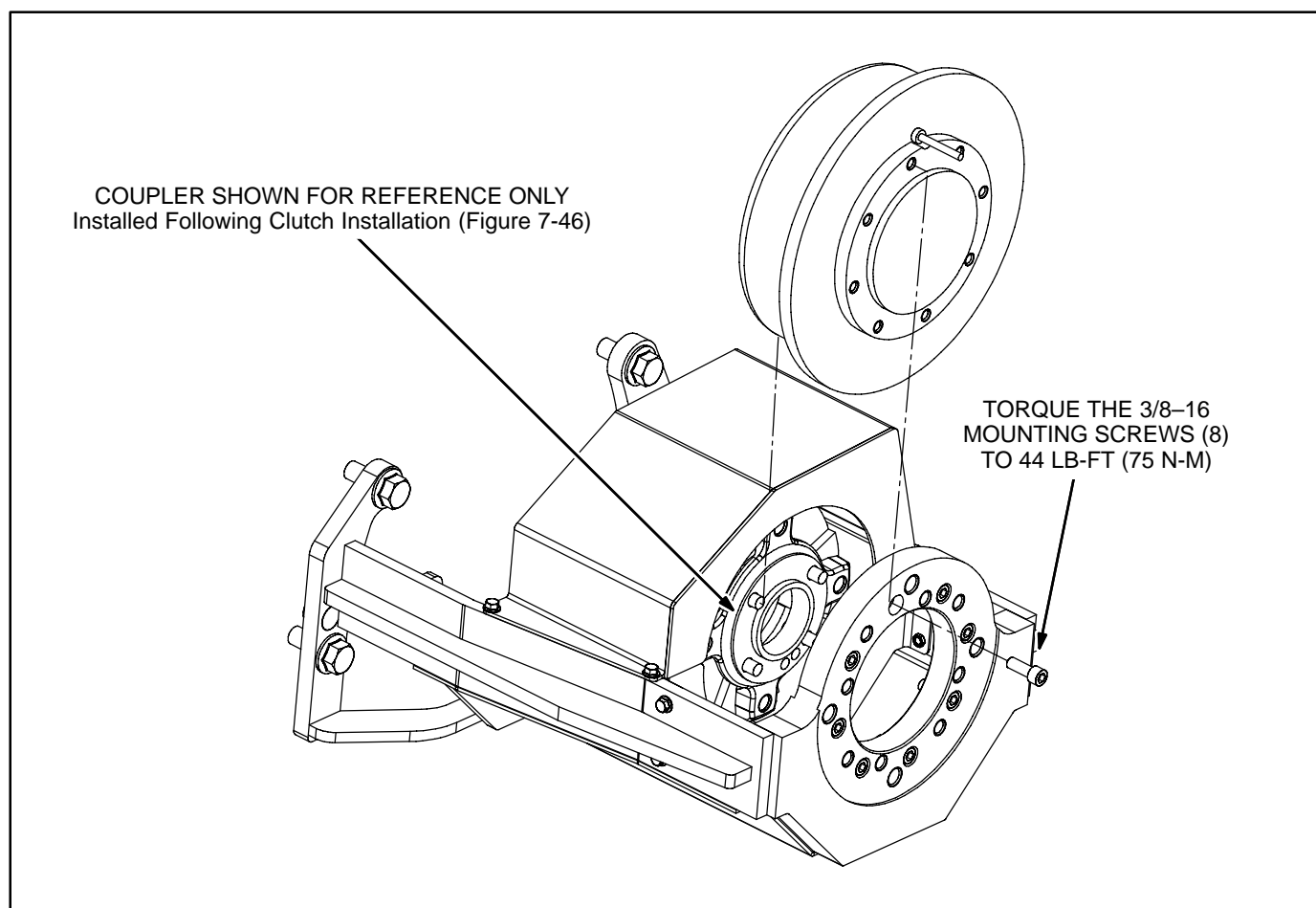


FIGURE 7-45. CLUTCH ASSEMBLY

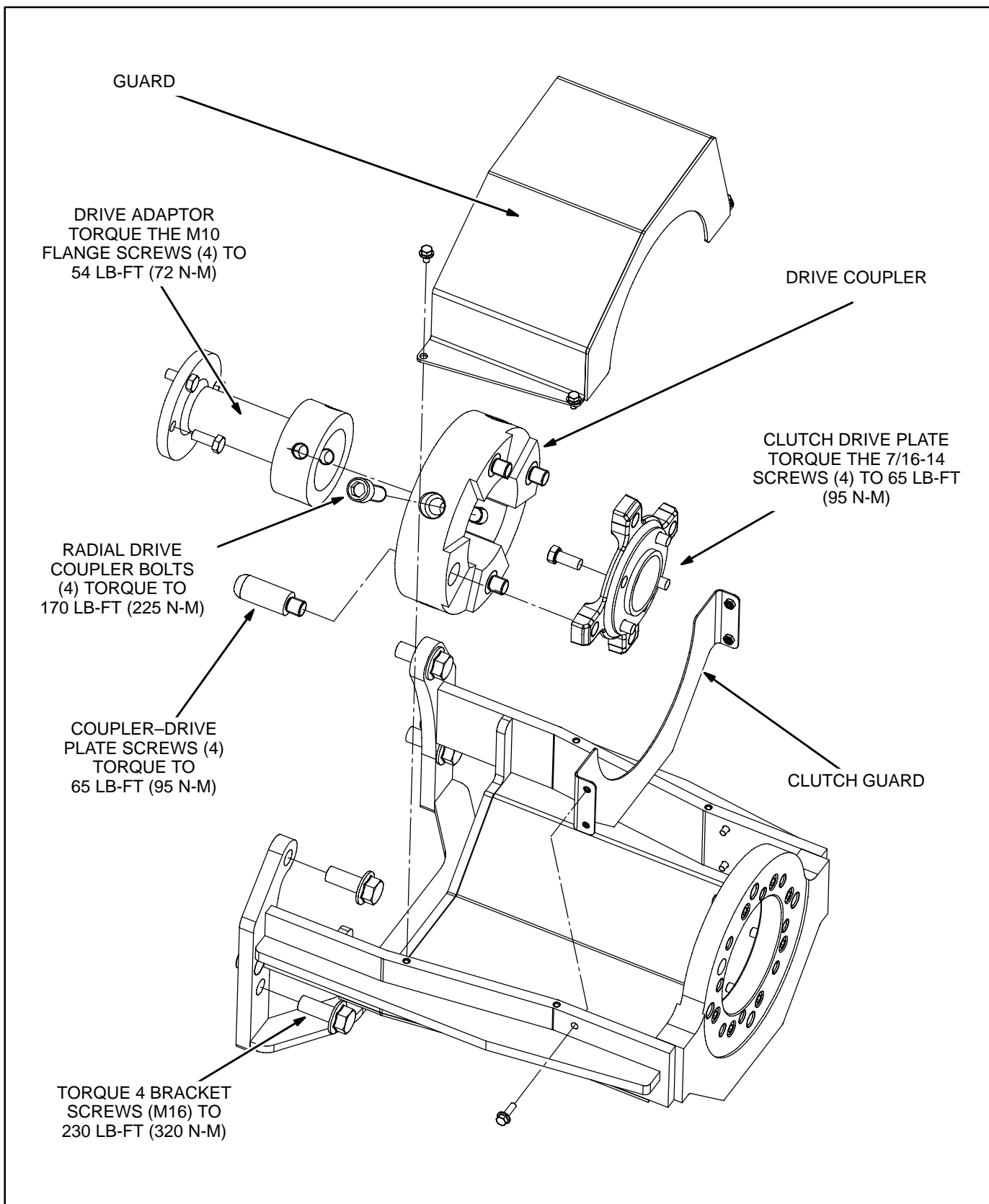


FIGURE 7-46. PTO BRACKET, DRIVE ADAPTER AND COUPLER

8. Troubleshooting

Use TABLE 8-1. TROUBLESHOOTING GENSET FAULTS in conjunction with the e-Series Digital Display or blinking control switch status lamp to troubleshoot the genset. Perform the step-by-step corrective actions suggested.

Many genset shutdowns can be avoided by performing periodic maintenance on schedule (TABLE 4-1. PERIODIC MAINTENANCE SCHEDULE) and by *not* running the genset out of fuel. Note that when gensets and propulsion engines draw from the same fuel tanks, the fuel dip tubes are usually arranged so that the gensets run out of fuel first. By marking the genset empty points on the fuel gauges, it will be easier to tell when to stop the gensets before running them out of fuel.

TROUBLESHOOTING WITH DIGITAL DISPLAY

If a fault shutdown occurs the ALARM status lamp on the e-Series Digital Display will blink and the LCD screen will display the Fault Number, a description of the Fault and the hour in total genset running time when the Fault occurred (Figure 2-4).

The fault will be displayed indefinitely. Touch any button to clear the fault. The display will turn off in 5 minutes after the fault has been cleared.

Engine Fault Code No. 16

If this engine fault occurs, refer to TABLE 8-2. TROUBLESHOOTING ENGINE FAULT CODE NO. 16.

Engine Pre-Alarms

If an engine pre-alarm condition is displayed, refer to TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARMS.

Last Five Faults

See Page 2-6 to display any of the last five faults in fault history.

TROUBLESHOOTING WITH STATUS LAMP

Status Lamp Blink Code

If a fault shutdown occurs, the amber status lamp on the control switch will repeatedly blink sets of 3, 4, 5, 6 or 7 blinks.

- **Three blinks** indicate a service fault. Press **Stop** once to cause the two-digit code to blink. (Pressing **Stop** again will stop the blinking.) The two-digit code consists of 1 to 7 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the shutdown code number. For example, **fault code No. 36** appears as:

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

- **Four blinks** indicate shutdown due to a failure to start within the time allowed for cranking.
- **Five blinks** indicate shutdown due to high levels of Carbon Monoxide (CO) in the vessel.
- **Six blinks** indicate shutdown due to low or high engine oil level.
- **Seven blinks** indicate shutdown due to a loss of raw water flow for engine and exhaust cooling.

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

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

Engine Pre-Alarms and Fault Code No. 16

An e-Series Digital Display is required to display further information regarding engine pre-alarms and faults.

TABLE 8-1. TROUBLESHOOTING GENSET FAULTS

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

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

NO RESPONSE AT DIGITAL DISPLAY OR CONTROL SWITCH

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

Corrective Action: *Refer to Pages A-1 through A-6 as appropriate.*

1. At the genset control panel, push the emergency stop switch On.
2. Try the local Digital Display or control switch if there is no response at the remote Display or control switch, and vice versa. If neither local nor remote control works, go to Step 3. If at least one control switch or Display works, but not the others, go to Step 7.
3. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-4).
4. If there still is no response, disconnect the mate (P1 or P33) from connector J4 in the control box. Check for 12 VDC across pins J4-4 and J4-1 (B+, Display, Start/Stop and ground). If there is voltage, go to Step 7. If there is no voltage, go to Step 5.
5. Disconnect connector P2 (grey) from the genset controller (Page 5-1) and check for battery voltage across pin sockets P2-1 and P2-6. If there is voltage, replace the controller. If there is no voltage, go to Step 6.
6. Test the emergency stop circuit breaker (CB1) and replace it if necessary (p. 5-5). If there still is no voltage, check for and repair faulty wiring and connectors between P2-1 to CB1-LOAD, CB1-LINE to B1-BAT and P2-6 to GND-2.
7. Test for and replace a faulty control switch (p. 5-5) or Display or repair faulty wiring and connectors. See Page A-4.

THE STARTER ENGAGES AND DISENGAGES

(Low cranking voltage)

Corrective Action: Service as necessary by cleaning and tightening battery cable connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-4).

THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

(Marginal battery, battery connections or charging system)

Corrective Action: *Refer to Pages A-1 through A-6 as appropriate.*

1. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-4).
2. Inspect the serpentine belt that drives the charging alternator and service as necessary (p. 4-14).
3. Service the battery charging alternator (p. 7-5).

TABLE 8-1. TROUBLESHOOTING GENSET FAULTS (CONT.)

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

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

NO AC POWER WHEN GENSET IS RUNNING

(A Circuit Breaker is OFF, tripped or malfunctioning or the generator is not connected properly)

Corrective Action: *Refer to Pages A-1 through A-6 as appropriate.*

1. Reset or turn ON the genset circuit breaker if OFF or tripped.
2. Reset or turn ON any other circuit breaker in the AC power supply system if OFF or tripped.
3. If the genset has a manual voltage regulator (Figure 2-1), push the manual voltage selector switch to **AUTO**.
4. Connect the generator as required for the application in accordance with the appropriate connection diagram on Page A-3.

SERVICE CHECK—CODE NO. 3

(A fault with a 2-digit fault code number occurred)

Corrective Action: Check the 2-digit fault code by *Pushing* and *Releasing Stop*. The 2-digit fault will be one of the following in this table. (Does not apply to e-Series Digital Display.)

OVERCRANK—CODE NO. 4

(First-level fault code—Cranking time exceeded 20 to 60 seconds, depending on ambient temperature)

Corrective Action: *Refer to Pages A-1 through A-6 as appropriate.*

1. Disconnect the PTO.
2. Check fuel level and refill as necessary. (Note: The genset fuel pickups are probably higher than the propulsion engine fuel pickups.)
3. Open any closed fuel supply and return valves.
4. Prime the engine fuel system for at least 30 seconds (p. 3-3).
5. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-4).
6. Check all fuel fittings for fuel and air leaks, tighten as necessary and reprime.
7. Replace the fuel filters and reprime (p. 4-8).
8. If so equipped, check for proper operation of Fuel Pump Relay K7 (p. 5-5) and fuel pump (p. 7-6) and repair as necessary.
9. Check the engine air filter and remove any blockage (p. 4-10).
10. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
11. Service the fuel injectors (p. 7-10).
12. Have an authorized John Deere service representative service the engine.

WARNING—SHUTDOWN DUE TO VESSEL CO—CODE NO. 5

(First-level shutdown—Dangerous levels of Carbon Monoxide in Vessel)

Corrective Action: Get everyone out into fresh air immediately and seek medical attention.

TABLE 8-1. TROUBLESHOOTING GENSET FAULTS (CONT.)

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

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

OIL LEVEL HIGH OR LOW—CODE NO. 6

(First-level shutdown—Engine oil level is too low or too high)

Corrective Action: Add or drain oil as necessary and check for leaks.

LOSS OF RAW WATER FLOW—CODE NO. 7

(First-level shutdown—Low raw water pressure in heat exchanger)

Corrective Action:

1. Open the sea cock.
2. Check for and clean a blocked sea water strainer. If the strainer is above the water line, fill it with water to assist priming.
3. Check for kinked or leaking hoses and reconnect, reroute or replace.
4. Check for a worn raw water impeller and replace as necessary (p. 4-13).
5. Check the bottom of the hull for any blockage at the through-hull fitting.

HIGH AC VOLTAGE—CODE NO. 12

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

Corrective Action: Does not apply when genset has PMG excitation.

1. Push the genset line circuit breaker OFF, start the genset and measure output voltage. If output voltage is normal, the problem is in the circuits external to the genset. If there is no voltage, test for grounded or shorted main, field or quadrature windings and service as necessary (p. 6-1).
2. Replace the genset controller (p. 5-1).

LOW AC VOLTAGE—CODE NO. 13

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

Corrective Action: Does not apply when genset has PMG excitation.

1. Push the genset line circuit breaker OFF and disconnect the PTO. If the genset now runs and voltage and frequency are normal, reduce the number of electrical and mechanical (PTO) loads. If there is no voltage, test for grounded or shorted main, field or quadrature windings and service as necessary (p. 6-1).
2. Replace the genset controller (p. 5-1).

TABLE 8-1. TROUBLESHOOTING GENSET FAULTS (CONT.)

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

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

HIGH AC FREQUENCY—CODE NO. 14

(After the starter was engaged Frequency jumped to more than 70 Hz for 40 milliseconds or to more than 2% over nominal for 6 seconds)

Corrective Action:

1. Check for a tripped genset circuit breaker, reset it if necessary, and run with fewer connected loads. (A breaker tripping under load can cause genset frequency to overshoot.)
2. Check all fuel fittings for fuel and air leaks, tighten as necessary and reprime. (Air bubbles can disrupt frequency.)
3. Have an authorized John Deere service representative service the engine.

LOW AC FREQUENCY—CODE NO. 15

(During normal operation Frequency fell to less than 90% of nominal for more than 8 seconds)

Corrective Action:

1. Push the genset line circuit breaker OFF and disconnect the PTO. If the genset now runs, reduce the number of electrical and mechanical (PTO) loads, especially those with high motor starting loads such as air conditioners.
2. Check fuel level and fill as necessary.
3. Prime the engine fuel system for at least 30 seconds (p. 3-3).
4. Check all fuel fittings for fuel and air leaks, tighten as necessary and reprime. (Air bubbles can disrupt frequency.)
5. Replace the fuel filters and reprime (p. 4-8).
6. If so equipped, check for proper operation of Fuel Pump Relay K7 (p. 5-5) and fuel pump (p. 7-6) and repair as necessary.
7. Check the engine air filter and remove any blockage (p. 4-10).
8. Service the fuel injectors (p. 7-10).
9. Have an authorized John Deere service representative service the engine.

ENGINE FAULT—CODE NO. 16

(The genset Controller shut down the genset due an engine fault)

Corrective Action: See TROUBLESHOOTING ENGINE FAULT CODE NO. 16 on Page 8-9.

LOSS OF AC VOLTAGE SENSE—CODE NO. 27

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

Corrective Action: *Refer to Pages A-1 through A-6 as appropriate.*

1. Disconnect controller connector **J3/P3** (p. 5-2) and check for loose connections or an open quadrature winding (**P3-4—P3-5**). Service the generator rotor or stator as necessary (p. 6-1).
2. Replace the genset controller (p. 5-1).

TABLE 8-1. TROUBLESHOOTING GENSET FAULTS (CONT.)

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

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

HIGH BATTERY VOLTAGE—CODE NO. 29

(During startup the genset Controller sensed that battery system voltage was greater than 19.2 volts if 12 VDC system or 32.2 volts if 24 volt system)

Corrective Action:

1. Check battery bank connections and reconnect if necessary for 12 volts or 24 volts, depending on genset model.
2. Select a lower battery booster charge rate.

STARTING FAULT—CODE NO. 32

(The genset Controller could not detect cranking speed [quadrature zero crossings] for 3 seconds)

Corrective Action: *Refer to Pages A-1 through A-6 as appropriate.*

1. Disconnect the PTO.
2. Have the propulsion engines running while trying to start the genset. Their charging alternators may be able to maintain a high enough battery terminal voltage to start the genset.
3. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-4).
4. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.
5. Check for proper operation of Start Relay K5 and J. D. Power Relay K6 and replace if necessary (p. 5-5).
6. Service or replace the start solenoid or starter motor assembly (p. 7-4).
7. Have an authorized John Deere service representative service the engine.
8. Replace the genset controller (p. 5-1).

CONTROL CARD FAILURE—EE—CODE NO. 35

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

Corrective Action: Replace the genset controller (p. 5-1)

TABLE 8-1. TROUBLESHOOTING GENSET FAULTS (CONT.)

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

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

UNKNOWN SHUTDOWN—SEE MANUAL—CODE NO. 36

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

Corrective Action:

1. Reduce the number of electrical and mechanical (PTO) loads on the genset.
2. Check fuel level and refill as necessary. (Note: The genset fuel pickups are probably higher than the propulsion engine fuel pickups.)
3. Prime the engine fuel system for at least 30 seconds (p. 3-3).
4. Check all fuel fittings for fuel and air leaks, tighten as necessary and reprime.
5. Replace the fuel filters and reprime (p. 4-8).
6. Check the engine air filter and remove any blockage (p. 4-10).
7. Service the fuel injectors (p. 7-10).
8. Have an authorized John Deere service representative service the engine.
9. Replace the genset controller (p. 5-1).

INVALID GENSET CONFIGURATION—CODE NO. 37

(The genset Controller is not configured properly for the genset)

Corrective Action:

1. Reconfigure the genset controller (p. 2-9).
2. Replace the genset controller.

CONTROL CARD FAILURE—RAM—CODE NO. 43

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

Corrective Action: Replace the genset controller (p. 5-1)

SPEED SENSE LOST—CODE NO. 45

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

Corrective Action:

1. Disconnect controller connector **J3/P3** (p. 5-2) and check for loose connections or an open quadrature winding (**P3-4—P3-5**). Service the generator rotor or stator as necessary (p. 6-1).
2. Replace the genset controller (p. 5-1).

GENSET OVERLOAD—CODE NO. 46

(The genset Controller shutdown the genset because engine load exceeded 135 percent of genset rating for 10 seconds)

Corrective Action: Reduce the number of electrical and mechanical (PTO) loads on the genset.

TABLE 8-1. TROUBLESHOOTING GENSET FAULTS (CONT.)

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

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

OVERPRIME—CODE NO. 57

(A local or remote control switch was held in the Prime position for more than 5 minutes)

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

HIGH EXHAUST TEMPERATURE—CODE NO. 58

(Exhaust temperature exceeded design limits due to lack of water delivered to the exhaust/water mixer)

Corrective Action:

1. Check for and reconnect or replace any disconnected or leaking raw water hoses.
2. Check for and clean a blocked sea water strainer. If the strainer is above the water line, fill it with water to assist priming.
3. Check for kinked or leaking hoses and reconnect, reroute or replace.
4. Inspect the siphon break (if provided) for proper operation.
5. Check for a worn raw water impeller and replace as necessary (p. 4-13).
6. Clean the heat exchanger (p. 4-16).

LOW COOLANT LEVEL—CODE NO. 59

(The engine coolant level fell below the coolant level sensor)

Corrective Action: Add coolant as necessary and repair leaks.

EXTERNAL SHUTDOWN—CODE NO. 61

(Genset was shut down by a fire suppression system or other external control)

Corrective Action: Make all necessary repairs to the genset and connected equipment and reset the external control which shut down the genset.

LOST NIM COMMUNICATIONS—CODE NO. 72

(The genset Controller lost communication with the NIM [Network Interface Module] for 15 seconds)

Corrective Action: *Refer to Pages A-1 through A-6 as appropriate.*

1. Check for and repair all missing, damaged or corroded connector pins and sockets and faulty wiring connected to NIM board connectors J10 and J11 (p. 5-6).
2. Replace the NIM board.

TROUBLESHOOTING ENGINE FAULT CODE NO. 16

If this fault occurs, press the INFO button (which appears only for this fault) to display the engine FAULT INFO screen for a description of the engine fault (Figure 8-1). Find the corresponding fault in Table 8-2 and perform the step-by-step corrective actions.

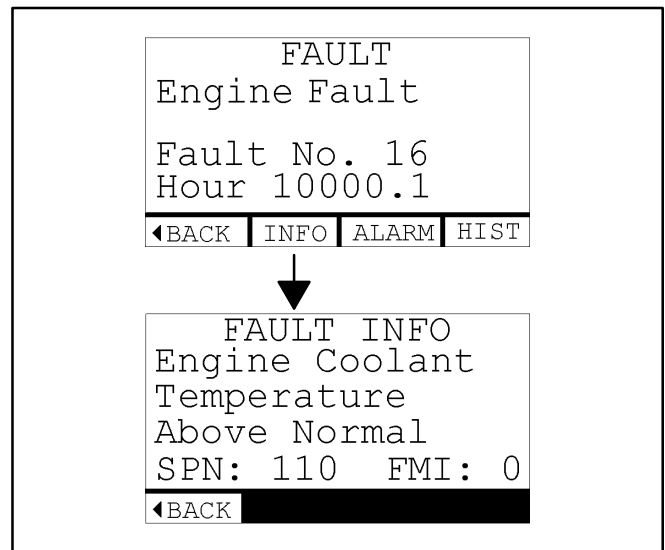


FIGURE 8-1. TYPICAL FAULT SCREEN

TABLE 8-2. TROUBLESHOOTING ENGINE FAULT CODE NO. 16

<p>⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions (p. iv).</p> <p><i>Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (–) cable from the battery to prevent the engine from starting.</i></p>
<p align="center">ENGINE FAULT, ABOVE NORMAL—SPN: 1, FMI: 0 (Engine Controller not in communication with NIM)</p> <p>Corrective Action: Refer to Pages A-1 through A-6 as appropriate.</p> <ol style="list-style-type: none"> 1. Check J11-1 to J21-V, J11-2 to J21-U and J11-3 to J21-F (p. 5-6) for missing, damaged or corroded connector pins and sockets and faulty wiring. Repair as necessary. 2. Replace the NIM board (p. 5-6). 3. Have an authorized John Deere service representative service the engine.
<p align="center">WATER IN FUEL INDICATOR, ABOVE NORMAL—SPN: 97, FMI: 0 (Water is present in the fuel separator)</p> <p>Corrective Action: Drain the water from the fuel separator (p. 4-9).</p>
<p align="center">ENGINE OIL PRESSURE, BELOW NORMAL—SPN: 100, FMI: 1 (Engine oil pressure is below 20 to 41 psi [135 to 280 kPa]—depending on engine speed)</p> <p>Corrective Action:</p> <ol style="list-style-type: none"> 1. Check engine oil level, add or drain oil as necessary and repair any leaks (p. 4-5) 2. Have an authorized John Deere service representative service the engine.

TABLE 8-2. TROUBLESHOOTING ENGINE FAULT CODE NO. 16(CONT.)

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

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

ENGINE COOLANT TEMPERATURE, ABOVE NORMAL—SPN: 110, FMI: 0
(Engine coolant temperature is above 244° F [118° C])

Corrective Action:

1. Check for and clean a blocked sea water strainer. If the strainer is above the water line, fill it with water to assist priming.
2. Check engine coolant level and add coolant as necessary.
3. Check for kinked or leaking hoses and reconnect, reroute or replace.
4. Inspect the serpentine belt that drives the coolant pump and service as necessary (p. 4-14).
5. Inspect the siphon break (if provided) for proper operation.
6. Check for a worn raw water impeller and replace as necessary (p. 4-13).
7. Clean the heat exchanger (p. 4-16).
8. Check the bottom of the hull for any blockage at the through-hull fitting.
9. Replace the coolant thermostat, which might not be fully opening (p. 4-15)
10. Have an authorized John Deere service representative service the engine.

ENGINE SPEED, ABOVE NORMAL—SPN: 190, FMI: 0
(Engine speed exceeded 3400 rpm)

Corrective Action: Have an authorized John Deere service representative service the engine.)

CONTROLLER # 1, OUT OF CALIB.—SPN: 629, FMI: 13
(The engine Controller requires recalibration)

Corrective Action: Have an authorized John Deere service representative service the engine.)

AUXILIARY ENGINE SHUTDOWN SWITCH—SPN: 970, FMI: 31
(An external controller sent a shutdown signal to the engine Controller)

Corrective Action: Investigate the cause of shutdown, make necessary adjustments and repairs and reset the external controller.

FUEL INJECTION PUMP VALVE, VOLT. OUT/ RANGE—SPN: 1076, FMI: 3
(Sensor or wiring shorted or open)

Corrective Action: Have an authorized John Deere service representative service the engine.)

FUEL INJECTION PUMP VALVE, CUR. OUT/ RANGE—SPN: 1076, FMI: 5
(The fuel injection pump fuel control valve open)

Corrective Action: Have an authorized John Deere service representative service the engine.)

FUEL INJECTION PUMP VALVE, CUR. OUT/ RANGE—SPN: 1076, FMI: 6
(The fuel injection pump fuel control valve open or grounded)

Corrective Action: Have an authorized John Deere service representative service the engine.)

TABLE 8-2. TROUBLESHOOTING ENGINE FAULT CODE NO. 16(CONT.)

<p>⚠WARNING <i>Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions (p. iv).</i></p> <p><i>Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (–) cable from the battery to prevent the engine from starting.</i></p>
<p>FUEL INJECTION PUMP VALVE, ABNORMAL RT/CHG—SPN: 1076, FMI: 10 (The fuel injection pump fuel control valve circuit resistance)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>FUEL INJECTION PUMP VALVE, OUT OF CALIB.—SPN: 1076, FMI: 13 (The fuel injection pump fuel control valve circuit resistance due to connector)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>APPROACHING SHUTDOWN—SPN: 1109, FMI: 31 (Engine Controller protection circuit approaching shutdown [30 seconds]—condition not available)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>ENGINE HAS SHUT DOWN—SPN: 1110, FMI: 31 (Engine Controller protection circuit has shutdown—condition not available)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>ENGINE TORQUE DERATE—SPN: 1569, FMI: 31 (A derate condition exists—Check Coolant Temperature, Oil pressure, Fuel Temperature)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>ECU FAILURE, CUR. OUT/RANGE—SPN: 2000, FMI: 06 (ECU failure)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>

TROUBLESHOOTING ENGINE PRE-ALARMS

The PRE-ALARM status lamp will start to blink as certain engine running conditions approach their limits for engine shutdown. To display information about the pre-alarm condition, press the FAULT button on any GEN STATUS screen. Then press the ALARM button to display the PRE-ALARM screen (Figure 8-2). Find the corresponding fault in Table 8-3 and perform the step-by-step corrective actions.

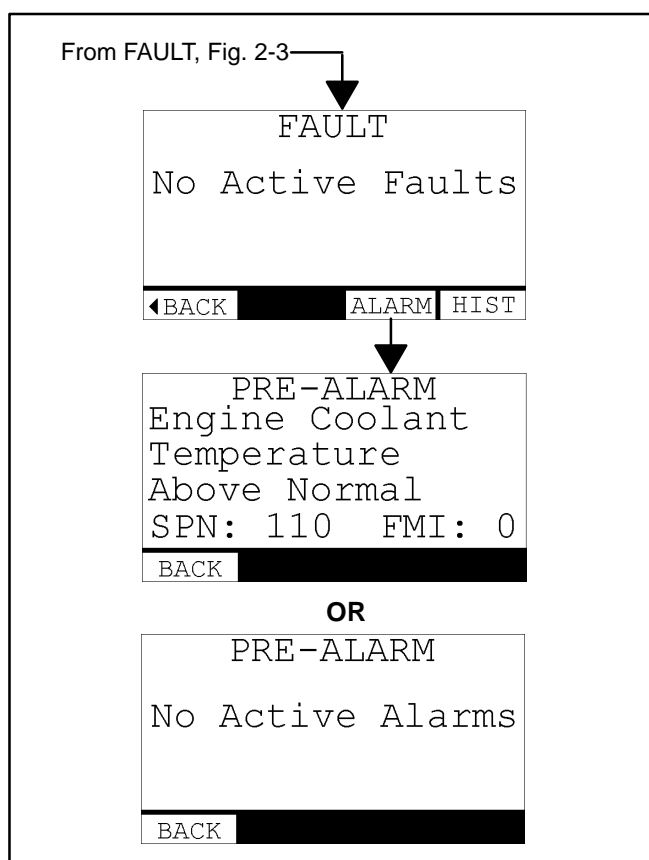


FIGURE 8-2. TYPICAL PRE-ALARM SCREEN

TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARMS

⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions (p. iv).	
Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (–) cable from the battery to prevent the engine from starting.	
WATER IN FUEL INDICATOR, ABOVE NORMAL—SPN: 97, FMI: 16 (Water is present in the fuel separator)	
Corrective Action: Drain the water from the fuel separator (p. 4-9).	
ENGINE OIL PRESSURE, VOLT. OUT/RANGE—SPN: 100, FMI: 3 (Sensor or wiring shorted or open)	
Corrective Action: Have an authorized John Deere service representative service the engine.)	
ENGINE OIL PRESSURE, VOLT. OUT/RANGE—SPN: 100, FMI: 4 (Engine oil pressure sensor or wiring open or grounded)	
Corrective Action: Have an authorized John Deere service representative service the engine.)	

TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARMS(CONT.)

<p>⚠WARNING <i>Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions (p. iv).</i></p> <p><i>Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (–) cable from the battery to prevent the engine from starting.</i></p>
<p>ENGINE OIL PRESSURE, BELOW NORMAL—SPN: 100, FMI: 18 (Engine oil pressure is below 24 to 51 psi [165 to 350 kPa]—depending on engine speed)</p> <p>Corrective Action:</p> <ol style="list-style-type: none"> 1. Check engine oil level, add or drain oil as necessary and repair any leaks (p. 4-5) 2. Have an authorized John Deere service representative service the engine.
<p>INTAKE MANIFOLD TEMPERATURE, VOLT. OUT/RANGE—SPN: 105, FMI: 3 (Sensor or wiring shorted or open)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>INTAKE MANIFOLD TEMPERATURE, ABOVE NORMAL—SPN: 105, FMI: 16 (Intake manifold temperature above 302° F [150° C])</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>ENGINE COOLANT TEMPERATURE, VOLT. OUT/RANGE—SPN: 110, FMI: 3 (Sensor or wiring shorted or open)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>ENGINE COOLANT TEMPERATURE, VOLT. OUT/RANGE—SPN: 110, FMI: 4 (Sensor or wiring shorted to ground)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>ENGINE COOLANT TEMPERATURE, ABOVE NORMAL—SPN: 110, FMI: 15 (Engine coolant temperature is above 226° F [108° C])</p> <p>Corrective Action:</p> <ol style="list-style-type: none"> 1. Check for and clean a blocked sea water strainer. If the strainer is above the water line, fill it with water to assist priming. 2. Check engine coolant level and add coolant as necessary. 3. Check for kinked or leaking hoses and reconnect, reroute or replace. 4. Inspect the serpentine belt that drives the coolant pump and service as necessary (p. 4-14). 5. Inspect the siphon break (if provided) for proper operation. 6. Check for a worn raw water impeller and replace as necessary (p. 4-13). 7. Clean the heat exchanger (p. 4-16). 8. Check the bottom of the hull for any blockage at the through-hull fitting.

TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARMS(CONT.)

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

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

ENGINE COOLANT TEMPERATURE, ABOVE NORMAL—SPN: 110, FMI: 16

(Engine coolant temperature is above 235° F [113° C])

Corrective Action:

1. Check for and clean a blocked sea water strainer. If the strainer is above the water line, fill it with water to assist priming.
2. Check engine coolant level and add coolant as necessary.
3. Check for kinked or leaking hoses and reconnect, reroute or replace.
4. Inspect the serpentine belt that drives the coolant pump and service as necessary (p. 4-14).
5. Inspect the siphon break (if provided) for proper operation.
6. Check for a worn raw water impeller and replace as necessary (p. 4-13).
7. Clean the heat exchanger (p. 4-16).
8. Check the bottom of the hull for any blockage at the through-hull fitting.

BATTERY POTENTIAL, BELOW NORMAL—SPN: 158, FMI: 17

(ECU cannot power down)

Corrective Action: Have an authorized John Deere service representative service the engine.)

FUEL TEMPERATURE, VOLT. OUT/RANGE—SPN: 174, FMI: 3

(Sensor or wiring shorted or open)

Corrective Action: Have an authorized John Deere service representative service the engine.)

FUEL TEMPERATURE, VOLT. OUT/RANGE—SPN: 174, FMI: 4

(Sensor or wiring shorted or open)

Corrective Action: Have an authorized John Deere service representative service the engine.)

FUEL TEMPERATURE, ABOVE NORMAL—SPN: 174, FMI: 16

(Return fuel temperature is above 248° F [120° C])

Corrective Action: Have an authorized John Deere service representative service the engine.)

ENGINE SPEED, ABOVE NORMAL—SPN: 190, FMI: 16

(Engine speed exceeded 3000 rpm)

Corrective Action: Have an authorized John Deere service representative service the engine.)

5 VOLTS DC SUPPLY, VOLT. OUT/RANGE—SPN: 620, FMI: 3

(5V supply shorted to battery voltage)

Corrective Action: Have an authorized John Deere service representative service the engine.)

TABLE 8-3. TROUBLESHOOTING ENGINE PRE-ALARMS(CONT.)

<p>⚠WARNING <i>Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions (p. iv).</i></p> <p><i>Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (–) cable from the battery to prevent the engine from starting.</i></p>
<p>5 VOLTS DC SUPPLY, VOLT. OUT/RANGE—SPN: 620, FMI: 4 (5V supply shorted to ground)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>TIMING (CRANK) SENSOR, DATA ERRATIC—SPN: 637, FMI: 2 (Excessive signal noise)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>TIMING (CRANK) SENSOR, ABNORMAL RT/CHG—SPN: 637, FMI: 10 (Improper signal pattern)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>ENGINE DERATE SWITCH—SPN: 971, FMI: 31 (An external derate input has been activated)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>FUEL INJECTION PUMP VALVE, ABOVE NORMAL—SPN: 1076, FMI: 0 (Closure too long)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>FUEL INJECTION PUMP VALVE, ABOVE NORMAL—SPN: 1076, FMI: 1 (Closure too short)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>FUEL INJECTION PUMP VALVE, ABOVE NORMAL—SPN: 1076, FMI: 1 (Closure too short)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>FUEL INJECTION PUMP VALVE, ABOVE NORMAL—SPN: 1076, FMI: 7 (ECU failed to detect closure)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>
<p>FUEL INJECTION PUMP VALVE, ABOVE NORMAL—SPN: 1076, FMI: 7 (ECU failed to detect closure)</p> <p>Corrective Action: Have an authorized John Deere service representative service the engine.)</p>

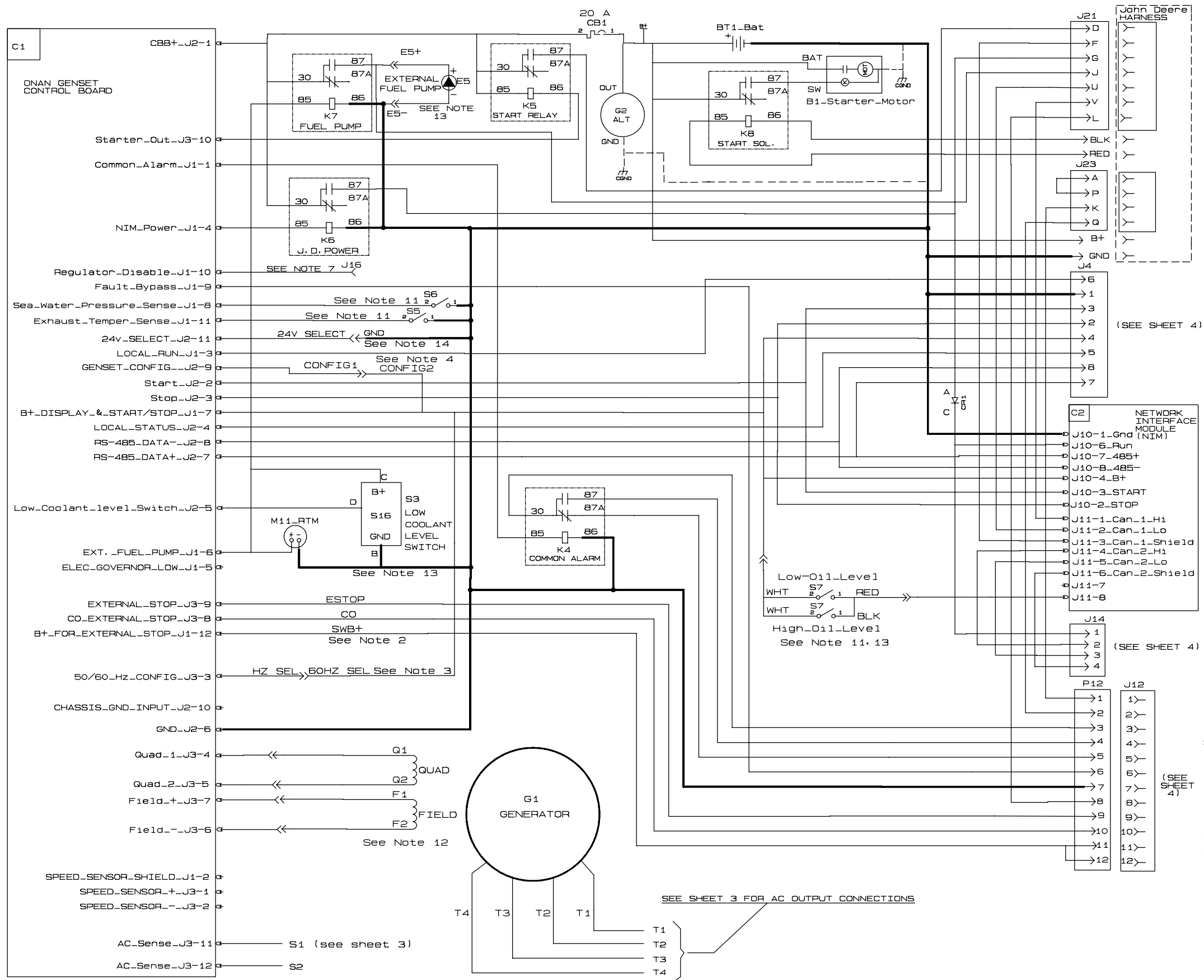
9. Specifications

	60 HERTZ MODELS				
	MDDCA	MDDCB	MDDCC	MDDCD	MDDCE
Genset Output Ratings – See Nameplate					
General Genset Data					
Size without Sound Shield – inches (mm)					
Length	68.3 (1734)	70.0 (1779)		84.3 (2142)	
Width	32.4 (822)				
Height	39.1 (994)				
Size with Sound Shield – inches (mm)					
Length	68.4 (1738)	70.2 (1783)		84.5 (2146)	
Width	33.1 (840)				
Height	40.9 (1039)				
Weight – Lbs (kg)					
Weight of Base Unit – Dry	2143 (972)	2352 (1067)	2352 (1067)	2910 (1320)	2910 (1320)
Weight of Base Unit – Wet	2200 (998)	2410 (1093)	2410 (1093)	3019 (1370)	3019 (1370)
Additional Weight for Various Options:					
Sound Shield	220 (100)	220 (100)	220 (100)	251(113)	251(113)
Single Phase Alternator	57 (26)	55 (25)	55 (25)	0	84 (38)
Sound Level – Housed (1 meter)					
Sound Level	72 dB(A)	72 dB(A)	72 dB(A)	72 dB(A)	72 dB(A)
Engine Detail					
Engine	4-Stroke Cycle Diesel, Direct Injection, Turbocharged, Microprocessor Controlled				
Operating Speed	1800 rpm				
10% Overload Engine Power	107 hp (80 kW)			162 hp (121 kW)	
Number of Cylinders (in-line)	4			6	
Firing Order	1–3–4–2			1–5–3–6–2–4	
Compression Ratio	17.6 : 1			17.0 : 1	
Displacement	275 in ³ (4.5 L)			415 in ³ (6.8 L)	
Bore	4.2 in (106.5 mm)				
Stroke	5.0 in (127 mm)				
Maximum Angularity, any direction	30 Degrees				
Lubrication System					
Lube Oil Capacity, including filters	13.3 qt (12.6 L)			20.5 qt (19.4 L)	
Lube Oil Drain Connection	3/8 inch NPT				
DC Electrical System					
Recommended Battery Capacity @ 32° F (0° C)	12V – 640 CCA / 24V – 570 CCA			12V – 800 CCA / 24V – 570 CCA	
Starter Rolling Current @ 32° F (0° C)	12V – 780 Amps / 24V – 600 Amps			12V – 920 Amps / 24V – 600 Amps	
Maximum Starting Current Resistance	12V – 0.0012 Ohm / 24V – 0.002 Ohm				
Battery Charging Output – Neg Gnd	12V – 60 Amps / 24V – 40 Amps				
Battery Charging Output – Iso Gnd	12V – 70 Amps / 24V – 45 Amps				

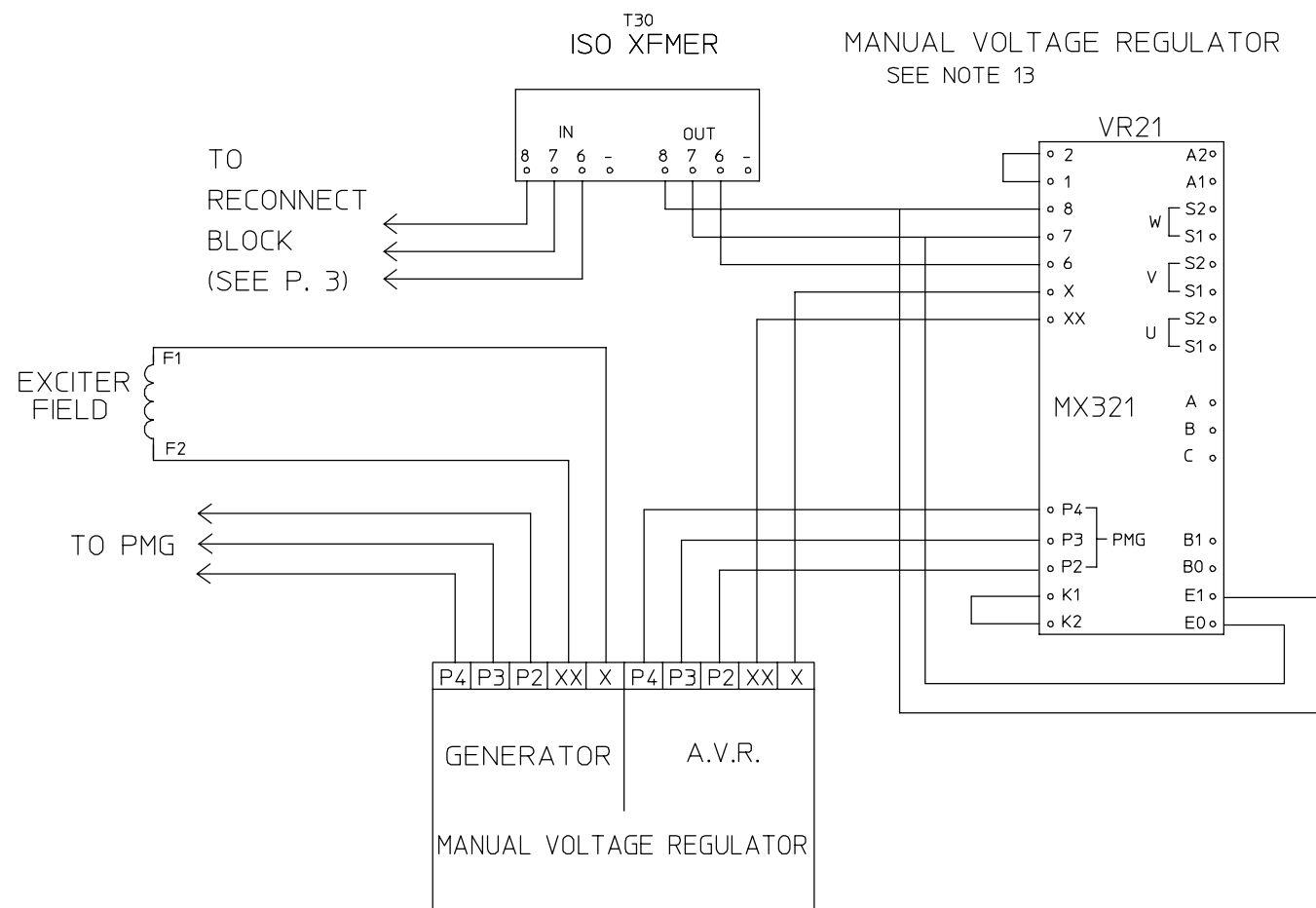
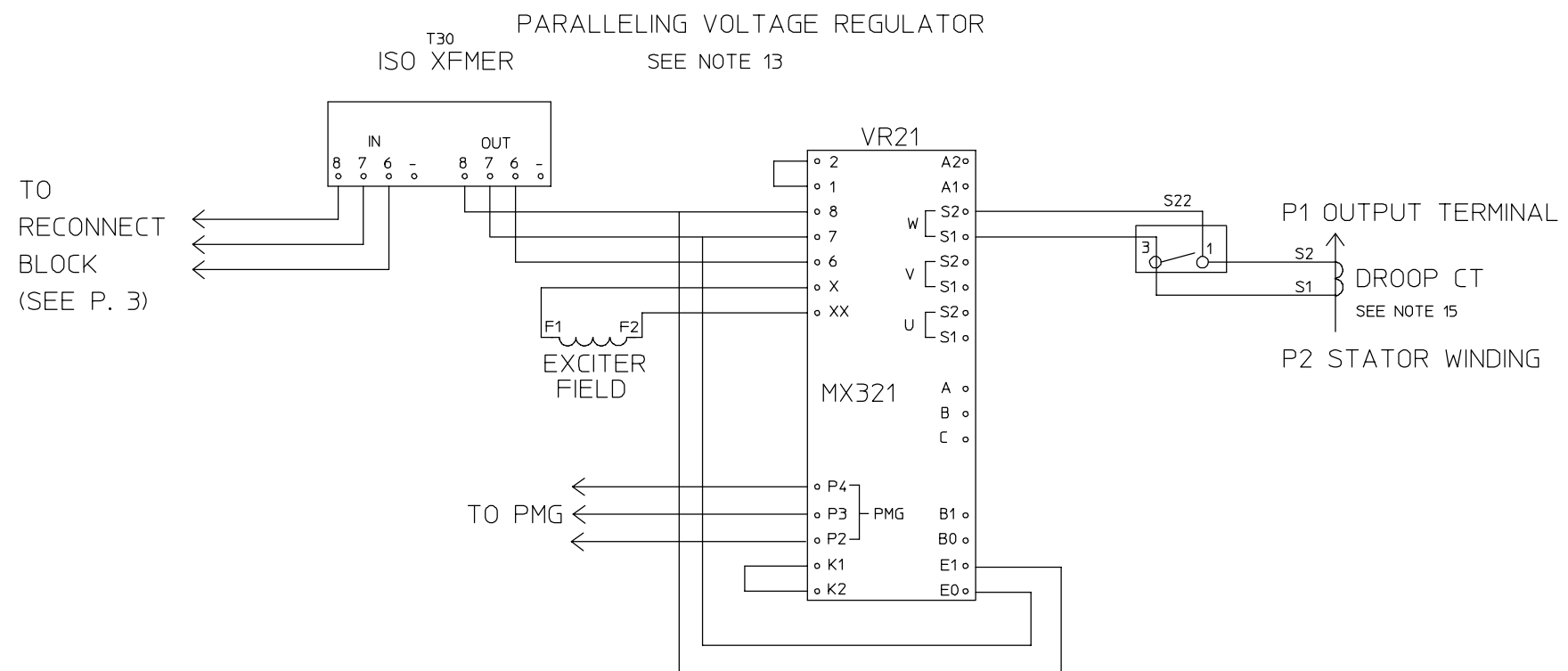
	60 HERTZ MODELS (CONTINUED)				
	MDDCA	MDDCB	MDDCC	MDDCD	MDDCE
Air Flow					
Combustion Air Flow	184 ft³/min (m³/min)			378 ft³/min (m³/min)	
Maximum Air Intake Restriction	Clean Element – 12 inches H₂O (3.0 kPa) Dirty Element – 25 inches H₂O (6.25 kPa)				
Alternator Cooling Air Flow ft³/min (m³/sec)	530 (0.25)	1090 (0.514)	1090 (0.514)	1090 (0.514)	1090 (0.514)
Heat Radiated to Room Btu/min (kW)	965 (17.0)	1116 (19.6)	1216 (21.4)	1651 (29.0)	1842 (32.4)
Fuel System					
Recommended Fuel	No. 2 Diesel Fuel specified to EN 590 or ASTM D975				
Minimum Required Fuel Line ID	0.25 inch (6 mm)				
Fuel Supply and Return Connection Size	1/4 – 18 NPTF				
Total Fuel Flow	212 lb/hr (96 kg/hr) 30 gal/hr (113 L/hr)				
Maximum Leak–off Line Pressure	3 psi (20 kPa)				
Maximum Leak–off Return Height	8 ft (2.5 m)				
Maximum Fuel Height above Inj. Pump	10 ft (3 m)				
Maximum Fuel transfer pump suction	8 in Hg (27 kPa)				
Max. Fuel transfer suction with Auxiliary Pump	18 in Hg (60 kPa)				
Fuel consumption: Gal/hr (L/hr)					
1/4 load	1.2 (4.5)	1.4 (5.5)	1.5 (5.8)	2.0 (7.6)	2.4 (9.2)
1/2 load	1.9 (7.2)	2.4 (9.3)	2.8 (10.7)	3.5 (13.2)	4.1 (15.5)
3/4 load	2.6 (9.9)	3.4 (13.0)	4.0 (14.3)	4.9 (18.7)	6.0 (22.9)
full load	3.4 (12.7)	4.4 (16.8)	5.2 (19.7)	6.4 (24.2)	7.8 (29.4)
Cooling System					
Coolant Flow Rate	25 gal/min (94 L/min)			33 gal/min (125 L/min)	
Heat Rejection to Coolant	3523 Btu/min (62 kW)			5863 Btu/min (103 kW)	
Coolant Capacity – engine only	15 qt (14 L)			32 qt (30 L)	
Recommended Pressure Cap	10 psi (70 kPa)				
Thermostat Start To Open	180 F (82 C)				
Thermostat Fully Open	203 F (95 C)				
Max. Pressure Drop Across Keel Cooler	4 psi (30 kPa)				
Sea Water System					
Raw Water Inlet Connection Size (OD)	1.25 in (31.8 mm)				
Sea Water Pump Flow	22 gal/min (84 L/min)				
Maximum Pump Inlet Restriction	120 inches H₂O (30 kPa)				
Maximum Pump Suction Lift	10 ft (3 m)				
Maximum Outlet Pressure	20 psi (135 kPa)				
Exhaust System					
Exhaust Gas Flow	463 ft³/min (13.1 m³/min)			848 ft³/min (24 m³/min)	
Exhaust Temperature	889° F (476° C)			745° F (396° C)	
Maximum Back Pressure	30 inches H₂O (7.5 kPa)				

	50 HERTZ MODELS			
	MDDCF	MDDCG	MDDCH	MDDCJ
Genset Output Ratings – See Nameplate				
General Genset Data				
Size without Sound Shield – inches (mm)				
Length	68.3 (1734)	70.0 (1779)	84.3 (2142)	
Width	32.4 (822)			
Height	39.1 (994)			
Size with Sound Shield – inches (mm)				
Length	68.4 (1738)	70.2 (1783)	84.5 (2146)	
Width	33.1 (840)			
Height	40.9 (1039)			
Weight – Lbs (kg)				
Weight of Base Unit – Dry	2200 (998)	2352 (1067)	2910 (1320)	2910 (1320)
Weight of Base Unit – Wet	2213 (1004)	2430 (1102)	3019 (1370)	3019 (1370)
Additional Weight for Various Options:				
Sound Shield	220 (100)	220 (100)	251(113)	251(113)
Single Phase Alternator	0	55 (25)	0	84 (38)
Sound Level – Housed (1 meter)				
Sound Level	72 dB(A)	72 dB(A)	70 dB(A)	70 dB(A)
Engine Detail				
Engine	4-Stroke Cycle Diesel, Direct Injection, Turbocharged, Microprocessor Controlled			
Operating Speed	1500			
10% Overload Engine Power	82 hp (61 kW)		131 hp (98 kW)	
Number of Cylinders (in-line)	4		6	
Firing Order	1–3–4–2		1–5–3–6–2–4	
Compression Ratio	17.6 : 1		17.0 : 1	
Displacement	275 in3 (4.5 L)		415 in3 (6.8 L)	
Bore	4.2 in (106.5 mm)			
Stroke	5.0 in (127 mm)			
Maximum Angularity, any direction	30 Degrees			
Lubrication System				
Lube Oil Capacity, including filters	13.3 qt (12.6 L)		20.5 qt (19.4 L)	
Lube Oil Drain Connection	3/8 inch NPT			
DC Electrical System				
Recommended Battery Capacity @ 32° F (0° C)	12V – 640 CCA / 24V – 570 CCA		12V – 800 CCA / 24V – 570 CCA)	
Starter Rolling Current @ 32° F (0° C)	12V – 780 Amps / 24V – 600 Amps		12V – 920 Amps / 24V – 600 Amps	
Maximum Starting Current Resistance	12V – 0.0012 Ohm / 24V – 0.002 Ohm			
Battery Charging Output – Neg Gnd	12V – 60 Amps / 24V – 40 Amps			
Battery Charging Output – Iso Gnd	12V – 70 Amps / 24V – 45 Amps			

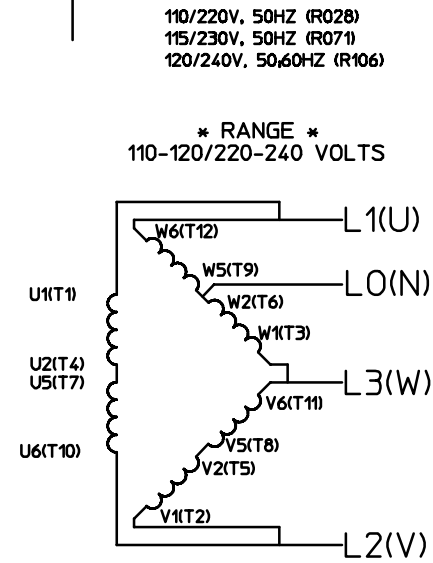
	50 HERTZ MODELS (CONTINUED)			
	MDDCF	MDDCG	MDDCH	MDDCJ
Air Flow				
Combustion Air Flow	124 ft³/min (m³/min)		244 ft³/min (m³/min)	
Maximum Air Intake Restriction	Clean Element – 12 inches H ₂ O (3.0 kPa) Dirty Element – 25 inches H ₂ O (6.25 kPa)			
Alternator Cooling Air Flow ft3/min (m3/sec)	530 (0.25)	1090 (0.514)	1090 (0.514)	1090 (0.514)
Heat Radiated to Room Btu/min (kW)	805 (14.2)	906 (15.9)	1290 (22.7)	1441 (25.3)
Fuel System				
Recommended Fuel	No. 2 Diesel Fuel specified to EN 590 or ASTM D975			
Minimum Required Fuel Line ID	0.25 inch (6 mm)			
Fuel Supply and Return Connection Size	1/4 – 18 NPTF			
Total Fuel Flow	205 lb/hr (93 kg/hr) 29 gal/hr (109 L/hr)			
Maximum Leak–off Line Pressure	3 psi (20 kPa)			
Maximum Leak–off Return Height	8 ft (2.5 m)			
Maximum Fuel Height above Inj. Pump	10 ft (3 m)			
Maximum Fuel transfer pump suction	8 in Hg (27 kPa)			
Max. Fuel transfer suction with Auxiliary Pump	18 in Hg (60 kPa)			
Fuel consumption: Gal/hr (L/hr)				
1/4 load	1.0 (3.9)	1.2 (4.6)	1.5 (5.7)	1.8 (6.7)
1/2 load	1.7 (6.4)	2.0 (7.6)	2.6 (9.9)	3.1 (11.8)
3/4 load	2.4 (9.0)	2.9 (10.8)	3.7 (14.1)	4.5 (16.9)
full load	3.0 (11.5)	3.7 (14.1)	4.9 (18.4)	5.9 (22.4)
Cooling System				
Coolant Flow Rate	14 gal/min (53 L/min)		31 gal/min (116 L/min)	
Heat Rejection to Coolant	2681 Btu/min (47 kW)		4554 Btu/min (80 kW)	
Coolant Capacity – engine only	15 qt (14 L)		32 qt (30 L)	
Recommended Pressure Cap	10 psi (70 kPa)			
Thermostat Start To Open	180 F (82 C)			
Thermostat Fully Open	203 F (95 C)			
Max. Pressure Drop Across Keel Cooler	3 psi (20 kPa)			
Sea Water System				
Raw Water Inlet Connection Size (OD)	1.25 in (31.8 mm)			
Sea Water Pump Flow	18 gal/min (70 L/min)			
Maximum Pump Inlet Restriction	100 inches H ₂ O (25 kPa)			
Maximum Pump Suction Lift	10 ft (3 m)			
Maximum Outlet Pressure	20 psi (135 kPa)			
Exhaust System				
Exhaust Gas Flow	300 ft³/min (9.0 m³/min)		558 ft³/min (16 m³/min)	
Exhaust Temperature	851° F (455° C)		772° F (411° C)	
Maximum Back Pressure	30 inches H ₂ O (7.5 kPa)			



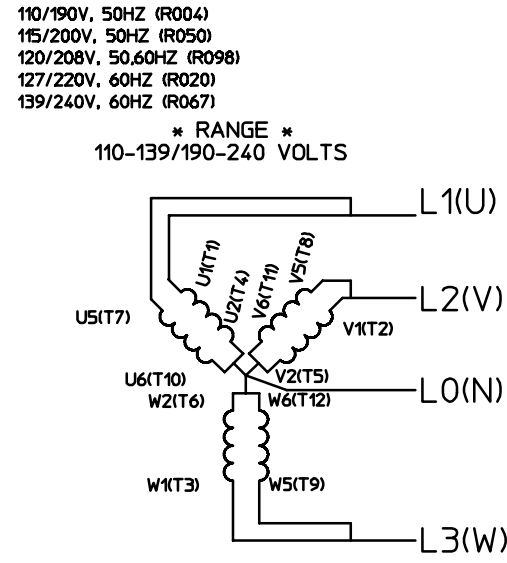
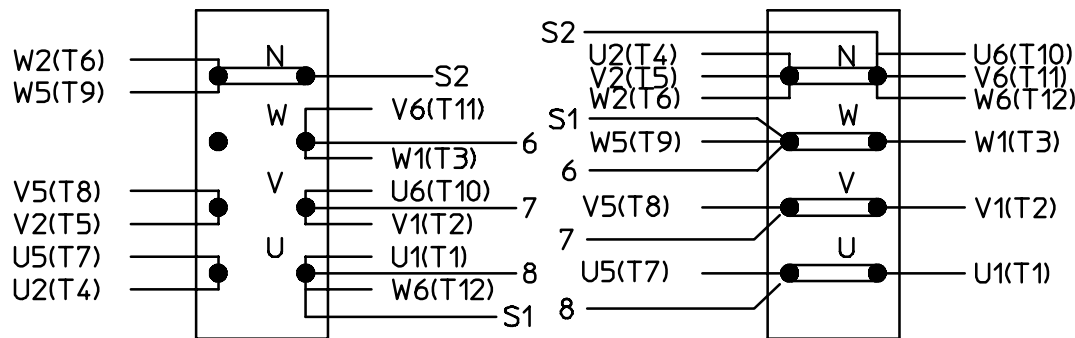
WIRING DIAGRAM (SHEET 1)



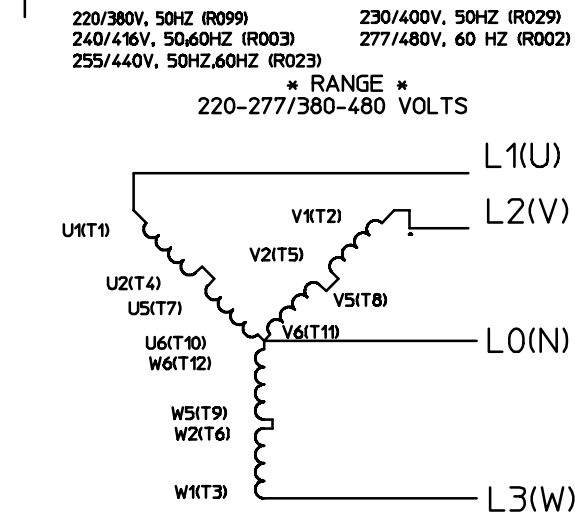
3 PHASE RECONNECTABLE, 12 LEAD



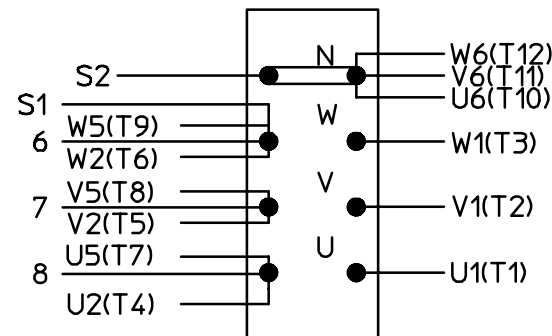
SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



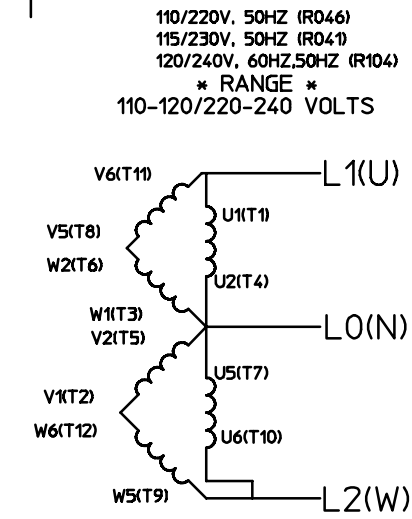
PARALLEL STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



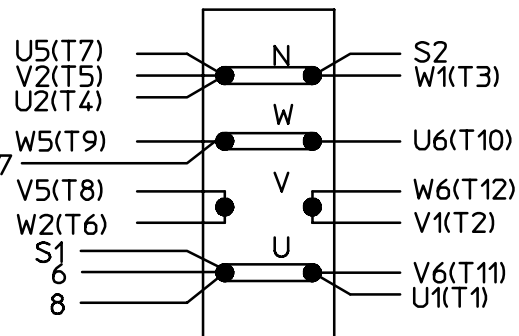
SERIES STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



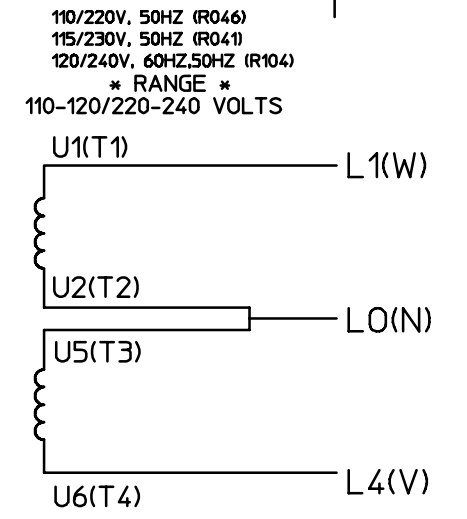
1 PHASE RECONNECTABLE, 12 LEAD (NOTE 20)



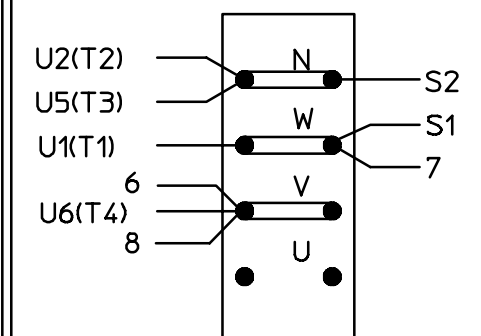
DOUBLE DELTA
1 PHASE 3 WIRE
OUTPUT TERMINALS
U.W. CENTER TAP N.



1 PHASE NON-RECONNECTABLE, 4 LEAD



1 PHASE 3 WIRE
OUTPUT TERMINALS
W, V, CENTER TAP N
SEE NOTE 17



NOTES:

16. UVW PHASE SEQUENCE WITH C.W. ROTATION
FACING DRIVE END.

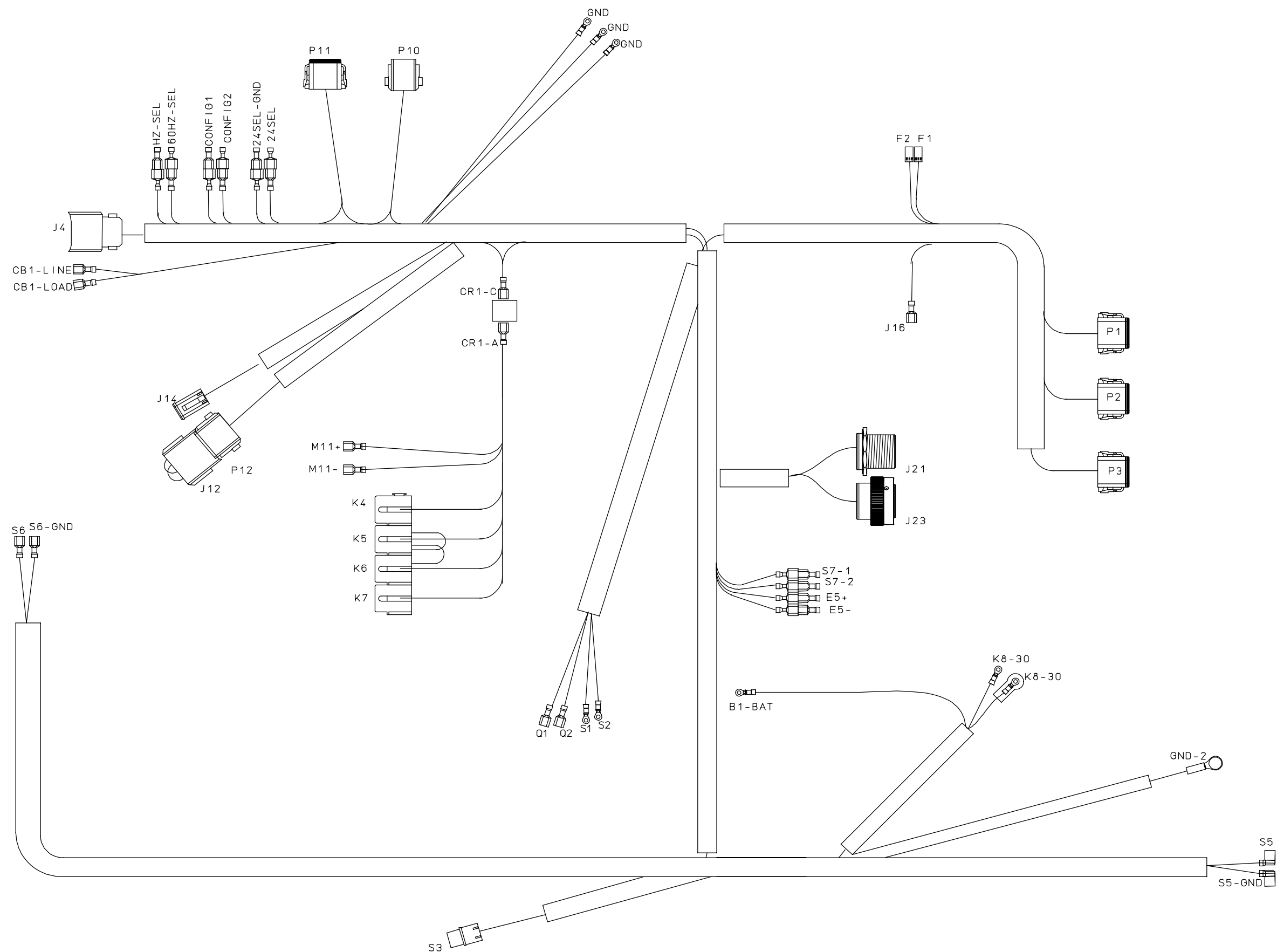
17. 1 PHASE NON-RECONNECTABLE: LARGER KW GENSETS
HAVE 8 OUTPUT TERMINALS SMALLER KW HAVE 4.

18. WHEN RECONNECTING GENERATOR LEADS, BOLTS
SHOULD BE TORQUED AT 22 ±2 FT-LBS.

19. SENSING LEADS 6, 7,& 8 ARE ONLY USED WITH
THE MX321 REGULATOR.

20. OUTPUT POWER REDUCED TO 2/3 OF NAMEPLATE RATING.

21. APPLY B+ FOR SERIAL COMMUNICATIONS WHEN
GENSET IS NOT RUNNING.



CONTROL WIRING HARNESS

