# RV Generator Service Manual

"Power Boost"
Models: 9CCO
12.5CCOPY
12.5CCO
14.5CCO

KOHLER®
GENERATORS

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# INTRODUCTION

This manual covers the operation, maintenance, and repair of the 9kW, 12.5kW and 14.5kW "Power Boost" RV generator set. Carefully read this manual before servicing generator. Parts catalogs and Engine Service Manuals for these units are available separately. The illustrations in this manual are representative of most units. Your generator may differ slightly from those shown.

# SERVICE ASSISTANCE

See the Yellow Pages under GENERATOR Electric for your closest Kohler Generator Dealer or contact your local RV Service Center. Record the MODEL, SPECIFICATION, SERIAL, and ENGINE SPECIFICATION numbers as found on the plate attached to the generator frame and engine block. This information is necessary for your Service Dealer to supply you with correct literature for your generator.

# SAFETY PRECAUTIONS

A Generator Set, like any other electro-mechanical device can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best safeguards against accident are to be ever mindful of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating to operating of a Generator set follow. Keep these in mind. This manual contains several types of safety precautions which are explained below.

### ⚠ DANGER

Danger is used to indicate the presence of a hazard which *will* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

### ⚠ WARNING

Warning is used to indicate the presence of a hazard which *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

### ⚠ CAUTION

Caution is used to indicate the presence of a hazard which *will* or *can* cause *minor* personal injury or property damage if the warning is ignored.

### NOTE

Note is used to notify people of installation, operation, or maintenance information which is important but not hazard-related.

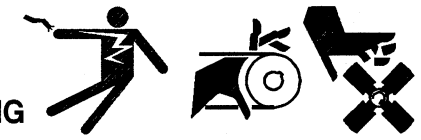
### ⚠ WARNING

**Carbon monoxide can cause death, severe nausea or fainting.** Never operate the generator set inside a building unless the exhaust gas is piped safely outside. Never operate in any area where exhaust gas could accumulate and seep back inside an occupied building or coach. Be careful when parking your coach to avoid obstructing the exhaust outlet. The exhaust gases must discharge freely, otherwise carbon monoxide may deflect into the vehicle. Avoid breathing exhaust fumes when working on or near the generator set. Carbon monoxide is particularly dangerous because it is an odorless, colorless, tasteless, nonirritating gas which can cause death if inhaled for even a short period of time. The exhaust system must be leakproof and routinely inspected.

**Carbon monoxide can cause death, severe nausea or fainting.** Install exhaust system tail pipe so discharged exhaust gases will not be drawn into vehicle interior through windows, doors, air conditioners, etc. Do not use flexible tail piping since this type could crack and allow lethal exhaust fumes to enter the vehicle.

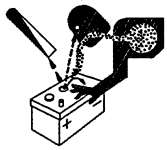
### ⚠ CAUTION

**Short circuits can cause bodily injury and/or equipment damage.** Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.



**⚠ WARNING**

**Accidental starting can cause death or serious personal injury.** Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by remote start/stop switch unless this precaution is followed.

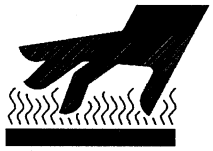


**⚠ WARNING**

**Sulfuric acid in batteries can cause permanent damage to eyes, burn skin, and eat holes in clothing.**
Always wear splash–proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous spattering of electrolyte.

**⚠ CAUTION**

**Hazardous noise can cause loss of hearing.**
Never operate generator without adequate hearing protection or muffler. Never operate generator with faulty exhaust system.



**⚠ CAUTION**

**Hot parts can cause personal injury.** Do not touch hot engine parts. An engine gets hot while running and exhaust system components get extremely hot.

**⚠ WARNING**

**Hazardous voltage can cause death or severe injury.**
Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule -- replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

**⚠ WARNING**

**Hot coolant can cause severe burns.**
Allow engine to cool and release pressure from cooling system before opening pressure cap. To release pressure, cover the pressure cap with a thick cloth then turn it slowly counterclockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap. If generator set is equipped with a coolant recovery tank, check coolant level at tank.

**NOTE**

**RV generator sets do not comply with United States Coast Guard (U.S.C.G.) requirements and must not be used for marine applications.** Use only generator sets specified for marine use in marine installations. U.S.C.G. Regulation 33CFR183 requires a generator set to be "ignition protected" when used in a gasoline–fueled environment.

**⚠ WARNING**

**A sudden backfire can cause serious burns.** Do not operate with air cleaner removed.

**⚠ CAUTION**

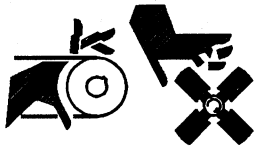
**Hot exhaust system can ignite adjacent combustible materials.** Do not locate electrical wiring, fuel lines, or combustible material above the exhaust muffler. Be careful when parking your RV to prevent grass fires started by exhaust system and hot exhaust gases.

**⚠ WARNING**

**Battery gases can cause an explosion.**
Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. Do not mount battery in generator compartment. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

**⚠ WARNING**

**A flash fire can cause serious burns.** Do not smoke or permit flame or spark to occur near carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. When removing fuel line or carburetor, use a proper container to catch all fuel.



**⚠ WARNING**

**Exposed moving parts can cause severe injury.**
Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set. Do not open generator compartment door when unit is running.

**⚠ WARNING**

**Hazardous voltage can cause death or severe injury.** Do not contact electrical connections with adjustment tool while the generator is running. Remove wristwatch, rings, and jewelry that can cause short circuits. Do not touch electrical equipment when standing in water, on wet ground, or when your hands are wet.

**⚠ WARNING**

**All fuels are highly explosive in a vapor state. Use extreme care when handling, storing, and using fuels**
Store fuel in a well–ventilated area away from spark producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running since spilled fuel may ignite on contact with hot parts or from ignition spark. Do not smoke or permit flame or spark to occur near potential sources of spilled fuel or fuel vapors. Keep fuel lines and connections tight and in good condition--don't replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration. Additional precautions must be taken when using the following fuels:
**Gasoline** – Store gasoline only in approved red containers clearly marked GASOLINE. Do not store gasoline in any occupied building.
**Propane (LP)** – Adequate ventilation is mandatory. Propane is heavier than air; install gas detectors low in room. Inspect detectors often.
**Natural Gas** – Adequate ventilation is mandatory. Natural gas rises; install gas detectors high in room. Inspect detectors often.

**⚠ CAUTION**

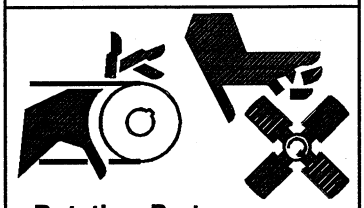
**Hot generator can ignite debris in compartment.**
Keep the compartment and generator set clean and free of debris and combustible materials to minimize chances of fire. Do not block fuel/oil drain opening in generator mounting tray. If sub–flooring is used, cut a corresponding hole in the sub–flooring for drain opening.

**⚠ WARNING**

**Hazardous voltage can cause death or serious injury.** The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

# Safety Decals

**⚠ WARNING**



**Rotating Parts Can Cause Severe Injury.**

Do not operate generator set without all guards, screens or covers in place.

249808

**⚠ WARNING**

**Hazardous voltage backfed to utility system can cause electrocution or property damage.**

Do not connect to any building electrical system without connecting through an approved device and after building main switch is open. See operator's manual.

239771

**⚠ WARNING**

**Hot coolant and steam can cause severe burns and personal injury.**

Before removing cap stop generator, allow to cool and loosen cap to relieve pressure. Fill system before starting unit.

249810

**⚠ CAUTION**

**Hot engine and exhaust system can cause severe burns.**

Do not work on generator set until unit is allowed to cool.

249809

# SECTION 1. SPECIFICATIONS

## Engine

This Kohler generator set is powered by a Perkins or Yanmar three, or four-cylinder water-cooled diesel engine. For specific service information other than that listed below, refer to Section 3. Scheduled Maintenance.

**Model ... Yanmar 3TN82-R, 4TN82-U, 4TN82-R**
No. of Cylinders
3TN82-R ..... 3
4TN82-U or 4TN82-R ..... 4
Bore x Stroke ..... 3.228 in. x 3.386 in.
Bore x Stroke ..... 82 mm x 86 mm
Displacement
3TN82-R ..... 83.11 cu. in. (1362 cc)
4TN82-U or 4TN82-R 110.8 cu. in. (1817 cc)
Compression Ratio
3TN82-R ..... 18.06:1
4TN82-U or 4TN82-R ..... 23:1
Horsepower
3TN82-R ..... 16.5
4TN82-U or 4TN82-R ..... 22.0
RPM (60 Hz) ..... 1800
Lube Oil Capacity
3TN82-R ..... 5 U.S. qts. (4.7 L)
4TN82-U or 4TN82-R .. 6.1 U.S. qts. (5.8 L)
Cooling System Capacity (Engine Only)
3TN82-R ..... 2.1 qts. (2 L)
4TN82-U or 4TN82-R ..... 2.85 qts. (2.7 L)
Cooling System Capacity (w/ In-line Kohler Radiator)
3TN82-R ..... 10.6 qts. (10 L)
4TN82-U or 4TN82-R ..... 19 qts. (18 L)
Remote Radiator Coolant
Capacity (Kohler Model) ..... 4 gal. (15.1 L)
Engine Firing Order (#1 Cyl. nearest to Flywheel)
3TN82-R ..... 1-3-2-1
4TN82-U or 4TN82-R ..... 1-3-4-2-1
Fuel Injection Timing (Degrees) . $12^0$ +/- $1^0$ BTDC
Combustion System ..... Direct Injection
Battery Voltage ..... 12 Volts
Battery Recommendation (Min.) ..... 500 Cold Cranking Amps.,100 Amp Hr.
Direction of Rotation (As Viewed from the Generator End) ..... Counterclockwise
Cold Weather Starting Aids-
4TN82-U ..... Glow Plugs
4TN82-R ..... Air Intake Heater
Valve Clearance (Cold) .... 0.0079 in. (0.20 mm)
Fuel Recommendation .. Diesel, ATSM/D975-66T, No. 2-D
Oil Recommendation ..... SAE CC or CD
Battery Charging Alternator,
(if equipped) ..... 35 Amps.; 40 Amps, 9CCO

**Model ..... Perkins 4-108**
No. of Cylinders ..... 4
Bore x Stroke ..... 3.125 in. x 3.5 in.
Bore x Stroke ..... 79 mm x 89 mm
Displacement ..... 107.4 in. (1760 cc)
Compression Ratio ..... 22:1
Horsepower ..... 24.6
RPM ..... 1800
Lube Oil Capacity . Spec. Nos. 961015, 961017 4 U.S. qts. (3.8 L)
All Others 7 U.S. qts. (6.6 L)
Coolant Capacity ..... 2.5 gal. (9.5L)*
(Remote Radiator Models, Follow Rad. Mfg.'s Recommendations)
Engine Firing Order ..... 1-3-4-2-1
Fuel Injection Timing (Degrees) ... Consult Engine Service Manual
Battery Voltage ..... 12 Volts
Battery Recommendation (Min.) ..... 500 Cold Cranking Amps., 100 Amp. Hr.
Direction of Rotation (Viewed from Generator End) ..... Counterclockwise
Cold Weather Starting Aids ..... Glow Plugs
Valve Clearance (Cold) .. 0.012 in. (0.30 mm)
Fuel Recommendation Diesel, ATSM/D975-66T, No. 1-D or No. 2-D
Oil Recommendation SAE CC or CD

*Standard model - offset radiator models may vary slightly.

## Generator

Kohler designed and built rotating field 60 Hz generators are direct connected to the engine for permanent alignment.
DERATION: All units are rated at 1.0 power factor. The kilowatts of the generator set will decrease 3.5% for each 1,000 feet (305 meters) above 500 feet (152 meters) above sea level and 1% for each $10^0$ F ($5.5^0$ C) above $85^0$ F ($30^0$ C).
9 CCO Rated kW, 60 Hz ..... 9
12.5 CCO Rated kW, 60 Hz ..... 12.5
14.5 CCO Rated kW, 60 Hz ..... 14.5
Rated Voltage ..... 120-V., 1-phase, 2W 120/240-V., 1-phase, 3W
Rated Amperes-9 CCO
120 Volt ..... 75
120/240 Volt ..... 37.5
Rated Amperes-12.5 CCO
120 Volt ..... 104
120/240 Volt ..... 52

Rated Amperes–14.5 CCO
120 Volt ..... 120
120/240 Volt ..... 60
Rotor Resistance ..... 2.9 Ohms
Stator Resistance 1–2, 3–4, 33–44 .... 068 Ohms
55–66 ..... 1.1 Ohms
Coupling Type ..... Flexible Disc, Tapered Shaft, Thru–Bolt
Thru–Bolt Torque ..... 50 ft. lbs. (68 Nm)
Over–Bolt Torque ..... 260 in. lbs. (29 Nm)
Excitation Method ..... Static Brush–Type
Circuit Protection–9CCO, Two 40 Amp. Circuit Breakers; 12.5 CCO (if equipped),Two 60 Amp. Circuit Breakers;14.5 CCO, Two 70 Amp. Circuit Breakers

## Controller

The Kohler relay controller may be located at the set or, if a later model, at a location remote from the generator. The controller has a momentary contact start/stop switch for test operating the set at the controller. Also included is a combination preheat/prime switch (Perkins: preheat only), 10 Amp. fuse (Perkins: 15 Amp.) and, on some models, a slide tray switch.

When toggled to the ''preheat'' position, the preheat/prime switch aids in cold weather starting. When moved to the ''prime'' position, the switch actuates the fuel pump to help bleed air from the fuel system (see ''Fuel System Bleeding''). The fuse protects the controller against faults in the engine wiring system or the wiring to the remote start/stop switch. The slide tray switch (if equipped) controls the mechanism used to move the set in and out of the coach when servicing.

Inside the controller is a terminal strip for connecting remote operating controls. In some installations, the coach manufacturer may have provided a special wiring harness which permits remote control connection without accessing the controller terminal strip.
If the generator set has stopped running due to a high water temperature (HWT) or low oil pressure (LOP) shutdown, the set cannot be restarted until the fault has been corrected.

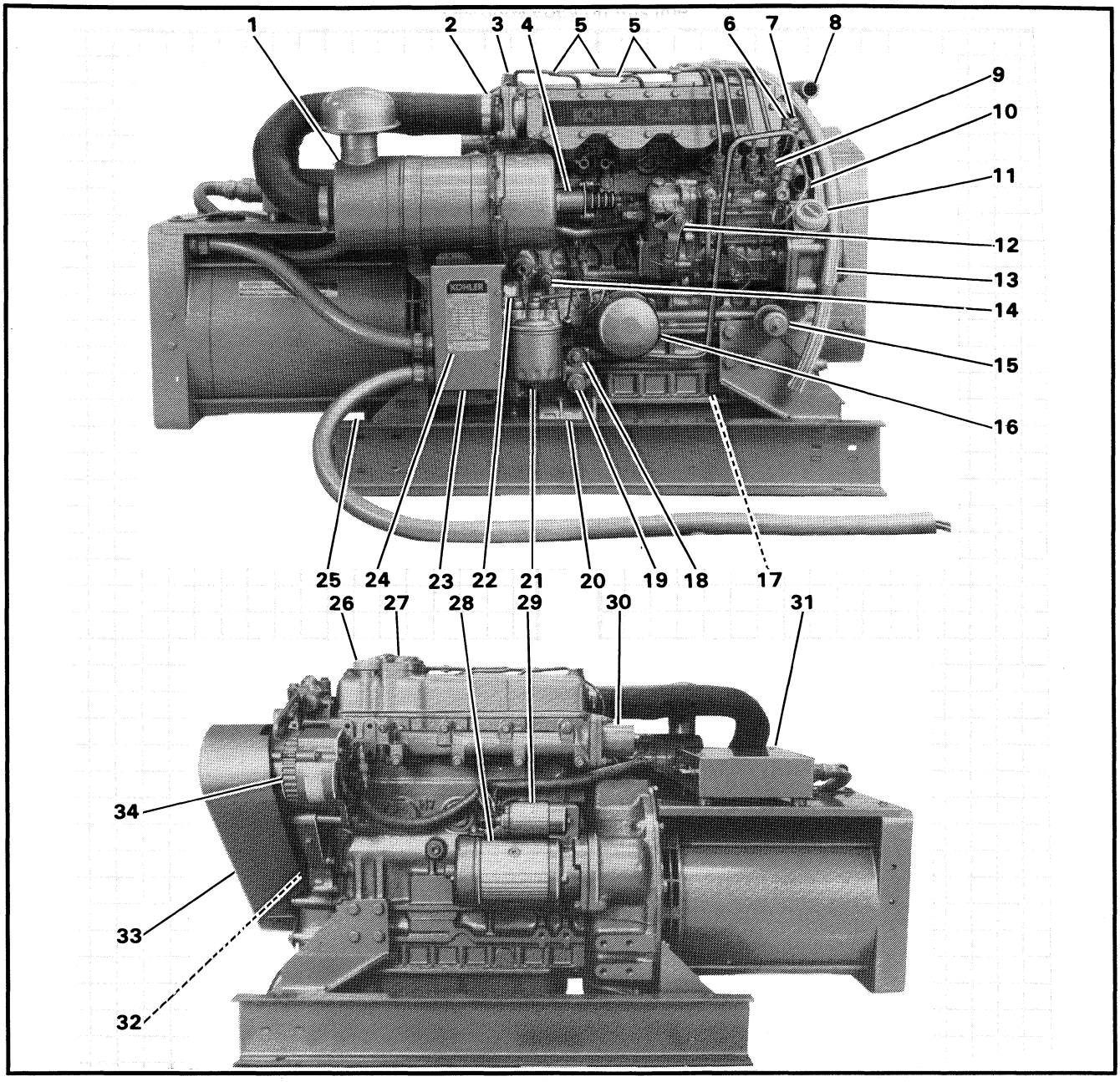



**Figure 1-1. Service Views Yanmar-Powered 12.5 and 14.5 CCO**

1. Air Cleaner (If Equipped)
2. Air Intake Connection
3. Hoisting Eye
4. Fuel Solenoid
5. Injectors
6. High Water Temperature (HWT) Shutdown Switch
7. Water Temperature Gauge Sender (If Equipped)
8. Water Outlet
9. Fuel Injection Pump
10. Water Inlet
11. Lube Oil Fill
12. Governor
13. Breather Hose
14. Low Oil Pressure (LOP) Shutdown Switch
15. Oil Pressure Gauge Sender (If Equipped)
16. Lube Oil Filter
17. Oil Drain
18. Fuel Return Line Connector
19. Fuel Inlet Connector
20. Fuel Pump
21. Fuel Filter
22. Circuit Breakers (If Equipped)
23. Junction Box (If Equipped)
24. Nameplate
25. Ground Lug
26. Lube Oil Fill
27. Breather Cap
28. Starter
29. Starter Solenoid
30. Exhaust Outlet
31. Controller
32. V-Belt
33. Belt Guard
34. Battery Charging Alternator (If Equipped)
35. Radiator (If Equipped)

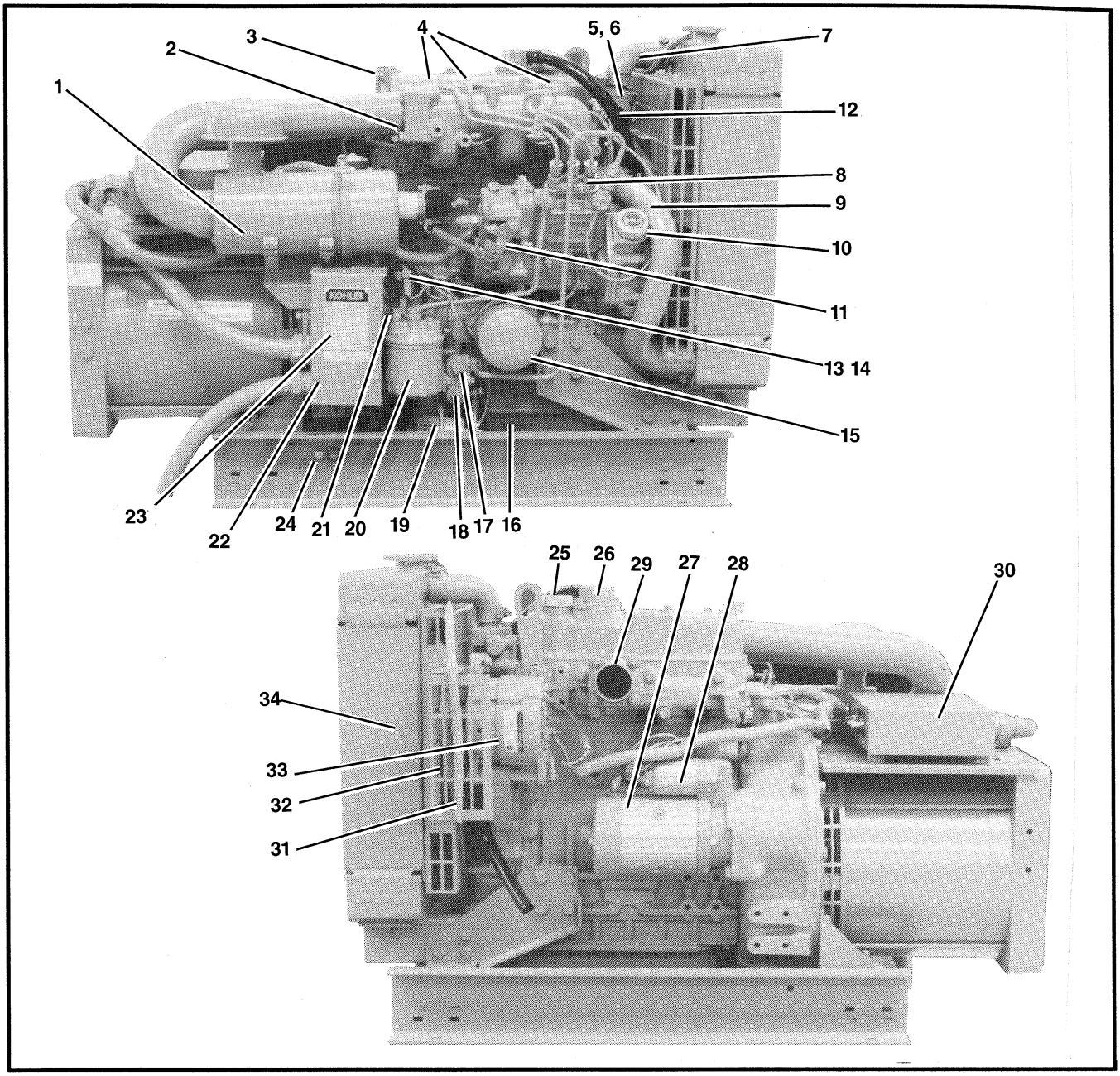



**Figure 1-2. Service Views Yanmar -Powered 9 CCO**

1. Air Cleaner (If Equipped)
2. Air Intake Connection
3. Hoisting Eye
4. Injectors
5. High Water Temperature (HWT) Shutdown Switch
6. Water Temperature Gauge Sender (If Equipped)
7. Water Outlet
8. Fuel Injection Pump
9. Water Inlet
10. Lube Oil Fill
11. Governor
12. Breather Hose
13. Low Oil Pressure (LOP) Shutdown Switch
14. Oil Pressure Gauge Sender (If Equipped)
15. Lube Oil Filter
16. Oil Drain
17. Fuel Return Line Connector
18. Fuel Inlet Connector
19. Fuel Pump
20. Fuel Filter
21. Circuit Breakers (If Equipped)
22. Junction Box (If Equipped)
23. Nameplate
24. Ground Lug
25. Lube Oil Fill
26. Breather Cap
27. Starter
28. Starter Solenoid
29. Exhaust Outlet
30. Controller
31. V-Belt
32. Belt Guard
33. Battery Charging Alternator (If Equipped)
34. Radiator (If Equipped)

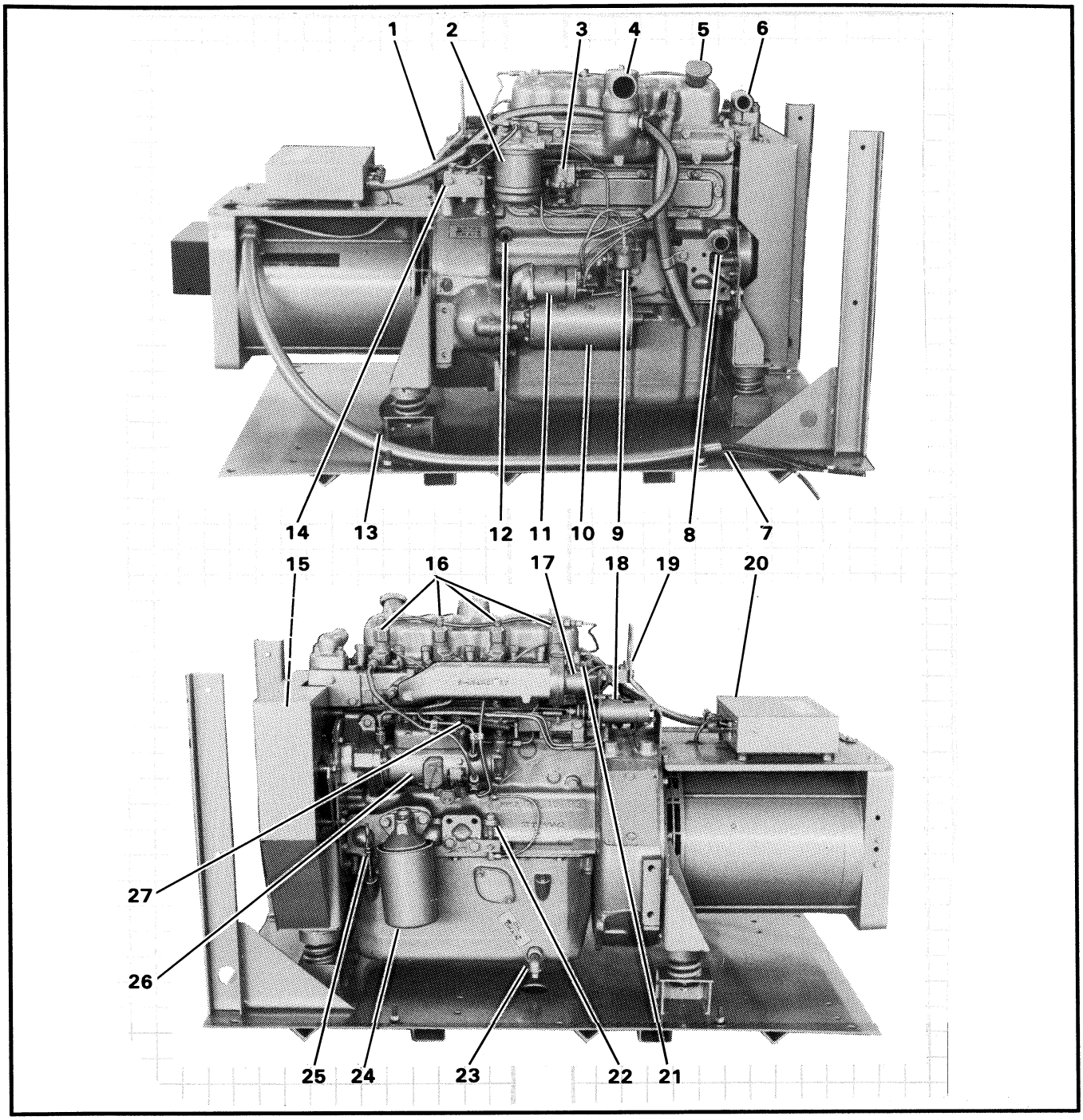



**Figure 1-3. Service Views Perkins -Powered**

1. Nameplate
2. Fuel Filter
3. Fuel Feed Pump
4. Intake Elbow
5. Oil Fill
6. Outlet Elbow (To Radiator)
7. Output Leads
8. Inlet Elbow (From Radiator)
9. Glow Plug Solenoid
10. Starter
11. Starter Solenoid
12. Water Drain
13. Ground Lug
14. Fuel Block
15. V-Belt
16. Fuel Injectors
17. Exhaust Elbow
18. Fuel Solenoid
19. Hoisting Eye
20. Controller
21. High Water Temperature Shutdown Switch
22. Low Oil Pressure Shutdown Switch
23. Oil Drain
24. Lube Oil Filter
25. Oil Check
26. Fuel Injection Pump
27. Governor

# SECTION 2. OPERATION

## Prestart Checklist

**NOTE**

Do not crank engine continuously for more than 10 seconds at a time. A 60 second cool-down period must be allowed between cranking attempts if the engine does not start. If the unit fails to start after three attempts contact an Authorized Service Dealer for repair. Failure to follow these guidelines may result in burn-out of the starter motor.

**NOTE**

To insure satisfactory operation of the generator, refer to the following procedures. Follow all recommendations and safety precautions when operating the generator.

| | |
|---|---|
| OIL LEVEL: | Should be at or near full mark (not over). |
| AIR INLETS: | Must be clear and unobstructed. |
| COMPARTMENT: | Interior must be clean. Check the condition of fuel system, exhaust piping, hoses, and muffler. If fuel leaks, fumes, exhaust gases, or electrical sparks are noted, contact a quali fied service technician before operating generator set. |
| EXHAUST: | Tail pipe must be clear, muffler and piping tight and in good condition. |
| ELECTRICAL: | All connections including battery must be tight. |
| FUEL LEVELS: | Make sure the fuel tank(s) are full and the fuel system primed for operation. |
| COOLING: | If the cooling system is equipped with a coolant recovery tank, check cool ant level at tank. Maintain level according to mark-ings on tank. On units with out coolant recovery tanks, remove pressure cap to check coolant level. Coolant level should be just below the overflow tube. |

**⚠ WARNING**

**Hot coolant can cause severe burns.**
Allow engine to cool and release pressure from cooling system before opening pressure cap. To release pressure, cover the pressure cap with a thick cloth then turn it slowly counter-clockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap. If generator set is equipped with a coolant recovery tank, check coolant level at tank.

## Controller Features

To identify controller components, refer to Figure 2-1, Figure 2-2, or Figure 2-3. Controllers pictured are representative of most units. Your controller may differ slightly from those shown.

## Starting

Move the START/STOP switch to the START position and hold in the position until the engine is running. Release switch. Normally the engine will start within 2 seconds. However, if the engine fails to start after cranking for 5 seconds, release the switch. Allow the engine to stop completely before attempting to restart.

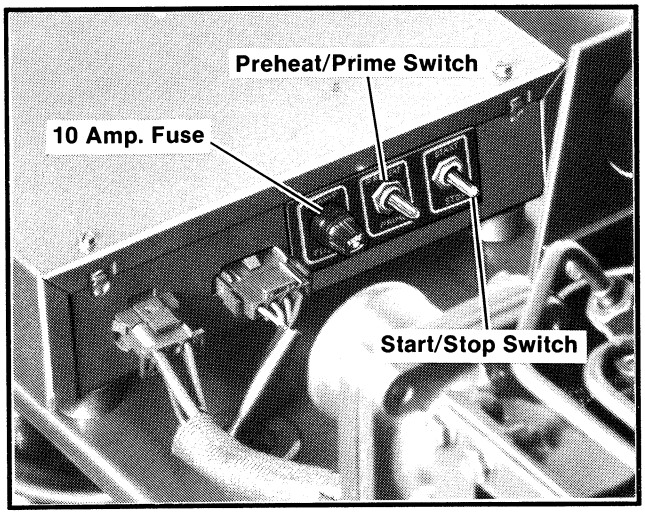



**Figure 2–1. Controller, Yanmar–Powered (Early Models)**

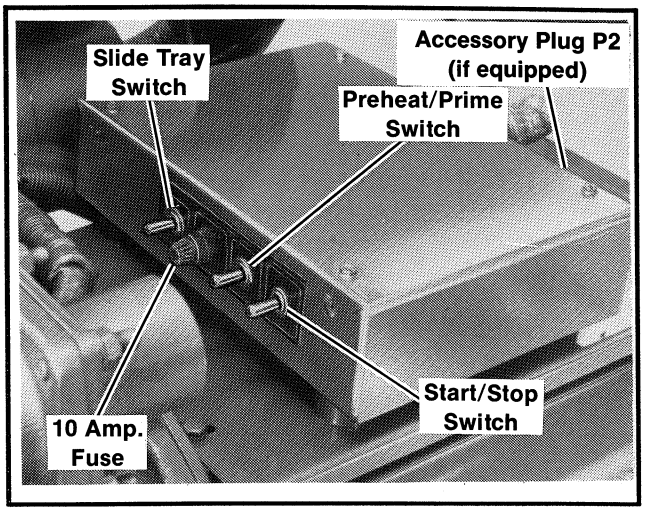



**Figure 2–2. Controller, Perkins–Powered**

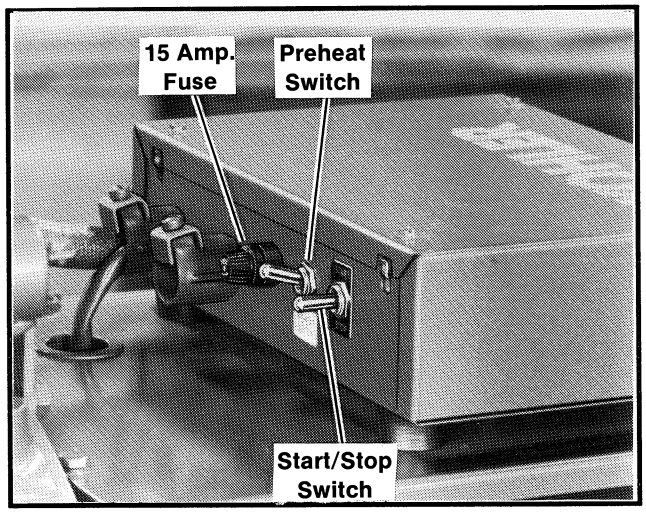



**Figure 2–2. Controller, Yanmar–Powered (Later Models)**

**NOTE**

The generator is equipped with a preheat device. Use of this feature may be necessary if the temperature is below 40° F (4° C) and the engine exhausts white smoke during an unsuccessful starting attempt. Activate preheater by pressing preheat switch for 15–20 seconds. Release switch and initiate starting procedure.

**NOTE**

If the engine starts and then stops, be sure the engine stops completely before attempting to restart. The flywheel ring gear teeth may be damaged if the starter pinion gear is engaged while the flywheel ring gear is still rotating.

### Stopping

When possible, allow a brief cooling period before shutdown, by running generator at low or no load, for several minutes. Stop generator by holding START/STOP switch in the STOP position until the set stops completely.

**NOTE**

If the generator set shuts down automatically, identify and correct cause of shutdown before attempting to restart.

## Fault Shutdowns

### Low Oil Pressure

The engine is protected by a low oil pressure shutdown switch. In Yanmar powered units, the generator will stop when oil pressure drops below 7.1 psi (49 kPa). Units with Perkins engines will shut down 10–20 seconds after oil pressure drops below 15 psi (103 kPa). The problem must be corrected before the set can be restarted.

**NOTE**

This is not a low oil level shutdown. Proper oil level must be maintained for low oil level shutdown switch to function.

### High Water Temperature

When the Yanmar engine water temperature exceeds 230$^0$ F (110$^0$ C) the engine will automatically shut down. Perkins–powered units shut down 10–20 seconds after coolant temperature exceeds 225$^0$ F (107$^0$ C). The generator cannot be started until the problem has been corrected. High water temperature shutdown may be avoided by keeping cooling air inlets clean and unobstructed and coolant at the proper level.

**NOTE**

This is not a low coolant level switch. Proper coolant level must be maintained for high water temperature shutdown switch to function.

# SECTION 3. SCHEDULED MAINTENANCE

## General

The following service schedules were prepared to cover Yanmar and Perkins–powered generator sets. Schedule routine maintenance according to the table pertaining to the engine used in the generator. Service more frequently if the unit is subject to extreme operating conditions. Consult the operation and installation manual (TP–5191 or TP–5261) for additional instructions in performing maintenance on Yanmar–powered units. For generators with Perkins engines, refer to the Engine Service Manual and the Operation and Installation Manual of the coach manufacturer.

**⚠ WARNING**

**Accidental starting can cause death or serious personal injury.** Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by remote start/stop switch unless this precaution is followed.

### Service Schedule

| Yanmar–Powered Generators | Before Starting | After 50 Hrs. or 1 Month | Every 150 Hrs. or 3 Months | Every 300 Hrs. or 6 Months | Every 600 Hrs. or Yearly |
|---|---|---|---|---|---|
| FUEL SYSTEM | | | | | |
| Check the fuel oil level | X | | | | |
| Fill fuel tank | X | | | | |
| Remove sediment from fuel tank | X | | | | |
| Replace the fuel filter element | | X(Initially) | | X | |
| Check the injection timing | | | | | X |
| Check governor operation and adjust as necessary | | | | | X |
| Check the injection spray condition | | | | | X |
| LUBRICATION SYSTEM | | | | | |
| Check the oil level crankcase | X | | | | |
| Replace the oil crankcase | | X (Break–In Period) | X | | |
| Replace the lube oil filter element | | X(Initially) | | X | |
| COOLING SYSTEM | | | | | |
| Check coolant level | X | | | | |
| Adjust the tension of water pump V–belt | | X (Initially) | X | | |
| Check the thermostat function | | | | | X |
| Change coolant | | | | | X |
| Clean radiator fins | | | X | | |
| AIR CLEANER, ETC. | | | | | |
| Replace the air cleaner element | | | | X | |
| Clean the breather pipe | | | X | | |
| ELECTRICAL SYSTEM | | | | | |
| Check the electrolyte level in the battery | | X | | | |
| Check the electrical connections | | | X | | |
| Check the battery specific gravity | | | | X | |

## Service Schedule- continued

| Yanmar-Powered Generators | Before Starting | After 50 Hrs. or 1 Month | Every 150 Hrs. or 3 Months | Every 300 Hrs. or 6 Months | Every 600 Hrs. or Yearly |
|---|---|---|---|---|---|
| CYLINDER HEAD, ETC. | | | | | |
| Check for leakage of water and oil | X | | X | | |
| Retighten all major nuts and bolts | X | X(Initially) | | | X |
| Check mounting bolts and vibro mounts for tightness | | | | X | |
| Retighten the cylinder head bolts | | | | | X |
| Adjust intake/exhaust valve clearance | | | | X | |
| REMOTE CONTROL SYSTEM, ETC. | | | | | |
| Check the remote control operation | | | X | X | |
| Check compartment condition | | X(fuel or oil leaks, exhaust gases, etc.) | | | |
| GENERATOR | | | | | |
| Blow dust out of generator | | | | | X |
| Clean slip rings and inspect brushes | | | | | X |

| Perkins-Powered Generators | Before Starting | After 50 Hrs. or 1 Month | Every 100 Hrs. or 6 Months | Every 200 Hrs. or 12 Months | Every400 Hrs. or 12 Months | Every 600 Hrs. or 12 Months |
|---|---|---|---|---|---|---|
| FUEL SYSTEM | | | | | | |
| Check the fuel oil level | X | | | | | |
| Fill fuel tank | X | | | | | |
| Remove sediment from fuel tank | X | | | | | |
| Replace fuel filter element | | | | X | | |
| Inspect Injectors | | | | | X | |
| Check/adjust governor operation | | | | | X | |
| LUBRICATION SYSTEM | | | | | | |
| Check oil level-crankcase | X | | | | | |
| Replace the oil-crankcase | | | X | | | |
| Replace lube oil filter element | | | X | | | |
| COOLING SYSTEM | | | | | | |
| Check coolant level | X | | | | | |
| Check/adjust water pump belt tension | | | X | | | |
| Check tightness and condition of hoses and clamps | | | | X | | |
| AIR CLEANER | | | | | | |
| Replace air cleaner element | | | X | | | |
| ELECTRICAL SYSTEM | | | | | | |
| Check electrolyte level in battery | X | | | | | |
| Check electrical connections | | X | | | | |
| Check battery specific gravity | | | X | | | |
| CYLINDER HEAD, ETC. | | | | | | |
| Check for leakage of oil and water | | | X | | | |
| Check tightness of vibro mounts and mounting tray bolts | | | X | | | |
| Check and adjust valve tappets | | | | | X | |
| REMOTE CONTROL SYSTEM, ETC. | | | | | | |
| Check the remote control operation | | X | | X | | |
| Check compartment condition | | X(fuel or oil leaks, exhaust gases, etc.) | | | | |
| GENERATOR | | | | | | |
| Blow dust out of generator | | | | | | X |
| Clean slip rings and inspect brushes | | | | | | X |

## Fuel System

### Specifications

Use a clean, good quality No. 1–D or No. 2–D (DIN 51 601) diesel fuel oil. The fuel must meet the requirements of the American Society of Testing and Materials (ASTM) diesel fuel classification D975 (Federal Specification W–F–800a). Cleanliness of the fuel is especially important on diesel engines which have easily clogged, precision fuel injectors and pumps. See charts below.

| | | |
|---|---|---|
| **United States** | **ASTM/D975** | **No. 2–D Diesel Oil** |
| **United Kingdom** | **BS2869** | **Class A1 or A2** |

| Air Temperature | Diesel/Fuel (ASTM/D975) |
|---|---|
| Below 40°F (5°C) | 1–D |
| Above 40°F (5°C) | 2–D |

Other Considerations:

Sulfur Content ..... Less than 0.5%

Sediment and

Water Content ..... Not to exceed 0.1%

Cetane Number ..... 40 minimum

Pour Point . At least 10°F (5.6°C) below the lowest outside air temperature

**NOTE**

Never store diesel fuel in galvanized containers; diesel fuel and the galvanized coating react chemically to product flaking which quickly clogs filters, or causes failure of the fuel pump or injectors. Do not run the generator set out of fuel. Air will be drawn into the fuel lines and the entire system will have to be bled before the unit can be restarted.

**NOTE**

Avoid storing fuel over long periods of time. Take special precautions to keep all dirt, water, and other contaminants out of the fuel. Storage tanks containing diesel fuel contaminated with water may cause the growth of "microbes." The presence of microbes will form a slime which will clog fuel filters and lines.

### Fuel Filter– All Models

The fuel filter is paper and no attempt should be made to clean it. Its useful life will be determined largely by the quality and condition of the fuel used. Under normal conditions, the fuel filter element on Yanmar–Powered units should be replaced for the first time after 50 hours, or one month and then every 300 hours or six months. Replace the fuel filter on Perkins–Powered sets at 200 hour/12 month intervals (normal operating conditions). To service the fuel filter, refer to the procedure below which pertains to the engine used in the generator set.

### Fuel Filter Service– Yanmar–Powered Models

1. Loosen fuel filter by turning in a counterclockwise direction. Figure 3–1. Use rags to clean up spilled fuel oil. Remove and discard.
2. Clean contact surface on fuel filter adapter.
3. Lightly lubricate the gasket surface of the new fuel filter with fresh fuel oil. Thread fuel filter to adapter until gasket makes contact, then hand–tighten an additional one–half turn.
4. See "Bleeding" section following.

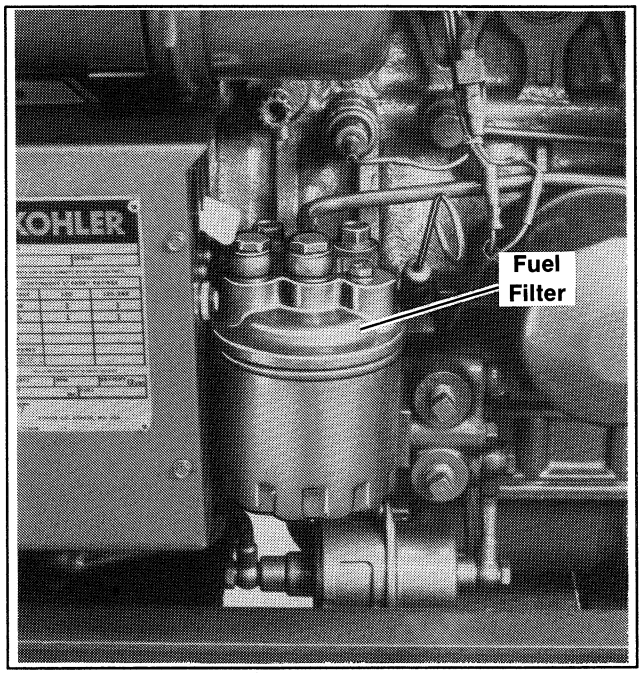



**Figure 3–1. Fuel Filter– Yanmar**

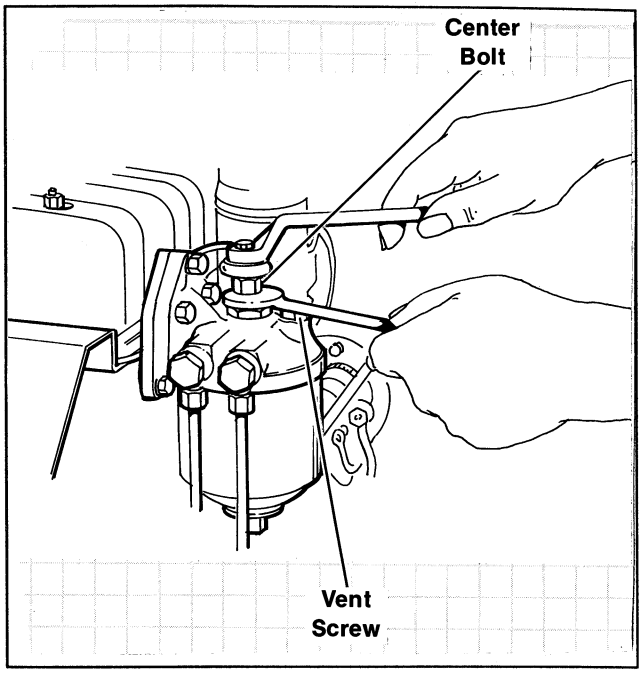



**Figure 3–2. Fuel Filter– Perkins**

**Fuel Filter Service– Perkins–Powered Models**

1. Loosen center bolt holding canister to filter head, see Figure 3–2; lower canister to remove.

2. Inspect sealing rings in filter head; replace if ANY damage is noted.

3. Discard old filter element and replace with new one. Hold element and canister firmly against bottom of filter head; reinsert center bolt and moderately tighten. Do NOT overtighten.

4. See "Bleeding" section following.

## Fuel System Bleeding– All Models

If the generator set engine runs out of fuel, air leaks develop in the suction side of the fuel system, or the fuel filter is replaced, it will be necessary to bleed the entire system to prevent starting failures and/or erratic operation. Refer to the procedure pertaining to the engine used in the generator set.

## Bleeding Yanmar– Powered Models

1. Loosen line connection at fuel filter inlet.

2. Using priming switch (see Figure 3–3) on controller, operate fuel pump until fuel, free from air bubbles, flows from this point. Tighten line connection.

3. Loosen small vent screw (with Phillips head) on fuel filter.

4. Using priming switch on controller, operate fuel pump until fuel, free from air bubbles, flows from this point. Tighten vent screw.

5. Loosen line connection at fuel injection pump inlet.

6. Using priming switch on controller, operate fuel pump until fuel, free from air bubbles, flows from this point. Tighten line connection.

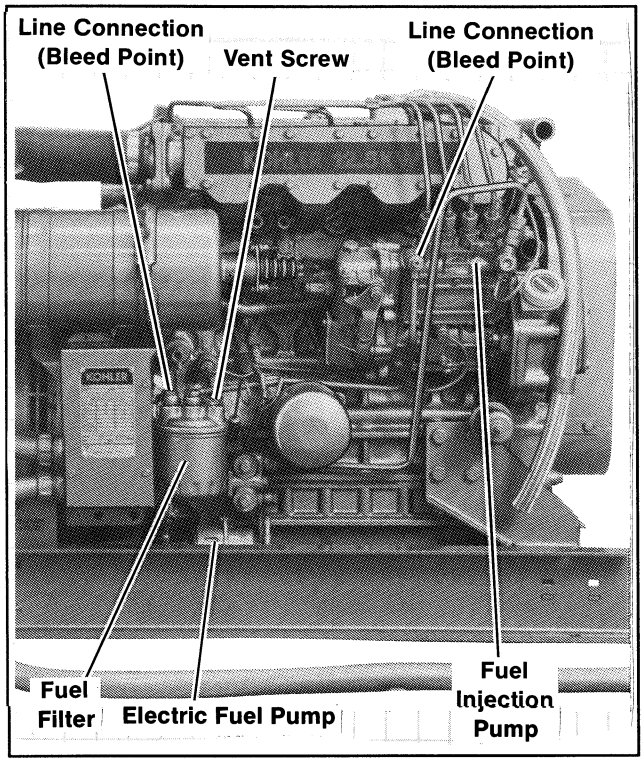



**Figure 3–3. Bleeding Fuel System–Yanmar**

**Bleeding Perkins–Powered Models**

1. Loosen the vent screw on the fuel filter. See Figure 3–4.

2. Loosen vent screw on fuel injection pump body and vent screw on the governor housing.

3. Operate priming lever on fuel feed pump until fuel, free of air bubbles, flows from these points.

4. Retighten vents in this order: Filter vent screw, vent on injection pump body and finally vent on governor housing.

5. Loosen the connecting nut on the inlet to the fuel injection pump. Operate priming lever on fuel pump until fuel, free of air bubbles, flows from around the threads. Retighten connecting nut.

6. Loosen the connecting nuts on the fuel inlet lines to each injector. Crank the engine with the starting motor until air bubbles no longer appear in the fuel flowing from the connecting points. From 30 to 60 seconds of cranking may be needed to bleed air at these points. Retighten connection points.

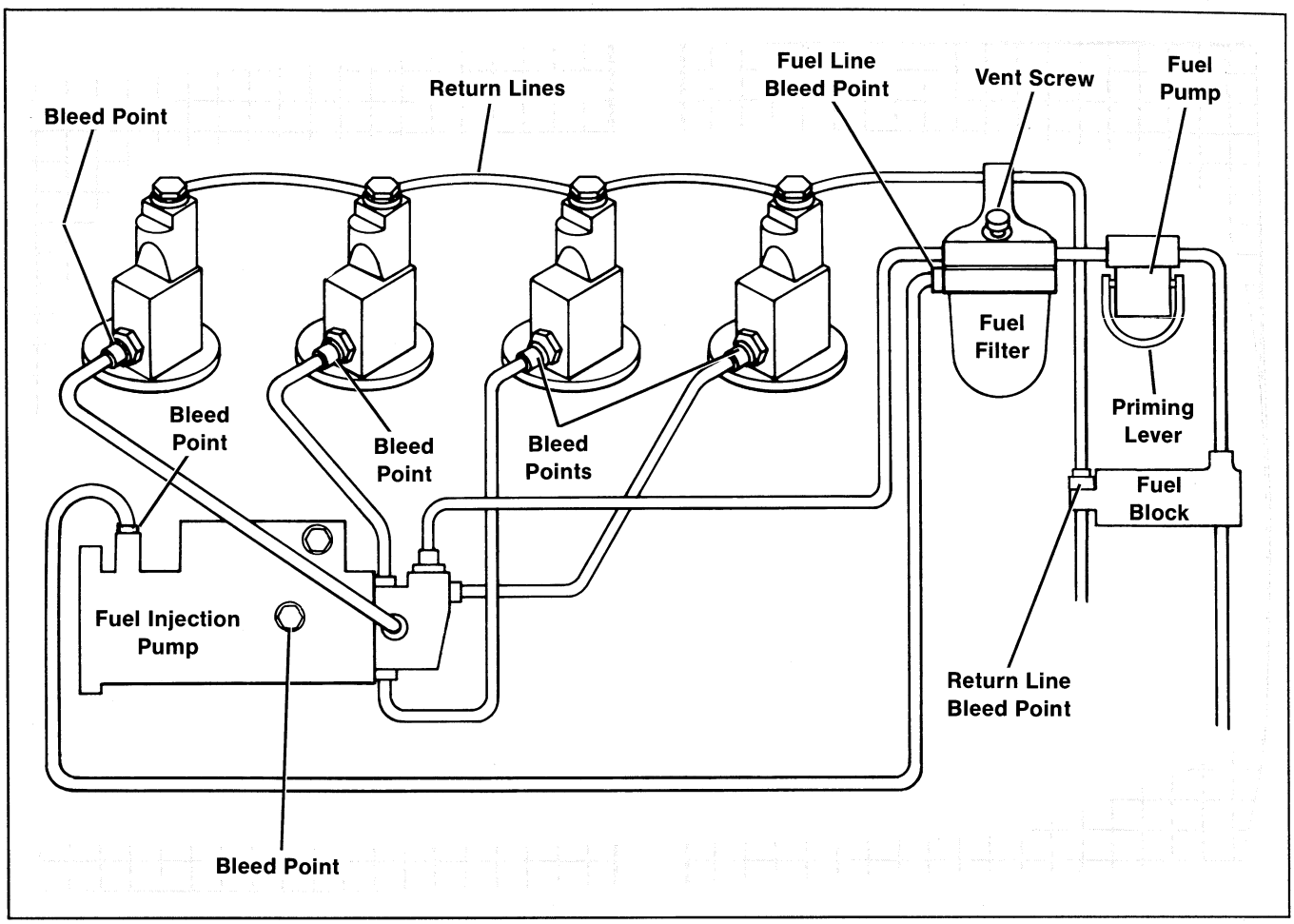



**Figure 3-4. Bleeding Fuel System- Perkins**

## Engine Lubrication- Yanmar-Powered Models

### Oil Selection- Yanmar

The selection of engine oil is very important to a diesel engine. If an unsuitable oil is used or an oil change is neglected, it may result in engine damage and a shorter engine life. Oil must meet the American Petroleum Institute (API) classification of CC or CD. Recommended SAE viscosity designation for given temperature ranges are listed in Table 3-1.

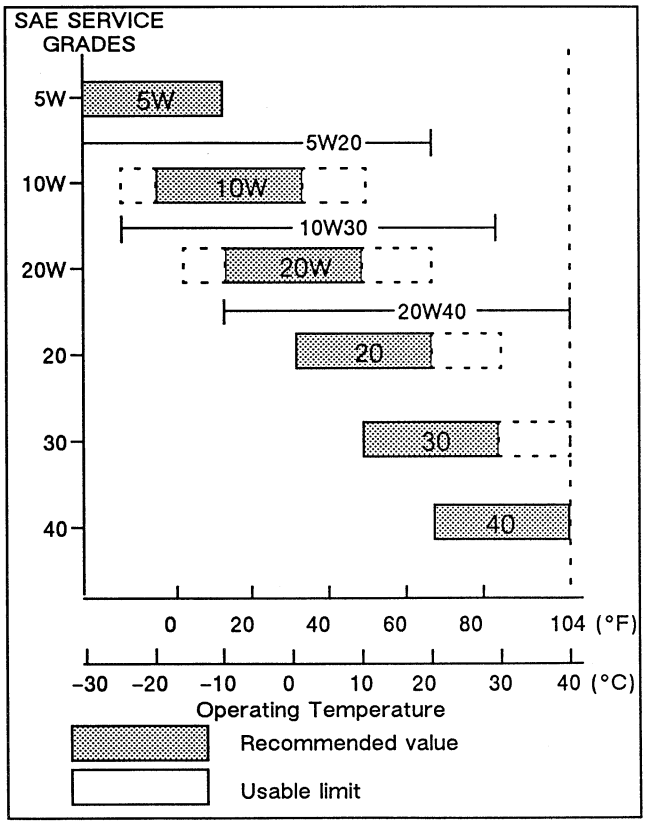



**Table 3-1. Engine Oil Selection - Yanmar**

**NOTE**

Failure to observe these standards may cause inadequate oil pressure and cold-starting difficulties.

**Oil Check- Yanmar**

Check the oil level in the crankcase daily or before each start-up to insure that the level is in the "safe range." To check oil level, remove dipstick and wipe the end clean, reinsert as far as possible, and remove. Level should be between MIN and MAX marks on the dipstick (see Figure 3-5).

**NOTE**

Do not operate the set if the level is below the MIN mark or above the MAX mark.

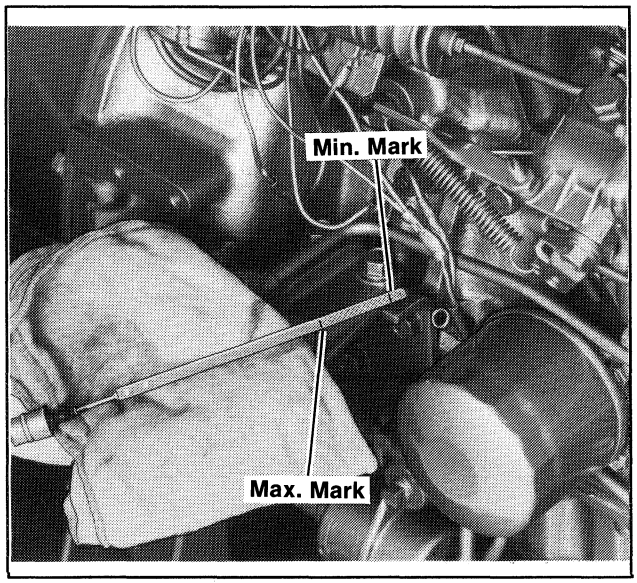



**Figure 3-5. Oil Level Check- Yanmar**

**Oil Change- Yanmar**

Change oil for the first time after 50 hours or one month and then every 150 hours or three months. Change oil more frequently under dirty, dusty conditions. Change oil while the engine is still warm.

1. Place a container below the oil drain hole and remove oil drain plug. Allow sufficient time for the old oil to drain completely. Replace oil drain plug.
2. Remove oil fill cap. One is located on the rocker arm cover and one is located near the fuel injection pump. See Figure 3-6.
3. Fill crankcase with proper amount and type of oil, see "Specifications Engine," Section 1.
4. If engine oil filter is to be replaced, see "Oil Filter" following.
5. Start generator set and check for oil leaks.
6. Stop generator set. Remove dipstick and wipe clean. Re-insert as far as possible, and remove to check oil level. Add oil, as necessary, to bring level up to MAX mark.

**NOTE**

Too high an oil level causes high oil consumption and carbonizing of the engine. Too low a level will damage the engine.

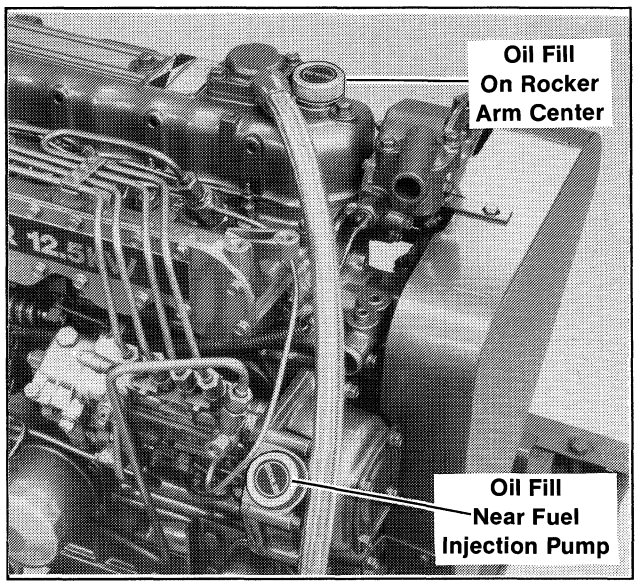



**Figure 3-6. Oil Fill Locations- Yanmar**

**Oil Filter- Yanmar**

Replace the oil filter for the first time after 50 hours, or one month, and then every 300 hours, or six months. Change more frequently if operating in dirty, dusty conditions. See Figure 3-7 and refer to the following procedure.

1. Loosen oil filter by turning in a counterclockwise direction. Use rags to clean up spilled oil. Remove and discard.

2. Clean contact surface on oil filter adapter.

3. Lightly lubricate the gasket surface of the new oil filter with the fresh engine oil. Thread oil filter to adapter until gasket makes contact then hand-tighten an additional one-half turn.

4. Start generator set and check for oil leaks.

5. Stop generator set. Remove dipstick and wipe clean, reinsert as far as possible, and remove to check oil level. Add oil, as necessary, to bring level up to MAX level.

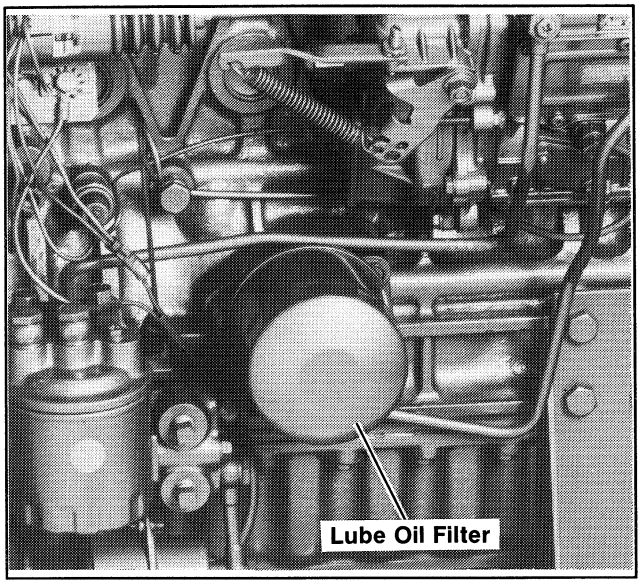



**Figure 3-7. Oil Filter Location- Yanmar**

## Engine Lubrication
## Perkins-Powered Models

**Oil Selection- Perkins**

The oil must meet the requirements of the American Petroleum Institute (API) service classification CC or CD. Oil viscosity is selected according to anticipated ambient temperatures. Refer to Table 3-2.

| Air Temperature | *Oil Viscosity |
|---|---|
| 00 to 450F (-180 to 70C) | 10W CC, CD |
| 450 to 800F (70 to 270C) | 20W CC, CD |
| 800F and above (270C and above) | 30W CC, CD |

*Multi-viscosity oils may be used providing the viscosity range is compatible with the specified viscosity. (Example: 10W/30 may be used in place of 10W oil.)

**Table 3-2. Engine Oil Selection Perkins**

**Oil Check- Perkins**

Check the oil level in the crankcase daily or before each start-up to insure that the level is in the safe range between the MIN and MAX marks on the dipstick (Figure 3-8). Do not operate the set if the level is below the MIN mark or above the MAX mark.

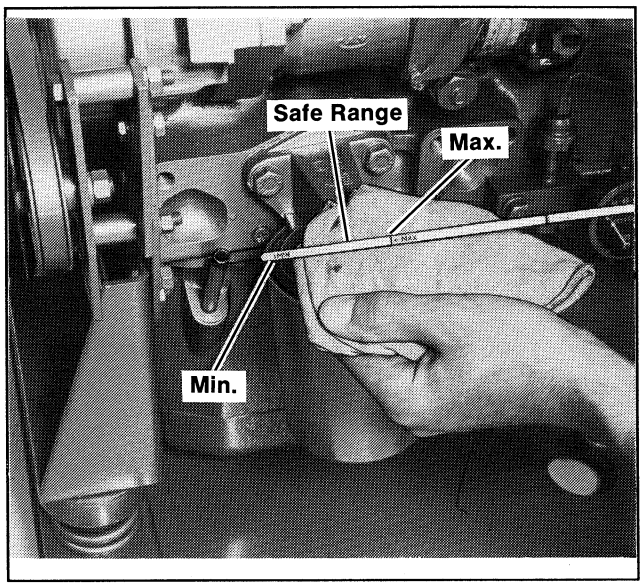



**Figure 3-8. Oil Level Check- Perkins**

**Oil Pressure- Perkins**

After the engine has been thoroughly warmed up and is operating with proper weight of oil in crankcase, the oil pressure should be between 30-60 psi (207-414 kPa)

**NOTE**

Generator oil pressure gauge is located in the coach on the dashboard.

The generator set is equipped with a low oil pressure shutdown. This feature protects the engine against internal damage in the event the oil pressure drops too low due to oil pump failure or other malfunction.

**NOTE**

The low oil pressure shutdown does NOT protect against damage from operation with the oil level below the safe range. It is not a low oil level shutdown. The only protection against running out of oil is to check the level regularly, and to add oil as needed.

**Oil and Filter Change– Perkins**

Change the oil and filter at 100–hour intervals, or every 6 months, whichever occurs first. Change more frequently if operating under dirty, dusty conditions. If possible, drain oil while hot. Follow the procedure outlined below.

1. Place a suitable container below generator compartment oil drain opening.

2. Loosen crankcase drain plug, and protecting hands with rags or gloves, remove drain plug. Allow time for oil to drain completely. Replace drain plug and tighten securely.

3. Add recommended oil type and amount to filler neck at cylinder head valve cover, see Figure 3–9. For proper oil capacity see Section 1. Specifications Engine.

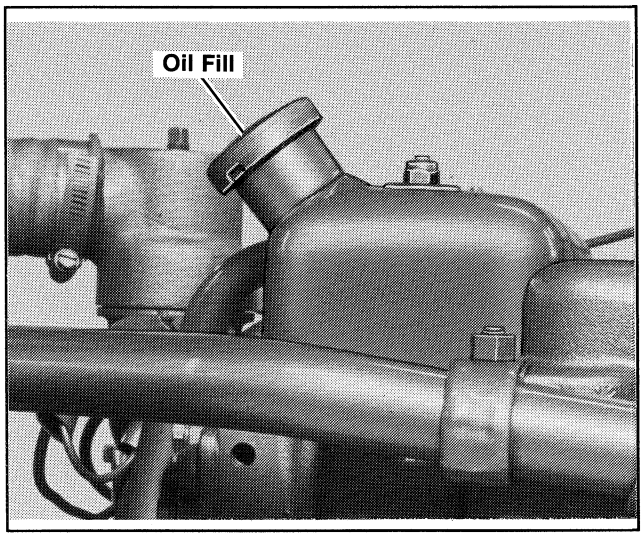



**Figure 3–9. Oil Fill Location– Perkins**

4. While protecting hands with rags or gloves, remove oil filter and discard.

5. Prime new filter holding filter with threaded opening upward. Fill filter with fresh oil to bottom of threaded hole allowing oil to saturate element paper. Filter should hold about one (1) quart (.946 liters) of oil. See Figure 3–10.

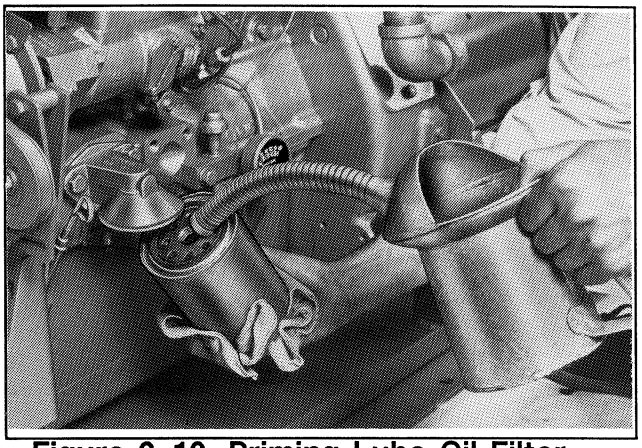


**Figure 3–10. Priming Lube Oil Filter – Perkins**

6. Apply a light coating of fresh oil to the rubber gasket at top of filter. Thread filter onto filter head until gasket seats. Final tighten by hand with additional half turn.

7. Start engine and check for oil leaks.

8. Stop engine. Remove dipstick, wipe clean, reinsert, and remove to check oil level. Add oil as necessary to bring level up to MAX mark.

**NOTE**

The specified oil capacity is intended to be used as a guide. The actual capacity should be governed by the level indicated on the dipstick.

## Air Cleaner Service- All Models

The air cleaner paper element should be replaced at 300 hour/6 month intervals on Yanmar-powered sets and at 100 hour/6 month intervals on units with Perkins engines. Change more frequently if operated under extremely dirty, dusty conditions. To replace the air cleaner element, refer to the procedure below the air cleaner illustration which resembles the one on your set. If the air cleaner on your generator does not resemble those pictured, consult the coach manufacturer for service information.

### Air Cleaner- Dry Type

1. Loosen eye bolt and clamp enough to remove air cleaner cover.

2. Remove wing nut and slide air cleaner element from threaded rod.

3. Clean dry element by tapping edges on a hard surface. Replace if damaged or very dirty.

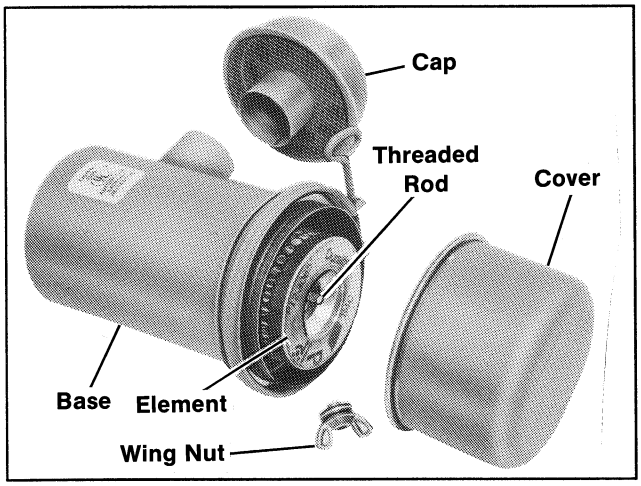



**Figure 3-11. Air Cleaner- Dry Type**

**NOTE**

Do not attempt to clean dry type element in any liquid or with compressed air as this will damage paper filter material.

4. Wipe dirt or dust accumulation from cover and base. Check that all clamps are tight on inlet/outlet connections.

5. Install air cleaner element on threaded rod. Tighten wing nut while making sure parts fit properly.

6. Position cover with arrow "up." Place clamp over base and cover and tighten eye bolt.

### Air Cleaner- Oil Bath Type

1. Loosen two spring clamps securing bottom bowl to filter canister; lower and remove bowl. See Figure 3-12.

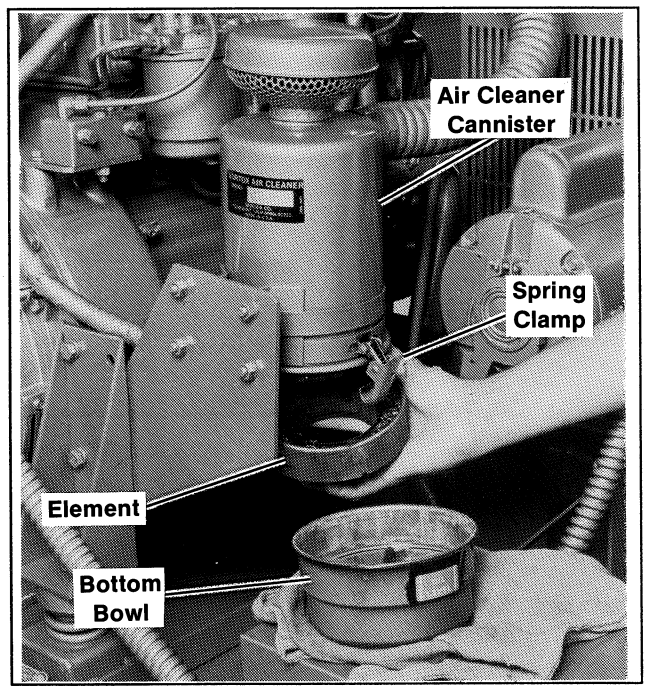



**Figure 3-12. Air Cleaner Components- Oil Bath Type**

2. Turn filter element to left; lower to remove.

3. Discard oil from bowl; wash bowl and element with non-flammable evaporative solvent. Allow to air dry.

4. Reinsert element and turn to right to lock in place. Refill bowl with fresh oil to indicated level.

**Cooling System– All Models**

To prevent the inconvenience of having the generator set shut down or become damaged due to overheating, keep the cooling air inlets to the component clean and unobstructed at all times.

**⚠ WARNING**

**Hot coolant can cause severe burns.**

Allow engine to cool and release pressure from cooling system before opening pressure cap. To release pressure, cover the pressure cap with a thick cloth then turn it slowly counterclockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap. If generator set is equipped with a coolant recovery tank, check coolant level at tank.

Consult coach manufacturer for cooling system capacity. Coolant capacity of Kohler supplied radiator is 4 gal. (15.1 L). A drain petcock is provided on the underside of the radiator and the engine block to drain the system. When draining the coolant, remove the radiator cap and open the block drain located near the flywheel housing (Yanmar) or fuel filter (Perkins). This will allow the entire system to drain and prevent air pockets from restricting coolant passage in the block. When operating in climates subject to freezing temperatures, make sure a sufficient amount of antifreeze solution is added to prevent freezing of the system. Mixture proportions (ethylene glycol/water) are given in Table 3–3. For maximum protection, always use a solution which will remain liquid below the lowest anticipated temperature.

| Temperature | 16°F (–9°C) | 3°F (–16°C) | –11°F (–24°C) | –31°F (–35°C) (Recommended) |
|---|---|---|---|---|
| Mixture Proportions (Ethylene Glycol/Water) | 20/80 | 30/70 | 40/60 | 50/50 |

**Table 3–3. Antifreeze Protection**

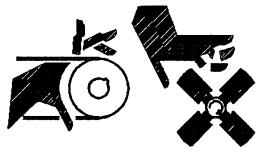
Check coolant level frequently and add water or antifreeze as needed to maintain level according to the coach manufacturer's recommendations.

**NOTE**

Special attention should be given when checking for proper coolant level. After a radiator has been drained, it normally requires some time to refill all air cavities.

**Belt Tension Yanmar– Powered Models**

The belt tension should be adjusted so that it can be depressed about .38 inch (10 mm) with about 22 lbs. (10 kg) of force (see Figure 3–13). Use the following procedure to adjust belt.



**⚠ WARNING**

**Exposed moving parts can cause severe injury.**

Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set. Do not open generator compartment door when unit is running.

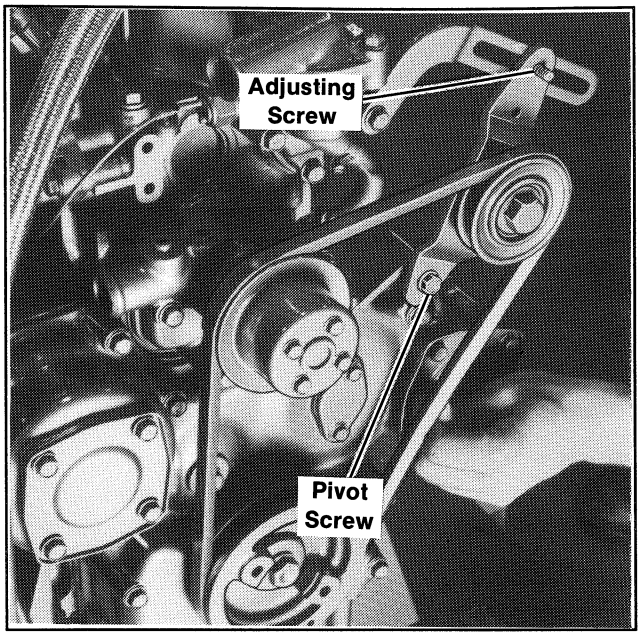
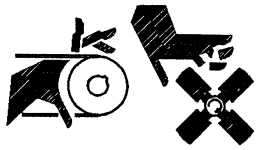



**Figure 3–13. Belt Tension– Yanmar**

1. Remove belt guard (if equipped).
2. Loosen pivot and adjusting screws.
3. While prying idler pulley outward, tighten adjusting screw.
4. Tighten pivot screw.
5. Recheck and adjust as necessary.
6. Replace belt guard (if equipped).

**Belt Tension Perkins– Powered Models**

Belt tension should be adjusted so that the belt can be depressed about 1/2 to 1 in. (12.7–25.4 mm) in the center of the longest span. Use the following procedure to adjust belt.



**⚠ WARNING**

**Exposed moving parts can cause severe injury.**

Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set. Do not open generator compartment door when unit is running.

1. Loosen two mounting bolts. See Figure 3–14.

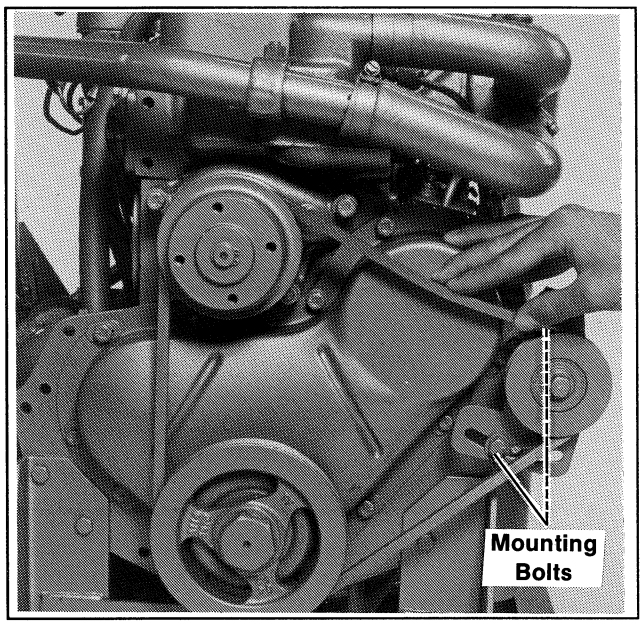



**Figure 3–14. Belt Tension– Perkins**

2. Shift plate out to increase tension or in to decrease tension. Move plate all the way in to remove worn or damaged belt.
3. Tighten two mounting bolts.
4. Recheck and adjust as necessary.

# SECTION 4. GENERAL TROUBLESHOOTING

Use the following table as a quick reference in trouble shooting individual problems. Generator faults are listed by specific groups and correlated with probable causes and corrections. The source of more detailed information needed to correct a problem is indicated. See the appropriate Operation and Installation Manual (TP-5191 or TP-5261) for additional information on Yanmar-powered units. For generators with Perkins engines, see the Engine Service Manual and the Operation/ Installation Manual of the coach manufacturer.

Corrective action and testing often requires knowledge of electrical and electronic circuits. It is recommended that service only be done by Authorized Service Dealers. Improper repair by unauthorized personnel can lead to additional failures.

| Problem | Possible Cause | Corrective Action | Reference |
|---|---|---|---|
| **Engine** | | | |
| Engine hard to start or will not start | Weak or dead battery | Recharge or replace | |
| | Battery connections reversed | Check connections | |
| | Faulty ground | Clean and retighten | |
| | Fuse blown | Replace | Oper. and Installation Manual |
| | Out of fuel | Replenish | |
| | Fault shutdown | Check low oil pressure and high water temperature shutdown switches | Section 2. ''Fault Shutdowns'' |
| | Clogged fuel filter | Replace filter element | Section 3. ''Fuel System'' |
| | Air cleaner clogged | Clean or replace element | Section 3. ''Air Cleaner Service'' |
| | Defective fuel feed pump | Replace fuel feed pump | |
| | Air in fuel system | Bleed air | Section 3. ''Fuel System'' |
| | Water, dirt in fuel system | Drain, flush fuel system | Engine Service Manual |
| | Dirty or faulty injectors | Clean/replace injectors | Engine Service Manual |
| | Improper compression | Inspect head gasket, valves, rings | Engine Service Manual |
| | Improper type of fuel | Use proper type of fuel; consult fuel supplier | Section 1. ''Specifications'' |
| | Improper type of crankcase lube oil | Use proper lube oil | Oper. and Installation Manual |
| Engine knocks | Improper type of fuel | Use proper type of fuel; consult fuel supplier | Section 1. ''Specifications'' |
| | Incorrect fuel injection timing | Check injection timing | Engine Service Manual |
| | Improper cylinder top clearance | Check cylinder clearance | Engine Service Manual |
| | Defective piston or piston ring | Replace piston/rings | Engine Service Manual |
| | Defective crankshaft bearing or piston pin bearing | Replace bearing | Engine Service Manual |
| | Improper valve clearance | Adjust valve clearance | Yanmar: TP-5191 or TP-5261 ''Valve Adjustment'' Perkins: Engine Service Manual |

| Problem | Possible Cause | Corrective Action | Reference |
|---|---|---|---|
| | Air in injectors | Bleed air | Section 3. ''Fuel System'' |
| Engine runs irregularly or stalls frequently | Vent in fuel tank cap obstructed | Clean cap in solvent, blow dry | |
| | Clogged fuel filter | Replace fuel filter element | Section 3. ''Fuel System'' |
| | Water, dirt, or air in fuel system | Drain, flush, fill, and bleed air in the system | Section 3. ''Fuel System'' |
| | Dirty of faulty injectors | Clean/replace injectors | Engine Service Manual |
| | Faulty governor linkage | Repair/replace linkage | Engine Service Manual |
| | Defective fuel feed pump | Replace fuel feed pump | |
| | Improper valve clearance | Adjust proper valve clearance | Yanmar: TP-5191 or TP-5261 ''Valve Adjustment''. Perkins: Engine Service Manual |
| | Defective valve spring | Replace valve spring | Engine Service Manual |
| | Improper compression | Inspect head gasket, valves, rings | Engine Service Manual |
| Lack of engine power | Engine overloaded | Reduce load | |
| | Air intake restriction | Service air cleaner | Section 3. ''Air Cleaner Service'' |
| | Clogged fuel filter | Replace filter element | Section 3. ''Fuel System'' |
| | Improper type of fuel | Use proper fuel | Section 1. ''Specifications'' |
| | Improper valve clearance | Adjust proper valve clearance | Yanmar: TP-5191 or TP-5261 ''Valve Adjustment''. Perkins: Engine Service Manual |
| | Dirty or faulty injectors | Clean/replace injectors | Engine Service Manual |
| | Incorrect fuel injection | Check fuel injection timing | Engine Service Manual |
| | Improper engine compression | Inspect head gasket, valves, rings | Engine Service Manual |
| | Vent in fuel tank cap obstructed | Clean cap in solvent; blow dry | |
| Engine overheats | Engine overloaded | Reduce load | |
| | Defective cooling system | Check water pump, radiator | Engine Service Manual |
| | Loose or defective water pump V-belt | Adjust belt tension or replace belt | Section 3. ''Cooling System'' |
| | Cooling system needs flushing | Flush cooling system | Section 3. ''Cooling System'' |
| | Defective thermostat | Replace thermostat | Engine Service Manual |
| | Defective high water temperature switch | Replace switch | |
| | Cooling water leaks from water passages | Check water passages | Engine Service Manual |
| | Radiator clogged with dirt or oil | Clean with water soluble grease remover and flush cooling system | Section 3. ''Cooling System'' |

| Problem | Possible Cause | Corrective Action | Reference |
|---|---|---|---|
| Engine emits black or gray exhaust smoke | Improper type of fuel | Use proper fuel | Section 1. ''Specifications |
| | Clogged or dirty air cleaner | Service air cleaner | Section 3. ''Air Cleaner Service'' |
| | Defective injection pump | Replace injection pump | Engine Service Manual |
| | Faulty injectors | Clean/replace injectors | Engine Service Manual |
| | Incorrect fuel injection timing | Check the injection timing | Engine Service Manual |
| | Improper valve clearance | Adjust valve clearance | Yanmar: TP-5191 or TP-5261 ''Valve Adjustment'' Perkins: Engine Service Manual |
| | Lube oil level too high | Drain out surplus | Section 3. ''Engine Lubrication'' |
| | Improper lube oil | Use proper viscosity oil | Section 3. ''Engine Lubrication'' |
| Low lube oil pressure | Low lube oil level | Add lube oil | Section 3. ''Engine Lubrication'' |
| | Improper lube oil viscosity | Drain, fill with proper viscosity oil | Section 3. ''Engine Lubrication'' |
| | Defective lube oil pump | Replace lube oil pump | Engine Service Manual |
| | Defective low oil pressure switch | Replace switch | |
| High lube oil consumption | Too light viscosity oil | Use proper viscosity oil | Section 3. ''Engine Lubrication'' |
| | Oil leaks | Check for leaks in lines around gasket and drain plug | |
| | Improper type of oil | Use oil of proper viscosity | Section 3. ''Engine Lubrication'' |
| | Clogged breather system | Clean breather system | Engine Service Manual |
| | Defective piston ring, piston cylinder liner, valve guide, or valve seat | Check rings, cylinder liner, valve guides, and seats | Engine Service Manual |
| High fuel consumption | Improper type of fuel | Use proper fuel | Section 1. ''Specifications'' |
| | Clogged or dirty air cleaner element | Service air cleaner element | Section 3. ''Air Cleaner Service'' |
| | Engine overloaded | Reduce load | |
| | Improper valve clearance | Adjust valve clearance | Yanmar: TP-5191 or TP-5261 ''Valve Adjustment'' Perkins: Engine Service Manual |
| | Incorrect fuel injection timing | Check injection timing | Engine Service Manual |
| | Low engine temperature | Check thermostat | Engine Service Manual |
| | Improper compression | Inspect head gasket, valves, rings | Engine Service Manual |
| | Fuel leakage | Check for leaks at fuel tank, lines, and engine fuel system | |

| Problem | Possible Cause | Corrective Action | Reference |
|---|---|---|---|
| **Electrical System** | | | |
| Battery will not charge | Loose or corroded connections | Clean and tighten connection | |
| | Sulfated or worn–out battery | Check electrolyte level and specific gravity (batteries with filler caps only) | Oper. and Installation Manual |
| | Defective generator alternator (if equipped) | Replace generator alternator | |
| | Defective vehicle alternator | Replace vehicle alternator | |
| | Loose or defective vehicle alternator belt | Adjust belt tension or replace belt | Oper. and Installation Manual |
| Starter does not work | Loose or corroded connections | Clean and tighten connection | |
| | Low battery output | Check electrolyte level and specific gravity (batteries with filler caps only) | Oper. and Installation Manual |
| | Defective starter solenoid | Replace starter solenoid | Engine Service Manual |
| | Defective starter switch | Replace starter switch | Engine Service Manual |
| | Defective wiring to starter | Check wiring | |
| Preheat/Prime function does not work | Defective C Relay | Check relay | Section 7. ''Component Testing'' |
| | Defective C1 Relay | Check relay | Section 7. ''Component Testing'' |
| | Defective 1CR | Check relay | Section 7. ''Component Testing'' |
| Starter cranks slowly | Low battery output | Check electrolyte level and specific gravity (batteries with filler caps only) | Oper. and Installation Manual |
| | Too heavy viscosity lube oil | Use proper viscosity oil | Section 3. ''Engine Lubrication'' |
| | Loose or corroded wiring | Clean and tighten loose connections | |
| | High starter current draw | Rebuild or replace starter | Engine Service Manual |
| **Generator** No AC output | Circuit breakers on generator (if equipped) open, or defective | Return to ON position/ replace if defective | |
| | Circuit breakers (in coach) open or defective | Return to ON position/ replace if defective | TP–5261 ''Circuit Protection'' |
| | No DC power for controller | Check battery connections | |
| | Blown fuse in end bracket, or junction box | Replace fuse. If fuse blows again, check voltage regulator and stator auxiliary windings | Section 7. ''Component Testing'' Section 9. ''Wiring Diagrams'' |
| | Brushes not contacting slip rings | Check brush alignment and condition of brush spring | Section 7. ''Component Testing'' |

# SECTION 5. CONTROLLER TROUBLESHOOTING

The following is the controller sequence of operation when starting, running, stopping, and during fault shutdowns. Use this section as a starting point for controller troubleshooting. Refer to the generator description, specification, and wiring diagram for your generator set.

**Sequence of Operation, Yanmar-Powered Models**
Specification: 135010 only

**Starting**

- Close start-switch (local or remote) between 3 and 4 to energize C and 1CR relays.
- Normally open C contacts close to energize starter solenoid(s). Starter solenoid S contacts close to energize start/stop solenoid (pull-in) and starter motor.
- 1CR normally open contacts close to provide field flashing current to rotor slip rings. Electric fuel pump is energized (Yanmar only) and fuel solenoid is supplied with hold-in current. Normally closed 1CR contacts open to disable prime switch. Engine starts.

**Running**

- When the generator comes up to proper voltage, CR relay (voltage interlock) is energized. Normally closed CR contacts open to disconnect build-up circuit to rotor.
- Normally open CR contacts close to allow H.W.T. and L.O.P. switches to function. 1CR relay is energized.
- Normally open 1CR contacts remain closed to maintain current path for fuel pump and fuel solenoid.

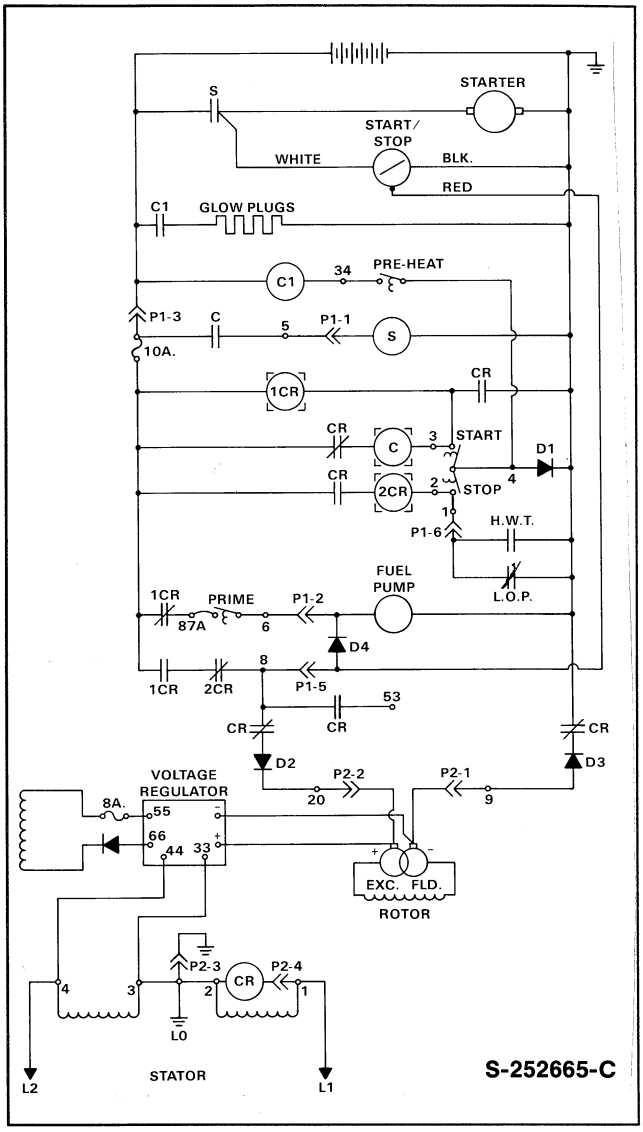



**Figure 5-1. Sequence of Operation, Yanmar-Powered models Specification 135010**

**Stopping**

- Close stop-switch between 2 and 4. 2CR relay is energized, opening normally closed 2CR contacts. Fuel pump and fuel solenoid are de-energized to stop unit.

**Low Oil Pressure (LOP) Shutdown Switch**
Low oil pressure will cause (LOP) switch contacts to close and energize 2CR relay. Normally closed 2CR contacts open to de-energize fuel pump and fuel solenoid. Unit shuts down.

### High Water Temperature (HWT) Shutdown Switch

- High water temperature (above 230°F, 110°C) will cause (HWT) switch contacts to close and energize 2CR relay. Normally closed 2CR contacts open to de-energize fuel pump and fuel solenoid. Unit shuts down.

### Preheat

- Start/stop switch in normal off position.
- Close pre-heat switch between 34 and 4 to energize C1 contactor.
- Normally open C1 contacts close to supply battery current to glow plugs (circuit completed to ground).

### Fuel Priming Switch

- Start/stop switch in normal-off position.
- Close fuel priming switch between 87A and 6.
- Normally closed 1CR contacts permit energizing of fuel pump.

### Sequence of Operation, Yanmar-Powered Models

Specifications: 135012 to 135050.

### Starting

- Close start-switch (local or remote) between 3 and 4 to energize C and 1CR relays.
- Normally open C contacts close to energize starter solenoid(s). Starter solenoid S contacts close to energize starter motor.
- 1CR normally-open contacts close to provide field flashing current to slip rings. Electric fuel pump and fuel solenoid are energized and, if equipped, battery charger sensing circuit is completed. Normally-closed 1CR contacts open to disable prime switch. Engine starts.

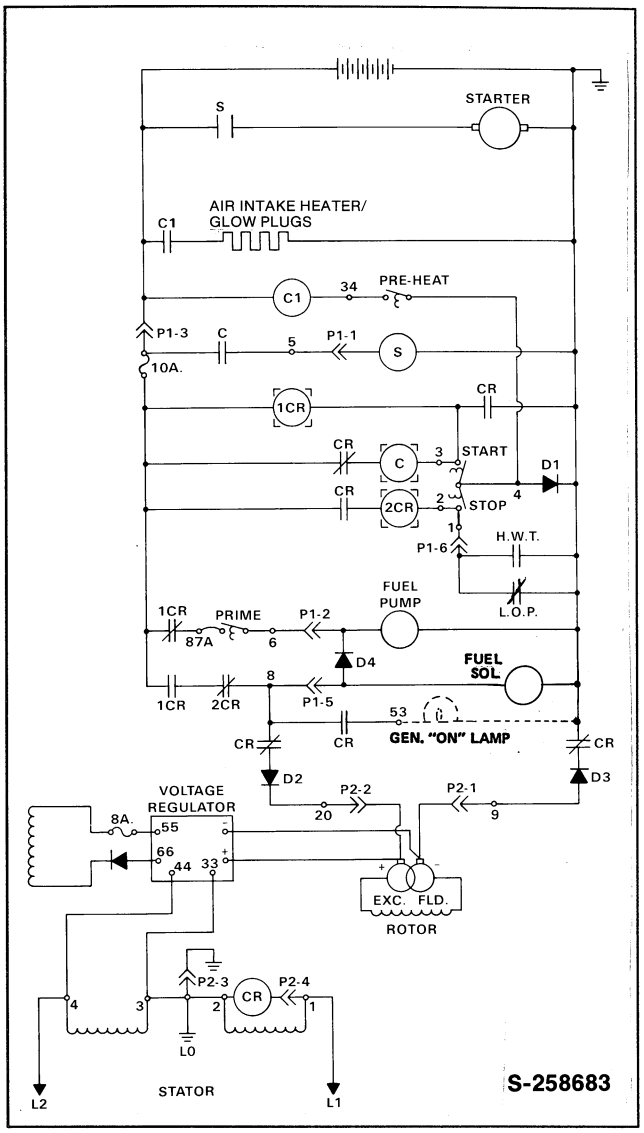



**Figure 5-2. Sequence of Operation, Yanmar-Powered Models Specifications 135012 to 135050**

### Running

- When the generator comes up to proper voltage, CR relay (voltage interlock) is energized. Normally closed CR contacts open to disconnect build-up circuit to rotor.
- Normally open CR contacts close to allow H.W.T. and L.O.P. switches to function. 1CR relay is energized.

- Normally open 1CR contacts remain closed to maintain current path for fuel pump and fuel solenoid.

### Stopping

- Close stop switch between 2 and 4. 2CR relay is energized, opening normally closed 2CR contacts. Fuel pump and fuel solenoid are de-energized to stop unit.

### Low Oil Pressure (LOP) Shutdown Switch

- Low oil pressure will cause (LOP) switch contacts to close and energize 2CR relay. Normally closed 2CR contacts open to de-energize fuel pump and fuel solenoid. Unit shuts down.

### High Water Temperature (HWT) Shutdown Switch

- High water temperature (above 230°F, 110°C) will cause (HWT) switch contacts to close and energize 2CR relay. Normally closed 2CR contacts open to de-energize fuel pump and fuel solenoid. Unit shuts down.

### Preheat

- Start/stop switch in normal off position.
- Close pre-heat switch between 34 and 4 to energize C1 contactor.
- Normally open C1 contacts close to supply battery current to glow plugs or air intake heater (later models). Circuit completed to ground.

### Fuel Priming Switch

- Start/stop switch in normal off position.
- Close fuel priming switch between 87A and 6.
- Normally closed 1CR contacts permit energizing of fuel pump.

## Sequence of Operation–Perkins-Powered Models

Specifications: 961017, 961016, 961015C, 961014C, 961013C, 61012C, and 961011C

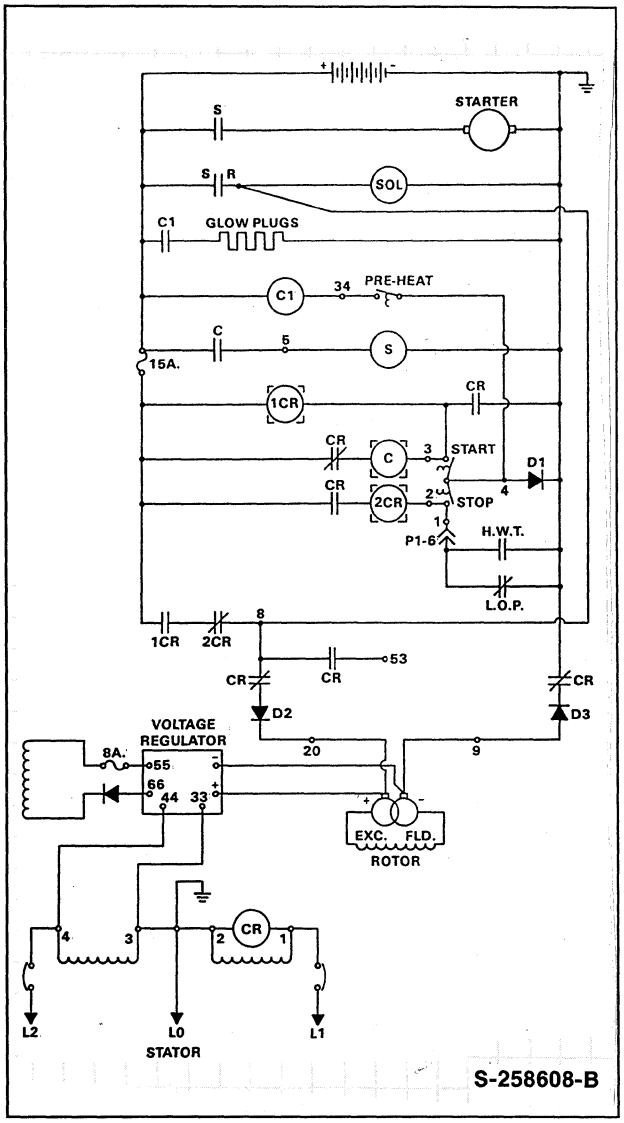



**Figure 5-3. Sequence of Operation, Perkins-Powered Models Specifications 961017, 96101C, 961015C, 961014C, 961013C, 961012C, 961011C**

### Starting

- Close start-switch between 3 and 4.
- C relay energizes and normally open C contacts close.
- S relay energizes and normally open S contacts close.

- One set of S contacts close to engage the starter motor. The other set of S contacts close to energize the fuel solenoid and field flashing.

**Running**

- Once the unit comes up to proper voltage, CR relay is energized.
- One set of normally closed CR contacts open to de-energize C relay. C contacts open to de-energize S relay. S contacts open to disengage starter motor.
- The other two sets of normally closed CR contacts open to de-energize field flashing.
- One set of normally open CR contacts close to energize 1CR relay. Normally open 1CR contacts close to maintain voltage to fuel solenoid.
- The second set of normally open CR contacts close to energize generator "on" lamp.
- The third set of normally open CR contacts close to permit shutdown switches to function.
- Fan motor (offset radiator models only) is run on output leads L1 and L2.

**Stopping**

- Close stop-switch between 2 and 4.
- 2CR relay energizes and 2CR contacts open to de-energize fuel solenoid.

**Low Oil Pressure Shutdown Switch**

- Low oil pressure will cause LOP contacts to close and energize 2CR relay.
- 2CR contacts open to de-energize fuel solenoid.

**High Water Temperature (HWT) Shutdown Switch**

- High water temperature will cause HWT contacts to close and energize 2CR relay.
- 2CR contacts open to de-energize fuel solenoid.

**Preheat**

- Close momentary switch between 4 and 34 to energize C1 relay.
- Normally open C1 contacts close to energize glow plugs.
- Momentary switch is spring-loaded to de-energize C1 relay when switch is released.

# SECTION 6. GENERATOR TROUBLESHOOTING

The flow chart below is a guide to troubleshoot the generator set. Before beginning the troubleshooting procedure, read all safety precautions at the beginning of this manual. Additional safety precautions are included with the tests. Do not neglect these precautions.

### Separate Excitation (Field Flashing)

To determine the cause of no or low AC output, separately excite the generator. The generator field (rotor) may be excited (magnetized) using an outside power source and the following procedures.

**⚠ WARNING**

**Hazardous voltage can cause death or severe injury.** Do not contact electrical connections with adjustment tool while the generator is running. Remove wristwatch, rings, and jewelry that can cause short circuits. Do not touch electrical equipment when standing in water, on wet ground, or when your hands are wet.

**⚠ WARNING**

**Hazardous voltage can cause death or severe injury.**
Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule -- replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

1. Disconnect all leads from voltage regulator. See Figure 6-1.

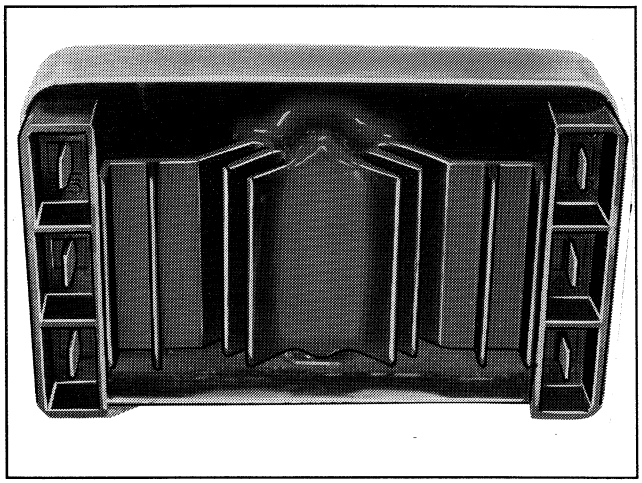


**Figure 6-1. 6-Pin Voltage Regulator**

2. Connect an ammeter and a 12-Volt automotive battery to the positive (+) and negative (-) brush leads. Refer to Figure 6-2. Note and record the ammeter reading.

3. The ammeter reading should approximate battery voltage divided by specified rotor resistance (Table 7-1).

4. Start engine and check that the ammeter remains stable. Excessive current indicates a running short in rotor winding and zero current indicates an open winding. Refer to Section 7. "Component Testing." If am meter reading is stable, proceed to Step 5.

5. Check for AC output across leads 1-2, 3-4, 33-44, and 55-66. Output should be approximately 40-75 Volts. If reading is incorrect, this indicates a faulty voltage regulator. Refer to "Component Testing."

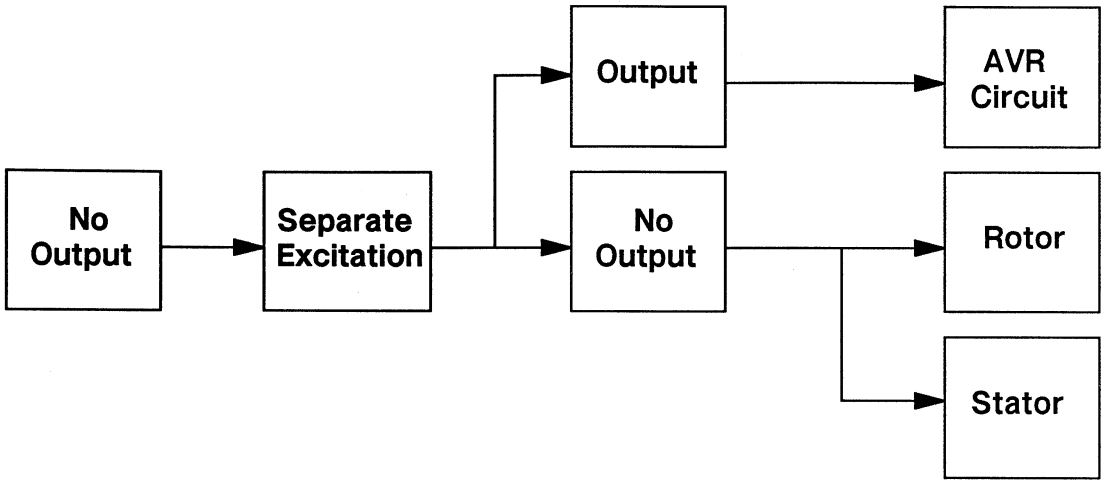



**Table 6-1. Generator Troubleshooting**

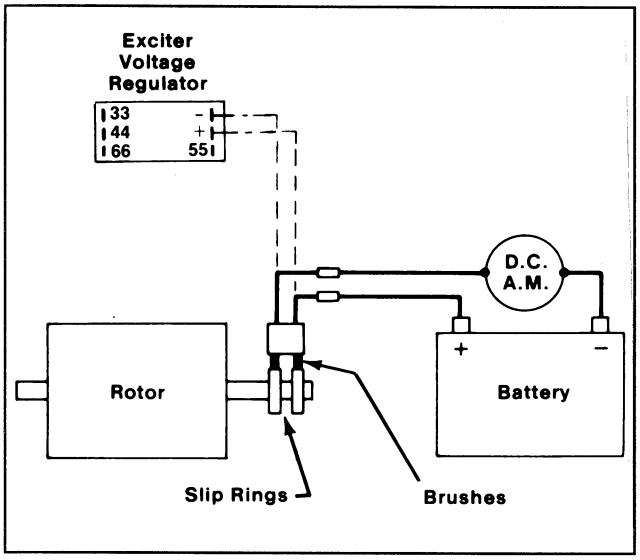



**Figure 6-2. Separate Excitation Connections**

## Rotor Field Voltage and Current Readings

In order to obtain output from a generator, the (rotor) field must be energized and moving. A battery is used to initially energize the (rotor) field. The engine moves the (rotor) field past the stator conductors which induces an AC voltage across the stator leads. The voltage regulator takes the voltage from the stator auxiliary windings, rectifies it, and supplies it back to the rotor. This strengthened (rotor) field produces a higher output voltage. This action continues until a desired AC output voltage is reached. At this point, a regulated DC voltage is supplied to the rotor through the regulator. See Figure 6-3 for proper meter connections. See Table 6-2 for exciter voltages and currents by varying loads.

| | Rotor Voltage | | | Rotor Current | | |
|---|---|---|---|---|---|---|
| Model | 9 | 12.5 | 14.5 | 9 | 12.5 | 14.5 |
| No Load | 21.0 | 22.6 | 22.6 | 5.0 | 6.0 | 6.0 |
| 1/4 Load | 23.0 | 26.4 | 26.7 | 5.2 | 7.0 | 7.1 |
| 1/2 Load | 27.0 | 28.3 | 28.8 | 6.1 | 7.5 | 7.7 |
| 3/4 Load | 31.0 | 29.8 | 31.8 | 6.9 | 7.9 | 8.4 |
| Full Load | 37.0 | 33.9 | 36.0 | 8.0 | 9.0 | 9.6 |

**Table 6-2. Rotor Voltage and Current Readings**

**NOTE**

Rotor resistance (cold) is 3.7 Ohms for 9 CCO's; 2.9 for 12.5 and 14.5CCO, 2.9 Ohms. Rotor resistance will vary directly with increase in temperature.

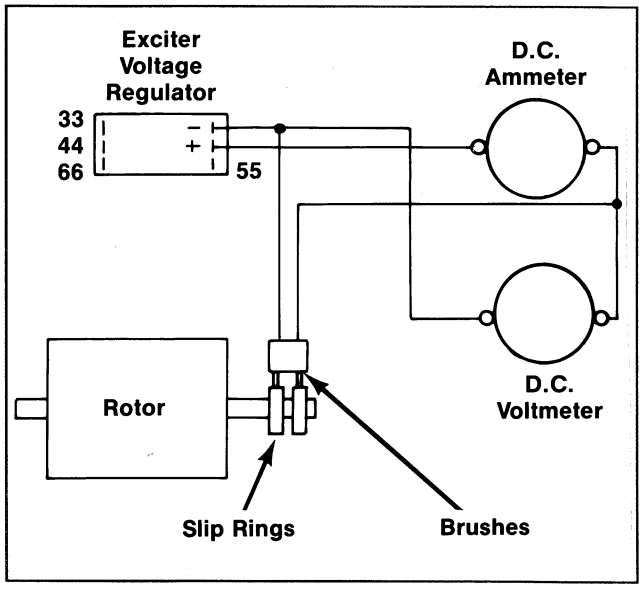



**Figure 6-3. Meter Connections**

# SECTION 7. COMPONENT TESTING

Use this section as a guide in checking generator components for improper operation. Follow the safety precautions in front of this manual. Additional safety precautions are included with the tests; do not neglect these precautions.

### Voltage Regulator Test

This test is designed to check regulator output. To test, you will need the following components.

- Variable Transformer, 0–140 Volts (.5 Amp. min.)
- 1:1 Isolation Transformer (.6 Amp. min.)
- 120 Volt AC Plug (60 Hz)
- Double–Pole, Single–Throw Switch
- 120 Volt, 100 Watt Lamp
- 2 Amp. Fuse
- AC Voltmeter
- Recommended #14 AWG Copper Wire (minimum)

**⚠ WARNING**

**Hazardous voltage can cause death or severe injury.**
Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule –– replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

**⚠ WARNING**

**Hazardous voltage can cause death or serious injury.** The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

1. Connect components as shown in Figure 7–1.
2. Plug in variable transformer and AC plug.
3. Turn switch S1 on. Lamp should be on. If lamp does not go on, this indicates a faulty voltage regulator. Replace it.
4. Turn variable transformer on. Slowly increase variable transformer voltage. The lamp should go out at approximately 110 volts.
5. If the lamp does not go out or stays at a dull glow, this indicates a faulty regulator that should be replaced.
6. Turn switch off and unplug AC cords.

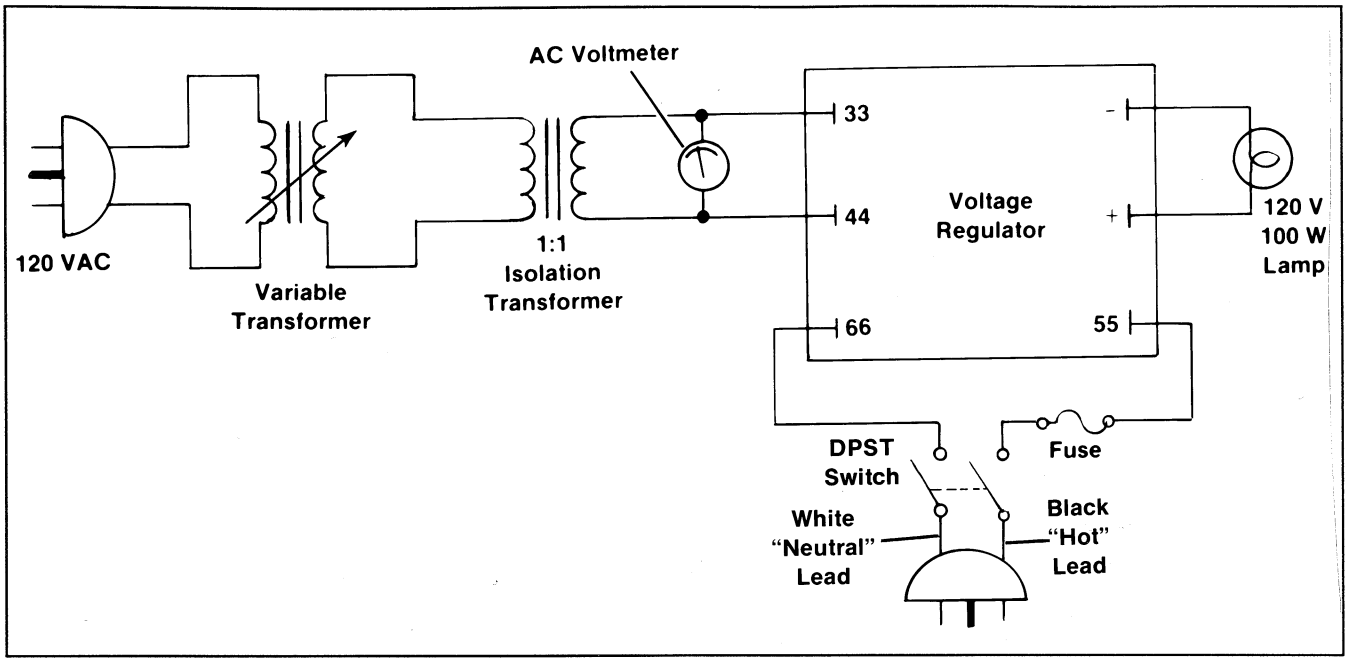



**Figure 7–1. Voltage Regulator Test**

## Rotor

The four–pole rotor creates the magnetic field needed to raise alternating current in the stator windings. Prior to testing, inspect the rotor for visible damage to pole shoes, insulation, exposed coil windings, and slip ring surfaces. Check bearing for noise when rotated, wear, or heat discoloration.

Slip rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright, newly–machined appearance. Ordinary cleaning with a dry, lint–free cloth is usually sufficient. Very fine sandpaper (#l00) may be used to remove roughness. Use light pressure on the sandpaper. Do not use emery or carborundum paper or cloth. Clean out all carbon dust from the generator. If the rings are black or pitted, remove the rotor and remove some of the surface material by using a lathe.

Using an ohmmeter, check the rotor for continuity and resistance. Measure the rotor resistance (ohms) between the two slip rings (Figure 7–2). See Table 7–1 for typical readings.

**NOTE**

Since ohmmeters do vary in their accuracy, use Table 7–1 as a reference for approximate readings. All readings must be taken at room temperature.

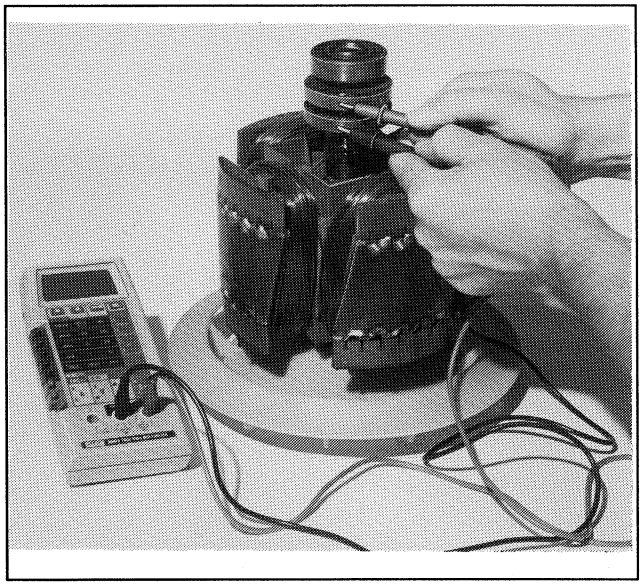


**Figure 7–2. Rotor Resistance Check**

| Model | Resistance |
|---|---|
| All, 9 to 14.5 | 2.9 Ohms |

**Table 7–1. Rotor Resistance**

To detect a rotor shorted to ground, adjust ohmmeter to zero ohms. Touch one ohmmeter

lead to either rotor slip ring and the other lead to rotor shaft or poles. The ohmmeter should indicate no continuity. If rotor fault is detected through the above tests, the rotor must be repaired or replaced.

### Stator

The stator consists of a series of wire coils wound in a laminated steel frame. The stator leads supply voltage to the AC load and the excitation system. Prior to testing, inspect stator for visible damage to lead wires, exposed coil windings, frame laminations, and housing. Inspect stator coils for heat discoloration and be sure the stator is securely riveted in its housing.

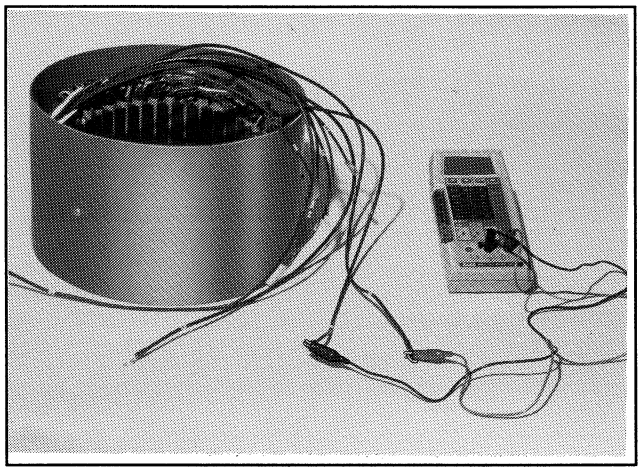


**Figure 7–3. Checking Stator Continuity**

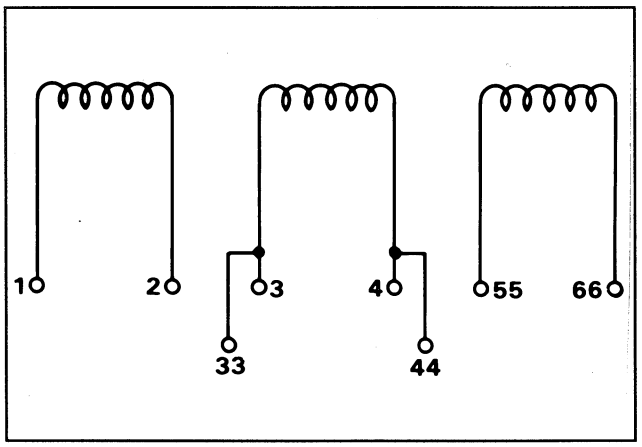



**Figure 7–4. Generator Stator Leads**

1. To check stator continuity, set ohmmeter on R x 1 scale (Figure 7–3). Contact red and black meter leads; adjust meter to zero ohms. Check stator continuity, connect ing meter leads to stator leads (Figure 7–4). Leads 1, 2, 3, and 4 are the generator output leads. Leads 33, 44, 55, and 66 are voltage regulator supply and sensing leads.

   - There must be continuity between leads 1 and 2.
   - There must be continuity between leads 3, 4, 33, and 44.
   - There must be continuity between leads 55 and 66.
   - There should be no continuity between lead 1 and leads 3, 4, 33, and 44.
   - There should be no continuity between lead 1 and leads 55 and 66.
   - There should be no continuity between lead 4 and leads 55 and 66.
   - There should be no continuity between any stator lead and ground on the stator housing or frame laminations.

2. Contact red and black meter leads and readjust ohmmeter to zero ohms. Check cold resistance of stator windings, connecting meter leads to stator leads 1 and 2, leads 3 and 4, leads 33 and 44, and leads 55 and 66. See Table 7–2 for typical stator resistance readings.

**NOTE**

Since ohmmeters do vary in their accuracy, use Table 7–2 as a reference for approximate readings. Readings must be at room temperature.

**NOTE**

Most ohmmeters will not give accurate readings when measuring less than 1 ohm. Therefore, in all likelihood, the stator can be considered good if the reading shows low resistance or continuity and there is no evidence of it being shorted (heat discoloration).

**NOTE**

When taking an ohmmeter reading using lead 55, make connection prior to in-line fuse. Make lead 66 connection prior to diode (D5).

If any of the stator test readings differ considerably from the prescribed levels in Table 7-2, the stator must be repaired or replaced.

| Leads | Readings +/-10% (in Ohms) 9 CCO | 12.5 & 14.5 CCO |
|---|---|---|
| 1 and 2 | .14 | .07 |
| 3 and 4 | .14 | .07 |
| 33 and 44 | .14 | .07 |
| 55 and 66 | 1.5 | 1.1 |

**Table 7-2. Stator Winding, Cold Resistance**

## Brushes

The brushes transfer current from the voltage regulator to slip rings. The brushes carry a very low current (approximately 2 Amps.) and should last the life of the generator set. Abrasive dust on the slip rings could, however, shorten the life of the brushes. Excessive arcing at the brushes could damage the voltage regulator. Arcing could be caused by weak springs, damaged slip rings, sticking brushes, loose holder, poor brush contact, or loose brush holder connections.

The brushes must be free to move within the holder and be held in proper contact by the springs. When properly positioned, spring pressure on the brush surface will cause the brush to wear evenly. Brushes must ride 100% on rings or arcing will occur and result in burned rings or failure of the voltage regulator. Figure 7-5 shows the correct positioning of the brushes.

Replace brushes if worn excessively or unevenly. Replace the springs if damaged or discolored.

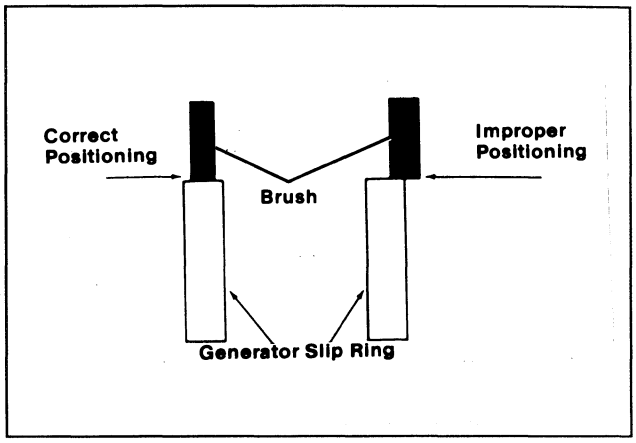



**Figure 7-5. Brush Positioning**

## Fuel Solenoid

The fuel solenoid will stop fuel flow through the fuel injection pump when the start/stop switch is placed in the stop position. Early Yanmar-Powered models use a three-lead fuel solenoid. During cranking, the white lead energizes the "pull-in" solenoid windings. Upon start-up, the "hold" solenoid winding is energized by the red lead. The black lead serves as common ground. Current draw during "pull-in" is 50 Amps. and 1 Amp. when in the "hold" position.

Later Yanmar-Powered models use a two terminal solenoid with an internal microswitch to transfer from the "pull-in" coil to the "hold" coil. Current draws during "pull-in" and "hold" is 20 Amps. and 5 Amps. respectively.

Units powered by Perkins engines also use a two terminal fuel solenoid which incorporates an internal microswitch to transfer from the solenoid "pull-in" phase to the "hold" phase. Solenoid current draw for units with Perkins engines is 10 Amps. during "pull-in" and 0.5 Amps during "hold."

**NOTE**

Later models powered by Perkins engines utilize a solenoid incorporated in the fuel injection pump. Consult the Perkins engine service manual for additional information on these models.

To determine if the solenoid is open or shorted, test the resistance of the solenoid windings. Disconnect fuel solenoid from engine wiring harness before performing these tests. See Table 7–3 for fuel solenoid resistance readings.

| Fuel Solenoid Lead | Resistance |
|---|---|
| Three–Lead (Yanmar) | |
| Black–White | .12–.25 Ohms |
| Black–Red | 11–13 Ohms |
| Two–Terminal (Yanmar) | |
| Plunger "Out" | .40–.65 Ohms |
| Plunger "In" | 18–26 Ohms |
| Two–Terminal (Perkins) | |
| Plunger "Out" | .40–.65 Ohms |
| Plunger "In" | 18–26 Ohms |

**Table 7–3. Fuel Solenoid Resistance**

It is extremely important that the linkage between the fuel solenoid and fuel injector pump is properly adjusted to allow the solenoid plunger to fully compress. Improper adjustment may cause the solenoid "pull–in" coil to burn out. If the fuel solenoid is removed or the linkage adjustment is believed incorrect, readjust linkage according to the procedure which pertains to your set.

### Solenoid Adjustment– Yanmar–Powered Models

1. Loosen lock nut on fuel solenoid linkage (early models only). See Figure 7–6.

2. With fuel solenoid mounted to engine block, compress plunger and adjust fuel solenoid linkage so that linkage connects to fuel control level 1/16 in. (1.6 mm) before lever contacts internal full stop.

3. Attach cotter pin to fuel solenoid linkage.

4. Tighten fuel solenoid linkage lock nut against plunger body (early models only).

### Solenoid Adjustment– Perkins–Powered Models

**NOTE**

Later models powered by Perkins engines utilize a solenoid incorporated in the fuel injection pump. Linkage adjustment is not necessary on these models.

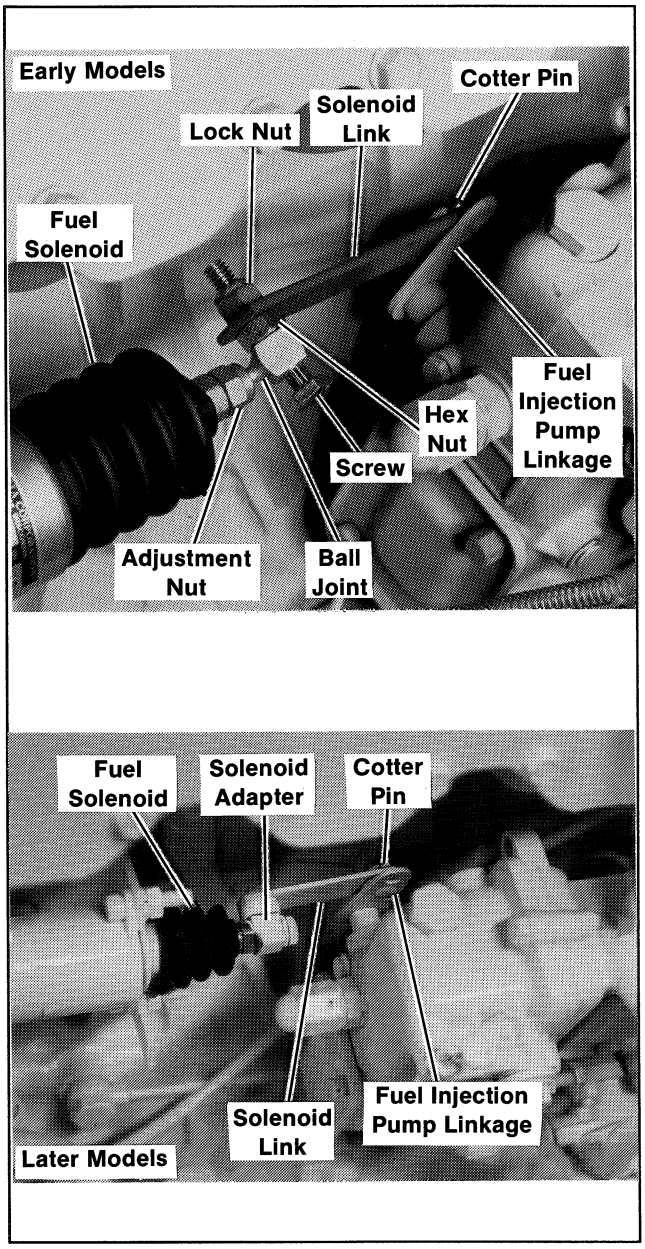



**Figure 7–6. Fuel Solenoid (Yanmar)**

1. Loosen solenoid linkage at solenoid.

2. Push solenoid plunger to full-bottomed position. Plunger must fully compress to disconnect "pull-in" coil.

3. Adjust linkage so plunger is fully-bottomed and fuel control is in open position approximately 1/16 in. before fuel control lever contacts fuel control stop.

### Relays

Each relay, and the functions it controls, is listed below and illustrated on the following page. Consult the wiring diagram and the sequence of operation in Section 5 for additional information.

1. C Relay
   - Energizes S solenoid (pull-in current)

2. 1CR Relay
   - Energizes exciter field
   - Energizes fuel pump
   - Supplies fuel solenoid "hold" current
   - Provides "prime" switch connection (Yanmar only)

3. 2CR Relay (Shutdown Relay)
   - De-energizes fuel pump
   - De-energizes fuel solenoid

4. CR Relay (Voltage Interlock)
   - De-energizes rotor build-up circuit
   - Provides interlock of 1CR relay

5. C1 Relay
   - Energizes glow plugs or air intake heater (later models only)

6. S Relay (Starter Solenoid)
   - Energizes starter motor
   - Energizes fuel solenoid

Table 7-4 identifies the coil resistance readings of each relay. Use the information in this table, the controller wiring diagram, and sequence of operation in Section 6 to aid in the identification of faulty relays.

| Relay | Coil Resistance |
|---|---|
| C1 | 16.6-20.3 Ohms |
| CR | 1700 Ohms +/- 15% |
| 2CR | 85 Ohms +/- 6% |
| 1CR | 85 Ohms +/- 6% |
| C | 85 Ohms +/- 6% |

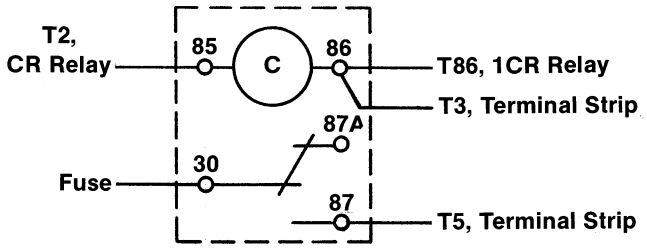
**Table 7-4. Relay Resistance**

### Fuses

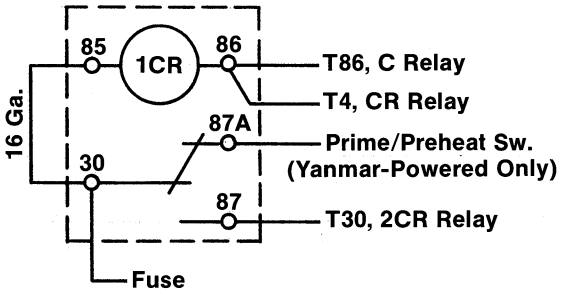
One 10 Amp. fuse (Perkins: 15 Amp.) located at the controller protects the controller against faults in the engine wiring system or wiring to the remote start/stop switch. If the fuse blows, the generator set will stop. If the generator has stopped for reasons other than lack of fuel or fault shutdowns, inspect the fuse. If blown, replace the fuse and attempt to restart generator set. If fuse blows again, locate fault and correct it before attempting to restart unit.

An 8 Amp. fuse located either in the end bracket or junction box protects the voltage regulator from a shorted rotor.

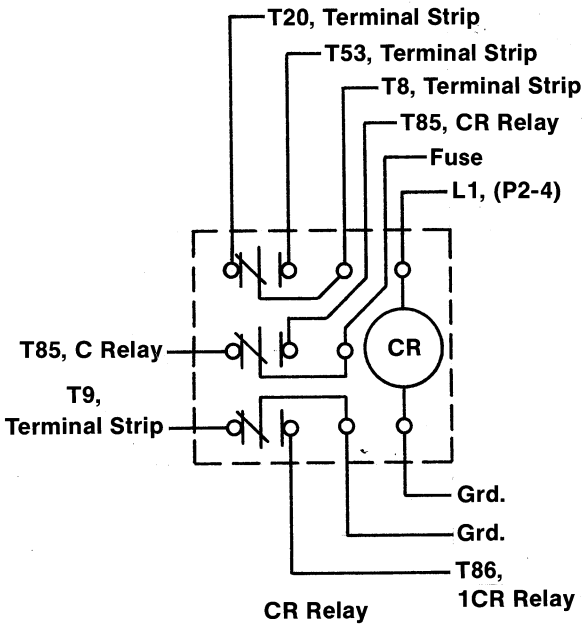
# Relay Schematics



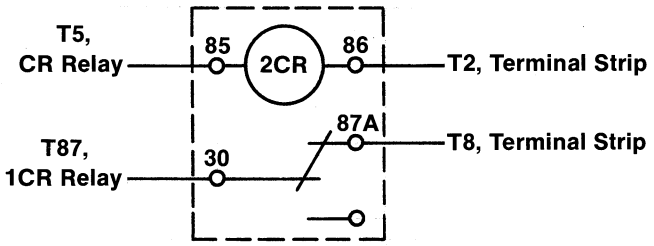

C Relay



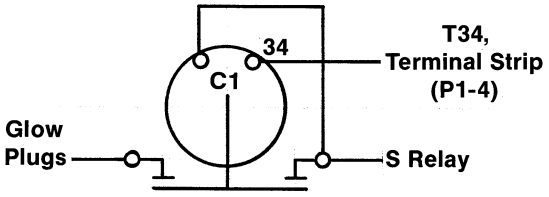

1CR Relay



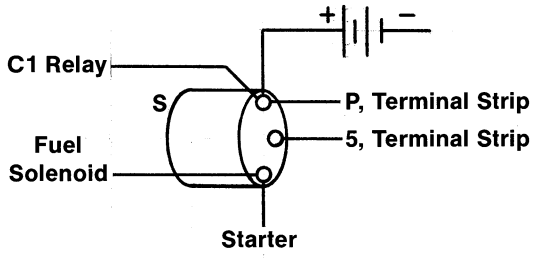

CR Relay



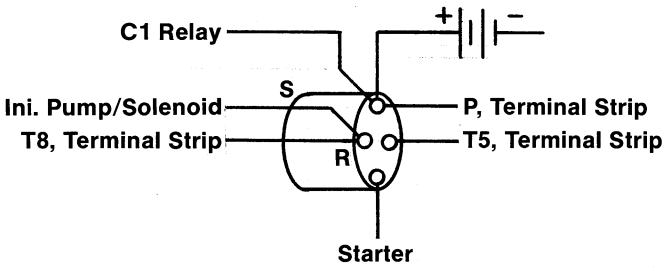

2CR Relay




C1 Relay




S Relay — Yanmar Powered




S Relay — Perkins Powered

# SECTION 8. DISASSEMBLY/REASSEMBLY

Prior to disassembly, the generator set must be removed from the coach. Disconnect battery, fuel lines, load leads, remote leads, exhaust system, and air intake. Observe all safety precautions during this procedure.

**NOTE**

Your generator may differ slightly from those shown. Significant differences between models are noted in text.

### Disassembly

1. Remove the four screws securing the end bracket panel. Remove the panel to expose the end bracket assembly. See Figure 8–1.

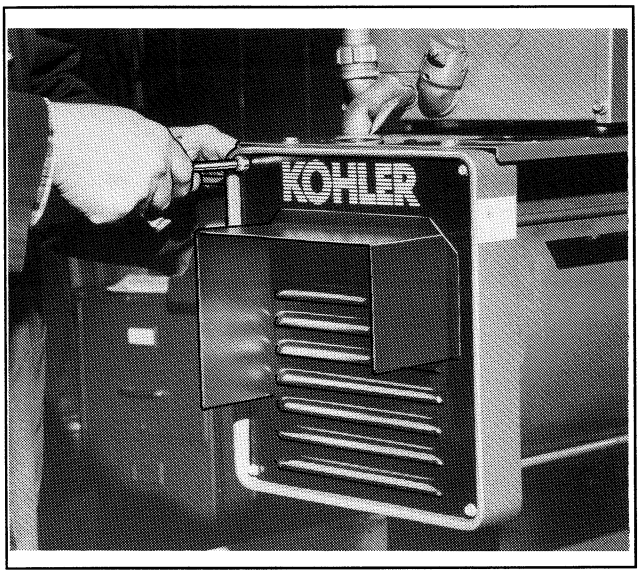



**Figure 8–1. Removing End Bracket Panel**

2. Remove the mounting screws securing the controller cover. Separate cover from controller.

3. Loosen clamps and fittings securing load leads to end bracket assembly.

4. Remove engine and generator lead plugs from controller panel on units with external controller connections. Engine and generator lead connections may remain intact on units with internally connected controllers unless controller replacement is required.

5. Remove leads 9 and 20 from brush assembly.

6. Remove load leads from generator connections. For units with terminals side mounted in end bracket, disconnect leads L1 and L2 from insulated terminals. If disassembling a unit with spliced connections, cut L1 and L2 leads at insulink connectors in end bracket assembly. See Figure 8–2. Remove L0 and green ground lead (if equipped) from ground connection(s).

7. Pull leads through ports at rear of end bracket.

8. Disconnect ground strap from end bracket (Yanmar) or engine adapter connection (Perkins). Figure 8–3.

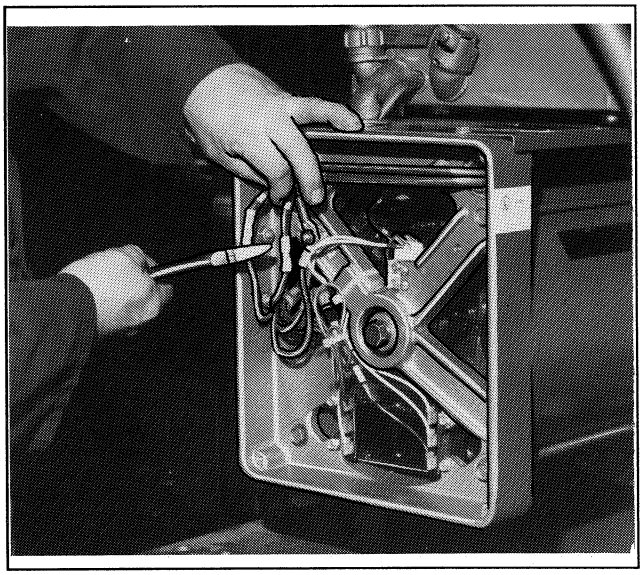


**Figure 8–2. Cutting Load Leads**

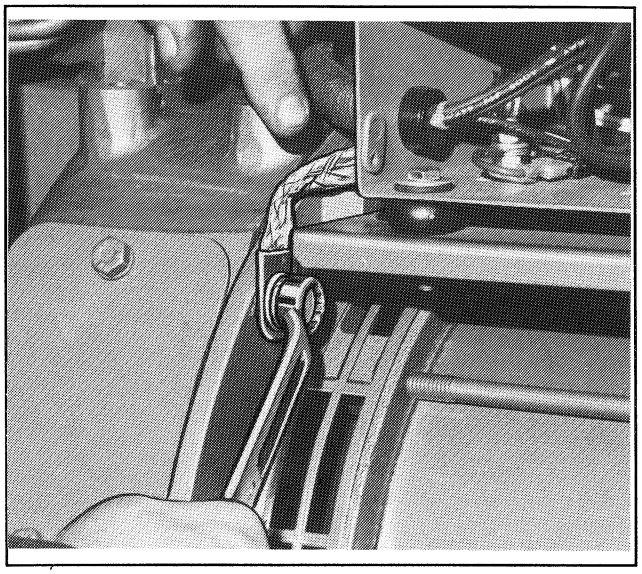


**Figure 8–3. Removing Ground Strap**

9. Remove bolts securing controller mounting plate to the generator (except offset radiator models). Separate controller and mounting plate from generator. Controllers with external plug–in connections may be removed completely. For units with controllers internally connected, gently rotate controller and mounting plate back onto engine. Use care to avoid damaging engine components during temporary placement of controller and mounting plate.

10. Cut cable ties securing leads to end bracket. Figure 8–4.

11. Remove leads 33, 44, 55, and 66 from voltage regulator pins. See Figure 8–5.

12. Raise brushes in holder by grasping leads. Lock brushes in position by inserting a retainer wire, as shown in Figure 8–6.

13. Remove the four over–bolts securing the end bracket as shown in Figure 8–7.

14. Remove end bracket by bumping with a soft rubber mallet. See Figure 8–8.

15. Gently remove stator by pulling stator over rotor assembly. Use a hoist to support stator during removal.

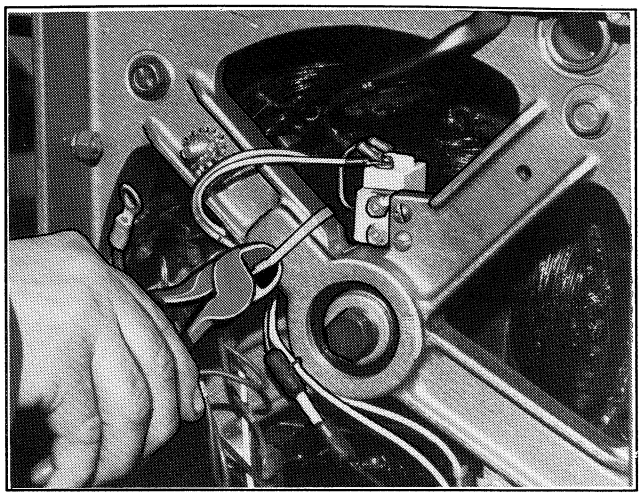


**Figure 8–4. Removing Lead Ties**

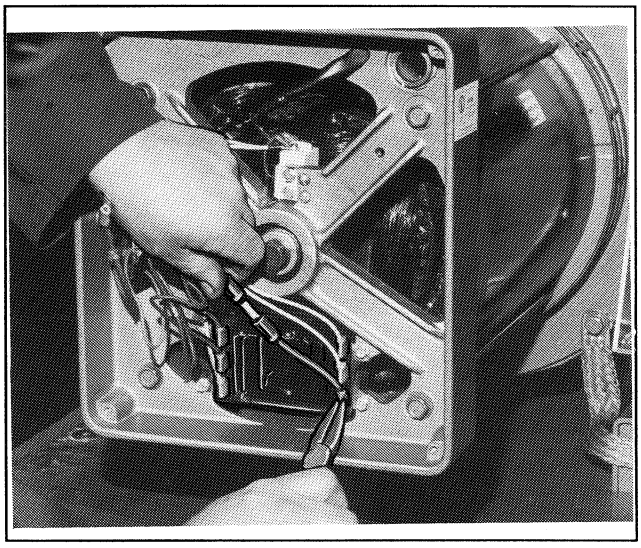


**Figure 8–5. Removing Leads from Voltage Regulator**

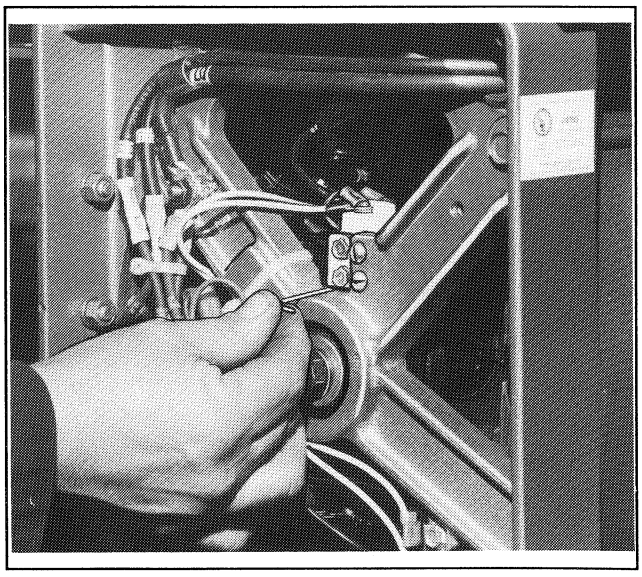


**Figure 8–6. Inserting Retainer Wire**

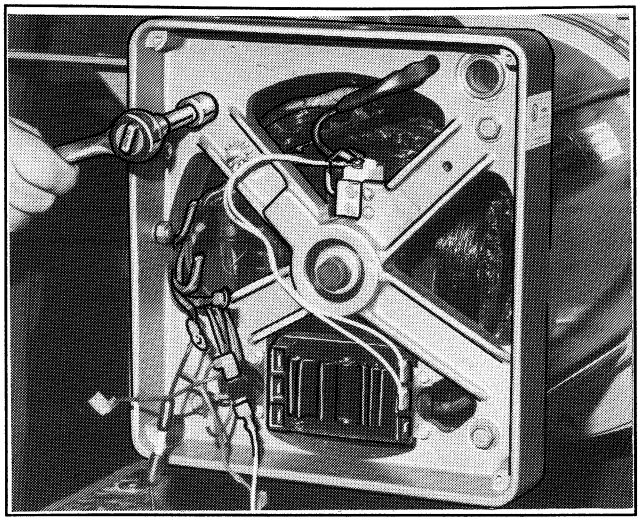


**Figure 8–7. Removing Over–Bolts**

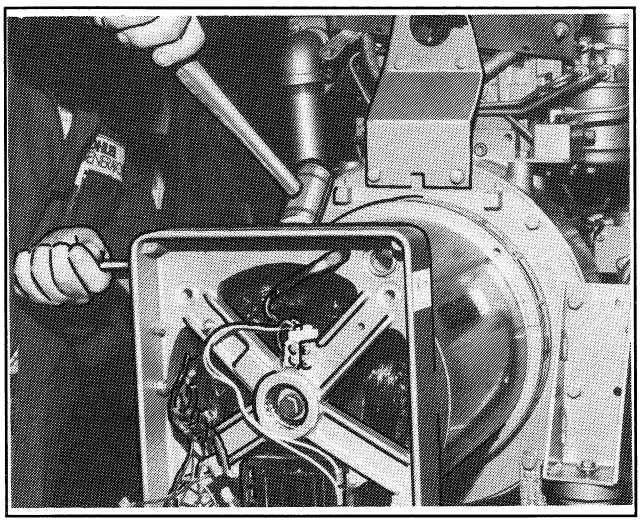


**Figure 8–8. Removing End Bracket**

16. On 9 and 12.5kW models, loosen rotor thru–bolt several turns by rotating counterclockwise while holding rotor stationary. Figure 8–9. To separate the rotor from the taper, strike the bolt head with a heavy lead mallet. After loosening rotor, remove thru–bolt and pull rotor away from engine. The generator fan remains attached to the rotor.

    On 14.5kW models, the rotor/shaft assembly is pressed into the engine drive hub and cannot be removed until drive disc is separated from flywheel.

**NOTE**

Do not attempt to remove rotor by blocking cooling fan and turning rotor with any kind of wrench. Damage to rotor and fan blades may result.

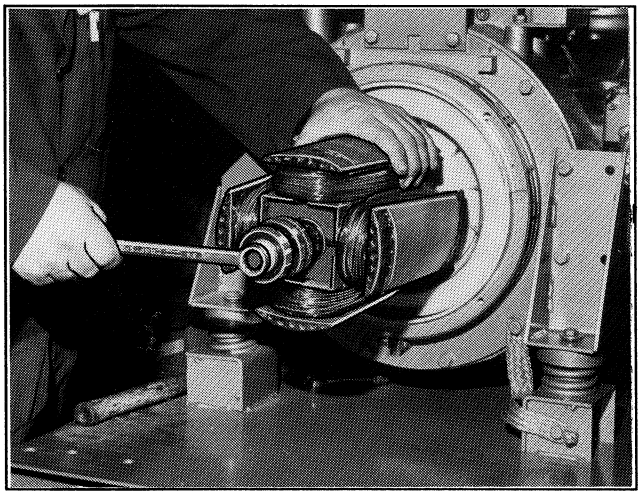


**Figure 8–9. Removing Rotor Thru–Bolt**

17. With a hoist supporting the generator by the lifting eye, remove bolts securing vibro mount brackets to the adapter plate (Yanmar) or flywheel housing (Perkins). See Figure 8–10.

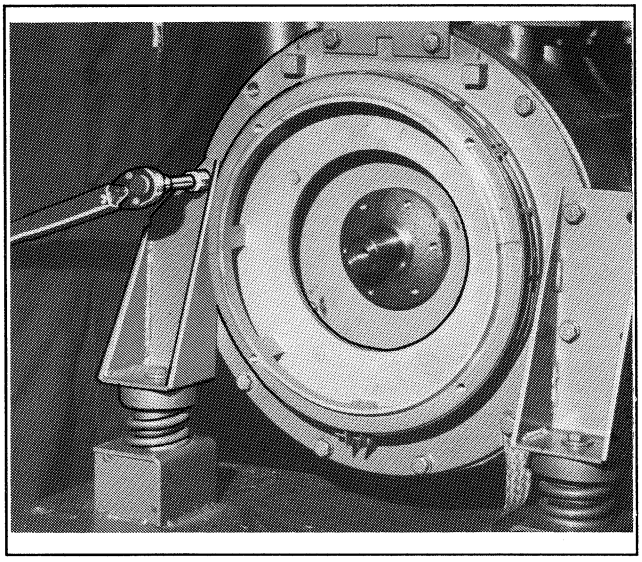


**Figure 8–10. Removing Vibro–Mount Brackets**

18. Raise generator end slightly with hoist to allow placement of wooden support block un-

der generator adapter. Lower generator onto block and remove hoist.

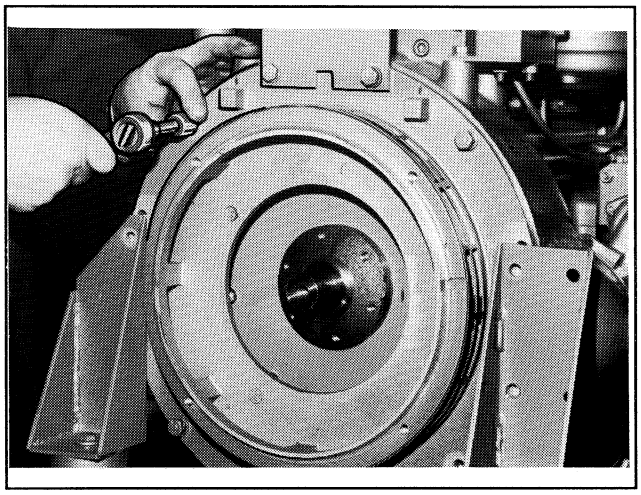


**Figure 8–11. Removing Adapter Plate**

19. Remove bolts securing adapter plate and lifting eye. See Figure 8–11. Remove lifting eye and ground strap. Bump adapter plate with rubber mallet to separate adapter plate from engine.

20. On 14.5kW models, remove bolts to separate generator fan from flywheel.

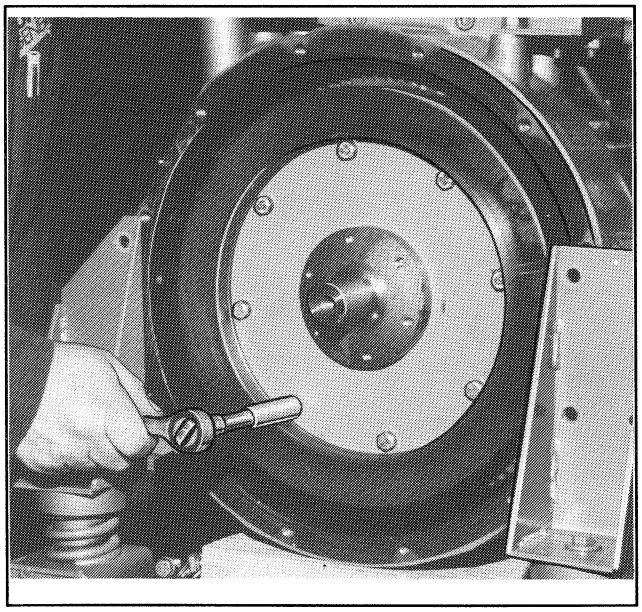


**Figure 8–12. Removing Drive Disc**

21. Remove bolts connecting drive disc to flywheel. Figure 8–12. Separate drive disc from flywheel. On 14.5kW models, the rotor assembly can now be removed.

22. On 9 and 12.5kW models, secure drive disc in a vice to remove the six bolts connecting the drive disc and stub shaft. On 14.5kW models, secure the rotor assembly and remove the six bolts connecting the drive disc and drive hub.

### Reassembly

1. Reposition drive disc on stub shaft (9 and 12.5kW) or rotor/drive hub (14.5kW). Replace the six mounting bolts and torque to 150 in. lbs./16.9 Nm (9 and 12.5kW) or 228 in. lbs./25.7 Nm (14.5kW).

2. Re–attach drive disc (14.5kW) drive disc/ rotor) to flywheel with mounting bolts torqued to 165 in. lbs. (18.6 Nm). Be sure to tighten bolts evenly.

3. On 14.5kW models, secure generator fan (with spacers) to flywheel. Torque to 240 in. lbs. (27 Nm).

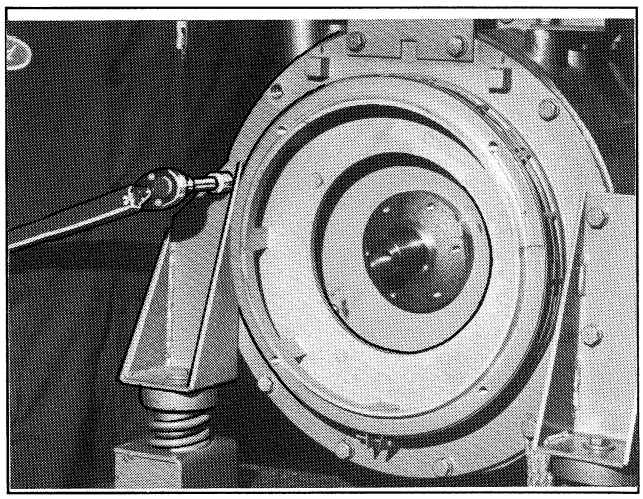


**Figure 8–13. Replacing Adapter Plate**

4. Align adapter plate, lifting eye (Perkins), and vibro–mount bracket with holes in flywheel housing. Replace mounting strap and torque mounting bolts to 32 ft. lbs. (43 Nm). Replace fan guard if removed during disassembly.

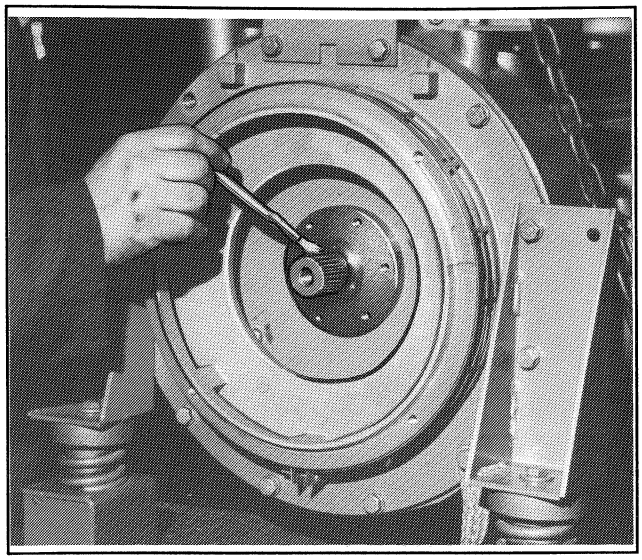


**Figure 8–14. Applying Anti–Seize Compound**

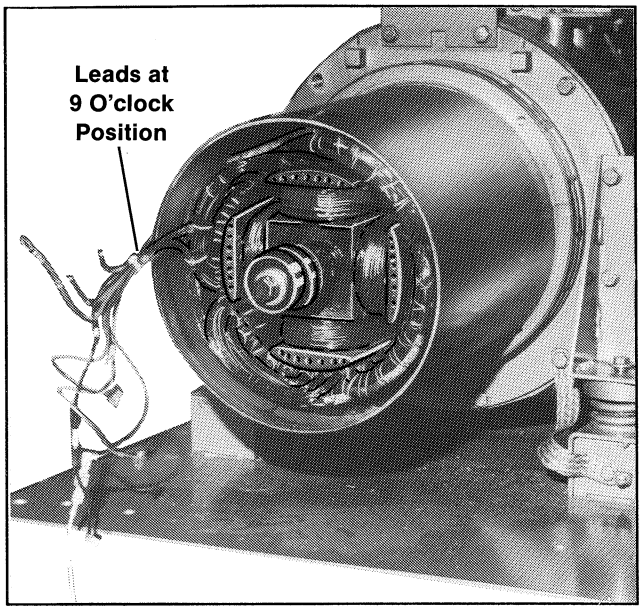



**Figure 8–16. Proper Stator Position**

6. Reposition stator over rotor and on adapter lip. Be careful to avoid damaging rotor. When stator is properly positioned, stator leads should be at 9 o'clock position as shown in Figure 8–16.

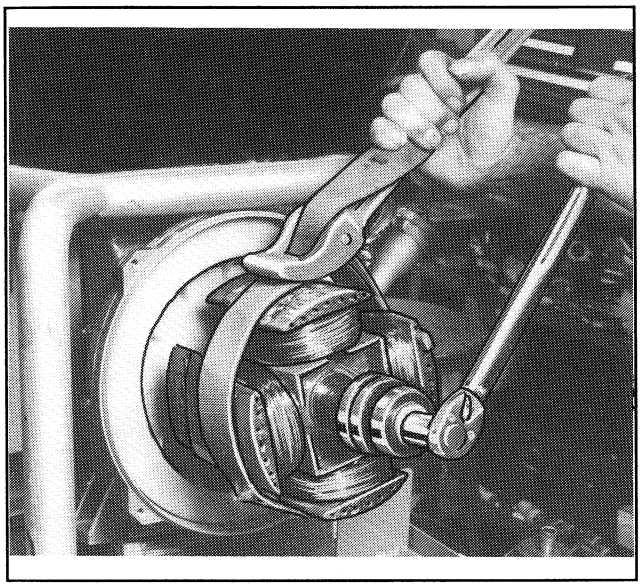


**Figure 8–15. Torquing Thru–Bolt**

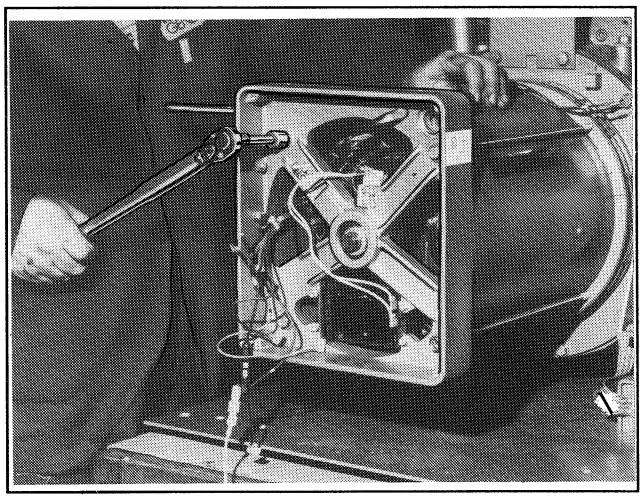
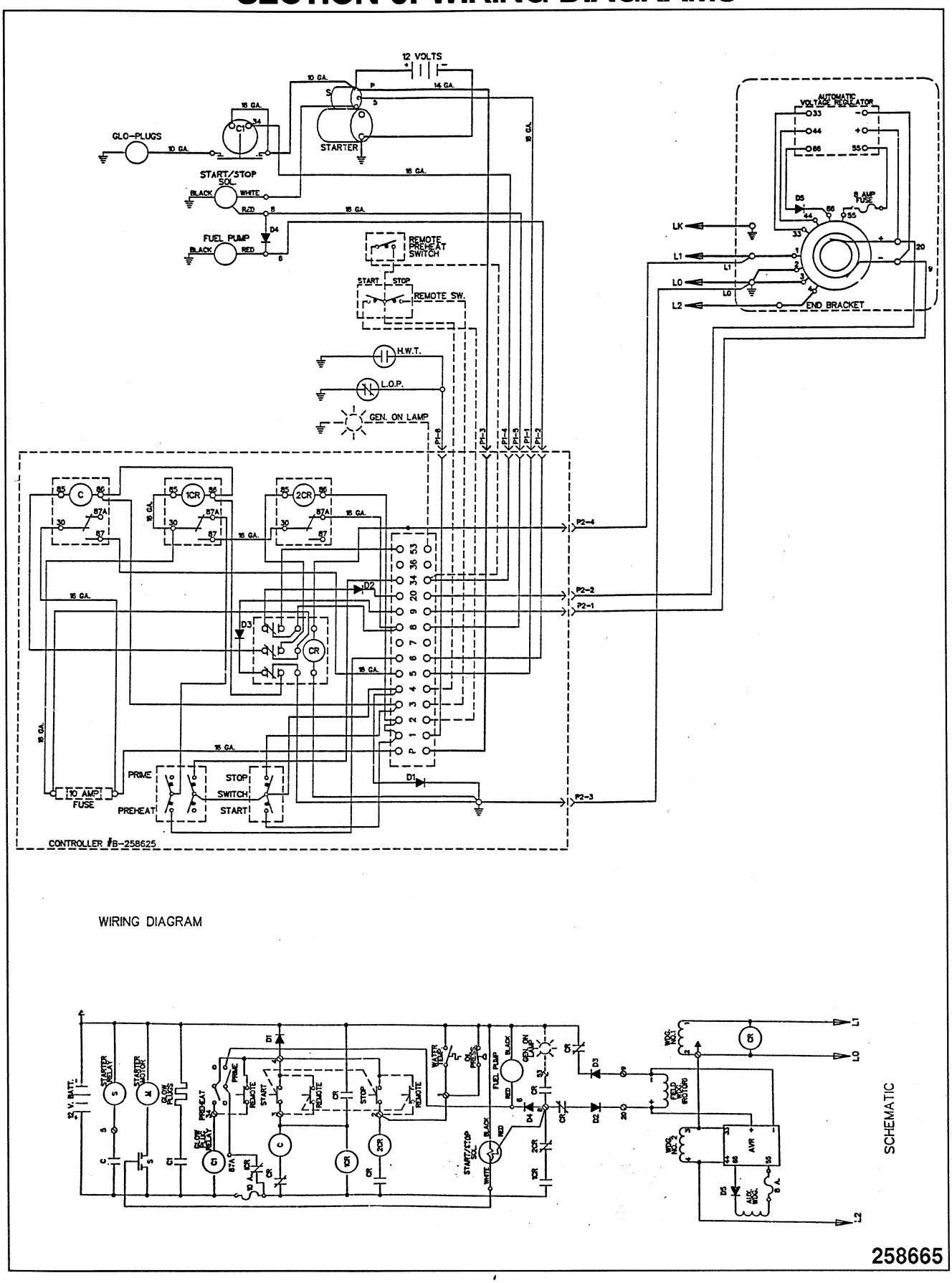


**Figure 8–17. Torquing Over–Bolts**

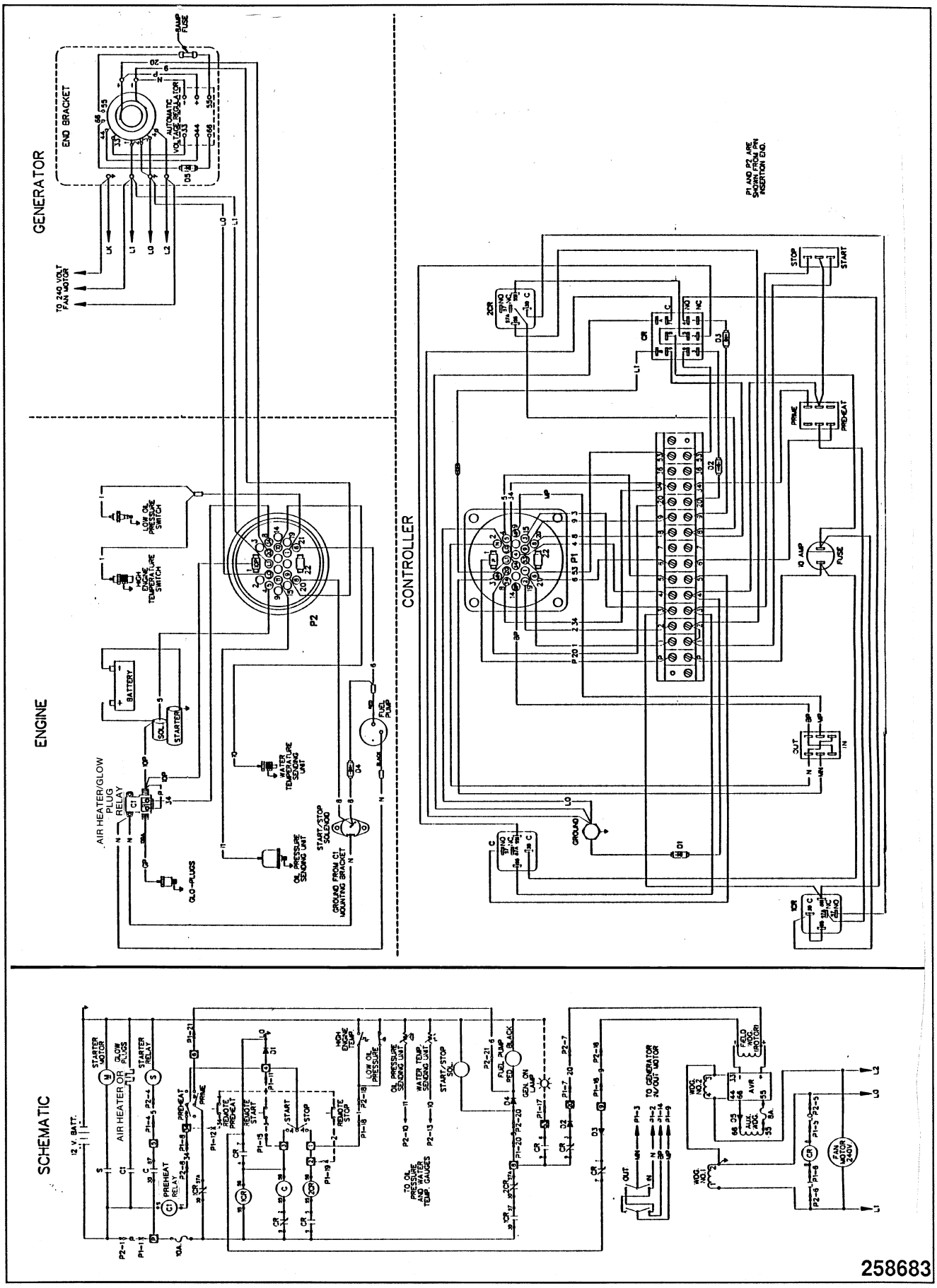
5. On 9 and 12.5kW units, apply anti–seize compound to stub shaft as shown in Figure 8–14. Slide rotor onto tapered shaft and hand–tighten thru–bolt. Use a strap wrench to hold rotor while torquing thru–bolt to 50 ft. lbs. (68 Nm). See Figure 8–15.

7. Route stator leads through opening in end bracket. Use a rubber mallet to establish end bracket position on stator. Replace over–bolts securing end bracket and stator to generator adapter. Torque over–bolts to 260 in. lbs. (29.0 Nm). Figure 8–17.

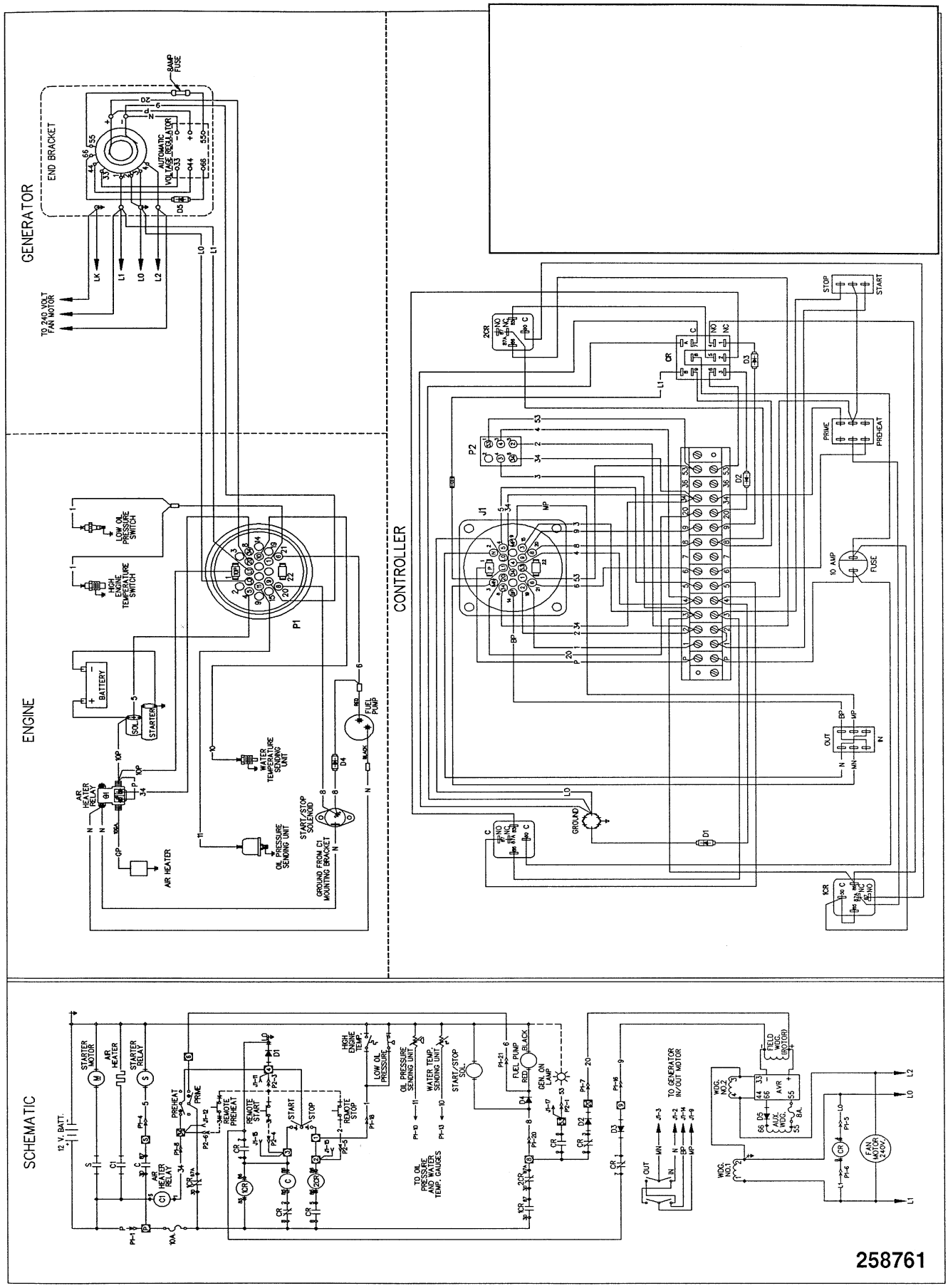
# SECTION 9. WIRING DIAGRAMS



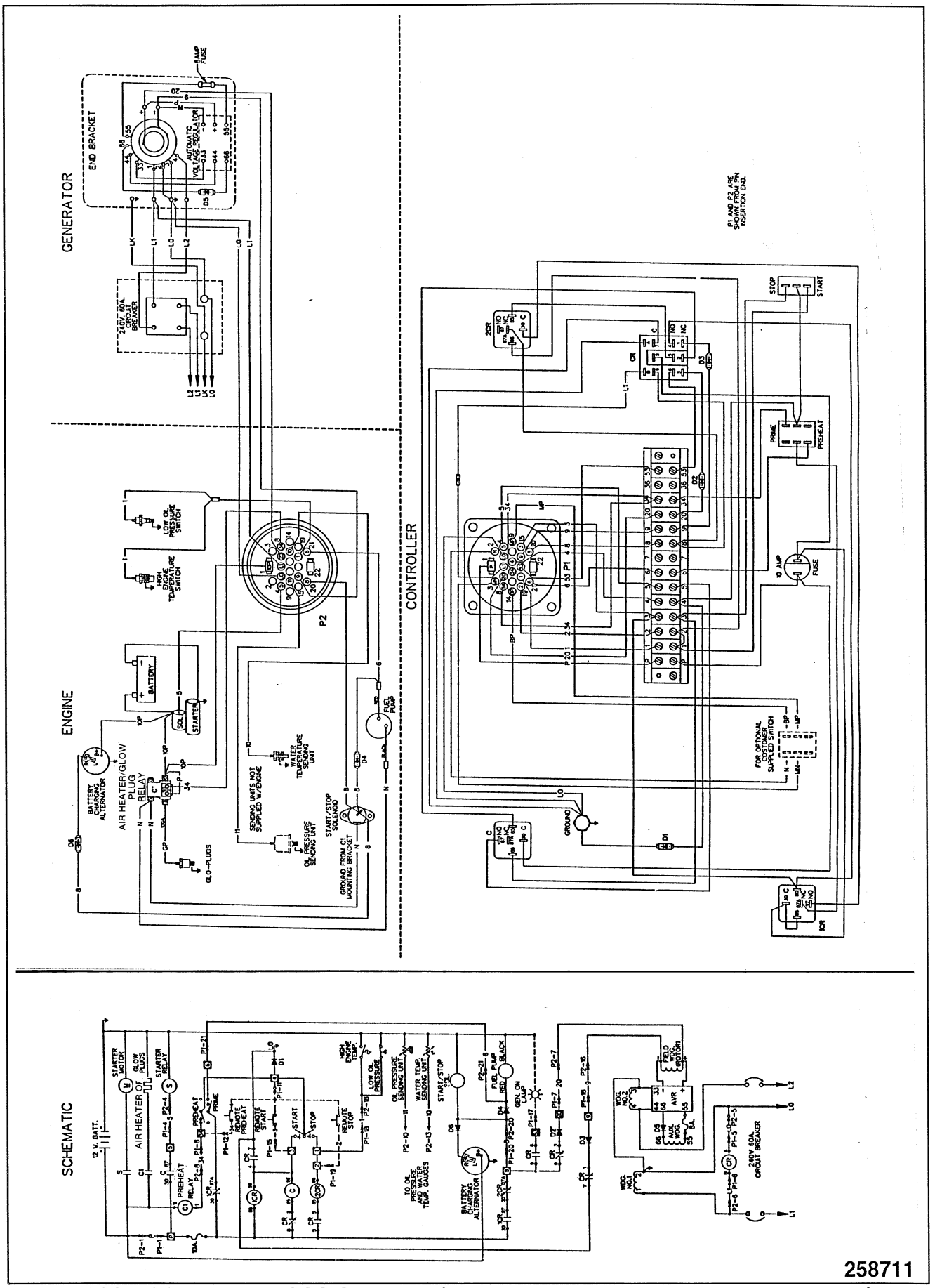

**Wiring Diagram 12.5CCO Bluebird–Specification 135010 (Yanmar)**



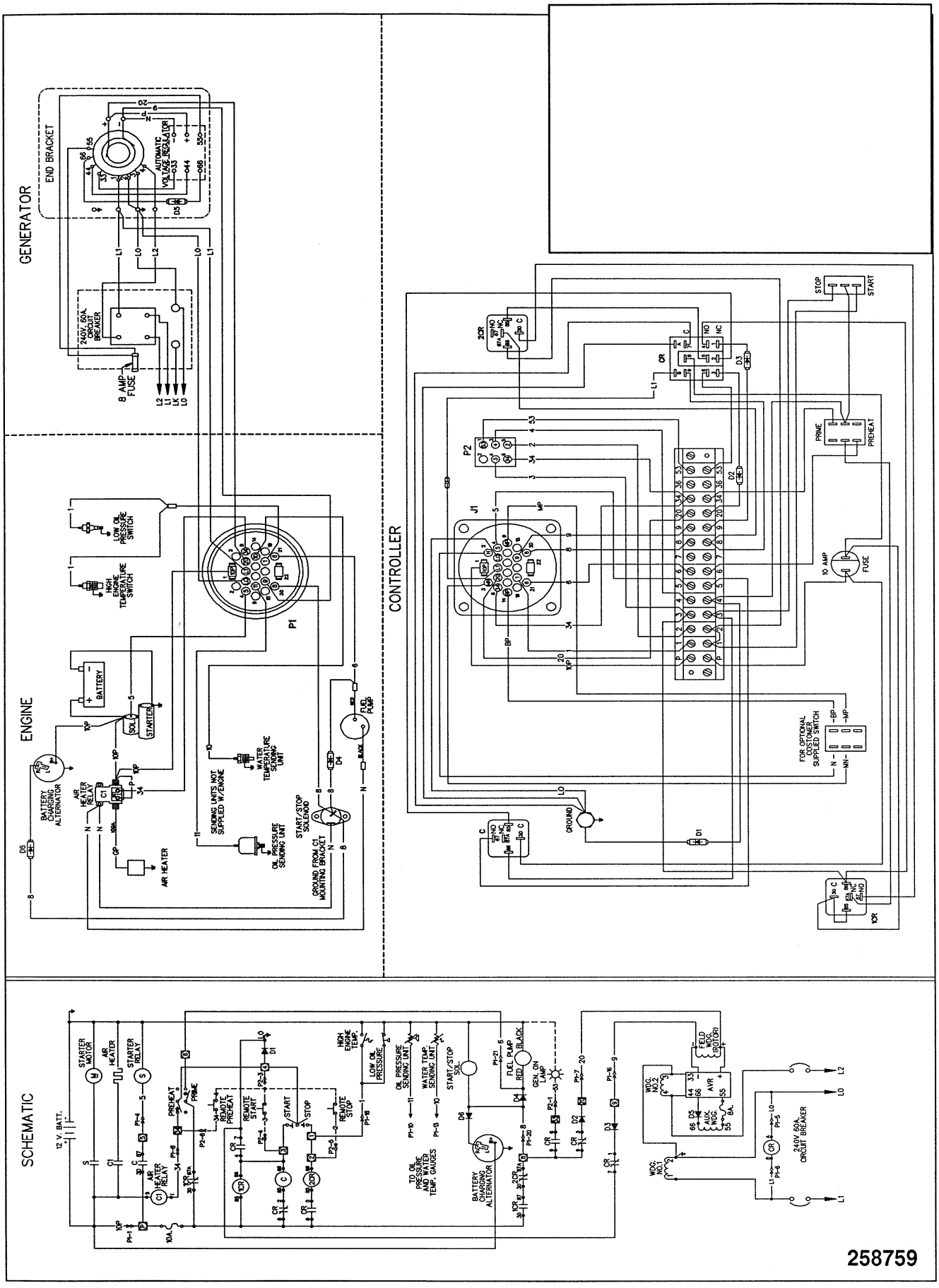

**Wiring Diagram 12.5CCO–Bluebird (early controller, w/out P2 accessory plug)**



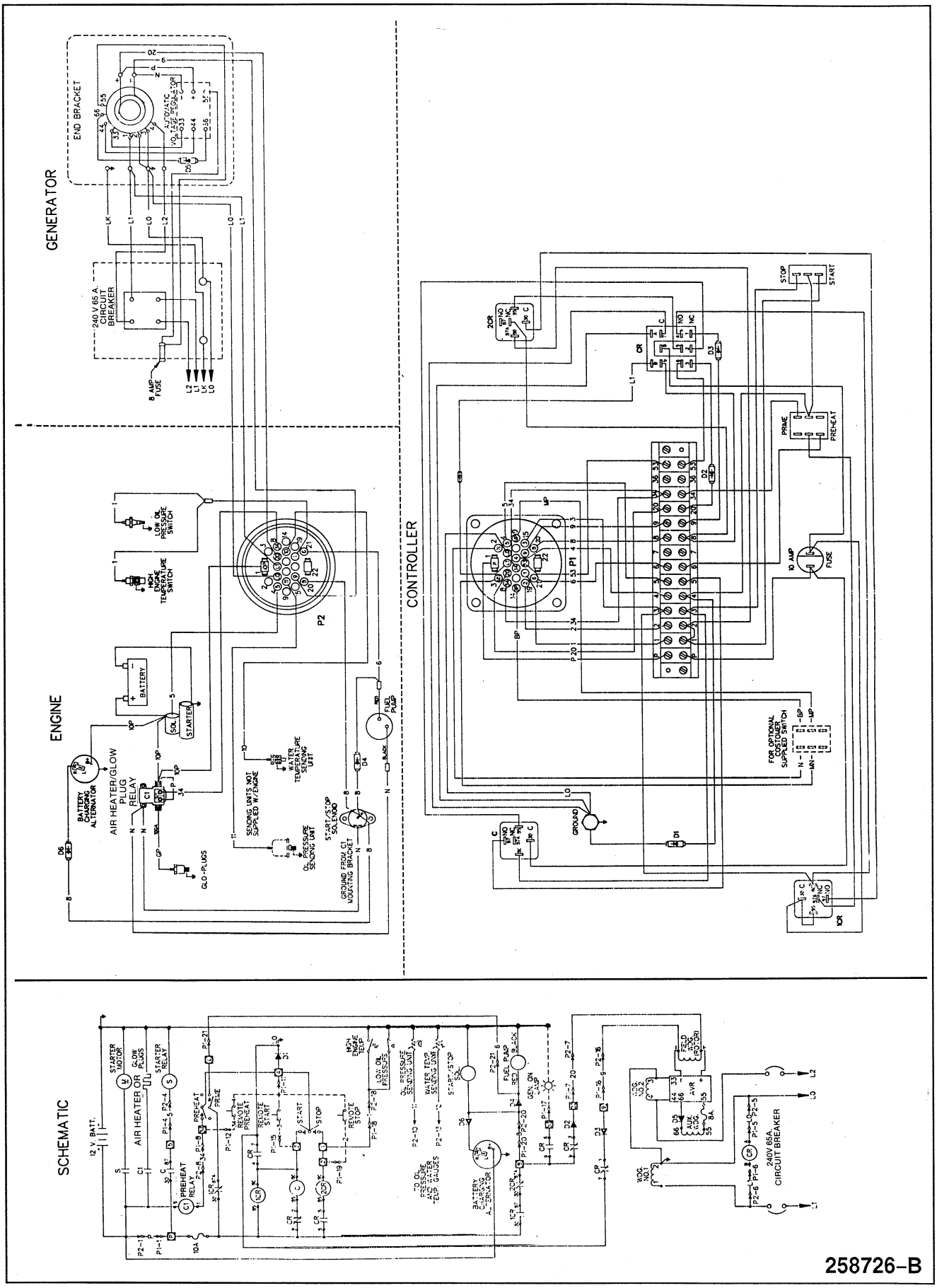

**Wiring Diagram 12.5CCO–Bluebird (late controller, w/P2 accessory plug)**



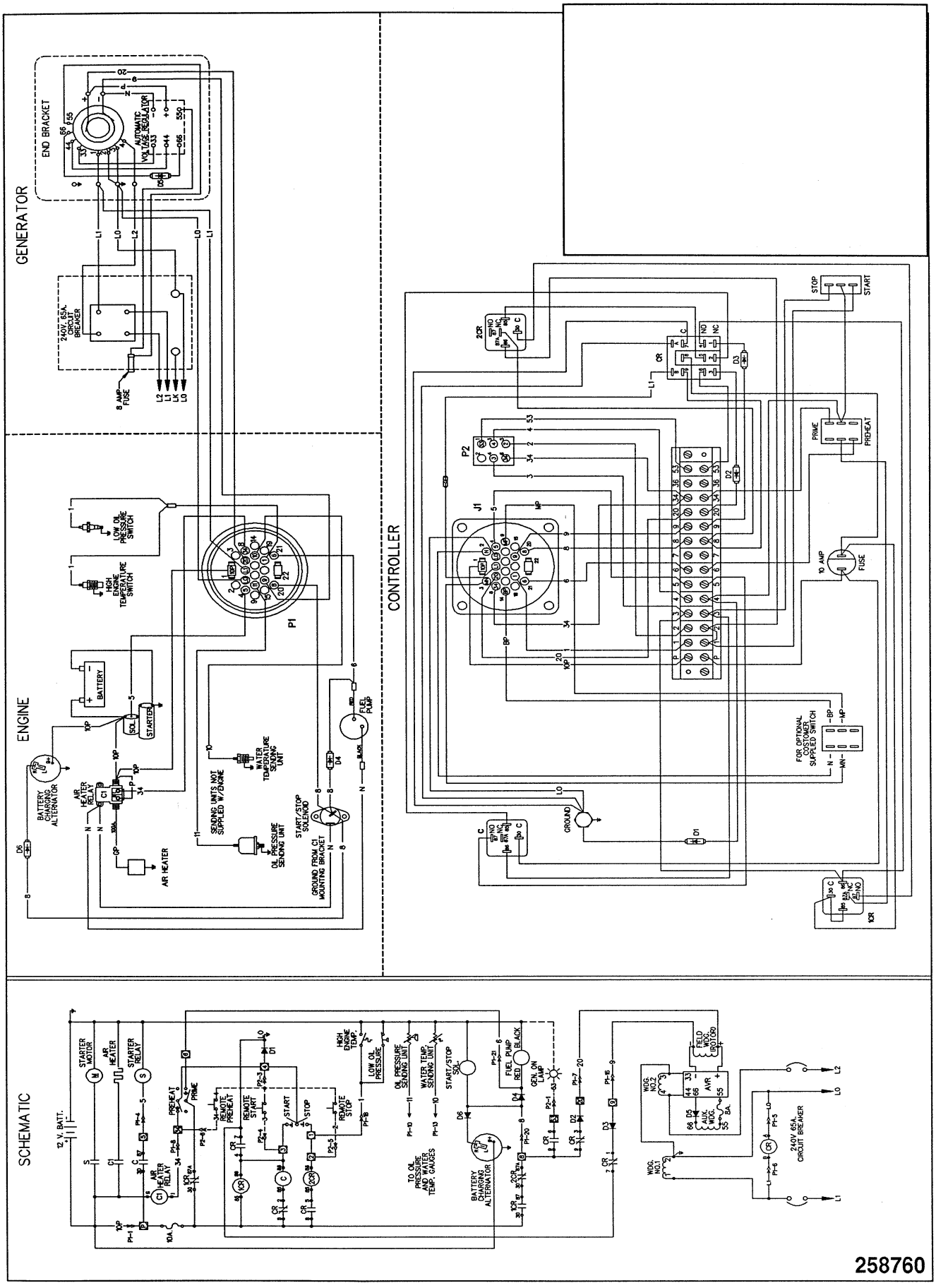

**Wiring Diagram 12.5CCO Standard (early controller, w/out P2 accessory plug)**



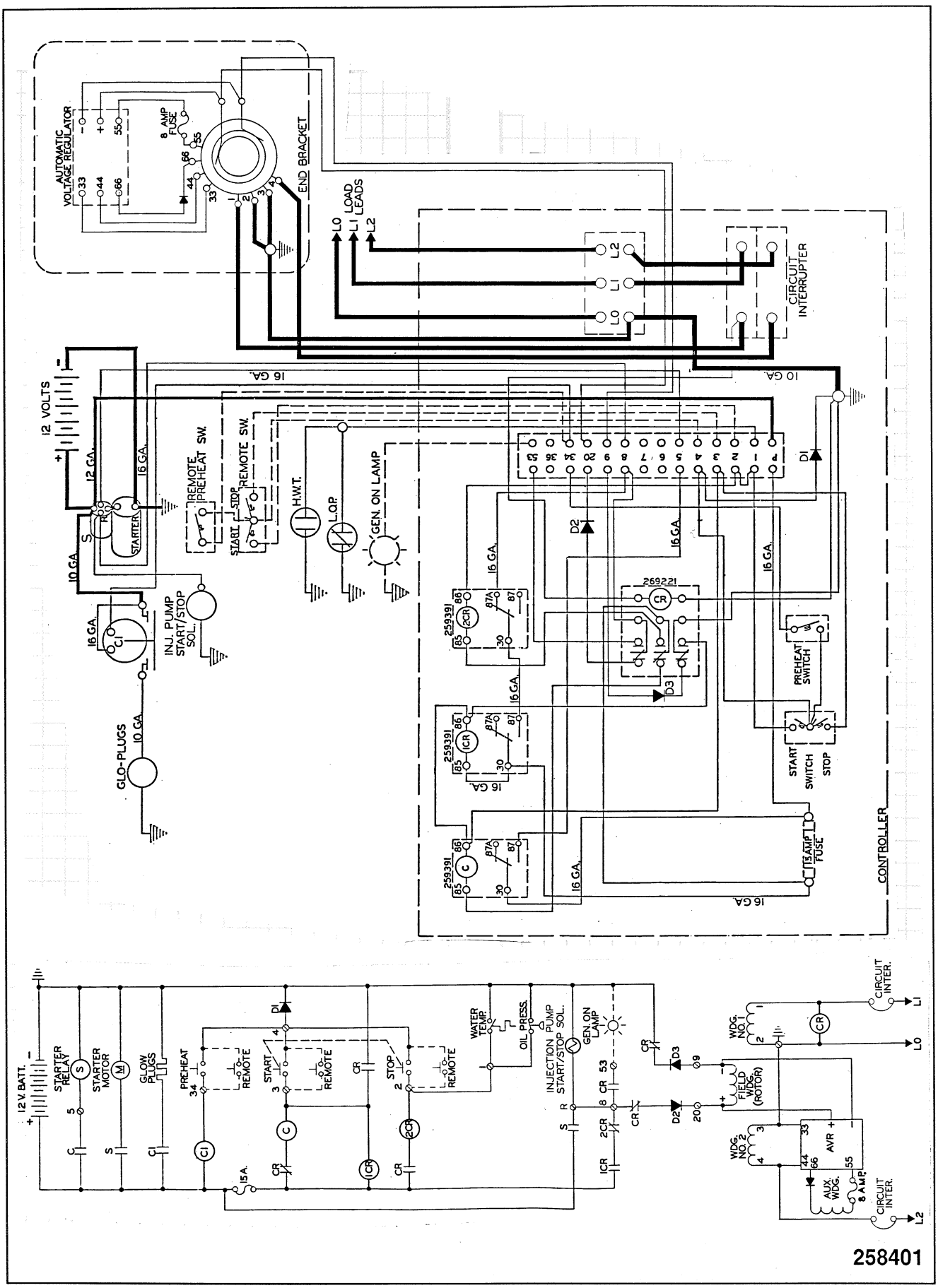

**Wiring Diagram 9CCO, 12.5CCO Standard (late controller, w/P2 accessory plug)**



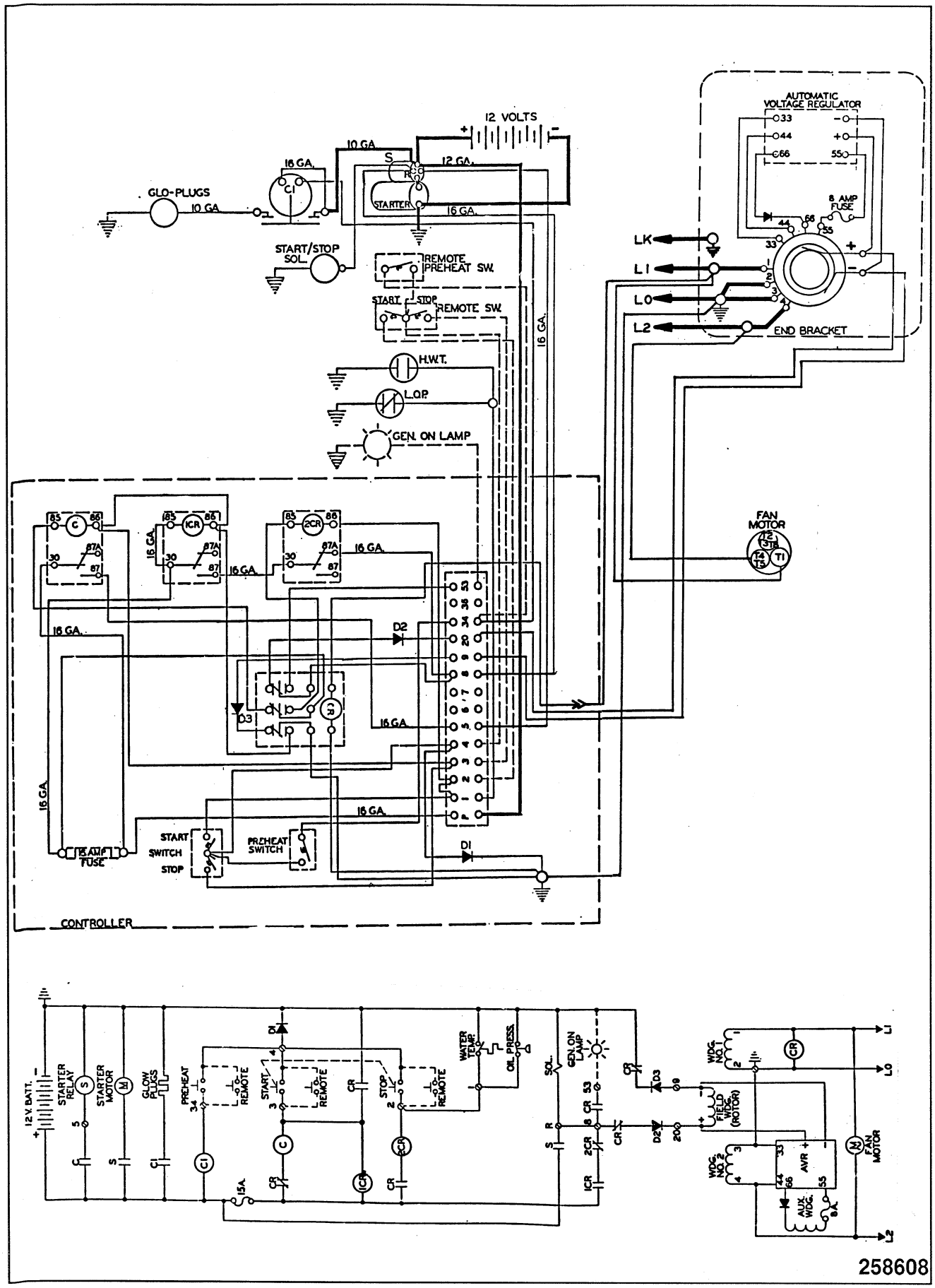

**Wiring Diagram 14.5CCO (early controller w/out P2 accessory plug)**



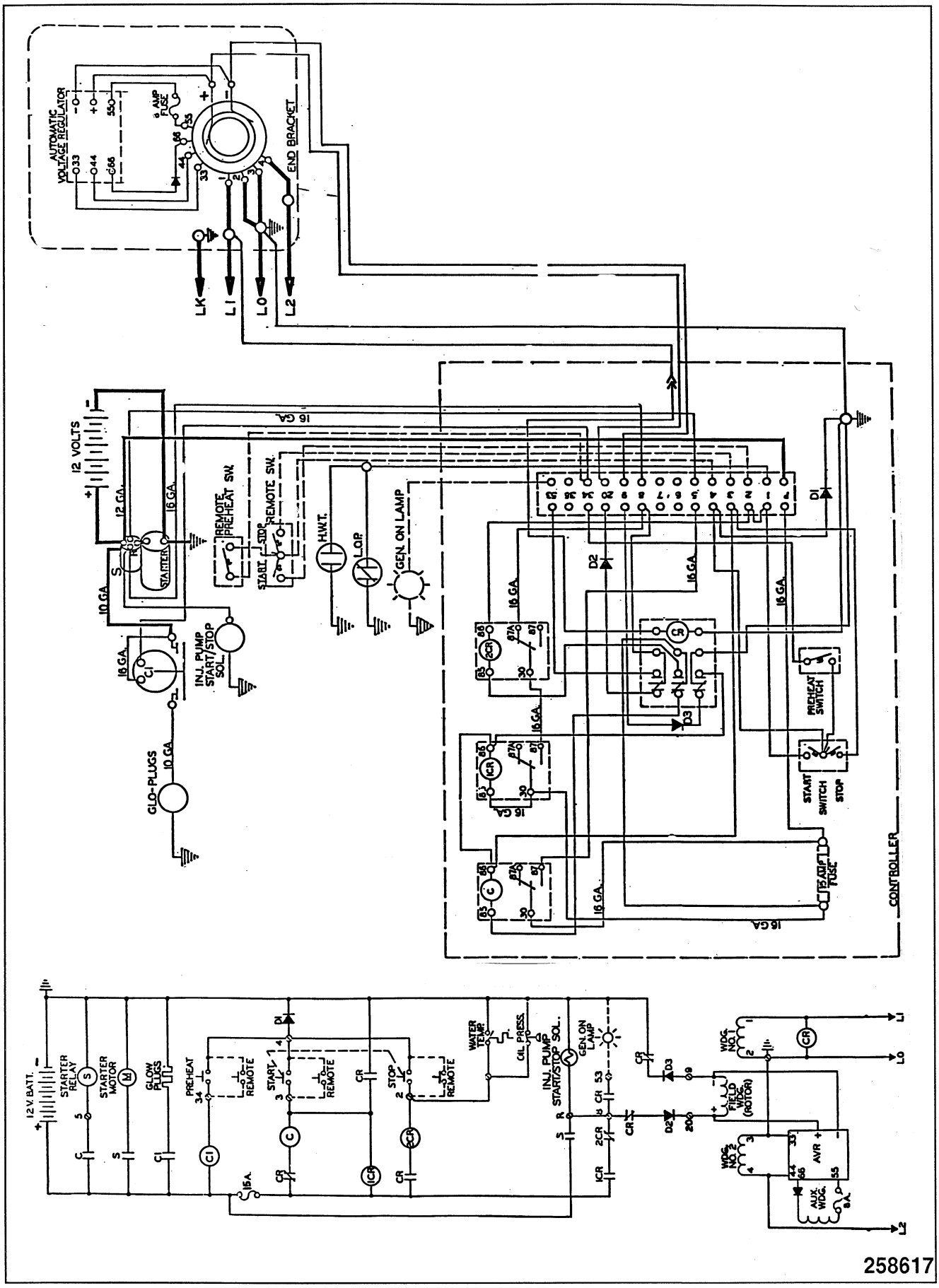

**Wiring Diagram 14.5CCO (late controller w/P2 accessory plug)**



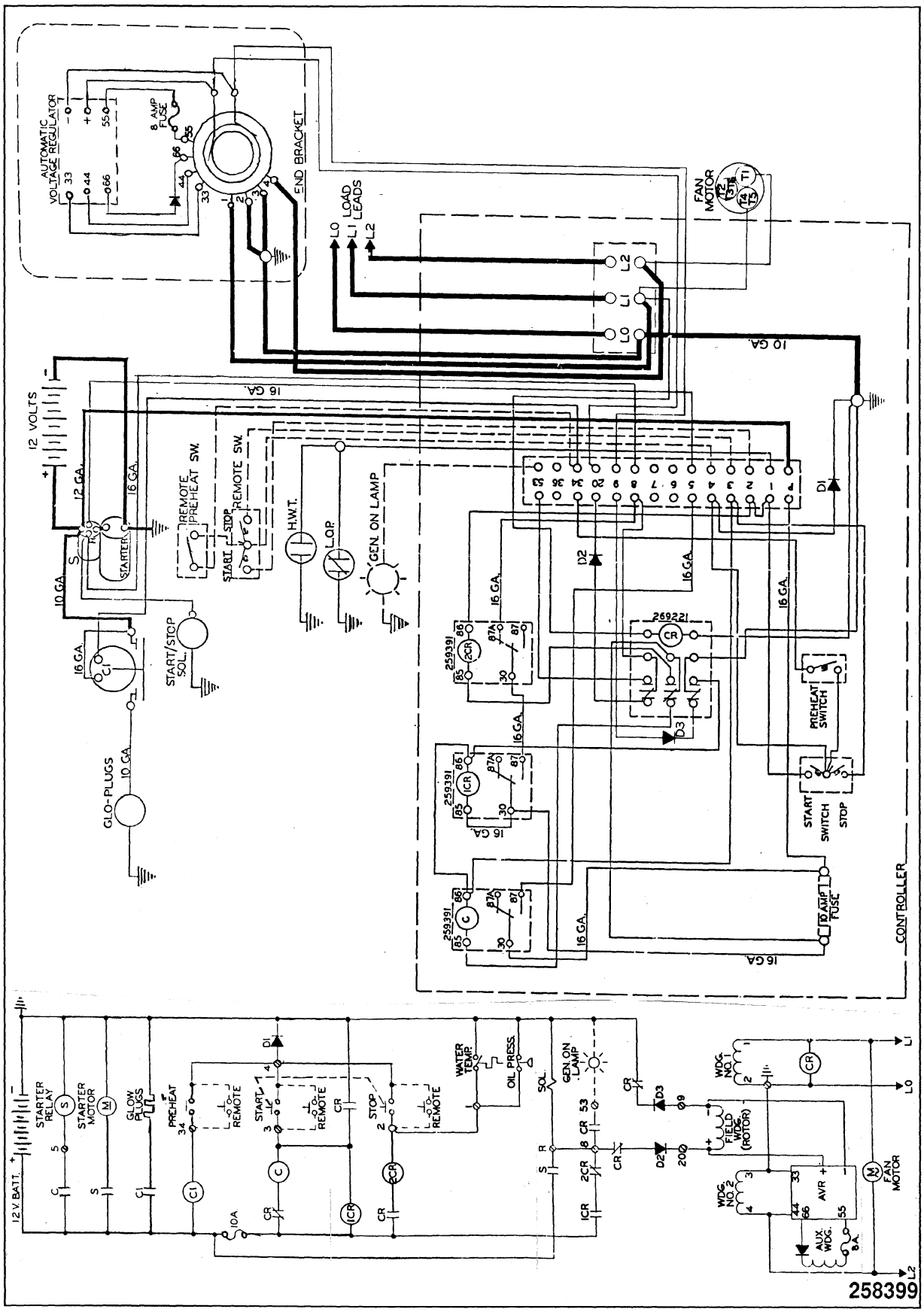

**Wiring Diagram Specification 961011, 961013, 961016, 961017 (Perkins)**




**Wiring Diagram Specification 961015 (Perkins)**




**Wiring Diagram Specification 961014 (Perkins)**




**Wiring Diagram Specification 961012 (Perkins)**

# Section 10. Specifications Chart

## Generators

| | | |
|---|---|---|
| Rated kW, 60 Hz-- 9CCO | | 9 |
| Rated kW, 60 Hz-- 12.5CCO/12.5CCO67 | | 12.5 |
| Rated kW, 60 Hz-- 14.5CCO | | 14.5 |
| Rated Amperes/Voltage-- 9CCO | 120-Volt, 2W | 75 |
| | 120/240-Volt, 3W | 37.5 |
| Rated Amperes/Voltage-- 12.5CCO | 120-Volt, 2W | 104.2 |
| | 120/240-Volt, 3W | 52.1 |
| Rated Amperes/Voltage--14.5CCO | 120-Volt, 2W | 120 |
| | 120/240-Volt, 3W | 60 |
| Shaft rpm, 60 Hz | | 1800 |
| Stator Resistance (in Ohms) | 1-2, 3-4, 33-44 | 9CCO, 1.5; 12.5 & 14.5, .07 |
| | 55-66 | 9CCO, 1.5; 12.5 & 14.5, 1.1 |
| Coupling Type-- 9 & 12.5CCO | | Flexible disc, tapered shaft, thru-bolt |
| Coupling Type-- 14.5CCO | | Flexible disc, friction-fit shaft/drive hub |
| Thru-bolt Torque (9 & 12.5 CCO only) | | 50 ft. lbs. (68 Nm) |
| Overbolt Torque | | 260 in. lbs. (29 Nm) |
| Excitation Method | | Static, brush type |
| Rotor Field Readings | | Voltage/Current |
| No load | | 22.6/6.0 |
| 1/4 load | | 26.4/7.0 |
| 1/2 load | | 28.3/7.5 |
| 3/4 load | | 29.8/7.9 |
| Full Load | | 33.9/9.0 |

| Engines | Yanmar | | Perkins |
|---|---|---|---|
| Model | 3TN82E-R | 4TN82-U/R | 4-108 |
| No. of Cylinders | 3 | 4 | 4 |
| Bore x Stroke In. | 3.228 x 3.386 | | 3.125 x 3.5 |
| mm | 82 x 86 | | 79 x 89 |
| Displacement cu.in. (cc) | 83.11(1362) | 110.8(1816) | 107.4(1760) |
| Horsepower | 16.5 | 22.0 | 24.0 |
| RPM | 1800 | | 1800 |
| Lube Oil Capacity-U.S.qts.(L) | 5(4.7) | 6.1(5.8) | Spec. 961015 4.0(3.8)<br>All others 7 U.S. qts. (6.6 L) |
| Oil Recommendation | SAE CC or CD | | SAE CC or CD |
| Fuel Type | Diesel, ATSM/D975-66T No. 2-D | | Diesel, ATSM/D975-66T No. 1-D or No. 2-D |
| Battery Voltage | 12 Volts | | 12 Volts |
| Battery Recommendation | 500 Cold Cranking Amps. | | 385 Cold Cranking Amps. |
| Fuel Injection Pressure | 2844 psi (200 kg/cm$^2$) | | 2200 psi (155 kg/cm$^2$) |
| Fuel Injection Timing | 16°+/- 1° BTDC | | See Engine Service Manual |
| Valve Clearance (Cold) | 0.0079 In. (0.20 mm) | | 0.012 In. (.30 mm) |
| Engine Firing Order | 1-3-2-1 | 1-3-4-2-1 | 1-3-4-2-1 |
| Cooling Capacity (Engine) qts. (L) | 2.1 (2) | 2.85 (2.7) | 2.5 gal. (9.5 L)* |
| Cooling Cap.(In-Line Rad.) qts. (L) | 10.6 (10) | 19 (18) | Remote Radiator Models, Follow Radiator Manufacturer's Recommendations |
| Remote Radiator Coolant Capacity (Kohler Model) | 4 gal. (15.1 L) | | |
| Compression Ratio | 18.06:1 | | 22:1 |
| Direction of Rotation (as viewed from generator end) | Counterclockwise | | Counterclockwise |
| Cylinder Head Tightening Torque | 29 ft.lbs.(39 Nm) Initial<br>58 ft.lbs.(78 Nm) Final | | 60 ft. lbs. (81 Nm) |

*Standard model - offset radiator model may vary slightly.

TP-5235 11/90
PRINTED IN U.S.A.

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GENERATORS

KOHLER CO. KOHLER, WISCONSIN 53044