Technical Training

Participant's Guide

RV GenSets ™

9/2000
932-0376

RV GenSet Module

Table of Contents

The introduction describes the audience, the purpose, and the structure of the training module.

This section presents an overview of the Emerald/Marquis generator set, the steps needed to complete a correct and safe installation, the periodic maintenance schedule, locating service points, and test and adjust procedures, and the troubleshooting steps and job aids for the Emerald/Marquis generator set. It will cover the use of the troubleshooting sections of the *Service Manuals,* AC and DC schematic reading, the use of special tools for diagnostic testing, and troubleshooting common GenSet problems.

This section presents an overview of the MicroLite generator set, the steps needed to complete a correct and safe installation, the periodic maintenance schedule with location of service points, and test and adjust procedures, and the troubleshooting steps and job aids for the MicroLite generator set. It will cover the use of the troubleshooting sections of the *Service Manuals,* AC and DC schematic reading, the use of special tools for diagnostic testing, and troubleshooting common genset problems.

This section presents an overview of the Onan Quiet Diesel generator set, the steps needed to complete the correct and safe installation, the periodic maintenance schedule, location of service points, and test and adjust procedures, and the troubleshooting steps and job aids for the Onan/Kubota generator set. It will cover the use of the troubleshooting sections of the *Service Manuals,* AC and DC schematic reading, the use of special tools for diagnostic testing, and troubleshooting common genset problems.

This section presents an overview of the Emerald Advantage, Marquis Gold and Marquis Platinum generator sets, the steps needed to complete a correct and safe installation, the periodic maintenance schedule, locating service points, and test and adjust procedures, and the troubleshooting steps and job aids for the Emerald Advantage, Marquis Gold and Marquis Platinum generator sets. It will cover the use of the troubleshooting sections of the *Service Manuals,* AC and DC schematic reading, the use of special tools for diagnostic testing, and troubleshooting common GenSet problems.

This section lists the most common terms used through this training module pertaining to basic electricity and generators.

Includes manuals, spec sheets, and supplemental material used in the delivery of the RV GenSet training module.

Introduction

Welcome!

Welcome to the Participant's Guide for the Onan RV GenSet module! This guide was written by Onan's Sales and Technical Training department for your use and reference.

We suggest you read through the entire Introduction to become familiar with the guide's structure. Then, just follow along in the guide during your training session.

Module Purpose

The purpose of the RV GenSet module is to help you, the Cummins/Onan distributor, dealer or OEM service technician, understand Onan RV GenSets.

With this information, you will be better prepared to meet your customers' varying needs.

Module Audience

This module was written for Cummins/Onan distributor, dealer or OEM service technicians who have previous experience with or knowledge of electrical, engine, and generator basics.

Module Structure

This module contains lessons on related topics. Each lesson follows a carefully designed training format, including a warm up, presentation, and activity (or exercise).

Lesson Format

Warm ups help you focus and begin thinking about the lesson topic. The *presentation* portion of the lesson is where you receive new information. The *activity* follows the presentation; it gives you the chance to practice new skills or work with new ideas.

Module Assessment

After completing all the lessons in the module, you will complete a *module assessment*. The module assessment lets us evaluate the level of knowledge you have on the topic after completing the module.

Module Comment Form

You will also complete a *module comment form*. This form gives you the chance to comment on the usefulness and effectiveness of the training module and make suggestions for improvements.

We will use the results from the module assessment and module comment form to help us determine if there is a need to modify the module.

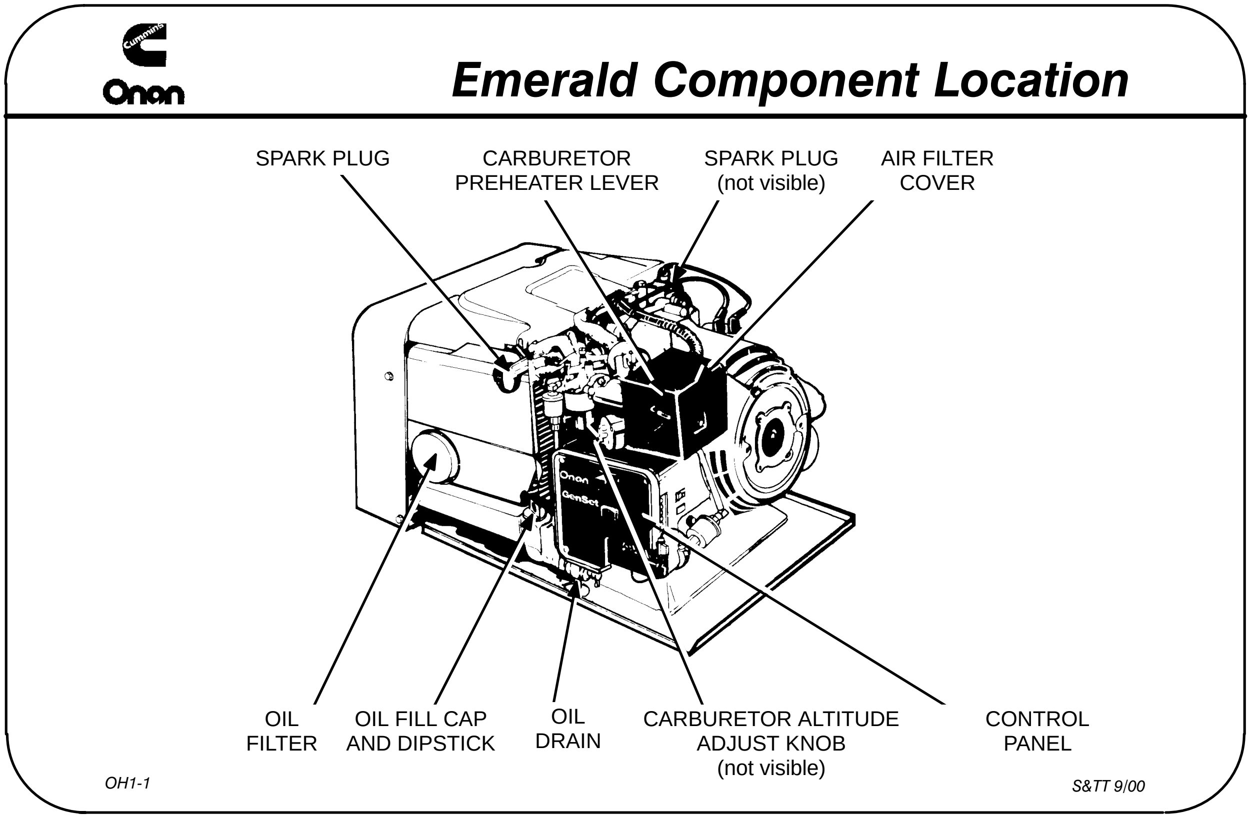
Emerald/Marquis GenSet Overview

This lesson presents an overview of the Emerald/Marquis generator set.

Objectives

After completing this lesson, you should be able to:

- Identify the main features of the Emerald/Marquis GenSet.
- Locate the Emerald/Marquis GenSet Model Tag.
- Decipher the Model Identification.
- Decipher the GenSet Serial Number.



Emerald Component Location

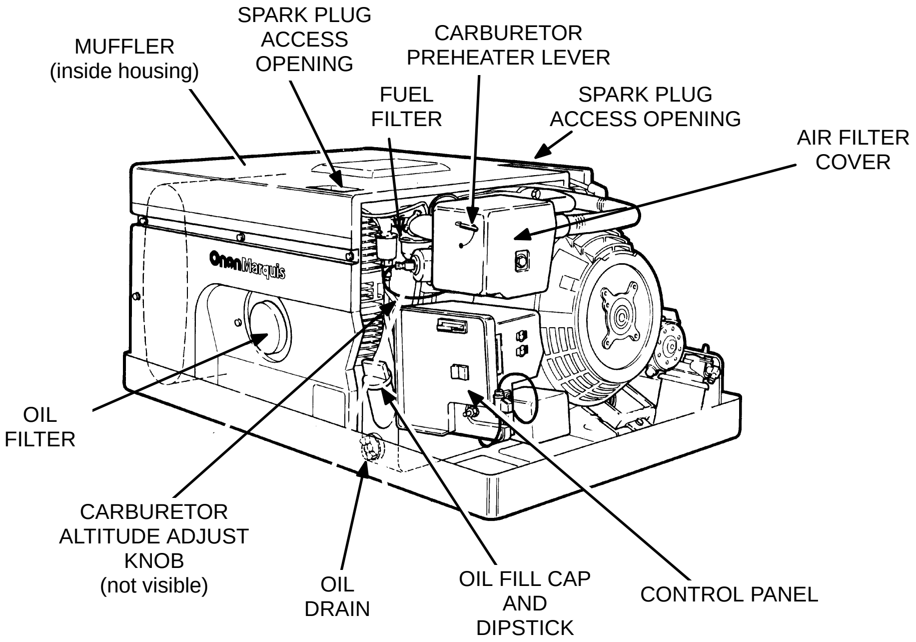
OH1-1

S&TT 9/00

Slide 1-1: Emerald Component Locations

- Twin cylinder Performer™ engines (gasoline and propane fueled).
- 4 to 6.5 kW, 50/60 Hz.
- Rotating field generator.
- Transformer (early) and automatic voltage regulated (late models).
- Above and below floor mounted.

Marquis Component Location

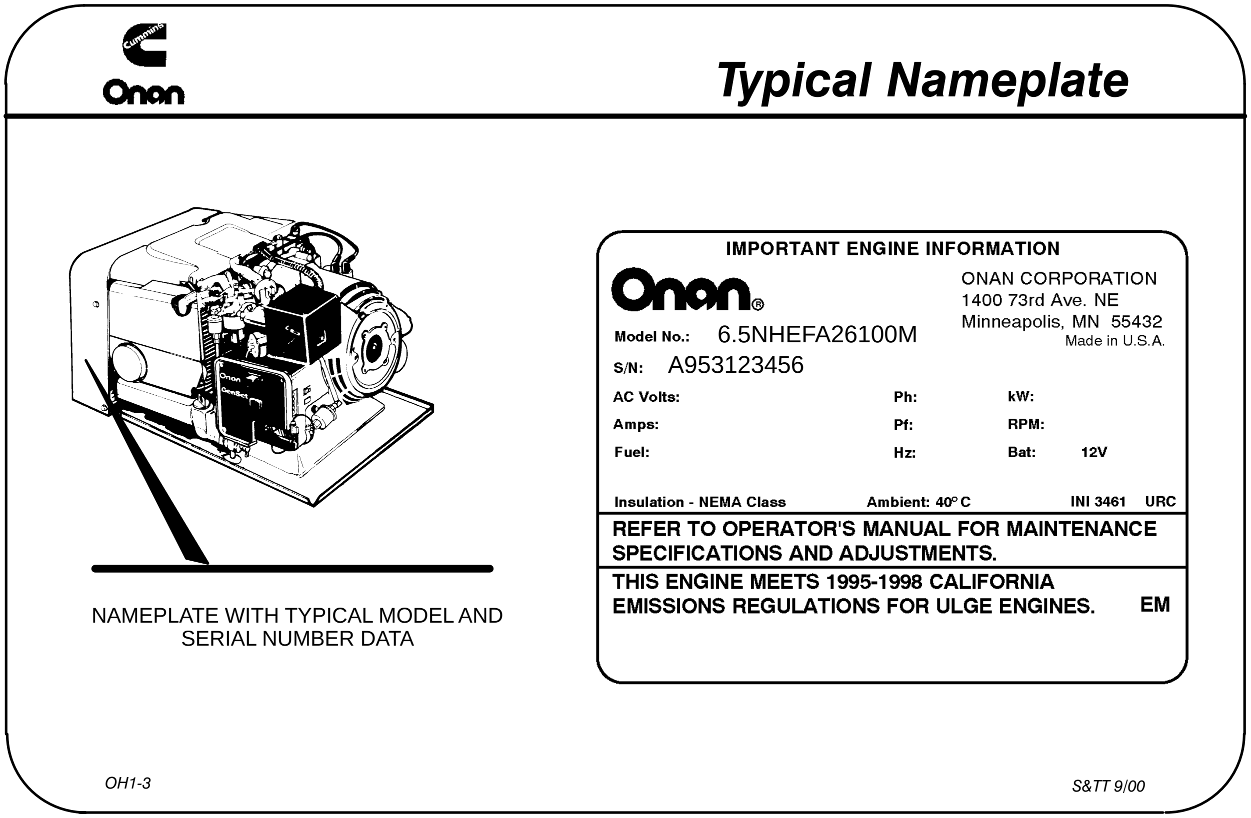


OH1-2

S&TT 9/00

Slide 1-2: Marquis Component Locations

- Twin cylinder Performer™ engines (gasoline and propane fueled).
- 5.5 to 7 kW, 60 Hz.
- Rotating field generator.
- Automatic voltage regulation.
- Electronic governor control.



Onan

Typical Nameplate

NAMEPLATE WITH TYPICAL MODEL AND SERIAL NUMBER DATA

IMPORTANT ENGINE INFORMATION

Onan®

ONAN CORPORATION
1400 73rd Ave. NE
Minneapolis, MN 55432
Made in U.S.A.

Model No.: 6.5NHEFA26100M

S/N: A953123456

AC Volts: **Ph:** **kW:**

Amps: **Pf:** **RPM:**

Fuel: **Hz:** **Bat:** 12V

Insulation - NEMA Class **Ambient: 40° C** **INI 3461 URC**

REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.

THIS ENGINE MEETS 1995-1998 CALIFORNIA EMISSIONS REGULATIONS FOR ULGE ENGINES. **EM**

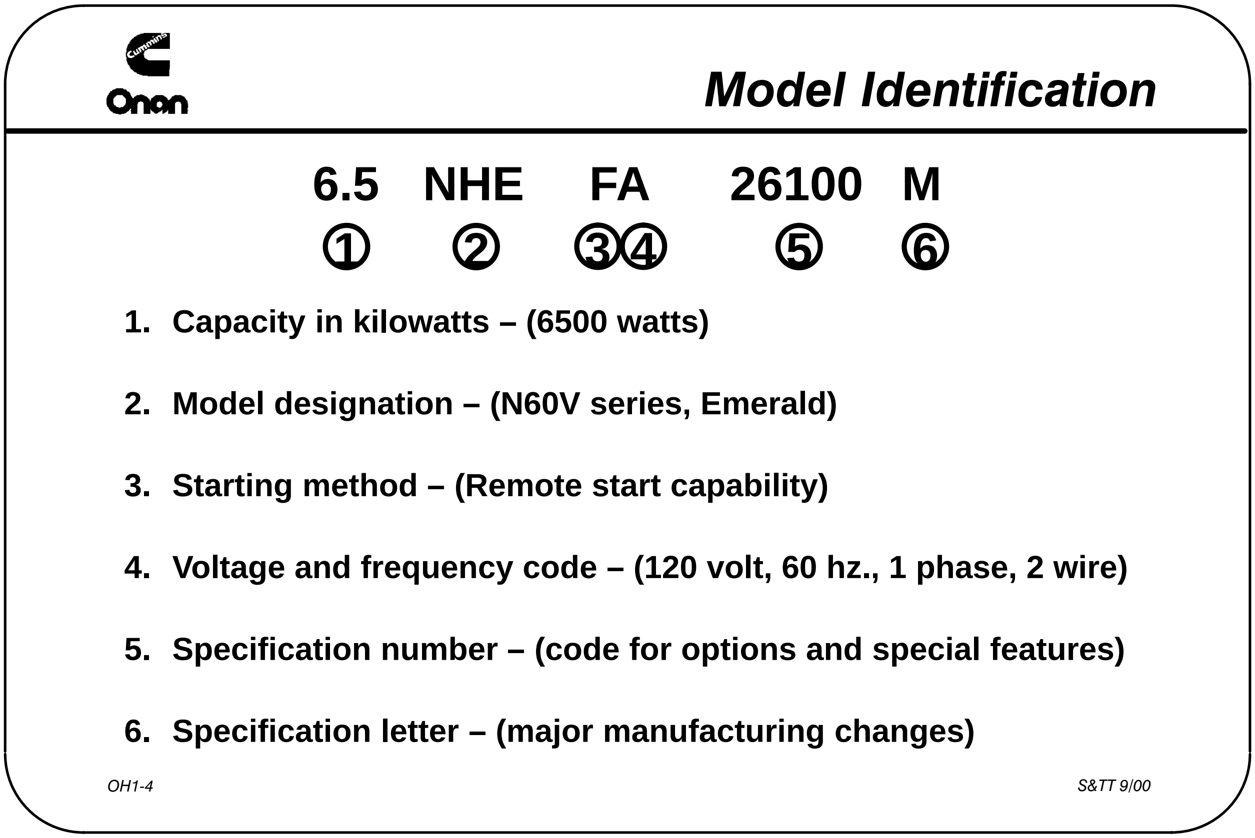
OH1-3

S&TT 9/00

Slide 1-3: Typical Nameplate

Used for:

- Parts ordering.
- Manuals, literature and troubleshooting aids.
- Communicating with distributor/factory.



Model Identification

6.5 NHE FA 26100 M

① ② ③④ ⑤ ⑥

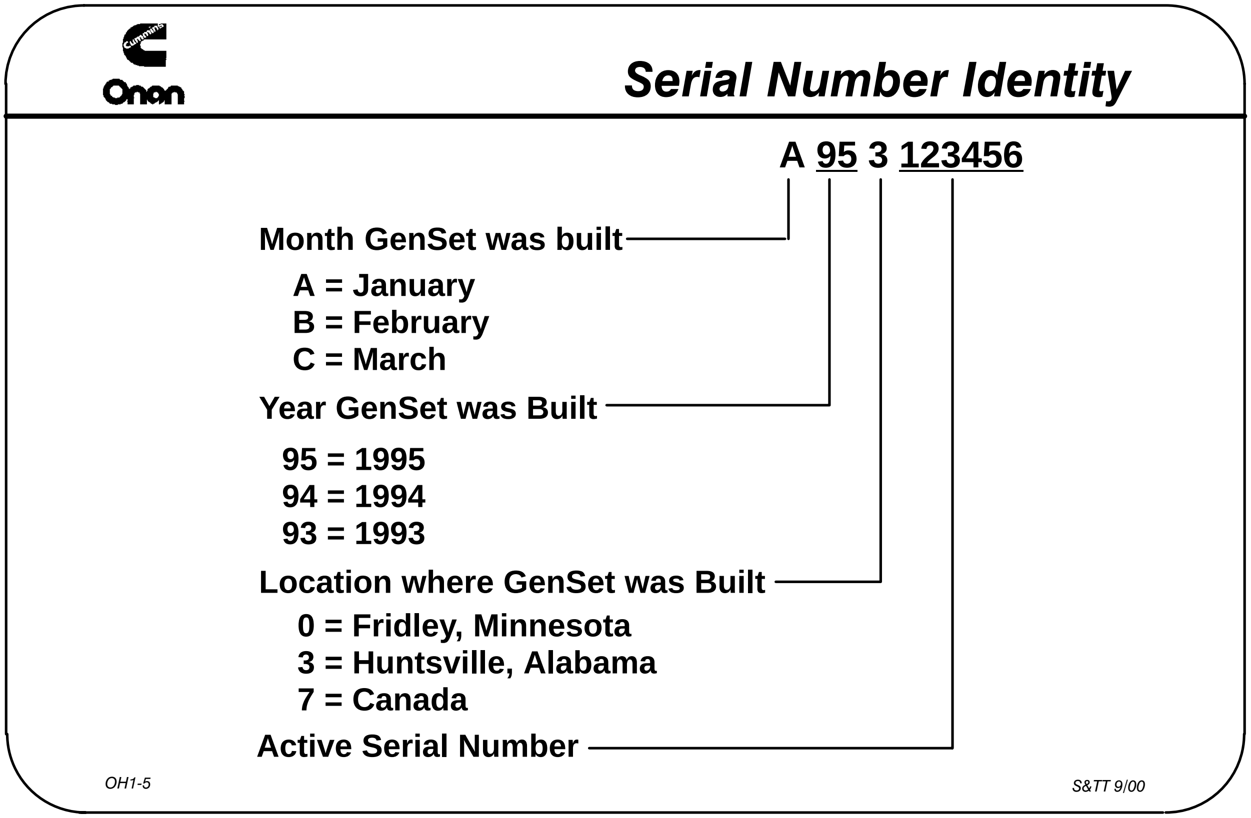
1. **Capacity in kilowatts – (6500 watts)**
2. **Model designation – (N60V series, Emerald)**
3. **Starting method – (Remote start capability)**
4. **Voltage and frequency code – (120 volt, 60 hz., 1 phase, 2 wire)**
5. **Specification number – (code for options and special features)**
6. **Specification letter – (major manufacturing changes)**

OH1-4 *S&TT 9/00*

Slide 1-4: Model Identification

Helps to:

- Obtain proper parts.
- Find specific troubleshooting procedures and specifications.
- Communicate with distributor and/or factory or service or warranty.



Serial Number Identity

A 95 3 123456

Month GenSet was built

A = January
B = February
C = March

Year GenSet was Built

95 = 1995
94 = 1994
93 = 1993

Location where GenSet was Built

0 = Fridley, Minnesota
3 = Huntsville, Alabama
7 = Canada

Active Serial Number

OH1-5

S&TT 9/00

Slide 1-5: Serial Number Identification

Use to:

- Identify when manufactured.
- Identify where manufactured.

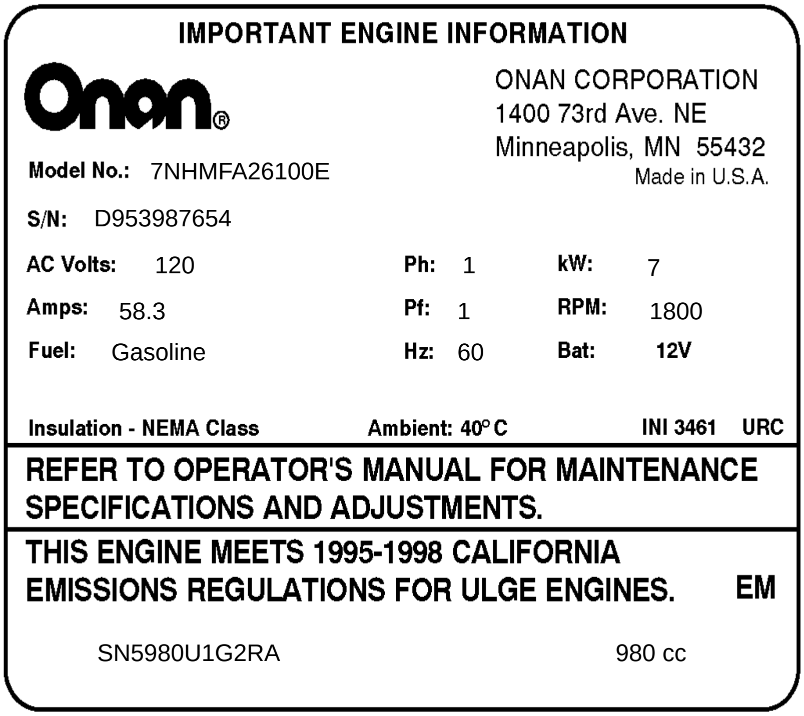
Activity

Slide 1-6:

Directions: Identify the following using the nameplate below:

Year GenSet was built:______________________________
Month GenSet was built:____________________________
Specification letter:_________________________________
Specification number:______________________________
Kilowatt rating:____________________________________
Starting method:___________________________________
Voltage code:______________________________________
Output amps:______________________________________
Power factor: _____________________________________
Actual serial number:_______________________________
Frequency output:__________________________________
Engine family:_____________________________________
Location where GenSet was built:___________________

NAMEPLATE WITH TYPICAL MODEL AND SERIAL NUMBER DATA



IMPORTANT ENGINE INFORMATION

ONAN CORPORATION
1400 73rd Ave. NE
Minneapolis, MN 55432
Made in U.S.A.

Model No.: 7NHMFA26100E

S/N: D953987654

AC Volts:	120	**Ph:**	1	**kW:**	7
Amps:	58.3	**Pf:**	1	**RPM:**	1800
Fuel:	Gasoline	**Hz:**	60	**Bat:**	**12V**

Insulation - NEMA Class **Ambient: 40° C** **INI 3461 URC**

REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.

THIS ENGINE MEETS 1995-1998 CALIFORNIA EMISSIONS REGULATIONS FOR ULGE ENGINES. **EM**

SN5980U1G2RA 980 cc

OH1-6

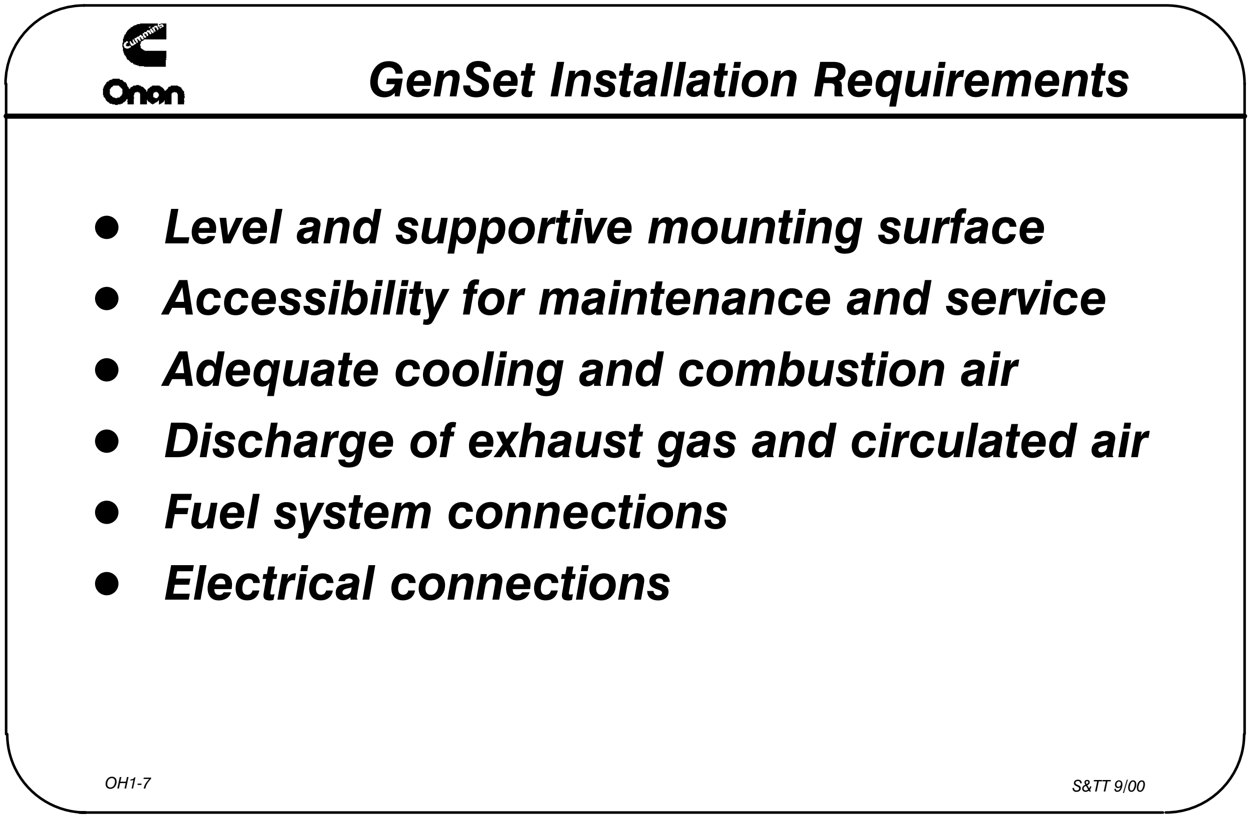
Emerald/Marquis GenSet Installation

This lesson presents the steps needed to complete a correct and safe installation of an Emerald/Marquis generator set.

Objectives

After completing this lesson, you should be able to:

- Identify the requirements to consider prior to installation of an Emerald/Marquis GenSet.
- Make all applicable exhaust, fuel and battery connections.
- Connect a load bank and start the GenSet.
- Plot a no-load to full-load power curve.



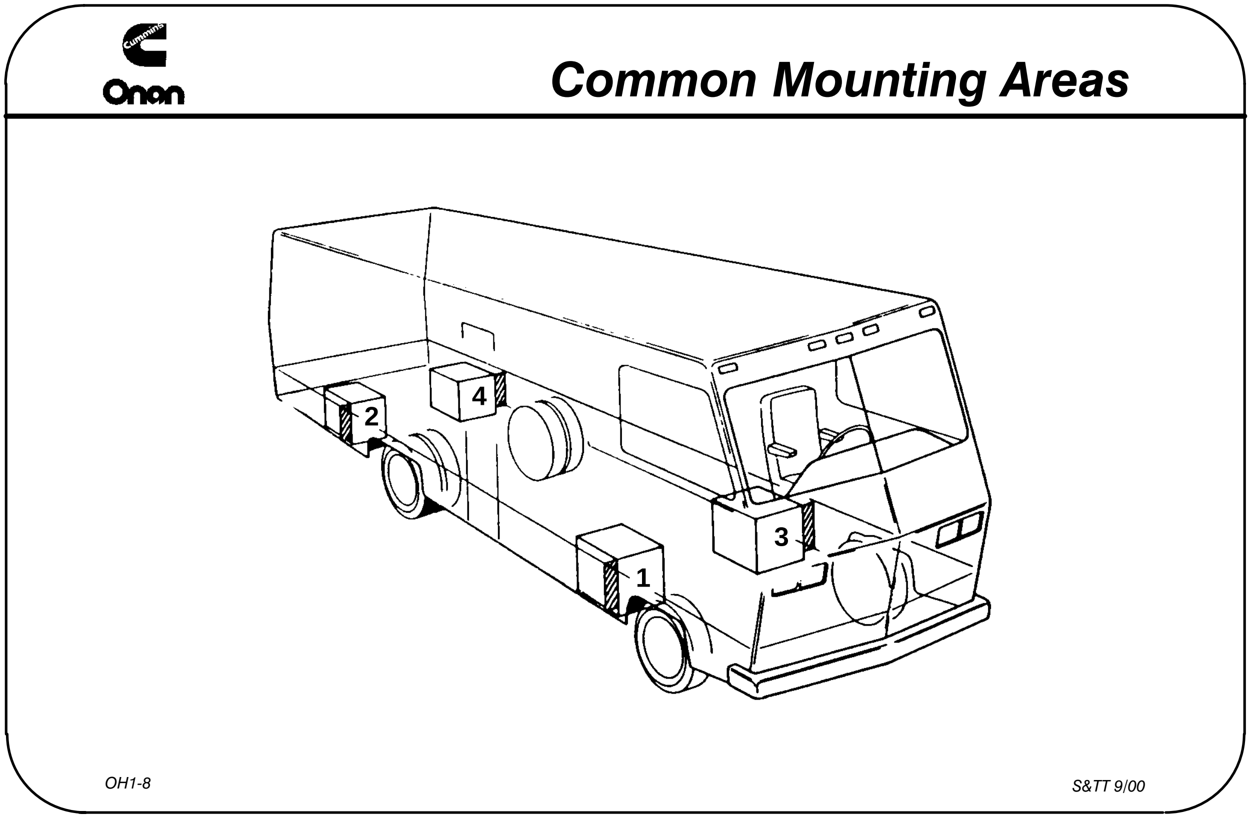
GenSet Installation Requirements

- ***Level and supportive mounting surface***
- ***Accessibility for maintenance and service***
- ***Adequate cooling and combustion air***
- ***Discharge of exhaust gas and circulated air***
- ***Fuel system connections***
- ***Electrical connections***

OH1-7

S&TT 9/00

Slide 1-7: GenSet Installation Requirements



Common Mounting Areas

OH1-8

S&TT 9/00

Slide 1-8: Common Mounting Areas

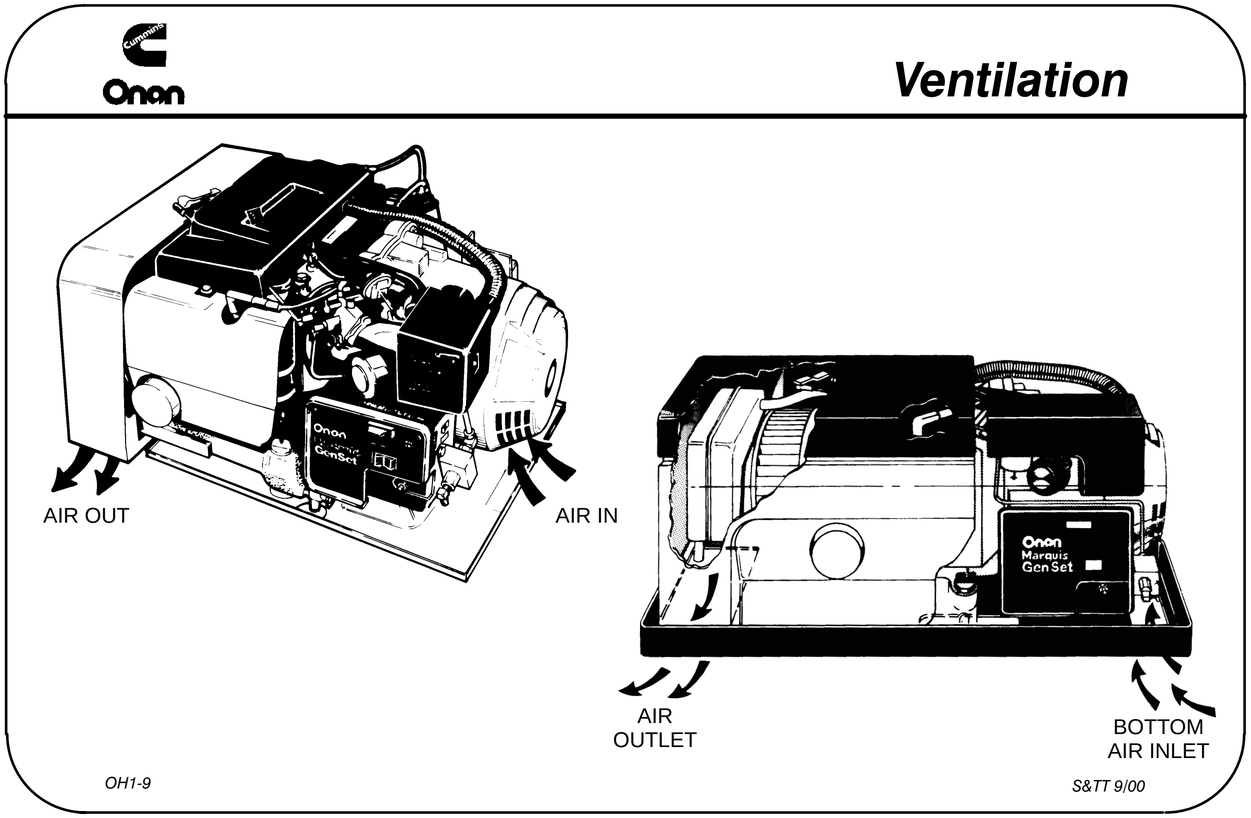
Compartment must have:

- Walls sealed for exhaust and fuel vapor containment.
- 26-gauge or greater galvanized steel construction.
- Drains in floor to prevent accumulation of gas and oil.

GenSet must be level and supported.

What service items must you provide access to?

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________



Ventilation

OH1-9

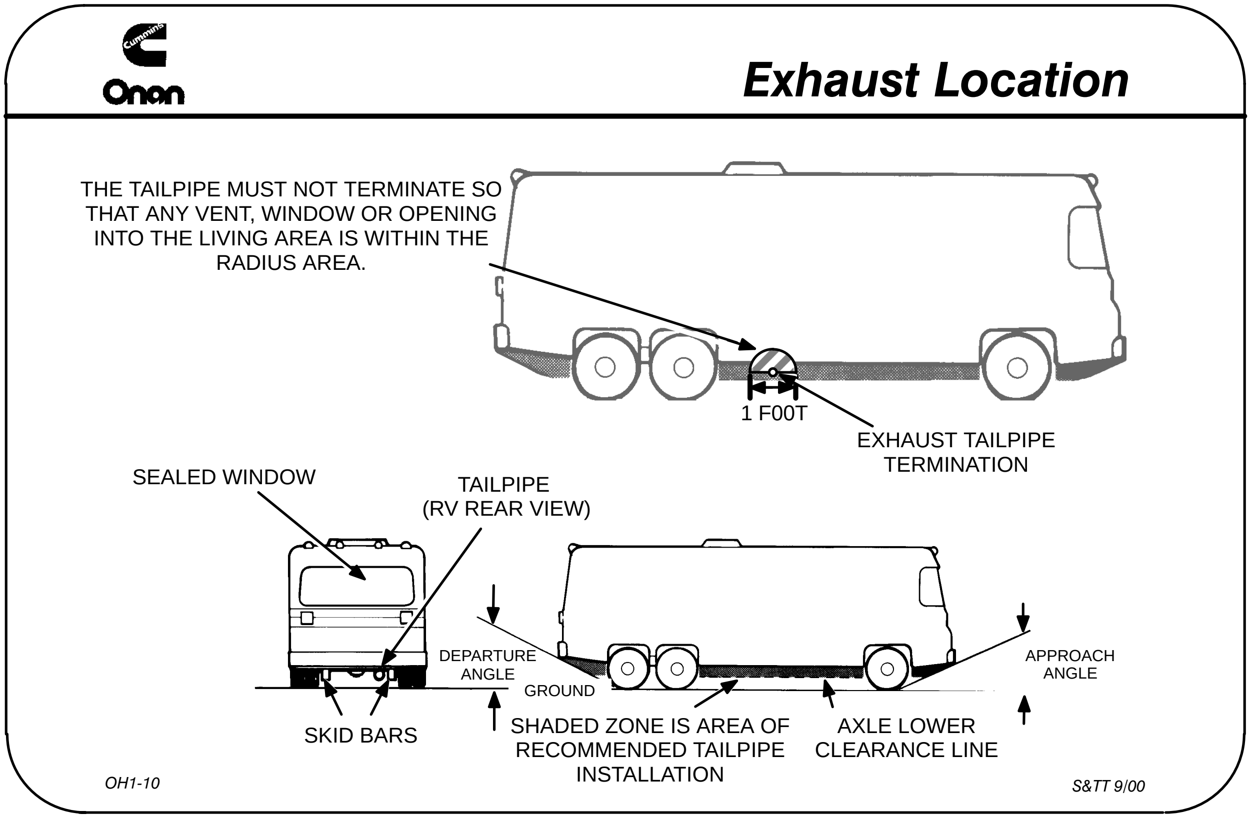
S&TT 9/00

Slide 1-9: Ventilation

- Vacu-Flo® cooling
- The free air inlet area is critical.
- Sufficient incoming air for _________________________ and _________________________.
- Adequate exhausting of _________________________ air.

Note: Use GenSet spec. sheet to find correct the minimum cfm for combustion, engine cooling and generator cooling requirements.

Note: Use GenSet *Installation Manual* to find the minimum air inlet area (sq. inches and sq. cm) for combustion, engine cooling and generator cooling requirements.



Exhaust Location

THE TAILPIPE MUST NOT TERMINATE SO THAT ANY VENT, WINDOW OR OPENING INTO THE LIVING AREA IS WITHIN THE RADIUS AREA.

1 F00T

EXHAUST TAILPIPE TERMINATION

SEALED WINDOW

TAILPIPE (RV REAR VIEW)

DEPARTURE ANGLE

GROUND

APPROACH ANGLE

SKID BARS

SHADED ZONE IS AREA OF RECOMMENDED TAILPIPE INSTALLATION

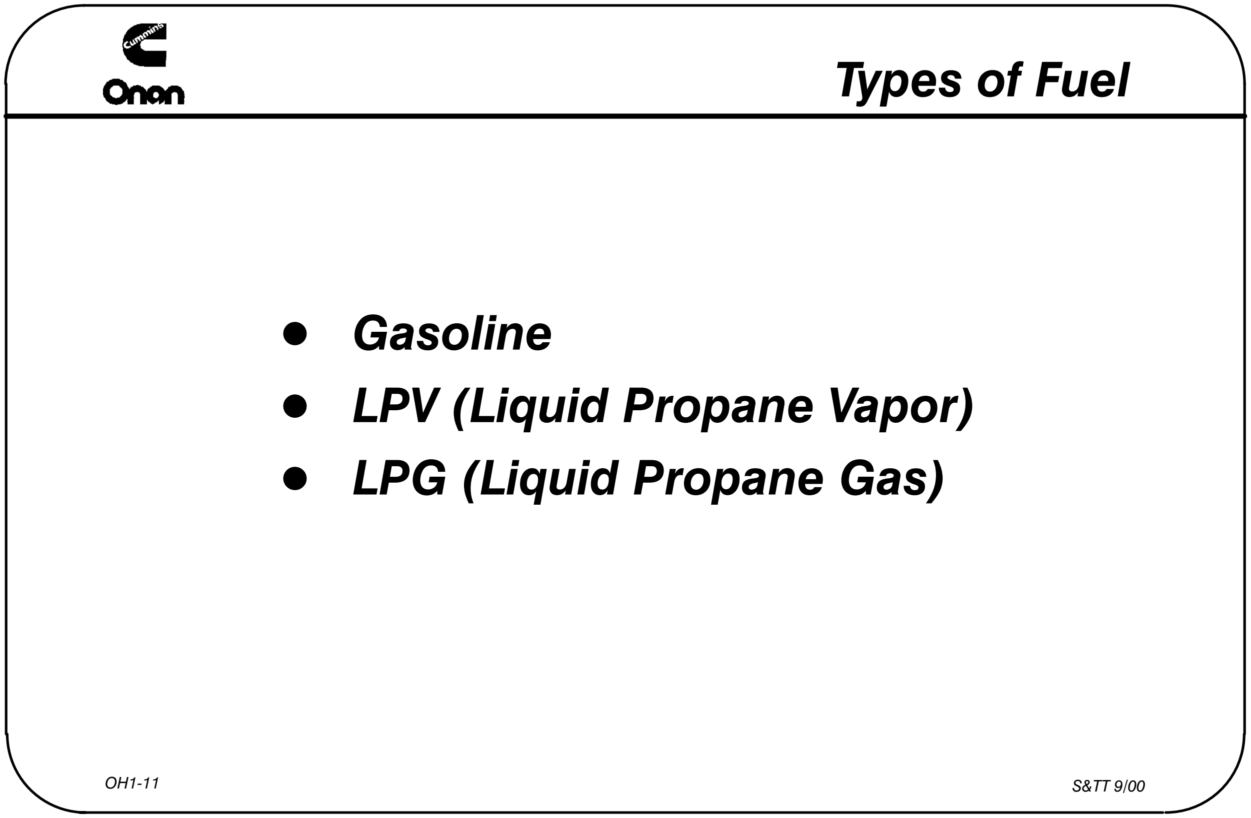
AXLE LOWER CLEARANCE LINE

OH1-10

S&TT 9/00

Slide 1-10: Exhaust Location

- Do not terminate exhaust under vehicle.
- Support the exhaust at or near the perimeter of vehicle.
- Use only Onan approved, spark arrested mufflers.
- System must extend a minimum of 1 inch beyond perimeter of vehicle.
- Use double rubber, U-shaped shock mounting hangers.



Types of Fuel

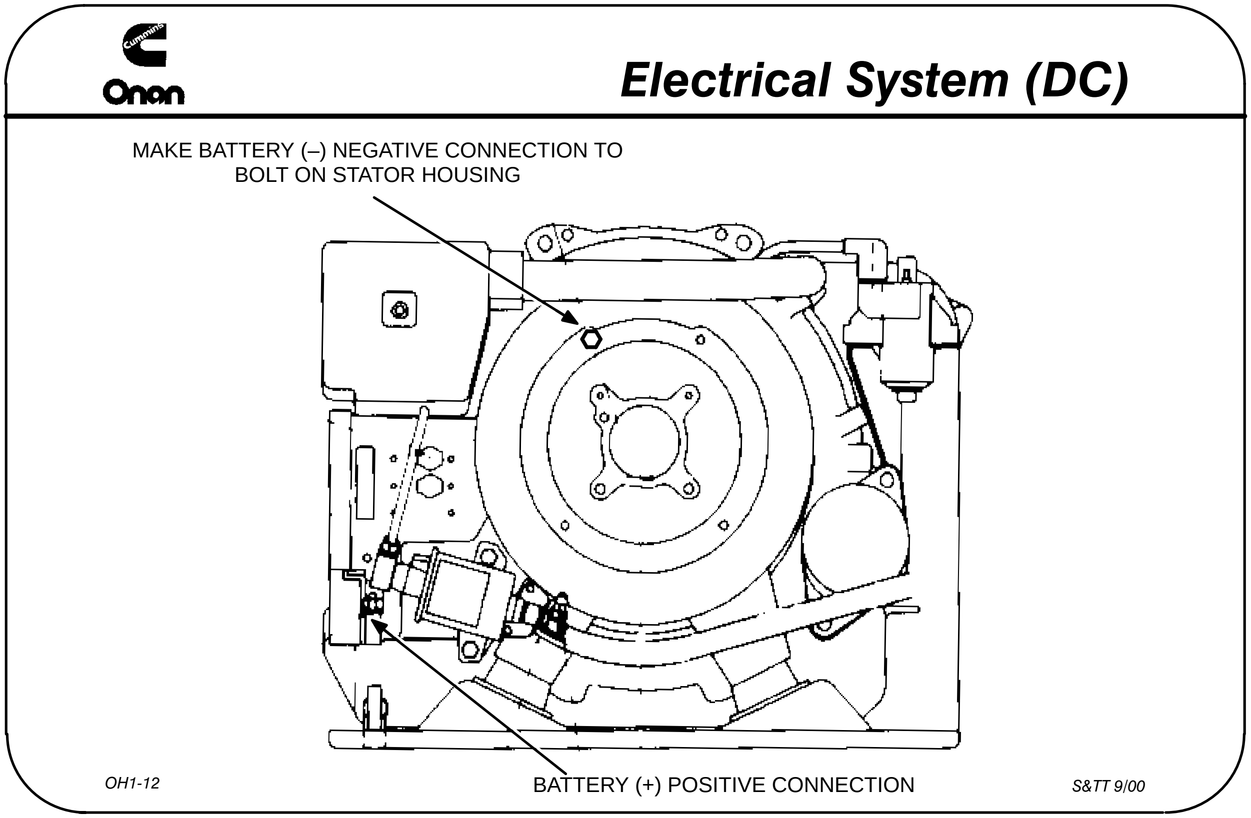
- Gasoline
- LPV (Liquid Propane Vapor)
- LPG (Liquid Propane Gas)

OH1-11

S&TT 9/00

Slide 1-11: Fuel System

- Use a separate fuel pickup tube at tank.
- The fuel pickup should not extend below the bottom $^1/_4$ of tank (gasoline).
- Use a flexible, non-metallic line between set and vehicle fuel system.
- Keep piping, hoses and fittings away from heat.
- Don’t run fuel lines in conjunction with electrical wiring.



Electrical System (DC)

MAKE BATTERY (–) NEGATIVE CONNECTION TO BOLT ON STATOR HOUSING

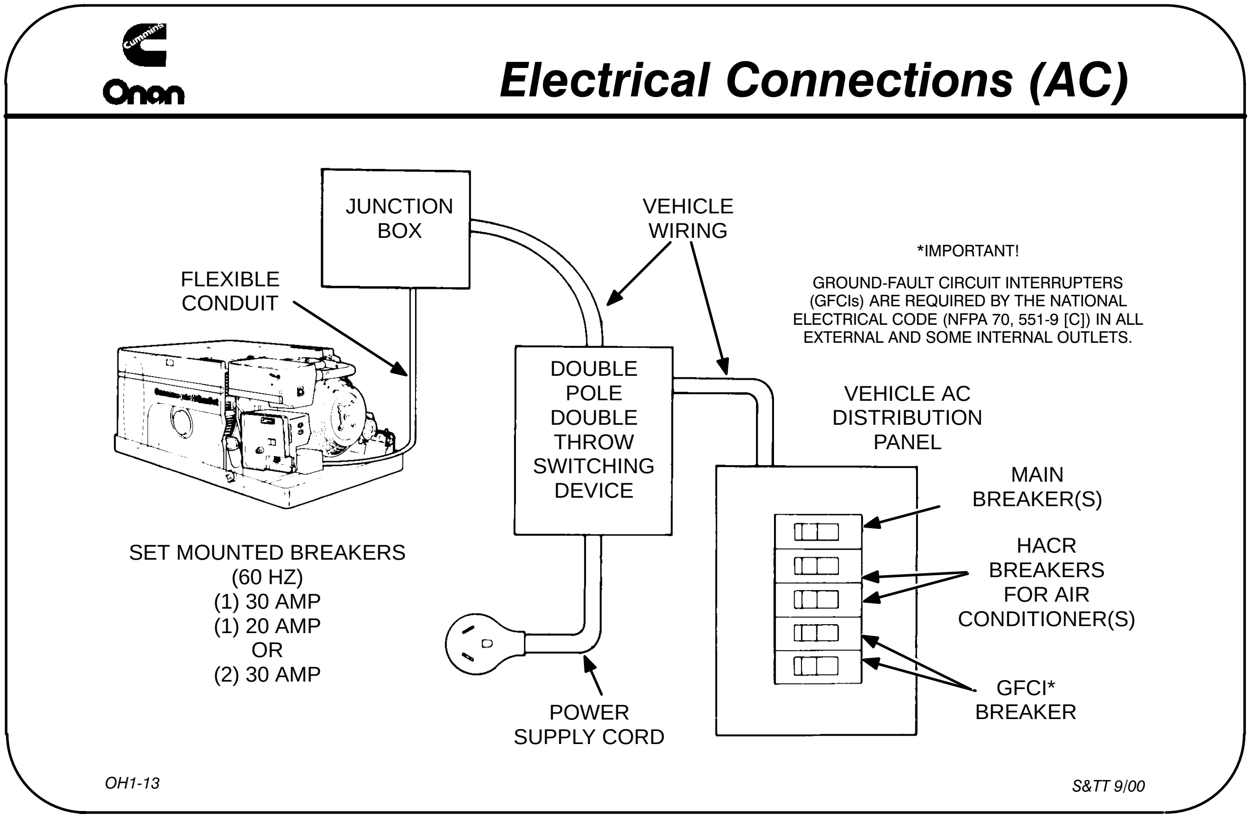
BATTERY (+) POSITIVE CONNECTION

OH1-12

S&TT 9/00

Slide 1-12: Electrical Connections (DC)

- Select a battery and cables that are appropriate for the GenSet cold cranking needs.
- Mount the battery in its own compartment.
- Use the same size battery cable for both positive (+) and negative (-) battery connections.
- Connect B+ cable to start solenoid and cover with terminal boot.
- Connect B- cable to stator housing using bolt and washer.



Electrical Connections (AC)

JUNCTION BOX

FLEXIBLE CONDUIT

VEHICLE WIRING

*IMPORTANT!

GROUND-FAULT CIRCUIT INTERRUPTERS (GFCIs) ARE REQUIRED BY THE NATIONAL ELECTRICAL CODE (NFPA 70, 551-9 [C]) IN ALL EXTERNAL AND SOME INTERNAL OUTLETS.

DOUBLE POLE DOUBLE THROW SWITCHING DEVICE

VEHICLE AC DISTRIBUTION PANEL

MAIN BREAKER(S)

HACR BREAKERS FOR AIR CONDITIONER(S)

GFCI* BREAKER

SET MOUNTED BREAKERS
(60 HZ)
(1) 30 AMP
(1) 20 AMP
OR
(2) 30 AMP

POWER SUPPLY CORD

OH1-13

S&TT 9/00

Slide 1-13: Electrical Connections (AC)

- All wiring must meet local electrical codes.
- Conductors must be current rated not less than 115% of nameplate.
- Use stranded wire for all load connections.
- Use a flexible conduit from GenSet to junction box and seal internally from exhaust gases.
- There must be no possibility of an outside power source being connected to the GenSet.

Activity

Directions: Setup the GenSet to run and document its performance by plotting a power curve.

Follow these steps:

1. Check the GenSet oil level.

   ☐ oil level

2. Connect the GenSet exhaust, fuel and battery.

   ☐ exhaust
   ☐ fuel
   ☐ battery

3. Connect the appropriately sized load bank.

   ☐ load bank

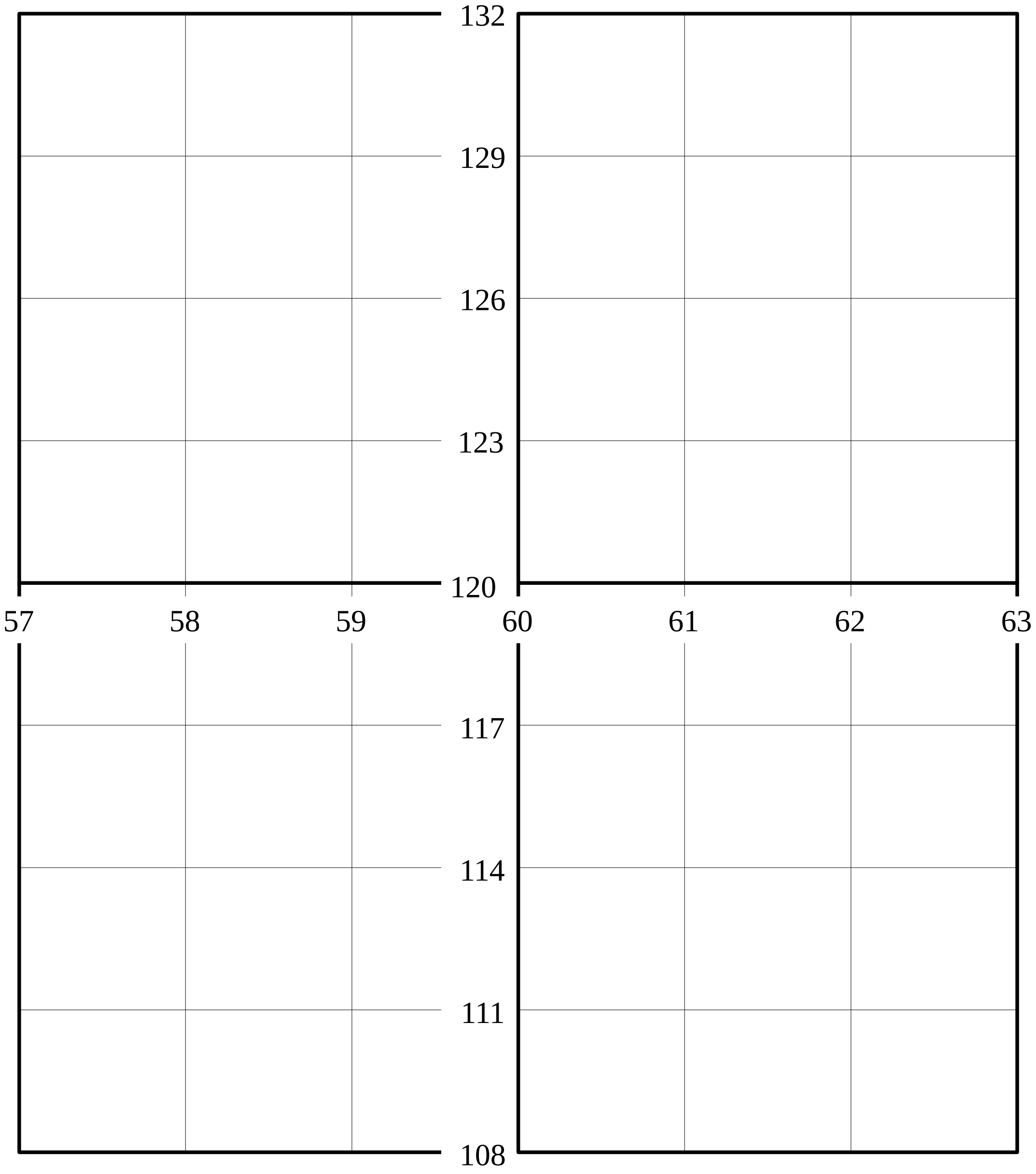
4. Start GenSet and warm it up by applying 50% load for 5 minutes.

   ☐ warm-up

5. Record the GenSet performance on the Power Curve chart on the next page.

Note: Be sure to use the ratings on the GenSet nameplate.

Power Curve



Load Step	Amperes	Voltage	Frequency
0%			
25%			
50%			
75%			
100%			

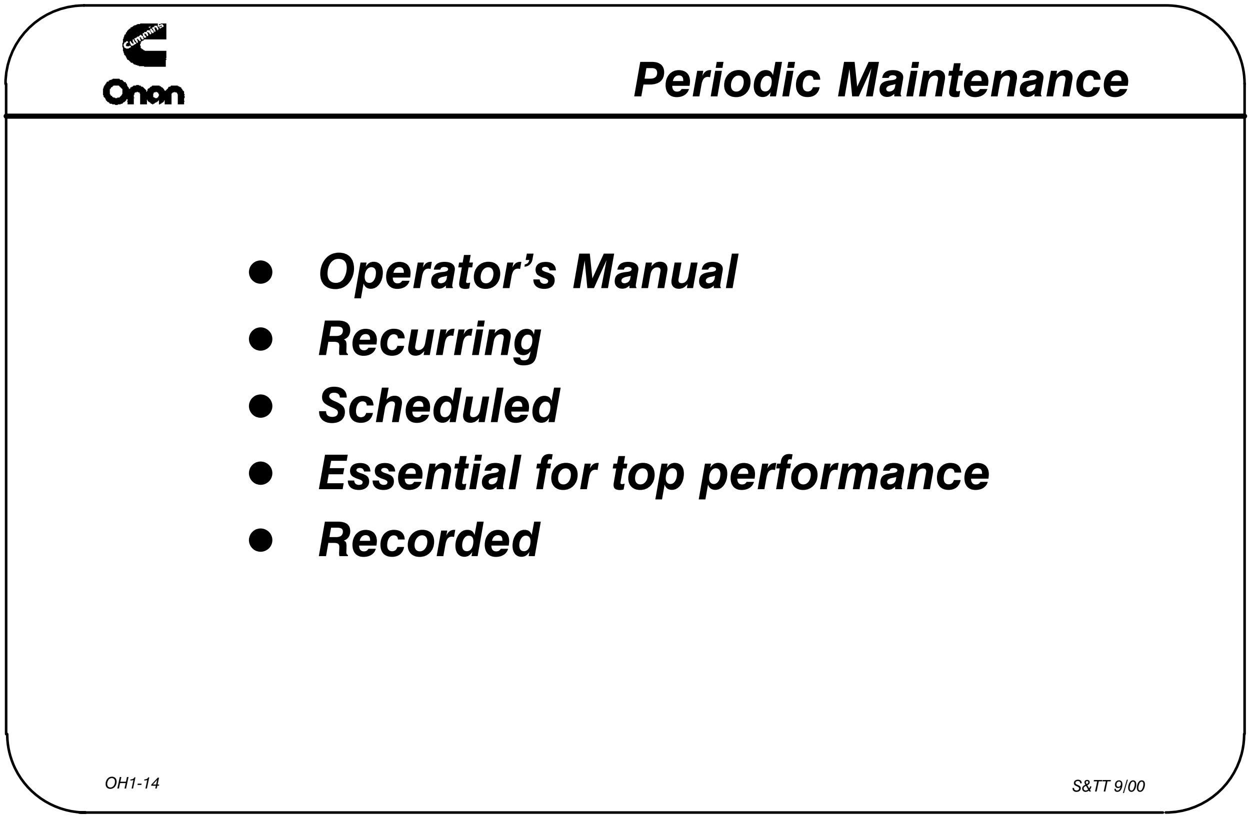
Emerald/Marquis GenSet Periodic Maintenance

This lesson presents the preventive maintenance on an Emerald/Marquis generator set.

Objectives

After completing this lesson, you should be able to:

- Find and use the periodic maintenance schedule in the *Operator's Manual*.
- Locate maintenance points and perform all scheduled service.
- Adjust the engine governor, carburetor choke and fuel system.
- Adjust the generator nominal no-load voltage and frequency.
- Perform a final Test and Adjust no-load to full-load power curve.



Periodic Maintenance

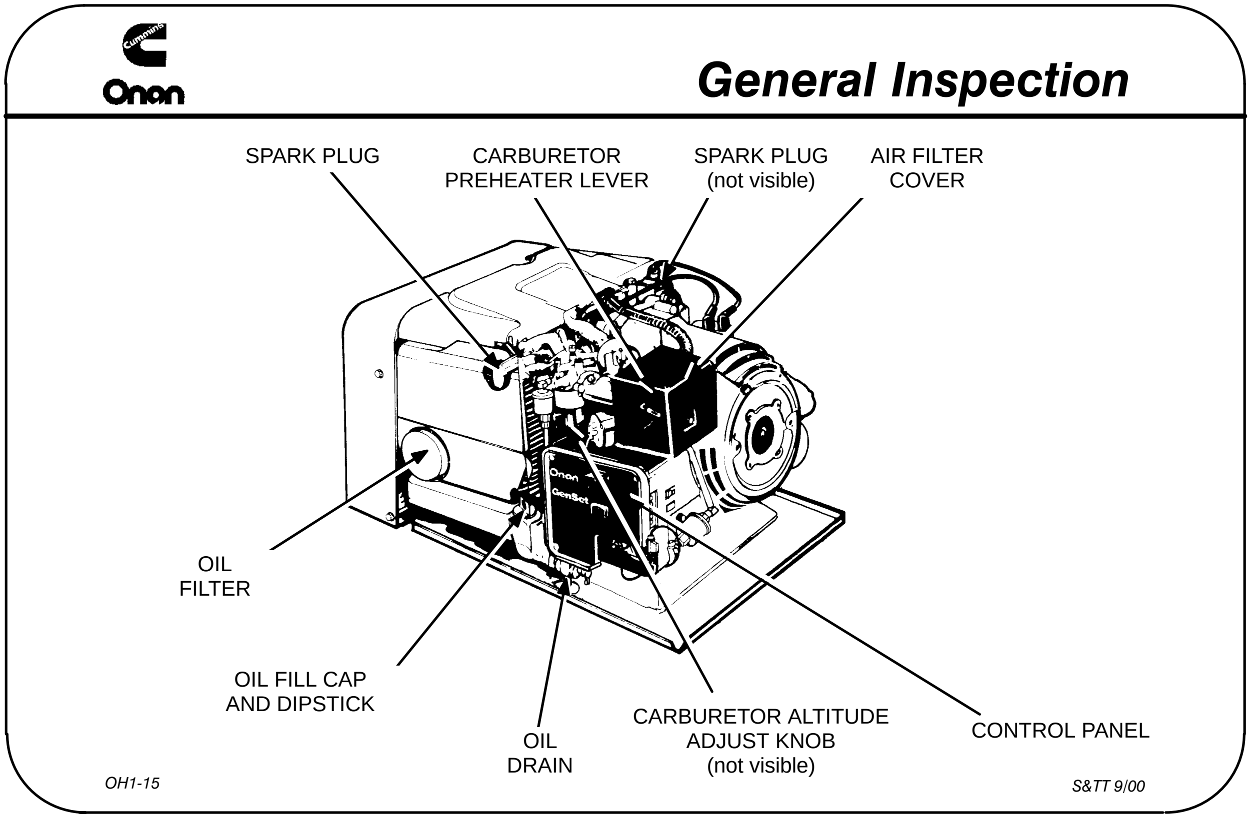
- Operator’s Manual
- Recurring
- Scheduled
- Essential for top performance
- Recorded

OH1-14

S&TT 9/00

Slide 1-14: Periodic Maintenance

- A periodic maintenance schedule is found in the *Operator’s Manual*.
- Periodic maintenance is done as often as necessary.
- Done according to a schedule.
- Must be done for performance and longevity of the GenSet.
- Recording when and what was done is important.



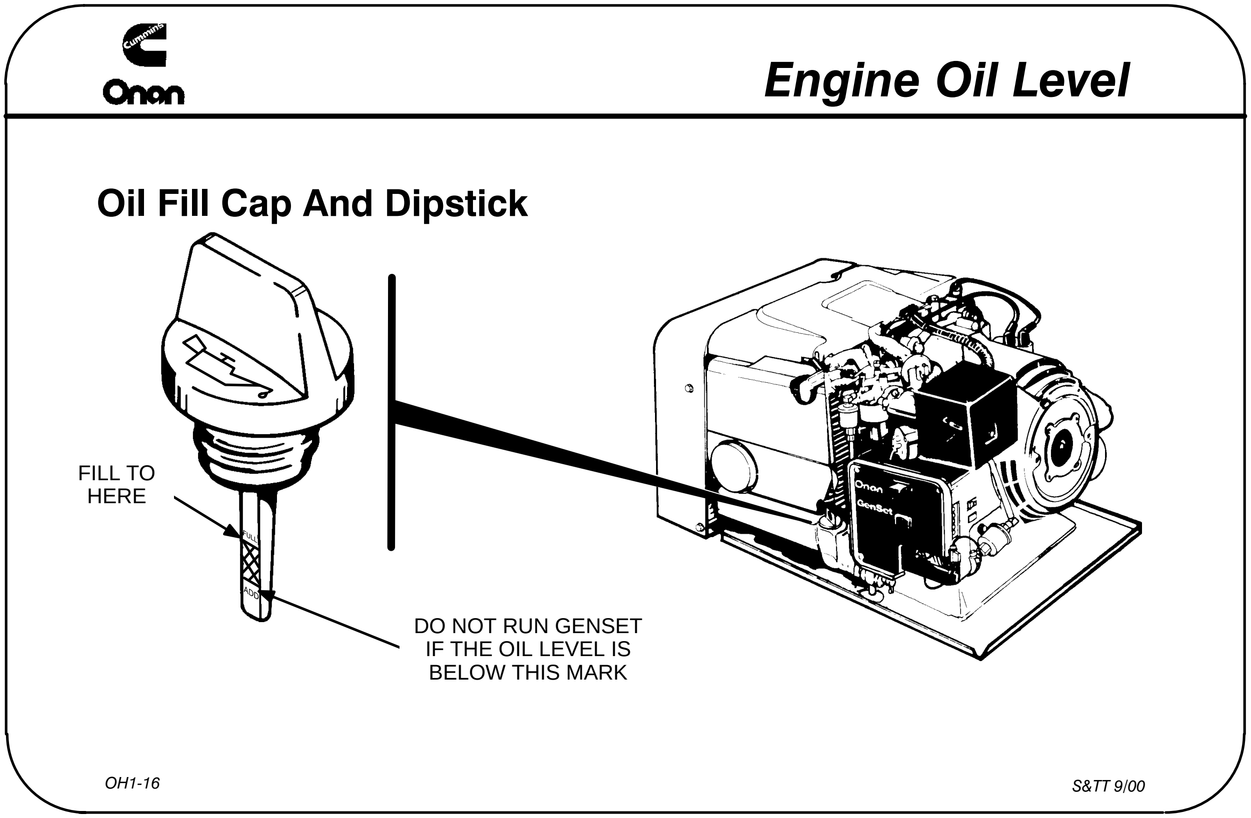
General Inspection

OH1-15

S&TT 9/00

Slide 1-15: General Inspection

- Should be done daily or every 8 hours of use.
- **Inspect:**
  - Exhaust system
  - Oil or fuel leaks
  - Battery connections
  - Missing or loose hardware
  - Unusual noise
  - Cleanliness
  - Stored items in compartment



Engine Oil Level

Oil Fill Cap And Dipstick

FILL TO HERE

DO NOT RUN GENSET IF THE OIL LEVEL IS BELOW THIS MARK

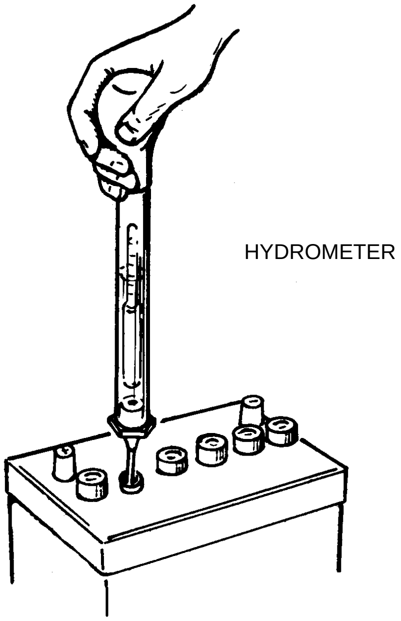
OH1-16

S&TT 9/00

Slide 1-16: Engine Oil Level

- Should be done daily or every 8 hours of use.
- Vehicle should be on level ground.
- Engine must be shut off.
- Engine should be warm.
- Oil fill cap is removed and then screwed back in.
- Fill to “fill mark” only.
    - See table one in *Operator’s Manual* for correct viscosity.
- Do not operate GenSet if the oil level is below the add mark.

Battery Check

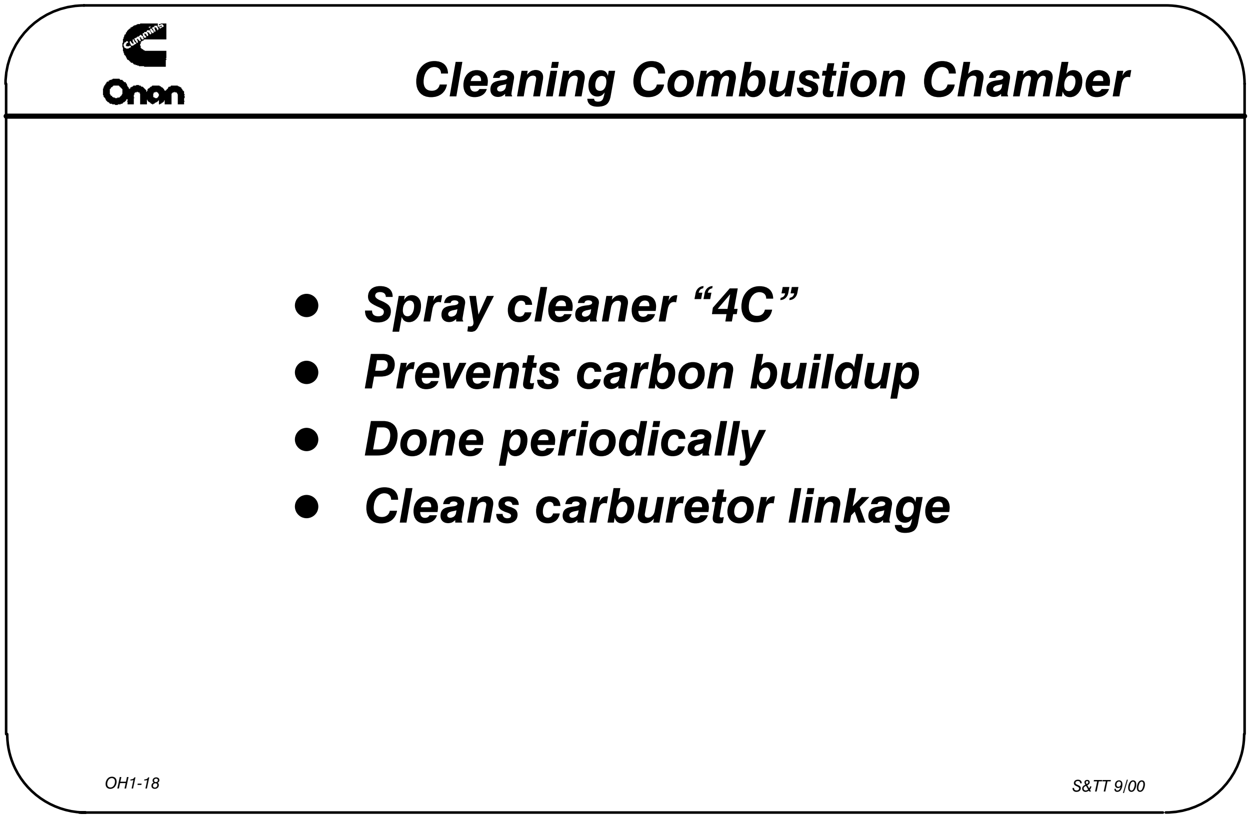


OH1-17

S&TT 9/00

Slide 1-17: Battery Check

- Should be done every month (more often in hot weather).
- Inspection steps:
  - Battery is clean and dry.
  - Connections are clean and tight.
  - Remove corrosion with baking soda and water.
- Check specific gravity using a hydrometer.
  - Should be between 1.215 (hot climate zones) and 1.260 (cold climate zones).
  - Charge if lower than 1.215.
  - Stop charging when the specific gravity reaches 1.260 at approximately 80° F.
- Add only distilled water.
- Batteries give off explosive gases.



Cleaning Combustion Chamber

- *Spray cleaner "4C"*
- *Prevents carbon buildup*
- *Done periodically*
- *Cleans carburetor linkage*

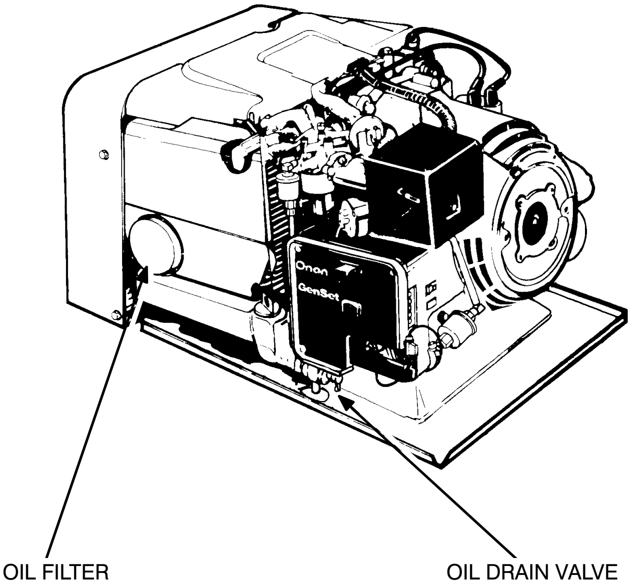
OH1-18

S&TT 9/00

Slide 1-18: Cleaning Combustion Chamber

- Should be done every 150 hours of use.
- Park and run vehicle outdoors.
- Run GenSet until warm.
- Spray into carburetor throat.
  - Follow directions on the can.
  - While waiting prescribed interval, change the oil and filter, spark plugs and air filter.
- Once complete, run GenSet at full load for 15 minutes to expel the carbon loosened by cleaner.

Change Oil Filter



OH1-19

S&TT 9/00

Slide 1-19: Change Oil Filter

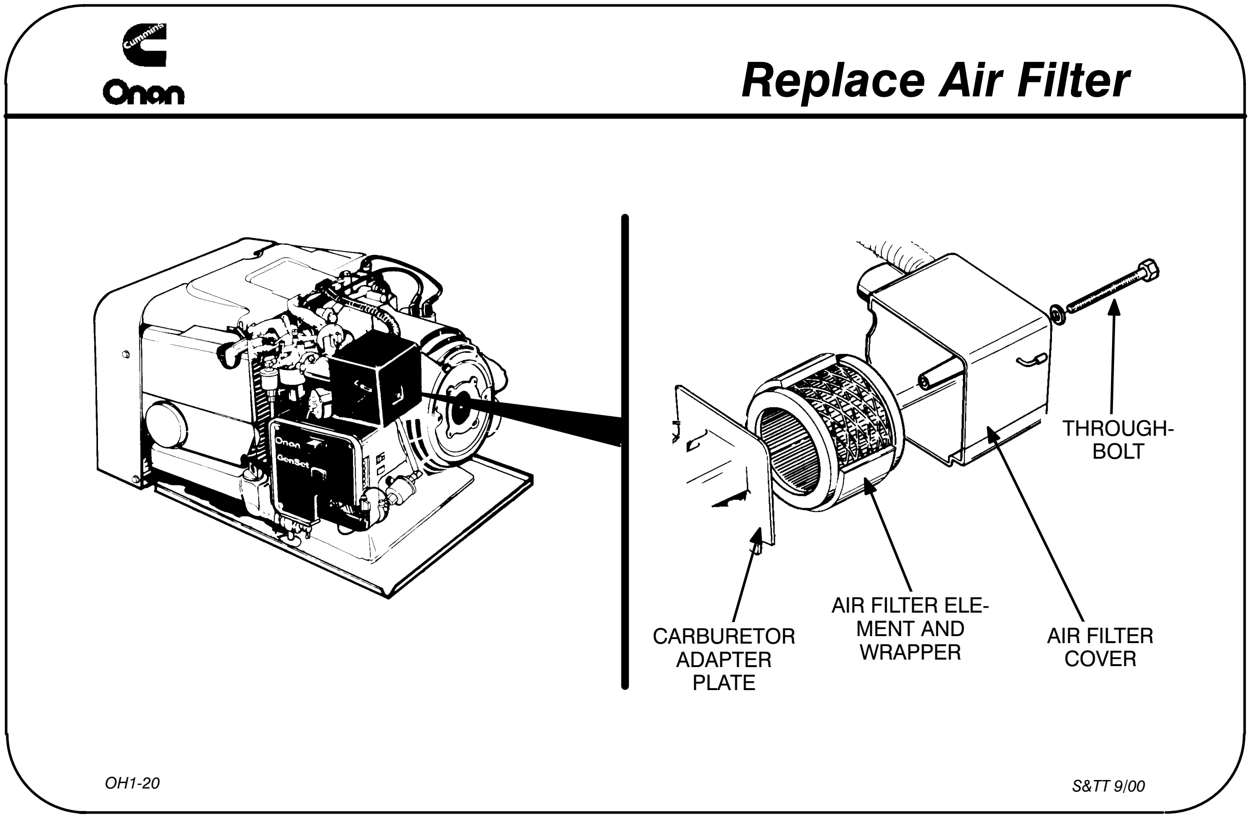
- Should be done every 150 hours or once a year.
  - After the first 50 hours of wear-in period.
  - More often in hot weather.
  - More often in dusty conditions.

- Unit should be warm.

- Remove oil drain valve and filter.
  - Use an approved container to collect used oil.
  - Discard used oil according to local regulations.

- Clean mounting surface and replace drain plug and filter.
  - Apply thin film of oil on the new filter gasket.
  - Use only Onan replacement filter.
  - Tighten filter snug, then an additional $^{1}/_{2}$ to $^{3}/_{4}$ turn.

- Fill to “full mark” only.
  - See table one in the *Operator’s Manual* for correct viscosity.
  - Screw oil fill cap on securely.



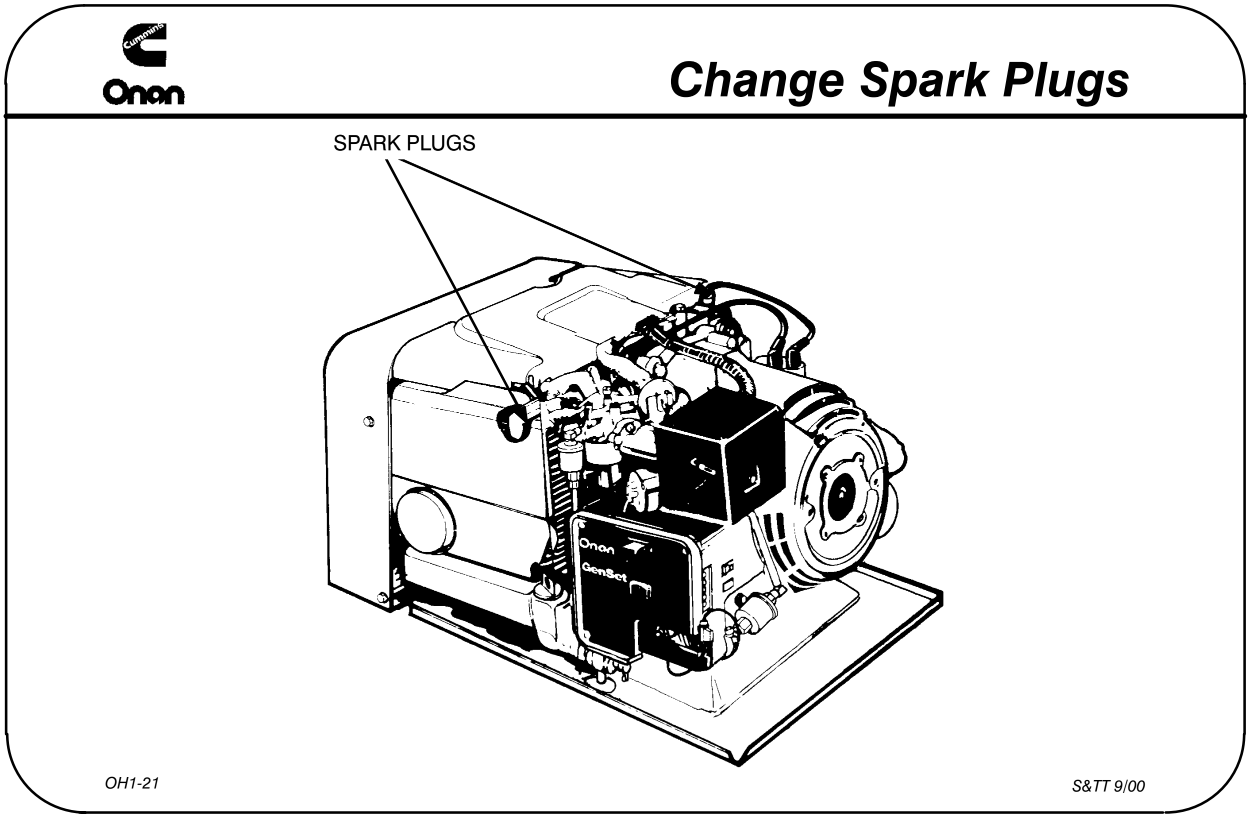
Replace Air Filter

OH1-20

S&TT 9/00

Slide 1-20: Replace Air Filter

- Should be done every 150 hours or once a year.
  - More often in dusty conditions.
- To replace, remove through-bolt and filter cover.
  - Remove and replace air filter element and wrapper.
  - Replace through-bolt and tighten securely.
- Use only Onan replacement filter.
- Be sure to remove the cellophane shipping shrink wrap from filter element and wrapper.



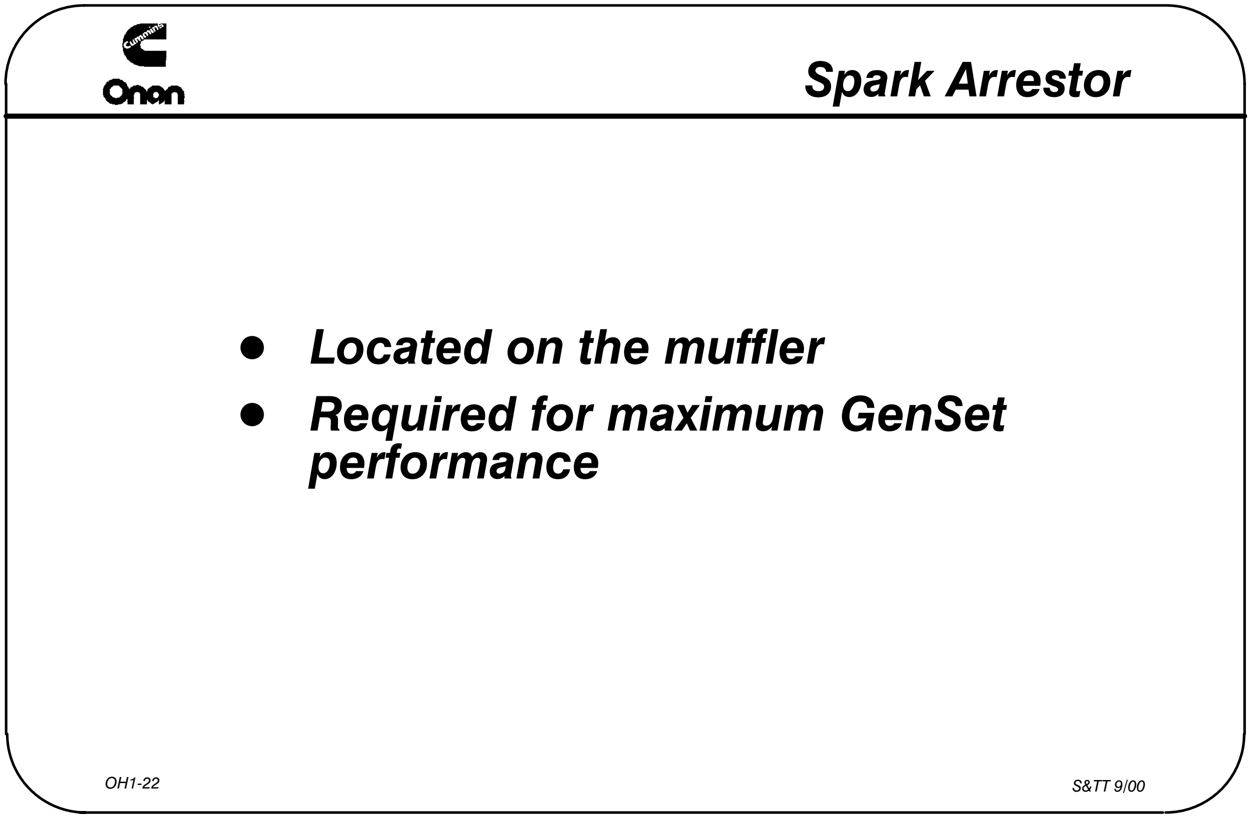
Change Spark Plugs

OH1-21

S&TT 9/00

Slide 1-21: Replace Spark Plugs

- Should be done every 500 hours or once a year.
- GenSet has 2 plugs.
- Ensure gap is correct.
- Thread replacement plugs in by hand.
- Torque to 8 lbs-ft (10 N-m).
- Use only Onan replacement plugs.



Spark Arrestor

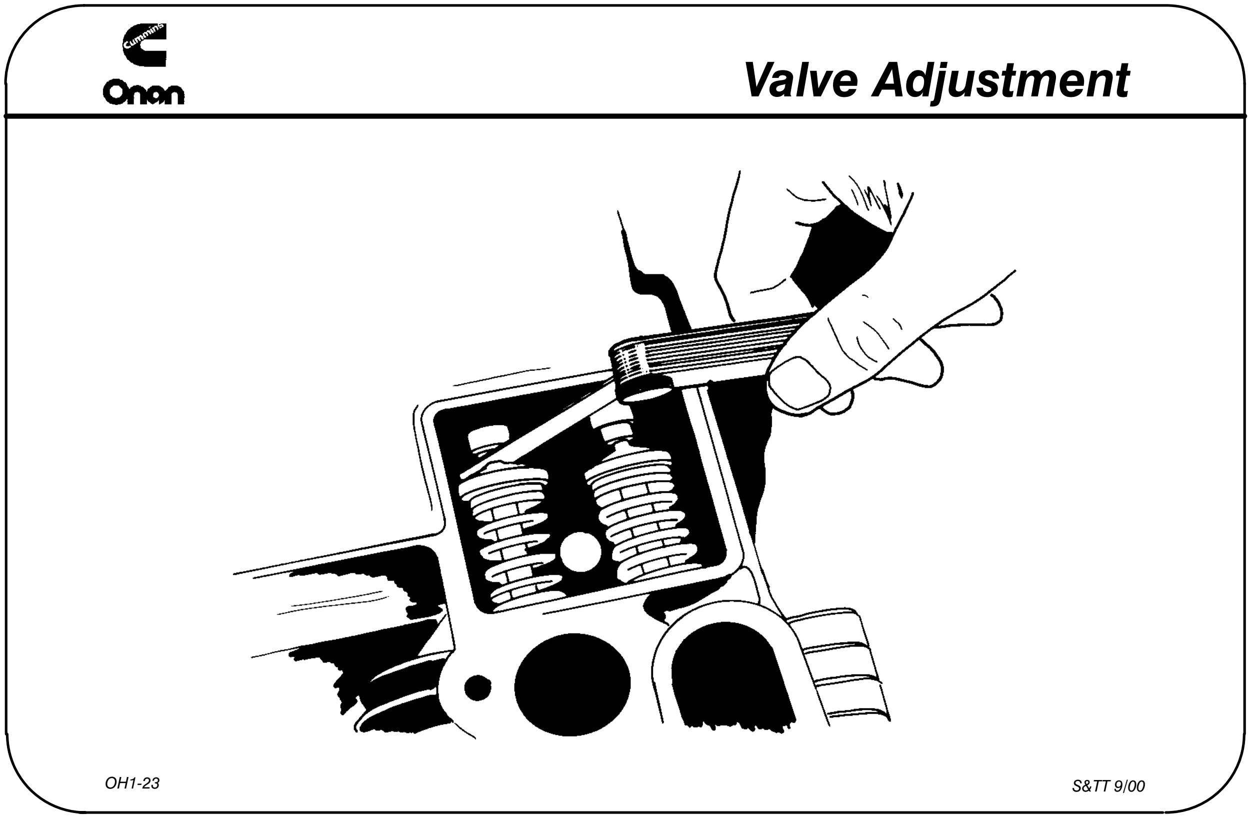
- ***Located on the muffler***
- ***Required for maximum GenSet performance***

OH1-22

S&TT 9/00

Slide 1-22: Spark Arrestor

- Should be done every 50 hours and after using Onan “4C” combustion chamber cleaner.
- Allow muffler to cool before removing plug.
- Remove plug.
  - Start GenSet and apply 75% load.
  - Run 5 minutes to expel soot in muffler.
- Allow muffler to cool before replacing plug.



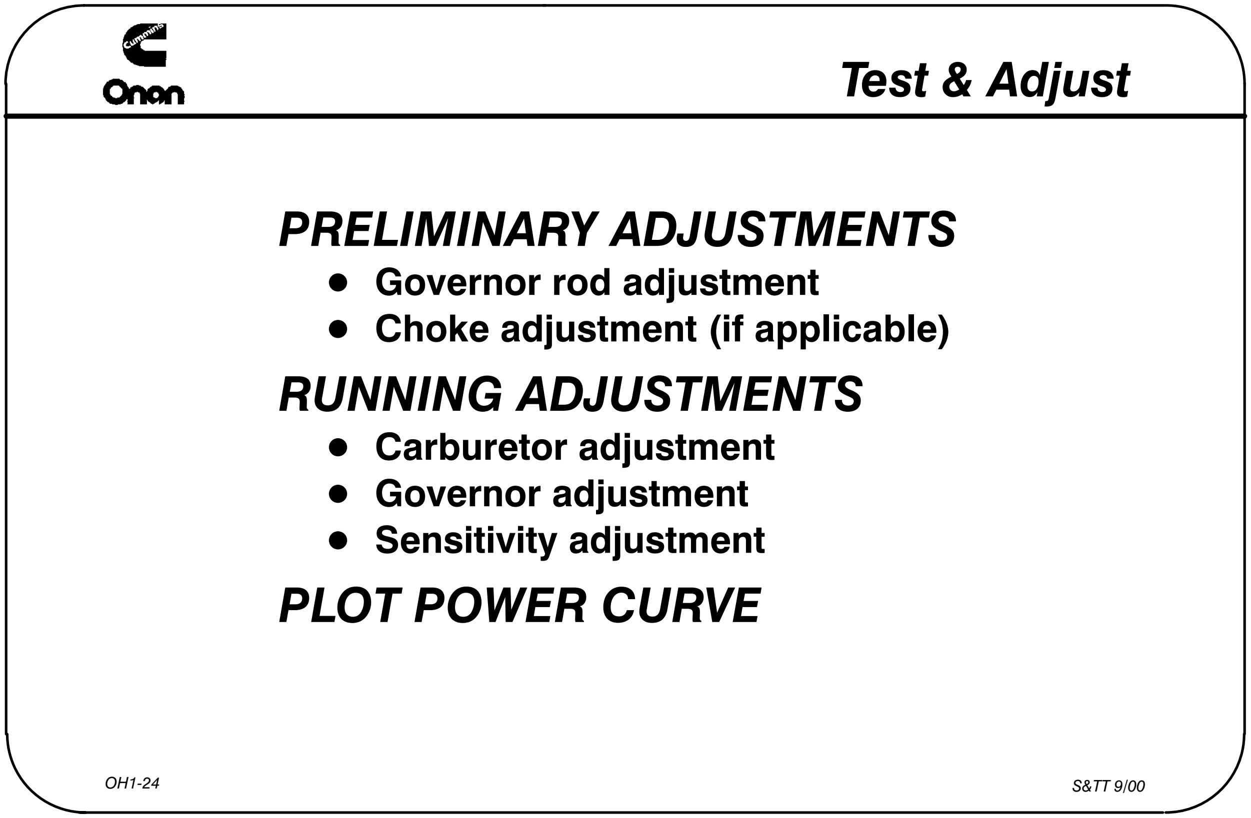
Valve Adjustment

OH1-23

S&TT 9/00

Slide 1-23: Valve Adjustment

- Should be done every 500 hours.
- Adjust clearance according to the *Service Manual*.
- Follow the adjustment procedure outlined in the *Service Manual*.



Test & Adjust

PRELIMINARY ADJUSTMENTS

- Governor rod adjustment
- Choke adjustment (if applicable)

RUNNING ADJUSTMENTS

- Carburetor adjustment
- Governor adjustment
- Sensitivity adjustment

PLOT POWER CURVE

OH1-24

S&TT 9/00

Slide 1-24: Test and Adjust

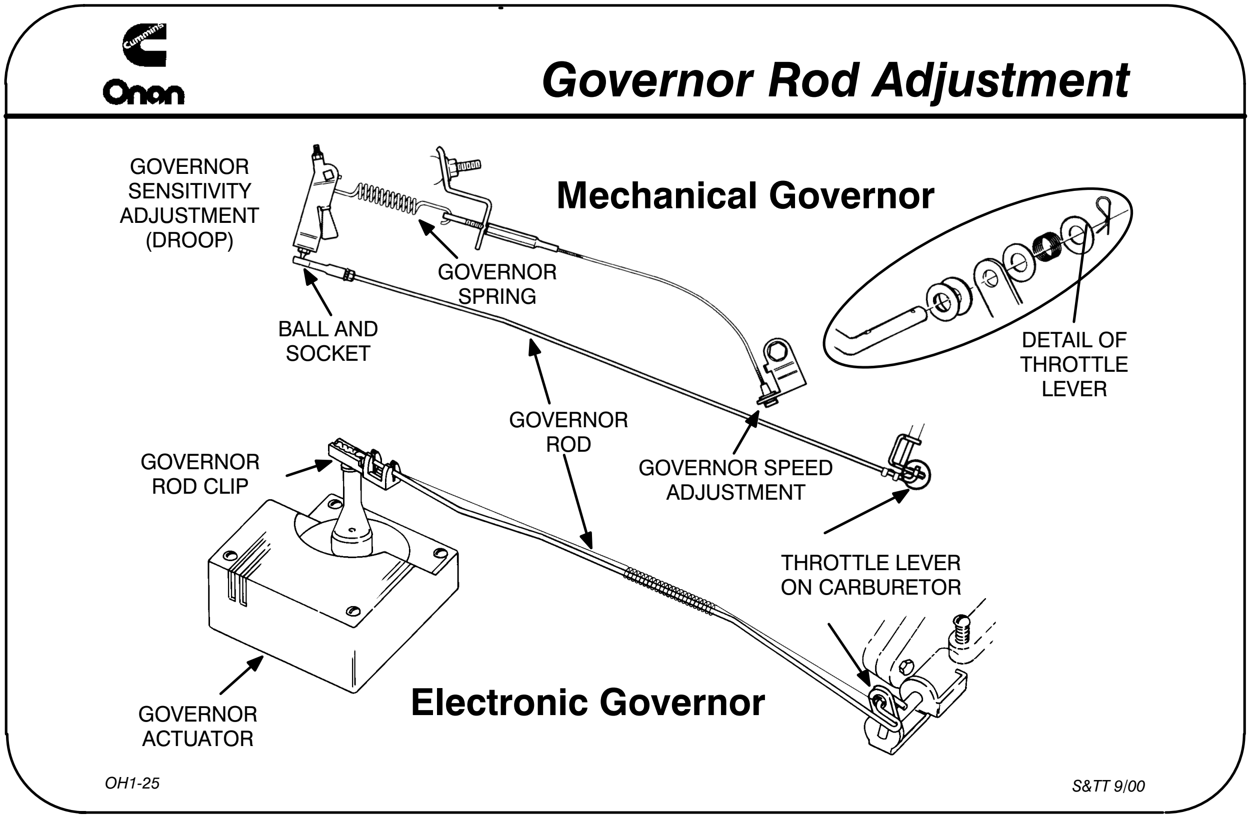
Preliminary Adjustments:

- Perform governor rod adjustment.
- Perform choke adjustment.
- Perform idle and main mixture adjustments.

Running Adjustments:

- Verify no-load frequency.
- Adjust the main adjustment screw at full-load.
- Adjust the throttle stop screw to the specified frequency.
- Adjust no-load frequency.
- Adjust the idle adjustment screw at no-load.
- Adjust the sensitivity.
- Recheck the sensitivity and stability.
- Verify the no-load frequency.

Record Your Results



Governor Rod Adjustment

OH1-25

S&TT 9/00

Slide 1-25: Preliminary Governor Rod Adjustments

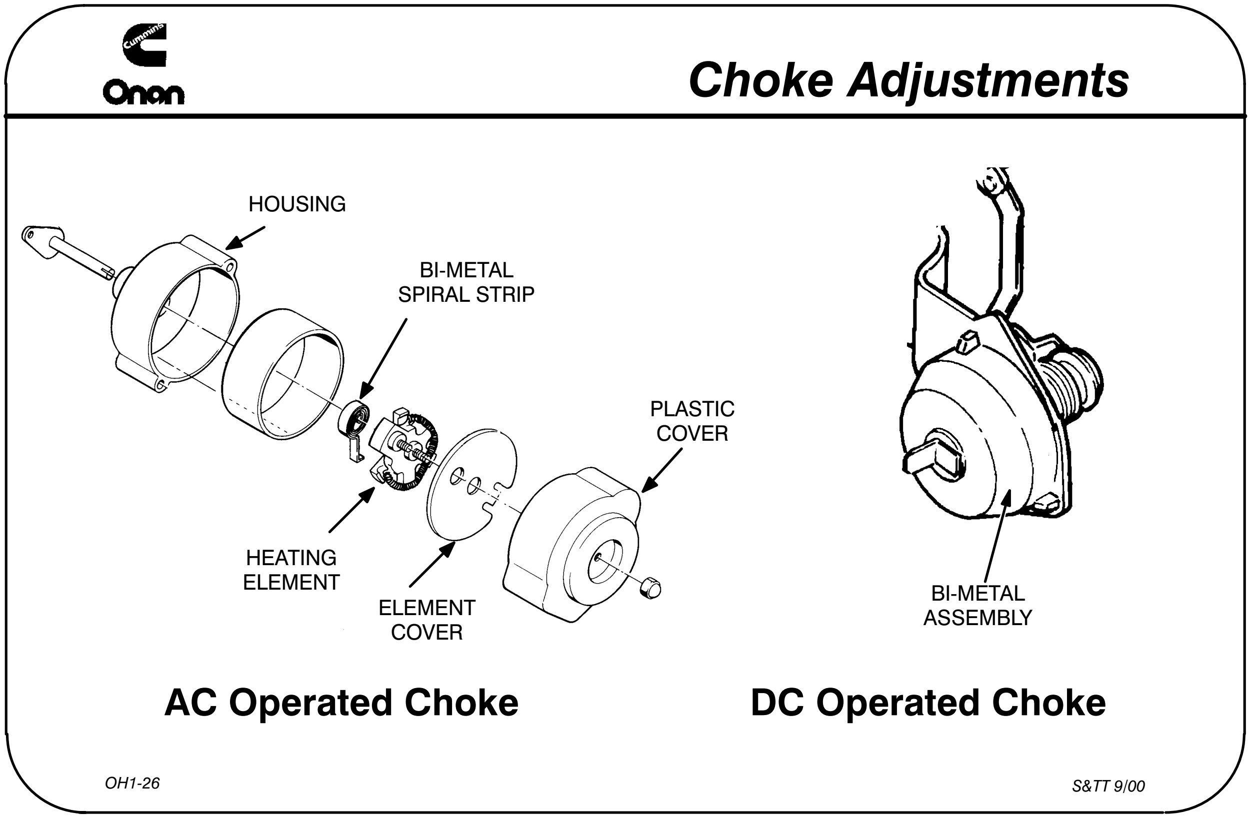
- First adjustment to be made in the system.
- Make adjustment with GenSet cold and not running.
- Critical for correct operation of the governor.
- Make certain that movement is free and fully opens and closes throttle.
- Refer to the *Service Manual* for correct adjustment procedure.

Mechanical Governor

- Governor set speed and sensitivity must be adjusted using load bank.

Electronic Governor

- Governor set speed and sensitivity are preset in the governor controller and cannot be adjusted.



Choke Adjustments

AC Operated Choke **DC Operated Choke**

OH1-26 S&TT 9/00

Slide 1-26: Preliminary Choke Adjustments

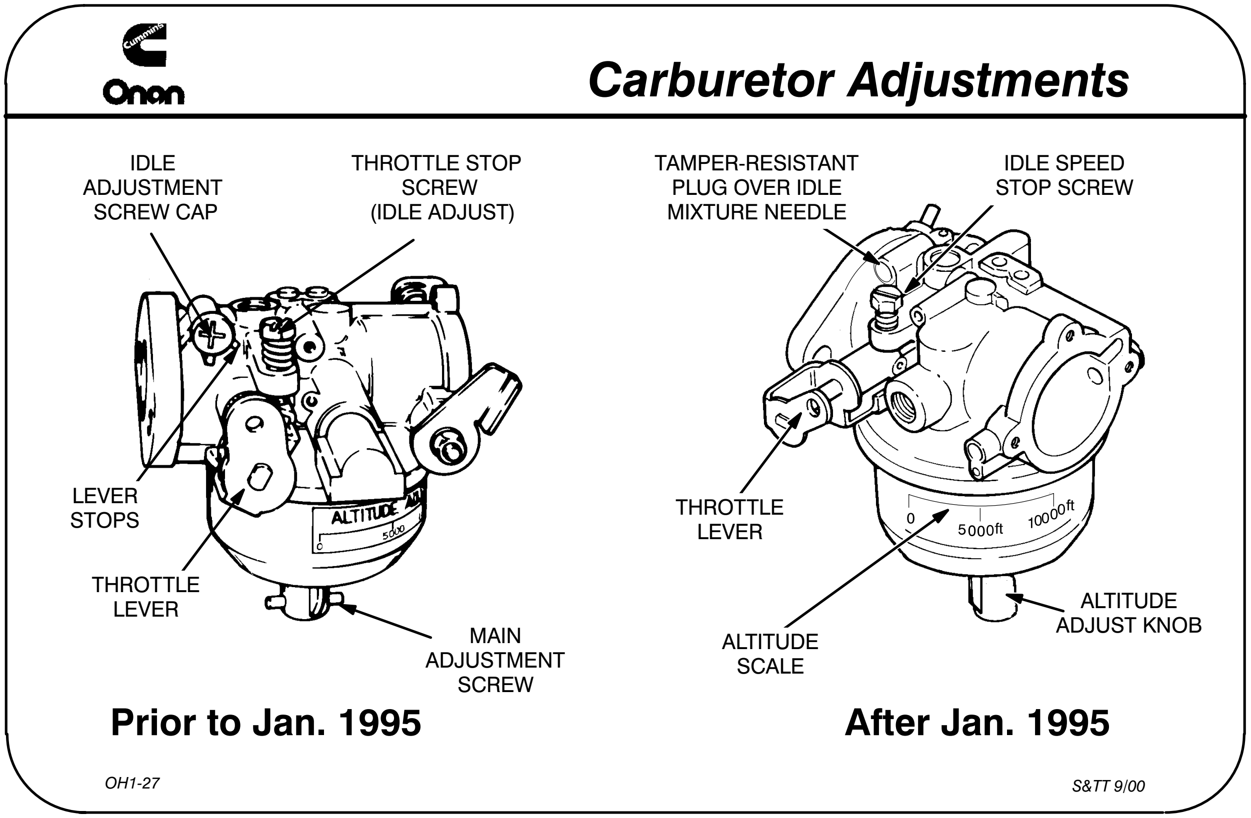
AC Operated Choke

- Must be done with engine cold.
- Receives AC voltage from the generator.
- Bi-metal strip receives heat from the heating element.
- Choke shaft turns and opens choke gradually.
- Refer to the *Service Manual* for correct adjustment procedure.

DC Operated Choke

- No adjustment required.
- Receives battery voltage from the control.
- Shaft is spring loaded to prevent flooding upon start-up.
- Replace Bi-metal assembly if choke is faulty.

Note: Refer to *Service Manual* for choke breather assembly adjustment.



Carburetor Adjustments

Prior to Jan. 1995

After Jan. 1995

OH1-27

S&TT 9/00

Slide 1-27: Preliminary Carburetor Adjustments

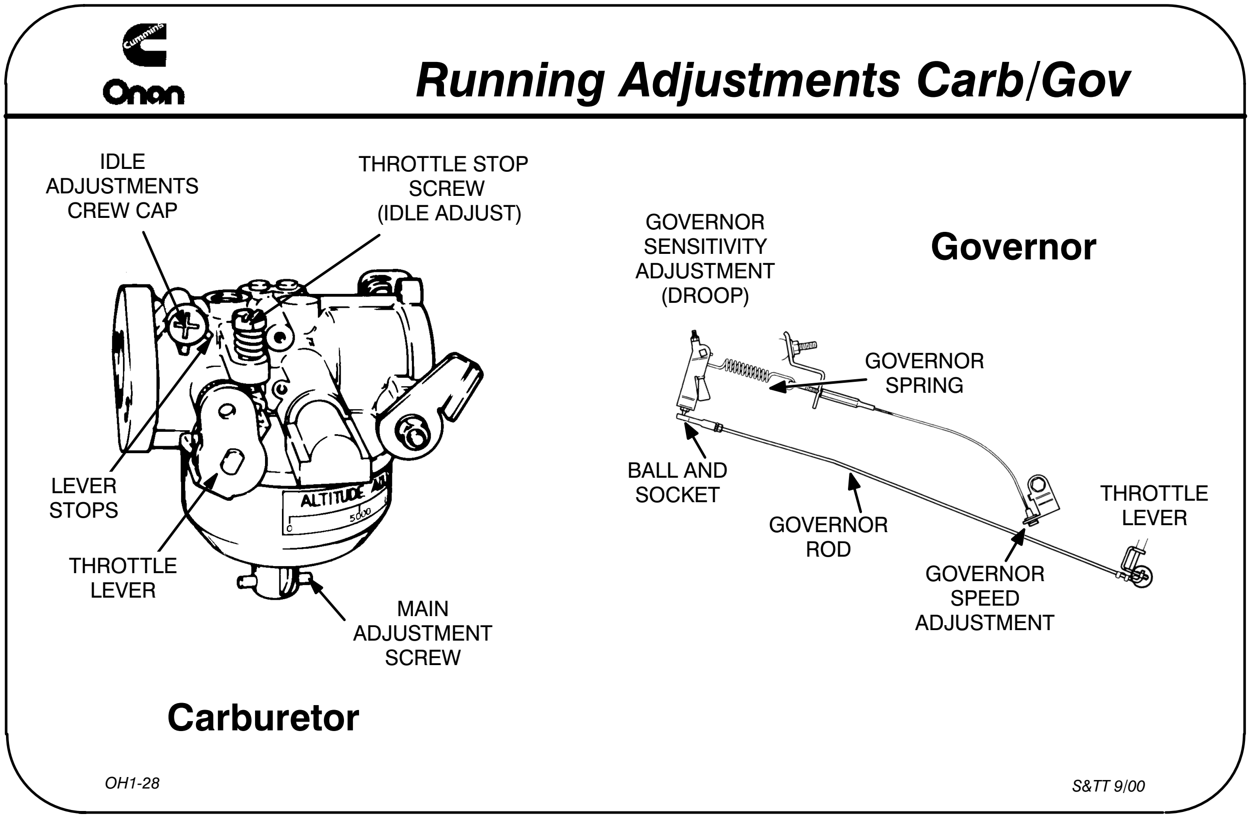
Carburetor prior to January, 1995

- Plastic limiter caps to be removed.
- Mixture screws must be lightly seated so the needle and seat are not damaged.
- Main adjustment screw turned all the way in and then turned out the specified number of turns.
- Idle adjustment screw turned all the way in and then turned out the specified number of turns.
- Throttle stop screw is adjusted during governor adjustment while the engine is running.

Carburetor after January, 1995

- Fuel mixture adjustments are not required.
- Only the altitude adjustment knob requires adjustment.
- Throttle stop screw is adjusted during governor adjustment while the engine is running.

Note: Refer to the *Service Manual* for correct preliminary settings.



Running Adjustments Carb/Gov

OH1-28

S&TT 9/00

Slide 1-28: Running Adjustments - Carburetor/Governor

1. Start the GenSet, apply 50% load for 5 minutes and allow for warm-up.
2. Apply full-load and adjust the main adjustment for the highest frequency and smoothest running.
3. Remove the load and verify that the frequency is within the specified range. Adjust the governor speed adjustment if required.
4. Adjust the idle adjustment for smoothest running.
5. Adjust the governor speed adjustment to 50 Hz. Turn out the throttle stop screw if necessary.
6. Turn the throttle stop screw in to achieve 55 Hz.
7. Readjust the governor speed adjustment to achieve 62-63 Hz. at no-load.
8. Apply full rated load to the GenSet and check the sensitivity from no-load to full-load.
9. Adjust the droop if necessary.
10. Recheck the no-load frequency setting.
11. Perform the power curve.

Note: Refer to the *Service Manual* for the correct adjustment procedures.

Activity

Situation One

Perform the necessary steps for governor and carburetor adjustments. Document its performance by plotting a power curve. Follow these steps:

1. Perform preliminary governor rod adjustment.

   ☐ Refer to the *Service Manual*

   ☐ Governor rod adjustment

2. Perform preliminary choke adjustment.

   ☐ Refer to the *Service Manual*

   ☐ Choke adjustment

3. Perform preliminary carburetor adjustments.

   ☐ Refer to the *Service Manual*

   ☐ Carburetor adjustments

4. Start the GenSet, apply 50% load for 5 minutes and allow for warm-up.

   ☐ Warm-up

5. Apply full-load and adjust the main adjustment for the highest frequency and smoothest running.

   ☐ Main adjustment

6. Remove the load and verify that the frequency is within the specified no-load range. Adjust the governor speed adjustment if required.

   ☐ Refer to the *Service Manual*

   ☐ Verify no-load frequency

7. Adjust the idle adjustment for smoothest running.

   ☐ Idle adjustment

8. Adjust the governor speed adjustment to 50 Hz. Turn out the throttle stop screw if necessary.

   ☐ Speed to 50 Hz.

9. Turn the throttle stop screw in to achieve 55 Hz.

   ☐ Throttle stop set to 55 Hz.

10. Readjust the governor speed adjustment to 62-63 Hz. at no-load.

    ☐ No-load frequency at 62-63 Hz.

11. Apply full-load to the GenSet and check the sensitivity from no-load to full-load.

    ☐ Sensitivity

12. Adjust the droop if necessary.

    ☐ Refer to the *Service Manual*

    ☐ Adjust droop

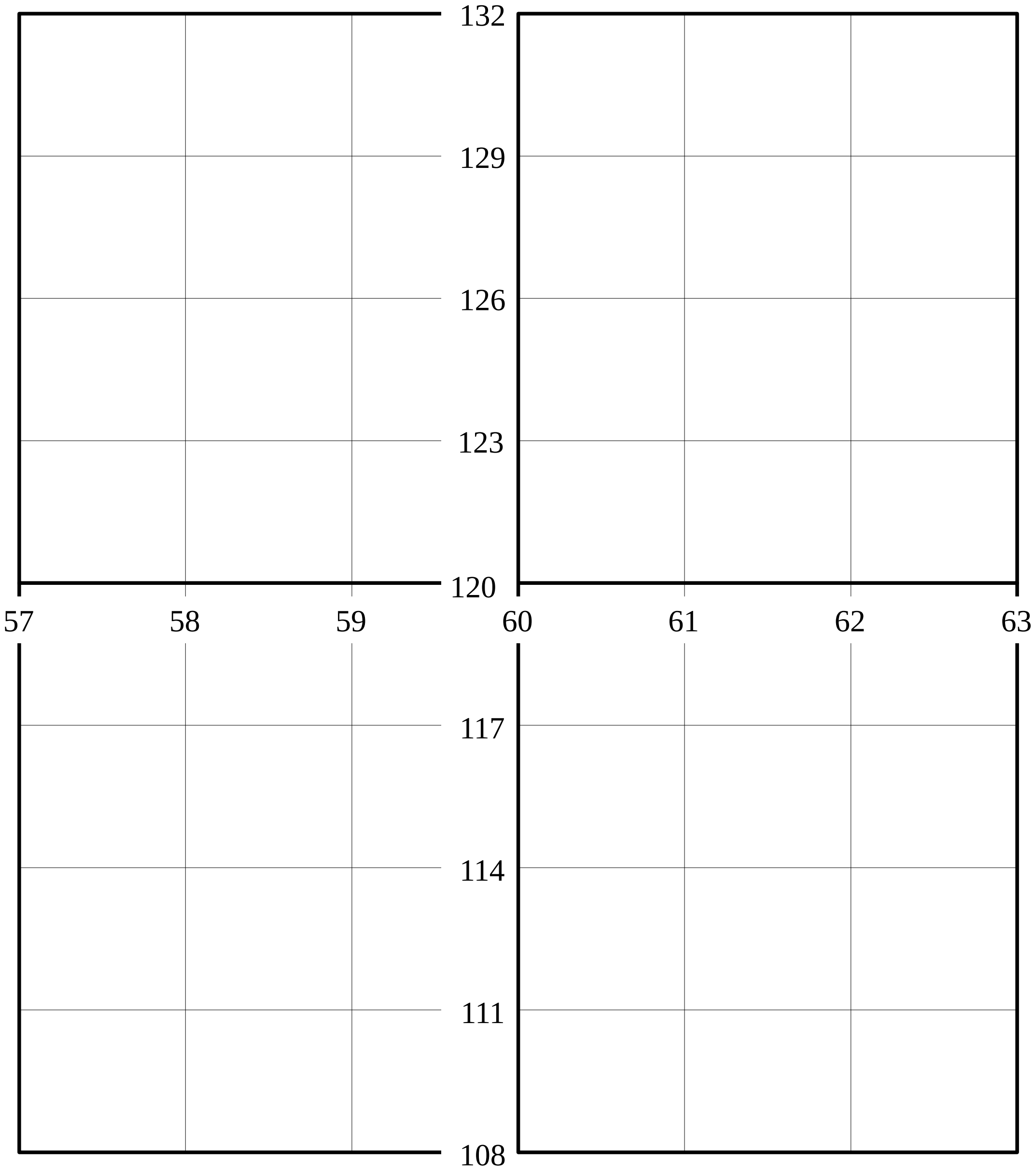
13. Recheck the no-load frequency setting.

    ☐ No-load frequency at 62-63 Hz.

14. Record the GenSet performance by plotting the power curve on the next page.

Note: Be sure to use the ratings on the GenSet nameplate.

Power Curve



Load Step	Amperes	Voltage	Frequency
0%			
25%			
50%			
75%			
100%			

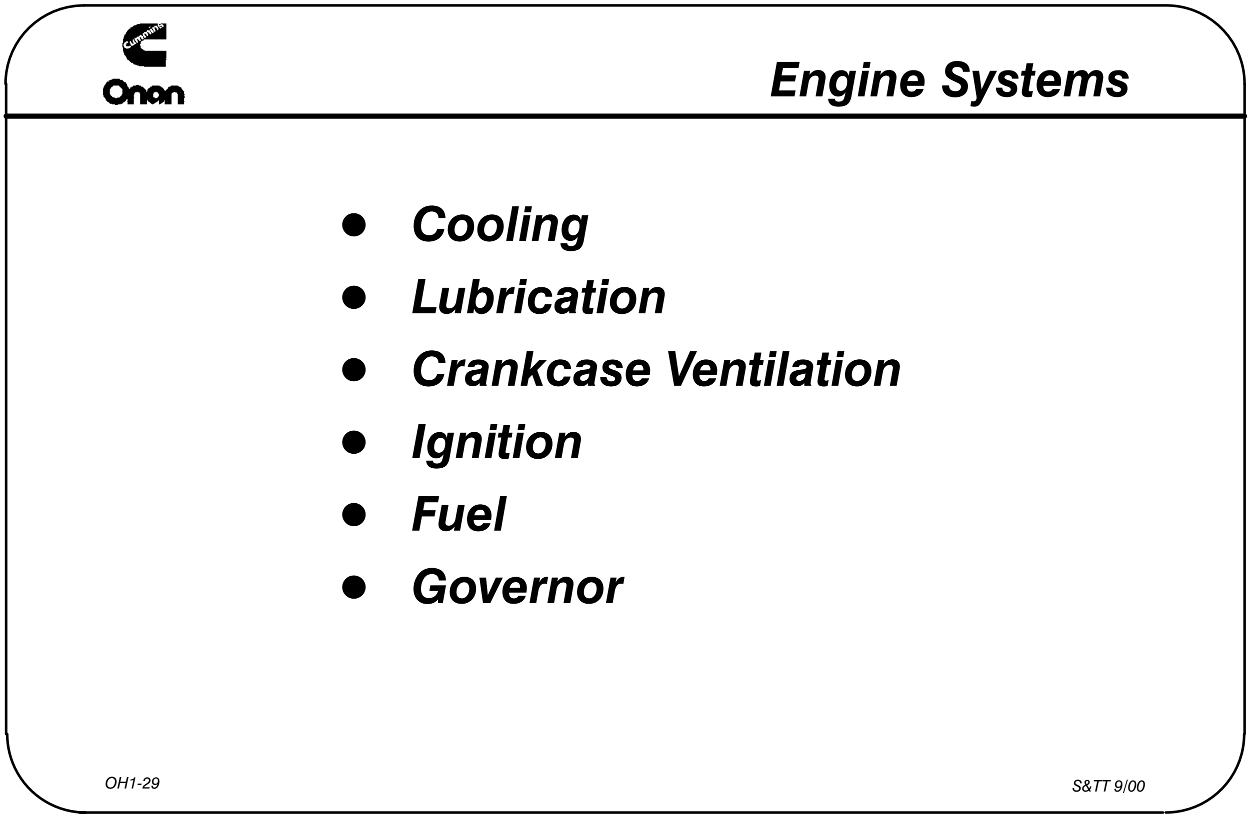
Emerald/Marquis GenSet Troubleshooting

This lesson presents the troubleshooting steps and job aids for the Emerald/Marquis generator set.

Objectives

After completing this lesson, you should be able to:

- Find and use the engine/generator/control troubleshooting sections in the Emerald/Marquis GenSet *Service Manuals*.
- Read and understand AC and DC schematics.
- Use special tools for diagnostic testing.
- Troubleshoot common engine, generator and control problems.



Engine Systems

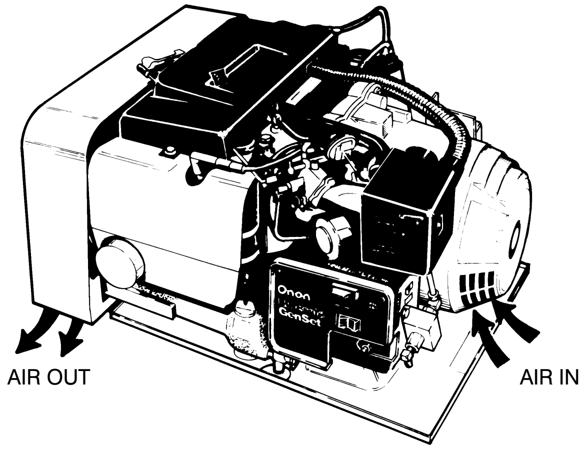
- Cooling
- Lubrication
- Crankcase Ventilation
- Ignition
- Fuel
- Governor

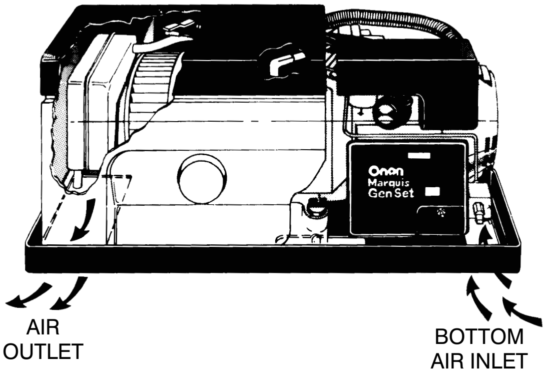
OH1-29

S&TT 9/00

Slide 1-29: Engine Systems

Cooling System



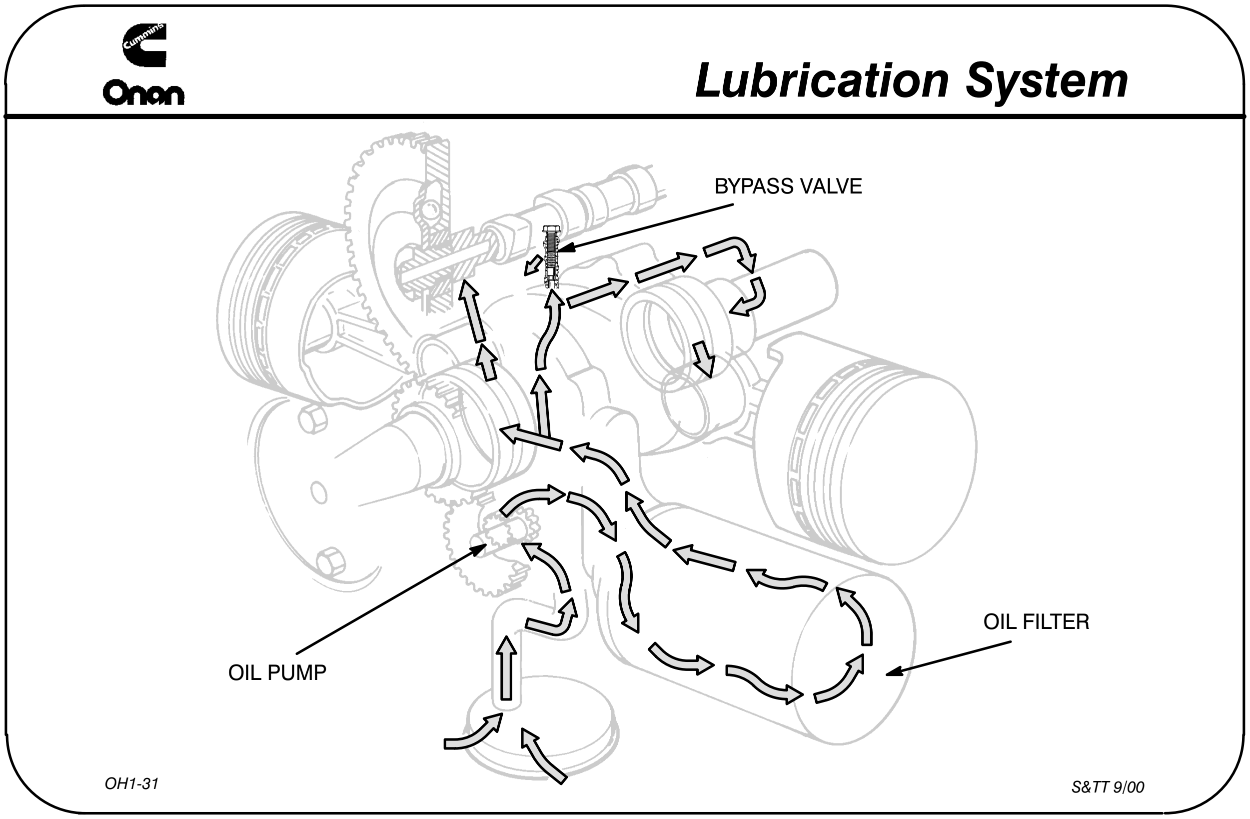


OH1-30

S&TT 9/00

Slide 1-30: Cooling System

- Cooling air flows through the generator end and across the engine cooling fins.
  Note: This area must be free of dirt, dust, and debris.
- Two fans: one on generator rotor to cool generator; one on the engine flywheel to cool the engine.
- Seal discharge outlet to compartment outlet to prevent recirculation of hot air into compartment.



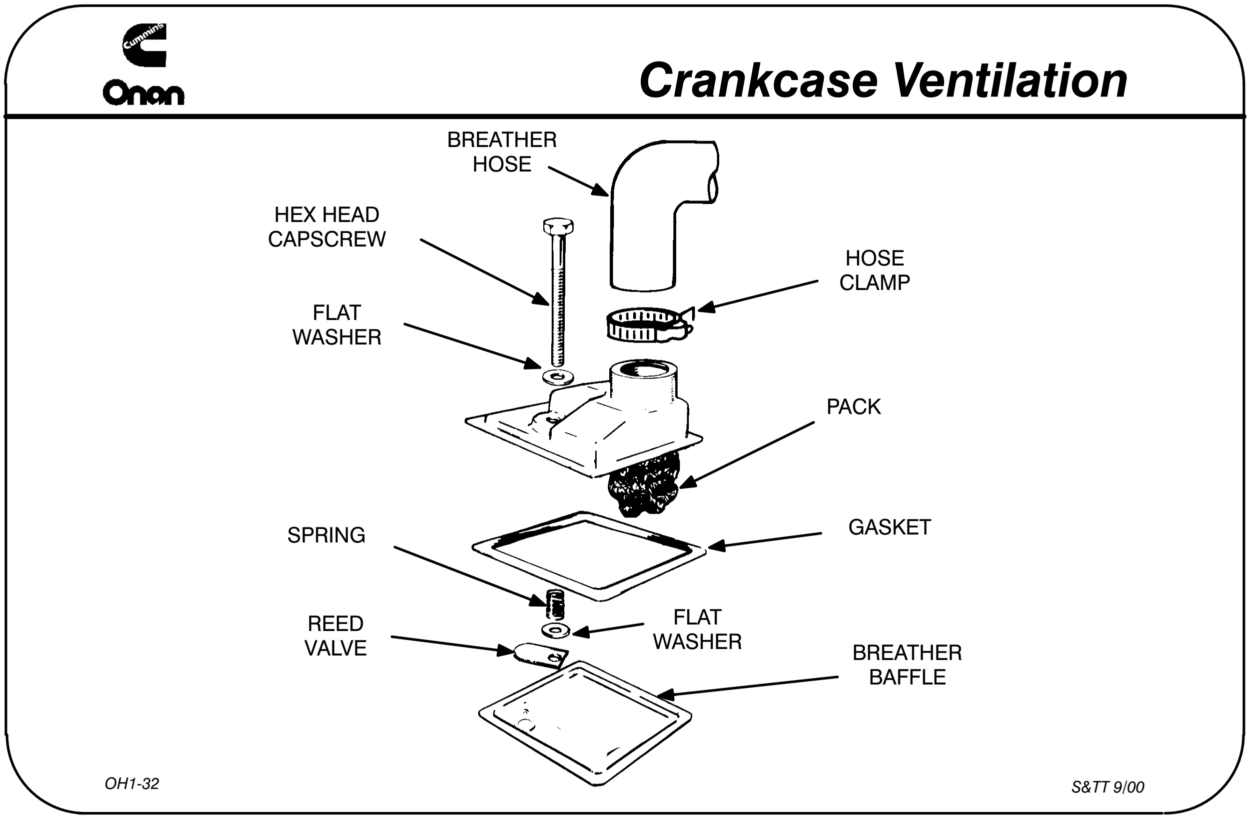
Lubrication System

OH1-31

S&TT 9/00

Slide 1-31: Lubrication System

- Gear type oil pump.
- Oil filter with bypass valve.
- Location for low oil pressure switch or gauge.
- Bypass valve limits oil pressure to about 20 psi.



Crankcase Ventilation

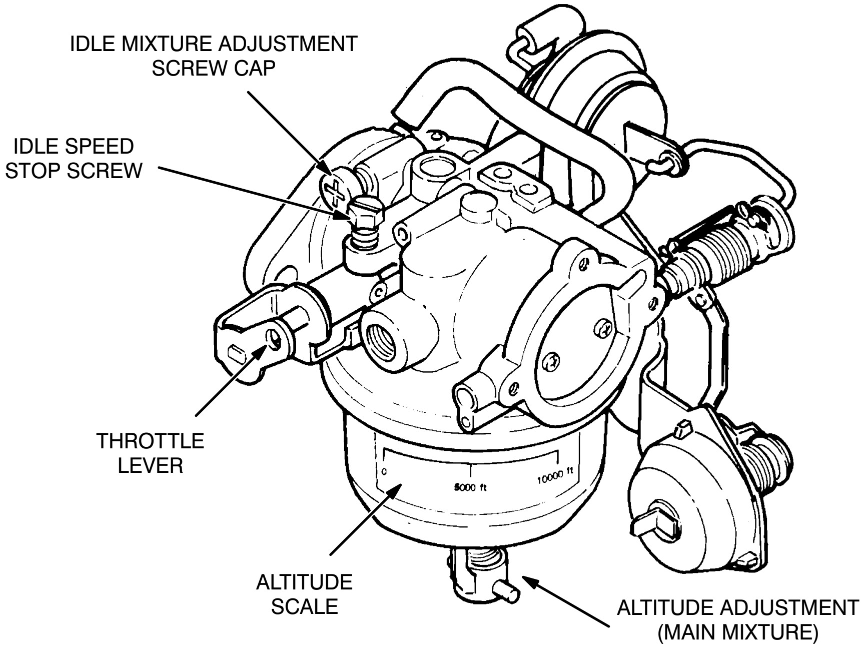
OH1-32

S&TT 9/00

Slide 1-32: Crankcase Ventilation

- Reed valve type.
- Maintains negative crankcase pressure.
- Packing is a serviceable item.
- Do not overtighten the valve cover bolt.
- A faulty breather can cause oil leaks, high oil consumption, reduced engine performance, sludge, and varnish buildup.

Gasoline Carburetor

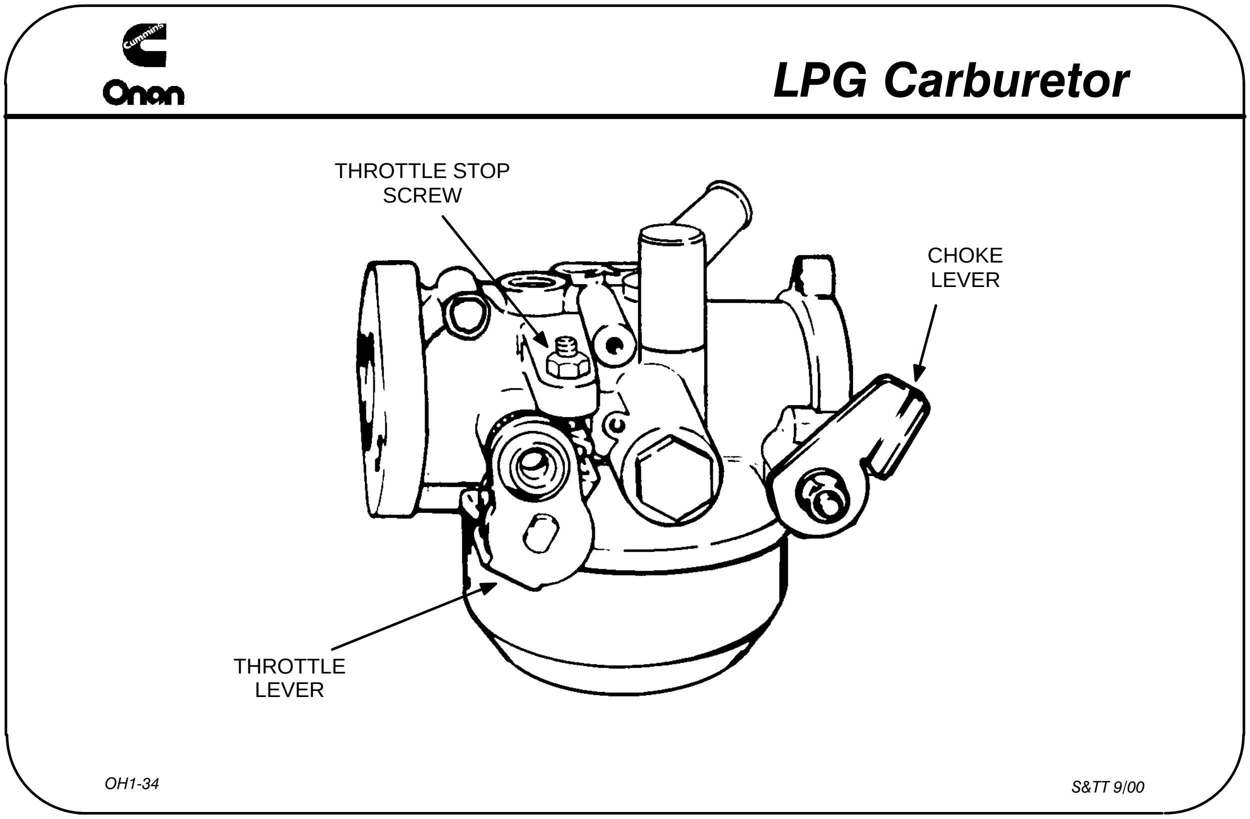


OH1-33

S&TT 9/00

Slide 1-33: Gasoline Carburetor

- Nikki® brand side draft carburetor.
- 3 adjustments - idle speed, idle mixture, and main mixture.
  Note: GenSets manufactured after January, 1995, have idle speed and altitude adjustments only.
- Automatic choke.



LPG Carburetor

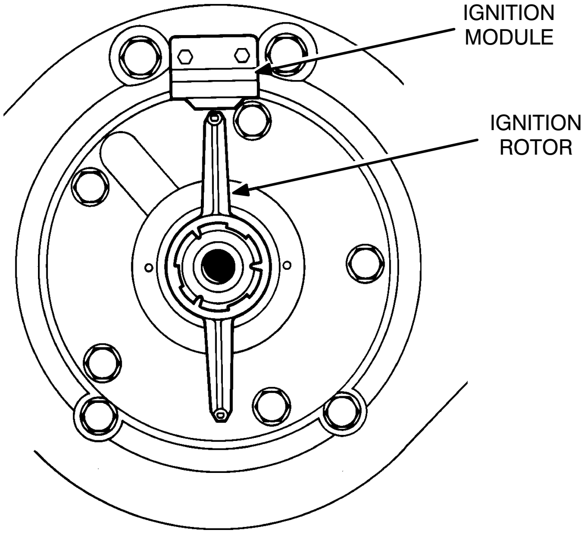
OH1-34

S&TT 9/00

Slide 1-34: LPG Carburetor

- The throttle stop screw sets the width of the throttle plate opening when the throttle plate is pulled back to the closed position.

Ignition



OH1-35

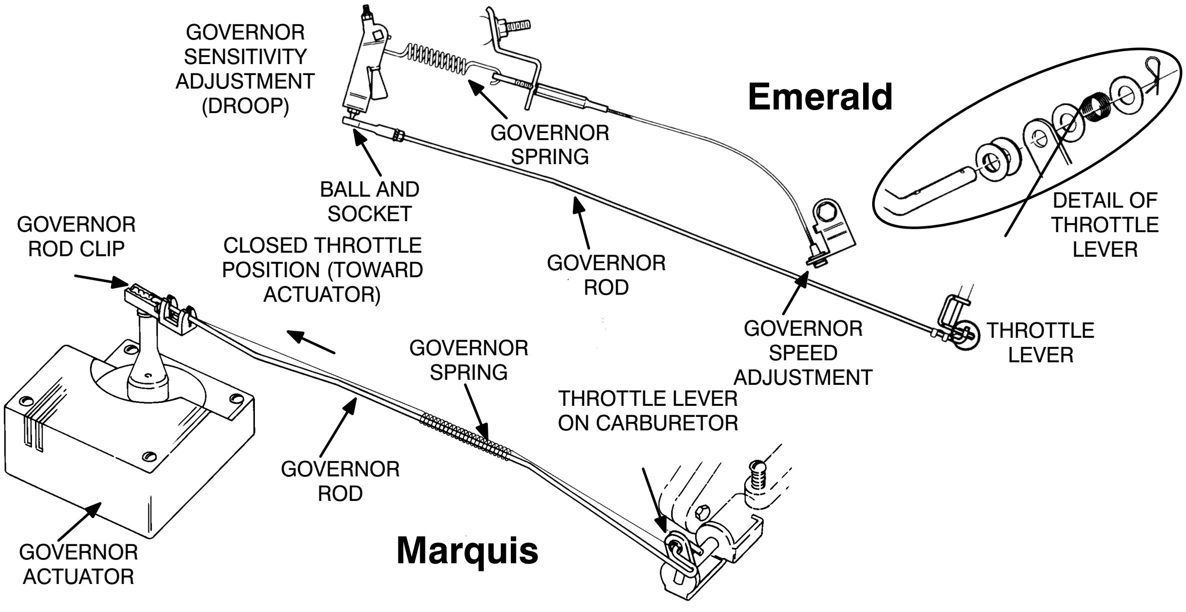
S&TT 9/00

Slide 1-35: Ignition

- Consists of rotor and module.
- Rotor is driven by engine crankshaft.
- Rotor has North and South magnets on ends.
- Module is located on engine to generator adapter.
- Timing fixed at 14°-18° BTC.
  Note: GenSets manufactured after January, 1995, have timing set to 12° BTC.

Onan

Governor

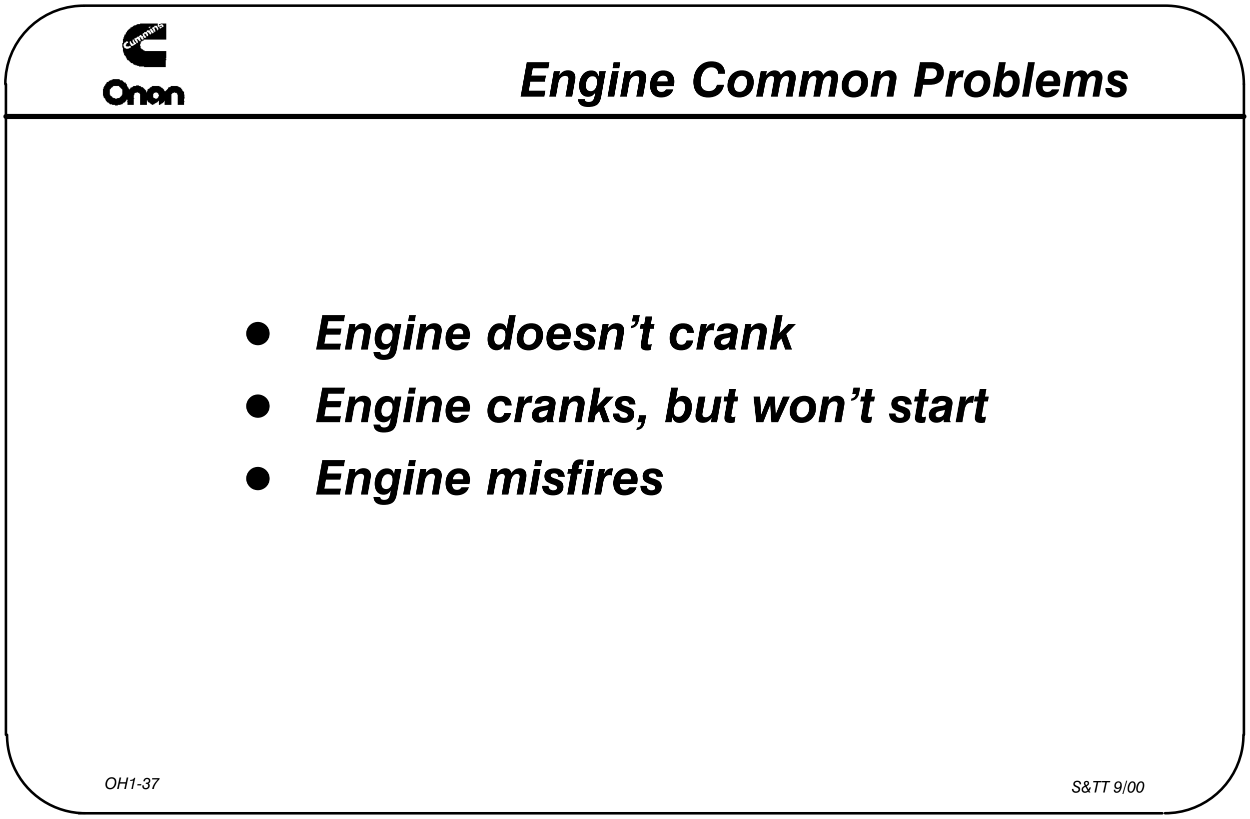


NOTE: GOVERNOR SPRING AND GOVERNOR ROD HOOK INTO OPPOSITE SIDES OF PLASTIC GROMMET IN THROTTLE LEVER.

OH1-36 *S&TT 9/00*

Slide 1-36: Governor

- Emerald has mechanical and Marquis has electronic governor controls.
- Marquis is non-adjustable.
- Emerald has both rod length and sensitivity (droop) adjustments.
- The governor controls engine speed (frequency) to 1740 to 1890 rpm (58 to 63 Hz.).



Engine Common Problems

- Engine doesn't crank
- Engine cranks, but won't start
- Engine misfires

OH1-37

S&TT 9/00

Slide 1-37: Engine Common Problems

Engine won't crank:

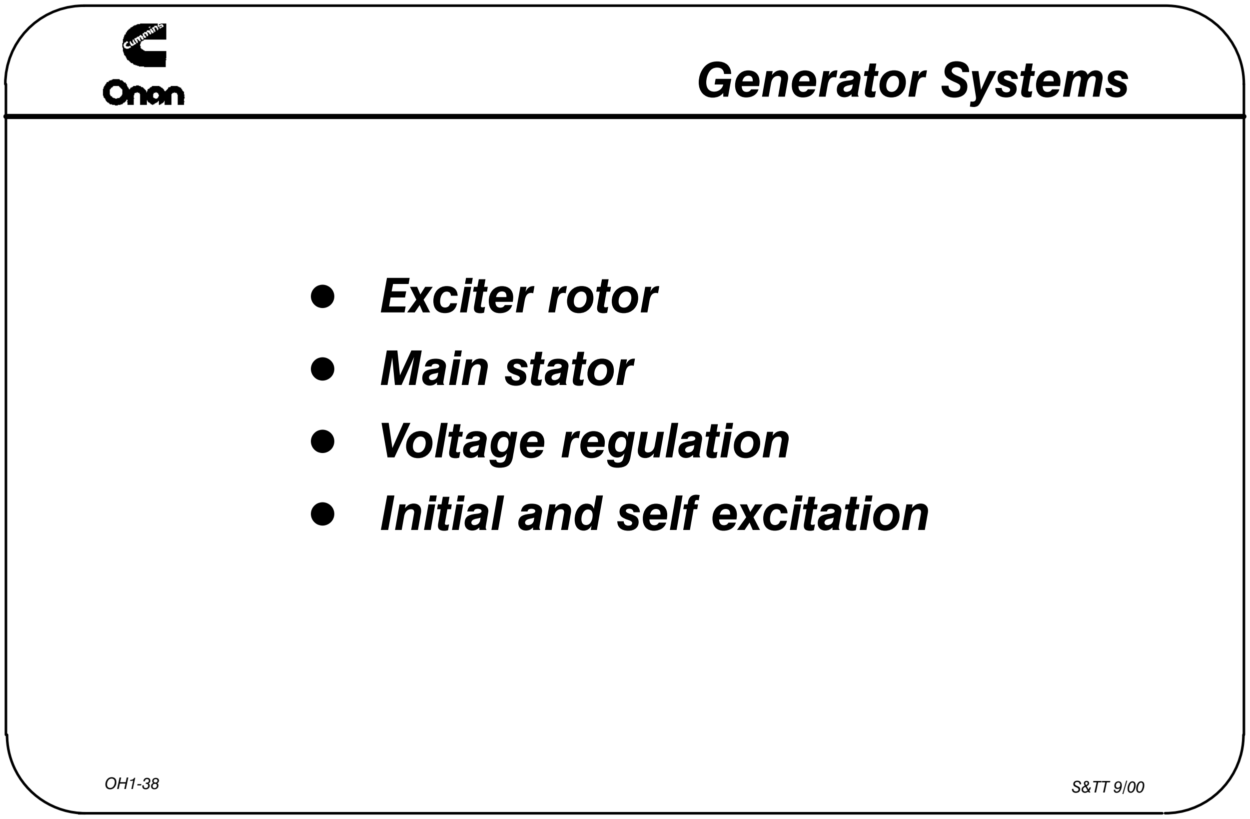
1. Check F1 fuse.
2. Check starting ability both at set and remote.
3. Check battery and terminals.

Engine cranks but won't start:

1. Check F2 fuse.
2. Check fuel level and fuel shut off valve.
3. Check restricted air filter or exhaust.
4. Check for faulty ignition components.
5. Check K4 or K5 relay.

Engine misfires:

1. Check for faulty spark plugs or wires.
2. Check for loose ignition coil terminal nuts.
3. Check for lean fuel mixture.



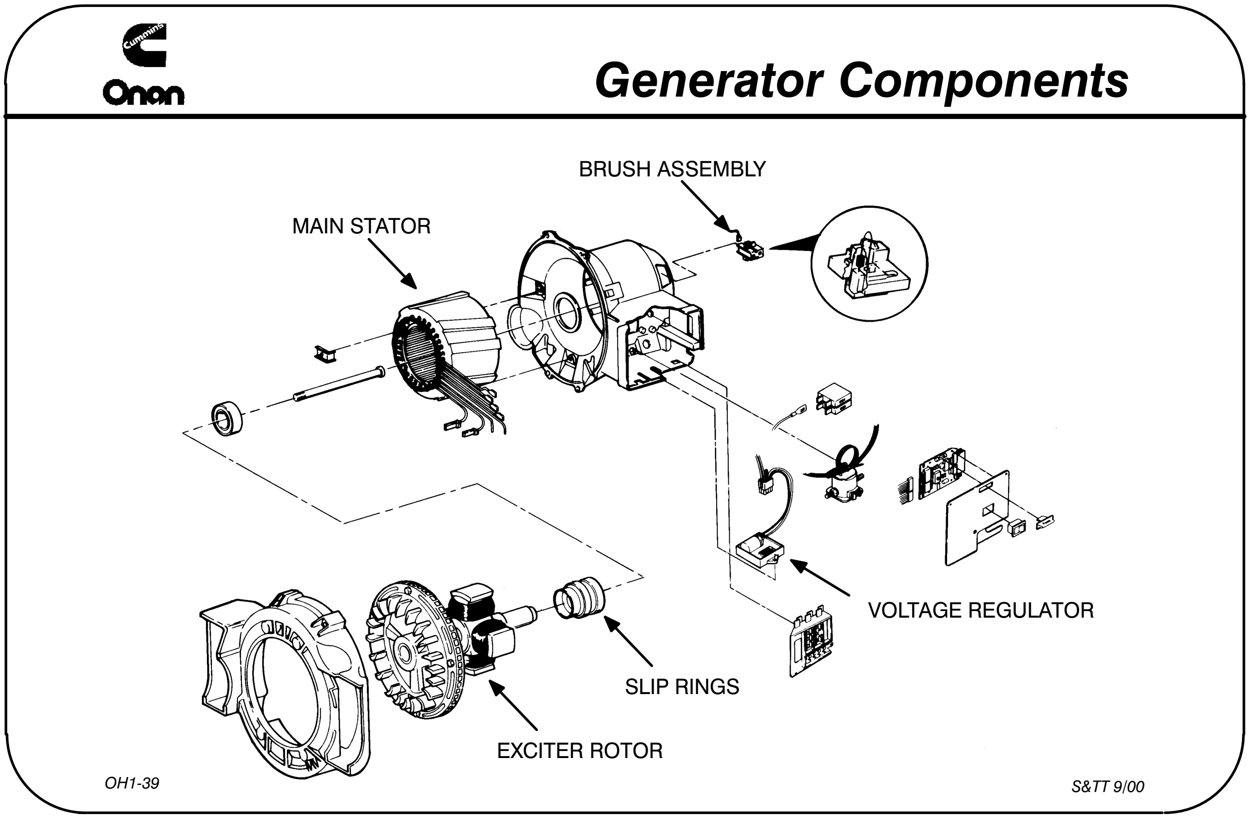
Generator Systems

- Exciter rotor
- Main stator
- Voltage regulation
- Initial and self excitation

OH1-38

S&TT 9/00

Slide 1-38: Generator Systems



Generator Components

OH1-39

S&TT 9/00

Slide 1-39: Generator Components

Exciter Rotor

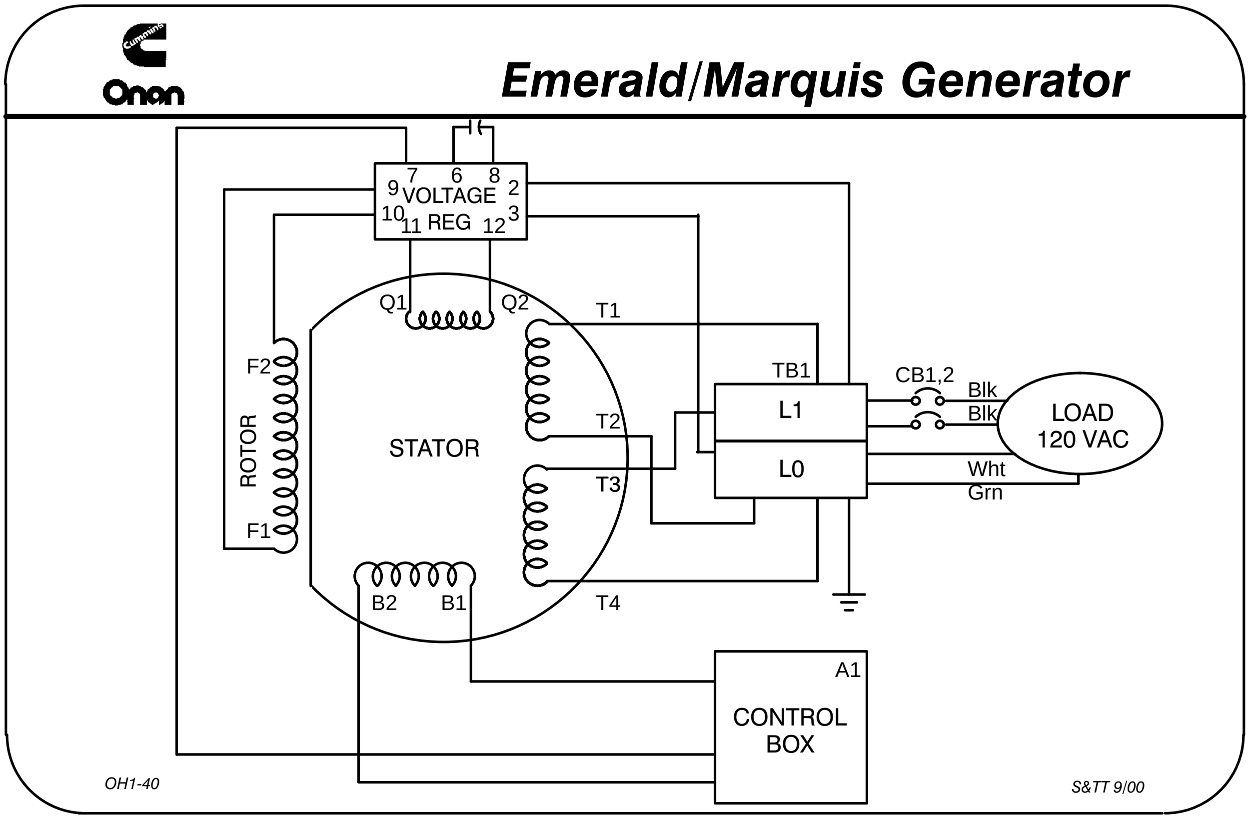
- 4 pole electromagnet.
- Rotates inside stator assembly.
- Produces electromagnetism for excitation.
- Bolted to blower wheel for cooling.
- Attached to slip rings that deliver DC voltage for excitation.

Main Stator

- Located inside generator housing.
- Stationary part of generator.
- Contains AC voltage producing windings.
- Provides AC current for battery charging, regulation and loads.

Voltage Regulation

- Located behind control cover on stator housing.
- Receives input from stator.
- Monitors load voltage.
- Produces DC voltage for exciter field regulation.



Emerald/Marquis Generator

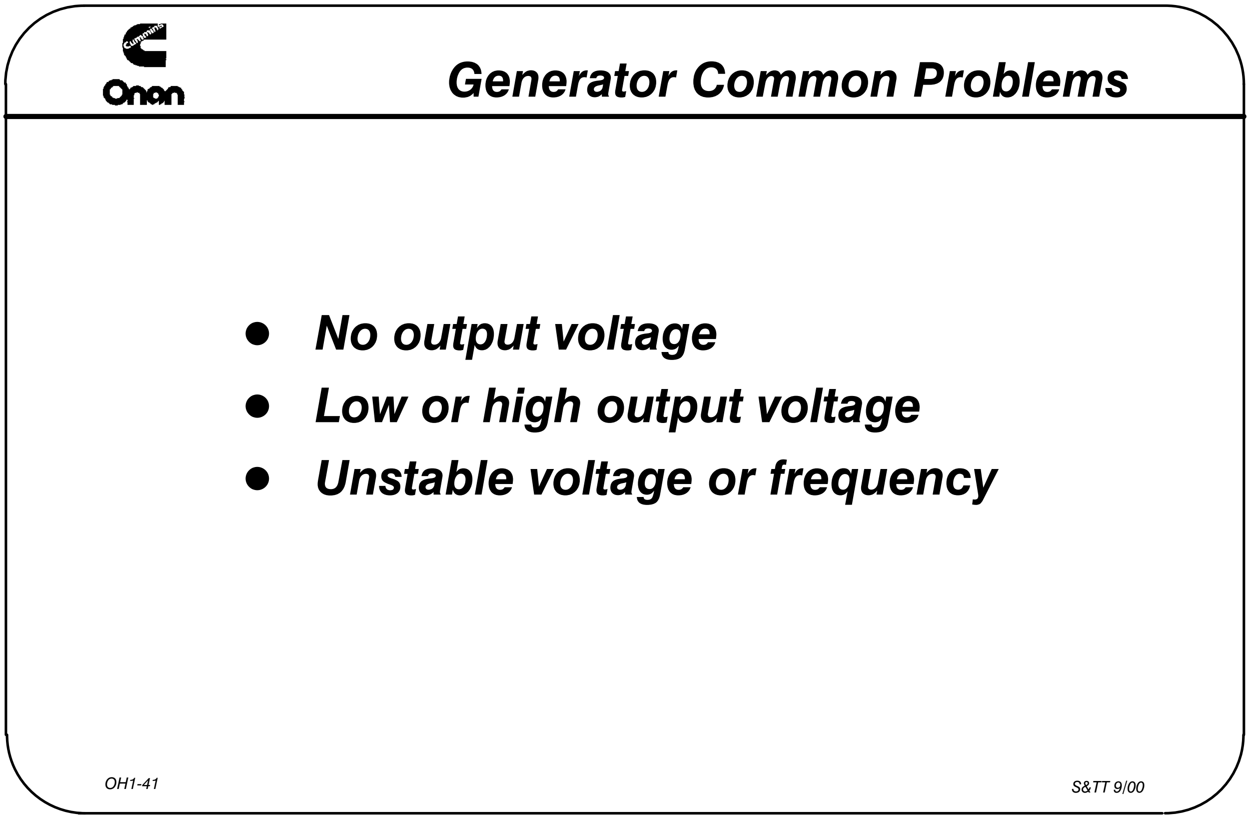
OH1-40

S&TT 9/00

Slide 1-40: Initial and Self Excitation

During GenSet start, battery B+ is applied to the rotor through the slip rings. This momentary **field flash** connection provides adequate residual magnetism in the rotor. With this **initial excitation** and the electromagnetic field rotating inside the stator, an AC voltage is induced into the stator windings. A portion of this voltage is provided to the voltage regulator where it is rectified to DC and supplied to the slip rings for the field **self excitation**. As the load changes, the DC voltage to the slip rings will **automatically change** to keep the output voltage constant.

Note: This is the process of **automatic voltage regulation**.



Generator Common Problems

- No output voltage
- Low or high output voltage
- Unstable voltage or frequency

OH1-41

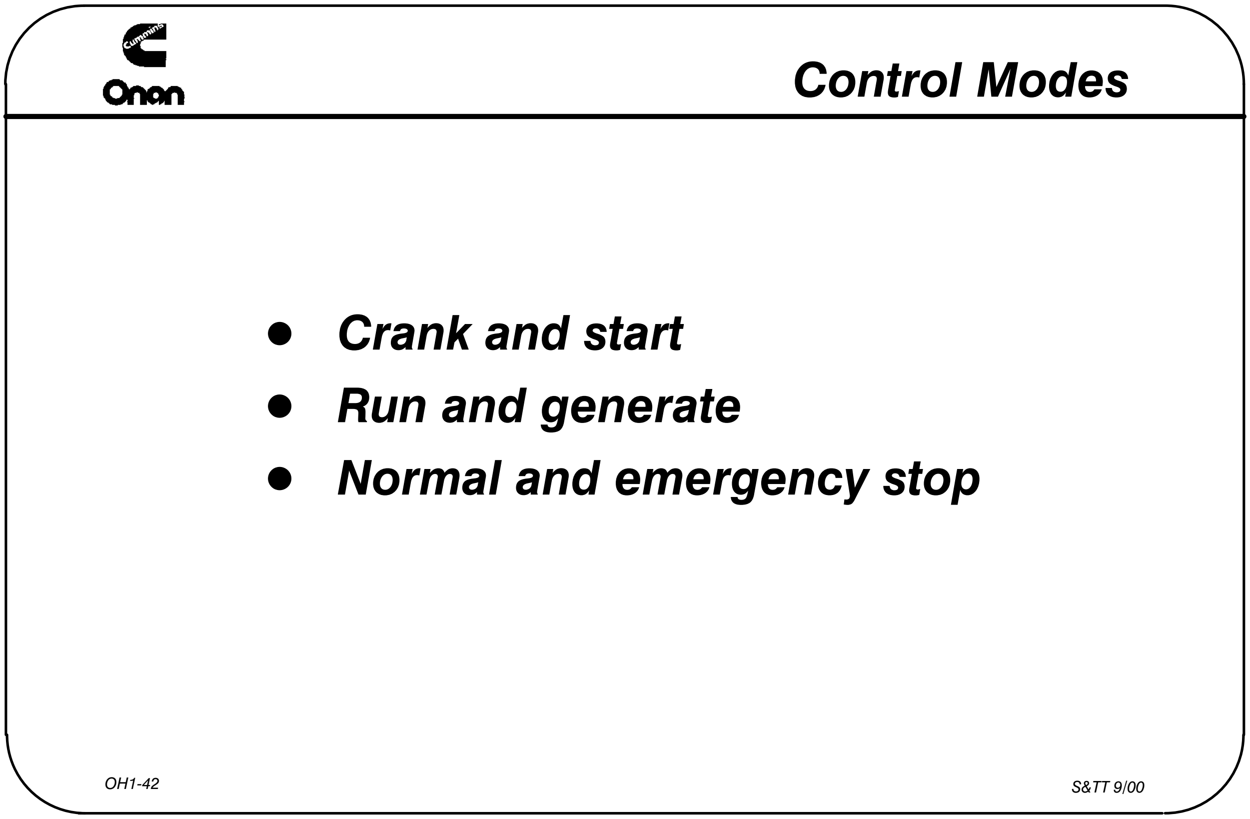
S&TT 9/00

Slide 1-41: Generator Common Problems

No output voltage:
- Check AC circuit breakers
- Check brushes and slip rings
- Check wiring to regulator
- Check rotor and stator for opens, shorts or grounds
- Check regulator using tester

Low or high output voltage:
- Check engine speed
- Check engine governor adjustment
- Check brushes and slip rings
- Check wiring to regulator
- Check rotor and stator for opens, shorts or grounds

Unstable voltage or frequency:
- Check engine governor for sensitivity, sticking or binding
- Check carburetor for lean mixture
- Check intake manifold and gaskets for vacuum leaks



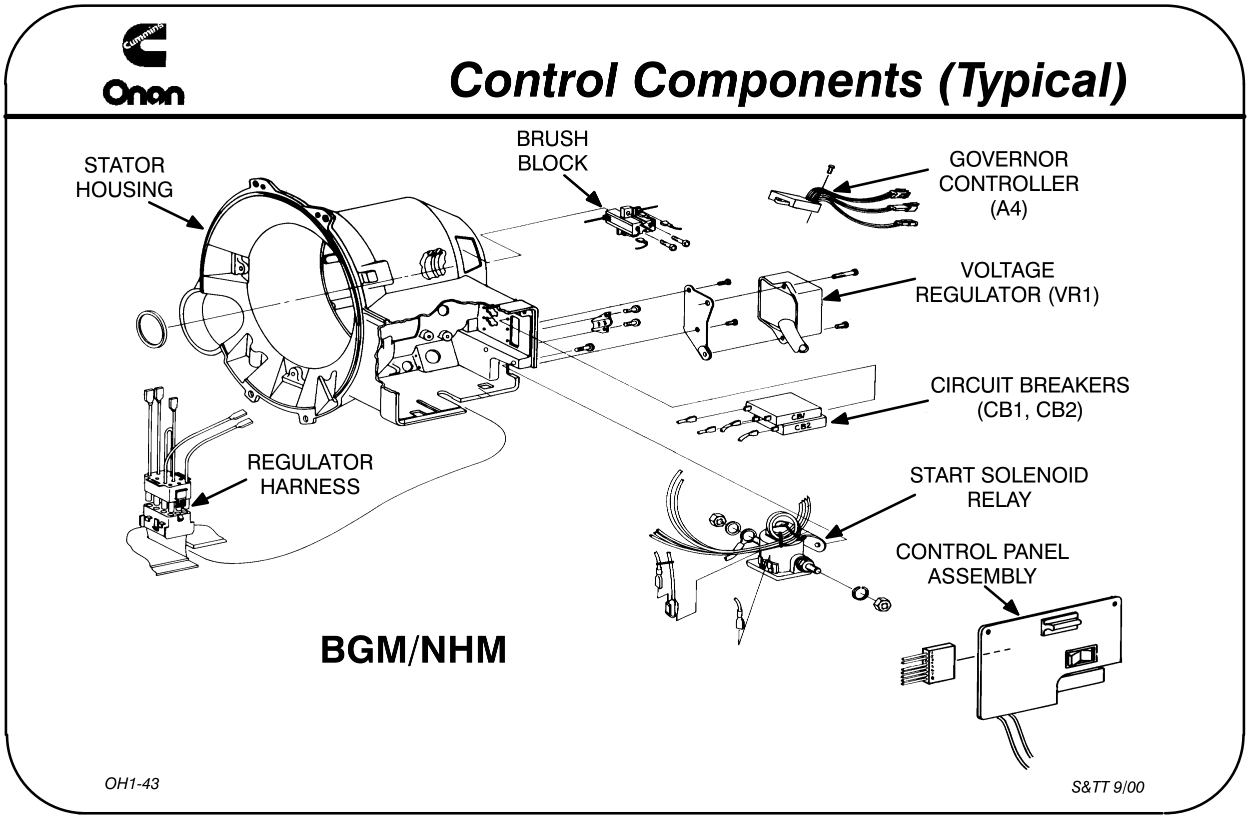
Control Modes

- Crank and start
- Run and generate
- Normal and emergency stop

OH1-42

S&TT 9/00

Slide 1-42: Control Modes



Control Components (Typical)

OH1-43

S&TT 9/00

Slide 1-43: Control Components (Typical)

- Located on generator stator housing.
- Consists of the A1 printed circuit board, starter, fuel and electronic governor components.
- Controls and monitors the start, run and stop functions.

Activity

Directions: Using your highlighters, and the copies of the **Emerald** GenSet control schematic, **611-1244**, follow along with the instructor and color the modes of operation on your sheets.

The left page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **Emerald GenSets** when they don’t operate properly.

Start Mode

Slide 1-44: **Print 611-1244**

Note: Everything prefaced with **A1** in the following description is on the A1 control board.

When the start/stop switch, **A1-S1**, is pressed to the start position, a ground is supplied to the **A1-K4** relay. The battery, **BT1**, positive current is already supplied to the **A1-K4** relay through the fuse **F1**. This causes the **A1-K4** normally open, **N.O.**, contacts to close allowing current to flow to the starter solenoid, **K1**, closing its contacts and energizing the starter motor, **B1**.

Battery current will flow through the **A1-K3** normally closed, **N.C.**, contacts energizing the choke and fuel pump relay, **K4**, closing its N.O. contacts. Current will now flow through fuse, **F2**, to energize the fuel pump, **E2**, and the choke heater, **H1**.

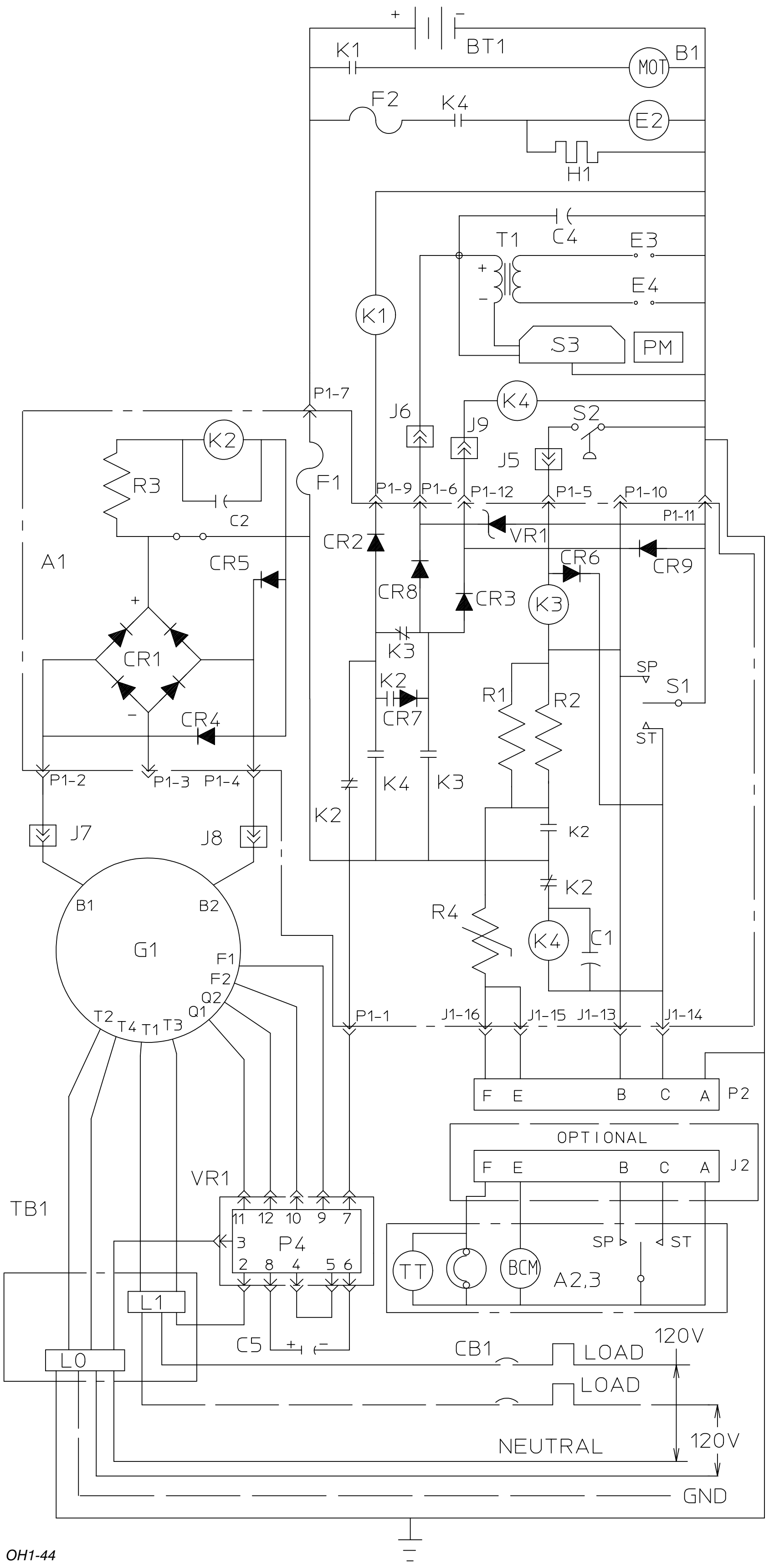
Battery current also flows to the ignition coil, **T1**, and the ignition module, **S3**.

Generator field current flows through the **N.C. A1-K2** contacts to the automatic voltage regulator, **VR1**, and to the generator rotor brushes **F1** and **F2**.

- **Fuel pump pressure is 3.5 to 5 psi**

BGE Genset
611-1244

A1	**Control Assembly**
A2	**Deluxe Remote Control**
A3	**Standard Remote Control**
B1	**Starter Motor**
BT1	**Battery**
C4,5	**Capacitor**
CB1,2	**AC Circuit Breaker**
E2	**Fuel Pump**
E3,4	**Spark Plugs**
F1	**Fuse 10 Amp**
F2	**Fuse 10 Amp**
G1	**Generator**
K1	**Starter Solenoid Relay**
K4	**Choke & Fuel Pump Relay**
PM	**Permanent Magnet**
S1	**Start/Stop Switch**
S2	**Low Oil Pressure Switch**
S3	**Ignition Module**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**



OH1-44

S&TT 9/00

Run Mode

Slide 1-45: **Print 611-1244**

Note: Everything prefaced with **A1** in the following description is on the A1 control board.

As the engine oil pressure rises, the low oil pressure switch, **S2**, closes. This will supply a ground to the **A1-K3** run relay. The generator, **G1**, is now producing voltage and the **B1/B2** winding is sending AC voltage to the **A1-CR1** rectifier. This DC voltage energizes the **A1-K2** relay closing its **N.O.** contacts allowing battery **B+** current to energize the **A1-K3** relay. The **A1-K3 N.O.** contacts close and keep current flowing to the ignition and fuel circuits.

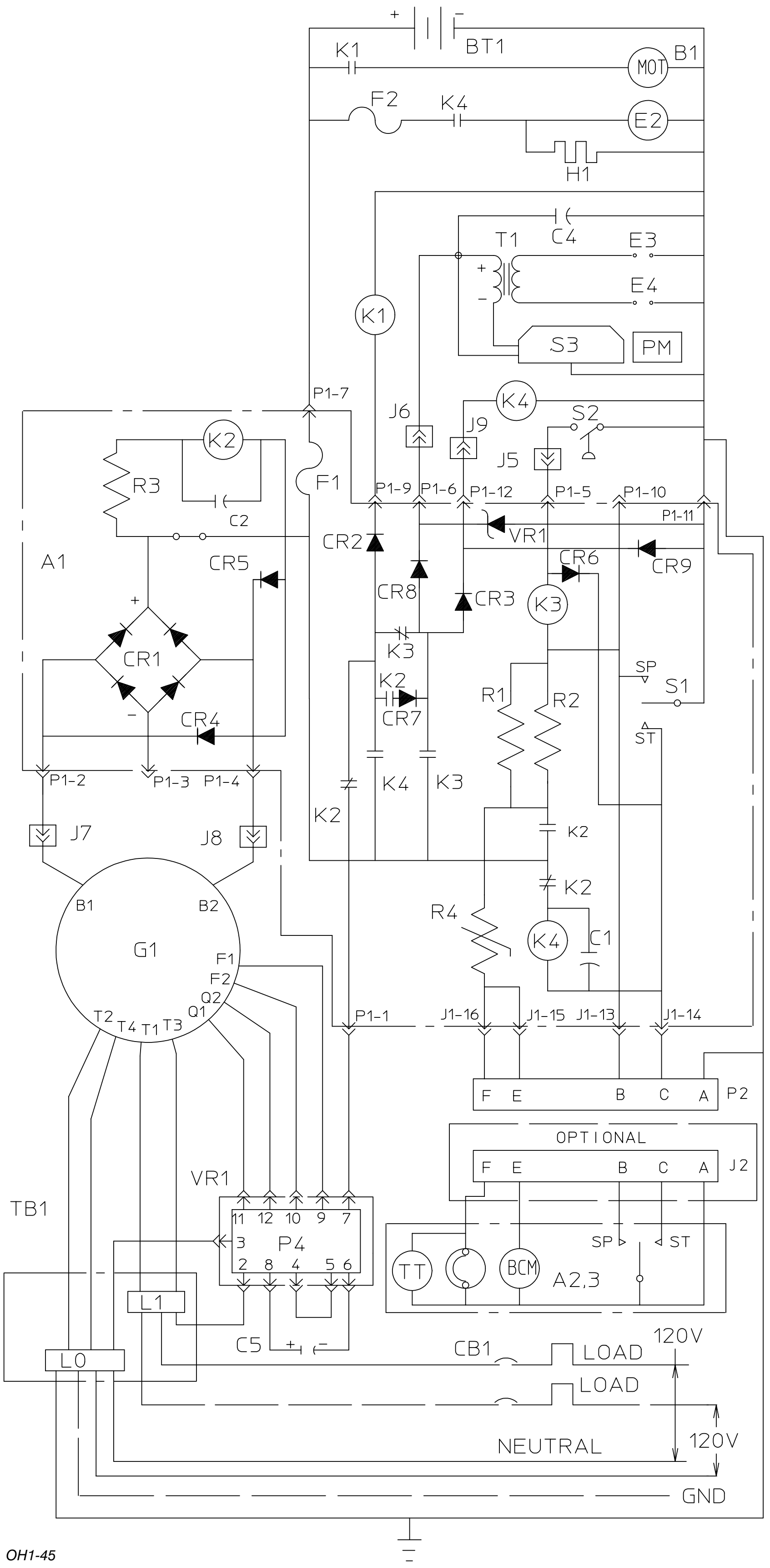
Two other sets of **A1-K2 N.C.** contacts open, deenergizing the **A1-K4** relay which removes current from the starter and generator field circuits.

Generator **T1-T4** windings produce AC voltage for the load and a reference voltage to the **VR1** regulator. The **Q1/Q2** winding produces a voltage, converted by the **VR1** regulator, for generator field self excitation.

- **S2 closing pressure is 5-9 psi**
- **Normal engine operating oil pressure is approximately 14 psi**
- **L1 to L0 voltage is approximately 128 AC volts**
- **Q1 to Q2 voltage is about 160 AC volts**
- **F1 to F2 voltage is about 18 to 60 DC volts from no load to full load**

BGE Genset
611-1244

A1	**Control Assembly**
A2	**Deluxe Remote Control**
A3	**Standard Remote Control**
B1	**Starter Motor**
BT1	**Battery**
C4,5	**Capacitor**
CB1,2	**AC Circuit Breaker**
E2	**Fuel Pump**
E3,4	**Spark Plugs**
F1	**Fuse 10 Amp**
F2	**Fuse 10 Amp**
G1	**Generator**
K1	**Starter Solenoid Relay**
K4	**Choke & Fuel Pump Relay**
PM	**Permanent Magnet**
S1	**Start/Stop Switch**
S2	**Low Oil Pressure Switch**
S3	**Ignition Module**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**



OH1-45

S&TT 9/00

Stop Mode

Slide 1-46: **Print 611-1244**

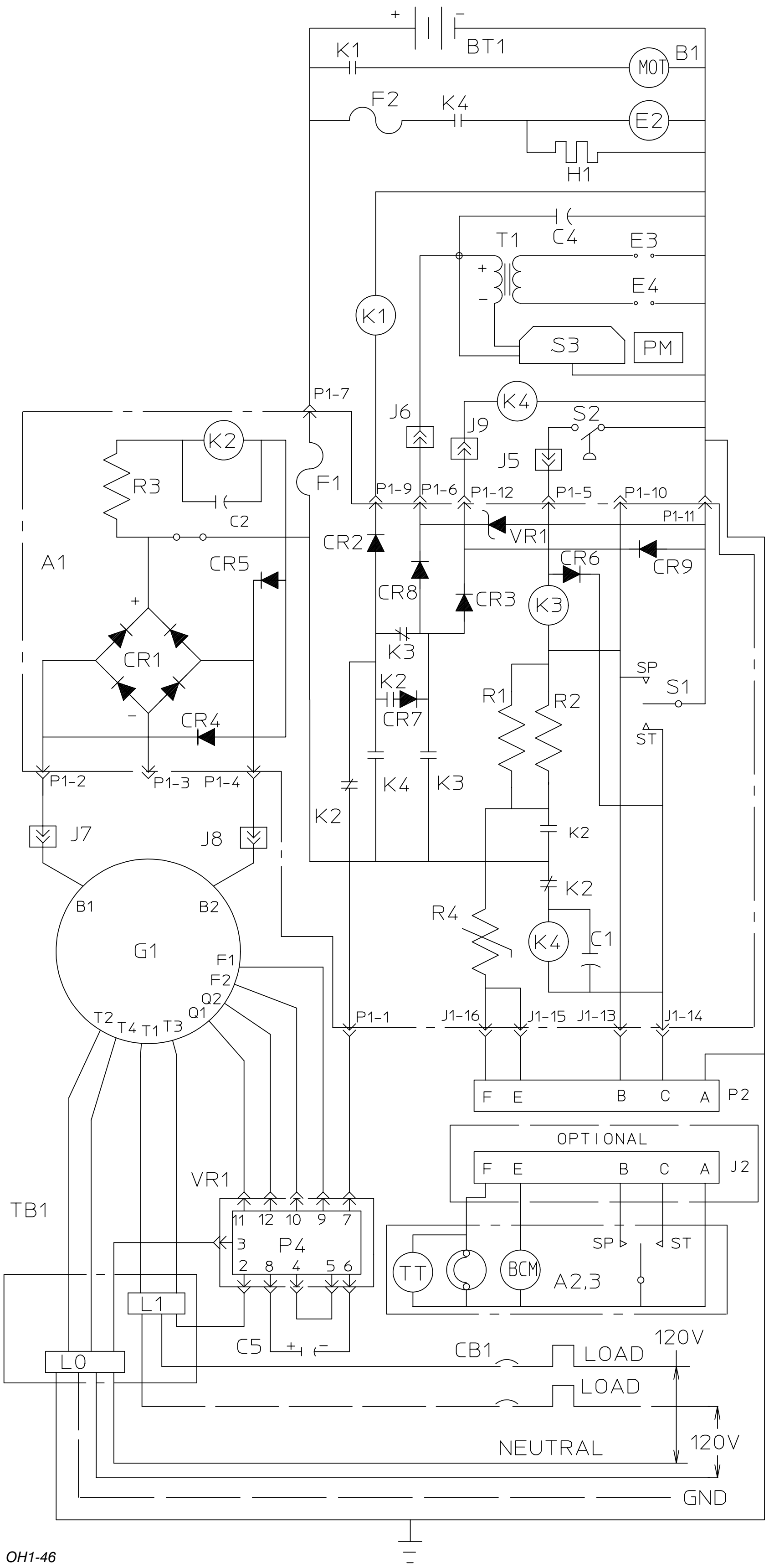
Note: Everything prefaced with **A1** in the following description is on the A1 control board.

Pressing the start/stop switch, **A1-S1**, to the stop position deenergizes the **A1-K3** relay opening the closed contacts removing current to the ignition and fuel circuits.

Emergency Stop

Note: Everything prefaced with **A1** in the following description is on the A1 control board.

This occurs when the oil pressure switch, **S2**, opens with a drop in oil pressure or when the **A1-K2** relay deenergizes due to a loss of **B1/B2** generator voltage.



BGE Genset 611-1244

A1	**Control Assembly**
A2	**Deluxe Remote Control**
A3	**Standard Remote Control**
B1	**Starter Motor**
BT1	**Battery**
C4,5	**Capacitor**
CB1,2	**AC Circuit Breaker**
E2	**Fuel Pump**
E3,4	**Spark Plugs**
F1	**Fuse 10 Amp**
F2	**Fuse 10 Amp**
G1	**Generator**
K1	**Starter Solenoid Relay**
K4	**Choke & Fuel Pump Relay**
PM	**Permanent Magnet**
S1	**Start/Stop Switch**
S2	**Low Oil Pressure Switch**
S3	**Ignition Module**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**

OH1-46

S&TT 9/00

Activity

Directions: Read through your input/output sequence sheet on the **Emerald 611-1244** control, then with your colored schematics, follow along with the instructor in identifying the inputs and outputs of the printed circuit board.

Sequence of Operation for **BGE/NHE** GenSet's using the **611-1244** control print:

MODE	INPUTS	OUTPUTS	RESULTS
STATIC	B+ at A1P1-7		B+ at F1 fuse
	GND at A1P1-11	GND at P2-A	GND to Remote Control

Operator moves S1 or Remote Start Switch to "Start" position.

CRANK			
	GND at P2-C (Remote)	B+ to A1P1-9	For K1 Start Solenoid to energize Starter motor (B1).
		B+ to A1P1-6	Powers Ignition System.
		B+ to A1P1-12	For K4 to energize E2 (fuel pump) and H1 (choke heater)
		B+ to A1P1-1	Field Flash to P4-7 (VR1)

START DISC.	B+ at A1P1-7		B+ at F1 fuse
	GND at A1P1-11	GND at P2-A	GND to Remote Control
	GND at P2-C (Remote)		
	AC at A1P1-2 and A1P1-4	*B+ removed from A1P1-9*	*Starter motor (B1) stops.*
		B+ removed from A1P1-1	*Field Flash removed*

RUN	B+ at A1P-7		B+ at F1 fuse
		GND at P2-A	GND to Remote Control
	AC at A1P1-2 and A1P1-4	*B+ removed from A1P1-9*	*Starter motor (B1) stops.*
		B+ removed from A1P1-1	*Field Flash removed*
	GND to P1-5 from S2 (LOP)		GenSet continues to run when S1 released.
		B+ to A1P1-6	Powers Ignition System.
		B+ to A1P1-12	For K4 to energize E2 (fuel pump) and H1 (choke heater)

Blank Page

Activity

Directions: Using your highlighters, and the copies of the **Marquis** GenSet control schematic, **611-1251**, follow along with the instructor and color the modes of operation on your sheets.

The left page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **Marquis GenSet's** when they don't operate properly.

Start Mode

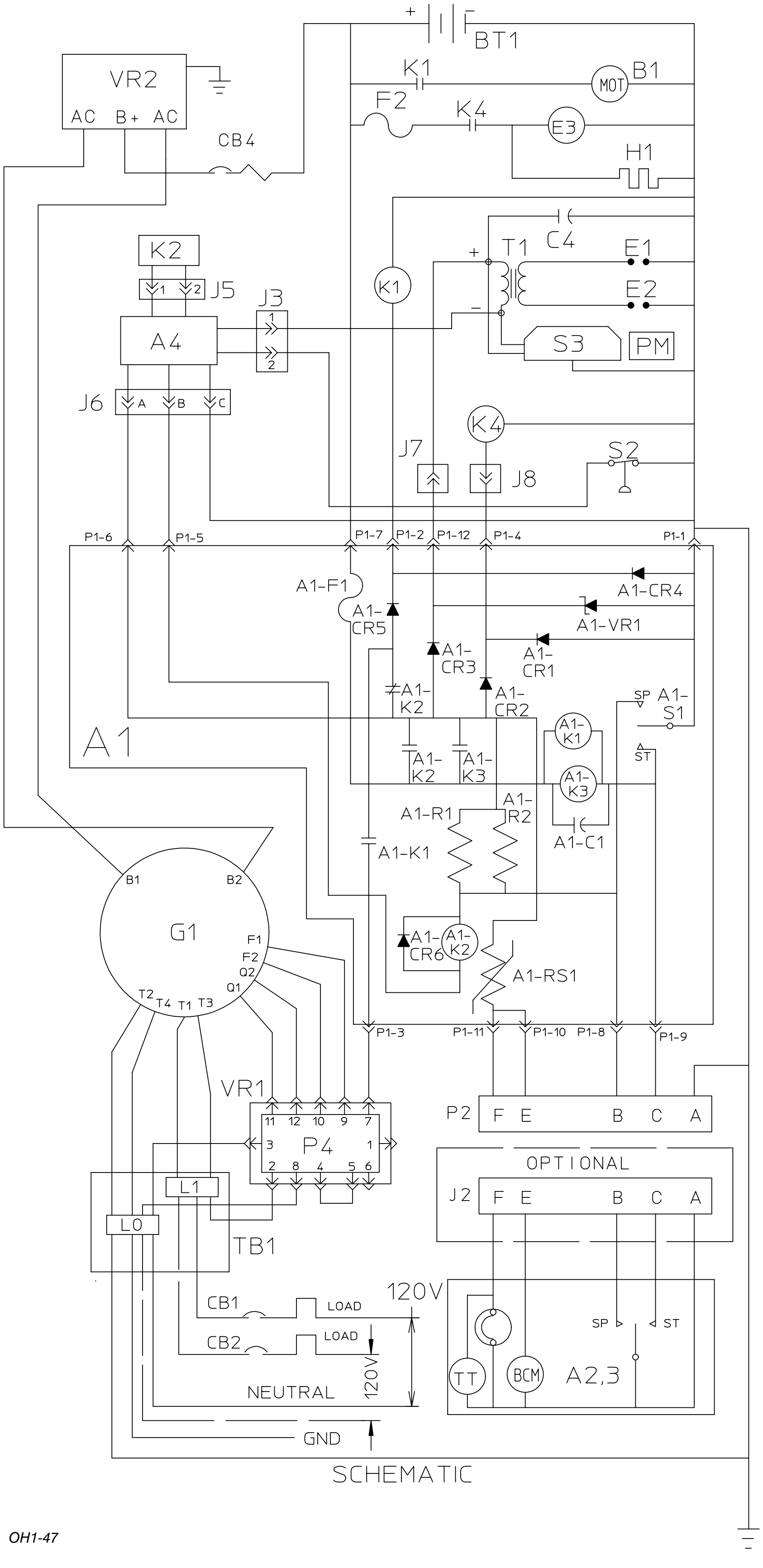
Slide 1-47: **Print 611-1251**

Moving the start/stop switch, **A1-S1**, to the start position connects battery ground, **B-**, to relays **A1-K3** and **A1-K1**. Battery positive, **B+**, is supplied to these relays through the fuse, **A1-F1**. The normally open, **N.O.**, contacts of **A1-K3** and **A1-K1** relays now close and allow battery current to flow to the following:

- **Starter solenoid, K1, and starter motor, B1, when the K1 contacts close**
- **Ignition coil, T1**
- **Choke and fuel pump relay, K4, closing the K4 contacts**
- **E3 fuel pump, and H1 choke**
- **Governor control board, A4, and governor actuator, K2**
- **Generator field, F1/F2, through the voltage regulator, VR1**

After the engine has cranked approximately **1** second, a ground signal from the ignition coil, **T1**, is sent to the electronic governor, **A4**, and the governor actuator, **K2**, opens the carburetor throttle.

- **Fuel pump pressure is 3.5 to 5 psi**



SCHEMATIC

OH1-47

S&TT 9/00

BGM/NHM
611-1251

A1	**Control Board**
A2	**Dlx. Remote Control**
A3	**Std. Remote Control**
A4	**Electronic Governor**
B1	**Starter Motor**
BT1	**Battery 12V**
C4	**Capacitor**
CB1,2	**AC Circuit Breaker**
CB4	**DC Circuit Breaker**
E1,2	**Spark Plugs**
E3	**Fuel Pump**
F1	**Control Fuse**
F2	**Fuel Pump Fuse**
G1	**Generator**
H1	**Choke**
K1	**Start Solenoid Relay**
K2	**Governor Actuator**
K4	**Choke/Fuel Pump Relay**
PM	**Permanent Magnet**
A1-S1	**Local Start/Stop Switch**
S2	**Low Oil Pressure Sw.**
S3	**Ignition Module**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**
VR2	**DC Voltage Regulator**

Run Mode

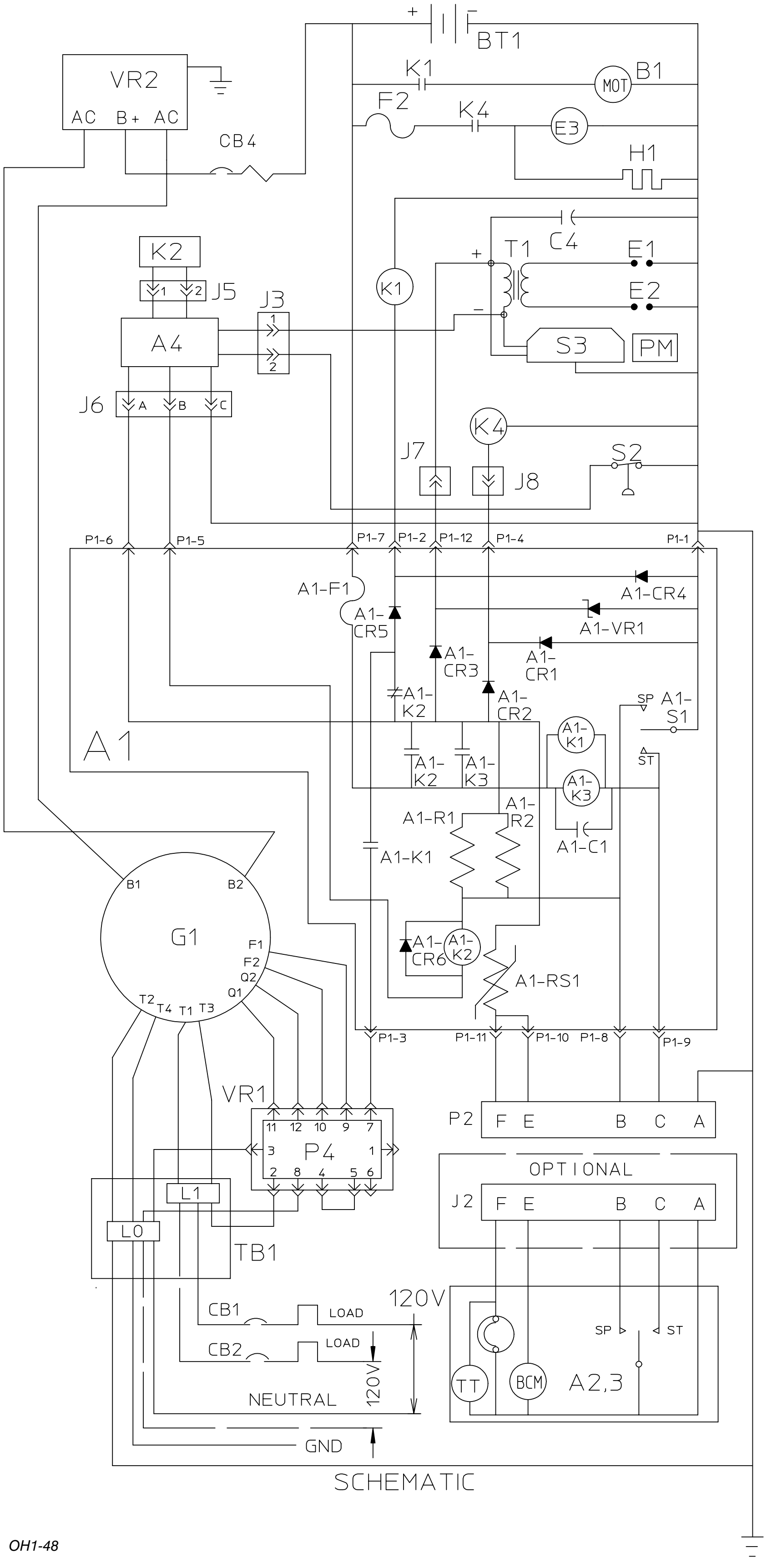
Slide 1-48: **Print 611-1251**

As the engine starts, oil pressure opens the low oil pressure switch, **S2**, removing the safety shut-down ground from the governor controller, **A4**. When the governor controller receives the ignition coil signal that the speed has reached **1150** rpm it connects a ground to the **A1-K2** relay. The **A1-K2 N.O**. contacts close providing a new path for **B+** current to flow to the ignition, fuel and choke circuits. The **A1-K2 N.C**. contacts open removing **B+** current from the starter and generator field circuits. Releasing the start/stop switch will now deenergize the **A1-K3** and **A1-K1** relays, opening their contacts.

Generator outputs **B1** and **B2** send AC voltage to the DC voltage regulator, **VR2**, to provide battery charge current. **T1-T4** provide AC voltage to the load and a reference voltage to the voltage regulator, **VR1**. **Q1** and **Q2** also provide an AC voltage to the voltage regulator, **VR1**, for the generator field self excitation.

Battery current flows from the control board **A1- P1-10,11** pins for the remote run light, battery condition meter, **BCM**, and the time totalizer, **TT**.

- **S2 opening pressure is 5-9 psi**
- **Normal engine oil pressure is approximately 14 psi**
- **L1 to L0 and L2 to L0 are approximately 128 AC volts**
- **Q1 and Q2 are approximately 160 AC volts**
- **F1 to F2 is about 18 to 60 volts DC from no load to full load**
- **Battery charge current is about 1 amp**



SCHEMATIC

BGM/NHM
611-1251

A1	**Control Board**
A2	**Dlx. Remote Control**
A3	**Std. Remote Control**
A4	**Electronic Governor**
B1	**Starter Motor**
BT1	**Battery 12V**
C4	**Capacitor**
CB1,2	**AC Circuit Breaker**
CB4	**DC Circuit Breaker**
E1,2	**Spark Plugs**
E3	**Fuel Pump**
F1	**Control Fuse**
F2	**Fuel Pump Fuse**
G1	**Generator**
H1	**Choke**
K1	**Start Solenoid Relay**
K2	**Governor Actuator**
K4	**Choke/Fuel Pump Relay**
PM	**Permanent Magnet**
A1-S1	**Local Start/Stop Switch**
S2	**Low Oil Pressure Sw.**
S3	**Ignition Module**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**
VR2	**DC Voltage Regulator**

OH1-48

S&TT 9/00

Stop Mode

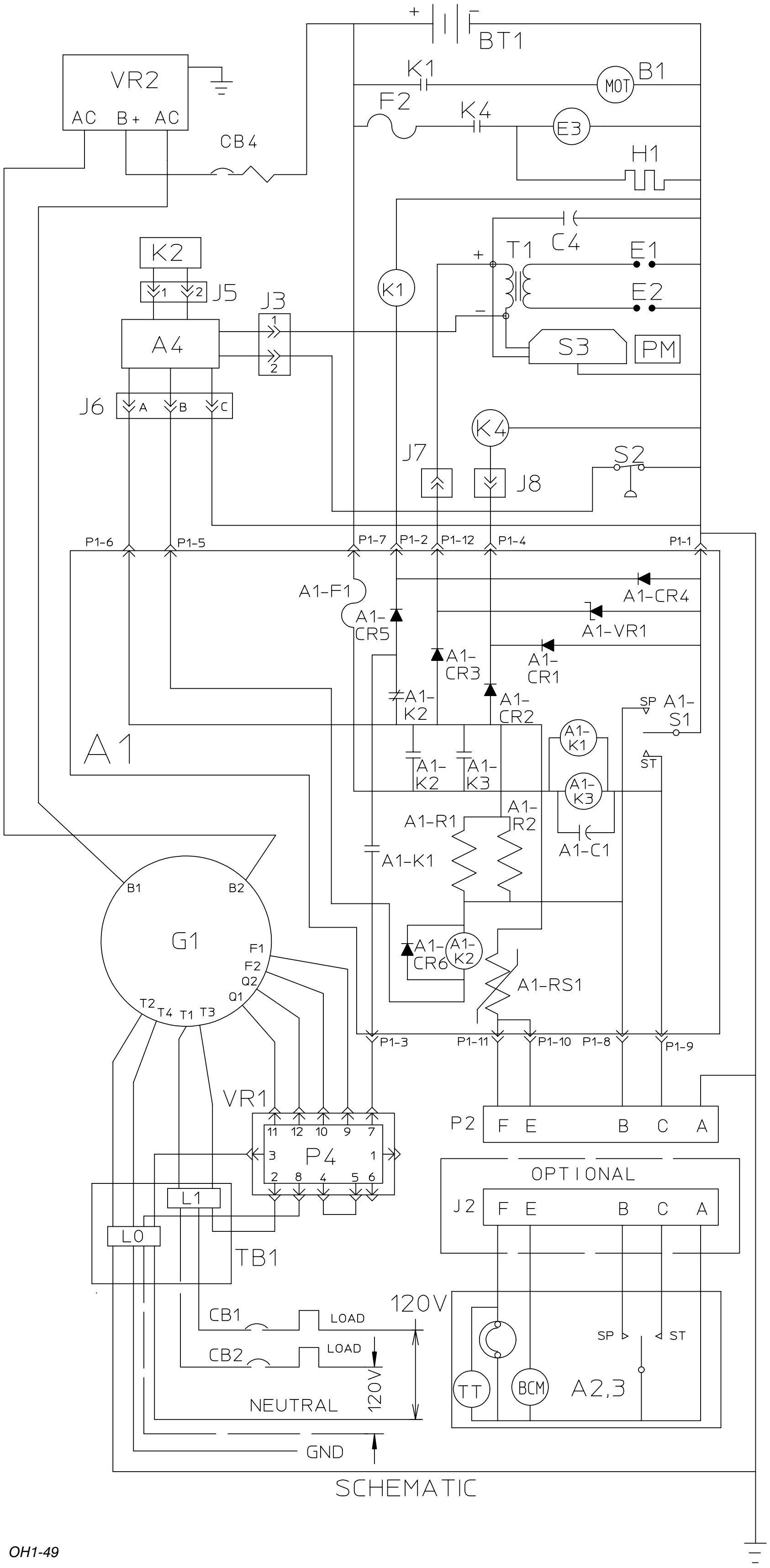
Slide 1-49: **Print 611-1251**

When the start/stop switch, **A1-S1**, is pressed to the stop position, it supplies a ground to the **A1-R1, R2** resisters deenergizing the **A1-K2** relay. This removes battery **B+** current from the ignition, fuel, choke and governor control circuits.

Emergency Stop

Emergency shut-down occurs when any of the following events happen:

- **Loss of B+ to governor controller for more than $^1/_2$ second**
- **Loss of ignition module signal for more than $^1/_2$ second**
- **GenSet speed goes over 2700 rpm**
- **GenSet speed goes below 1760 rpm for more than 30 seconds**
- **Loss of oil pressure closes the S2 switch**



SCHEMATIC

BGM/NHM
611-1251

A1	**Control Board**
A2	**Dlx. Remote Control**
A3	**Std. Remote Control**
A4	**Electronic Governor**
B1	**Starter Motor**
BT1	**Battery 12V**
C4	**Capacitor**
CB1,2	**AC Circuit Breaker**
CB4	**DC Circuit Breaker**
E1,2	**Spark Plugs**
E3	**Fuel Pump**
F1	**Control Fuse**
F2	**Fuel Pump Fuse**
G1	**Generator**
H1	**Choke**
K1	**Start Solenoid Relay**
K2	**Governor Actuator**
K4	**Choke/Fuel Pump Relay**
PM	**Permanent Magnet**
A1-S1	**Local Start/Stop Switch**
S2	**Low Oil Pressure Sw.**
S3	**Ignition Module**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**
VR2	**DC Voltage Regulator**

OH1-49

S&TT 9/00

Activity

Directions: Read through your input/output sequence sheet on the **Marquis 611-1251** control, then with your colored schematics, follow along with the instructor in identifying the inputs of the printed circuit board.

Sequence of Operation for Marquis GenSet's using the **611-1251** control print #1:

MODE	INPUTS	OUTPUTS	RESULTS
STATIC	B+ at A1P1-7		B+ at F1 fuse
	GND at A1P1-1	GND at P2-A	GND to Remote Control
	GND at J3-2 from LOP (S2)		LOP Shutdown GND to A4 Module
	GND at J6-C		GND to A4 Module

Operator moves A1-S1 or Remote Start Switch to "Start" position.

CRANK	B+ at A1P1-7		B+ at F1 fuse
	GND at A1P1-1	GND at P2-A	GND to Remote Control
	GND at J6-C		GND to A4 Module
	GND at J3-2 from LOP (S2)		LOP Shutdown GND to A4 Module
	GND at J6-C		
	GND at A1P1-9 from Remote.	B+ at A1P1-2	For K1 Start Solenoid to energize Starter motor (B1).
		B+ at A1P1-12	Powers Ignition System.
		B+ at A1P1-4	For K4 to energize E3 (fuel pump) and H1 (choke heater).
		B+ at A1P1-3	Field Flash to P4-7 (VR1)
		B+ at A1P1-6	B+ to A4 Module

Approximately 1 second after engine starts cranking, a GND signal is sent from T1 (Ign coil) to Module A4 (Electronic governor). This GND signal allows the A4 Module to energize K2 (Governor actuator).

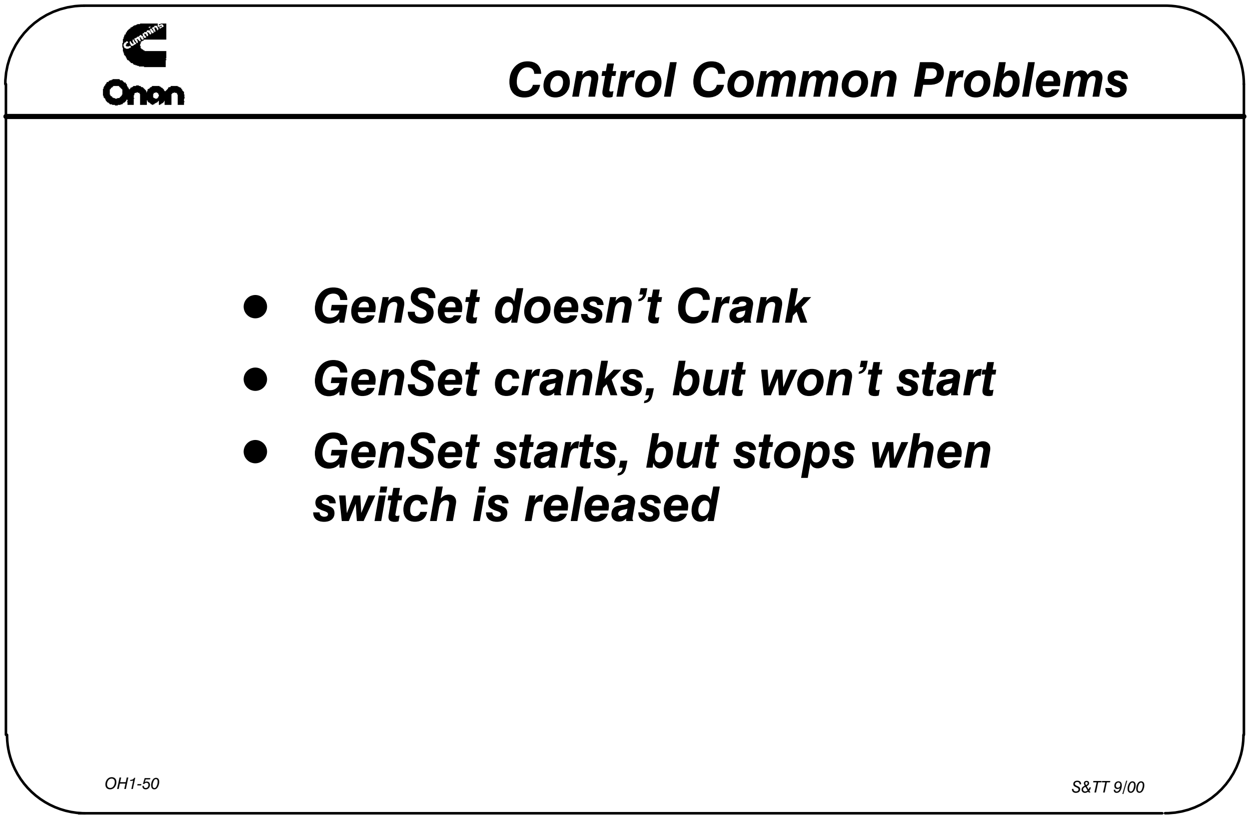
	Signal GND at J3-1 from T1/S3		Throttle opens.

Sequence of Operation for Marquis GenSet’s using the **611-1251** control print #2:

MODE	INPUTS	OUTPUTS	RESULTS
START DISC.	B+ at A1P1-7		B+ at F1 fuse
	GND at A1P1-1	GND at A1P2-1	GND to Remote Control
	GND at J6-C		GND to A4 Module
	NO GND at J3-2 from LOP (S2)		***NO*** GND to A4 Module
			LOP (S2) opens when oil pressure reaches 5-9 psi. If no ground to J3-1 from T1/S1, GenSet stops.
A4	Signal GND at J3-1 from T1/S3 indicating 1150 RPM.	GND at J6-B to A1P1-5	GND to A1-K2 removes B+ from A1P1-7 for K1 and from A1P1-3 for Field Flash.
		B+ at A1P1-12	Powers Ignition System.
		B+ at A1P1-4	For K4 to energize E3 (fuel pump) and H1 (choke heater).
		B+ *removed from* A1P1-3	*Field Flash removed from P4-7.*
		B+ at A1P1-6	B+ to A4 and K2 to keep throttle from closing.

Sequence of Operation for Marquis GenSet’s using the **611-1251** control print #3:

MODE	INPUTS	OUTPUTS	RESULTS
RUN	B+ at A1P1-7		B+ at F1 fuse
	GND at A1P1-1	GND at P2-A	GND to Remote Control
	GND at J6-C		GND to A4 Module
	GND at A1P1-5 from A4 Module	B+ at A1P1-12	Powers Ignition System.
		B+ at A1P1-4	For K4 to energize E3 (fuel pump) and H1 (choke heater).
	Signal GND at J3-1 from T1/S3	B+ at A1P1-6	B+ through A4 to K2 to keep throttle from closing.
		B+ at A1P1-11	B+ to RUN lamp and time totalizer (TT).
		B+ at A1P1-10	B+ to Battery Condition meter (BCM).



Control Common Problems

- *GenSet doesn’t Crank*
- *GenSet cranks, but won’t start*
- *GenSet starts, but stops when switch is released*

OH1-50

S&TT 9/00

Slide 1-50: Control Common Problems

GenSet doesn’t crank:

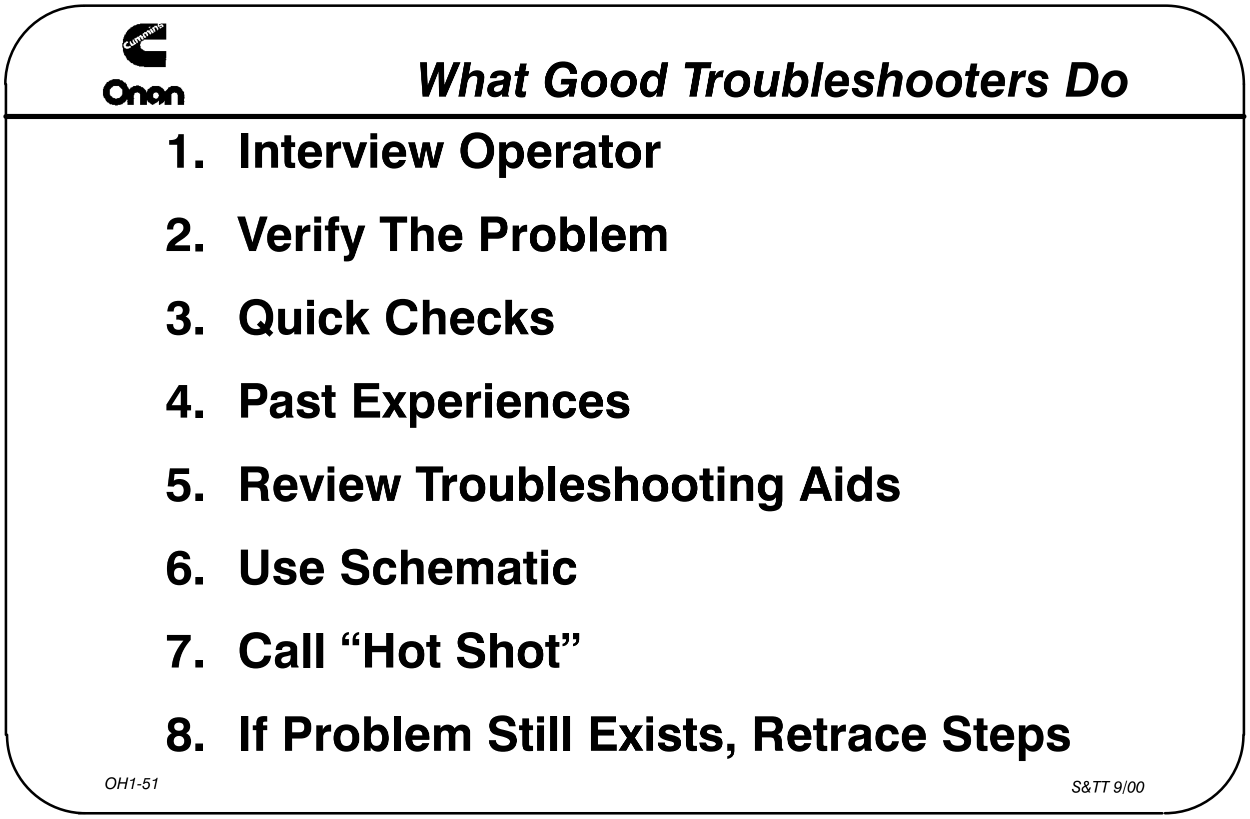
- Check F1 control fuse.
- Check battery and cables.
- Check start solenoid and starter motor.
- Check starting ability both at set and remote.
- Check control board.

GenSet cranks, but won’t start:

- Check F2 fuse.
- Check fuel level and fuel pump.
- Check for faulty ignition components.
- Check K4 relay.
- Check control board.

GenSet starts, but stops when switch is released:

- Check oil level and S2 pressure switch.
- Check for field flash from control to brushes.
- Check for generator input to control board (BGE/NHE).
- Check control board.



What Good Troubleshooters Do

1. Interview Operator
2. Verify The Problem
3. Quick Checks
4. Past Experiences
5. Review Troubleshooting Aids
6. Use Schematic
7. Call “Hot Shot”
8. If Problem Still Exists, Retrace Steps

OH1-51

S&TT 9/00

Slide 1-51: What Good Troubleshooters Do

1. Interview Operator
   - Witness
   - Points to trouble area
2. Verify the Problem
   - First hand experience
3. Quick Checks
   - Fuse
   - Connectors
   - Oil level
4. Experience
   - “Last time this happened”
5. Review Troubleshooting Aids
   - PSBs
   - Flow chart
   - “If/then” chart
6. Use Schematic
   - “Split half search”
7. Call “Hot Shot”
8. If Still Problem, Retrace Steps

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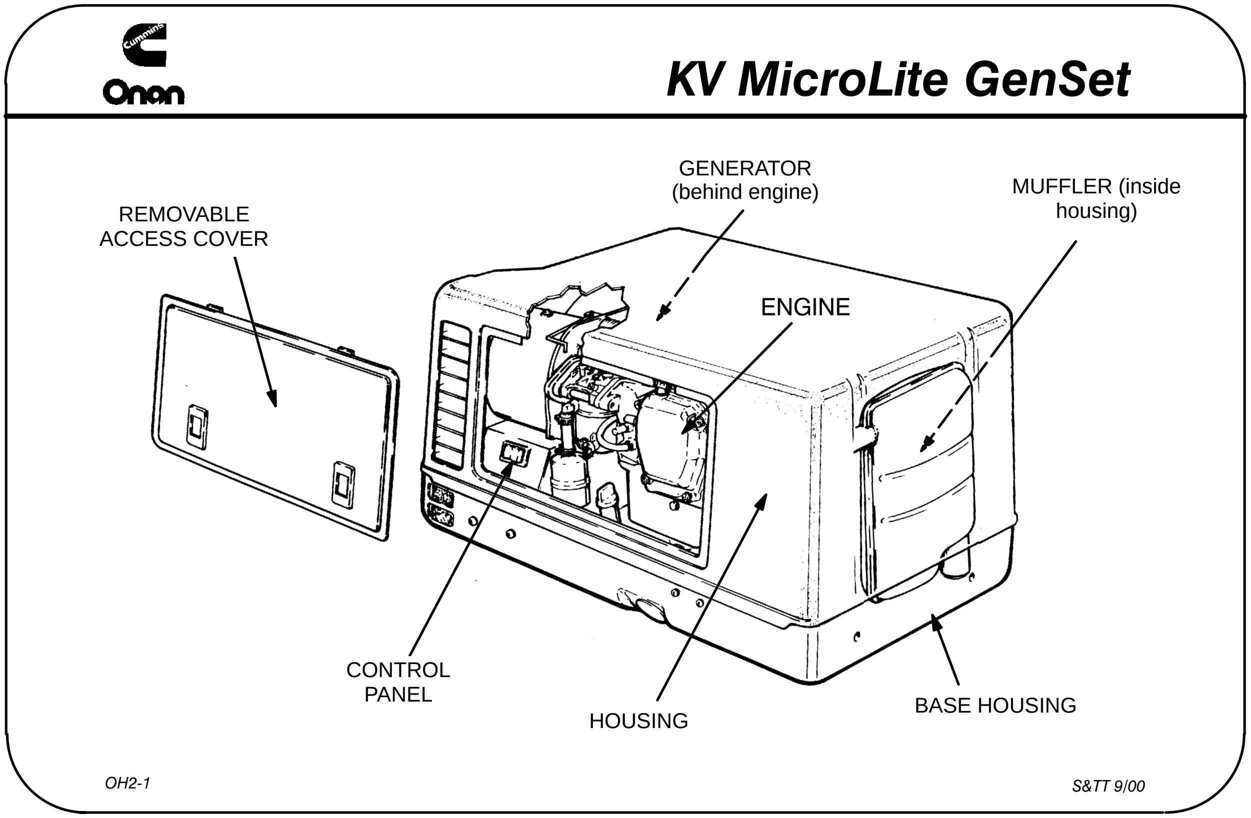
MicroLite GenSets Overview

This lesson presents an overview of the MicroLite generator set.

Objectives

After completing this lesson, you should be able to:

- Identify the main features of the MicroLite GenSet.
- Locate the MicroLite GenSet Model Tag.
- Decipher the Model Identification.
- Decipher the GenSet Serial Number.



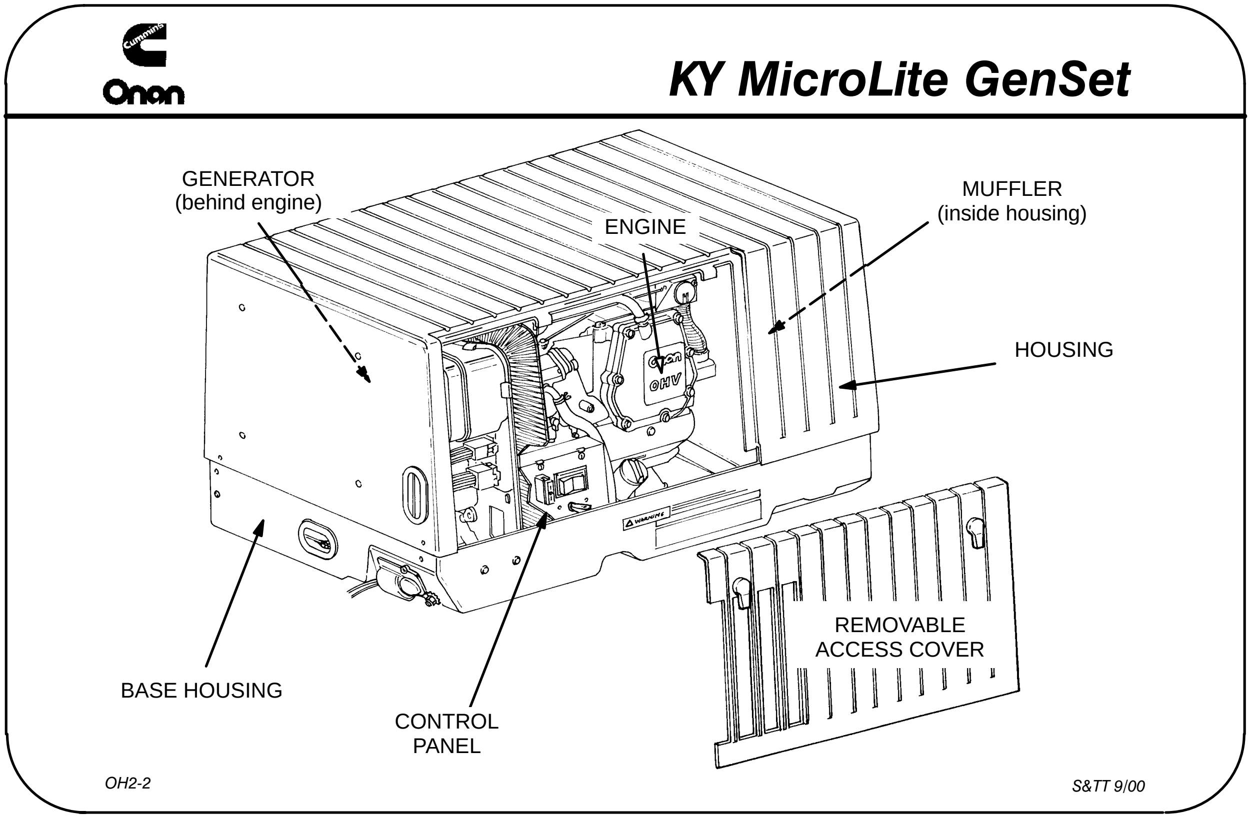
KV MicroLite GenSet

OH2-1

S&TT 9/00

Slide 2-1: KV MicroLite GenSet

- Onan GH-200 4-cycle, single cylinder, overhead valve engine.
- 3000 or 3600 rpm operational speed.
- Electronic Magneto ignition.
- Low oil level protection.
- Gasoline and LP fueled.
- Enclosed muffler.
- Onan YVB style, 2 pole, revolving field generator.
- 50 and 60 Hz. frequency.
- Electronic voltage regulation.



KY MicroLite GenSet

GENERATOR
(behind engine)

ENGINE

MUFFLER
(inside housing)

HOUSING

BASE HOUSING

CONTROL
PANEL

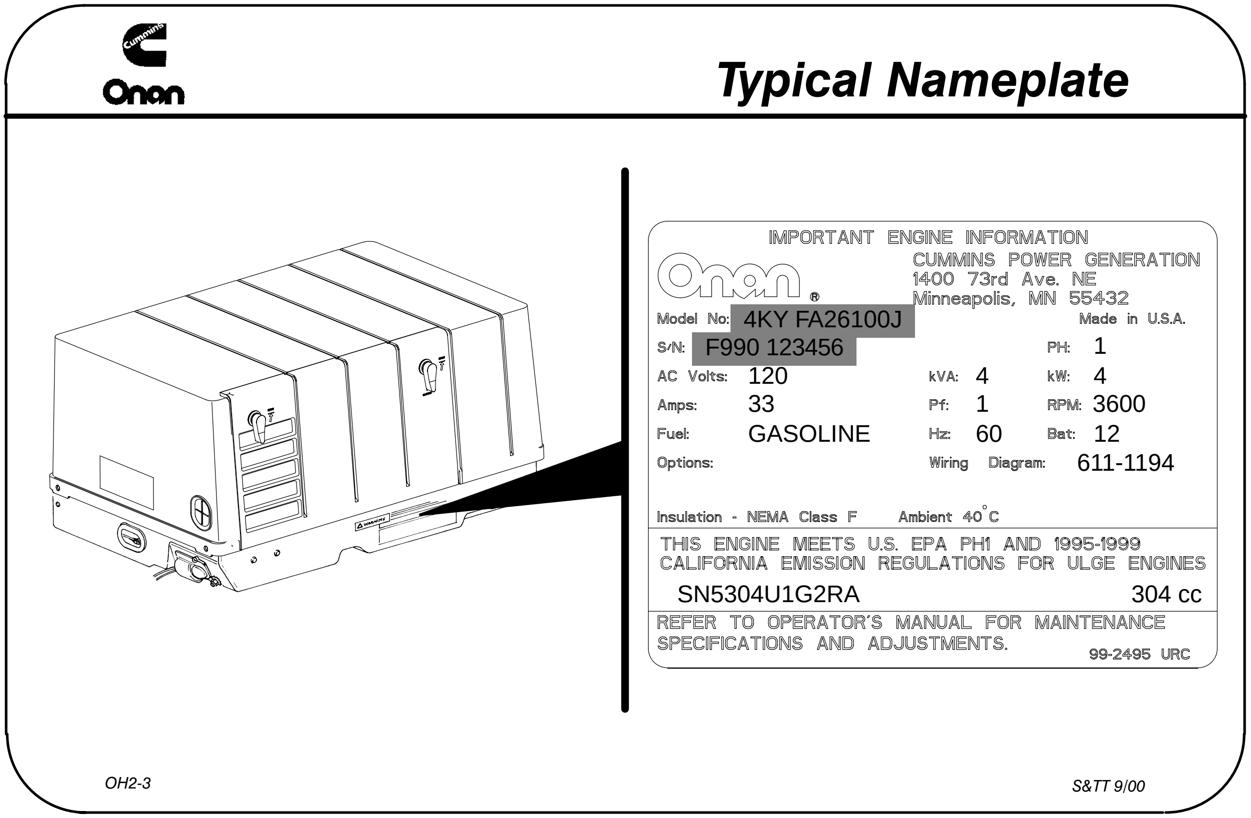
REMOVABLE
ACCESS COVER

OH2-2

S&TT 9/00

Slide 2-2: KY MicroLite GenSet

- Onan EO95H-G 4-cycle, single cylinder, overhead valve engine.
- 3000 or 3600 rpm operational speed.
- Electronic Magneto ignition.
- Gasoline and LP fueled.
- Enclosed muffler.
- Onan YK style, 2 pole, revolving field generator.
- 50 and 60 Hz. frequency.
- Electronic voltage regulation.



Typical Nameplate

IMPORTANT ENGINE INFORMATION

Onan®

CUMMINS POWER GENERATION
1400 73rd Ave. NE
Minneapolis, MN 55432

Made in U.S.A.

Model No:	4KY FA26100J				
S/N:	F990 123456			PH:	1
AC Volts:	120	kVA:	4	kW:	4
Amps:	33	Pf:	1	RPM:	3600
Fuel:	GASOLINE	Hz:	60	Bat:	12
Options:		Wiring Diagram:	611-1194		

Insulation - NEMA Class F Ambient 40°C

THIS ENGINE MEETS U.S. EPA PH1 AND 1995-1999 CALIFORNIA EMISSION REGULATIONS FOR ULGE ENGINES

SN5304U1G2RA 304 cc

REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.

99-2495 URC

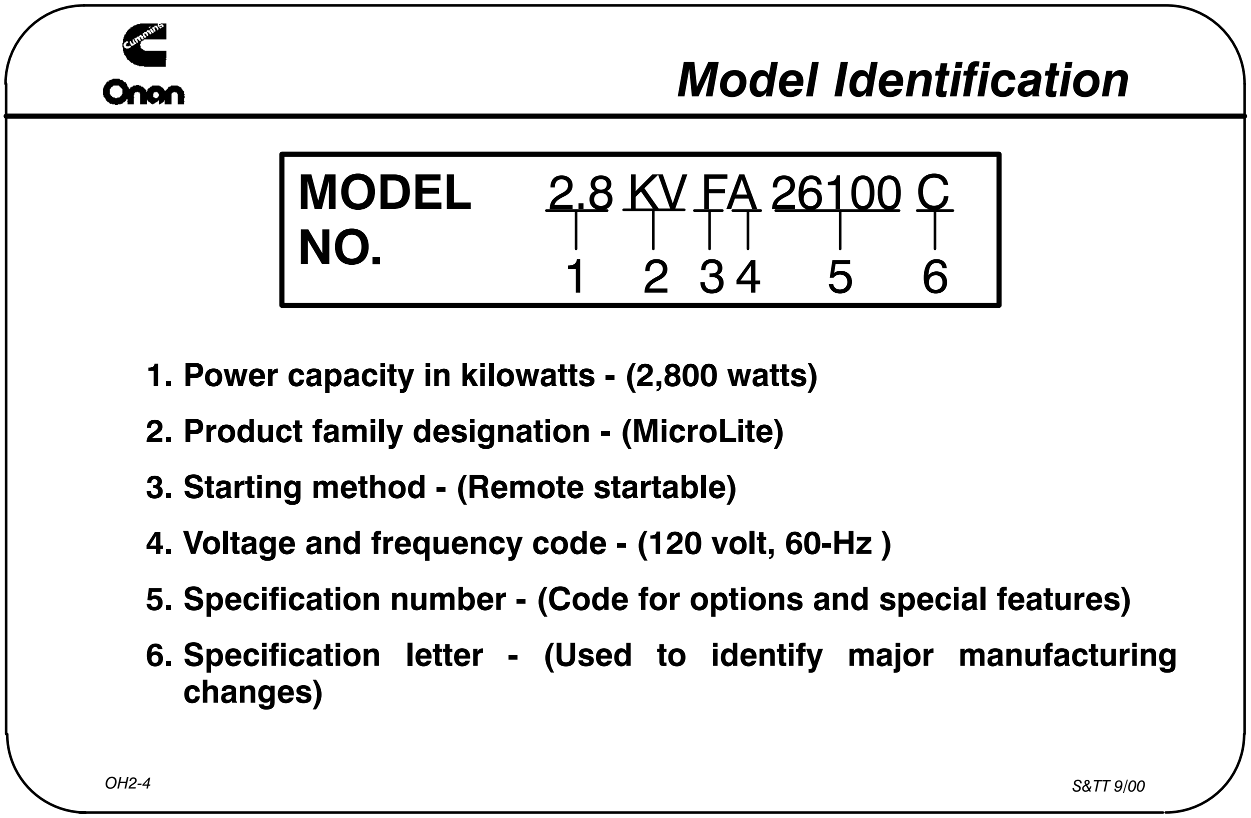
OH2-3

S&TT 9/00

Slide 2-3: Typical Nameplate

Used for:

- Parts ordering.
- Manuals, literature and troubleshooting aids.
- Communicating with distributor/factory.



Model Identification

MODEL NO. 2.8 KV F A 26100 C

1 2 3 4 5 6

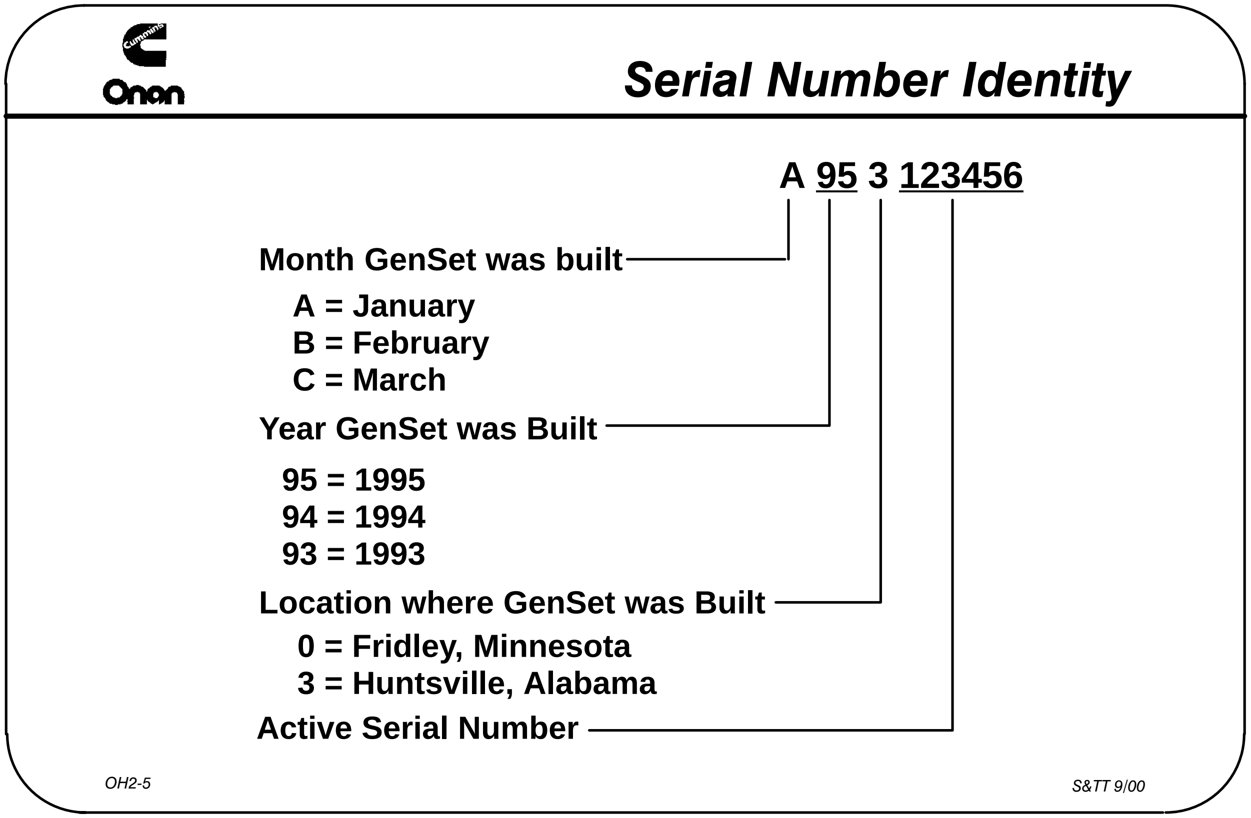
1. **Power capacity in kilowatts - (2,800 watts)**
2. **Product family designation - (MicroLite)**
3. **Starting method - (Remote startable)**
4. **Voltage and frequency code - (120 volt, 60-Hz)**
5. **Specification number - (Code for options and special features)**
6. **Specification letter - (Used to identify major manufacturing changes)**

OH2-4

S&TT 9/00

Slide 2-4: Model Identification

1. Kilowatt rating of GenSet–(2800 watts).
2. Engine designation–(Onan, 304cc, 1 cylinder).
3. Starting method–(startable at set and remote)
4. Voltage and frequency code–(120 VAC at 60 Hz.)
5. Specification number–(code for options and special features).
6. Specification letter–(major manufacturing changes).



Serial Number Identity

A 95 3 123456

Month GenSet was built

A = January
B = February
C = March

Year GenSet was Built

95 = 1995
94 = 1994
93 = 1993

Location where GenSet was Built

0 = Fridley, Minnesota
3 = Huntsville, Alabama

Active Serial Number

OH2-5

S&TT 9/00

Slide 2-5: Serial Number Identification

Use to:

- Identify when manufactured.
- Identify where manufactured.

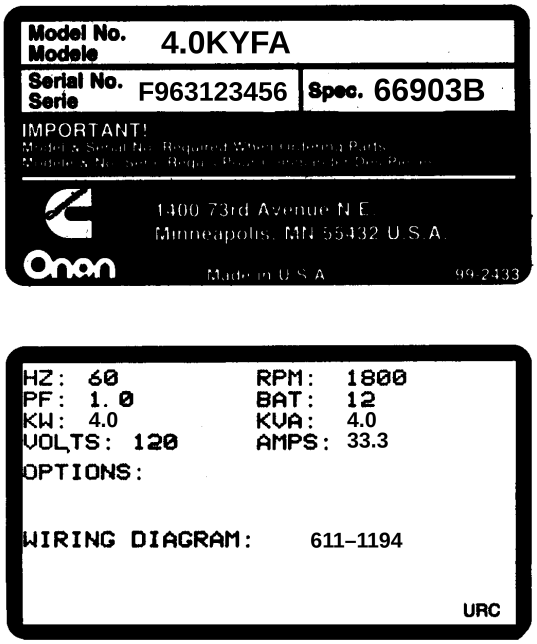
Activity

Slide 2-6:

Directions: Identify the following using the nameplate below:

Year GenSet was built:_____________________________
Month GenSet was built:___________________________
Specification letter:________________________________
Specification number:______________________________
Kilowatt rating:____________________________________
Starting battery voltage:____________________________
Output voltage:____________________________________
Output amps:______________________________________
Power factor: ____________________________________
Actual serial number:_______________________________
Frequency output:__________________________________
Engine family:_____________________________________
Location where GenSet was built:___________________

NAMEPLATE WITH TYPICAL MODEL AND SERIAL NUMBER DATA



Model No.
Modele 4.0KYFA

Serial No.
Serie F963123456

Spec. 66903B

IMPORTANT!
Model & Serial No. Required When Ordering Parts

1400 73rd Avenue N.E.
Minneapolis, MN 55432 U.S.A.

Onan

Made in U.S.A. 99-2433

HZ: 60 RPM: 1800
PF: 1.0 BAT: 12
KW: 4.0 KVA: 4.0
VOLTS: 120 AMPS: 33.3
OPTIONS:

WIRING DIAGRAM: 611–1194

URC

OH2-6

S&TT 9/00

MicroLite GenSet Installation

This lesson presents the steps needed to complete a correct and safe installation of an MicroLite generator set.

Objectives:

After completing this lesson, you should be able to:

- Identify the requirements to consider prior to installation of an MicroLite GenSet.
- Make all applicable fuel, exhaust and battery connections.
- Connect a load bank and start the GenSet.
- Plot a no-load to full-load power curve.

GenSet Installation Requirements

- ***Level and supportive mounting surface***
- ***Accessibility for maintenance and service***
- ***Adequate cooling and combustion air***
- ***Discharge of exhaust gas and circulated air***
- ***Fuel system connections***
- ***Electrical connections***

OH2-7

S&TT 9/00

Slide 2-7: GenSet Installation Requirements

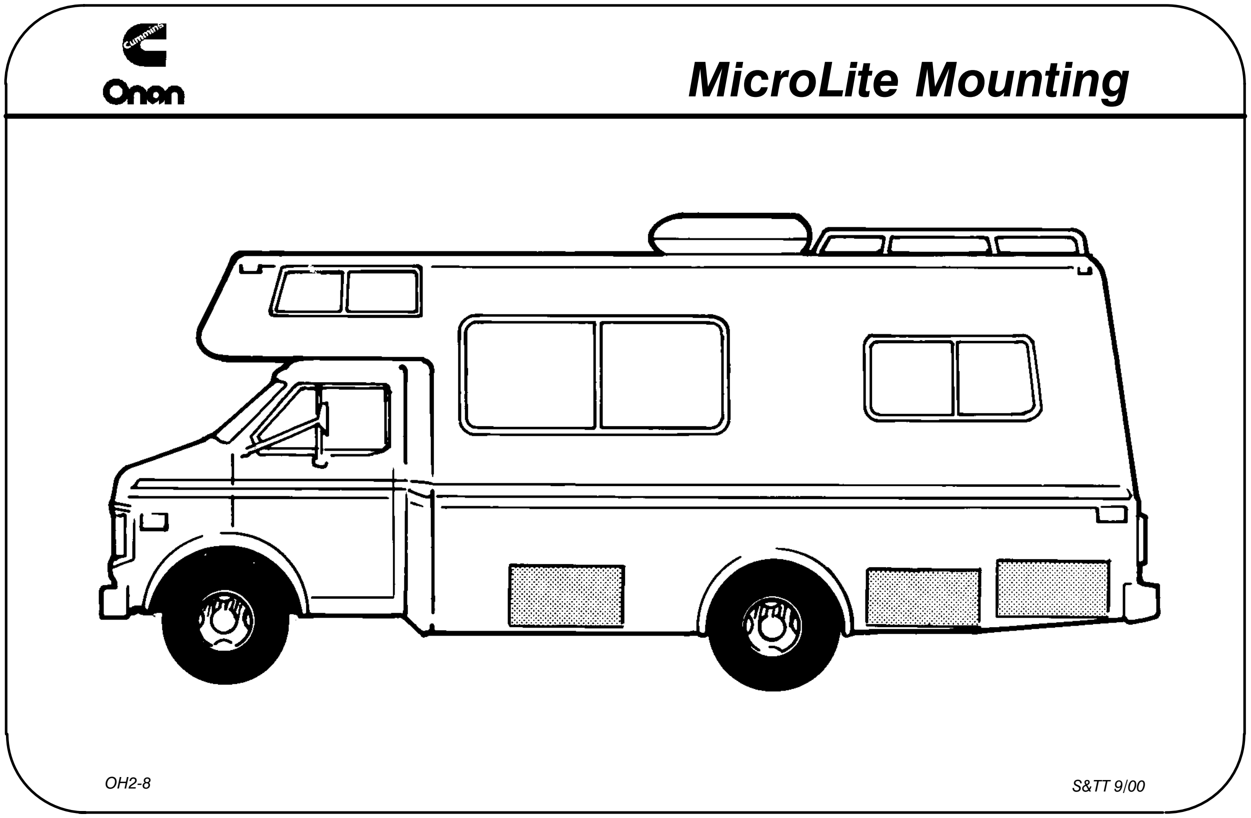
- Guidelines for GenSet installation.
- When properly installed, the GenSet will meet or exceed the following requirements:

NFPA 70-Article 551

ANSI/RVIA EGS-1 – 1986

ANSI A119.2/NFPA 501C

CSA Electrical Bulletin 946



MicroLite Mounting

OH2-8

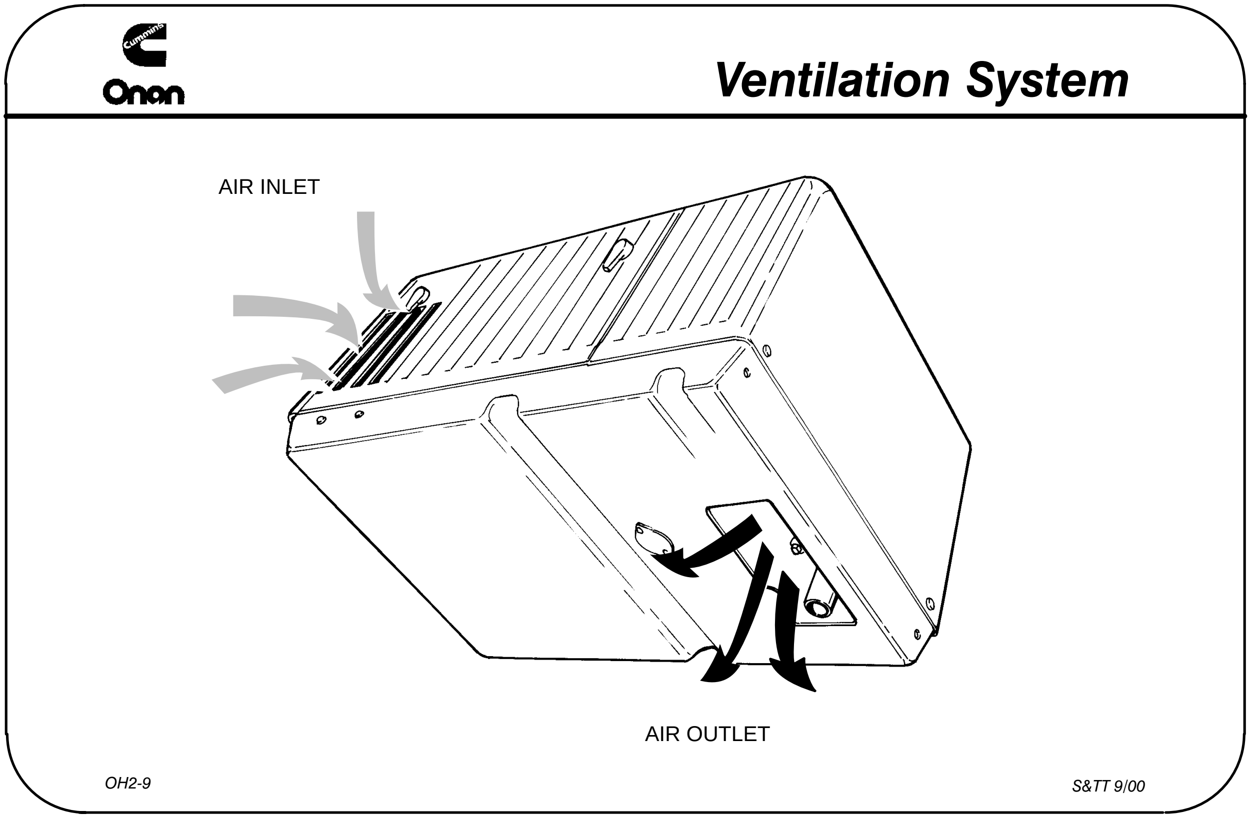
S&TT 9/00

Slide 2-8: Mounting

- The location must be well ventilated and insulated.
- Walls must be vapor-tight between GenSet and living quarters.
- Must support weight of GenSet.
- Allow access to service components.

What service items must you provide access to?

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________



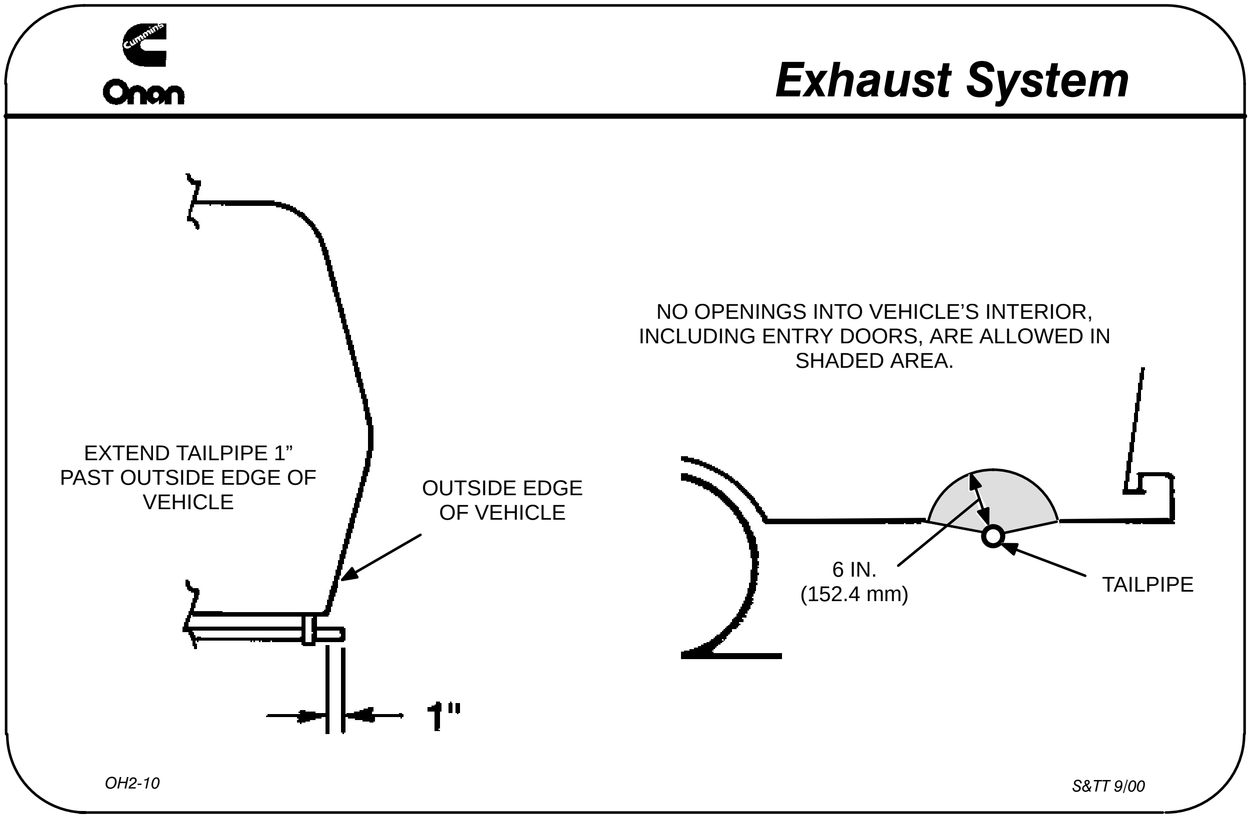
Ventilation System

OH2-9

S&TT 9/00

Slide 2-9: Ventilation System

- Be sure that nothing obstructs or restricts the air intake or air outlet.
- Allow for restriction of grilles and ductwork.
- Never use discharged cooling air for heating.
- Air for combustion, cooling and exhaust all enter the side of the GenSet.
- Heated cooling air and exhaust exit the GenSet through the bottom.
- The muffler is mounted inside the GenSet housing.



Exhaust System

EXTEND TAILPIPE 1” PAST OUTSIDE EDGE OF VEHICLE

OUTSIDE EDGE OF VEHICLE

1"

NO OPENINGS INTO VEHICLE’S INTERIOR, INCLUDING ENTRY DOORS, ARE ALLOWED IN SHADED AREA.

6 IN. (152.4 mm)

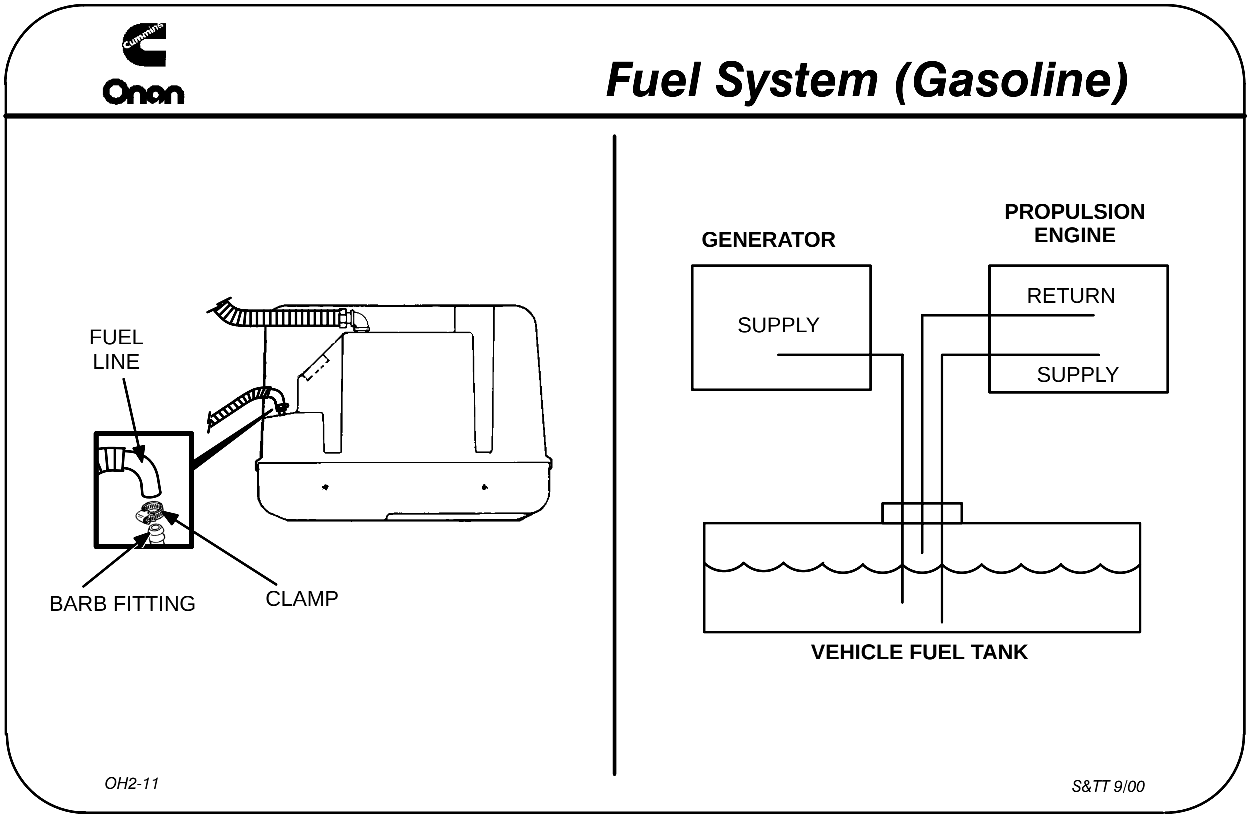
TAILPIPE

OH2-10

S&TT 9/00

Slide 2-10: Exhaust System

- A U.S. Forest Service-approved Onan spark arrested muffler is used.
- Must be located no closer than 3 inches from combustible materials.
- Must extend a minimum of 1 inch beyond the perimeter of the vehicle.
- No vent, window or opening can be located within a 6″ radius of tailpipe.
- Be aware of any opening that is not permanently sealed from the vehicle living space.
- Use automotive type tailpipe hangers to support the system.
- Do not connect the GenSet exhaust to the vehicle exhaust system.
- Observe the maximum allowable exhaust back pressure.



Fuel System (Gasoline)

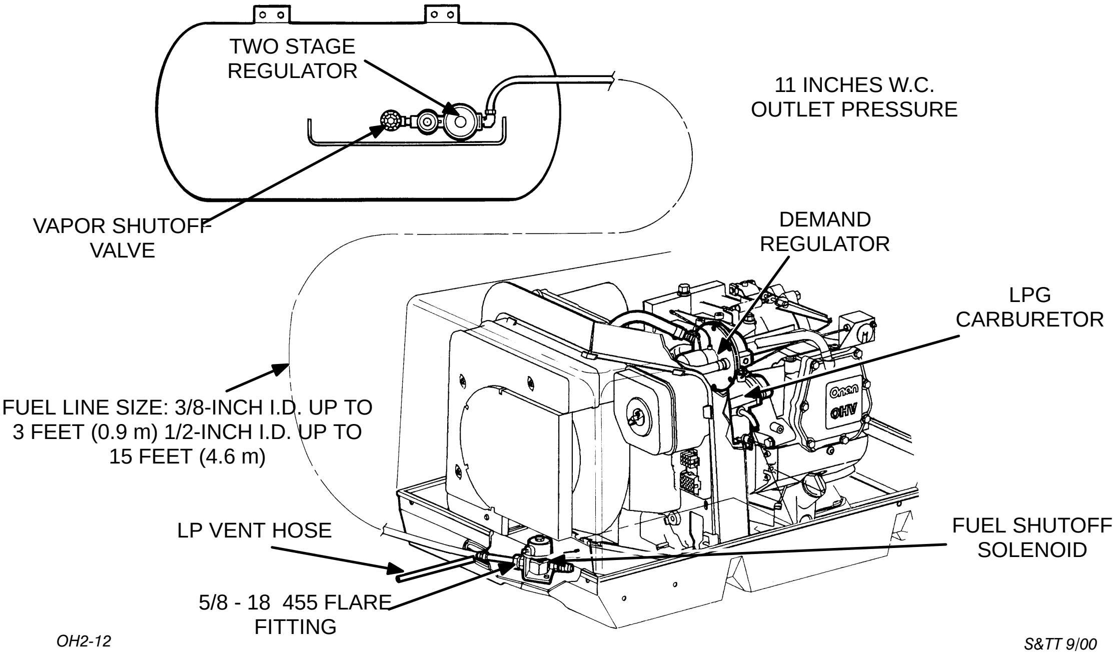
OH2-11

S&TT 9/00

Slide 2-11: Fuel System (Gasoline)

- Use a separate fuel pickup tube at tank or a separate tank.
- Do not tee GenSet fuel line into vehicle fuel supply line.
- The fuel pickup should not extend below the bottom $^1/_4$ of tank.
- Use a flexible, non-metallic line between set and vehicle fuel system.
- Keep piping, hoses and fittings away from heat.
- Don’t run fuel lines in conjunction with electrical wiring.

Fuel System (LP)

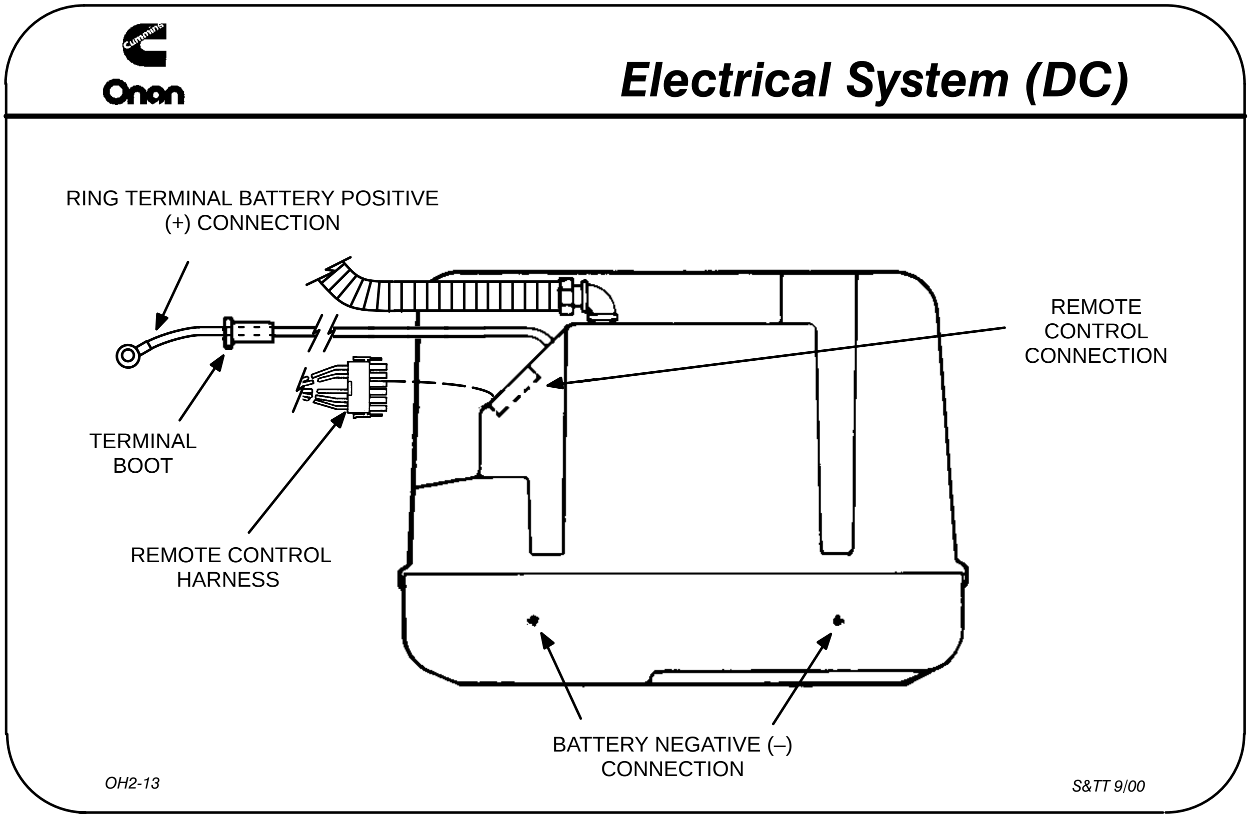


OH2-12

S&TT 9/00

Slide 2-12: Fuel System (LP)

- LPG models are designed for a low-pressure vapor-withdrawal type supply system.
- A regulator must be used between the GenSet and the fuel cylinder.
- Do not connect the GenSet fuel line directly into to LPG fuel cylinder.
- Use a flexible, non-metallic line between set and vehicle fuel system.
- Keep fuel lines away from hot engine and exhaust.
- Keep electrical and fuel lines as far apart as possible, do not tie together.
- Provide a separate fuel supply line for the GenSet, do not tie into an appliance fuel line.



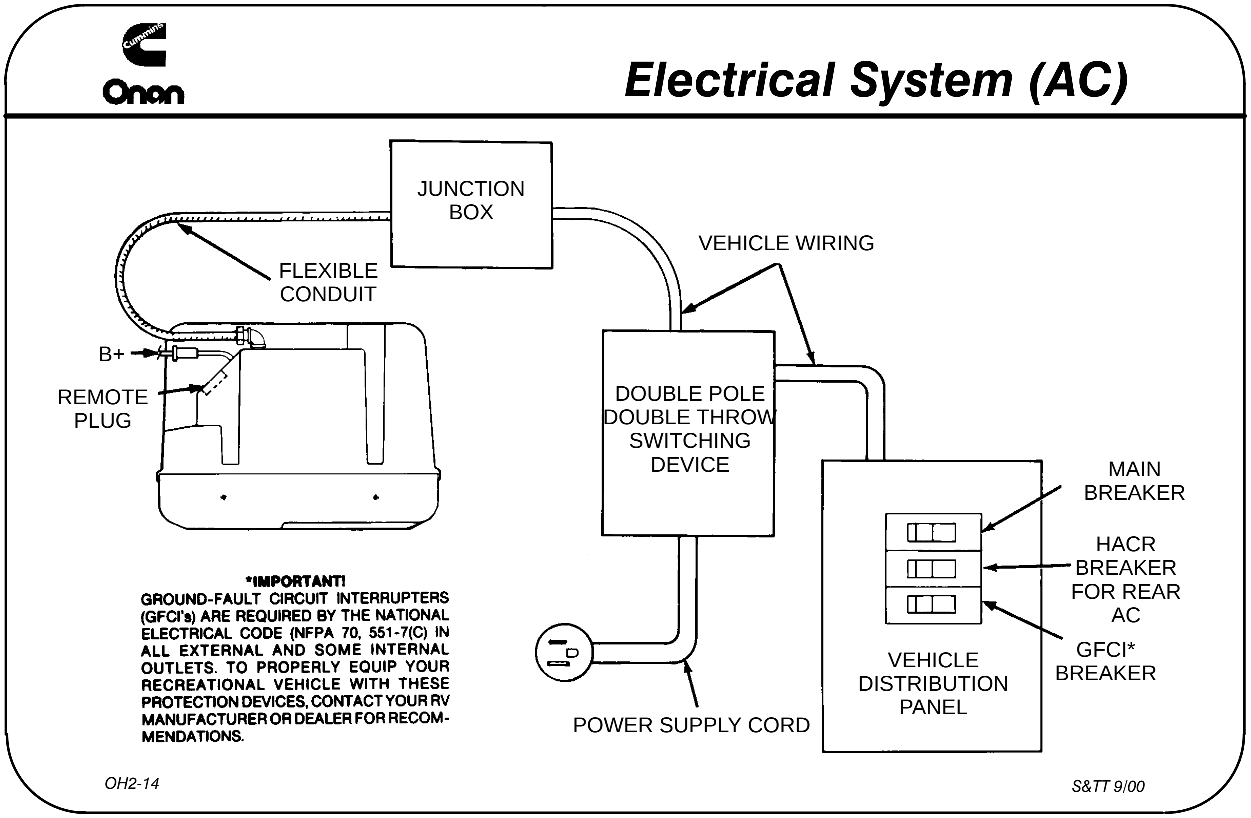
Electrical System (DC)

OH2-13

S&TT 9/00

Slide 2-13: (DC) Electrical System

- Do not route the remote start harness through the same conduct as the AC load wires.
- Seal all openings made for wiring to prevent exhaust or fuel vapors from entering vehicle.
- House the cranking battery in its own well ventilated, spark free compartment.
- Battery cables must meet the cold cranking needs of the set and have minimum resistance connections.
- It is not recommended that the vehicle chassis frame be used as a path to the battery negative (–).



Electrical System (AC)

***IMPORTANT!**
GROUND-FAULT CIRCUIT INTERRUPTERS (GFCI's) ARE REQUIRED BY THE NATIONAL ELECTRICAL CODE (NFPA 70, 551-7(C) IN ALL EXTERNAL AND SOME INTERNAL OUTLETS. TO PROPERLY EQUIP YOUR RECREATIONAL VEHICLE WITH THESE PROTECTION DEVICES, CONTACT YOUR RV MANUFACTURER OR DEALER FOR RECOMMENDATIONS.

OH2-14

S&TT 9/00

Slide 2-14: (AC) Electrical System

- Wiring must be protected from sharp edges, hot engine parts and fuel system.
- Route load conductors to the junction box in approved flexible conduct.
- Seal all openings made through the compartment into the coach interior.
- Load wiring must be appropriately sized and insulated for the specified current rating.
- The feeder conductors must terminate at a disconnecting device so that the GenSet cannot be connected to an outside power source.
- All AC wiring should be inspected by a qualified electrician.
- Ground fault circuit interrupters (GFCIs) should be used for all branch circuits with convenience power receptacles.
- AC wiring, remote control wiring and fuel lines should all be routed separately.

Activity

Directions: Setup the GenSet to run and document its performance by plotting a power curve.

Follow these steps:

1. Check the GenSet oil level.

   ☐ oil level

2. Connect the GenSet exhaust, fuel and battery.

   ☐ exhaust
   ☐ fuel
   ☐ battery

3. Connect the appropriately sized load bank and meters.

   ☐ load bank
   ☐ voltmeter
   ☐ ammeter
   ☐ frequency meter

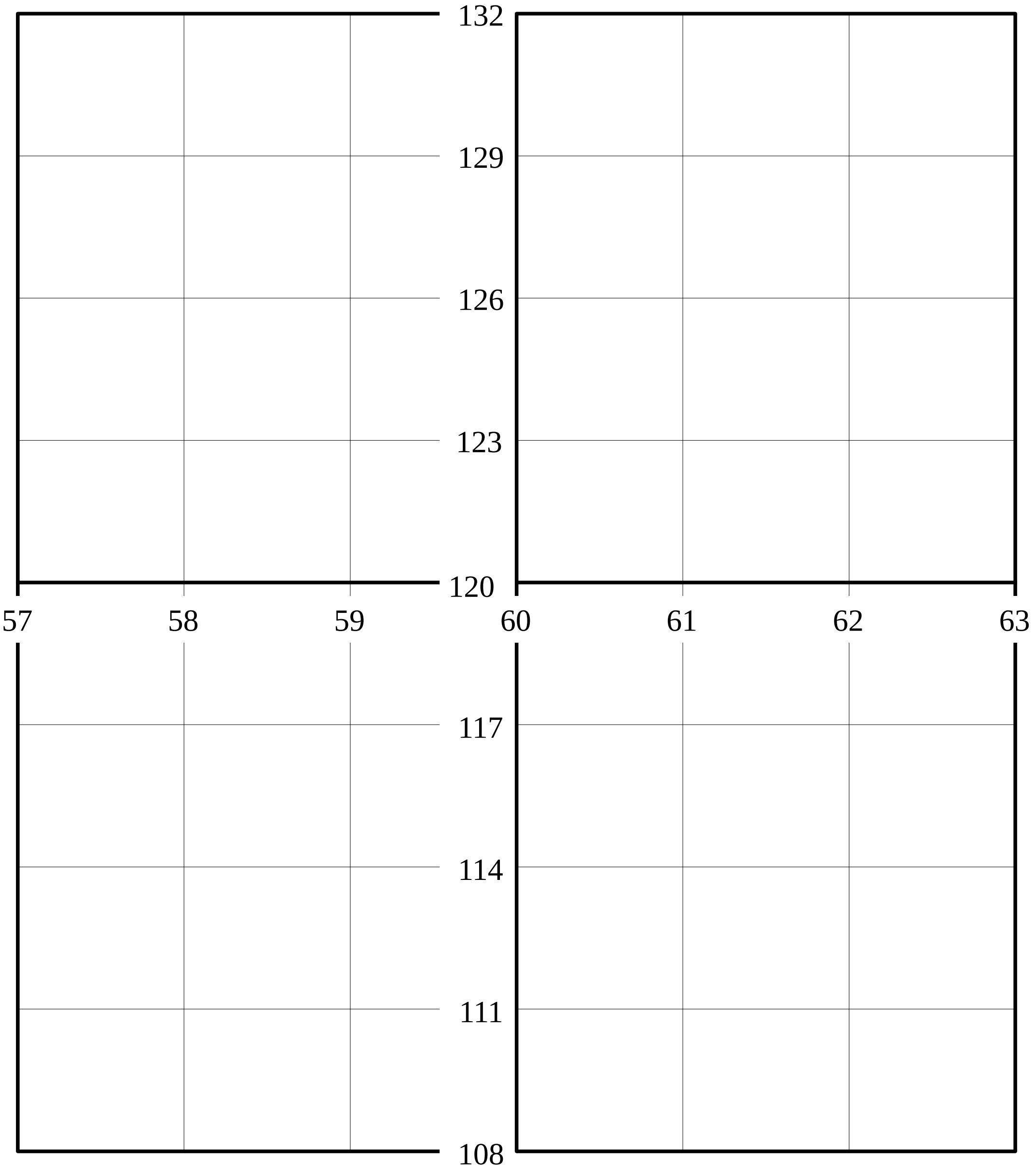
4. Start GenSet and warm it up by applying 50% load for 5 minutes.

   ☐ warm-up

5. Record the GenSet performance in $^1/_4$ load steps on the Power Curve chart of the next page.

NOTE: Be sure to use the ratings on the GenSet nameplate.

Power Curve



Load Step	Amperes	Voltage	Frequency
0%			
25%			
50%			
75%			
100%			

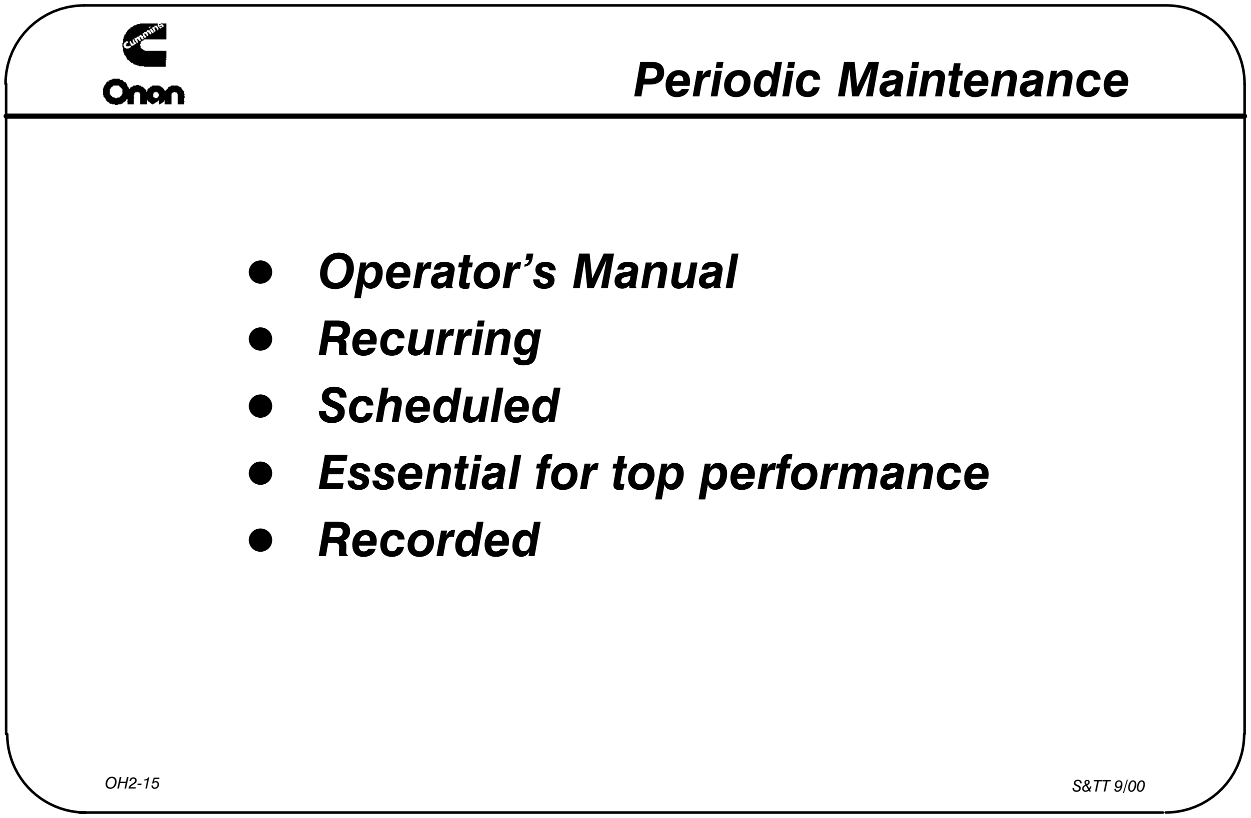
MicroLite GenSet Periodic Maintenance

This lesson presents the preventive maintenance on an MicroLite generator set.

Objectives:

After completing this lesson, you should be able to:

- Find and use the periodic maintenance schedule in the *Operator's Manual*.
- Locate maintenance points and perform all scheduled service.
- Adjust the engine speed and governor stability.
- Adjust the generator nominal no-load voltage and frequency.
- Perform a final Test and Adjust no-load to full-load power curve.



Periodic Maintenance

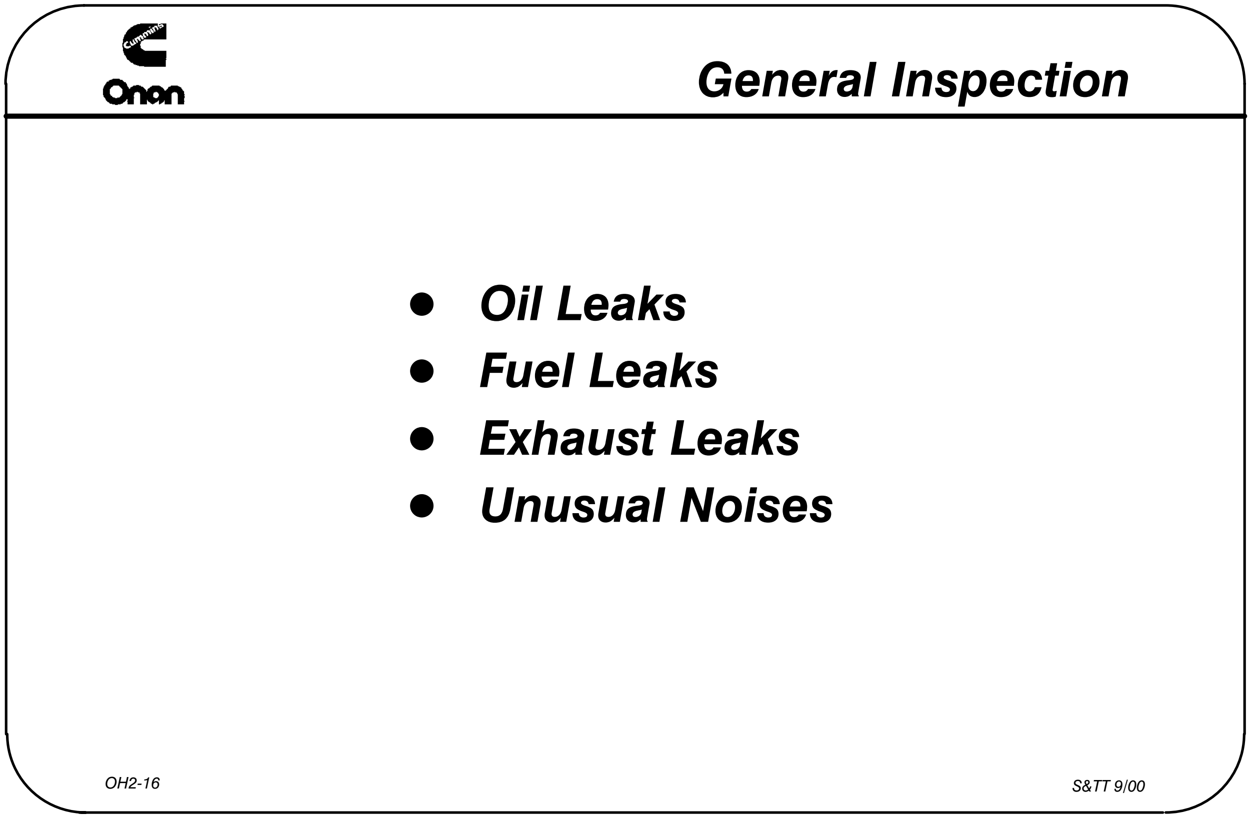
- Operator’s Manual
- Recurring
- Scheduled
- Essential for top performance
- Recorded

OH2-15

S&TT 9/00

Slide 2-15: Periodic Maintenance

- A periodic maintenance schedule is found in the *Operator’s Manual*.
- Periodic maintenance is done as often as necessary.
- Done according to a schedule.
- Must be done for performance and longevity of the GenSet.
- Recording when and what was done is important.



General Inspection

- Oil Leaks
- Fuel Leaks
- Exhaust Leaks
- Unusual Noises

OH2-16

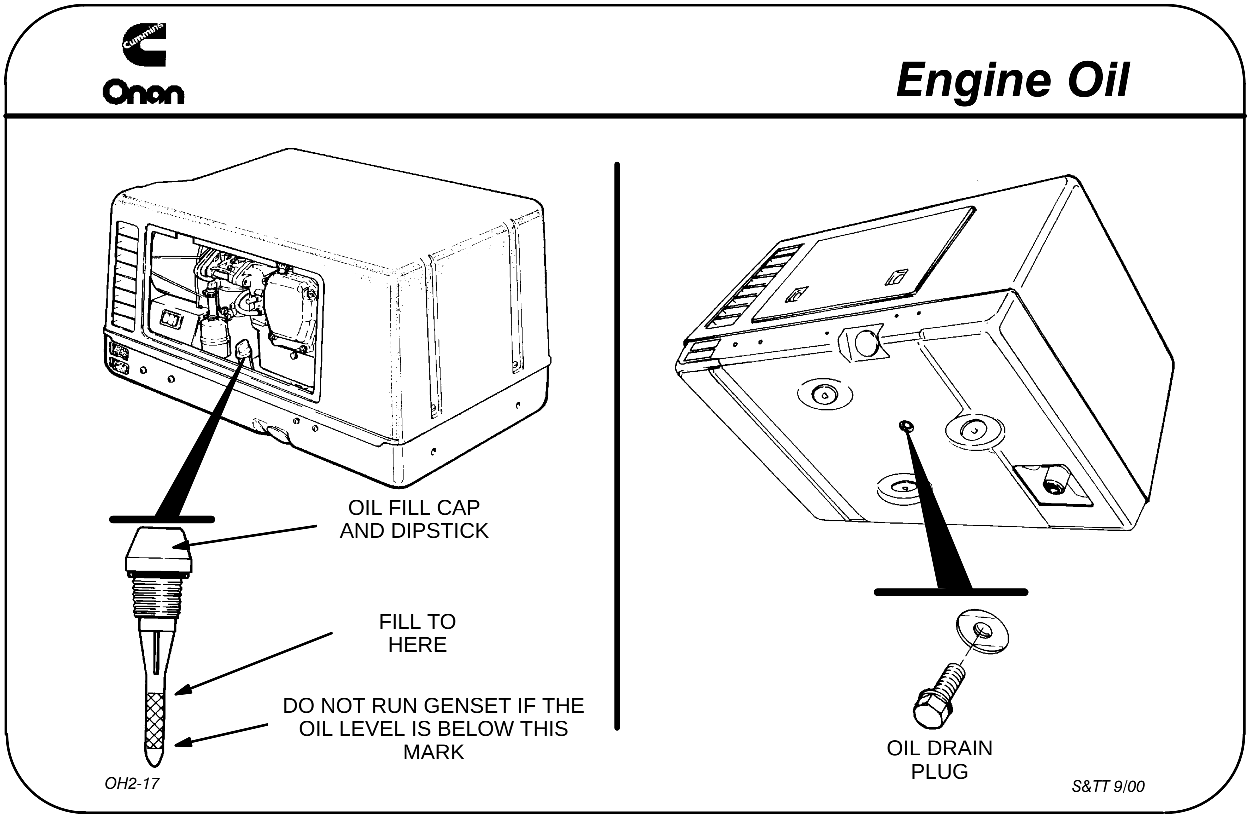
S&TT 9/00

Slide 2-16: General Inspection

- Should be done daily or every 8 hours of use.

Inspect

- Oil or fuel leaks.
- Exhaust system.
- Battery connections and condition.
- Missing or loose hardware.
- General cleanliness.
- Stored items in compartment or room.
- Unusual noise during startup.



Engine Oil

OIL FILL CAP AND DIPSTICK

FILL TO HERE

DO NOT RUN GENSET IF THE OIL LEVEL IS BELOW THIS MARK

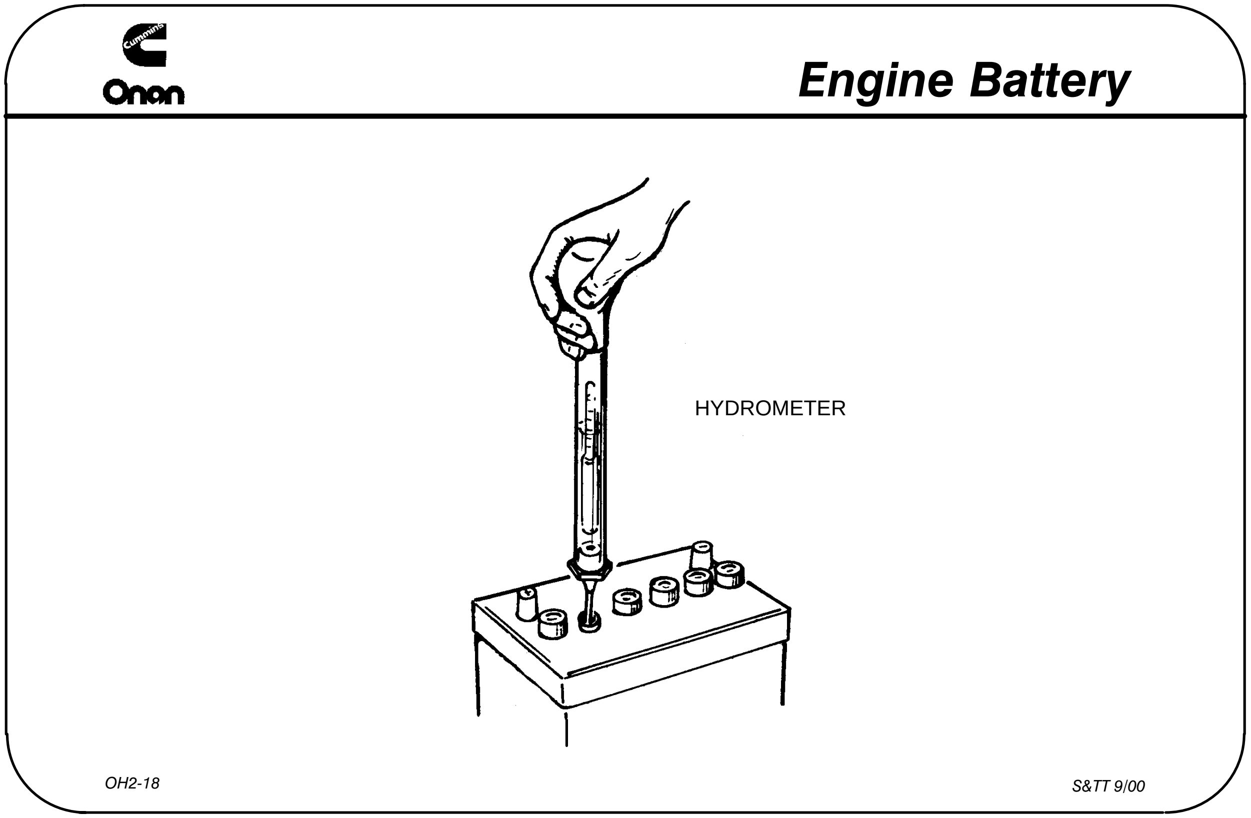
OIL DRAIN PLUG

OH2-17

S&TT 9/00

Slide 2-17: Engine Oil

- Should be checked daily or every 8 hours of use.
  - Change after first 20 hours on a new GenSet then follow the table in the *Operator's Manual.*
  - Use oil that meets API classification and SAE viscosity grade as indicated in the *Operator's Manual.*
  - To check level on KV, **do not** screw dipstick in. On the KY **do** screw the dipstick in.
  - Do not operate GenSet if the oil level is below the add mark.
- Use only Onan approved parts to prevent damage to the GenSet.



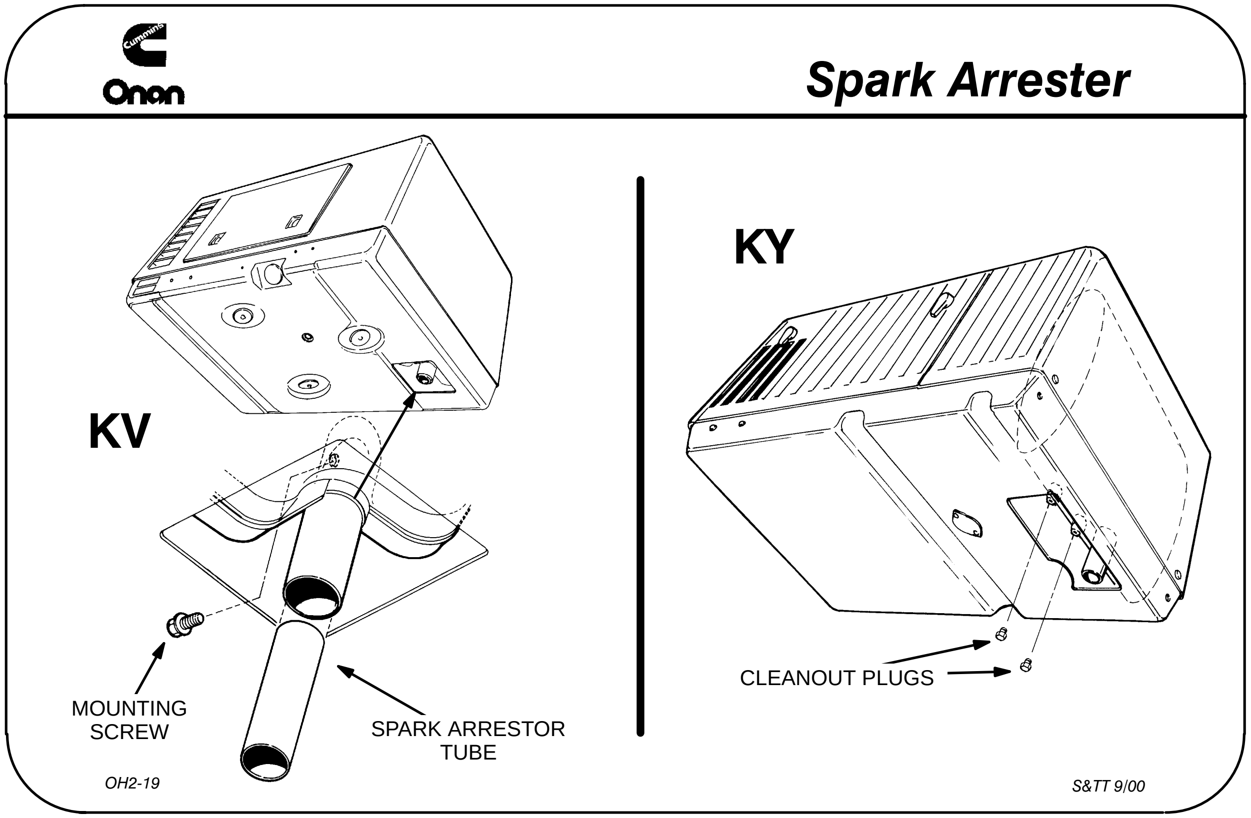
Engine Battery

OH2-18

S&TT 9/00

Slide 2-18: Engine Battery

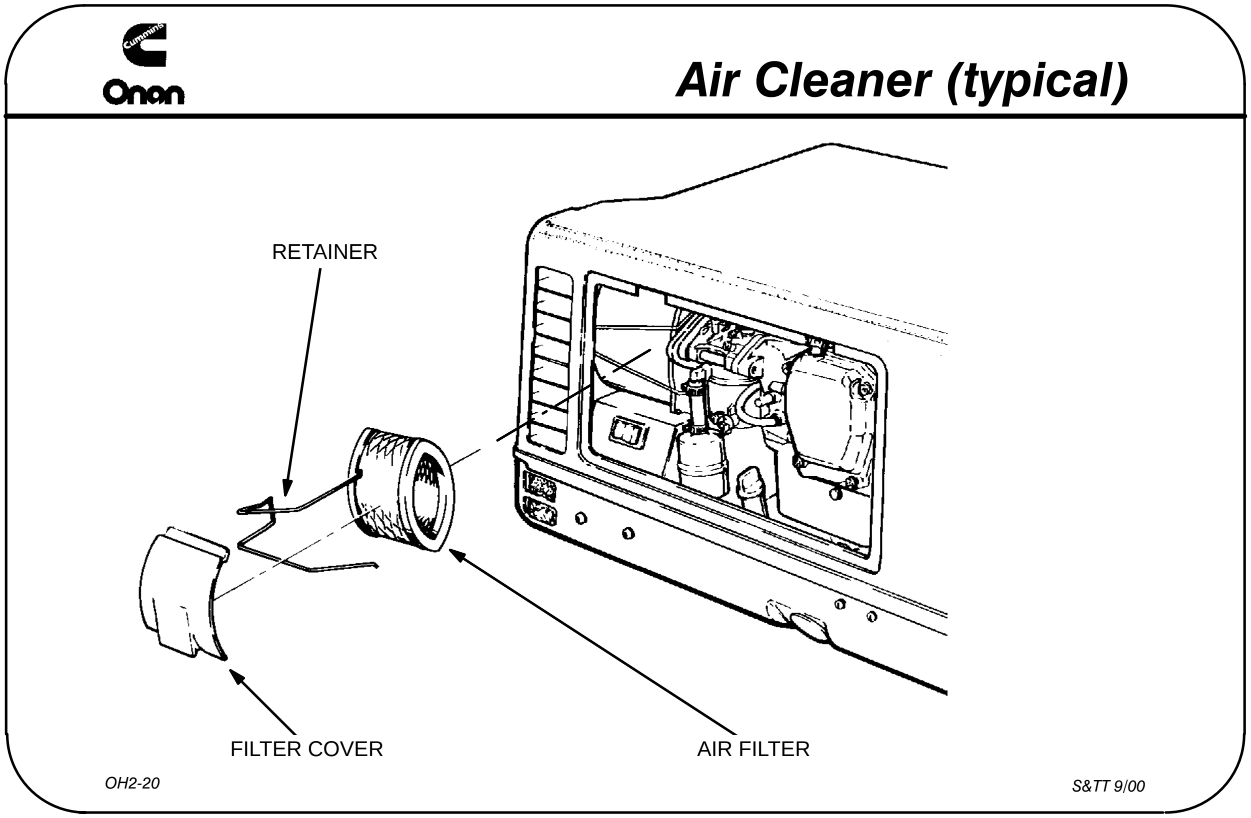
- Check battery charging system monthly.
  - Charge if specific gravity is lower than 1.215.
  - Stop charging when the specific gravity reaches 1.260 at approximately 80° F.
- Check battery specific gravity monthly.
  - Should be 1.215 (hot climate zones) and 1.260 (cold climate zones).
- Add only distilled water.



Spark Arrester

Slide 2-19: Spark Arrester

- Clean the spark arrester every 50 hours for safe operation and maximum efficiency.
  - Remove the plug (KV) and run the set at full load for 5 minutes.
  - Remove the tube and screen (KY) and clean with a wire brush.
  - Allow muffler to cool before replacing plug.



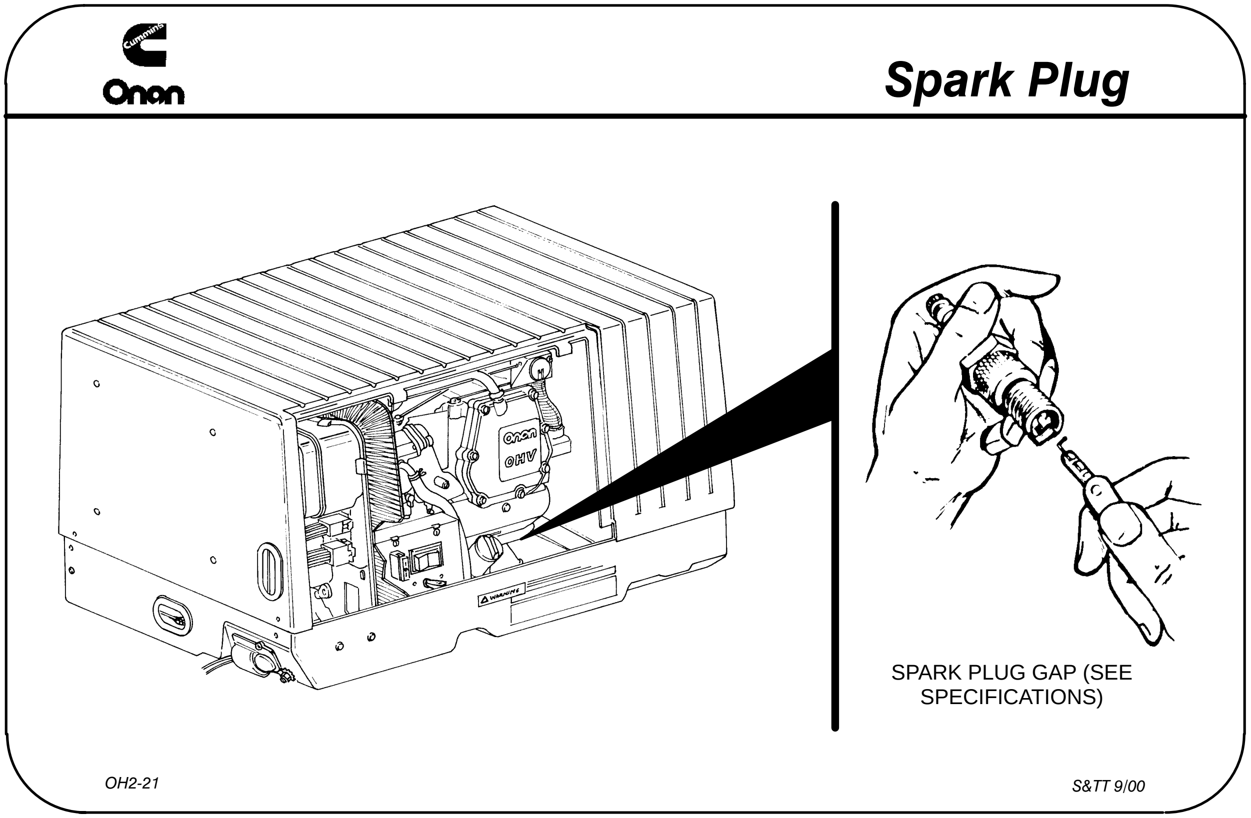
Air Cleaner (typical)

OH2-20

S&TT 9/00

Slide 2-20: Air Cleaner

- Change the air cleaner every 150 hrs. (KV) 250 hrs. (KY).
  - More often in dusty conditions.
  - Use only Onan approved replacement filters to prevent damage to the engine.



Spark Plug

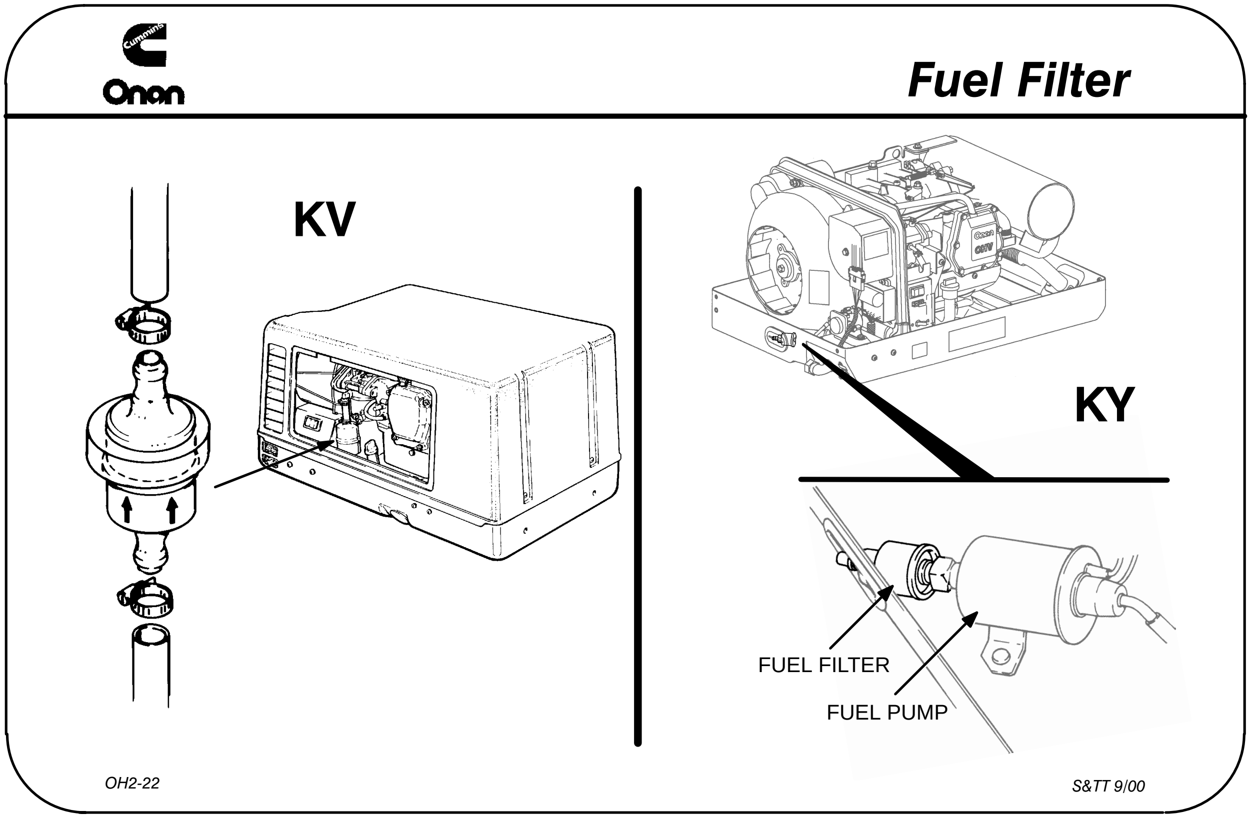
SPARK PLUG GAP (SEE SPECIFICATIONS)

OH2-21

S&TT 9/00

Slide 2-21: Spark Plug

- Change the spark plug every 500 hours.
  - Perform more often if engine performance deteriorates.
  - KY spark plug is accessed through hole in base pan.
  - To prevent crossthreading, start plug by hand.
  - Use only Onan approved spark plugs to prevent engine damage.



Fuel Filter

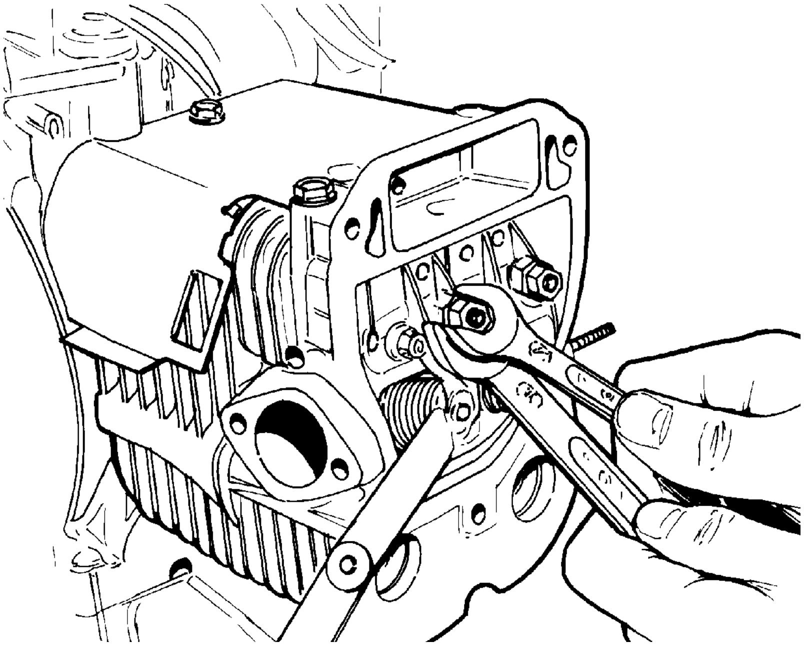
OH2-22

S&TT 9/00

Slide 2-22: Fuel Filter

- Change the fuel filters every 500 hours.
  - Perform more often if engine performance deteriorates.
  - Use only Onan approved filters to prevent fuel system damage.

Adjust Valve Lash

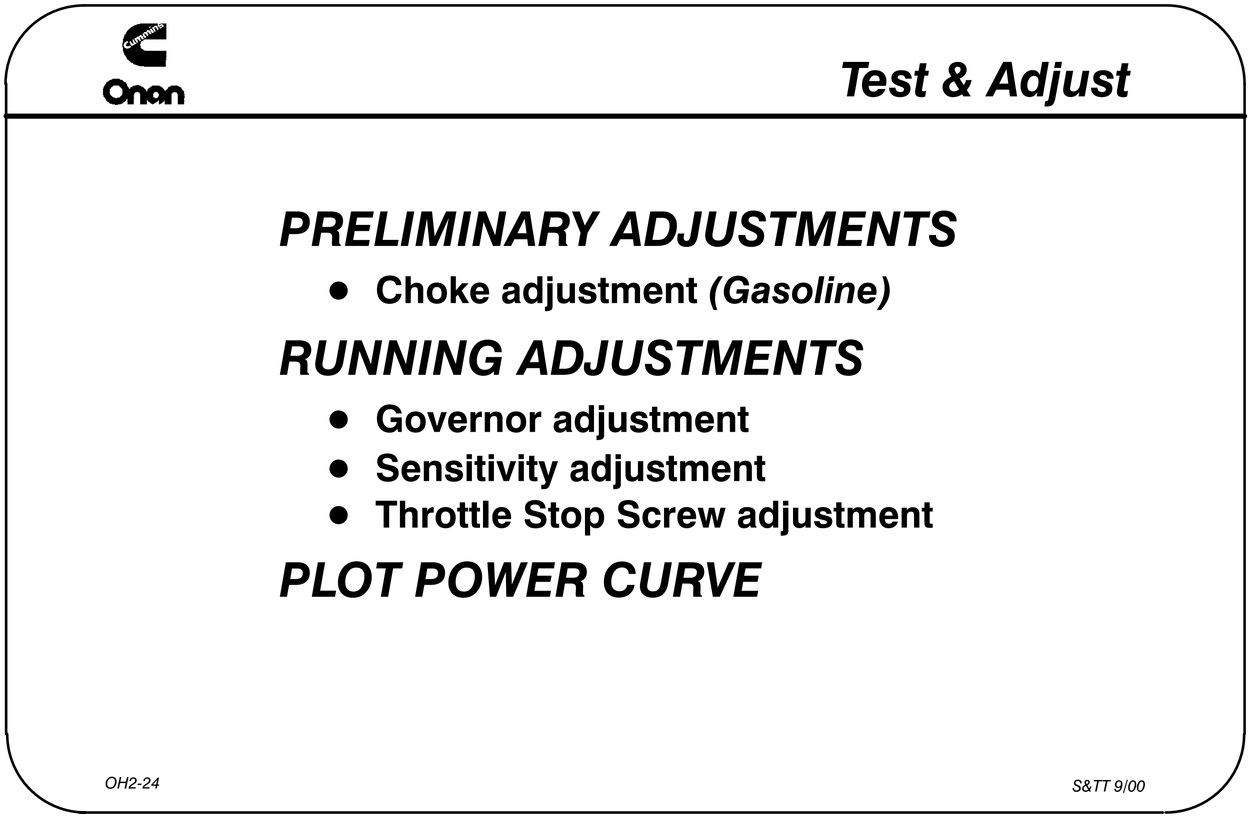


OH2-23

S&TT 9/00

Slide 2-23: Adjust Valve Lash

- Perform every 500 hrs.
  - Perform at ambient temperature.
  - Perform at piston top dead center (TDC).
  - Check cylinder head torque before performing.
  - Use clearances shown in the *Service Manual*.
  - Hold lower adjusting nut when loosening top locking nut.



Test & Adjust

PRELIMINARY ADJUSTMENTS

- Choke adjustment *(Gasoline)*

RUNNING ADJUSTMENTS

- Governor adjustment
- Sensitivity adjustment
- Throttle Stop Screw adjustment

PLOT POWER CURVE

OH2-24

S&TT 9/00

Slide 2-24: Test And Adjust

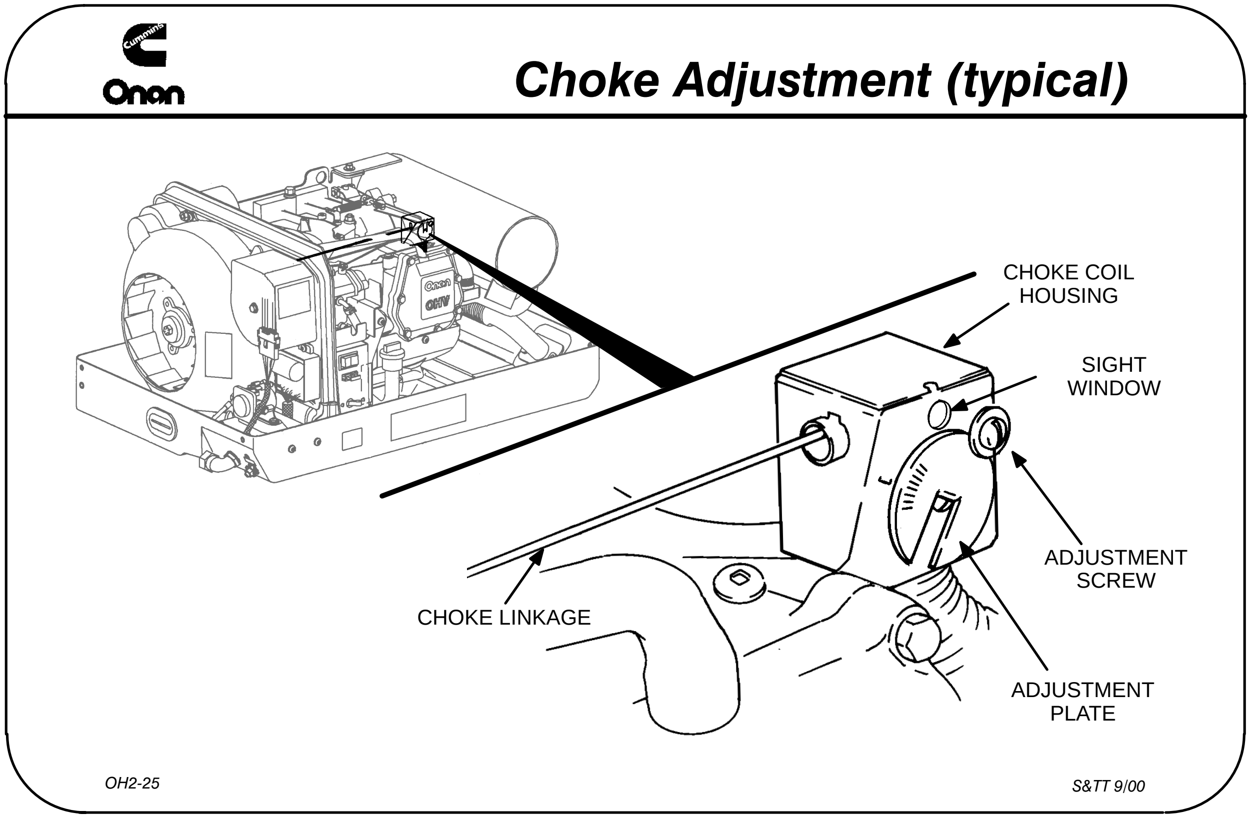
Preliminary Adjustments

- Perform choke adjustment *(Gasoline)*.

Running Adjustments

- Verify full-load frequency.
- Check no-load to full-load frequency.
- Adjust the sensitivity.
- Adjust the throttle stop screw.
- Recheck the sensitivity and stability.

Record Your Results



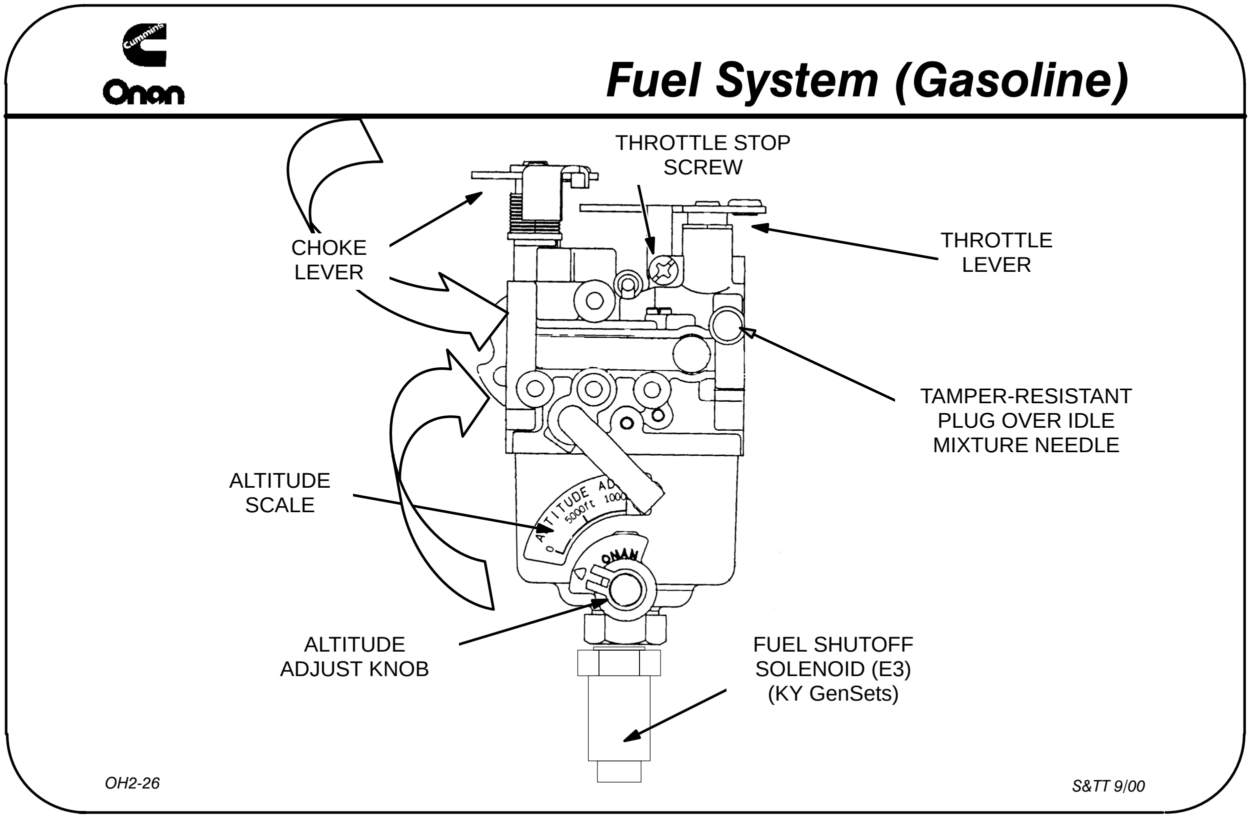
Choke Adjustment (typical)

OH2-25

S&TT 9/00

Slide 2-25: Choke Adjustment

- Adjustments must be made at approximately 70°F ambient temperature.
    - Loosen the plate locking screw(s).
    - On KV models, rotate choke plate until the choke is full on.
    - On KY models, rotate choke plate until choke shaft connection is visible in window.
    - Retighten plate locking screw(s).
    - Rotate clockwise to lean and counterclockwise to richen.



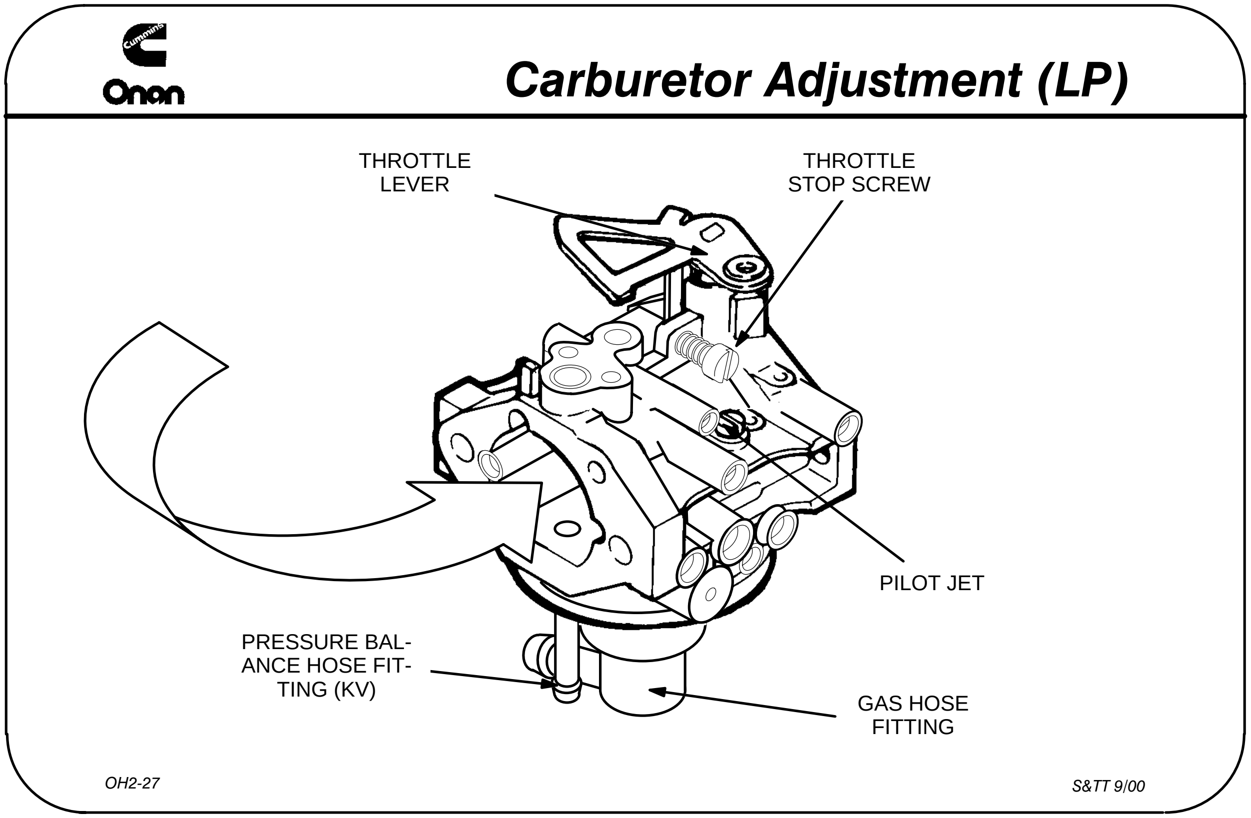
Fuel System (Gasoline)

OH2-26

S&TT 9/00

Slide 2-26: Fuel System (Gasoline)

- Carburetor beginning spec. D (KY) and spec. E (KV):
  - Fuel mixture adjustments are not required.
  - Only the altitude adjustment knob requires adjustment.
  - Throttle stop screw is adjusted during governor adjustment while the engine is running.



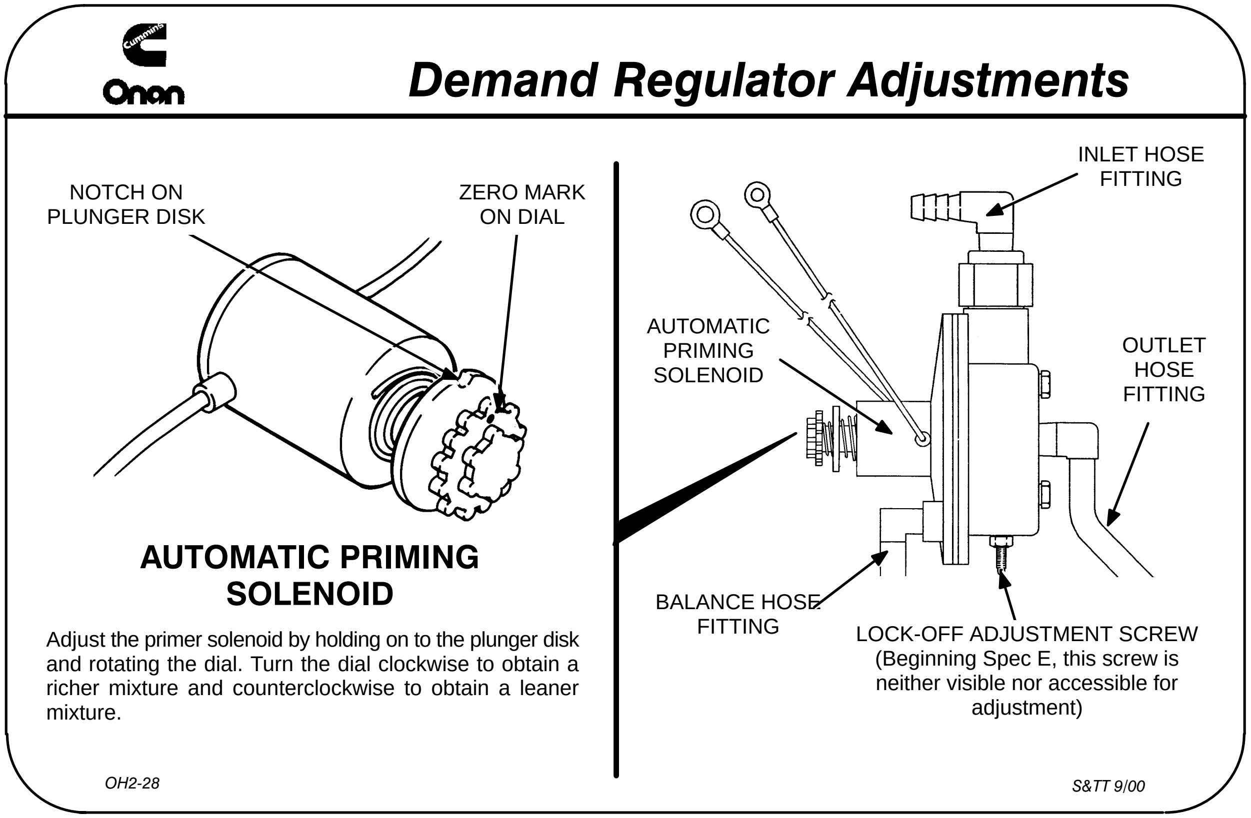
Carburetor Adjustment (LP)

OH2-27

S&TT 9/00

Slide 2-27: Carburetor Adjustment (LP)

- Carburetor beginning spec. E (KV) and spec. E (KY):
    - Fuel mixture adjustments are not required.
    - Pressure balance hose connects to demand regulator.
    - Throttle stop screw is adjusted during governor adjustment while the engine is running.



Demand Regulator Adjustments

(Beginning Spec E, this screw is neither visible nor accessible for adjustment)

AUTOMATIC PRIMING SOLENOID

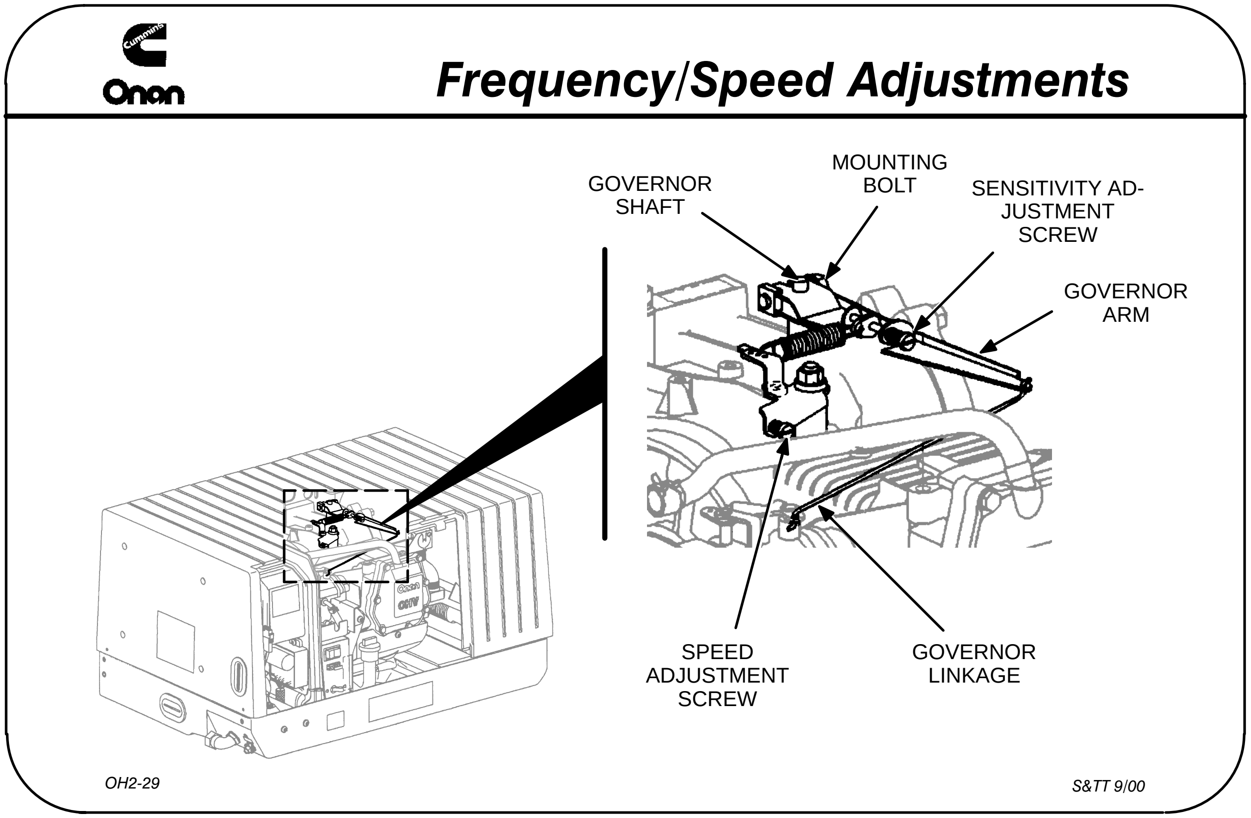
Adjust the primer solenoid by holding on to the plunger disk and rotating the dial. Turn the dial clockwise to obtain a richer mixture and counterclockwise to obtain a leaner mixture.

OH2-28

S&TT 9/00

Slide 2-28: Demand Regulator Adjustments

- System designed for low-pressure vapor-withdrawal.
  - Supplies fuel to carburetor.
  - Inlet pressure to regulator must be 9 to 13 inches water column.
  - Balance hose connects to carburetor fitting on KV.
- Regulator equipped with built-in automatic priming solenoid.
  - Allows fuel to pass through during cranking.
  - Turn clockwise to richen – counterclockwise to lean.



Frequency/Speed Adjustments

OH2-29

S&TT 9/00

Slide 2-29: Frequency/Speed Adjustments:

- Critical for correct operation of the GenSet.

Preliminary Adjustments

- ▪ Verify proper frequency position of governor spring (KV).

Running Adjustments

- ▪ Attach frequency, voltage, and ammeter to GenSet output.
- ▪ Run GenSet to obtain normal operating temperature.
- ▪ At full rated load, adjust the speed adjust screw until the desired frequency is obtained.
- ▪ Check the no-load frequency; if the frequency is not within 3 Hz. (60 Hz.) or 2.5 Hz. (50 Hz.), adjust the sensitivity adjustment screw.

Activity

Situation One

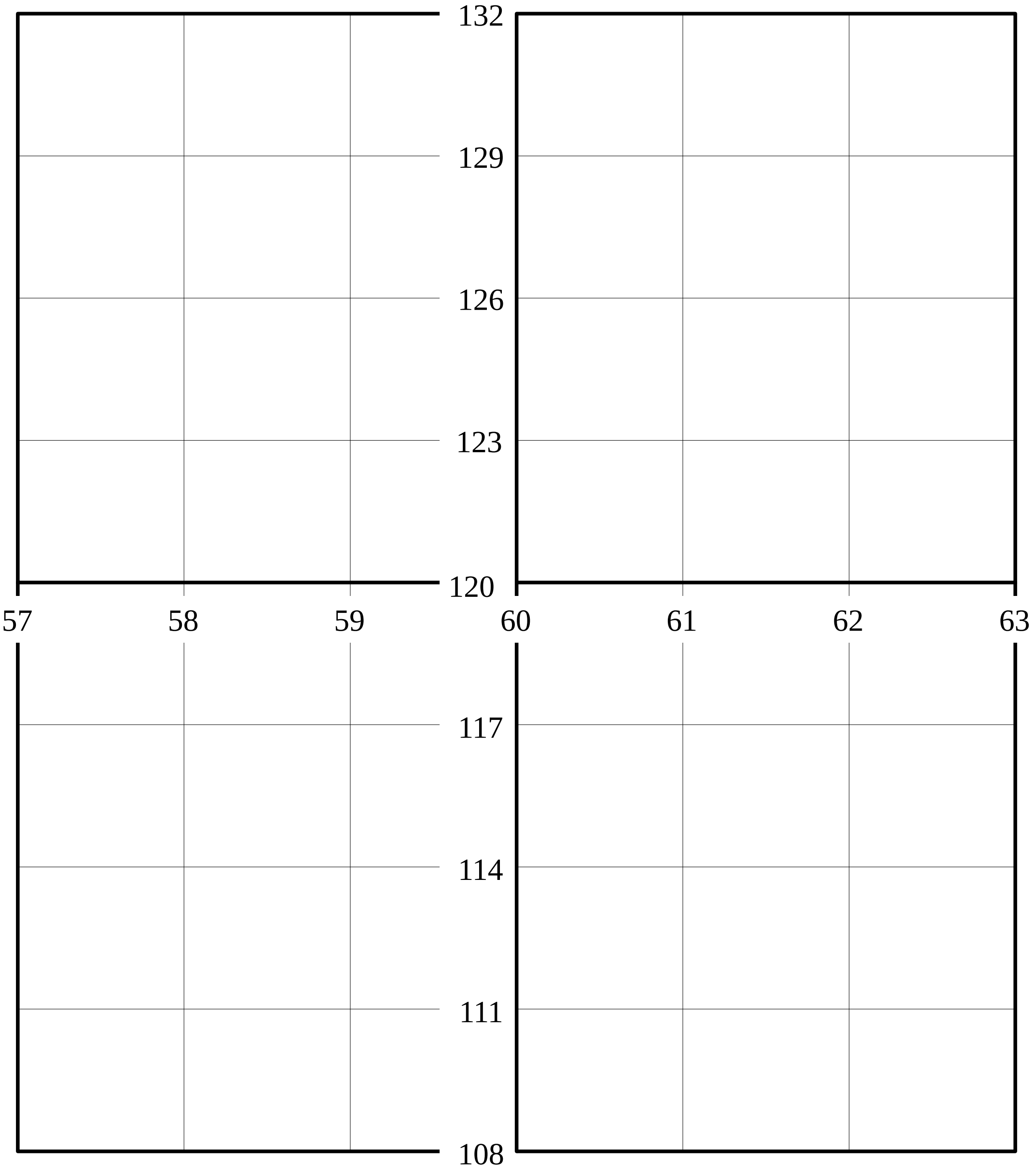
Perform the necessary ”Test & Adjust” steps for GenSet frequency (speed) and output voltage adjustments. Document its performance by plotting a power curve.

Follow these steps:

6. Perform preliminary choke adjustment *(Gasoline)*.
   - ☐ Refer to the *Service Manual*.
   - ☐ Index the choke lever to the adjustment plate.
7. Perform preliminary GenSet frequency selection.
   - ☐ Refer to the *Service Manual*.
   - ☐ Position governor spring to proper position (50 or 60 hz.).
8. Start the GenSet and allow for warm-up.
   - ☐ Connect voltmeter, frequency meter and ammeter.
   - ☐ Connect appropriately sized load bank(s).
   - ☐ Apply 50 to 75% load for 10 minutes.
9. Apply maximum rated load to GenSet output.
   - ☐ Refer to GenSet nameplate
   - ☐ Refer to the *Service Manual*.
   - ☐ Adjust speed adjust screw to obtain desired frequency (50 or 60 hz.).
10. Apply no-load to check governor droop.
    - ☐ Refer to the *Service Manual*.
    - ☐ If frequency is greater than 3 Hz. (60 Hz.) 2.5 Hz. (50 Hz.), adjust the sensitivity adjustment screw.
11. Check N.L. to F.L. performance and stability.
12. Record the GenSet performance by plotting the power curve on the next page.

NOTE: Be sure to use the ratings on the GenSet nameplate.

Power Curve



Load Step	Amperes	Voltage	Frequency
0%			
25%			
50%			
75%			
100%			

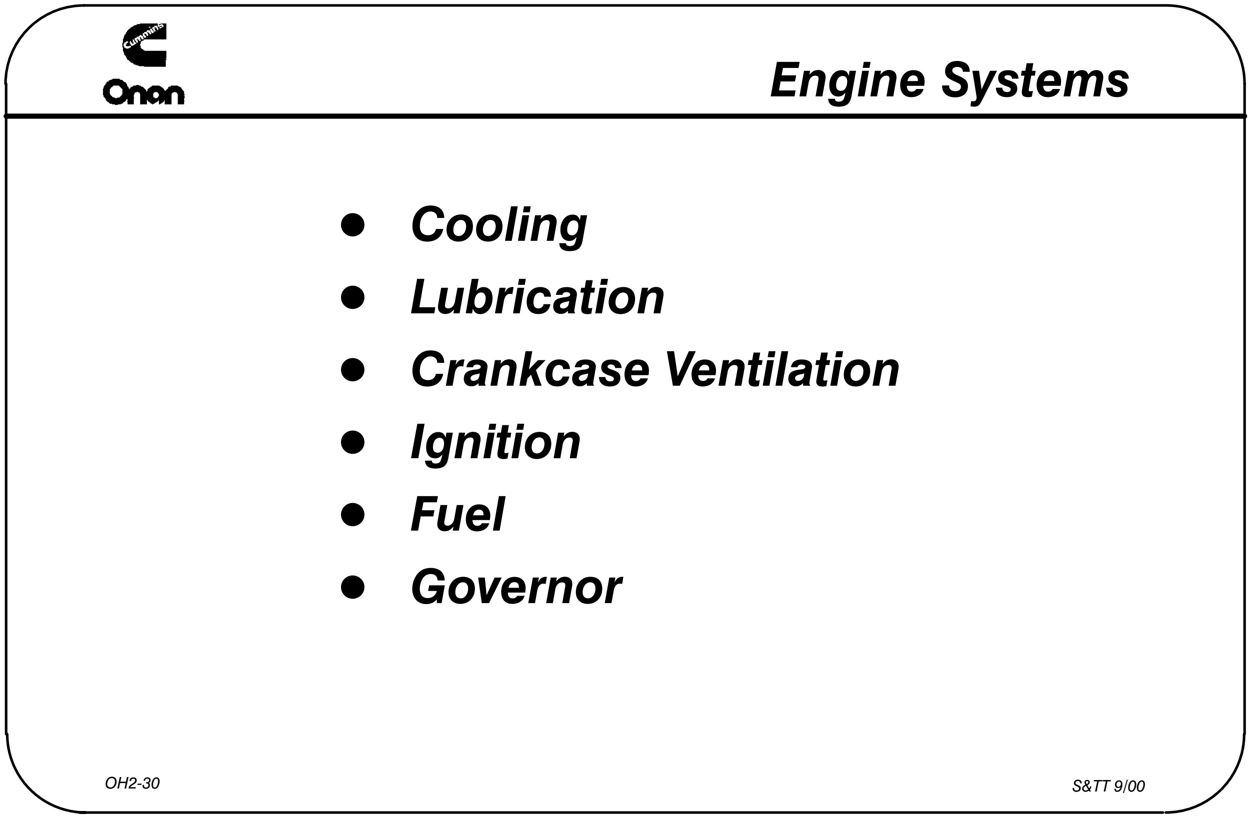
MicroLite GenSet Troubleshooting

This lesson presents the troubleshooting steps and job aids for the MicroLite generator set.

Objectives:

After completing this lesson, you should be able to:

- Find and use the engine/generator/control troubleshooting sections in the MicroLite GenSet *Service Manuals*.
- Read and understand AC and DC schematics.
- Use special tools for diagnostic testing.
- Troubleshoot common engine, generator and control problems.



Engine Systems

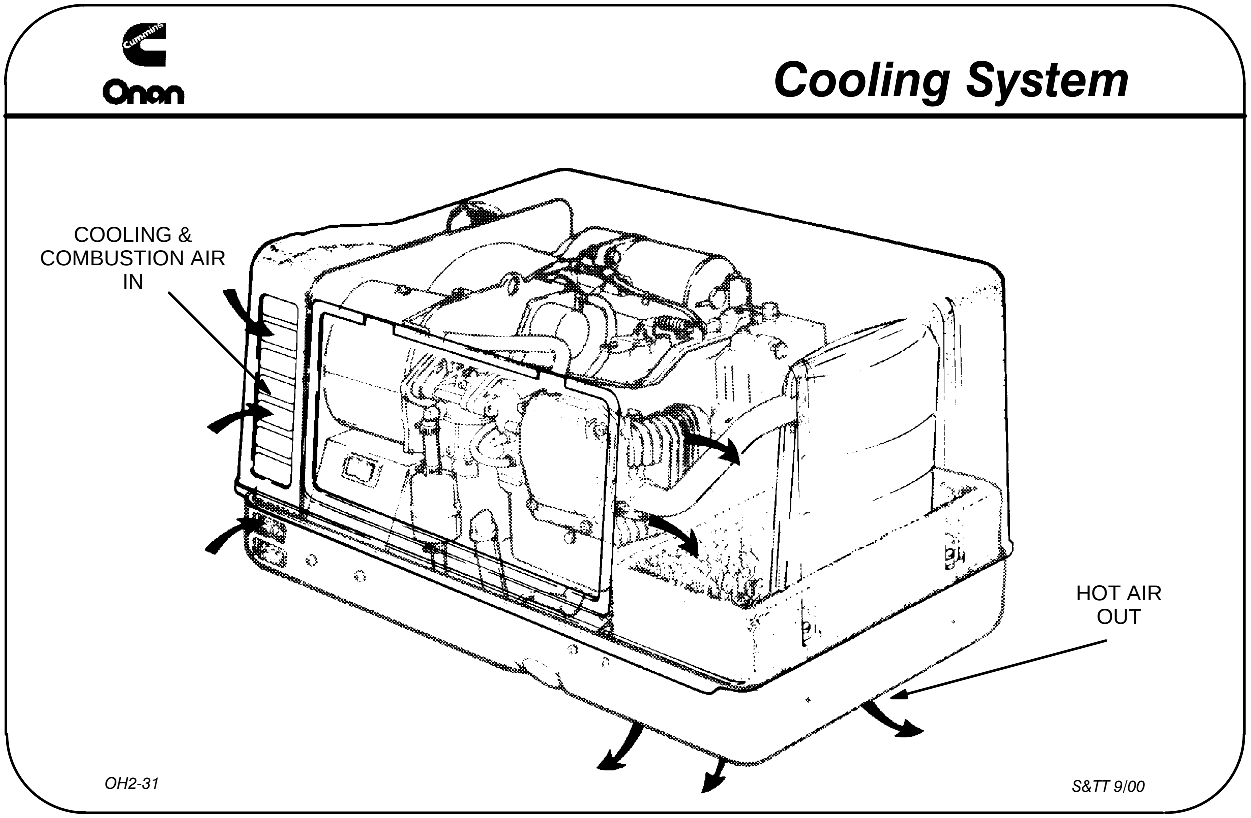
- Cooling
- Lubrication
- Crankcase Ventilation
- Ignition
- Fuel
- Governor

OH2-30

S&TT 9/00

Slide 2-30: Engine Systems

- Four cycle, air cooled by centrifugal fan.
- Splash lubrication.
- Closed loop breather system.
- Flywheel Magneto ignition.
- Gasoline and LPV fueled.
- Flyweight governor.



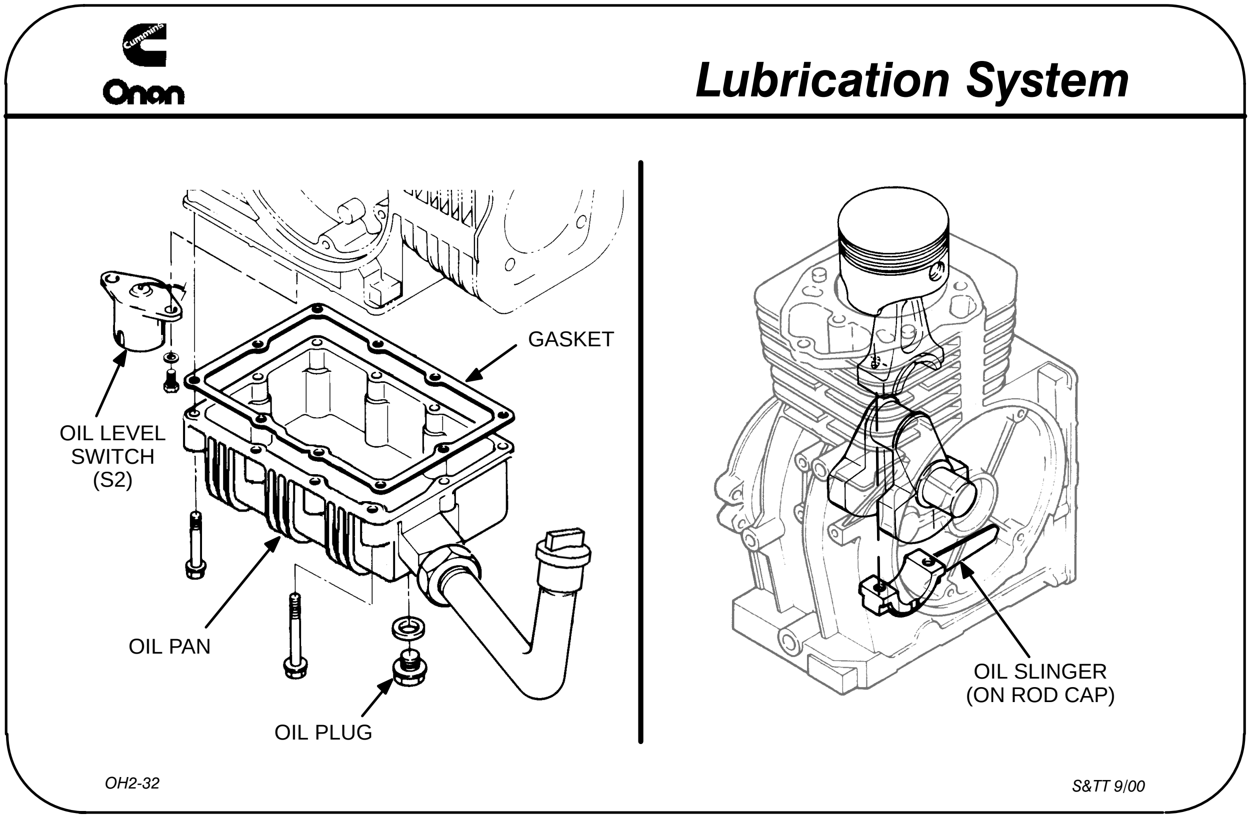
Cooling System

OH2-31

S&TT 9/00

Slide 2-31: Cooling System

- Centrifugal fan provides required airflow.
    - Combustion and cooling air volume is about **315 cfm.**
- Keep cooling fins clean of dirt.
- Never operate GenSet with housing or service access panel removed.
- Seal discharge outlet to compartment outlet to prevent recirculation of hot air into compartment.



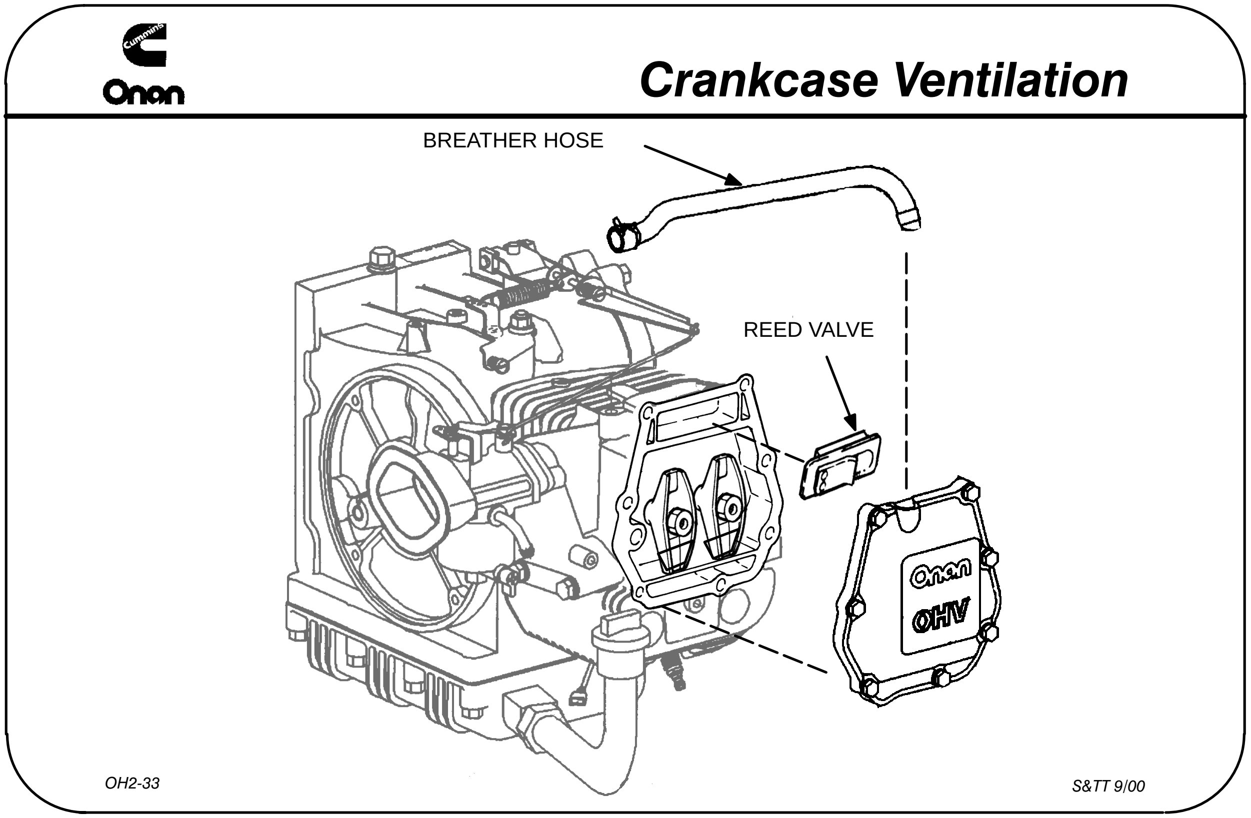
Lubrication System

OH2-32

S&TT 9/00

Slide 2-32: Lubrication System

- Splash lubricated by oil slinger.
- Low oil level switch (**S2)** connected across magneto ignition **(G2)** on **KV**.
- Low oil level switch (**S2)** is not used on the **KY.**



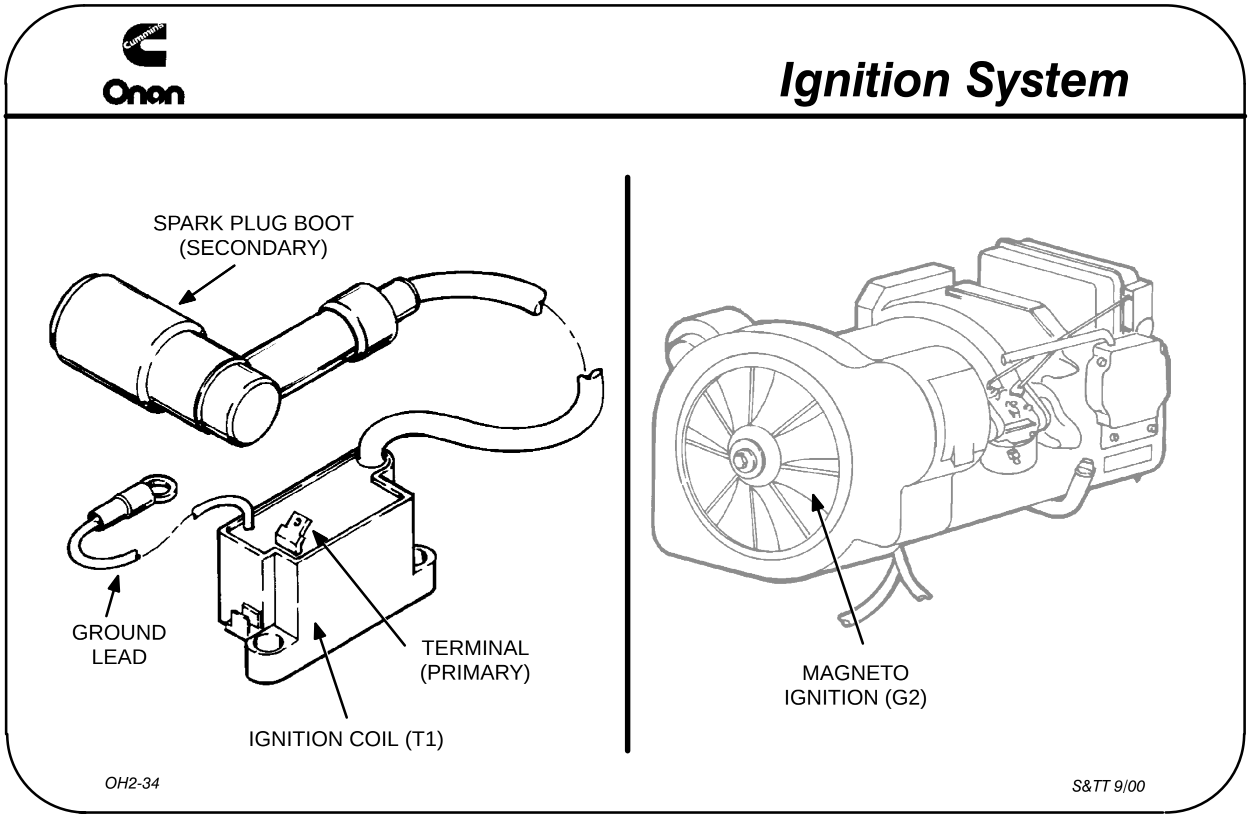
Crankcase Ventilation

OH2-33

S&TT 9/00

Slide 2-33: Crankcase Ventilation

- Maintains negative crankcase pressure.
- Reed valve type.
- Breather is a serviceable item.
- Hose connected to air inlet.
- Do not overtighten the valve cover bolts.
- A faulty breather can cause oil leaks, high oil consumption, reduced engine performance, sludge, and varnish buildup.



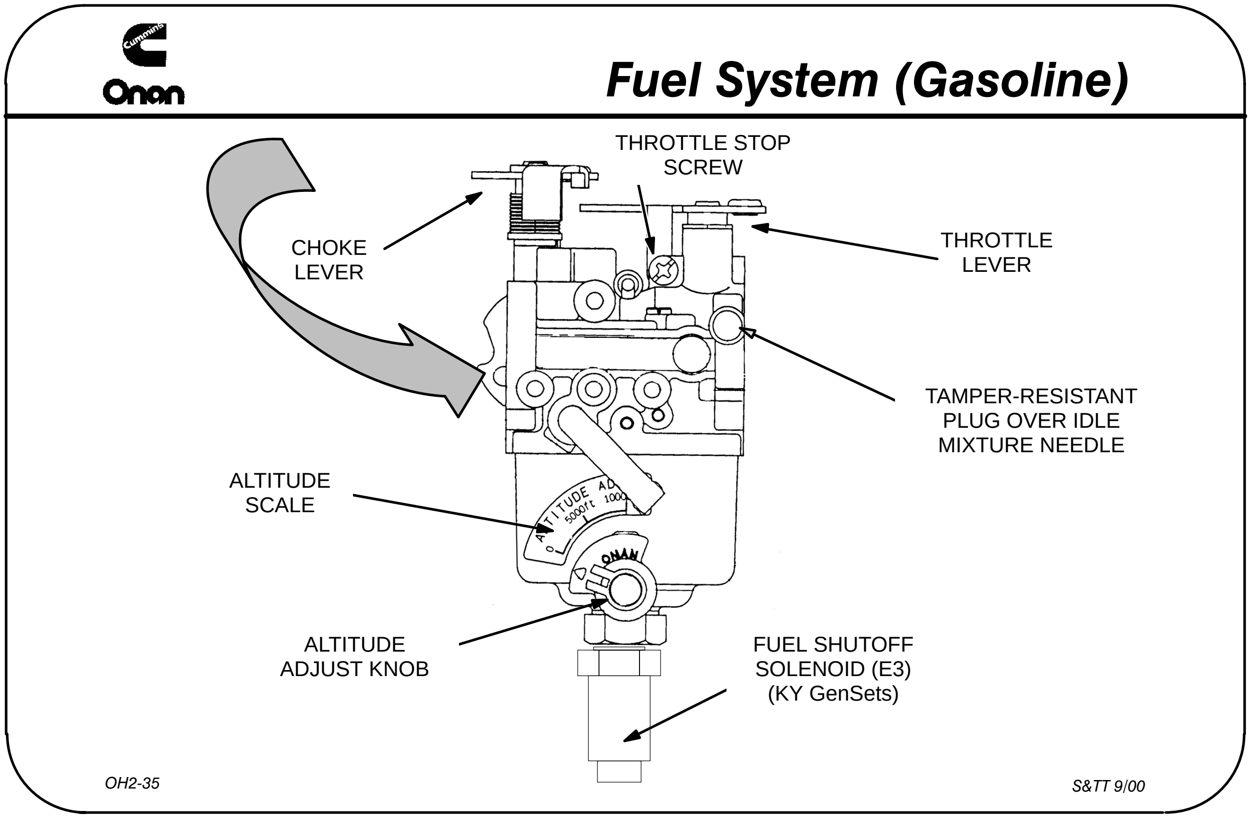
Ignition System

OH2-34

S&TT 9/00

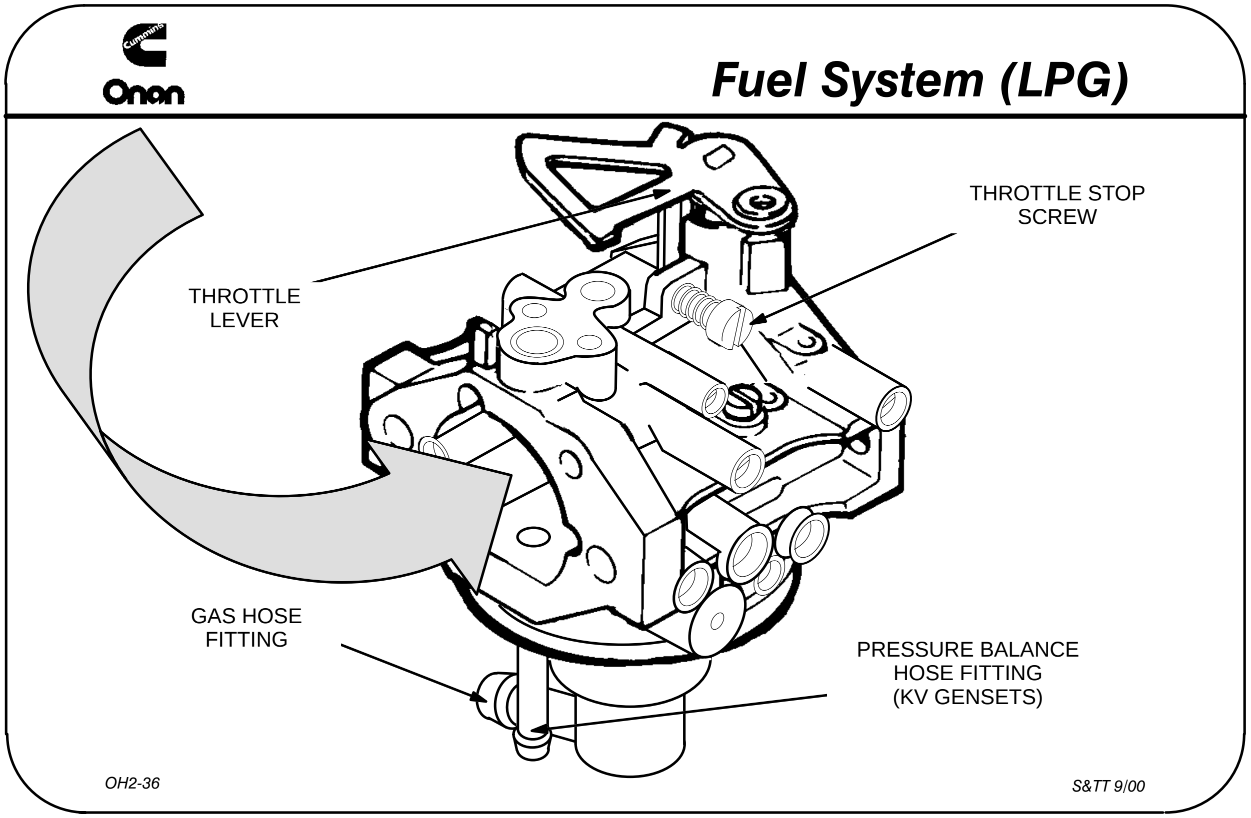
Slide 2-34: Ignition System

- Flywheel magneto ignition.
    - Timing is **25° BTDC**, non-adjustable.
    - Discharge voltage is about **16 to 60 VAC.**
- Use spark plug condition to detect engine problems.
- Ignition coil is a step-up transformer.
    - Running output voltage is about **20,000 VAC.**



Slide 2-35: Fuel System (Gasoline)

- No mixture adjustments.
- Only adjustments are altitude knob and throttle stop screw.
- Overhaul should not be attempted.
    - Malfunctioning carburetor should be replaced.
- Fuel shutoff solenoid **(E3)** on **KY** prevents engine “run-on” when stopped.



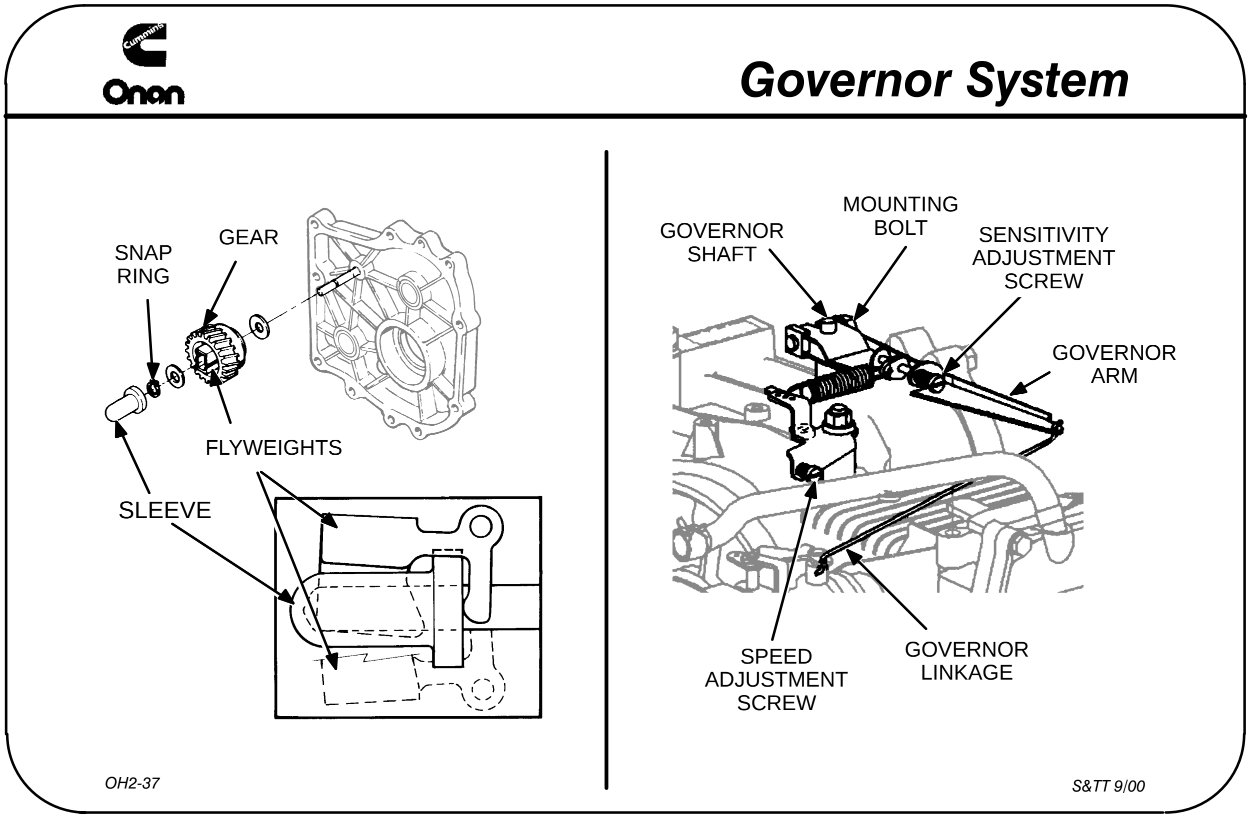
Fuel System (LPG)

OH2-36

S&TT 9/00

Slide 2-36: Fuel System (LPG)

- No mixture adjustments.
- Only adjustment is the throttle stop screw.
- Overhaul should not be attempted.
    - Malfunctioning carburetor should be replaced.
- Pressure balance hose on the **KV can not** be cut, have its length altered, kinked or disconnected.



Governor System

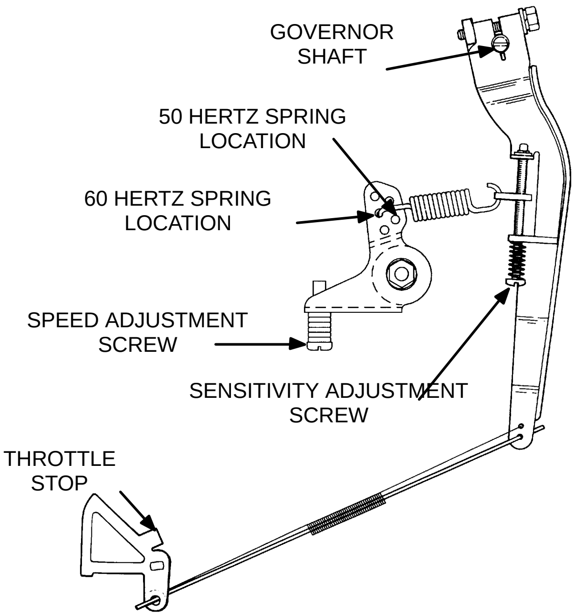
OH2-37

S&TT 9/00

Slide 2-37: Governor System

- Controls engine speed which affects generator output and frequency.
- To reset governor arm:
  - Loosen governor shaft mounting bolt.
  - Move the governor arm to the wide open throttle position.
  - Turn the governor shaft fully clockwise and tighten bolt.

Governor System (Gasoline)

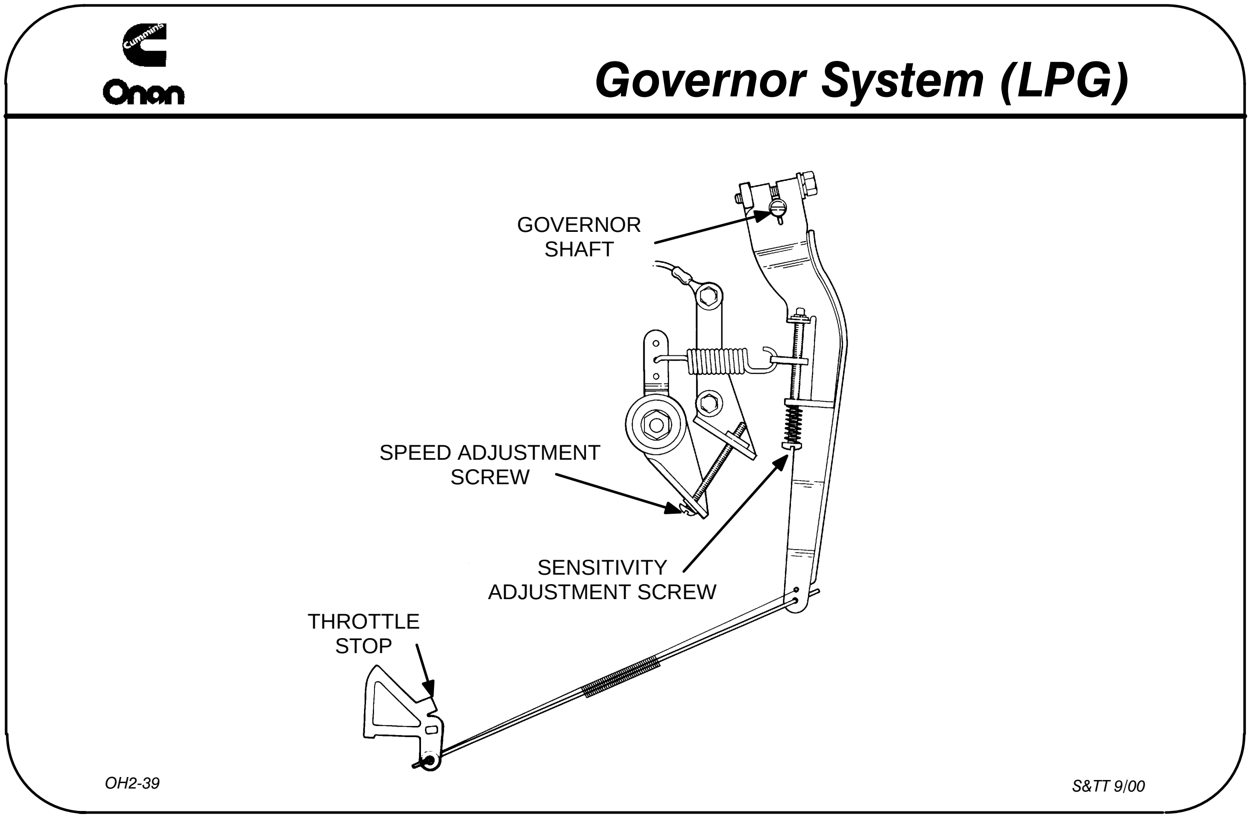


OH2-38

S&TT 9/00

Slide 2-38: Governor System (Gasoline)

- KV has 50 or 60 hz. spring position.
- Sensitivity screw controls engine droop.
- Governor speed adjustment screw controls speed (frequency).



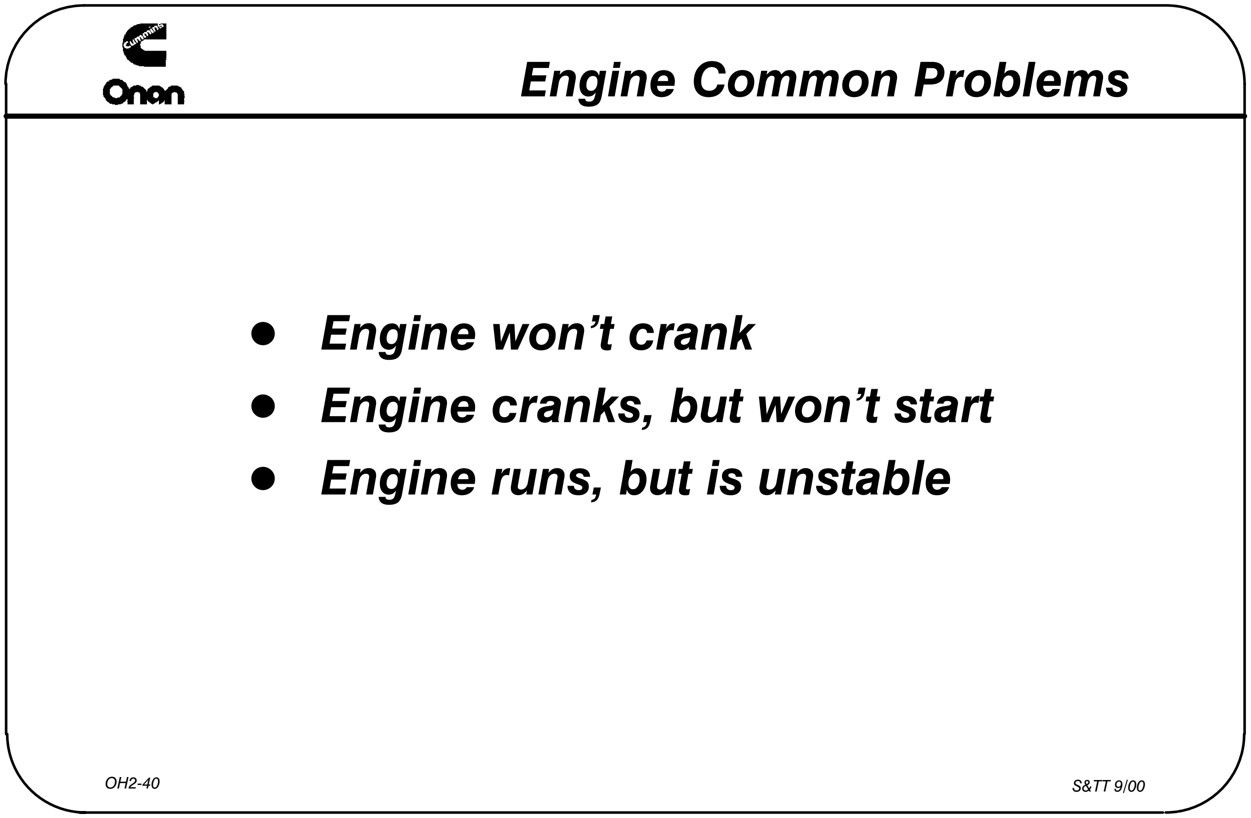
Governor System (LPG)

OH2-39

S&TT 9/00

Slide 2-39: Governor System (LPG)

- Governor speed adjustment screw controls speed (frequency).
- Sensitivity screw controls engine droop.



Engine Common Problems

- Engine won’t crank
- Engine cranks, but won’t start
- Engine runs, but is unstable

OH2-40

S&TT 9/00

Slide 2-40: Engine Common Problems

Engine won’t crank:

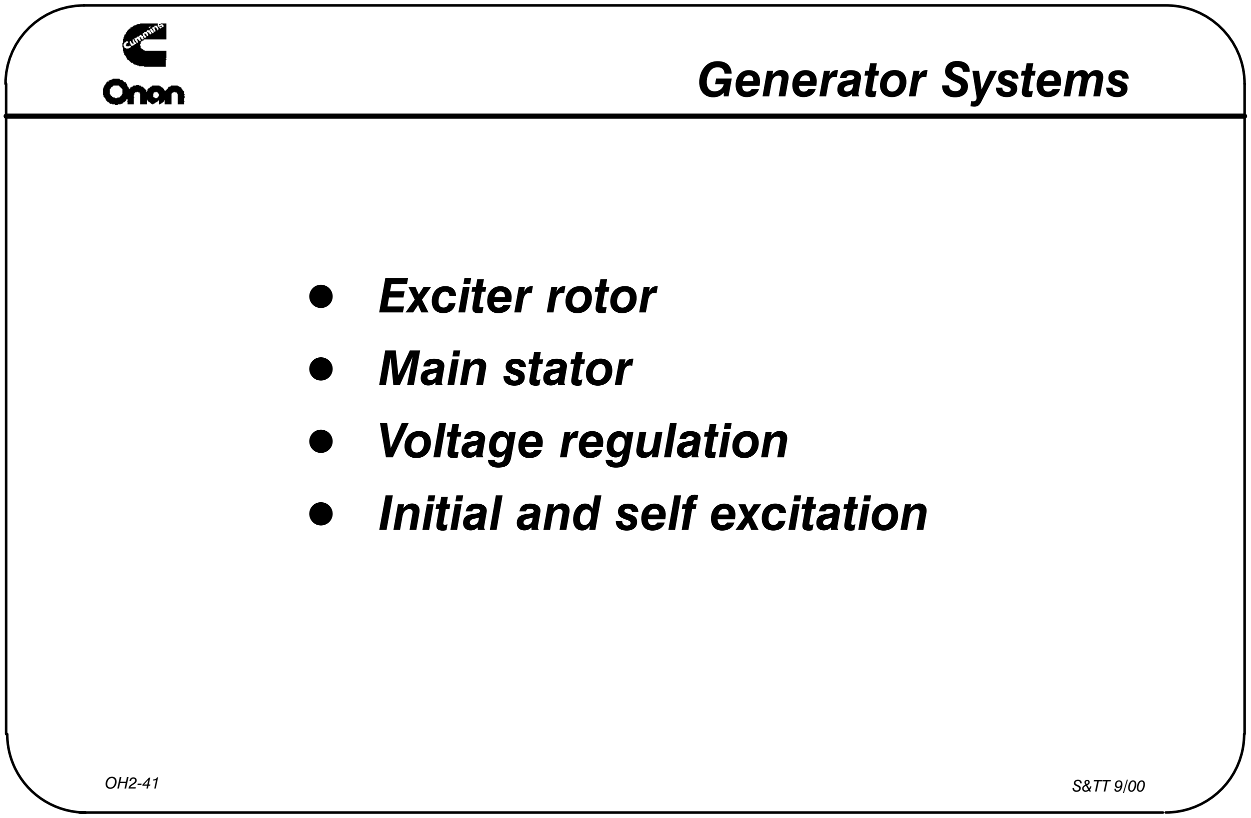
- Check starting ability both at set and remote.
- Check control fuse.
- Check battery and terminals.
- Check starter and solenoid

Engine cranks but won’t start:

- Check fuel level in tank.
- Check any fuel shut off valve or solenoid.
- Check engine oil level.
- Check restricted air filter or exhaust.
- Check fuel filter.
- Check spark plug circuit.

Engine runs, but is unstable:

- Check fuel level and tank.
- Check engine oil level.
- Check governor adjustment.



Onan

Generator Systems

- Exciter rotor
- Main stator
- Voltage regulation
- Initial and self excitation

OH2-41

S&TT 9/00

Slide 2-41: Generator Systems

Rotor

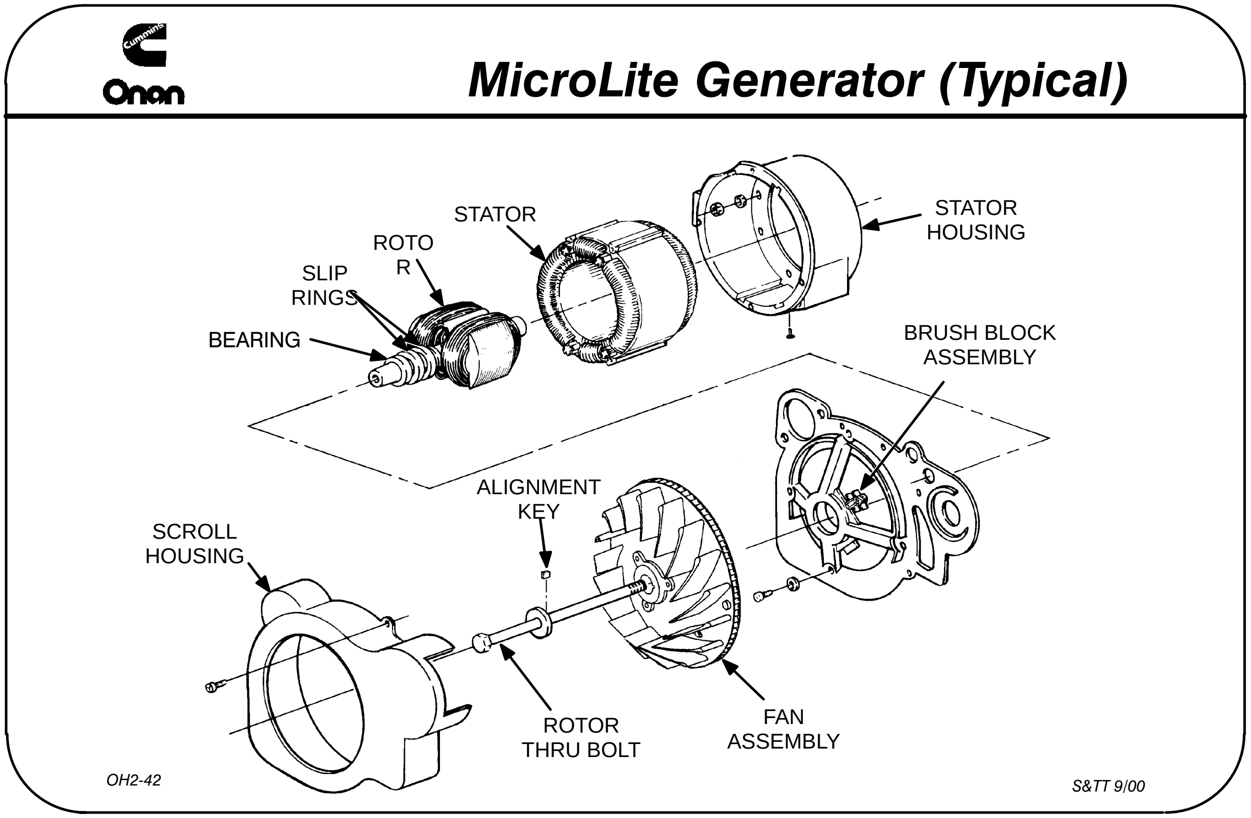
- The exciter rotor provides the rotating magnetic field that is required to generate an AC voltage potential in the stator windings. The DC current required for field excitation is supplied through two slip rings on the rotor shaft.

Stator

- During GenSet operation, AC current is produced in the windings of the stator. Stator winding leads are routed to the set control for control component operation and to the automatic voltage regulator for output voltage monitoring and adjustment.

Voltage Regulator

- The voltage regulator helps provide stable output voltage under varying loads. During initial start of the set, the voltage regulator receives DC current from the starting battery, and begins the initial excitation process in the generator. After the GenSet starts and runs, it provides AC power to the voltage regulator for the self excitation system. The AC voltage is rectified to DC voltage, and the proper DC excitation voltage is conducted to the rotor in proportion to changes in load demand.



MicroLite Generator (Typical)

OH2-42

S&TT 9/00

Slide 2-42: Generator (Typical)

Exciter Rotor

- Rotates inside stator assembly.
- 2 pole electromagnet.
- Produces electromagnetism for excitation.
- Bolted to blower wheel for cooling.
- Attached to slip rings that deliver DC voltage for excitation.

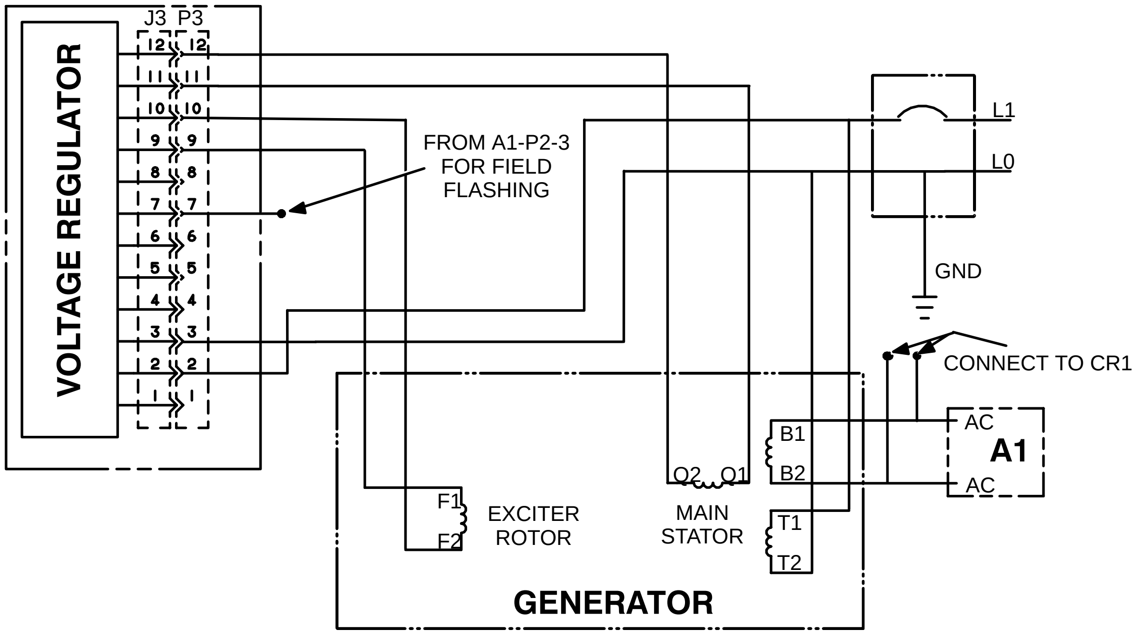
Main Stator

- Located inside generator housing.
- Stationary part of generator.
- Contains AC voltage producing windings.
- Provides AC current for battery charging (KV), control functions, regulation and loads.

Voltage Regulation (not shown)

- Located inside set compartment.
- Receives input from stator.
- Monitors load voltage.
- Produces DC voltage for exciter field regulation.

YVB Generator (KV)



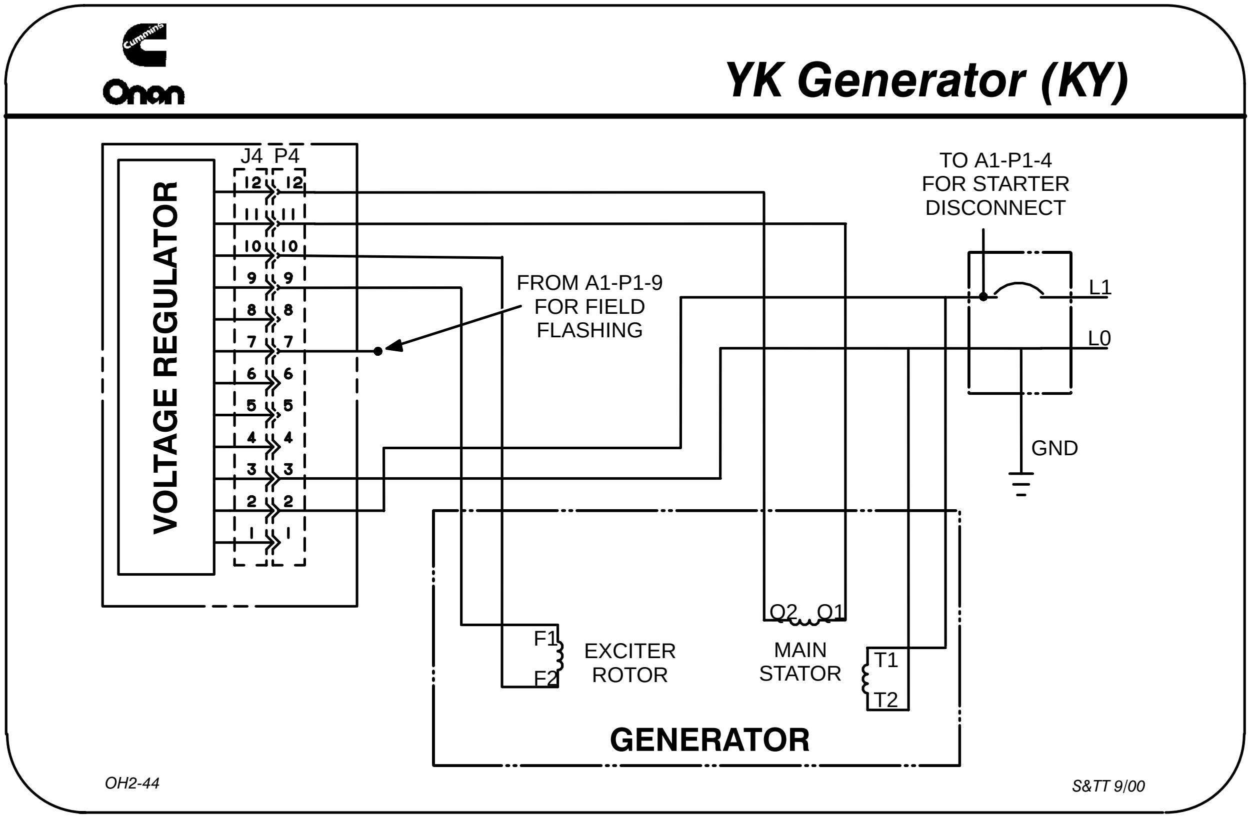
OH2-43

S&TT 9/00

Slide 2-43: YVB Generator (KV)

During GenSet start, battery **B+** is applied to the exciter rotor, through the voltage regulator, to the slip rings **(F1/F2)**. This momentary field flash connection provides adequate electromagnetism in the rotor for start. With this **initial excitation** and the exciter rotor rotating inside the stator, an **AC** voltage is induced into the stator windings. The **Q1/Q2** winding provides a voltage to the voltage regulator **(VR1)** where it is rectified to **DC** and supplied to the slip rings for the field **self excitation.** As the load changes, the **DC** voltage to the slip rings will automatically change to keep the **T1/T2** winding output voltage constant. The **B1/B2** winding voltage is sent to the control board for start disconnect and to the **CR1** bridge rectifier for battery charging.

Note: This is the process of **automatic voltage regulation**.



YK Generator (KY)

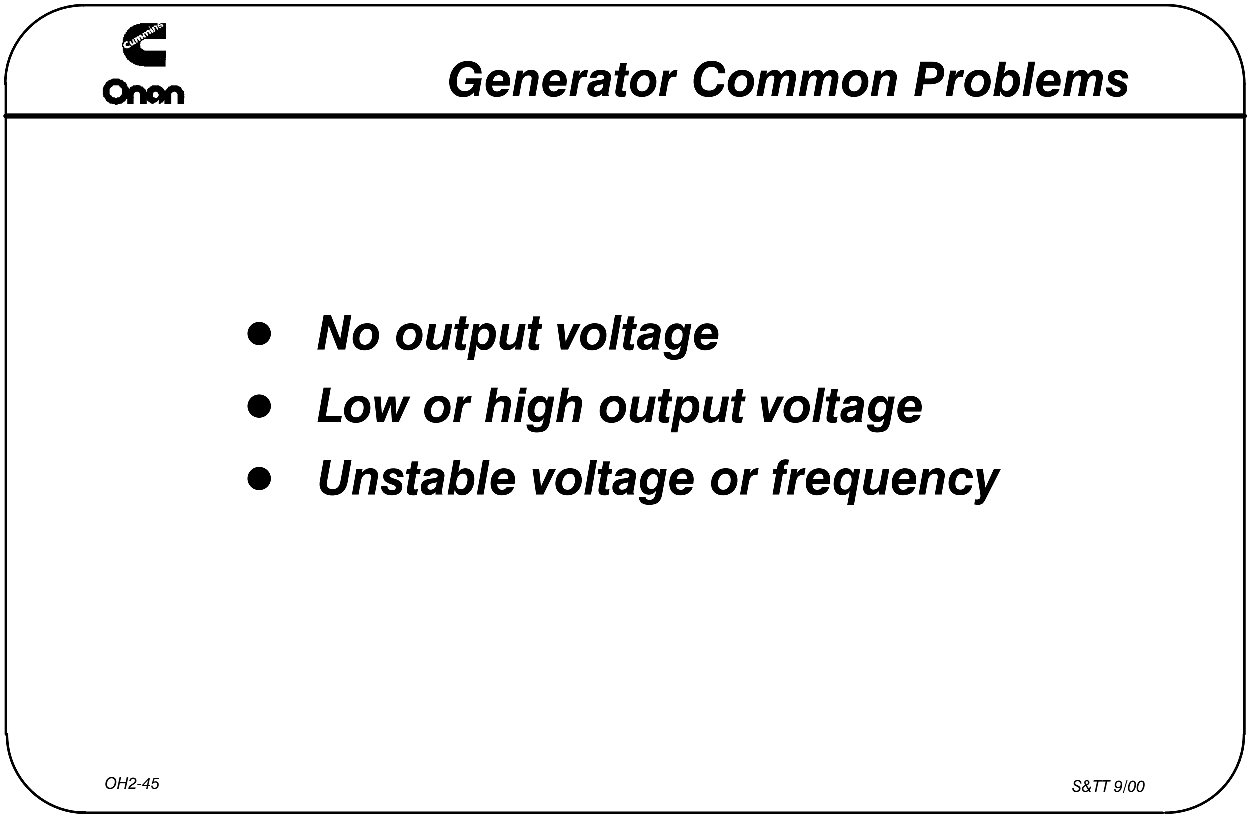
OH2-44

S&TT 9/00

Slide 2-44: YK Generator (KY)

During GenSet start, battery **B+** is applied to the exciter rotor, through the voltage regulator, to the slip rings **(F1/F2)**. This momentary field flash connection provides adequate electromagnetism in the rotor for start. With this **<u>initial excitation</u>** and the exciter rotor rotating inside the stator, an **AC** voltage is induced into the stator windings. The **Q1/Q2** winding provides a voltage to the voltage regulator **(VR1)** where it is rectified to **DC** and supplied to the slip rings for the field **<u>self excitation</u>**. As the load changes, the **DC** voltage to the slip rings will automatically change to keep the output voltage constant. Line voltage **(L1)** is sent to the **A1** control board for start disconnect.

Note: This is the process of **automatic voltage regulation**.



Generator Common Problems

- No output voltage
- Low or high output voltage
- Unstable voltage or frequency

OH2-45

S&TT 9/00

Slide 2-45: Generator Common Problems

No output voltage:

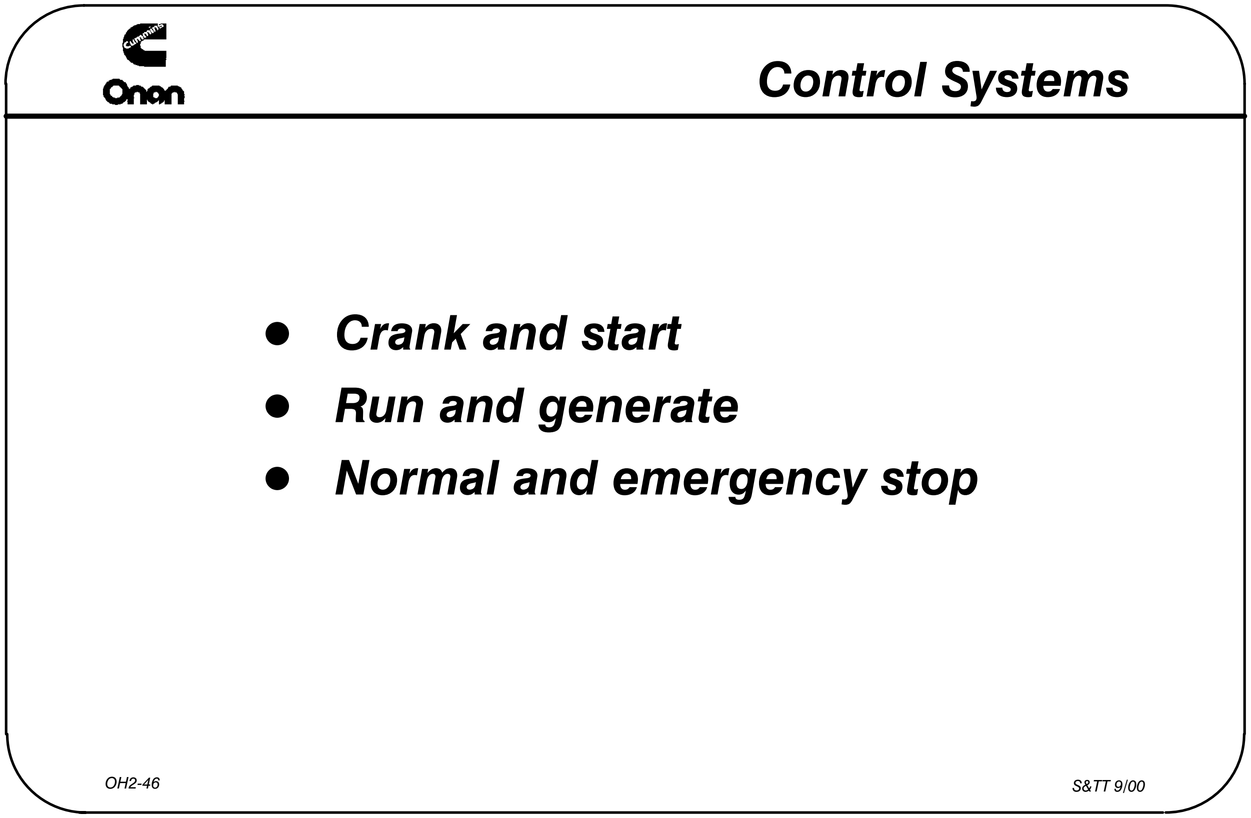
- Check AC circuit breakers.
- Check field flash circuit.
- Check brushes and slip rings.
- Check voltage regulator.
- Check rotor and stator for opens, shorts or grounds.

Low or high output voltage:

- Check N.L. & F.L. engine speed.
- Check voltage regulator.
- Check brushes and slip rings.
- Check rotor and stator for shorts.
- Check control for field flash disconnect.

Unstable voltage or frequency:

- Check engine governor.
- Check fuel system.
- Check voltage regulator.



Control Systems

- Crank and start
- Run and generate
- Normal and emergency stop

OH2-46

S&TT 9/00

Slide 2-46: Control Modes

Crank and start circuits

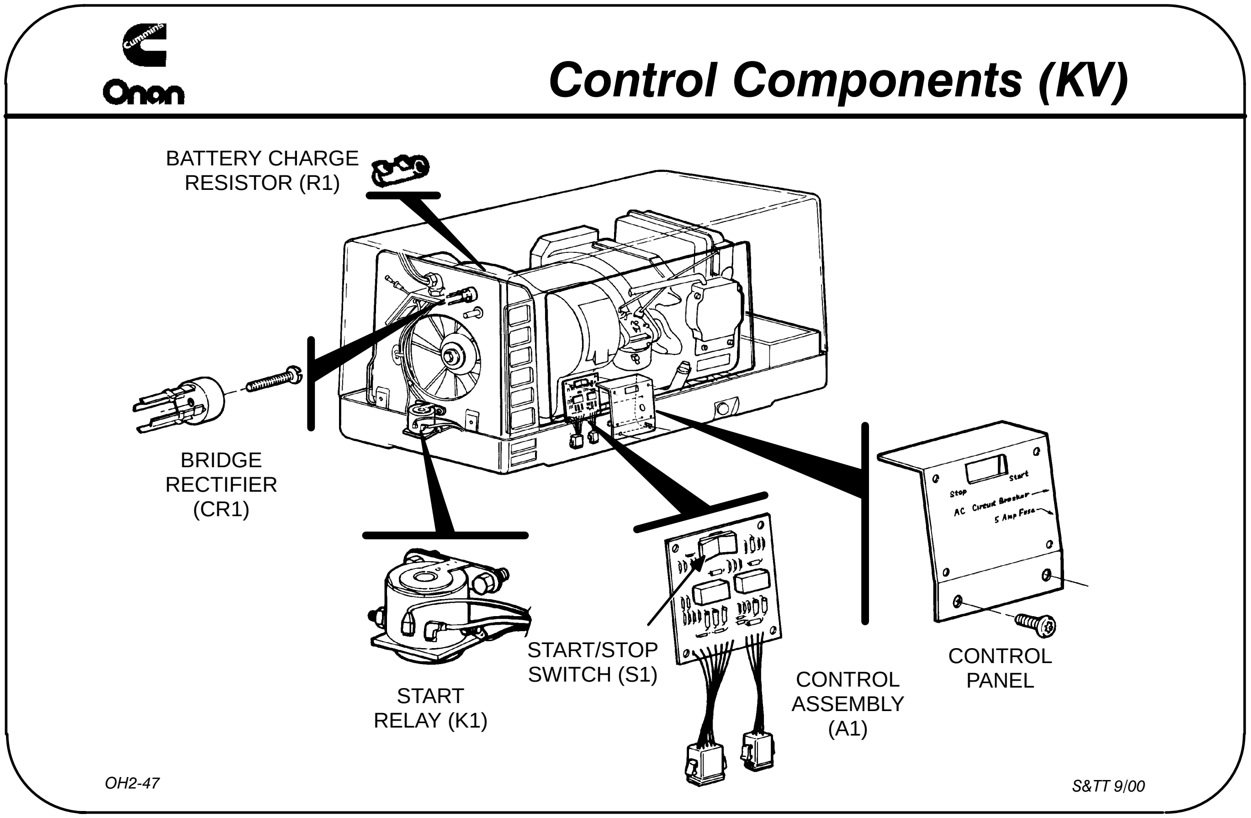
- Starter.
- Fuel.
- Ignition.
- Field flash.

Run and generate circuits

- Starter disconnect.
- Battery charge.
- Field flash disconnect.

Normal and emergency stop circuits

- Ignition disconnect.
- Fuel disconnect.
- Low oil level switch.



Control Components (KV)

OH2-47

S&TT 9/00

Slide 2-47: Control Components (KV)

- Located in generator housing.
- Controls and monitors the engine and generator.

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Activity

Directions: Using your highlighters, and the copies of the **KV MicroLite** control schematic, **610-0382**, follow along with the instructor and color the modes of operation on your sheets.

The page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **KV GenSets** when they don’t operate properly.

Start Mode

Slide 2-48: **Print 610-0382**

When the start/stop switch on the **A1** control board is pressed to the start position, current from the **BT1** battery will flow through the **F1** fuse to the control and out to the **K1** starter relay.

Its **N.O.** contacts close allowing current to energize the **B1** starter motor and the **K2** LP regulator primer if so equipped.

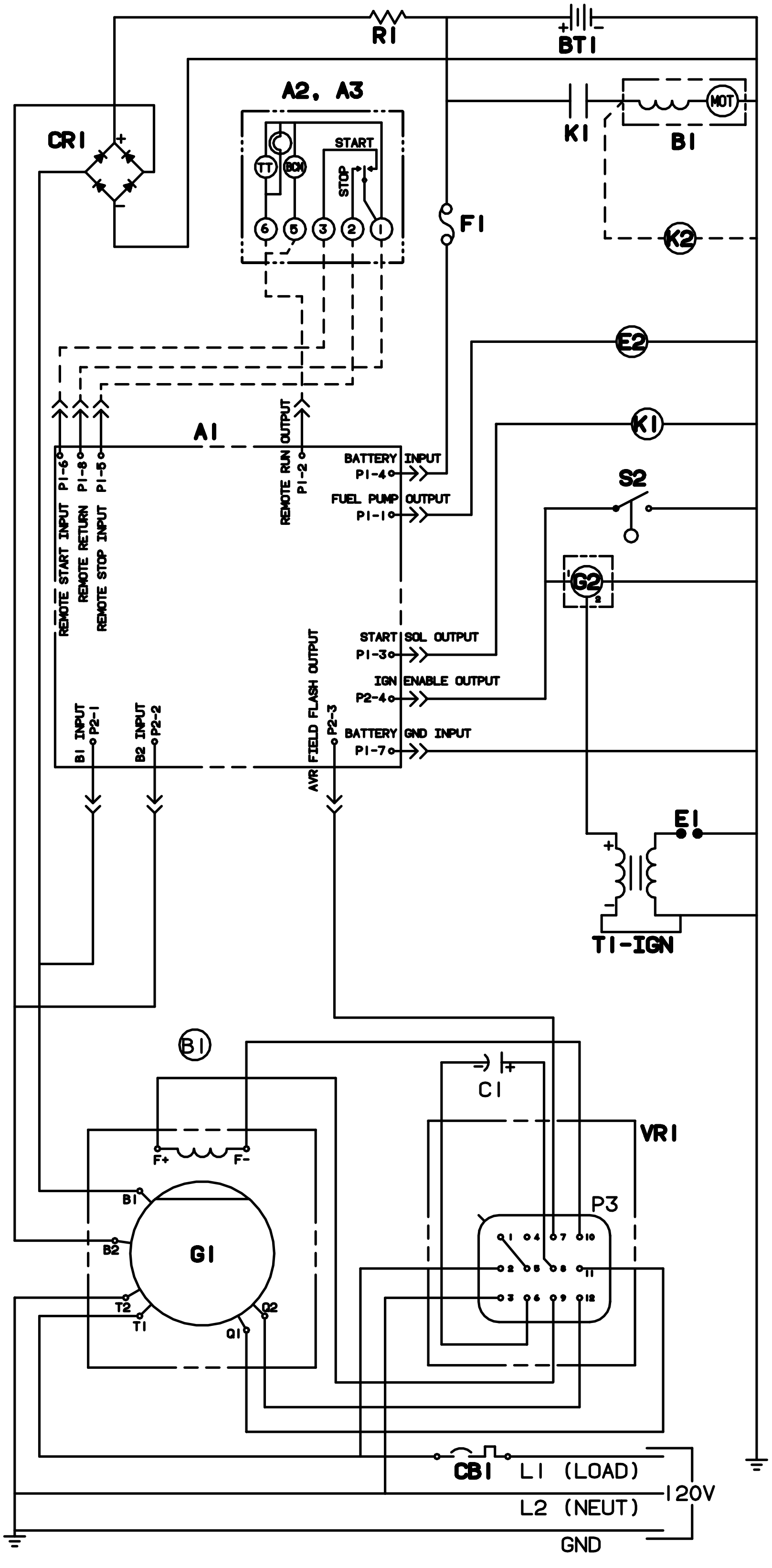
Current from the control will also flow to the **E2** electric fuel pump (fuel solenoid if LP).

When the motor is cranking, voltage is produced by the **G2** ignition magneto to power the **T1** ignition coil and the **E1** spark plug.

Initial excitation of the **G1** generator is accomplished by current flowing from the control board, through the **VR1** voltage regulator to the **F1/F2** field winding.

Values: **G2** ignition magneto = **16 to 60 VAC**.
T1 ignition coil output = **20,000 VAC**.
E2 fuel pump = **$3^1/_2$ to 5 psi.**

KV GenSet 610-0382



A1	Control Assembly
A2	Deluxe Remote Control
A3	Standard Remote Control
B1	Starter Motor
BT1	Battery
CB1	AC Circuit Breaker
CR1	Bridge Rectifier
C1	Capacitor
E1	Spark Plug
E2	Fuel Pump (LP Fuel Sol.)
F1	Fuse
G1	Generator
G2	Ignition Magneto
K1	Starter Relay
K2	LP Regulator Solenoid
R1	Battery Charge Resistor
S1	Start/Stop Switch
S2	Low Oil Level Switch
T1	Ignition Coil
VR1	AC Voltage Regulator

OH2-48

S&TT 9/00

Run Mode

Slide 2-49: **Print 610-0382**

As the engine is coming up to speed, AC voltage is being produced by the **G1** generator. Voltage from the **B1/B2** winding will flow to the control board and cause it to remove the output to the **K1** starter relay (and the **K2** LP fuel primer) deenergizing the **B1** starter motor.

It will also remove the initial field flash output to the **VR1** regulator and the **G1** generator.

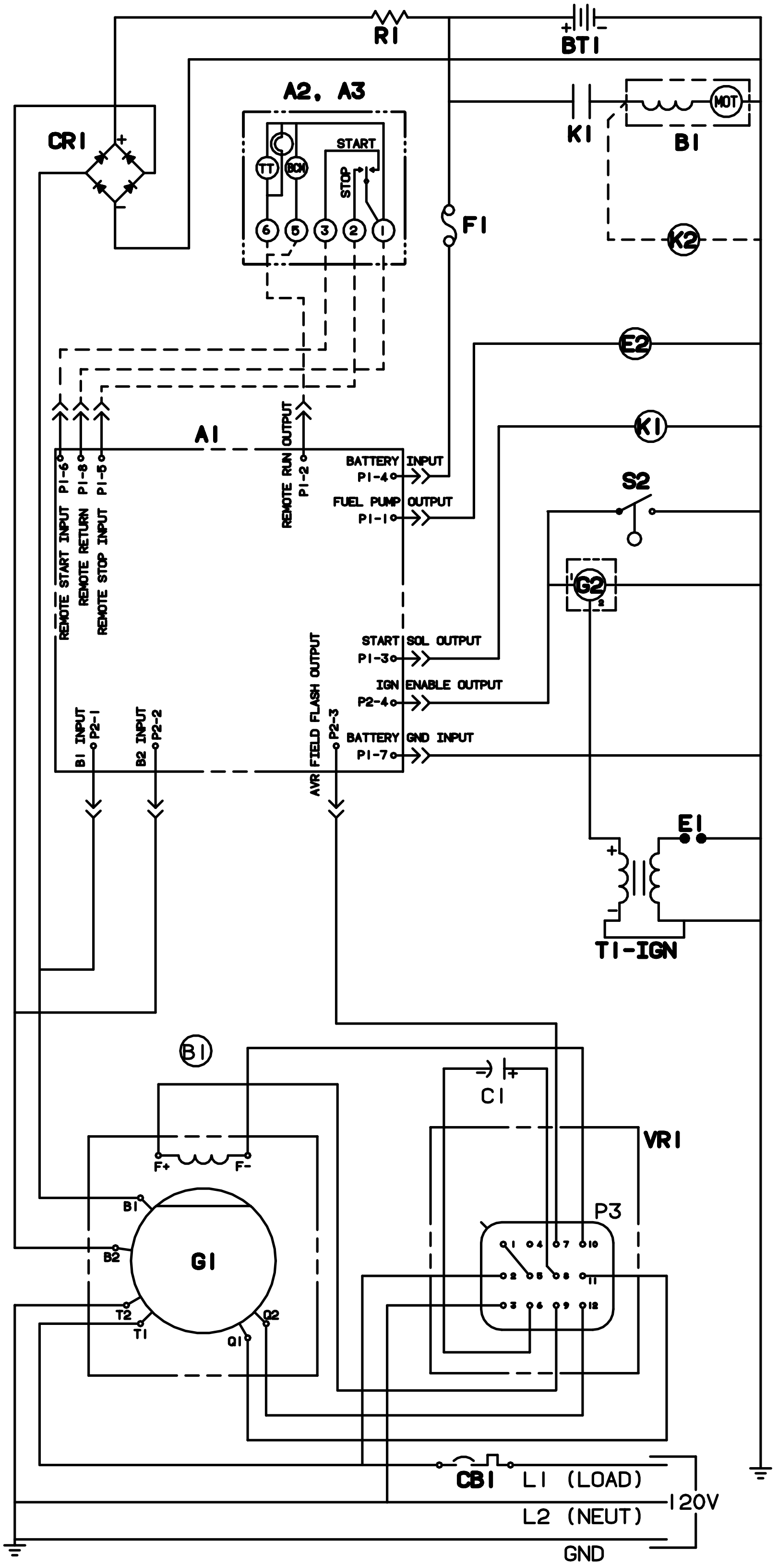
B1/B2 voltage will flow to the **CR1** bridge rectifier which is reduced by the **R1** resister to charge the battery.

Output from the **T1/T2** winding will go to the **L1/L2** load and to the **VR1** regulator as a reference voltage.

Output from the **Q1/Q2** winding will go to the regulator to be rectified into an excitation voltage for the **F1/F2** field rotor.

Values: **B1/B2** winding voltage = **20 VAC.**
T1/T2 winding voltage = **126-128 VAC**.
Q1/Q2 winding voltage = **90 VAC.**
F1/F2 field voltage = **18-60 VDC.**
CR1/R1 output = **13.5-14 VDC.**

KV GenSet
610-0382



A1	Control Assembly
A2	Deluxe Remote Control
A3	Standard Remote Control
B1	Starter Motor
BT1	Battery
CB1	AC Circuit Breaker
CR1	Bridge Rectifier
C1	Capacitor
E1	Spark Plug
E2	Fuel Pump (LP Fuel Sol.)
F1	Fuse
G1	Generator
G2	Ignition Magneto
K1	Starter Relay
K2	LP Regulator Solenoid
R1	Battery Charge Resistor
S1	Start/Stop Switch
S2	Low Oil Level Switch
T1	Ignition Coil
VR1	AC Voltage Regulator

OH2-49 *S&TT 9/00*

Stop Mode

Slide 2-50: **Print 610-0382**

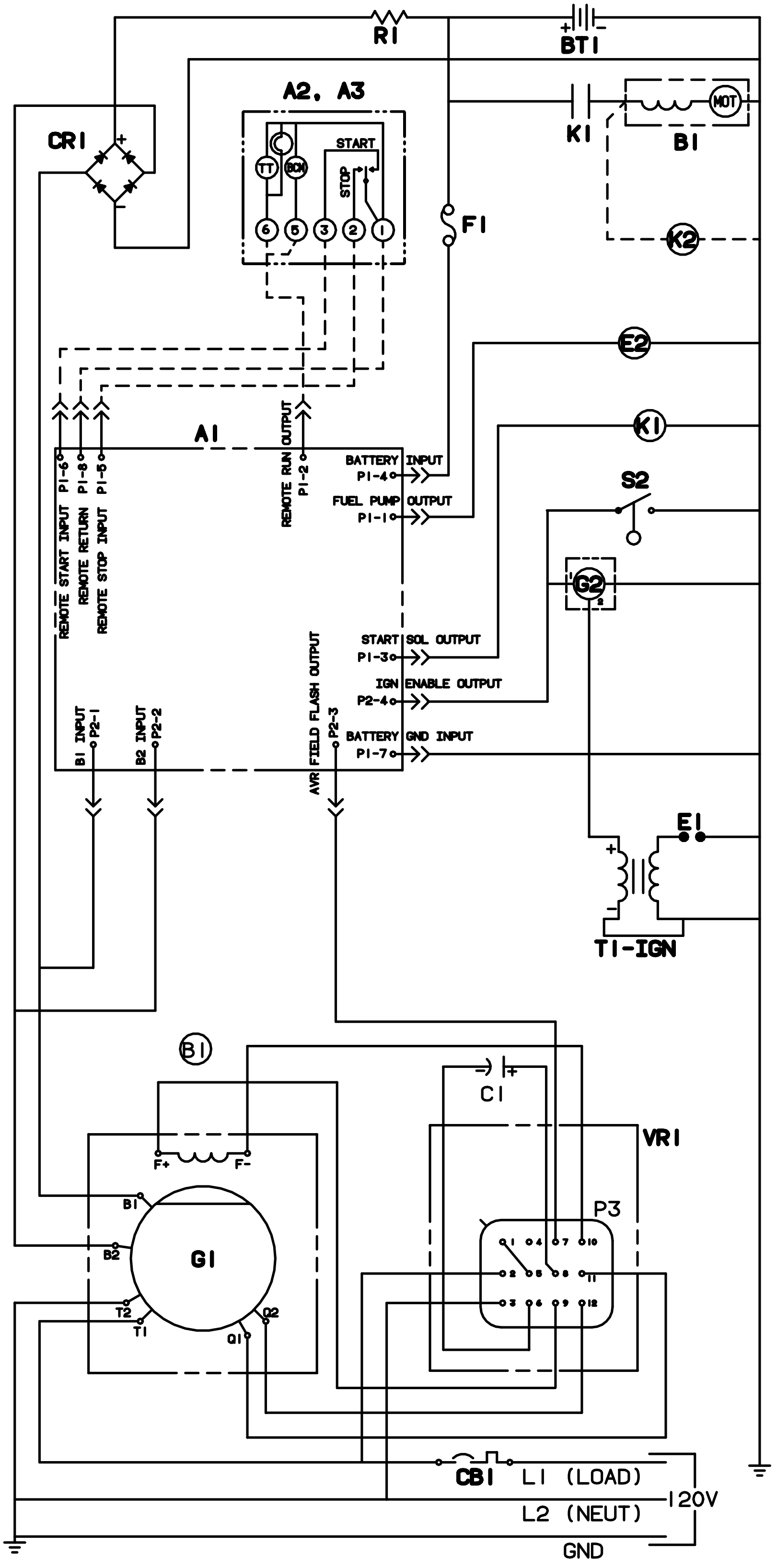
When the start/stop switch on the **A1** control board is pressed to the stop position, a ground signal is passed from the control to the **G1** ignition magneto stopping its operation. The output to the **E2** fuel pump is also removed.

Emergency Stop

Emergency stop occurs if the **S2** low oil level switch closes because of low oil level. When it closes it applies a ground to the **G2** ignition magneto stopping the ignition system.

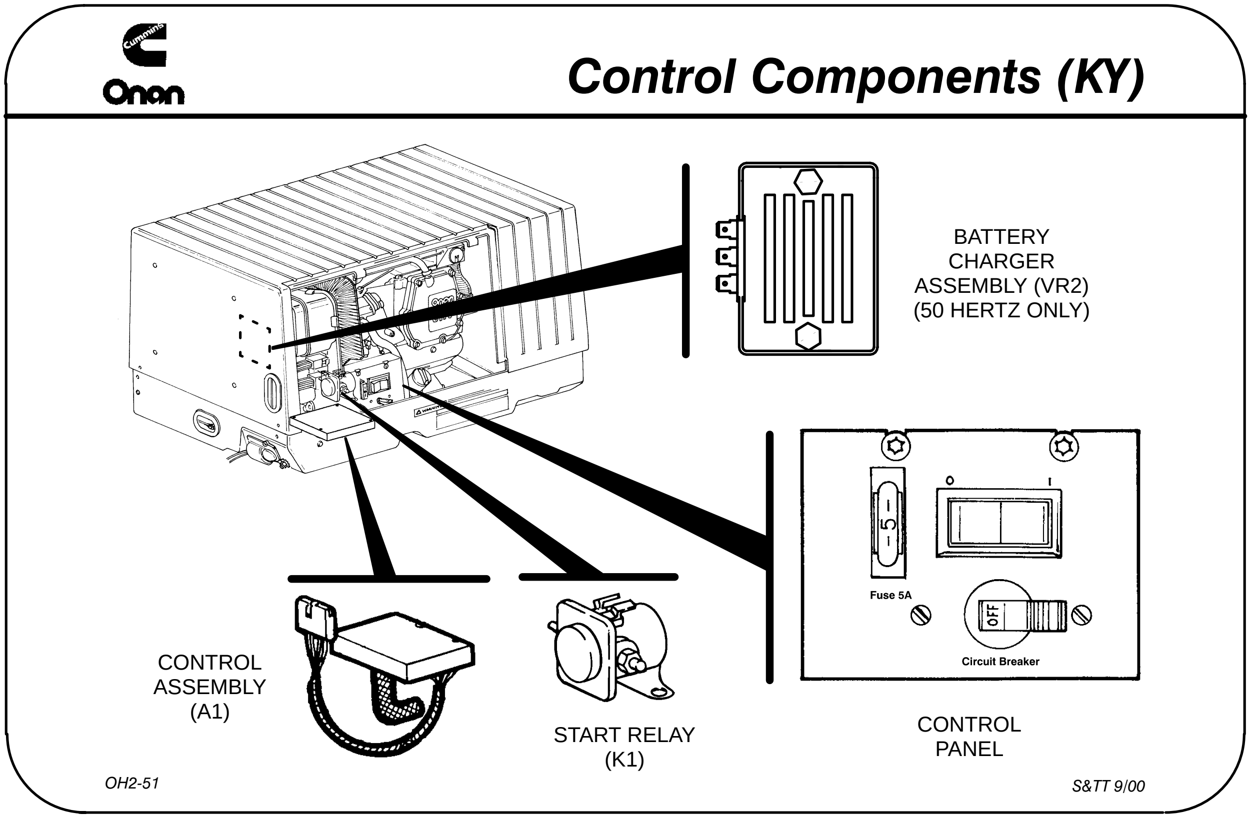
KV GenSet
610-0382

A1	Control Assembly
A2	Deluxe Remote Control
A3	Standard Remote Control
B1	Starter Motor
BT1	Battery
CB1	AC Circuit Breaker
CR1	Bridge Rectifier
C1	Capacitor
E1	Spark Plug
E2	Fuel Pump (LP Fuel Sol.)
F1	Fuse
G1	Generator
G2	Ignition Magneto
K1	Starter Relay
K2	LP Regulator Solenoid
R1	Battery Charge Resistor
S1	Start/Stop Switch
S2	Low Oil Level Switch
T1	Ignition Coil
VR1	AC Voltage Regulator



OH2-50

S&TT 9/00



Control Components (KY)

BATTERY CHARGER ASSEMBLY (VR2) (50 HERTZ ONLY)

CONTROL ASSEMBLY (A1)

START RELAY (K1)

CONTROL PANEL

OH2-51

S&TT 9/00

Slide 2-51: Control Components (KY)

- Located inside the generator housing.
- Controls and monitors the engine and generator.

Activity

Directions: Using your highlighters, and the copies of the **KY MicroLite** control schematic, **611-1265**, follow along with the instructor and color the modes of operation on your sheets.

The page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **KY GenSets** when they don’t operate properly.

Start Mode

Slide 2-52: **Print 611-1265**

When the **S1** start/stop switch is pressed to the start position, current from the **BT1** battery flows through the **F1** fuse to the **A1** control board and out to the **K1** starter relay.

When energized, it closes its **N.O.** contacts allowing current to flow to the **B1** starter motor and the **K2** LP primer solenoid if so equipped.

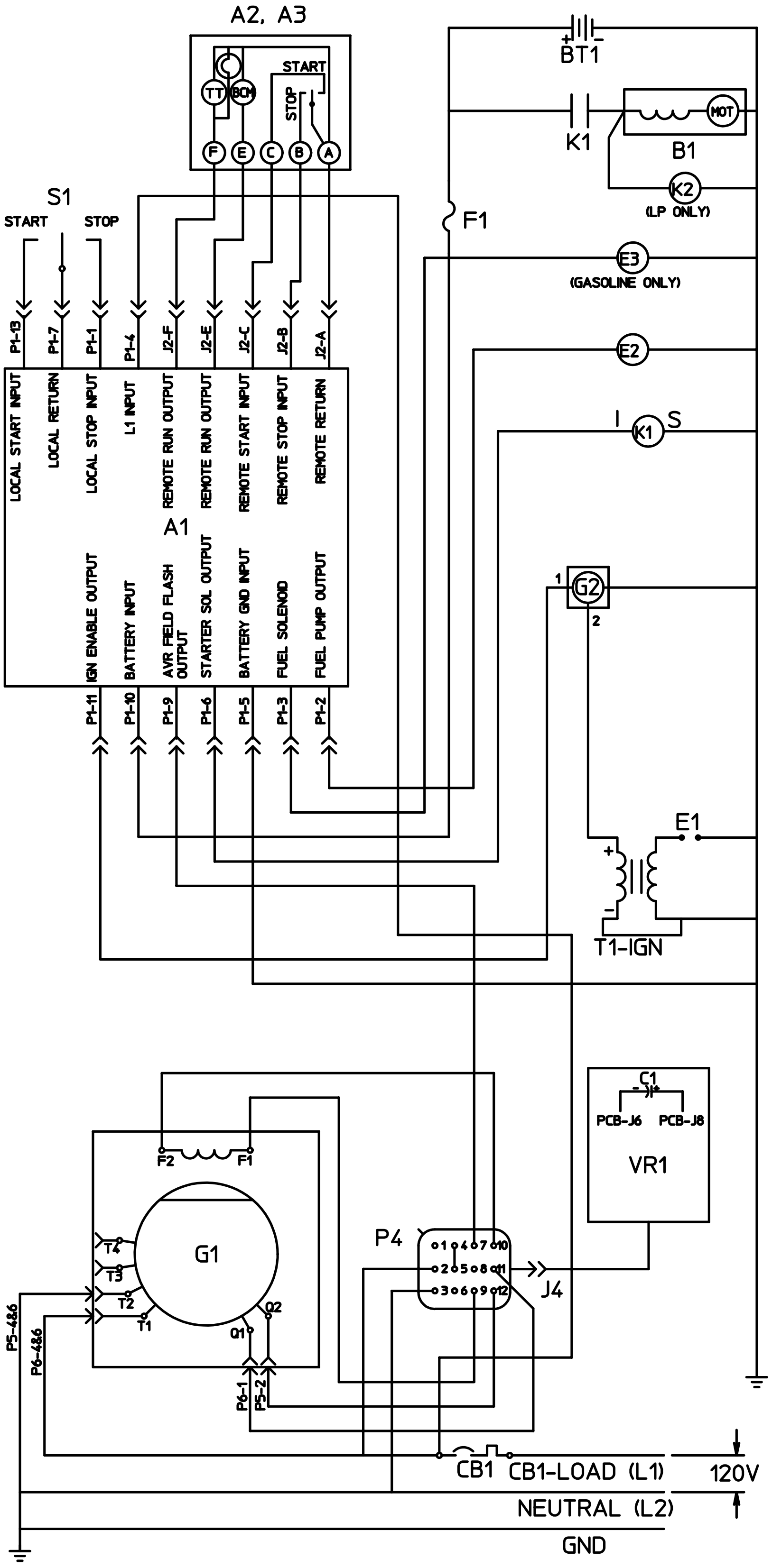
The control board will also supply battery current to the **E2** fuel pump (fuel solenoid if LP) and the **E3** fuel shutoff solenoid.

When the motor is cranking, voltage is produced by the **G2** ignition magneto to power the **T1** ignition coil and the **E1** spark plug.

Initial excitation of the **G1** generator is accomplished by current flowing from the control board, through the **VR1** voltage regulator to the **F1/F2** field winding.

Values: **G2** ignition magneto = **16 to 60 VAC**.
T1 ignition coil output = **20,000 VAC**.
E2 fuel pump = **$3^1/_2$ to 5 psi.**

KY GenSet
611-1265



OH2-52

S&TT 9/00

A1	**Control Assembly**
A2	**Deluxe Remote Control**
A3	**Standard Remote Control**
B1	**Starter Motor**
BT1	**Battery**
CB1	**AC Circuit Breaker**
E1	**Spark Plug**
E2	**Fuel Pump (LP Fuel Sol.)**
E3	**Fuel Shutoff Solenoid**
F1	**Fuse**
G1	**Generator**
G2	**Ignition Magneto**
K1	**Starter Relay**
K2	**LP Regulator Solenoid**
S1	**Start/Stop Switch**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**

Run Mode

Slide 2-53: Print 611-1265

As the engine is coming up to speed, AC voltage is being produced by the **G1** generator. Voltage from the **L1** line will flow to the control board and cause it to remove the output to the **K1** starter relay (and the **K2** LP fuel primer) deenergizing the **B1** starter motor.

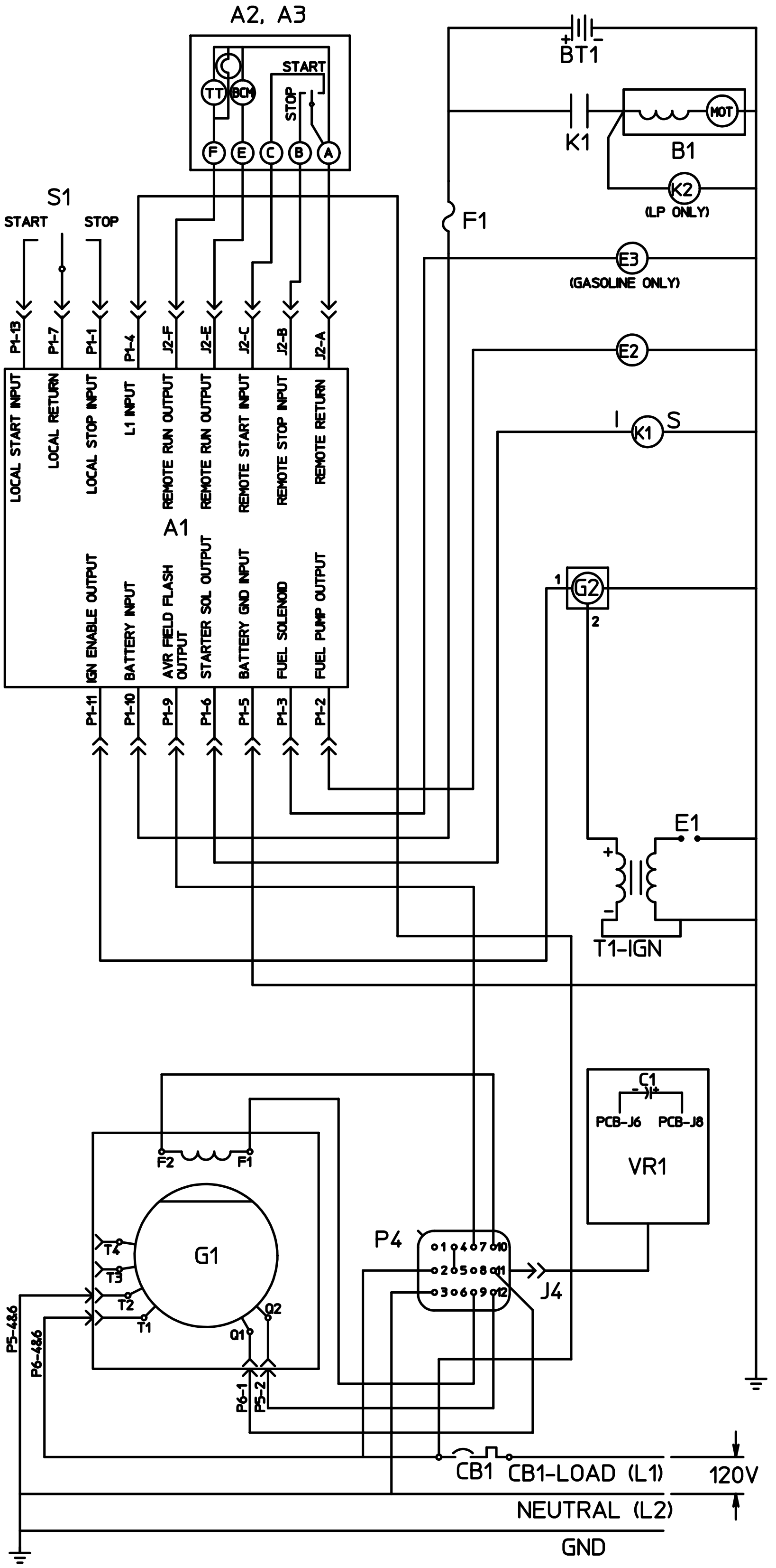
It will also remove the initial “field flash” excitation to the **VR1** voltage regulator and the **G1** generator.

Generator output from the **T1/T2** winding will go to the **L1/L2** load and to the **VR1** regulator as a reference voltage.

Output from the **Q1/Q2** winding will go to the regulator to be rectified into excitation voltage for the **F1/F2** field rotor.

Values: **T1/T2** winding voltage = **126-128 VAC**.
Q1/Q2 winding voltage = **130-150 VAC.**
F1/F2 field voltage = **40-100 VDC.**

KY GenSet 611-1265



A1	**Control Assembly**
A2	**Deluxe Remote Control**
A3	**Standard Remote Control**
B1	**Starter Motor**
BT1	**Battery**
CB1	**AC Circuit Breaker**
E1	**Spark Plug**
E2	**Fuel Pump (LP Fuel Sol.)**
E3	**Fuel Shutoff Solenoid**
F1	**Fuse**
G1	**Generator**
G2	**Ignition Magneto**
K1	**Starter Relay**
K2	**LP Regulator Solenoid**
S1	**Start/Stop Switch**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**

OH2-53

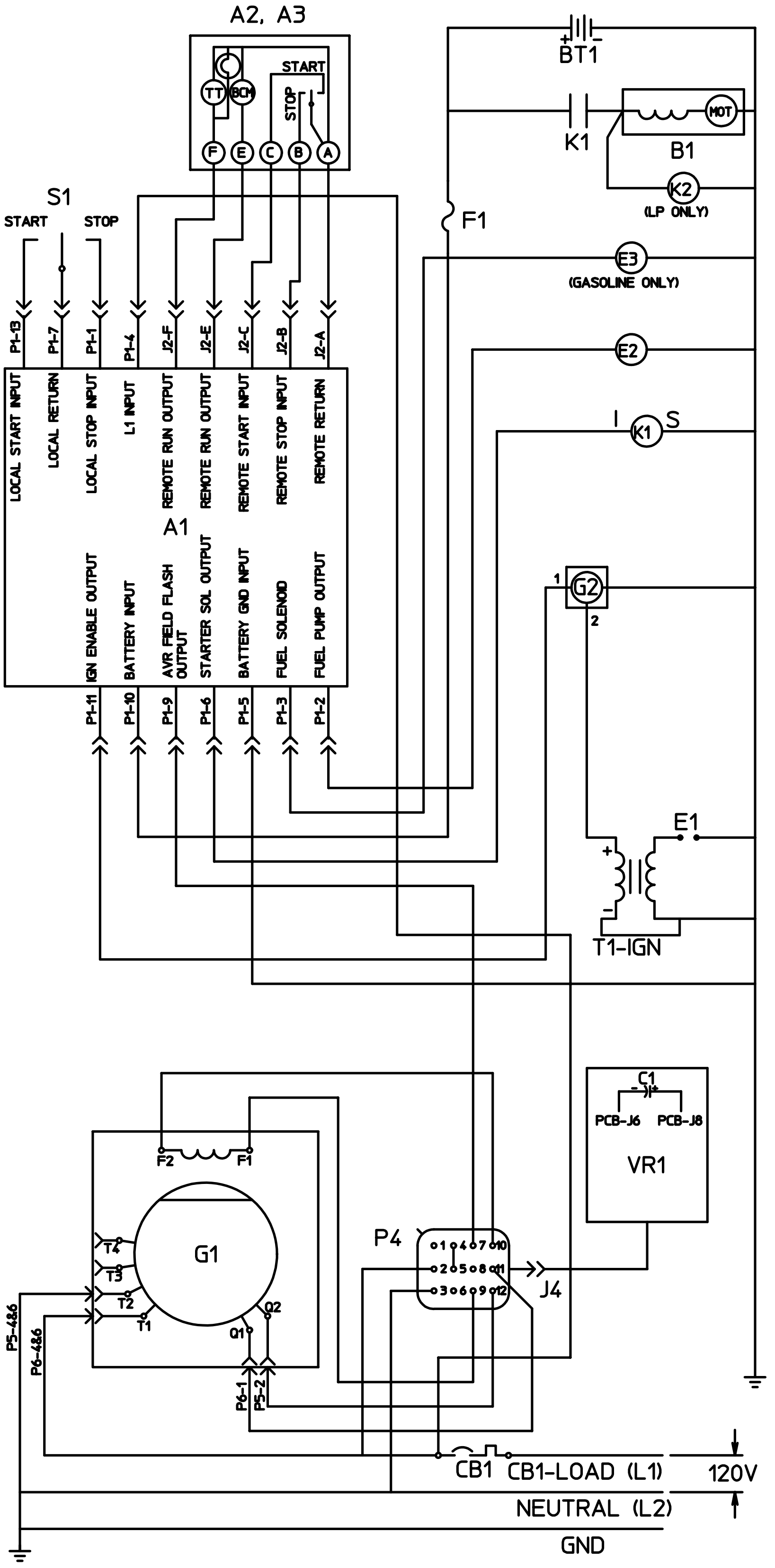
S&TT 9/00

Stop Mode

Slide 2-54: **Print 611-1265**

When the start/stop switch on the **A1** control board is pressed to the stop position, a ground signal is passed from the control to the **G1** ignition magneto stopping its operation. The output to the **E2** fuel pump is also removed.

KY GenSet
611-1265



OH2-54

S&TT 9/00

A1	**Control Assembly**
A2	**Deluxe Remote Control**
A3	**Standard Remote Control**
B1	**Starter Motor**
BT1	**Battery**
CB1	**AC Circuit Breaker**
E1	**Spark Plug**
E2	**Fuel Pump (LP Fuel Sol.)**
E3	**Fuel Shutoff Solenoid**
F1	**Fuse**
G1	**Generator**
G2	**Ignition Magneto**
K1	**Starter Relay**
K2	**LP Regulator Solenoid**
S1	**Start/Stop Switch**
T1	**Ignition Coil**
VR1	**AC Voltage Regulator**

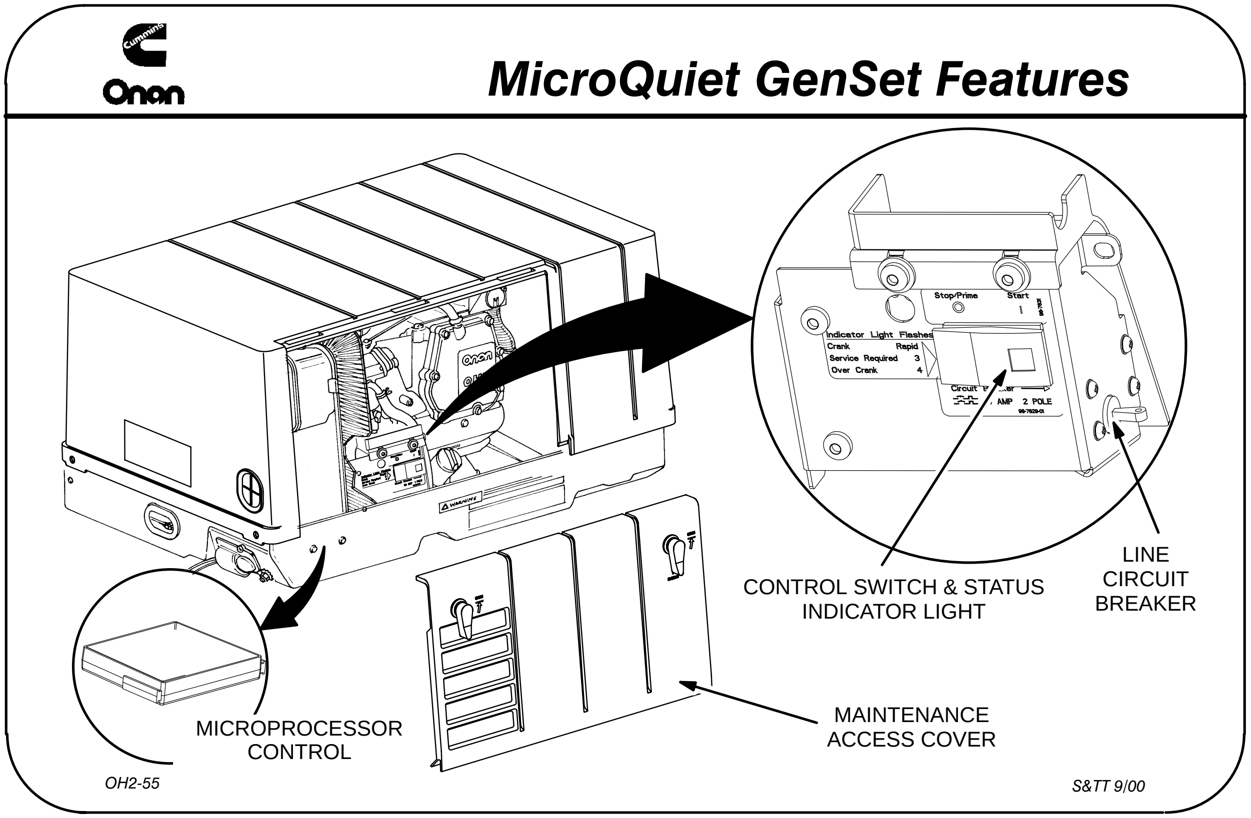
MicroQuiet GenSet

This lesson presents an overview of the differences on the MicroQuiet generator set.

Objectives:

After completing this lesson, you should be able to:

- Identify the main features of the MicroQuiet GenSet.
- Locate the MicroQuiet GenSet microprocessor control.
- Understand the AC connection diagram.
- Decipher electrical problems using the control schematic.
- Understand and use the troubleshooting section of the *Service Manual*.



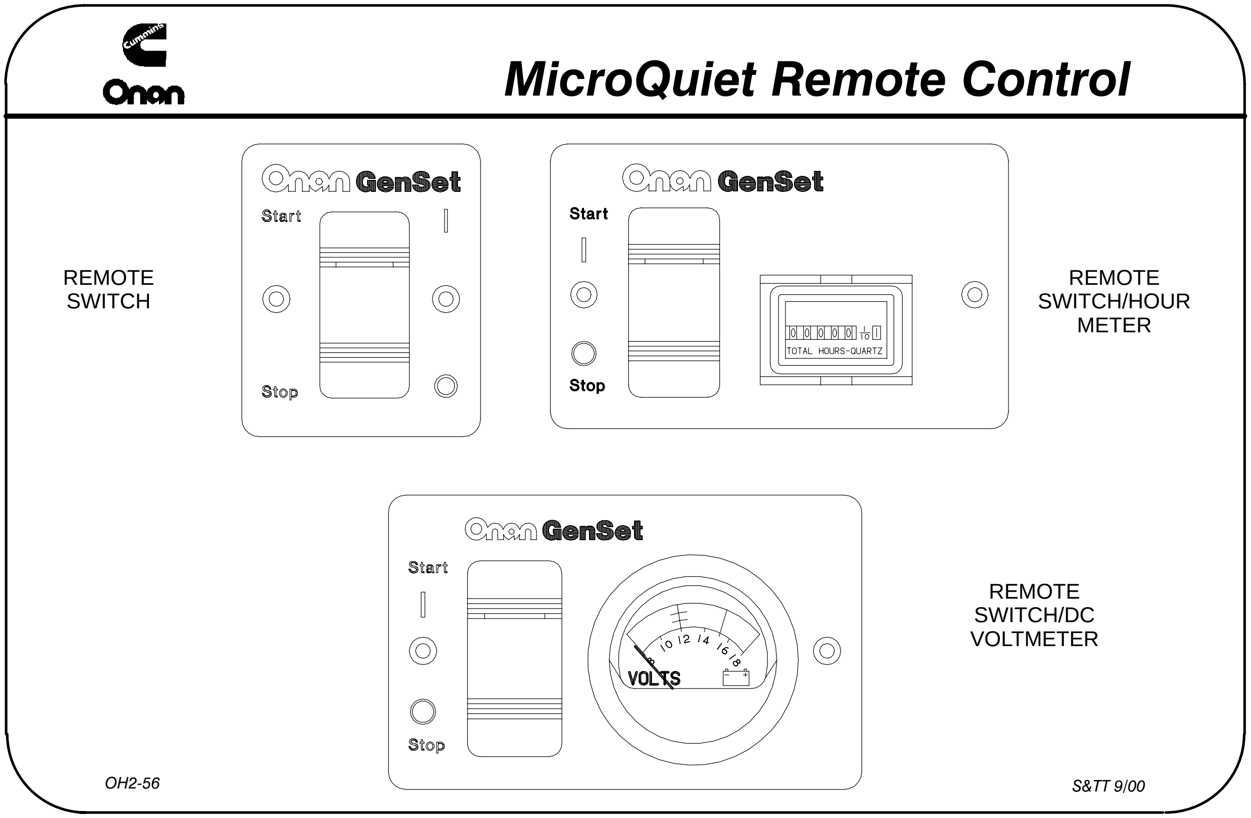
MicroQuiet GenSet Features

OH2-55

S&TT 9/00

Slide 2-55: MicroQuiet GenSet Features

- Gasoline and LPV
- 3.3 to 4.0 Kw
- 50 & 60 Hz
- 120 to 240 VAC
- Microprocessor with voltage regulation and service diagnostics
- Reconnectable output on 50 Hz model
- 10 amp battery charger on 50 Hz model



MicroQuiet Remote Control

REMOTE SWITCH

REMOTE SWITCH/HOUR METER

REMOTE SWITCH/DC VOLTMETER

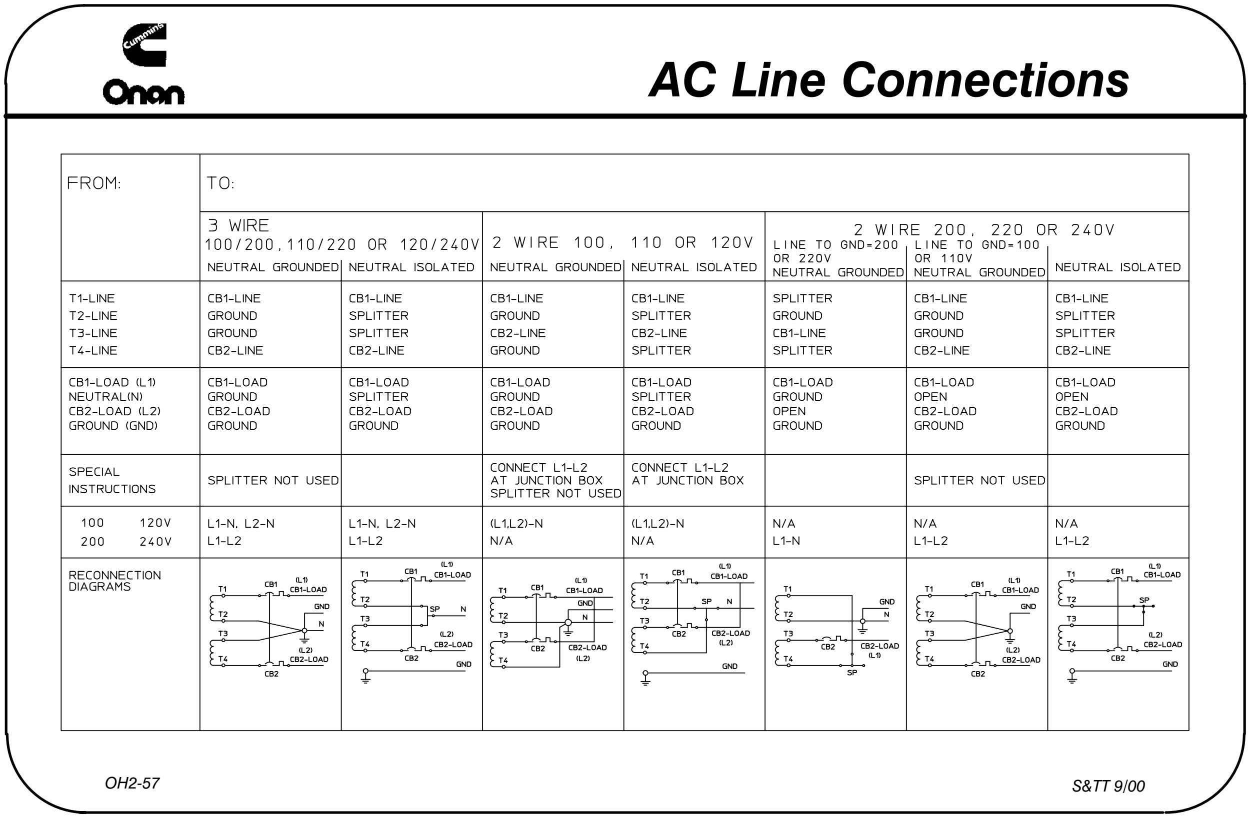
OH2-56

S&TT 9/00

Slide 2-56: MicroQuiet Remote Control

Onan offers three varieties of remote control panel:

- Remote start/stop switch with status indicator light only.
- Remote start/stop switch with status indicator light and hour meter.
- Remote start/stop switch with status indicator light and DC voltmeter.



AC Line Connections

FROM:	TO:						
	3 WIRE 100/200, 110/220 OR 120/240V		2 WIRE 100, 110 OR 120V		2 WIRE 200, 220 OR 240V		
	NEUTRAL GROUNDED	NEUTRAL ISOLATED	NEUTRAL GROUNDED	NEUTRAL ISOLATED	LINE TO GND=200 OR 220V NEUTRAL GROUNDED	LINE TO GND=100 OR 110V NEUTRAL GROUNDED	NEUTRAL ISOLATED
T1-LINE T2-LINE T3-LINE T4-LINE	CB1-LINE GROUND GROUND CB2-LINE	CB1-LINE SPLITTER SPLITTER CB2-LINE	CB1-LINE GROUND CB2-LINE GROUND	CB1-LINE SPLITTER CB2-LINE SPLITTER	SPLITTER GROUND CB1-LINE SPLITTER	CB1-LINE GROUND GROUND CB2-LINE	CB1-LINE SPLITTER SPLITTER CB2-LINE
CB1-LOAD (L1) NEUTRAL(N) CB2-LOAD (L2) GROUND (GND)	CB1-LOAD GROUND CB2-LOAD GROUND	CB1-LOAD SPLITTER CB2-LOAD GROUND	CB1-LOAD GROUND CB2-LOAD GROUND	CB1-LOAD SPLITTER CB2-LOAD GROUND	CB1-LOAD GROUND OPEN GROUND	CB1-LOAD OPEN CB2-LOAD GROUND	CB1-LOAD OPEN CB2-LOAD GROUND
SPECIAL INSTRUCTIONS	SPLITTER NOT USED		CONNECT L1-L2 AT JUNCTION BOX SPLITTER NOT USED	CONNECT L1-L2 AT JUNCTION BOX		SPLITTER NOT USED	
100 120V 200 240V	L1-N, L2-N L1-L2	L1-N, L2-N L1-L2	(L1,L2)-N N/A	(L1,L2)-N N/A	N/A L1-N	N/A L1-L2	N/A L1-L2
RECONNECTION DIAGRAMS							

OH2-57

S&TT 9/00

Slide 2-57: AC Line Connections

- Reconnects for series, parallel, or series/parallel for the required output voltage.
- Remove the control panel for access to the generator leads and circuit breaker terminals.
- Check voltage after reconnections and (50 Hz model only) adjust no-load voltage as necessary with the adjustment pot on the control panel.
- When the vehicle has provision for connecting utility power it must have an approved device to keep the GenSet and utility from being interconnected. See the *Service Manual* for connections.

⚠WARNING ***Interconnecting the GenSet and the public utility (or any other power source) can lead to the electrocution of personnel working on the utility lines, damage to equipment and fire. An approved switching device must be used to prevent interconnections.***

Start Mode

Slide 2-58: **Print 611-1267**

When the **S1** start/stop switch is pressed to the start position, current from the **BT1** battery flows to the **A1** control board and out to the **K1** starter relay. When energized, it closes its **N.O.** contacts allowing current to flow to the **B1** starter motor and the **K2** LP primer solenoid, if so equipped.

The **LED** status indicator light on the **S1** switch will flash rapidly while the GenSet is cranking.

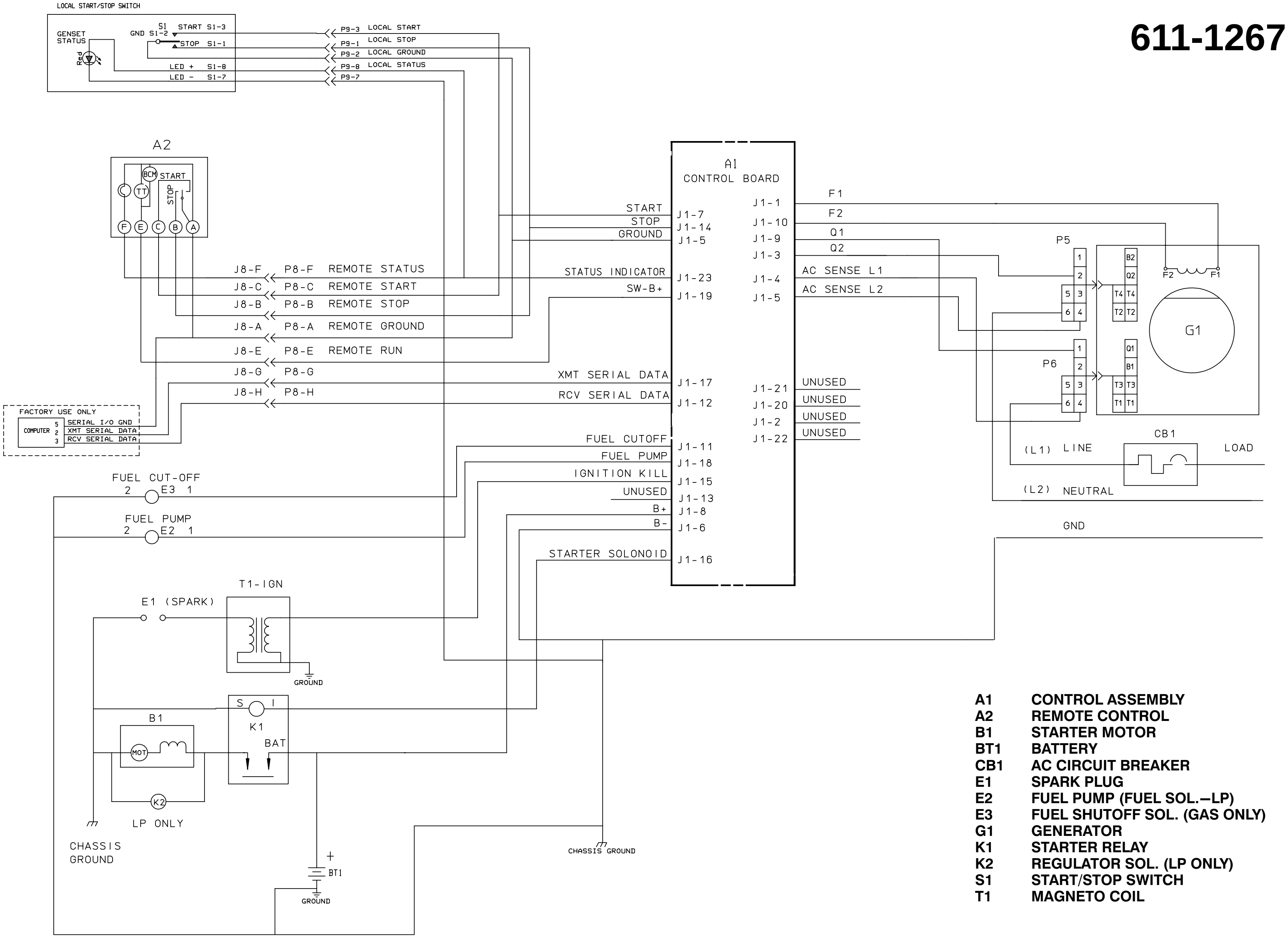
The control board will also supply battery current to the **E2** fuel pump (fuel solenoid on LP sets) and the **E3** fuel shutoff solenoid (gasoline sets only).

When the **A1** control is enabled, the ignition kill ground is removed from the **T1-IGN** coil. With the motor is cranking, voltage is produced by the **T1** ignition magneto coil to power the **E1** spark plug.

Initial excitation of the **G1** generator is accomplished by battery current flowing from the control board, then through the **F1/F2** field winding.

Values: **T1** ignition coil output = **20,000 VAC**.
E2 fuel pump = **$3^1/_2$ to 5 psi.**

611-1267



A1	**CONTROL ASSEMBLY**
A2	**REMOTE CONTROL**
B1	**STARTER MOTOR**
BT1	**BATTERY**
CB1	**AC CIRCUIT BREAKER**
E1	**SPARK PLUG**
E2	**FUEL PUMP (FUEL SOL.–LP)**
E3	**FUEL SHUTOFF SOL. (GAS ONLY)**
G1	**GENERATOR**
K1	**STARTER RELAY**
K2	**REGULATOR SOL. (LP ONLY)**
S1	**START/STOP SWITCH**
T1	**MAGNETO COIL**

Run Mode

Slide 2-59: **Print 611-1267**

As the engine is coming up to speed, AC voltage is being produced by the **G1** generator. Voltage from the generator will flow to the control board and at approximately 2000 rpm cause it to remove the output to the **K1** starter relay (and the **K2** LP fuel primer) deenergizing the **B1** starter motor.

The **LED** status indicator light on the **S1** switch will remain on as long as the GenSet is running.

It will also remove the initial **"field flash"** excitation to the **F1/F2** rotor of the **G1** generator.

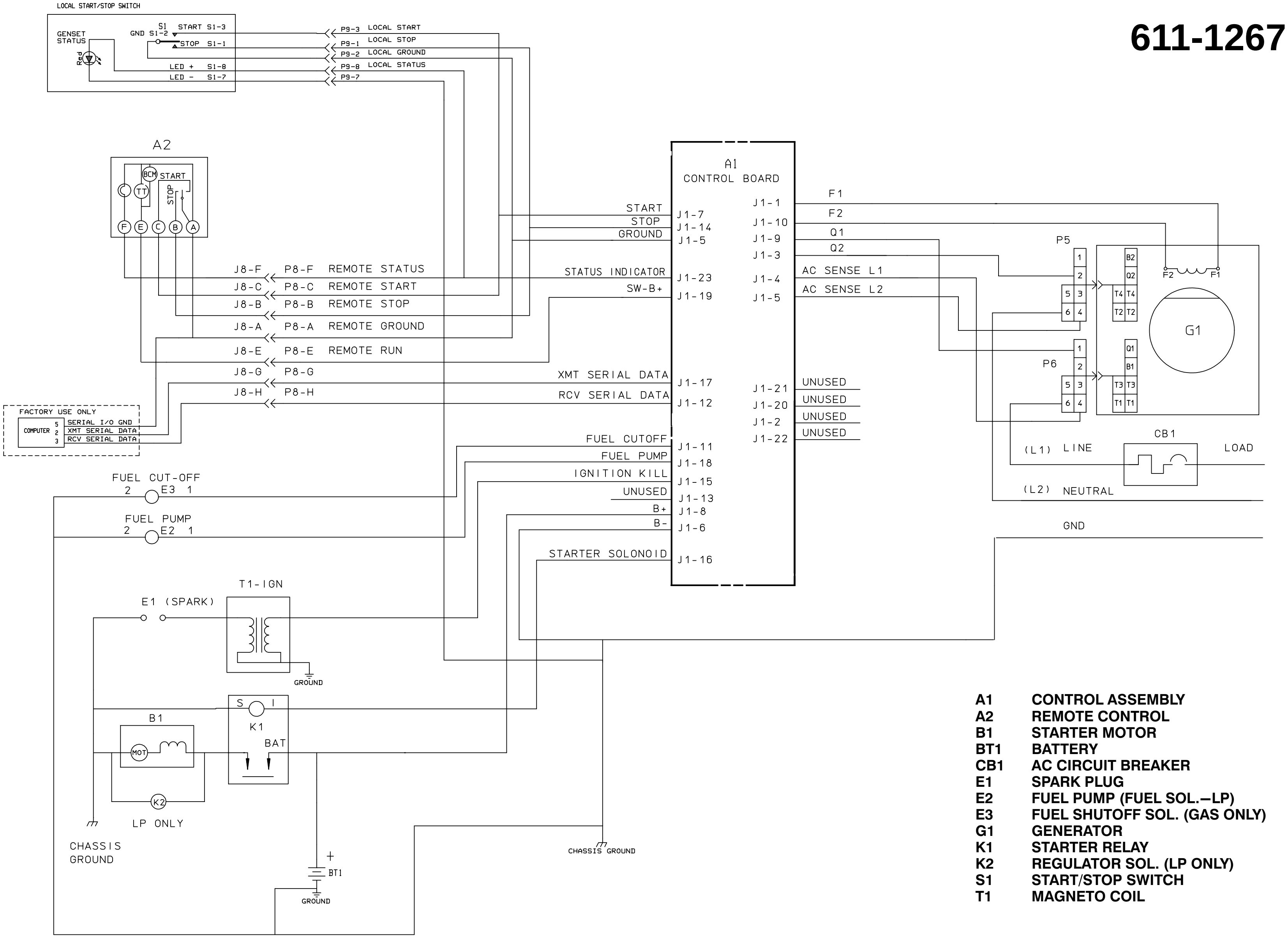
Generator output will go to the **L1/L2** load and to the control board as a sensing voltage.

Output from the **Q1/Q2** winding will go to the control board where it is converted into excitation voltage for the **F1/F2** field rotor.

Values: **T1/T2** winding voltage = **126-128 VAC.**
Q1/Q2 winding voltage = **130-150 VAC.**
F1/F2 field voltage = **40-100 VDC.**

OH2-59

611-1267



A1	**CONTROL ASSEMBLY**
A2	**REMOTE CONTROL**
B1	**STARTER MOTOR**
BT1	**BATTERY**
CB1	**AC CIRCUIT BREAKER**
E1	**SPARK PLUG**
E2	**FUEL PUMP (FUEL SOL.—LP)**
E3	**FUEL SHUTOFF SOL. (GAS ONLY)**
G1	**GENERATOR**
K1	**STARTER RELAY**
K2	**REGULATOR SOL. (LP ONLY)**
S1	**START/STOP SWITCH**
T1	**MAGNETO COIL**

S&TT 9/00

Stop Mode

Slide 2-60: **Print 611-1267**

When the **S1** start/stop switch is pressed to the stop position, an ignition kill ground signal is passed from the control to the **T1** ignition magneto stopping its operation.

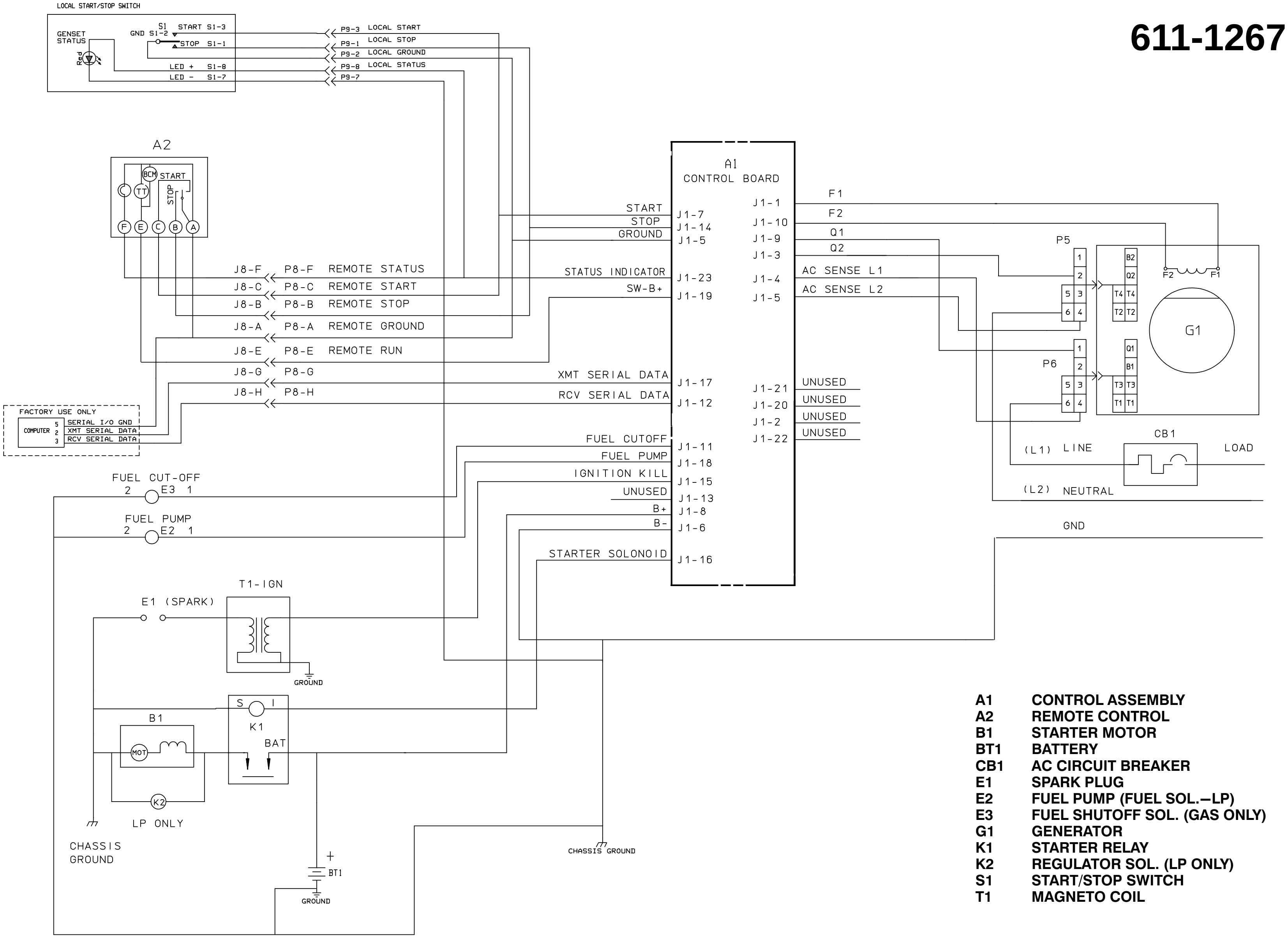
The output to the **E2** fuel pump (or LP fuel solenoid) and the **E3** fuel shutoff solenoid (gasoline sets only) is also removed.

Emergency Stop Mode

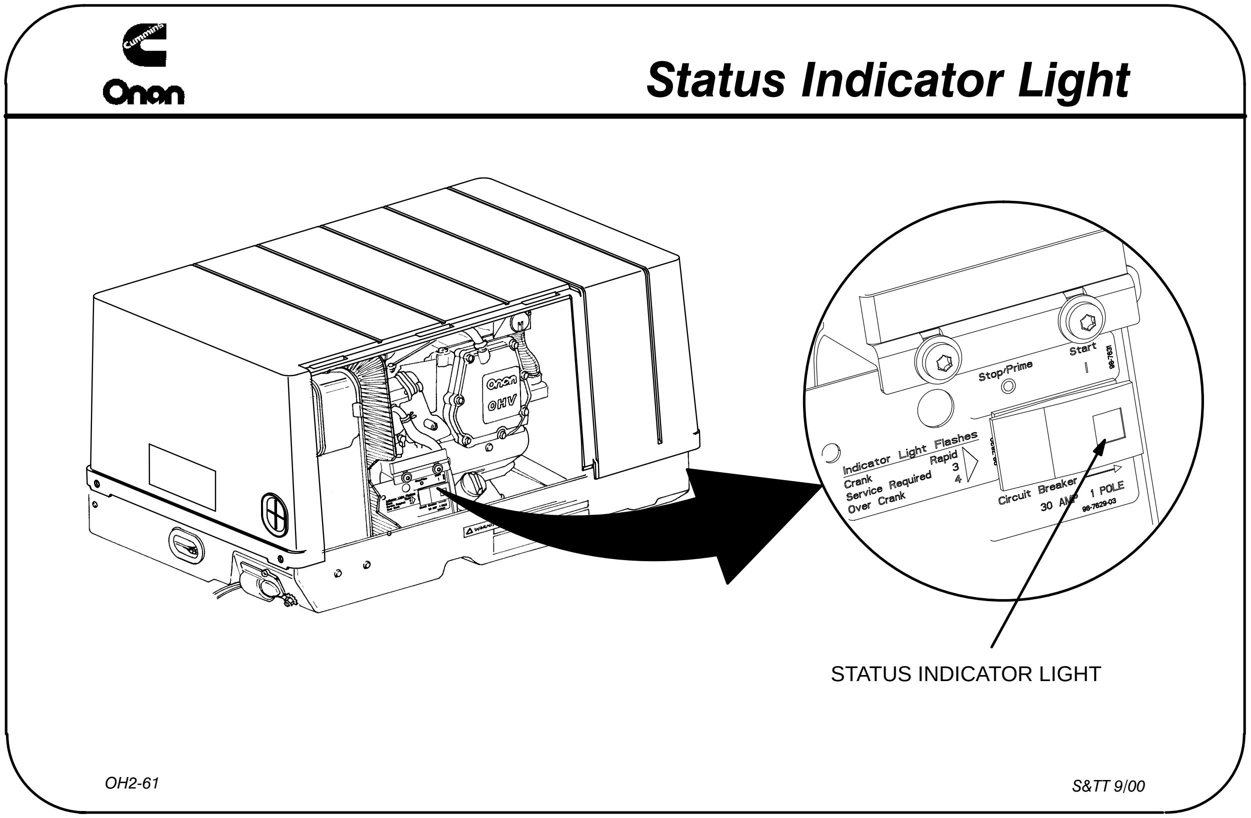
The GenSet will shutdown for any of the following faults:

Values: Overcrank = > 20 seconds
Low Crank Speed = < 180 RPM for more than 2 seconds
Overvoltage = > 150 VAC is instantaneous
or between 138 & 149 for over 3 seconds
Undervoltage = < 108 VAC for more than 7 seconds
Overfrequency = > 70 Hz is instantaneous
or between 66 & 69 Hz for over 3 seconds
Underfrequency = < 54 Hz for over 8 seconds
Overcurrent = Field voltage over 150 VDC for greater than 10 seconds
High Battery Volts = > 19 VDC

611-1267



A1	**CONTROL ASSEMBLY**
A2	**REMOTE CONTROL**
B1	**STARTER MOTOR**
BT1	**BATTERY**
CB1	**AC CIRCUIT BREAKER**
E1	**SPARK PLUG**
E2	**FUEL PUMP (FUEL SOL.–LP)**
E3	**FUEL SHUTOFF SOL. (GAS ONLY)**
G1	**GENERATOR**
K1	**STARTER RELAY**
K2	**REGULATOR SOL. (LP ONLY)**
S1	**START/STOP SWITCH**
T1	**MAGNETO COIL**



Status Indicator Light

STATUS INDICATOR LIGHT

OH2-61

S&TT 9/00

Slide 2-61: Status Indicator Light

Use to:

- Flashes during cranking.
- On steady during run.
- Flashes code during fault.

Troubleshooting

This lists the Fault Codes in numerical order along with step-by-step instructions for corrective action. If you fail to resolve the problem after taking the corrective actions suggested, contact an authorized Onan dealer.

First note the following:

- Maintaining engine oil level, keeping battery connections clean and tight, watching the fuel gauge, not overloading the GenSet, etc. will prevent most shutdowns.
- When the GenSet and vehicle engine share a common fuel tank the fuel dip tubes are usually arranged so that the GenSet will run out of fuel first. Marking the GenSet empty point on the fuel gauge will make it easier to tell when to stop the GenSet before running it out of fuel.

FAULT CODES

The GenSet controller provides extensive diagnostics by causing the status indicator light on the Control Switch to blink in a coded fashion. Following a fault shutdown, the indicator light will repeatedly blink 3 blinks or 4 blinks at a time.

- **Three blinks** indicates a service fault. Press **Stop** once to cause the two-digit, second-level fault code to blink. (Pressing **Stop** again will stop the blinking.) The two-digit code consists of 1, 2, 3 or 4 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the fault code number. For example, **Fault Code No. 36** appears as:

  blink-blink-blink—*pause*—blink-blink-blink-blink-blink-blink...

- **Four blinks** indicates that cranking exceeded 15 to 20 seconds without the engine starting.
- **Note: Fault Code Nos. 3 and 4 are first level faults. Avoid interpreting them as second-level Fault Code Nos. 33 and 44, which have not been assigned as fault codes.**

Restoring Fault Code Blinking – The fault code stops blinking after five minutes. Press **Stop** three times within five seconds to restore blinking. ***Note that the last fault logged will blink, even after the condition that caused the shutdown has been corrected.***

⚠ WARNING ***Some genset service procedures present hazards that can result in severe sonal injury or death. Only qualified service personnel with knowledge of fuels, electricity machinery hazards should perform genset service. See Safety Precautions.***

NO RESPONSE—STATUS INDICATOR LIGHT DEAD

(Faulty connections, no battery voltage)

Corrective Action:

1.. Try the genset Start Switch if the remote Start Switch does not work, and vice versa. If neither works, disconnect remote control panel connector J8/P8 and try the genset Start Switch again.
   A.. If nothing works, go to Step **2.**.
   B.. If only the genset start switch works, go to Step **5.**.
   C.. If only the remote start switch works, go to Step **7.**.
2.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.
3.. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
4.. Disconnect engine harness connector P1 from the controller and check for battery voltage between pin 8 (B+) and pin 6 (B–).
   A.. If there is no voltage, check for missing, bent or corroded connector pins, faulty wiring and loose engine harness B+ and chassis ground connections and [60 Hz] or and repair as necessary.
   B.. If there is voltage, hold the genset start switch in its Start position and then in its Stop position while checking for electrical continuity between pins 7 and 5 (start) and pins 14 and 5 (stop) on connector P1. Replace a switch that does not close in its start or stop position, or open when released. Check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.
   C.. Replace controller A1.
5.. Reconnect remote control panel connector J8/P8 and disconnect engine harness connector P1 from the controller. First hold the remote start switch in its Start position and then in its Stop position while checking for electrical continuity between pins 7 and 5 (start) and pins 14 and 5 (stop) on connector P1. Replace a switch that does not close in its start or stop position, or open when released. Check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.
6.. Replace controller A1.
7.. Disconnect engine harness connector P1 from the controller. First hold the genset start switch in its Start position and then in its Stop position while checking for electrical continuity between pins 7 and 5 (start) and pins 14 and 5 (stop) on connector P1. Replace a switch that does not close in its start or stop position, or open when released. Check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.
8.. Replace controller A1.

WARNING ***Some genset service procedures present hazards that can result in severe***
sonal injury or death. Only qualified service personnel with knowledge of fuels, electricity
machinery hazards should perform genset service. See Safety Precautions.

GENSET RUNS ON A FEW SECONDS AFTER STOP COMMAND

(Faulty ignition kill connection)

Corrective Action:

1.. Disconnect engine harness connector P1 from the controller and check for continuity to ground at pin 15. If the circuit is open, repair or reconnect the ignition kill lead to the magneto assembly.
2.. Replace controller A1.

STARTING BATTERIES RUN DOWN

(Marginal batteries, connections, or charging system or, parasitic loads)

Corrective Action:

1.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.
2.. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
3.. Have a battery charging system installed or serviced.

STARTER ENGAGES-DISENGAGES

(Cranking voltage dips below 6 volts—low battery charge, poor connections, long cables)

Corrective Action:

1.. Have the propulsion engine running while trying to start the genset—the battery charging alternator may be able to maintain starting voltage high enough to get the genset started.
2.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.
3.. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
4.. Increase battery cable size or run parallel cables.

NO POWER—GENSET RUNNING, STATUS LIGHT ON

(Line circuit breaker OFF, or tripped due to short circuit or overload)

Corrective Action:

1.. Turn on or reset the line circuit breaker on the genset.
2.. Turn on or reset the line circuit breakers on the main AC distribution panel.
3.. Check for and reconnect or repair faulty AC wiring connections inside the genset.
4.. Replace a faulty circuit breaker.
5.. Run fewer loads at the same time.

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

SERVICE CHECK FAULT—CODE NO. 3

(First-level fault code—Indicates fault with second-level fault code)

Corrective Action: Check the second-level fault code by pressing **STOP** once. The second-level fault code will have two-digits. The faults are listed in numerical order in this table.

OVERCRANK FAULT—CODE NO. 4

(First-level fault code—Cranking exceeded 20 seconds without engine starting)

Corrective Action for Gasoline Gensets:

1.. Check for fuel and fill the fuel tank as necessary. (Note: The genset fuel pickup is probably higher in the fuel tank than the propulsion engine pickup.)
2.. Prime the engine fuel system by holding the control switch at **Stop/Prime** for 30 seconds. If the fuel pump doesn't function, go to Step 10..
3.. Open any closed fuel valves.
4.. Secure the spark plug lead on the spark plug.
5.. Remove the spark plug and conduct the ignition system tests.
6.. Service the air cleaner.
7.. Replace the fuel filter.
8.. Check for and replace contaminated fuel.
9.. Replace fuel shutoff solenoid E3 if it does not click (open) when B+ is applied.
10.. Conduct the fuel pump tests.
11.. Check for binding governor linkage and readjust and repair as necessary.
12.. Check and readjust the choke assembly as necessary.
13.. Conduct the engine leak down test and service the engine as necessary.
14.. Replace the carburetor.

Corrective Action for LPG Gensets:

1.. Check for fuel and fill the fuel tank as necessary. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will no vaporize in ambients below 32° F (0° C). Use HD-5 grade LPG.
2.. Open any closed fuel valves.
3.. Secure the spark plug lead on the spark plug.
4.. Remove the spark plug and conduct the ignition system tests.
5.. Service the air cleaner.
6.. Readjust the automatic priming solenoid as necessary.
7.. Check the fuel-shutoff solenoid (E2) and replace it if necessary.
8.. Check LPG regulator lock-off pressure and its automatic priming solenoid function and replace the demand pressure regulator if necessary.
9.. Check for binding governor linkage and readjust and repair as necessary.
10.. Conduct the engine leak down test and service the engine as necessary.

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

OVERVOLTAGE FAULT—CODE NO. 12

(Controller unable to maintain rated voltage)

Corrective Action:

1.. Service the brushes and slip rings as necessary.
2.. Replace controller A1.

UNDERVOLTAGE FAULT—CODE NO. 13

(Controller unable to maintain rated voltage)

Corrective Action:

1.. Reduce the number of connected appliances, especially when air conditioners and battery chargers are running.
2.. Service the brushes and slip rings as necessary and test the generator field, stator and quadrature windings for opens or shorts. Replace a rotor or stator with faulty windings.
3.. Replace controller A1.

OVERFREQUENCY FAULT—CODE NO. 14

(Engine governor unable to maintain rated frequency)

Corrective Action: Readjust and repair the governor as necessary.

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

UNDERFREQUENCY FAULT—CODE NO. 15

(Engine governor unable to maintain rated frequency)

Corrective Action for Gasoline Gensets: Turn the genset line circuit breaker off. If the genset runs without shutting down, reduce the number of connected appliances, especially when air conditioners and battery chargers are running. If not:

1.. Service the air cleaner.
2.. Check for and repair a blocked exhaust system.
3.. Replace the fuel filter.
4.. Check for and replace contaminated fuel.
5.. Conduct the fuel pump tests.
6.. Check for binding governor linkage and readjust and repair as necessary.
7.. Check and readjust the choke assembly as necessary.
8.. Check for and replace leaking carburetor and intake manifold gaskets.
9.. Readjust valve lash.
10.. Conduct the engine leak down test and service the engine as necessary.
11.. Replace the carburetor.
12.. Replace controller A1.

Corrective Action for LPG Gensets: Turn the genset line circuit breaker off. If the genset runs without shutting down, reduce the number of connected appliances, especially when air conditioners and battery chargers are running. If not:

1.. Check for fuel and fill the fuel tank as necessary. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will no vaporize in ambients below 32° F (0° C). Use HD-5 grade LPG.
2.. Service the air cleaner.
3.. Check for and repair a blocked exhaust system.
4.. Check for binding governor linkage and readjust and repair as necessary.
5.. Check for and replace leaking carburetor and intake manifold gaskets.
6.. Check LPG regulator lock-off pressure and its automatic priming solenoid function and replace the demand pressure regulator if necessary.
7.. Readjust valve lash.
8.. Conduct the engine leak down test and service the engine as necessary.
9.. Replace the carburetor.
10.. Replace controller A1.

VOLTAGE SENSE FAULT—CODE NO. 27

(Controller unable to sense output voltage)

Corrective Action:

1.. Check AC sense circuitry and 60 Hz] or and [50 Hz]). On 50 Hz and 100V, 60 Hz gensets, check and repair transformer T2 and voltage trim potentiometer R5 as necessary.
2.. Replace controller A1.

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

HIGH BATTERY VOLTAGE FAULT—CODE NO. 29

(Voltage across battery system greater than 19 volts)

Corrective Action:

1.. Check battery bank connections and reconnect if necessary so that the 12 volt batteries serving the genset are connected in parallel (12 volt) rather than in series (24 volt).
2.. Select a lower battery boost charge rate.

LOW CRANKING SPEED FAULT—CODE NO. 32

(Cranking speed less than 180 rpm for more than 2 seconds)

Corrective Action (When engine does not crank or appears to crank slowly):

1.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.
2.. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
3.. Replace engine oil with oil of proper viscosity for ambient temperatures. (High oil viscosity can slow down cranking speed.)
4.. Check for and repair or replace a faulty starter or starter solenoid.

Corrective Action (When engine appears to crank normally):

1.. Service the brushes and slip rings as necessary and test the generator field and quadrature windings for opens or shorts. Replace a rotor or stator with faulty windings. (The quadrature windings provide the speed sense signal).
2.. Replace controller A1.

CONTROL CARD FAILURE FAULT—CODE NO. 35

(Microprocessor EEPROM error during self-test)

Corrective Action: Replace controller A1.

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

ENGINE STOPPED FAULT—CODE NO. 36

(Engine stopped without command by controller)

Corrective Action for Gasoline Gensets:

1.. Check for fuel and fill the fuel tank as necessary. (Note: The genset fuel pickup is probably higher in the fuel tank than the propulsion engine pickup.)
2.. Secure the spark plug lead on the spark plug.
3.. Check for and repair mechanical damage.
4.. Check for and repair a blocked exhaust system.
5.. Service the air cleaner.
6.. Replace the spark plug and conduct the ignition system tests.
7.. Check for and remove cooling air flow restrictions (higher temperatures can cause fuel vapor lock).
8.. Replace the fuel filter.
9.. Replace fuel shutoff solenoid E3 if it does not click (open) when B+ is applied.
10.. Conduct the fuel pump tests.
11.. Check for binding governor linkage and readjust and repair as necessary.
12.. Service the brushes and slip rings as necessary and test the generator field and quadrature windings for opens or shorts. Replace a rotor or stator with faulty windings. (The quadrature windings provide the speed sense signal).
13.. Replace controller A1.

Corrective Action for LPG Gensets:

1.. Check for fuel and fill the fuel tank as necessary. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will no vaporize in ambients below 32° F (0° C). Use HD-5 grade LPG.
2.. Secure the spark plug lead on the spark plug.
3.. Check for and repair mechanical damage.
4.. Check for and repair a blocked exhaust system.
5.. Service the air cleaner.
6.. Replace the spark plug and conduct the ignition system tests.
7.. Check the fuel-shutoff solenoid (E2) and replace it if necessary.
8.. Check LPG regulator lock-off pressure and its automatic priming solenoid function and replace the demand pressure regulator if necessary.
9.. Check for binding governor linkage and readjust and repair as necessary.
10.. Service the brushes and slip rings as necessary and test the generator field and quadrature windings for opens or shorts. Replace a rotor or stator with faulty windings. (The quadrature windings provide the speed sense signal).
11.. Replace controller A1.

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

INVALID GENSET CONFIGURATION FAULT—CODE NO. 37

(Genset configuration is preprogrammed at the factory)

Corrective Action: Replace controller A1.

FIELD OVERLOAD FAULT—CODE NO. 38

(Low power factor loads)

Corrective Action:

1.. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2.. Have air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause very low power factor.)

GENERATOR ROTOR FAULT—CODE NO. 41

(Controller unable to sense field voltage)

Corrective Action:

1.. Service the brushes and slip rings as necessary and test the generator field windings for opens or shorts. Replace a rotor with faulty windings.
2.. Replace controller A1.

PROCESSOR FAULT—CODE NO. 42

(Microprocessor ROM error during self-test)

Corrective Action: Replace controller A1

PROCESSOR FAULT—CODE NO. 43

(Microprocessor RAM error during self-test)

Corrective Action: Replace controller A1.

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

SPEED SENSE FAULT—CODE NO. 45

(Controller unable to sense quadrature frequency)

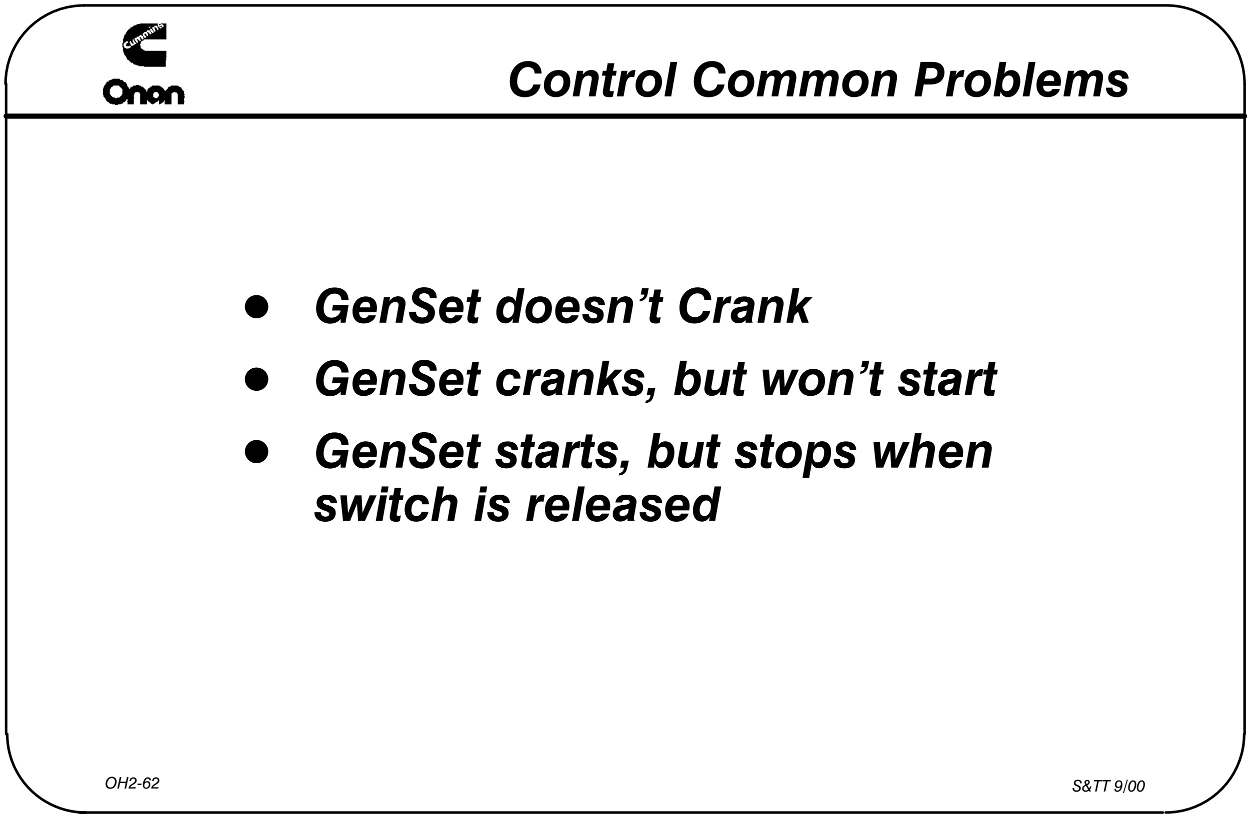
Corrective Action:

1.. Service the brushes and slip rings as necessary and test the generator field and quadrature windings for opens or shorts. Replace a rotor or stator with faulty windings. (The quadrature windings provide the speed sense signal).
2.. Replace controller A1.

GENERATOR FIELD SENSE FAULT—CODE NO. 48

(Controller unable to sense field voltage)

Corrective Action: Replace controller A1



Control Common Problems

- GenSet doesn’t Crank
- GenSet cranks, but won’t start
- GenSet starts, but stops when switch is released

OH2-62

S&TT 9/00

Slide 2-62: Control Common Problems

GenSet doesn’t crank:

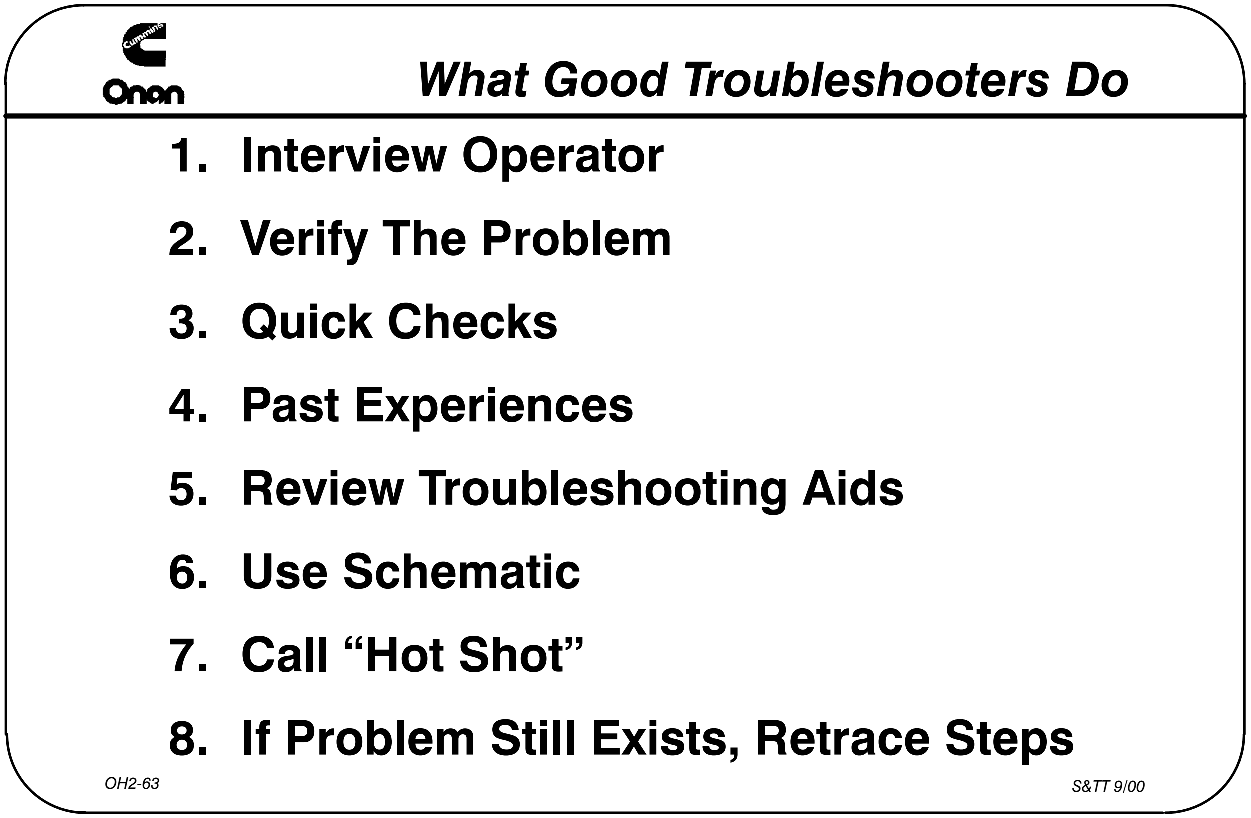
- Check control fuses.
- Check starting ability both at set and remote.
- Check battery and cables.
- Check starter solenoid and motor.

GenSet cranks, but won’t start:

- Check fuel circuit.
- Check ignition circuit.

GenSet starts, but stops when switch is released:

- Check oil level and level switch (KV).
- Check field flash circuit.
- Check rotor and stator for opens, shorts, and grounds.
- Check control.
- Check voltage regulator.



What Good Troubleshooters Do

1. Interview Operator
2. Verify The Problem
3. Quick Checks
4. Past Experiences
5. Review Troubleshooting Aids
6. Use Schematic
7. Call “Hot Shot”
8. If Problem Still Exists, Retrace Steps

OH2-63

S&TT 9/00

Slide 2-63: What Good Troubleshooters Do

1. Interview Operator
   - Witness
   - Points to trouble area
2. Verify the Problem
   - First hand experience
3. Quick Checks
   - Fuse
   - Connectors
   - Oil level
4. Experience
   - “Last time this happened”
5. Review Troubleshooting Aids
   - PSBs
   - Flow chart
   - “If/then” chart
6. Use Schematic
   - “Split half search”
7. Call “Hot Shot”
8. If Still Problem, Retrace Steps

7.5/8.0 Quiet Diesel GenSet Overview

This lesson presents an overview of the QD generator set.

Objectives

After completing this lesson, you should be able to:

- Identify the main features of the QD GenSet.
- Locate the QD GenSet model tag.
- Decipher the model identification.
- Decipher the GenSet serial number.

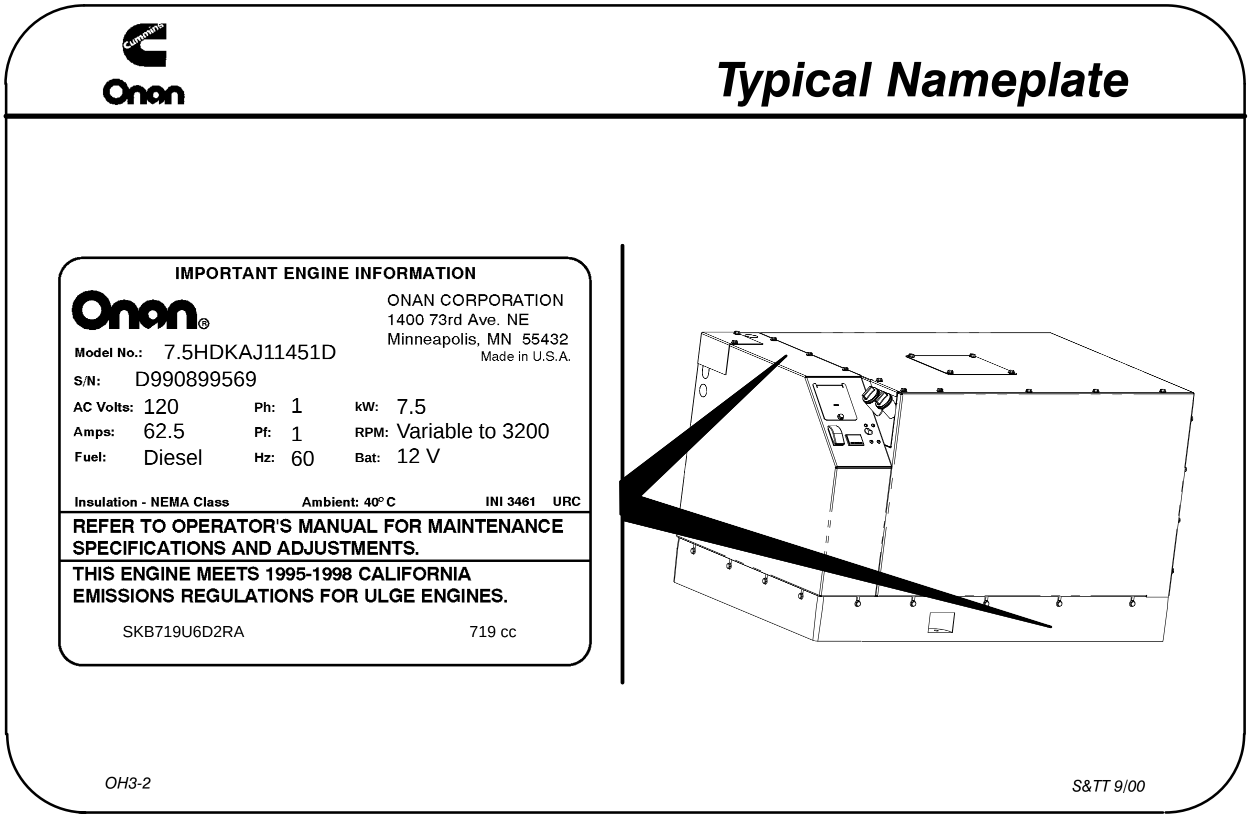
QD GenSet

OH3-1

S&TT 9/00

Slide 3-1: QD GenSet

- Two models: 7.5 kw **HDKAJ** and 8 kw **HDKAK**.
- C.A.R.B. certified Kubota 3 cylinder engine.
- Onan’s YZ brushless permanent magnet revolving field generator.
- Variable speed electronic governor.
- Digital voltage regulation with microprocessor control.
- It incorporates its own service diagnostics.



Typical Nameplate

IMPORTANT ENGINE INFORMATION

Onan®

ONAN CORPORATION
1400 73rd Ave. NE
Minneapolis, MN 55432
Made in U.S.A.

Model No.: 7.5HDKAJ11451D
S/N: D990899569

AC Volts:	120	**Ph:**	1	**kW:**	7.5
Amps:	62.5	**Pf:**	1	**RPM:**	Variable to 3200
Fuel:	Diesel	**Hz:**	60	**Bat:**	12 V

Insulation - NEMA Class **Ambient: 40° C** **INI 3461 URC**

REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.

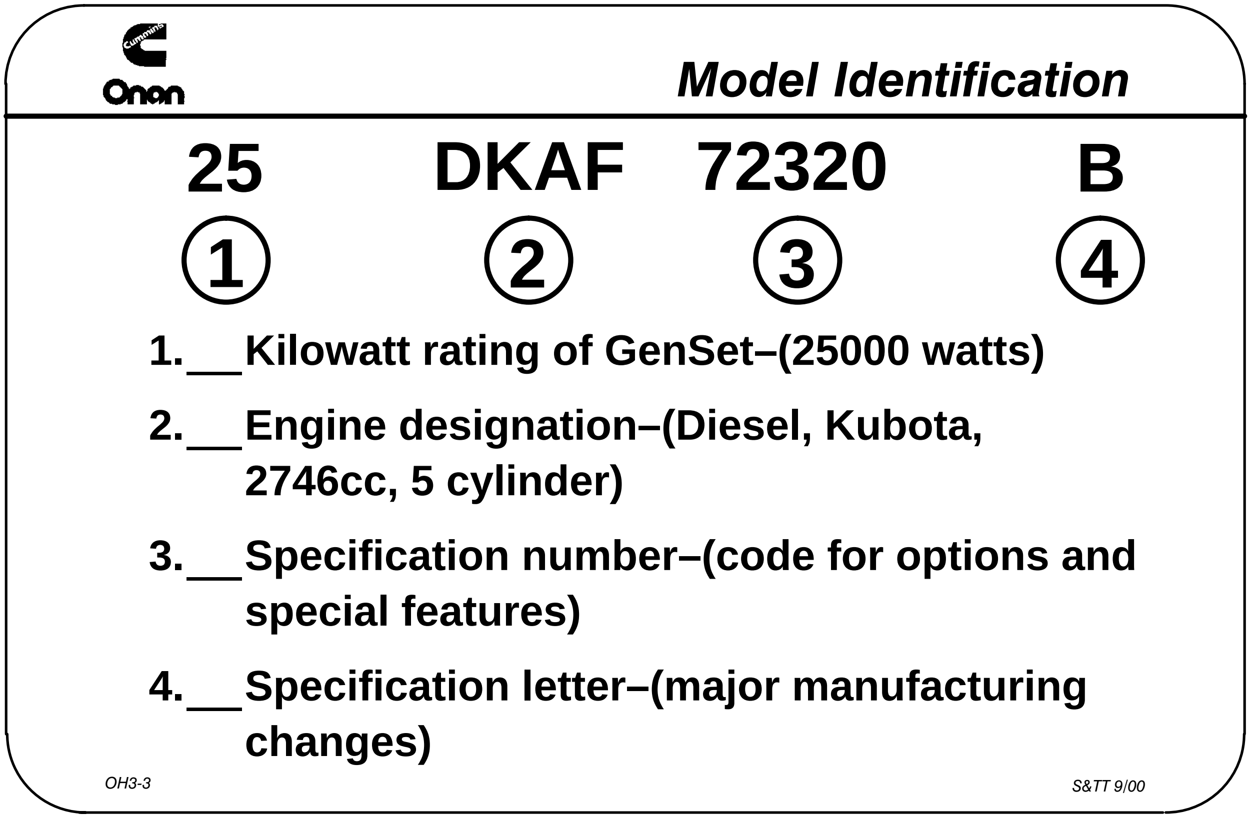
THIS ENGINE MEETS 1995-1998 CALIFORNIA EMISSIONS REGULATIONS FOR ULGE ENGINES.

SKB719U6D2RA 719 cc

OH3-2 *S&TT 9/00*

Slide 3-2: Typical Nameplate

- Ordering parts
- Acquiring literature
- Communicating with the distributor or factory



Model Identification

25 DKAF 72320 B

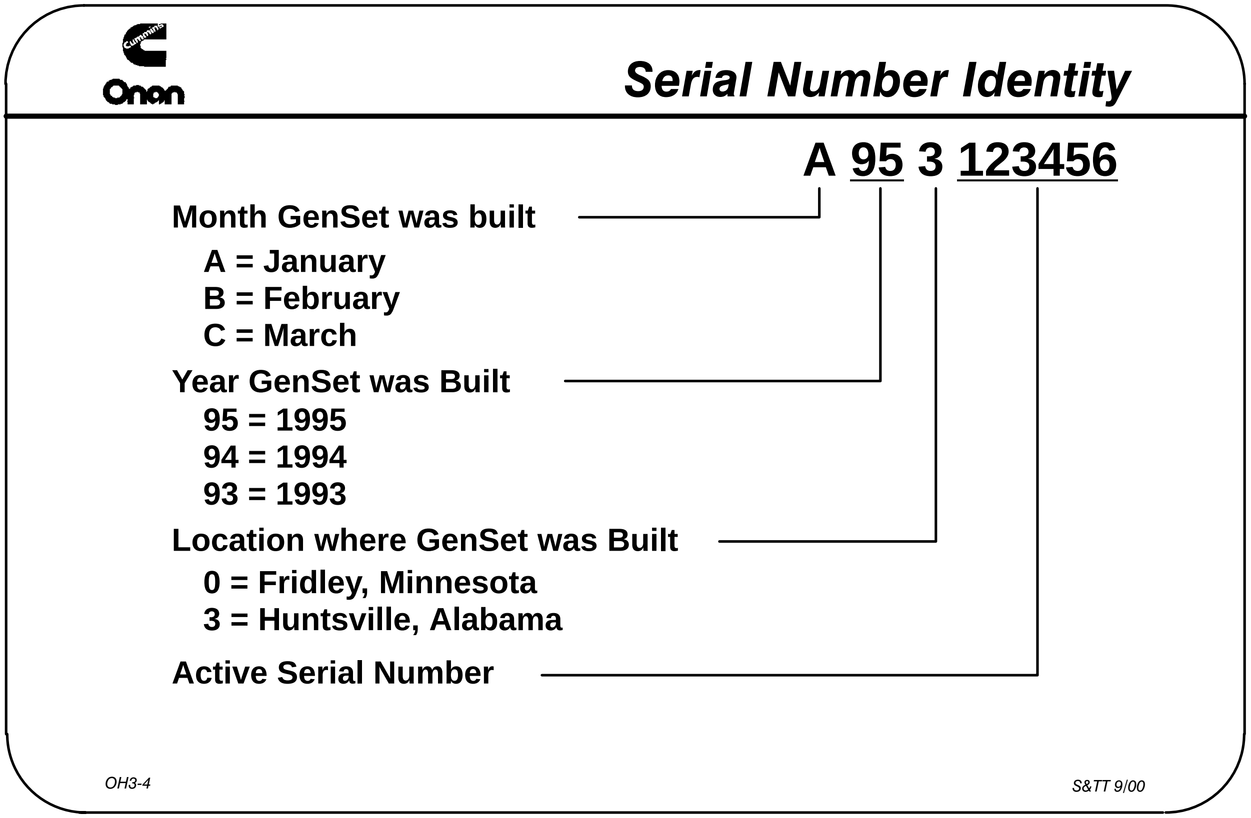
① ② ③ ④

1. __Kilowatt rating of GenSet–(25000 watts)
2. __Engine designation–(Diesel, Kubota, 2746cc, 5 cylinder)
3. __Specification number–(code for options and special features)
4. __Specification letter–(major manufacturing changes)

OH3-3 *S&TT 9/00*

Slide 3-3: Model Identification

- Kilowatt rating
- Engine model
- Options and special features
- Manufacturing changes



Serial Number Identity

A 95 3 123456

Month GenSet was built

A = January
B = February
C = March

Year GenSet was Built

95 = 1995
94 = 1994
93 = 1993

Location where GenSet was Built

0 = Fridley, Minnesota
3 = Huntsville, Alabama

Active Serial Number

OH3-4

S&TT 9/00

Slide 3-4: Serial Number Identity

- Found on the ID tag
- When unit was manufactured
- Where unit was manufactured
- Number is stamped on the engine block. It can be used to obtain model identification if the tag is missing by calling the distributor and giving them this number.

Activity

Slide 3-5:

Directions: Identify the following using the nameplate below:

Year GenSet was built:______________________________

Month GenSet was built:____________________________

Specification letter:________________________________

Specification number:______________________________

Kilowatt rating:____________________________________

Starting battery voltage:____________________________

Output voltage:____________________________________

Output amps:______________________________________

Power factor: ____________________________________

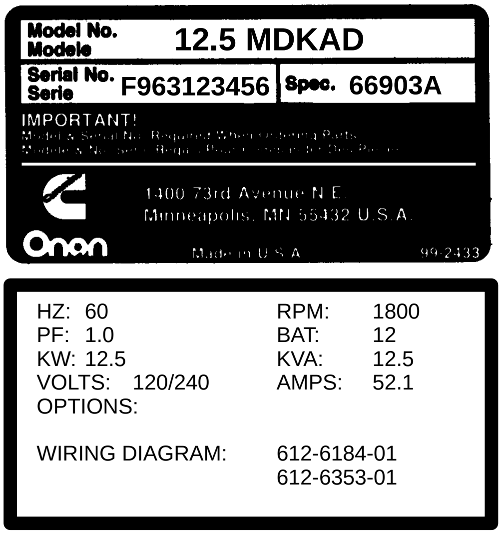
Actual serial number:_______________________________

Frequency output:__________________________________

Engine family:_____________________________________

Location where GenSet was built:___________________

NAMEPLATE WITH TYPICAL MODEL AND SERIAL NUMBER DATA



Model No.
Modele 12.5 MDKAD

Serial No.
Serie F963123456

Spec. 66903A

IMPORTANT!
Model & Serial No. Required When Ordering Parts
Modele & No. serie Requis Pour Commander Des Pieces

1400 73rd Avenue N.E.
Minneapolis, MN 55432 U.S.A.

Onan

Made in U.S.A. 99-2433

HZ: 60
PF: 1.0
KW: 12.5
VOLTS: 120/240
OPTIONS:

RPM: 1800
BAT: 12
KVA: 12.5
AMPS: 52.1

WIRING DIAGRAM: 612-6184-01
612-6353-01

OH3-5 S&TT 9/00

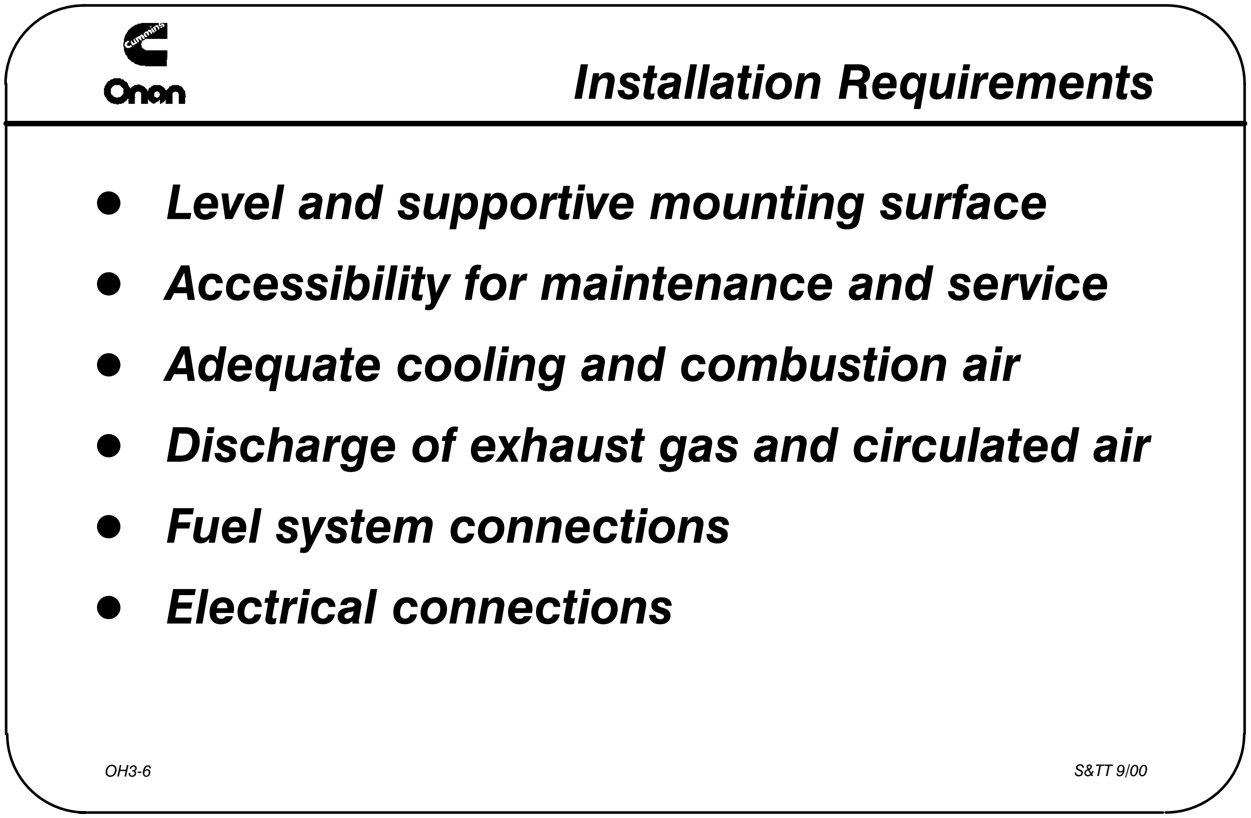
QD GenSet Installation

This lesson presents the steps needed to complete a correct and safe installation of an QD generator set.

Objectives

After completing this lesson, you should be able to:

- Identify the requirements to consider prior to installation of an QD GenSet.
- Make all applicable exhaust, fuel and battery connections.
- Connect a load bank and start the GenSet.
- Plot a no-load to full-load power curve.



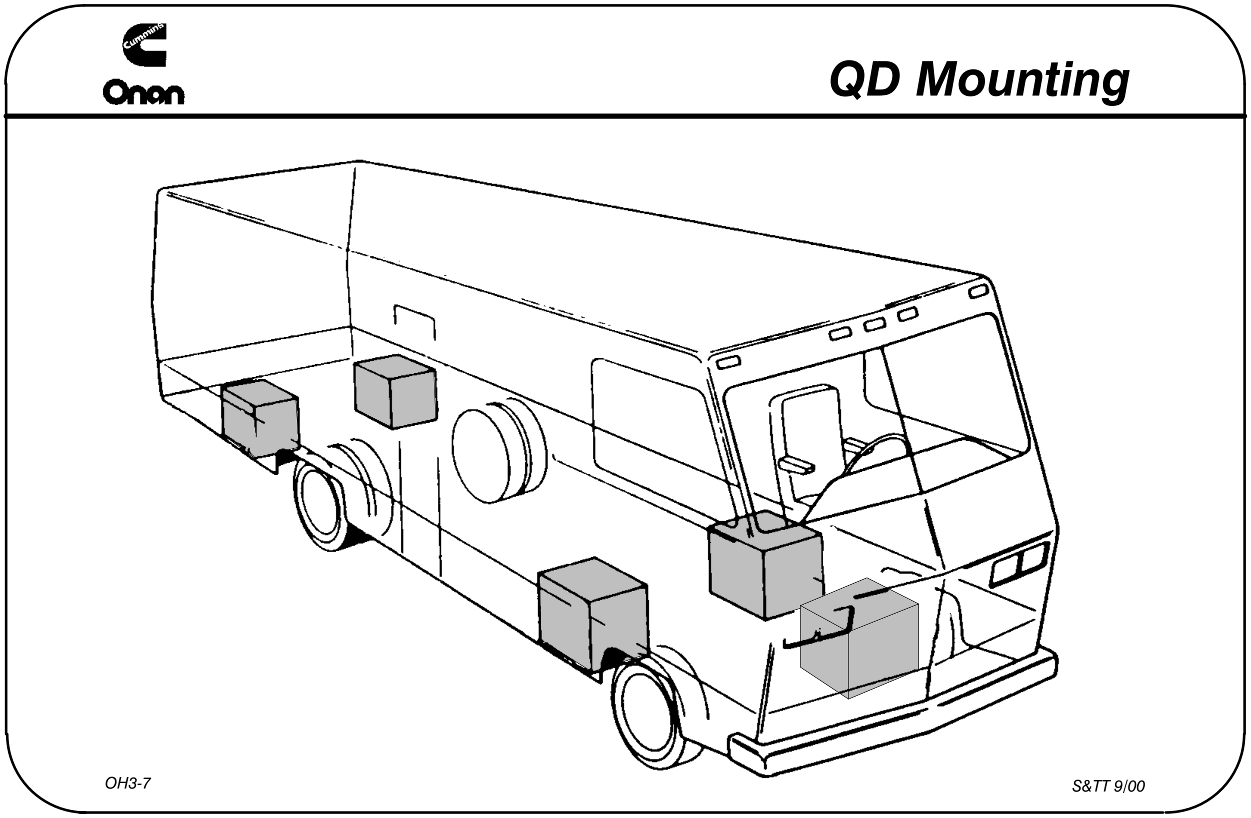
Installation Requirements

- Level and supportive mounting surface
- Accessibility for maintenance and service
- Adequate cooling and combustion air
- Discharge of exhaust gas and circulated air
- Fuel system connections
- Electrical connections

OH3-6

S&TT 9/00

Slide 3-6: Installation Requirements



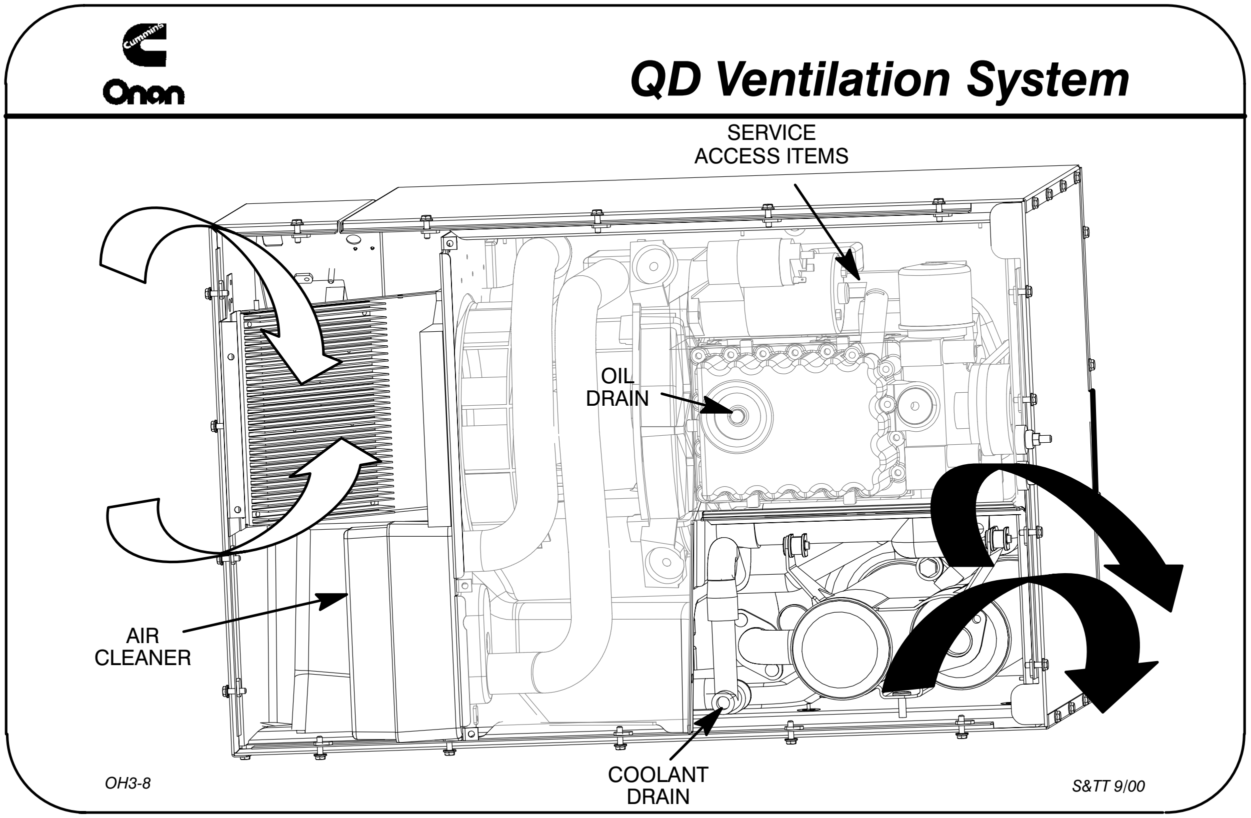
QD Mounting

OH3-7

S&TT 9/00

Slide 3-7: QD Mounting

- Orient the GenSet so that the operator's console is outboard
- Provide sufficient clearance for access to service items
- To reduce the transmission of vibration and noise, there should be a slight clearance all around the GenSet housing
- Make sure other vehicle components that may be located below the GenSet will not obstruct the service points on the GenSet
- The GenSet should be protected from direct road splash if it is located behind a road wheel
- There must be a vapor-tight, fire-resistive barrier between the GenSet and the interior of the vehicle.



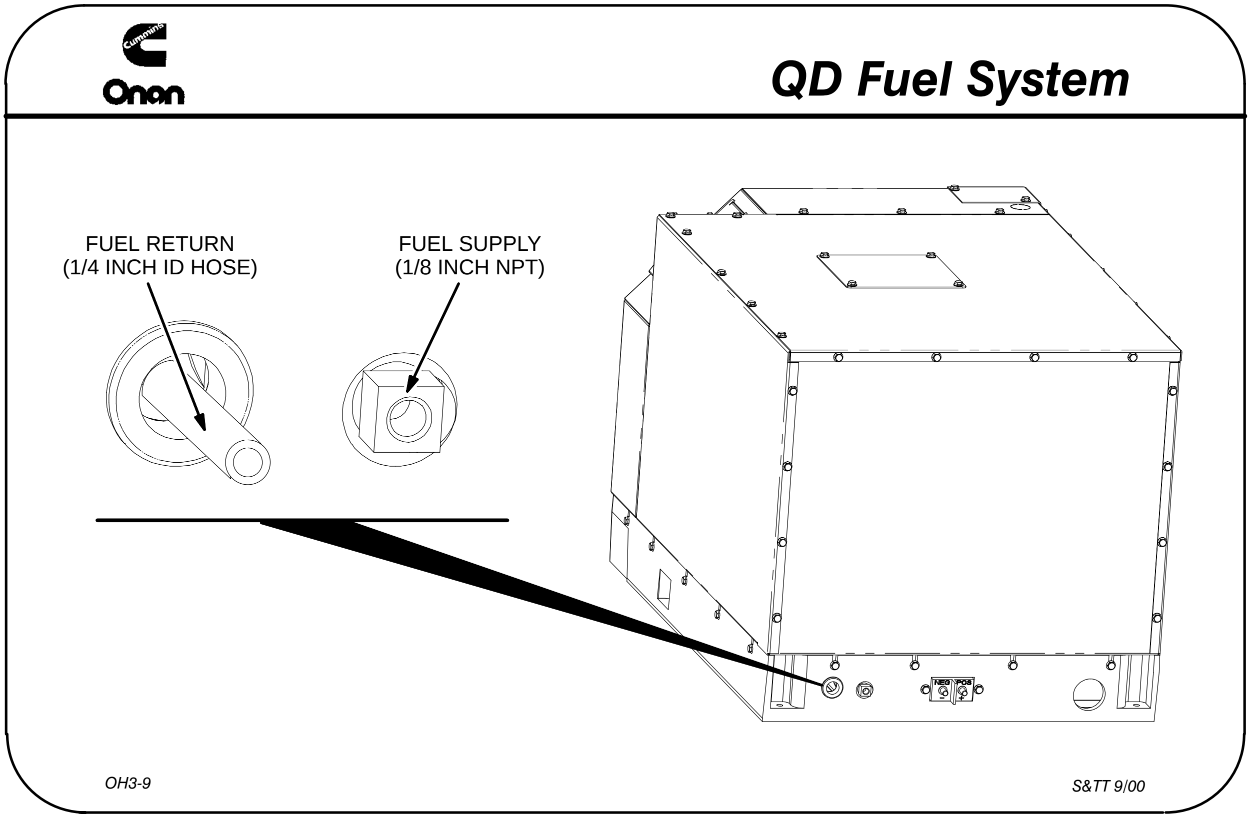
QD Ventilation System

OH3-8

S&TT 9/00

Slide 3-8: QD Ventilation System

- Air for combustion, cooling, and exhaust all enter and exit the GenSet through the bottom.
- The GenSet radiator and the intake air cleaner are mounted in the cooling air inlet.
- The muffler is mounted inside the GenSet housing.
- Do not route the tailpipe such that it will interfere with opening the maintenance door or draining engine oil or coolant or restrict the air inlet.



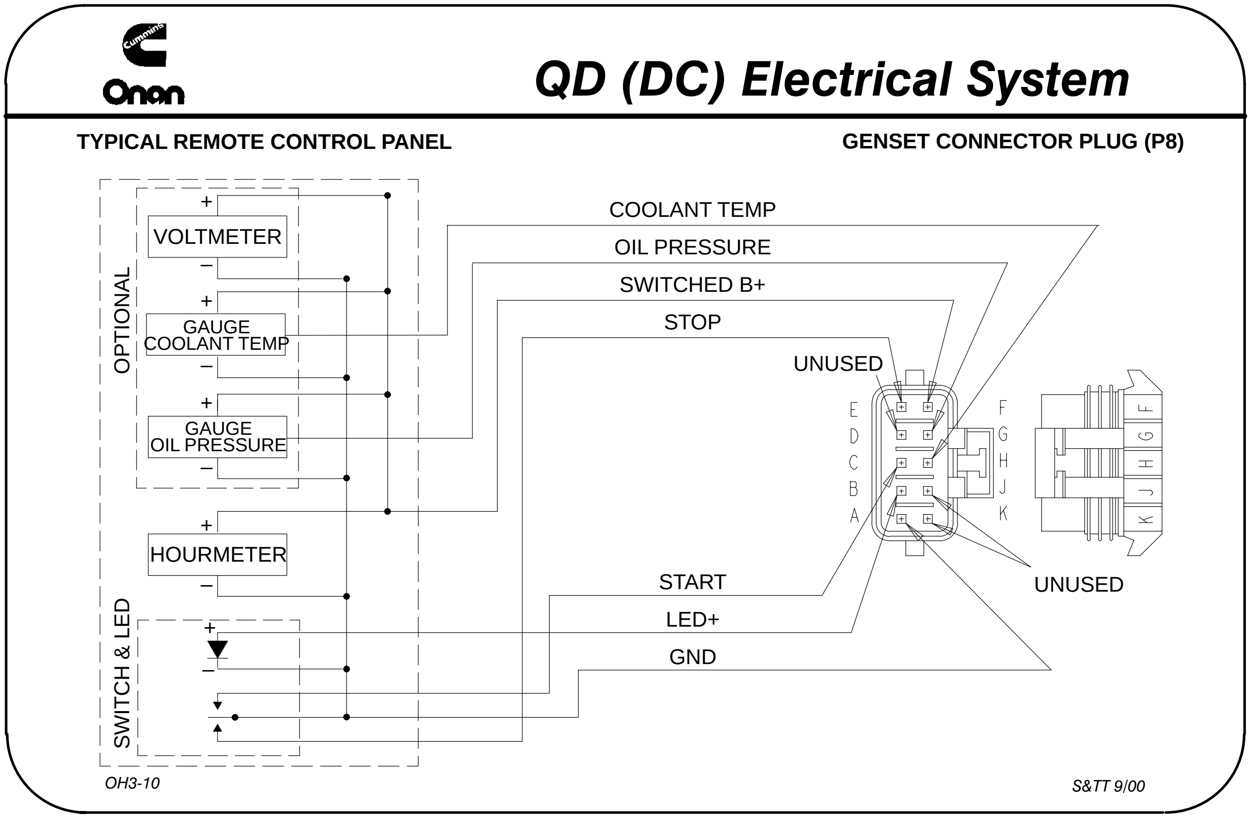
QD Fuel System

OH3-9

S&TT 9/00

Slide 3-9: QD Fuel System

- Use a separate fuel pickup tube, do not “Tee” into vehicle fuel system.
- Install an in-line manual fuel shutoff valve for set service or removal.
- Never use galvanized or copper fuel lines, fittings or tanks.
- Install an approved flexible non-metallic, non-organic fuel line between set and supply.
- Keep electrical and fuel lines as far apart as possible, do not tie together.



QD (DC) Electrical System

TYPICAL REMOTE CONTROL PANEL

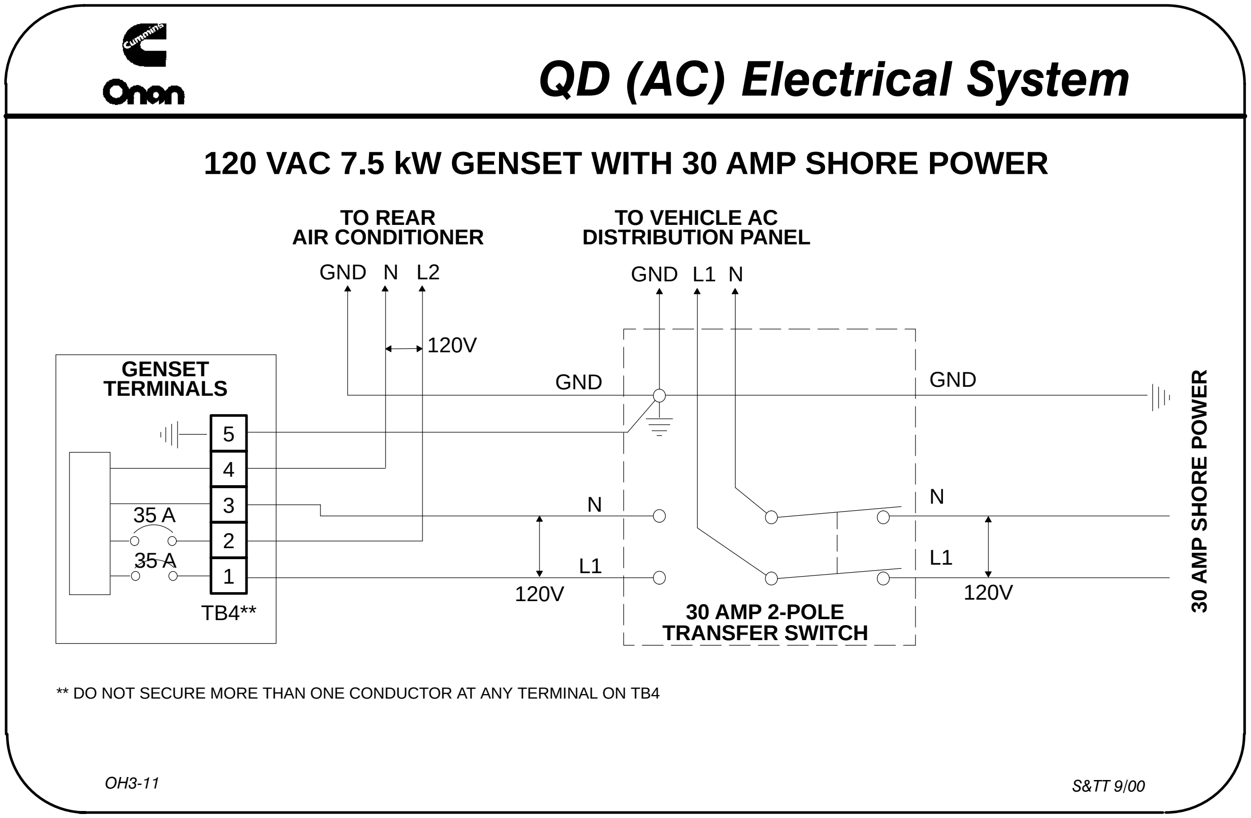
GENSET CONNECTOR PLUG (P8)

OH3-10

S&TT 9/00

Slide 3-10: QD (DC) Electrical System

- Route control leads separately from AC power leads and fuel lines.
- Seal the conduit where the leads enter the interior of the vehicle with silicone rubber to keep out exhaust gas.
- Batteries must be mounted in a separate compartment from that of the GenSet and away from spark-producing equipment.
- It is not recommended that the vehicle chassis frame be used as a path to the battery negative (–).



QD (AC) Electrical System

120 VAC 7.5 kW GENSET WITH 30 AMP SHORE POWER

** DO NOT SECURE MORE THAN ONE CONDUCTOR AT ANY TERMINAL ON TB4

OH3-11

S&TT 9/00

Slide 3-11: QD (AC) Electrical System

- All AC wiring should be inspected by a qualified electrician.
- Ground fault circuit interrupters (GFCIs) should be used for all branch circuits with convenience power receptacles.
- Seal all conduit holes entering the vehicle living area with silicone caulk.
- AC wiring, remote control wiring and fuel lines should all be routed separately.
- When the vehicle has provision for connecting utility power it must have an approved device to keep the GenSet and utility from being interconnected.

Activity

Directions: Setup the GenSet to run and document the performance by plotting a power curve.

Follow these steps:

1. Check the GenSet oil level.

   ☐ Oil level

2. Connect the GenSet exhaust, fuel, and battery.

   ☐ Exhaust
   ☐ Fuel
   ☐ Battery

3. Connect the appropriately sized load bank.

   ☐ Load bank

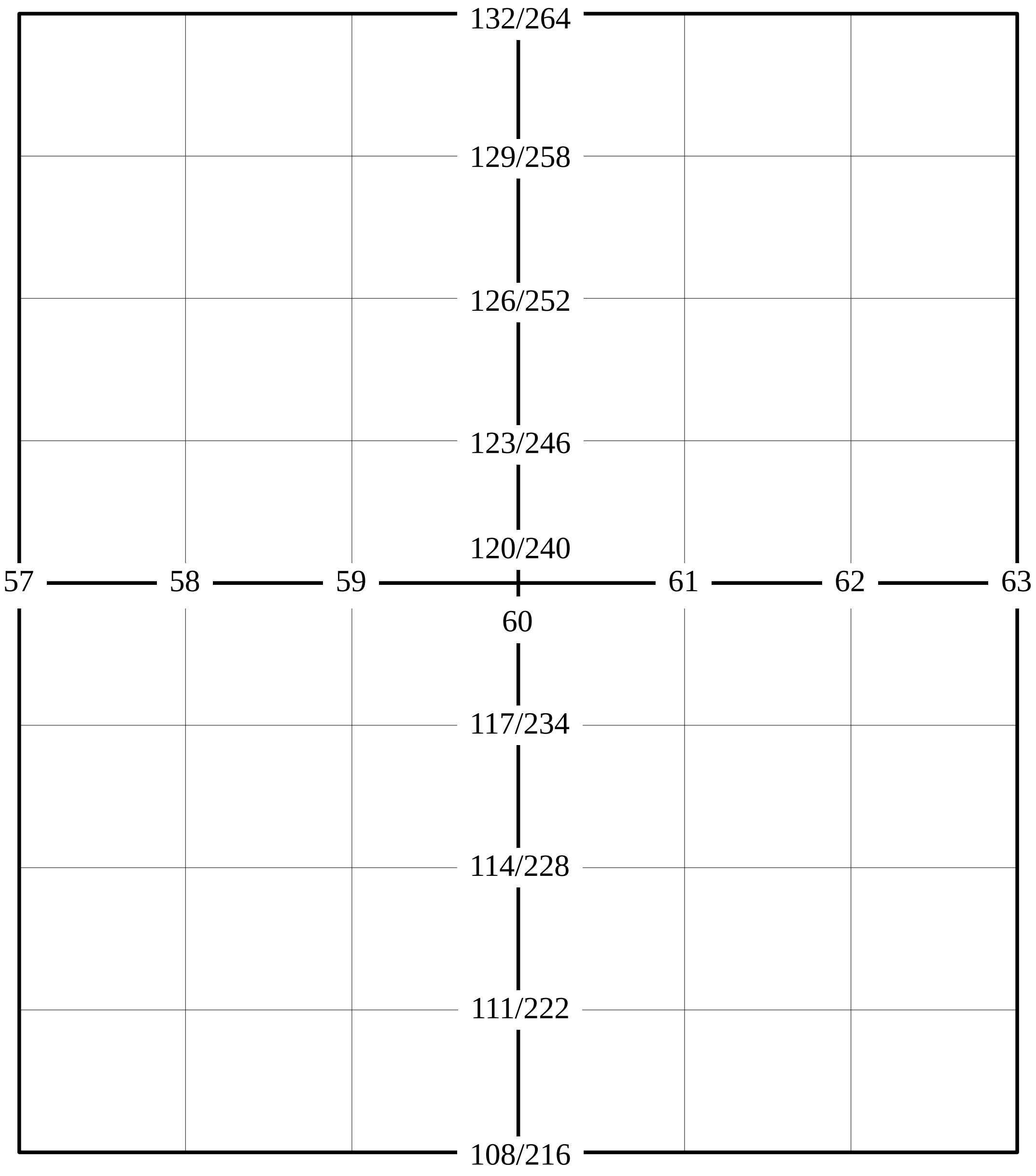
4. Start GenSet and allow for warm up by applying 50% load for five minutes.

   ☐ Warm up

5. Record the GenSet performance on the Power Curve chart on the next page.

Note: Be sure to use the ratings on the GenSet nameplate.

Power Curve



Applied Load	Amperes	Voltage	Frequency
0%			
25%			
50%			
75%			
100%			

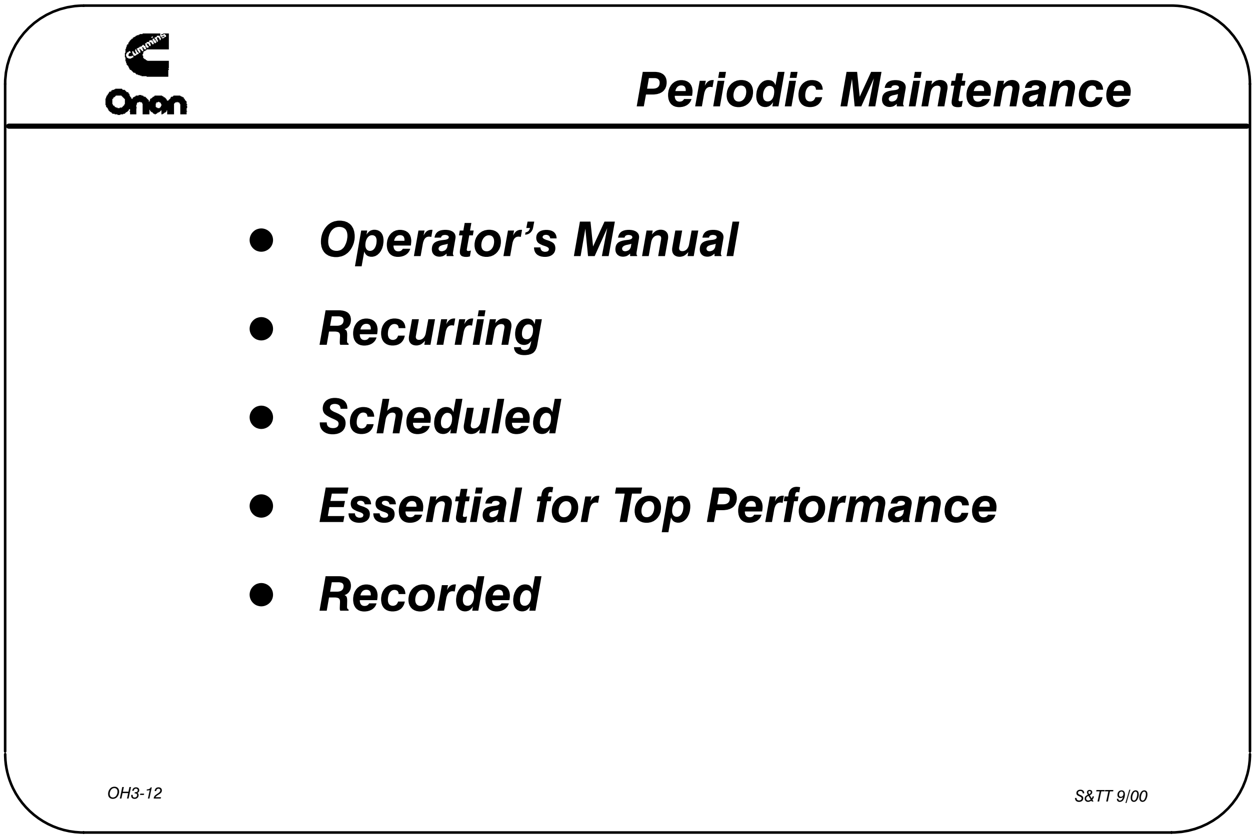
Quiet Diesel GenSet Periodic Maintenance

This lesson presents the periodic maintenance on an QD generator set.

Objectives

After completing this lesson, you should be able to:

- Find and use the periodic maintenance schedule outlined in the *Operator's Manual*
- Adjust the governor nominal no load voltage and frequency
- Locate maintenance points and perform all scheduled service
- Adjust the engine governor, regulator and fuel systems
- Perform a final test and adjust no load to full load power curve



Periodic Maintenance

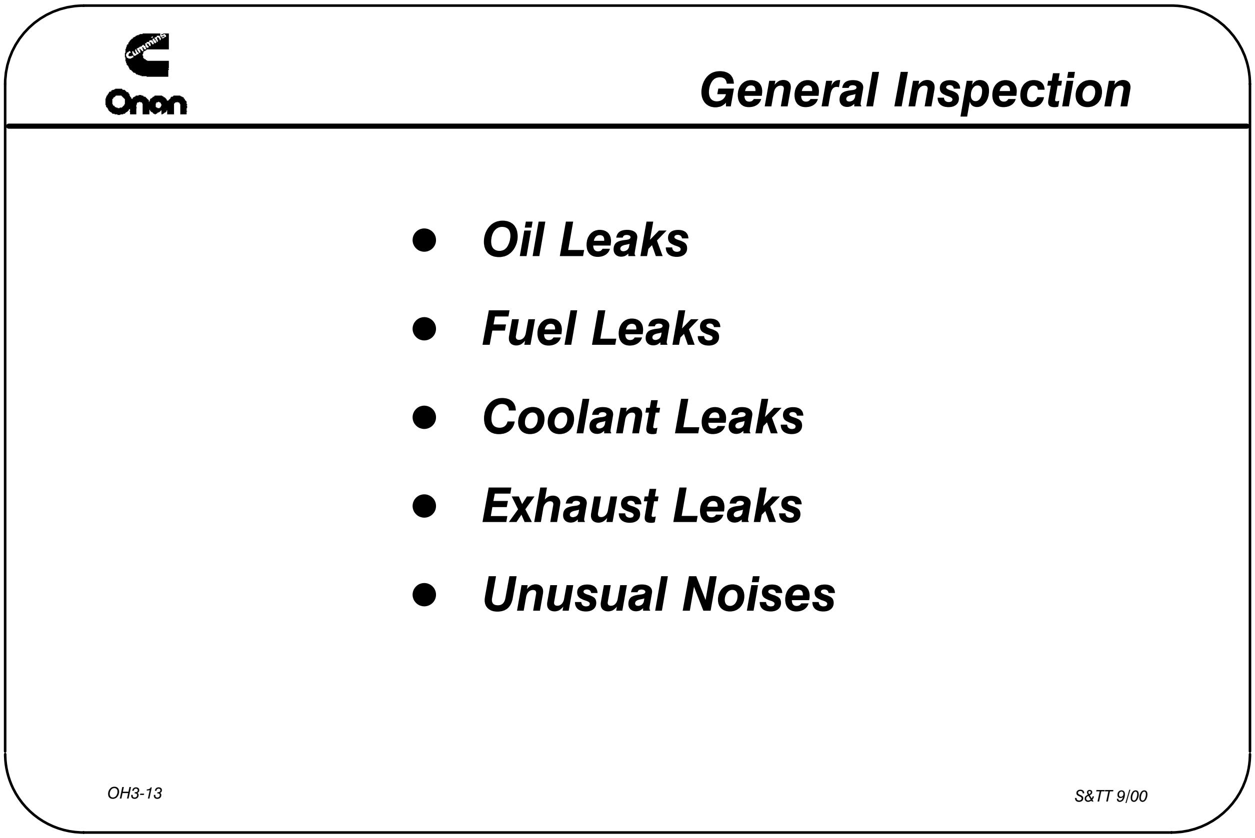
- ***Operator's Manual***
- ***Recurring***
- ***Scheduled***
- ***Essential for Top Performance***
- ***Recorded***

OH3-12

S&TT 9/00

Slide 3-12: Periodic Maintenance

- A periodic maintenance schedule is found in the *Operator's Manual*.
- Periodic maintenance is done as often as necessary.
- Done according to a schedule.
- Must be done for performance and longevity of the GenSet.
- Recording when and what was done is important.



General Inspection

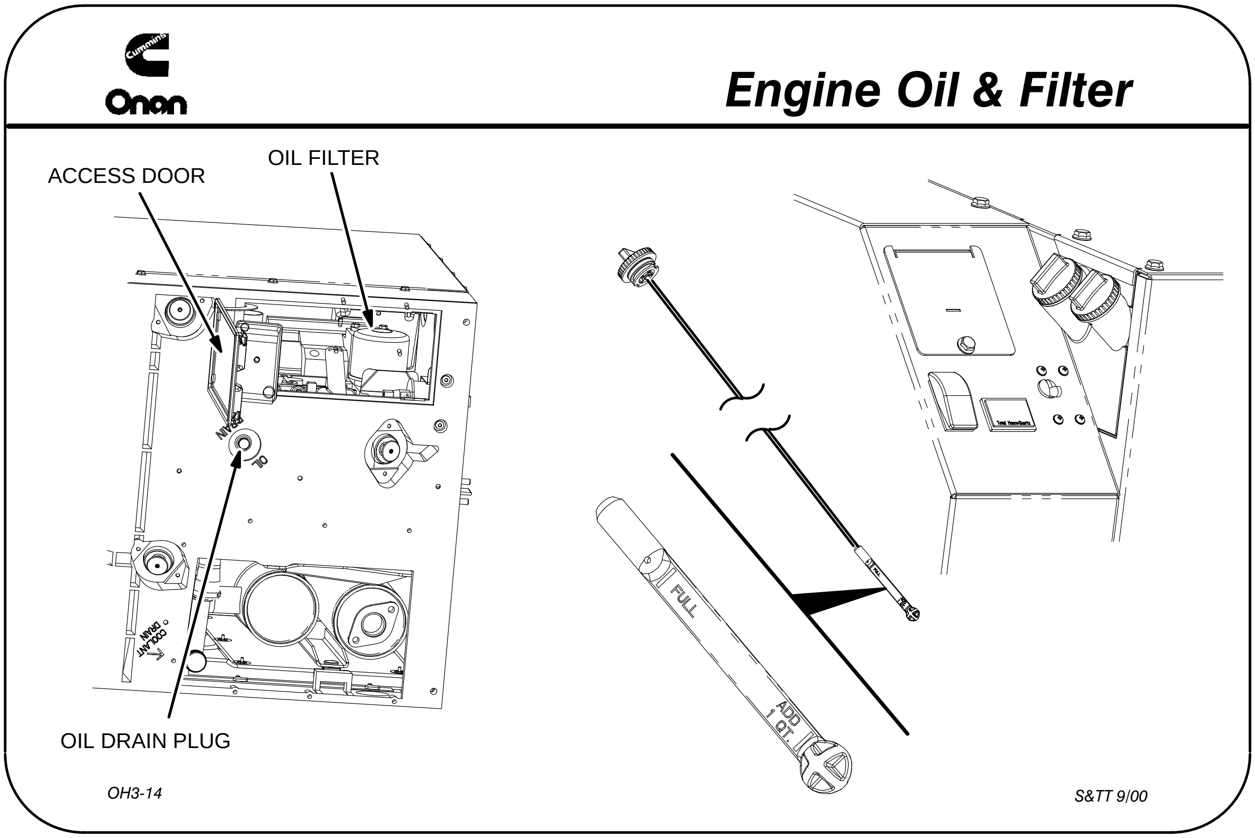
- Oil Leaks
- Fuel Leaks
- Coolant Leaks
- Exhaust Leaks
- Unusual Noises

OH3-13

S&TT 9/00

Slide 3-13: General Inspection

- Should be done daily or every eight hours of use.
- Inspect:
    - Oil or fuel leaks
    - Coolant Leaks
    - Exhaust system
    - Battery connections and condition
    - Missing or loose hardware
    - General Cleanliness
    - Stored items in compartment or room
    - Unusual noise during startup



Engine Oil & Filter

ACCESS DOOR

OIL FILTER

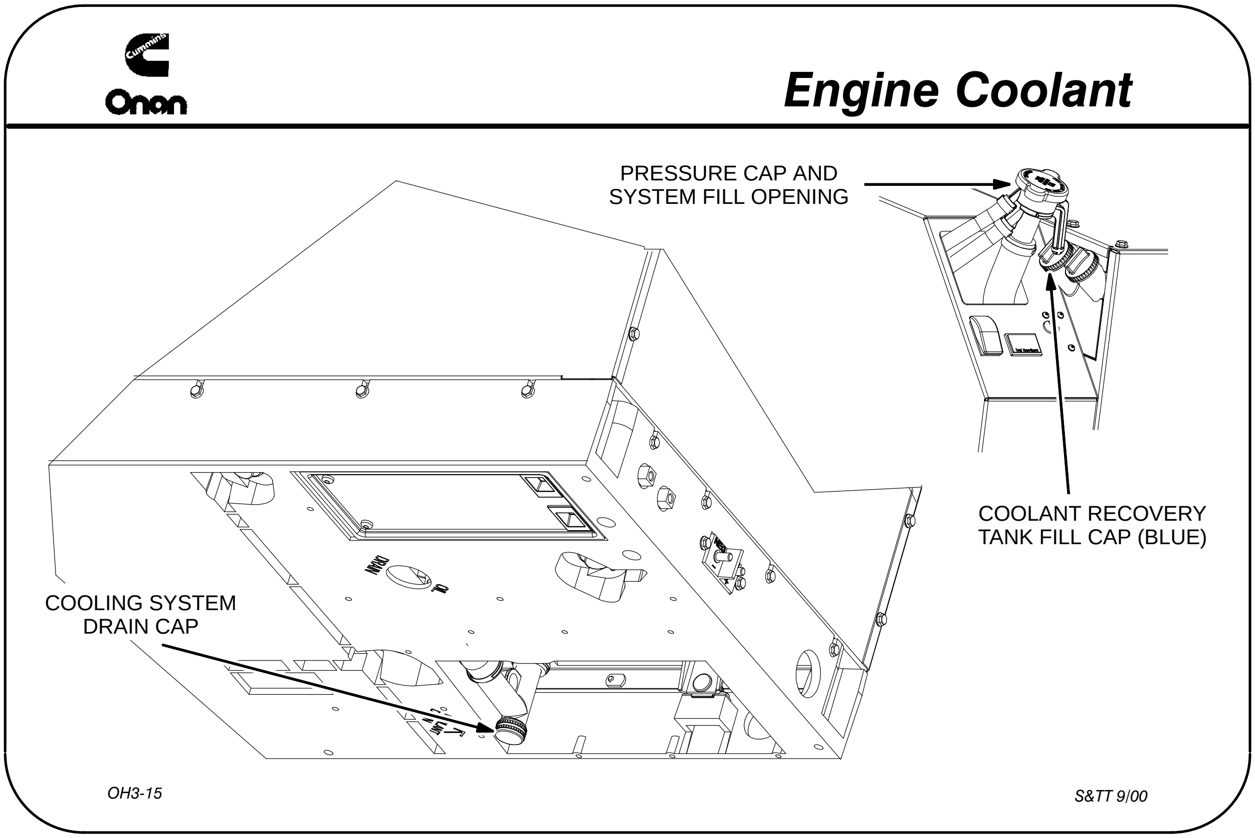
OIL DRAIN PLUG

OH3-14

S&TT 9/00

Slide 3-14: Engine Oil & Filter

- Should be checked daily or every eight hours of use.
- Change after first 35 hours on new GenSet then follow the table in the *Operator's Manual*
- Use oil that meets API classification and SAE viscosity grade as indicated in the *Operator's Manual*
- Do not operate GenSet if the oil level is below the add mark



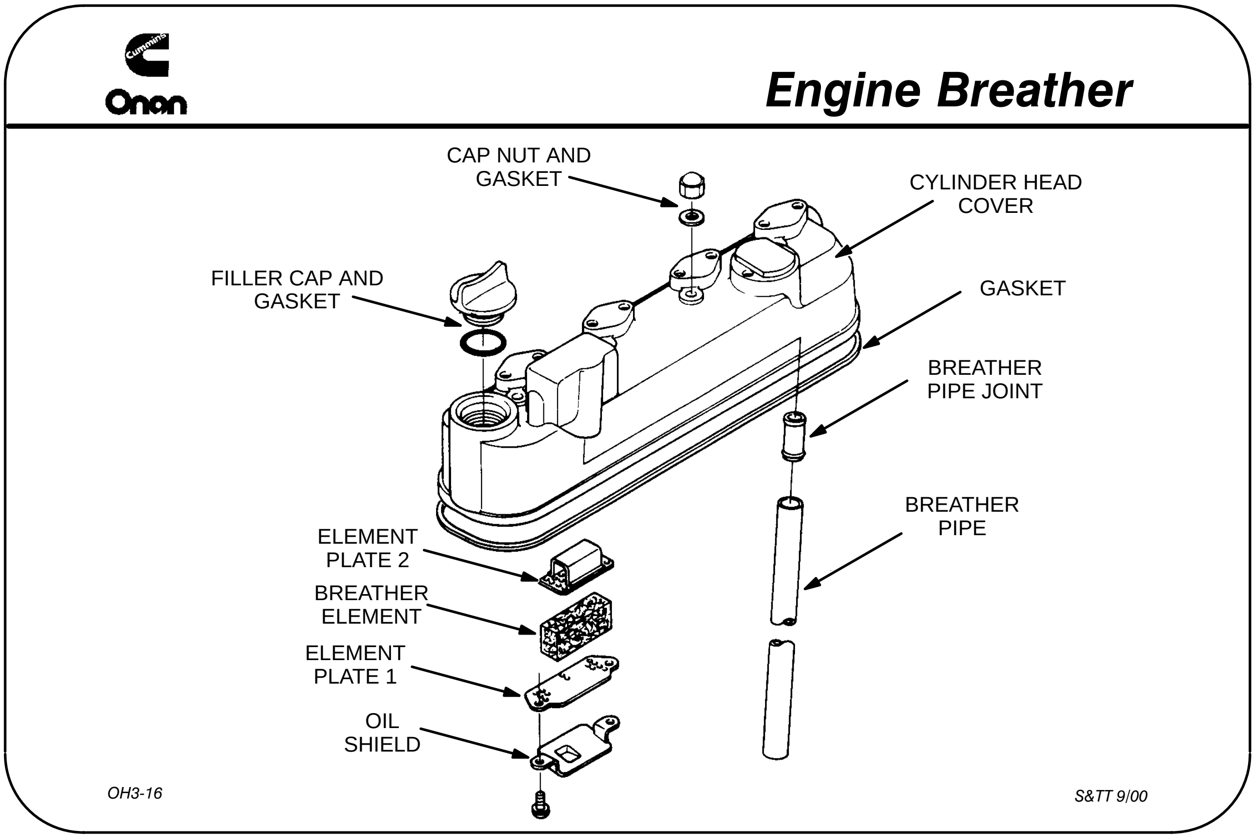
Engine Coolant

OH3-15

S&TT 9/00

Slide 3-15: Engine Coolant

- Check coolant level daily or every eight hours of use.
- A 50/50 mixture of ethylene glycol anti-freeze and water is recommended to inhibit corrosion and to protect against freezing.
- Use distilled or soft water to prevent clogging of the radiator with minerals.
- Check coolant level in the recovery tank or separate expansion tank, if equipped, when system is cold.
- Once a year drain, flush, and refill the cooling system with new coolant.



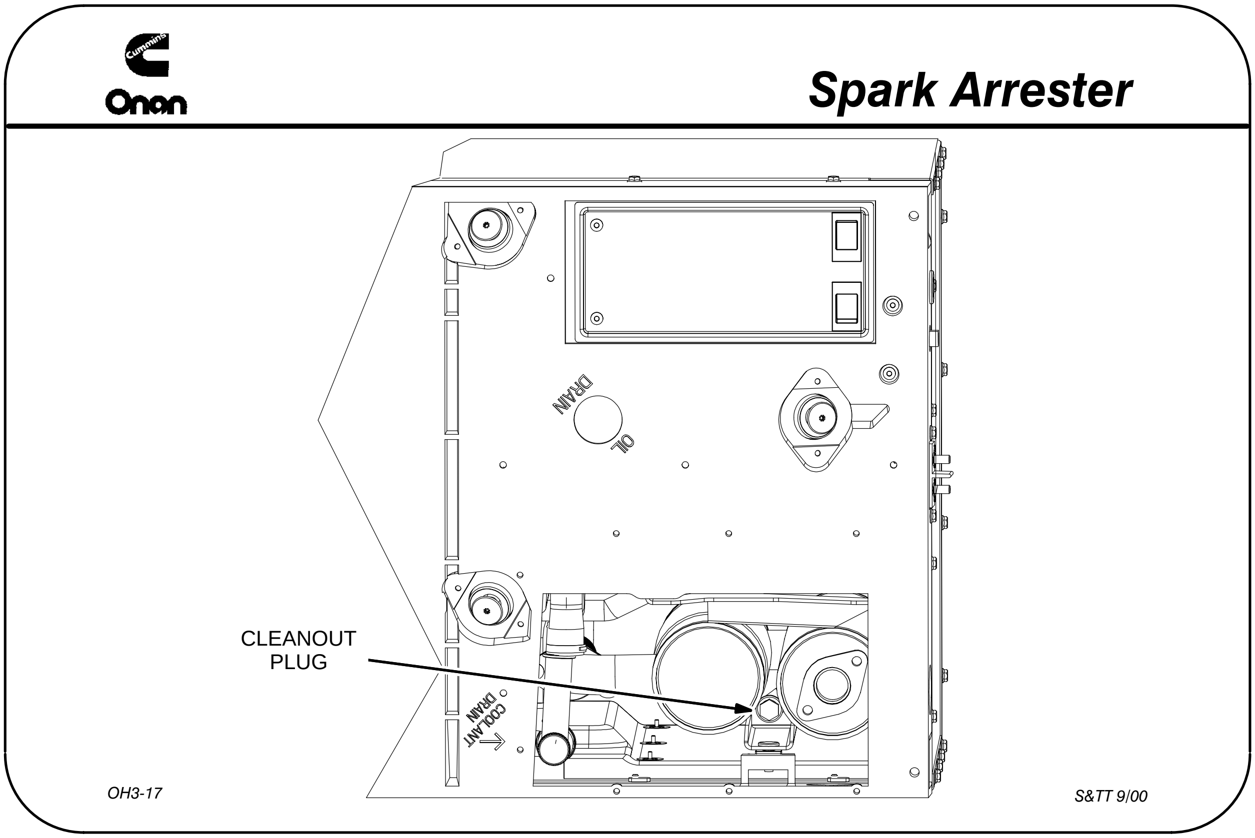
Engine Breather

OH3-16

S&TT 9/00

Slide 3-16: Engine Breather

- Clean the crankcase breather every 6 months or 250 hours as outlined in the *Operator's Manual*
- Clean the element in a suitable solvent, dry, then saturate with oil before replacing



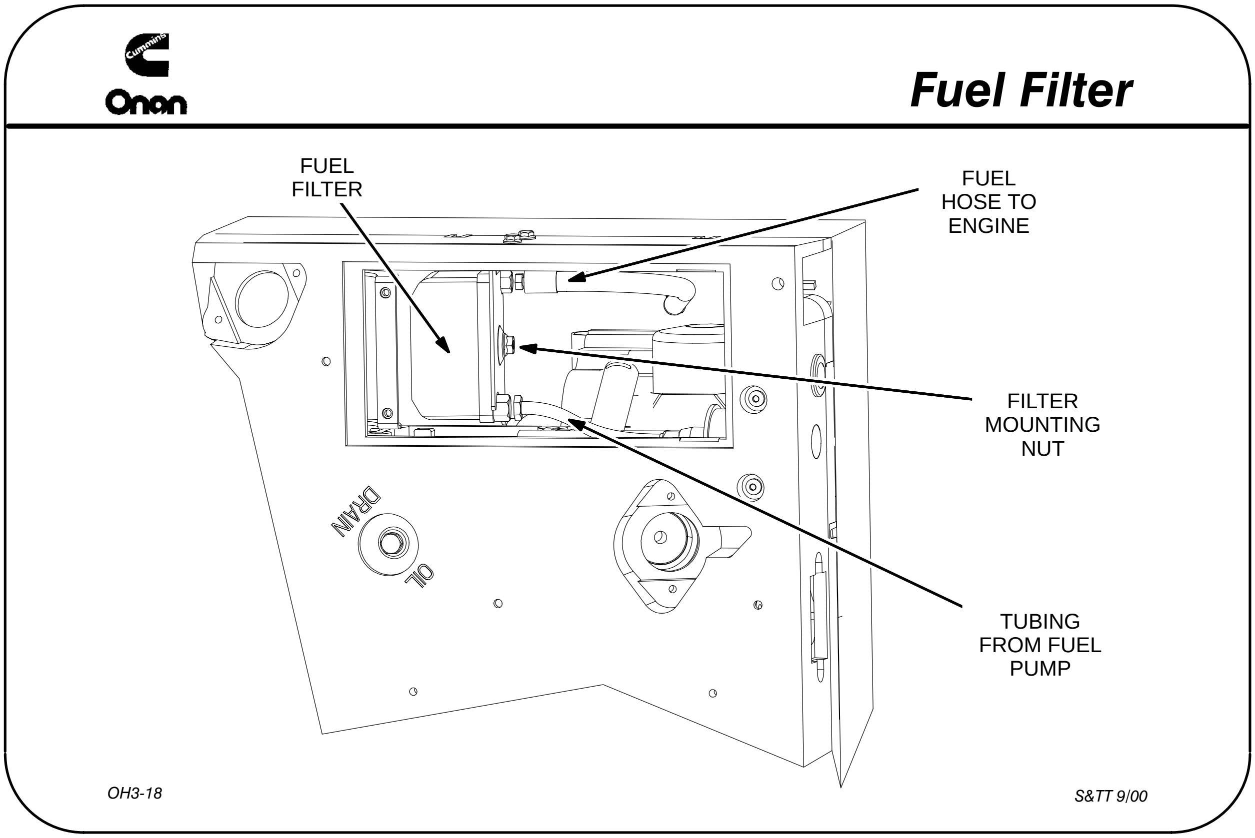
Spark Arrester

OH3-17

S&TT 9/00

Slide 3-17: Spark Arrester

- Clean spark arrester every 50 hours for safe operation and maximum efficiency
- Remove the plug and run the set at full load for 5 minutes
- Allow the muffler to cool before replacing the plug



Fuel Filter

FUEL FILTER

FUEL HOSE TO ENGINE

FILTER MOUNTING NUT

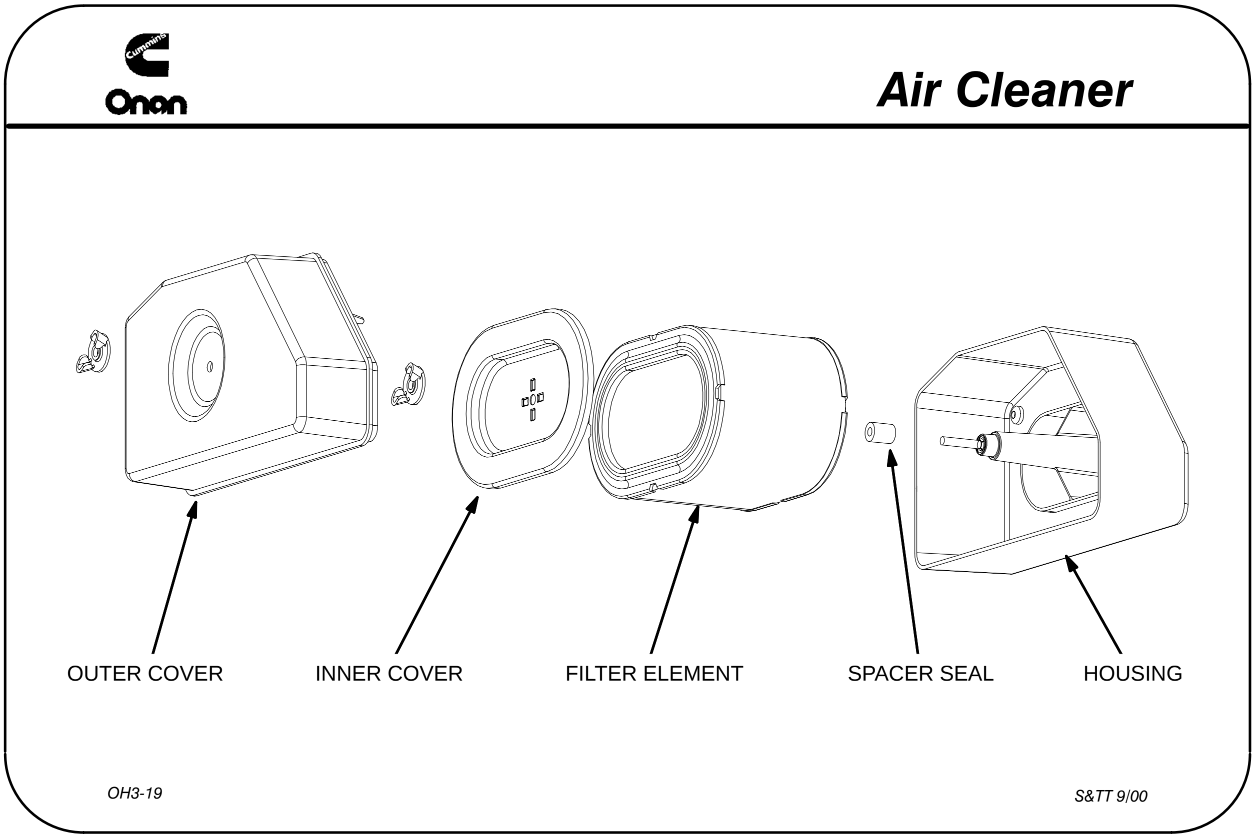
TUBING FROM FUEL PUMP

OH3-18

S&TT 9/00

Slide 3-18: Fuel Filter

- Change the fuel filters every 6 months or 250 hours
- Use only Onan approved filters to prevent fuel system damage
- The fuel system will need bleeding after filter replacement. Follow the procedures outlined in the manual
- Drain the filter of water and sediment monthly, every 100 hours or after an exercise period



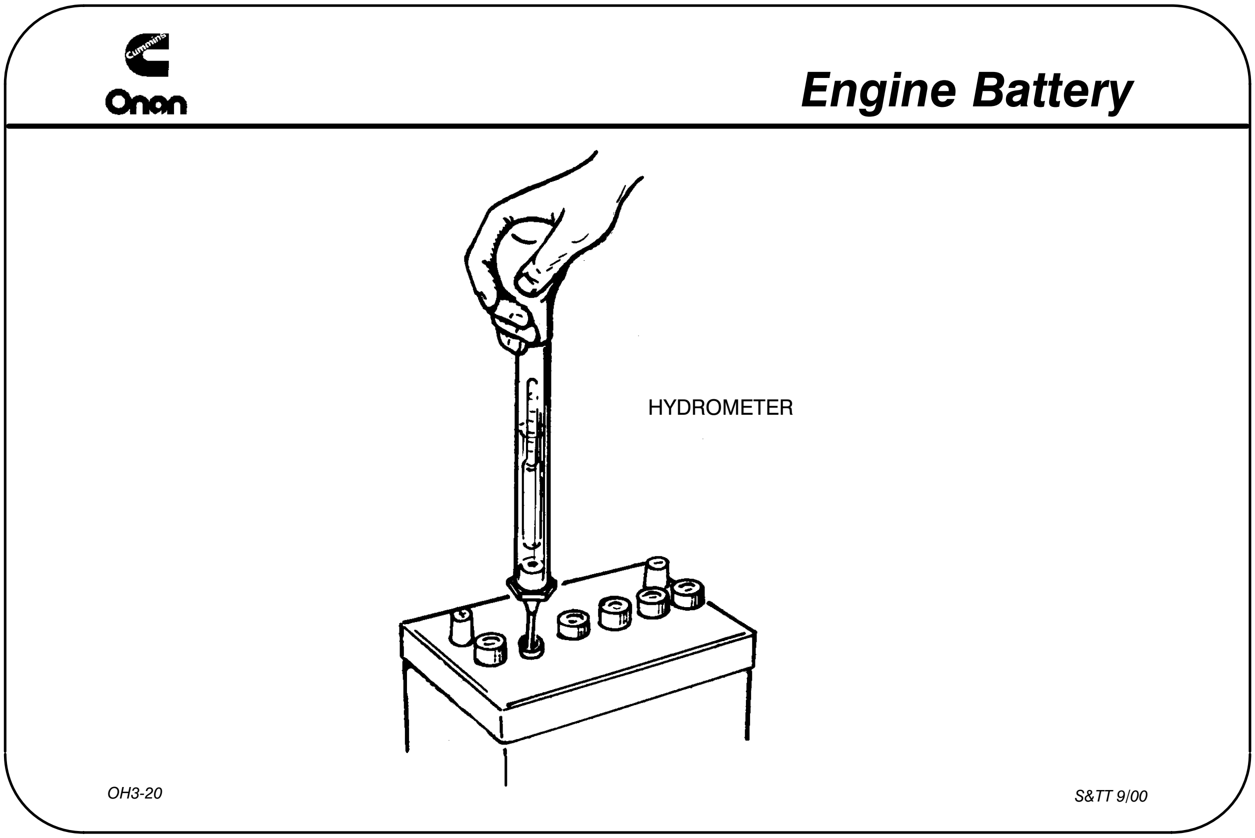
Air Cleaner

OH3-19

S&TT 9/00

Slide 3-19: Air Cleaner

- Check air cleaner, and clean if required, weekly or after 50 hours of operation
  - More often in dusty conditions
- Replace air cleaner according to the schedule in the *Operator's Manual*
  - More often in dusty conditions
- Use only Onan approved replacement filters to prevent damage to the engine



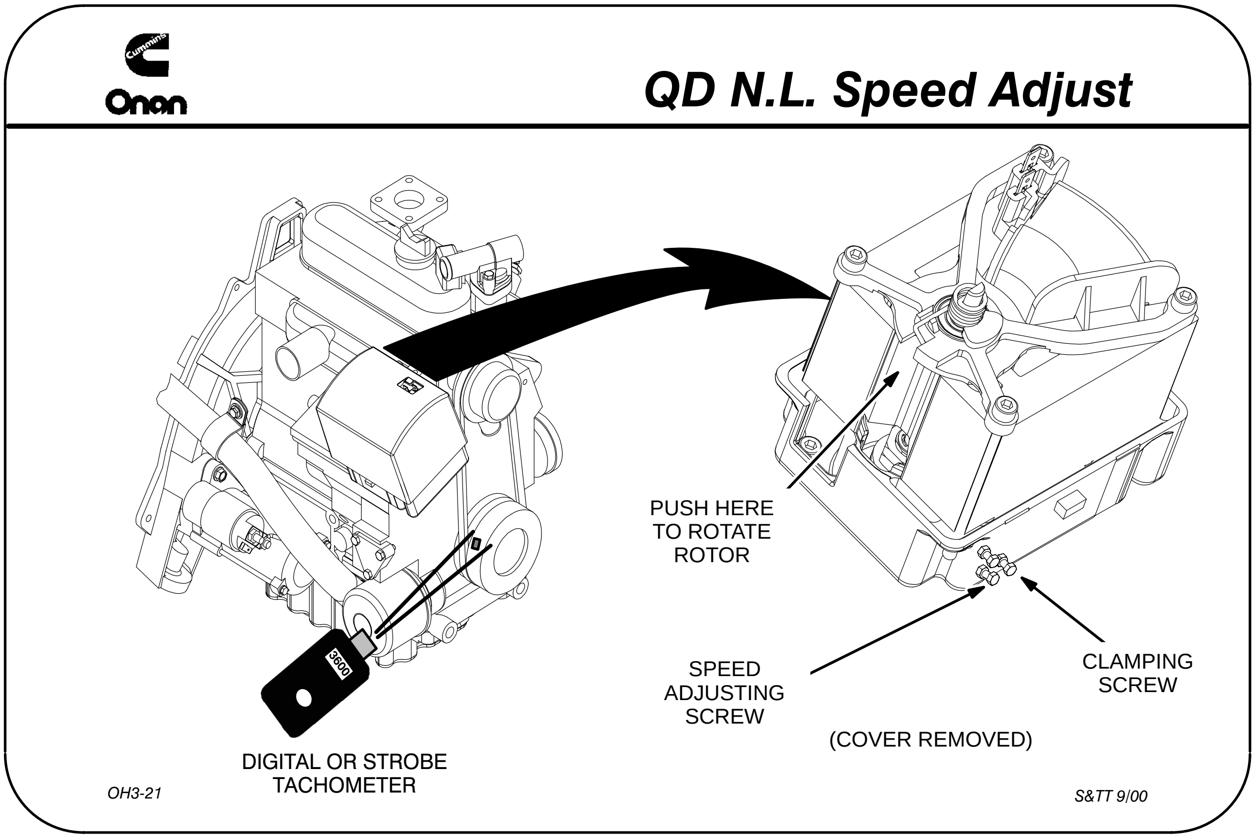
Engine Battery

OH3-20

S&TT 9/00

Slide 3-20: Engine Battery

- Check battery charge system monthly or after 100 hours of operation
    - Charge if specific gravity is lower than 1.215
    - Stop charging when the specific gravity reaches 1.260 at approximately 80° F
- Check battery specific gravity monthly or after 100 hours of operation
    - Should be 1.215 (hot climate zones) and 1.260 (cold climate zones)
- Add only distilled water



QD N.L. Speed Adjust

OH3-21

S&TT 9/00

Slide 3-21: QD Speed Adjust

The actuator speed control lever stop must be adjusted whenever a different actuator base assembly is installed. The stop screw, rather than the fuel rack control lever, must stop the speed control linkage when the fuel rack is driven to the right, no-fuel position.

1. Start the GenSet and push the actuator rotor clockwise by hand as far as it will go (about $^1/_2$ inch [12 mm]) and hold it there (It may be easier to use a wrench on the flat at the top of the shaft to hold the rotor position). Make sure the fuel rack return spring is in place on the rotor shaft to shut down the GenSet if you lose hold.

2. Adjust high idle speed to 3500-3600 rpm:

   a) Loosen the lock nuts on the two screws in the bottom row and back out the clamping screw.

   b) Adjust high idle speed by turning the adjusting screw and set its lock nut.

   c) Run the clamping screw in by hand until snug and set its lock nut.

3. Let the rotor go. The GenSet should stop and display a fault code. Restart the GenSet and recheck high idle speed. Readjust if necessary.

Activity

Situation:

Perform the necessary “No Load Speed Adjust” steps for the 7.5/8.0 QD GenSet.

Follow these steps:

1. Start the GenSet and allow for warm-up

   ☐ Apply 50% to 75% load for 15 minutes

2. Stop the set and remove the service side panel

   ☐ Refer to the *Service Manual*.

3. Perform set-up for preliminary no-load engine speed adjustment

   ☐ If using a strobe tachometer, attach your focus strip to a rotating part of the GenSet that rotates at **crankshaft speed**

   ☐ Refer to tachometer instruction sheet

   ☐ Unplug the actuator and remove its cover, then reconnect the wires.

   ☐ Refer to the *Service Manual.*

4. Perform preliminary no-load engine speed adjustment

   ☐ Start the GenSet and apply **no-load**

   ☐ Manually rotate governor actuator fully **clockwise**. Engine will go to high idle speed

   ☐ Using adjustment tools and tachometer, adjust speed to **3600 RPM**

   ☐ Refer to the *Service Manual.*

5. Stop GenSet and replace service side panel

   ☐ Unplug the actuator then replace the cover and reconnect the wires.

   ☐ Refer to the *Service Manual.*

6. Check N.L. to F.L. performance and stability.

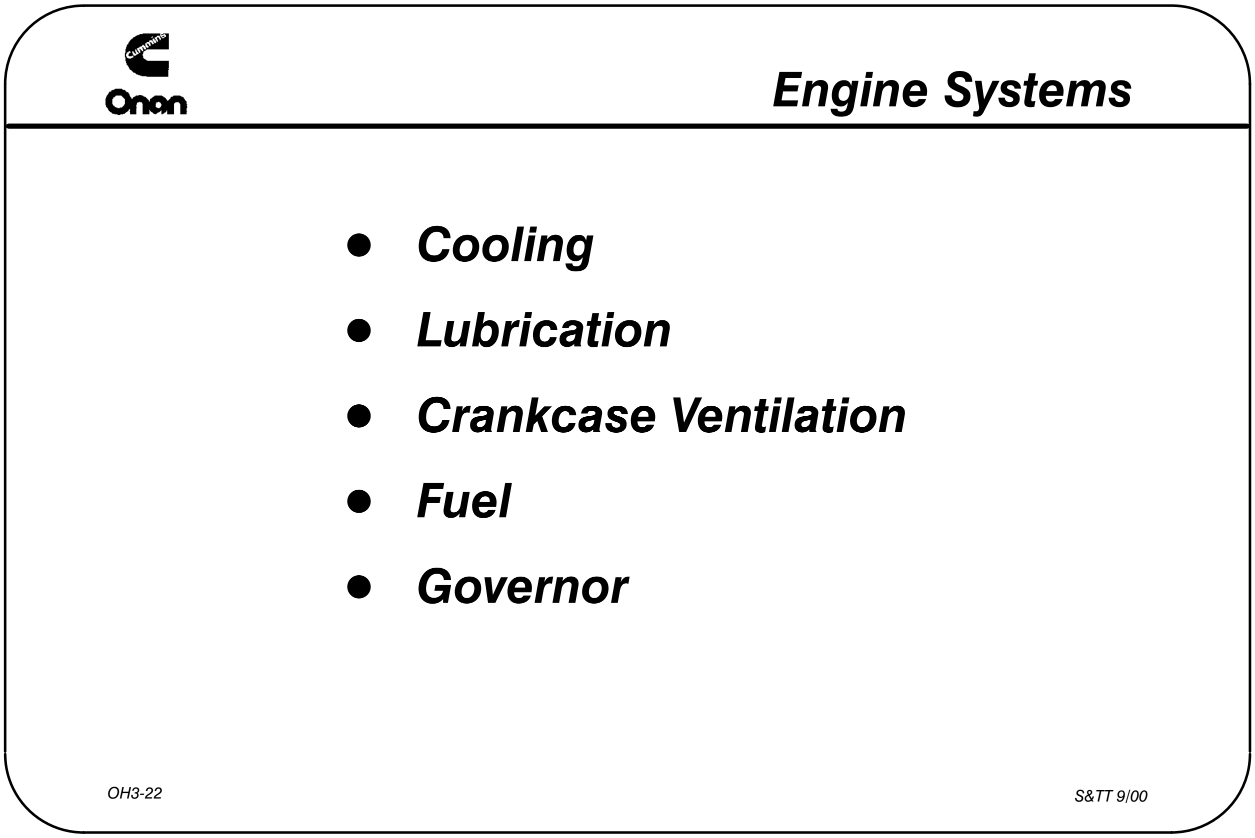
Quiet Diesel GenSet Troubleshooting

This lesson presents the troubleshooting steps and job aids for the generator set.

Objectives

After completing this lesson, you should be able to:

- Find and use the engine, generator, and control troubleshooting sections in the GenSet *Service Manual.*
- Read and understand AC and DC schematics.
- Use special tools for diagnostic testing.
- Troubleshoot common engine, generator, and control problems.



Engine Systems

- Cooling
- Lubrication
- Crankcase Ventilation
- Fuel
- Governor

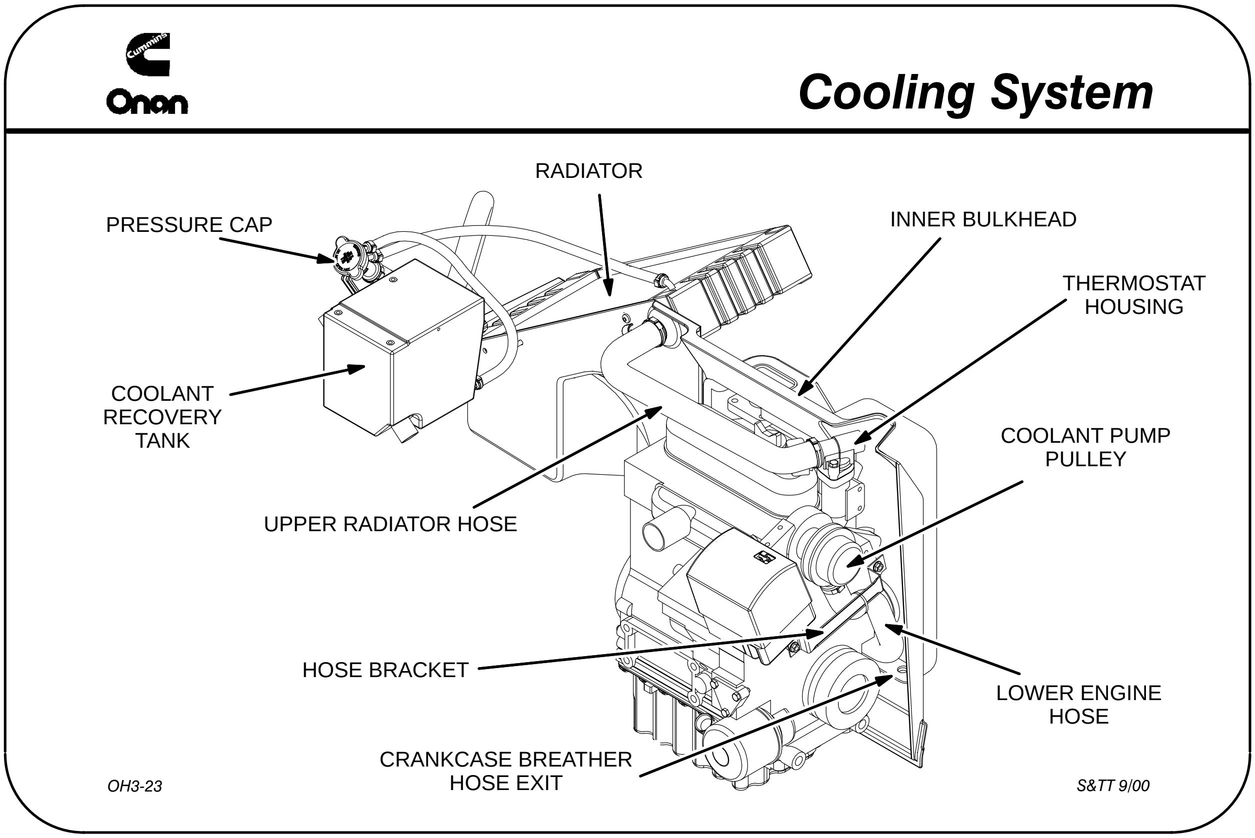
OH3-22

S&TT 9/00

Slide 3-22: Engine Systems

Its important to determine what system the problem is in. This will aid in the time needed to troubleshoot the problem.

- Four cycle, four stroke diesel engine
- Naturally aspirated induction system
- Over 80% parts interchangeability within same stroke engine series



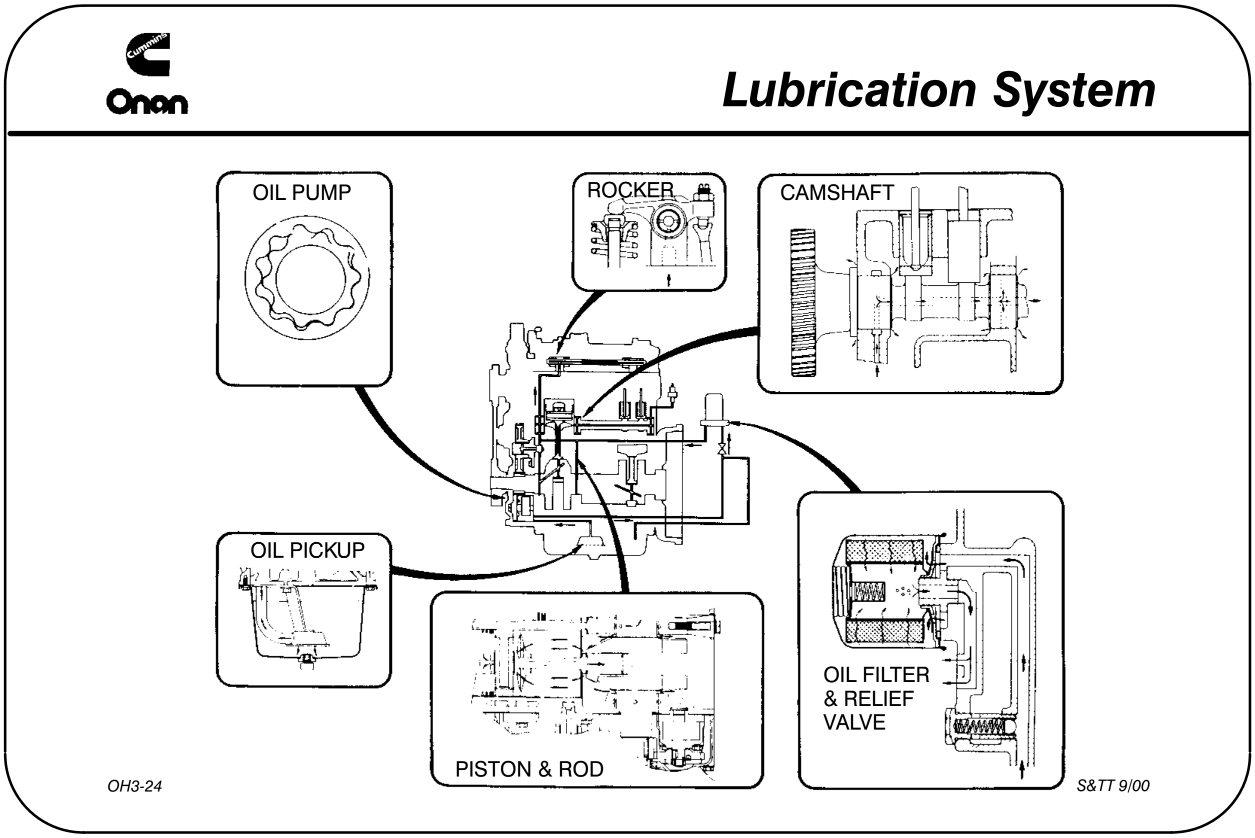
Cooling System

OH3-23

S&TT 9/00

Slide 3-23: Cooling System

- Cooling system consists of a radiator, cooling fan, a coolant pump, and a thermostat.
- Cooling air is pushed through the radiator from the fan assembly on the generator rotor
- The radiator cooling fins must be unrestricted and free of dirt and debris.
- The thermostat is set to open at about 160° Fahrenheit.
- A 50/50 mixture of ethylene glycol anti-freeze and water is recommended to inhibit corrosion and to protect against freezing.



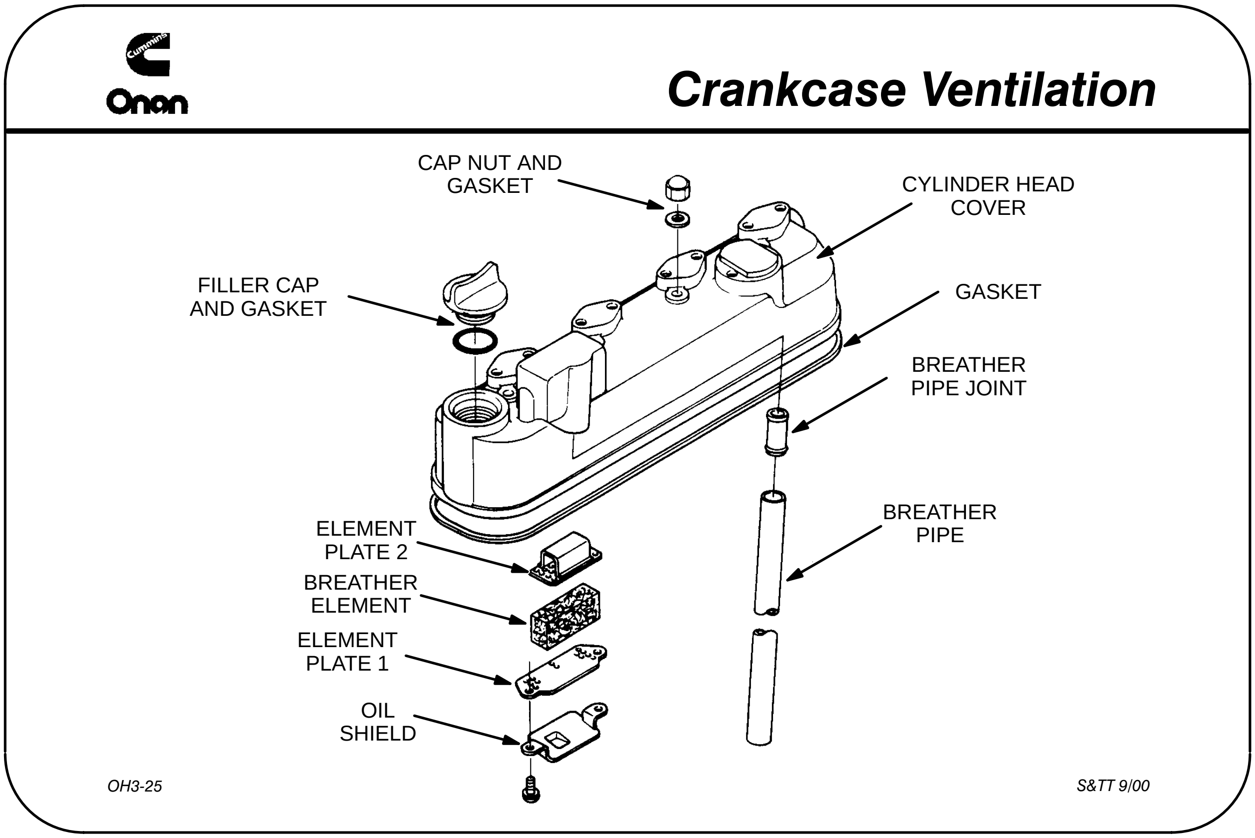
Lubrication System

OH3-24

S&TT 9/00

Slide 3-24: Lubrication System

- Oil pump is gear driven from the camshaft.
- Oil filter has an internal bypass valve.
- Use only an Onan oil filter.
- Location for low oil pressure switch or gauge.
- Bypass valve limits oil pressure to about 28 to 64 psi.
- Low oil pressure switch set to fault at about 9 to 14 psi
- Follow the recommended oil viscosity outlined in the *Operator's Manual*.



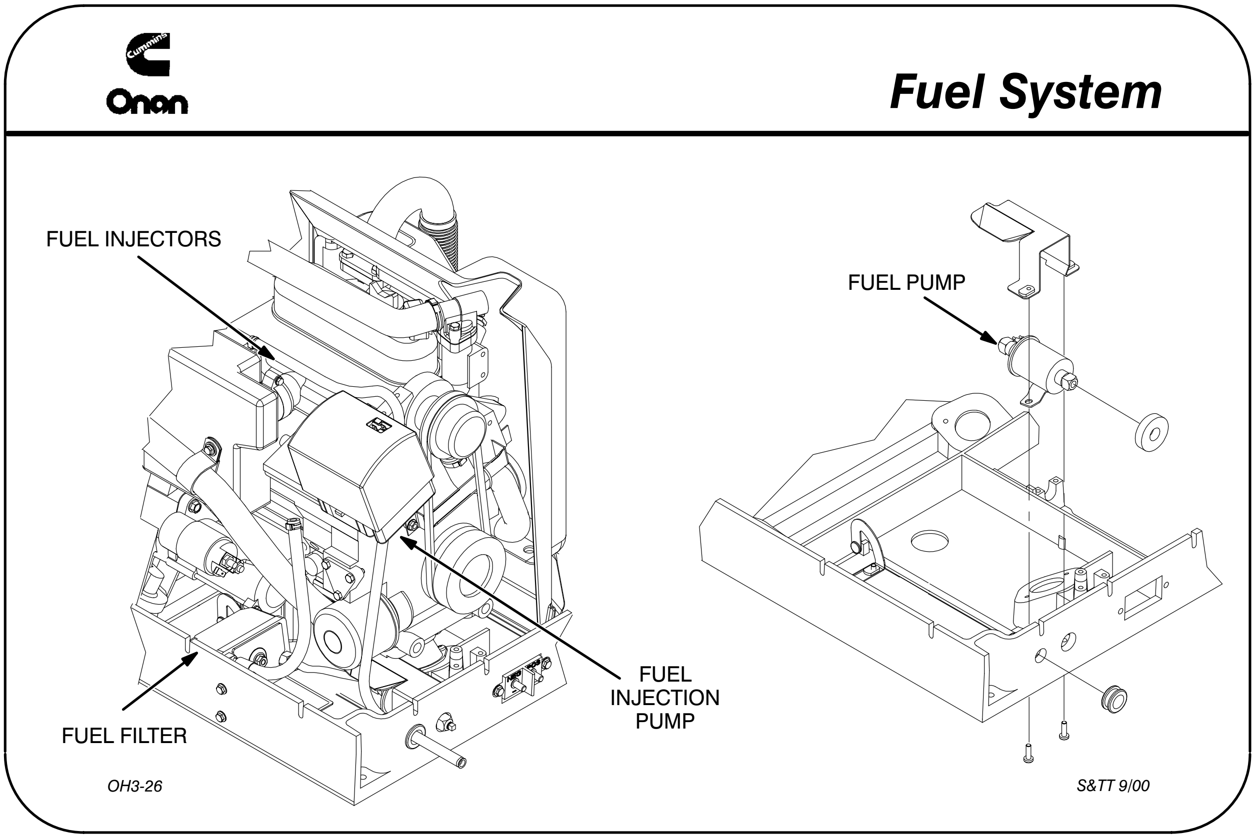
Crankcase Ventilation

OH3-25

S&TT 9/00

Slide 3-25: Crankcase Ventilation

- Maintains a negative crankcase pressure.
- Crankcase vacuum can be measured with a manometer at the dipstick with the engine operating at any speed.
- Crankcase pressure can cause serious oil leaks and often occurs in engines which need overhauling.



Fuel System

OH3-26

S&TT 9/00

Slide 3-26: Fuel System

Consists of a fuel lift pump, fuel injection pump, and injector for each cylinder.

Fuel Injectors

- Throttle type fuel injectors.
- Injection nozzle pressure is about 1991 to 2133 psi.

Fuel Injection pump

- Injection pump has shim pack under pump to control proper injection timing.

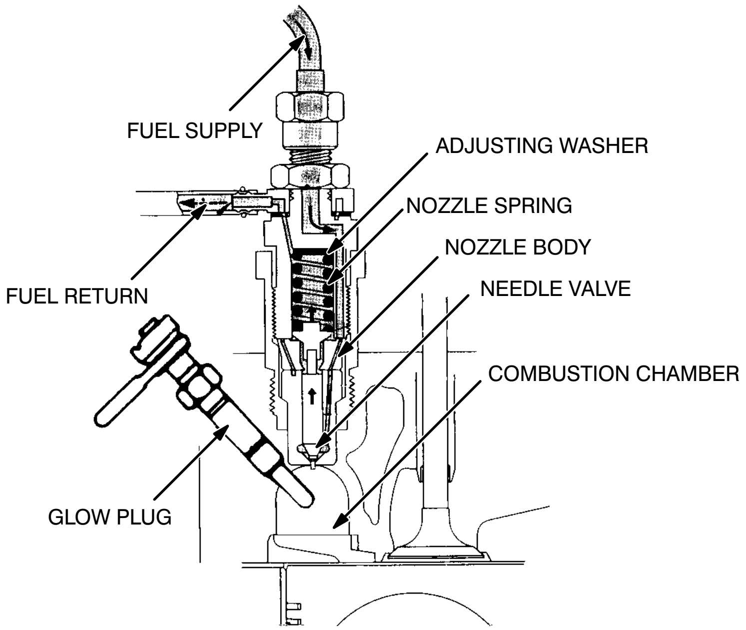
Fuel Lift Pump

- Has a 3 foot lift maximum at about 3.5 to 6 psi.

Fuel Filter

- Can be accessed through the service access cover on bottom of GenSet

Fuel System



OH3-27

S&TT 9/00

Slide 3-27: Fuel System

Consists of a fuel injector, glow plug, and precombustion chamber.

Fuel Injectors

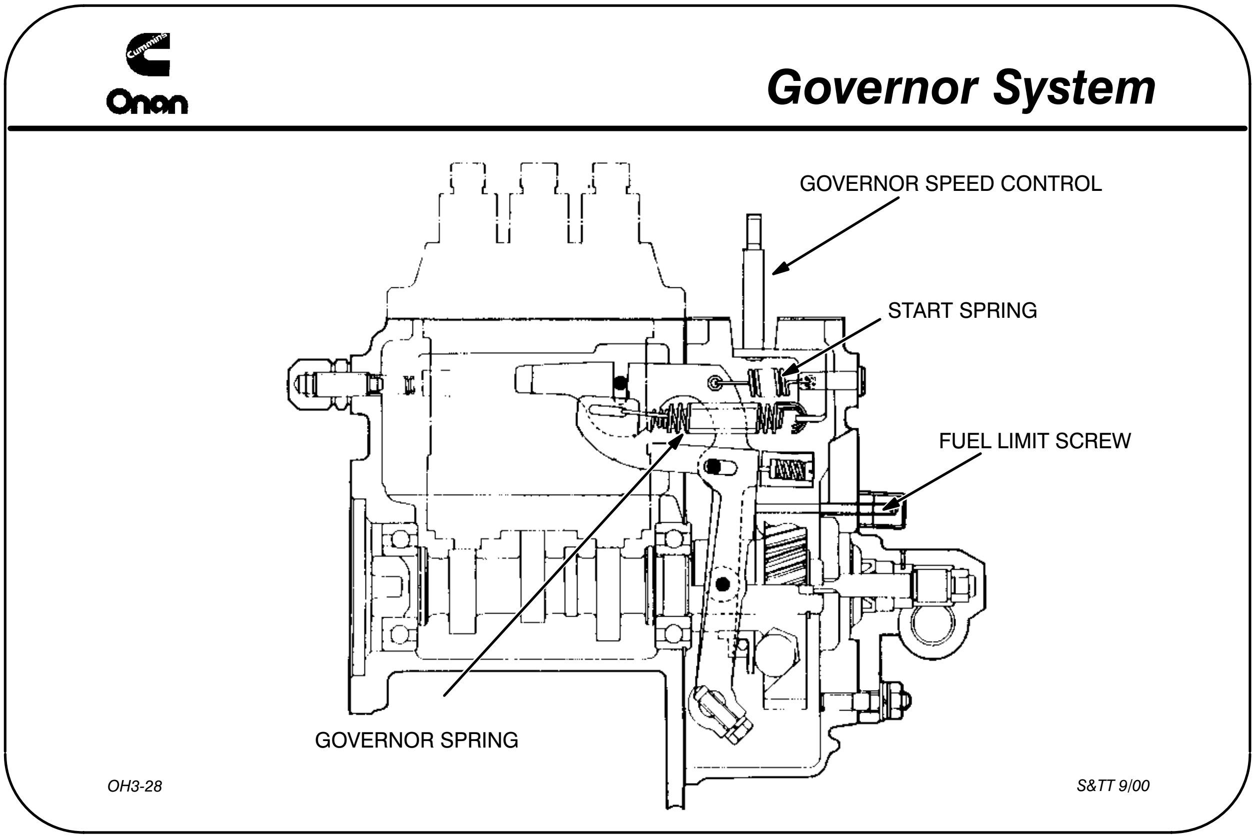
- Indirect fuel injection system (IDI)
- Adding or subtracting adjusting washers changes pressure 142 psi

Glow Plugs

- Pre-heats incoming fuel

Precombustion Chamber

- Pre-heats incoming fuel



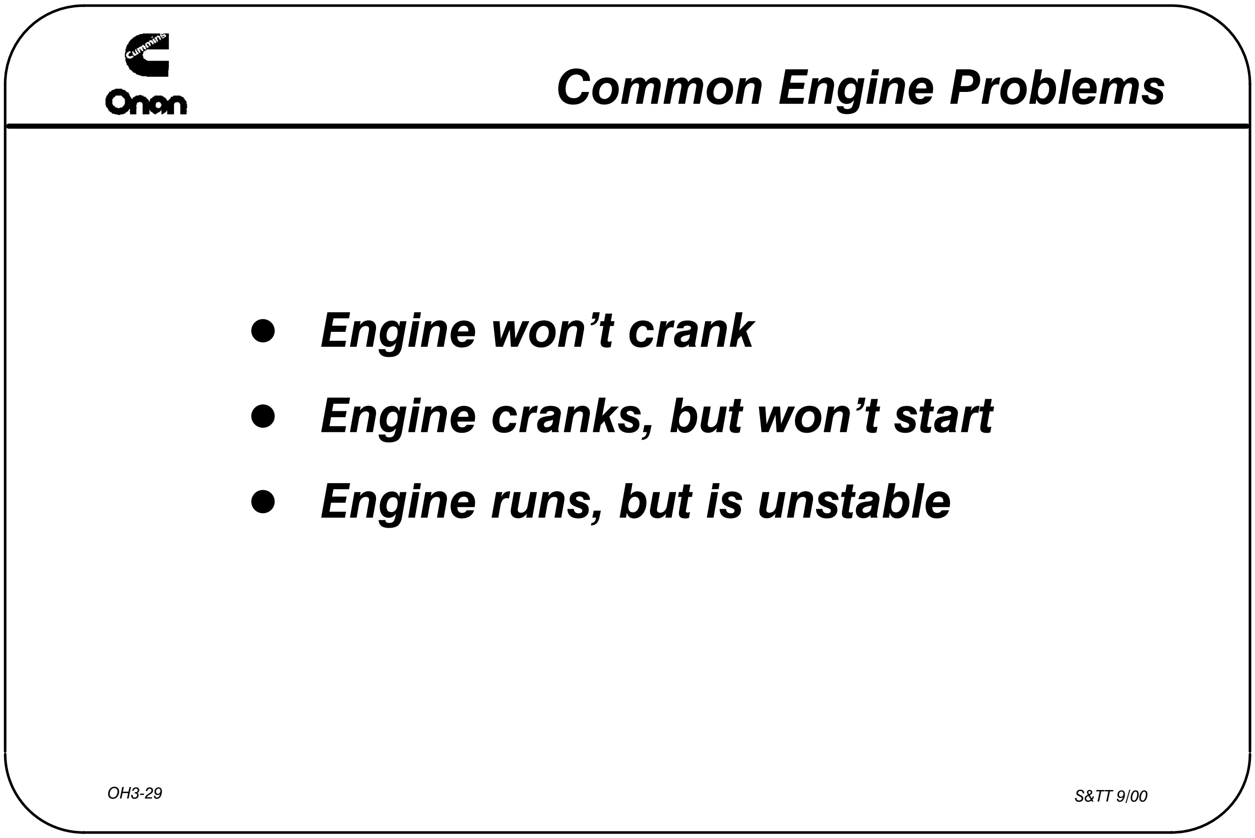
Governor System

OH3-28

S&TT 9/00

Slide 3-28: Governor System

- Injection Pump and Governor driven by the same camshaft.
- Governor speed control sets N.L to F.L. speed.
- Start spring permits easy starting.
- Fuel limit screw sets F.L. fuel delivery (do not adjust).



Common Engine Problems

- Engine won’t crank
- Engine cranks, but won’t start
- Engine runs, but is unstable

OH3-29

S&TT 9/00

Slide 3-29: Common Engine Problems

Engine cranks but won’t start:

- Lack of fuel.
- Unstable or wrong fuel.
- Air in the fuel system.
- Fuel pump or governor actuator not energizing.

Engine blows smoke:

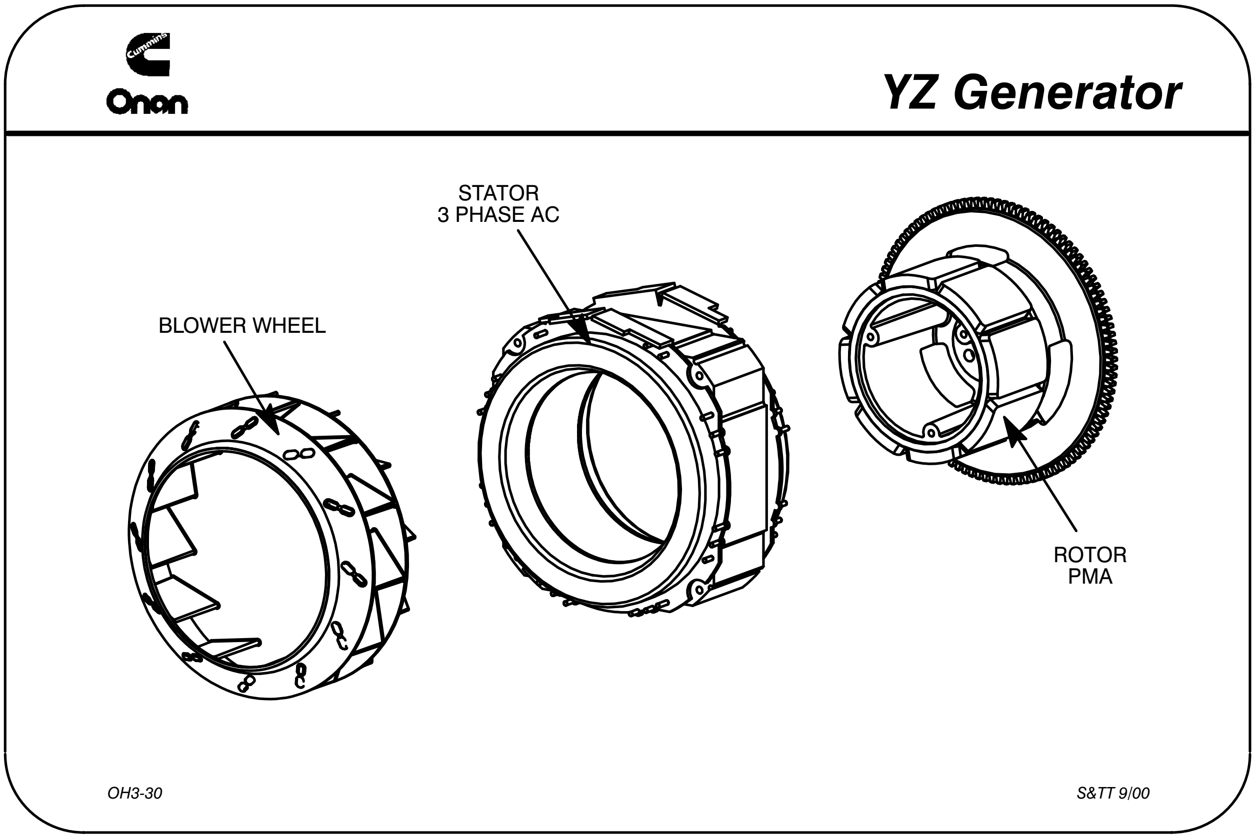
- Blue smoke indicates engine burning oil.
- White smoke indicates lack of engine heat.
- Black smoke indicates too much fuel or over loading.
- Restricted air filter/exhaust.

Engine lacks power:

- Restricted air filter.
- Restricted exhaust system.
- Restricted fuel filter.
- Engine overheated.

Engine runs, but unstable:

- Air in the fuel system.
- Governor adjustment.
- Insufficient fuel delivery.
- Injector pump adjustment.



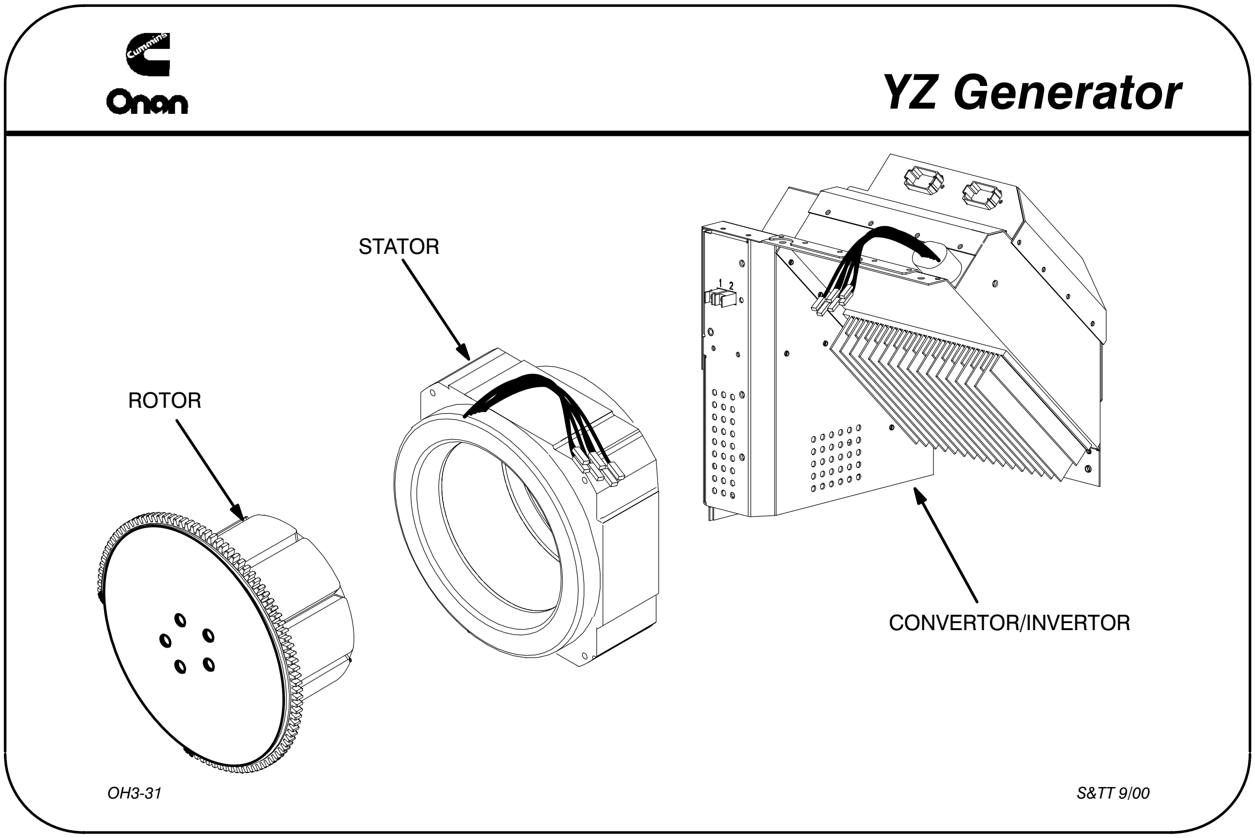
YZ Generator

OH3-30

S&TT 9/00

Slide 3-30: YZ Generator

- Brushless, Exciterless, Bearingless.
- High density permanent magnet alternator (PMA)
- High voltage 3 phase stator.
- Rotor mounted blower wheel.



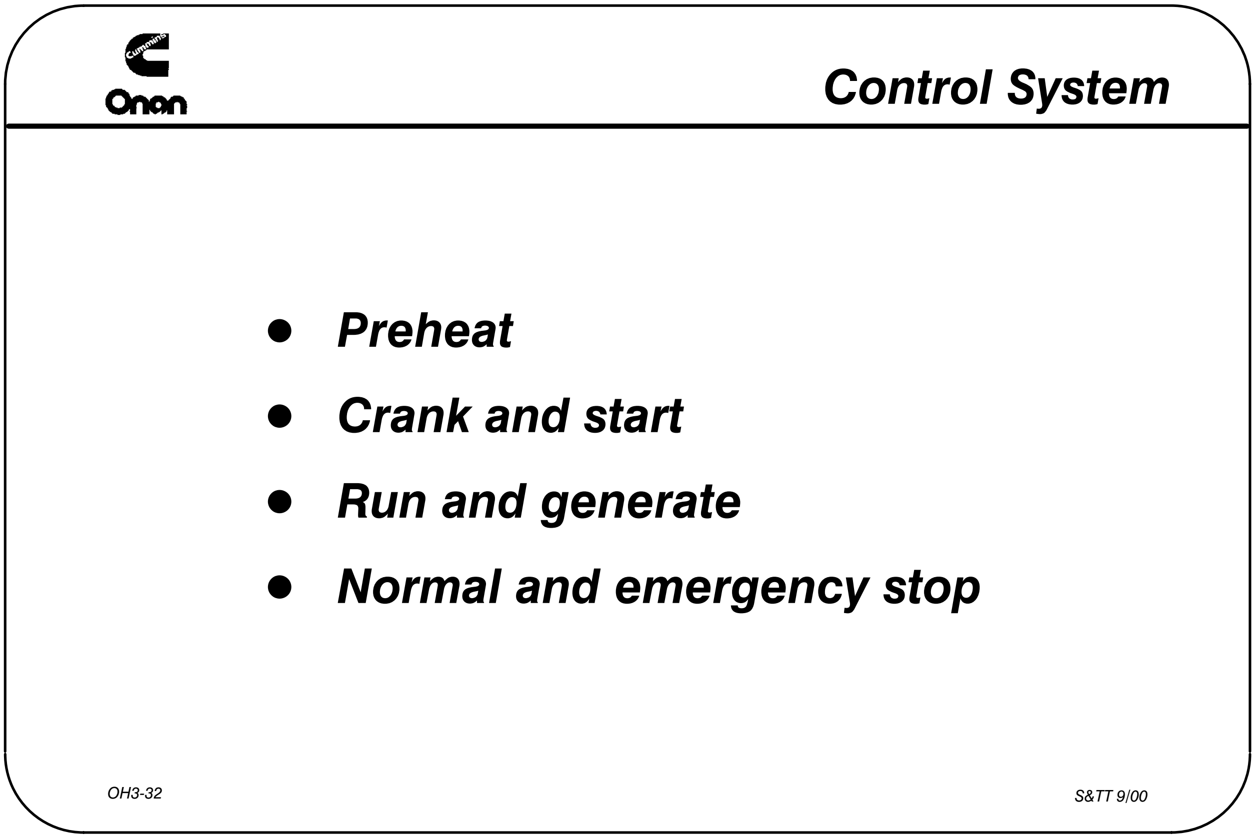
YZ Generator

OH3-31

S&TT 9/00

Slide 3-31: YZ Generator

- Rotor is bolted to the engine crankshaft.
- Stator is stationary and bolted to the generator adaptor.
- Rotor/Stator produce high frequency, high voltage 3 phase AC.
- Convertor changes 3 phase AC into DC voltage.
- Invertor changes DC voltage into steady state 60 Hz 1 phase AC voltage.



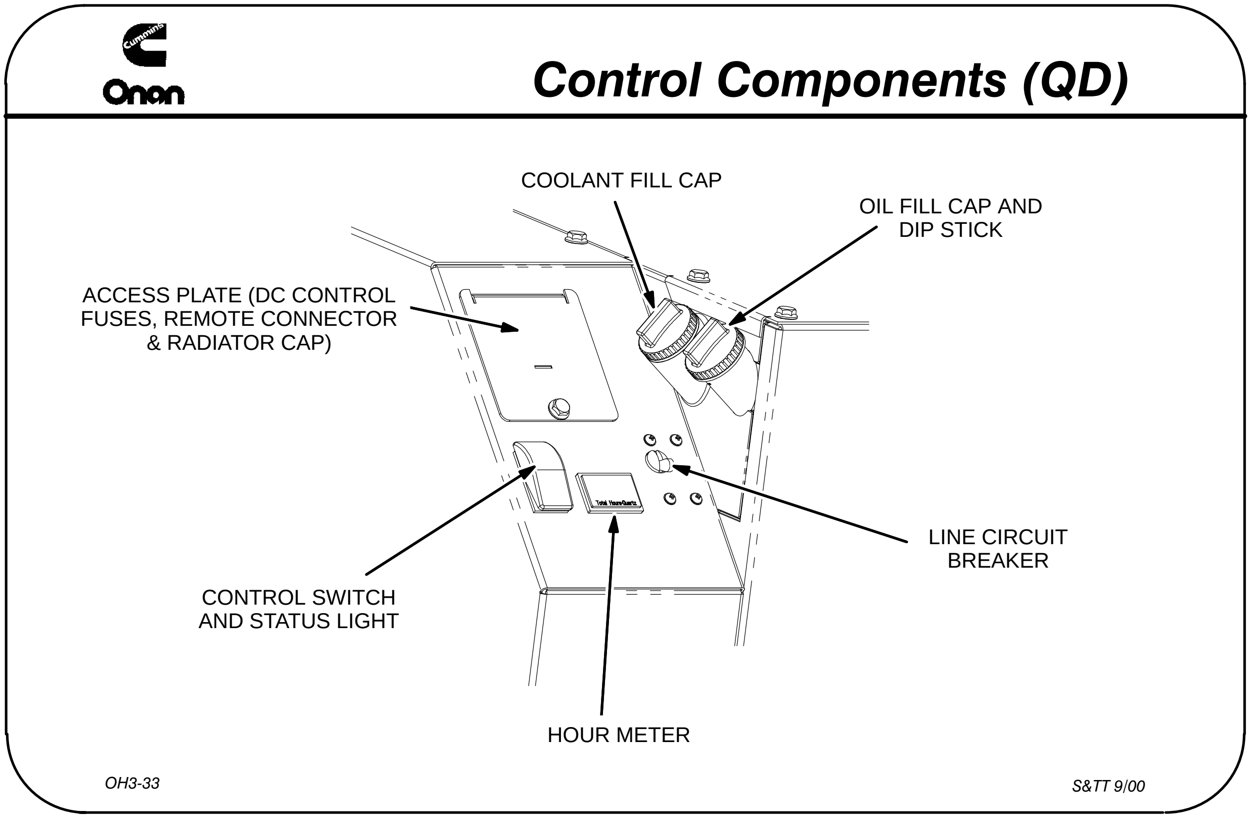
Control System

- Preheat
- Crank and start
- Run and generate
- Normal and emergency stop

OH3-32

S&TT 9/00

Slide 3-32: Control System



Control Components (QD)

OH3-33

S&TT 9/00

Slide 3-33: Control Components (QD)

- Located inside the GenSet control box.
- Consists of the A11 engine monitor board, VR21 voltage regulator, A15 preheat module & the A28 auxiliary relay board.
- Controls and monitors the engine and generator functions.

Activity

Directions: Using your highlighters, and the copies of the **HDKAJ** control schematic, **611-1236**, follow along with the instructor and color the modes of operation on your sheets.

The page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **HDKAJ GenSets** when they don't operate properly.

Preheat Mode

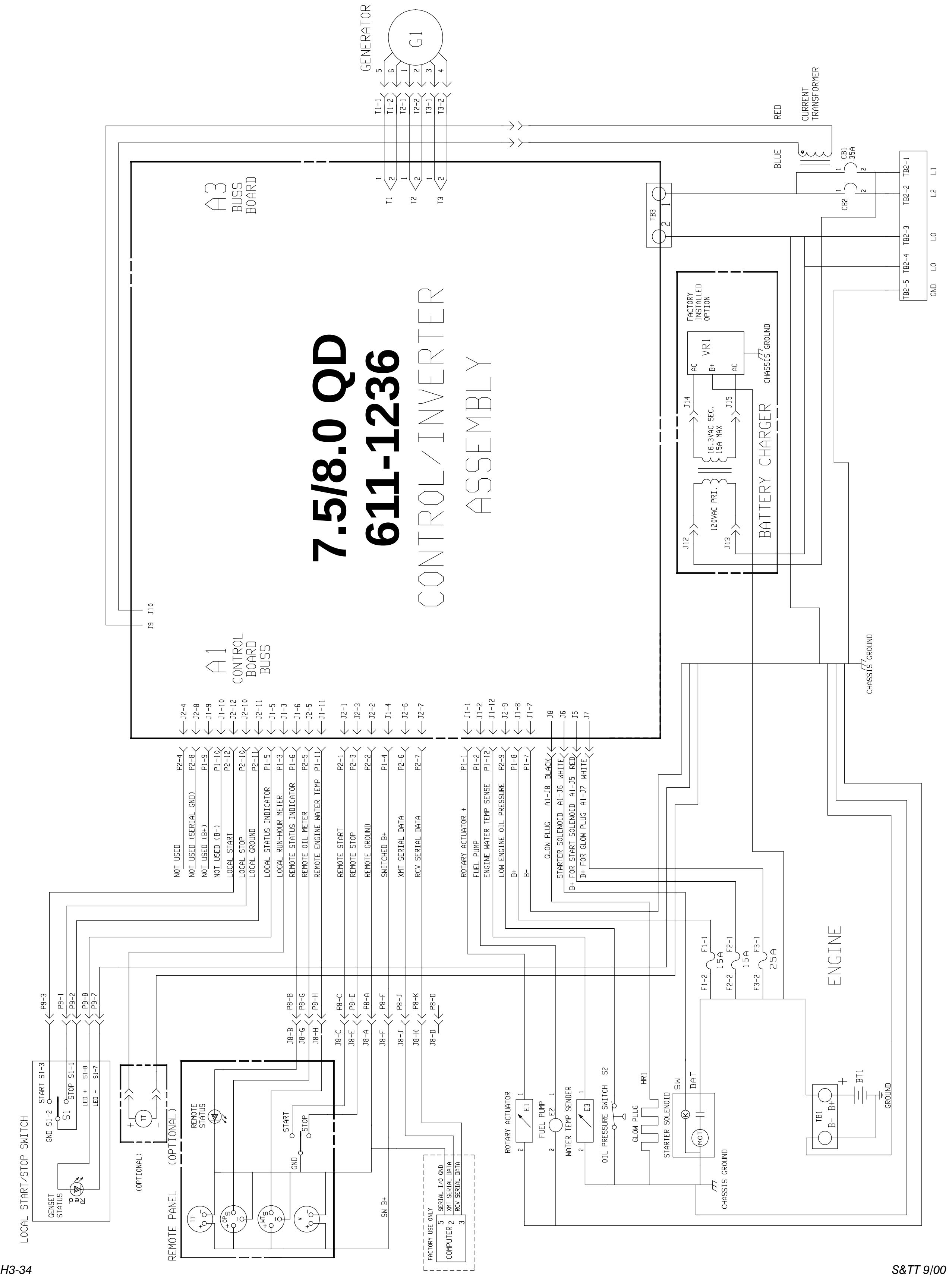
Slide 3-34: **611-1236**

For the preheat process to occur, battery, **BT1**, **B+** current has to enter the **A1** control board at **A1-J1-8** after passing through the **F1** fuse. **B–** enters the control board at **A1-J1-7**. Pressing the **S1** start/stop switch to the start position sends a ground signal to the control board energizing the preheat circuit. Battery current will flow through the **F3** fuse and enter the control at **A1-J7** and exit at **A1-J8** where it flows to the **HR1** glow plugs. Battery current also flows from **A1-J1-2** to prime the **E2** fuel pump. During preheat, the GenSet status **LED** will flash rapidly.

Values: **HR1-3** glow plugs = **15 amps each.**
E2 fuel pump = **3$^1/_2$ to 5 psi.**

Preheat sequence of operation:

1. **S1 pressed to the preheat position.**
2. **A1 control board energized.**
3. **HR1 glow plugs preheat.**
4. **E2 fuel pump primes.**
5. **GenSet status LED flashes.**



OH3-34

S&TT 9/00

Start Mode

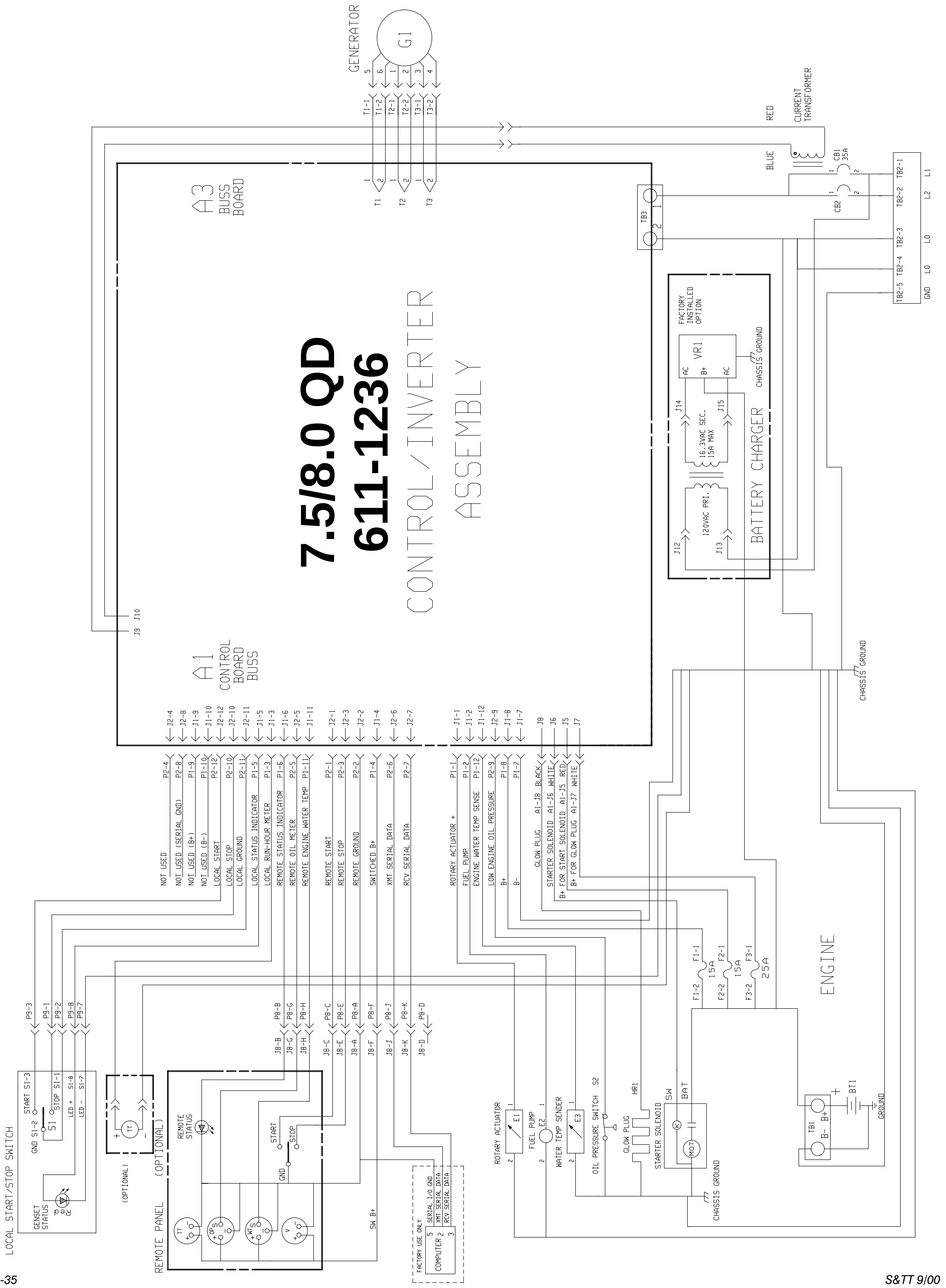
Slide 3-35: **611-1236**

When the **S1** start/stop switch is pressed to the start position, and the preheat timer satisfied, battery current from the **F2** fuse will enter the control board at **A1-J5**. It will exit the control board at **A1-J1-2** and energize the **E2** fuel pump. The **E1** rotary actuator, that positions the fuel injection pump, will be energized next from **A1-J1-1**. Battery current will at last exit the board at **A1-J6** and energize the **B1** starter motor.

Battery current will continue to flow to the GenSet status **LED,** displaying a steady light.

Start sequence of operation:

1. **S1 pressed to the start position.**
2. **A1 control board energized.**
3. **Fuel Pump E2 energized.**
4. **Rotary Actuator E1 energized.**
5. **Starter B1 energized.**
6. **GenSet status light remains on.**



OH3-35

S&TT 9/00

Run Mode

Slide 3-36: **611-1236**

For the **QD** to go into the run mode, the **G1** generator must be producing enough control/inverter input voltage to tell the control that the engine has reached approximately **800 rpm**. With this signal, the control removes the output to the starter solenoid at **A1-J6** deenergizing the **B1** starter motor.

The outputs to the **E1** rotary actuator, **E2** fuel pump and the GenSet status **LED** will remain energized.

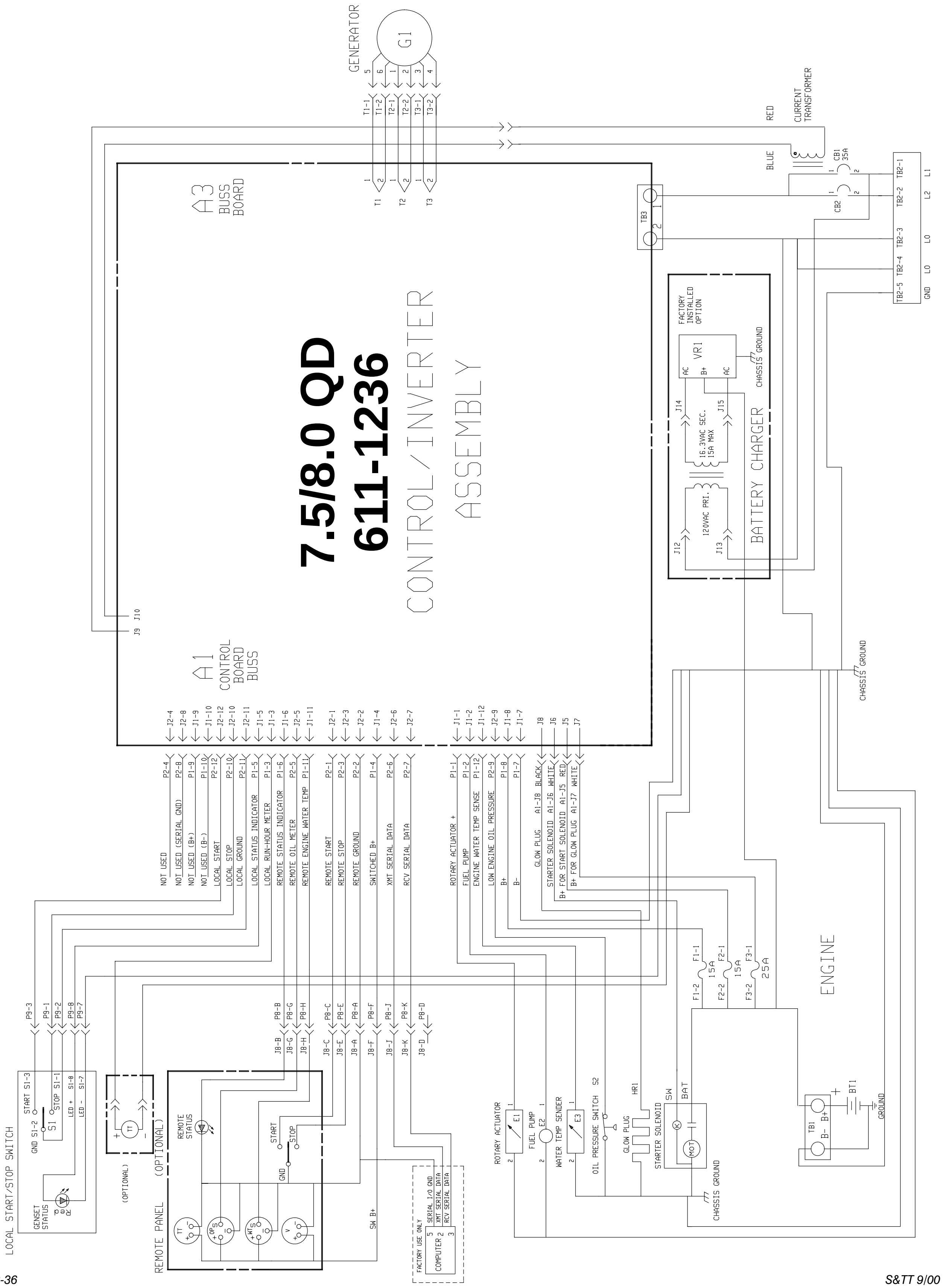
There is a short time delay before the control gets the signals from the **E3** water temperature sender and the **S2** oil pressure switch that engine is ok to continue to run.

The optional battery charger gets its operating voltage from the generator output. It goes through a step-down transformer and a voltage regulator/rectifier before it is sent to charge the battery.

Values: **Battery Charger = 14–15 VDC, 0–10 amps.**

Run sequence of operation:

1. **G1 generator output.**
2. **Starter solenoid output deenergized.**
3. **Starter motor deenergized.**
4. **E1 & E2 remain energized.**
5. **E3 & S2 enabled.**
6. **Battery charger operates.**



OH3-36

S&TT 9/00

Stop Mode

Slide 3-37: **611-1236**

Normal stop occurs when the start/stop switch **(S1)** is pressed to the stop position. This puts a ground signal to the control board that deenergizes the run circuit.

Battery current is removed from the fuel pump **(E2)** and the rotary actuator **(E1)** causing the injection pump to go to zero fuel.

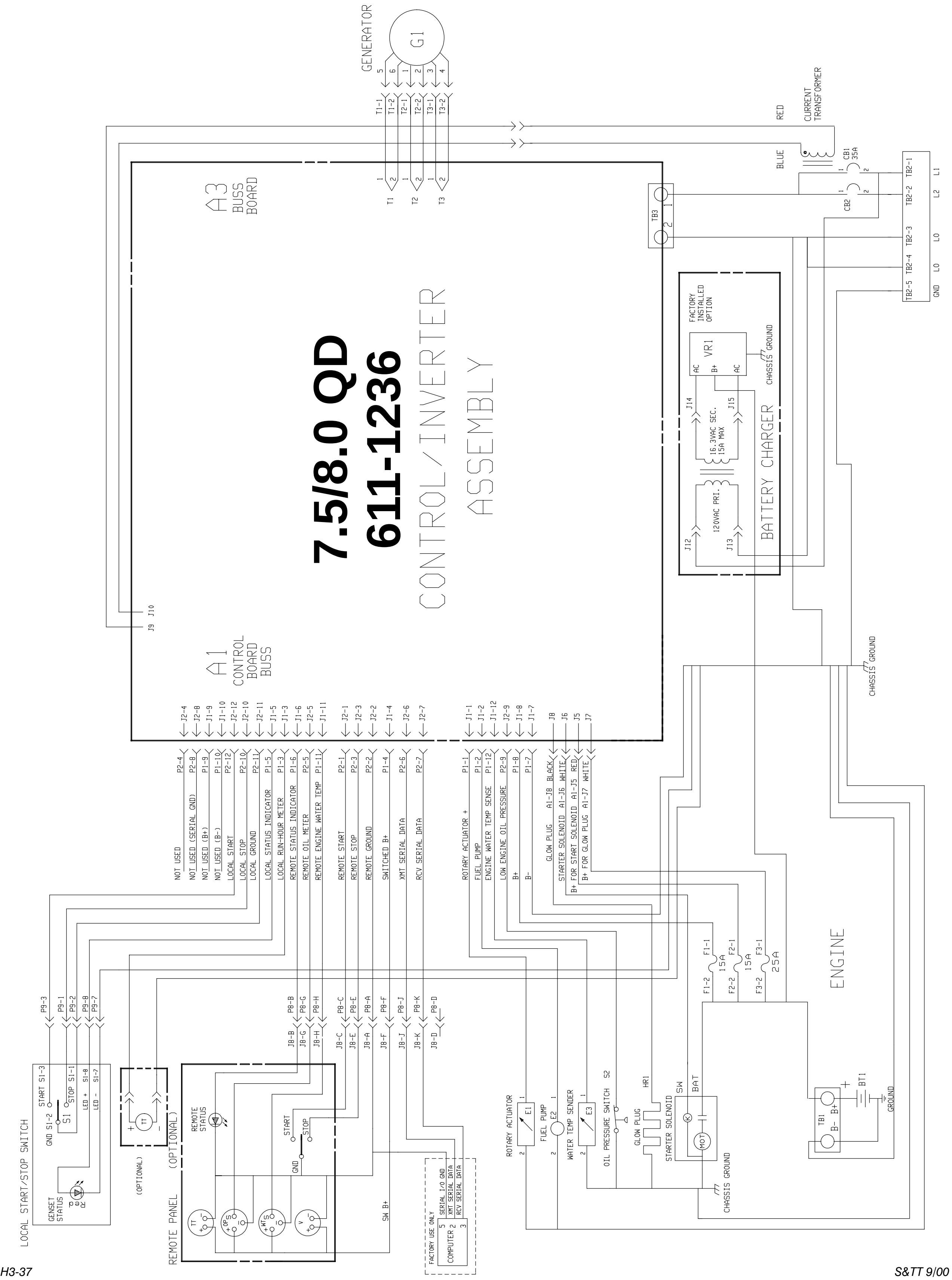
Stop sequence of operation:

1. **S1 switch pressed to stop.**
2. **A1 control board deenergized.**
3. **E1 & E2 deenergized.**

Emergency Stop

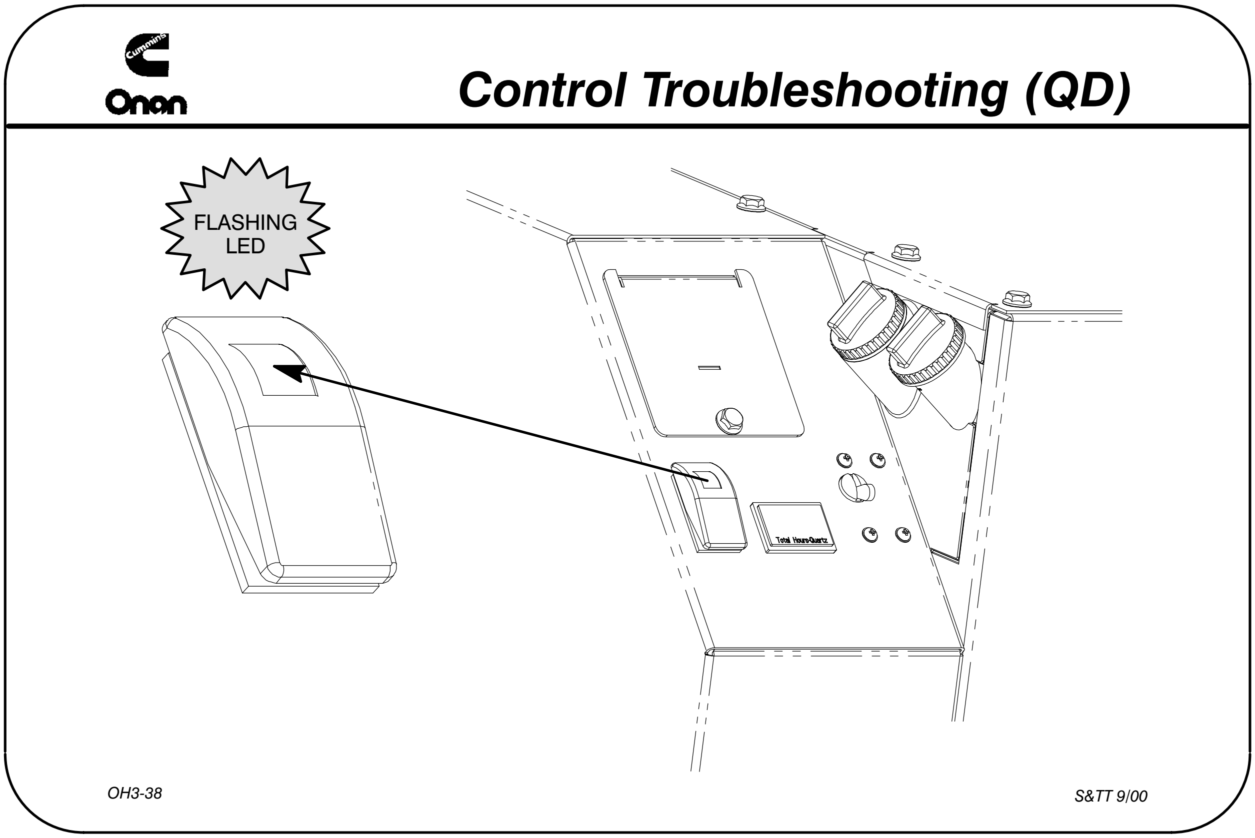
For emergency stop to happen, the engine oil pressure **(S2)** would have to drop below **7 psi.**, the engine temperature **(E3)** would have to exceed **230° F.**, or the inverter temperature would have to exceed **170° F.** to fault.

The rest of the faults are identified by the status indicator LED.



OH3-37

S&TT 9/00



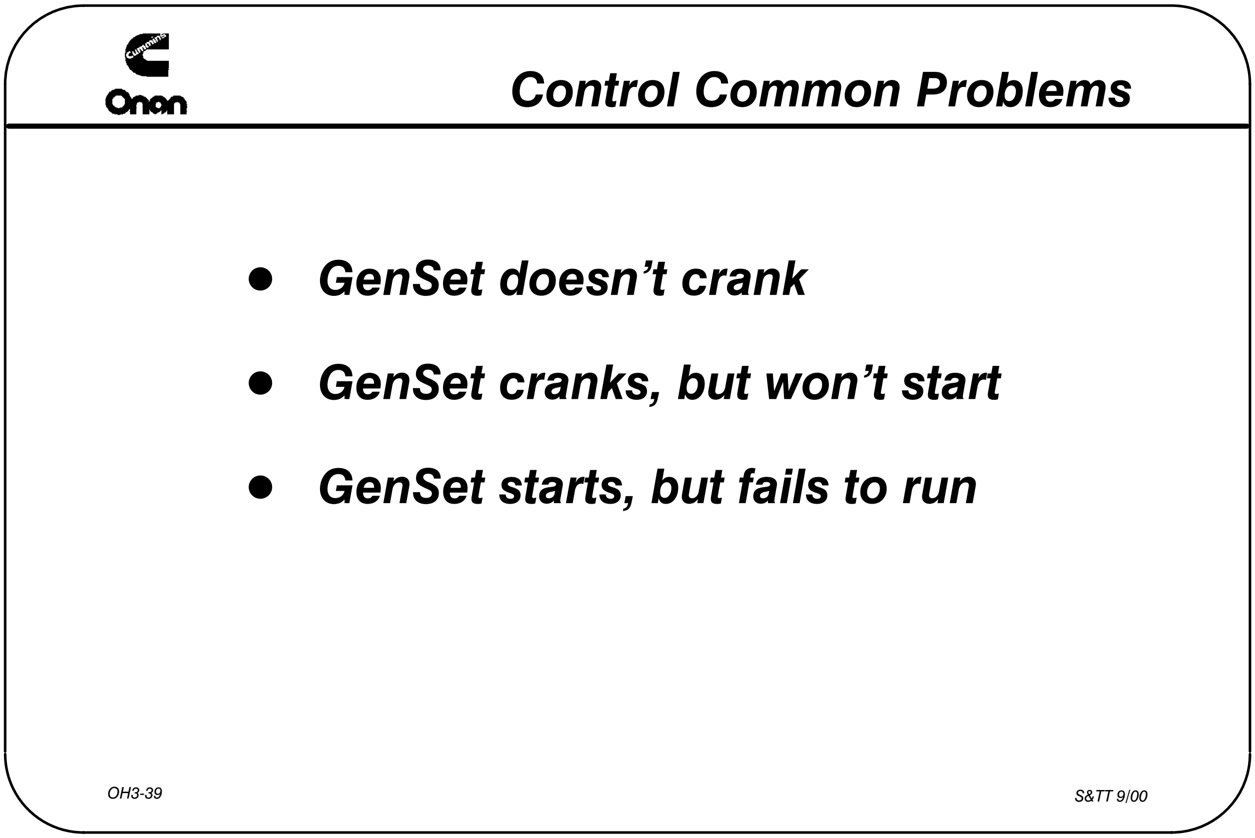
Control Troubleshooting (QD)

FLASHING LED

OH3-38

S&TT 9/00

Slide 3-38: Control Troubleshooting (QD)



Control Common Problems

- GenSet doesn't crank
- GenSet cranks, but won't start
- GenSet starts, but fails to run

OH3-39

S&TT 9/00

Slide 3-39: Control Common Problems

GenSet doesn't crank:

- Check the control fuse.
- Check control switch.
- Check battery and cables.
- Check starting ability both at set and remote.
- Fault circuit breaker open.
- Check the starter relay.
- Check the DC disconnect relay.

GenSet cranks, but won't start:

- Check fuel level and fuel shut off valve.
- Check for a blocked air cleaner.
- Low engine temperature/no pre-heat.

GenSet starts, but fails to run:

- Check the oil level/LOP switch.
- Check the high temp switch.

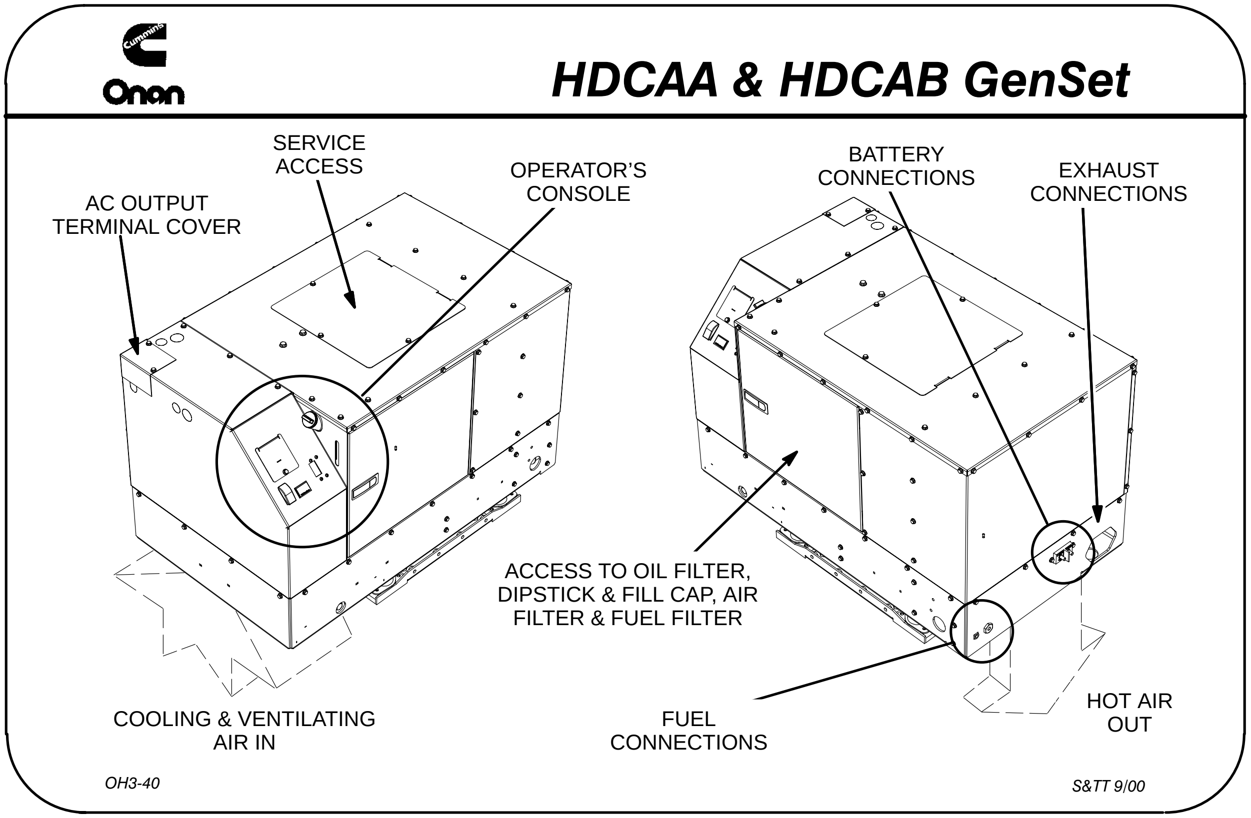
10/12.5 QD GenSet Overview

This lesson presents an overview of the Onan/Kubota generator set.

Objectives

After completing this lesson, participants should be able to:

- Identify the main features of the 10/12.5 QD GenSet.
- Identify the requirements to consider prior to installation of an 10/12.5 QD GenSet.
- Locate maintenance points and perform all scheduled service.
- Troubleshoot common engine, generator and control problems.



HDCAA & HDCAB GenSet

SERVICE ACCESS

AC OUTPUT TERMINAL COVER

OPERATOR'S CONSOLE

BATTERY CONNECTIONS

EXHAUST CONNECTIONS

ACCESS TO OIL FILTER, DIPSTICK & FILL CAP, AIR FILTER & FUEL FILTER

COOLING & VENTILATING AIR IN

FUEL CONNECTIONS

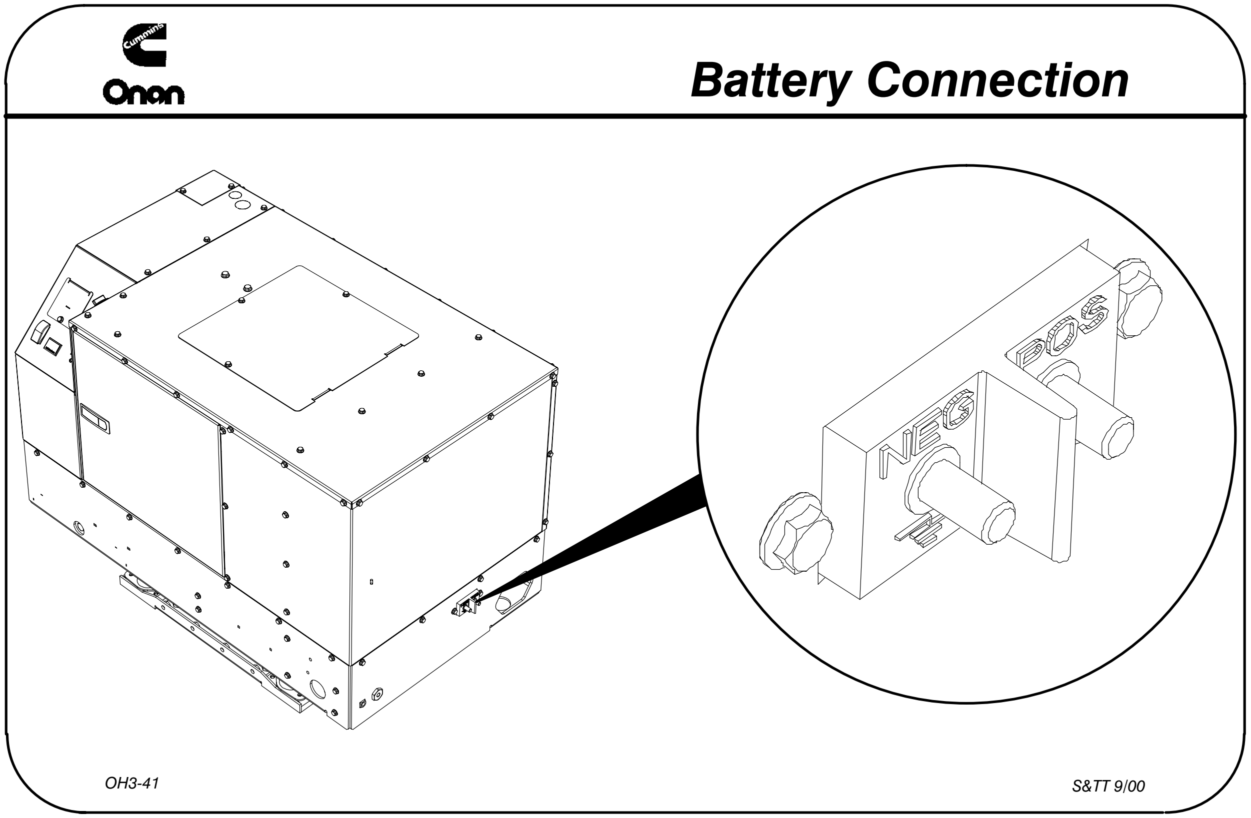
HOT AIR OUT

OH3-40

S&TT 9/00

Slide 3-40: HDCAA & HDCAB GenSet

- It comes in two models for <u>mobile</u> use: the 10 kW **HDCAA** & the 12.5 kW **HDCAB**.
- It uses the C.A.R.B. certified **Isuzu** 3 cylinder (1496 cc) diesel engine.
- It uses Onan's YK 4 pole revolving field generator.
- It has a Microprocessor control incorporating both user and service personnel diagnostics.
- It is designed for both up front and side of coach mounting applications.



Battery Connection

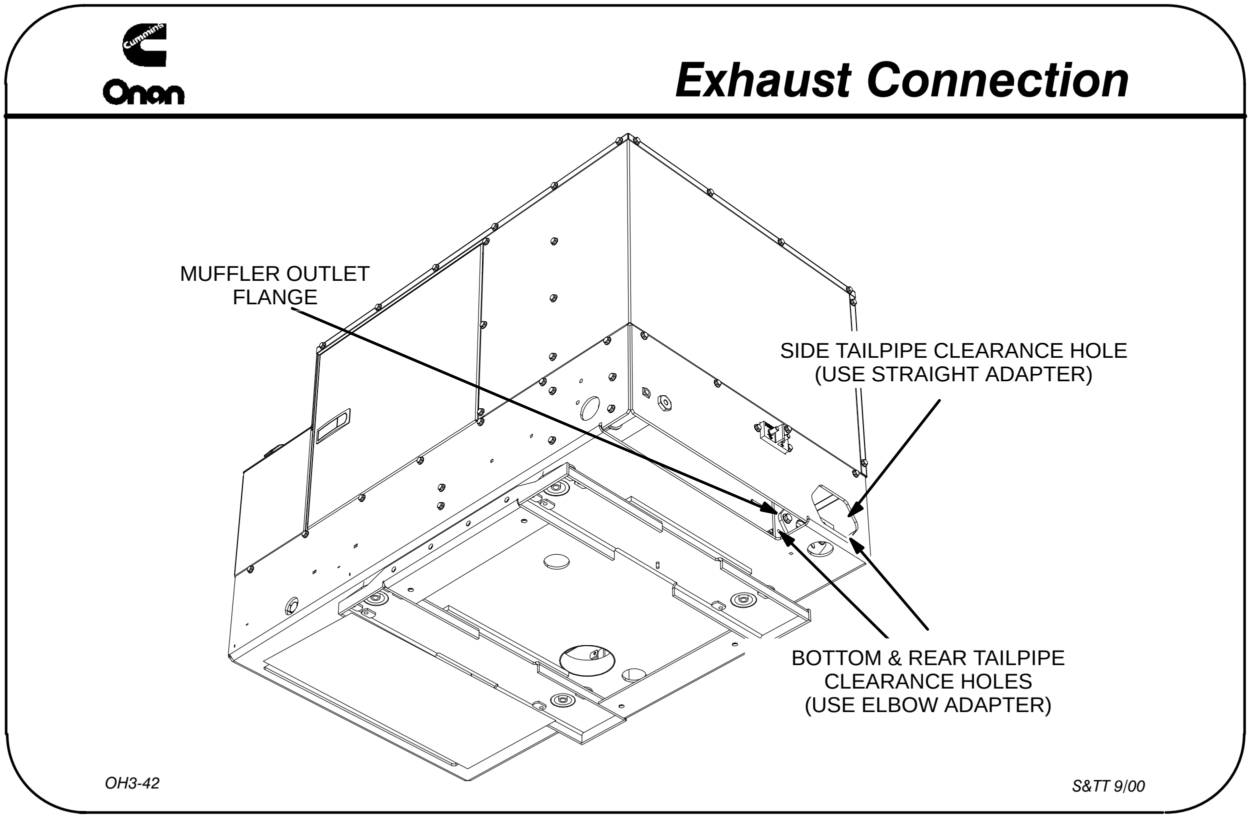
OH3-41

S&TT 9/00

Slide 3-41: Battery Connection

Be concerned about:

- Batteries
- Battery Capacity
- Battery Recharging
- Battery Compartment
- Battery Cables
- GenSet Bonding Terminal
- Connecting Battery And Bonding Cables



Exhaust Connection

MUFFLER OUTLET FLANGE

SIDE TAILPIPE CLEARANCE HOLE
(USE STRAIGHT ADAPTER)

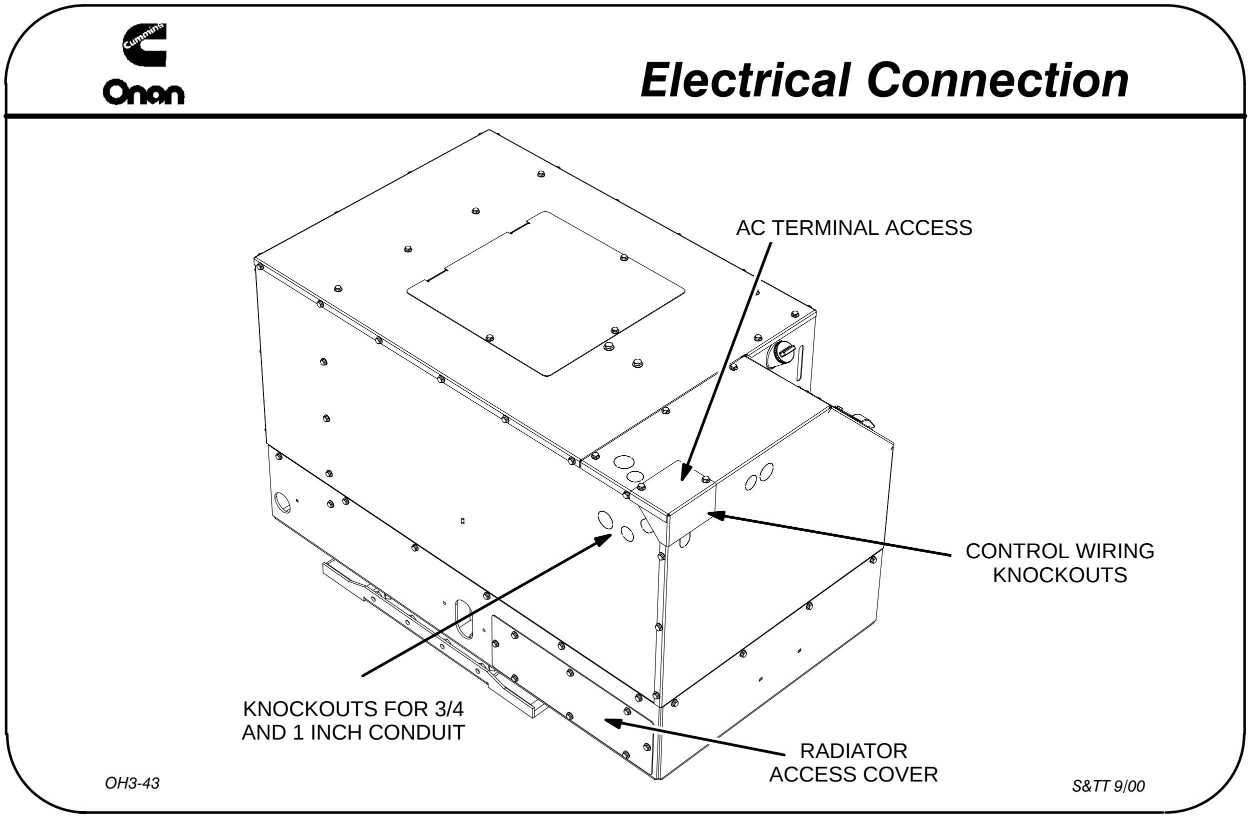
BOTTOM & REAR TAILPIPE
CLEARANCE HOLES
(USE ELBOW ADAPTER)

OH3-42

S&TT 9/00

Slide 3-42: Exhaust Connection

- The exhaust system must be gas-tight and designed to limit entry of exhaust gases into the vehicle.
- Do not connect the GenSet to the vehicle engine exhaust system.
- The muffler meets the requirements of the U.S. Forest Service as a spark-arrest muffler. (Failure to provide and maintain a spark arrester can be a violation of the law.)
- Tailpipe adapter kits are available separately.
- Do not terminate the tailpipe underneath the vehicle.
- Do not route the tailpipe such that it will interfere with draining engine oil or coolant or restrict the air inlet.
- Do not route the tailpipe closer than 3 inches (76 mm) to combustible material (wood, felt, cotton, organic fibers, etc.) unless it is insulated or shielded.
- Do not terminate the tailpipe such that it is closer than 6 inches (153 mm) to any opening into the vehicle interior (door, window, vent).



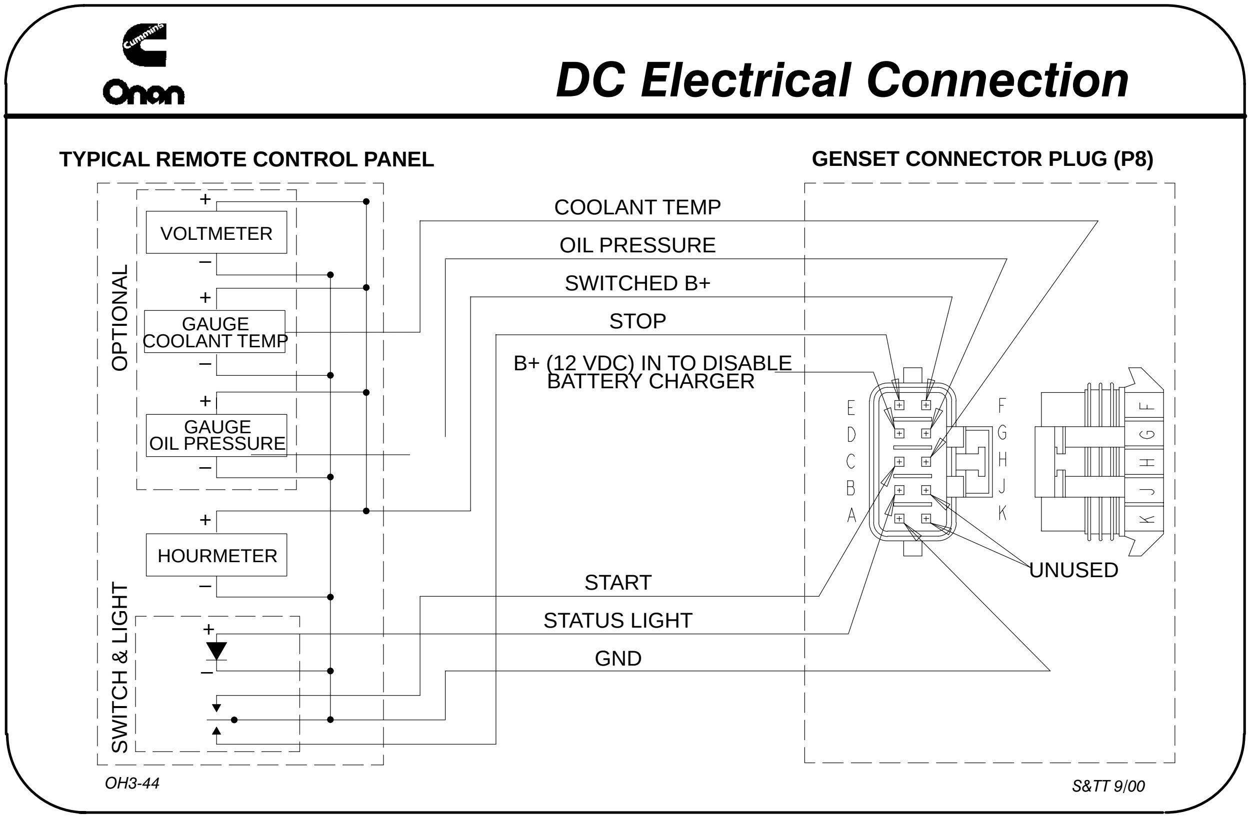
Electrical Connection

OH3-43

S&TT 9/00

Slide 3-43: Electrical Connection

- To prevent accidental starting of the GenSet during installation, do not connect the battery cables at the battery until so instructed in the *Installation Review and Startup Section*.
- The GenSet is equipped with a terminal block and conduit connector knockouts for AC power output connections.



DC Electrical Connection

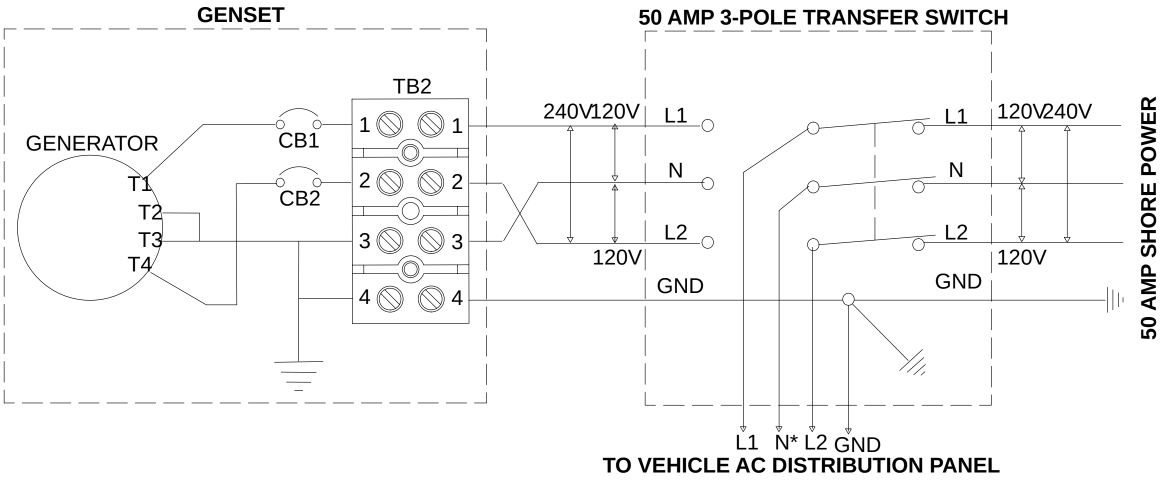
OH3-44

S&TT 9/00

Slide 3-44: DC Electrical Connection

- The 10-pin plug that connects to the end of the remote control lead is stowed inside the AC terminal enclosure when the GenSet is shipped from the factory. Harnesses of various lengths with mating receptacles are available separately.
- If the harness does not have a plug for connections at the control panel, use solder-type butt connectors and heat-shrink insulation tubing to connect to the wiring from the remote panel. Use insulated 18 AWG copper conductors for the wiring from the remote panel.
- Keep control leads away from AC power leads to reduce the possibility of erratic operation due to induced signals.
- Seal the hole where the leads enter the interior of the vehicle to keep out exhaust gas. Use silicone rubber or an equivalent type of sealant.
- The control switch should be a two-pole, momentary-contact, center-return/center-off type of switch with an indicator light.
- The engine oil pressure and water temperature gauges should be compatible with the GenSet.
- The GenSet battery charger can be disabled when another battery charger is active, such as the alternator on the vehicle propulsion engine, by connecting GenSet connector P8-D to B+ (12 VDC).

AC Electrical Connection

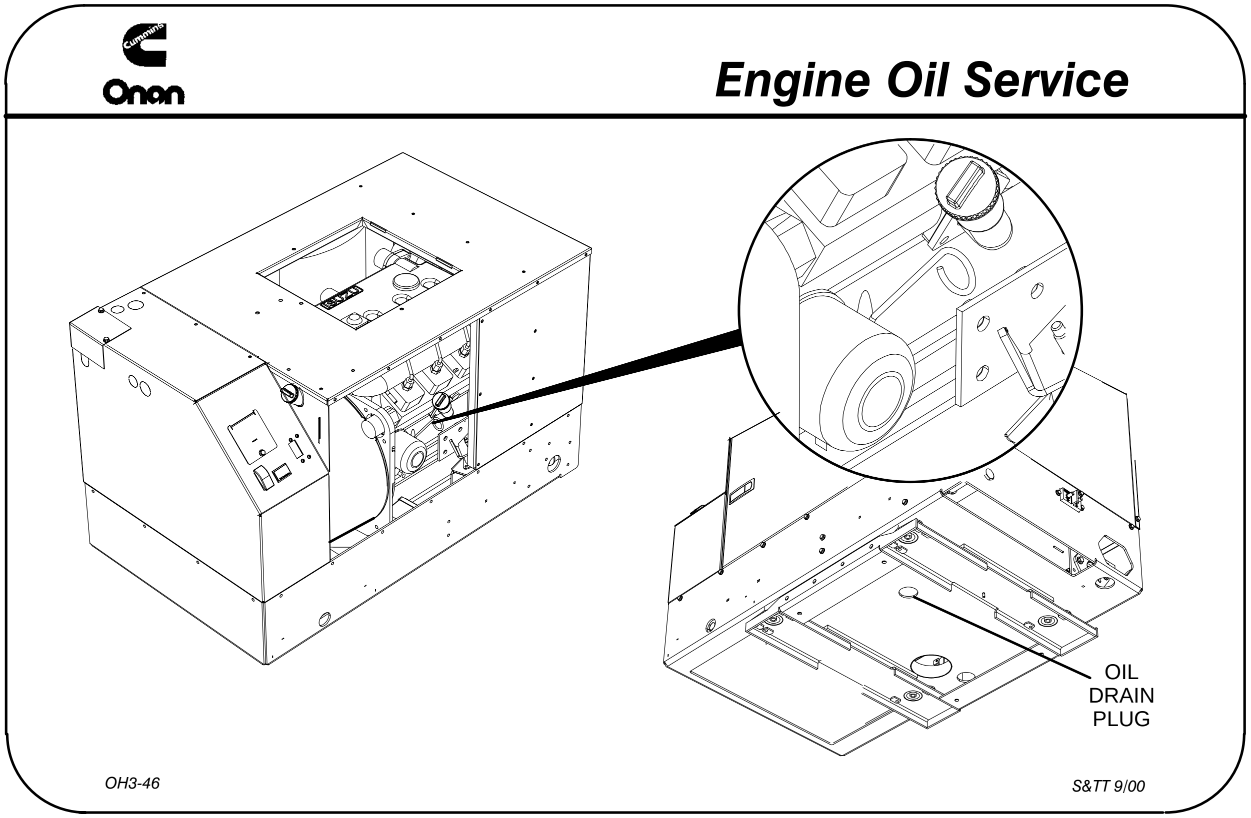


OH3-45

S&TT 9/00

Slide 3-45: AC Electrical Connection

- Wiring methods must be in accordance with applicable codes. See the *Service Manual* for typical connections.
- Seal all wiring entrance holes into the interior of the vehicle (inside and outside all conduit connectors) to keep out exhaust gas. Use silicone rubber or an equivalent type of sealant.
- Secure only one lead at each AC output terminal. The terminals are suitable for wire sizes up to No. 6 AWG.
- Use rain-tight conduit, conduit connectors and junction boxes for all exterior wiring.
- Use ground fault circuit interrupters (GFCIs) for all branch circuits with convenience power receptacles.
- Route or protect AC wiring so that it will not be cut or abraded, exposed to hot surfaces or damaged by road debris. Keep AC wiring away from fuel lines and control wiring.
- When the vehicle has provision for connecting utility power it must have an approved device to keep the GenSet and utility from being interconnected. See the *Service Manual* for typical connections.



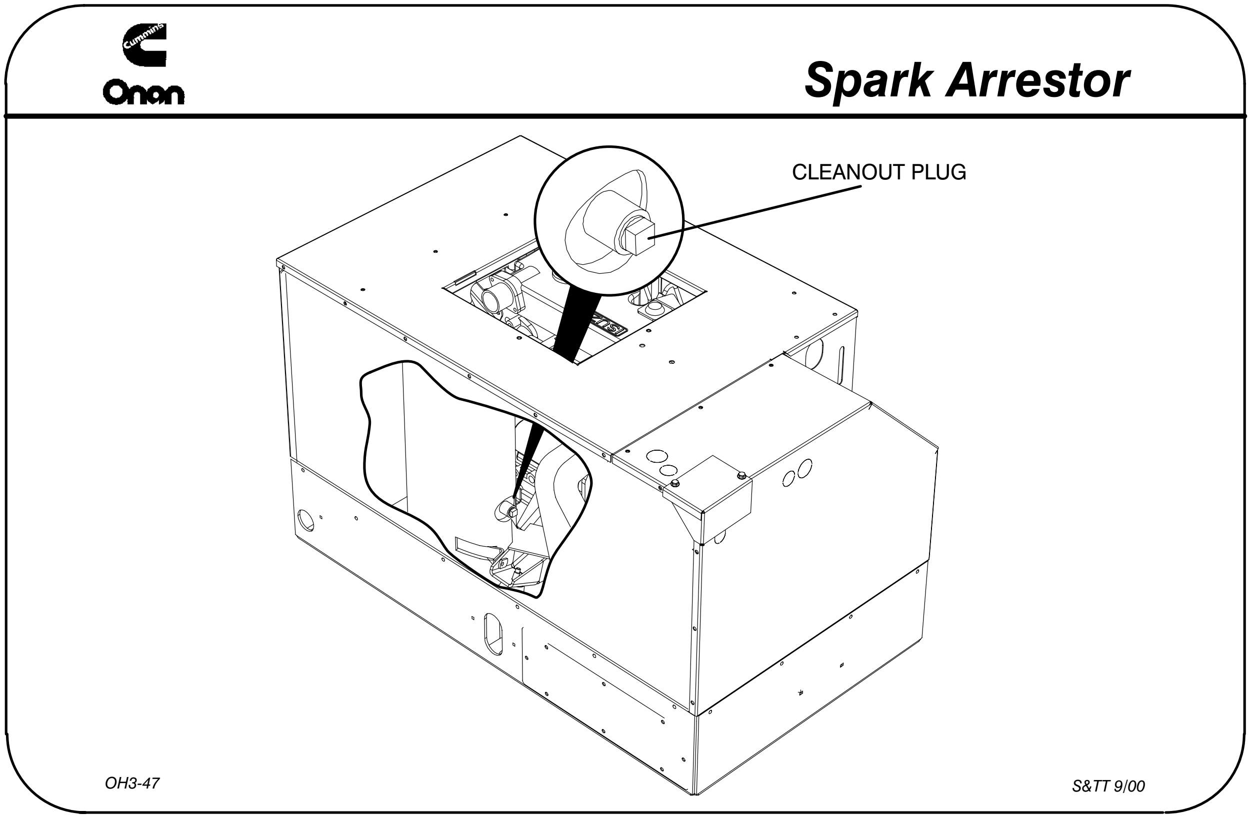
Engine Oil Service

OH3-46

S&TT 9/00

Slide 3-46: Engine Oil Service

- Check oil quality and quantity before each use. Make sure its not diluted with fuel, dirty or gritty feeling and that the level is properly maintained.
- Change the oil after the first 50 hours of break-in then every 250 hours or once a year thereafter.
- Perform more often when operating in dusty conditions or when operating in hot weather.
- Use the *Engine Oil Recommendations* list in the *Operator's Manual* for the correct oil to use.



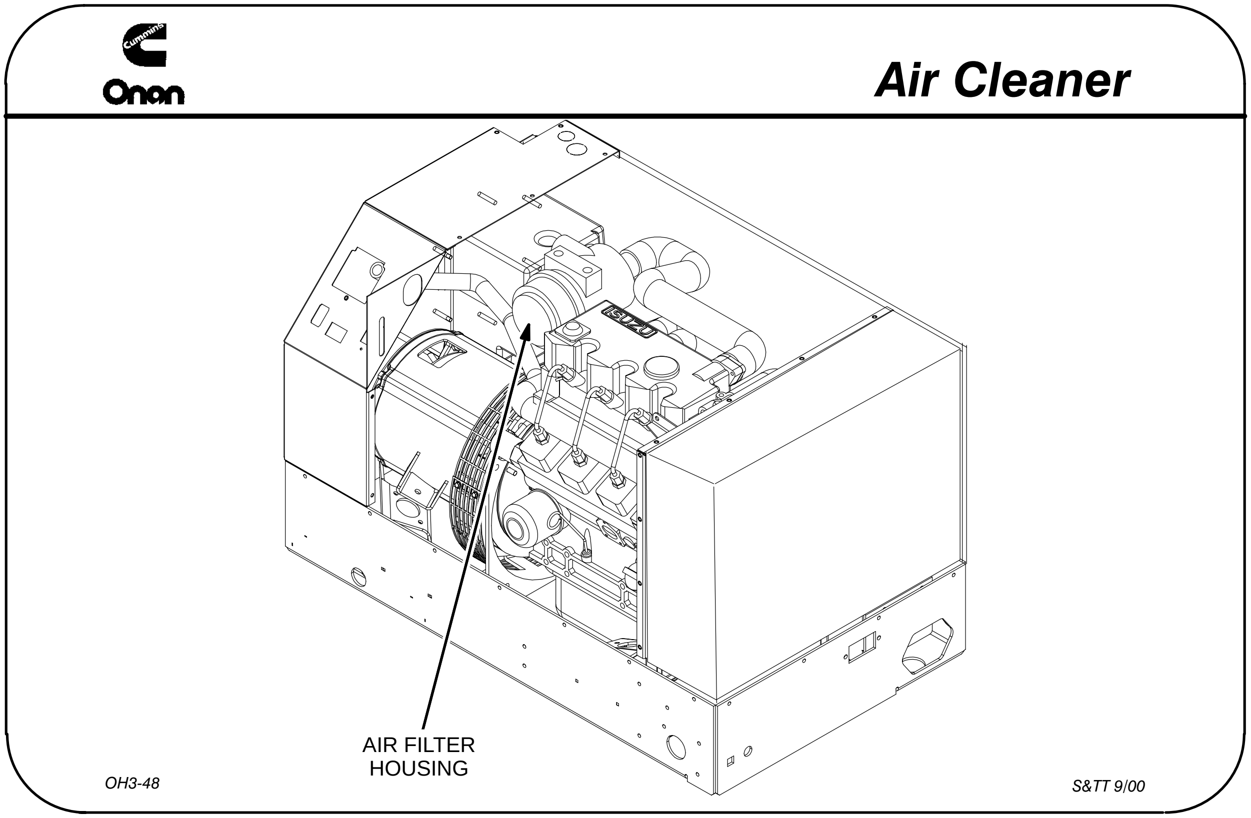
Spark Arrestor

OH3-47

S&TT 9/00

Slide 3-47: Spark Arrestor

- The muffler is mounted inside the GenSet housing. The spark arrestor cleanout plug is located on the side of the muffler and is accessible through the top service access cover.
- Remove the cleanout plug ($^{7}/_{16}$ inch square head) from the muffler and secure the top access cover before running the GenSet. With the cover in place there will be enough air flow to cool the engine properly and carry the soot out of the compartment.
- Start the GenSet and load it nearly to full power. Let the GenSet run for about five minutes to expel the soot. Stop the GenSet, allow the muffler to cool down, reinstall the cleanout plug and secure the service access cover.



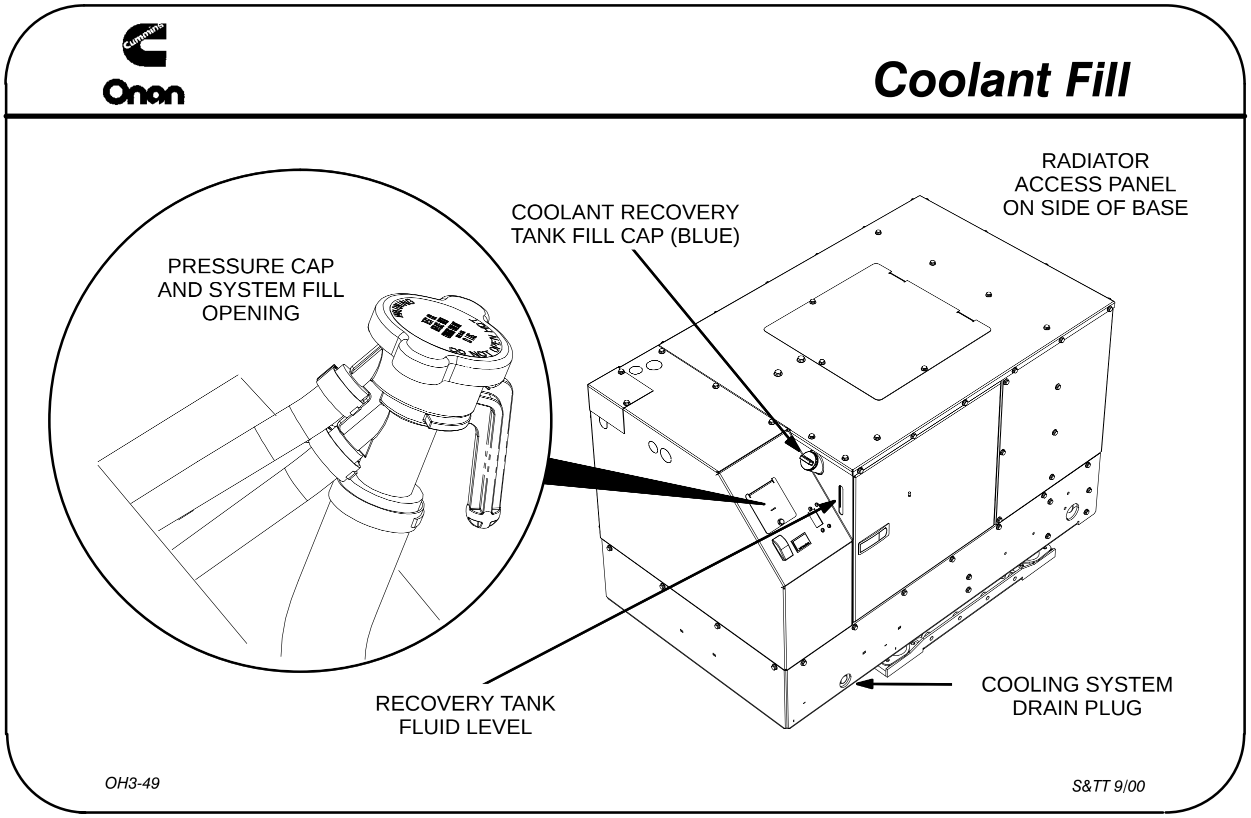
Air Cleaner

OH3-48

S&TT 9/00

Slide 3-48: Air Cleaner

- Service the air filter every 500 hours or at least once a year.
- In dusty conditions the air filter element should be inspected and changed more frequently for best operation.
- The air filter is accessible through the front service access opening after loosening the three screws that secure the coolant recovery tank to the top housing panel and moving the tank out of the way.
- To change the air filter element, remove the end cap, withdraw the element and reassemble with a new air filter element. Re-secure the service access door.



Coolant Fill

PRESSURE CAP AND SYSTEM FILL OPENING

COOLANT RECOVERY TANK FILL CAP (BLUE)

RADIATOR ACCESS PANEL ON SIDE OF BASE

RECOVERY TANK FLUID LEVEL

COOLING SYSTEM DRAIN PLUG

OH3-49

S&TT 9/00

Slide 3-49: Coolant Fill

- The engine cooling system is filled with a 50/50 mixture of ethylene glycol and water when the GenSet leaves the factory, which is suitable for temperatures down to -34° F (-37° C).

- Replace the coolant every two years. Use ethylene or propylene glycol anti-freeze solution that contains a rust and corrosion inhibitor, ***but not a stop-leak additive***. The water should be clean, low in minerals and free of corrosive chemicals (distilled water if available).

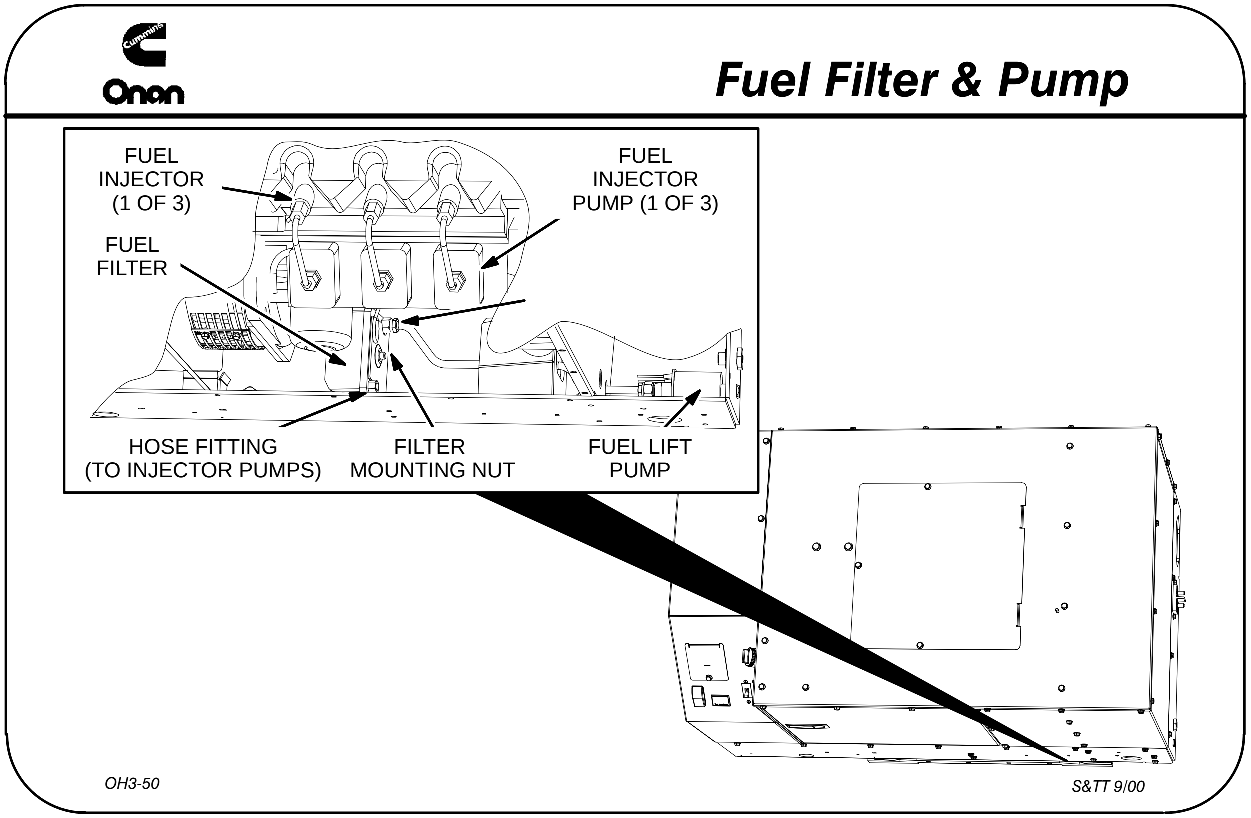
- Replace pressure caps every two years to maintain proper cooling system pressure (14 psi) for optimal engine cooling and minimal coolant loss.

- Allow the engine to cool before removing the pressure cap.

- It is recommended that the system be cleaned and flushed before refilling.

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

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



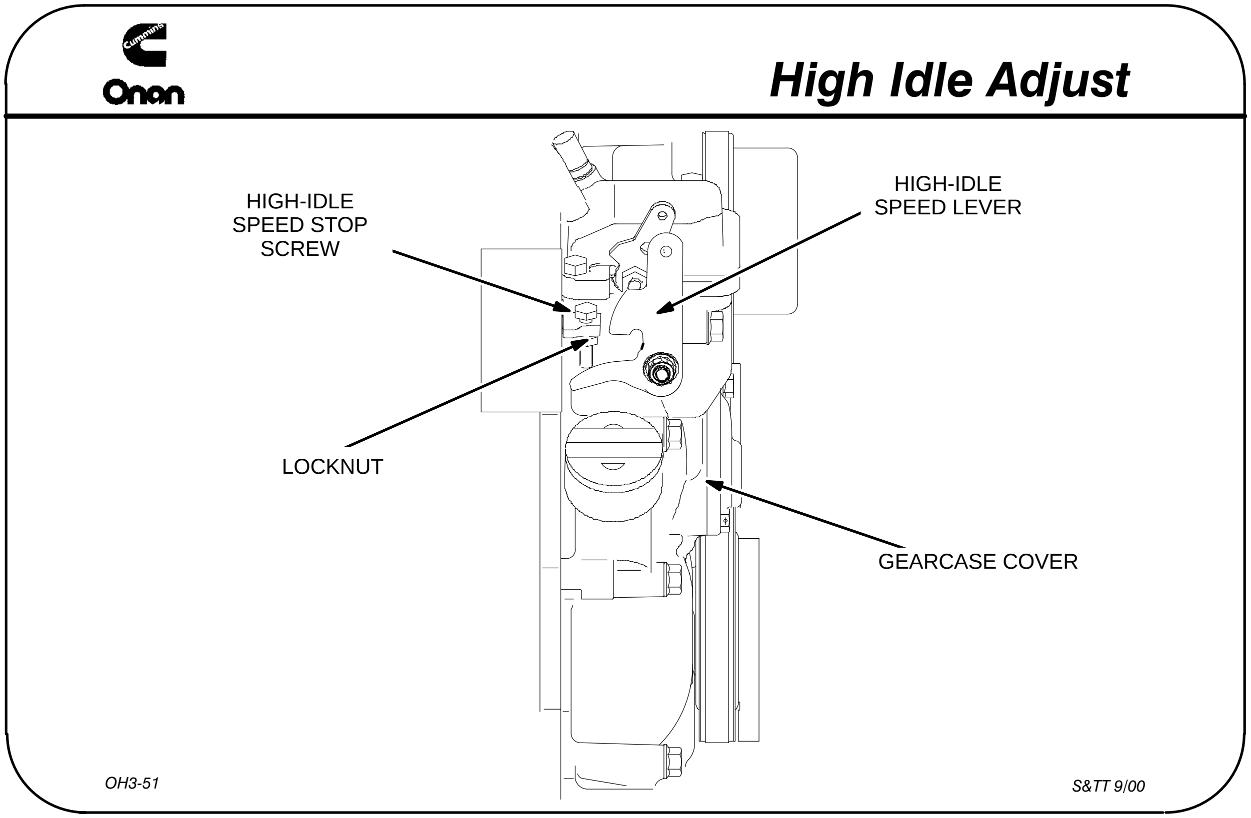
Fuel Filter & Pump

OH3-50

S&TT 9/00

Slide 3-50: Fuel Filter & Pump

- Service the fuel filter every 500 hours or at least once a year.
- A dirty fuel filter may be the cause of a failure to start. The fuel filter is accessible through the front service access door.
- Take care to spill as little fuel as possible when disconnecting the filter from the fuel line. Close any shut off valve in the fuel line. Wipe dirt off the fuel hose fittings at the filter.
- Connect the fuel fittings before tightening the filter mounting nut. Take care not to crossthread the fuel fittings. Thread them in by hand and tighten one flat past seating.
- Prime the fuel system by holding the control switch down in its **Stop** position for at least 1 minute after replacing the fuel filter. Priming is necessary to displace the air in the new filter and fill it with fuel.



High Idle Adjust

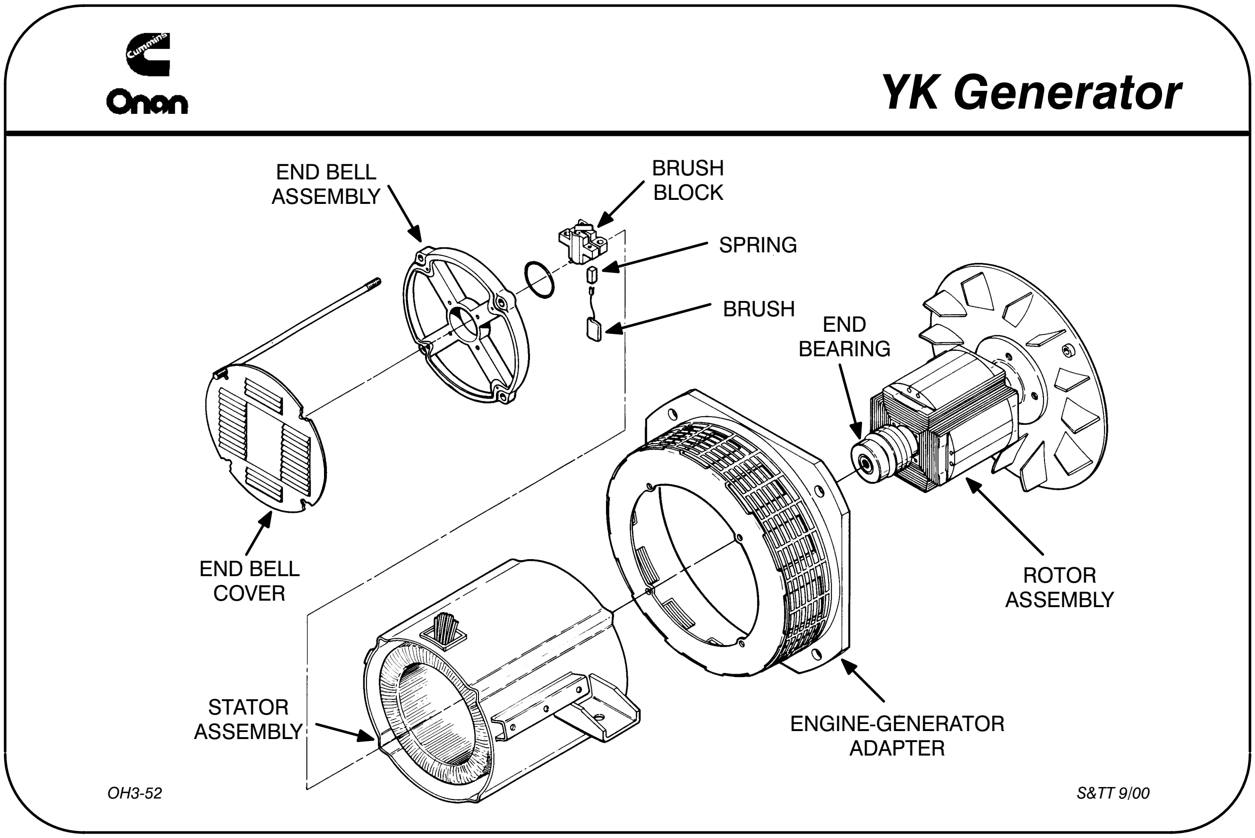
OH3-51

S&TT 9/00

Slide 3-51: High Idle Adjust

High-idle speed will have to be reset if the stop screw seal has been broken or internal governor parts have been replaced or are worn. To reset high-idle speed:

- Remove the top housing panel for access to the stop screw.
- Disconnect the governor actuator leads from the engine harness and connect them across a 12 volt battery so that the engine will continue to run even though the controller drives towards shutdown because of overspeed.
- Adjust the stop screw to obtain a frequency of **67.3-68.3 Hertz (2019-2049 rpm).**
- Put the top panel back on and check speed. The frequency should be **68-69 Hertz (2040-2070 rpm)** when the top panel is on. Repeat the adjustment if necessary and seal the threads with paint.
- Disconnect the 12 volt battery from the governor actuator and reconnect to leads from the engine harness.



YK Generator

OH3-52

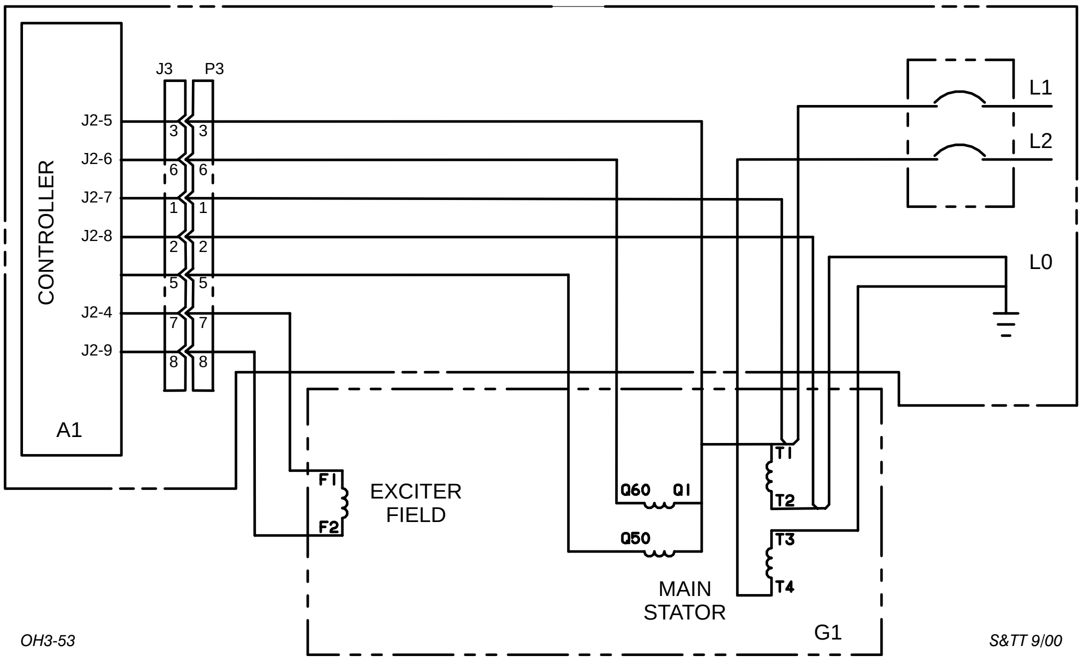
S&TT 9/00

Slide 3-52: YK Generator

- During GenSet start, battery B+ is applied to the rotor through the slip rings. This momentary **field flash** connection provides adequate residual magnetism in the rotor. With this **initial excitation** and the electromagnetic field rotating inside the stator, an AC voltage is induced into the stator windings.
- A portion of this voltage is provided to the microprocessor where it is rectified to DC and supplied to the slip rings for the field **self excitation.**
- As the load changes, the DC voltage to the slip rings will **automatically change** to keep the output voltage constant.

Note: This is the process of **automatic voltage regulation**.

YK Generator



OH3-53

S&TT 9/00

Slide 3-53: YK Generator

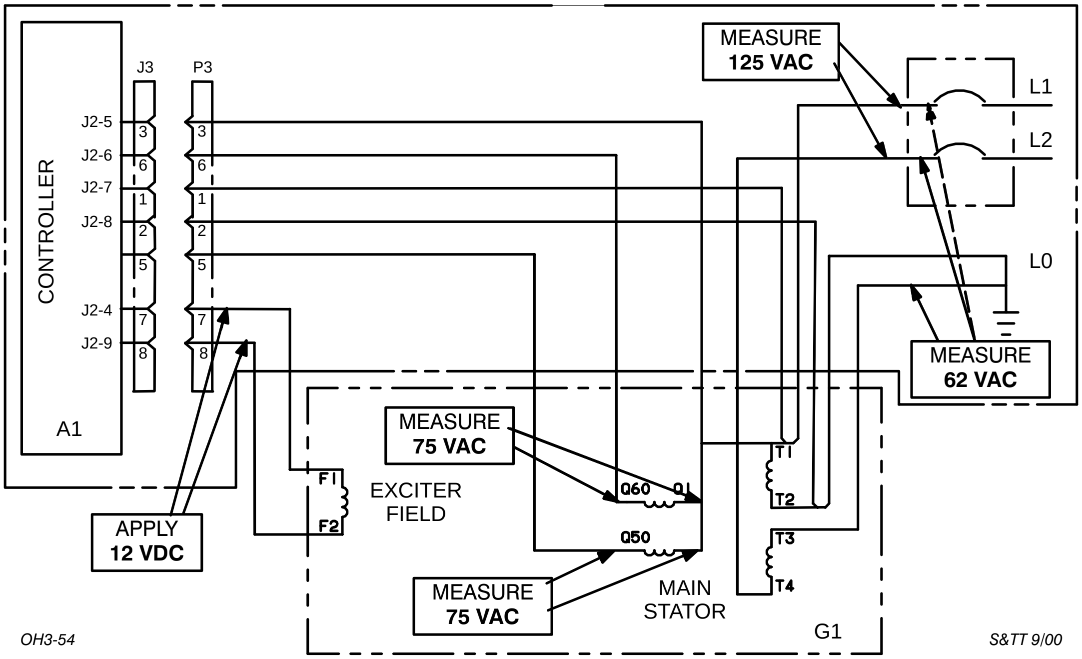
- **The Microprocessor/Controller** supplies DCV to the field winding **(F1/F2 leads)** through brushes and slip rings, thereby establishing a revolving 4-pole magnetic field. The battery is connected during startup to initiate this initial field excitation process. The microprocessor supplies the self excitation field current during generator operation. Rated output voltage is maintained as the generator load varies, by varying field current to maintain field strength proportional to the load.

- **The revolving magnetic field** induces ACV in the stator windings **(T1/T2, T3/T4 and Q1/Q2)** which are connected to the microprocessor and the load.

- Under light load, **the stator windings** can supply sufficient current for the field to maintain rated output voltage.

- As the load increases, load currents increase, resulting in a proportional increase of current, which in turn supplies the field. Rated output voltage is thereby maintained as the load varies.

YK Gen/Reg Test



OH3-54 S&TT 9/00

Slide 3-54: YK Gen/Reg Test

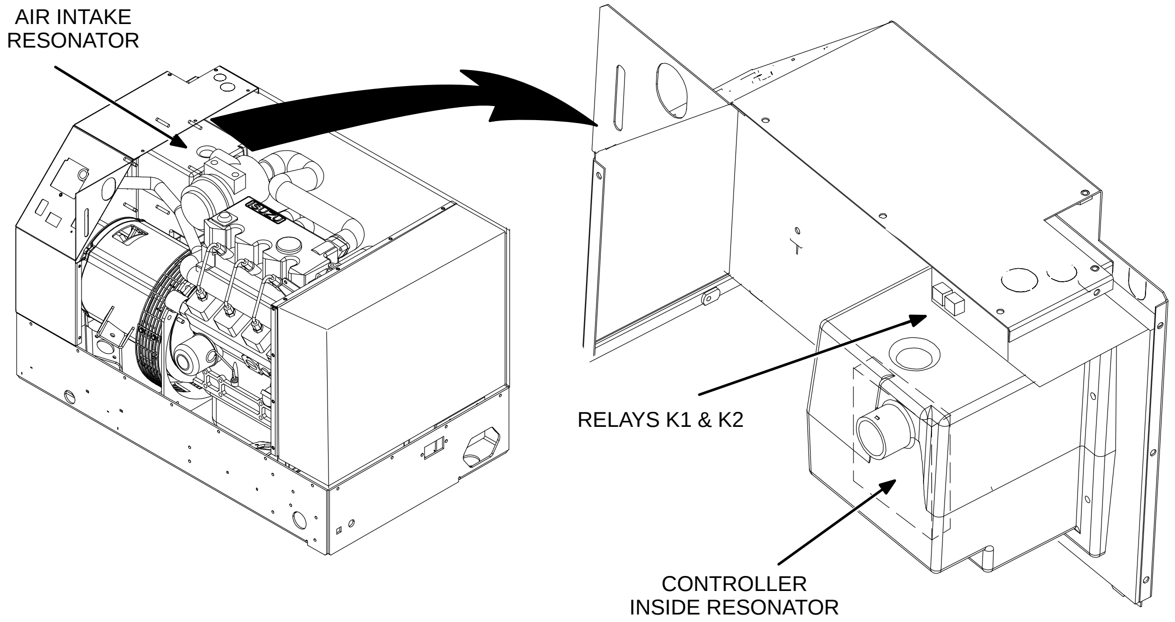
- Replaced the microprocessor with a 12-volt DC battery; 12 volts DC applied to the F1/F2 exciter stator should produce, at N.L. about 125 volts AC generator output voltage at L1/L2.
- Using a sharp voltage probe, touch carefully to the pins or terminals when making these tests.

1. Stop the generator set.
2. Unplug the microprocessor from the wiring harness.
3. Using jumpers and a spare plug or other connector, connect a 12-volt DC battery to the F1/F2 terminals or brushes.
4. Start the generator set. Use a voltmeter to measure the following voltages:

J4-4 - J4-6: 62 VAC + 20 VAC	**L1 - L2: 125 VAC + 20 VAC**
L1 - L0: 62 VAC + 20 VAC	**L2 - L0: 62 VAC + 20 VAC**
Q60 - Q1: 75 VAC + 20 VAC	**(50 Hz sets) Q50 - Q1: 75 VAC + 20 VAC**
S1 - S2: 62 VAC + 20 VAC	

5. If these voltages are measured, then the generator is operating correctly and the problem is elsewhere.

Controller



OH3-55

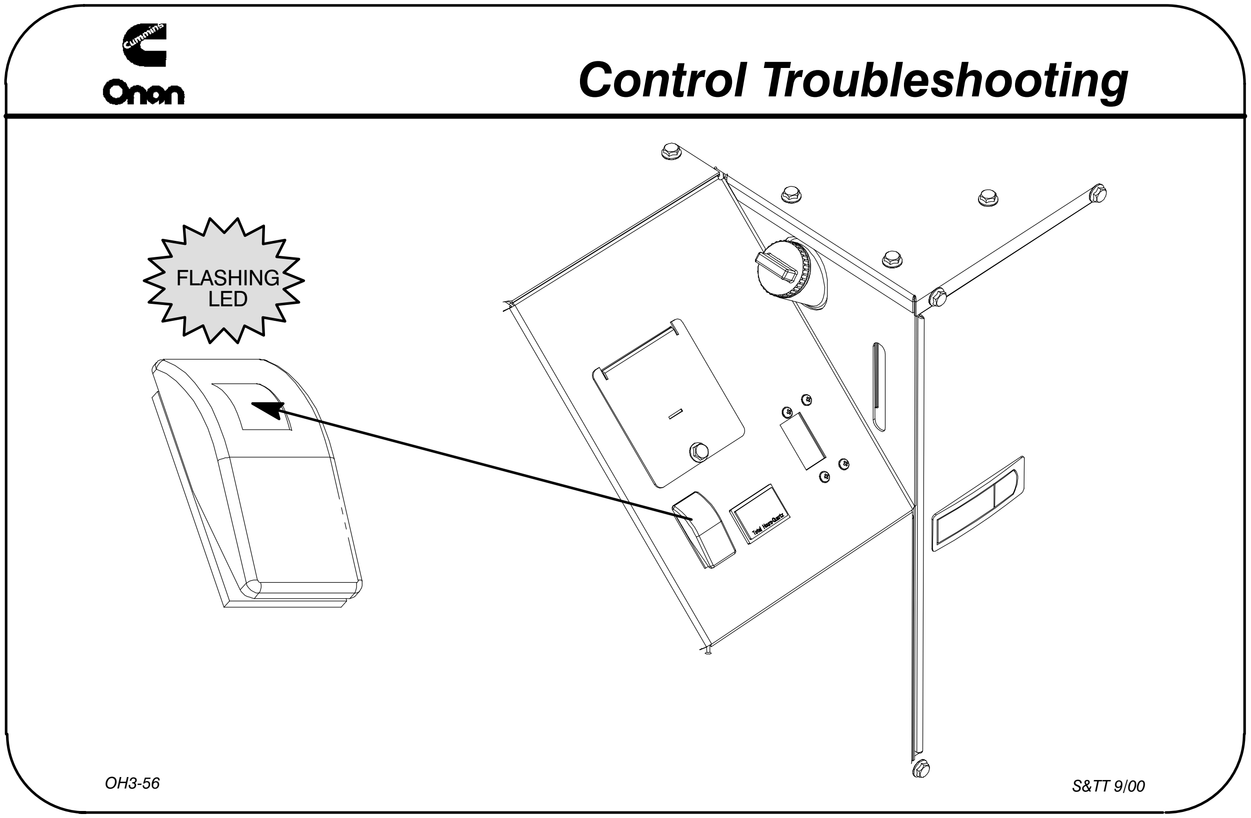
S&TT 9/00

Slide 3-55: Controller

- Controller **A1** is an integrated microprocessor-based engine and generator control which provides all the control, monitoring and diagnostics functions required to operate the GenSet.
- It is mounted inside the air intake resonator with three screws.
- Two connectors provide for all connections:

  J1/P1, which is gray and mounted outboard of the other connector.

  J2/P2, which is black and mounted inboard.
- Two auxiliary relays, **K1** (alternator disable) and **K2** (starter pilot) are mounted above the resonator, on the back of the output terminal compartment.



Control Troubleshooting

FLASHING LED

OH3-56

S&TT 9/00

Slide 3-56: Control Troubleshooting

- ***Control Switch –*** This switch is used to start and stop the GenSet, prime the engine fuel system and restore the blinking fault code.
- ***Status Light –*** This is an LED (light emitting diode) in the control switch which blinks rapidly during preheat and cranking. The controller automatically varies the time based on engine temperature. After the GenSet starts up, this light stays on continuously, indicating that the GenSet is running and that the starter has disconnected. If the GenSet shuts down, this light blinks in a coded fashion to indicate the nature of the fault shutdown.

Activity

Directions: Using your highlighters, and the copies of the **HDCAA/AB** control schematic, **611-1256**, follow along with the instructor and color the modes of operation on your sheets.

The page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **HDCAA/AB GenSet’s** when they don’t operate properly.

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Preheat Mode

Slide 3-57: **611-1256**

For the preheat process to occur, battery, **BT1**, **B+** current has to enter the **A1** control board at **A1-J2-2** after passing through the **F1** fuse. **B–** enters the control board at **A1-J2-3**. Pressing the **S1** start/stop switch to the start position sends a ground signal to the control board energizing the preheat circuit. During pre-heat, battery current will enter the control at **A1-J2-12** and exit at **A1-J2-1** where it flows to the **HR1** glow plugs.

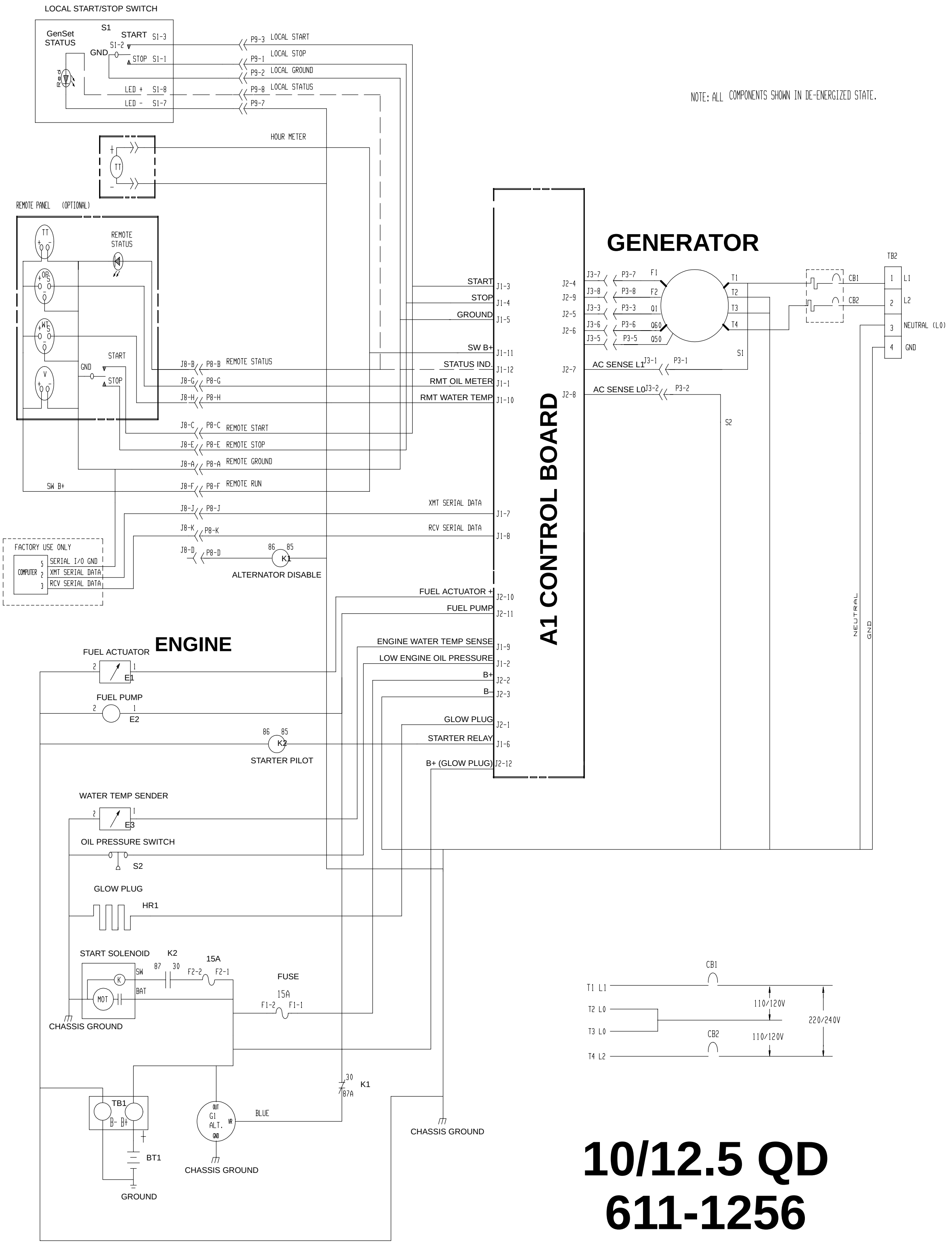
Battery current also flows from **A1-J2-11** to prime the **E2** fuel pump.

During preheat, the GenSet status **LED** will flash rapidly.

Values: **HR1-3** glow plugs = **15 amps each.**
E2 fuel pump = **3$^1/_2$ to 5 psi.**

Preheat sequence of operation:

1. **S1 pressed to the start position.**
2. **A1 control board energized.**
3. **HR1 glow plugs preheat.**
4. **E2 fuel pump primes.**
5. **GenSet status LED flashes.**



10/12.5 QD
611-1256

OH3-57

S&TT 9/00

Start Mode

Slide 3-58: **611-1256**

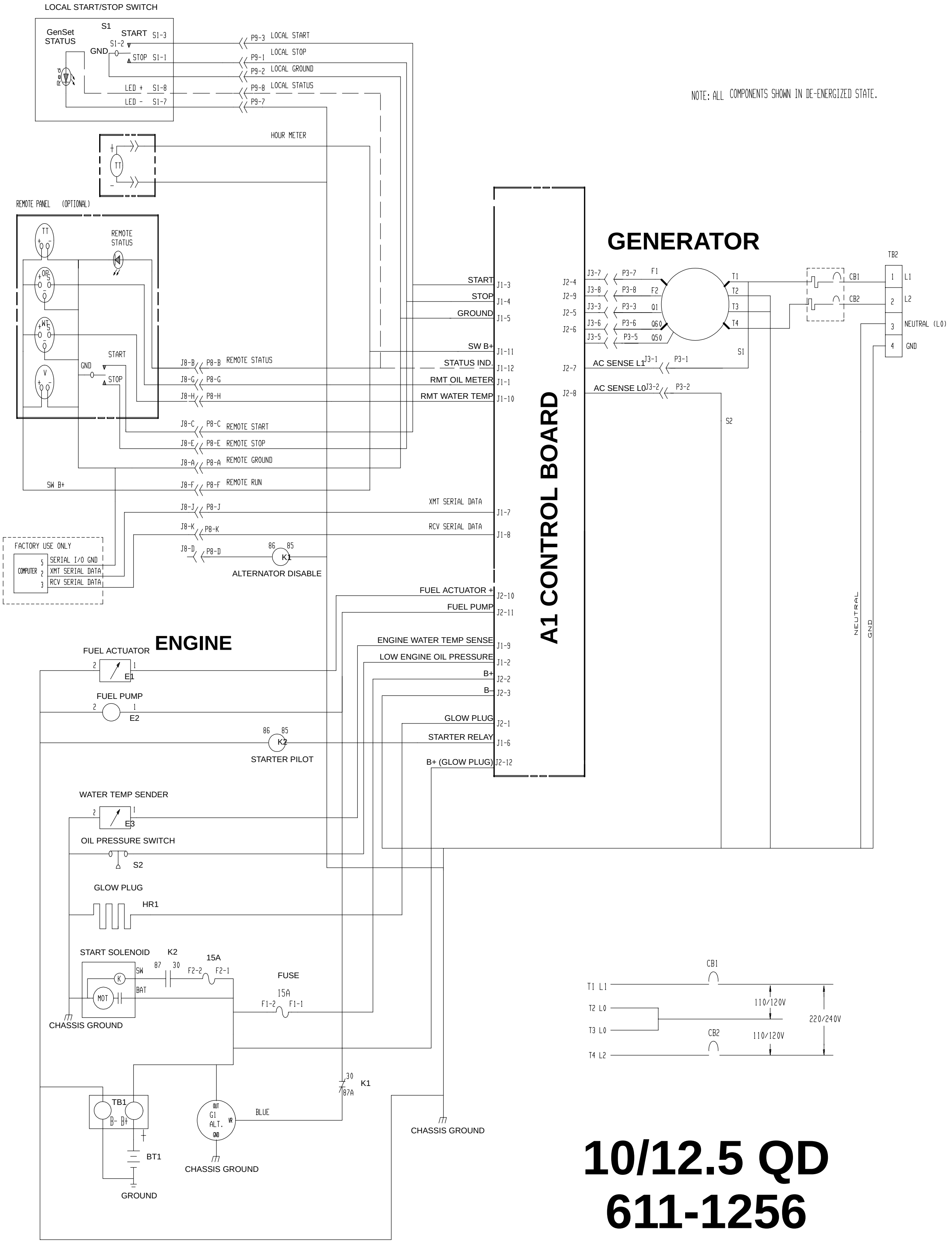
When the **S1** start/stop switch is pressed to the start position, and the preheat timer satisfied, battery current from **A1-J2-10** will energize the **E1** fuel actuator that positions the fuel injection pump. Battery current will now exit the board at **A1-J1-6** and energize the **K2** starter pilot relay which closes its contacts allowing current to energize the **B1** starter motor. Battery current will also continue to exit the control board at **A1-J2-11** and energize the **E2** fuel pump.

During start, the low oil pressure switch is by-passed.

Battery current will continue to flow to the GenSet status **LED,** displaying a steady light.

Start sequence of operation:

1. **S1 pressed to the start position.**
2. **A1 control board energized.**
3. **Fuel Pump E2 energized.**
4. **Fuel Actuator E1 energized.**
5. **Starter B1 energized.**
6. **GenSet status light remains on.**



10/12.5 QD
611-1256

OH3-58

S&TT 9/00

Run Mode

Slide 3-59: **611-1256**

For the **QD** to go into the run mode, the **AC** generator Q1/Q60 or Q50 winding must be producing enough frequency to tell the control that the engine has reached approximately **800 rpm**. With this signal, the control removes the output from **A1-J1-6** to the **K2** starter pilot and the starter motor.

The outputs to the **E1** rotary actuator, **E2** fuel pump and the GenSet status **LED** will remain energized.

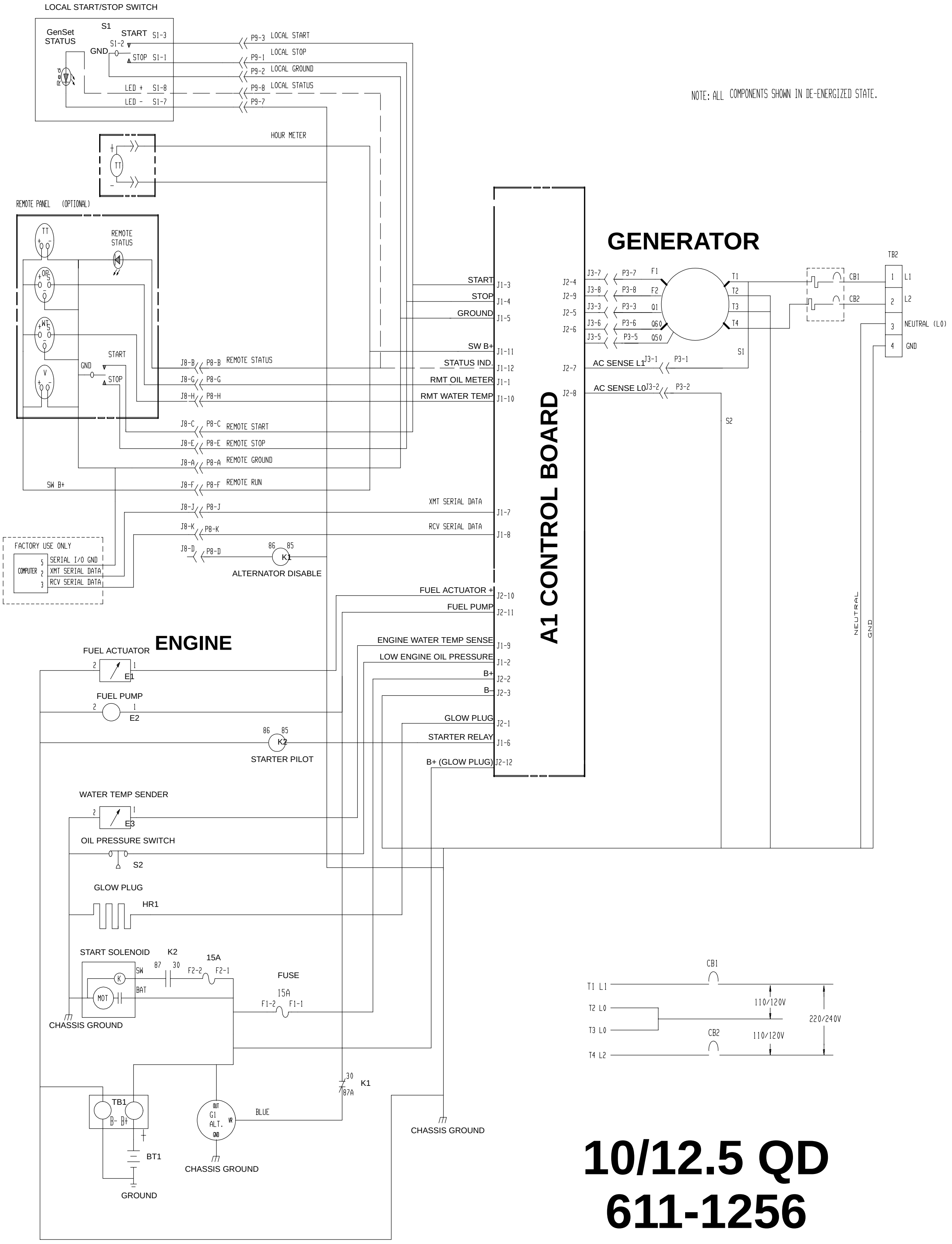
There is a short time delay before the control gets the signals from the **E3** water temperature sender and the **S2** oil pressure switch that engine is ok to continue to run.

The battery charger gets its operating voltage from **A1-J2-11**, it goes through the N.C. **K1** alternator disable relay contacts to flash the field on the **G1** alternator. To disable the battery charge system, apply a battery B+ to terminal 86 of the **K1** relay.

Values: Battery Charger = 14–15 VDC, 0–10 amps.

Run sequence of operation:

1. **AC generator output.**
2. **Starter pilot deenergized.**
3. **Starter motor deenergized.**
4. **E1 & E2 remain energized.**
5. **E3 & S2 enabled.**
6. **Battery charger operates.**



OH3-59

S&TT 9/00

Stop Mode

Slide 3-60: **611-1256**

Normal stop occurs when the start/stop switch **(S1)** is pressed to the stop position. This puts a ground signal to the **A1** control board that deenergizes the run circuit.

Battery current is removed from the fuel pump **(E2)** and the fuel actuator **(E1)** causing the injection pump to go to zero fuel.

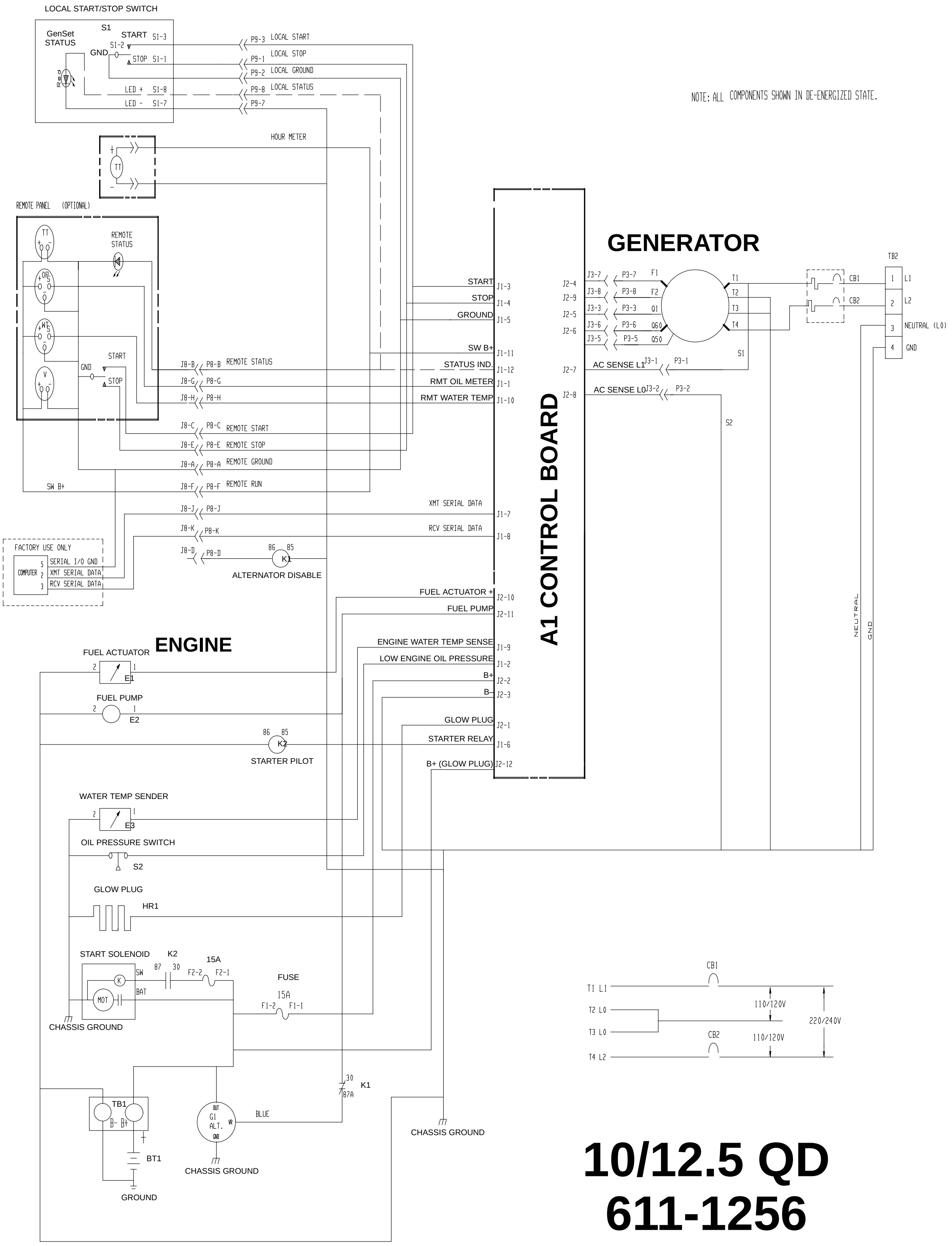
Stop sequence of operation:

1. **S1 switch pressed to stop.**
2. **A1 control board deenergized.**
3. **E1 & E2 deenergized.**

Emergency Stop

For emergency stop to happen, the engine oil pressure **(S2)** would have to drop below **7 psi.**, the engine temperature **(E2)** would have to exceed **230° F.**

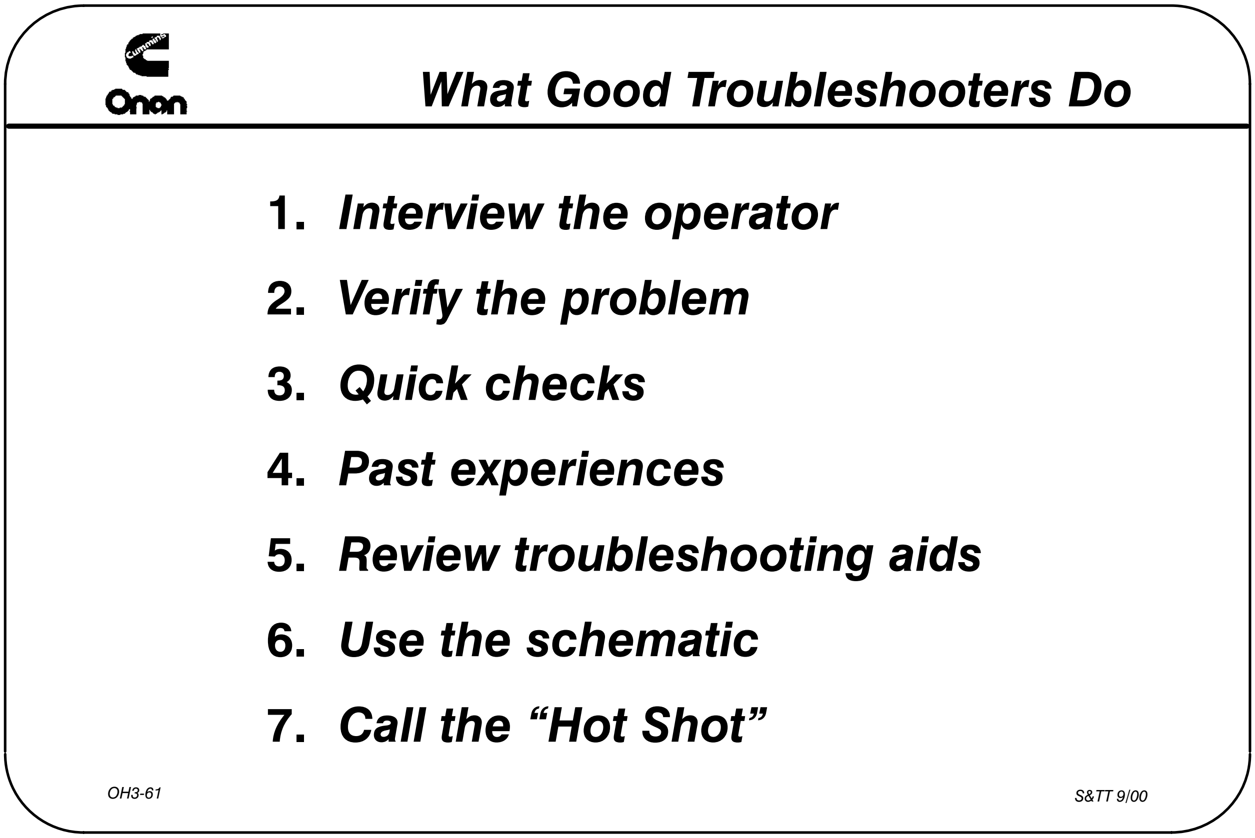
The rest of the faults are identified by the status indicator LED.



10/12.5 QD
611-1256

OH3-60

S&TT 9/00



What Good Troubleshooters Do

1. *Interview the operator*
2. *Verify the problem*
3. *Quick checks*
4. *Past experiences*
5. *Review troubleshooting aids*
6. *Use the schematic*
7. *Call the "Hot Shot"*

OH3-61

S&TT 9/00

Slide 3-61: What Good Troubleshooters Do

1. Interview the operator
   Witness the trouble
   Points to troubled area

2. Verify the problem
   First hand experience

3. Quick checks
   Fuses
   Connectors
   Oil level, fuel level
   Remote switch position

4. Experience
   "Last time this happened"

5. Review troubleshooting aids
   PSB's
   *Service Manual*s
   Flow charts
   "If/then" chart

6. Use the schematic
   "Split half search" method

7. Call the "Hot Shot"
   Distributor or Factory

8. If still have problem, re-trace steps

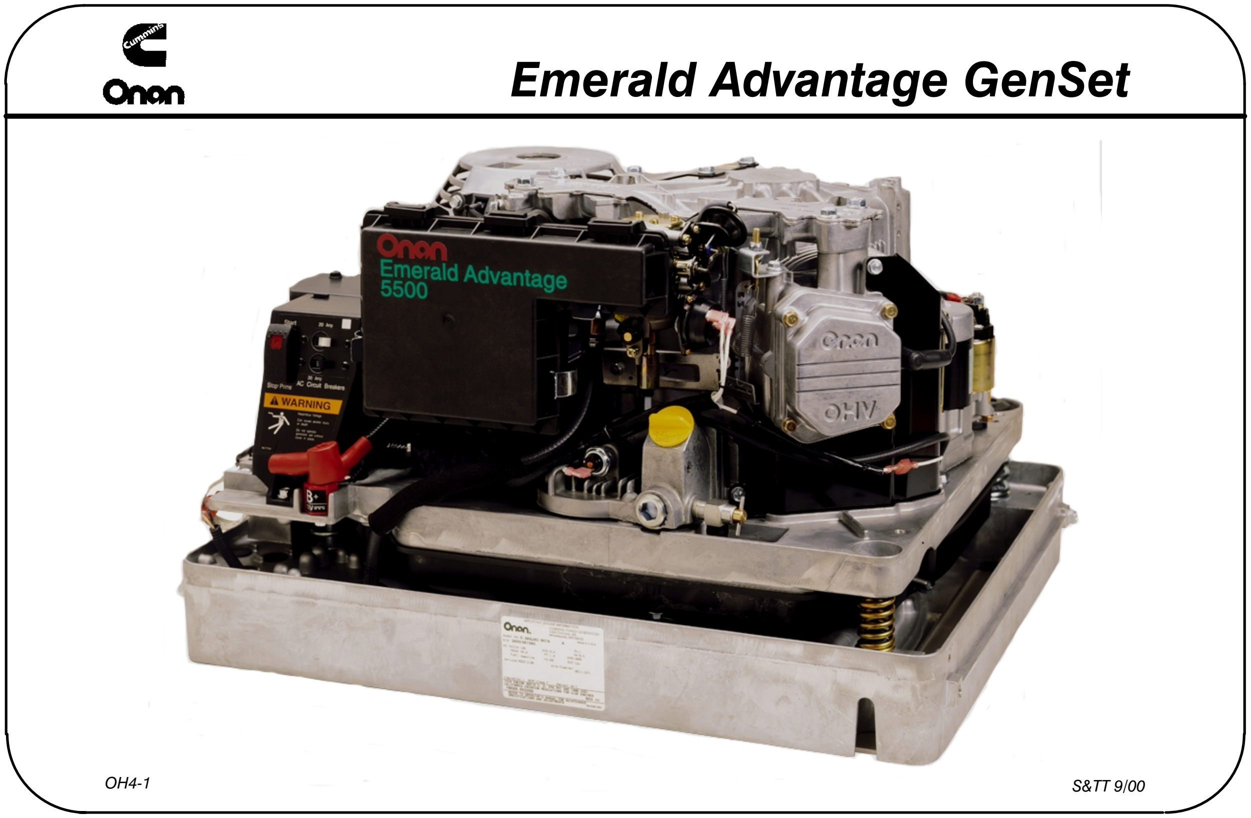
Advantage/Gold/Platinum GenSet Overview

This lesson presents an overview of the Advantage, Gold, and Platinum generator sets.

Objectives

After completing this lesson, you should be able to:

- Identify the main features of the Advantage, Gold, and Platinum generator sets.
- Locate the Advantage, Gold, and Platinum GenSet Model Tag.
- Decipher the Model Identification.
- Decipher the GenSet Serial Number.



Emerald Advantage GenSet

OH4-1

S&TT 9/00

Slide 4-1: Emerald Advantage GenSet

- Emerald Advantage – HGJAC
- 5.5 to 7 kW, 50 & 60 Hz.
- YVB Revolving field generator.
- Automatic voltage regulation.
- Mechanical governor control.
- Electronic Ignition.
- Microprocessor control.

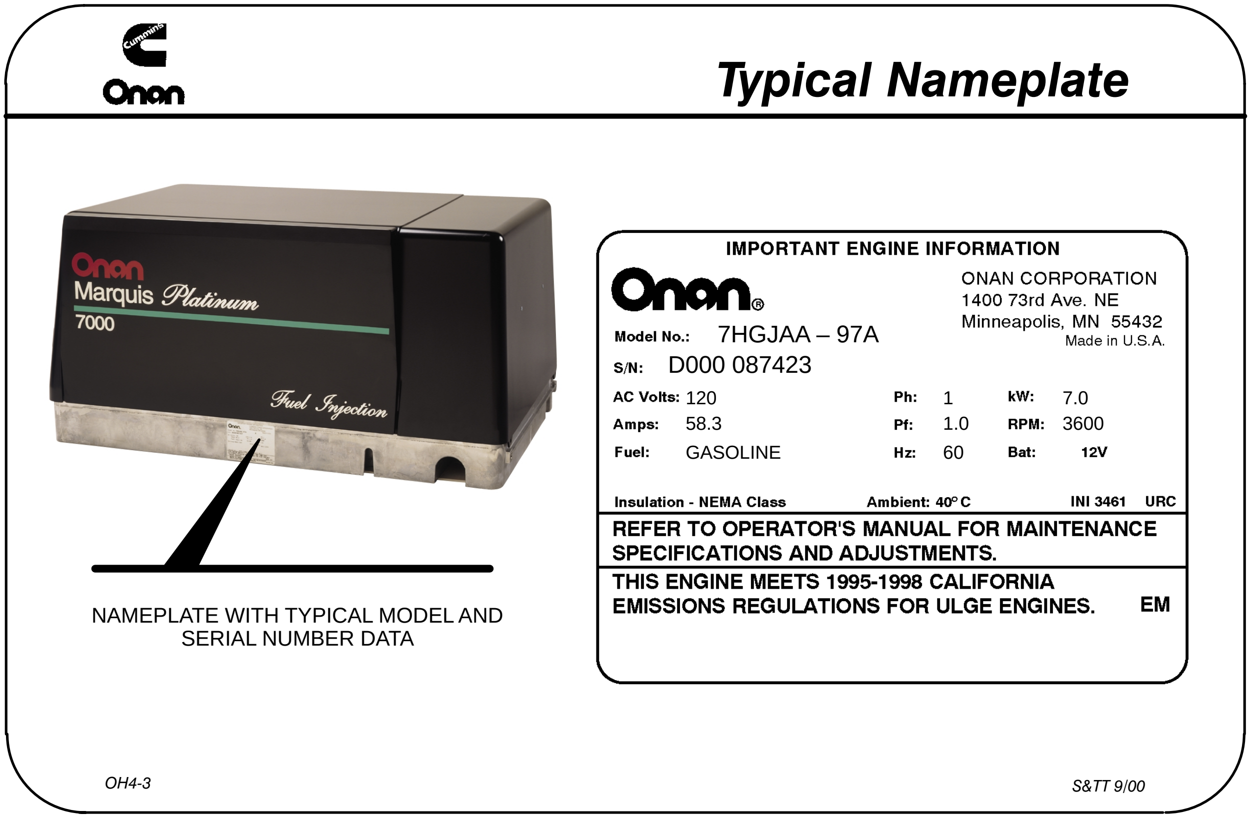
Marquis Gold/Platinum GenSet

OH4-2

S&TT 9/00

Slide 4-2: Marquis Gold/Platinum GenSet

- Marquis Gold – HGJAB, Marquis Platinum – HGJAA
- 5.5 to 7 kW, 60 Hz.
- Revolving field generator.
- Automatic voltage regulation.
- Electronic governor control (Platinum)
- Carburetor (Gold) or Fuel Injection (Platinum)
- Electronic Ignition.
- Microprocessor control.



Typical Nameplate

IMPORTANT ENGINE INFORMATION

Onan®

ONAN CORPORATION
1400 73rd Ave. NE
Minneapolis, MN 55432
Made in U.S.A.

Model No.: 7HGJAA – 97A

S/N: D000 087423

AC Volts:	120	**Ph:**	1	**kW:**	7.0
Amps:	58.3	**Pf:**	1.0	**RPM:**	3600
Fuel:	GASOLINE	**Hz:**	60	**Bat:**	**12V**

Insulation - NEMA Class **Ambient: 40° C** **INI 3461 URC**

REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.

THIS ENGINE MEETS 1995-1998 CALIFORNIA EMISSIONS REGULATIONS FOR ULGE ENGINES. **EM**

NAMEPLATE WITH TYPICAL MODEL AND SERIAL NUMBER DATA

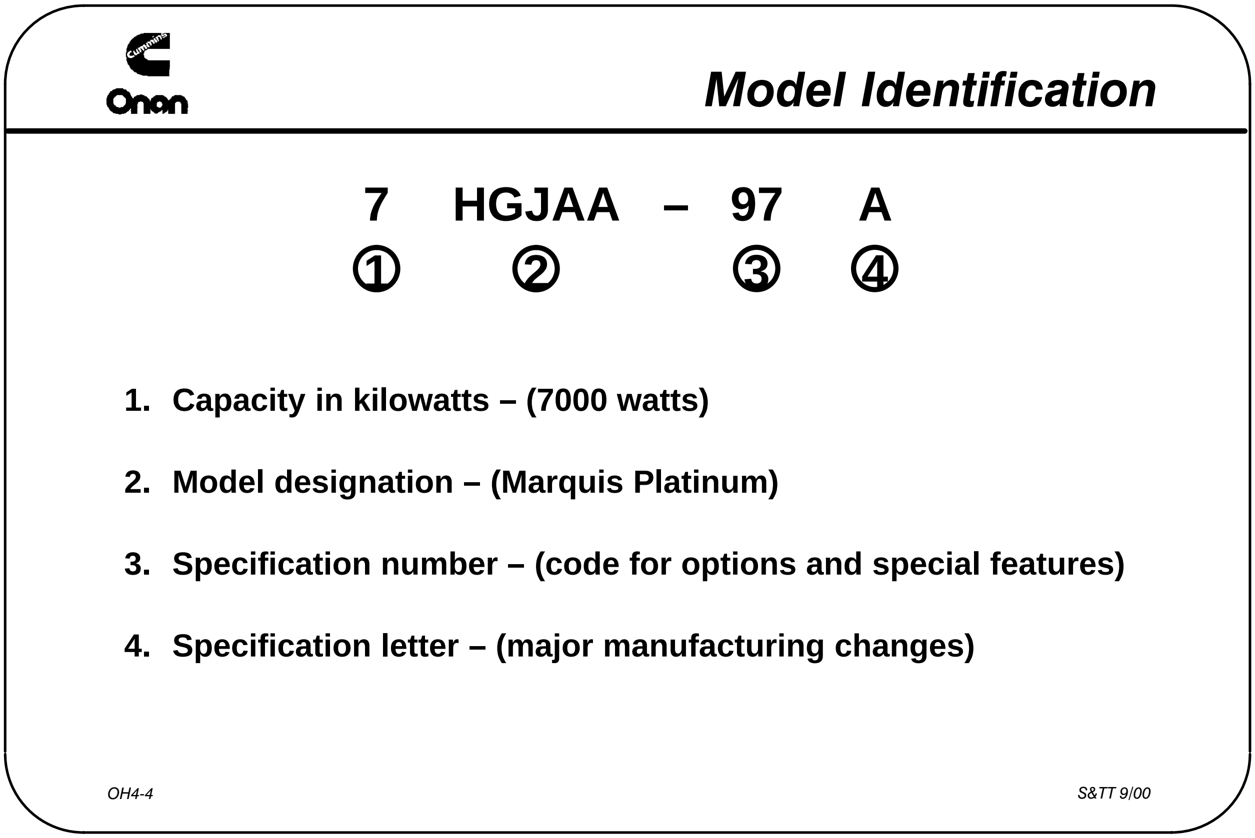
OH4-3

S&TT 9/00

Slide 4-3: Typical Nameplate

Used for:

- Parts ordering.
- Manuals, literature and troubleshooting aids.
- Communicating with distributor/factory.



Model Identification

7 HGJAA – 97 A

① ② ③ ④

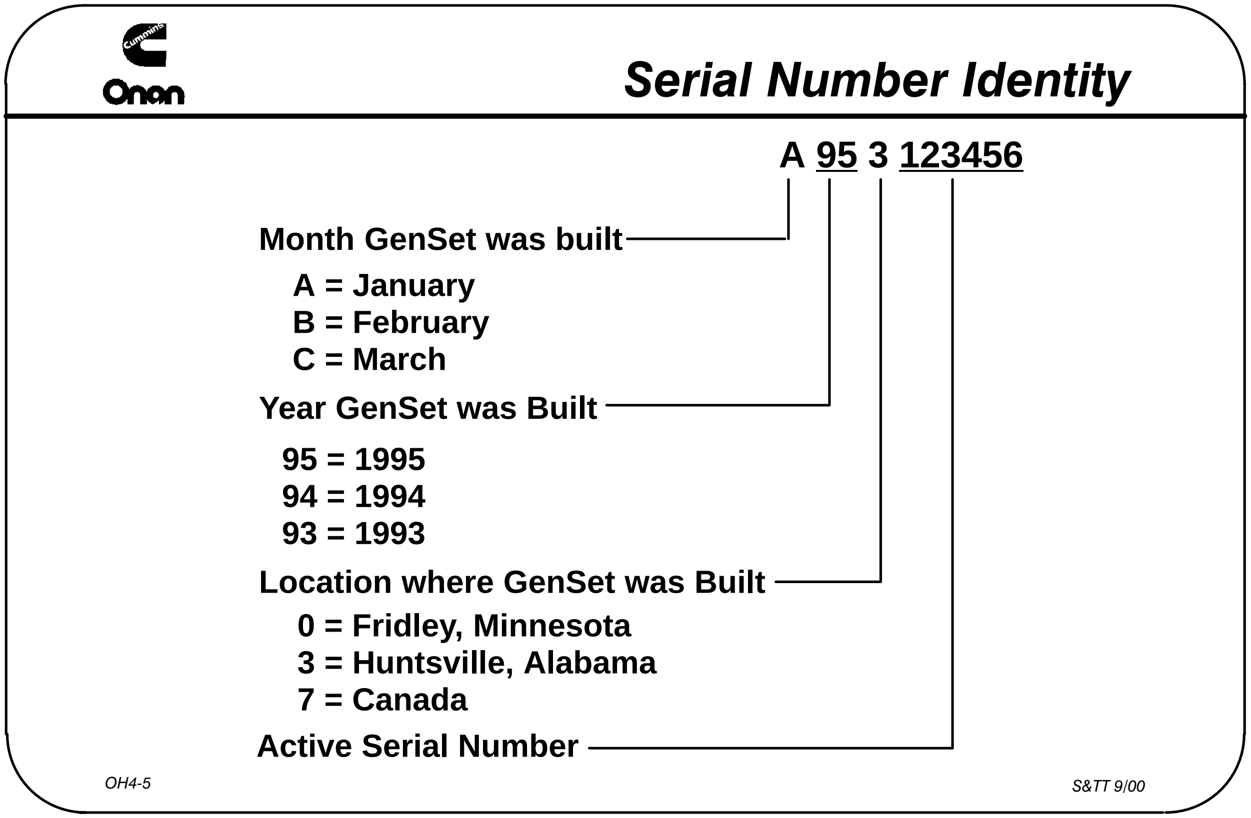
1. **Capacity in kilowatts – (7000 watts)**
2. **Model designation – (Marquis Platinum)**
3. **Specification number – (code for options and special features)**
4. **Specification letter – (major manufacturing changes)**

OH4-4 *S&TT 9/00*

Slide 4-4: Model Identification

Helps to:

- Obtain proper parts.
- Find specific troubleshooting procedures and specifications.
- Communicate with distributor and/or factory or service or warranty.



Serial Number Identity

A 95 3 123456

Month GenSet was built

A = January
B = February
C = March

Year GenSet was Built

95 = 1995
94 = 1994
93 = 1993

Location where GenSet was Built

0 = Fridley, Minnesota
3 = Huntsville, Alabama
7 = Canada

Active Serial Number

OH4-5

S&TT 9/00

Slide 4-5: Serial Number Identification

Use to:

- Identify when manufactured.
- Identify where manufactured.

Activity

Slide 4-6:

Directions: Identify the following using the nameplate below:

Year GenSet was built: ______________________________

Month GenSet was built: ____________________________

Specification letter: _________________________________

Specification number: ______________________________

Wattage rating: _____________________________________

Voltage rating:_______________________________________

Output amps: _______________________________________

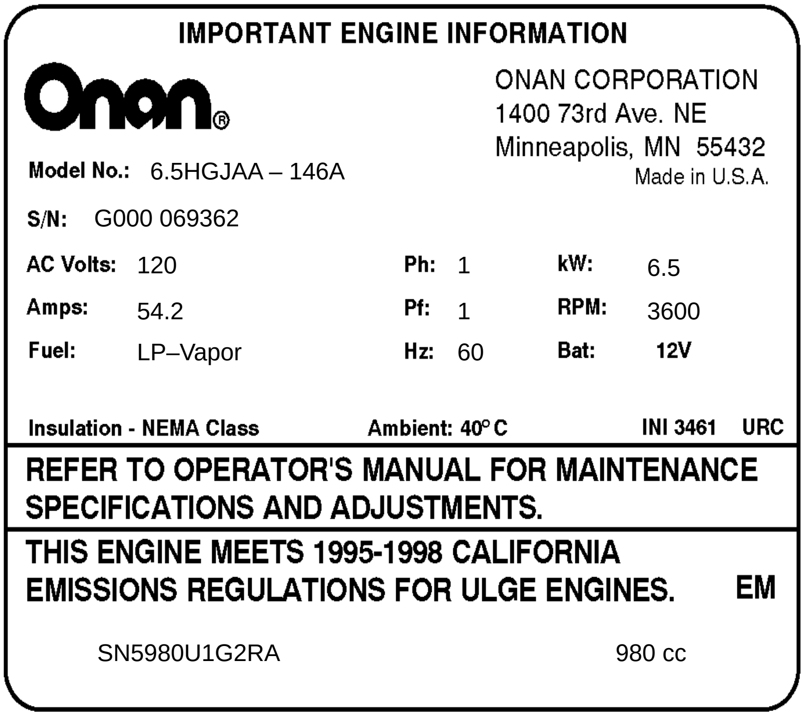
Power factor: _______________________________________

Actual serial number: _______________________________

Frequency output: __________________________________

Location where GenSet was built: ____________________

NAMEPLATE WITH TYPICAL MODEL AND SERIAL NUMBER DATA



IMPORTANT ENGINE INFORMATION

Onan®

ONAN CORPORATION
1400 73rd Ave. NE
Minneapolis, MN 55432
Made in U.S.A.

Model No.: 6.5HGJAA – 146A

S/N: G000 069362

AC Volts:	120	**Ph:**	1	**kW:**	6.5
Amps:	54.2	**Pf:**	1	**RPM:**	3600
Fuel:	LP–Vapor	**Hz:**	60	**Bat:**	**12V**

Insulation - NEMA Class **Ambient: 40° C** **INI 3461 URC**

REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.

THIS ENGINE MEETS 1995-1998 CALIFORNIA EMISSIONS REGULATIONS FOR ULGE ENGINES. **EM**

SN5980U1G2RA 980 cc

OH4-6

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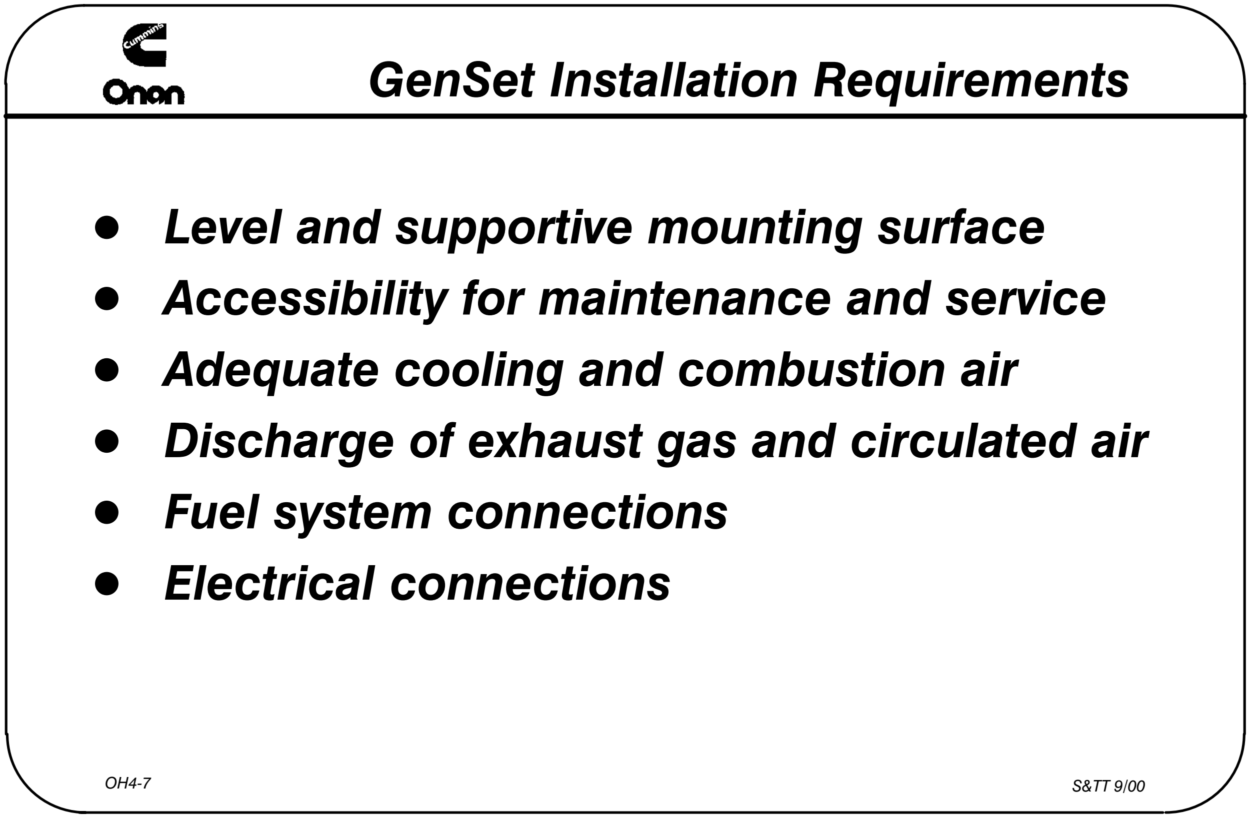
Advantage/Gold/Platinum GenSet Installation

This lesson presents the steps needed to complete a correct and safe installation of an Advantage/Gold/Platinum generator set.

Objectives

After completing this lesson, you should be able to:

- Identify the requirements to consider prior to installation of an Advantage/Gold/Platinum GenSet.
- Make all applicable exhaust, fuel and battery connections.
- Connect a load bank and start the GenSet.
- Plot a no-load to full-load power curve.



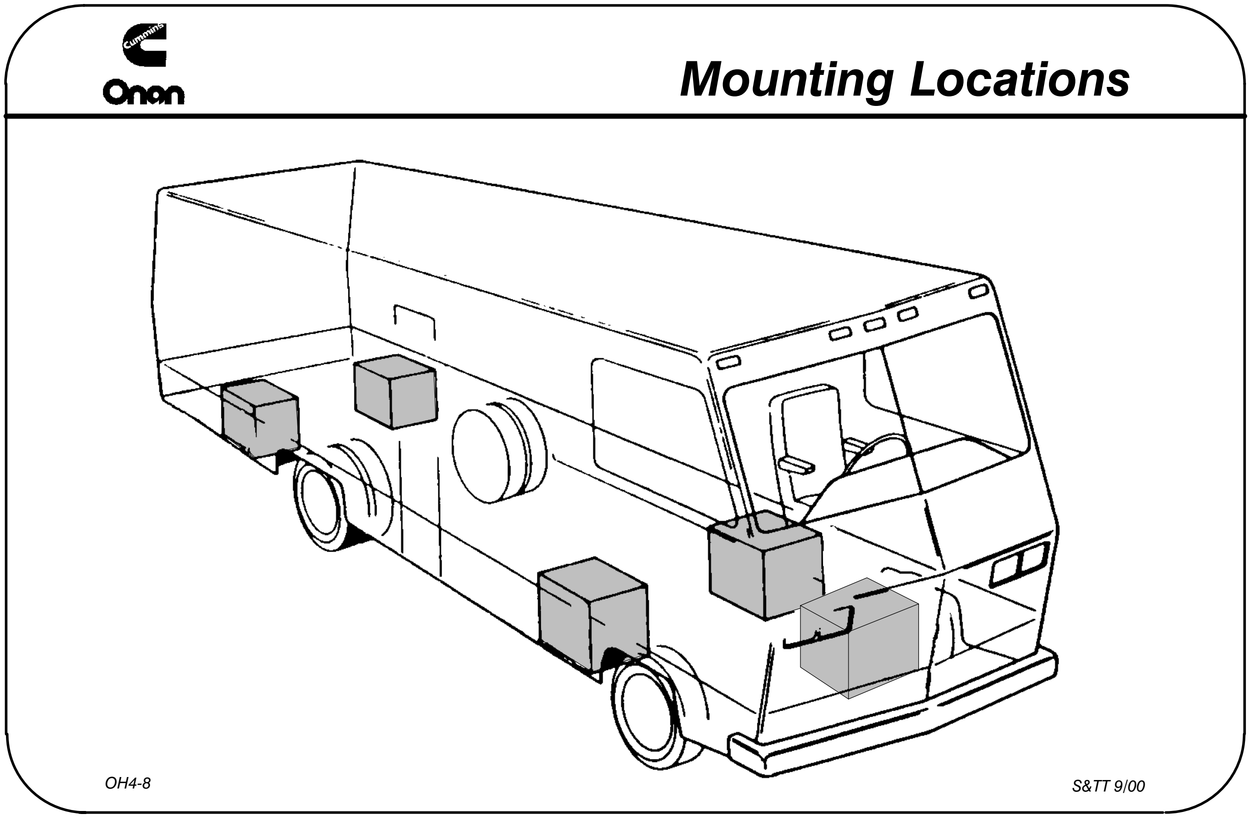
GenSet Installation Requirements

- Level and supportive mounting surface
- Accessibility for maintenance and service
- Adequate cooling and combustion air
- Discharge of exhaust gas and circulated air
- Fuel system connections
- Electrical connections

OH4-7

S&TT 9/00

Slide 4-7: GenSet Installation Requirements



Mounting Locations

OH4-8

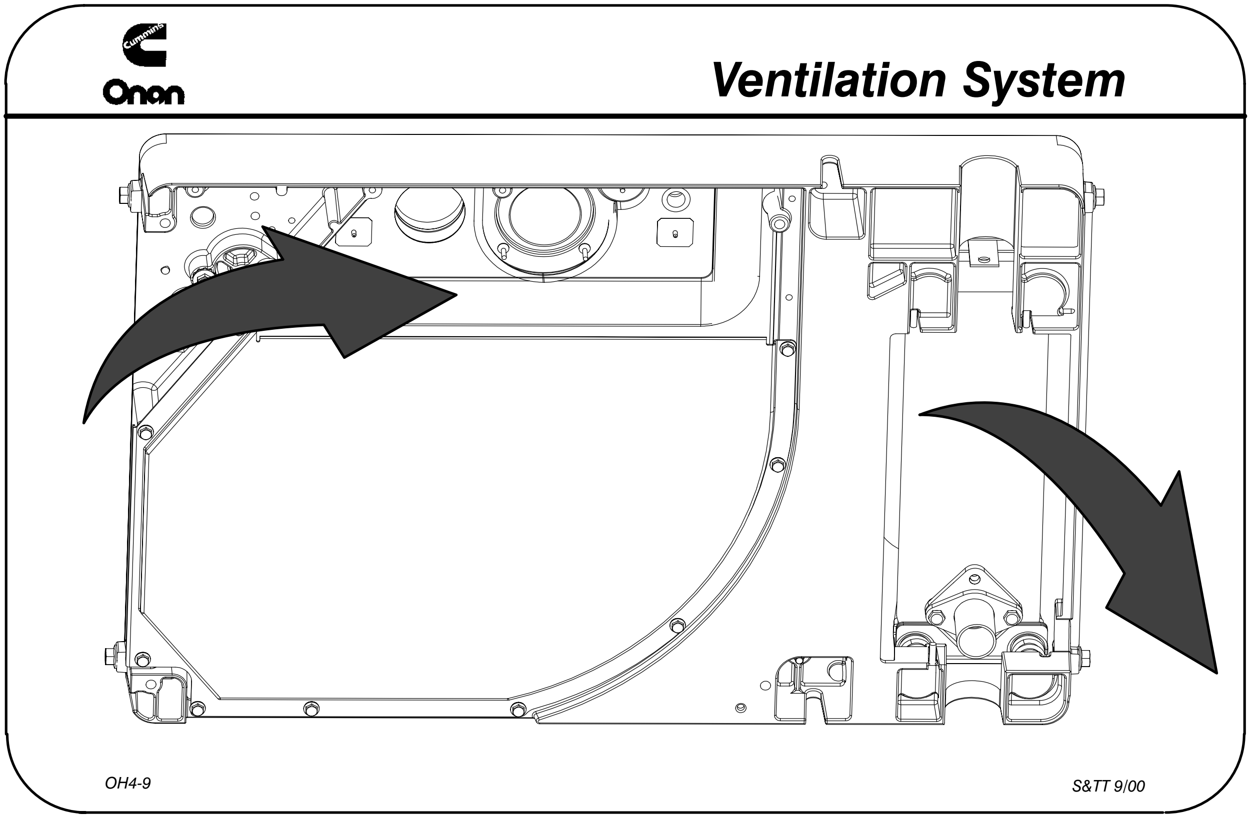
S&TT 9/00

Slide 4-8: Mounting Locations

- Orient the GenSet so that the operator's console is outboard.
- To reduce the transmission of vibration and noise, there should be a slight clearance all around the GenSet housing.
- Provide sufficient clearance for access to service items. Make sure other vehicle components that may be located below the GenSet will not obstruct the service points on the GenSet.
- The GenSet should be protected from direct road splash if it is located behind a road wheel.
- There must be a vapor-tight, fire-resistive barrier between the GenSet and the interior of the vehicle.
- Walls, 26-gauge or greater galvanized steel construction, sealed for exhaust and fuel vapor containment. Drains in floor to prevent accumulation of gas and oil.

What service items must you provide access to?

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________



Ventilation System

OH4-9

S&TT 9/00

Slide 4-9: Ventilation System

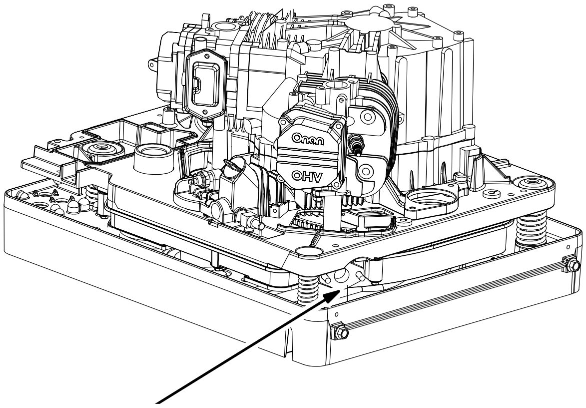
- Generator mounted fan for high air volume.
- Pressurized system.
- Air enters and exits bottom of unit.
- Sufficient incoming air for _________________________ and _________________________.
- Adequate exhausting of _________________________ air.

Note: Use GenSet spec. sheet to find correct the minimum cfm for combustion, engine cooling and generator cooling requirements.

- Rated load air requirements:
  - ➥ 5.5 HGJAC 60 Hz = ___________ cfm.
  - ➥ 7 HGJAA 60 Hz = ____________ cfm.

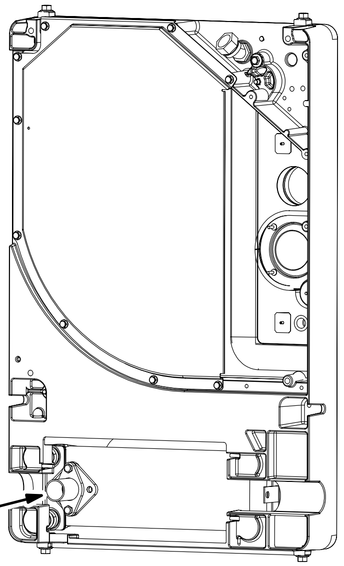
Exhaust Location

EMERALD ADVANTAGE



EXHAUST OUTLET FLANGE

MARQUIS GOLD/PLATINUM



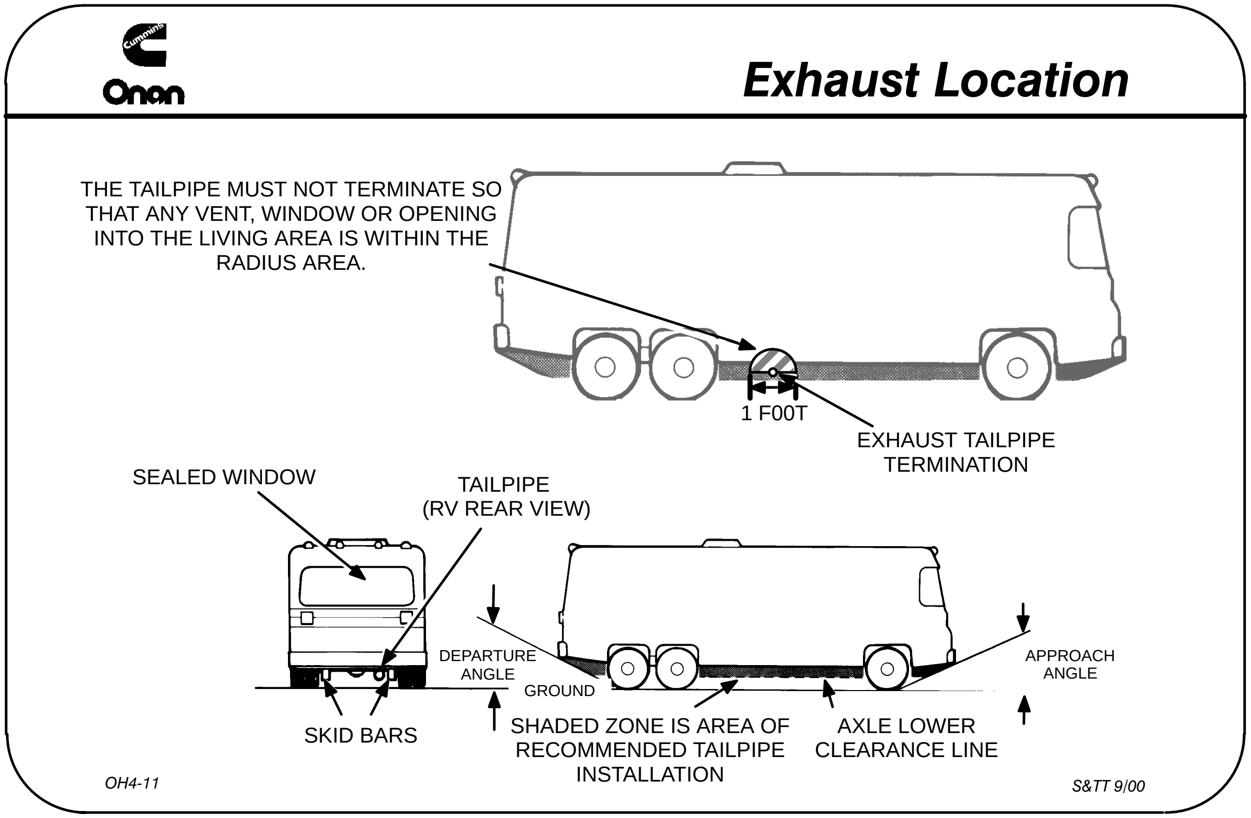
MUFFLER OUTLET FLANGE
AND TAILPIECE

OH4-10

S&TT 9/00

Slide 4-10: Exhaust Location

- Do not terminate exhaust under vehicle.
- Muffler separate on Advantage – included on Gold/Platinum
- Support the exhaust at or near the perimeter of vehicle.
- Use only Onan approved, spark arrested mufflers.
- System must extend a minimum of 1 inch beyond perimeter of vehicle.
- Use double rubber, U-shaped shock mounting hangers.



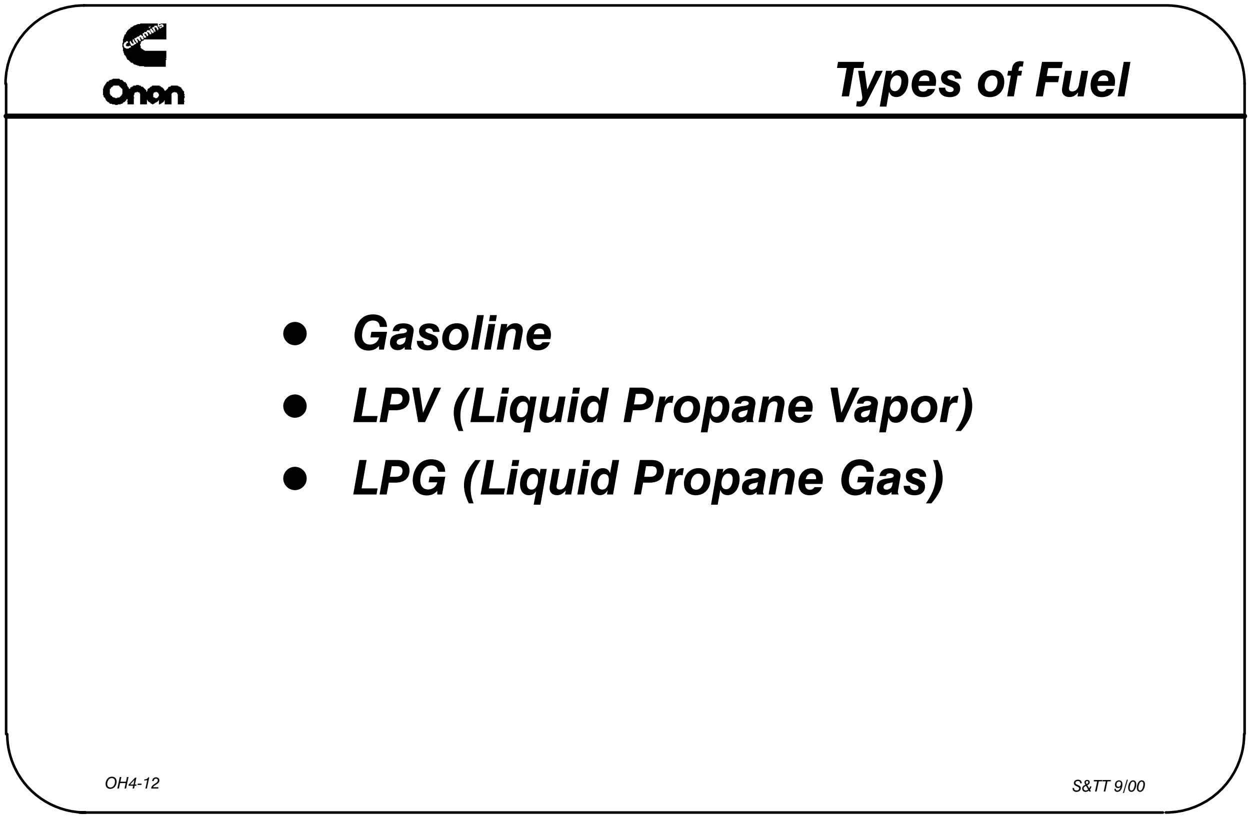
Exhaust Location

OH4-11

S&TT 9/00

Slide 4-11: Exhaust Location

- Do not terminate exhaust under vehicle.
- Support the exhaust at or near the perimeter of vehicle.
- Use only Onan approved, spark arrested mufflers.
- System must extend a minimum of 1 inch beyond perimeter of vehicle.
- Use double rubber, U-shaped shock mounting hangers.



Types of Fuel

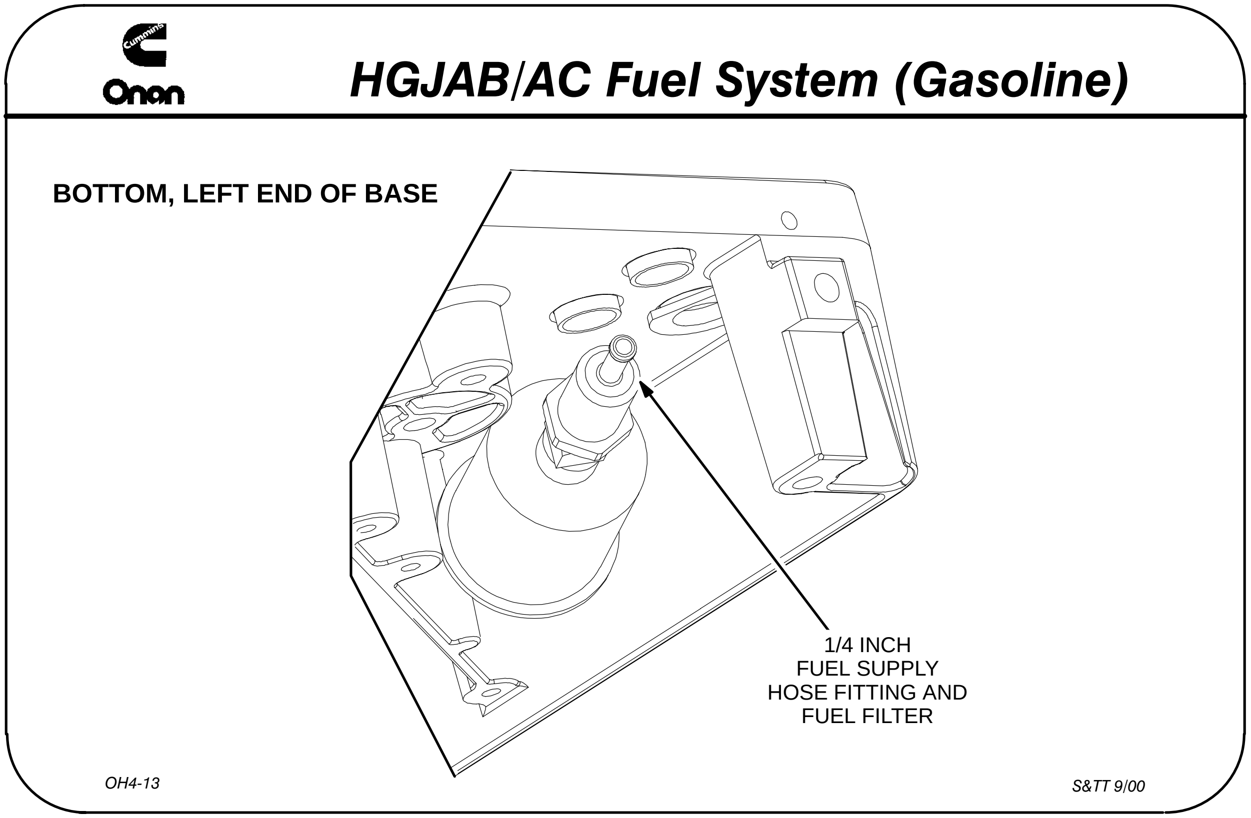
- *Gasoline*
- *LPV (Liquid Propane Vapor)*
- *LPG (Liquid Propane Gas)*

OH4-12

S&TT 9/00

Slide 4-12: Fuel System

- Use a gasoline with a minimum octane rating of 87.
- Avoid using leaded gasoline or fuels containing methanol.
- Use a HD-5 grade LPG consisting of a least 90% propane.



HGJAB/AC Fuel System (Gasoline)

BOTTOM, LEFT END OF BASE

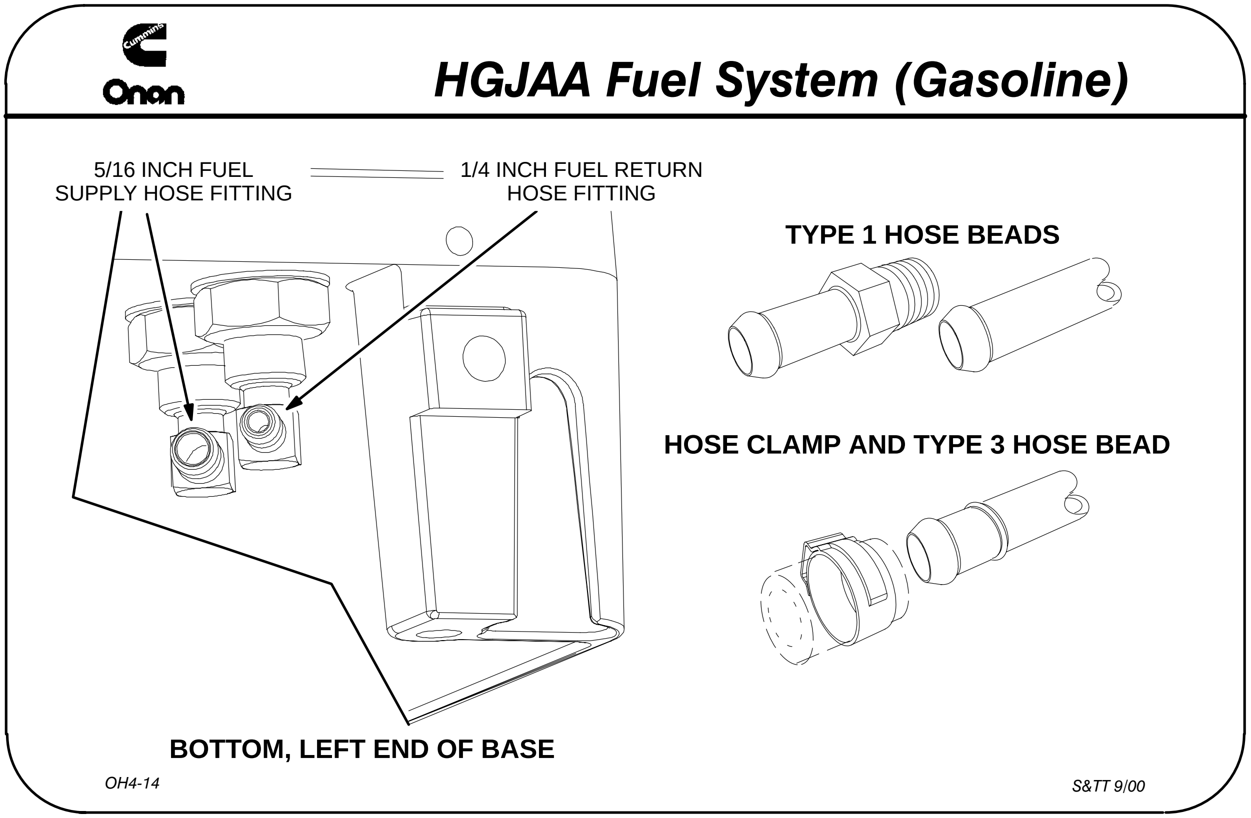
1/4 INCH
FUEL SUPPLY
HOSE FITTING AND
FUEL FILTER

OH4-13

S&TT 9/00

Slide 4-13: HGJAB/AC Fuel System (Gasoline)

- Use a separate fuel pickup tube at tank or a separate tank.
- Do not tee GenSet fuel line into vehicle fuel supply line.
- The fuel pickup should not extend below the bottom $^{1}/_{4}$ of tank.
- Use a flexible, non-metallic line between set and vehicle fuel system.
- Keep piping, hoses and fittings away from heat.
- Don’t run fuel lines in conjunction with electrical wiring.



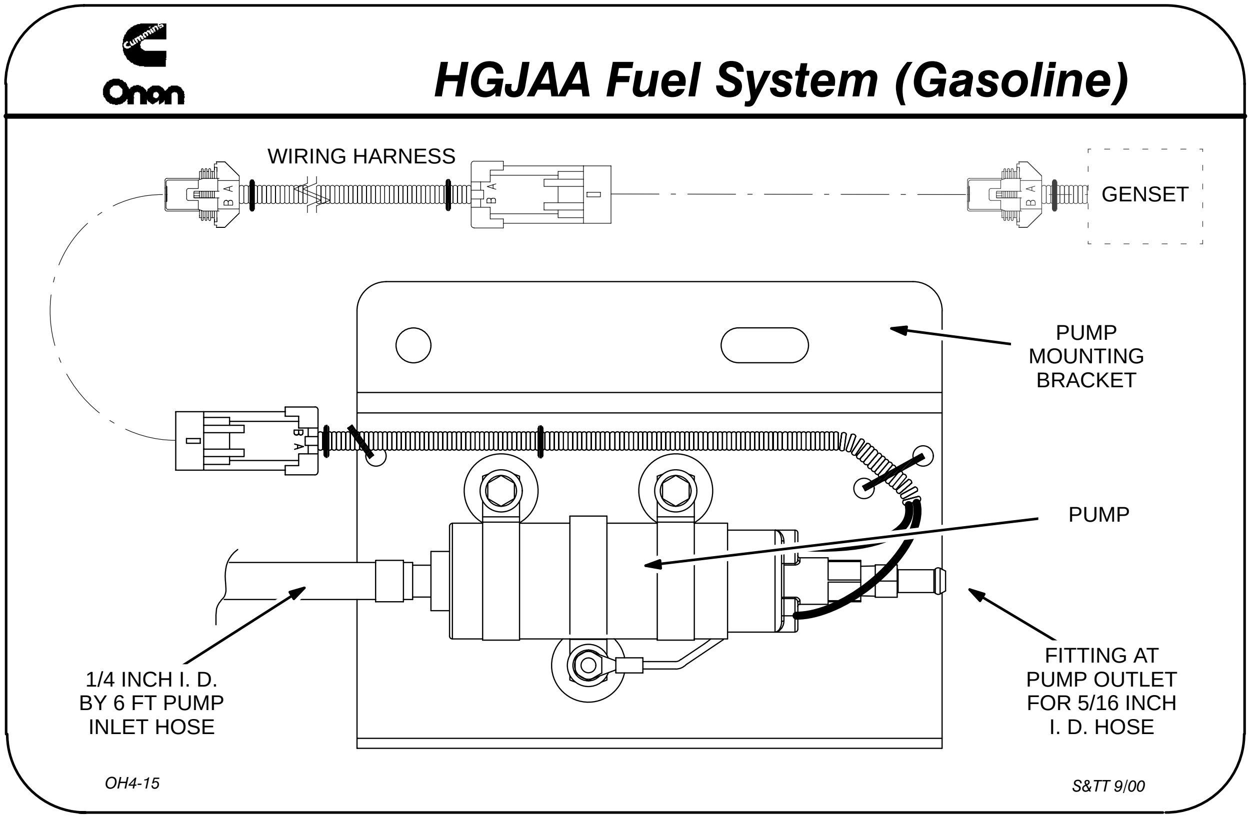
HGJAA Fuel System (Gasoline)

OH4-14

S&TT 9/00

Slide 4-14: HGJAA Fuel System (Gasoline)

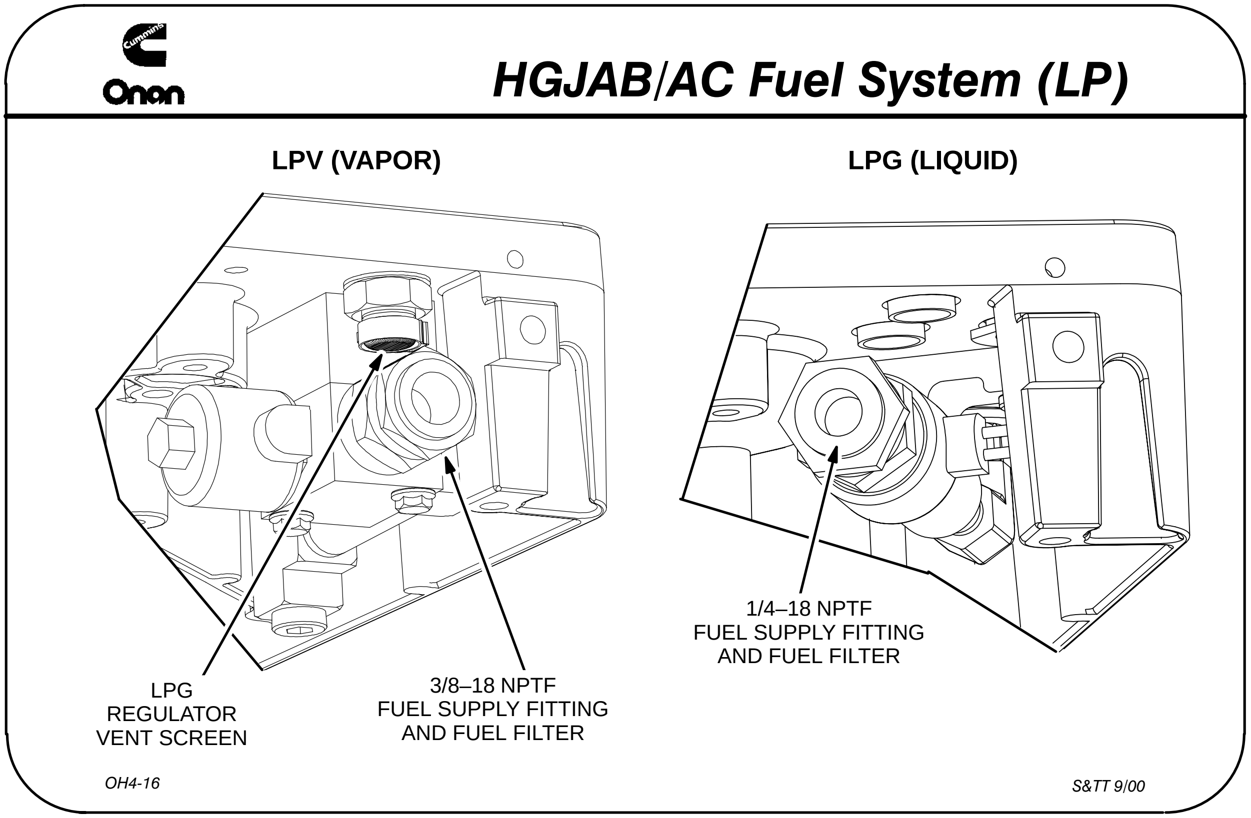
- Needs 2 auxiliary fittings at tank – one supply and one return.
- GenSet uses separate high pressure fuel pump.
- Do not tee GenSet fuel line into vehicle fuel supply line.
- The fuel pickup should not extend below the bottom $^1/_4$ of tank.
- Use a flexible, non-metallic line between set and vehicle fuel system.
- Keep piping, hoses and fittings away from heat.
- Don’t run fuel lines in conjunction with electrical wiring.



HGJAA Fuel System (Gasoline)

Slide 4-15: HGJAA Fuel System (Gasoline)

- The fuel supply pump used for fuel injection is **not** located with the GenSet but is remotely located near vehicle fuel tank.
- The 2–pin harness from the pump plugs into the remote fuel pump connector on the GenSet control harness.
- The fuel pump kit can be ordered with 15 foot harness.
- Do not tee GenSet fuel line into vehicle fuel supply line.
- The fuel pickup should not extend below the bottom $^1/_4$ of tank.
- Use a flexible, non-metallic line between set and vehicle fuel system.
- Keep piping, hoses and fittings away from heat.
- Don’t run fuel lines in conjunction with electrical wiring.



HGJAB/AC Fuel System (LP)

Slide 4-16: HGJAB/AC Fuel System (LP)

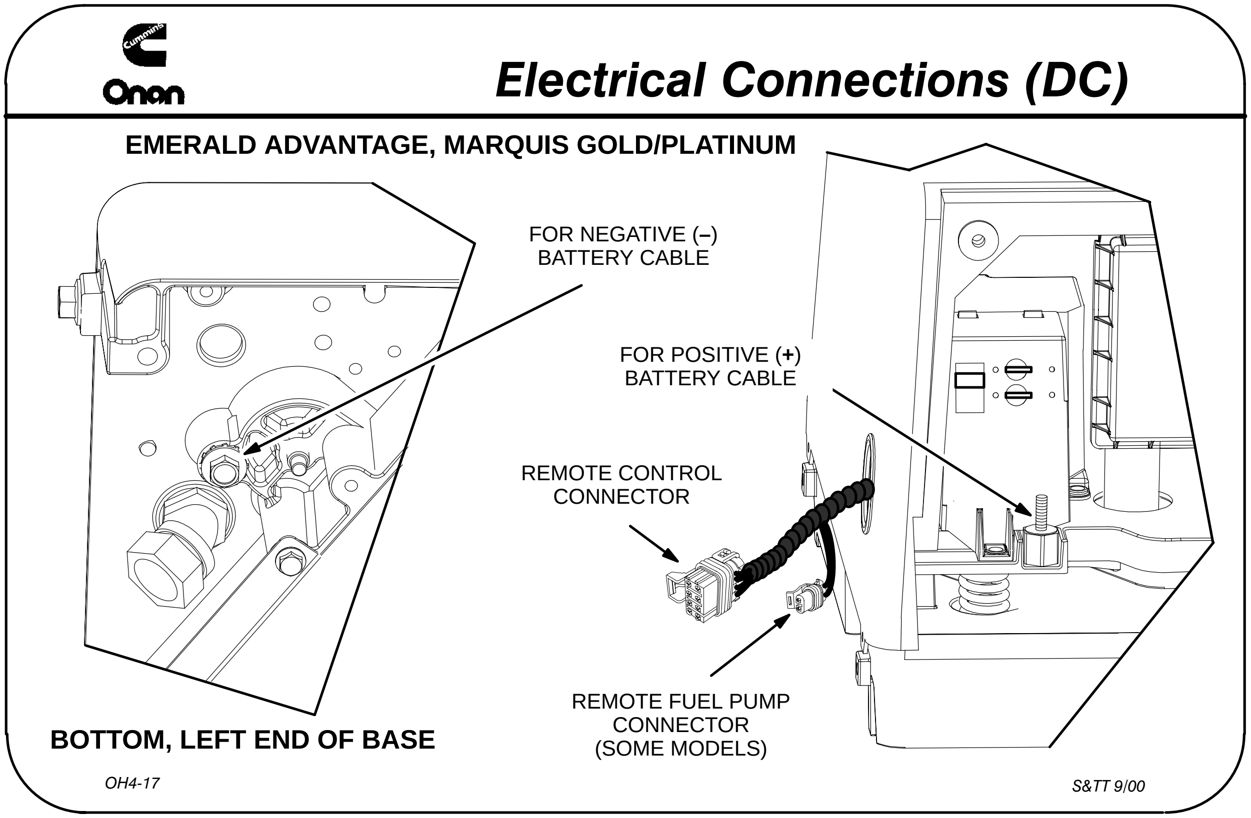
- Use a flexible, non-metallic line between set and vehicle fuel system.
- Keep fuel lines away from hot engine and exhaust.
- Keep electrical and fuel lines as far apart as possible, do not tie together.
- Check all connections with soapy water for leaks.

LPV:

- A low-pressure demand regulator is supplied with the GenSet.
- Must be connected to the Vapor Withdrawal fitting on tank.
- **Do not** connect to any appliance fuel line.

LPG:

- A high-pressure, 350 psi rated, flexible, non-conductive fuel line must be used.
- Vaporizing, pressure-reducing regulator is mounted on the GenSet.
- Do not connect the GenSet fuel line directly into to LPG fuel cylinder.



Electrical Connections (DC)

EMERALD ADVANTAGE, MARQUIS GOLD/PLATINUM

FOR NEGATIVE (–)
BATTERY CABLE

FOR POSITIVE (+)
BATTERY CABLE

REMOTE CONTROL
CONNECTOR

REMOTE FUEL PUMP
CONNECTOR
(SOME MODELS)

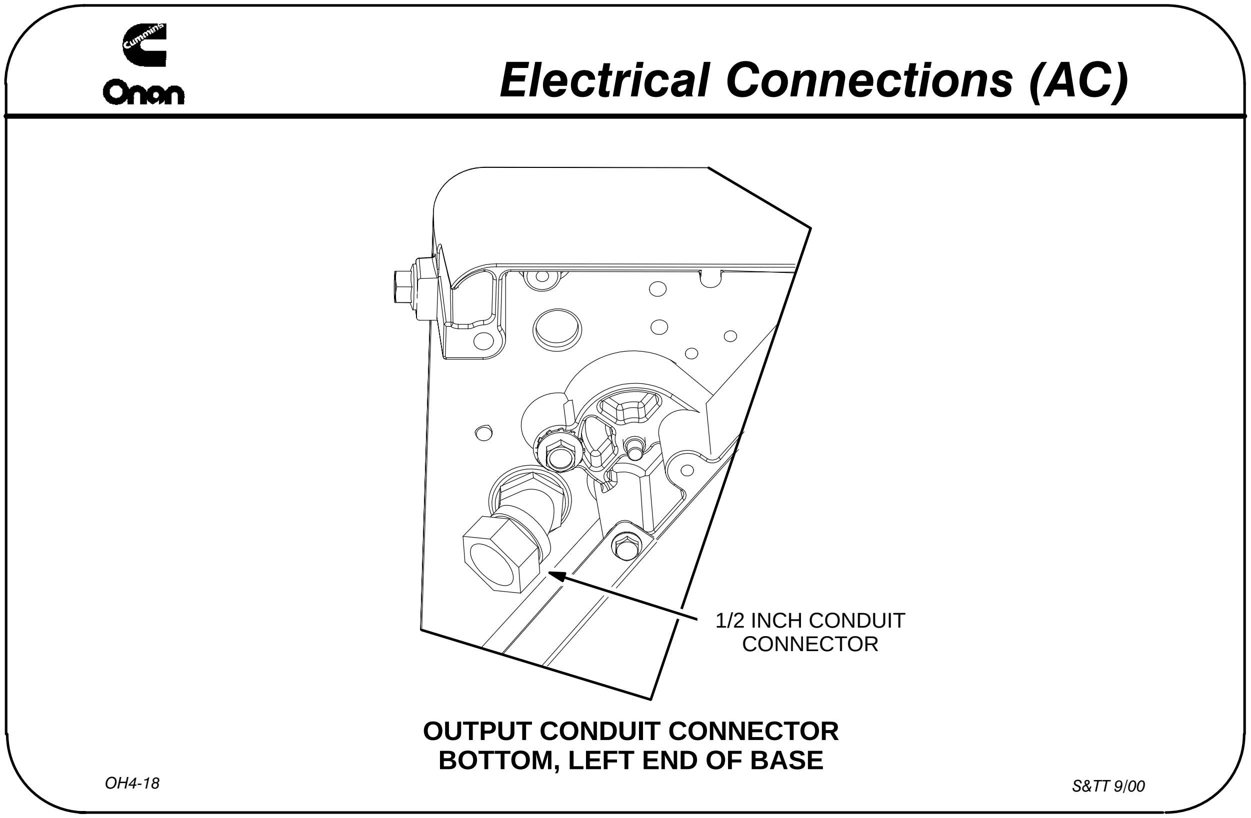
BOTTOM, LEFT END OF BASE

OH4-17

S&TT 9/00

Slide 4-17: Electrical Connections (DC)

- Select a battery and cables that are appropriate for the GenSet cold cranking needs.
- Mount the battery in its own compartment.
- Use the same size battery cable for both positive (+) and negative (-) battery connections.
- Connect B+ cable to the red insulated battery terminal in front of the control.
- Connect B- cable to bolt and washer located below base.
- The 8 pin remote control connector connects to the up to 30 foot remote control harness.
- The 2 pin connector connect to the remote, high pressure, fuel injection fuel pump.



Electrical Connections (AC)

**OUTPUT CONDUIT CONNECTOR
BOTTOM, LEFT END OF BASE**

OH4-18

S&TT 9/00

Slide 4-18: Electrical Connections (AC)

- Set comes with 120 inch long leads installed.
- All wiring must meet local electrical codes and be inspected by a qualified electrician.
- Conductors must be current rated not less than 115% of GenSet nameplate rating.
- Use stranded wire for all load connections.
- Use a flexible conduit from GenSet to junction box and seal internally from exhaust gases.
- Wiring must be protected from sharp edges, hot engine parts and fuel system.
- The feeder conductors must terminate at a disconnecting device so that the GenSet cannot be connected to an outside power source.
- Ground fault circuit interrupters (GFCIs) should be used for all branch circuits with convenience power receptacles.
- AC wiring, remote control wiring and fuel lines should all be routed separately.

Activity

Directions: Setup the GenSet to run and document its performance by plotting a power curve.

Follow these steps:

1. Check the GenSet oil level.

   ☐ oil level

2. Connect the GenSet exhaust, fuel and battery.

   ☐ exhaust
   ☐ fuel
   ☐ battery

3. Connect the appropriately sized load bank.

   ☐ load bank

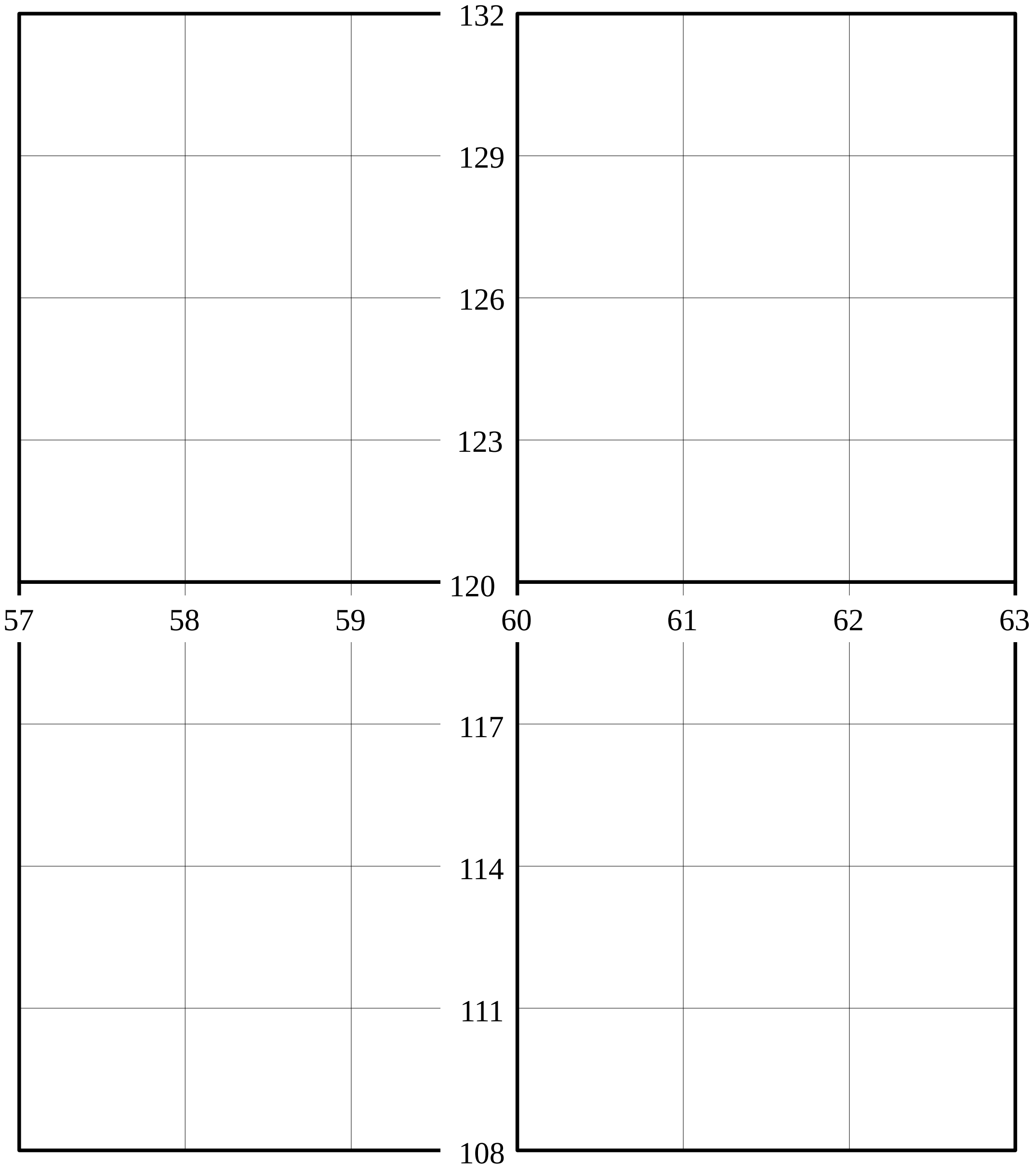
4. Start GenSet and warm it up by applying 50% load for 5 minutes.

   ☐ warm-up

5. Record the GenSet performance on the Power Curve chart on the next page.

Note: Be sure to use the ratings on the GenSet nameplate.

Power Curve



Load Step	Amperes or Watts	Voltage	Frequency
0%			
25%			
50%			
75%			
100%			

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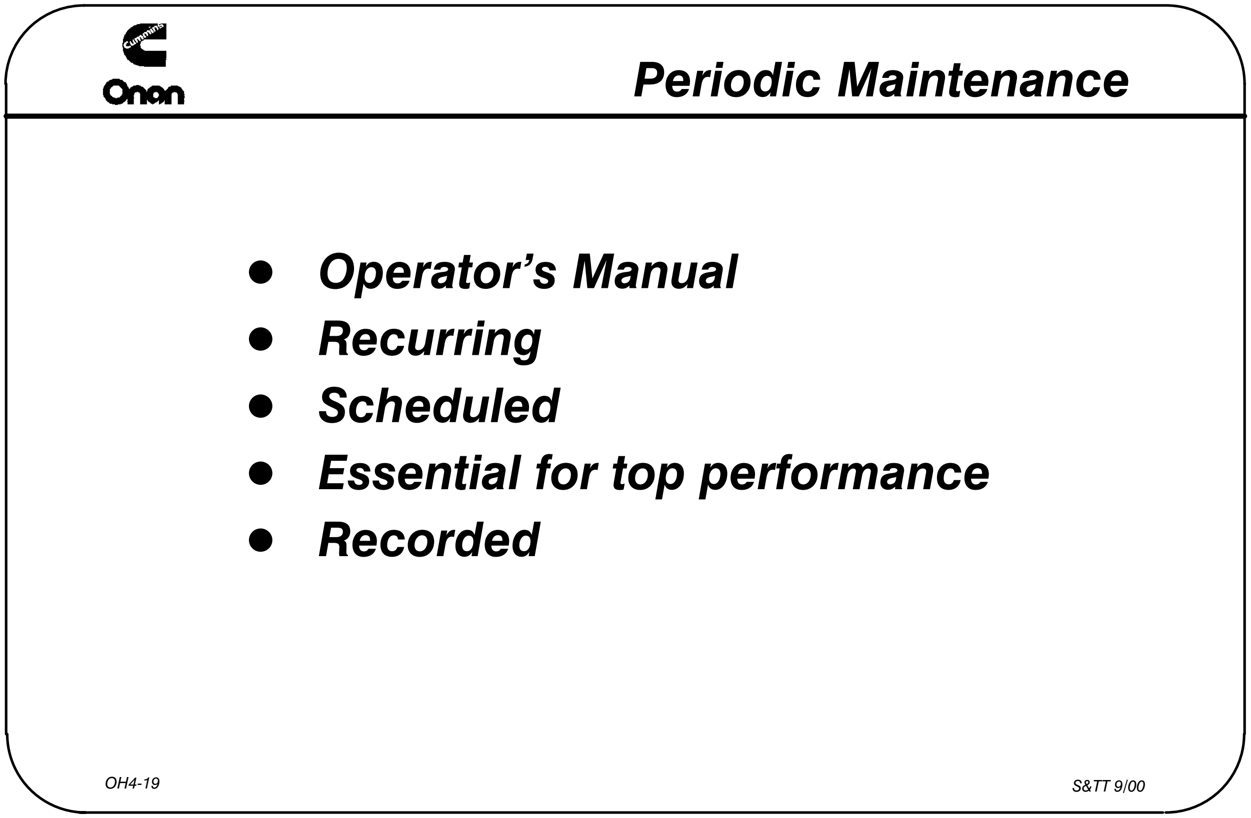
Advantage/Gold/Platinum GenSet Periodic Maintenance

This lesson presents the preventive maintenance on an Advantage/Gold/Platinum generator set.

Objectives

After completing this lesson, you should be able to:

- Find and use the periodic maintenance schedule in the *Operator's Manual*.
- Locate maintenance points and perform all scheduled service.
- Adjust the engine governor, carburetor choke and fuel system.
- Adjust the generator nominal no-load voltage and frequency.
- Perform a final Test and Adjust no-load to full-load power curve.



Periodic Maintenance

- Operator’s Manual
- Recurring
- Scheduled
- Essential for top performance
- Recorded

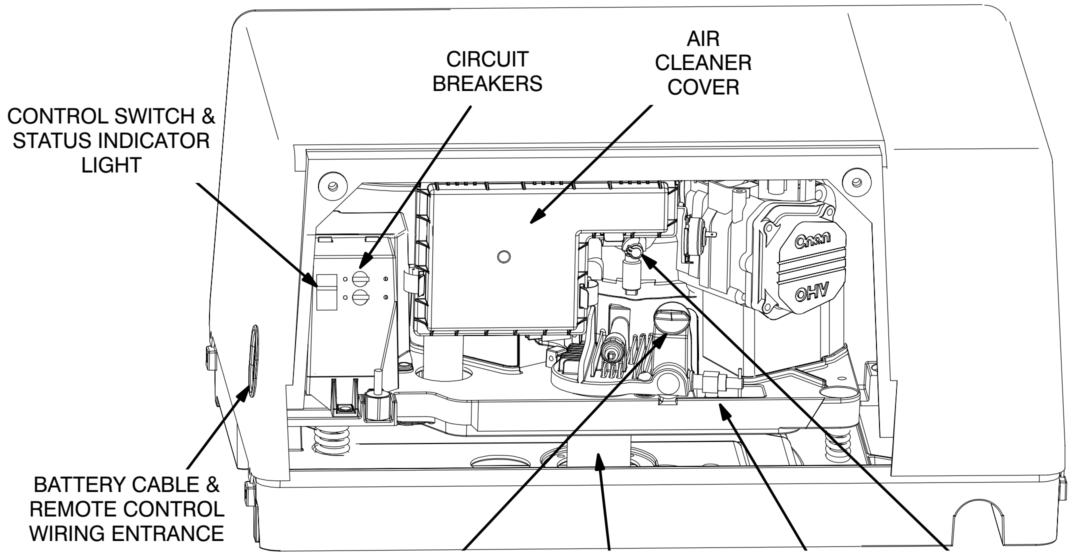
OH4-19

S&TT 9/00

Slide 4-19: Periodic Maintenance

- A periodic maintenance schedule is found in the *Operator’s Manual*.
- Periodic maintenance is done as often as necessary.
- Done according to a schedule.
- Must be done for performance and longevity of the GenSet.
- Recording when and what was done is important.

General Inspection

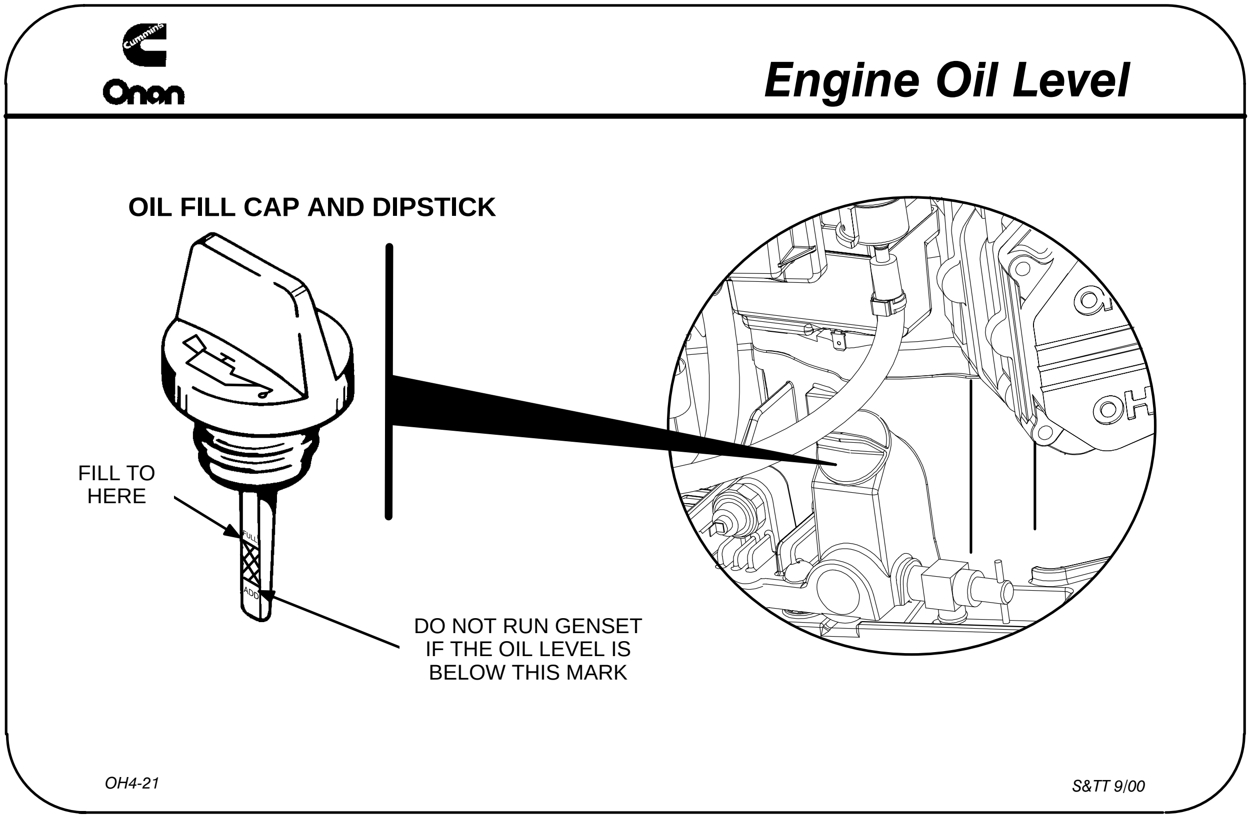


OH4-20

S&TT 9/00

Slide 4-20: General Inspection

- Should be done daily or every 8 hours of use.
- **Inspect:**
  - Exhaust system
  - Oil or fuel leaks
  - Battery connections
  - Missing or loose hardware
  - Unusual noise
  - Cleanliness
  - Stored items in compartment



Engine Oil Level

OIL FILL CAP AND DIPSTICK

FILL TO HERE

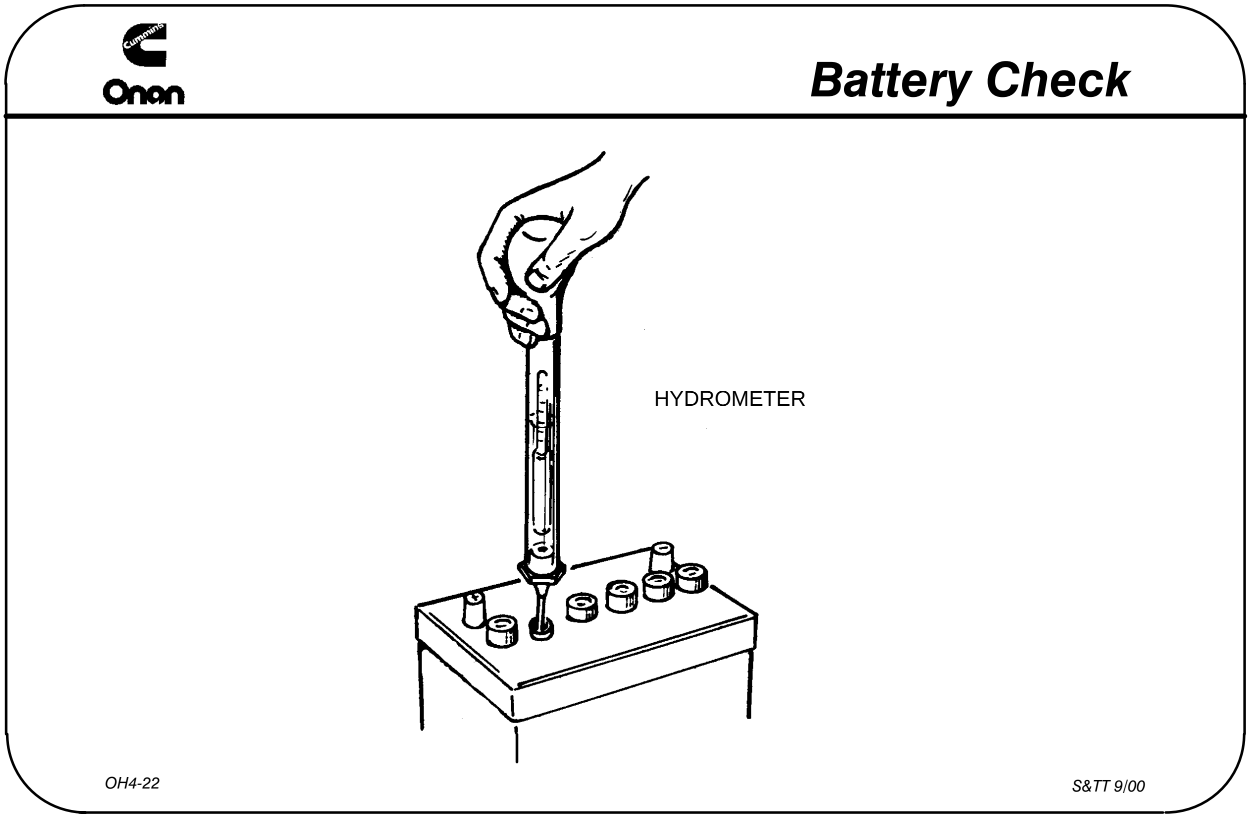
DO NOT RUN GENSET IF THE OIL LEVEL IS BELOW THIS MARK

OH4-21

S&TT 9/00

Slide 4-21: Engine Oil Level

- Should be done daily or every 8 hours of use.
- Vehicle should be on level ground.
- Engine must be shut off.
- Engine should be warm.
- Oil fill cap is removed and then screwed back in.
- Fill to “fill mark” only.
    - See table one in *Operator’s Manual* for correct viscosity.
- Do not operate GenSet if the oil level is below the add mark.



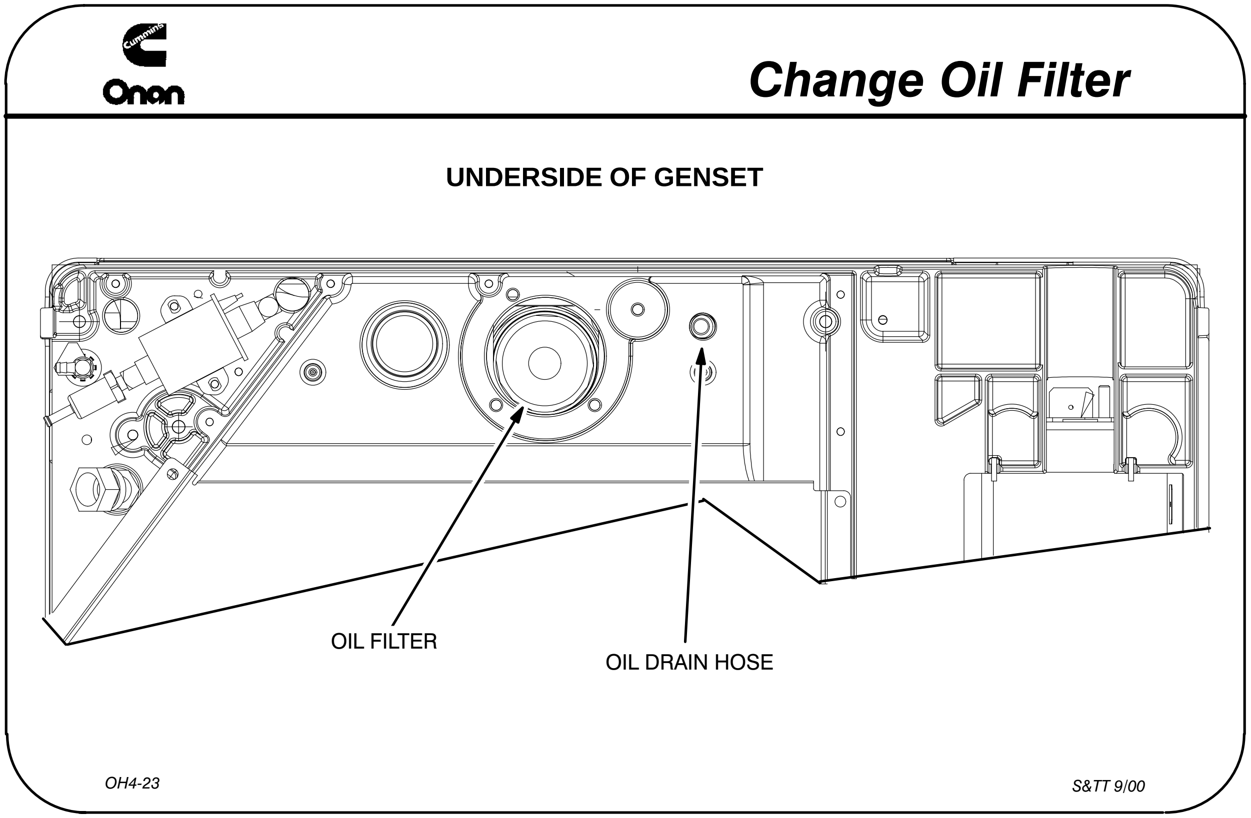
Battery Check

OH4-22

S&TT 9/00

Slide 4-22: Battery Check

- Should be done every month (more often in hot weather).
- Inspection steps:
    - Battery is clean and dry.
    - Connections are clean and tight.
    - Remove corrosion with baking soda and water.
- Check specific gravity using a hydrometer.
    - Should be between 1.215 (hot climate zones) and 1.260 (cold climate zones).
    - Charge if lower than 1.215.
    - Stop charging when the specific gravity reaches 1.260 at approximately 80° F.
- Add only distilled water.
- Batteries give off explosive gases.



Change Oil Filter

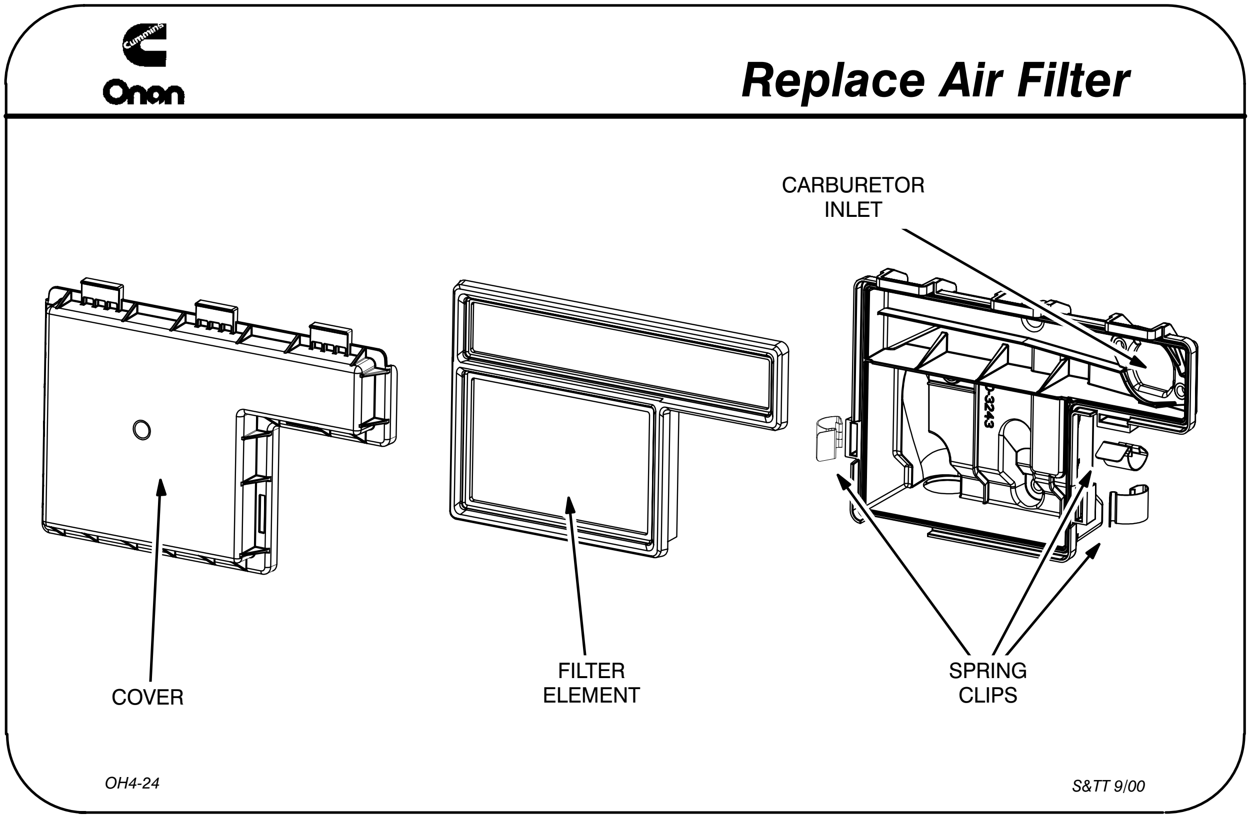
UNDERSIDE OF GENSET

OH4-23

S&TT 9/00

Slide 4-23: Change Oil Filter

- Should be done every 150 hours or once a year.
  - After the first 20 hours of wear-in period.
  - More often in hot weather.
  - More often in dusty conditions.
- Unit should be warm.
- Remove oil drain valve and filter.
  - Use an approved container to collect used oil.
  - Discard used oil according to local regulations.
- Clean mounting surface and replace drain plug and filter.
  - Apply thin film of oil on the new filter gasket.
  - Use only Onan replacement filter.
  - Tighten filter snug, then an additional $^1/_2$ to $^3/_4$ turn.
- Fill to “full mark” only.
  - See table one in the *Operator’s Manual* for correct viscosity.
  - Screw oil fill cap on securely.



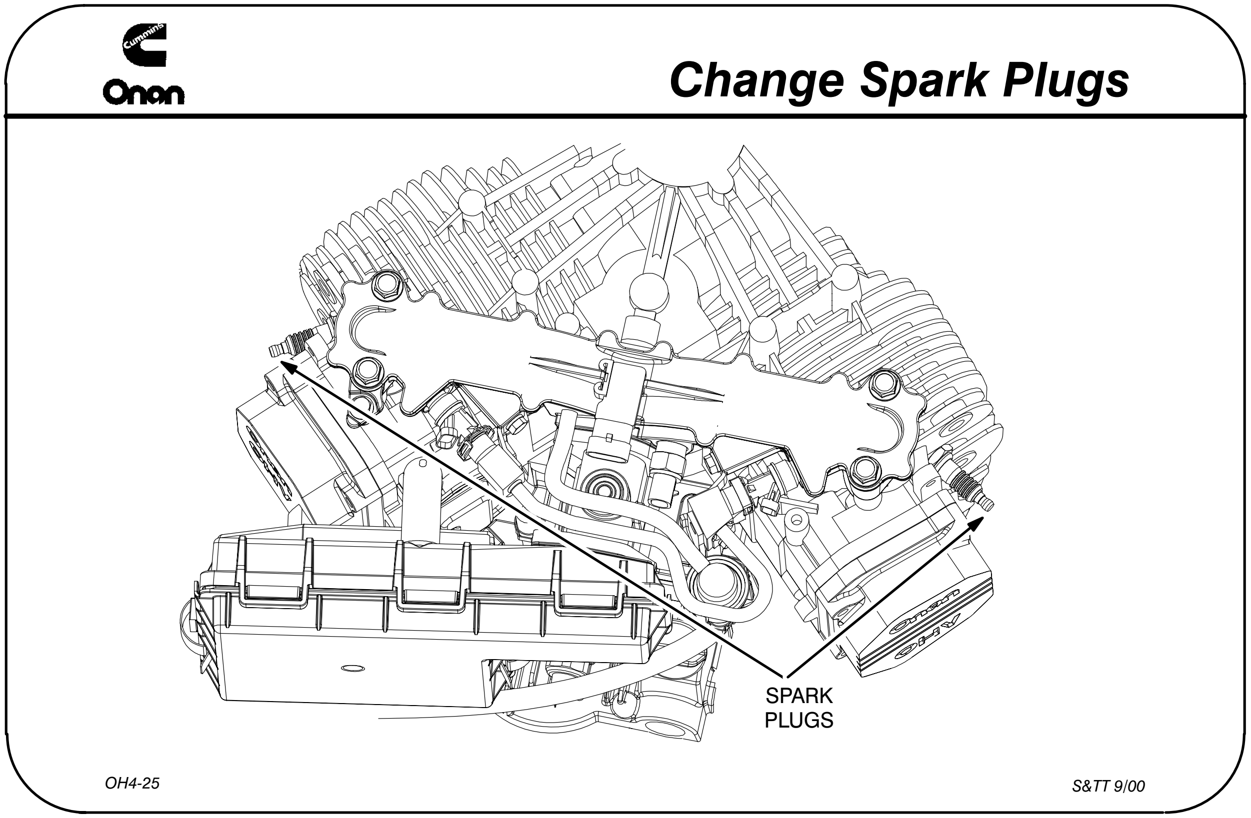
Replace Air Filter

OH4-24

S&TT 9/00

Slide 4-24: Replace Air Filter

- Should be done every 150 hours or once a year.
  - More often in dusty conditions.
- To replace:
  - Unclamp spring clips and remove filter cover.
  - Remove and replace air filter element and wrapper.
  - Replace filter cover and secure spring clips.
- Use only Onan replacement filter.
- Be sure to remove the cellophane shipping shrink wrap from filter element and wrapper.



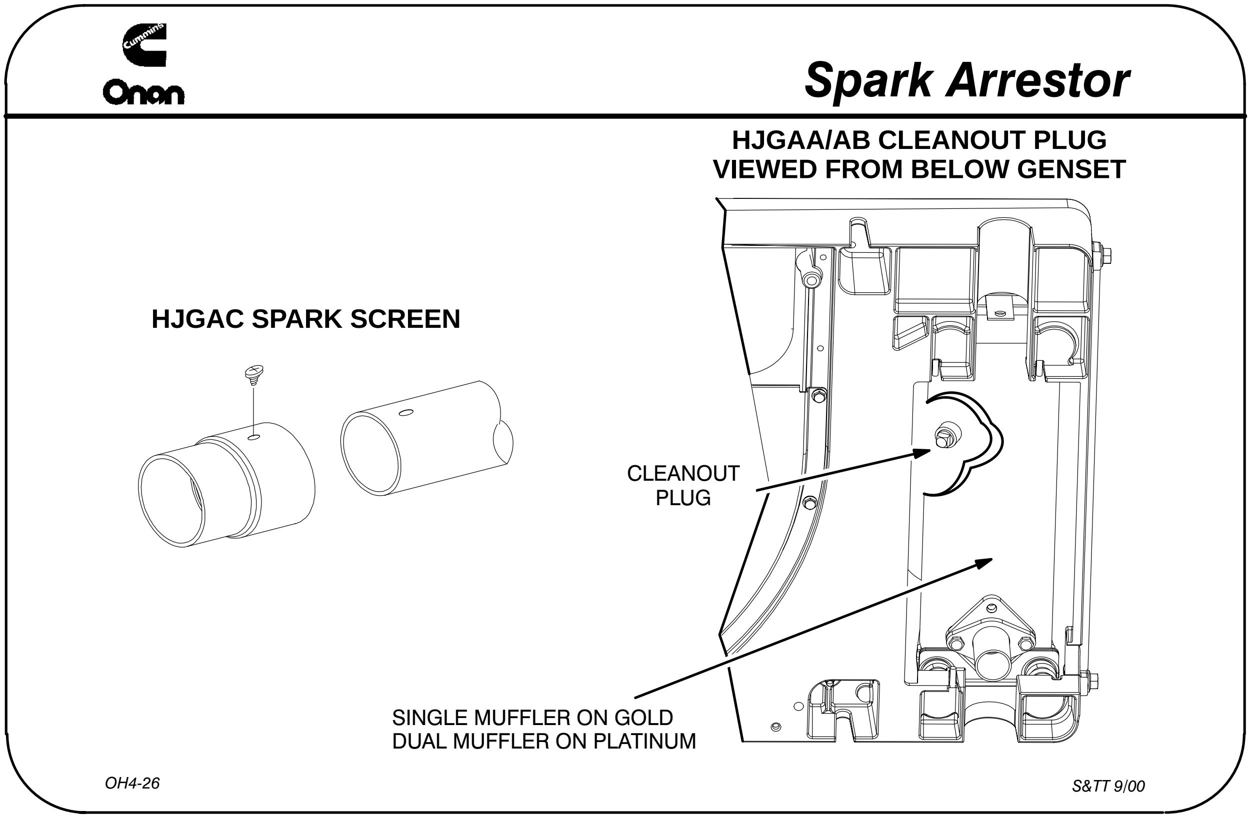
Change Spark Plugs

OH4-25

S&TT 9/00

Slide 4-25: Replace Spark Plugs

- Should be done every 450 hours.
  - Perform sooner if performance deteriorates.
- GenSet has 2 plugs.
- Ensure gap is correct.
- Thread replacement plugs in by hand.
- Torque to 8 lbs-ft (10 N-m).
- Use only Onan replacement plugs.



Spark Arrestor

HJGAA/AB CLEANOUT PLUG
VIEWED FROM BELOW GENSET

HJGAC SPARK SCREEN

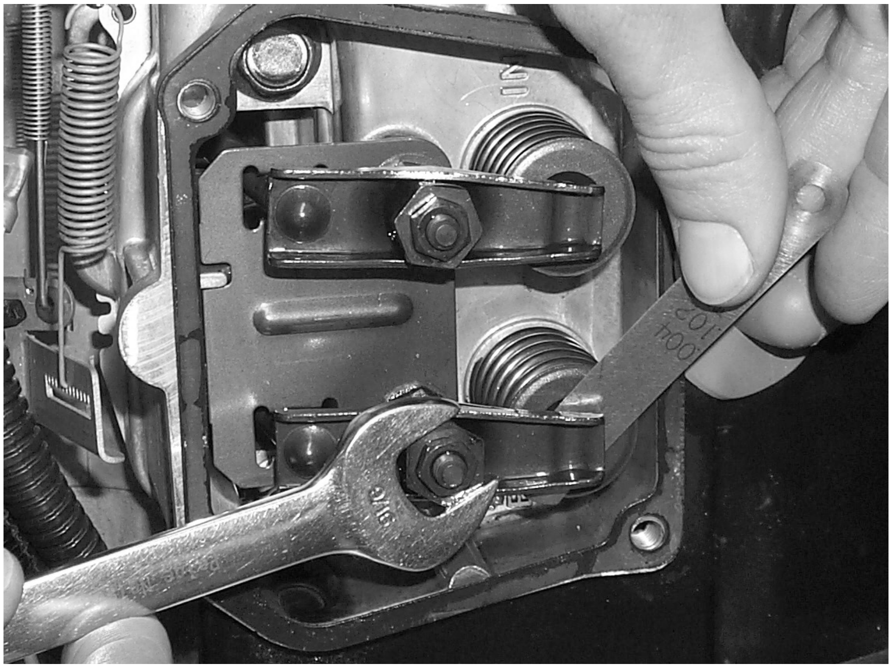
OH4-26

S&TT 9/00

Slide 4-26: Spark Arrestor

- Should be done every 50 hours.
- Allow muffler to cool before removing plug.
- Remove plug.
  - Start GenSet and apply 75% load.
  - Run 5 minutes to expel soot in muffler.
- Allow muffler to cool before replacing plug.

Valve Adjustment

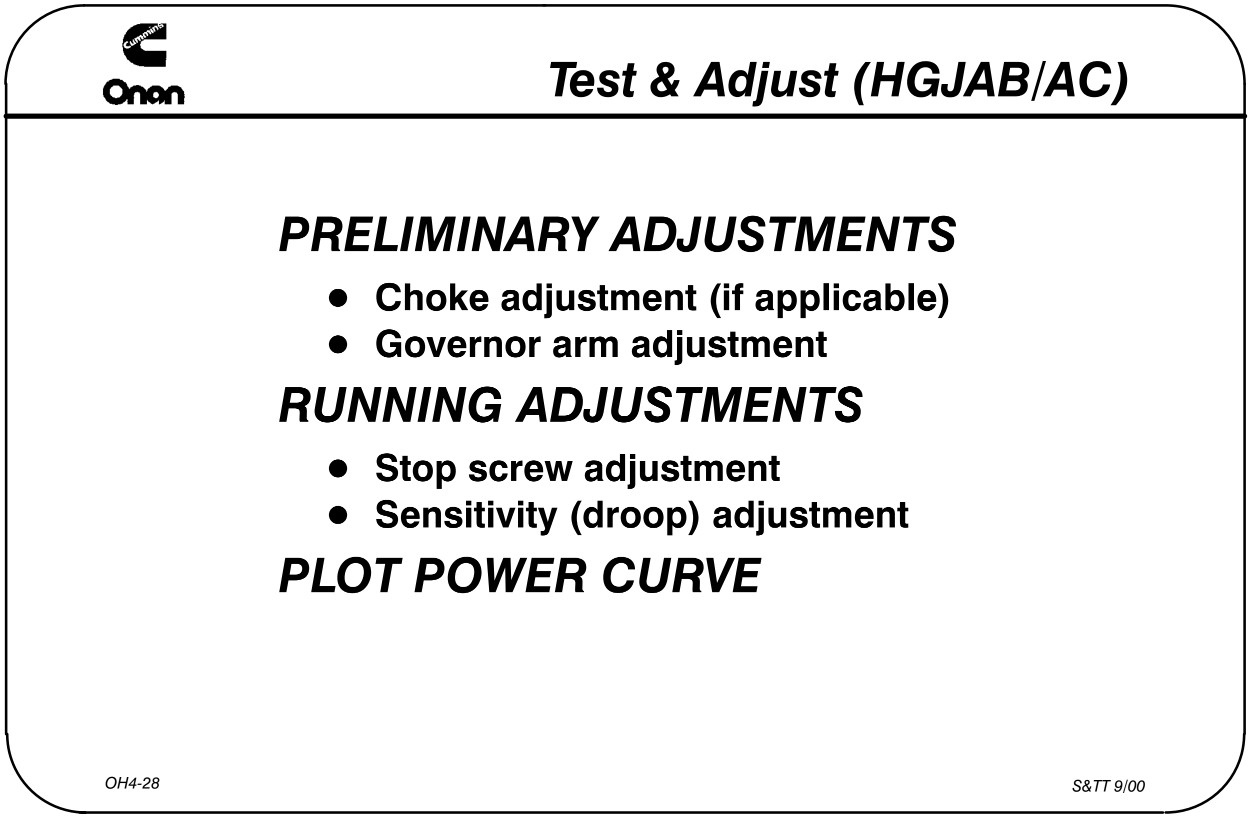


OH4-27

S&TT 9/00

Slide 4-27: Valve Adjustment

- Should be done every 450 hours.
    - Must be performed by a qualified mechanic.
- Adjust clearance according to the *Service Manual*.
- Follow the adjustment procedure outlined in the *Service Manual*.



Test & Adjust (HGJAB/AC)

PRELIMINARY ADJUSTMENTS

- Choke adjustment (if applicable)
- Governor arm adjustment

RUNNING ADJUSTMENTS

- Stop screw adjustment
- Sensitivity (droop) adjustment

PLOT POWER CURVE

OH4-28

S&TT 9/00

Slide 4-28: Test and Adjust

Preliminary Adjustments:

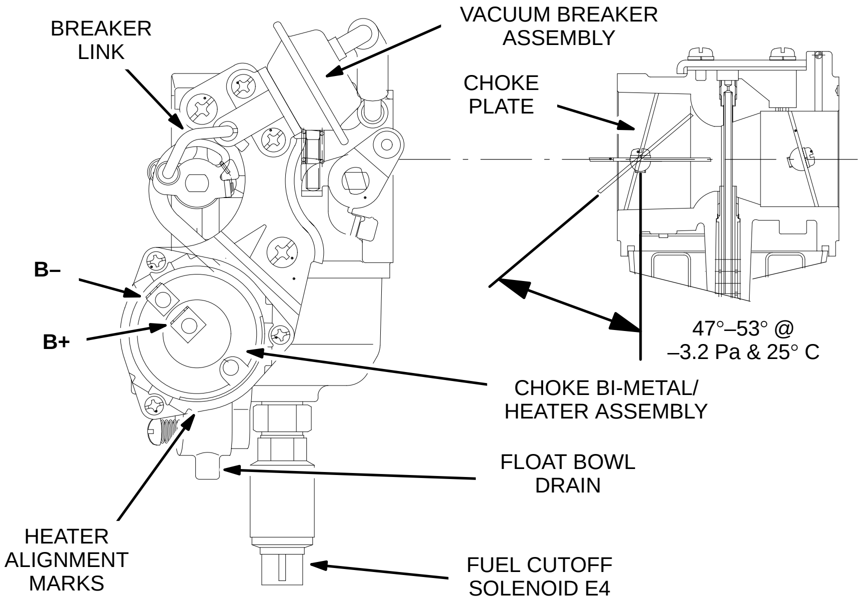
- Perform choke adjustment.
- Perform governor arm adjustment.

Running Adjustments:

- Adjust no-load frequency.
- Adjust the idle stop screw to the specified frequency.
- Re-adjust no-load frequency.
- Check full-load droop.
- Adjust the sensitivity.
- Recheck full-load droop.
- Recheck the sensitivity and stability.

Record Your Results

Choke Adjustments



OH4-29

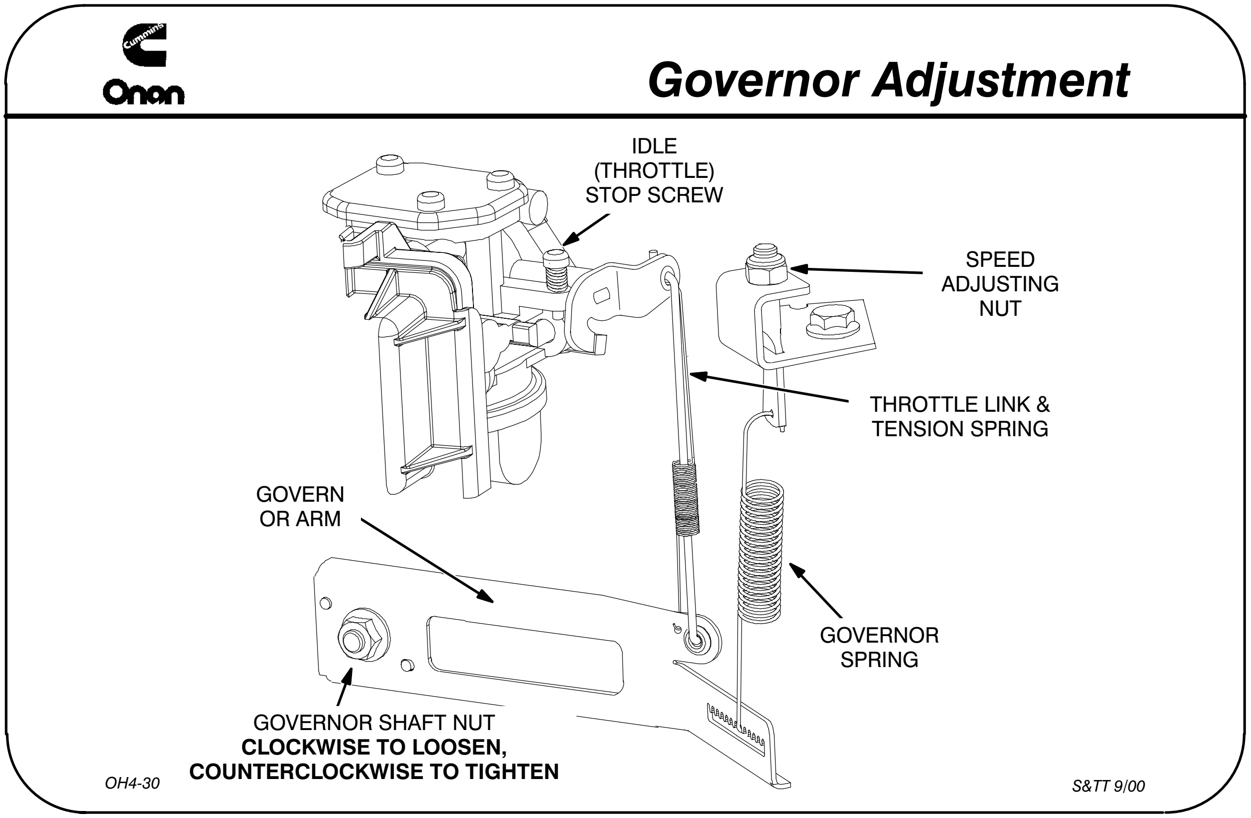
S&TT 9/00

Slide 4-29: Preliminary Choke Adjustments

DC Operated Choke

- Bi-metal heater assembly with vacuum breaker.
- Receives battery voltage from the control.
- Shaft is spring loaded to prevent flooding upon start-up.
- Replace Bi-metal assembly if choke is faulty.

Note: Refer to *Service Manual* for choke assembly adjustment.



Governor Adjustment

Slide 4-30: Governor Adjustments

Resetting of Governor Arm

- Make adjustment with GenSet cold and not running.
- Critical for correct operation of the governor.
- Make certain that movement is free and fully opens and closes throttle.
- Refer to the *Service Manual* for correct adjustment procedure.

Adjusting Governor

- Governor set speed and sensitivity must be adjusted using load bank.
  - 60 Hz = 63/62 Hz (no load) 2-4 Hz Droop
  - 50 Hz = 52.5/51.5 Hz (no load) 2-4 Hz Droop

Adjusting Carburetor

- Adjust idle stop screw.
  - 60 Hz = 51 to 53 Hz (no-load) 50 Hz = 41 to 43 Hz (no-load).

Activity

Situation One:

Perform the necessary steps for choke, governor and carburetor adjustments. Document its performance by plotting a power curve. Follow these steps:

1. Perform preliminary choke adjustment.

   ☐ Refer to the *Service Manual*

   ☐ Choke adjustment

2. Perform preliminary governor arm adjustment.

   ☐ Refer to the *Service Manual*

   ☐ Governor arm adjustment

3. Start the GenSet, apply 50% load for 5 minutes and allow for warm-up.

   ☐ Warm-up

4. Apply no-load and adjust the speed adjust nut to the proper frequency set point.

   ☐ Refer to the *Service Manual*

5. Hold down the throttle stop lever and set the throttle stop screw.

   ☐ Refer to the *Service Manual*

6. Apply full-load and check the N.L. to F.L. frequency droop.

   ☐ Refer to the *Service Manual*

7. Remove the load and adjust the governor sensitivity if required.

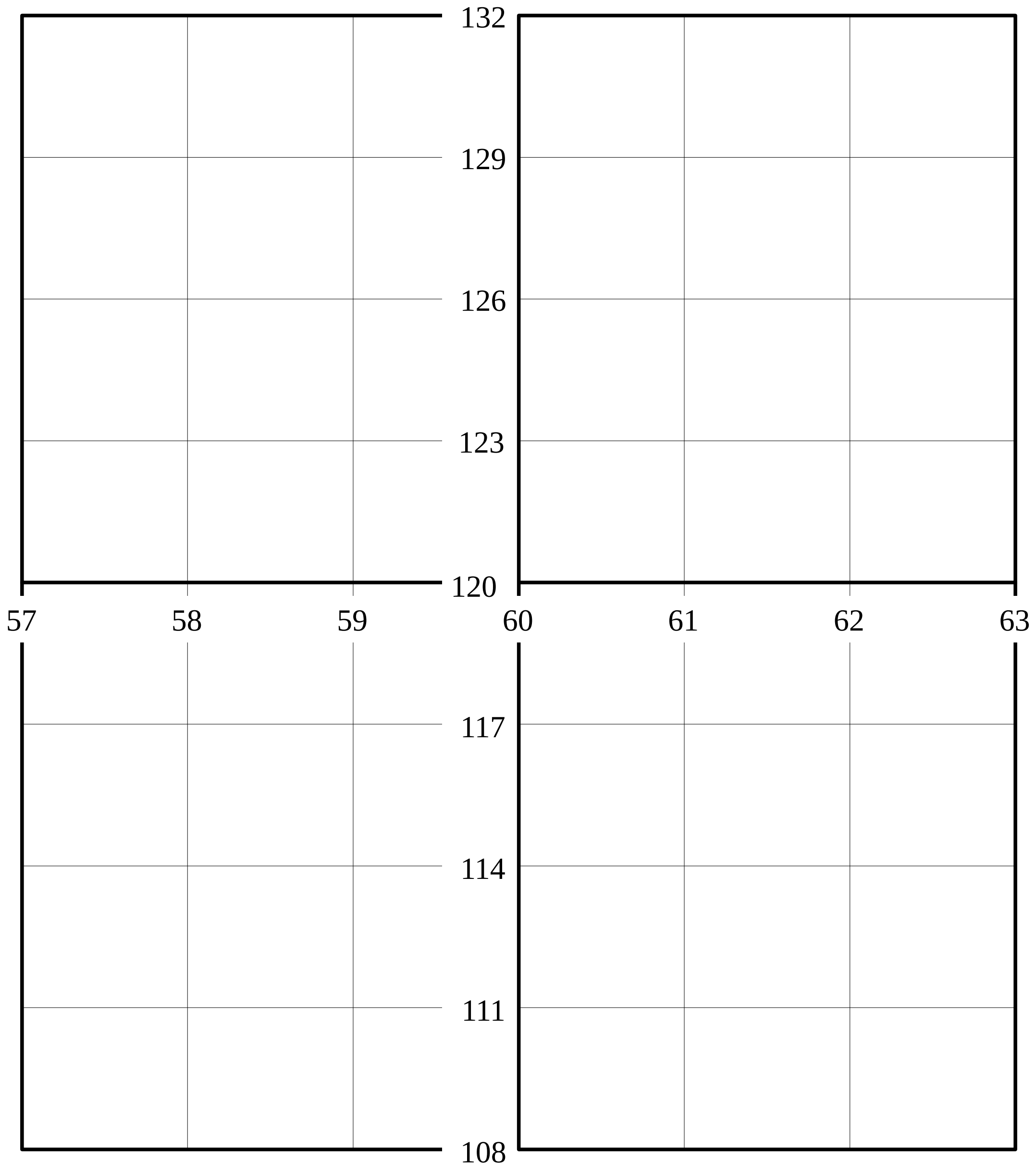
   ☐ Refer to the *Service Manual*

8. Reverify no-load to full-load frequency.

   ☐ Refer to the *Service Manual*

9. Record the GenSet performance by plotting the power curve on the next page.

Power Curve



Load Step	Amperes or Watts	Voltage	Frequency
0%			
25%			
50%			
75%			
100%			

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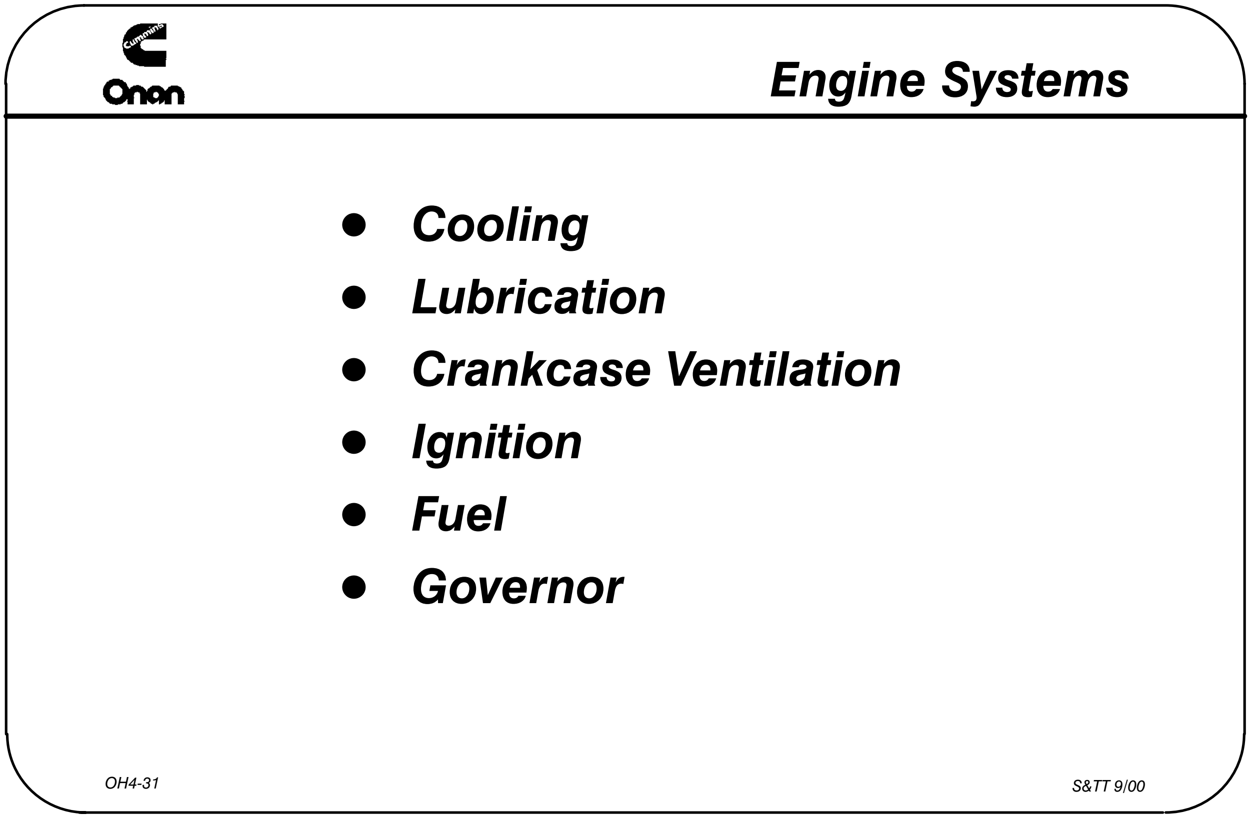
Advantage/Gold/Platinum GenSet Troubleshooting

This lesson presents the troubleshooting steps and job aids for the Advantage/Gold/Platinum generator set.

Objectives

After completing this lesson, you should be able to:

- Find and use the engine/generator/control troubleshooting sections in the Advantage/Gold/Platinum GenSet *Service Manuals*.
- Read and understand AC and DC schematics.
- Use special tools for diagnostic testing.
- Troubleshoot common engine, generator and control problems.



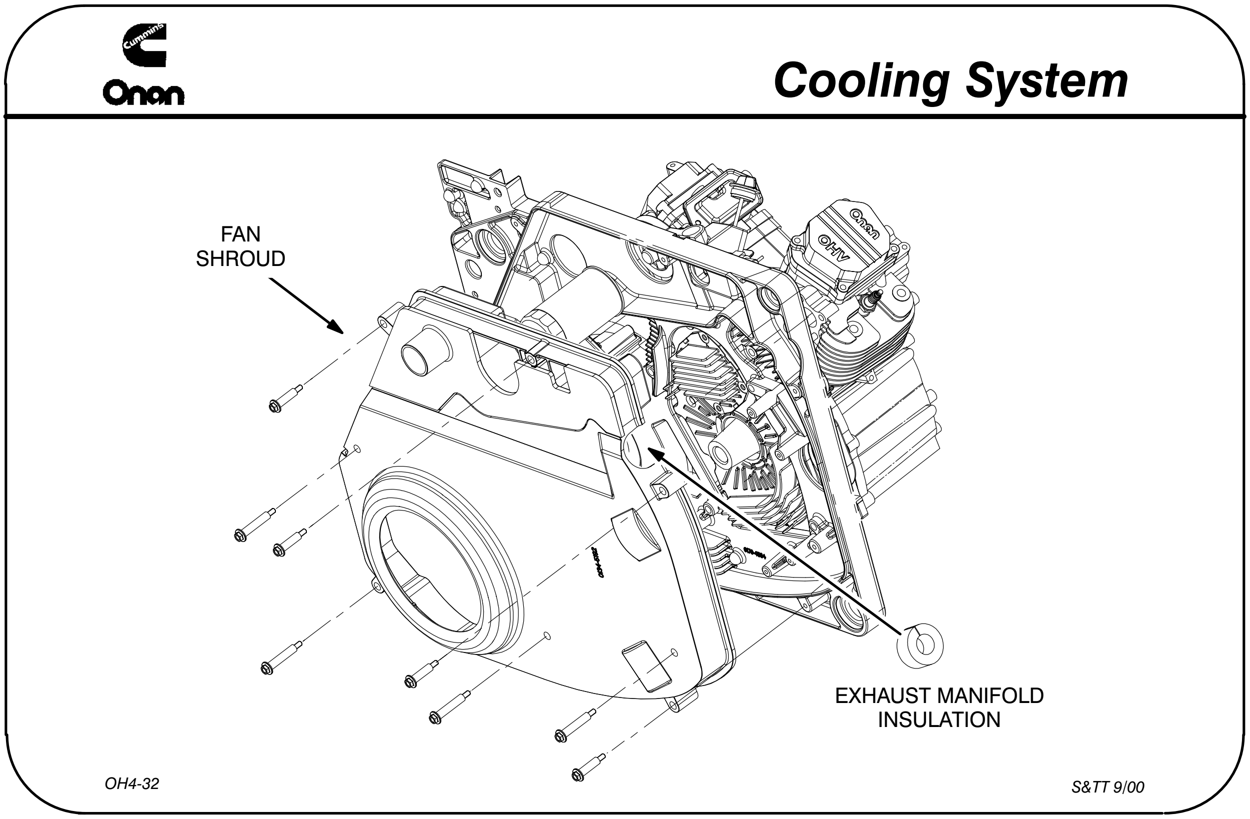
Engine Systems

- Cooling
- Lubrication
- Crankcase Ventilation
- Ignition
- Fuel
- Governor

OH4-31

S&TT 9/00

Slide 4-31: Engine Systems



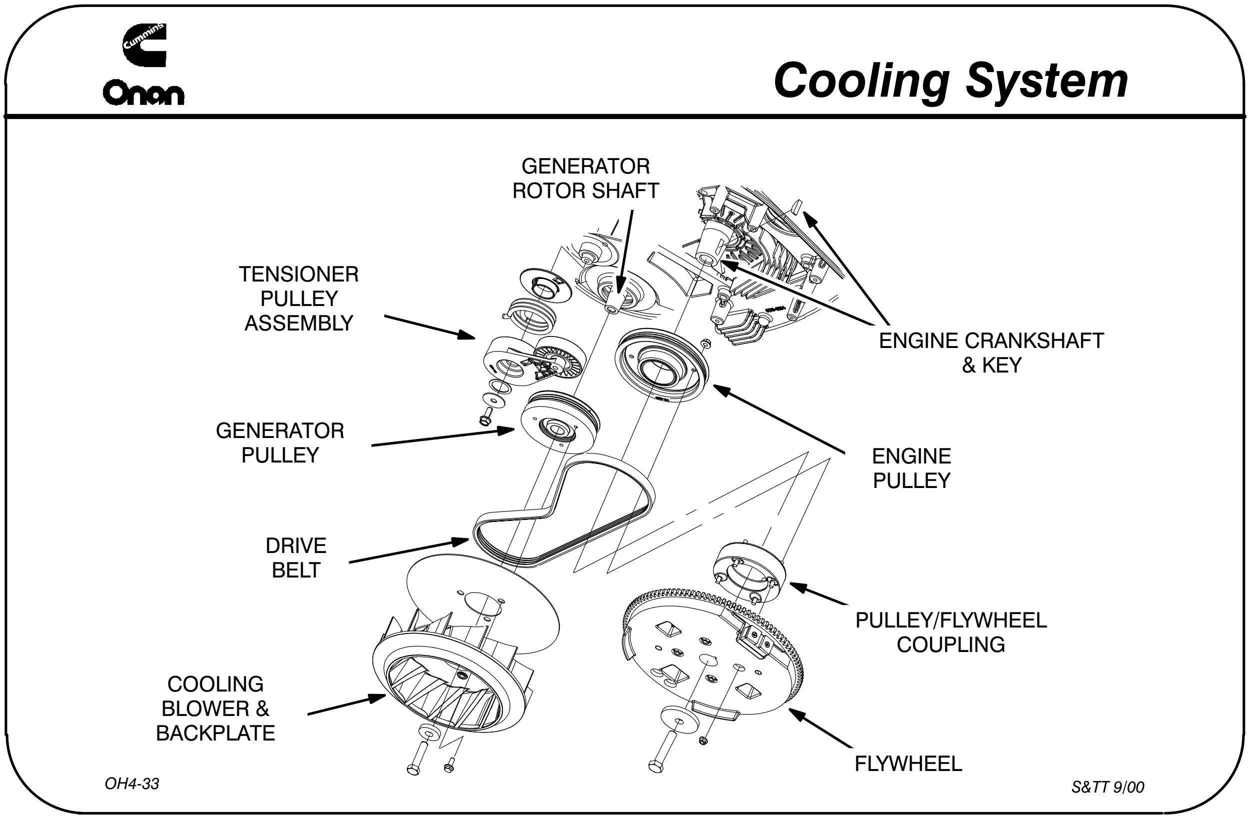
Cooling System

OH4-32

S&TT 9/00

Slide 4-32: Cooling System

- Cooling air flows from the bottom of the base, through the generator end and across the engine cooling fins then exiting the GenSet through the muffler opening.
  Note: This area must be free of dirt, dust, and debris.
- Centrifugal fan mounted on the generator rotor.
- Rotor/cooling fan are belt driven by the engine.



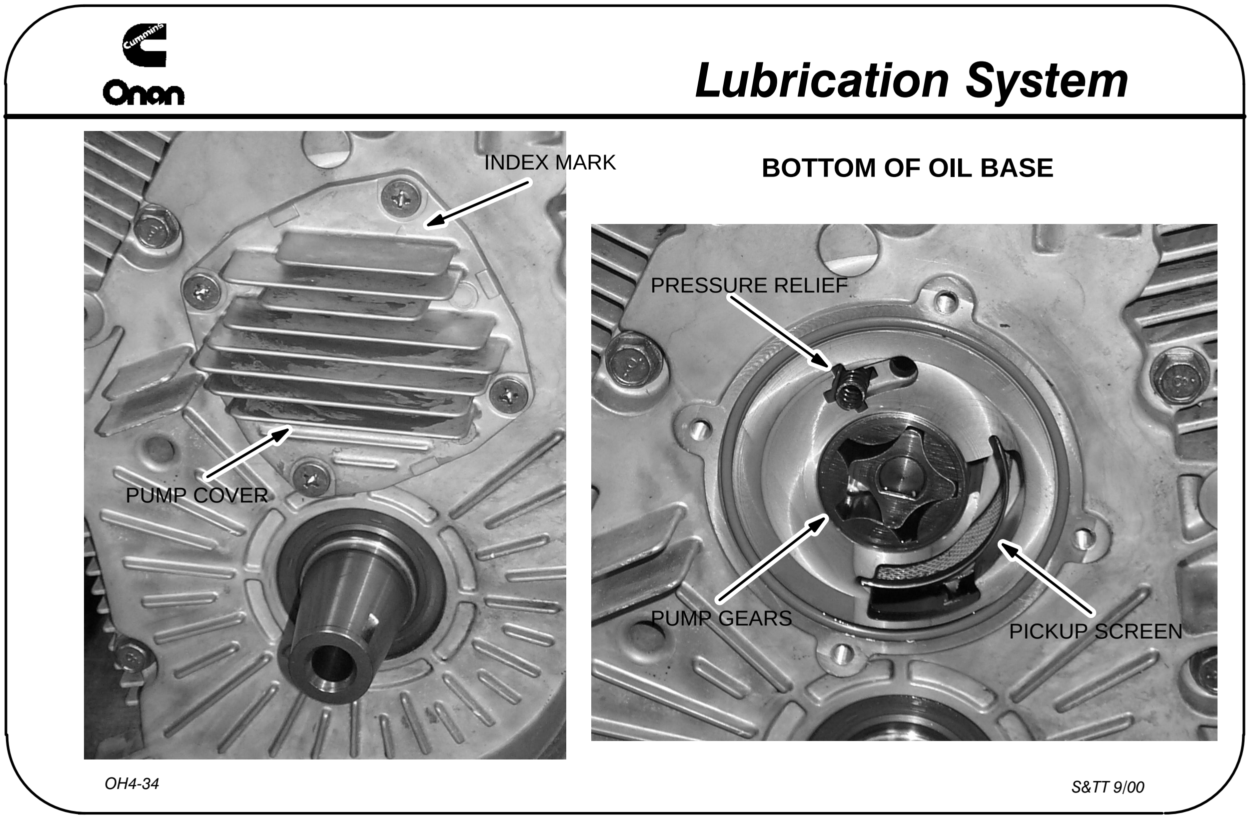
Cooling System

OH4-33

S&TT 9/00

Slide 4-33: Cooling System

- Rotor/cooling fan driven by 4-rib “Poly-Vee” belt.
- Belt tension maintained by the self-tensioning pulley assembly.



Lubrication System

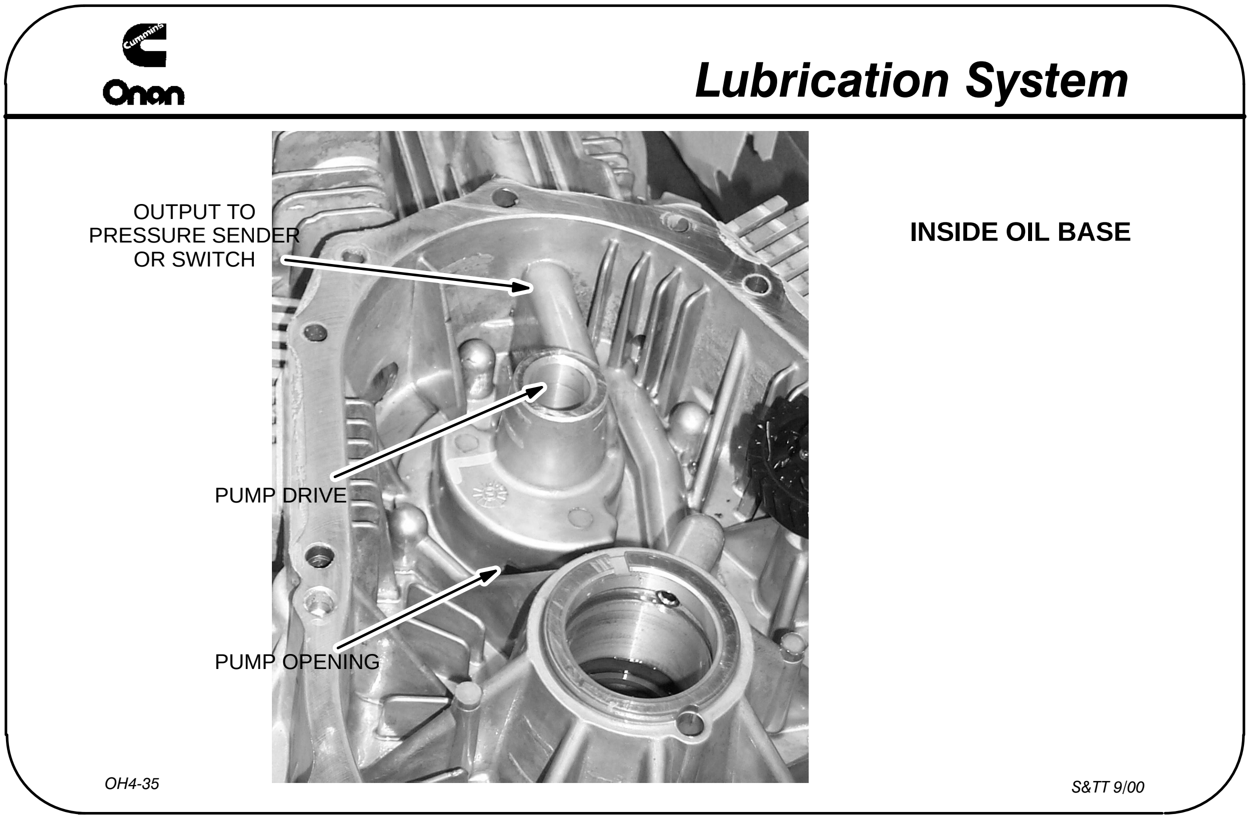
BOTTOM OF OIL BASE

OH4-34

S&TT 9/00

Slide 4-34: Lubrication System

- Rotor type oil pump.
- Driven by camshaft.
- Pressure relief valve limits operating oil pressure.
- Oil filter with bypass valve.
- Location for low oil pressure switch or gauge.



Lubrication System

OUTPUT TO
PRESSURE SENDER
OR SWITCH

PUMP DRIVE

PUMP OPENING

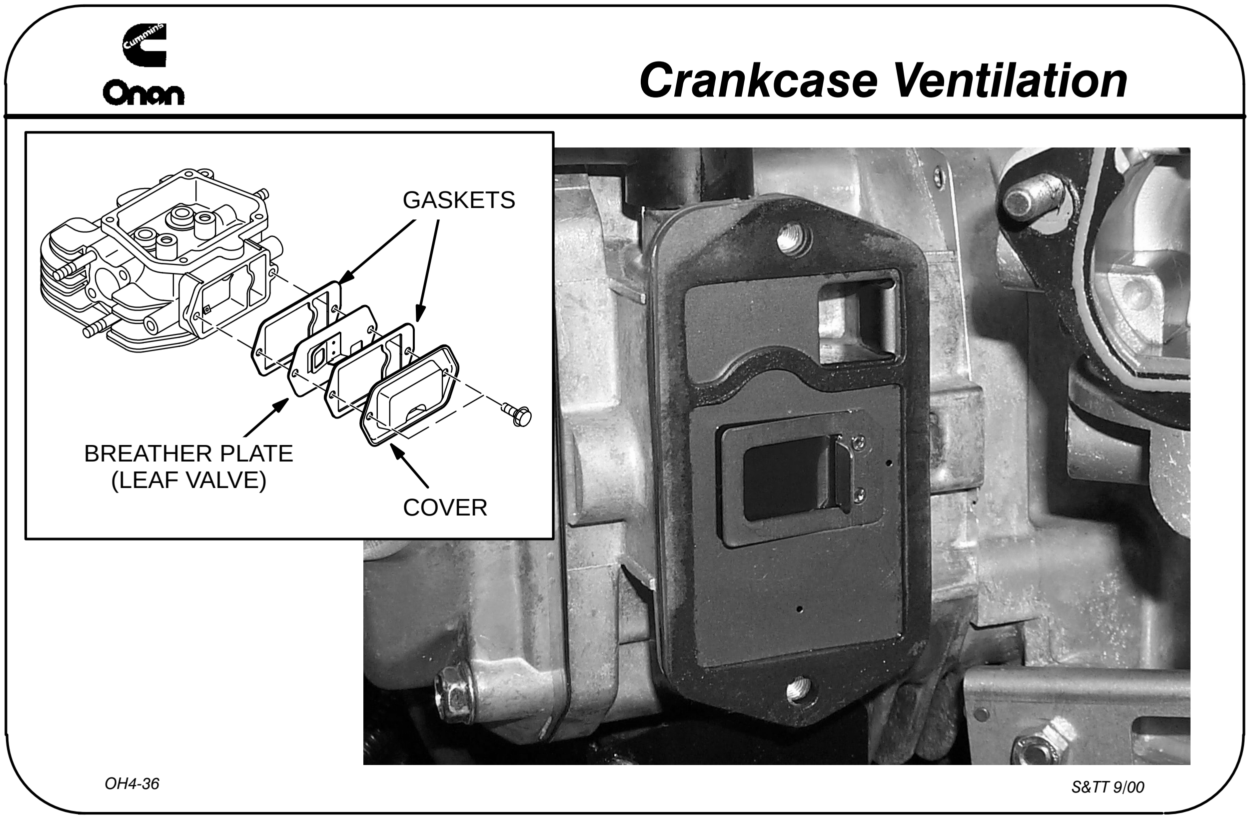
INSIDE OIL BASE

OH4-35

S&TT 9/00

Slide 4-35: Lubrication System

- Rotor type oil pump, shaft driven by camshaft.
- Location for low oil pressure switch or gauge.
- Internal pickup with screen.



Crankcase Ventilation

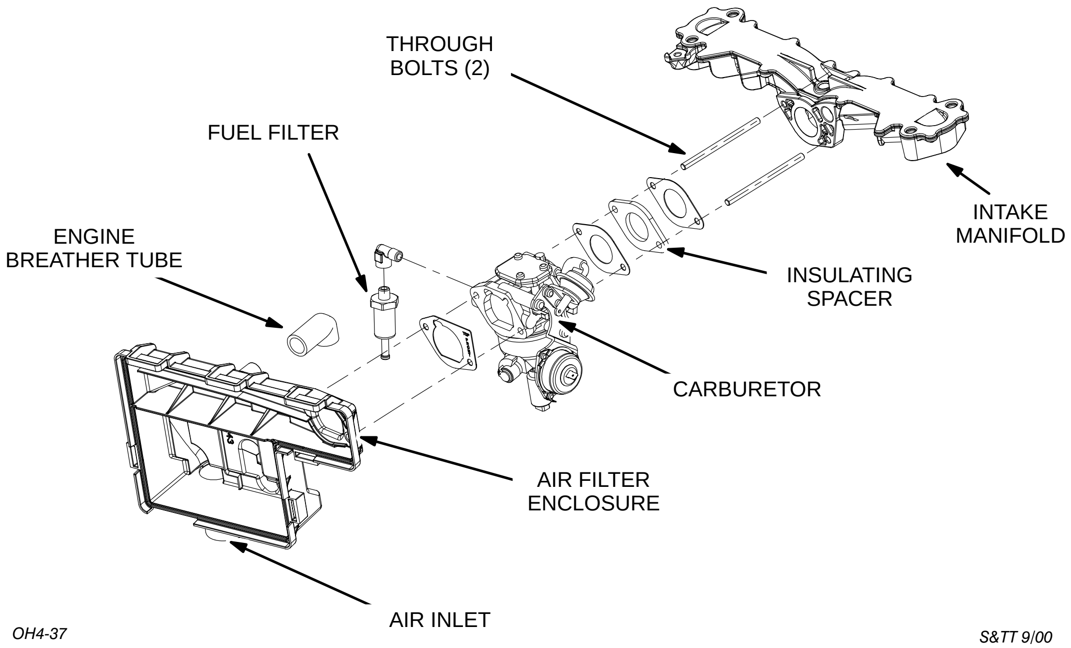
OH4-36

S&TT 9/00

Slide 4-36: Crankcase Ventilation

- Reed valve type.
- Maintains negative crankcase pressure.
- Do not overtighten the valve cover bolt.
- A faulty breather can cause oil leaks, high oil consumption, reduced engine performance, sludge, and varnish buildup.

Gasoline Carburetor

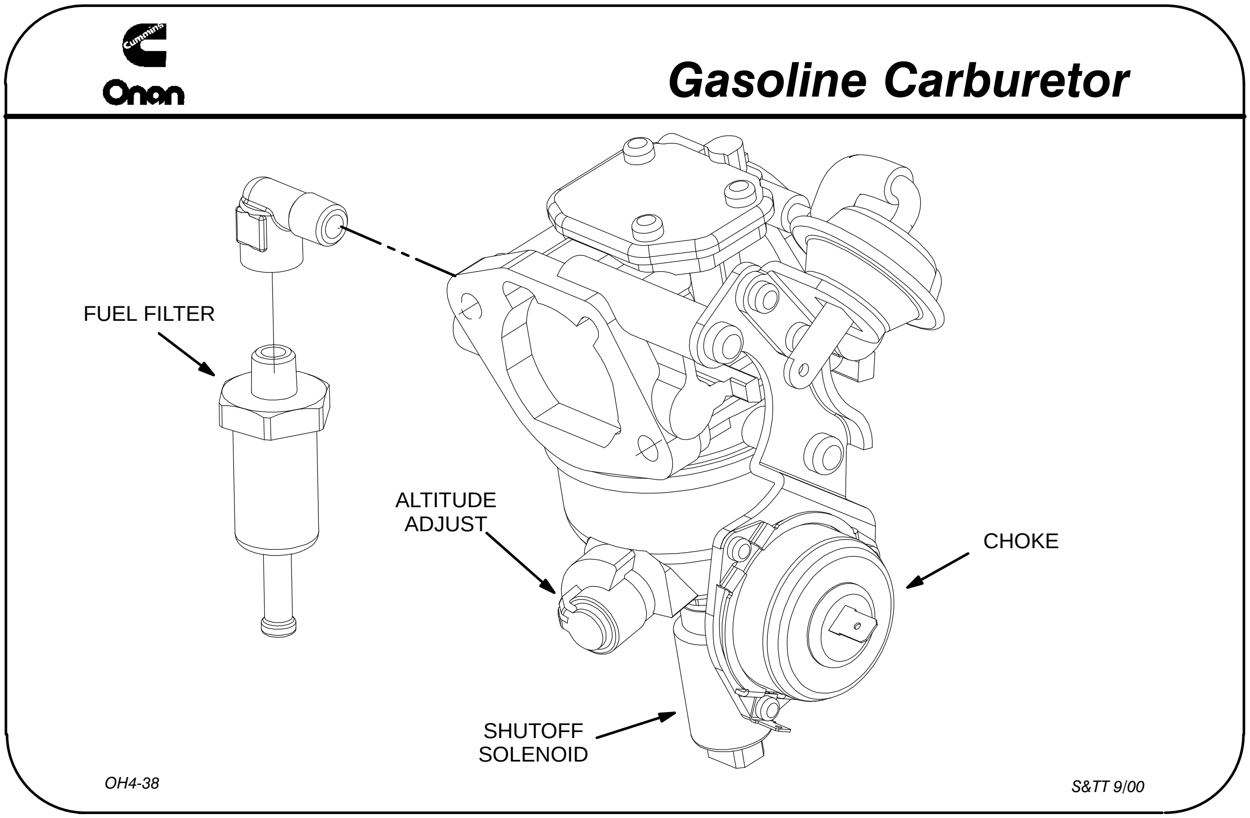


OH4-37

S&TT 9/00

Slide 4-37: Gasoline Carburetor

- Nikki® brand side draft carburetor.
- Fuel filter.
- 2.5 to 4.0 psi supply pressure.



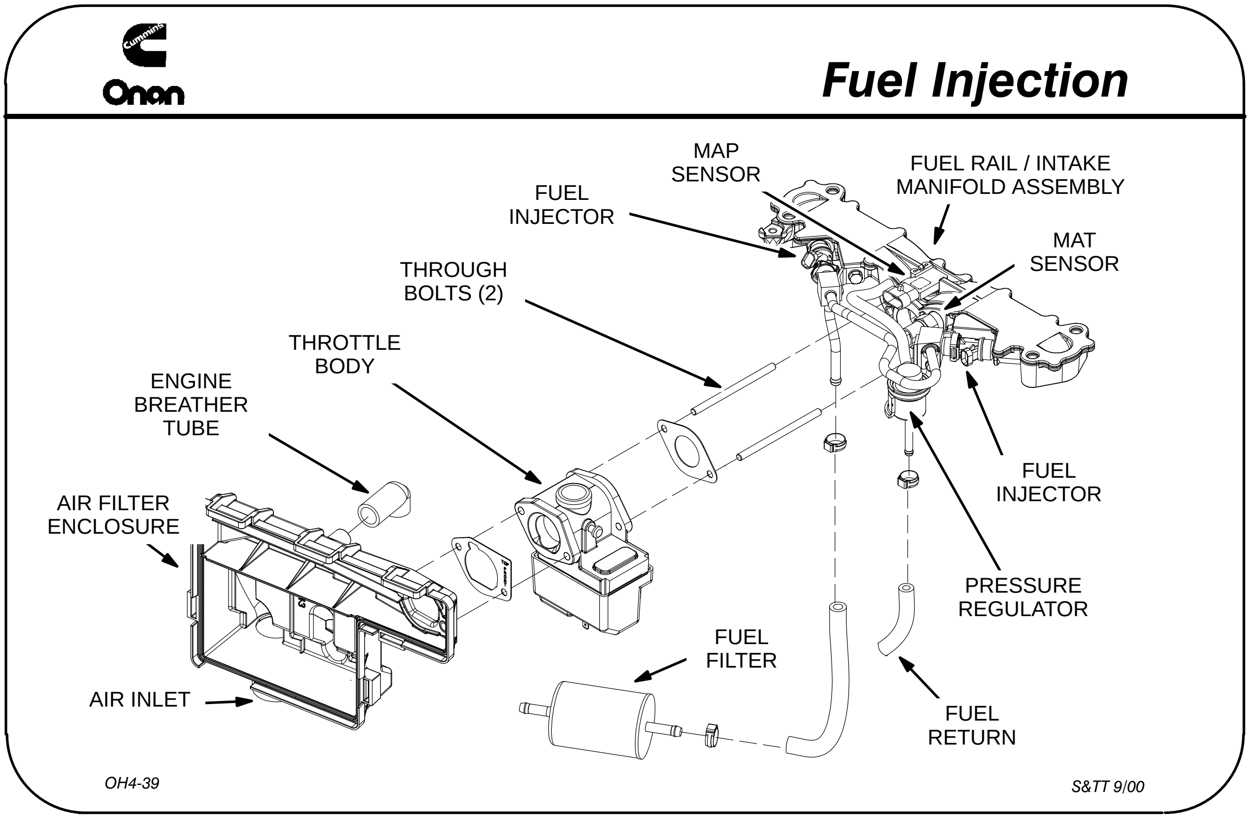
Gasoline Carburetor

OH4-38

S&TT 9/00

Slide 4-38: Gasoline Carburetor

- Nikki® brand side draft carburetor.
- Throttle stop screw and altitude adjustments only – no mixture adjustments.
- Automatic choke.
- Fuel cutoff solenoid.
- Bowl drain.



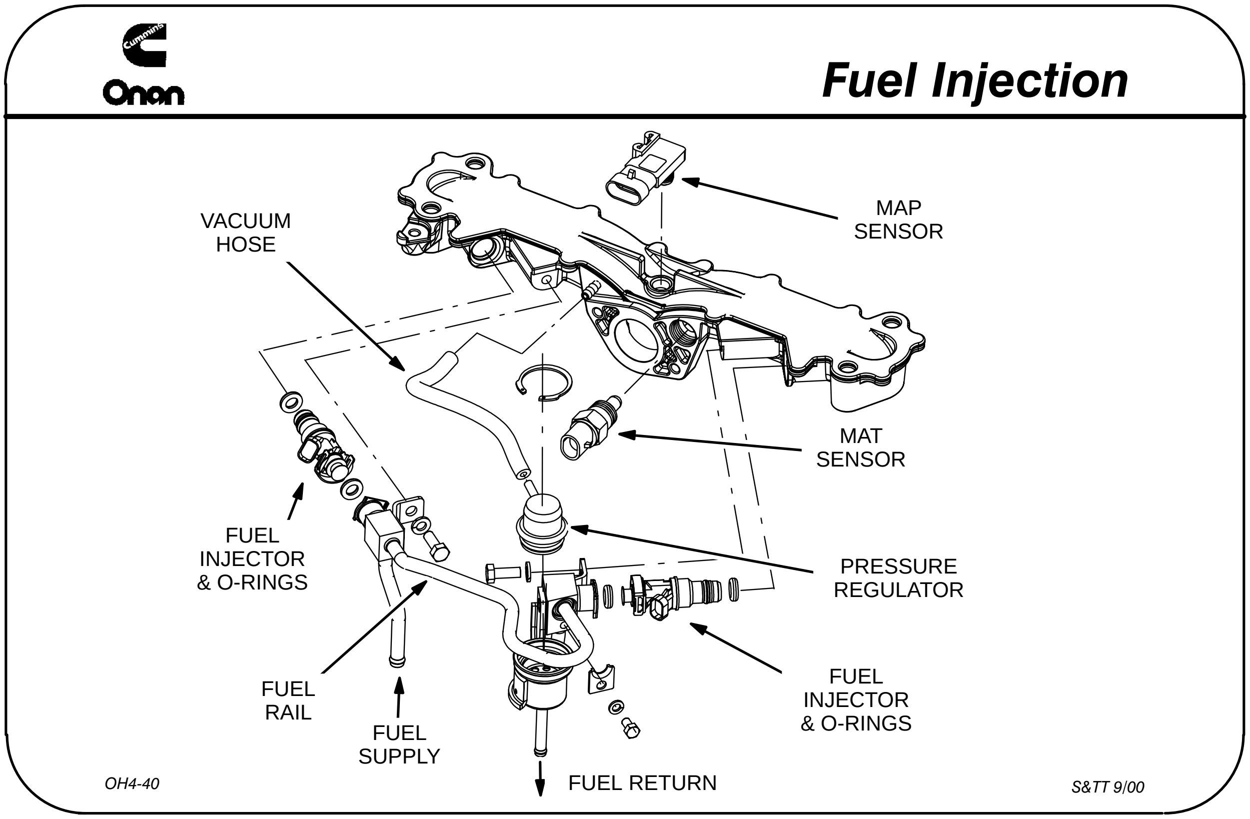
Fuel Injection

OH4-39

S&TT 9/00

Slide 4-39: Fuel Injection

- Nikki® brand throttle body carburetor.
- Digitally controlled, electronic fuel injection.
- Electronically controlled throttle body governor.
- High pressure fuel supple (43.5 psi).



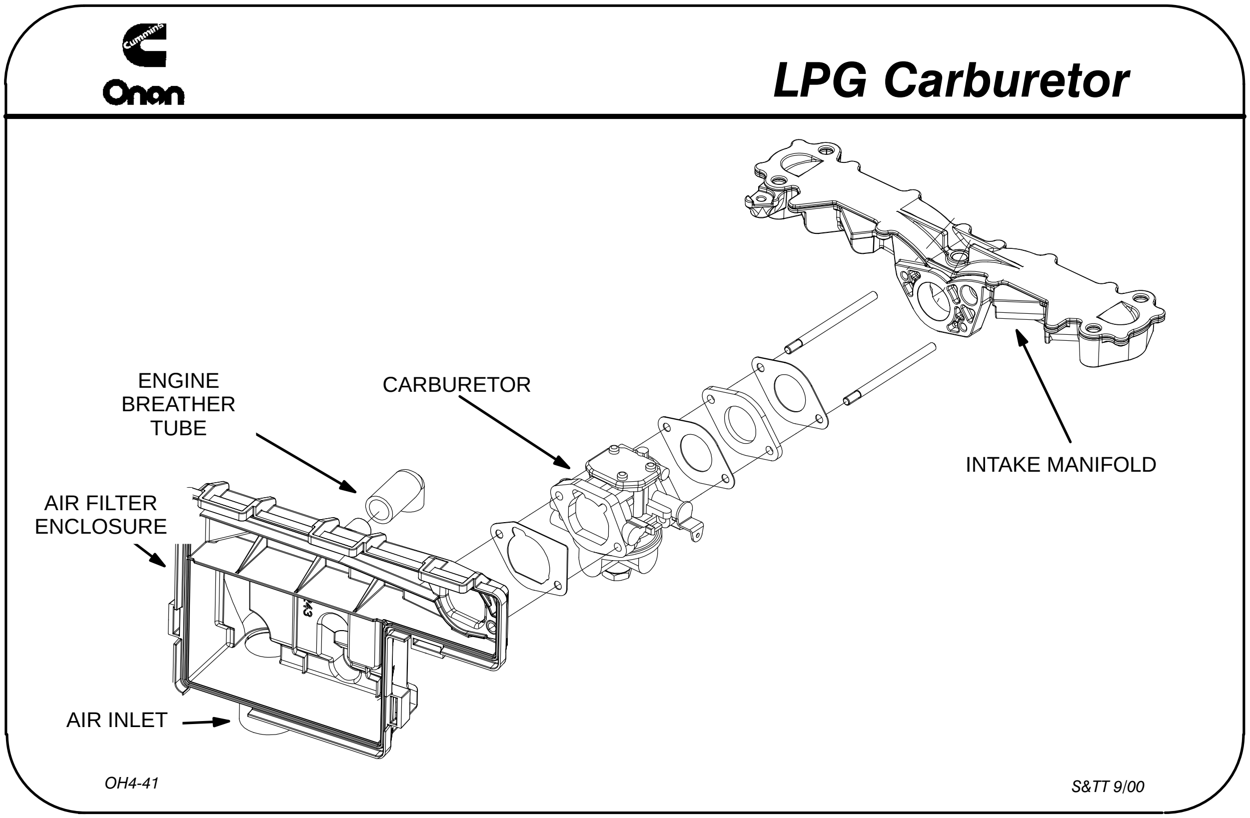
Fuel Injection

OH4-40

S&TT 9/00

Slide 4-40: Fuel Injection

- Fuel pressure regulator
- Manifold air temperature (MAT) sensor.
- Manifold absolute pressure (MAP) sensor.



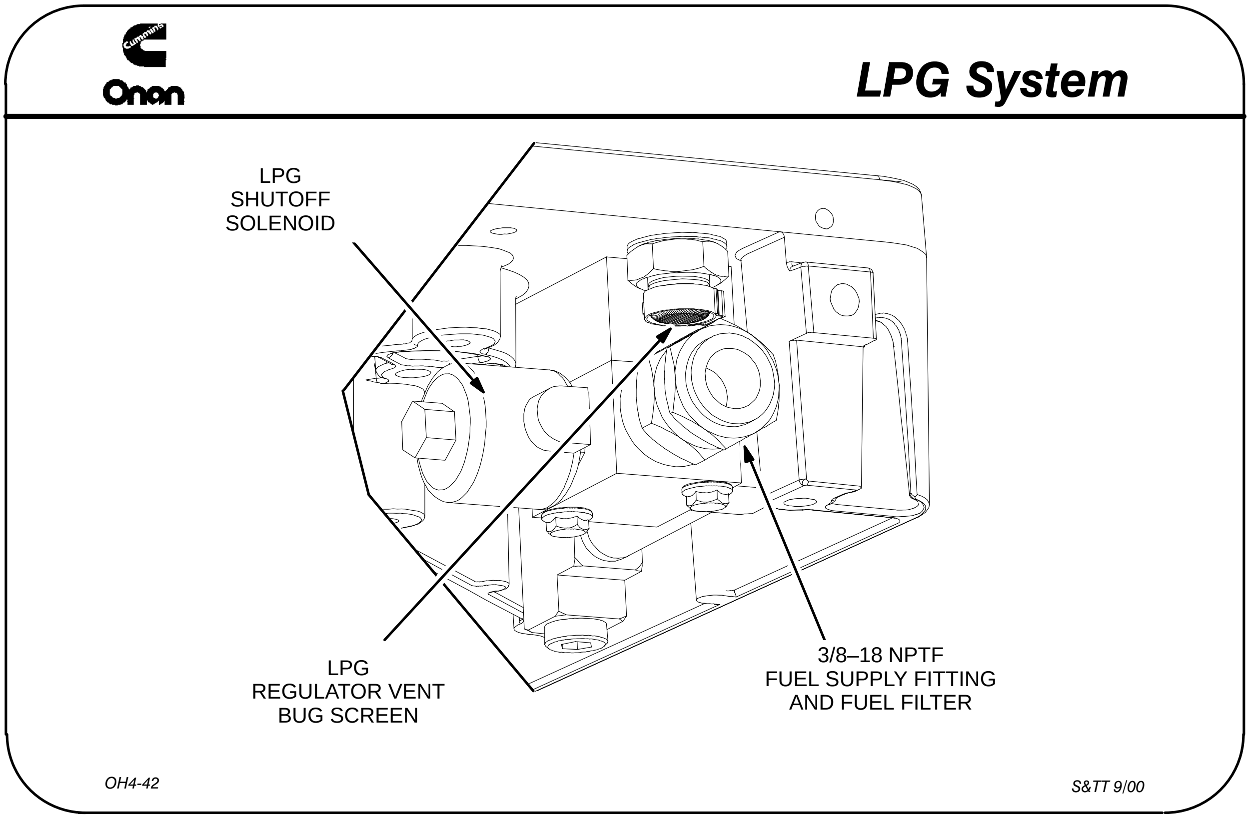
LPG Carburetor

OH4-41

S&TT 9/00

Slide 4-41: LPG Carburetor

- Nikki® brand LPG fuel mixer.



LPG System

LPG SHUTOFF SOLENOID

LPG REGULATOR VENT BUG SCREEN

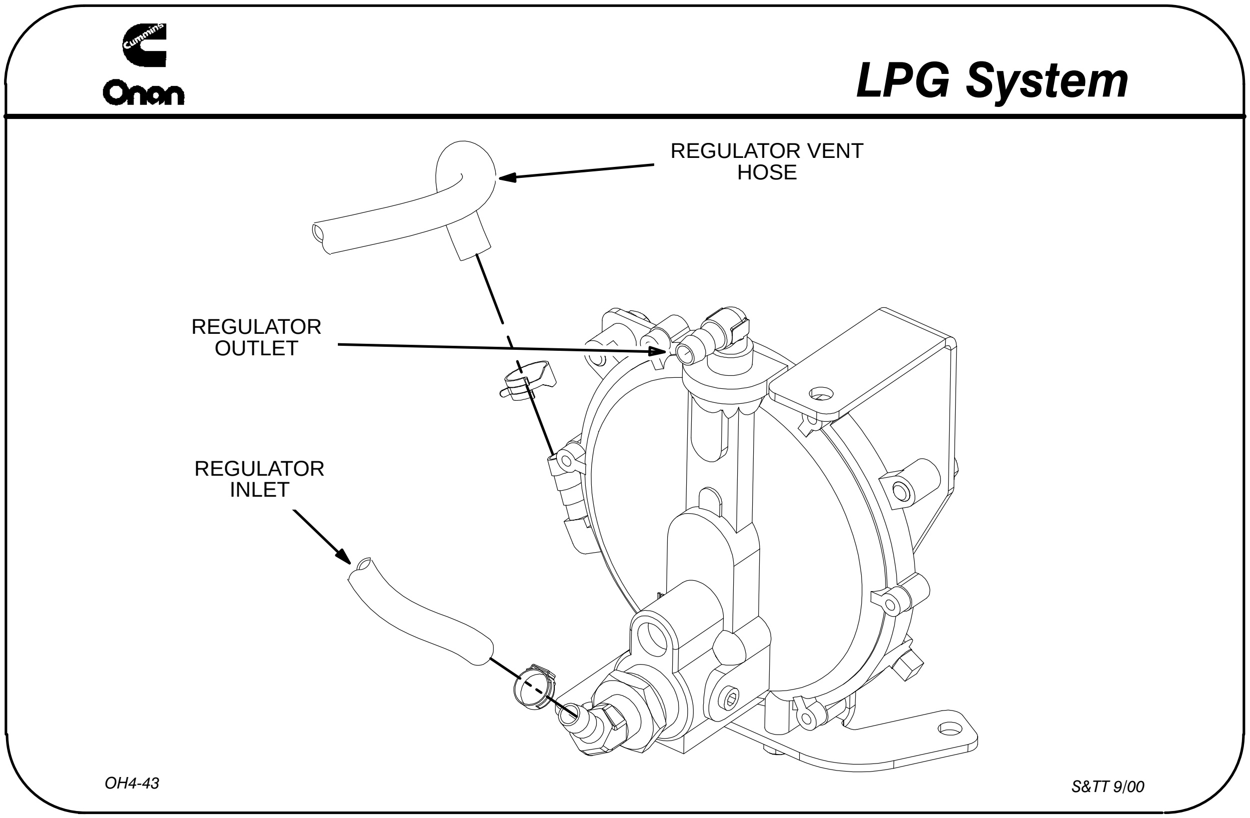
3/8–18 NPTF FUEL SUPPLY FITTING AND FUEL FILTER

OH4-42

S&TT 9/00

Slide 4-42: LPG System

- Vapor withdrawal GenSets are connected directly to the vapor tap on the LP tank.
- Tank supply to the GenSet must be regulated to 9–13 inches of water column pressure.
- Regulator vent is vented out GenSet base.
- Periodically clean filter in inlet end of fuel solenoid.



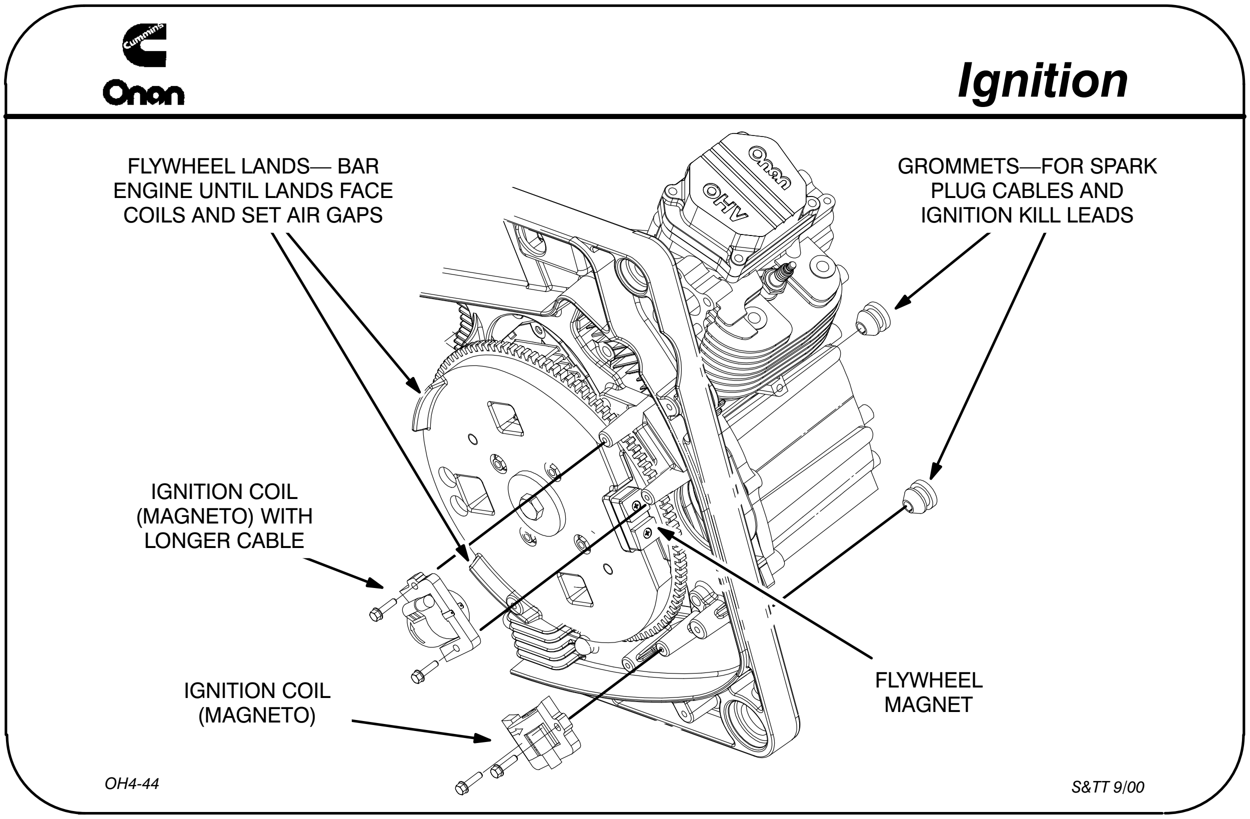
LPG System

OH4-43

S&TT 9/00

Slide 4-43: LPG System

- Demand regulator opens (operates) at about 0.25 to 0.35 inches of water column vacuum.
- Normal operating fuel supply to the mixer is about 9–13 inches of water column pressure.
- Regulator vent hose is routed outside of GenSet base next to the solenoid.
- No adjustment are required to regulator.



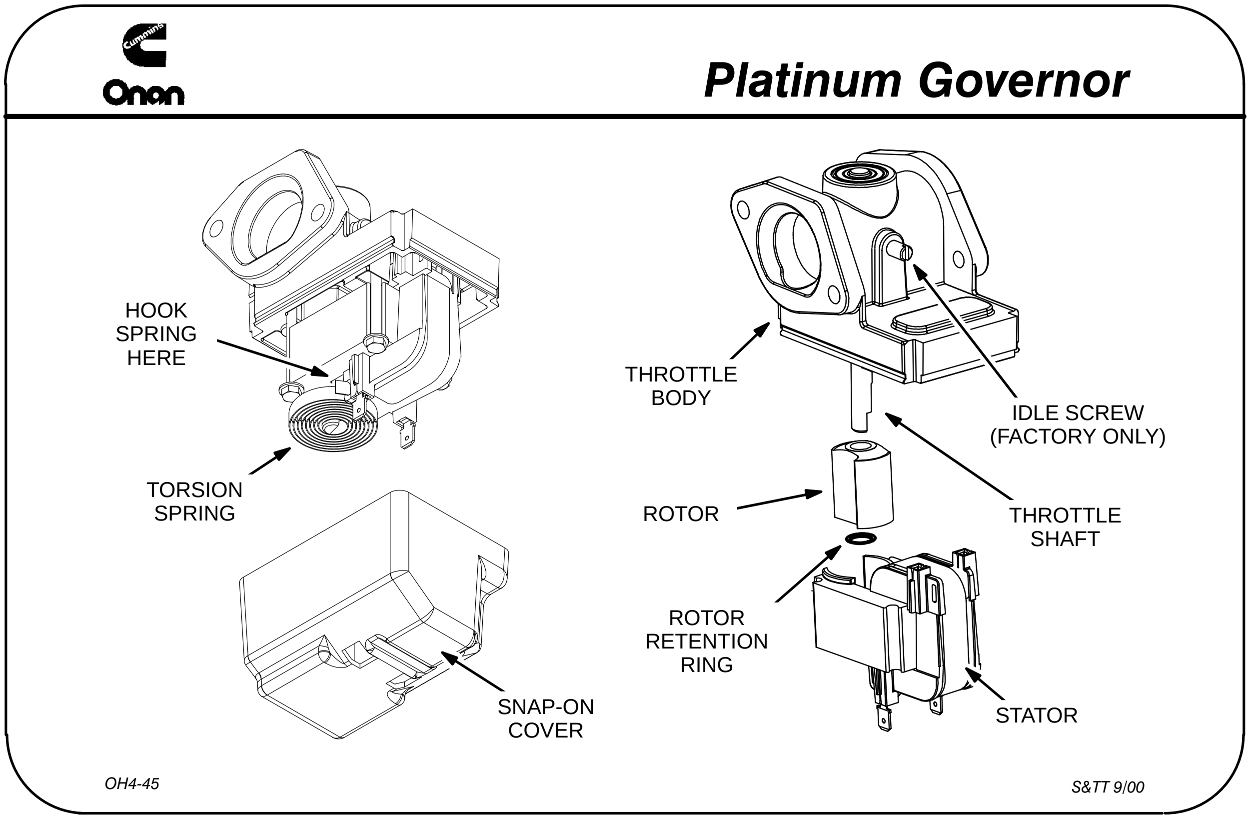
Ignition

OH4-44

S&TT 9/00

Slide 4-44: Ignition

- Flywheel mounted magnet a 2 magneto coils.
- Air gap between flywheel lands and magnetos is 0.012 inch.
- Magneto resistance from spark plug end of coil wire and ground is about 33k ohms for #1 and 27k ohms for #2.
- Coil with longer lead goes to number 1 spark plug.
- Ignition timing is 20° BTDC – non-adjustable.



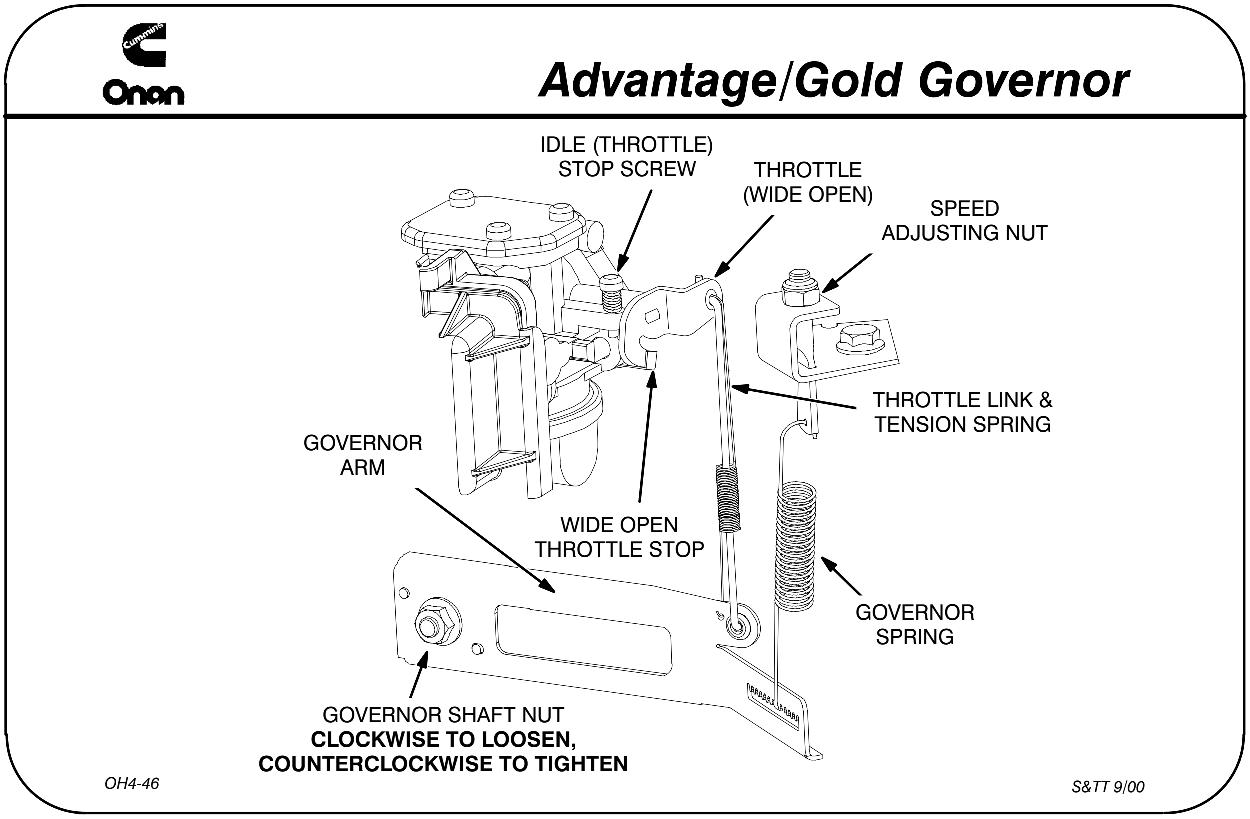
Platinum Governor

OH4-45

S&TT 9/00

Slide 4-45: Platinum Governor

- Marquis has electronic governor controls.
- Governor is non-adjustable.
- Rotor positions throttle plate.



Advantage/Gold Governor

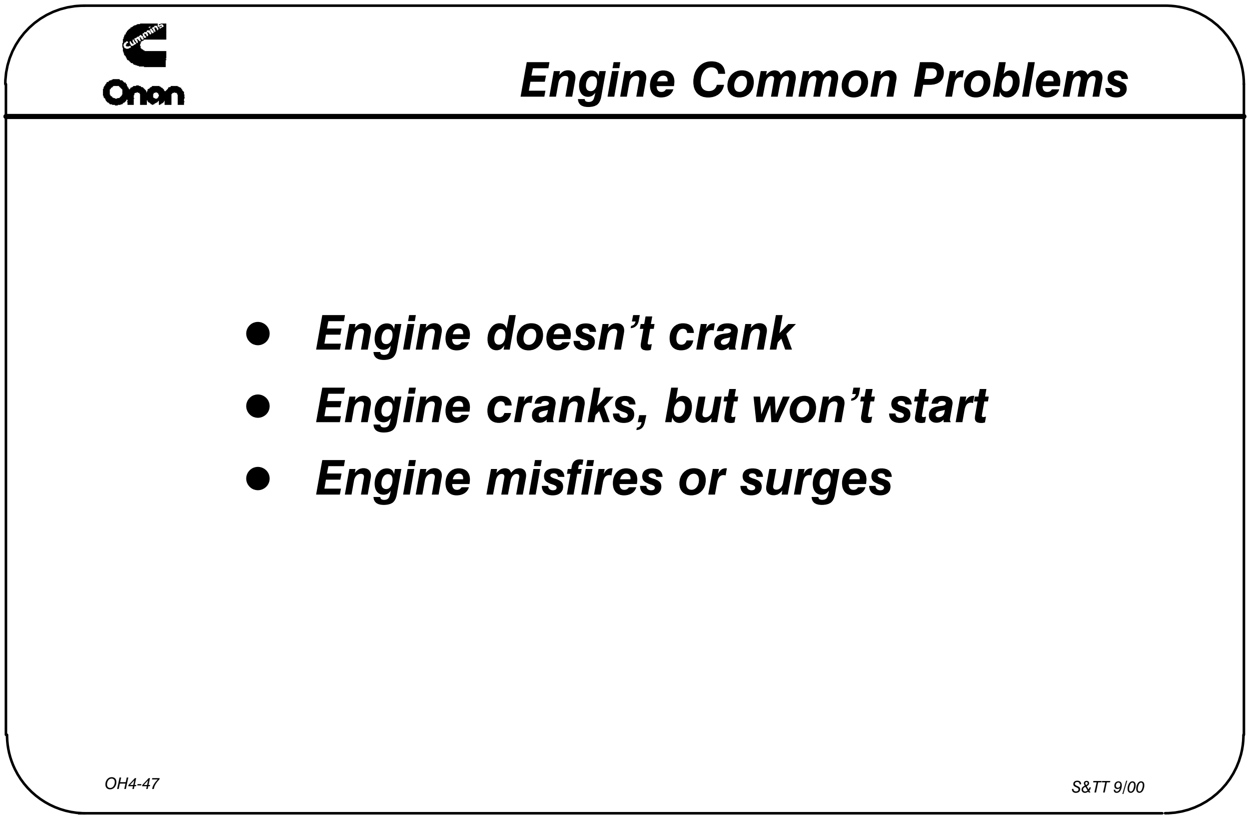
CLOCKWISE TO LOOSEN, COUNTERCLOCKWISE TO TIGHTEN

OH4-46

S&TT 9/00

Slide 4-46: Advantage/Gold Governor

- Mechanical governor.
- Sensitivity (droop) adjustment.
- Speed nut increases or decreases engine speed (generator frequency).
- Governed speed of engine is 2400 to 2880 rpm depending on kW and frequency rating.



Engine Common Problems

- Engine doesn't crank
- Engine cranks, but won't start
- Engine misfires or surges

OH4-47

S&TT 9/00

Slide 4-47: Engine Common Problems

Engine won't crank:

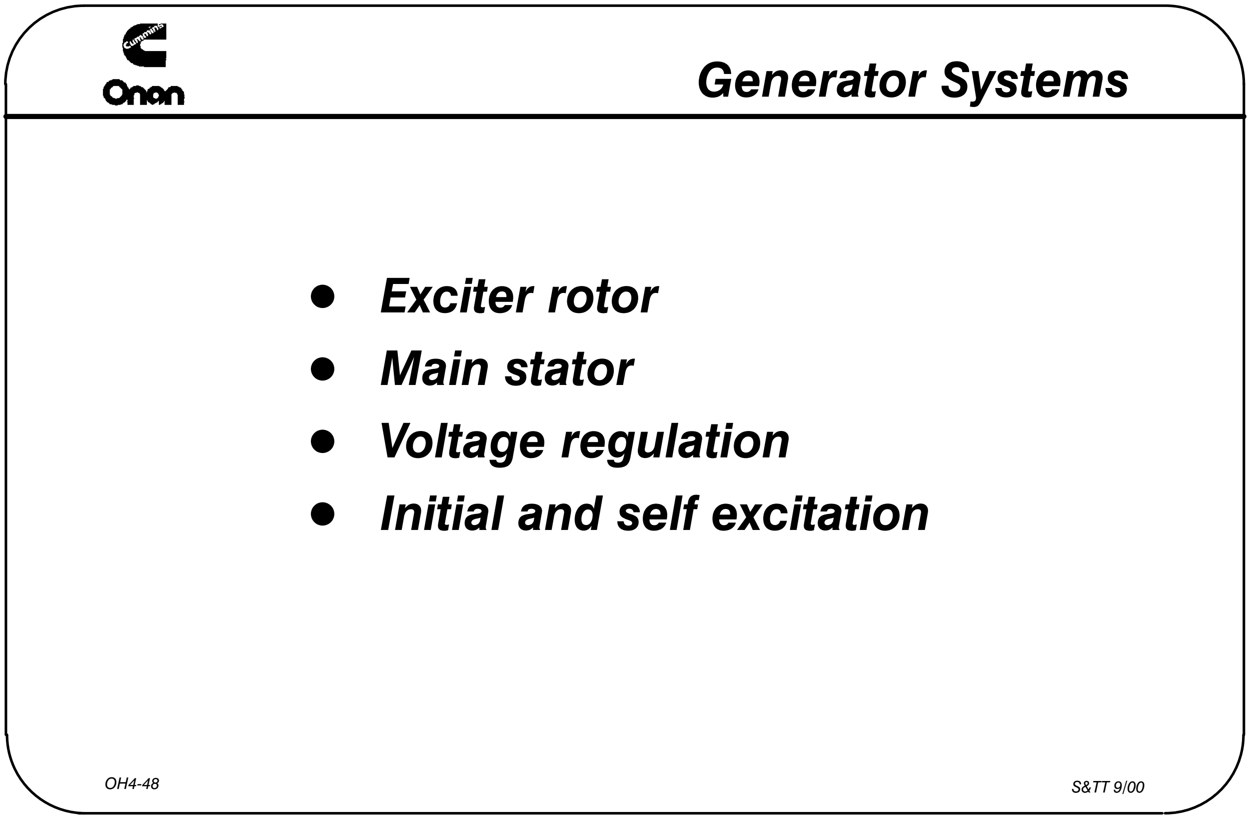
1. Check for controller fault codes.
2. Check starting ability both at set and remote.
3. Check battery and terminals.
4. Check starter solenoid and motor.

Engine cranks but won't start:

1. Check for controller fault codes.
2. Check fuel level, fuel pump and fuel shut off valve.
3. Check restricted air filter or exhaust.
4. Check for faulty ignition components.
5. Check governor actuator (HGJAA)

Engine misfires or surges:

1. Check for controller fault codes.
2. Check for faulty spark plugs or wires.
3. Check for lean fuel mixture.
4. Check for misadjusted governor (HGJAB/AC)
4. Check for sticking throttle plate (all models)



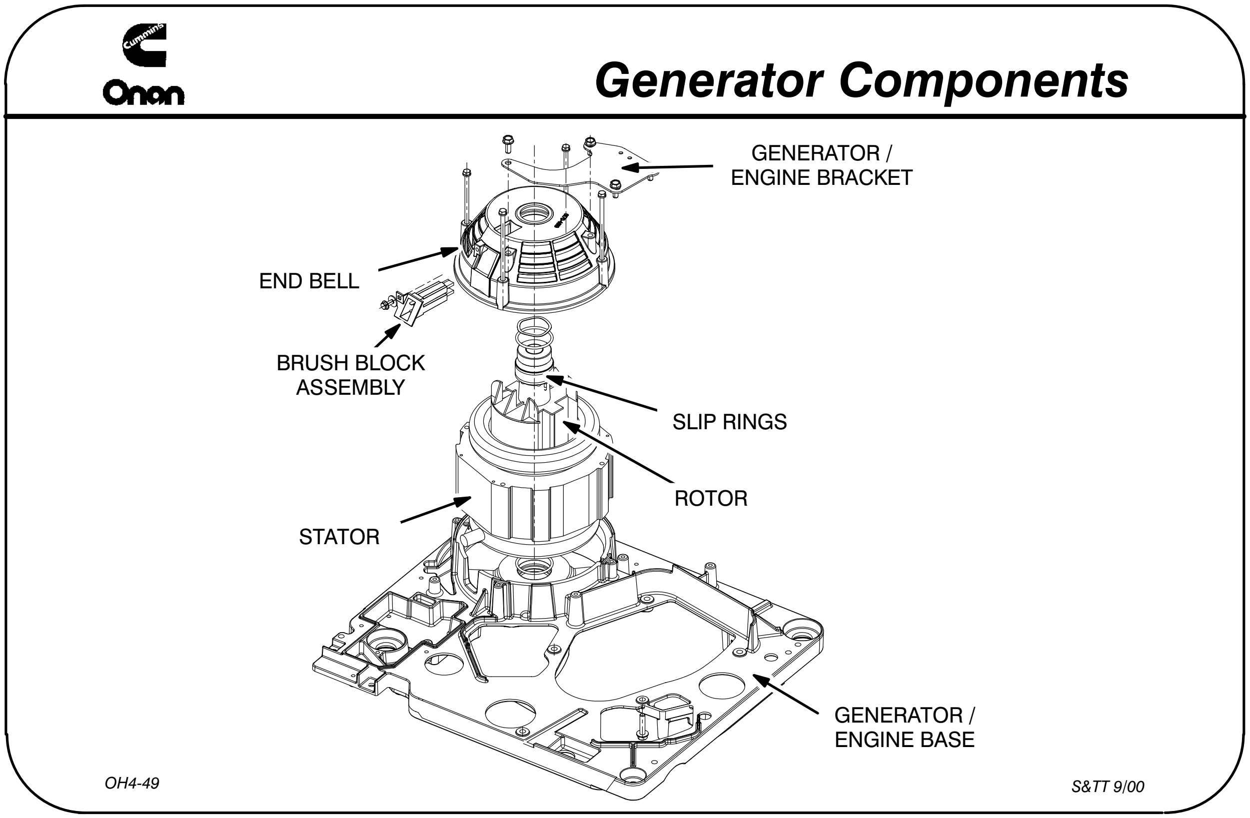
Generator Systems

- *Exciter rotor*
- *Main stator*
- *Voltage regulation*
- *Initial and self excitation*

OH4-48

S&TT 9/00

Slide 4-48: Generator Systems



Generator Components

OH4-49

S&TT 9/00

Slide 4-49: Generator Components

Exciter Rotor

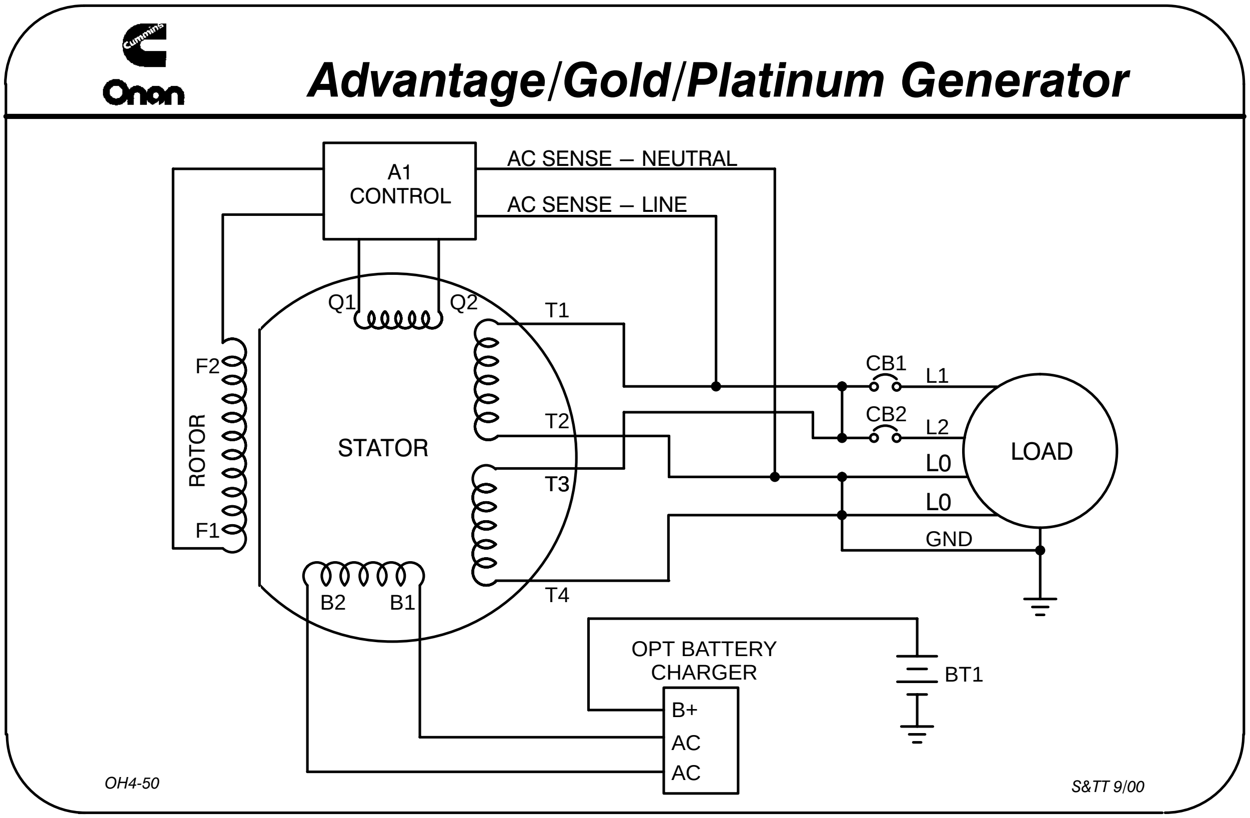
- 2 pole electromagnet.
- Rotates inside stator assembly.
- Produces electromagnetism for excitation.
- Bolted to blower wheel for cooling.
- Attached to slip rings that deliver DC voltage for excitation.

Main Stator

- Located next to engine.
- Stationary part of generator.
- Contains AC voltage producing windings.
- Provides AC current for battery charging, regulation and loads.

Voltage Regulation

- Located behind control cover on GenSet base.
- Integrated part or the microprocessor control.
- Monitors load voltage.
- Produces DC voltage for exciter field regulation.

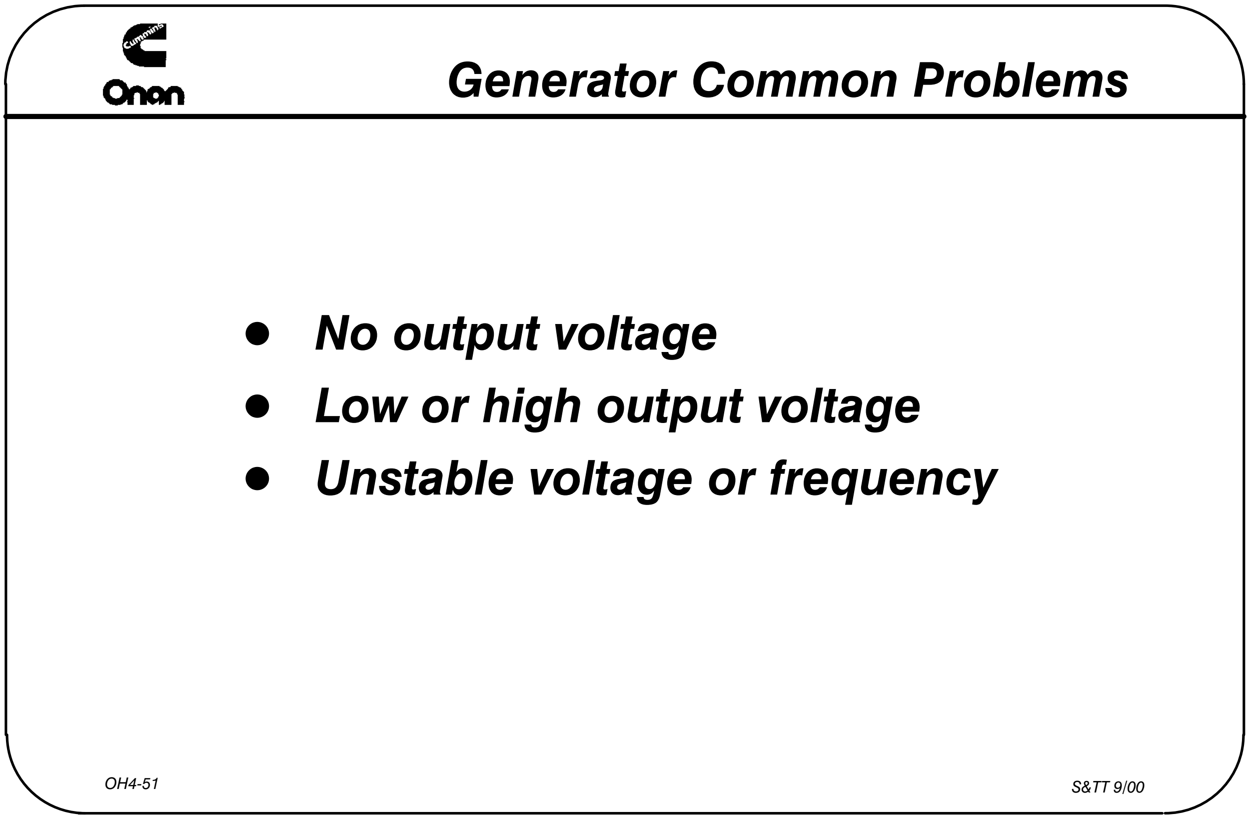


Advantage/Gold/Platinum Generator

Slide 4-50: Initial and Self Excitation

During GenSet start, battery B+ is applied to the rotor through the slip rings. This momentary **field flash** connection provides adequate residual magnetism in the rotor. With this **<u>initial excitation</u>** and the electromagnetic field rotating inside the stator, an AC voltage is induced into the stator windings. A portion of this voltage is provided to the voltage regulator portion of the microprocessor control where it is rectified to DC and supplied to the slip rings for the field **<u>self excitation</u>**. As the load changes, the DC voltage to the slip rings will **automatically change** to keep the output voltage constant.

Note: This is the process of **automatic voltage regulation**.



Generator Common Problems

- No output voltage
- Low or high output voltage
- Unstable voltage or frequency

OH4-51

S&TT 9/00

Slide 4-51: Generator Common Problems

No output voltage:

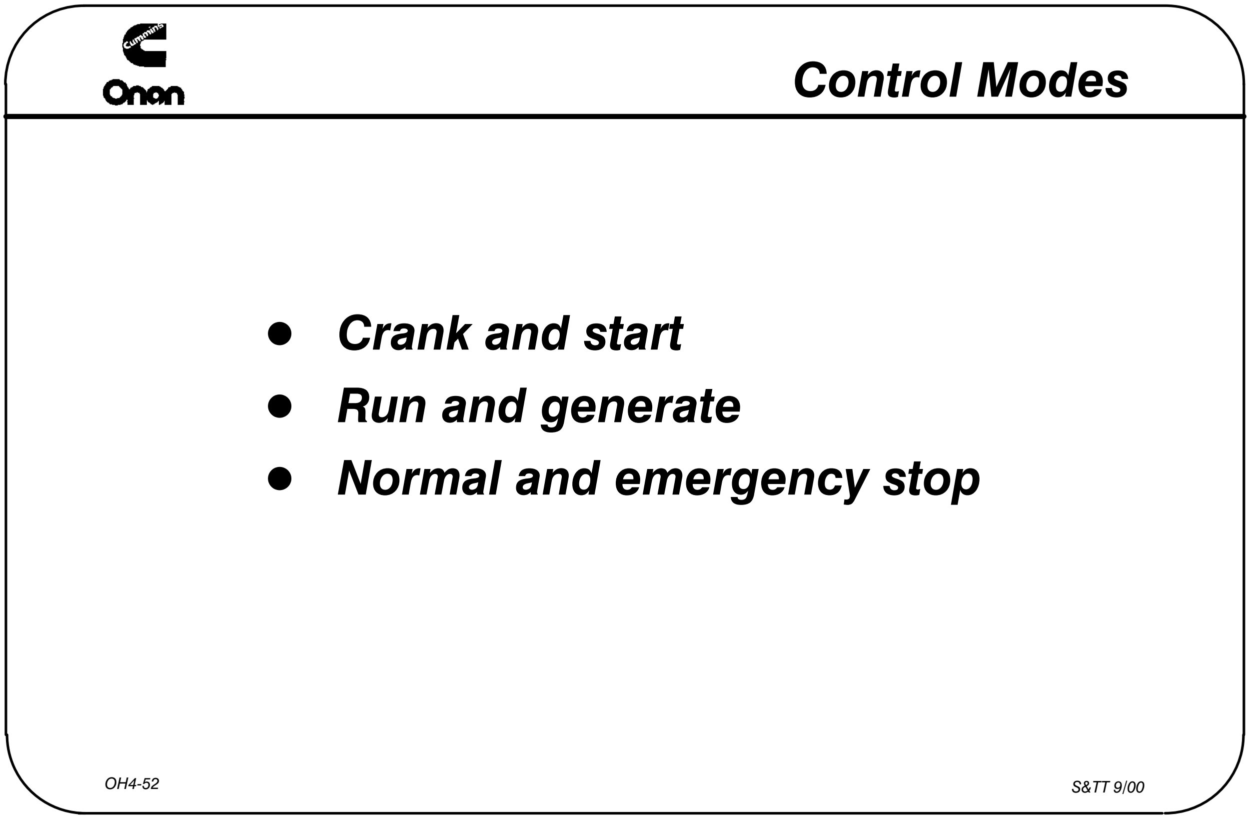
- Check AC circuit breakers
- Check brushes and slip rings
- Check wiring to controller
- Check rotor and stator for opens, shorts or grounds
- Check fault codes

Low or high output voltage:

- Check engine speed
- Check engine governor adjustment
- Check brushes and slip rings
- Check wiring to controller
- Check rotor and stator for opens, shorts or grounds
- Check fault codes

Unstable voltage or frequency:

- Check engine governor for sensitivity, sticking or binding
- Check carburetor for lean mixture
- Check intake manifold and gaskets for vacuum leaks
- Check fault codes



Control Modes

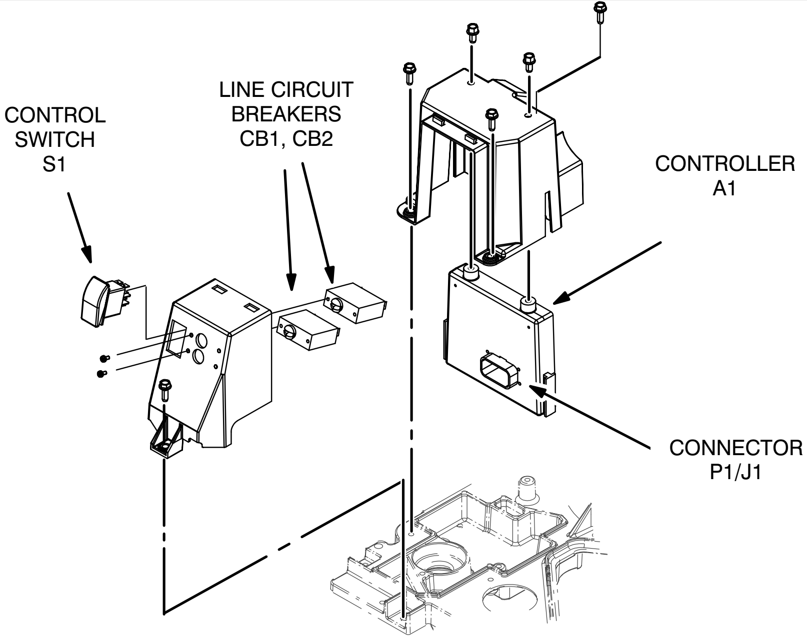
- Crank and start
- Run and generate
- Normal and emergency stop

OH4-52

S&TT 9/00

Slide 4-52: Control Modes

Control Components (Typical)



OH4-53

S&TT 9/00

Slide 4-53: Control Components (Typical)

- Located in front of the stator on the GenSet.
- Consists of the A1 printed circuit board, starter, fuel and electronic governor components.
- Controls and monitors the start, run and stop operation, plus voltage regulation and fault diagnostics.

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

Fuel Prime(Gasoline Gensets): Press and hold the stop switch for more than 3 seconds to cause the fuel pump to prime the fuel system.

Activity

Directions: Using your highlighters, and the copies of the **Emerald Advantage/Marquis Gold** GenSet control schematic, **611-1271**, follow along with the instructor and color the modes of operation on your sheets.

The left page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **Emerald Advantage/Marquis Gold** GenSet's when they don't operate properly.

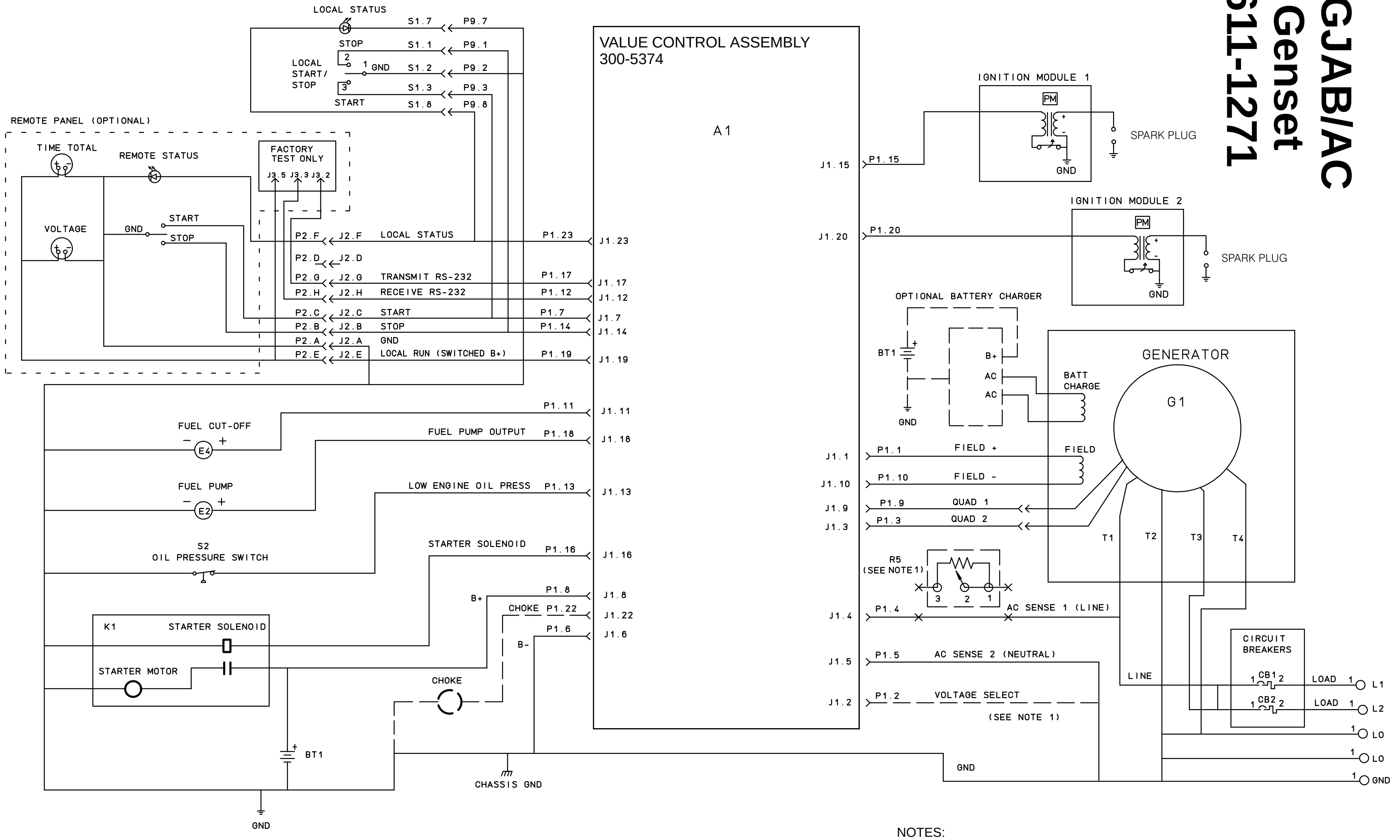
Start Mode

Slide 4-54: **Print 611-1271**

Startup: Press and hold the start switch until the genset starts. The controller:

- Energizes the fuel pump E2 (gasoline models).
- Enables ignition modules (removes ground).
- Energizes starter solenoid and starter motor K1.
- Energizes the gasoline carburetor fuel cutoff solenoid E4 and applies bi-metallic spring tension to the choke (gasoline models).
  NOTE: E4 is also the fuel cutoff solenoid on the LPG models.
- Flashes the field (F1-F2).
- The status indicator light flashes during cranking.

HGJAB/AC Genset 611-1271



NOTES:

1. FOR VOLTAGES OTHER THAN 120VAC, GROUND P1–2 AND ADJUST R5 (NOT PRESENT ON STANDARD 60HZ PRODUCT

Run Mode

Slide 4-55: **Print 611-1271**

Start disconnect and normal running: When the quadrature frequency indicates that the engine speed is greater than 1300 rpm, the controller:

- Disconnects the starter motor K1.
- Enables electric choke heater (gasoline models).
- Turns the status indicator light on solid.
- Turns on Switched B+ (remote pin J1-19).
- Starts regulator self excitation and disables initial field flash.
- Operating oil pressure opens pressure switch 2 seconds after start.
- Enables time totalizer and voltage meters.

Fuel Control:

- Fuel pump pressure is about 2.5 to 4 psi (17 to 27 kPa) nominal.
- The maximum fuel pump lift is 36 inches (914 mm).

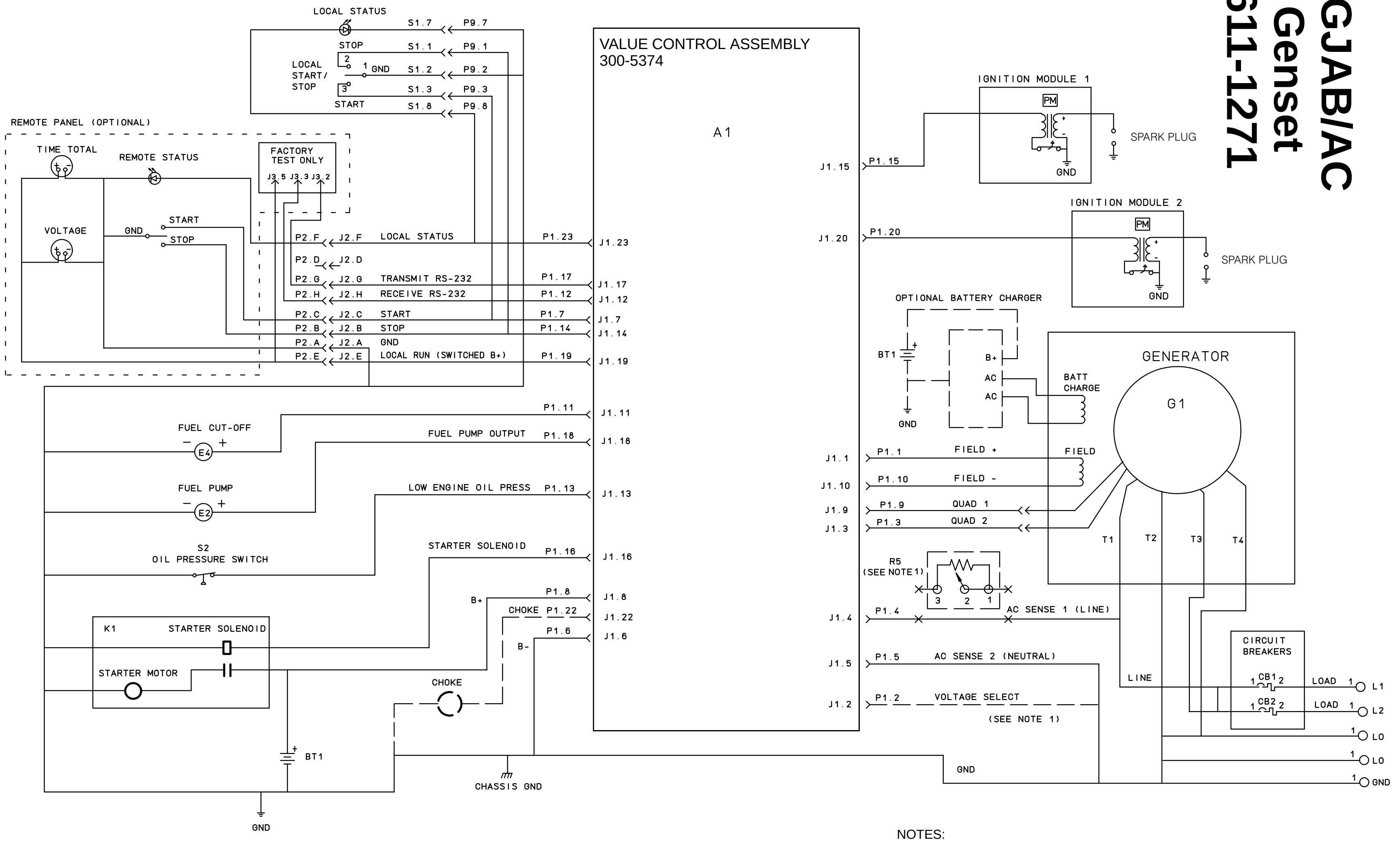
Voltage Control: The controller maintains nominal AC output voltage during steady state operation by varying field current as load varies.

- In response to transient loads it lowers the voltage setpoint to allow engine recovery.
- Field power (DC) is supplied by the quadrature windings (AC) through the controller.
  - ↳ Field voltage is approximately 100 to 150 VDC (NL to FL)
  - ↳ Quadrature voltage is approximately 170 to 230 VAC (NL to FL)
- Output voltage specifications:

HGJAB & HGJAC VOLTAGE / FREQUENCY / DROOP

Rated Voltage	Voltage		Frequency	
	Max No Load	Min Full Load	No Load	Droop
60 HERTZ GENSETS				
100	108	93	63/62	2–4
120	125	112	63/62	2–4
200	216	186	63/62	2–4
240	250	224	63/62	2–4
50 HERTZ GENSETS				
100	108	93	52.5/51.5	2–4
200	216	186	52.5/51.5	2–4
220	238	205	52.5/51.5	2–4
230	249	215	52.5/51.5	2–4
240	250	224	52.5/51.5	2–4

HGJAB/AC Genset 611-1271



NOTES:

1. FOR VOLTAGES OTHER THAN 120VAC, GROUND P1–2 AND ADJUST R5 (NOT PRESENT ON STANDARD 60HZ PRODUCT

Stop Mode

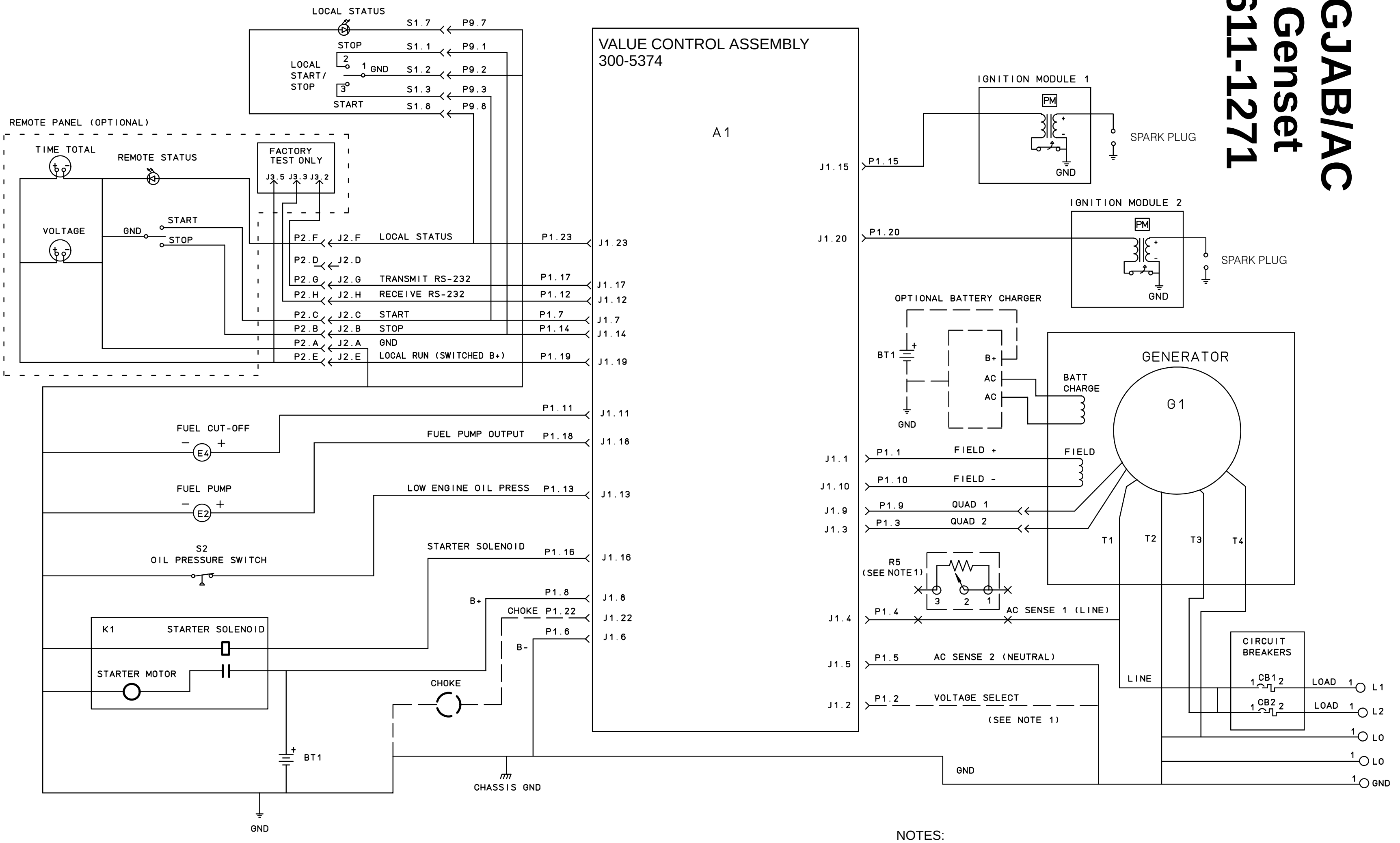
Slide 4-56: **Print 611-1271**

Stop: Press the stop switch momentarily. The controller:

- Disables output voltage.
- Deenergizes the fuel pump and fuel cutoff solenoid.
- Disables ignition (applies ground).
- Turns off the status indicator light.
- Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM).
- Removes processor power when idle 5 minutes.

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

HGJAB/AC Genset 611-1271



NOTES:

1. FOR VOLTAGES OTHER THAN 120VAC, GROUND P1–2 AND ADJUST R5 (NOT PRESENT ON STANDARD 60HZ PRODUCT

OH4-56

S&TT 9/00

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Activity

Directions: Using your highlighters, and the copies of the **Marquis Platinum** GenSet control schematic, **611-1272**, follow along with the instructor and color the modes of operation on your sheets.

The left page describes the sequence of operation for the print in case you get lost during this exercise.

The focus of this exercise is to have you leave this training session with prints you can use for troubleshooting **Marquis Platinum** GenSet's when they don't operate properly.

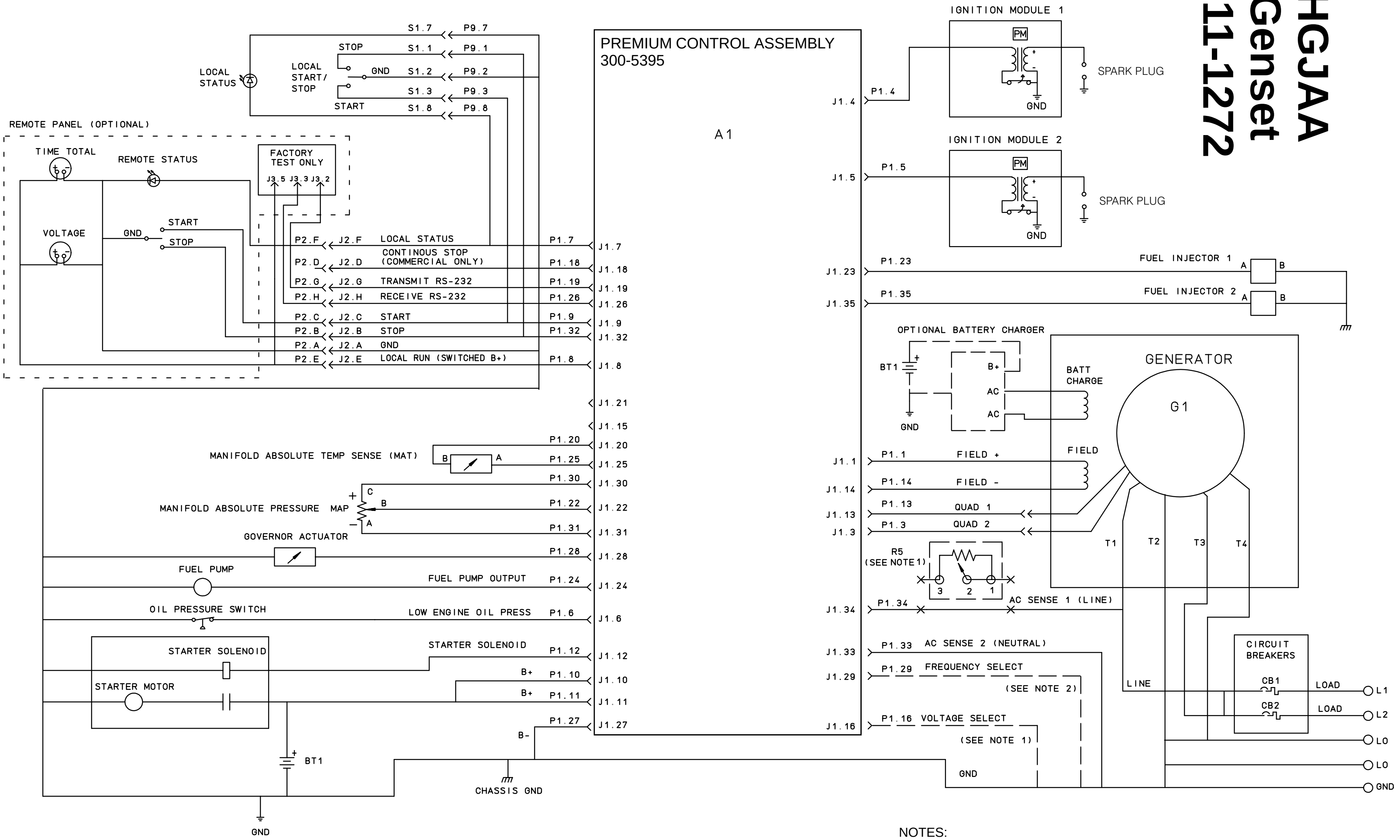
Start Mode

Slide 4-57: **Print 611-1272**

Startup: Press and hold the start switch until the genset starts. The controller:

- Energizes the fuel pump (gasoline models only).
- Enables ignition modules (removes ground).
- Energizes starter solenoid and starter motor.
- Flashes the field (10 to 12 VDC at F1-F2).
- Energizes the governor actuator.
    - ↳ 12 VDC on startup.
    - ↳ 4 to 12 VDC (NL to FL) during operation.
- Enables fuel injection.
- The status indicator light flashes during cranking.

HGJAA Genset 611-1272



NOTES:

1. FOR VOLTAGES OTHER THAN 120VAC, GROUND P1–16 AND ADJUST R5 (NOT PRESENT ON STANDARD 60HZ PRODUCT
2. GROUND FOR 50HZ OPERATION

Run Mode

Slide 4-58: **Print 611-1272**

Start disconnect and normal running: When the quadrature frequency indicates that the engine speed is greater than 1300 rpm, the controller:

- Disconnects the starter motor.
- Turns the status indicator light on solid.
- Turns on Switched B+ (remote pin J1-8).
- Enables generator output voltage two seconds after operating speed is reached.
- Turns off field flash.
- Operating oil pressure opens pressure switch 2 seconds after start.

Fuel Control:

- Fuel pump pressure is about 43.5 psi (300 kPa) nominal.
- The maximum fuel pump lift is about 36 inches (914 mm).

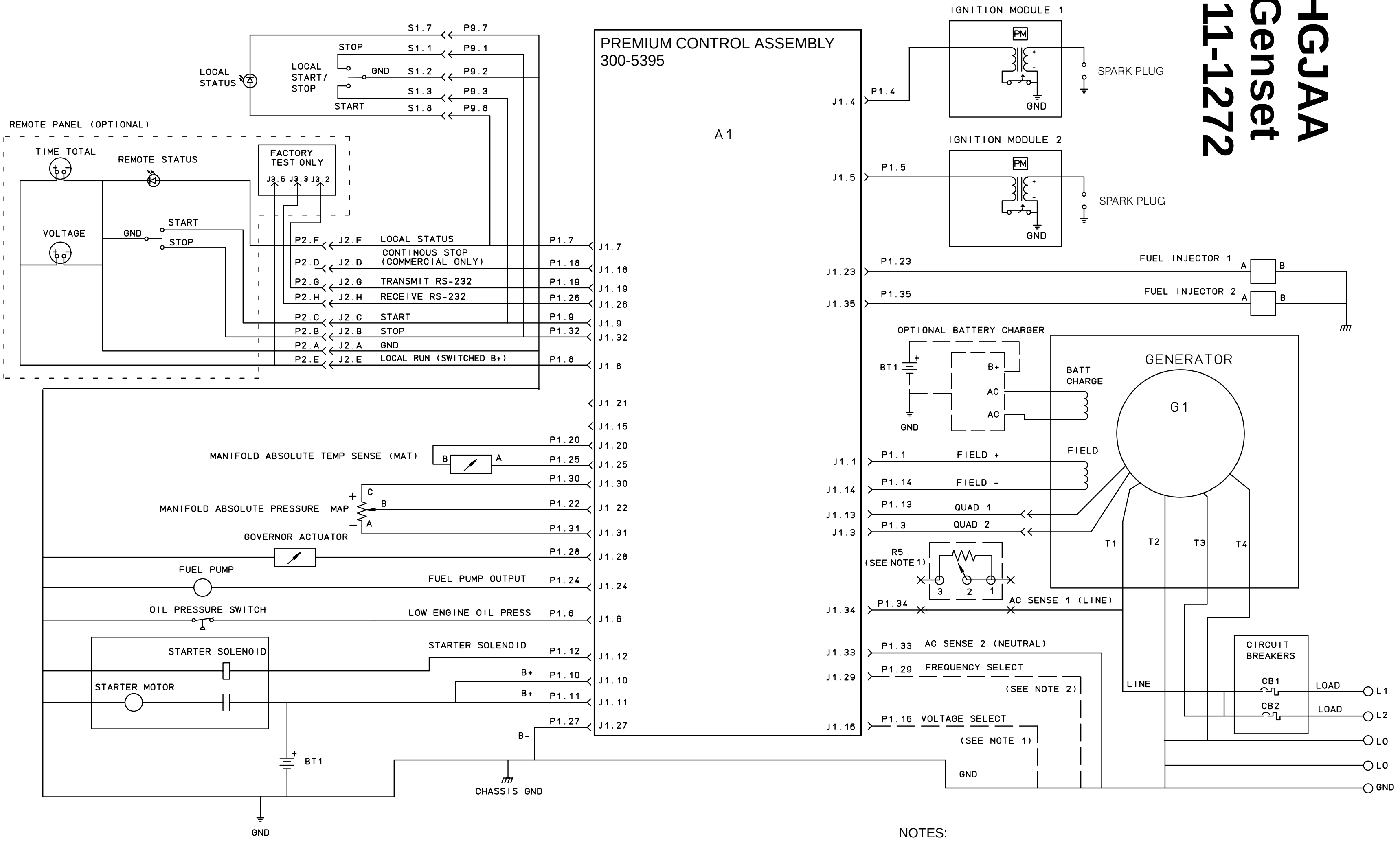
Voltage Control: The controller maintains nominal AC output voltage during steady state operation by varying field current as load varies.

- In response to transient loads it lowers the voltage setpoint to allow engine recovery.
- Field power (DC) is supplied by the quadrature windings (AC) through the controller.
    - ↳ Field voltage is approximately 100 to 150 VDC (NL to FL)
    - ↳ Quadrature voltage is approximately 170 to 230 VAC (NL to FL)
- Output voltage specifications:

HGJAA VOLTAGE / FREQUENCY / DROOP

Voltage			Frequency (Hz)		
Rated Voltage (60 Hz)	**Max No Load**	**Min Full Load**	**Rated**	**No Load**	**Droop**
120	125	115	60.8/60.2	61/60	N/A
240	250	230	60.8/60.2	61/60	N/A

HGJAA Genset 611-1272



NOTES:

1. FOR VOLTAGES OTHER THAN 120VAC, GROUND P1–16 AND ADJUST R5 (NOT PRESENT ON STANDARD 60HZ PRODUCT
2. GROUND FOR 50HZ OPERATION

Stop Mode

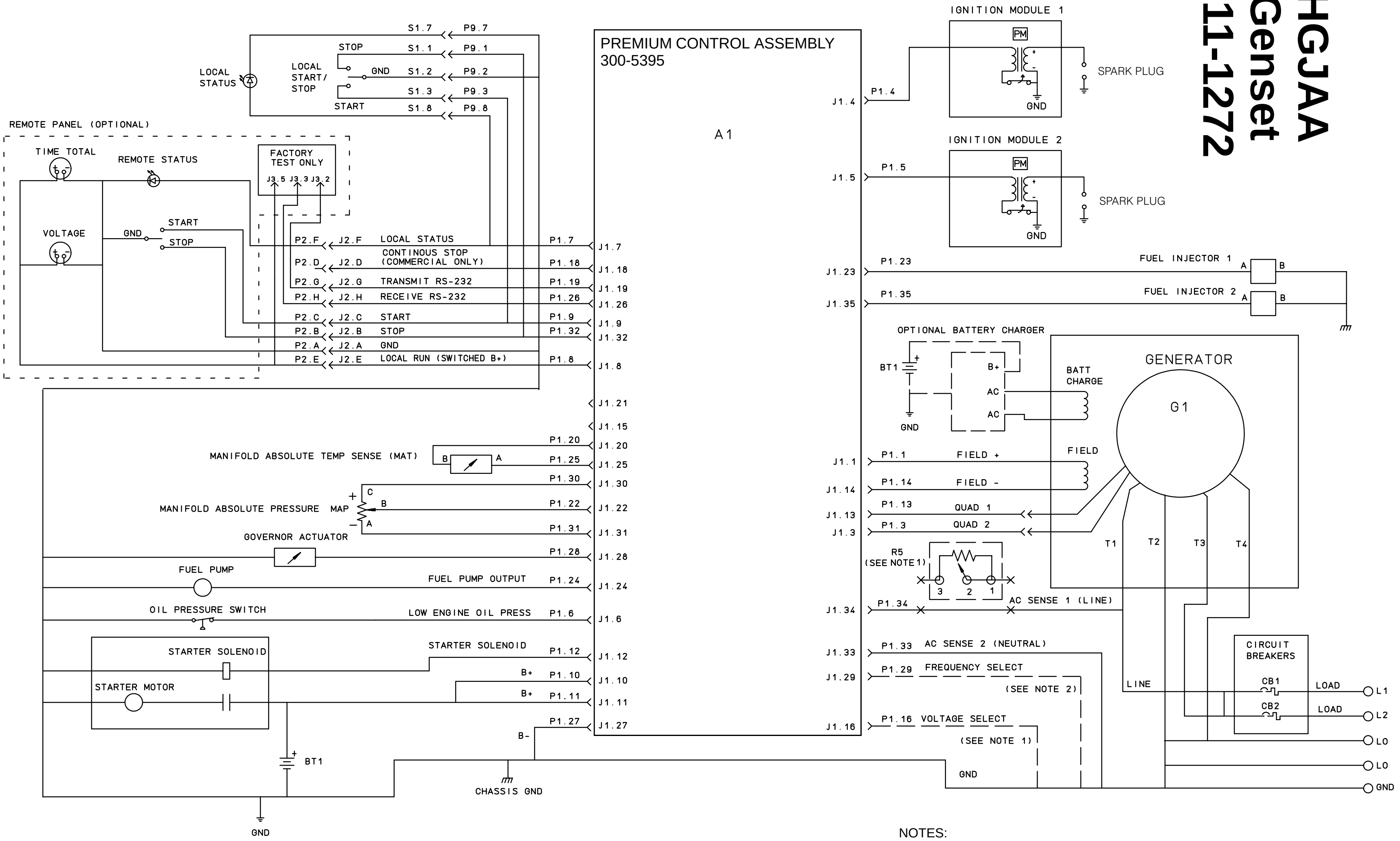
Slide 4-59: **Print 611-1272**

Stop: Press the stop switch momentarily. The controller:

- Disables output voltage.
- Deenergizes the fuel pump and fuel injectors.
- Turns off the status indicator light.
- Disables ignition (applies ground) after slight TD (for spark plug cleansing).
- Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM).
- Removes processor power when idle 15 minutes.

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

HGJAA Genset 611-1272



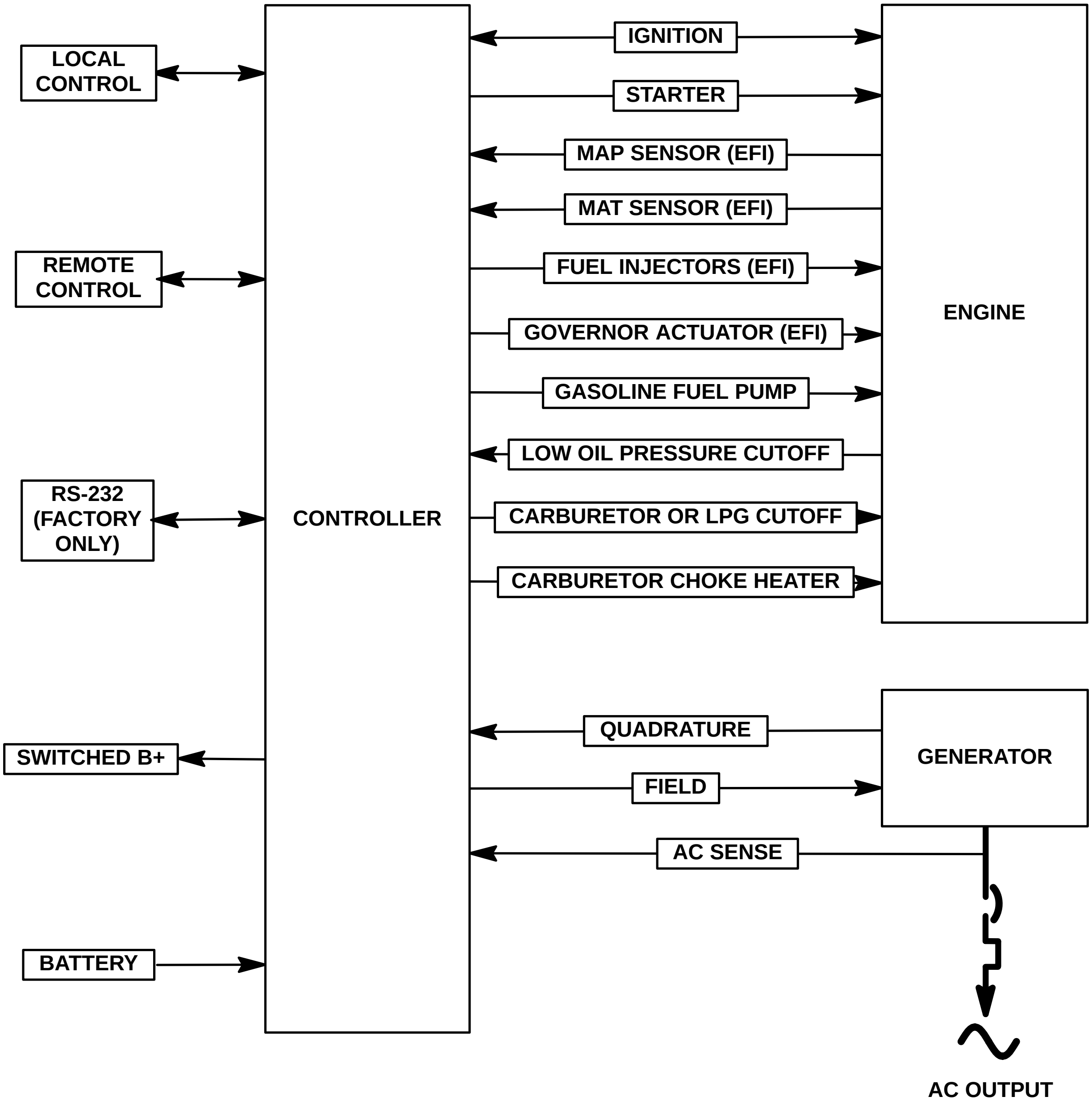
NOTES:

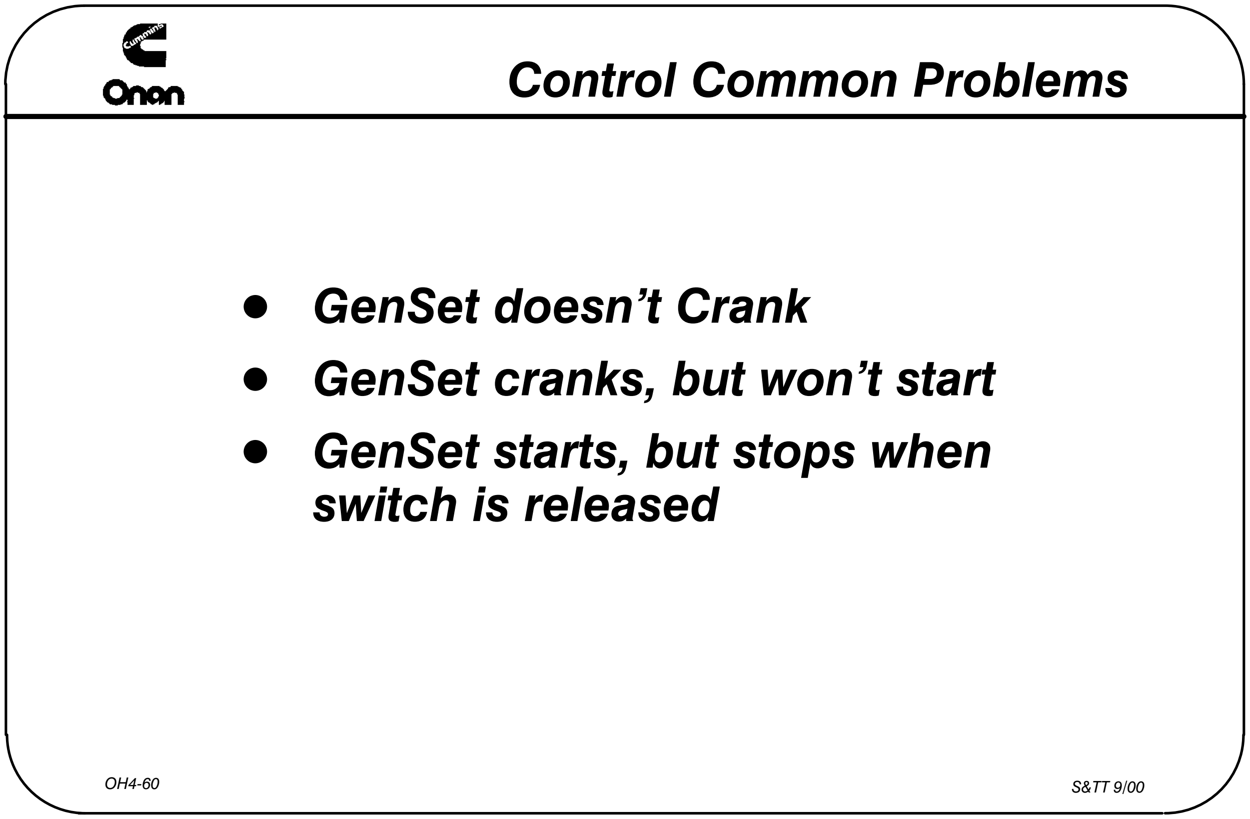
1. FOR VOLTAGES OTHER THAN 120VAC, GROUND P1–16 AND ADJUST R5 (NOT PRESENT ON STANDARD 60HZ PRODUCT
2. GROUND FOR 50HZ OPERATION

Activity

Directions: Read through your input/output sequence sheet on the **Marquis 611-1272** control, then with your colored schematics, follow along with the instructor in identifying the inputs of the printed circuit board.

Controller A1 Block Diagram





Control Common Problems

- GenSet doesn't Crank
- GenSet cranks, but won't start
- GenSet starts, but stops when switch is released

OH4-60

S&TT 9/00

Slide 4-60: Control Common Problems

GenSet doesn't crank:

- Check starting ability both at set and remote.
- Check battery and cables.
- Check start solenoid and starter motor.
- Check harness connections
- Check status light.

GenSet cranks, but won't start:

- Check fuel level and fuel pump.
- Check for faulty ignition components.
- Check harness connections.
- Check status light.

GenSet starts, but stops when switch is released:

- Check oil level and S2 oil pressure switch.
- Check harness connections.
- Check for field flash from control to brushes.
- Check for generator for opens, shorts and grounds.
- Check status light.

Troubleshooting

⚠WARNING ***Hot engine parts can cause severe burns. Always allow the engine time to cool before performing any maintenance or service.***

TROUBLESHOOTING lists the Fault Codes in numerical order along with step-by-step corrective actions. Refer to the wiring diagrams and wiring harness drawings in the Service Manual if necessary.

First note the following:

- Maintaining engine oil level, keeping battery connections clean and tight, watching the fuel gauge, not overloading the genset, etc. will prevent most shutdowns.
- When the genset and vehicle engine share a common fuel tank the fuel dip tubes are usually arranged so that the genset will run out of fuel first. Marking the genset empty point on the fuel gauge will make it easier to tell when to stop the genset before running it out of fuel.

FAULT CODES

The genset controller provides extensive diagnostics by causing the status indicator light on the Control Switch to blink in coded fashion. Following a fault shutdown, the indicator light will repeatedly blink 2, 3 or 4 blinks at a time.

- **Two blinks** indicates a low oil pressure fault.
- **Three blinks** indicates a service fault. Press **Stop** once to cause the two-digit, second-level fault code to blink. (Pressing **Stop** again will stop the blinking.) The two-digit code consists of 1, 2, 3, 4 or 5 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the fault code number. For example, **Fault Code No. 36** appears as:

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

- **Four blinks** indicates that cranking exceeded 30 seconds without the engine starting.
- **Note: Fault Code Nos. 3 and 4 are first level faults. Avoid interpreting them as second-level Fault Code Nos. 33 and 44, which have purposely not been assigned as fault codes.**

Restoring Fault Code Blinking – The fault code stops blinking after five minutes (15 minutes, Series HGJAA). Press **Stop** three times within five seconds to restore blinking. ***Note that the last fault logged will blink even after the condition that caused the shutdown has been corrected.***

⚠ WARNING ***Some genset service procedures present hazards that can result in severe sonal injury or death. Only qualified service personnel with knowledge of fuels, electricity machinery hazards should perform genset service. See Safety Precautions.***

NO RESPONSE—STATUS INDICATOR LIGHT DEAD

(Faulty connections, no battery voltage)

Corrective Action:

1.. Try the genset (local) control switch if the remote control switch does not work, and vice versa. If neither works, disconnect remote control connector J2/P2 and try the local control switch.
  - If nothing works, go to Step **2.**.
  - If only the remote control switch works, go to Step **6.**.
  - If only the local control switch works, go to Step **9.**.

2.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.

3.. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.

4.. Disconnect connector P1 from the controller and check for battery voltage between:
  - **HGJAA –** Pins P1-10 and P1-27 (B+ / B–). Step 5. if no voltage, Step 6. if 12 VDC.
  - **HGJAB / HGJAC –** Pins P1-8 and P1-6 (B+ / B–). Step 5. if no voltage, Step 6. if 12 VDC.

5.. Check for missing, bent or corroded connector pins, faulty wiring and loose engine harness B+ and ground and bond strap connections. Repair as necessary.

6.. Check for continuity across connector P1 pins while trying Start and Stop at local control switch:
  - **HGJAA –** Pins P1-9 and P1-27 (start) and P1-32 and P1-27 (stop). Step 7. if open, Step 8. if closed.
  - **HGJAB / HGJAC –** Pins P1-7 and P1-6 (start) and P1-14 and P1-6 (stop). Step 7. if open, Step 8. if closed.

7.. Replace a switch that does not close in its start or stop position, or open when released. Check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.

8.. Replace controller A1.

9.. Reconnect remote control connector J2/P2 and disconnect connector P1 from the controller. Check for continuity while trying Start and Stop at remote control switch:
  - **HGJAA –** Pins P1-9 and P1-27 (start) and P1-32 and P1-27 (stop). Step 10. if open, Step 11. if closed.
  - **HGJAB / HGJAC –** Pins P1-7 and P1-6 (start) and P1-14 and P1-6 (stop). Step 10. if open, Step 11. if closed.

10.. Replace a switch that does not close in its start or stop position, or open when released. Check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.

11.. Replace controller A1.

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STARTING BATTERIES RUN DOWN

(Marginal batteries, connections or charging system, or parasitic loads)

Corrective Action:

1.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.
2.. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
3.. Have a battery charging system installed or serviced.

STARTER ENGAGES-DISENGAGES

(Cranking voltage dips below 6 volts—low battery charge, poor connections, long cables)

Corrective Action:

1.. Have the vehicle propulsion engine running while trying to start the genset—its charging alternator may be able to maintain starting voltage high enough to get the genset started.
2.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.
3.. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
4.. Increase battery cable size or run parallel cables.

NO POWER—GENSET RUNNING, STATUS LIGHT ON

(Line circuit breaker OFF, or tripped due to short circuit or overload)

Corrective Action:

1.. Turn on or reset the line circuit breaker on the genset.
2.. Turn on or reset the line circuit breakers on the main distribution panel in the vehicle.
3.. Replace a faulty circuit breaker.

LOW OIL PRESSURE FAULT—CODE NO. 2

(Low oil pressure)

Corrective Action:

1.. Check engine oil level and add or drain oil as necessary.
2.. Service the engine lubrication system as required.

SERVICE CHECK FAULT—CODE NO. 3

(First-level fault code—Indicates fault with second-level fault code)

Corrective Action: Check the second-level fault code by pressing **STOP** once. The second-level fault code will have two-digits. The faults are listed in numerical order in this table.

OVERCRANK FAULT—CODE NO. 4

(First-level fault code—Cranking exceeded 30 seconds without engine starting)

Corrective Action for HGJAA Gensets:

1.. Check and fill the fuel tank. (The genset fuel pickup is usually higher than the vehicle engine pickup.)
2.. Open any closed fuel valves.
3.. Prime fuel system. If the fuel pump does not function, replace the in-line fuse if blown. If it is good, go to Step 7..
4.. Secure the spark plug leads on the spark plugs.
5.. Remove the spark plugs and conduct the ignition system tests.
6.. Check that throttle plate is open during cranking and replace or repair as necessary.
7.. Conduct the fuel pump tests.
8.. Replace the air filter element.
9.. Replace the fuel filter.
10.. Check for and replace contaminated fuel.
11.. Service the engine as necessary.

Corrective Action for HGJAB / HGJAC Gasoline Gensets:

1.. Check and fill the fuel tank. (The genset fuel pickup is usually higher than the vehicle engine pickup.)
2.. Open any closed fuel valves.
3.. Prime fuel system. If the fuel pump does not function, go to Step 7..
4.. Secure the spark plug leads on the spark plugs.
5.. Remove the spark plugs and conduct the ignition system tests.
6.. Check for binding governor linkage and readjust and repair as necessary.
7.. Conduct the fuel pump tests.
8.. Replace the air filter element.
9.. Replace the fuel filters.
10.. Check for and replace contaminated fuel.
11.. Check and replace fuel cutoff solenoid E4 as necessary.
12.. Check and readjust the choke assembly as necessary.
13.. Service the engine as necessary.
14.. Replace the carburetor.

Corrective Action for LPG Gensets:

1.. Check and fill the fuel tank. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will not vaporize in ambients below 32° F (0° C). Use HD-5 grade LPG.
2.. Open any closed fuel valves.
3.. Secure the spark plug leads on the spark plugs.
4.. Remove the spark plugs and conduct the ignition system tests.
5.. Check for binding governor linkage and readjust and repair as necessary.
6.. Replace the air filter element.
7.. Check the fuel-shutoff solenoid (E2) and replace if necessary.
8.. Check LPG regulator lock-off pressure and replace as necessary.
9.. Service the engine as necessary.

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

OVERVOLTAGE FAULT—CODE NO. 12

(Controller unable to maintain rated voltage)

Corrective Action:

1.. Service the brushes and slip rings as necessary and test the generator field, stator and quadrature windings for opens or shorts. Replace a rotor or stator with faulty windings.
2.. Replace controller A1.

UNDERVOLTAGE FAULT—CODE NO. 13

(Controller unable to maintain rated voltage)

Corrective Action:

1.. Reduce the number of connected appliances, especially when air conditioners and battery chargers are running.
2.. Service the brushes and slip rings as necessary and test the generator field, stator and quadrature windings for opens or shorts. Replace a rotor or stator with faulty windings.
3.. Replace controller A1.

OVERFREQUENCY FAULT—CODE NO. 14

(Engine governor unable to maintain rated frequency)

Corrective Action for HGJAA Gensets:

1.. Reset the line circuit breaker if tripped and reduce load. (A circuit breaker opening under overload can lead to this fault shutdown.)
2.. Check that the vacuum hose is connected properly and in good condition and repair as necessary. (An intake air leak is more likely to cause this shutdown under no-load.)
3.. Check for and replace leaking throttle body and intake manifold gaskets. (An intake air leak is more likely to cause this shutdown under no-load.)
4.. Repair or replace throttle body as necessary.
5.. Replace controller A1.

Corrective Action for HGJAB / HGJAC:

1.. Reset the line circuit breaker if tripped and reduce load. (A circuit breaker opening under overload can lead to this fault shutdown.)
2.. Check for binding governor linkage and readjust and repair as necessary.
3.. Replace controller A1.

UNDERFREQUENCY FAULT—CODE NO. 15

(Engine governor unable to maintain rated frequency)

Corrective Action: If the genset runs without shutting down when the circuit breaker is off, reduce the number of connected appliances, especially when air conditioners and battery chargers are running.

HGJAA Gensets:

1.. Replace the air filter element.
2.. Check for and repair a blocked exhaust system.
3.. Replace the fuel filter.
4.. Check that the vacuum hose is on and not leaking.
5.. Conduct the fuel pump tests.
6.. Check for and replace contaminated fuel.
7.. Repair or replace throttle body as necessary.
8.. Readjust valve lash.
9.. Service the engine as necessary.
10.. Replace controller A1.

HGJAB / HJGAC Gasoline Gensets:

1.. Replace the air filter element.
2.. Check for and repair a blocked exhaust system.
3.. Replace the fuel filters.
4.. Conduct the fuel pump tests.
5.. Check for and replace contaminated fuel.
6.. Check for binding governor linkage and readjust and repair as necessary.
7.. Check and readjust the choke assembly as necessary.
8.. Check for and replace leaking carburetor and intake manifold gaskets.
9.. Readjust valve lash.
10.. Service the engine as necessary.
11.. Replace the carburetor.
12.. Replace controller A1.

LPG Gensets:

1.. Check and fill the fuel tank. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will not vaporize in ambients below 32° F (0° C). Use HD-5 grade LPG.
2.. Replace the air filter element.
3.. Check for and repair a blocked exhaust system.
4.. Check for binding governor linkage and readjust and repair as necessary.
5.. Check for and replace leaking mixer and intake manifold gaskets.
6.. Check LPG regulator lock-off pressure and replace as necessary.
7.. Readjust valve lash.
8.. Service the engine as necessary.
9.. Replace the air/fuel mixer.
10.. Replace controller A1.

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

GOVERNOR ACTUATOR FAULT—CODE NO. 19

(Controller sensed open or shorted circuit)

Corrective Action:

1.. Reconnect the leads to the actuator if loose.
2.. Check actuator stator winding continuity and replace the actuator stator if open.
3.. Disconnect connector P1 from the controller and check for continuity between Pin P1-28 and actuator lead E+ and between Pin P1-27 and actuator lead E– and repair as necessary.
4.. Check for missing, bent or corroded connector pins and and repair as necessary.

GOVERNOR ACTUATOR OVERLOAD FAULT—CODE NO. 22

(Duration of operation at or near full-duty cycle beyond design limit)

Corrective Action:

1.. Reduce the number of connected appliances, especially when air conditioners and battery chargers are running.
2.. Replace the air filter element.
3.. Check for and repair a blocked exhaust system.
4.. Service the engine as necessary.

LOW OIL PRESSURE CUTOFF SWITCH FAULT—CODE NO. 23

(Controller sensed switch still open during start—not a running fault)

Corrective Action:

1.. Reconnect the lead to the low oil pressure cutoff switch if loose.
2.. Replace the low oil pressure cutoff switch.

VOLTAGE SENSE FAULT—CODE NO. 27

(Controller unable to sense output voltage)

Corrective Action:

1.. Disconnect connector P1 from the controller and check for continuity between:
  - **HGJAA –** Pin P1-34 and CB1 and P1-33 to neutral ground screw. Step 2. if open, Step 3. if closed.
  - **HGJAB / HGJAC –** Pin P1-4 and CB1 and P1-5 to neutral ground screw. Step 2. if open, Step 3. if closed.

2.. Check for missing, bent or corroded connector pins and faulty wiring and repair as necessary.
3.. Replace controller A1.

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

HIGH BATTERY VOLTAGE FAULT—CODE NO. 29

(Voltage across battery system greater than 19 volts)

Corrective Action:

1.. Check battery bank connections and reconnect if necessary so that the 12 volt batteries serving the genset are connected in parallel (12 volt) rather than in series (24 volt).
2.. Select a lower battery boost charge rate.

OVERSPEED FAULT—CODE NO. 31

(Engine speed greater than 3400 rpm)

Corrective Action for HGJAA Gensets:

1.. Check that the vacuum hose is connected properly and in good condition and repair as necessary.
2.. Check for and replace leaking throttle body and intake manifold gaskets.
3.. Repair or replace throttle body as necessary.

Corrective Action for HGJAB / HGJAC:

1.. Check for binding governor linkage and readjust and repair as necessary.

LOW CRANKING SPEED FAULT—CODE NO. 32

(Cranking speed less than 100 rpm for more than 3 seconds)

Corrective Action (When engine does not crank or appears to crank slowly):

1.. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery, chassis frame and genset.
2.. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
3.. Replace engine oil with oil of proper viscosity for ambient temperatures. (High oil viscosity can slow down cranking speed.)
4.. Check for and repair or replace a faulty starter or starter solenoid.

Corrective Action (When engine appears to crank normally):

1.. Service brushes and slip rings and test field and quadrature windings for opens or shorts. Replace a faulty rotor or stator. (The quadrature windings provide speed sense).
2.. Replace controller A1.

CONTROL CARD FAILURE FAULT—CODE NO. 35

(Microprocessor EEPROM error during self-test)

Corrective Action: Replace controller A1.

ENGINE STOPPED FAULT—CODE NO. 36

(Engine stopped without command from controller)

Corrective Action for HGJAA Gensets:

1.. Check and fill the fuel tank. (The genset fuel pickup is usually higher than the vehicle engine pickup.)
2.. Secure the spark plug leads on the spark plugs.
3.. Check for and repair mechanical damage.
4.. Check for and repair a blocked exhaust system.
5.. Replace the air filter element.
6.. Remove the spark plugs and conduct the ignition system tests.
7.. Conduct the fuel pump tests.
8.. Replace the fuel filter.
9.. Service brushes and slip rings and test field and quadrature windings for opens or shorts. Replace a faulty rotor or stator. (The quadrature windings provide speed sense).
10.. Replace controller A1.

Corrective Action for HGJAB /HGJAC Gasoline Gensets:

1.. Check and fill the fuel tank. (The genset fuel pickup is usually higher than the vehicle engine pickup.)
2.. Secure the spark plug leads on the spark plugs.
3.. Check for and repair mechanical damage.
4.. Check for and repair a blocked exhaust system.
5.. Replace the air filter element.
6.. Remove the spark plugs and conduct the ignition system tests.
7.. Check for and remove cooling air flow restrictions (higher temperatures can cause fuel vapor lock).
8.. Conduct the fuel pump tests.
9.. Replace the fuel filters.
10.. Check and replace fuel cutoff solenoid E4 as necessary.
11.. Check for binding governor linkage and readjust and repair as necessary.
12.. Service brushes and slip rings and test field and quadrature windings for opens or shorts. Replace a faulty rotor or stator. (The quadrature windings provide speed sense).
13.. Replace controller A1.

Corrective Action for LPG Gensets:

1.. Check and fill the fuel tank. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will not vaporize in ambients below 32° F (0° C). Use HD-5 grade LPG.
2.. Secure the spark plug leads on the spark plugs.
3.. Check for and repair mechanical damage.
4.. Check for and repair a blocked exhaust system.
5.. Replace the air filter element.
6.. Remove the spark plugs and conduct the ignition system tests.
7.. Check the fuel-shutoff solenoid (E2) and replace if necessary.
8.. Check LPG regulator lock-off pressure and replace as necessary.
9.. Check for binding governor linkage and readjust and repair as necessary.
10.. Service brushes and slip rings and test field and quadrature windings for opens or shorts. Replace a faulty rotor or stator. (The quadrature windings provide speed sense).
11.. Replace controller A1.

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

INVALID GENSET CONFIGURATION FAULT—CODE NO. 37

(Controller unable to determine genset configuration)

Corrective Action: See an authorized Onan dealer.

1.. Service brushes and slip rings and test field and quadrature windings for opens or shorts. Replace a faulty rotor or stator. (The quadrature windings provide speed sense).
2.. Replace controller A1.

OVERCURRENT (FIELD OVERLOAD) FAULT—CODE NO. 38

(Low power factor loads)

Corrective Action:

1.. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2.. Have air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause very low power factor.)

GENERATOR ROTOR FAULT—CODE NO. 41

(Controller unable to sense field voltage)

Corrective Action:

1.. Service brushes and slip rings and test field windings for opens or shorts. Replace a faulty rotor.
2.. Replace controller A1.

PROCESSOR FAULT—CODE NO. 42

(Microprocessor ROM error during self-test)

Corrective Action: Replace controller A1.

PROCESSOR FAULT—CODE NO. 43

(Microprocessor RAM error during self-test)

Corrective Action: Replace controller A1.

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

SPEED SENSE FAULT—CODE NO. 45

(Controller unable to sense quadrature frequency)

Corrective Action:

1.. Service brushes and slip rings and test field and quadrature windings for opens or shorts. Replace a faulty rotor or stator. (The quadrature windings provide speed sense).
2.. Replace controller A1.

IGNITION FAULT—CODE NO. 47

(Controller unable to sense ignition)

Corrective Action:

1.. If loose, reconnect the ignition kill leads (two) where they come up with the spark plug cables through the grommets in the base.
2.. Disconnect connector P1 from the controller and check for continuity to ground at:
    - **HGJAA –** Pin P1-15 and P1-20
    - **HGJAB / HGJAC –** Pin P1-4 and P1-5

    If there is continuity to ground at both pins, replace controller A1. If not, disconnect the leads at the grommets where they come up from the base and test for electrical continuity in the wiring harness. If the harness leads are good, go to Step 3..
3.. Disassemble the genset to the point where the ignition coils are accessible. Connect loose ignition kill leads at the ignition coils. Replace the ignition coil if open between the terminal and ground.

GENERATOR FIELD SENSE FAULT—CODE NO. 48

(Controller unable to sense field voltage)

Corrective Action: Replace controller A1.

PROCESSOR FAULT—CODE NO. 51

(Microprocessor malfunction)

Corrective Action: Replace controller A1.

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

FUEL INJECTOR FAULT—CODE NO. 52

(Open or short circuit in fuel injector)

Corrective Action: HGJAA only

1.. If loose, reconnect the connectors at the fuel injectors (two).
2.. Disconnect the fuel injector connectors from the fuel injectors and connector P1 from the controller and check for electrical continuity in the wiring harness between the injector connectors and controller pins:

    P1-23 to INJ1 (left hand injector)
    P1-35 to INJ2 (right hand injector).

    Replace the wiring harness if either lead is open. Replace the fuel injector if the wiring is good.
3.. Replace controller A1.

MAT SENDER FAULT—CODE NO. 54

(Open or short circuit in MAT sender)

Corrective Action: HGJAA only

1.. If loose, reconnect the connector at the sensor.
2.. Disconnect the connector from the sensor and connector P1 from the controller and check for electrical continuity in the wiring harness between sensor connector pins and controller pins:

    P1-25 to MAT-A
    P1-20 to MAT-B.

    Replace the wiring harness if either lead is open. Replace the sensor if the wiring is good.
3.. Replace controller A1.

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

MAP SENDER FAULT—CODE NO. 56

(Open or short circuit in MAP sender)

Corrective Action: HGJAA only

1.. If loose, reconnect the connector at the sensor.
2.. Disconnect the connector from the sensor and connector P1 from the controller and check for electrical continuity in the wiring harness between sensor connector pins and controller pins:

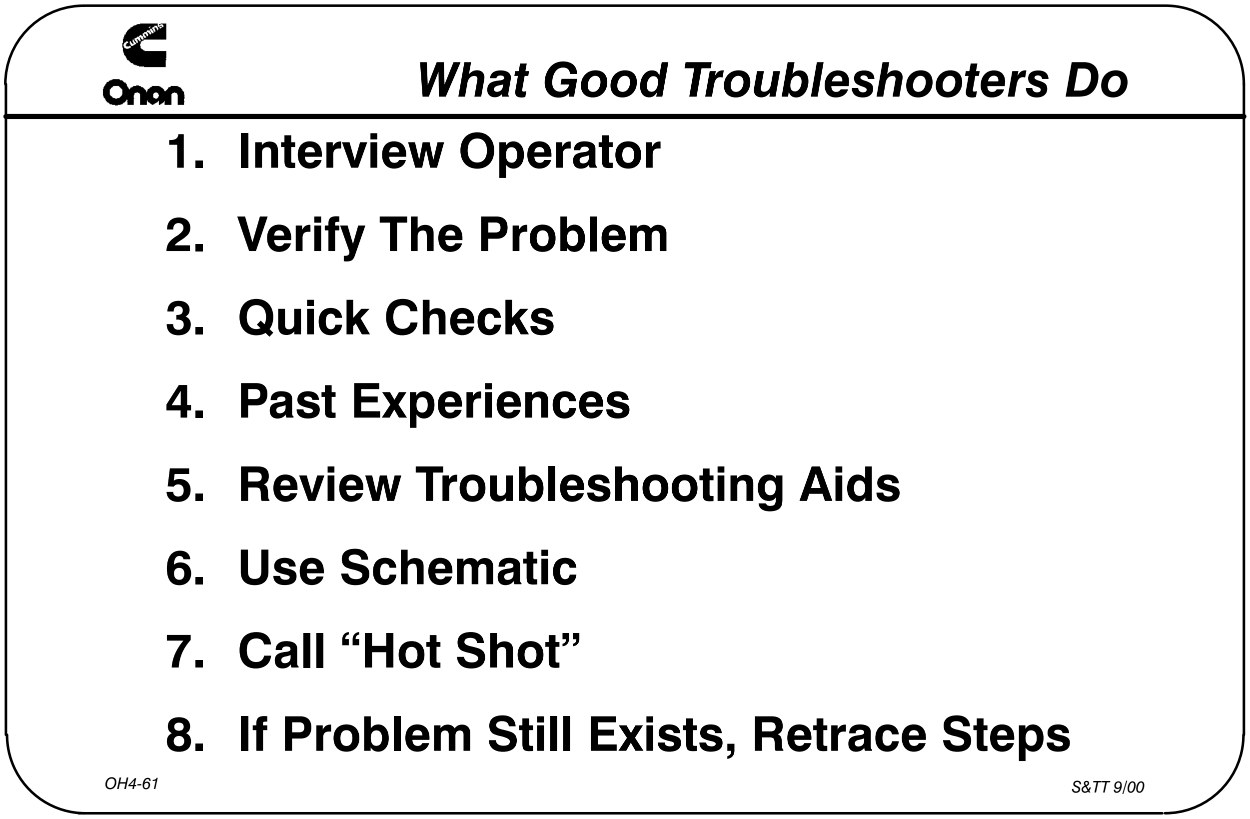
    P1-31 to MAP-A
    P1-22 to MAP-B
    P1-30 to MAP-C

    Replace the wiring harness if either lead is open. Replace the sensor if the wiring is good.
3.. Replace controller A1.

OVERPRIME FAULT—CODE NO. 57

(Prime mode exceeded 3 minutes)

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



What Good Troubleshooters Do

1. Interview Operator
2. Verify The Problem
3. Quick Checks
4. Past Experiences
5. Review Troubleshooting Aids
6. Use Schematic
7. Call “Hot Shot”
8. If Problem Still Exists, Retrace Steps

OH4-61

S&TT 9/00

Slide 4-61: What Good Troubleshooters Do

1. Interview Operator
   Witness
   Points to trouble area

2. Verify the Problem
   First hand experience

3. Quick Checks
   Fuse
   Connectors
   Oil level

4. Experience
   “Last time this happened”

5. Review Troubleshooting Aids
   PSBs
   Flow chart
   “If/then” chart

6. Use Schematic
   “Split half search”

7. Call “Hot Shot”

8. If Still Problem, Retrace Steps

Alternating Current (AC)

Alternating current is electric current (electron flow) that alternates between a positive maximum value and a negative maximum value at a characteristic frequency, usually 50 or 60 cycles per second (Hertz). This reversal of current is due to the change in the polarity of the electromagnetic field.

AC Generator

AC generator is the preferred term for referring to a generator that produces alternating current (AC). See Alternator and Generator.

Acoustic Material

Acoustic material is any material considered in terms of its acoustic properties, especially its properties of absorbing or deadening sound.

Active Power

Active power is the real power (kW) supplied by the generator set to the electrical load. Active power creates a load on the set's engine and is limited by the horsepower of the engine and efficiency of the generator. Active power does the work of heating, lighting, turning motor shafts, etc.

Air Circuit Breaker

An air circuit breaker automatically interrupts the current flowing through it when that current exceeds the trip rating of the breaker. Air is the medium of electrical insulation between electrically live parts and grounded (earthed) metal parts. Also see Power Circuit Breaker.

Annunciator

An annunciator is an accessory device used to give remote indication of the status of an operating component in a system. Annunciators are typically used in applications where the equipment monitored is not located in a portion of the facility that is normally attended. The NFPA has specific requirements for remote annunciators used in some applications, such as hospitals.

Alternator

Alternator is another term for AC generator. It is a device for generating alternating current using either a revolving armature with a stationary field or a revolving field with a stationary (stator) coil(s).

Amortisseur Windings

The amortisseur windings of a synchronous AC generator are the conductors embedded in the pole faces of the rotor. They are connected together at both ends of the poles by end rings. Their function is to dampen waveform oscillations during load changes.

Ampacity

Ampacity is the safe current-carrying capacity of an electrical conductor in amperes as defined by code.

Ampere

The ampere (A) is a unit of electric current flow. 6,242,000,000,000,000,0000 electrons flowing past a given point in one second equals one ampere. One ampere of current will flow when a potential of one volt is applied across a resistance of one ohm.

Ammeter

Measures the current from the generator or feeder and is used to check the load and load balance. Indication is polarity sensitive.

Apparent Power

Apparent power is the product of current and voltage, expressed as kVA. It is real power (kW) divided by the power factor (PF).

Armature

The armature of an AC generator is the assembly of windings and metal core laminations in which the output voltage is induced. It is the stationary part (stator) in a revolving-field generator.

Authority Having Jurisdiction

The authority having jurisdiction is the individual with the legal responsibility for inspecting a facility and approving the equipment in the facility as meeting applicable codes and standards.

Backup Protection

Backup protection consists of protective devices which are intended to operate only after other protective devices have failed to operate or detect a fault.

Base Load

Base load is that portion of a building load demand which is constant. t is the "base" of the building demand curve.

Battery

A device that produces direct current (DC) through a chemical reaction.

Black Start

Black start refers to the starting of a power system with its own power sources, without assistance from external power supplies.

Bridge Rectifier

Rectification is the process of changing AC to DC by the use of a diode. When an AC voltage is applied to a diode, the diode will conduct only on the positive portions of the sine wave. This is called half-wave rectification. In a bridge or full-wave rectifier, current will flow in the same direction on both alterations of the AC sine wave.

Brushes

Carbon or copper spring loaded sliding contacts that bear on the commutator or slip rings and carry current to or from the rotating part of the generator.

Bumpless Transition

Bumpless transition is make-before-break transfer of an electrical load from one source to another where voltage and frequency transients are kept to a minimum.

Bus

Bus can refer to the current-carrying copper bars that connect the AC generators and loads in a paralleling system, to the paralleled output of the AC generators in a system or to a feeder in an electrical distribution system.

Capacitance

The capacity to take an electrical charge is known as capacitance and is measured in farads. If voltage is applied to two conductors separated by an insulator, the insulator takes an electrical charge. When AC voltage is applied, alternating current flows into and out of the insulator (called a dielectric) and charges and discharges it with each reversal of alternating current. The charge reaches maximum but the current becomes zero as the voltage reaches maximum. Capacitance is opposite to inductance in that the current changes precede (lead) the voltage changes.

Capacitive Reactance

The opposition of capacitance to the change of an AC voltage causing the current wave to lead the voltage wave. It causes current to lead voltage by 90 degrees.

Capacitor or Condenser

A capacitor stores electrical charges, conducts AC, and blocks DC. It is an electrical device which causes the current to lead the voltage, opposite in effect to inductive reactance. Capacitors are used to neutralize the objectionable effect of lagging current (inductive reactance) which overloads the power source. It also acts as a low resistance path to grounds for currents of radio frequency, thus effectively reducing radio disturbance.

Circuit

A circuit is a path for an electric current across a potential (voltage).

Circuit Breaker

A circuit breaker is a protective device that automatically interrupts the current flowing through it when that current exceeds a certain value for a specified period of time. See Air Circuit Breaker, Main Breaker, Molded Case Circuit Breaker and Power Circuit Breaker.

Coil

A coil refers to a winding of conductors that can be used to produce an electrical current. This coil can then be used in relays to produce a mechanical function.

Commutator

The radial copper segments on the rotor of an electric generator or rotor. They conduct current from the rotating windings to the brushes, or vice versa for excitation.

Conductor

Any material that has a low resistance and conducts current readily. Example: gold, carbon, electrolyte. Substances which offer little resistance to the flow of electrical current such as silver, copper, and aluminum are especially good conductors although no material is a perfect conductor. Each of the wires lying in the armature slots of a generator is referred to as a conductor.

Contactor

A contactor is a device for opening and closing an electric power circuit.

Continuous Load

A continuous load is a load where the maximum current is expected to continue for three hours or more (as defined by the NEC for design calculations).

Cross Current Compensation

Cross current compensation is a method of controlling the reactive power supplied by AC generators in a paralleling system so that they share equally the total reactive load on the bus without significant voltage droop.

CT (Current Transformer)

Current transformers are instrument transformers used in conjunction with ammeters, control circuits and protective relaying. They usually have 5 ampere secondaries.

Current (Electrical Current)

Current is the flow of electricity or electric charge through a circuit (similar to the flow of water through a pipe). Its unit of measure is the ampere and is equal to one volt of pressure times one ohm of resistance.

Current Limiting Fuse

A current limiting fuse is a fast-acting device that, when interrupting currents in its current-limiting range, will substantially reduce the magnitude of current, typically within one-half cycle, that would otherwise flow.

Cycle

A cycle is one complete 360° mechanical or electrical rotation. There are two 360° cycles in the operation of a 4–stroke engine and one 360° cycle in the operation of a 2–stroke engine. One electrical cycle is the complete reversal of an alternating current or voltage from zero to a positive maximum to zero again and then from zero to a negative maximum to zero again. The number of cycles per second (cps) is the frequency (hertz).

dB/dB(A) Scale

The decibel (dB) scale used in sound level measurements is logarithmic. Sound level meters often have several decibel weighting scales (A, B,C). The A-scale, dB(A), is the most commonly used weighting scale for measuring the loudness of noise emitted from generator sets.

Delta Connection

Delta connection refers to a three-phase connection in which the start of each phase is connected to the end of the next phase, forming the Greek letter Δ. The load lines are connected to the corners of the delta.

Demand Factor

The demand factor is the ratio of actual load to the potential total connected load.

Deviation Factor

The deviation factor is the maximum instantaneous deviation, in percent, of the generator voltage from a true sine wave of the same RMS value and frequency.

Dielectric Strength

Dielectric strength is the ability of insulation to withstand voltage without rupturing.

Diode

The process of changing AC to DC is called Rectification. Rectification is achieved by using a device called a diode. When an AC voltage is applied to a diode, the diode will conduct in the direction of the arrow and only on the positive portions of the sine wave. The diode should have an extremely resistance in the opposite direction to prevent reverse current flow.

Direct Current (DC)

Direct current is current with no reversals in polarity, it only flows in one direction.

Differential Relay

A differential relay is a protective device which is fed by current transformers located at two different series points in the electrical system. The differential relay compares the currents and picks up when there is a difference in the two which signifies a fault in the zone of protection. These devices are typically used to protect windings in generators or transformers.

Eddy Current

The iron core of the armature acts as one large conductor which cuts through the magnetic lines-of-force as it revolves, generating voltage within the core itself. This action results in current flow called “eddy currents”. These currents produce heat which is added to the heat developed by current flow in the conductor. To reduce this effect, each lamination in the armature is coated to prevent large voltages from developing.

Efficiency (EFF)

Efficiency is the ratio of energy output to energy input, such as the ratio between the electrical energy input to a motor and the mechanical energy output at the shaft of the motor.

Electromagnetic Induction

The production of an electrical current in a conductor when it is moved in a magnetic field so as to cut the lines of magnetic force.

Electromagnetism

The lines-of-force (magnetic field or flux) produced around a straight wire or coil carrying an electric current.

Emergency System

An emergency system is independent power generation equipment that is legally required to feed equipment or systems whose failure may present a life safety hazard to persons or property.

Energy

Energy is manifest in forms such as electricity, heat, light and the capacity to do work. It is convertible from one form to another, such as in a generator set, which converts rotating mechanical energy into electrical energy. Typical units of energy are kW•h, Btu (British thermal unit), Hp•h, ft•lbf, joule and calorie.

Exciter

An exciter is a device that supplies direct current (DC) to the field coils of a synchronous generator, producing the magnetic flux required for inducing output voltage in the armature coils (stator). See Field.

Farad

The farad is a measure of electrical capacity of condensers. A microfarad is equal to one millionth of a farad and is abbreviated “mfd”.

Fault

A fault is any unintended flow of current outside its intended circuit path in an electrical system.

Field

The generator field (rotor) consists of a multi-pole electromagnet which induces output voltage in the armature coils (stator) of the generator when it is rotated by the engine. The field is energized by DC supplied by the exciter.

Free Field (Noise Measurements)

In noise measurements, a free field is a field in a homogeneous, isotropic medium (a medium having the quality of transmitting sound equally in all directions) which is free of boundaries. In practice, it is a field in which the effects of the boundaries are negligible in the region of interest. In the free field, the sound pressure level decreases 6 dB each doubling of the distance from a point source.

Frequency

Frequency is the number of complete cycles per unit of time of any periodically varying quantity, such as alternating voltage or current. It is usually expressed as Hertz (Hz) or cycles per second (CPS).

Frequency Regulation

Frequency regulation is a specification that states the difference between no-load and full-load frequency as a percentage of full-load frequency.

Fuse

A ribbon of fusible metal, rated at a specific current (amp) flow, that burns open upon detection of excessive current draw on its associated circuit.

Generator

A generator is a machine which converts rotating mechanical energy into electrical energy. See AC generator.

GFP (Ground Fault Protection)

A ground fault protection system is a system designed to limit the damage to equipment from line-to-ground fault currents.

Governor

A governor is a device on the engine which controls fuel to maintain a constant engine speed under various load conditions. The governor must have provision for adjusting speed (generator frequency) and speed droop (no load to full load).

Ground

A ground is a connection, either intentional or accidental, between an electrical circuit and the earth or some conducting body serving in place of the earth.

Grounding

Grounding is the intentional connection of the electrical system or the electrical equipment (enclosures, conduit, frames etc.) to earth.

Grounded Neutral

A grounded neutral is the intentionally grounded center point of a Y-connected, four-wire generator, or the mid-winding point of a single phase generator.

Ground Return

Ground return is a method of ground fault detection that employs a single sensor (CT) encircling the main bonding jumper between the power system neutral and ground. This device in itself is not capable of locating the faulted circuit but when used in conjunction with ground fault sensors on all feeders and source connections, can provide bus fault protection when properly coordinated (delayed).

Harmonics

Harmonics are voltage or current components which operate at integral multiples of the fundamental frequency of a power system (50 or 60 Hertz). Harmonic currents have the effect of distorting the shape of the voltage wave form from that of a pure sine wave.

Hertz (Hz)

The term Hertz is the preferred designation for cycles per second (CPS).

Hunting

Hunting is a phenomenon that can occur upon load changes in which the frequency or the voltage continues to rise above and fall below the desired value without reaching a steady-state value. It is caused by insufficient damping.

Hysteresis

This is the lagging of the magnetism behind the force producing it. Indication is by heat loss which is common in generators.

Impedance

Effects placed on alternating current by inductive reactance (current lags voltage), capacitive reactance (current leads voltage) and resistance (opposes current but doesn't lead or lag voltage) or any combination of the three. It is the total opposition to current flow in an AC circuit and is measured in ohms.

Inductive Reactance

The opposition of self inductance to current flow is called inductive reactance because it causes the current to lag behind the voltage that produces it. In an AC circuit with a definite frequency, inductance results in an inductive reactance which is measured in ohms. Inductive reactance causes current to lag voltage by 90 degrees.

Inductor

Any device that has a magnetic inertia which opposes any change of current. The characteristic that causes the magnetic inertia is called inductance. Inductance is quite apparent with alternating current since the voltage is continually changing in instantaneous value while the magnetic inertia is causing changes in current to lag behind changes in voltage.

Inherently Regulated

Inherently regulated means built-in voltage regulation through magnetic saturation of the steel in the field poles of the generator and the governed speed of the engine. The speed is limited to the frequency output of the genset. The correct quantity of the steel in the poles is important. Most small generators are inherently regulated. Saturation means the pole pieces of the generator are full of magnetism.

Insulator

Any material that has a very high resistance to current flow. Examples: rubber, wood, varnish. Substances which offer great resistances to the flow of electrical current such as glass, porcelain, paper, cotton, enamel, and paraffin are called insulators because they are practically non-conducting. However, no material is a perfect insulator.

Insulation

Insulation is non-conductive material used to prevent leakage of electric current from a conductor. There are several classes of insulation in use for generator construction, each recognized for a maximum continuous-duty temperature.

kVA (kilo-Volt-Amperes)

KVA is a term for rating electrical devices. A device's kVA rating is equal to its rated output in amperes multiplied by its rated operating voltage. In the case of three-phase generator sets, kVA is the kW ouput rating divided by 0.8, the rated power factor. kVA is the vector sum of the active power (kW) and the reactive power (kVAR) flowing in a circuit.

kVAR (kilo-Volt-Amperes Reactive)

KVAR is the product of the voltage and the amperage required to excite inductive circuits. It is associated with the reactive power which flows between paralleled generator windings and between generators and load windings that supply the magnetizing currents necessary in the operation of transformers, motors and other electromagnetic loads. Reactive power does not load the generator set's engine but does limit the generator thermally.

kW (kilo-Watts)

Kilowatt is a term used for power rating electrical devices and equipment. Generator sets in the United States are usually rated in kW. kW, sometimes called active power, loads the generator set's engine.

kW• h (kilo-Watt-hour)

This is a unit of electric energy. It is equivalent to one kW of electric power supplied for one hour.

Lagging Power Factor

Lagging power factor in AC circuits (a power factor of less than 1.0) is caused by inductive loads, such as motors and transformers, which cause the current to lag behind the voltage. See Power Factor.

Leg

A leg is a phase winding of a generator, or a phase conductor of a distribution system.

Line-To-Line Voltage

Line-to-line voltage is the voltage between any two phases of an AC generator.

Line-To-Neutral Voltage

In a 3-phase, 4-wire, Y-connected generator, line-to-neutral voltage is the voltage between a phase and the common neutral where the three phases are tied together.

Load Factor

The load factor is the ratio of the average load to the generator set power rating.

Low Voltage

In the context of this manual, low voltage refers to AC system operating voltages from 120 to 600 VAC.

Magnetism

Magnets attract certain materials, including nickel, cobalt, and especially iron. There is also a magnetic force between two magnets. Their opposite poles attract while their like poles repel. Magnetism is produced three ways; permanent, residual, and electromagnetically.

Magnetic Induction

Occurs when an iron bar is placed in a magnetic field so the lines-of-force passing through the bar will magnetize it.

Main Breaker

A main breaker is a circuit breaker at the input or output of the bus, through which all of the bus power must flow. The generator main breaker is the device, usually mounted on the generator set, that interrupts the set's power output.

Mains

Mains is a term used extensively outside the United States to describe the normal power service (utility).

Medium Voltage

In the context of this manual, medium voltage refers to AC system operating voltages from 601 to 15,000 VAC.

Molded Case Circuit Breaker

A molded case circuit breaker automatically interrupts the current flowing through it when the current exceeds a certain level for a specified time. *Molded case* refers to the use of molded plastic as the medium of electrical insulation for enclosing the mechanisms and for separating conducting surfaces from one another and from grounded (earthed) metal parts.

Motoring

In paralleling applications, unless a generator set is disconnected from the bus when its engine fails (usually as a result of a fuel system problem), the generator will drive (motor) the engine, drawing power from the bus. Reverse power protection which automatically disconnects a failed set from the bus is essential for paralleling systems. Also, in certain applications such as elevators, the load can motor the generator set if insufficient additional load is present.

Multimeter

Multimeter means a meter that can perform multiple electrical functions. They can be both analog or digital and record amps, volts, ohms along with other functions like frequency, speed, and temperature to name a few.

Mutual Induction

The electromagnetic induction of a voltage into one coil because of an increase or decrease of current flow in an adjacent coil.

NEC (National Electrical Code)

This document is the most commonly referenced general electrical standard in the United States.

Negative

The side or location of a circuit or component having the least amount of charged electrons therefor having the least amount of electrical pressure. Current flows to this location.

NEMA

(National Electrical Manufacturers Association)

Neutral

Neutral refers to the common point of a Y-connected AC generator, a conductor connected to that point or to the mid-winding point of a single-phase AC generator.

NFPA

(National Fire Protection Association)

Nonlinear Load

A nonlinear load is a load for which the relationship between voltage and current is not a linear function. Some common nonlinear loads are fluorescent lighting, SCR motor starters and UPS systems. Nonlinear loads cause abnormal conductor heating and voltage distortion.

Octave Band

In sound pressure measurements (using an octave band analyzer), octave bands are the eight divisions of the measured sound frequency spectrum, where the highest frequency of each band is twice that of its lowest frequency. The octave bands are specified by their center frequencies, typically: 63, 125, 250, 500, 1,000, 2,000, 4,000 and 8,000 Hz (cycles per second).

Ohm

The ohm is a unit of electrical resistance. One volt will cause a current of one ampere to flow through a resistance of one ohm.

Ohmmeter

An instrument for measuring electrical resistance in a circuit or component. It displays the number of ohms or resistance under measurement and is used on a deenergized circuit. It has its own power supply.

One-Line Diagram

A one-line diagram is a schematic diagram of a three-phase power distribution system which uses one line to show all three phases. It is understood when using this easy to read drawing that one line represents three.

Open Circuit

An open circuit is a circuit that has an infinite amount of resistance due to a separation, opening, of a conductor in the circuit.

Out-Of-Phase

Out-of-phase refers to alternating currents or voltages of the same frequency which are not passing through their zero points at the same time.

Overload Rating

The overload rating of a device is the load in excess of the nominal rating the device can carry for a specified length of time without being damaged.

Overshoot

Overshoot refers to the amount by which voltage or frequency exceeds the nominal value as the voltage regulator or governor responds to changes in load.

Parallel Circuit

A parallel circuit has all the resistors or power consuming components connected to the power source. Since each resistance is connected in parallel, the applied voltage is seen at each resistor.

Parallel Operation

Parallel operation is the operation of two or more AC power sources whose output leads are connected to a common load.

Peak Load

Peak load is the highest point in the kilowatt demand curve of a facility. This is used as the basis for the utility company's demand charge.

Peak Shaving

Peak shaving is the process by which loads in a facility are reduced for a short time to limit maximum electrical demand in a facility and to avoid a portion of the demand charges from the local utility.

Phase

Phase refers to the windings of an AC generator. In a three-phase generator there are three windings, typically designated as A-B-C, R-S-T or U-V-W. The phases are 120 degrees out of phase with each other. That is, the instants at which the three phase voltages pass through zero or reach their maximums are 120 degrees apart, where one complete cycle is considered 360 degrees. A single-phase generator has only one winding.

Phase Angle

Phase angle refers to the relation between two sine waves which do not pass through zero at the same instant, such as the phases of a three-phase generator. Considering one full cycle to be 360 degrees, the phase angle expresses how far apart the two waves are in relation to a full cycle.

Phase Rotation

Phase rotation (or phase sequence) describes the order (A-B-C, R-S-T or U-V-W) of the phase voltages at the output terminals of a three-phase generator. The phase rotation of a generator set must match the phase rotation of the normal power source for the facility and must be checked prior to operation of the electrical loads in the facility.

Pitch

Pitch is the ratio of the number of generator stator winding slots enclosed by each coil to the number of winding slots per pole. It is a mechanical design characteristic the generator designer may use to optimize generator cost verse voltage wave form quality.

Polarity

The distinction between the positive (+) and negative (–) terminals, wires, poles, and current flow of a circuit.

Pole

Pole is used in reference to magnets, which are bipolar. The poles of a magnet are designated North and South. Because magnets are bipolar, all generators have an even number of poles. The number of poles determines how fast the generator will have to be turned to obtain the specified frequency. For example, a generator with a 4-pole field would have to be run at 1800 rpm to obtain a frequency of 60 Hz (1500 rpm for 50 Hz).

Pole can also refer to the electrodes of a battery or to the number of phases served by a switch or breaker.

Positive

The side or location of a circuit or component having the greatest amount of charged electrons therefor having the greatest amount of electrical pressure. Current flows from this location.

Power Circuit Breaker

A power circuit breaker is a circuit breaker whose contacts are forced closed via a spring-charged, over-center mechanism to achieve fast closing (5-cycle) and high withstand and interrupting ratings. A power circuit breaker can be an insulated case or power air circuit breaker.

Power

Power refers to the rate of performing work or of expending energy. Typically, mechanical power is expressed in terms of horsepower and electrical power in terms of kilowatts. One kW equals 1.34 hp.

Power Factor (PF)

The inductances and capacitances in AC circuits cause the point at which the voltage wave passes through zero to differ from the point at which the current wave passes through zero. When the current wave precedes the voltage wave, a leading power factor results, as in the case of capacitive loads or overexcited synchronous motors. When the voltage wave precedes the current wave, a lagging power factor results. This is generally the case. The power factor expresses the extent to which the voltage zero differs from the current zero. Considering one full cycle to be 360 degrees, the difference between the zero points can then be expressed as an angle. Power factor is calculated as the cosine of the angle between zero points and is expressed as a decimal fraction (.8) or as a percentage (80%). It is the ratio of kW and kVA. In other words kW = kVA x PF.

Radio Interference

Radio interference refers to the interference with radio reception caused by a generator set.

Radio Interference Suppression

Radio interference suppression refers to the methods employed to minimize radio interference.

Reactance

Reactance is the opposition to the flow of current in AC circuits caused by inductances and capacitances. It is expressed in terms of ohms and its symbol is X.

Real Power

Real power refers to the product of current, voltage and power factor and is expressed as kW. See Watt.

Rectifier

A rectifier is a device that converts alternating current to direct current by the use of a diode. Diodes come in three fashions; single for half-wave rectification, bridge for full-wave, and three phase rectifiers.

Reluctance

This is the opposition to the magnetic lines-of-force. Increasing the air gap between the N and S poles reduces magnetic lines-of-force (flux) and increases reluctance.

Residual Magnetism

The magnetism remaining in iron or steel after the magnetizing force is removed. Residual Magnetism is stored in the DC (field) portion of the generator and can be restored by “flashing” the field using a DC battery.

Residual Voltage

Residual voltage is the voltage produced in a coil or wire when it is moved through the field set up by residual magnetism.

Resistance

Resistance is the opposition to the flow of current in DC circuits. It is expressed in ohms and its symbol is Ω or R.

Resistor

A resistor is a poor conductor used in a circuit to create resistance which limits the amount of current flow.

Retentivity

Retentivity is the ability of a material to hold or retain magnetism.

Rheostat

A resistor so arranged that its effective resistance can be readily varied.

RMS (Root Mean Square)

The RMS values of a measured quantity such as AC voltage, current and power are considered the “effective” values of the quantities. See Watt.

Rotor

A rotor is the rotating element of a motor or generator.

RPM

(Revolutions Per Minute)

Saturation

This is the condition where a piece of iron or steel is as full of magnetism as it can hold.

Saturated Field

Is when DC field lamination material has reached a point where it will no longer be able to increase its strength even with an increase in the DC field current.

Schematic

A symbolic drawing that represents a combination of electrical components.

SCR (Silicon Controlled Rectifier)

A SCR is a three-electrode solid-state device which permits current to flow in one direction only, and does this only when a suitable potential is applied to the third electrode, called the gate.

Selective Coordination

Selective coordination is the selective application of overcurrent devices such that short circuit faults are cleared by the device immediately on the line side of the fault, and only by that device.

Self Inductance

Is the electromagnetic induction of a voltage into a current carrying wire (inductor) when the current in the wire itself is changing with the increasing and decreasing magnetic field around the wire. The polarity of an induced voltage opposes the change in the current that produced it and attempts to prevent the current from increasing.

Series Circuit

A series circuit has a resistor or resistors connected so current has only one path to travel. Any open in the circuit causes a complete termination of current flow in the circuit.

Series/Parallel Circuit

A series/parallel circuit has the characteristics of both the series and parallel circuits.

Service Entrance

The service entrance is the point where the utility service enters the facility. In low voltage systems the neutral is grounded at the service entrance.

Short Circuit

A short circuit is generally an unintended electrical connection between current carrying parts.

Shunt Trip

Shunt trip is a feature added to a circuit breaker or fusible switch to permit the remote opening of the breaker or switch by an electrical signal.

Sine Wave

A sine wave is a graphical representation of a sine function, where the sine values (usually the y axis) are plotted against the angles (x axis) to which they correspond. AC voltage and current wave shapes approximate such a curve.

Single Phase

A single phase, alternating-current system has a single voltage in which voltage reversals occur at the same time and are of the same alternating polarity throughout the system.

Slip (Collector) Rings

Smooth, insulated conductor bands on the rotor shaft or armature used to feed AC to the brushes in a revolving armature or field generator.

Soft Loading

Soft loading refers to the ramping of load onto or off of a generator in a gradual fashion for the purpose of minimizing voltage and frequency transients on the system.

Sound

Sound is considered both in terms of the sound pressure waves travelling in air (pressures superimposed on the atmospheric pressure) and the corresponding aural sensation. Sound can be “structure-borne”, that is, transmitted through any solid elastic medium, but is audible only at points where the solid medium “radiates” the pressure waves into the air.

Sound Level Meter

A sound level meter measures sound pressure level. It has several frequency-weighted decibel (dB) scales (A, B, C) to cover different portions of the range of measured loudness. Sound level meters indicate RMS sound, unless the measurements are qualified as instantaneous or peak sound level.

Sound Pressure Level (SPL)

Sound pressure level refers to the magnitude of the pressure differential caused by a sound wave. It is expressed on a dB scale (A,B,C) referenced to some standard (usually 10^{-12} microbars).

Standby System

A standby system is an independent power system that allows operation of a facility in the event of normal power failure.

Star Connection

See Wye Connection.

Starting Current

The initial value of current drawn by a motor when it is started from standstill.

Stator

The stator is the stationary part of a generator or motor. See Armature.

Surge

Surge is the sudden rise in voltage in a system. It is usually caused by load disconnect.

Surge Suppressor

Surge suppressors are devices capable of conducting high transient voltages. They are used for protecting other devices that could be destroyed by the transient voltages.

Synchronization

In a paralleling application, synchronization is obtained when an incoming generator set is matched with and in step to the same frequency, voltage, and phase sequence as the operating power source.

Synchronous Generator

A synchronous generator is an AC generator having a DC exciter. Synchronous generators are used as stand-alone generators for emergency power and can also be paralleled with other synchronous generators and the utility system.

Telephone Influence Factor (TIF)

The higher harmonics in the voltage wave shape of a generator can cause undesirable effects on telephone communications when power lines parallel telephone lines. The telephone influence factor is calculated by squaring the weighted RMS values of the fundamental and the non-triple series of harmonics, adding them together and then taking the square root of the sum. The ratio of this value to the RMS value of the no-load voltage wave is called the **Balanced TIF**. The ratio of this value to three times the RMS value of the no-load phase-to-neutral voltage is called the **Residual Component RIF**.

Three Phase

A three phase, alternating-current system has three individual circuits or phases. Each phase is timed so the current alterations of the first phase is 1/3 cycle (120°) ahead of the second phase and 2/3 cycle (240°) ahead of the third phase.

Transformer

A transformer is a device that changes the voltage of an AC source from one value to another. It also changes the amount of current inversely proportional to the voltage.

Transfer Switch

A two-pole or three-pole, double-throw switch which prevents paralleling of the utility source of feedback into the utility line when an alternator/generator is used in an emergency for a power source.

True Power

In DC circuits, or purely resistive AC circuits, the power consumed is equal to the voltage times the current. In circuits containing reactance, inductive or reactive, the power is stored temporarily. If you were to measure the voltage and current in a reactive circuit then multiply them together you would get apparent power. This is the power supplied to the circuit by the source, but is not the power consumed by the circuit, which is the true power. True power is the in-phase produce of the resistive voltage and current consuming loads.

Undershoot

Undershoot refers to the amount by which voltage or frequency drops below the nominal value as the voltage regulator or governor responds to changes in load.

Utility

The utility is a commercial power source that supplies electrical power to specific facilities from a large central power plant.

Volt (Voltage)

The volt is a unit of electrical potential. A potential of one volt will cause a current of one ampere to flow through a resistance of one ohm.

Voltage Dip (Drop)

Voltage dip is the dip in voltage that results when a load is added, occurring before the regulator can correct it, or resulting from the functioning of the voltage regulator to unload an overloaded engine-generator.

Voltage Regulation

Voltage regulation is a specification that states the difference between maximum and minimum steady-state voltage as a percentage of nominal voltage.

Voltage Regulator

A voltage regulator is a device that maintains the voltage output of a generator near its nominal value in response to changing load conditions.

Voltmeter

A device used to measure the potential difference, in this case volts, across two points in a curcuit. A voltmeter is placed in parallel to or across a circuit or component and is measures the voltage drop or consumption of the circuit or component.

Watt

The watt is a unit of electric power. In direct current (DC) circuits, wattage equals voltage times amperage. In alternating current (AC) circuits, wattage equals effective (RMS) voltage times effective (RMS) amperage times power factor times a constant dependent on the number of phases. 1,000 watts equal one kW.

Wattmeter

Measures the watt or kilowatt output of the generator. The wattmeter is an electrodynamometer type of instrument which measures the instantaneous values of volts and amps and indicates the product in watts or kilowatts.

Windings

Multiple loops of electrical conductors are formed to produces coils. These coils of conductors are located in either the revolving or stationary portion of the generator. Here they are referred to as windings and produce either AC or DC currents used for specific input or output voltages.

Wiring Diagram

A drawing that shows electrical equipment and/or components together with all interconnecting wires.

Wye Connections

A Wye connection is the same as a star connection. It is a method of interconnecting the phases of a three-phase system to form a configuration resembling the letter Y. A fourth (neutral) wire can be connected at the center point.

Zenor Diode

A device that above a certain reverse voltage allows current to flow in the forward direction. Zener diodes are good voltage regulators and circuit overvoltage protectors.

Zero Sequence

Zero sequence is a method of ground fault detection that utilizes a sensor (CT) that encircles all the phase conductors as well as the neutral conductors. The sensor will produce an output proportional to the imbalance of current ground fault in the circuit. This output is then measured by a relay to initiate circuit breaker tripping or ground fault alarm.

Zones of Protection

Zones of protection are defined areas within a distribution system that are protected by specific groups of protective sensing and interrupting devices.

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PRETEST
GENERATOR FUNDAMENTALS

INSTRUCTIONS:

1. Carefully read each question and select the **one** best answer.
2. Blacken the letter of your answer. **Example** ■

1. The correct sequence of the four strokes in a four cycle engine are:
   a. Intake, power, compression, exhaust.
   b. Intake, compression, power, exhaust.
   c. Intake, exhaust, compression, power.
   d. Intake, compression, exhaust, power.
2. The air to fuel ratio of a gasoline engine is about:
   a. about 8 to 1.
   b. about 15 to 1.
   c. about 100 to 1.
   d. variable.
3. Using a leak down tester, you observe 40% leakage and a whistling noise at the dipstick tube. What problem have you isolated?
   a. Bad valve seating.
   b. Bad rings.
   c. Worn intake guides.
   d. Crankcase vacuum problem.
4. The purpose of a venturi in a carburetor is to move air:
   a. slower and increase pressure.
   b. slower and decrease pressure.
   c. faster and increase pressure.
   d. faster and decrease pressure.

5. An engine with approximately 100 hours is using abnormal amounts of oil. It is not leaking oil and a partial teardown reveals that the cylinder bore is glazed. What is the most probable cause?
    a. Use of poor quality fuel.
    b. Incorrect weight of oil.
    c. Excessive load during break-in.
    d. Insufficient load during break-in.
6. The primary function of a flywheel on an internal combustion engine is to provide:
    a. a place for timing marks.
    b. equal engine balance front to rear.
    c. rotating inertia to engine.
    d. weight to the engine.
7. To measure the primary resistance of an Onan ignition coil you would connect your ohmmeter leads to the:
    a. spark plug.
    b. + terminal and ground.
    c. + and – terminal on the coil.
    d. + terminal and the spark plug.
8. Ratings for gasoline fuels are in:
    a. Cetane.
    b. Butane.
    c. Octane.
    d. Methane.
9. Black smoke during start-up and running is a direct cause of:
    a. a lean carburetor mixture.
    b. low engine temperature.
    c. burning engine oil.
    d. restricted air filter.
10. Blue smoke during start-up and running is a direct cause of:
    a. a faulty carburetor.
    b. low engine temperature.
    c. burning engine oil.
    d. restricted air filter.

11. Voltmeters must be connected to a circuit so that:
    a. polarity is observed.
    b. readings are taken across the voltage source.
    c. readings are taken parallel to a source or load.
    d. all the above are observed.
12. Ammeters are connected in _____________ to the component or load.
    a. parallel.
    b. series-parallel.
    c. series.
    d. dedication.
13. Two 12 volt batteries connected in series provide 24 volts.
    a. True.
    b. False.
14. Two lines of 120 volts AC connected in parallel will produce 240 volts AC.
    a. True.
    b. False.
15. If an electric heater takes 10 amperes from a 120 volt AC line, how much power is it using?
    a. 10 watts.
    b. 12 watts.
    c. 120 watts.
    d. 1.2 kilowatts.
16. When a conductor moves through a magnetic field parallel to the magnetic lines of force, the resulting voltage induced into the conductor will be:
    a. maximum.
    b. zero.
    c. direct.
    d. alternating.
17. Voltage can be increased by what way(s)?
    a. Increasing the magnetic field strength.
    b. Increasing the number of conductors cutting the magnetic lines of force.
    c. Increasing the speed that the conductor moves through the magnetic lines of force.
    d. All of the above.

18. The output frequency of a generator is determined by the:
    a. number of conductors and size of the field poles.
    b. number of field poles and the speed of the conductors moving passed them.
    c. amount of output voltage and size of load.
    d. number of output phases of the genset.
19. Alternating current can be electronically changed to direct current by:
    a. transformers.
    b. resistors.
    c. rectifiers.
    d. solenoids.
20. A transformer can do what to an AC circuit?
    a. Change AC voltage to DC voltage.
    b. Increase or decrease output voltage.
    c. Increase or decrease output current.
    d. Both B & C.

QD PRETEST
GENERATOR FUNDAMENTALS

INSTRUCTIONS:

1. Carefully read each question and select the **one** best answer.
2. Blacken the letter of your answer. **Example** ■

1. The correct sequence of the four strokes in a four cycle engine is:
    a. Intake, power, compression, exhaust.
    b. Intake, compression, power, exhaust.
    c. Intake, exhaust, compression, power.
    d. Intake, compression, exhaust, power.
2. Ratings for diesel fuels are in:
    a. Octane.
    b. Butane.
    c. Cetane.
    d. Methane.
3. The air to fuel ratio of a diesel engine is:
    a. 8 to 1.
    b. 18 to 1.
    c. 100 to 1.
    d. variable.
4. Using a leak down tester, you observe 40% leakage and a whistling noise at the dipstick tube. What problem have you isolated?
    a. Bad valve seating.
    b. Bad rings.
    c. Worn intake guides.
    d. Crankcase vacuum problem.
5. On the diesel engine, ignition of the air/fuel mixture is achieved by:
    a. the glow plug.
    b. a spark plug.
    c. compression.
    d. the injector.

6. In cold weather conditions (below 32°) the required fuel for diesel engines would be ASTM:
   a. 1–D.
   b. 2–D.
   c. 3–D.
   d. 4–D.
7. An engine with approximately 100 hours is using abnormal amounts of oil. It is not leaking oil. A partial teardown reveals that the cylinder bore is glazed. What is the most probable cause?
   a. Use of poor quality fuel.
   b. Incorrect weight of oil.
   c. Excessive load during break-in.
   d. Insufficient load during break-in.
8. The primary function of a flywheel on an internal combustion engine is to provide:
   a. a place for timing marks.
   b. equal engine balance front to rear.
   c. reciprocating inertia to engine.
   d. weight to the engine.
9. The compression ratio of a diesel engine is approximately:
   a. 9 to 1.
   b. 19 to 1.
   c. 29 to 1.
   d. 39 to 1.
10. White smoke during cranking and start-up is a direct cause of:
    a. a faulty injector.
    b. low cylinder temperature.
    c. burning engine oil.
    d. restricted air filter.
11. DC Voltmeters must be connected to a circuit so that:
    a. polarity is observed.
    b. readings are taken across the voltage source.
    c. readings are taken parallel to a source or load.
    d. all the above are observed.

12. Ammeters are connected in _____________ to the component or load.
    a. parallel.
    b. series-parallel.
    c. series.
    d. dedication.
13. Two 12 volt batteries connected in series provide 24 volts?
    a. True.
    b. False.
14. Two source lines of 120 volts AC connected in parallel will produce 240 volts AC.
    a. True.
    b. False.
15. If an electric heater takes 10 amperes from a 120 volt AC line, how much power is it using?
    a. 10 watts.
    b. 12 watts.
    c. 120 watts.
    d. 1.2 kilowatts.
16. When a conductor moves through a magnetic field parallel to the magnetic lines of force, the resulting voltage induced into the conductor will be:
    a. maximum.
    b. zero.
    c. direct.
    d. alternating.
17. Voltage can be increased by what way(s)?
    a. Increasing the magnetic field strength.
    b. Increasing the number of conductors cutting the magnetic lines of force.
    c. Increasing the speed that the conductor moves through the magnetic lines of force.
    d. All of the above.
18. The output frequency of a generator is determined by:
    a. number of conductors and size of the field poles.
    b. number of field poles and the speed of the conductors moving passed them.
    c. amount of output voltage and size of load.
    d. number of output phases of the genset.

19. Alternating current can be electronically changed to direct current by:
    a. transformers.
    b. resistors.
    c. rectifiers.
    d. solenoids.
20. A transformer can do what to an AC circuit?
    a. Change AC voltage to DC voltage.
    b. Increase or decrease output voltage.
    c. Increase or decrease output current.
    d. Both B & C.

YK Series
Generator/Regulator Test

Check all voltages with generator operating at normal frequency.
When required, stop generator to disconnect or reconnect connectors.
All voltages are dependent upon speed (frequency), load and battery voltage (step 4).

NORMAL VOLTAGES, ± 10%:

1. Stop the genset and install the break–out tool into the wiring harness between the voltage regulator and the generator or connect two wires in parallel to the F1 and F2 connectors on the voltage regulator.

2. Start the genset and measure the voltages at the following points:

   a. Between L1 & L2 (output voltage): _____ VAC.
   b. Between L1 & L0 (output voltage): _____ VAC.
   c. Between L2 & L0 (output voltage): _____ VAC.
   d. Between Q1 & Q2 (quadrature voltage): _____ VAC.
   e. Between AC inputs to the control monitor board (starter protection relay for start disconnect): ____ VAC.
   f. Between F1 & F2 (excitation voltage) during the following loads:

      No Load = ______ VDC at _____ amps.
      25% Load = _____ VDC at _____ amps.
      50% Load = _____ VDC at _____ amps.
      75% Load = _____ VDC at _____ amps.
      100% Load = ____ VDC at _____ amps.

DYNAMIC VOLTAGES, ± 10% (All voltages taken with voltage regulator disconnected):

3. Stop the generator and disconnect the regulator end of the break–out tool or disconnect the F1 and F2 leads from the regulator.

4. Connect a **12 VDC** source to the tester F1 (+) and F2 (–) or to the ends of the F1 and F2 leads.

CAUTION: Do not leave the VDC source connected to the F1/F2 field excitation for extended periods without the genset running.

5. Start the generator and measure the voltage at the following points:

   a. Between L1 & L0 (output voltage): _______ VAC.
   b. Between Q1 & Q2 (quadrature voltage): _______ VAC.
   c. Between AC inputs at the control monitor board (starter protection relay for starter disconnect): _______ VAC.
   d. Between F1 & F2 (excitation voltage): _______ VDC.

6. Stop the genset, remove the break–out tool or the parallel leads to the F1 and F2 connectors and reconnect the regulator to the harness.

7. Start the genset and check for normal operation.

YVB Series
Generator/Regulator Test

Check all voltages with generator operating at normal frequency.
When required, stop generator to disconnect or reconnect connectors.
All voltages are dependent upon speed (frequency), load and battery voltage (step 4).

NORMAL VOLTAGES, ± 10%:

1. Stop the genset and install the break–out tool into the wiring harness between the voltage regulator and the generator or connect two wires in parallel to the F1 and F2 connectors on the voltage regulator.

2. Start the genset and measure the voltages at the following points:

   a. Between L1 & L2 (output voltage): _____ VAC.
   b. Between L1 & L0 (output voltage): _____ VAC.
   c. Between L2 & L0 (output voltage): _____ VAC.
   d. Between Q1 & Q2 (quadrature voltage): _____ VAC.
   e. Between AC inputs to the control monitor board
   (starter protection relay for start disconnect): ____ VAC.
   f. Between F1 & F2 (excitation voltage) during the following loads:

   No Load = ___ VDC at _____ amps.
   25% Load = ___ VDC at _____ amps.
   50% Load = _____ VDC at _____ amps.
   75% Load = ___ VDC at _____ amps.
   100% Load = ___ VDC at _____ amps.

DYNAMIC VOLTAGES, ± 10% (All voltages taken with voltage regulator disconnected):

3. Stop the generator and disconnect the regulator end of the break–out tool or disconnect the F1 and F2 leads from the regulator.

4. Connect a **12 VDC** source to the tester F1 (+) and F2 (–) or to the ends of the F1 and F2 leads.

CAUTION: Do not leave the VDC source connected to the F1/F2 field excitation for extended periods without the genset running.

5. Start the generator and measure the voltage at the following points:

   a. Between L1 & L0 (output voltage): _____ VAC.
   b. Between Q1 & Q2 (quadrature voltage): _____ VAC.
   c. Between AC inputs at the control monitor board
   (starter protection relay for starter disconnect): _____ VAC.
   d. Between F1 & F2 (excitation voltage): _____ VDC.

6. Stop the genset, remove the break–out tool or the parallel leads to the F1 and F2 connectors and reconnect the regulator to the harness.

7. Start the genset and check for normal operation.

YD Series
Generator/Regulator Test

Check all voltages with generator operating at normal frequency.
When required, stop generator to disconnect or reconnect connectors.
All voltages are dependent upon speed (frequency), load and battery voltage (step 4).

NORMAL VOLTAGES, ± 10%:

1. Stop the genset and install the break–out tool into the wiring harness between the voltage regulator and the generator or connect two wires in parallel to the F1 and F2 connectors on the voltage regulator.

2. Start the genset and measure the voltages at the following points:

   a. Between L1 & L2 (output voltage): _____ VAC.
   b. Between L1 & L0 (output voltage): _____ VAC.
   c. Between L2 & L0 (output voltage): _____ VAC.
   d. Between Q1 & Q2 (quadrature voltage): _____ VAC.
   e. Between AC inputs to the control monitor board
   (starter protection relay for start disconnect): ____ VAC.
   f. Between F1 & F2 (excitation voltage) during the following loads:

      No Load = ______ VDC at _____ amps.
      25% Load = _____ VDC at _____ amps.
      50% Load = _____ VDC at _____ amps.
      75% Load = _____ VDC at _____ amps.
      100% Load = ____ VDC at _____ amps.

DYNAMIC VOLTAGES, ± 10% (All voltages taken with voltage regulator disconnected):

3. Stop the generator and disconnect the regulator end of the break–out tool or disconnect the F1 and F2 leads from the regulator.

4. Connect a **6 VDC** source to the tester F1 (+) and F2 (–) or to the ends of the F1 and F2 leads.

CAUTION: Do not leave the VDC source connected to the F1/F2 field excitation for extended periods without the genset running.

5. Start the generator and measure the voltage at the following points:

   a. Between L1 & L0 (output voltage): _______ VAC.
   b. Between Q1 & Q2 (quadrature voltage): _______ VAC.
   c. Between AC inputs at the control monitor board
   (starter protection relay for starter disconnect): _____ VAC.
   d. Between F1 & F2 (excitation voltage): _______ VDC.

6. Stop the genset, remove the break–out tool or the parallel leads to the F1 and F2 connectors and reconnect the regulator to the harness.

7. Start the genset and check for normal operation.

7.5/8.0 QD TROUBLESHOOTING TABLE

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

THE STATUS INDICATOR LIGHT IS DEAD

(There is no battery voltage or Start signal)

Corrective Action:

1. Try starting the genset at the operator’s console if the remote panel light does not work, and vice versa.
   - *If the Start switch at the genset works*, repair the remote control circuit as required.
   - *If the remote Start switch works*, remove the front and top housing panels. Disconnect engine harness connector P2 from the controller/inverter assembly. Check for electrical continuity between pin P2-12 (local start) and pin P2-11 (local ground) while holding the control switch in its Start position, and between P2-10 (local stop) and P2-11 while holding the switch in its Stop position.
     - *If there is no electrical continuity*, tighten connections at the control switch. If that does not work, replace the switch or the wiring harness, as required.
     - *If there is electrical continuity,* push connector P2 on and off several times to wipe the pins clean. If that does not work, replace the controller/inverter assembly.
2. Replace **Fuse F1** (B+) if blown.
3. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
4. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
5. Remove the front and top housing panels. Disconnect engine harness connector P1 from the controller/inverter assembly. Check for B+ (12 VDC) at pin P1-8 and continuity to ground at pin P1-7.
   - *If there is no voltage or ground continuity*:
     - Recheck **Fuse F1** (B+) and replace if blown.
     - Check that all engine and battery harness wires are properly connected to the grounding bolt on the flywheel housing, to the B+ terminal on the starter solenoid and to the battery terminal block. Clean and tighten connections as necessary. If that does not work, replace the appropriate wiring harness.
   - *If there is voltage and ground continuity,* push connector P1 on and off several times to wipe the pins clean. If that does not work, replace the controller/inverter assembly.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

(The battery, battery connections or charging system are in marginal condition)

Corrective Action:

1. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
3. Service the battery charging system:
   - *If the genset is not equipped with a battery charger*, service the battery charging system in the vehicle.
   - *If the genset is equipped with a battery charger,* check battery charger performance by measuring voltage across the battery terminals while the genset is running. Turn the circuit breaker on the genset operator's console "On" and "Off" several times while watching the meter.
     - *If the voltage jumps to more than 12 VDC when the circuit breaker is turned "On"*, the battery charger is probably okay. Check for a parasitic load external to the genset and/or replace the battery.
     - *If there is no change in voltage when the circuit breaker is turned "On"*, remove the front housing panel.
       - *If the connections are loose,* reconnect battery charger transformer input connectors J12 and J13 to the AC HARNESS, output connectors J14 and J15 to the battery charger and the battery charger output lead to the B+ terminal on the starter solenoid.
       - *If the connections are secure*, disconnect transformer connectors J12 through J15 and check winding continuity across J12 and J13 and across J14 and J15.
         - *If a winding is open,* replace the transformer.
         - *If the windings are good,* reconnect J12 and J13 to the AC HARNESS and prepare to run the genset and measure voltages. *The genset will run for a short time only before shutdown when a panel is removed.*

           ⚠WARNING ***This test involves operating the genset without the housing panels secured in place. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. Keep your hands away from the engine pulleys, blower blades and electrical terminal block TB3 on the controller/inverter housing.***
           - *If there is approximately 16.3 VAC across J14 and J15*, replace the battery charger.
           - *If there is no voltage*, disconnect J12 and J13.
             - *If there is approximately 120 VAC across AC HARNESS connectors J12 and J13*, replace the transformer.
             - *If there is no voltage,* replace the AC wiring harness.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

THE ENGINE CRANKS BUT DOES NOT START

(Fuel delivery, pre-heat, cranking speed or the engine are in marginal condition)

Corrective Action:

1. Check the fuel level and refill if necessary.
2. Prime the engine fuel system.
3. Check for fuel leaks and proper fuel line connections, especially at the skid-base and fuel filter.
4. Conduct a fuel flow test and service as necessary.
5. Check the engine air filter and remove any blockage.
6. Replace **Fuse F3** (glow plugs) if blown. If the fuse blows again, remove the top housing panel.
    - If loose, reconnect engine harness spade connector HR-1 to the glow plug bus bar at the front of the engine.
    - Disconnect HR-1 from the glow plug bus bar and A1-J8 from the controller/inverter assembly. Check for continuity (ground short) between either connector and ground. Replace the engine harness if there is a ground short.
7. Remove the front and top housing panels.
    - If loose, reconnect engine harness connectors A1-J7 and A1-J8 to the leads from the controller/inverter assembly, spade connector HR-1 to the glow plug bus bar at the front of the engine, and the engine harness ground connections to the flywheel housing.
    - Remove the glow plug bus bar along side the engine valve cover and check for electrical continuity between each glow plug terminal and ground. Replace all three glow plugs if any glow plug is open.

      Note: If a glow plug does not come out after unscrewing it, or the end has broken off, it will be necessary to remove the engine head. Glow plugs can swell if preheat voltage is greater than 14 volts, such as when a battery booster is used for starting.
8. Remove the front and top housing panels, disconnect the PMA stator leads and listen to cranking speed while trying to start. If cranking speed is considerably higher when the PMA is not connected, replace the controller/Inverter assembly as internal components have probably shorted.
9. Service the engine.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

THE STARTER ENGAGES AND DISENGAGES

(Cranking voltage dips below 6 volts because of low battery charge, poor connections or long cables)

Corrective Action:

1. Have the vehicle propulsion engine running while trying to start the genset. Its battery charger may be able to maintain starting voltage high enough to get the genset started.
2. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
3. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
4. Relocate the starting batteries to reduce cable length (resistance).

THERE IS NO POWER WHEN THE GENSET IS RUNNING—THE RUN LIGHT IS ON

(A line circuit breaker is either “OFF” or has tripped or the genset has faulty wiring)

Corrective Action:

1. Reset the line circuit breaker on the genset operator’s console.
2. Reset the line circuit breakers on the main distribution panel in the vehicle.
3. Check the voltage at genset AC output terminal block TB2.
   - *If there is approximately 120 VAC across TB2-1 and TB2-3 and across TB2-2 and TB2-4,* repair or reconnect the wiring between the genset and the main vehicle distribution panel.
   - *If there is no voltage,* remove the front housing panel and check connections at TB3 and at the line circuit breakers.
     - *If the connections are loose*, clean and tighten as necessary.
     - *If the connections are good, r*eset the circuit breakers and check electrical continuity across the terminals.
       - *If there is no continuity,* replace the circuit breakers.
       - *If there is continuity,* prepare to run the genset and measure voltages. *The genset can be run for only a short time before shutdown with the housing panel removed.*

         ⚠WARNING ***This test involves operating the genset without the housing panels secured in place. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. Keep your hands away from the engine pulleys, blower blades and electrical terminal block TB3 on the controller/inverter housing.***

         - *If there is approximately 120 VAC across TB3-1 and TB3-2*, replace the AC wiring harness.
         - *If there is no voltage,* replace the controller/inverter assembly.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

THE GENSET WILL NOT STOP RUNNING—THE RUN LIGHT IS OFF

(The governor mechanism binds or is misadjusted)

Corrective Action:

1. Remove the front and top housing panels. Check the fuel rack return spring and replace it if it is worn or broken. Make sure it is reassembled correctly.
2. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand—against the action of the fuel rack return spring. It should rotate smoothly about 1/2 inch (12 mm) and return smoothly. If it binds or catches, remove the governor actuator base assembly and, as necessary, replace the actuator base assembly or service the internal engine governor mechanism.
3. Readjust the actuator speed control lever stop.

HIGH TEMPERATURE—FAULT CODE NO. 1

(The temperature of the engine coolant or of the electronics heat sink exceeded the design limit)

Corrective Action: Check the second-level fault code by momentarily pressing Stop. The second-level fault will be either No. **33** or No. **34**.

LOW OIL PRESSURE—FAULT CODE NO. 2

(The low oil pressure cutoff switch did not close)

Corrective Action:

1. Check the engine oil level and add oil as necessary.
2. Drain the excess oil if the oil level is above the Full mark on the dipstick.
3. Remove the top housing panel. Reconnect engine harness spade terminal connector S2 to the low oil pressure cutout switch if it is loose.
4. Pull engine harness plug P2 from the controller/inverter assembly. Check for electrical continuity between pin P2-9 and connector S2. Replace the engine harness if there is no continuity.
5. Replace the low oil pressure cutoff switch.
6. Service the engine.

SERVICE CHECK—FAULT CODE NO. 3

(A second-level fault occurred)

Corrective Action: Check the second-level fault code by momentarily pressing Stop. The second-level fault will be one of the following in this table.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

OVERCURRENT—FAULT CODE NO. 11

(An AC output short occurred)

Corrective Action: Turn the line circuit breaker on the operator's console "Off".

- *If the genset no longer shuts down*, the genset is probably okay: check for and repair a short circuit in the vehicle appliances or wiring.
- *If the genset continues to shut down*, remove the front and top housing panels and disconnect the AC harness from TB3 on the controller/inverter assembly. Prepare to run the genset and measure voltages. *The genset can be run for only a short time before shutdown with the housing panel removed.*

  ⚠WARNING ***This test involves operating the genset without the housing panels secured in place. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. Keep your hands away from the engine pulleys, blower blades and electrical terminal block TB3 on the controller/inverter housing.***

  - *If there is not approximately 120 VAC across TB3-1 and TB3-2,* replace the controller/inverter assembly.
  - *If there is voltage,* reconnect the line circuit breaker and output terminal block TB2 if misconnected. Test for a short across the AC harness leads TB3-1 and TB3-2 and replace the AC harness if shorted.

INVERTER OVERVOLTAGE—FAULT CODE NO. 12

(The controller is not able to regulate to rated voltage)

Corrective Action: Replace the controller/inverter assembly.

INVERTER UNDERVOLTAGE—FAULT CODE NO. 13

(The controller is not able to regulate to rated voltage)

Corrective Action: Turn the line circuit breaker on the operator's console "Off".

- *If the genset continues to run*, run the genset with fewer connected loads.
- *If the genset continues to shut down*, replace the controller/inverter assembly.

INVERTER OVERFREQUENCY—FAULT CODE NO. 14

(The controller is not able to regulate to rated frequency)

Corrective Action: Replace the controller/inverter assembly.

INVERTER UNDERFREQUENCY—FAULT CODE NO. 15

(The controller is not able to regulate to rated frequency)

Corrective Action: Replace the controller/inverter assembly.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

HAS NOT BEEN ASSIGNED—FAULT CODE NO. 16

(Has not been assigned)

FUEL PUMP FAULT—FAULT CODE NO. 17

(The controller senses an open circuit)

Corrective Action:

1. Reconnect the two fuel pump leads to the engine wiring harness if they are loose. They are accessible through the access door in the skid-base, and also through an access door in the front panel on some models.
2. Disconnect the fuel pump leads from the engine wiring harness and connect the white fuel pump lead to the positive (**+**) terminal of a 12 volt battery and the black lead to the negative (**–**) terminal. Replace the pump if there is no audible sound or vibration.
3. Remove the front and top housing panels and disconnect engine harness connector P1 from the controller/inverter assembly. Check for electrical continuity between pin P1-2 and connector E2-1 and between E2-2 and ground. Replace the engine harness if there is no electrical continuity in either leg.
4. Push connector P1 on and off several times to wipe the pins clean. If that does not work, replace the controller/inverter assembly.

GLOW PLUG CIRCUIT PROTECTION FAULT—FAULT CODE NO. 18

(The controller senses a short circuit)

Corrective Action:

1. Remove the top housing panel and reconnect engine harness spade connector HR-1 at the glow plug bus bar at the front of the engine if it is loose.
2. Disconnect engine harness connector HR-1 at the glow plug bus bar and A1-J8 at the controller/inverter assembly. Check for continuity between either connector and ground. Replace the engine harness if there is electrical continuity to ground.
3. Replace the controller/inverter assembly.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

GOVERNOR ACTUATOR FAULT—FAULT CODE NO. 19

(The controller senses an open or short circuit)

Corrective Action:

1. Remove the front housing panel and reconnect the engine wiring harness connectors E1-1 and E1-2 to the governor actuator if they are loose. Polarity does not matter.
2. Check for electrical continuity between the two actuator coil terminals. Coil resistance should be 2.5 to 3 ohms. Replace the actuator stator if the coil is open or shows a low resistance.
3. Disconnect engine harness connector P1 from the controller/inverter housing. Check for electrical continuity between pin P1-1 and quick-connect E1-1 and between E1-2 and ground. Replace the engine harness if there is no electrical continuity in either leg.
4. Push connector P1 on and off several times to wipe the pins clean. If that does not work, replace the controller/inverter assembly.

STARTER SOLENOID CIRCUIT PROTECTION FAULT—FAULT CODE NO. 21

(The controller senses a short circuit)

Corrective Action:

1. Open the maintenance access door and reconnect engine harness quick connector K-1 to the starter motor solenoid if it is loose.
2. Disconnect engine harness connector K-1 from the starter solenoid and connect battery positive (**+**) by means of a switch and jumper to energize the solenoid. If the starter does not crank the engine when the solenoid is energized, remove the starter motor assembly and replace the starter motor assembly or solenoid, as required.
3. Remove the top housing panel and reconnect engine harness connector A1-J6 at the controller/inverter assembly if it is loose.
4. Disconnect engine harness connector A1-J6 at the controller/inverter assembly and connector K1 at the starter solenoid and check for continuity to ground from either connector. Replace the engine harness if there is continuity to ground.
5. Replace the controller/inverter assembly.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

GOVERNOR ACTUATOR OVERLOAD—FAULT CODE NO. 22

(The duration of operation at or near full duty cycle is beyond design limits)

Corrective Action:

1. Reduce the number of appliances running at the same time.
2. Replace the engine air filter and clean the spark-arrest muffler.
3. Check for air leaks in the fuel supply line—up to and including the connection at the fuel pump.
4. Conduct a fuel flow test and service as necessary.
5. Remove the front and top housing panels. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand—against the action of the fuel rack return spring. It should rotate smoothly about 1/2 inch (12 mm) and return smoothly. If it binds or catches, remove the governor actuator base assembly and, as necessary, replace the actuator base assembly or service the internal engine governor mechanism.
6. Readjust high-idle speed.
7. Service the fuel injectors and injection pump as necessary.
8. Check fuel injection timing.
9. Service a worn engine.

LOW OIL PRESSURE CUTOFF SWITCH FAULT—FAULT CODE NO. 23

(The controller senses that the switch is still closed 5 minutes after stopping the genset)

Corrective Action:

1. Remove the top housing panel. If loose (it may be touching ground), reconnect engine harness spade terminal connector S2 to the low oil pressure cutoff switch.
2. Replace the low oil pressure cutoff switch.

COOLANT TEMPERATURE SENDER FAULT—FAULT CODE NO. 24

(The controller does not sense a change in temperature during the first 5 minutes of operation)

Corrective Action:

1. Remove the top housing panel. If loose (it may be open or touching ground), reconnect engine harness spade terminal connector E3-1 to the coolant temperature sender.
2. Pull engine harness plug P1 from the controller/inverter assembly. Check for electrical continuity between pin P1-12 and connector E3-1. Replace the engine wiring harness if there is no continuity.
3. Replace the coolant temperature sender.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

ENGINE ABOVE SPEED TARGET—FAULT CODE NO. 25

(The governor is unable to regulate to the target speed)

Corrective Action:

1. Remove the front and top housing panels. Check the fuel rack return spring and replace it if it is worn or broken. Make sure it is reassembled correctly.
2. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand—against the action of the fuel rack return spring. It should rotate smoothly about 1/2 inch (12 mm) and return smoothly. If it binds or catches, remove the governor actuator base assembly and, as necessary, replace the actuator base assembly or service the internal engine governor mechanism.
3. Readjust high-idle speed.

ENGINE BELOW SPEED TARGET—FAULT CODE NO. 26

(The governor is unable to regulate to the target speed)

Corrective Action:

1. Reduce the number of appliances running at the same time.
2. Prime the engine fuel system.
3. Replace the engine air filter and clean the spark-arrest muffler.
4. Check for air leaks in the fuel supply line—up to and including the connection at the fuel pump.
5. Conduct a fuel flow test and service as necessary.
6. Connect a source of known fuel quality, prime the fuel system and run the genset. If performance improves, replace the bad fuel in the supply tank.
7. Remove the front and top housing panels. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand—against the action of the fuel rack return spring. It should rotate smoothly about 1/2 inch (12 mm) and return smoothly. If it binds or catches, remove the governor actuator base assembly and, as necessary, replace the actuator base assembly or service the internal engine governor mechanism.
8. Readjust high-idle speed.
9. Service the fuel injectors and injection pump as necessary.
10. Check fuel injection timing.
11. Service a worn engine.

PMA SENSE LOST—FAULT CODE NO. 27

(The controller is unable to sense the required parameter)

Corrective Action: Replace the Controller/Inverter assembly.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

DC SENSE LOST—FAULT CODE NO. 28

(The controller is unable to sense the required parameter)

Corrective Action: Replace the Controller/Inverter assembly.

HIGH BATTERY VOLTAGE—FAULT CODE NO. 29

(The voltage across the battery system is greater than 19 volts)

Corrective Action:

1. Check battery bank connections and reconnect if necessary so that the 12 volt batteries serving the genset are connected in parallel (12 volt) rather than in series (24 volt).
2. Select a lower battery booster charge rate.

OVERSPEED—FAULT CODE NO. 31

(PMA voltage indicates that speed is greater than 3600 rpm)

Corrective Action:

1. Remove the front and top housing panels. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand—against the action of the fuel rack return spring. It should rotate smoothly about 1/2 inch (12 mm) and return smoothly. If it binds or catches, remove the governor actuator base assembly and, as necessary, replace the actuator base assembly or service the internal engine governor mechanism.
2. Readjust high-idle speed.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

LOW CRANKING SPEED—FAULT CODE NO. 32

(PMA voltage indicated that cranking speed was less than target)

Corrective Action:

1. Replace **Fuse F2** (starter solenoid) if blown. If the fuse blows again:
   - Open the maintenance access door and reconnect engine harness quick connector K-1 to the starter motor solenoid if it is loose.
   - Remove the top housing panel. Disconnect engine harness connector A1-J6 at the controller/inverter assembly and connector K1 at the starter solenoid and check for continuity (short) to ground from either connector. Replace the engine harness if there is a short.
2. Open the maintenance access door and reconnect engine harness quick connector K-1 to the starter motor solenoid if it is loose.
3. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
4. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
5. Change the engine oil, if necessary, to oil having the proper viscosity for the ambient temperature. (High oil viscosity can slow cranking speed.)
6. Open the maintenance access door and disconnect engine harness connector K-1 from the starter solenoid. Connect battery positive (**+**) by means of a switch and jumper to energize the solenoid. If the starter does not crank the engine when the solenoid is energized, remove the starter motor assembly and replace the starter motor assembly or solenoid, as necessary.
7. Remove the front and top housing panels, disconnect the PMA stator leads and listen to cranking speed while trying to start. If cranking speed is considerably higher when the PMA is not connected, replace the controller/Inverter assembly as internal components are probably shorted.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

HIGH ENGINE COOLANT TEMPERATURE—FAULT CODE NO. 33

(The engine coolant temperature exceeded design limits)

Corrective Action:

1. Check the engine coolant level and add coolant as necessary. Repair coolant leaks if it is necessary.
2. Check for and remove any objects blocking the air inlet or outlet openings in the bottom of the genset.
3. Look for a broken or worn coolant pump drive belt (visible through the maintenance access door in the skid-base). Replace the belt if it is necessary.
4. Remove the air intake grille in the skid-base and check to see that the cooling blower is secure and that the blades are not fouled.
5. Check for air leaks in the housing—missing or loose housing panels and access covers, including the access covers for the fuses and AC terminals.
6. Reduce the number of appliances connected at the same time. (Note that high altitude and high ambient temperature decrease engine cooling capacity.)
7. Clean and flush the cooling system to remove coolant passage fouling.
8. Remove the top housing panel. If loose, reconnect engine harness spade terminal connector E3-1 to the coolant temperature sender.
9. While the top housing panel is off (Step 8), check for fouling of the radiator air passages and clear out dust and debris with compressed air directed from below (reverse of normal air flow).
10. Replace the coolant thermostat.

HIGH INVERTER TEMPERATURE—FAULT CODE NO. 34

(The inverter temperature exceeded design limits)

Corrective Action:

1. Check for and remove any objects blocking the air inlet or outlet openings in the bottom of the genset.
2. Remove the air intake grille in the skid-base and clean the heat sink fins if they are fouled. Also check to see that the cooling blower is secure and that the blades are not fouled.
3. Reduce the number of appliances connected at the same time. (Note that high altitude and high ambient temperature decrease cooling capacity.)
4. Replace the controller/inverter assembly if the genset cannot carry rated load.

CONTROL CARD FAILURE—FAULT CODE NO. 35

(There was a memory error in the microprocessor during self test)

Corrective Action: Replace the Controller/Inverter assembly.

7.5/8.0 QD TROUBLESHOOTING TABLE (CONT.)

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

ENGINE STOPPED—FAULT CODE NO. 36

(The engine stopped without a command from the controller)

Corrective Action:

1. Check the fuel level and refill as necessary. Prime the engine fuel system if the genset ran out of fuel.
2. Check for fuel leaks and proper fuel line connections, especially at the skid-base and fuel filter.
3. Check the engine air filter and remove any blockage.
4. Check for mechanical damage.
5. Service the fuel pump.
6. Service the engine.

INVALID SET CONFIGURATION—FAULT CODE NO. 37

(The set configuration must be programmed for each replacement controller/inverter assembly)

Corrective Action: Reconfigure the genset controller. Special software and a PC are required. Call your distributor.

OVERLOAD—FAULT CODE NO. 38

(Too many loads were connected)

Corrective Action: Reduce the number of appliances running at the same time.

LOW BATTERY VOLTAGE—FAULT CODE NO. 39

(The battery voltage dropped to less than 9 volts while the genset was running)

Corrective Action:

1. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
2. Avoid running the genset while cranking the vehicle engine in installations where the genset batteries are used to supplement the vehicle engine batteries.

10/12.5 QD TROUBLESHOOTING TABLE

TROUBLESHOOTING tabulates the Fault Shutdown Codes in numerical order along with step-by-step instructions for corrective action. First, however, note the following:

- Most shutdowns can be prevented by proper maintenance and use: by maintaining oil and coolant levels, keeping battery connections clean and tight, watching the fuel gauge, and not overloading the genset.
- When the genset and vehicle engine share a common fuel tank the fuel dip tubes are usually arranged so that the genset will run out of fuel first. Marking the genset empty point on the fuel gauge will make it easier to tell when to stop the genset before running it out of fuel.

FAULT SHUTDOWN CODES

The genset controller provides extensive diagnostics by causing the status indicator light on the Control Switch to blink in a coded fashion. Following a fault shutdown, the indicator light will blink repeatedly: 1, 2 or 3 blinks at a time.

- One blink is code for shut down due to high temperature
- Two blinks is code for shutdown due to a loss of engine oil pressure
- Three blinks is code for shutdown due to some other abnormal condition.

For a ***3-blink*** fault code, momentarily press **Stop** to bring up a second-level fault code. This code consists of 1 to 4 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the fault code number. For example, < blink-blink—*pause*—blink-blink-blink >, is Fault Code **No. 23**.

The fault displayed will be the last fault logged, even though the condition has been corrected and the genset is running normally.

The fault code stops blinking after five minutes but can be restored by momentarily pressing **Stop**.

The code numbers that have been skipped over are not active for this series of gensets.

BYPASSABLE FAULTS

When a fault condition persists, the genset controller will drive towards shutdown when an attempt is made to restart the genset. There are two faults, however, which the genset controller will bypass on a *second* attempt to restart the genset. These are:

- **No. 23**—oil pressure switch fault
- **No. 24**—temperature sender fault.

Before making the second attempt at starting the genset, however, note that bypassing an oil pressure switch fault or temperature sender fault could lead to serious engine damage if the oil pressure fails or the engine overheats.

⚠CAUTION ***Operating the genset under oil pressure switch or temperature sender fault conditions can lead to serious engine damage. Read the Warranty regarding possible exclusions when operating the genset under such conditions.***

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

THE STATUS INDICATOR LIGHT IS DEAD

(There is no response to the control switch)

Corrective Action:

1. Try starting the genset at the operator's console if it does not start at the remote panel, and vice versa.
    - *If the Control Switch at the genset works*, repair the remote control circuit as required.
    - *If the remote Control Switch works*, remove the front maintenance access door and check for proper connections at Control Switch **S1**. If it still does not work, remove the top housing panel and disconnect connector **P1/J1** (gray, outboard) from Controller **A1**. Check for electrical continuity between pin **P1-3** (start) and pin **P1-5** (ground) while holding Control Switch **S1** in its Start position, and between **P1-4** (stop) and **P1-5** (ground) while holding it in its Stop position.
        - *If there is no electrical continuity*, replace Control Switch **S1** or the wiring harness, as required.
        - *If there is electrical continuity,* check for corroded or damaged pins in connector **P1/J1** and repair as necessary. If that does not work, replace Controller **A1**.
2. Check whether fuse **F1** is blown. If it is, first check the battery connections for proper polarity: battery positive (**BT1+**) to genset positive (**TB1+**) and battery negative (**BT1–**) to genset negative (**TB1–**). If necessary, reconnect the battery cables properly and replace the fuse. (The control circuit is designed so that the fuse will blow if battery polarity is wrong.)
3. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
4. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
5. Remove the top housing panel or the radiator access cover and disconnect connector **P2/J2** (black, inboard) from Controller **A1**. Check for B**+** (12 VDC) at pin **P2-2** and continuity to ground at pin **P2-3**.
    - *If there is voltage and ground continuity,* check for corroded or damaged pins in connector **P2/J2** and repair as necessary. If that does not work, replace Controller **A1**.
    - *If there is no voltage or ground continuity*:
        - Recheck fuse **F1** and replace if blown.
        - Check that all engine and battery harness wires are properly connected to the grounding bolt on the flywheel housing, to the **B+** (**BATT**) terminal on the starter solenoid and to battery terminal block **TB1**. Clean and tighten connections as necessary. If that does not work, replace the appropriate wiring harness.

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

(The battery, battery connections or charging system are in marginal condition)

Corrective Action:

1. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
3. The genset has a feature whereby genset battery charging alternator **G1** can be disabled, via relay **K1** by connecting remote connector pin **P8-D** to **B+** (12 VDC). Review the installation to determine whether or under which conditions the alternator should be disabled.
4. Service the battery charging system in the vehicle or on the propulsion engine if either is depended upon to recharge the genset starting battery.
5. Remove the top housing panel and check for electrical continuity between charging alternator **G1** and starter solenoid terminal **B+** (**BATT**) and repair as necessary.
6. Check for electrical continuity across terminals **30** and **87** (NC) on relay **K1**. Replace the relay if there is no electrical continuity.
7. Check for electrical continuity between terminal **VR** on alternator **G1** and terminal **87a** on **K1** and between terminal **30** on **K1** and pin **J2-11** on the black, inboard connector on Controller **A1**. Repair as necessary.
8. Replace battery charging alternator **G1**.

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

THE ENGINE CRANKS BUT DOES NOT START

(Fuel delivery, glow plugs or engine are marginal)

Corrective Action:

1. Check the fuel level and refill as necessary.
2. Prime the engine fuel system by holding the Control Switch (**S1**) at **Stop** for one minute.
3. Check the engine air filter and remove any blockage.
4. Check for fuel (air) leaks at all fuel fittings and tighten as necessary.
5. Replace the fuel filter.
6. Conduct a fuel flow test and service as necessary.
7. Remove the top housing panel.
   - If loose, reconnect the engine harness lead to the glow plug bus bar (**HR1**) along side the engine valve cover and the engine harness ground connections to the flywheel housing.
   - Remove the glow plug bus bar and check for electrical continuity between each glow plug terminal and ground. Replace all three glow plugs if any glow plug is open.

   Note: If a glow plug does not come out after unscrewing it, or the end has broken off, it will be necessary to remove the engine head. Glow plugs can swell if preheat voltage is greater than 14 volts, such as when a battery booster is used for starting.
8. Service the engine.

THE STARTER ENGAGES AND DISENGAGES

(Cranking voltage dips below 6 volts because of low battery charge or poor connections)

Corrective Action:

1. Have the vehicle propulsion engine running while trying to start the genset. (The battery charging alternator may be able to maintain starting voltage high enough to get the genset started.)
2. Clean and tighten the positive (**+**) and negative (**–**) battery cable connections at the battery and at the genset.
3. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
4. Relocate the starting batteries to reduce the cable length (resistance).

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

THERE IS NO POWER WHEN THE GENSET IS RUNNING

(A line circuit breaker is OFF, tripped or malfunctioning)

Corrective Action:

1. Reset or turn ON the line circuit breaker(**CB1**, **CB2**) on the genset.
2. Reset or turn ON any other circuit breaker in the power supply system.
3. Check the voltage at genset AC output terminal block **TB2** when the genset is running.
    - *If there is approximately 120 VAC across **TB2-1** and **TB2-3** and across **TB2-2** and **TB2-3**,* repair or reconnect the wiring between the genset and the main vehicle distribution panel.
    - *If there is no voltage,* remove the top housing panel.
        - Check for proper ***AC*** connections at **TB2**, at the line circuit breakers (**CB1**, **CB2**) and the ground bolt on the engine block. Reconnect wiring as necessary according to the wiring schematic and tighten all terminal screws and nuts.
        - Check for electrical continuity across the terminals of each circuit breaker (**CB1**, **CB2**). Replace a circuit breaker that does not close when turned “ON”.

THE GENSET WILL NOT STOP RUNNING (THE RUN LIGHT IS OFF)

(The governor mechanism is stuck or binding)

Corrective Action: Service the engine governor according to the Engine Workshop Manual.

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

HIGH TEMPERATURE FAULT—CODE NO. 1

(The engine coolant temperature exceeded 230° F [110° C])

Corrective Action:

1. Check the engine coolant level and add coolant as necessary.
2. Check for and remove any objects blocking the air inlet or outlet openings in the bottom of the genset and cleanout dirt fouling the radiator passages.
3. Watch the temperature gauge (optional) and run fewer appliances at the same time to keep down the engine temperature. (Note that high altitude and high ambient temperature decrease engine cooling capacity.)
4. Look for a loose or broken fan belt and readjust or replace as necessary.
5. Check for air leaks in the housing—missing or loose housing panels and access covers, including the access covers for the fuses and AC terminals.
6. Clean and flush the cooling system to remove coolant passage fouling.
7. Remove the top housing panel. Reconnect the lead to the coolant temperature sender if loose. (Controller **A1** interprets a loose lead touching ground as high temperature.)
8. Replace the coolant thermostat.
9. Replace temperature sender **E3**.

LOW OIL PRESSURE FAULT—CODE NO. 2

(The low oil pressure cutoff switch closed for more than 10 seconds)

Corrective Action:

1. Check the engine oil level and add oil as necessary.
2. Drain the excess oil if the oil level is above the Full mark on the dipstick. (The oil will foam if the level is too high and result in a possible loss of oil pressure.)
3. Remove the top housing panel and, if loose, reconnect the lead to low oil pressure cutout switch **S2**.
4. Replace low oil pressure cutoff switch **S2**.
5. Service the engine.

SERVICE CHECK—CODE NO. 3

(A second-level fault occurred)

Corrective Action: Check the second-level fault code by momentarily pressing Stop. The second-level fault will be one of the following in this table.

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

OVERVOLTAGE FAULT—CODE NO. 12

(The Controller is not able to regulate to rated voltage)

Corrective Action: Replace Controller **A1**.

UNDERVOLTAGE FAULT—CODE NO. 13

(The Controller is not able to regulate to rated voltage)

Corrective Action:

1. Turn OFF the line circuit breaker on the operator’s console (**CB1**, **CB2**). If the genset now runs, run it with fewer connected loads.
2. Replace Controller **A1**.
3. Replace a shorted generator rotor.

OVERFREQUENCY FAULT—CODE NO. 14

(The Controller is not able to regulate to rated frequency)

Corrective Action:

1. Prime the engine fuel system by holding the Control Switch at **Stop** for one minute. (There may be air in the fuel system.)
2. Check for a tripped genset circuit breaker (**CB1**, **CB2**), reset it if necessary, and run with fewer connected loads.
3. Replace Controller **A1**.
4. Service the engine governor according to the Engine Workshop Manual.

UNDERFREQUENCY FAULT—CODE NO. 15

(The Controller is not able to regulate to rated frequency)

Corrective Action:

1. Turn OFF the line circuit breaker on the operator’s console (**CB1**, **CB2**). If the genset now runs, run it with fewer connected loads.
2. Prime the engine fuel system by holding the Control Switch at **Stop** for one minute. (There may be air in the fuel system.)
3. Replace Controller **A1**.
4. Service the engine governor according to the Engine Workshop Manual.

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

STARTER SOLENOID CIRCUIT PROTECTION FAULT—CODE NO. 21

(The Controller sensed a starter control circuit short)

Corrective Action:

1. Remove the top housing panel and, if loose, reconnect the lead to terminal **85** on starter motor pilot solenoid **K2**.
2. Replace relay **K2** if there is continuity to ground at terminal **85**.
3. Replace Controller **A1**.

GOVERNOR ACTUATOR OVERLOAD FAULT—CODE NO. 22

(The duration of operation at or near full-duty cycle was beyond the design limit)

Corrective Action:

1. Replace the engine air filter and clean the spark-arrest muffler.
2. Replace the fuel filter.
3. Check for fuel (air) leaks at all fuel fittings and tighten as necessary.
4. Conduct a fuel flow test and service as necessary.
5. Readjust high-idle speed.
6. Service the fuel injectors and injection pump as necessary.
7. Check fuel injection timing.
8. Replace the governor actuator.
9. Service the engine.

LOW OIL PRESSURE CUTOFF SWITCH FAULT—CODE NO. 23

(The Controller sensed a defective switch)

Corrective Action: Also see BYPASSABLE FAULTS.

1. Remove the top housing panel and, if loose, reconnect the lead to low oil pressure cutout switch **S2**.
2. Replace the low oil pressure cutoff switch (**S2**).

COOLANT TEMPERATURE SENDER FAULT—CODE NO. 24

(The Controller sensed a defective sender)

Corrective Action: Also see BYPASSABLE FAULTS.

1. Remove the top housing panel and, if loose, reconnect the lead to coolant temperature sender **E3**.
2. Replace engine coolant temperature sender **E3**.

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

AC OUTPUT SENSE FAULT—CODE NO. 27

(The Controller was unable to sense the required parameter)

Corrective Action:

1. Disconnect Generator connector **J3/P3** and check for electrical continuity across pins **P3-1** and **P3-2**. Replace the generator stator assembly if the circuit is open.
2. Disconnect Controller connector **J2/P2** (black, inboard) and check for electrical continuity across leads **J3-1—P2-7** and **J3-2—P2-8**. Replace either lead if open.
3. Replace Controller **A1.**

QUADRATURE SENSE FAULT—CODE NO. 28

(The Controller was unable to sense the required parameter)

Corrective Action: Replace Controller **A1**.

HIGH BATTERY VOLTAGE FAULT—CODE NO. 29

(The Controller sensed battery system voltage greater than 19 volts)

Corrective Action:

1. Check battery bank connections and reconnect if necessary so that the 12 volt batteries serving the genset are connected in parallel (12 volt) rather than in series (24 volt).
2. Select a lower battery booster charge rate.

CONTROL CARD FAULT—CODE NO. 35

(There was a memory error in the microprocessor during self-test)

Corrective Action: Replace Controller **A1**.

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

ENGINE STOPPED FAULT—CODE NO. 36

(The genset stopped without a command from the Controller)

Corrective Action:

1. Check the fuel level and refill as necessary.
2. Prime the engine fuel system by holding the Control Switch at **Stop** for one minute.
3. Check the engine air filter and remove any blockage.
4. Check for mechanical damage.
5. Check for fuel (air) leaks at all fuel fittings and tighten as necessary.
6. Replace the fuel filter.
7. Conduct a fuel flow test and service as necessary.
8. Service the engine.

INVALID GENSET CONFIGURATION—CODE NO. 37

(There was a memory error in the microprocessor during self-test)

Corrective Action: Replace Controller **A1**).

10/12.5 QD TROUBLESHOOTING TABLE (CONT.)

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

FIELD OVERCURRENT—CODE NO. 38

(Too many low-power-factor-causing loads were connected)

Corrective Action:

1. Reduce the number of air conditioners running at the same time (and other appliances that cause low power factor).
2. Have the air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause very low power factor.)

SPEED SENSE LOST FAULT—CODE NO. 45

(The Controller failed to sense quadrature frequency during cranking)

Corrective Action if Engine Does Not Start:

1. Replace fuse **F2** if blown.
2. Remove the top housing panel and check for electrical continuity between terminal **SW** on the starter solenoid and terminal **87** on starter pilot relay **K2**, between terminal **30** on relay **K2** and fuse **F2** and between fuse **F2** and the **B+** (**BATT**) terminal on the starter solenoid. Repair as necessary.
3. Check for electrical continuity to ground at terminal **86** on relay **K2** and continuity between terminal **85** on relay **K2** and pin **J1-6** on the Controller connector (gray, outboard). Repair as necessary.
4. Energize relay **K2** with jumpers from a 12 volt battery. Replace the relay if the contacts across terminals **30** and **87** do not close.
5. Service or replace the starter motor assembly.
6. Replace Controller **A1**.

Corrective Action if Engine Does Start:

1. Disconnect Generator connector **J3/P3** and check for electrical continuity across pins **P3-7** and **P3-8** (field windings). If the circuit is open, service the generator brush block and slip rings and repeat the test. Service or replace the generator rotor if the circuit is still open.
2. Disconnect Generator connector **J3/P3** and check for electrical continuity across pins **P3-3** and **P3-6** (quadrature windings). Replace the generator stator assembly if the circuit is open.
3. Replace Controller **A1**.