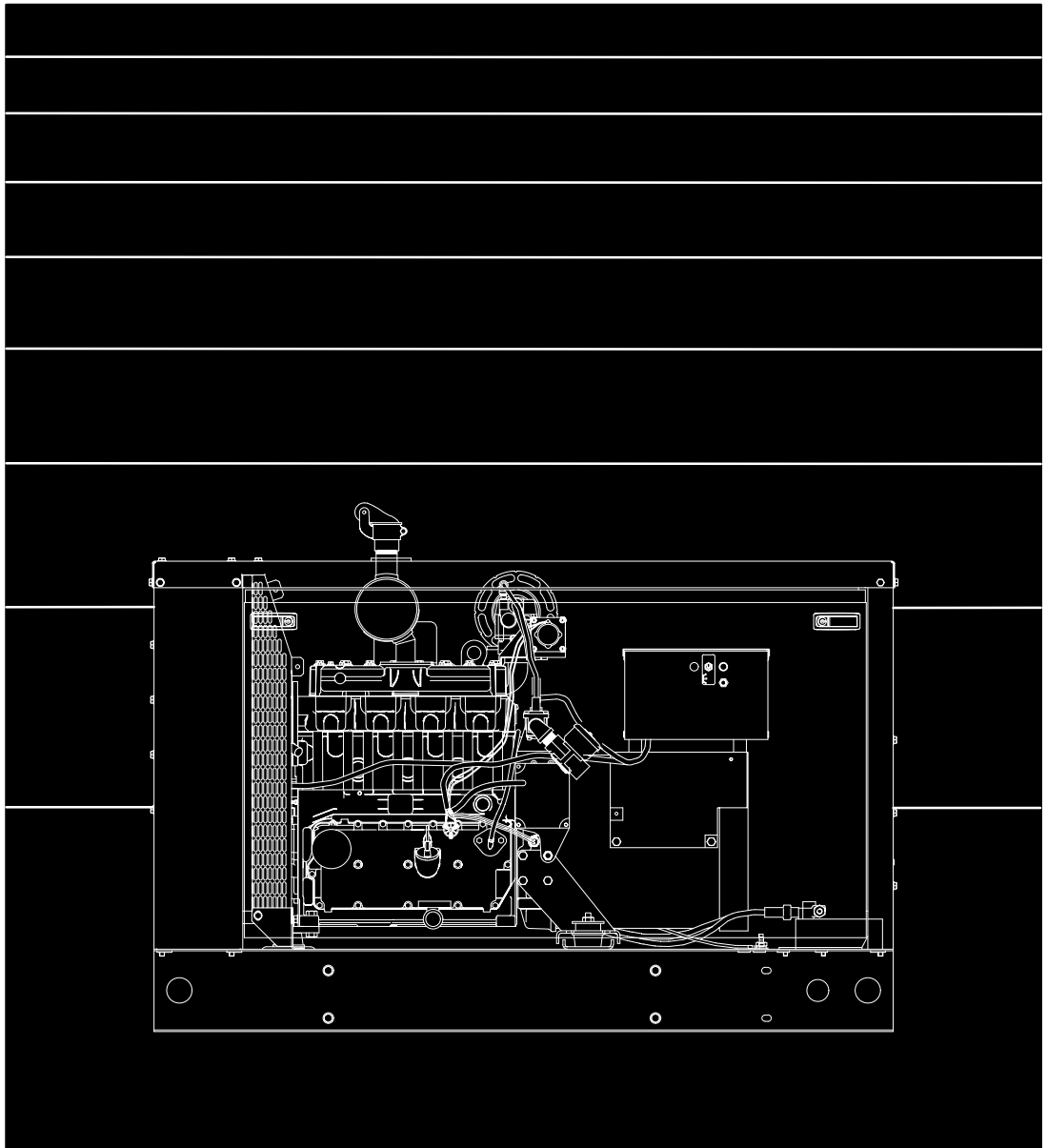


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Operator's Manual

GN SERIES GENERATOR SETS



Printed in U. S. A.

967-0110
10-97



WARNING:



The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

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Safety Precautions

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

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

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

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

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

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

GENERAL PRECAUTIONS

- Keep ABC fire extinguishers handy.
- Make sure all fasteners are secure and torqued properly.
- Keep the generator set and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray out and cause severe burns.
- Before working on the generator set, disconnect the negative (-) battery cable at the battery to prevent starting.
- Use caution when making adjustments while the generator set is running—hot, moving or electrically live parts can cause severe personal injury or death.

- Used engine oil has been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Do not work on the generator set when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.

GENERATOR VOLTAGE IS DEADLY!

- Generator output connections must be made by a qualified electrician in accordance with applicable codes.
- The generator set must not be connected to the public utility or any other source of electrical power. Connection could lead to electrocution of utility workers, damage to equipment and fire. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry and stand on a dry wooden platform on the ground or floor.

FUEL IS FLAMMABLE AND EXPLOSIVE

- Keep flames, cigarettes, sparks, pilot lights, electrical arc-producing equipment and switches and all other sources of ignition well away from areas where fuel fumes are present and areas sharing ventilation.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.
- Leaks can lead to explosive accumulations of gas. Natural gas rises when released and can accumulate under hoods and inside housings and buildings. LPG sinks when released and can accumulate inside housings, basements, sumps and other below-grade spaces. Prevent leaks and the accumulation of gas.
- Use approved non-conductive flexible fuel hose for fuel connections at the generator set.

ENGINE EXHAUST IS DEADLY!

- The exhaust system must be leak-free and convey all exhaust to the out-of-doors, away from buildings and building air vents, doors and windows. Look and listen for exhaust leaks daily and do not operate the generator set until all leaks have been fixed.
- Do not use engine exhaust or cooling air to heat a room or compartment.
- Make sure there is ample fresh air when operating the generator set.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.

- When disconnecting or reconnecting battery cables, always disconnect the negative (-) battery cable first and reconnect it last to reduce arcing.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

KEEP THIS MANUAL NEAR THE GENERATOR SET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

This manual provides general information for operating and maintaining your generator set. Study this manual carefully and observe all of its instructions and precautions. Safe operation and top performance can be obtained only when equipment is operated and maintained properly.

There are three sections covering OPERATION, one for each of three types of control system available. Tag the section that applies to your generator set.

HOW TO OBTAIN SERVICE

When the generator set requires servicing, contact your nearest dealer or distributor. Factory-trained Parts and Service representatives are ready to handle all your service needs.

If you are unable to locate a dealer or distributor, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS-ELECTRIC or
ELECTRICAL PRODUCTS

For the name of your local Cummins®/Onan® or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN (this automated service utilizes touch-tone phones only). By entering your area code and the first three digits of your local telephone number, you will receive the name and telephone number of the distributor nearest you.

Outside North America, call Onan Corporation (1-612-574-5000) between 7:30 AM and 4:00 PM Central Standard Time, Mondays through Fridays, or send a fax (1-612-574-8087).

When contacting your distributor, always supply the complete Model Number and Serial Number as shown on the generator set nameplate.

FUEL RECOMMENDATIONS

When **NG** (natural gas) is the fuel, use commercially available natural gas fuel having a methane content of at least 90 percent (by volume).

When **LPG** (liquefied petroleum gas) is the fuel, use grade HD-5 or equivalent consisting of at least 90

percent propane. Commercial LPG may contain more than 2.5 percent butane, which can result in poor fuel vaporization and poor engine starting in ambients below freezing.

⚠WARNING *Gaseous fuels are flammable and explosive and can cause severe personal injury or death. Do not smoke if you smell gas or are near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical switches, arc-producing equipment and all other sources of ignition well away. Keep a type ABC fire extinguisher handy.*

NFPA Standard No. 58 requires all persons handling LPG to be trained in proper handling and operating procedures.

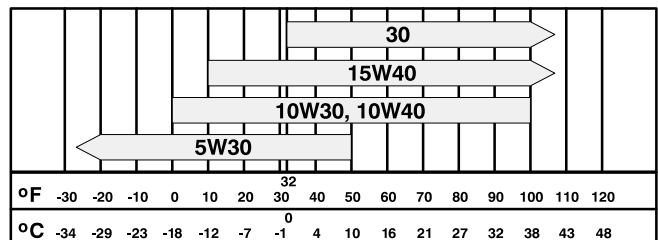
Satisfactory performance requires that the fuel gas be supplied at a pressure within the range indicated in *Specifications*.

⚠WARNING *High gas supply pressure can cause gas leaks which can lead to fire and severe personal injury or death. Gas supply pressure must be adjusted to Specifications by qualified personnel.*

ENGINE OIL RECOMMENDATIONS

Use premium quality motor oil. Look for the API (American Petroleum Institute) classification and use Class SG (SG/CD) or better oil. Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Chart 1-1, choose the viscosity grade appropriate for the range of ambient temperatures expected before the next scheduled oil change.

CHART 1-1. SAE VISCOSITY GRADE vs. AMBIENT TEMPERATURE



2. Specifications

| | MODEL | | |
|---|---|-------------------------------------|--------------------------------------|
| | GNAA | GNAB | GNAC |
| GENERATOR: Single-Bearing, 4-Pole Rotating Field, Brushless, Electronically Regulated | | | |
| 60 Hz LPG* Power Output Rating | 7.0 kW | 11.5 kW | 16.0 kW |
| 60 Hz NG* Power Output Rating | 6.0 kW | 10.0 kW | 14.0 kW |
| 50 Hz LPG* Power Output Rating | 6.5 kW | 9.0 kW | 12.5 kW |
| 50 Hz NG* Power Output Rating | 4.7 kW | 7.8 kW | 10.9 kW |
| FULL LOAD FUEL CONSUMPTION: | | | |
| 60 Hz LPG* | 45 cfh | 70 cfh | 87 cfh |
| 60 Hz NG* | 95 cfh | 144 cfh | 206 cfh |
| 50 Hz LPG* | 33 cfh | 50 cfh | 67 cfh |
| 50 Hz NG* | 75 cfh | 111 cfh | 157 cfh |
| ENGINE: Electronically Governed, 4-Stroke Cycle Spark-Ignited, Water Cooled | | | |
| Number of Cylinders | 2 | 3 | 4 |
| Bore | 86 mm (3.38 inch) | 86 mm (3.38 inch) | 86 mm (3.38 inch) |
| Stroke | 80 mm (3.15 inch) | 80 mm (3.15 inch) | 80 mm (3.15 inch) |
| Displacement | 0.93 liter (56.75 in ³) | 1.40 liter (85.13 in ³) | 1.86 liter (113.50 in ³) |
| Compression Ratio | 9.5:1 | 9.5:1 | 9.5:1 |
| Firing Order | 1-2 | 1-2-3 | 1-3-4-2 |
| Coolant Capacity | 6.4 liter (6.8 quart) | 7.1 liter (7.5 quart) | 7.6 liter (8.0 quart) |
| Engine Oil Capacity** | 3.4 liter (3.6 quart) | 4.5 liter (4.7 quart) | 5.6 liter (5.9 quart) |
| Ignition Timing—LPG* | 10° BTDC | | |
| Ignition Timing—NG* | 20° BTDC | | |
| Rotation | Clockwise (looking at radiator end) | | |
| Valve Lash | Hydraulic tappets | | |
| Spark Gap | 0.021 inch (0.53 mm) | | |
| Spark Plug Torque | 28 lb-ft (40 N-m) | | |
| Gas Supply Pressure—LPG* and NG* | 5.5-20 inch (30-508 mm) WC (Water Column) | | |
| Fuel Supply Connection | 3/4 inch NPT female | | |
| Maximum Exhaust Back Pressure | 15 inch (381 mm) WC (Water Column) | | |
| BATTERIES:*** | | | |
| Nominal Battery Voltage | 12 volts | | |
| Minimum CCA (Cold Cranking Amps) | 525 amps | | |
| Charging Alternator Output | 45 amps | | |
| INSTALLATION SPECIFICATIONS: | | | |
| See the appropriate Specification Bulletin and Outline Drawing for minimum cooling air flow; fuel, exhaust and electrical connection points; overall dimensions; weight; etc. | | | |
| * LPG (liquified petroleum gas), NG (natural gas) | | | |
| ** Includes Oil Filter | | | |
| *** A battery mounted in the built-in battery rack in the skid base must be of a type with barbed vent hose fittings for its cells. The vent lines must be routed away from the generator end bell (air inlet) to prevent battery gasses from entering the generator and causing corrosion. | | | |

3. Operation—Manual Control

⚠ WARNING *EXHAUST GAS IS DEADLY!*

All engine exhaust contains carbon monoxide, an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:

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

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

The exhaust system must be installed in accordance with the genset Installation Manual. Make sure there is ample fresh air when operating the genset in a confined area.

BREAK-IN

Drain and replace the crankcase oil after the first 50 hours of operation of the generator set. See *Periodic Maintenance* for recommended procedures.

EXERCISE PERIOD

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps provide reliable engine starting. Exercise the generator set at least once a week for a minimum of 30 minutes with load so that the engine reaches normal operating temperature.

NO-LOAD OPERATION

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine run-

ning for long periods of time when no electric output is required, best engine performance will be obtained by connecting “dummy” electrical loads, such as heater elements.

POWER RATING FACTORS

The generator set power ratings were established for the specified fuels at an altitude of 300 feet (92 m) in an ambient temperature of 77° F (25° C). For derating factors at other altitudes, ambient temperatures and fuels, contact your Onan/Cummins distributor.

VOLTAGE REGULATION

An electronic voltage regulator maintains AC output voltage at a preset level as the load varies. The voltage regulator is mounted inside the control box on top of the generator.

COLD WEATHER OPERATION

Change the engine oil if it is not of the viscosity recommended for the ambient temperature (Chart 1-1).

To prevent engine coolant from freezing, make sure it is a 50/50 mixture of anti-freeze and water.

Coolant heaters are available for easier starting in cold weather. Make sure the voltage of the separate power source is correct for the coolant heater element rating.

⚠ CAUTION *To avoid damage to the coolant heater, make sure the cooling system is full before applying power to the heater.*

PRESTART CHECKS

Perform any scheduled maintenance and check the following before starting the generator set.

Engine Oil

Check engine oil level. Keep the oil level as near as possible to the dipstick high mark without overfilling.

Engine Coolant

Check engine coolant level. The normal level of coolant in the radiator top tank for a cold engine is approximately 25 mm (1 inch) from the top. Add coolant if the level falls below this point. Use a 50/50 mixture of ethylene glycol and water.

⚠ WARNING *Hot coolant can cause severe burns. Let the engine cool down before removing the pressure cap.*

OPERATION

A Manual Control has an **OFF/RUN/START** switch on the control panel. See Figure 3-1. The control shuts down the genset under low oil pressure and

high engine temperature conditions. The fuse protects the control circuits from shorts to ground.

Starting

Push up and hold the control switch in the **START** position until the engine starts. Let go to disengage the starter. The genset should run up to governed speed and regulated voltage within a few seconds.

Whenever possible, it is recommended that the engine be allowed to warm up for a few minutes before connecting electrical loads.

See TROUBLESHOOTING in this section if the generator set does not start after a couple of tries or keeps shutting down.

⚠ CAUTION *Excessive cranking can overheat and damage the starter motor. Do not crank for more than 30 seconds at a time and wait at least 1 minute before trying again.*

Stopping

Push the control switch down to the **OFF** position. Whenever possible, it is recommended that the engine be allowed to cool down by running without load for a few minutes before stopping.

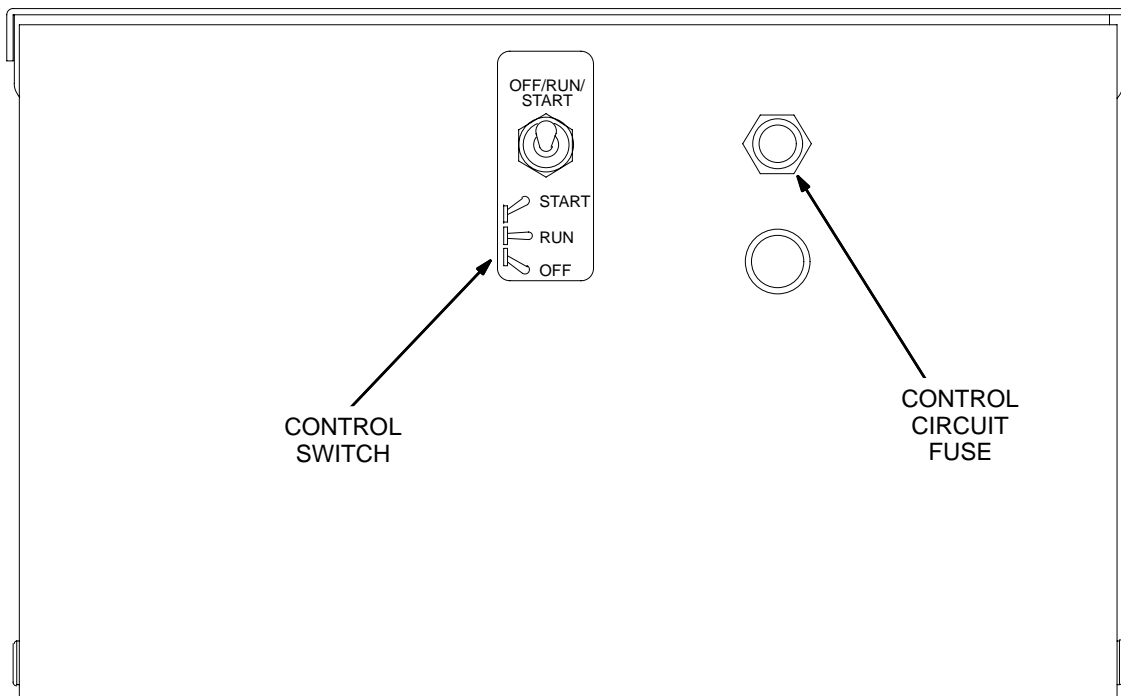


FIGURE 3-1. CONTROL PANEL

TROUBLESHOOTING

The following troubleshooting tables are designed to help you think through generator set problems. To save time troubleshooting, read the entire manual ahead of time to understand the generator set.

Try to think through problems. Go over what was done during the last service call. The problem could be as simple as an empty fuel tank, closed fuel shut-off valve, loose wire, blown fuse or tripped circuit breaker.

THE ENGINE DOES NOT CRANK

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|--|
| 1. The control panel fuse has blown. | Replace the fuse with one of the same type and amp rating (10 A). If the fuse blows again, look for a loose wire grounded to the block or frame and reconnect or replace it. |
| 2. Cranking voltage is too low to crank the engine. | <p>A. Clean and tighten or replace the positive (+) and negative (-) battery cable connectors and cables at the battery and the set.</p> <p>B. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C).</p> <p>C. If the set is in standby service, install a battery charger.</p> |

THE ENGINE CRANKS BUT DOES NOT START

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|--|
| 1. The engine is not getting fuel. | <p>A. Open any closed shutoff valve in the fuel supply system.</p> <p>B. Fill the LPG fuel supply tank if less than half full. <i>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 generator set demand. LPG with more than 2.5 percent butane will not vaporize in ambients below freezing. Use HD-5 grade LPG.</i></p> |
| 2. The spark plug cables and/or spark plugs are loose, fouled or damaged. | <p>A. Secure the spark plug cables at the spark plugs and at the ignition coil(s).</p> <p>B. Replace the spark plugs and/or cables.</p> |

THE ENGINE CRANKS BUT DOES NOT START(CONT.)

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|--|
| 3. The air cleaner or exhaust system is blocked. | Service as necessary. |
| 4. Low engine temperature is causing too low a cranking speed for starting. | A. Plug in, repair or install engine coolant and engine oil heaters. B. Replace the engine oil if it is not of the recommended viscosity for the ambient temperature. |
| 5. Cranking voltage is too low to reach required cranking speed. | A. Clean and tighten or replace the positive (+) and negative (-) battery cable connectors and cables at the battery and the set. B. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). |

THE ENGINE RUNS AND THEN SHUTS DOWN

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|-----------------------------|--|
| 1. Low engine oil pressure. | Check engine oil level, repair any leaks and fill to the proper level. |
| 2. High engine temperature. | A. Check engine coolant level, repair any leaks and fill to the proper level. B. Clean and service the cooling system as required to restore full cooling capacity. |

THE ENGINE LACKS POWER OR IS UNSTABLE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|--|
| 1. Fuel delivery to the set is inadequate. | A. Check for clogged fuel lines and filters. B. Fill the LPG fuel supply tank if less than half full. <i>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 generator set demand. LPG with more than 2.5 percent butane will not vaporize in ambients below freezing. Use HD-5 grade LPG.</i> |
| 2. The engine air filter element is dirty. | Replace the air filter element. |
| 3. The spark plug cables and/or spark plugs are loose, fouled or damaged. | A. Secure the spark plug cables at the spark plugs and at the ignition coil(s). B. Replace the spark plugs and/or cables. |
| 4. The exhaust system is partially blocked. | Service as necessary. |

NO OUTPUT VOLTAGE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|--|---|
| 1. A line circuit breaker is Off . | Find out why the circuit breaker was turned Off , make sure it is safe to reconnect power, and then throw the circuit breaker On . |
| 2. A line circuit breaker has Tripped . | Shut down the generator set and have service performed as necessary to clear the short circuit or ground fault that caused tripping. Then Reset the circuit breaker and start the set. |

4. Operation—Remote/ATS Control

⚠ WARNING EXHAUST GAS IS DEADLY!

All engine exhaust contains carbon monoxide, an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:

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

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

The exhaust system must be installed in accordance with the genset Installation Manual. Make sure there is ample fresh air when operating the genset in a confined area.

BREAK-IN

Drain and replace the crankcase oil after the first 50 hours of operation of the generator set. See *Periodic Maintenance* for recommended procedures.

EXERCISE PERIOD

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps provide reliable engine starting. Exercise the generator set at least once a week for a minimum of 30 minutes with load so that the engine reaches normal operating temperature.

NO-LOAD OPERATION

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting “dummy” electrical loads, such as heater elements.

POWER RATING FACTORS

The generator set power ratings were established for the specified fuels at an altitude of 300 feet (92 m) in an ambient temperature of 77° F (25° C). For derating factors at other altitudes, ambient temperatures and fuels, contact your Onan/Cummins distributor.

VOLTAGE REGULATION

An electronic voltage regulator maintains AC output voltage at a preset level as the load varies. The voltage regulator is mounted inside the control box on top of the generator.

COLD WEATHER OPERATION

Change the engine oil if it is not of the viscosity recommended for the ambient temperature (Chart 1-1).

To prevent engine coolant from freezing, make sure it is a 50/50 mixture of anti-freeze and water.

Coolant heaters are available for easier starting in cold weather. Make sure the voltage of the separate power source is correct for the coolant heater element rating.

⚠ CAUTION *To avoid damage to the coolant heater, make sure the cooling system is full before applying power to the heater.*

PRESTART CHECKS

Perform any scheduled maintenance and check the following before starting the generator set.

Engine Oil

Check engine oil level. Keep the oil level as near as possible to the dipstick high mark without overfilling.

Engine Coolant

Check engine coolant level. The normal level of coolant in the radiator top tank for a cold engine is approximately 25 mm (1 inch) from the top. Add coolant if the level falls below this point. Use a 50/50 mixture of ethylene glycol and water.

⚠️WARNING *Hot coolant can cause severe burns. Let the engine cool down before removing the pressure cap.*

OPERATION

A Remote/ATS Control has a **RUN/OFF/REMOTE** switch on the control panel for manual or remote, automatic control (Figure 4-1). The control automatically disengages the starter when the engine starts and it shuts down the genset under low oil pressure, high engine temperature and overcrank conditions. The circuit breaker on the control panel requires reset following a shutdown. The fuse protects the control circuits from shorts to ground.

Manual Starting

Push the control switch to **RUN**. The genset should start, disengage the starter and run up to governed speed and regulated voltage within a few seconds.

Whenever possible, it is recommended that the engine be allowed to warm up for a few minutes before connecting the electrical loads.

The engine will stop cranking in approximately 60 seconds if it has not started and the button on the circuit breaker on the control panel will pop out. Reset the control by first pushing the control switch to **OFF** and then resetting the circuit breaker on the panel by pushing in the button. See TROUBLESHOOTING in this section if the genset does not start or keeps shutting down.

Manual Stopping

Push the control switch to **OFF**. Whenever possible, it is recommended that the engine be allowed to cool down by running without load for a few minutes before stopping.

⚠️CAUTION *To restore automatic remote control of the genset, make sure to push the control switch to **REMOTE** before leaving the genset.*

Remote Automatic Starting and Stopping

Push the control switch to **REMOTE** for remote automatic control by a transfer switch or other kind of controller.

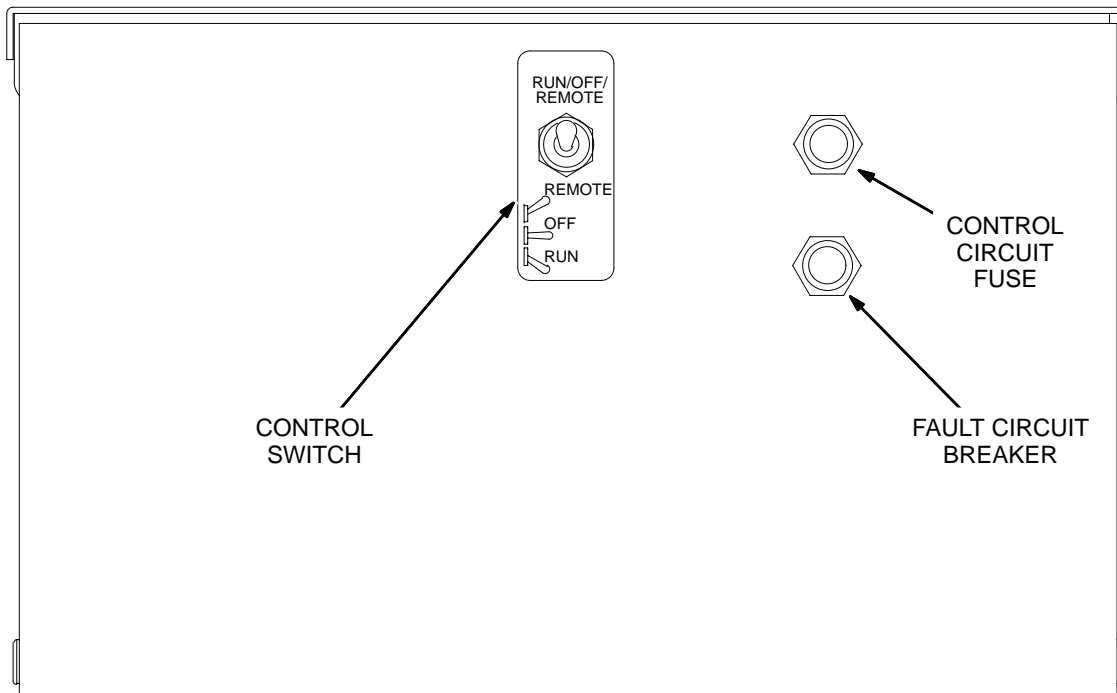


FIGURE 4-1. CONTROL PANEL

TROUBLESHOOTING

The following troubleshooting tables are designed to help you think through generator set problems. To save time troubleshooting, read the entire manual ahead of time to understand the generator set.

Try to think through problems. Go over what was done during the last service call. The problem could be as simple as an empty fuel tank, closed fuel shut-off valve, loose wire, blown fuse or tripped circuit breaker.

THE ENGINE DOES NOT CRANK IN RUN OR REMOTE MODE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|--|
| 1. The control panel fuse has blown. | Replace the fuse with one of the same type and amp rating (10 A). If the fuse blows again, look for a loose wire grounded to the block or frame and reconnect or replace it. |
| 2. A Fault Shutdown is being indicated by the fault circuit breaker reset button (extended out). | Service the set as necessary. To reset, push the control switch to Off and push in the reset button on the fault circuit breaker. |
| 3. Cranking voltage is too low to crank the engine. | <p>A. Clean and tighten or replace the positive (+) and negative (-) battery cable connectors and cables at the battery and the set.</p> <p>B. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C).</p> <p>C. If the set is in standby service, install a battery charger.</p> |

THE ENGINE CRANKS BUT DOES NOT START

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|---|
| 1. The engine is not getting fuel. | A. Open any closed shutoff valve in the fuel supply system. B. Fill the LPG fuel supply tank if less than half full. <i>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 generator set demand. LPG with more than 2.5 percent butane will not vaporize in ambients below freezing. Use HD-5 grade LPG.</i> |
| 2. The spark plug cables and/or spark plugs are loose, fouled or damaged. | A. Secure the spark plug cables at the spark plugs and at the ignition coil(s). B. Replace the spark plugs and/or cables. |
| 3. The air cleaner or exhaust system is blocked. | Service as necessary. |
| 4. Low engine temperature is causing too low a cranking speed for starting. | A. Plug in, repair or install engine coolant and engine oil heaters. B. Replace the engine oil if it is not of the recommended viscosity for the ambient temperature. |
| 5. Cranking voltage is too low to reach required cranking speed. | A. Clean and tighten or replace the positive (+) and negative (-) battery cable connections and cables at the battery and the set. B. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). |

THE ENGINE RUNS UNTIL FAULT SHUTDOWN

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|-----------------------------|--|
| 1. Low engine oil pressure. | Check engine oil level, repair any leaks and fill to the proper level. Push the control switch to Off and reset the fault circuit breaker. |
| 2. High engine temperature. | <p>A. Check engine coolant level, repair any leaks and fill to the proper level. Push the control switch to Off and reset the fault circuit breaker.</p> <p>B. Clean and service the cooling system as required to restore full cooling capacity.</p> |

THE ENGINE LACKS POWER OR IS UNSTABLE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|---|
| 1. Fuel delivery to the set is inadequate. | <p>A. Check for clogged fuel lines and filters.</p> <p>B. Fill the LPG fuel supply tank if less than half full. <i>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 generator set demand. LPG with more than 2.5 percent butane will not vaporize in ambients below freezing. Use HD-5 grade LPG.</i></p> |
| 2. The engine air filter element is dirty. | Replace the air filter element. |
| 3. The spark plug cables and/or spark plugs are loose, fouled or damaged. | <p>A. Secure the spark plug cables at the spark plugs and at the ignition coil(s).</p> <p>B. Replace the spark plugs and/or cables.</p> |
| 4. The exhaust system is partially blocked. | Service as necessary. |

NO OUTPUT VOLTAGE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|--|---|
| 1. A line circuit breaker is Off . | Find out why the circuit breaker was turned Off , make sure it is safe to reconnect power, and then throw the circuit breaker On . |
| 2. A line circuit breaker has Tripped . | Shut down the generator set and have service performed as necessary to clear the short circuit or ground fault that caused tripping. Then Reset the circuit breaker and start the set. |

5. Operation—Detector Control

⚠ WARNING EXHAUST GAS IS DEADLY!

All engine exhaust contains carbon monoxide, an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:

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

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

The exhaust system must be installed in accordance with the genset Installation Manual. Make sure there is ample fresh air when operating the genset in a confined area.

BREAK-IN

Drain and replace the crankcase oil after the first 50 hours of operation of the generator set. See *Periodic Maintenance* for recommended procedures.

EXERCISE PERIOD

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps provide reliable engine starting. Exercise the generator set at least once a week for a minimum of 30 minutes with load so that the engine reaches normal operating temperature.

NO-LOAD OPERATION

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine run-

ning for long periods of time when no electric output is required, best engine performance will be obtained by connecting “dummy” electrical loads, such as heater elements.

POWER RATING FACTORS

The generator set power ratings were established for the specified fuels at an altitude of 300 feet (92 m) in an ambient temperature of 77° F (25° C). For derating factors at other altitudes, ambient temperatures and fuels, contact your Onan/Cummins distributor.

VOLTAGE REGULATION

An electronic voltage regulator maintains AC output voltage at a preset level as the load varies. The voltage regulator is mounted inside the control box on top of the generator.

COLD WEATHER OPERATION

Change the engine oil if it is not of the viscosity recommended for the ambient temperature (Chart 1-1).

To prevent engine coolant from freezing, make sure it is a 50/50 mixture of anti-freeze and water.

Coolant heaters are available for easier starting in cold weather. Make sure the voltage of the separate power source is correct for the coolant heater element rating.

⚠ CAUTION *To avoid damage to the coolant heater, make sure the cooling system is full before applying power to the heater.*

PRESTART CHECKS

Perform any scheduled maintenance and check the following before starting the generator set.

Engine Oil

Check engine oil level. Keep the oil level as near as possible to the dipstick high mark without overfilling.

Engine Coolant

Check engine coolant level (liquid-cooled engines). The normal level of coolant in the radiator top tank for a cold engine is approximately 25 mm (1 inch) from the top. Add coolant if the level falls below this point. Use a 50/50 mixture of ethylene glycol and water.

⚠WARNING *Hot coolant can cause severe burns. Let the engine cool down before removing the pressure cap.*

OPERATION

Manual Starting

Push the control switch (Run/Stop/Remote) to **RUN** (Figure 5-1). The engine should crank, start and run up to governed speed and regulated voltage within a few seconds. The starter will disconnect automatically. The green run lamp will light indicating that the starter disconnected and that the generator set is running.

Whenever possible, it is recommended that the engine be allowed to warm up for a few minutes before connecting the electrical loads.

If the engine does not start, the starter will disengage and an Overcrank Fault will be indicated. A control having the standard 75-second cycle-cranking function will cycle up to 3 times, alternating 15-second periods of cranking with 15-second periods of rest. Continuous cranking is optional.

To clear an overcrank fault, push the control switch to **STOP** and the Reset switch to **RESET**. See TROUBLESHOOTING in this section.

Manual Stopping

Push the control switch to **STOP**. Whenever possible, it is recommended that the engine be allowed to cool down by running without load for a few minutes before stopping. The Detector Control has a stop time delay function which can be adjusted to suit (30 seconds to 30 minutes).

⚠CAUTION *To restore automatic remote control of the generator set, make sure to push the control switch to REMOTE before leaving the generator set.*

Remote Automatic Starting and Stopping

Push the control switch to **REMOTE** for remote, automatic control by a transfer switch or other kind of controller. The Detector Control has a start time delay function which can be adjusted to suit (0.5 to 15 seconds).

Emergency Stop (Optional)

Push the Emergency Stop switch in an emergency. To reset, pull the button out and push the control switch to **STOP** and the Reset switch to **RESET**.

CONTROL PANEL

The Detector control provides for manual and remote control. It has 12 indicator lights and provides shutdown and/or indication for various fault and pre-fault conditions. See Figure 5-1 and TROUBLESHOOTING.

Panel Lamp: Illuminates the control panel.

Oil Pressure Gauge: Indicates engine oil pressure.

Coolant Temperature Gauge: Indicates engine coolant temperature.

DC Voltmeter: Indicates battery voltage.

Control Switch (Run/Stop/Remote): *Run* and *Stop* run and stop the set locally and *Remote* allows operation by a remote controller.

Hour Meter: Registers the total number of hours run. It cannot be reset. Use it as a basis for periodic maintenance and service.

Reset / Lamp Test / Panel Lamp Switch: *Reset* resets the fault circuit (the control switch must be at *Stop*), *Lamp Test* tests the fault lamps and *Panel Lamp* turns on the control panel lamp.

Emergency Stop Button (Optional): Push-in switch for emergency shutdown of the set.

AC Voltmeter: A dual-range meter that indicates AC output voltage. Use the scale indicated by the scale indicator lamp.

AC Ammeter: A dual-range meter that indicates AC output current. Use the scale indicated by the scale indicator lamp.

Frequency/RPM Meter: Indicates generator output frequency in Hertz (cycles per second) and engine speed in rpm (revolutions per minute).

Voltage Adjusting Rheostat: Provides approximately ± 5 percent adjustment in output voltage.

Upper and Lower Scale Indicator Lamps: Indicates which AC meter scales to read.

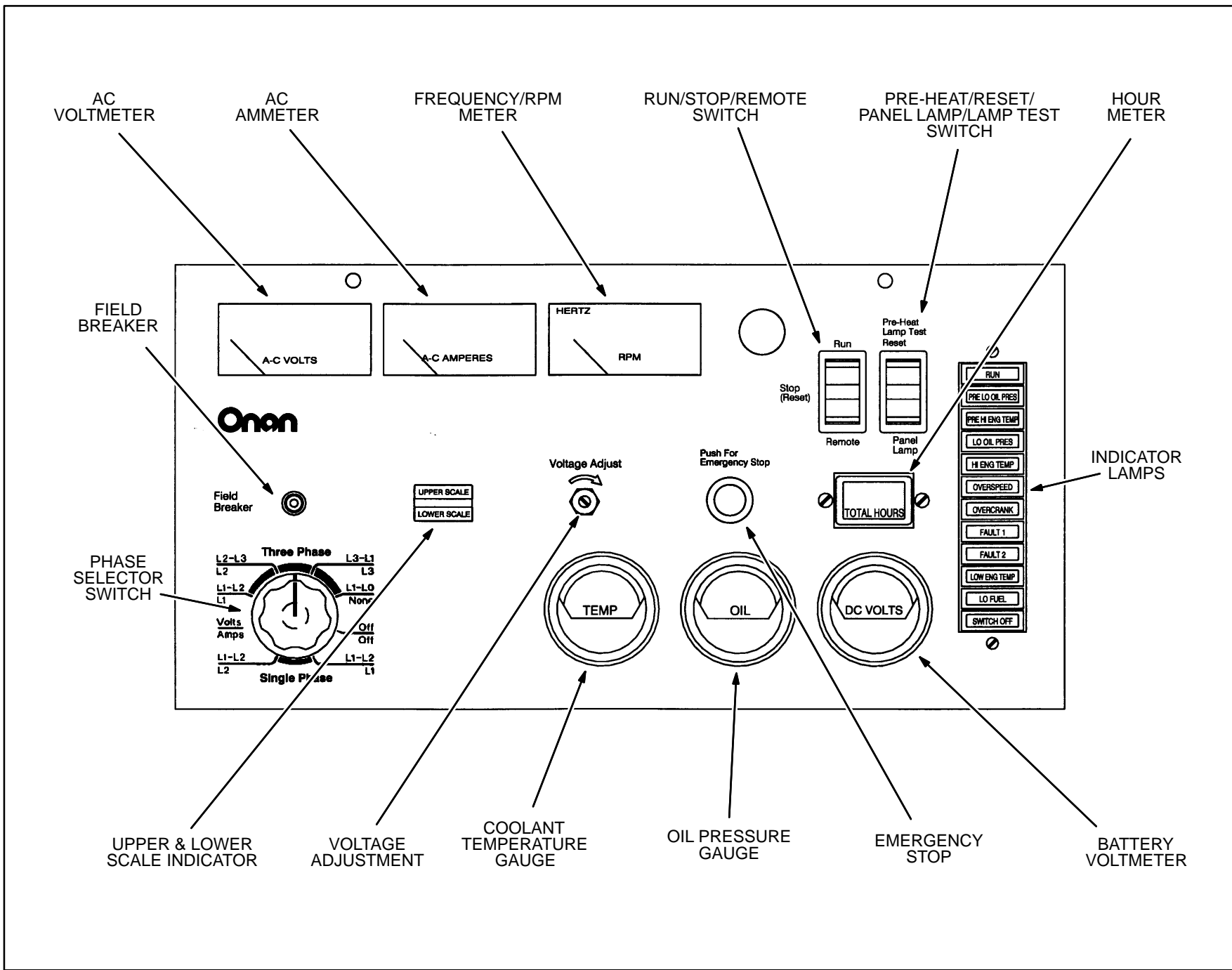
Phase Selector Switch: Selects the generator phase for voltage and current readings.

Field Breaker: Protects the generator exciter/regulator circuits from overheating under certain failure modes.

Indicator Lamps: The control panel has the following 12 indicator lamps:

- RUN (green) indicates that the starter has disconnected and that the set is running.
- PRE LO OIL PRES (yellow) indicates that engine oil pressure is marginal (low).
- PRE HI ENG TEMP (yellow) indicates that engine coolant temperature is marginal (high) or that the coolant level is low (when equipped with a low coolant level switch).
- LO OIL PRES (red) indicates that the engine has shut down because of low oil pressure.
- HI ENG TEMP (red) indicates that the engine has shut down because of high coolant temperature or low coolant level (when equipped with a low coolant level switch).
- OVERSPEED (red) indicates that the engine has shut down because of excessive speed.
- OVERCRANK (red) indicates that the engine has failed to start during the cranking period.
- FAULT 1 (red) indicates a nondedicated fault. May be selected as a shutdown or non-shutdown, timed or non-timed fault (normally set for timed shutdown).
- FAULT 2 (red) indicates a nondedicated fault. May be selected as a shutdown or non-shutdown, timed or non-timed fault (normally set for non-timed shutdown).
- LOW ENG TEMP (yellow) indicates that engine coolant temperature is marginal for starting (low).
- LO FUEL (yellow) can be used to indicate that the fuel supply is low (the customer must provide the fuel level switch).
- SWITCH OFF (flashing red) indicates that the control switch is not in its Remote position for automatic starting.

FIGURE 5-1. DETECTOR CONTROL PANEL



TROUBLESHOOTING

The following troubleshooting tables are designed to help you think through generator set problems. To save time troubleshooting, read the entire manual ahead of time to understand the generator set.

Try to think through problems. Go over what was done during the last service call. The problem could be as simple as an empty fuel tank, closed fuel shut-off valve, loose wire, blown fuse or tripped circuit breaker.

THE ENGINE DOES NOT CRANK IN RUN OR REMOTE MODE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|--|---|
| 1. The Emergency Stop switch has been used. (The switch button is lit.) | Pull the Emergency Switch button. To reset the engine control, push the Run-Stop-Remote switch to Stop and the Reset switch to Reset . Then push the Run-Stop-Remote switch to Run . |
| 2. A Fault Shutdown is being indicated by one of the red lights on the control panel. | Service the set as necessary. To reset the engine control, push the Run-Stop-Remote switch to Stop and the Reset switch to Reset . Then push the Run-Stop-Remote switch to Run . |
| 3. Cranking voltage is too low to crank the engine. | <ul style="list-style-type: none"> A. Clean and tighten or replace the positive (+) and negative (-) battery cable connectors and cables at the battery and the set. B. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). C. If the set is in standby service, install a battery charger. |

THE ENGINE CRANKS BUT DOES NOT START

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|---|
| 1. The engine is not getting fuel. | A. Open any closed shutoff valve in the fuel supply system. B. Fill the LPG fuel supply tank if less than half full. <i>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 generator set demand. LPG with more than 2.5 percent butane will not vaporize in ambients below freezing. Use HD-5 grade LPG.</i> |
| 2. The spark plug cables and/or spark plugs are loose, fouled or damaged. | A. Secure the spark plug cables at the spark plugs and at the ignition coil(s). B. Replace the spark plugs and/or cables. |
| 3. The air cleaner or exhaust system is blocked. | Service as necessary. |
| 4. Low engine temperature is causing too low a cranking speed for starting. | A. Plug in, repair or install engine coolant and engine oil heaters. B. Replace the engine oil if it is not of the recommended viscosity for the ambient temperature. |
| 5. Cranking voltage is too low to reach required cranking speed. | A. Clean and tighten or replace the positive (+) and negative (-) battery cable connections and cables at the battery and the set. B. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). |

THE ENGINE RUNS UNTIL FAULT SHUTDOWN

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|--|---|
| 1. The OVERSPEED lamp comes on when the engine shuts down. | Have service performed as required. |
| 2. The LO OIL PRES lamp comes on when the engine shuts down. | Check the engine oil level, repair any oil leaks and fill to the proper level. Then reset engine monitor board A11 by pushing the Run-Stop-Remote switch to Stop and the Reset switch to Reset . |
| 3. The HI ENG TEMP lamp comes on when the engine shuts down. | <p>A. Check the engine coolant level, repair any coolant leaks and refill as necessary. Then reset engine monitor board A11 by pushing the Run-Stop-Remote switch to Stop and the Reset switch to Reset.</p> <p>B. If coolant temperature exceeds 225° F (101° C), clean and service the entire cooling system as required to restore full cooling capacity.</p> |
| 4. The FAULT 1 or FAULT 2 lamp comes on when the engine shuts down. (May be specifically labeled.) | Have service performed as required. |

THE ENGINE LACKS POWER OR IS UNSTABLE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|--|
| 1. Fuel delivery to the set is inadequate. | A. Check for clogged fuel lines and filters. B. Fill the LPG fuel supply tank if less than half full. <i>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 generator set demand. LPG with more than 2.5 percent butane will not vaporize in ambients below freezing. Use HD-5 grade LPG.</i> |
| 2. The engine air filter element is dirty. | Replace the air filter element. |
| 3. The spark plug cables and/or spark plugs are loose, fouled or damaged. | A. Secure the spark plug cables at the spark plugs and at the ignition coil(s). B. Replace the spark plugs and/or cables. |
| 4. The exhaust system is partially blocked. | Service as necessary. |

AN AMBER WARNING LAMP IS ON

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|---|
| 1. The PREHET or PRELOP lamp comes on while the engine is running. | Shut down the set if possible or disconnect non-critical loads. (Oil pressure will be less than 20 psi but greater than 14 psi or engine temperature will be greater than 220° F but less than 230° F.) |
| 2. The LOW ENG TEMP lamp comes on during standby. | Plug in, repair or install an engine coolant heater. |
| 3. The FAULT 1 or FAULT 2 lamp comes on during standby. (May be a specifically labeled amber lamp.) | Have service performed as required. |

THE GREEN RUN LAMP STAYS OFF BUT THE SET RUNS NORMALLY

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|---|--|
| 1. The set mounted RUN lamp does not light although the starter has disconnected normally and the engine is running. | Press the panel Lamp Test switch and have the run lamp bulb replaced if it does not light. |
| 2. Neither the remote nor the set mounted RUN lamp light although the starter has disconnected normally and the engine is running. | Press the panel Lamp Test switch and have the run lamp bulb replaced if it does not light. Test the remote RUN lamp by suitable means and have it replaced if it does not light. |

NO OUTPUT VOLTAGE

⚠ WARNING *There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about the hazards of fuel, electricity and machinery. Read Safety Precautions and observe all instructions and precautions in this manual.*

| Possible Cause | Corrective Action |
|--|---|
| 1. A line circuit breaker is Off . | Find out why the circuit breaker was turned Off , make sure it is safe to reconnect power, and then throw the circuit breaker On . |
| 2. A line circuit breaker has Tripped . | Shut down the generator set and have service performed as necessary to clear the short circuit or ground fault that caused tripping. Then Reset the circuit breaker and start the set. |

6. Maintenance

Periodic maintenance is essential for top performance and long generator set life. Follow the maintenance instructions in this section carefully. Use Table 6-1 as a guide for normal periodic maintenance for *Standby Service*. Consult an authorized Onan dealer for a suitable maintenance schedule

for *Prime Power Service* and hot or dusty operating conditions. Keep a log of maintenance performed and the hours run. A log will help you keep maintenance regular and provide support for warranty claims. Use the hour meter (Detector control).

TABLE 6-1. PERIODIC MAINTENANCE SCHEDULE

| MAINTENANCE OPERATION | MAINTENANCE FREQUENCY | | | | |
|---|-----------------------|------------------------|--------------------------|-----------------------------|-------------------------|
| | Every Day or 8 Hours | Every Week or 50 Hours | Every Month or 100 Hours | Every 6 Months or 250 Hours | Every Year or 500 Hours |
| General Inspection | x | | | | |
| Check Engine Oil Level | x | | | | |
| Check Engine Coolant Level | x | | | | |
| Check Engine Coolant Heater | x | | | | |
| Check Air Cleaner | | x ² | | | |
| Check Battery Charging System | | x | | | |
| Check Anti-Freeze Concentration | | | x | | |
| Check Fan Belt Tension and Condition | | x ⁴ | x | | |
| Check Fuel Level (LPG) | | | x | | |
| Drain Exhaust Condensate Trap | | | x | | |
| Check Starting Battery | | | x | | |
| Check Generator Air Outlet | | | x | | |
| Change Engine Oil and Oil Filter | | x ¹ | | x ^{2, 3} | |
| Replace Engine Air Filter | | | | x ² | |
| Check Coolant Hoses and Clamps | | | | x | |
| Check Coolant Anti-freeze Protection | | | | x | |
| Replace Spark Plugs | | | | | x |
| Clean Cooling System | | | | | x |
| Replace Gas Supply Screen and Sediment Trap | | | | | x |

1 - As a part of engine break-in, change the engine oil and oil filter after the first 50 hours of operation.
 2 - Perform more often when operating in dusty conditions.
 3 - Perform more often when operating in hot weather.
 4 - Check after the first 50 hours of operation of a new belt.

GENERAL INSPECTION

Oil Level

Check the engine oil level and fill as necessary.

Engine Cooling System

Check the coolant level and look for coolant leaks. Minor leaks that can be replenished by daily additions of coolant to the recovery tank should be repaired by a qualified service technician as soon as possible. Larger leaks are cause for shutting down the genset until it can be repaired.

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

Exhaust System

Look and listen for exhaust system leaks while the genset is running. Shut down the genset if a leak is found and have it repaired before operating the genset.

WARNING *EXHAUST GAS IS DEADLY! Shut down the genset if a leak is found and have it repaired before operating the genset.*

Fuel System

Check the fuel supply line and fitting for leaks while the generator set is running. Check flexible fuel hose section for cuts, cracks and abrasions. Make sure the fuel line is not rubbing against other parts. Replace worn or damaged fuel line parts before leaks occur.

WARNING *Gaseous fuels are highly flammable and explosive and can cause severe personal injury or death. Shut down the generator set immediately and repair a gas leak without delay.*

Mechanical

Look for mechanical damage. Start the genset and look and listen for any unusual noises and vibrations that may indicate mechanical problems.

Check to see that the openings and ducts for cooling and combustion air are free of obstructions and that shutters open and close properly.

Check the engine gauges from time to time while the genset is running (if so equipped).

Battery Connections

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance, which makes for hard starting. Clean or replace as necessary.

WARNING *Arcing can ignite battery gases and cause severe personal injury and can cause voltage spikes that can damage generator set control circuits. To reduce arcing:*

Never disconnect the battery cables while the genset is cranking or running.

Always disconnect a battery charger from its AC source before disconnecting the battery cables.

Always disconnect the negative (-) cable first and reconnect it last. (This prevents arcing if the tool on the positive terminal touches grounded metal.)

Detector-12 Control Panel

Check the following while the genset is running:

Frequency/RPM Meter: The generator frequency should be stable and the reading should be the same as nameplate rating (50 Hertz [1500 rpm] or 60 Hertz [1800 rpm]), with 5% allowance for governor droop).

AC Voltmeter: Turn the phase selector switch to each line-to-line phase selection shown on the volts scale (L1-L2, L2-L3 and L3-L1). Read the AC voltmeter using the upper or lower scale as indicated by the scale indicator lamp. The line-to-line voltage(s) should be the same as the set nameplate rating.

AC Ammeter: Turn the phase selector switch to each phase selection shown on the amps scale (L1, L2 and L3). Read the ammeter using the upper or lower scale as indicated by the scale indicator lamp. At no load the current ratings should be zero. With a load applied, each line current should be about the same.

Fault Lamps: Push the Reset/Lamp switch on the control panel. All indicator lamps should light. Verify that all the bulbs are on and then release the switch. Replace any bulbs that are burned out.

ENGINE OIL

Check the engine oil level during engine shutdown periods at the intervals specified in Table 6-1. The oil dipstick is located on the side of the engine as shown in Figure 6-1. The dipstick is stamped with FULL and ADD to indicate the crankcase oil level. For accurate readings, shut off the engine and wait approximately 10 minutes before checking the oil level. This allows oil in the upper portion of the engine to drain back into the crankcase.

⚠WARNING *Crankcase pressure can blow out hot oil and cause severe burns. Do NOT check oil while the generator set is operating.*

Keep the oil level as near as possible to the FULL mark on the dipstick. Remove the oil fill cap on top or side of the engine and add oil of the same quality and brand when necessary.

⚠CAUTION *Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling can cause foaming or aeration of the oil while operation below the low mark can cause loss of oil pressure.*

Oil Change

Run the engine until thoroughly warm before draining the oil. Stop the set, place a pan under the drain outlet and remove the oil drain plug or open the drain valve. After the oil has completely drained, replace the drain plug or close the drain valve and refill. See *Introduction* for recommended engine oil.

⚠WARNING *State and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Take care to limit skin contact and breathing of vapors as much as possible. Use rubber gloves and wash exposed skin.*

Oil Filter Change

Spin off oil filter and discard it. Thoroughly clean filter mounting surface. Apply a thin film of oil to filter gasket and install new element. Spin element on by hand until gasket just touches mounting pad and then turn an additional 1/2 to 3/4 turn. Do not over-tighten. After filling with oil, start the engine and check for leaks around filter element. Retighten the filter only as much as necessary to eliminate leaks.

Note: Be sure to dispose of the used oil and oil filter in accordance with local environmental regulations.

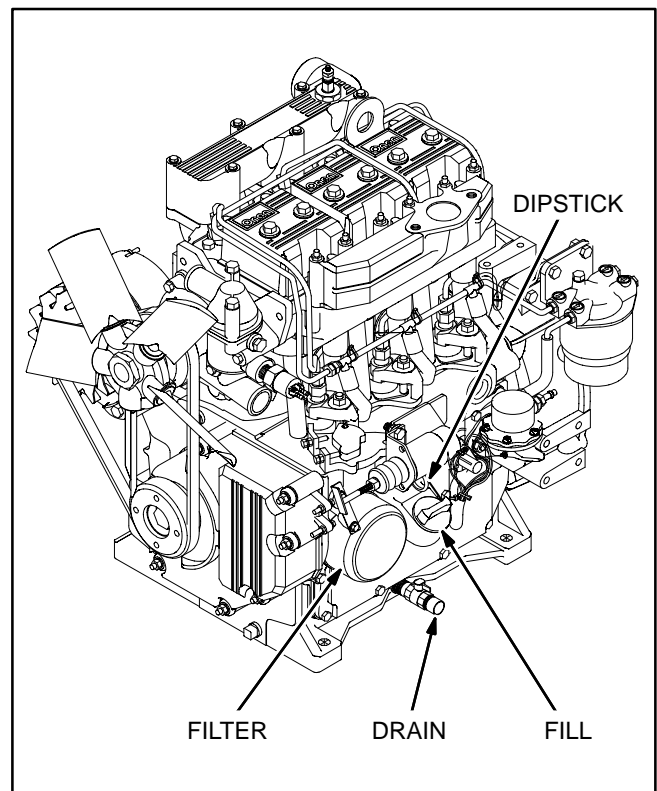


FIGURE 6-1. OIL FILL, DRAIN, FILTER AND DIPSTICK

COOLING SYSTEM

Check the engine coolant level during engine shutdown periods at the intervals specified in Table 6-1. The water used for engine coolant should be clean, low in mineral content and free of any corrosive chemicals such as chloride, sulphate or acid. Generally, any water that is suitable for drinking can be treated for use as engine coolant. Cooling system coolant must also have corrosion inhibitors. See Figure 6-2.

Cooling systems subjected to freezing conditions must also be protected with antifreeze. Use a 50/50 mixture of anti-freeze and water. If temperatures below -37 F (-38 C) can be expected, use a 65/35 mixture of antifreeze and water. Do not use an anti-freeze that contains anti-leak additives.

⚠ WARNING *Hot coolant is under pressure and can cause severe burns. Always let the engine cool down before removing the pressure/fill cap.*

⚠ CAUTION *If the engine coolant level falls too low the temperature sensor may not be able to sense coolant temperature and shut down the engine before damage occurs.*

⚠ CAUTION *A coolant heater must not be operated while the cooling system is empty or damage to the heater will occur.*

AIR CLEANER

Service the engine air cleaner at the interval indicated in Table 6-1.

Disposable Air Cleaner: A disposable air cleaner is clamped directly to the intake manifold by a hose clamp. It is not serviceable: replace it.

Heavy Duty Air Cleaner: A heavy duty air cleaner has a disposable filter element. To remove the filter element, remove the outer and inner end caps. Before replacing the filter, wipe out the inside of the the air cleaner, making sure the filter element seating surfaces inside the can and cap are clean.

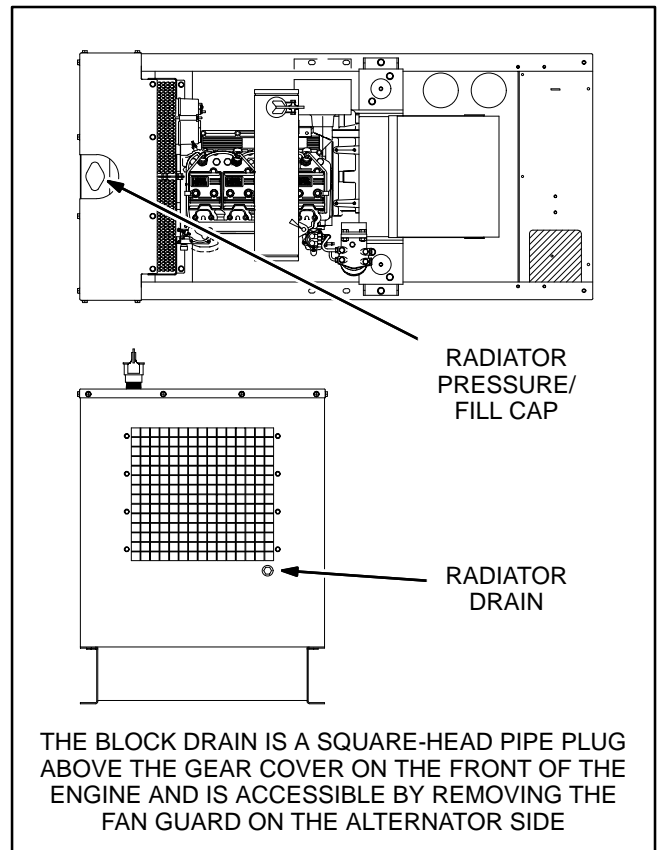


FIGURE 6-2. COOLANT FILL AND DRAIN POINTS

FAN BELT

An improperly adjusted fan belt can cause engine overheating and insufficient battery charging.

Before adjusting the belt, push the genset control switch to **STOP** and disconnect the battery (negative [-] cable first) to prevent accidental starting.

⚠ WARNING *Accidental starting can cause severe personal injury or death. To prevent accidental starting, push the control panel switch to OFF and disconnect the negative (-) battery cable from the battery before working on the generator set.*

Arcing can ignite battery gases and cause severe personal injury and can cause voltage spikes that can damage generator set control circuits. To reduce arcing:

Never disconnect the battery cables while the genset is cranking or running.

Always disconnect a battery charger from its AC source before disconnecting the battery cables.

Always disconnect the negative (-) cable first and reconnect it last. (This prevents arcing if the tool on the positive terminal touches grounded metal.)

To check belt tension, remove the belt guard and push the fan belt midway between the two pulleys shown in Figure 6-3. Use a spring balance to measure force (F) and a straight edge and ruler to measure belt deflection (d). Belt deflection should be 3.5 mm (0.14 in) under a force of 31.0-33.5 N (7.0-7.5 pounds [lbf]) for a new belt and 22.0-24.0 N (5.0-5.4 pounds [lbf]) for a used belt.

To adjust belt tension, loosen the two bolts on the battery charging alternator and adjust until proper tension is obtained. Recheck belt tension after rotating the engine so that the belt has travelled at least once around the pulleys. Retighten the alternator bolts after adjustment, reinstall the belt guard and reconnect the battery (negative [-] cable last).

⚠ CAUTION *Correct belt tension is critical for belt life. Check belt tension at the intervals indicated in Table 6-1 and adjust as instructed above.*

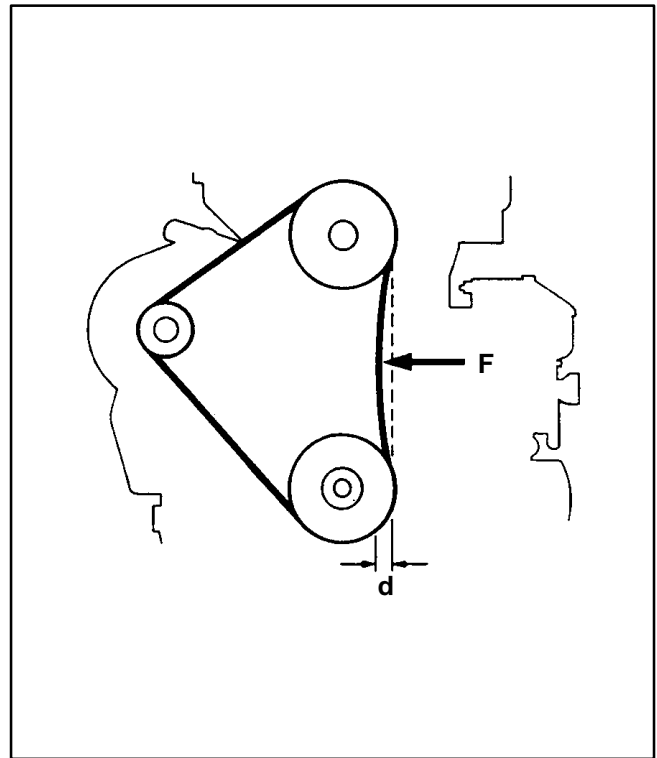


FIGURE 6-3. FAN BELT

BATTERIES

Refer to Table 6-1 for scheduled battery maintenance and to the battery manufacturer's recommendations and instructions for battery care. Check the electrolyte level more frequently during hot weather on batteries which are not of the "maintenance-free" type.

See that connections are clean and tight. A light coating of non-conductive grease will retard corrosion at the terminals. Keep the electrolyte at the proper level above the plates by adding distilled water. Check specific gravity using a hydrometer (Figure 6-4) and recharge if below 1.260.

⚠ WARNING *Arcing can ignite battery gases and cause severe personal injury and can cause voltage spikes that can damage generator set control circuits. To reduce arcing:*

Never disconnect the battery cables while the genset is cranking or running.

Always disconnect a battery charger from its AC source before disconnecting the battery cables.

Always disconnect the negative (-) cable first and reconnect it last. (This prevents arcing if the tool on the positive terminal touches grounded metal.)

⚠ CAUTION *A battery mounted in the built-in battery rack in the skid base must be of a type with barbed vent hose fittings for its cells. The vent lines must be routed away from the generator end bell (air inlet) to prevent battery gasses from entering the generator and causing corrosion.*

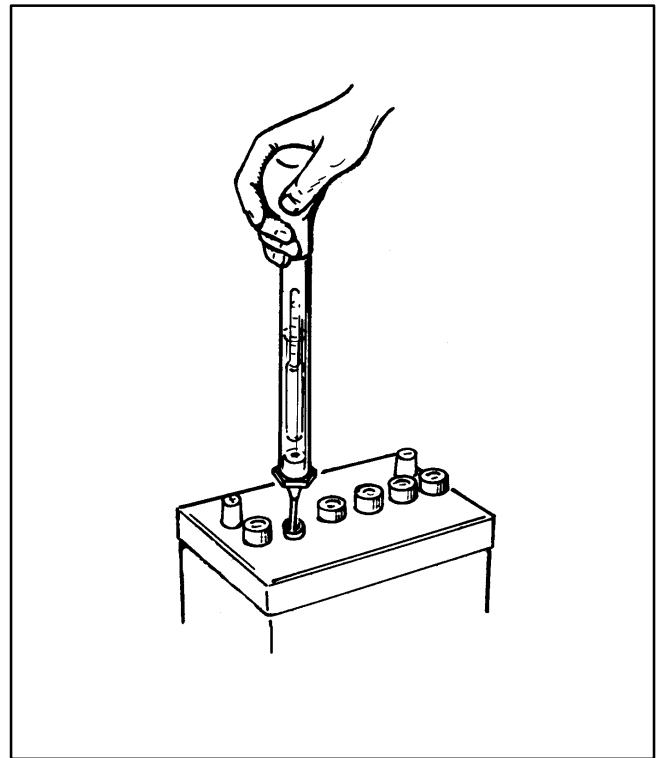


FIGURE 6-4. CHECKING BATTERY CHARGE

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