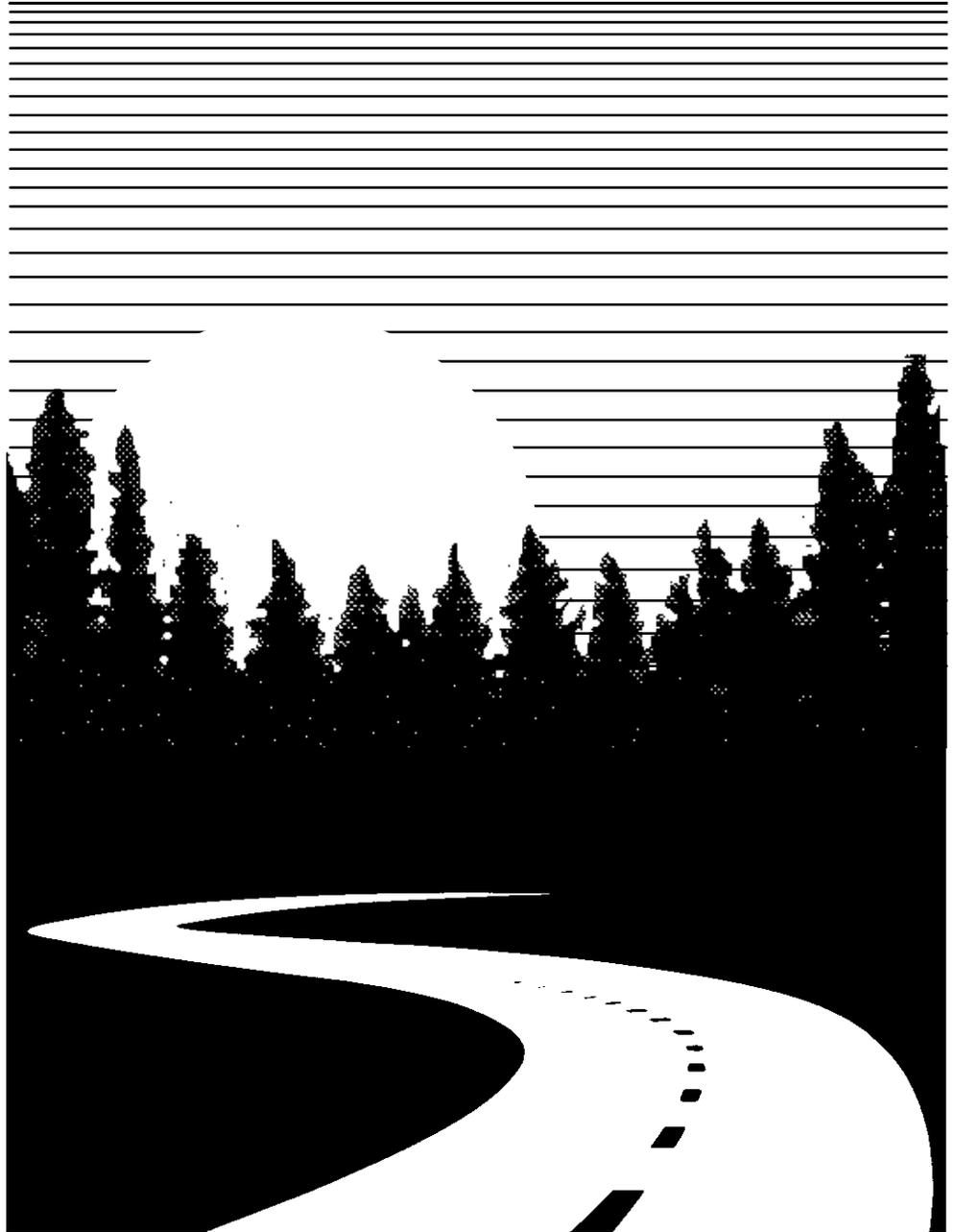


Onan *Mobile GenSet*

Operator's Manual

HDCAA, HDCAB



Printed in U.S.A.

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California

Proposition 65 Warning

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

! WARNING !

**Do not use this genset on a boat
Such use may violate U. S. Coast Guard
regulations and can result in
severe personal injury or death from
fire, electrocution, or
carbon monoxide poisoning**

Table of Contents

SAFETY PRECAUTIONS	2
INTRODUCTION	4
About this Manual	4
Model Identification	4
Fuel Recommendations	5
Engine Oil Recommendations	5
Starting Batteries	5
Typical Genset	5
Operator's Console	6
Remote Control Panel	6
OPERATION	7
Conducting the Pre-Start Checks	7
Priming the Fuel System	7
Starting the Genset	7
Stopping the Genset	7
Loading the Genset	8
Resetting Circuit Breakers	9
Connecting to Utility Power	9
Operating in Cold Weather	10
Operating in Hot Weather	10
Operating at High Altitude	10
Operating in Dusty Environments	10
Breaking in a New Engine	10
Exercising the Genset	10
Storing the Genset	11
PERIODIC MAINTENANCE	12
Conducting General Inspections	13
Checking Engine Oil Level	14
Changing Engine Oil and Oil Filter	15
Maintaining the Battery and Battery Connections	16
Replacing the Air Filter Element	16
Cleaning the Spark Arrestor	17
Replacing the Fuel Filter	18
Changing Coolant	19
TROUBLESHOOTING	20
SPECIFICATIONS	26
EMISSIONS	27
HOW TO OBTAIN SERVICE	28
MAINTENANCE RECORD	29

Safety Precautions

Thoroughly read the OPERATOR'S MANUAL before operating the genset. Safe operation and top performance can only be obtained 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 children away from the genset.
- Do not use evaporative starting fluids. They are highly explosive.
- To prevent accidental or remote starting while working on the genset, disconnect the negative (–) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray out and cause severe burns.
- Keep the genset and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Make sure all fasteners are secure and torqued properly.

- Do not work on the genset when mentally or physically fatigued or after consuming alcohol or drugs.
- You must be trained and experienced to make adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to the public utility or any other source of electrical power. Back-feed could lead to electrocution of utility personnel and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

ENGINE EXHAUST IS DEADLY

- Learn the symptoms of carbon monoxide poisoning in this manual.
- Never sleep in the vehicle while the genset is running unless the vehicle is equipped with a working carbon monoxide detector.
- The exhaust system must be installed in accordance with the genset Installation Manual.
- Engine cooling air must not be used for heating working or living spaces or compartments.
- Make sure there is ample fresh air when operating the genset in a confined area.

DIESEL FUEL IS COMBUSTIBLE

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

BATTERY GAS IS EXPLOSIVE

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. ***Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak, etc.*** The owners and operators of the genset are solely responsible for operating the genset safely.

Introduction

ABOUT THIS MANUAL

This manual covers the operation and maintenance of the HDCAA and HDCAB Series of generator sets (gensets). Study this manual carefully and observe all of its instructions and precautions. Keep this manual and the genset Installation Manual with the other vehicle manuals.

Operation, Periodic Maintenance and Troubleshooting provide the instructions necessary for operating the genset and maintaining it at top performance. The owner is responsible for performing maintenance in accordance with the PERIODIC MAINTENANCE SCHEDULE (Page 12). This manual also includes genset specifications, information on how to obtain service and information regarding compliance with emissions regulations.

⚠WARNING *This genset is not a life support system. It can stop without warning. Children, persons with physical or mental limitations, and pets could suffer personal injury or death. A personal attendant, redundant power or an alarm system must be used if genset operation is critical.*

MODEL IDENTIFICATION

When contacting an Onan dealer for parts, service or product information, be ready to provide the model and serial numbers on the genset nameplate. Figure 1 illustrates the nameplate and its location. The numbers in the gray boxes are typical model and serial numbers. Every character in these numbers is significant. (The last character of the model number is the specification letter, which is important for obtaining the right parts.) Record the model and serial numbers in the boxes in Figure 1 so that they are easy to find when you need them.

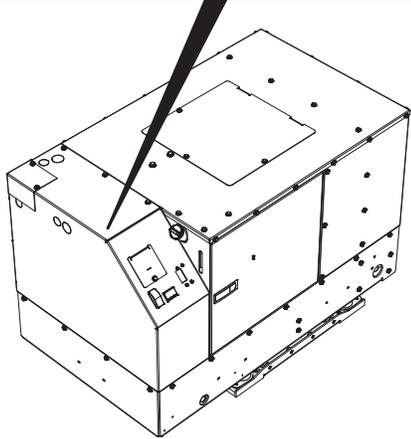
IMPORTANT ENGINE INFORMATION

 **CUMMINS POWER GENERATION**
1400 73rd Ave. NE
Minneapolis, MN 55432
Made in U.S.A.

Model No: 12.5HDCAB11506A	PH:
S/N: 1000 123456	kVA: kW:
AC Volts:	Amps: Pf: RPM:
Fuel:	Hz: Bet:
Options:	Wiring Diagram:

Insulation - NEMA Class F Ambient 40°C

[The engine family designation, engine displacement, statement of compliance with applicable EPA and / or California emissions regulations appear in this block on the actual nameplate on the genset.]



RECORD NUMBERS HERE

MODEL NUMBER:
SERIAL NUMBER:

FIGURE 1. TYPICAL NAMEPLATE

FUEL RECOMMENDATIONS

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

Use clean, fresh No. 2 diesel fuel (ASTM 2-D) when the outdoor ambient temperature is above freezing, and No. 1 diesel fuel (ASTM 1-D) when below freezing. The fuel should have a Cetane number of at least 45 for reliable starting.

ENGINE OIL RECOMMENDATIONS

Use API (American Petroleum Institute) performance Class **CH-4**, **CG-4** or **CF-4** engine oil, which may be in combination with performance Class SJ, SH or SG (for example: SJ/CH-4). Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 2, choose the viscosity grade appropriate for the ambient temperatures

expected until the next scheduled oil change. Multi-grade oils such as SAE 15W-40 are recommended for year-round use.

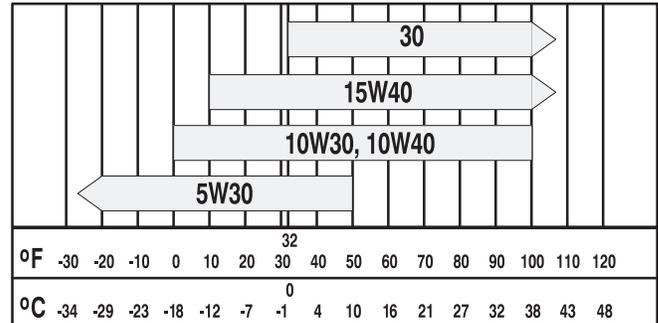


FIGURE 2. OIL VISCOSITY VS. TEMPERATURE
STARTING BATTERIES

The genset requires a 12 volt battery to power its control and starting circuits. Reliable genset starting and starter service life depend upon adequate battery system capacity and maintenance. See *Specifications* (Page 26) for battery requirements and *Periodic Maintenance* (Page 16) for battery care.

TYPICAL GENSET

Figure 3 illustrates a typical genset.

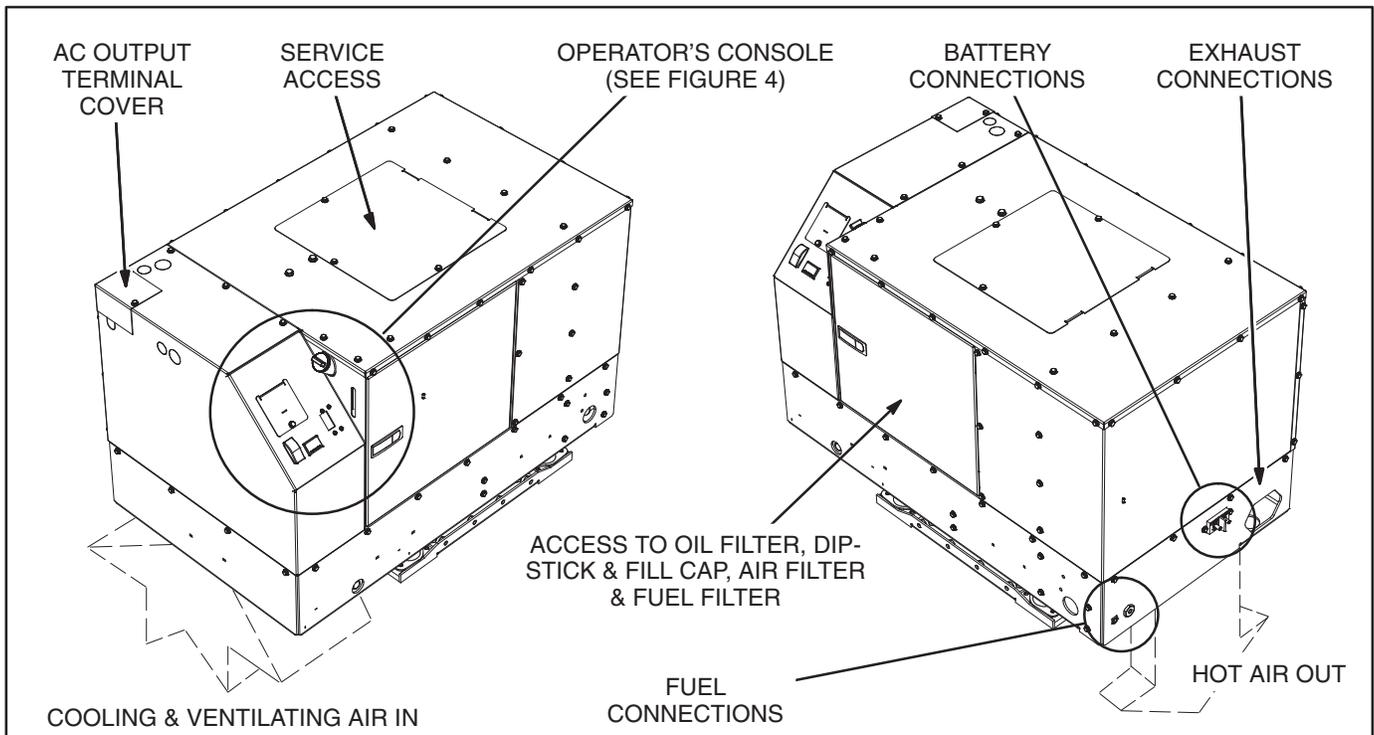


FIGURE 3. TYPICAL GENSET

OPERATOR'S CONSOLE

The operator's console (Figure 4) has the following features:

Control Switch – This switch is used to start and stop the genset, prime the engine fuel system and restore the fault code (blinking status light).

Status Light – This is an LED (light emitting diode) in the control switch which blinks rapidly during pre-heat and cranking. 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 coded fashion to indicate the nature of the fault shutdown (see *Troubleshooting*, Page 20).

(Rapid blinking before cranking starts indicates that the glow plugs are preheating the combustion chambers. The controller automatically varies the time based on engine temperature.)

Line Circuit Breaker(s) – The line circuit breaker(s) protect the AC power leads connected to the genset.

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

Coolant Pressure Cap – The coolant pressure cap is accessible by removing the access plate on the control console. Fill coolant here when refilling the system.

Fuses F1 and F2 – These fuses are accessible by removing the access plate on the control console. They protect the control circuits of the genset.

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

REMOTE CONTROL PANEL

The vehicle may be equipped with a remote control panel having a **Control Switch** and **Preheat/Diagnostics Light**. In addition, it may have an hour meter and the following engine gauges:

Oil Pressure Gauge – The oil pressure gauge indicates the presence of engine oil pressure.

Water Temperature Gauge – The water temperature gauge indicates engine coolant temperature.

Voltmeter – The voltmeter indicates battery voltage.

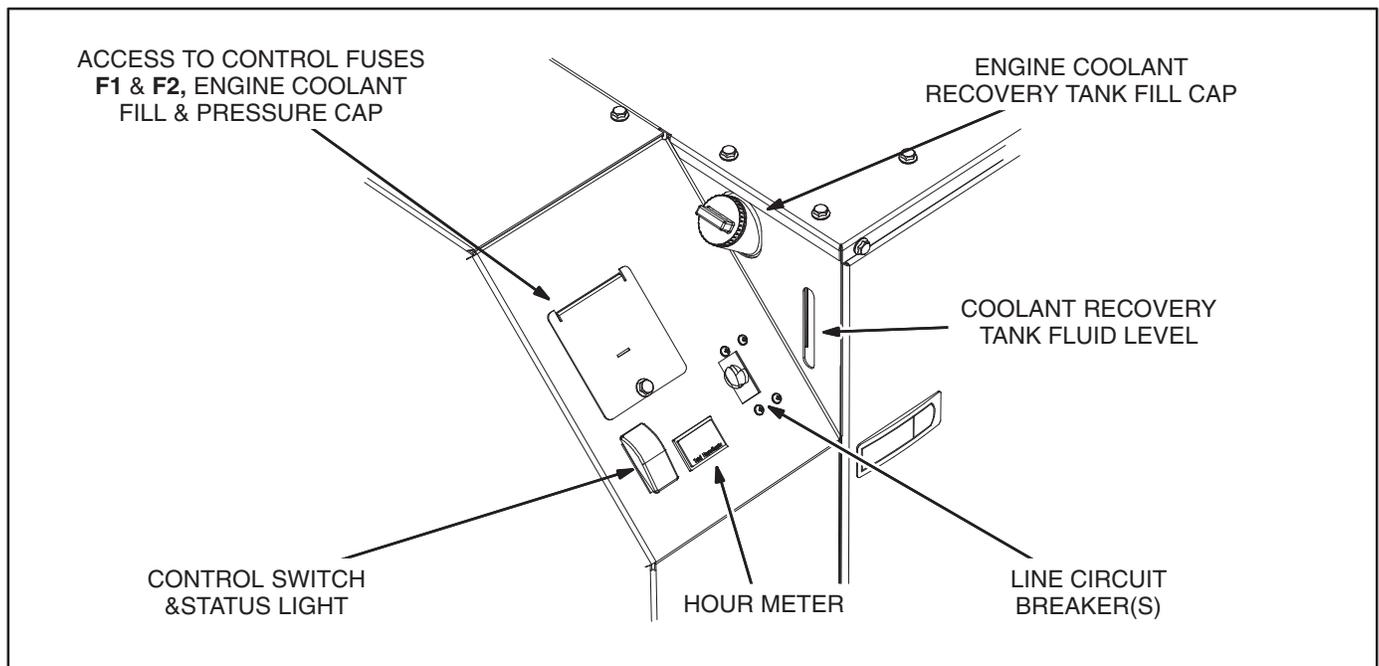


FIGURE 4. OPERATOR'S CONSOLE

Operation

⚠️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.

Never sleep in the vehicle while the genset is running unless the vehicle has a working carbon monoxide detector. The exhaust system must be installed in accordance with the genset Installation Manual. Make sure there is ample fresh air when operating the genset in a confined area.

CONDUCTING THE PRE-START CHECKS

Before the first start of the day and after every eight hours of operation, inspect the genset as instructed under CONDUCTING GENERAL INSPECTIONS (Page 13). Keep a log of maintenance and the hours run and perform any maintenance that may be due. See Returning the Genset to Service (Page 11) if the vehicle has been in storage.

Before each start:

1. Make sure all vehicle CO detectors are working.
2. Check for signs of fuel and exhaust leaks and damage to the exhaust system.
3. To prevent overheating and to reduce fouling with dust and debris, make sure the genset's normal ground clearance is not being reduced by sloping ground, curbs, logs or other objects. Repark the vehicle if necessary and/or remove any objects blocking the air inlet or air outlet.
4. Turn off air conditioners and other large appliances.

PRIMING THE FUEL SYSTEM

The fuel system should be primed after replacing the fuel filter or running the genset out of fuel. To prime the fuel system hold the control switch down in its **Stop** position for at least 1 minute.

STARTING THE GENSET

Start the genset from the genset control panel or remote control panel inside the vehicle.

1. Push and hold the switch at **START** until the genset starts. The status indicator light on the switch flashes during preheat and cranking. It will come on solid when the starter disconnects, indicating that the genset is running. (Depending on how cold it is, preheat can take up to 15 seconds, extending the time that the light blinks.)

⚠️CAUTION *Excessive cranking can over-heat and damage the starter motor. Do not crank for more than 30 seconds at a time. Wait at least 2 minutes before trying again.*

2. See *Troubleshooting* (Page 20) if the genset does not start after several tries.
3. For top performance and engine life, especially in colder weather, let the engine warm up for two minutes before connecting appliances.
4. Monitor the engine gauges if the remote panel is so equipped. Normal readings during operation are as follows:

Oil Pressure: Approximate center of scale

Temperature: 160°-220° F (71°-104° C)

DC Voltage: 14-15 volts.

5. Check for fuel, exhaust and coolant leaks. Stop the genset immediately if there is a fuel, exhaust or coolant leak and have it repaired.

STOPPING THE GENSET

Turn off air conditioners and other large appliances and let the genset run for two minutes to cool down. Then push the switch to **STOP**.

LOADING THE GENSET

The genset can power AC motors, air conditioners, AC/DC converters, battery chargers and other appliances. How much appliance load* can be powered depends upon the genset power rating. The genset will shut down or its circuit breakers will trip if the sum of the loads exceeds genset power. See *Troubleshooting* (Page 20).

To avoid overloading the genset and causing shut-downs, compare the sum of the loads of the appliances that are likely to be used at the same time to the power rating of the genset. Use Table 1 or the ratings on the appliances themselves (if so marked) to obtain the individual appliance loads. ***It may be necessary to run fewer appliances at the same time—the sum of the loads must not be greater than genset rating.***

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

Maximum power decreases as altitude increases because air density decreases. For every 1000-foot (305 m) increase in elevation you can expect power to decrease approximately 3 percent. Table 2 shows the results of typical calculations. ***It may be necessary to run fewer appliances at higher altitudes.***

TABLE 1. TYPICAL APPLIANCE LOADS

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

TABLE 2. POWER VS. ALTITUDE

Elevation above Sea Level	Maximum Power
at/below 500 ft (152 m)	12,500 W (rated)
at 2500 ft (762 m)	11,750 W
at 5500 ft (1676 m)	10,625 W
above 5500 ft (1676 m)	10,625 W minus 375 W every 1000 ft (305 m)

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

RESETTING CIRCUIT BREAKERS

If a circuit breaker in the main power distribution panel of the vehicle or on the genset (Figure 5) trips, either a circuit shorted or too many appliances were running. Note that the genset will continue to run after a circuit breaker trips.

If a circuit breaker trips, disconnect or turn off as many loads as possible and reset the circuit breaker. (Push the circuit breaker to **OFF** to reset it and then to **ON** to reconnect the circuit.) If the circuit breaker trips right away, either the electrical distribution system has a short or the circuit breaker is faulty. Call a qualified electrician.

If the circuit breaker does not trip, reconnect the appliances, one by one, up to a total load that does not overload the genset or cause the circuit breaker to trip. If a circuit breaker trips right away when an appliance is connected, the appliance probably has a short.

Electrical appliances and tools must be used and maintained properly and be properly grounded to cause the line circuit breakers to trip when short circuits occur.

⚠WARNING *Short circuits in electrical appliances and tools can cause fire and electrical shock leading to severe personal injury or death. Read and follow the equipment and tool manufacturer's instructions and warnings regarding use, maintenance and proper grounding.*

CONNECTING TO UTILITY POWER

When the vehicle has provisions for connecting to utility power, such as a cord for plugging into a power outlet receptacle, it must also have an approved device to keep the genset and utility from being interconnected. See the genset Installation Manual for more information.

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

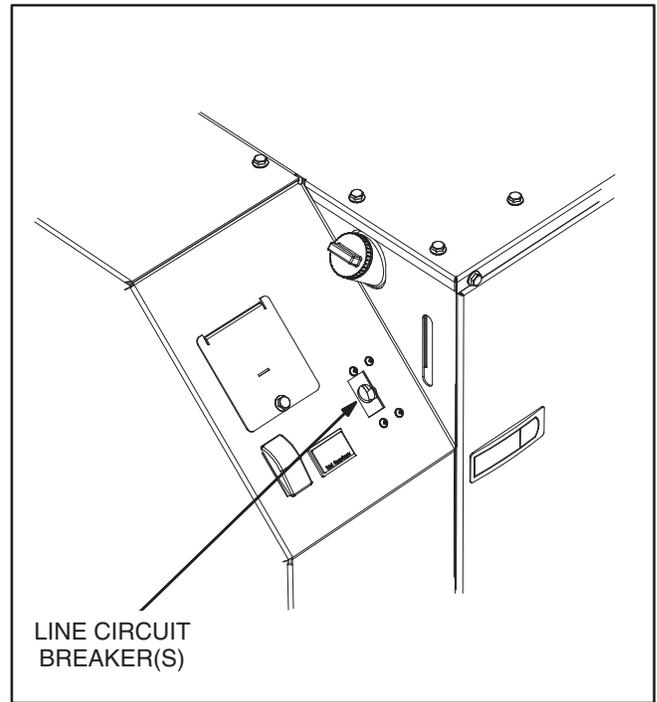


FIGURE 5. LINE CIRCUIT BREAKER

OPERATING IN COLD WEATHER

Make sure the engine oil viscosity is appropriate for the cold weather temperatures. See **ENGINE OIL RECOMMENDATIONS** (Page 5). Be sure to change the oil if a sudden drop in temperature occurs.

OPERATING IN HOT WEATHER

Pay particular attention to the following items when operating the genset in hot weather:

1. Make sure nothing blocks airflow to and from the genset.
2. Make sure engine oil viscosity is appropriate for the ambient temperatures. See **ENGINE OIL RECOMMENDATIONS** (Page 5).
3. Keep the genset clean.
4. Perform maintenance due. See **PERIODIC MAINTENANCE SCHEDULE** (Page 12).

OPERATING AT HIGH ALTITUDE

For the effect of altitude on maximum power, see **LOADING THE GENSET** (Page 8).

OPERATING IN DUSTY ENVIRONMENTS

Pay particular attention to the following items when operating the genset in dusty environments:

1. Do not let dirt and debris accumulate inside the genset compartment. Keep the genset clean.
2. Perform air cleaner maintenance more often. See **PERIODIC MAINTENANCE SCHEDULE** (Page 12).

3. Change engine oil more often. See **PERIODIC MAINTENANCE SCHEDULE** (Page 12).
4. Keep containers of engine oil that have been opened tightly closed to keep out dust.

BREAKING IN A NEW ENGINE

Proper engine break-in on a new genset or on one with a rebuilt engine is essential for top engine performance and acceptable oil consumption. Run the genset at approximately 1/2 rated power for the first 2 hours and then at 3/4 rated power for 2 more hours. See **LOADING THE GENSET** (Page 8).

Proper engine oil and oil level are especially critical during break-in because of the higher engine temperatures that can be expected. Change the oil if not appropriate for the ambient temperatures during break-in. See **ENGINE OIL RECOMMENDATIONS** (Page 5). Check oil level twice a day or every 4 hours during the first 24 hours of operation and change the oil and oil filter after the first 50 hours of operation.

EXERCISING THE GENSET

Exercise the genset at least 2 hours each month if use is infrequent. Run the genset at approximately 1/2 rated power. See **LOADING THE GENSET** (Page 8). A single two hour exercise period is better than several shorter periods.

Exercising a genset drives off moisture, re-lubricates the engine, replaces stale fuel and removes oxides from electrical contacts. The result is better starting, more reliable operation and longer engine life.

STORING THE GENSET

Proper storage is essential for preserving top genset performance and reliability when the genset cannot be exercised regularly and will be idle for more than 120 days.

Storing the Genset

1. Push the genset line circuit breaker OFF (Page 9).
2. Change the engine oil and attach a tag indicating oil viscosity. See ENGINE OIL RECOMMENDATIONS (Page 5).
3. Disconnect the battery cables (negative [-] cable first) from the starting battery and store the battery according to the battery manufacturer's recommendations. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (Page 16).
4. Plug the exhaust tail pipe to keep out dirt, moisture, bugs, etc.
5. Close the fuel supply valve (if so equipped).

Returning the Genset to Service

1. Check the oil tag on the genset and change the oil if the viscosity indicated is not appropriate for the temperatures expected. See ENGINE OIL RECOMMENDATIONS (Page 5).
2. Reconnect the starting battery (negative [-] cable last). See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (Page 16).
3. Remove the plug from the exhaust tailpipe.
4. Change the air filter element if it is dirty (Page 16).
5. Open the fuel supply valve (if so equipped).
6. Inspect the genset. See CONDUCTING GENERAL INSPECTIONS (Page 13).
7. Push the genset line circuit breaker ON (Page 9) when the genset is ready to power appliances.

Periodic Maintenance

Periodic maintenance is essential for top performance and long genset life. Use Table 3 as a guide for normal periodic maintenance. In hot and dusty environments some maintenance procedures should be performed more frequently, as indicated by the footnotes in the table. Keeping a log of maintenance performed and hours run (Page 29) will

help you keep genset maintenance regular and provide a basis for supporting warranty claims.

Maintenance, replacement or repair of emission control devices and systems may be performed by any engine repair establishment or individual. However, warranty work must be completed by an authorized Onan dealer.

TABLE 3. PERIODIC MAINTENANCE SCHEDULE

MAINTENANCE OPERATION	MAINTENANCE FREQUENCY								Page
	Every Day	After First 50 Hours	Every Month	Every 150 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours		
General Inspection	•								13
Check Engine Oil Level	•								14
Check Engine Coolant Level	•								13
Clean and Check Battery			• ²						16
Clean Spark Arrestor				• ³					17
Change Engine Oil and Oil Filter		•			• ^{1, 2, 3}				15
Check V-Belt Tension					• ⁷				–
Replace Engine Air Filter						• ^{1, 3}			16
Replace Fuel Filter						• ³			18
Check Coolant Anti-freeze Protection						• ³			18
Flush Coolant System							• ⁴		13
Replace Coolant Pressure Cap							• ⁴		13
Replace Engine V-belt							• ^{5, 6}		–
Replace Coolant Hoses and Thermostat							• ^{5, 6}		–
Adjust Engine Valve Lash							• ^{5, 6}		–
Service Fuel Injectors							• ^{5, 6}		–
1 – Perform more often when operating in dusty conditions. 2 – Perform more often when operating in hot weather. 3 – Perform at least once a year. 4 – Perform at least once every two years. 5 – Perform at least once every five years. 6 – Must be performed by a qualified mechanic (authorized Onan dealer). 7 – Tighten or replace the belt in accordance with the Service Manual if it can be deflected more than 1/2 in (12 mm) by thumb.									

CONDUCTING GENERAL INSPECTIONS

Inspect the genset before the first start of the day and after every eight hours of operation.

Oil Level

Check engine oil level (Page 14).

Engine Coolant System

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

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

Exhaust System

⚠ WARNING *EXHAUST GAS IS DEADLY! Do not operate the genset if there is an exhaust leak or any danger of exhaust gases entering or being drawn into the vehicle.*

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

Look for openings or holes between the genset compartment and vehicle cab or living space if the genset engine sounds louder than usual. Have all such openings or holes closed off or sealed to prevent exhaust gases from entering the vehicle.

Replace dented, bent or severely rusted sections of the tailpipe and make sure the tailpipe extends at least 1 inch (25.4 mm) beyond the perimeter of the vehicle.

⚠ WARNING *Do not park the vehicle in high grass or brush. Contact with the exhaust system can cause a fire.*

Park the vehicle so that the genset exhaust gases can disperse away from the vehicle. Barriers such as walls, snow banks, high grass and brush and oth-

er vehicles can cause exhaust gases to accumulate in and around the vehicle.

Do not operate power ventilators or exhaust fans while the vehicle is standing with the genset running. The ventilator or fan can draw exhaust gases into the vehicle.

Fuel System

Check for leaks at hose, tube and pipe fittings in the fuel supply system while the genset is running and while it is stopped. Check flexible fuel hose sections for cuts, cracks, and abrasions. Make sure the fuel line is not rubbing against other parts. Replace worn or damaged fuel line parts before leaks occur.

⚠ WARNING *Diesel fuel leaks can lead to fire. Do not operate the genset if operation causes fuel to leak.*

Battery Connections

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting harder. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (Page 16).

⚠ WARNING *Arcing at battery terminals or in light switches or other equipment, and flames or sparks, can ignite battery gas causing severe personal injury—Ventilate battery area before working on or near battery—Wear safety glasses—Do not smoke—Switch work light ON or OFF away from battery—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (-) cable first and reconnect last.*

Mechanical

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

Look for mechanical damage and listen for unusual noises. Check the genset mounting bolts.

To prevent overheating and to reduce fouling with dust and debris, make sure the genset's normal ground clearance is not being reduced by sloping ground, curbs, logs or other objects. Repark the vehicle if necessary and/or remove any objects blocking the air inlet or air outlet.

CHECKING ENGINE OIL LEVEL

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

1. Park the vehicle on level ground, shut down the genset and remove the service access panel.
2. Pull out the oil dip stick, wipe it clean, reinsert it and pull it out again to check the oil level (Figure 6).
3. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (Page 5). Keep the oil level between the FULL and ADD marks.

⚠ CAUTION *Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the FULL and ADD marks.*

4. Reinsert the dipstick and secure the oil fill cap and maintenance access panel.

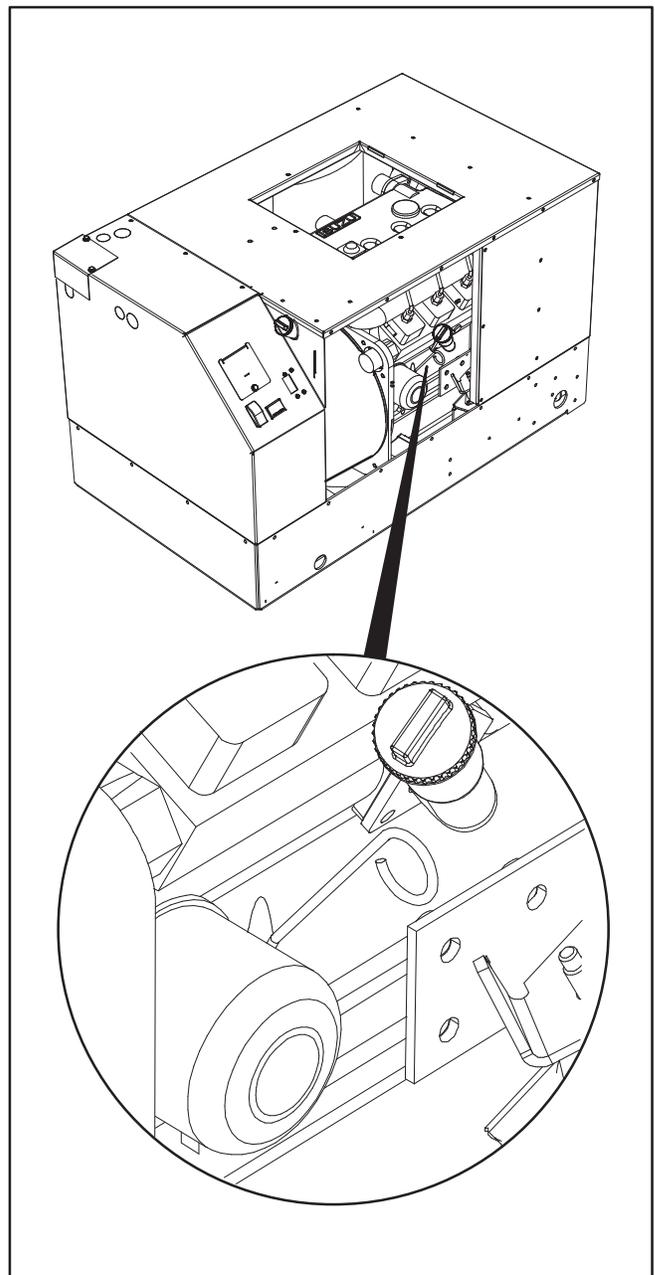


FIGURE 6. CHECKING ENGINE OIL LEVEL

CHANGING ENGINE OIL AND OIL FILTER

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

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

1. Place a pan under the oil drain plug (Figure 7), run the genset until warm and shut it off.
2. Remove the maintenance access panel and the oil fill cap (Page 14), unscrew the oil drain plug (24 mm hex head) and drain all the oil from the engine. **Reinstall the oil drain plug securely.**
3. Spin off the oil filter canister (Page 14) and clean the filter mounting surface on the engine block. Remove the old gasket if it remains.
4. Make sure the gasket is in place on the new filter and apply a thin film of clean oil to the gasket. Spin the new filter on until the gasket just touches the block. Turn it an additional 1/2 to 3/4 turn. Do not overtighten.
5. Refill with 6.7 quarts (6.3 liters) of oil and check the level (Page 14).
6. Dispose of the used oil and oil filter according to local environmental regulations.

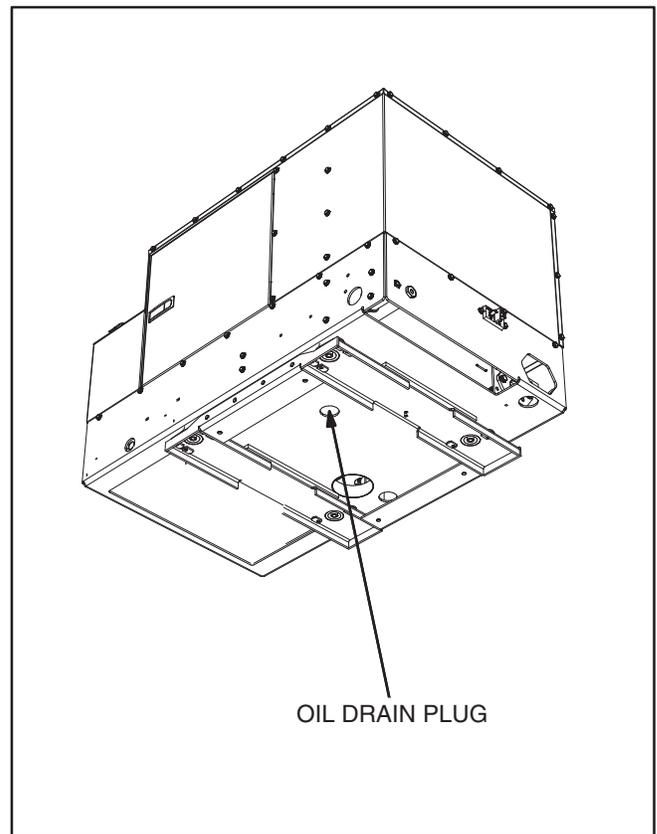


FIGURE 7. OIL DRAIN PLUG

MAINTAINING THE BATTERY AND BATTERY CONNECTIONS

⚠WARNING Arcing at battery terminals or in light switches or other equipment, and flames or sparks, can ignite battery gas causing severe personal injury—Ventilate battery area before working on or near battery—Wear safety glasses—Do not smoke—Switch work light ON or OFF away from battery—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.

Refer to Table 3 for scheduled battery maintenance, and follow the battery manufacturer's instructions. Have the battery charging system serviced if DC system voltage is consistently low or high. Always:

1. Keep the battery case and terminals clean and dry and the terminals tight.
2. Remove battery cables with a battery terminal puller.
3. Make sure which terminal is positive (+) and which is negative (–) before making battery connections, always removing the negative (–) cable first and reconnecting it last to reduce arcing.

REPLACING THE AIR FILTER ELEMENT

Refer to Table 3 for scheduled air filter element replacement. In dusty environments the filter element should be inspected and changed more frequently.

The air filter is accessible through the front service access opening (Figure 8). Loosen the three screws that secure the coolant recovery tank to the top housing panel (removed to show air filter) and move 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. Secure the maintenance access door.

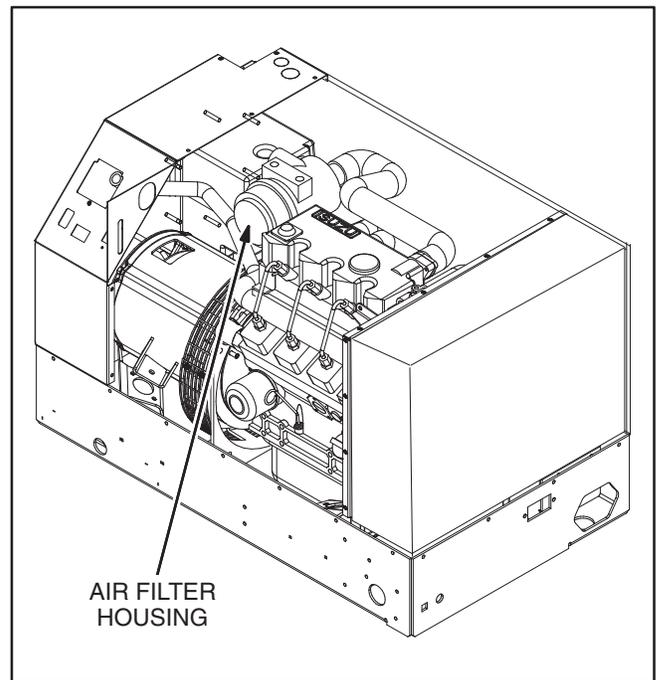


FIGURE 8. AIR FILTER

CLEANING THE SPARK ARRESTOR

Refer to Table 3 for scheduled cleaning of the spark arrestor muffler (which meets U.S. Forest Service requirements). Cleaning is required for maximum genset performance.

⚠WARNING *A hot muffler can cause severe burns. Let the muffler cool down before removing or installing the cleanout plug.*

The 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 (Figure 9). Clean out the muffler as follows:

1. Remove the top service access cover.
2. 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.
3. Start the genset and load it nearly to full power. Let the genset run for about five minutes to expel the soot.
4. Stop the genset, allow the muffler to cool down, reinstall the cleanout plug and secure the service access cover.

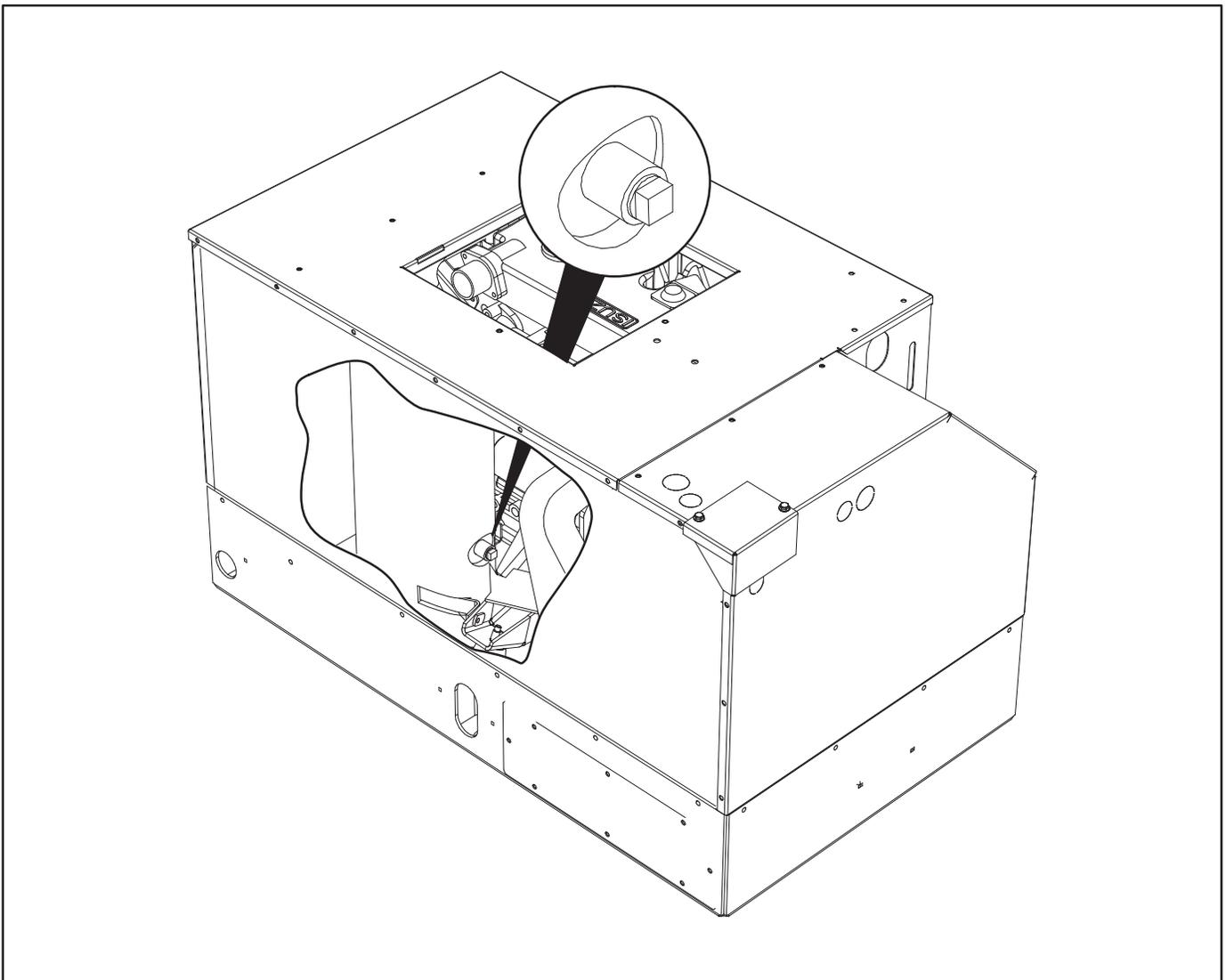


FIGURE 9. SPARK ARRESTOR CLEANOUT PLUG

REPLACING THE FUEL FILTER

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

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

See Table 3 for scheduled fuel filter replacement. A dirty fuel filter may be the cause of a failure to start. The fuel filter is accessible through the front service access door (Figure 10).

⚠️CAUTION Wipe dirt off the fuel hose fittings at the fuel filter before disconnecting the hoses so as to keep dirt out of the fuel system.

Removing the Fuel Filter: 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.

To remove the filter, disconnect the two fittings at the filter and remove the mounting nut. Apply a wrench on the filter fitting as well as on the flare nut so as not to stress the fitting. Flare nut wrenches should be used on the flare nuts so as not to round the corners on the nuts. Dispose of the fuel filter according to local regulations.

Installing the Fuel Filter: Rotate the filter half a turn around its mounting stud if the fittings interfere with the bracket. It only fits properly one way.

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.

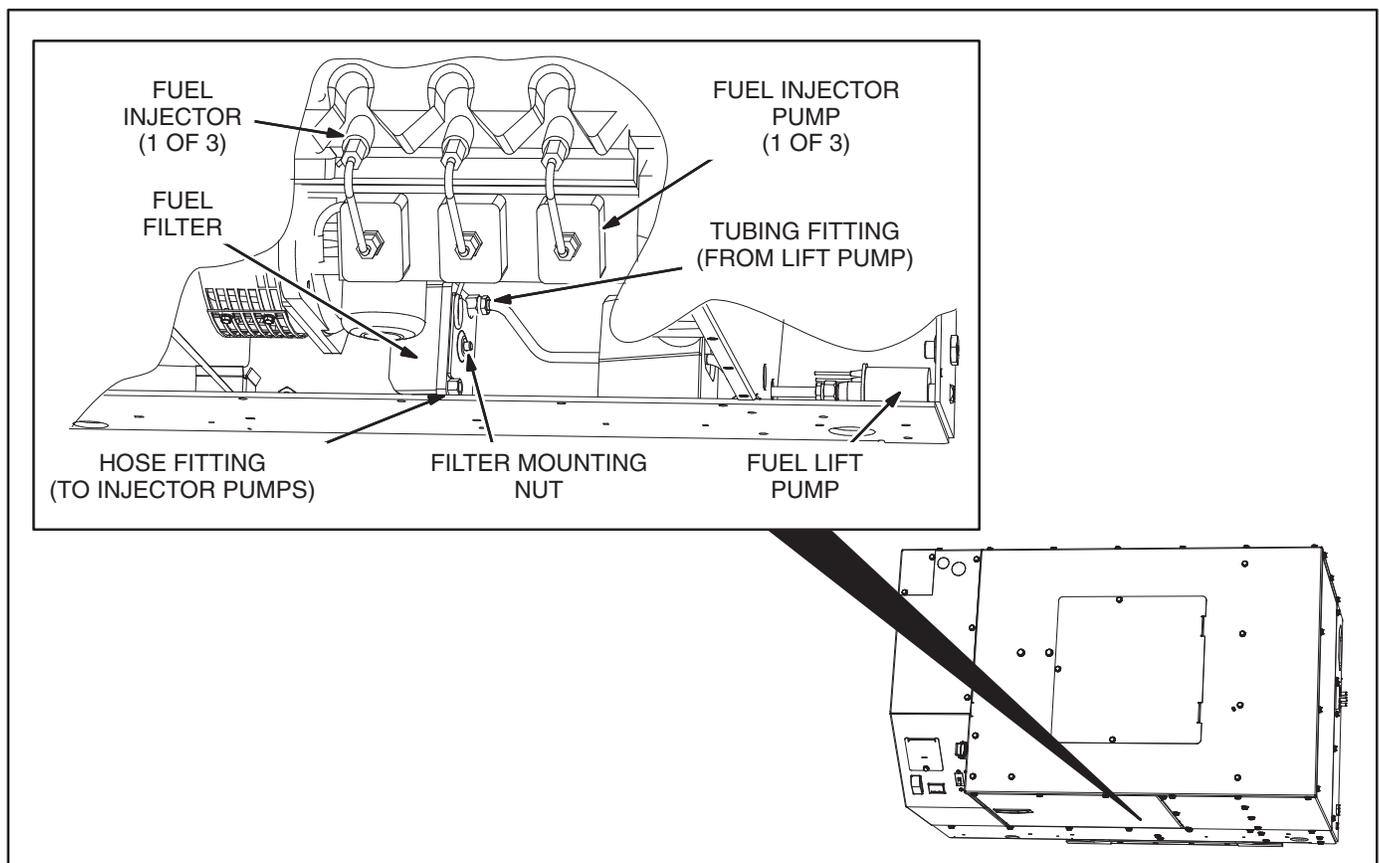


FIGURE 10. FUEL FILTER

CHANGING COOLANT

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

Use the best quality ethylene or propylene glycol antifreeze solution available. It should be fully formulated with rust inhibitors and coolant stabilizers. Use fresh water that is low in minerals and corrosive chemicals. Distilled water is best. The cooling system has a 6.1 quart (5.8 L) capacity.

Pressure Cap

Replace the pressure cap (Figure 11) every two years (seals deteriorate and leak). Proper cooling system pressure (14 psi) is essential for optimal engine cooling and minimal coolant loss.

Draining the Cooling System

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

Let the engine cool before removing the pressure cap. Relieve any remaining pressure by turning the pressure cap slowly, without pushing down. When the pressure has been relieved, push down on the cap, turn it the rest of the way and withdraw it. Then remove the coolant drain cap (Figure 11) and drain the coolant into a suitable container.

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

Clean and flush the cooling system before refilling. Radiator cleaning chemicals are available at local auto parts stores. Follow the instructions for cleaning and flushing that come with the cleaning solution.

Refilling the Cooling System

Wet the O-ring in the coolant drain cap with coolant and thread the cap on just snug with a wrench. To avoid damaging the O-ring, do not torque to more than 5 lb-ft (6.8 N-m). Replace the O-ring if snugging the cap a little tighter does not stop leakage.

Fill the system with coolant through the fill opening. Pull the hose connected to the pressure cap assembly out as far as it will go. When the coolant level reaches the fill opening, start and operate the genset for a few minutes and shut it down. Add more coolant if necessary and secure the pressure cap.

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

Coolant Level Check

Check coolant level in the recovery tank (Figure 11) before the first startup of each day and fill to the COLD mark if necessary.

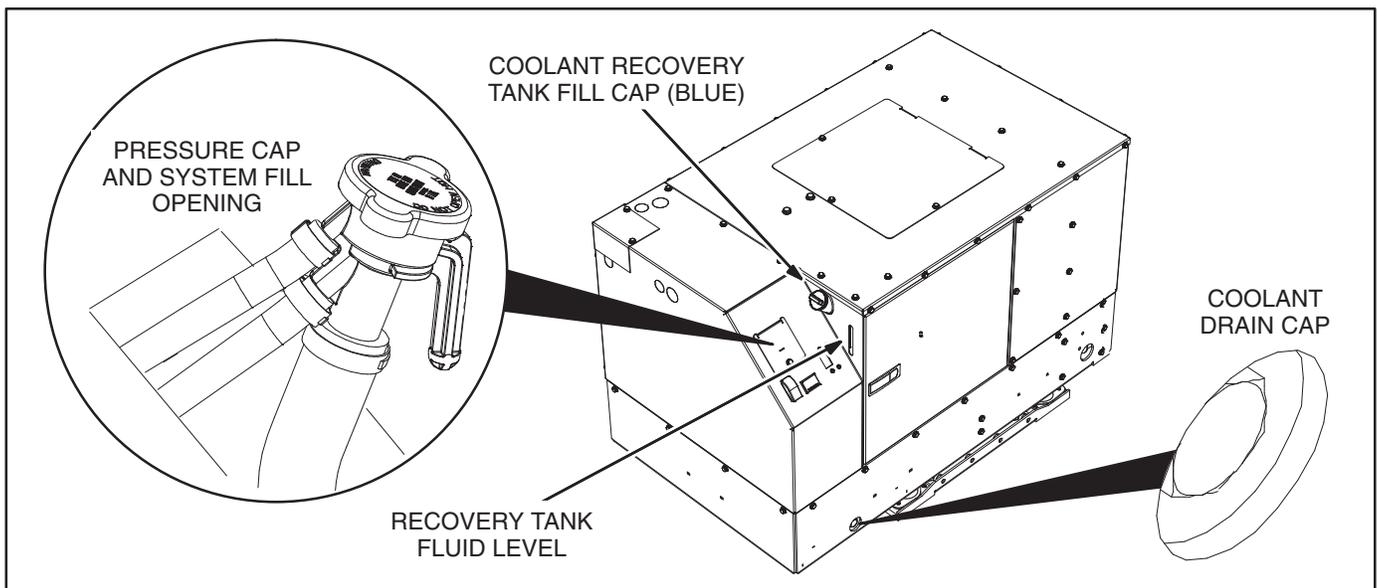


FIGURE 11. ENGINE COOLING SYSTEM FILL AND DRAIN CAPS

Troubleshooting

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

TABLE 4. TROUBLESHOOTING 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. See *How to Obtain Service* (Page 28).

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.

First-Level 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 1, 2 or 3 blinks at a time.

- **One blink** indicates shut down due to high temperature
- **Two blinks** indicates shutdown due to a loss of engine oil pressure
- **Three blinks** indicates shutdown due to some other abnormal condition.

Second-Level Fault Codes

For a 1-blink or 3-blink first-level fault code, one touch to **Stop** brings up a second-level fault code. This 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. 23** would appear as:

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

NOTE: Fault Code Nos. 1, 2 and 3 are first-level faults. Avoid interpreting them as second-level Fault Codes 11, 22 and 33. The pauses between repetitions of the fault code are longer than the pauses between the tens and units digits of the the code. For example, Fault Code 33 would appear as:

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

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.

Bypassable Faults

The genset will shut down again if it is started without first servicing the condition that caused the shutdown. There are two faults, however, which will be bypassed on a *second* attempt to restart the genset:

- **No. 23**—oil pressure switch fault
- **No. 24**—temperature sender fault.

Before making the second attempt at starting the genset, note that serious engine damage can result if the oil pressure fails or the engine overheats and the engine is not stopped.

⚠ CAUTION *Operating the genset under oil pressure switch or temperature sender fault conditions can lead to serious engine damage. Read Warranty regarding possible exclusions when operating the genset under such conditions.*

TABLE 4. TROUBLESHOOTING

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

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.
2. Check whether **Fuse F1** is blown. If it is, first check the battery connections for proper polarity: battery positive (+) to genset positive (+) and battery negative (-) to genset negative (-). 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.

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.

THE ENGINE CRANKS BUT DOES NOT START

(Fuel delivery is marginal)

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 fuel (air) leaks at all fuel fittings and tighten as necessary.
5. Replace the fuel filter.

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.

TABLE 4. TROUBLESHOOTING (CONT.)

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

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 on the genset. See **RESETTING CIRCUIT BREAKERS** (Page 9).
2. Reset or turn ON any other circuit breaker in the power supply system.

THE GENSET WILL NOT STOP RUNNING (THE RUN LIGHT IS OFF)

(The governor mechanism is stuck or binding)

Corrective Action: See an authorized Onan dealer.

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.
3. Watch the temperature gauge (optional) and run fewer appliances at the same time to keep down the engine temperature.

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 possible loss of oil pressure.)

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.

OVERVOLTAGE FAULT—CODE NO. 12

(The controller is not able to regulate to rated voltage)

Corrective Action: See an authorized Onan dealer.

TABLE 4. TROUBLESHOOTING (CONT.)

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

UNDERVOLTAGE FAULT—CODE NO. 13

(The controller is not able to regulate to rated voltage)

Corrective Action: Turn OFF the line circuit breaker on the operator's console. If the genset now runs, run it with fewer connected loads.

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, reset it if necessary, and run with fewer connected loads.

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. 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.)

STARTER SOLENOID CIRCUIT PROTECTION FAULT—CODE NO. 21

(The controller sensed a starter control circuit short)

Corrective Action: See an authorized Onan dealer.

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. Reduce the number of appliances running at the same time.
2. Replace the engine air filter and clean the spark-arrest muffler.
3. Replace the engine fuel filter.

LOW OIL PRESSURE CUTOFF SWITCH FAULT—CODE NO. 23

(The controller sensed a defective switch)

Corrective Action: See an authorized Onan dealer. Also see BYPASSABLE FAULTS (Page 20).

TABLE 4. TROUBLESHOOTING (CONT.)

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

COOLANT TEMPERATURE SENDER FAULT—CODE NO. 24

(The controller sensed a defective sender)

Corrective Action: See an authorized Onan dealer. Also see BYPASSABLE FAULTS (Page 20).

QUADRATURE SENSE FAULT—CODE NO. 27

(The controller was unable to sense the required parameter)

Corrective Action: See an authorized Onan dealer.

AC OUTPUT SENSE FAULT—CODE NO. 28

(The controller was unable to sense the required parameter)

Corrective Action: See an authorized Onan dealer.

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: See an authorized Onan dealer.

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.

TABLE 4. TROUBLESHOOTING (CONT.)

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

INVALID GENSET CONFIGURATION—CODE NO. 37

(There was a memory error in the microprocessor during self-test)

Corrective Action: See an authorized Onan dealer.

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 FAULT—CODE NO. 45

(The controller failed to sense quadrature frequency and voltage during cranking)

Corrective Action: See an authorized Onan dealer.

Specifications

	Model HDCAA	Model HDCAB
GENSET CONTROLLER: Integrated Microprocessor Based Engine and Generator Controller		
GENERATOR: Single-Bearing, 4-Pole Rotating Field, 1800 RPM		
Power (@ 1.0 power factor)	10,000 W	12,500 W
Voltage	120 / 240	120 / 240
Frequency	60 Hz	60 Hz
Number of Phases	1	1
Current	83.3 / 41.7 amps	104 / 52 amps
Line Circuit Breaker	2-pole, 45 amp	2-pole, 50 amp
FUEL CONSUMPTION:		
No-load	0.11 gph (0.41 lph)	0.11 gph (0.41 lph)
Half-load	0.62 gph (2.34 lph)	0.75 gph (2.84 lph)
Full-load	1.10 gph (4.16 lph)	1.33 gph (5.03 lph)
ENGINE: 3-Cylinder In-Line, Water-Cooled, Indirect-Injection, 4-Stroke Cycle Diesel		
Bore	3.27 in (83 mm)	
Stroke	3.62 in (92 mm)	
Displacement	91 in ³ (1,496 cc)	
Compression Ratio	22 : 1	
Fuel Injection Timing (BTDC)	19°	
Firing Order	1-3-2	
Cylinder Compression Test	370 psi (2.55 mPa) minimum @ 250 rpm	
Fuel Nozzle Injection Pressure	1900 psi (13.1 mPa)	
Valve Lash: Intake & Exhaust (cold)	0.008 in (0.20 mm)	
Oil Capacity (with filter)	6.7 quart (6.3 liter)	
Cooling System Capacity	6.1 quart (5.8 liter)	
DC SYSTEM:		
Nominal Battery Voltage	12 volts	
Minimum Battery Capacity CCA (Cold Cranking Amps)	475 amps down to 0° F (-17° C) 650 amps down to -20° F (-29° C)	
Max. Regulated Charging Current	20 amps	
Fuse F1 (control circuit)	15 amp mini-bayonet	
Fuse F2 (starter circuit)	15 amp mini-bayonet	
WEIGHT: 660 lbs (300 kg)		
SIZE (L x W x H): 41.4 x 24.5 x 27 in (105 x 62 x 68.6 cm)		
SOUND LEVEL: 68 dB(A) @ 10 ft (3m) & 54 dB(A) @ 50 ft (15m)—in “free field site” @ half load		

Emissions

This genset meets the requirements of California’s Exhaust Emissions Standards as stated on the nameplate. Figure 1 (Page 4) illustrates where this information appears on the nameplate.

California users of these gensets should be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the genset label is prohibited.

You should carefully review Operator (Owner), Installation and other manuals and information you receive with your genset. If you are unsure that the installation, use, maintenance or service of your genset is authorized, you should seek assistance from an approved Onan dealer.

California genset users may use Table 5 as an aid in locating information related to the California Air Resources Board requirements for emissions control.

TABLE 5. EMISSIONS CONTROL INFORMATION

Emissions Warranty Information	The California emissions control warranty statement is located in the same packet of information as this manual when the genset is shipped from the factory.
Engine Valve Clearance (Lash)	See <i>Specifications</i> (Page 26).
Engine Fuel Requirements	The engine is certified to operate on diesel fuel. See FUEL RECOMMENDATIONS (Page 5).
Engine Lubricating Oil Requirements	See ENGINE OIL RECOMMENDATIONS (Page 5).
Engine Adjustments	High Idle Speed. This is a service procedure requiring trained personnel and proper tools. See the Service Manual.
Engine Emission Control System	The engine emission control system consists of engine design and precision manufacture. (IFI)

How to Obtain Service

When you need service, parts, or product literature (such as the Service Manual) for your genset, contact the nearest authorized distributor. Onan has factory-trained representatives to handle your needs for genset parts and service.

Call 1-800-888-ONAN to contact the nearest Cummins/Onan or Onan-only distributor in the United States or Canada. (This automated service utilizes touch-tone phones only). Select OPTION 1 (press 1) to be automatically connected to the distributor nearest to you.

If you are unable to contact a distributor using the automated service, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS – ELECTRIC,
ENGINES – GASOLINE OR DIESEL, or
RECREATIONAL VEHICLES – EQUIPMENT,
PARTS AND SERVICE.

If you are outside North America, call Onan Corporation at 1-763-574-5000 from 7:30 AM to

4:00 PM, Central Standard Time, Monday through Friday, or fax 1-763-528-7229.

Before calling for service, have the following information available:

1. *The complete genset model number and serial number. See Model Identification (Page 4).*
2. *The date of purchase*
3. *The nature of the problem. See Troubleshooting (Page 20).*

If you have difficulty in arranging service or resolving a problem, please contact the Service Manager at the nearest Cummins/Onan distributor for assistance.

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

Onan

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