Service Manual

Cummins **Onan**

Performance you rely on.™

Portable Generator Set

EGMBB, P2400 (Spec A)
EGMBG, P3500 (Spec A)

English 9–2009 914–0500 (Issue 3)

⚠ 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

F-1260

⚠ WARNING: ⚠

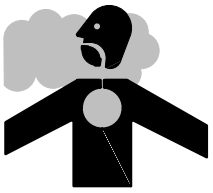
The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

⚠ WARNING

Gasoline and its vapor are flammable and explosive.

- **Keep gasoline away from heat, sparks, and flame sources.**
- **Stop and cool unit 15 minutes before refueling.**
- **Refuel carefully and only outdoors on level ground.**
- **Fuel can leak from fuel cap vent.**
  - **Do not overfill.**
  - **Do not tip unit more than 15° (6.9 inches).**
  - **Cool unit and drain fuel before transporting.**
- **Wipe up fuel leaks immediately.**

⚠ WARNING



Generator exhaust contains poisonous CO (carbon monoxide) that can cause serious injury or death.

- You cannot see, taste or smell CO.
- Operate only outdoors with exhaust directed away from people and building air intakes.
- Never operate generator inside any enclosed or semi-enclosed area. A hazardous CO level can occur even with open doors and ventilation fans.

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1 Safety Precautions

Thoroughly read the Operator Manual before operating the generator set. Safe operation and top performance can only be obtained when equipment is operated and maintained properly.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to operators, service personnel, and the equipment.

DANGER: This symbol alerts you to an immediate hazard that will result in severe personal injury or death.

WARNING: This symbol alerts you to a hazard or unsafe practice that can result in severe personal injury or death.

CAUTION: This symbol alerts you to a hazard or unsafe practice that can result in personal injury or damage to equipment or property.

1.1 Exhaust Gas Is Deadly

- Operate the generator set outdoors only. Stay away from the exhaust outlet.
- Make sure generator set exhaust will not enter windows, doors, vents, or air intakes of adjacent buildings, vehicles, or boats.
- NEVER USE THE GENERATOR SET INSIDE a home, garage, crawl space, barn, shed, cabin, boat, boat house, RV, or tent; or in a confined outdoor space such as an alley, ditch, parking garage, or courtyard; or in any other space where exhaust can accumulate. Note that HAZARDOUS CARBON MONOXIDE LEVELS FROM ENGINE EXHAUST CAN ACCUMULATE INDOORS, EVEN WHEN ALL WINDOWS AND DOORS ARE OPEN AND FANS ARE RUNNING.
- Even when you use a generator set correctly, CO may leak into the home. ALWAYS use a battery-powered or battery-backup CO alarm in the home.
- If you feel sick, dizzy, or weak after the generator set has been running, move to fresh air RIGHT AWAY. See a doctor. You could have carbon monoxide poisoning.

WARNING

Generator exhaust contains poisonous CO (carbon monoxide) that can cause serious injury or death.
- You cannot see, taste or smell CO.
- Operate only outdoors with exhaust directed away from people and building air intakes.
- Never operate generator inside any enclosed or semi-enclosed area. A hazardous CO level can occur even with open doors and ventilation fans.

1.2 Gasoline is Flammable / Explosive

- Refuel the generator set outdoors only.

- Static electric sparks caused by fuel flowing through a service station pump nozzle can ignite gasoline. Never fill the generator set with a service station pump nozzle. Instead, fill a safety tank sitting on the ground and then slowly transfer fuel to the generator set from the safety tank.
- DO NOT fill fuel tanks while the engine is running. A hot engine can ignite the fuel.
- To prevent fire due to fuel leakage, always close the fuel valve and let the generator set cool before transporting it or storing it in a confined space.
- DO NOT SMOKE OR ALLOW AN OPEN FLAME near the generator set. Keep flames, sparks, electrical switches, pilot lights, electrical arcs, arc-producing equipment, and all other sources of ignition well away.

1.3 Generator Voltage is Deadly

- DO NOT CONNECT THE GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Back-feed could cause electrocution of utility line workers and could damage equipment. An approved switching device must be used to prevent interconnections. A trained and experienced electrician must make electrical connections when the generator set is used for emergency power.
- Make sure clothing, shoes, and skin are dry when handling electrical equipment.
- Never operate the generator set in rain or snow or when it is sitting on wet ground.

1.4 Moving Parts Can Cause Severe Personal Injury or Death

- Before performing any maintenance on the generator set, disconnect the spark plug wire.
- Always keep hands away from moving parts.
- Do not wear loose clothing or jewelry while servicing the generator set. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts causing sparks, flame, and electrical shock.
- Make sure that fasteners and clamps on the generator set are tight. Keep guards in position over fans, rotors, etc.

1.5 Battery Gases Are Explosive

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

1.6 General Precautions

- Keep children away from the generator set.
- Wear hearing protection when near an operating generator set.

- Keep a multi-class ABC fire extinguisher readily at hand. Class A fires involve ordinary combustible materials, such as wood and cloth. Class B fires involve combustible and flammable liquids and gaseous fuels. Class C fires involve live electrical equipment. (ref. NFPA No. 10).
- Benzene and lead may be found in gasoline and have been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact gasoline.
- Used engine oils have been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used engine oil or its vapors.
- Keep the generator set clean and dry at all times. Excess grease and oil can catch fire and/or accumulate dirt, which can cause overheating.
- Do not store anything on the generator set, such as oil cans, oily rags, chains or wooden blocks. A fire could result or operation could be adversely affected.
- Do not work on the generator set when you are mentally or physically fatigued or have consumed alcohol or drugs.

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2 Introduction

2.1 About This Manual

This manual covers the generator sets listed on the front cover. Study this manual and observe all of its warnings and precautions. Using and maintaining the generator set properly will result in longer generator set life, better performance, and safer operation.

2.2 Model Identification

Be ready to provide the generator set model and serial numbers on the generator set nameplate when contacting Cummins Onan for parts, service, or product information. The nameplate and its location on the generator set is illustrated in the Figure below.

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

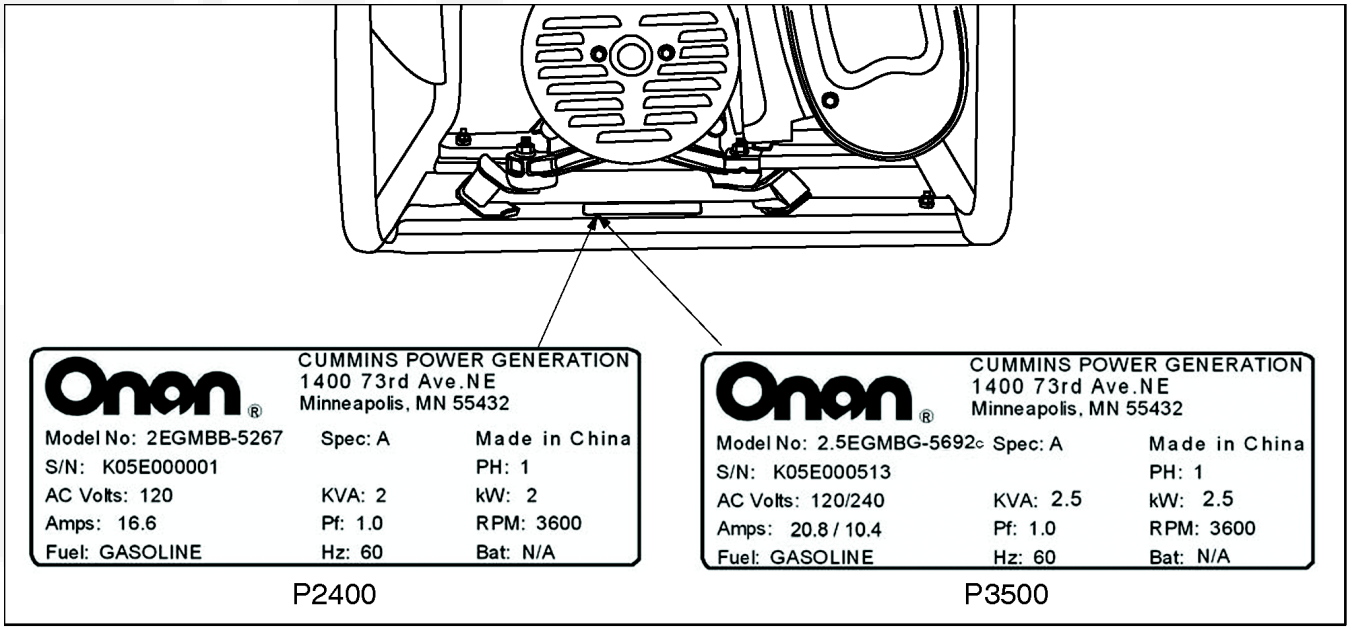


FIGURE 1. NAMEPLATE LOCATION FOR P2400 AND P3500

2.3 Fuel Requirements

Use clean, fresh unleaded gasoline with an octane rating (anti-knock index) of 87 or higher.

During part of the year, only mandated "oxygenated" gasoline may be available. While "oxygenated" gasoline is acceptable for use, it is not preferable. Using leaded gasoline will result in extra maintenance to remove combustion chamber and spark plug deposits. Do not use starting fluids and do not use gasoline or gasoline additives (de-icers) containing methanol. Methanol is corrosive to fuel system components.

WARNING: Evaporative starting fluids, such as ether, are highly explosive which can result in severe personal injury or death. Do not use starting fluids.

CAUTION: Methanol is corrosive to fuel system components. Do not use gasoline or gasoline additives containing methanol.

CAUTION: ***Avoid using leaded gasoline because of the extra engine maintenance that will be required.***

WARNING: Gasoline is highly flammable and explosive which can result in severe personal injury or death. Do not smoke if you smell gasoline or are near fuel tanks or gasoline-burning equipment, or are in the area sharing ventilations with such equipment. Keep flames, sparks, electrical switches, pilot lights, arc-producting equipment, and all other sources of ignition well away from the area.

2.4 Generator Set Assembly Instructions

1. Remove the generator set from the box.

WARNING: The generator set is heavy. Dropping the generator set can cause severe personal injury or death. Keep feet and hands clear when lifting the generator set.

2. If necessary, install the wheel kit (see the **Wheel Kit Assembly Instructions**).
3. Add oil to the generator set (see **Engine Oil Recommendations**).

CAUTION: Too little oil can cause severe engine damage. Make sure that the oil level is above the Add mark on the dipstick.

4. Add gasoline to the fuel tank (see **Fuel Requirements** on the previous page).

CAUTION: Methanol is corrosive to fuel system components. Do not use gasoline or gasoline additives containing methanol.

CAUTION: The use of leaded gasoline will require extra maintenance. Avoid using leaded gasoline.

2.5 Wheel Kit Assembly Instructions

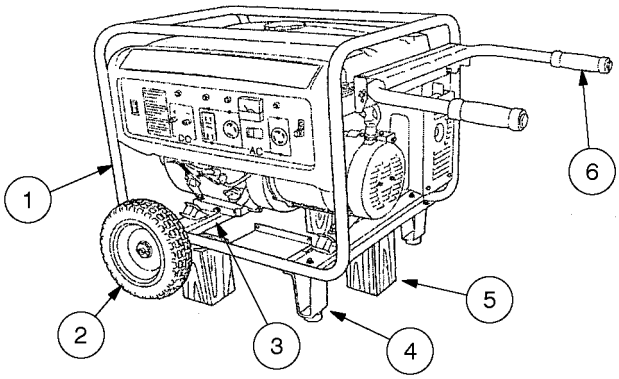
CAUTION: Improper handling of the generator set can result in equipment damage. Do not turn the generator set on the side, top, or end. Doing so may damage the generator set or cause dangerous fuel or oil leakage. Do not place items on top of the generator set. The wheel kit is designed to support the generator only.

Required Tools

- 10 and 12 mm wrenches, sockets, and ratchet
- Three 6-inch high blocks of wood
- Pliers

Installation Procedure

1. Install the handle assembly (handle, bracket, hinge pin, grips, end plugs, two cotter pins, and fasteners).
   a. Use two long bolts to attach the handle assembly to the frame.
   b. Tighten securely; do not crush the frame tube.
2. Block up the generator set under both frame tubes as shown below. Place a block under the center of the cross-member on the exhaust end.
3. Install the leg assembly.
   a. Install a leg assembly (support leg, rubber pad, and fastener) onto each side of the exhaust end cross-member.
   b. Use two bolts and nuts for each leg and tighten securely.
4. Install the wheel and axle assembly (axle assembly and wheel assemblies).
   a. Remove the rubber pads secured to the frame where the axle is attached.
   b. Remove the cotter pins and loose washers from the axle assembly (axle, two loose washers, two cotter pins, and fasteners).
   c. Install the wheels (flat free tire and wheel); make sure the long hub is to the inside.
   d. Reinstall the washers and cotter pins on the axle assembly. Bend one leg of each cotter pin.
   e. Place the axle assembly under the cross member as shown and install four bolts and nuts. Tighten securely.



No.	Description	No.	Description
1	Frame	4	Support Leg Assembly
2	Wheel Assembly	5	Wooden Blocks
3	Axle Assembly	6	Handle Assembly

FIGURE 2. INSTALLED WHEEL KIT

2.6 Engine Oil Recommendations

Use American Petroleum Institute (API) performance class SL or SJ engine oil or better. Also look for Society of Automotive Engineers (SAE) viscosity grade oil (see the table below). Choose the viscosity grade appropriate for the ambient temperature expected until the next scheduled oil change. Refer to the **Specifications** section for engine oil capacity.

Single-grade SAE 30 oil is best when temperatures are consistently above freezing. Multi-grade oils are better when wide temperature variations are expected.

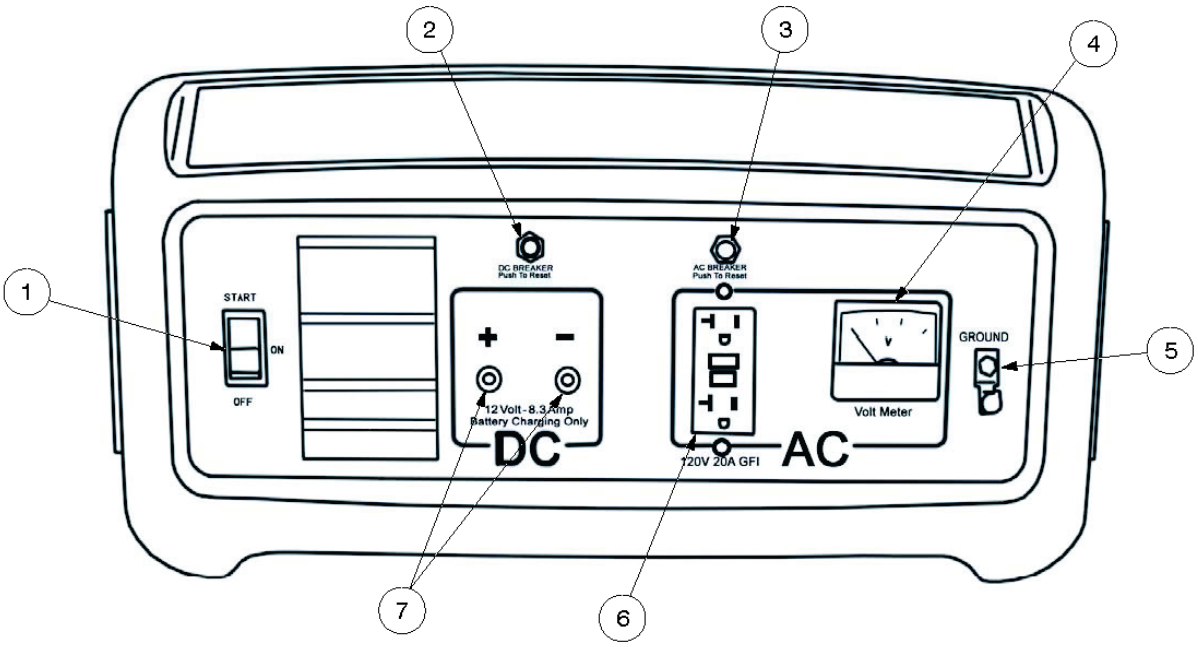
TABLE 1. OIL VISCOSITY VS. TEMPERATURE

Expected Ambient Temperatures	SAE Viscosity Grade
30° F (0 C) and higher	30
10° F to 100° F (-12° C to 38° C)	15W-40
0° F to 80° F (-18° C to 27° C)	10W-30 10W-40
-20° F to 50° F (-28° to 10° C)	5W-30

3 Starting and Running the Generator Set

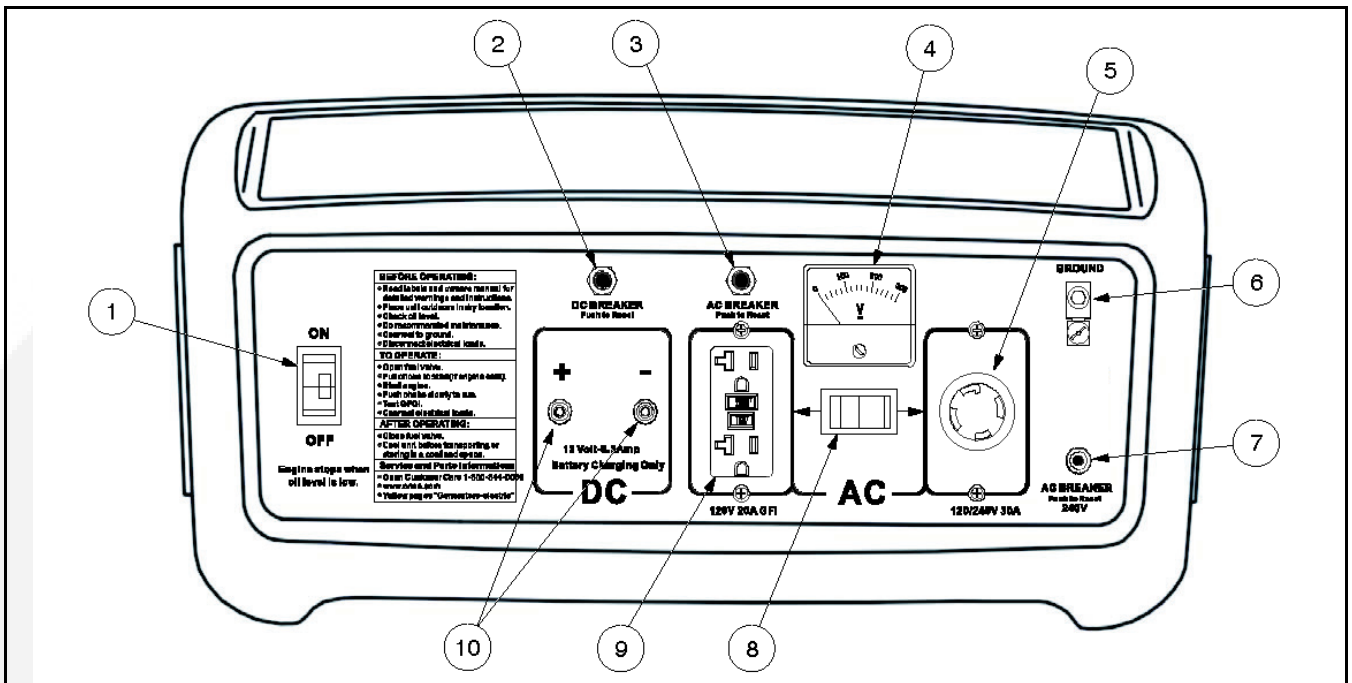
3.1 Control Panel

The control panels for the models covered in this manual are illustrated below. The control switches, meters, output receptacles, and circuit breaker reset buttons are grouped for convenient operation.



No.	Description	No.	Description
1	Start/On/Off Switch	5	Earth Ground Lug
2	DC Circuit Breaker Reset	6	Two 120 VAC, 20A Receptacles (GFCI)
3	AC Circuit Breaker Reset	7	12 Volt DC Terminals
4	AC Voltmeter		

FIGURE 3. P2400 CONTROL PANEL



No.	Description	No.	Description
1	Start/On/Off Switch	6	Earth Ground Lug
2	DC Circuit Breaker Reset	7	AC Circuit Breaker Reset
3	AC Circuit Breaker Reset	8	120 VAC or 120/240 VAC Selector Switch
4	AC Voltmeter	9	Two 120 VAC, 20A Receptacles (GFCI)
5	One 120/240 VAC 30A Receptacle (L14-30R)	10	12 Volt DC Terminals

FIGURE 4. P3500 CONTROL PANEL

3.2 Pre-Start Checks

DANGER: EXHAUST GAS IS DEADLY! THE INDOOR USE OF A GENERATOR SET CAN KILL QUICKLY.

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness, severe personal injury, and death. Symptoms of carbon monoxide poisoning include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and sleepiness***
- ***Throbbing in temples***
- ***Muscular twitching***

- ***Vomiting***
- ***Inability to think coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET INTO FRESH AIR IMMEDIATELY. Then:

- ***Seek immediate advice from poison control, medical center, or 911. Be aware that:***
- ***CO symptoms can be mistaken for flu, dehydration, food poisoning, or other illness.***
- ***Injury or death can occur later when in fresh air and apparently recovering.***
- ***Call the Fire Department to determine when it is safe to re-enter the area.***

Operate the generator set OUTDOORS only. Stay away from and upwind of the exhaust outlet.

Make sure exhaust will not enter windows, doors, vents, or air intakes of adjacent buildings, vehicles, or boats.

Never operate the generator set inside a home, garage, crawl space, barn, shed, cabin, boat, boat house, recreational vehicle, or tent; or in a confined outdoor space such as an alley, ditch, parking garage, or courtyard; or any other space where exhaust can accumulate. Hazardous carbon monoxide levels from generator set exhaust can accumulate indoors even when windows and doors are open and fans are running.

Even when you use a generator set correctly, CO may leak into the home. ALWAYS use a battery-powered or battery-backup CO alarm in the home.

If you feel sick, dizzy, or weak after the generator set has been running, more to fresh air RIGHT AWAY. See a doctor. You could have carbon monoxide poisoning.

⚠ WARNING

Generator exhaust contains poisonous CO (carbon monoxide) that can cause serious injury or death.
- You cannot see, taste or smell CO.
- Operate only outdoors with exhaust directed away from people and building air intakes.
- Never operate generator inside any enclosed or semi-enclosed area. A hazardous CO level can occur even with open doors and ventilation fans.

Before the first start of the day and after every eight hours of operation, perform GENERAL INSPECTIONS and any scheduled maintenance due, as indicated in the **Maintenance Schedule**. If the generator set has been in storage, return it to service as instructed in the **Out-of-Service Protection** section.

WARNING: Moving parts can cause severe personal injury or death. Hot exhaust parts can cause severe burns. Make sure all protective guards are properly in place before starting the generator set.

WARNING: A non-functioning GFCI, or a damaged or overloaded extension cord, can cause electrocution or fire. Test the GFCI receptacles for proper operation. Make sure all extension cords are in good condition, are rated for outdoor use, have the proper plugs, and have the proper amp and voltage ratings.

WARNING: Gasoline is highly flammable and explosive and can be ignited by static electric sparks caused by fuel flowing through a service station pump nozzle which can result in severe personal injury or death. Never fill the generator set with a service station pump nozzle. Instead, fill a safety tank sitting on the ground and then slowly transfer fuel to the generator set from the safety tank.

1. Locate the generator set outdoors in a dry, level place and chock the wheels, if so equipped.
2. Check fuel and oil levels, and fill as necessary.

WARNING: If the generator neutral supply is not grounded to earth, the user may be left without ground fault protection, which could result in serious personal injury or death. Always make sure the generator neutral supply is grounded to earth before operating the generator set.

3. Connect the grounding lug to earth ground in accordance with the local electrical code.
4. Test the GFCI for proper operation.
5. Make sure that all extension cords are in good condition, are rated for outdoor use and have the proper amp and voltage ratings, and that they are equipped with proper plugs having grounding blades.
6. Make sure all tools and appliances have been turned off or are disconnected.

3.3 Starting the Generator Set

WARNING: Operating a generator set in an inappropriate environment can result in a fire which can result in severe personal injury or death. Do not operate the generator set in hazardous environments where it could ignite flammable gasses or combustible materials. To avoid the risk of electrocution, never operate the generator set in rain or snow or when it is sitting on wet ground. Be careful not to touch or allow any combustible materials to touch the muffler which can get very hot.

CAUTION: The voltage surge at startup can damage appliances such as TVs, microwave ovens, computers, etc. Be sure to disconnect all appliances before starting the generator set.

1. Open the fuel valve (see **Figure 5**).
2. Pull the choke rod out to close the choke if the engine is cold (see **Figure 6**).
3. Verify that the On/Off switch is in the ON position.
4. With one hand on the generator, grip the recoil handle with the other hand and pull it out quickly and smoothly. Repeat as necessary until the engine starts (see **Figure 7**).
5. As the engine warms up, gradually push the choke rod in.
6. Let the engine warm up for a few minutes before connecting tools or appliances. See **Powering Tools and Appliances**.

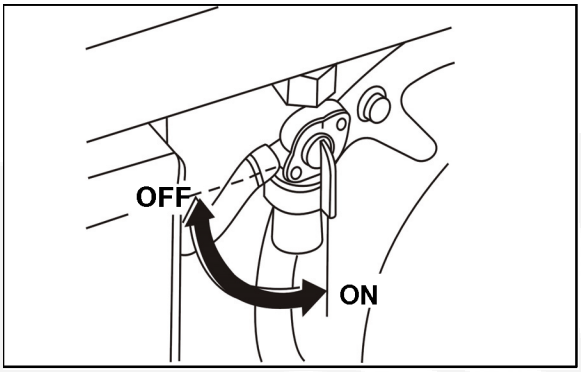
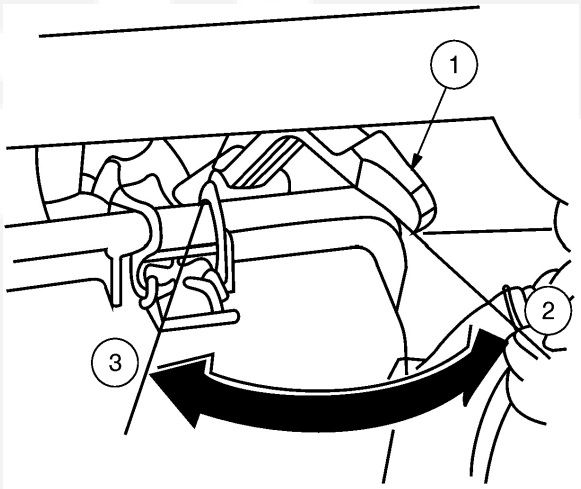


FIGURE 5. FUEL VALVE



No.	Description	No.	Description
1	Choke Lever	3	Closed
2	Open		

FIGURE 6. CHOKE ROD

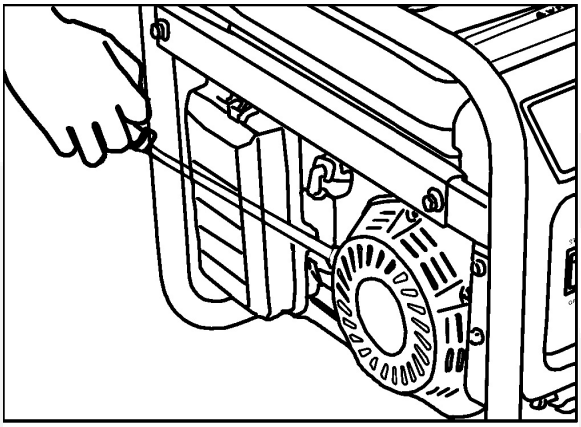


FIGURE 7. RECOIL START HANDLE

3.4 Stopping the Generator Set

1. Turn off or disconnect all tools and appliances.
2. Let the generator set run for a few minutes to cool down.
3. Stop the generator set by pressing and holding the On/Off switch in the Off position until the generator set stops.
4. Close the fuel valve.

WARNING: Gasoline is highly flammable and explosive which can result in servere personal injury or death. Always close the fuel valve when the engine is not in use to reduce the risk of fuel spillage.

3.5 Powering Tools and Appliances

CAUTION: Continuous overloading can damage the generator set due to overheating. Make sure loading is within the generator set nameplate rating.

3.5.1 Voltage Selector Switch

An AC voltage selector switch is available on P3500 portable generator sets.

To Power 120/240 Volt AC Circuits: Push the voltage selector switch on the control panel towards the 120/240 Volt output receptacle. *Power will also be available at the 120 Volt AC receptacles.* The voltmeter on the control panel will indicate approximately 240 Volts AC when the generator set is running.

To Power 120 Volt AC Circuits Only: Push the voltage selector switch on the control panel towards the 120 Volt output receptacles. The voltmeter on the control panel will indicate approximately 120 Volts AC when the generator set is running.

3.5.2 Connecting Tools and Appliances

TABLE 2. TYPICAL POWER DRAW RATINGS OF COMMON TOOLS AND APPLIANCES

Appliance or Tool	Running Watts (Rated)[1]	Starting Watts (Peak)[1]
Ceiling Fan	800	1200
Central Air Conditioner - 10,000 BTU[2]	1500	3000
Central Air Conditioner - 24,000 BTU[2]	3800	4950
Circular Saw - 7¼"	1400	2300
Clock Radio	100	-
Clothes Dryer - Gas	700	1200
Coffee Maker	1500	-
Computer - 17" Monitor	800	-
Deep Freezer	700	1000
Dishwasher	1500	1500
Electric Water Heater - 40 Gallon[2]	4000	-
Furnace Fan	800	1300
Garage Door Opener	750	1200
Hair Dryer	1250	-
Hot Plate	2100	-
Iron	1200	-
Laser Printer	950	-
Lighting	75	-
Microwave Oven	1000	-
Miter Saw - 10"	1650	2400
Oscillating Fan	200	400
Quartz Halogen Work Light	1000	-
Reciprocating Saw	1200	2000
Refrigerator/Freezer	700	1500
Security System[2]	500	-
Space Heater	1800	-
Stereo Receiver	450	-
Sump Pump	800	1200
Table Fan - 14"	200	400
Television - 27"	500	-
VCR/DVD Player	100	-
Water Well Pump - 1/3 HP (220V)[2]	1000	2000
Window Air Conditioner - 10,000 BTU	1200	2200

[1]The wattage values listed in this table are based on estimated wattage requirements. For exact wattage, check the data plate or the operator's manual for the item you wish to power.

[2]These units are usually hard-wired and require a professionally-installed transfer switch.

NOTE: Ratings apply to altitudes up to 1000 feet (304.8 m), 85°F (30°C). Total power available will decrease 3.5% for each 1000 feet (304.8 m) above 1000 feet and 2.0% for each 10°F (5.5°C) increase in ambient temperature above 85°F (30°C).

1. Make sure the tools and appliances to be connected are rated for the voltages at the generator set power output receptacles.
2. Note the kW rating on the generator set nameplate.
3. Check the power draw (watts) of each tool or appliance to be connected. The table above lists typical tool and appliance ratings in watts.
4. Add the watt ratings of all the loads that the generator set will be powering at the same time. Make sure that total wattage will not exceed the generator kW rating.

   Example: A generator set rated 2.5 kW (2500 watts) can power one 1500 watt heater, a 500 watt drill and a 100 watt light at the same time (2100 watts altogether). One of these loads probably will have to be disconnected if some other tool or appliance is to be powered.

NOTE: **A motor draws much more power when starting up than when running. It may be necessary to power fewer tools or appliances when motors and air conditioners are cycling on and off.**

CAUTION: *Excessive power draw can overload the generator set. A motor draws much more power when starting up than when running. It may be necessary to power fewer tools or appliances when motors and air conditioners are cycling on and off.*

5. Connect the AC power cords to the appropriate receptacles on the control panel. See **Grounding**.

3.5.3 High Altitude

Maximum power decreases roughly four percent every 1000 feet (310 meters) of increase in elevation above sea level. When operating the generator set at altitudes above 1000 feet, it may be necessary to power fewer loads at the same time.

3.6 Charging Batteries

To reduce arcing, always stop the generator set before connecting or disconnecting the battery to be charged. Connect the battery to be charged to the DC terminals on the control panel. Make sure polarity is correct: positive (+) to positive (+); negative (**–**) to negative (**–**).

WARNING: ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals can ignite battery gases. Ventilate the area before working on batteries. Wear safety glasses and do not smoke. Always stop the generator set before disconnecting the battery. Always disconnect the negative (–) cable first and reconnect it last.***

NOTE: **The battery on electric-start models has its own charging circuit and therefore must not be connected to the DC charging terminals.**

3.7 Circuit Breakers

FIGURE 8. AC AND DC CIRCUIT BREAKERS

If too many tools or appliances are connected, or a tool or appliance fails due to a short circuit, one or more of the AC or DC circuit breakers on the control panel will trip. Disconnect or turn off as many tools and appliances as possible and reset the circuit breaker by pushing the reset button back in. (It takes at least 10 seconds after tripping to reset.) Turn on or reconnect only as many tools and appliances as the generator set can power.

A tool or appliance probably has a short if it causes a circuit breaker to immediately trip when connected.

WARNING: Short circuits in faulty electrical tools and appliances can cause electrocution or fire. Read and follow the tool and appliance manufacurer's instructions and warnings regarding use, maintenance, and proper grounding.

3.8 Grounding

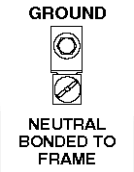


FIGURE 9. EARTH GROUND LUG

Ground the generator set to earth ground by connecting a suitable ground wire to the ground lug terminal on the generator set control panel. The other end of the wire must be connected to a suitable earth ground according to local electrical codes.

Do not connect grounds from tools or appliances to the Ground Lug terminal. Extension cords for tools or appliances with grounding blades must have grounding blades.

WARNING: If the generator neutral supply is not grounded to earth, the user may be left without ground fault protection, which could result in serious personal injury or death. Always make sure the generator neutral supply is grounded to earth before operating the generator set.

3.9 Low Oil Shutdown

The generator set automatically stops if it senses low oil level. If the engine stops while running, or starts but then stops, check the oil level and add oil as necessary. See the **Maintenance** section of this manual.

3.10 Electrical Interference with Communications or Appliances

If the generator set causes electrical interference with communications devices, move the generator set and device farther apart or shut down the generator set while the device is operating.

3.11 Exercising the Generator Set

Exercise the generator set at least two hours every month if use is infrequent. Run it at approximately 50 percent capacity. A single two-hour exercise period is better than several shorter periods. Exercising a generator set 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.

3.12 Engine Break-In

Proper engine break-in is necessary for top performance.

1. Operate the generator set as it is intended to be operated. However, for the first 1-1/2 hours, if possible, run the generator set at 50 percent capacity, occasionally operating at full power for brief periods. Avoid prolonged low-power operation during break-in.
2. Make sure the engine has oil of the proper viscosity for the ambient temperature (see **Engine Oil Recommendations**).
3. Check the oil level twice a day or after every 4 hours of operation during the first 20 hours of operation. Change the engine oil after the first 20 hours of operation.

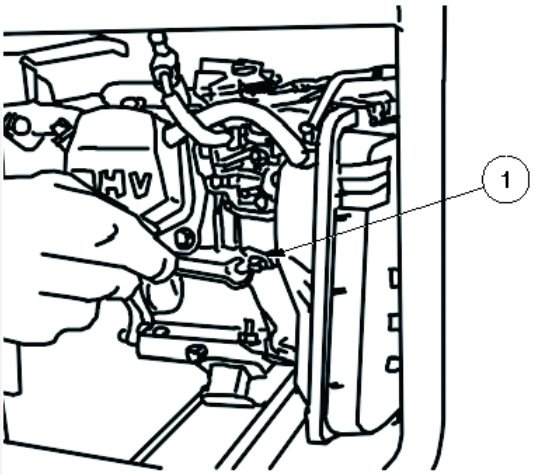
3.13 Out-of-Service Protection

If you are unable to exercise the generator set regularly, and it will not be in use for more than 120 days, the following storage procedure is recommended. Failure to provide out-of-service protection can result in difficult starting, rough engine operation, and reduced engine life.

3.13.1 Storing the Generator Set

WARNING: Fuel additives can cause a risk of personal injury. Read and follow the manufacturer's instructions.

1. Add a fuel preservative and stabilizer to the fuel tank, or let the generator set run out of fuel. Follow the manufacturer's instructions for using the fuel additive.
2. Shut the fuel valve and drain the carburetor bowl (see **Figure 10**).
3. Remove the spark plug. Squirt one tablespoon (about 30 cm^3) of clean engine oil into the spark plug hole. Turn the engine over several revolutions. Replace the spark plug. Pull the recoil starter handle out slowly until compression is felt.
4. Change engine oil and attach a tag indicating the viscosity of oil used.
5. Store the generator set in a dry, protected area.



No.	Description
1	Fuel Drain Bolt

FIGURE 10. CARBURETOR DRAIN

3.13.2 Returning the Generator Set to Service

1. Check the tag on generator set to verify that oil viscosity is correct for the current ambient temperature. Add or change oil as necessary.
2. Clean the air cleaner if dirty.
3. Open the fuel valve.
4. Start the generator set. Initial start-up may be rough and smoky due to the extra oil in the cylinder. Remove and clean the spark plug if necessary.

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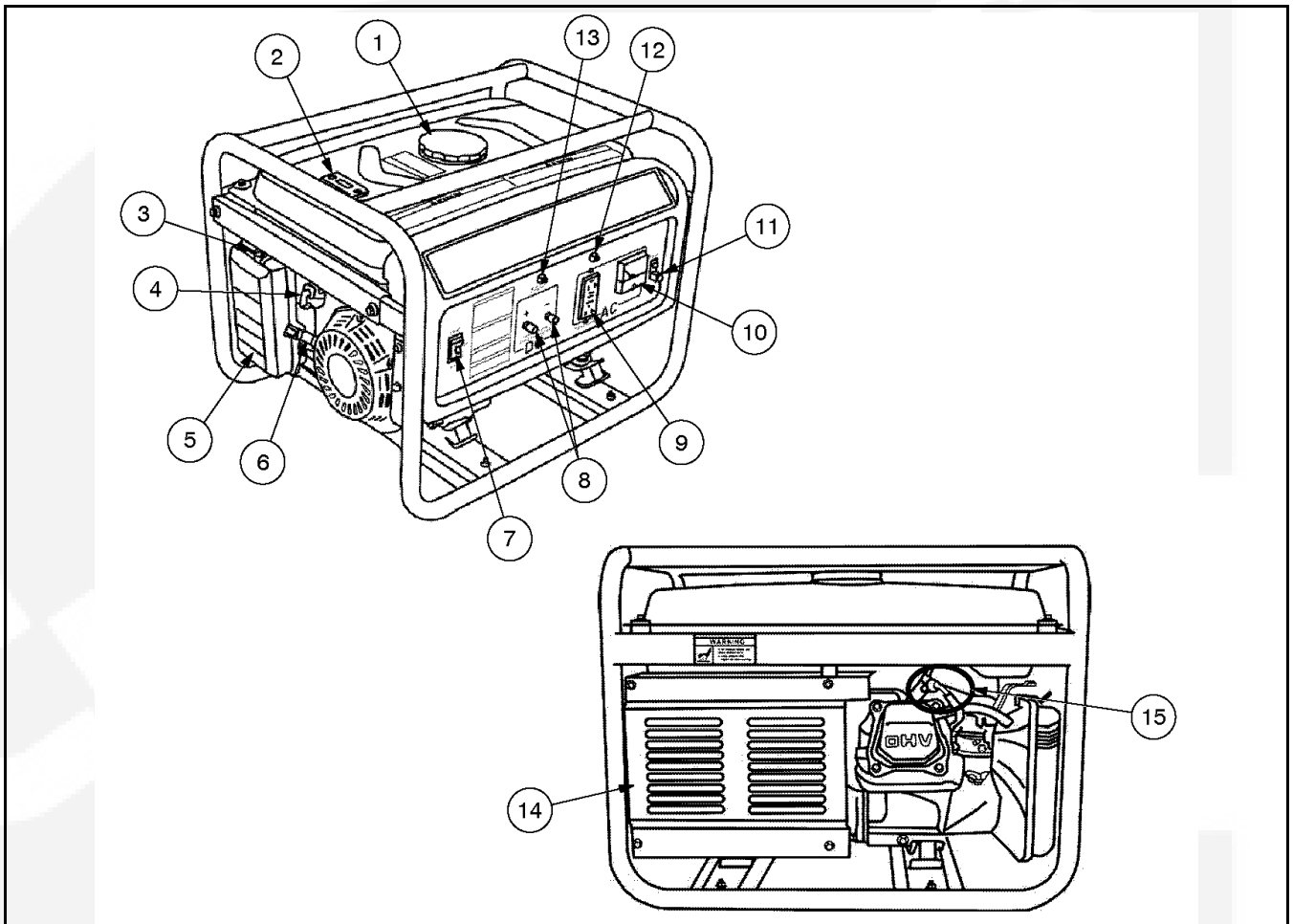
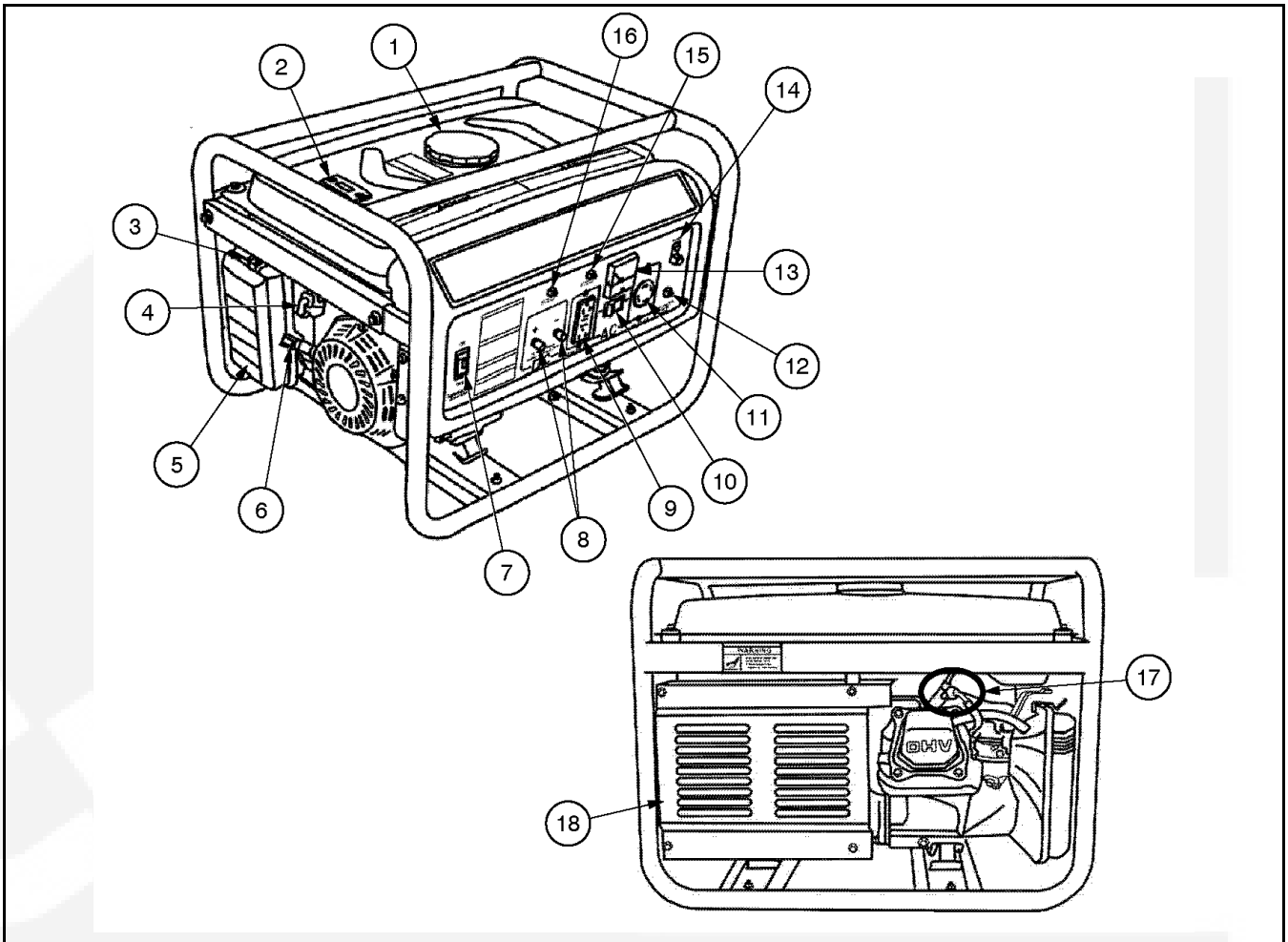
4 Generator Components



No.	Description	No.	Description
1	Fuel Tank Cap	9	120 VAC Receptacle (GFCI)
2	Fuel Gauge	10	AC Voltmeter
3	Choke Lever	11	Earth Ground Lug
4	Fuel Valve	12	AC Breaker Reset Switch
5	Air Cleaner	13	DC Breaker Reset Switch
6	Recoil Starter Grip	14	Muffler
7	On / Off Switch	15	Spark Plug Boot
8	12 Volt DC Terminals		

FIGURE 11. P2400 COMPONENTS



No.	Description	No.	Description
1	Fuel Tank Cap	10	Voltage Select Switch
2	Fuel Gauge	11	AC Receptacle (240 VAC)
3	Choke Lever	12	AC Breaker Reset Switch
4	Fuel Valve	13	AC Voltmeter
5	Air Cleaner	14	Earth Ground Lug
6	Recoil Starter Grip	15	AC Breaker Reset Switch
7	On / Off Switch	16	DC Breaker Reset Switch
8	12 Volt DC Terminals	17	Spark Plug Boot
9	120 VAC Receptacle (GFCI)	18	Muffler

FIGURE 12. P3500 COMPONENTS

5 Specifications

TABLE 3. P2400 (EGMBB) AND P3500 (EGMBG) SPECIFICATIONS

GENERATOR	P2400 (EGMBB)	P3500 (EGMBG)
AC OUTPUT:		
Frequency (Hertz)	60 Hz	60 Hz
Voltage	120 Volts	120 / 240 Volts
Rated Power	2000 Watts	2500 Watts
Rated Current	16.6 Amps	20.8 / 10.4 Amps
DC OUTPUT:	12 VDC / 8.3 Amps	12 VDC / 8.3 Amps
ENGINE		
Engine Speed (RPM)	3600	3600
Fuel	Gasoline	Gasoline
Engine Oil Capacity*	0.63 US qt (0.6 L)	0.63 US qt (0.6 L)
Spark Plug Type	F7RTC	F7RTC
Spark Plug Gap	0.028 in. (0.7 mm)	0.028 in. (0.7 mm)
Engine Valve Lash (Intake and Exhaust)	0.0039 –0.006 inches (0.10 – 0.15 mm)	0.0039 –0.006 inches (0.10 – 0.15 mm)
Ignition Timing (fixed)	20° BTDC	20° BTDC
Starting System	Recoil	Recoil
Displacement	197 cc	197 cc
GENERATOR SET		
Dry Weight	99.9 lb (45 kg)	106.6 lb (48 kg)
Dimensions:		
Length	24.1 inches (612 mm)	24.1 inches (612 mm)
Width	19.6 inches (497 mm	19.6 inches (497 mm
Height	19.3 inches (490 mm)	19.3 inches (490 mm)
Fuel Tank Capacity	4 US Gal (15 L)	4 US Gal (15 L)
Operating Time at Rated Output	13 Hours	12 Hours
* See **Engine Oil Recommendations** for recommended engine oil type.		

TABLE 4. FUEL CONSUMPTION AND RUN TIME VS. PERCENT LOAD - P2400 (EGMBB) MODELS

Tank Capacity	Fuel Rate	Percent Load				
		100%	75%	50 %	25 %	0 %
15.1L	Grams / hr	1125	980	910	830	740
	Liter / Hr	1.40	1.30	1.20	1.10	1.00
	Gallons / hr	0.37	0.35	0.32	0.30	0.26
	Estimated Run Time (hr)	10.90	11.40	12.30	13.50	15.10

TABLE 5. FUEL CONSUMPTION AND RUN TIME VS. PERCENT LOAD - P3500 (EGMBG) MODELS

Tank Capacity	Fuel Rate	Percent Load				
		100%	75%	50 %	25 %	0 %
15.1L	Grams / hr	1153	1033	947	839	744
	Liter / Hr	1.60	1.40	1.30	1.10	1.00
	Gallons / hr	0.41	0.37	0.34	0.30	0.27
	Estimated Run Time (hr)	9.70	10.80	11.80	13.30	15.00

6 Dimensions and Torques

6.1 Engine Dimensions

TABLE 6. DIMENSIONS AND TORQUES FOR EGMBB (P2400) AND EGMBG (P3500) PORTABLE GENERATOR SETS

Part	Item		Factory Specification	Allowable Limit
Engine	Maximum Speed		3750 ±150 rpm	-
	Idle Speed		1400 ±150 rpm	-
	Cylinder Compression		6.0-8.5 kg/cm^2 (85.4 – 121 lbs/in^2) at 600 rpm	-
Cylinder	Sleeve I.D.		68.015 mm (2.6778 in)	68.165 mm (2.6837 in)
Cylinder Head	Warpage		-	0.10 mm (0.004 in)
Piston	Skirt O.D.		67.985 mm (2.6766 in)	67.845 mm (2.6711 in)
	Piston-to-Cylinder Clearance		0.030 - 0.050 mm (0.0012 - 0.0020 in)	0.12 mm (0.005 in)
	Piston Pin Bore I.D.		18.002 mm (0.7087 in)	18.048 mm (0.7105 in)
	Pin O.D.		17.998 mm (0.7086 in)	17.954 mm (0.7068 in)
	Piston-to-Piston Pin Bore Clearance		0.004 - 0.016mm (0.00016 - 0.0006 in)	0.06 mm (0.002 in)
Piston Rings	Ring Side Clearance Top/Second/Oil		0.015 - 0.045 mm (0.0006 - 0.0018 in)	0.15 mm (0.0006 in)
	Ring End Gap	Top/Second Oil	0.2 - 0.4 mm (0.008 - 0.016 in)	1.0 mm (0.04 in)
	Ring Width	Top/Second	1.5 mm (0.06 in)	1.37 mm (0.054 in)
		Oil	2.5 mm (0.10 in)	2.37 mm (0.093 in)
Connecting Rod	Small End I.D. (Pin End)		18.007 mm (0.7089 in)	18.07 mm (0.711 in)
	Big End I.D. (Crankshaft)		30.015 mm (1.1817 in)	30.0667 mm (1.1837 in)
	Big End Oil Clearance		0.030 0.050 mm (0.0012 - 0.0020 in)	0.12 mm (0.0048 in)
	Big End Side Clearance		0.1 - 0.7 mm (0.004-0.028 in)	1.1 mm (0.043 in)

Crankshaft	Crankshaft O.D. (Connecting Rod Large End)		29.985 mm (1.181 in)	29.92 mm (1.178 in)
Valves	Valve Lash	IN	0.15 ±0.02 mm (0.006 ±0.001 in)	-
		EX	0.20 ±0.02 mm (0.008 ±0.001 in)	-
	Stem O.D.	IN	5.48 mm (0.216 in)	5.318 mm (0.2094 in)
		EX	5.47 mm (0.215 in)	5.275 mm (0.2077 in)
	Guide I.D.	IN/EX	5.50 mm (0.217 in)	5.572 mm (0.2194 in)
	Stem Clearance	IN	0.02 - 0.044 mm (0.0008 - 0.0017 in)	0.10 mm (0.004 in)
		EX	0.06 - 0.087 mm (0.0024 - 0.0034 in)	0.12 mm (0.005 in)
	Seat Wdith		0.8 mm (0.03 in)	2.0 mm (0.08 in)
	Spring Free Length		30.0 mm (1.18 in)	28.5 mm (1.122 in)
Camshaft	Cam Height	IN	27.7 mm (1.09 in)	27.45 mm (1.081 in)
		EX	27.75 mm (1.093 in)	27.5 mm (1.083 in)
	Camshaft O.D.		13.984 mm (0.5506 in)	13.916 mm (0.5479 in)
Crankcase Cover	Camshaft-Bearing I.D.		14.0 mm (0.55 in)	14.048 mm (0.5531 in)
Spark Plug	Gap		0.7 - 0.8 mm (0.028 - 0.031 in)	-
Ignition Coil	Resistance	Primary Coil	0.8 - 1.0 Ω	-
		Secondary Coil	5.9 - 7.1 KΩ	-
	Air Gap (At Flywheel)		0.4 ±0.2 mm (0.016 ±0.008 in)	-

6.2 Generator Dimensions

TABLE 7. DIMENSIONS FOR P2400 (EGMBD) 2 KW GENERATORS

Part	Item	Factory Specification
Main winding (R / Bu)	Resistance	0.51 - 0.53 Ω
Field winding	Resistance	40 - 50 Ω
Exciter winding (Bu / Bu)	Resistance	3.1 - 3.3 Ω
DC Winding (G / G)	Resistance	0.4 - 0.6 Ω

Carbon brush	Brush length	5-9 mm

TABLE 8. DIMENSIONS FOR P3500 (EGMBE) 2.5 KW GENERATORS

Part	Item	Factory Specification
Main winding I (Br / W)	Resistance	0.76 - 0.79 Ω
Main winding II (R / Bu)	Resistance	0.76 - 0.79 Ω
Field winding	Resistance	35 - 45 Ω
Exciter winding (Bu / Bu)	Resistance	1.5 - 1.7 Ω
DC winding (G / G)	Resistance	0.4 - 0.6 Ω
Carbon brush	Brush length	5 - 9 mm

6.3 Torque Specifications

Part	Fastener Size	Torque Values N•m (kg•cm, ft·lb)
Cylinder head bolt	8×1.25×55 mm	26-28 (260 - 280, 18.8 - 20.2)
Pivot bolt	6×0.5 mm	8 - 12 (80 - 120, 5.8 - 8.7)
Pivot adjusting nut	6×1.25 mm	22 - 26 (220 - 260, 15.9 - 18.8)
Crankcase cover bolt	8×1.25×32 mm	24 - 26 (240 - 260, 17.4 - 18.8)
Connecting rod bolt	7×1.25 mm	12 - 14 (120 - 140, 8.7 - 17.4)
Air cleaner wing nut	6×1.0 mm	7 - 10 (70 - 100, 5.1 - 7.2)
Air cleaner mounting nut	6×1.0 mm	7 - 10 (70 - 100, 5.1 - 7.2)
Muffler mounting bolt	8×1.25 mm	20 - 28 (200 - 280, 14.5 - 20.2)
Oil drain bolt	10×1.5 mm	20 - 25 (200 - 250, 14.5 - 18.1)
Fuel tank mounting bolt/ nut	6×1.0 mm	8 - 12 (80 - 120, 5.8 - 8.7)
Fuel valve joint nut	10×1.25 mm	20 - 25 (200 - 250, 14.5 - 18.1)
Oil level switch mounting nut	10×1.25 mm	8 - 12 (80 - 120, 5.8 - 8.7)
Flywheel mounting nut	14×1.25 mm	80 - 90 (800 - 900, 58 - 865.3)

6.4 Standard Torque Specifications

Standard torque values	5 mm bolt, nut	4 - 7 (40 - 70, 2.9 - 5.1)
	6 mm bolt, nut	8 - 12 (80 - 120, 5.8 - 8.7)
	8 mm bolt, nut	20 - 28 (200 - 280, 14.5 - 20.2)
	10 mm bolt, nut	35 - 40 (350 - 400, 14.5 - 20.2)
	12 mm bolt, nut	50 - 60 (500 - 600, 36.2 - 43.4)

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7 Maintenance

7.1 Maintenance Schedule

Periodic maintenance is essential for top performance. Use the table below as a guide. Under hot or dusty operating conditions, some maintenance operations should be performed more frequently, as indicated by the footnotes in the table.

Keep a log of maintenance performed and the hours run. Recording maintenance will help you keep it regular and provide a basis for supporting warranty claims. A **Maintenance Record** form is included at the back of this manual.

WARNING: Accidental starting of the generator set during maintenance can cause severe personal injury or death. Before performing maintenance, disconnect the spark plug wire from the spark plug. For electric start models, disconnect both of the generator set starting battery cables. To reduce the risk of arcing, remove the negative (–) cable first and reconnect it last.

WARNING: Contact with a hot generator set can cause severe burns. Always shut down the generator set and allow it to cool before performing any maintenance or service.

TABLE 9. PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	SERVICE INTERVAL					
	EACH USE	FIRST MONTH OR 20 HOURS	EVERY 3 MONTHS OR 50 HOURS	EVERY MONTH	EVERY 6 MONTHS OR 100 HOURS	EVERY YEAR OR 300 HOURS
General Inspection	X [1]					
Check Oil Level	X					
Test GFCI	X					
Change Engine Oil		X			X	
Clean Air Filter			X [2]			
Clean Cylinder Cooling Fins			X [2]			
Clean Spark Plug					X	
Clean the Spark Arrestor					X	
Clean Fuel Sediment Cup						X [3]
Clean Fuel Tank						X [3]
Adjust Valve Lash						X [3]
Check fuel line	Every 2 years (Replace if necessary) [3]					

1. See **General Inspections**.
2. Service more frequently when used in dusty environments.
3. These items must be performed by a trained and experienced mechanic (A list of authorized Cummins Onan dealers is available at www.cumminsonan.com).

7.2 General Inspections

The operator should check the following before the first start of the day and after every eight hours of operation:

1. Look for fuel leaks around the fuel tank, fuel hose, fuel valve, and carburetor. Close the fuel valve and repair leaks immediately.
2. Look and listen for exhaust leaks while the engine is running. Have all leaks repaired before continuing operation.

WARNING: Contact with a hot generator set can cause severe burns. Always allow the generator set to cool before performing any maintenance or service.

3. Check for dirt and debris and clean as necessary.

CAUTION: A clogged flywheel air inlet screen or dirty cooling fins can cause overheating and engine damage. Keep the cooling fins and air inlet screen clean.

4. Check the engine oil level and add oil as necessary. See **Changing Engine Oil**.

7.3 Engine Oil

7.3.1 Engine Oil Recommendations

Use American Petroleum Institute (API) performance class SL or SJ engine oil or better. Also look for Society of Automotive Engineers (SAE) viscosity grade oil (see the table below). Choose the viscosity grade appropriate for the ambient temperature expected until the next scheduled oil change. Refer to the **Specifications** section for engine oil capacity.

Single-grade SAE 30 oil is best when temperatures are consistently above freezing. Multi-grade oils are better when wide temperature variations are expected.

TABLE 10. OIL VISCOSITY VS. TEMPERATURE

Expected Ambient Temperatures	SAE Viscosity Grade
30° F (0 C) and higher	30
10° F to 100° F (-12° C to 38° C)	15W-40
0° F to 80° F (-18° C to 27° C)	10W-30 10W-40
-20° F to 50° F (-28° to 10° C)	5W-30

7.3.2 Checking Engine Oil Level

Check the oil level BEFORE EACH USE with the generator set on a level surface and with the engine stopped.

1. Remove the oil filter cap the wipe the dipstick clean.
2. Check the oil level by inserting the dipstick into the filler neck without screwing it in.
3. If the level is low, add enough of the recommended oil so that oil level is at the upper mark on the dipstick.

WARNING: Used motor oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Thoroughly wash your hands with soap and water as soon as possible after handling used oil.

7.3.3 Changing Engine Oil

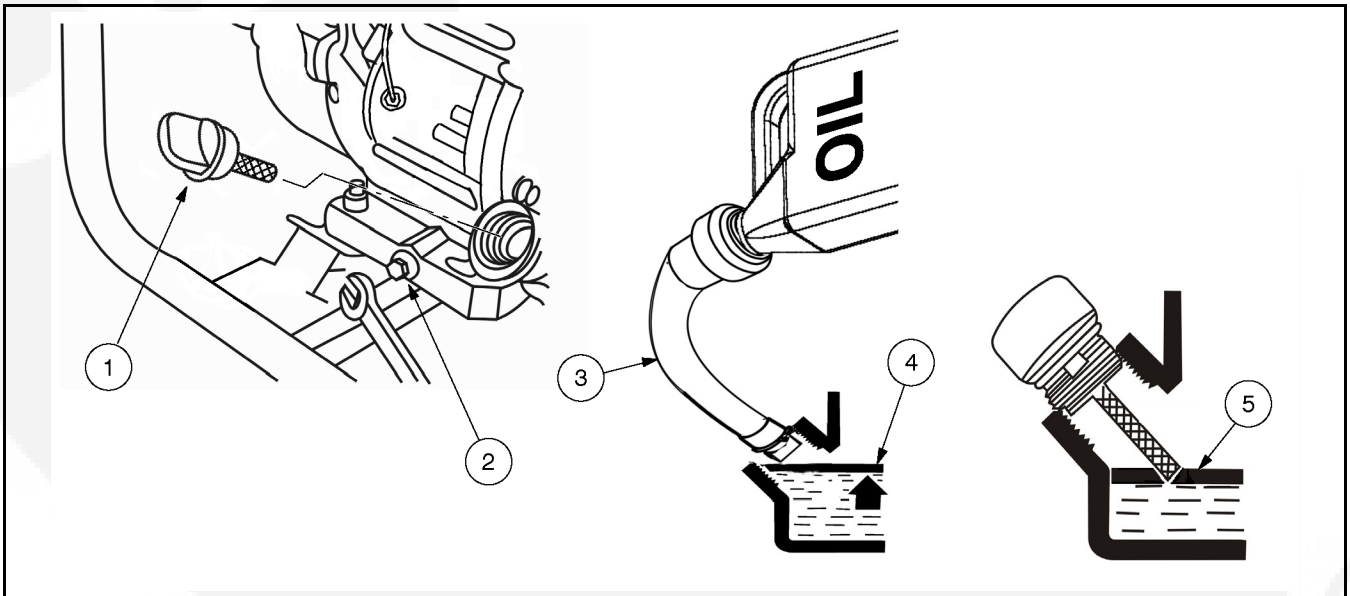
NOTE: Drain the oil while the engine is still warm to assure rapid and complete draining.

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

1. Remove the oil fill cap and drain plug.
2. Drain the oil from the crankcase.
3. Reinstall the drain plug securely.
4. Add new oil up to the bottom edge of the oil fill hole with the engine stopped and in a level position.
5. Reinstall the oil fill cap and tighten it securely.

Engine Oil Capacity = 1.16 US quart (1.1 liters).

Recommended Engine Oil: SAE 10W30 is recommended for general, all temperature use: American Petroleum Institute (API) SG - SF/CC - CD.



No.	Description	No.	Description
1	Oil Filler Cap	4	Upper Level
2	Oil Drain Bolt	5	Lower Level
3	Oil Fill Tube		

FIGURE 13. OIL CHECK, FIL, AND DRAIN

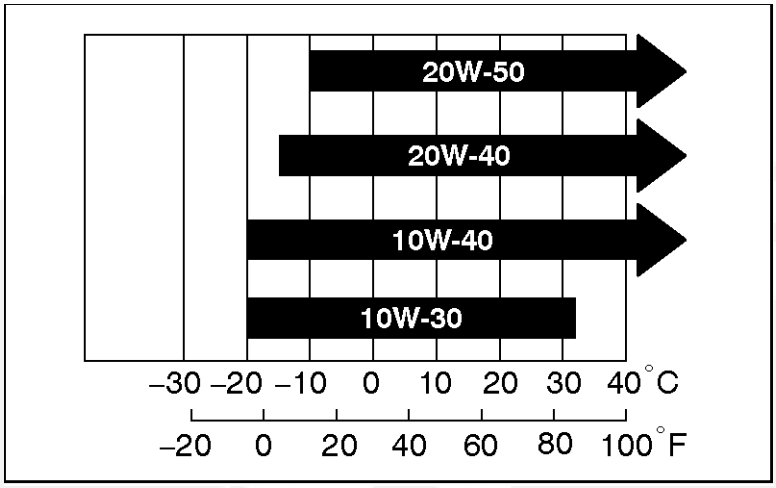


FIGURE 14. OIL VISCOSITY VS. TEMPERATURE

WARNING: Used motor oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Thoroughly wash your hands with soap and water as soon as possible after handling used oil.

7.4 Air Filter Maintenance

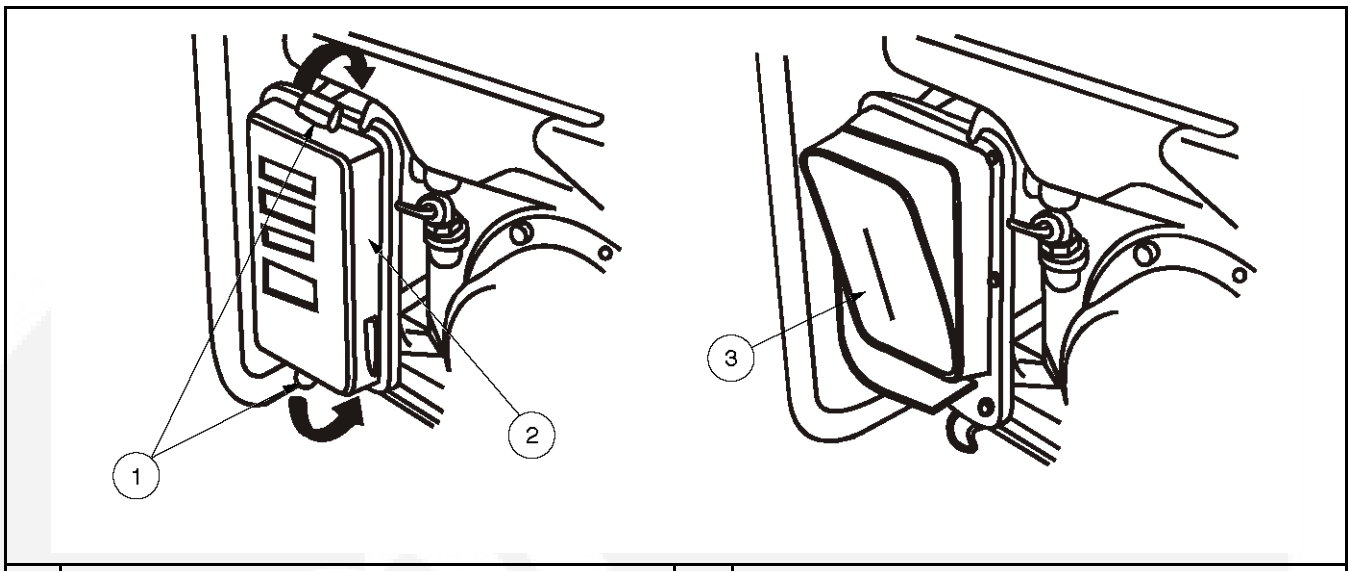
Refer to the **Maintenance Schedule** for scheduled air filter maintenance. Clean more often in dusty environments.

CAUTION: A dirty air cleaner restricts air flow to the carburetor. To prevent carburetor malfunction, service the air cleaner regularly. Service more frequently when operating the generator set in extremely dusty areas.

WARNING: Using gasoline or flammable solvents to clean components can cause a fire or explosion, which can result in severe personal injury or death. Only use soapy water or a nonflammable solvent for cleaning components.

CAUTION: Running the engine without an air cleaner causes rapid engine wear. Never run the engine without the air cleaner installed.

1. Remove the filter cover (Item 2 in **Figure 15**) by unsnapping the two spring clips (Item 1).
2. Remove the two foam filter elements (Item 3) and thoroughly wash them with soap and water. Let them dry thoroughly.
3. Knead in 1 teaspoon (5 cm^3) of clean engine oil into each foam filter element. The oil should be distributed evenly throughout each filter element.
4. Reinstall the filter elements, the gray filter first (finer pores), and then the black filter (larger pores).
5. Secure the cover with the spring clips.



No.	Description	No.	Description
1	Clip	3	Air Filter Element
2	Air Filter Cover		

FIGURE 15. AIR FILTER

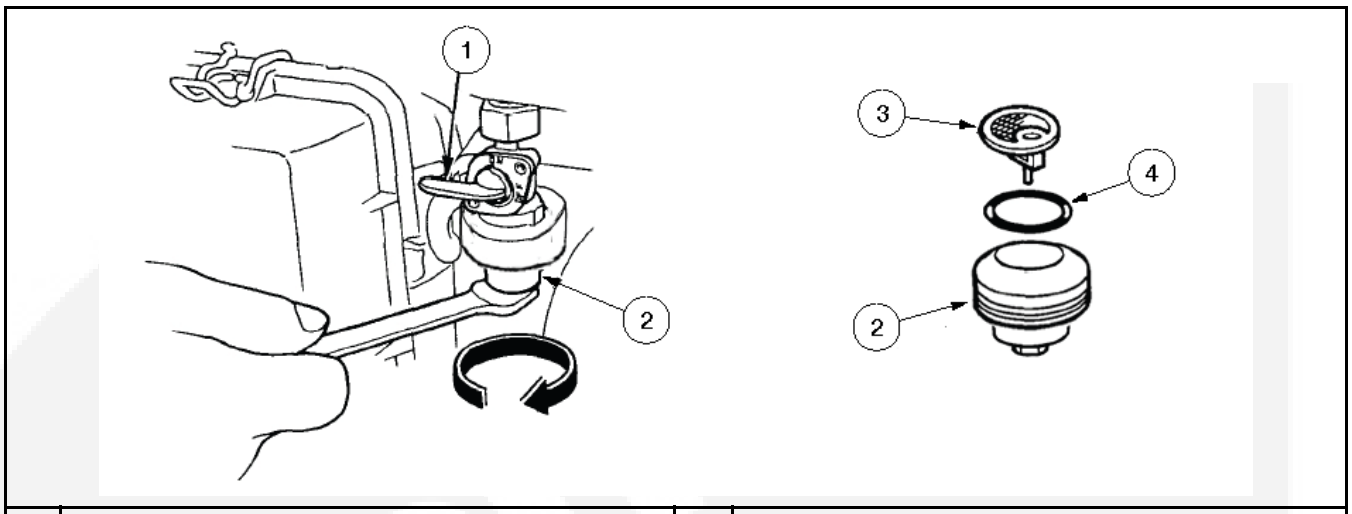
7.5 Fuel Sediment Cup Cleaning

The sediment cup prevents dirt or water which may be in the fuel tank from entering the carburetor. If the engine has not been run for a long time, the sediment cup should be cleaned. Refer to the **Maintenance Schedule** for scheduled fuel sediment cup cleaning.

WARNING: Gasoline is highly flammable and explosive which can result in severe personal injury or death. Do not smoke if you smell gasoline or are near fuel tanks or gasoline-burning equipment, or are in the area sharing ventilations with such equipment. Keep flames, sparks, electrical switches, pilot lights, arc-producting equipment, and all other sources of ignition well away from the area.

WARNING: Gasoline is highly flammable and explosive which can result in severe personal injury or death. After reassembly, check for leaks and make sure the area is dry before starting the engine.

1. Turn the fuel valve to the OFF position. Remove the sediment cup, and o-ring.
2. Clean the sediment cup and o-ring in a nonflammable or high flash-point solvent.
3. Reinstall the o-ring and sediment cup.
4. Turn the fuel valve ON and check for leaks.



No.	Description	No.	Description
1	Fuel Valve	3	Fuel Filter
2	Sediment Cup (10 mm)	4	O-Ring

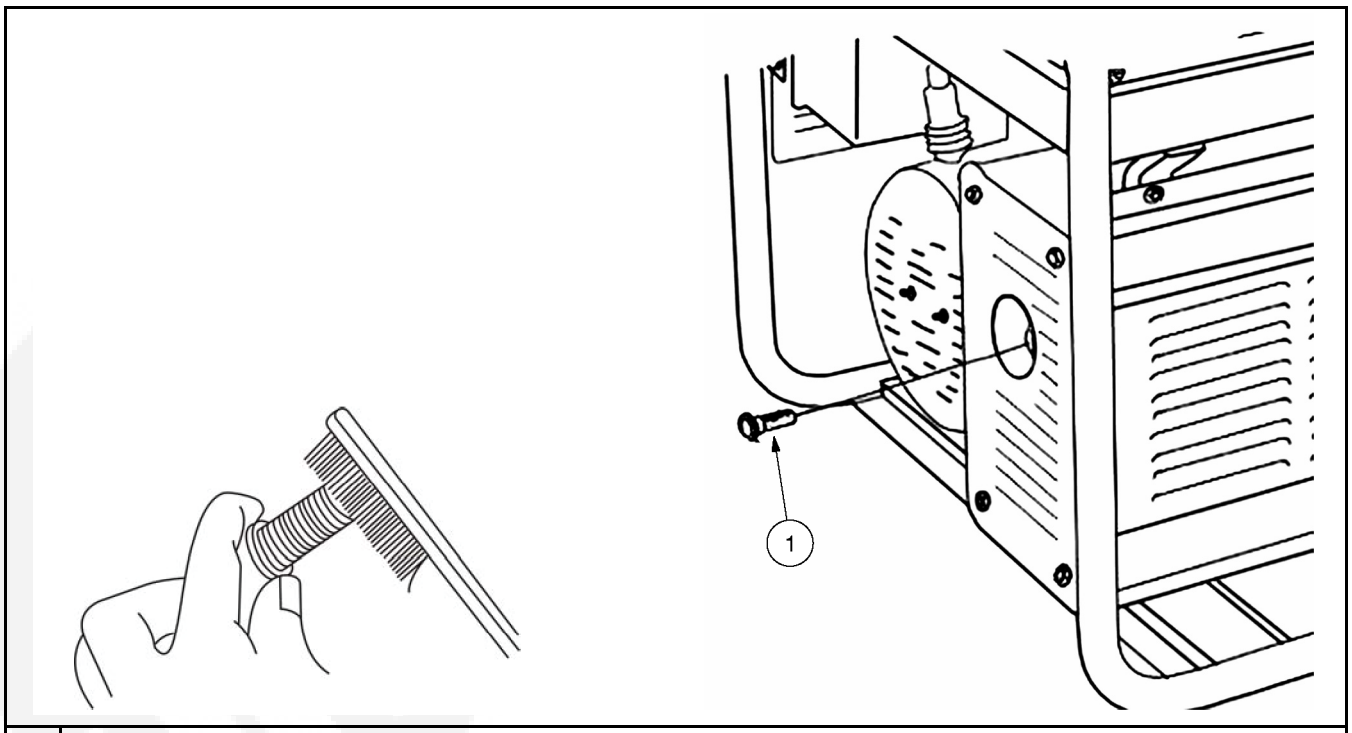
FIGURE 16. FUEL SEDIMENT CUP COMPONENTS

7.6 Cleaning the Spark Arrester

WARNING: Contact with a hot muffler can cause severe burns. Allow the generator set to cool before servicing the muffler.

Refer to the **Maintenance Schedule** for scheduled spark arrester cleaning.

After letting the generator set cool down, remove the spark arrester screen. Inspect for damage and replace if defective. To clean, lightly tap the screen and clean any deposits with a wire brush. Reinstall the spark arrester and tighten the screw securely.



No.	Description
1	Spark Arrestor

FIGURE 17. SPARK ARRESTOR

7.7 Valve Clearance

Refer to the **Maintenance Schedule** for scheduled valve clearance adjustment.

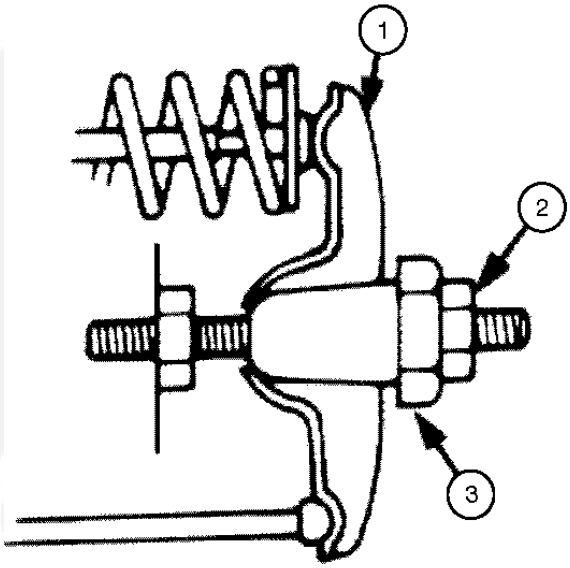
CAUTION: Valve clearance inspection and adjustment must be performed with the engine cold.

1. Remove the valve cover, and set the piston at top dead center of the compression stroke (both valves fully closed).
2. Insert a feeler gauge between the rocker arm and valve to measure valve clearance. The recommended valve clearance is shown below.

Standard Valve Clearance	IN	0.15 ±0.02 mm (0.006 ±0.001 in)
	EX	0.20 ±0.02 mm (0.008 ±0.001 in)

3. If adjustment is necessary, proceed as follows:
   a. Hold the rocker arm pivot and loosen the pivot lock nut.
   b. Turn the rocker arm pivot to obtain the specified clearance.
   c. Retighten the lock nut while holding the rocker arm pivot.

d. Recheck valve clearance after tightening the lock nut.



No.	Description	No.	Description
1	Rocket Arm	3	Pivot
2	Lock Nut (10-14 Nm)		
To increase valve clearance, screw lock nut out. To decrease valve clearance, screw lock nut in.			

FIGURE 18. VALVE COMPONENTS

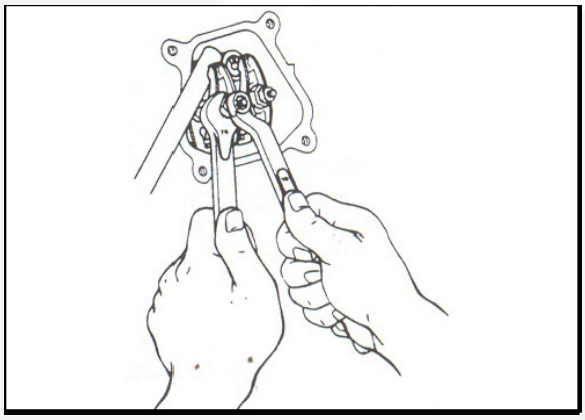


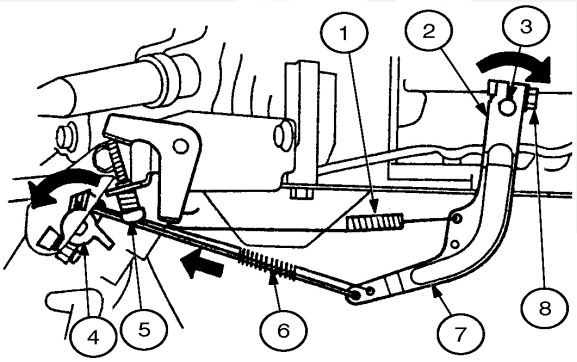
FIGURE 19. VALVE ADJUSTMENT WITH FEELER GAUGE INSTALLED

7.8 Governor Adjustments

1. Remove the fuel tank.
2. Loosen the nut on the governor arm pinch bolt.

3. Move the arm until the throttle is completely open, and hold it in that position.
4. Rotate the governor arm shaft as far as it will go in same direction it was just moved by the governor arm, and then tighten the governor arm pinch bolt.
5. Check to see if the arm and throttle move smoothly.
6. Reinstall the fuel tank.
7. Start the engine and let it warm up. Once the engine is warm, adjust the limiting screw to set the idle speed.

The idle speed should be set to 3600 ±150 RPM.



No.	Description	No.	Description
1	Governor Nut Spring	5	Limiting Screw
2	Governor Arm Shaft	6	Anti-Surge Spring
3	Governor Arm Pinch Bolt	7	Governor Arm
4	Throttle	8	Nut

FIGURE 20. GOVERNOR ASSEMBLY

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8 Servicing the Generator Set

8.1 Preparing for Service

8.1.1 Safety Considerations

There are hazards in servicing generator sets. Study the **Safety Precautions** section of this manual and become familiar with the hazards listed in **Table 11**. Note the following safeguards and ways of avoiding hazards.

- ***Use personal protection:*** Wear appropriate protective safety equipment, such as safety shoes and safety glasses.
- Do not wear rings or jewelry and do not wear loose or damp clothing that might get caught in equipment or conduct electricity.
- ***Reduce the hazard:*** A safe, orderly workshop area, and well-maintained equipment reduce the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working condition. Store flammable liquids in approved containers; away form fire, flame, spark, pilot light, switches, arc-producing equipment, and other ignition sources. Keep the workshop clean and well-lighted and provide adequate ventilation.
- ***Develop safe work habits:*** Unsafe actions cause accidents with tools and machines. Be familiar with the equipment and know how to use them safely. Use the correct tool for the job and check its condition before starting. Comply with the warnings in this manual and take special precautions when working around electrical equipment. Do not work alone if possible and take no risks.
- ***Be prepared for an accident:*** Keep fire extinguishers and safety equipment nearby. Agencies such as the Red Cross and public safety departments offer courses in first aid, CPR and fire control. Take advantage of this information to be ready to respond to an accident. Learn to be safety-conscious and make safety procedures part of the work routine.

TABLE 11. HAZARDS AND THEIR SOURCES

Fire and Explosion	• Leaking or spilled fuel • Hydrogen gas from battery • Oily rag improperly stored • Flammable liquids improperly stored
Burns	• Hot exhaust pipes • Hot engine and generator surfaces
Poisonous Gas	• Operating generator set where exhaust gases can accumulate

Electrical Shock (AC)	• Improper generator connections • Faulty wiring • Working in damp conditions • Jewelry touching electrical components
Rotating Machinery	• Fan guards not in place
Slippery Surfaces	• Leaking or spilled oil
Heavy Objects	• Removing the generator set from the vehicle • Removing heavy components

8.1.2 Special Tools

Engine:

A complete set of standard and metric shop tools are required to service the engine.

Control and Generator:

A complete set of standard and metric shop tools are required to service the control and generator. Also needed are:

- Lead or dead blow hammer
- Battery hydrometer
- Torque wrench
- VOM meter
- Frequency meter
- Armature growler
- Load bank
- Jumper wires
- Rotor puller

8.2 Removal and Replacement of Gaskets

The following is a list of portable generator sets that may have been built with gaskets that contain some percentage of asbestos.

- All 60 Hz Cummins Onan branded HomeSite Power portable generator sets built before January 1, 2008 - Models 5EGMBE, 4EGMBD, 2.5EGMBG, 2EGMBB
- All 50 hz Cummins branded portable generator sets built before November 1, 2008 - Models 5EGMBU, 4EGMBT, 2EGMBR, 2.5EGMBS

The manufactured date can be determined from the product serial number located on the unit's nameplate (see the figure below). The first alpha character represents the month the unit was manufactured (A = January, B = February through L = December). The second and third digits represent the year the unit was manufactured. In the example shown below, the generator set was manufactured in November of 2005.

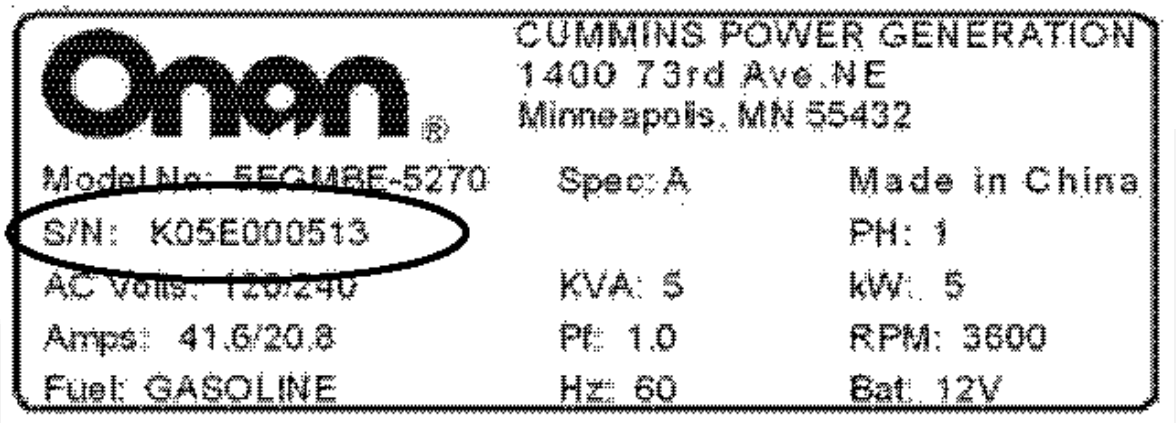

FIGURE 21. PORTABLE GENERATOR SET NAMEPLATE

OSHA (USA) classifies the removal and handling of these gaskets as "Class III" asbestos work, which is the lowest OSHA category of activity that is considered likely to disturb asbestos-containing material. OSHA has established the following precautions for Class III asbestos work.

- **Product Repair Instructions:** The normal operation of generators subject to this communication does not require any additional precautions. However, when performing any repair involving a gasketed joint, to ensure the safe removal and handling of the gasket, 1) the gasket must be wetted down and, 2) if available, local exhaust and ventilation systems must be used.
- The used gasket(s) should then be disposed of by following all local rules and regulations regarding the disposal of hazardous materials.

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9 Control Panel

The control panel is the direct point of interface for the operation of the generator set. It contains the receptacles, circuit breakers and switches required for safe customer load connections.

This section includes information on the following:

- Control panel components
- Control panel service

9.1 Control Panel Components

The following is a description of components included on the control panel of portable generator sets. Please note that not all of the components listed below are on all control panels.

9.1.1 Engine Switch (Manual Start)

To start the generator, move the switch to the Run position. To turn off the generator, move the switch to the Off position.

9.1.2 DC Terminals

The DC terminals are the point of connection for DC loads. The DC terminals provide 12 VDC with a peak current of 8.3 Amps.

9.1.3 DC Breaker

The DC breaker protects the DC load connections and the generator from DC electrical faults. The breaker is set to trip at 8.3 Amps.

9.1.4 GFCI Receptacle

The Ground Fault Circuit Interrupter (GFCI) receptacle provides power at 120 V, 60 Hz. The receptacle has an internal circuit breaker that trips if the circuit senses that there has been a short to ground. If the GFCI has tripped, press the Reset button on the front face of the receptacle to reset the circuit breaker. To test the functionality of the GFCI, press the Test button located on the front face of the receptacle. If the Test button does not cause the GFCI breaker to trip, replace the receptacle.

9.1.5 L14-30 Receptacle

The L14-30 receptacle is a circular four-prong electrical outlet. It provides 240 VAC, 60 Hz.

9.1.6 AC Circuit Breakers

The AC circuit breakers provide electrical protection to both the generator set and the connected loads. Each circuit breaker is connected to the outlet situated directly below the breaker. The load rating of each breaker can be seen below each breakers corresponding outlet.

9.1.7 Diodes

The diodes are located within the control panel assembly. The diodes rectify AC power into DC power to be used by the DC terminals.

9.1.8 Voltmeter

The voltmeter displays the output voltage of the generator set on an analog scale.

9.1.9 Voltage Selector Switch

The generator can produce either 120 or 240 VAC, based on the position of the voltage selector switch. When in the 120 VAC position, only the GFCI and the L5-30 receptacle provides power at 120 VAC, 60 Hz. When the voltage selector switch is set to the 120/240 VAC position, the L14-30 provides 240 VAC, 60 Hz at full load. In the 120/240 VAC position, the 120 VAC receptacles can only provide half the load. Between all three receptacles, the total sum of all loads cannot exceed the generator power rating.

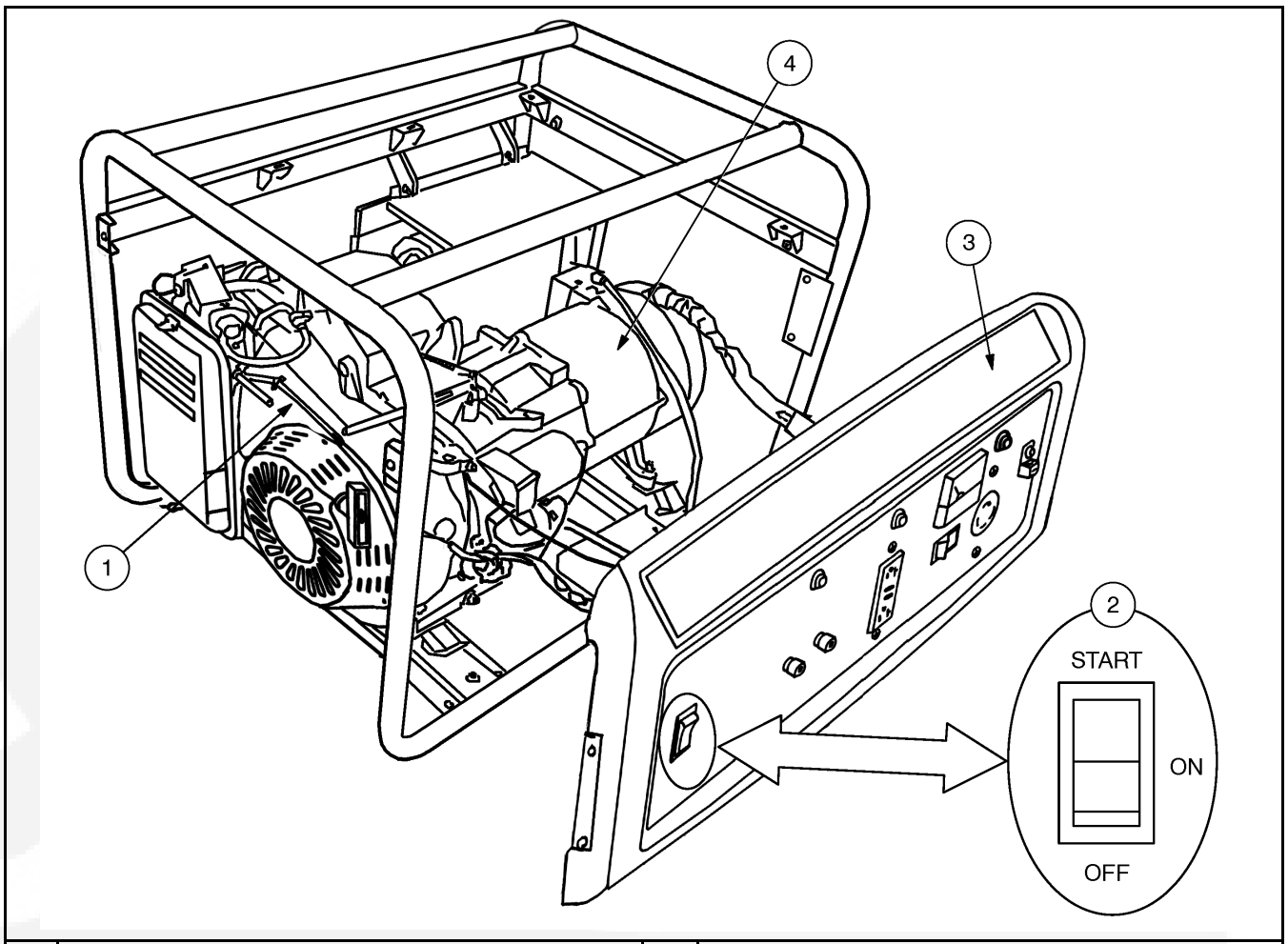
9.1.10 Ground Connection

The ground connection provides a point to connect an earthen terminated ground to protect the user from ground faults.

9.2 Control Panel Service

9.2.1 Control Panel Removal

Removal of the control panel is shown in the following figure.



No.	Description	No.	Description
1	Fuel Cutoff Solenoid Lead	3	Control Panel
2	On / Off Switch	4	Generator End Cover

FIGURE 22. CONTROL PANEL REMOVAL

To remove the control panel,

1. Remove the two bolts on each side of the control panel to disconnect the control panel from the frame.
2. Disconnect the lead connecting the engine ground.
3. Disconnect the fuel cut-off solenoid, the oil alert system, and the field winding.
4. To disconnect the control panel from the start solenoid, first unplug the ground connection. Then unscrew the nut holding on the positive lead.
5. Remove the two bolts on the end cap to remove the end cap.
6. Disconnect the DC coupler and field winding coupler. Unscrew the bolt holding the couplers in place.

7. Unscrew the nuts holding the main winding leads and disconnect them.

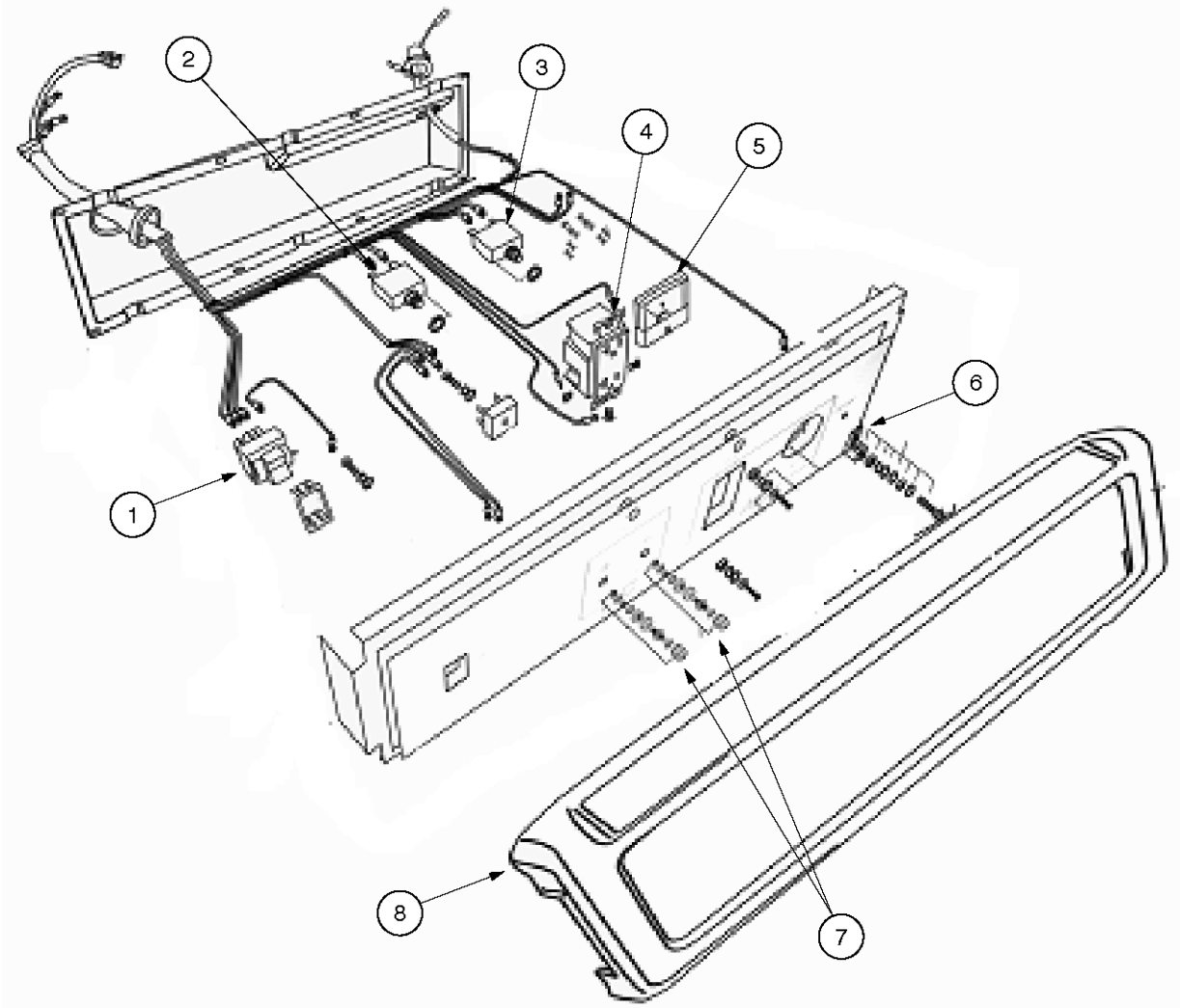
9.2.2 Control Panel Installation

Reassembly if the control panel is the reverse of removal.

1. Reconnect the main winding leads and secure them with nuts.
2. Connect the DC coupler and field winding coupler. Use a bolt to secure them in place.
3. Use two bolts to secure the end cap.
4. Use a nut to secure the positive lead to the start solenoid and then plug in the ground connection.
5. Connect the fuel cut-Off solenoid, the oil alert system, and the field winding.
6. Connect the lead connecting the engine ground .
7. Use two bolts to secure each side of the control panel to the frame.

9.2.3 Control Panel Internal Components for P2400 (EGMBB)

The Control Panel internal components for P2400 (EGMBB) generator sets are shown in the following figure.



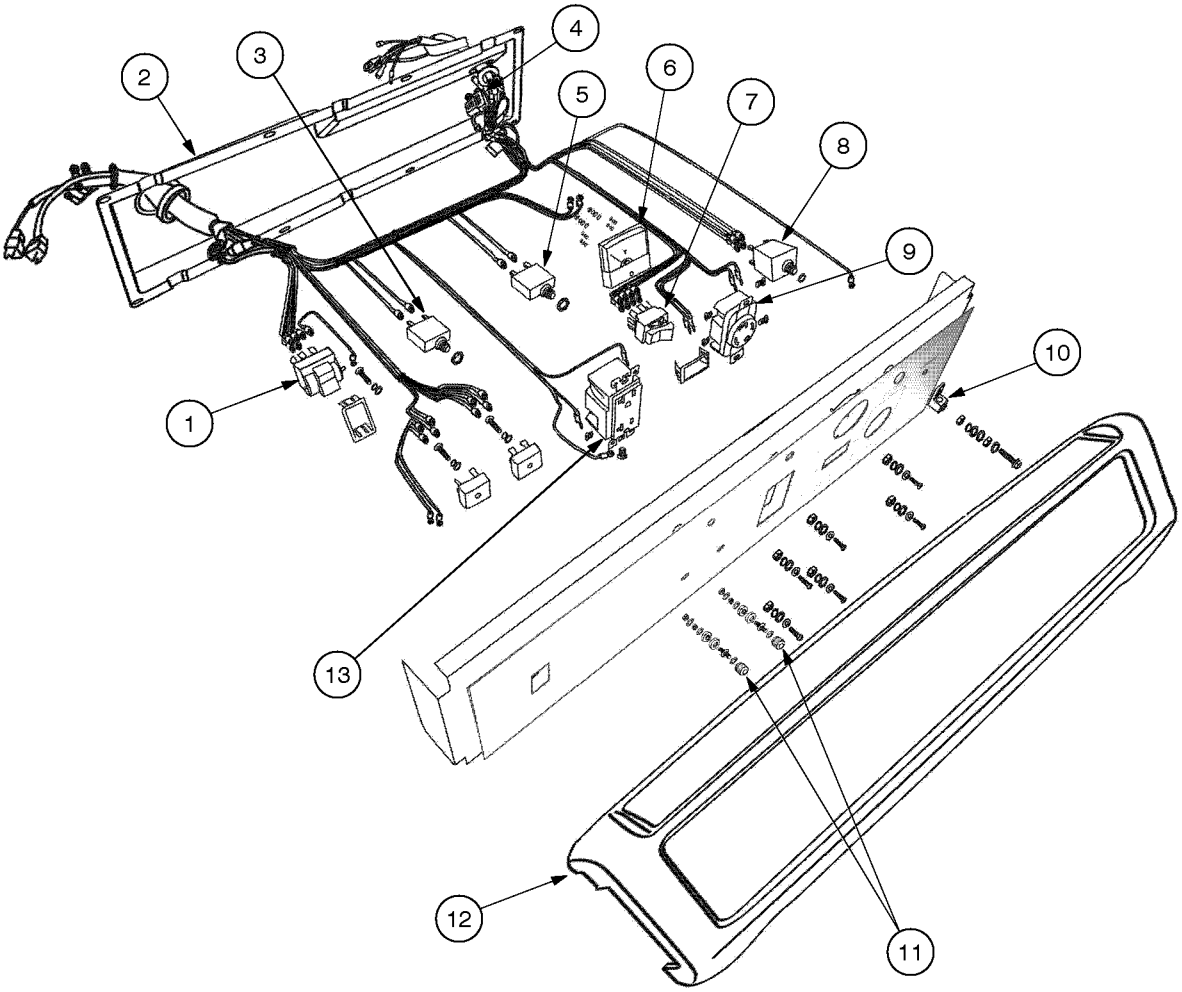
No.	Description	No.	Description
1	On / Off Switch	5	Voltmeter
2	DC Breaker Reset Switch	6	Earth Ground Lug
3	AC Breaker Reset Switch	7	12 Volt DC Terminals
4	GFCI Receptacle	8	Panel Front Cover

FIGURE 23. CONTROL PANEL COMPONENTS

To gain access to the control panel internal components,

1. Follow the steps described in **Control Panel Removal**.
2. Remove the back panel from the control panel assembly by removing the eight nuts holding it in place (7 mm).
3. Remove the two rubber grommets on the back of the control panel to allow for the cables to slide through, and the back panel to be removed.

9.2.4 Control Panel Internal Components for P3500 (EGMBG)



No.	Description	No.	Description
1	On / Off SwitchAC Breaker Reset Switches	8	AC Breaker Reset Switch
2	Panel End Cover	9	AC Receptacle (120 / 240 VAC)
3	DC Breaker Reset Switch	10	Earth Ground Lug
4	Fuse and Fuse Cover	11	12 Volt DC Terminals
5	AC Breaker Reset Switch	12	Panel Front Cover
6	Voltmeter	13	GFCI Receptacle
7	Voltage Selector Switch		

FIGURE 24. CONTROL PANEL COMPONENTS

To gain access to the control panel internal components,

1. Follow the steps described in *Control Panel Removal.*

2. Remove the back panel from the control panel assembly by removing the eight nuts holding it in place (7 mm).
3. Remove the two rubber grommets on the back of the control panel to allow for the cables to slide through, and the back panel to be removed.

9.2.4.1 Receptacles

To test and/or replace a receptacle,

1. Disconnect the leads to the receptacle.
2. Remove the receptacle from the control panel by unscrewing the connection while holding the locking nut in place.
3. To reinstall a receptacle, install the receptacle on the control panel, secure with the locking nuts, and reconnect the leads.

9.2.4.2 Diodes

To test and/or replace a diode,

1. Disconnect the leads to the diode.
2. Remove the screw passing through the center of the diode.
3. To reinstall a diode, use the screw to secure it to the control panel and reconnect the leads.

9.2.4.3 Circuit Breakers

To test and/or replace a circuit breaker,

1. Disconnect the leads to the circuit breaker.
2. Unscrew the nut on the front of the control panel while holding the circuit breaker in place. Then remove the circuit breaker.
3. To reinstall a circuit breaker, use the screw to secure it to the control panel and reconnect the leads.

9.2.4.4 Ground Connection

1. Remove the nut on the back of the ground connection to disconnect the leads.
2. Remove the nut on the back of the ground connection to remove it from the control panel.
3. Reassemble in the reverse order.

9.2.4.5 Voltmeter

NOTE: A voltmeter is not available on all models.

To test and/or replace the voltmeter,

1. Remove the nuts connecting the leads to the back of the voltmeter.
2. Remove the four nuts holding the voltmeter in place and remove the voltmeter from the control panel.
3. Reverse this procedure to install the voltmeter.

9.2.4.6 Voltage Selector Switch

To remove and replace the voltage selector switch,

1. Disconnect the leads from the voltage selector switch.
2. The switch is held in place by two metal brackets. Press these brackets away from the switch to remove the switch.
3. To reinstall, first make sure the brackets are seated properly, and then press the switch firmly into place. Make sure that the switch locks into both brackets and then reconnect the leads.

9.2.4.7 DC Terminals

To remove and reinstall the DC terminals,

1. Remove the nuts connecting the leads to the DC terminals.
2. Remove the nuts holding the DC terminals in place.
3. To reinstall the DC terminals, use the nuts to secure the DC terminals and then reconnect the leads to the DC terminals.

9.2.4.8 Start / Stop Switch

To remove and install the Start / Stop Switch,

1. Disconnect the leads from the Start / Stop Switch.
2. The switch is held in place by two metal brackets. Press these brackets away from the switch to remove the switch.
3. To reinstall, first make sure the brackets are seated properly, and then press the switch firmly into place. Make sure that the switch locks into both brackets and then reconnect the leads.

9.2.5 Control Panel Component Testing

9.2.5.1 Engine Switch

Check for continuity between the terminals with the switch in each position.

The engine switch includes the following connection wires:

- IG - Yellow/Black
- E - Black
- FS - Green/White
- G - Green/White
- L - Red
- L - White

When the switch is set to the “OFF” position, IG is connecting to E. When the switch is set to the “ON” position, L is connecting to L.

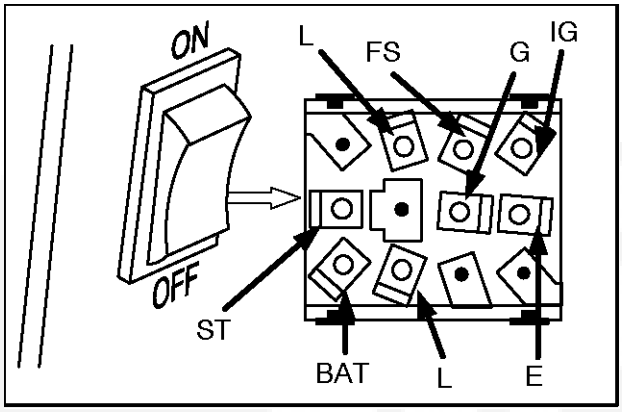


FIGURE 25. ENGINE ON / OFF SWITCH

9.2.5.2 DC Breaker Reset Switch

Check continuity between the breaker terminals.

There should be continuity with the breaker button pushed in.

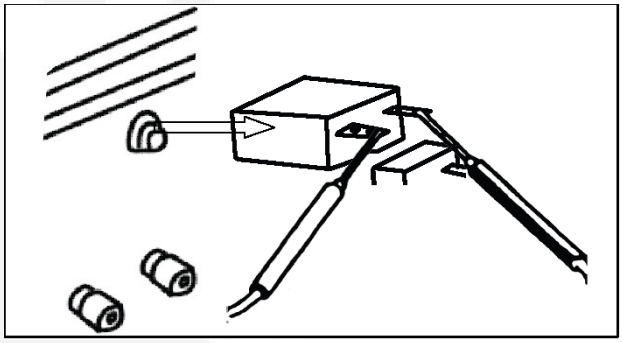


FIGURE 26. DC BREAKER RESET SWITCHES

9.2.5.3 AC Breaker Reset Switches

Check continuity between the breaker terminals.

There should be continuity with the breaker button pushed in.

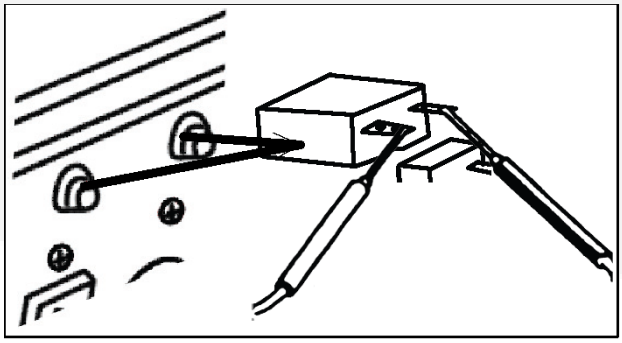


FIGURE 27. AC BREAKER RESET SWITCHES

9.2.5.4 Voltmeter

Using an ohmmeter, check for continuity between the terminals.

Continuity should exist between them.

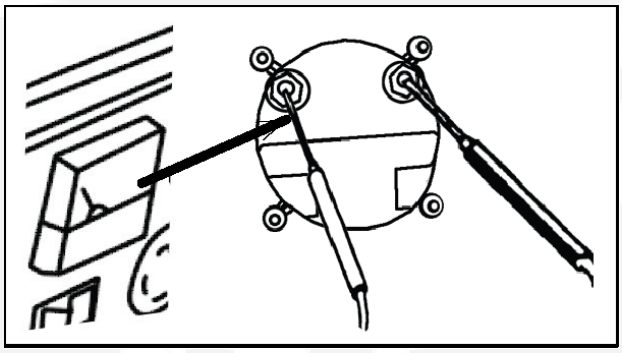


FIGURE 28. VOLTMETER

9.2.5.5 AC Receptacle

1. Disconnect the wires from the back of the receptacle.
2. Connect the terminals on the front of the receptacle using a piece of wire.
3. Using an ohmmeter, check for continuity between the terminals.
4. If there is no continuity, the receptacle is defective, and must be replaced.

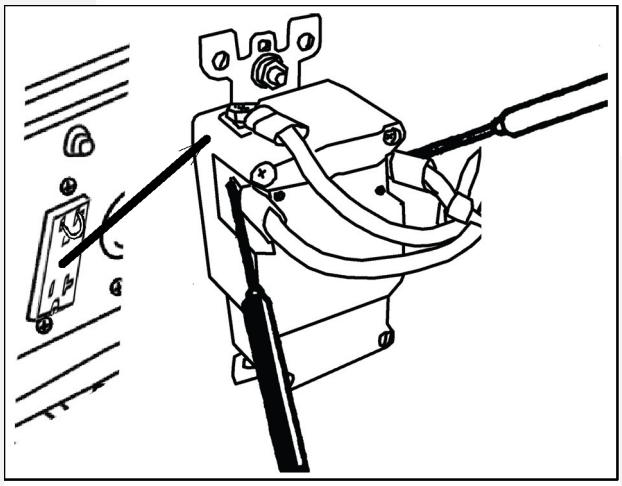


FIGURE 29. AC RECEPTACLE

9.2.5.6 Fuse

There should be continuity between the terminals.

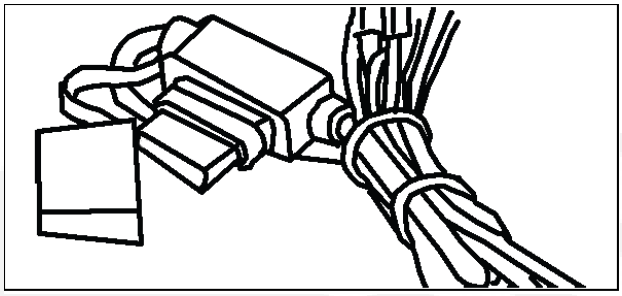


FIGURE 30. FUSE

9.2.5.7 Voltage Selector Switch

Using an ohmmeter, check for continuity between the pins as shown, with the switch wires unplugged.

- When voltage selector switch to “120” position, 4 is connecting to 1, 5 is connecting to 2 and 6 is connecting to 3.
- When voltage selector switch to “240” position, 1 is connecting to 7, 2 is connecting 8 and 3 is connecting to 9.

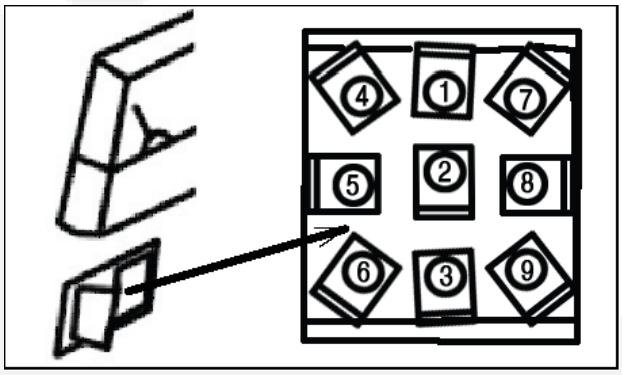


FIGURE 31. VOLTAGE SELECTOR SWITCH CONNECTIONS

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10 Generator Service

Generator service includes the following:

- Disassembling and assembling the generator
- Examining the brush block and slip rings
- Testing the generator

10.1 Generator Disassembly

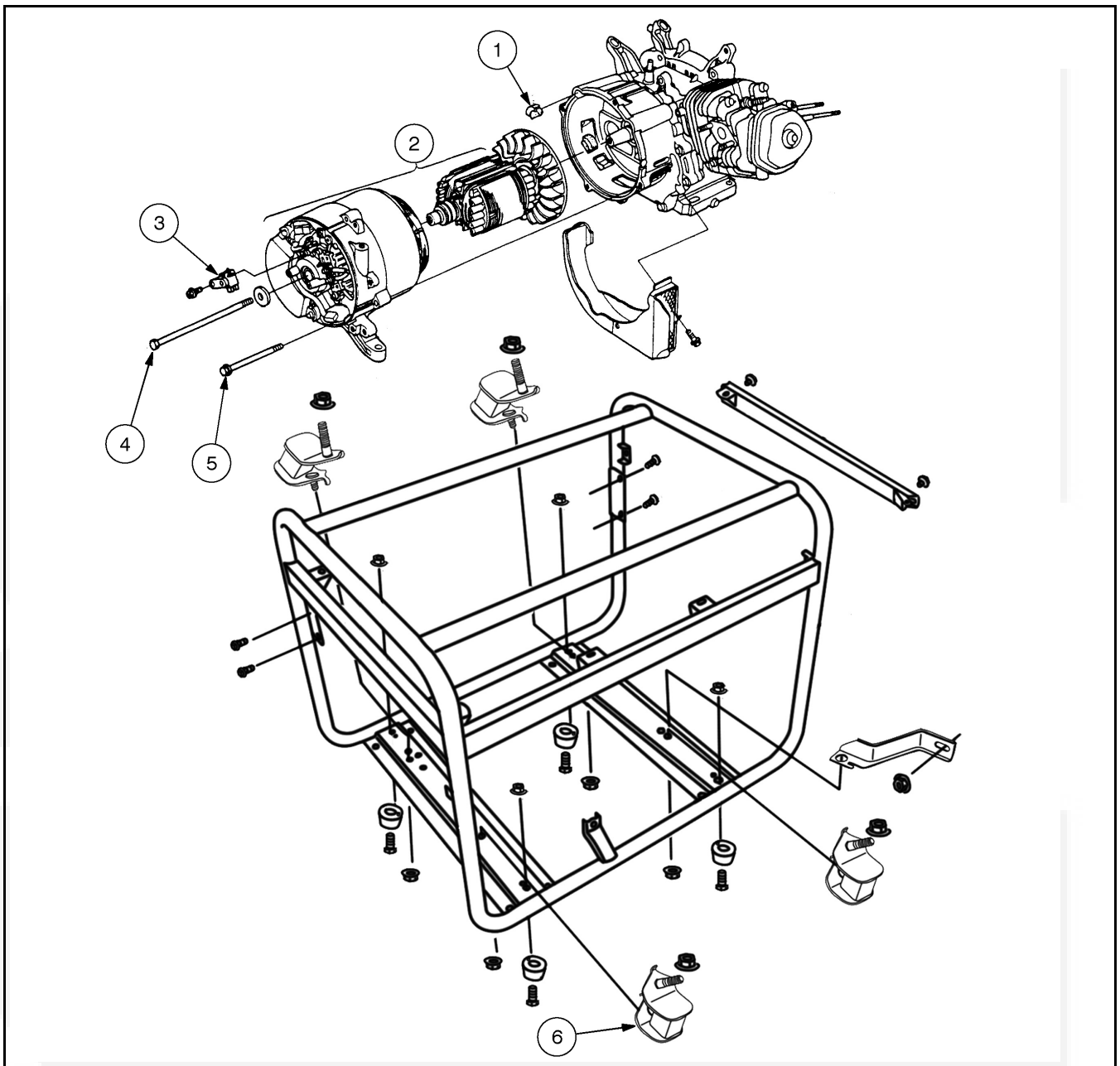
1. Place a brace block underneath the alternator.
2. Remove the two bolts on the end cap to remove the end cap.
3. Disconnect the DC coupler and field winding coupler. Unscrew the bolt holding the couplers in place.
4. Unscrew the nuts holding the main winding leads and disconnect them.
5. Remove the bolt holding the field windings and disconnect the connector.
6. Remove the brush block assembly.
7. Remove the voltage regulator.
8. Remove the muffler mounting bracket.
9. Remove the ground wire from the top of the alternator assembly.
10. Remove the alternator cooling fan shroud.
11. Remove the rotor through bolt (item 4).
12. Remove the nuts securing the alternator to the vibration isolators (item 6).
13. Remove the four bolts on the outside of the generator connecting the alternator to the engine adaptor.
14. Carefully remove the stator assembly from the generator adaptor.

CAUTION: To avoid damaging the rotor, place a wooden block and a shop rag under the rotor for support.

15. Use a rotor puller to remove the rotor. When removing the rotor, hold the flywheel and torque the puller to 6.9 Kg-cm (50 ft-lbs).

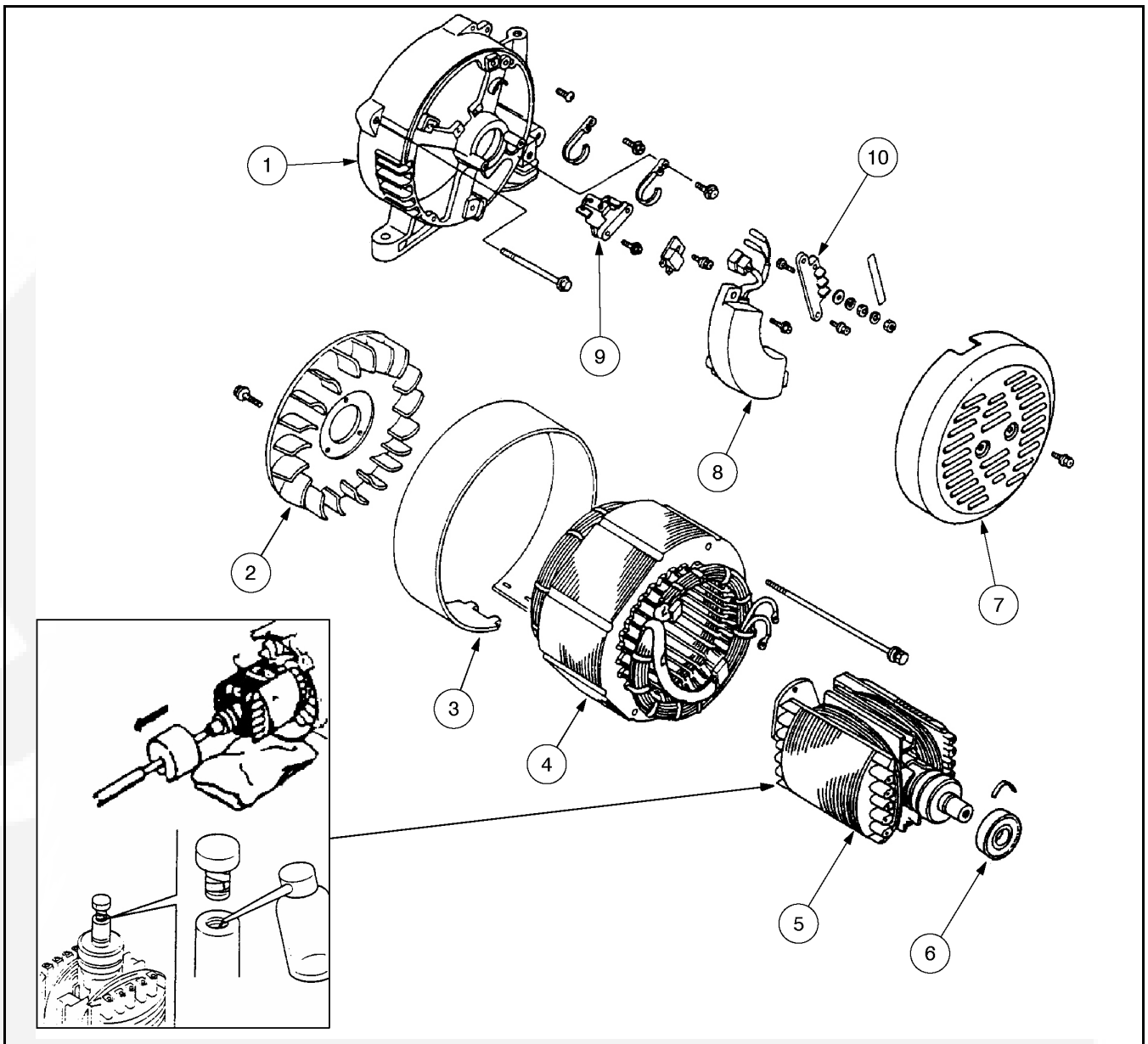
NOTE: If torquing the rotor puller does not free the rotor from the crankshaft, tap the end of the puller with a brass hammer to help loosen the rotor.

WARNING: Contact with sharp or moving parts can cause severe personal injury or death. To prevent eye injury, always wear safety glasses or goggles when striking the end of the rotor puller.



No.	Description	No.	Description
1	Crankcase Grommet	4	Rotor Bolt
2	Generator Assembly	5	Stator Bolt
3	Brush Holder Assembly	6	Rubber Mount

FIGURE 32. GENERATOR REMOVAL



No.	Description	No.	Description
1	Rear Housing	6	Ball Bearing
2	Generator Cooling Fan	7	Generator End Cover
3	Stator Cover	8	AVR Assembly
4	Stator	9	Brush Holder Assembly
5	Rotor	10	AC Output Terminal

FIGURE 33. REAR HOUSING COMPONENTS

10.2 Generator Reassembly

To reassemble the generator,

1. Wipe dirt and oil off the tapered portion of the rotor and crankshaft.
2. Install the stator assembly on the generator adapter.
3. Make sure the crankcase grommet is inserted securely.
4. Use four stator bolts to install the alternator on the engine adapter. Do not tighten the bolts yet.
5. Use the nuts to install the alternator on the vibration isolators.
6. Tighten the stator bolts in a crisscross pattern. Torque the stator bolts to 8-12 N·m (5.8-8.7 ft-lbs). Make sure there is no clearance between the crankcase cover and the stator cover.
7. Install the washer and rotor through bolt. Torque the through bolt to 43-47 N·m (31.0-33.9 ft-lbs).
8. Install the alternator cooling fan shroud.
9. Install the ground wire on the top of the alternator assembly.
10. Install the muffler mounting bracket.
11. Install the voltage regulator.
12. Install the brush block assembly.
13. Use a bolt to install the field windings and connect the connector.
14. Connect the main winding leads and use the nuts to secure them.
15. Connect the DC coupler and the field winding coupler. Secure the couplers.
16. Install the end cap and secure it with two bolts.

10.3 Brush Block and Slip Rings

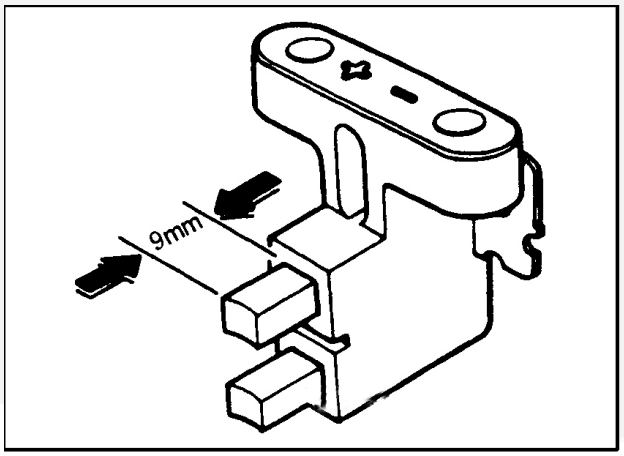


FIGURE 34. BRUSH HOLDER ASSEMBLY

1. To remove the brush block, remove the end cap and the brush block mounting screw. Then remove the brush block from the generator end bell.

2. Check the brush for length, wearing condition, or any other defect. Replace if the length is less than 5 mm (0.20 in).

NOTE: Connect the blue wire lead to the positive (+) side of the brush holder. Avoid damaging the brushes when removing and installing the brush holder.

3. Visually inspect the slip rings for dust, rust or other damage. If necessary, wipe them with a clean lint-free cloth. If they are rusted or damaged, remove the rotor and rub with fine emery cloth.

10.4 Generator Component Testing

10.4.1 Field Winding

Remove the brushes and measure resistance between the slip rings.

RESISTANCE	P2400	40-50 Ω
	P3500	35-45 Ω
	Slip Ring - END	∝

If the specified resistance is obtained at the slip rings but not at the brush terminals, clean or replace the brushes.

If the specified resistance is not obtained at the slip rings, clean or replace the rotor.

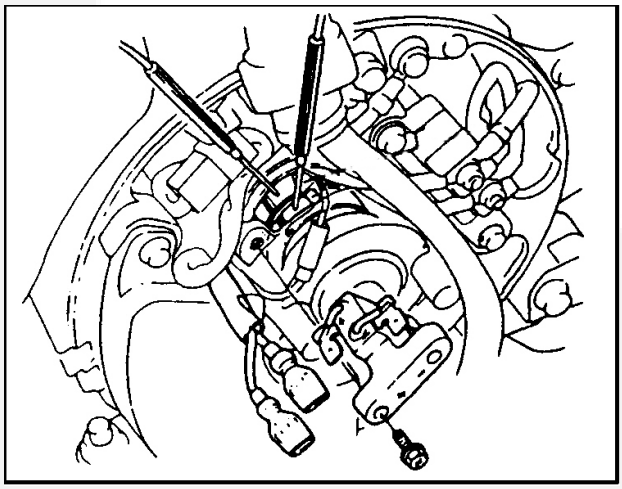


FIGURE 35. MEASURING FIELD WINDING RESISTANCE

10.4.2 Main Winding

1. Using an ohmmeter, measure the resistance between the AC output terminals.

RESISTANCE	P2400	0.51-0.53 Ω
	P3500 (I)	0.76-0.79 Ω
	P3500 (II)	0.76-0.79Ω
	(I) - (II)	∝
	(I) - END	∝
	(II)- END	∝

NOTE: Set the voltage selector switch to 120 V only position.

2. If the resistance is out of specification, replace the stator.

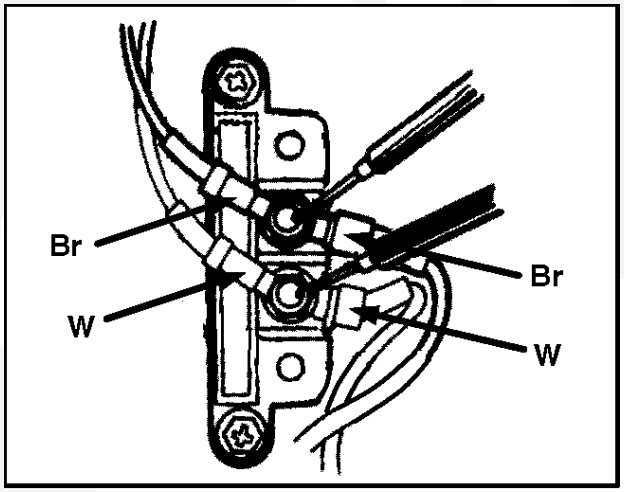


FIGURE 36. AC OUTPUT TERMINALS FOR P2400 (EGMBB) MODELS

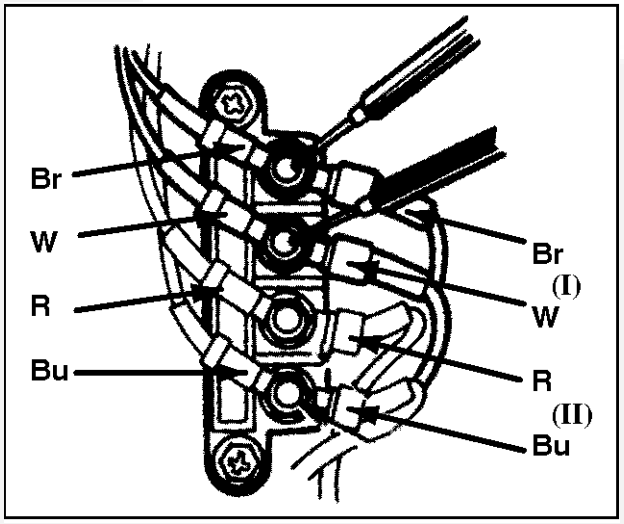


FIGURE 37. AC OUTPUT TERMINALS FOR P3500 (EGMBG) MODELS

10.4.3 Exciter Winding

1. Using an ohmmeter, measure the resistance between the Blue and Blue wires in the 4P coupler.

RESISTANCE	P2400	3.1-3.3 Ω
	P3500	1.5-1.7 Ω
	Slip Ring - Ground	∝

2. If the resistance is out of specification, replace the stator.

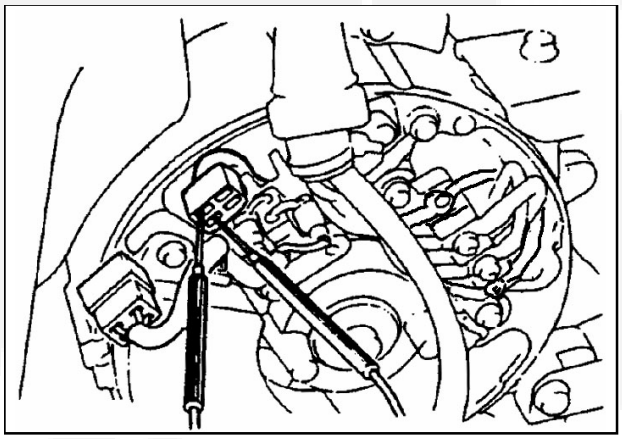


FIGURE 38. MEASURING EXCITER WINDING RESISTANCE

10.4.4 DC Winding

1. Using an ohmmeter, measure the resistance between the brown wire leads at the DC diode connecter.
2. The resistance should be 0.4 - 0.6 Ω. If the resistance is out of specification, replace the stator.

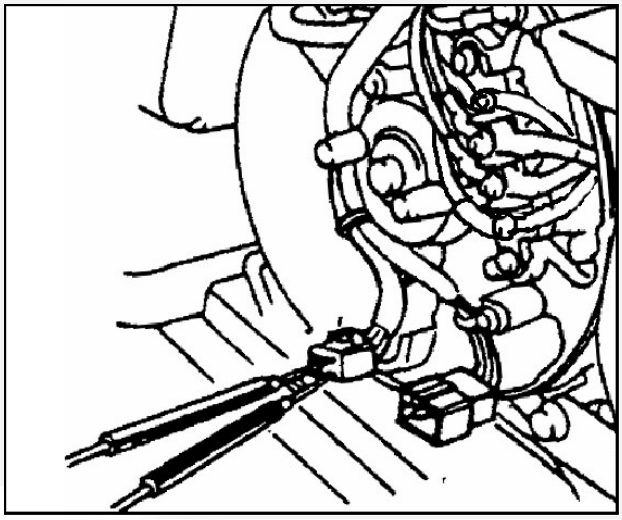


FIGURE 39. MEASURING DC WINDING RESISTANCE

10.4.5 Voltage Regulator

When using a voltmeter and a load bank, measure the voltage to the brushes, and the voltage received from the stator windings.

Model		2kW	2.5kW	2.8kW
Alternator to Regulator Voltage (VAC)	No Load	93.6 VAC	110.9 VAC	90.4 VAC
	Half Load	--	--	--
	Full Load	107.9 VAC	128.3 VAC	103 VAC
Alternator to Brush Voltage (VDC)	No Load	20.9 VDC	24.6 VDC	24.6 VDC
	Half Load	--	--	--
	Full Load	51.2 VDC	58.5 VDC	65.6 VDC
NOTE: The above spefication is for testing the generator set voltage at 240V.				

11 Engine

This section includes information on service the engine, including:

- Cylinder head/valves
- Camshaft/crankshaft
- Piston

11.1 Cylinder Head / Valves

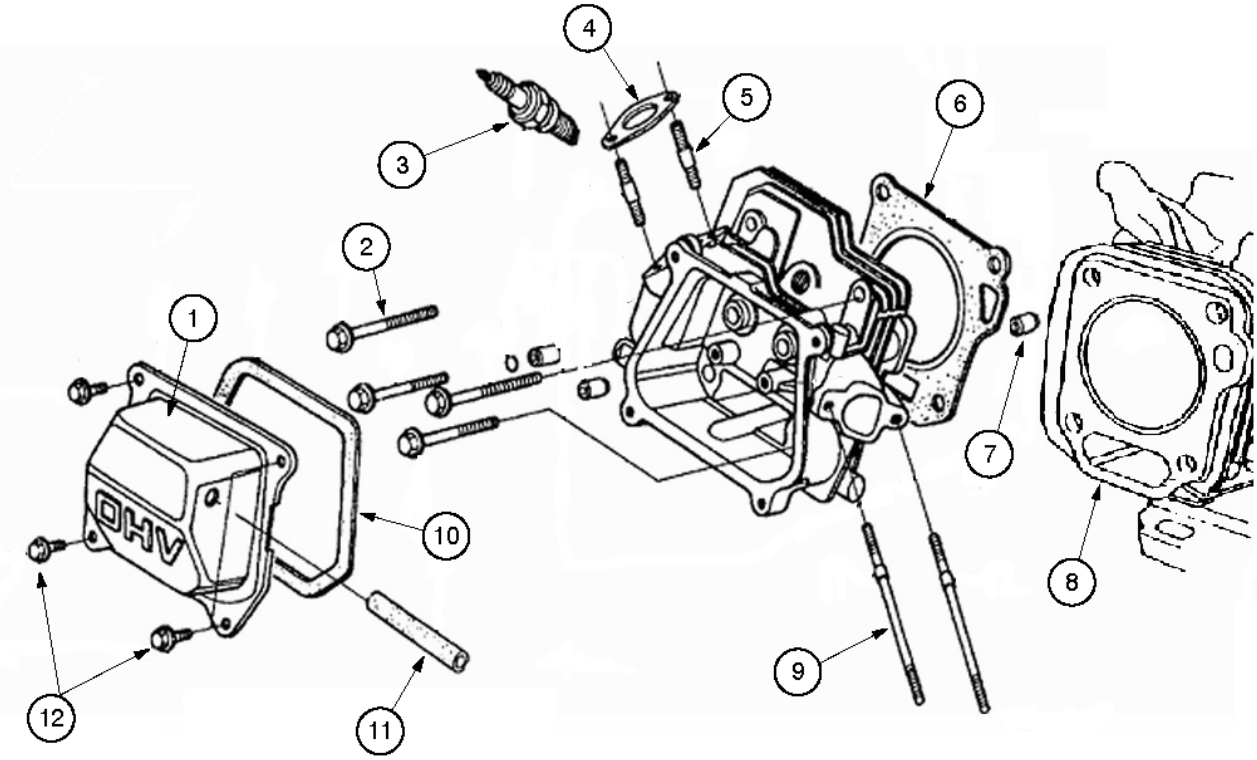
11.1.1 Disassembly / Reassembly

To disassemble the cylinder head and valves,

1. To remove the cylinder head, the carburetor, exhaust manifold, and all preceeding components must be removed.
2. Remove the breather tube and valve cover. Use solvent to clean any oil from the breather valve.
3. Loosen the cylinder head bolts and the cylinder head cover bolts using a crisscross pattern, and remove the cylinder head.

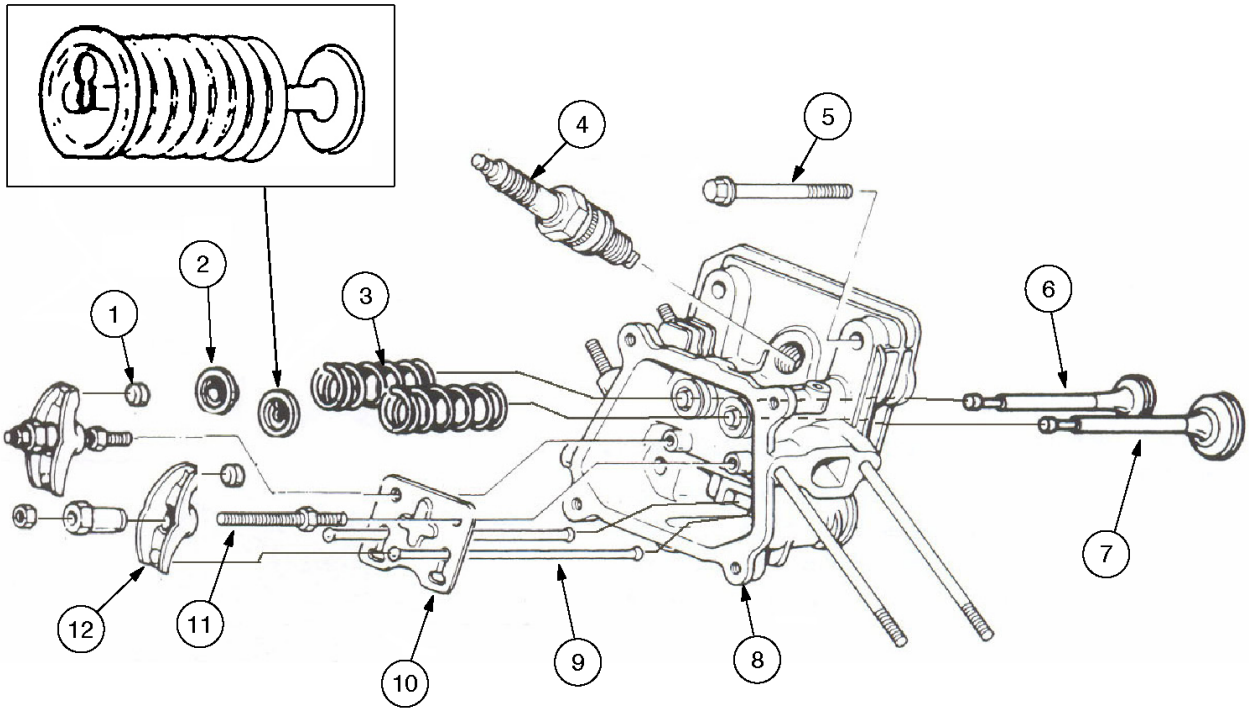
CAUTION: Removing the valve spring retainers while the cylinder head is installed will cause the valves to drop into the cylinder which can result in equipment damage. Do not remove the valve spring retainers while the cylinder head is installed.

4. Compress the valve spring and slide the retainer out to the side, so that the valve stem slips through the hole at the side of the retainer.
5. After the valves are removed, check both ends for wear and check the rod for straightness. Make sure the rod ends are firmly seated in the lifter.
6. Remove the rocker arms by removing the rocker lock and pivot nuts.



No.	Description	No.	Description
1	Cylinder Head Cover	7	Dowel Pin
2	Cylinder Head Bolt	8	Crankcase
3	Spark Plug	9	Stud
4	Muffler Gasket	10	Cylinder Head Cover Gasket
5	Stud	11	Breather Hose
6	Cylinder Head Gasket	12	Cylinder Head Cover Bolts

FIGURE 40. CYLINDER HEAD REMOVAL



No.	Description	No.	Description
1	Valve RotatorValve Rocket Arm	7	Intake Valve
2	Valve Spring Retainer	8	Cylinder Head
3	Valve Spring	9	Push Rod
4	Spark Plug	10	Pushrod Guide
5	Cylinder Head Bolt	11	Rocker Arm Pivot Stud
6	Exhaust Valve	12	Rocker Arm

FIGURE 41. CYLINDER HEAD COMPONENTS

To reassemble the cylinder head and valves,

1. Before reassembly, remove carbon deposits from the cylinder head combustion changer and inspect the valve seats.

   Valve Head Diameter: (IN = 24 mm (0.94 in), EX = 22 mm (0.87 in).

2. When reinstalling the valves, make sure that you do not interchange the intake valve with the exhaust valve.

⚠ *CAUTION: If the valve rotator is not installed correctly, the valve may drop into the cylinder when starting the engine, resulting in engine damage. Always make sure the valve rotator is properly installed.*

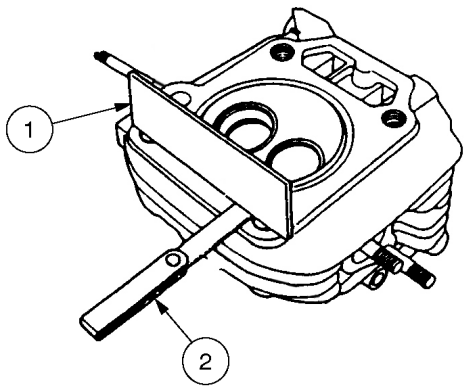
3. Before reinstalling the rocker arms, check the pivot bolts, push rods, and rocker arms. Remove all carbon deposits from the push rods and inspect the valve.

4. Note the installation direction of the cylinder head cover gasket before installing it.

5. Reinstall the cylinder head. Torque the cylinder head bolts to 26-28 N·m (260-280 kg·cm, 18.7-20.2 ft·lb) using a crisscross pattern.
6. Reinstall the cylinder head cover. Torque the cylinder head cover bolts to 12-14 N·m (120-140 kg·cm, 8.7-17.4 ft·lb).
7. After reassembly, measure the compression of the cylinder head.
8. Before reinstalling the spark plug, clean and adjust as necessary.

11.1.2 Cylinder Head Inspection

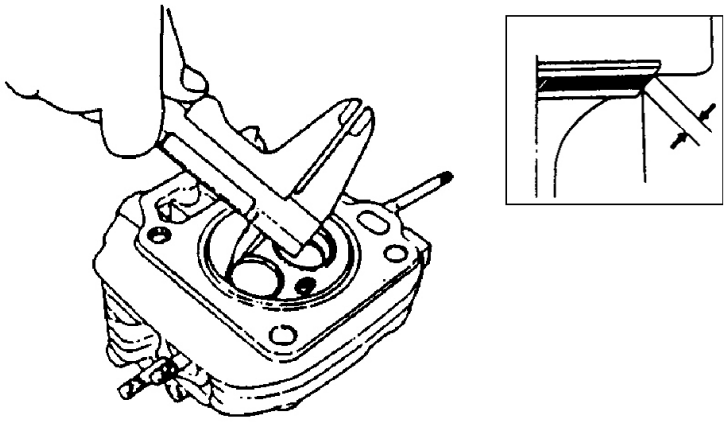
TABLE 12. CYLINDER HEAD



No.	Description	No.	Description
1	Straight Edge	2	Feeler Gauge

1. Remove carbon deposits from the combustion chamber. Clean off any gasket material from the cylinder head surface.
2. Check the spark plug hole and valve areas for cracks.
3. Use a straight edge and a feeler gauge to check the cylinder head for flatness. The allowable limit is 0.1 mm (0.004 in).

TABLE 13. VALVE SEAT WIDTH

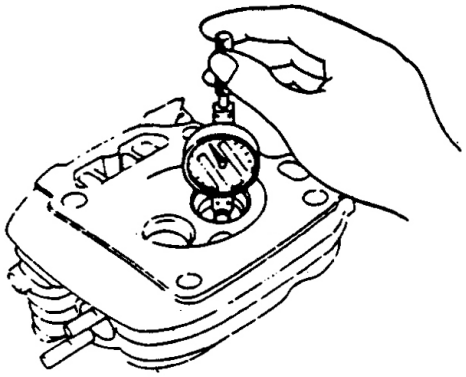


Factory Specification	Allowable Limit

0.8 mm (0.03 in)	2.0 mm (0.08 in)

1. Measure the valve seat width.
2. If the valve seat width is under the factory specification or over the service limit, recondition the valve seat.

TABLE 14. VALVE GUIDE INSIDE DIAMETER



Factory Specification	Allowable Limit
5.50 mm (0.217 in)	5.572 mm (0.2194 in)

NOTE: Ream the valve guides to remove any carbon deposits before measuring.

1. Measure and record each valve guide inside diameter.
2. Replace the cylinder head if it is over the allowable limit.

TABLE 15. GUIDE TO STEM CLEARANCE

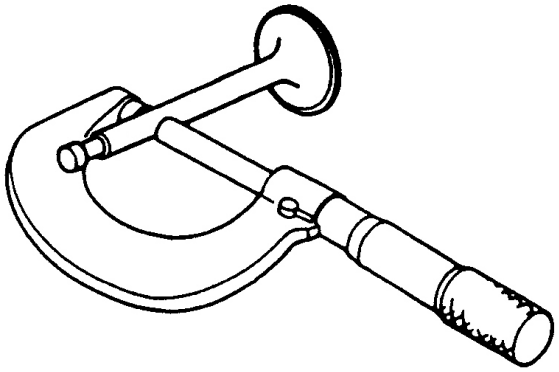
	Factory Specification	Allowable Limit
IN	0.02-0.044 mm (0.0008-0.0017 in)	0.10 mm (0.004 in)
EX	0.06-0.087 mm (0.0024-0.0034 in)	0.12 mm (0.005 in)

The guide to stem clearance is determined by subtracting each valve stem outside diameter from the corresponding guide inside diameter.

If the stem to guide clearance exceeds the allowable limit, determine if a new guide with standard dimensions would bring the clearance within tolerance. If so, replace any guide as necessary and ream to fit. If the stem to guide clearance exceeds the allowable limit with new guides, replace the valves as well.

NOTE: Whenever the valve guides are replaced, be sure to recondition the valve seats.

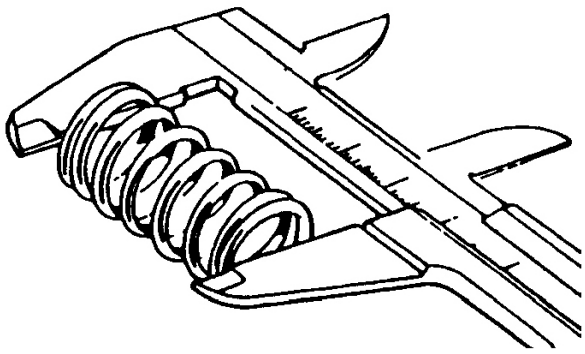
TABLE 16. VALVE STEM OUTSIDE DIAMETER



	Factory Specification	Allowable Limit
IN	5.48 mm (0.216 in)	5.318 mm (0.2094 in)
EX	5.47 mm (0.215 in)	5.275 mm (0.2077 in)

1. Inspect each valve for face irregularities, bending, or abnormal stem wear. Replace the valve if necessary. Measure and record each valve stem outside diameter.
2. Replace the valves if their outside diameter is smaller than the allowable limit.

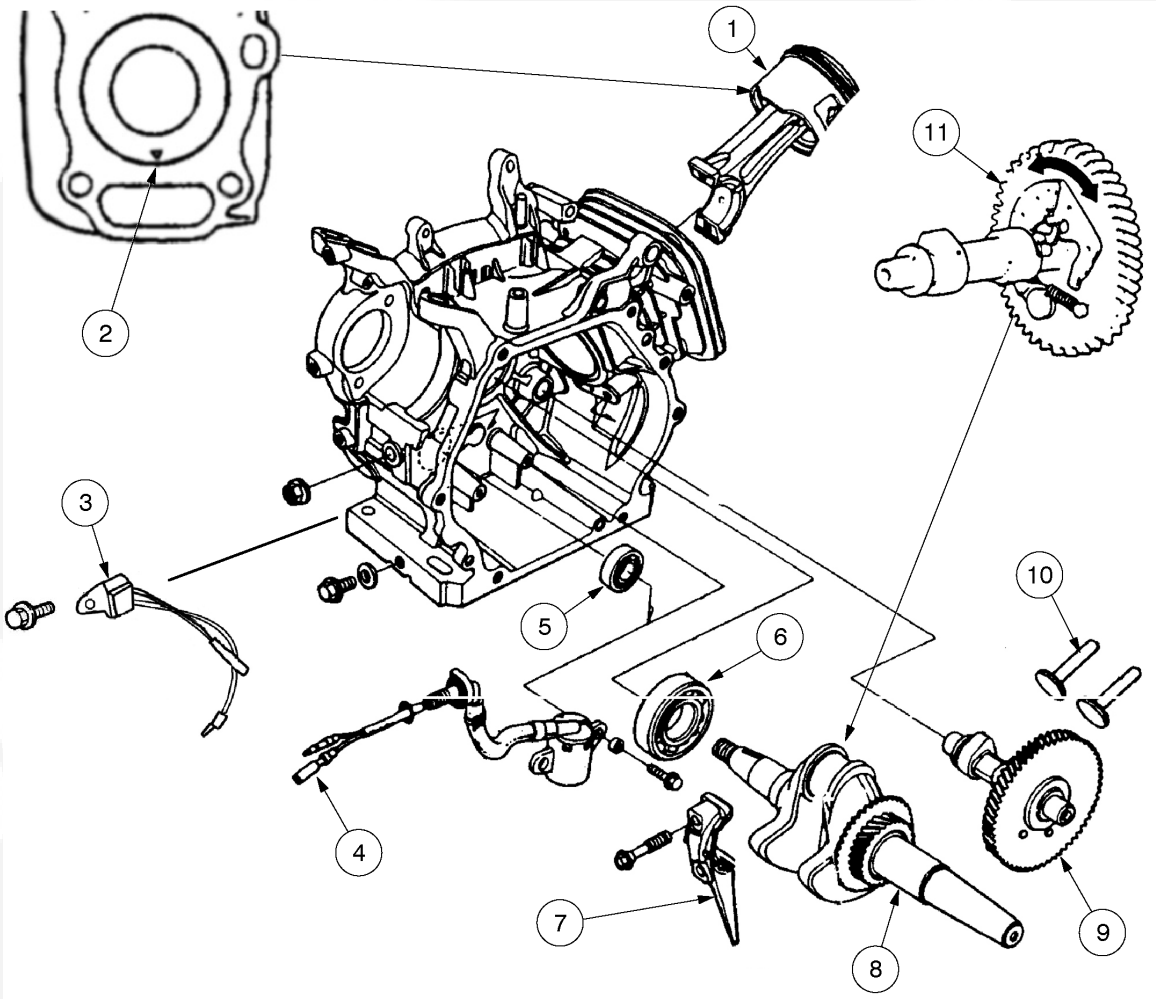
TABLE 17. VALVE SPRING FREE LENGTH



Factory Specification	Allowable Limit
30.0 mm (1.18 in)	28.5 mm (1.122 in)

1. Measure the free length of the valve springs.
2. Replace the springs if they are shorter than the allowable limit.

11.2 Camshaft/Crankshaft



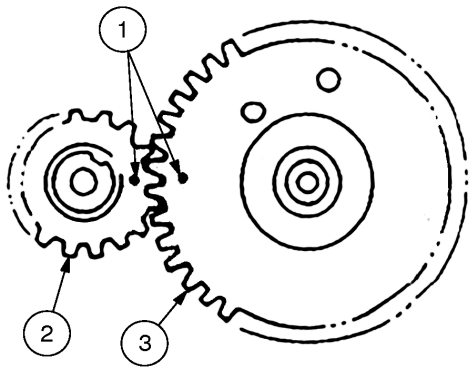
No.	Description	No.	Description
1	Piston	7	Oil Dipper
2	Piston Triangle Mark	8	Crankshaft
3	Oil Alert Unit	9	Camshaft
4	Oil Level Switch	10	Tappets
5	Oil Seal	11	Decompressor Weight
6	Radial Ball Bearing		

FIGURE 42. ENGINE COMPONENTS

Disassembly:

1. To gain access to the internal crankcase components, the generator and all preceeding components must be removed.
2. Remove the bolts securing the crankcase cover.

3. Gently tap the crankcase cover with a plastic hammer to loosen and remove the cover.
4. Remove the camshaft first.
5. To remove the crankshaft, the piston and flywheel must first be removed.



No.	Description	No.	Description
1	Crankshaft	3	Camshaft
2	Index Marks		

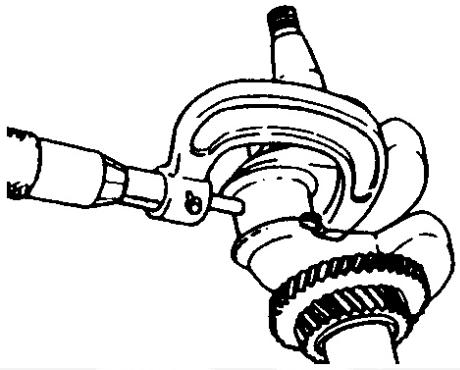
FIGURE 43. CAMSHAFT/CRANKSHAFT MARKINGS

Reassembly,

1. Push the camshaft (Item 8) in until the bearing touches the crankcase. Be careful not to damage the oil seal.
2. Reinstall the piston (item 1).
3. Install the tappets (item 10) immediately before installing the camshaft (item 9).
4. When reinstalling the camshaft, make sure the decompressor weight (item 11) moves smoothly and the spring is not weak or worn.
5. Align the index marks on the camshaft with the index mark on the crankshaft (see **Figure 43**).
6. Reinstall the crankcase cover.
7. Reinstall the bolts and torque to spec, using a crisscross pattern.

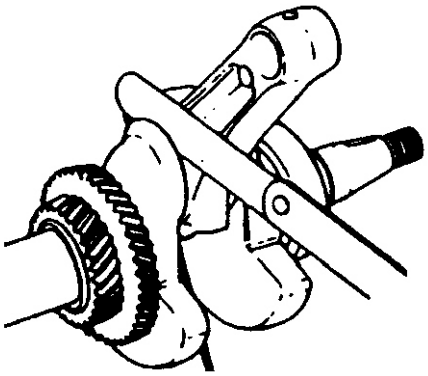
11.2.1 Camshaft / Crankshaft Inspection

TABLE 18. CRANKSHAFT OUTSIDE DIAMETER



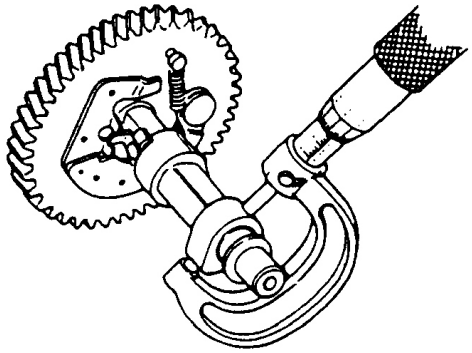
Factory Specification	Allowable Limit
29.985 mm (1.181 in)	29.92 mm (1.178 in)

TABLE 19. CONNECTING ROD LARGE END SIDE CLEARANCE



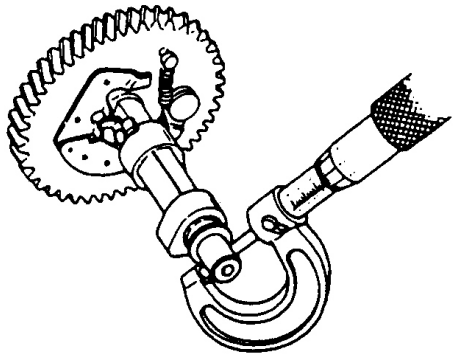
Factory Specification	Allowable Limit
0.1 - 0.7 mm (0.004 - 0.028 in)	1.1 mm (0.043 in)

TABLE 20. CAMSHAFT HEIGHT



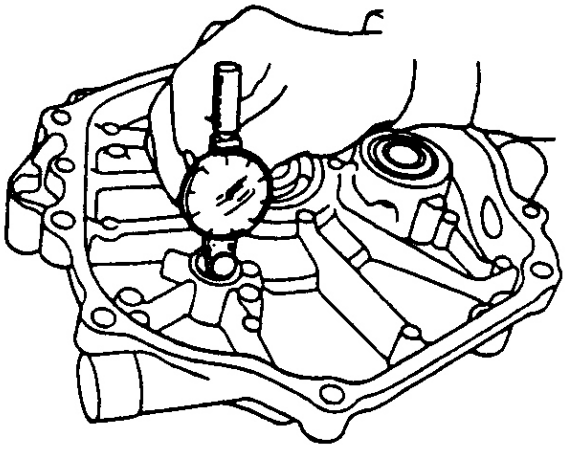
	Factory Specification	Allowable Limit
IN	27.7 mm (1.09 in)	27.45 mm (1.081 in)
EX	27.75 mm (1.093 in)	27.50 mm (1.083 in)

TABLE 21. CAMSHAFT OUTSIDE DIAMETER



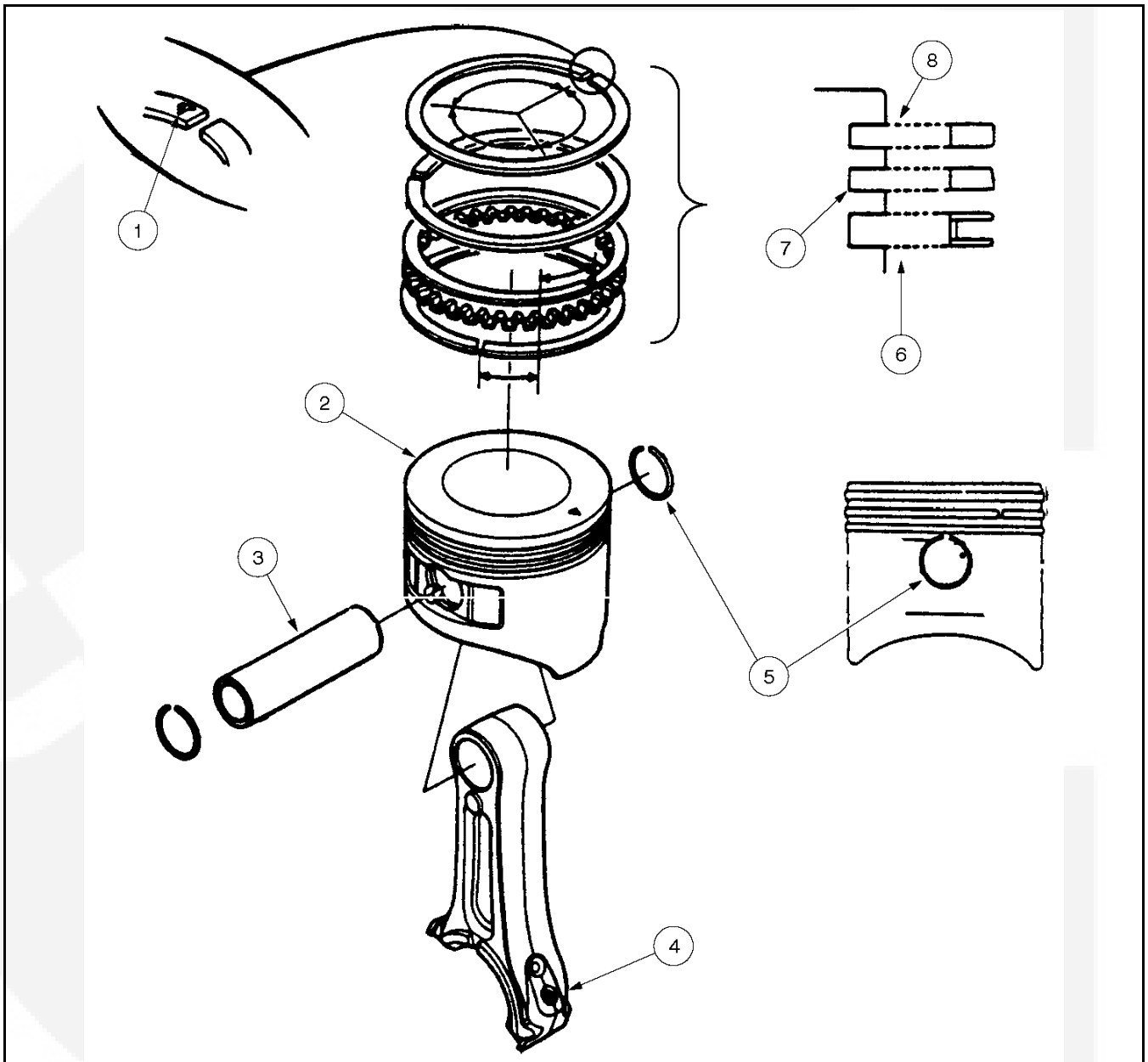
Factory Specification	Allowable Limit
13.984 mm (0.5506 in)	13.916 mm (0.5479 in)

TABLE 22. CRANKCASE COVER - CAMSHAFT HOLDER INSIDE DIAMETER



Factory Specification	Allowable Limit
14.00 mm (0.55 in)	14.048 mm (0.5531 in)

11.3 Piston



No.	Description	No.	Description
1	Marking	5	Piston Pin Clip
2	Piston	6	Oil Ring
3	Piston Pin	7	Second Ring
4	Connecting Rod	8	Top Ring (Chrome Plated)

FIGURE 44. PISTON ASSEMBLY

Disassembly:

1. To remove the piston, the cylinder head and crankcase cover must be removed.
2. Remove the connecting rod cap.

Reassembly:

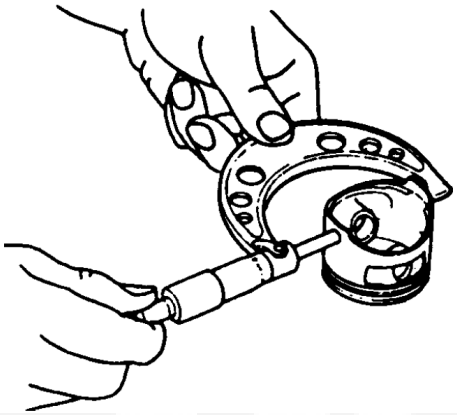
1. Install all rings with the markings facing upward.
2. Make sure that the top (chrome plated) ring (item 8) and the second ring (item 7) are not interchanged.
3. Once installed, make sure that the rings rotate smoothly.
4. Space the piston ring end gaps 120 degrees apart. Do not align the gaps with the piston pin bore.
5. Install the connecting rod with the long end toward the triangle marked side of the piston.
6. Install the piston pin clip (item 5) by setting one end of the clip in the piston grove, holding the other end with long-nosed pliers, and rotating the clip in. Do not align the end gap of the clip with the cut-out in the piston pin bore.
7. When reinstalling the piston into the cylinder (item 1) make sure the triangle mark (item 2) is facing the push rods.
8. Install the oil dipper (item 7) toward the camshaft. The ribs on the cap and the connecting rod must be aligned.

11.3.1 Piston Inspection

TABLE 23. CYLINDER SLEEVE INSIDE DIAMETER

Factory Specification	Allowable Limit
68.015 mm (2.6778 in)	68.165 mm (2.6837 in)

TABLE 24. PISTON SKIRT OUTSIDE DIAMETER

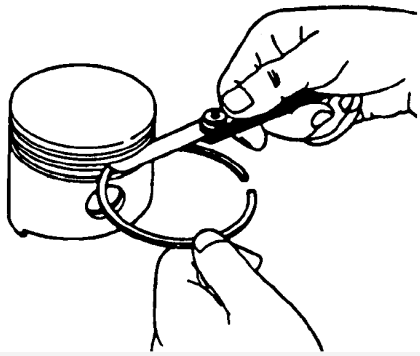


Factory Specification	Allowable Limit
67.985 mm (2.6766 in)	67.845 mm (2.6711 in)

TABLE 25. PISTON-TO-CYLINDER CLEARANCE

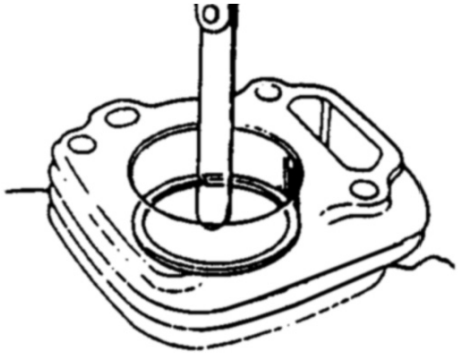
Factory Specification	Allowable Limit
0.03 - 0.05 mm (0.0012 - 0.002 in)	0.12 mm (0.005 in)

TABLE 26. PISTON RING SIDE CLEARANCE



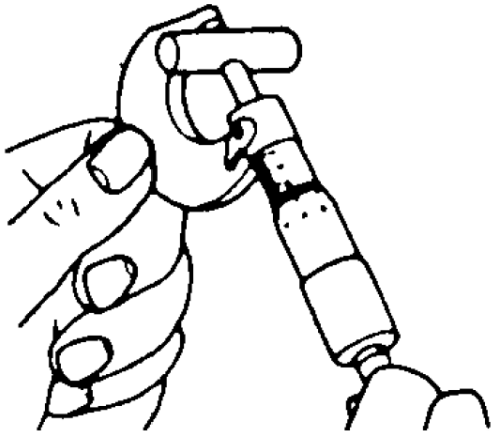
Factory Specification	Allowable Limit
0.030 - 0.060 mm (0.0012-0.0024 in)	0.15 mm (0.006 in)

TABLE 27. PISTON RING END GAP



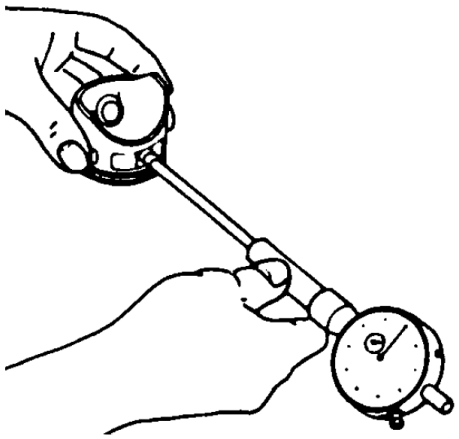
Factory Specification	Allowable Limit
0.2 - 0.4 mm (0.008 - 0.016 in)	1.0 mm (0.04 in)

TABLE 28. PISTON PIN OUTSIDE DIAMETER



Factory Specification	Allowable Limit
17.998 mm (0.7086 in)	17.954 mm (0.7068 in)

TABLE 29. PISTON PIN BORE INSIDE DIAMETER

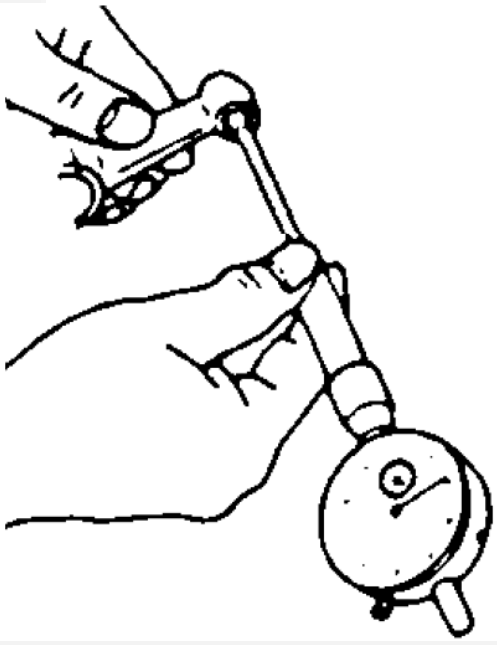


Factory Specification	Allowable Limit
18.002 mm (0.7087 in)	18.048 mm (0.7105 in)

TABLE 30. PISTON-TO-PISTON PIN BORE CLEARANCE

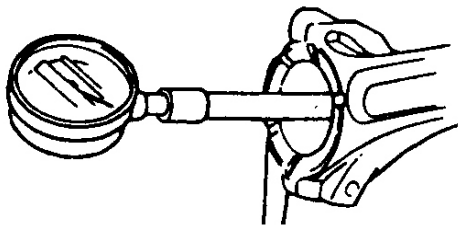
Factory Specification	Allowable Limit
0.004 - .016 mm (0.00016 - 0.0006 in)	0.06 mm (0.002 in)

TABLE 31. CONNECTING ROD SMALL END INSIDE DIAMETER



Factory Specification	Allowable Limit
18.006 mm (0.7089 in)	18.07 mm (0.711 in)

TABLE 32. CONNECTION ROD LARGE END INSIDE DIAMETER

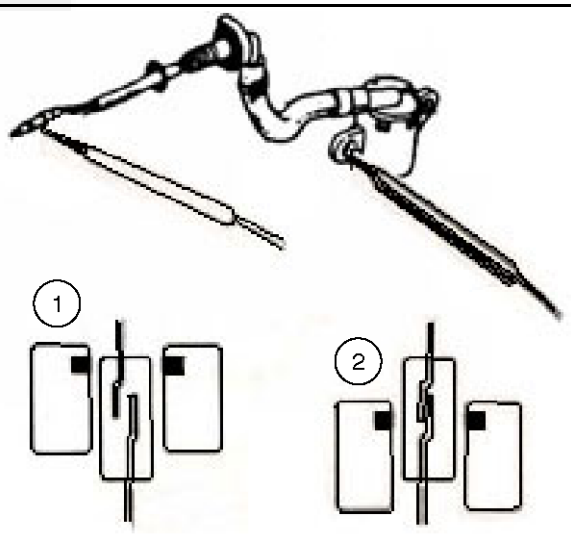


Factory Specification	Allowable Limit
30.015 mm (1.1817 in)	30.066 mm (1.1837 in)

11.4 Oil Level Switch

Check continuity of the switch with an ohmmeter.

1. Hold the switch in its normal position. The ohmmeter should read zero resistance.
2. Hold the switch upside down. The ohmmeter should read infinity (∞) resistance.
3. Inspect the float by dipping the switch into a container of oil. The ohmmeter reading should go from zero to infinity as the switch is lowered.



No.	Description	No.	Description
1	Off	2	On

FIGURE 45. CHECKING OIL LEVEL SWITCH CONTINUITY

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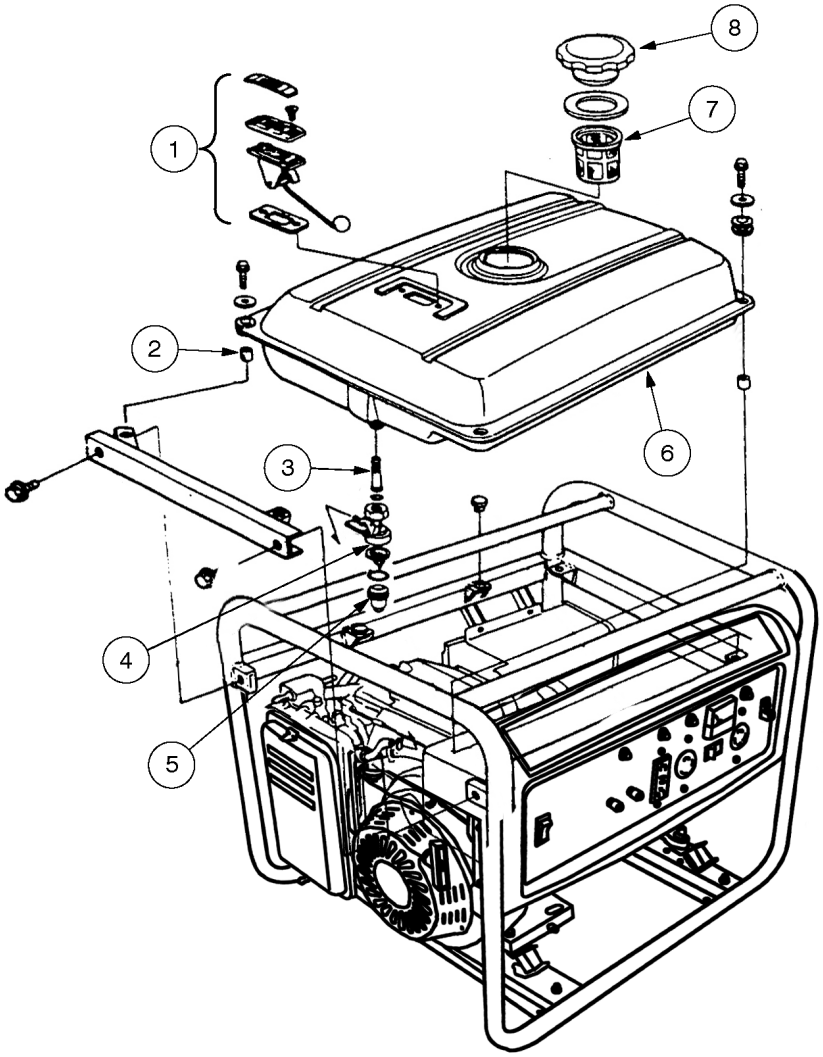
12 Fuel, Start, and Ignition Systems

12.1 Fuel System

This section includes information on servicing the fuel system, including:

- The fuel tank
- The choke assembly
- The governor assembly
- The carburetor
- The fuel cut-off solenoid

12.1.1 Fuel Tank Removal



No.	Description	No.	Description
1	Fuel Meter Assembly	5	Sediment Cup
2	Tank Cushion	6	Fuel Tank
3	Fuel Filter	7	Fuel Strainer
4	Fuel Check Valve	8	Fuel Tank Cap

FIGURE 46. FUEL TANK COMPONENTS

WARNING: Contact with a hot generator set can cause severe burns. Always shut down the generator set and allow it to cool before performing any maintenance or service.

WARNING: Accidental starting of the generator set can cause severe personal injury or death. Before performing maintenance, disconnect the spark plug wire from the spark plug.

WARNING: Gasoline is highly flammable and explosive which can result in serious injury or death. Drain the fuel tank and fuel line before disassembly. Wipe up any spilled fuel immediately.

To remove the fuel tank,

1. Make sure the generator set is turned off.
2. Disconnect the spark plug wire.
3. Drain the fuel from the fuel tank.
4. Close the fuel check valve (item 4).
5. Press the hose barb connecting the fuel line to the fuel check valve and remove the fuel line.
6. Remove the four bolts and flat washers on the four corners of the fuel tank that are securing the fuel tank to the fuel tank brackets.
7. Remove the brace located above the recoil by removing the two bolts holding the brace in place.
8. Slide the fuel tank out of the recoil side of the frame.

12.1.2 Fuel Tank Service and Installation

To service the fuel tank,

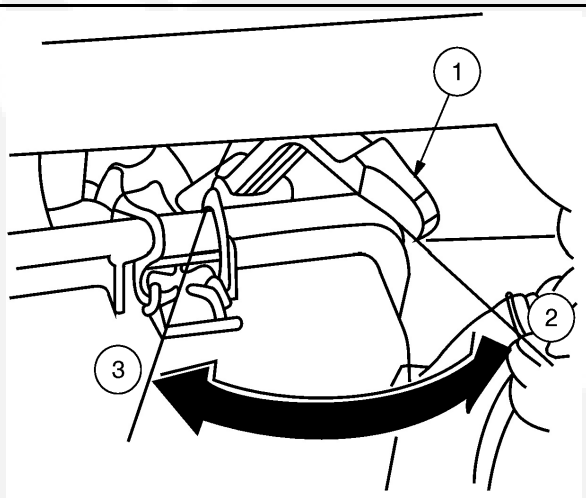
1. Wash the tank externally and internally to remove any sediment and allow it to thoroughly dry.
2. Remove the fuel tank cap, and fuel strainer.
   a. Check to see if they are clean and undamaged. Replace if necessary.
   b. Make sure that the air vent on the fuel tank cap is clean and unclogged. Blow with compressed air if necessary.
   c. Reinstall the fuel strainer, fuel tank cap, and seal.
3. Turn the tank over and remove the sediment cup, fuel valve, and fuel filter.
   a. Check the fuel filter and make sure it is clean and unclogged. Replace if necessary.
   b. Wash the sediment cup to remove sediment.
   c. Check the fuel valve passages to make sure they are not clogged.
   d. Reinstall the sediment cup, fuel valve, and fuel filter.
4. Slide the fuel tank into the recoil side of the frame.
5. Use the two bolts to secure the brace above the recoil.
6. Use the four bolts to secure the four corners of the fuel tank to the frame.
7. Reinstall the fuel line.
8. Open the fuel check valve.
9. Add fuel to the fuel tank.

10. Check the operation of the fuel meter float to make sure an accurate level is being displayed.
11. Reconnect the spark plug wire.
12. Start the generator set and let it run for a few minutes while checking for any fuel leaks at the fuel connection points and at the fuel valve. If any leaks are detected, shut the generator set off and repair as necessary.

WARNING: Gasoline is highly flammable and explosive which can result in severe personal injury or death. After reassembly, check for leaks and make sure the area is dry before starting the engine.

12.2 Choke Assembly

The choke assembly is used to help a cold generator start. To start a cold generator, pull the choke rod out into the start position. After starting the generator, push the choke rod back into the run position.



No.	Description	No.	Description
1	Choke Lever	3	Closed
2	Open		

FIGURE 47. CHOKE ROD

12.2.1 Choke Assembly Removal

To remove the choke assembly,

1. Make sure the generator set is turned off.
2. Disconnect the spark plug wire.
3. Remove the air cleaner, as described in **Air Filter Removal**.
4. Press the hose barb connecting the vacuum pull-off tube to the choke assembly and remove the hose.

5. Remove the choke assembly.

12.2.2 Choke Assembly Service and Installation

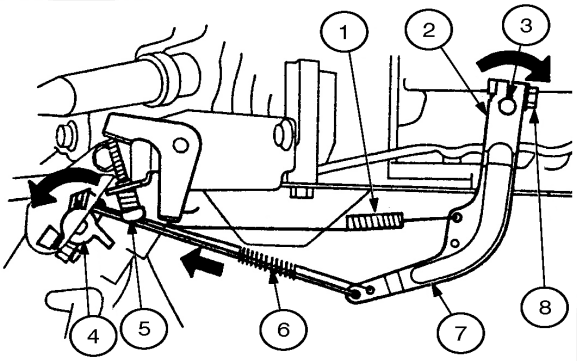
To service and reinstall the choke assembly,

1. Clean and inspect the choke assembly. Replace if necessary.
2. Install the choke assembly and reconnect the hose barb connecting the vacuum pull-off tube to the choke assembly.
3. Reinstall the air cleaner as described in the **Air Filter Service and Installation** section.

12.3 Governor Assembly

The governor assembly regulates the speed of the generator by balancing the forces between the governor gear and the governor spring. To adjust the governor, see the **Governor Adjustments** section.

12.3.1 Governor Assembly Removal



No.	Description	No.	Description
1	Governor Nut Spring	5	Limiting Screw
2	Governor Arm Pinch Bolt	6	Anti-Surge Spring
3	Governor Arm Shaft	7	Governor Arm
4	Throttle	8	Nut

FIGURE 48. GOVERNOR ASSEMBLY

To remove the governor assembly,

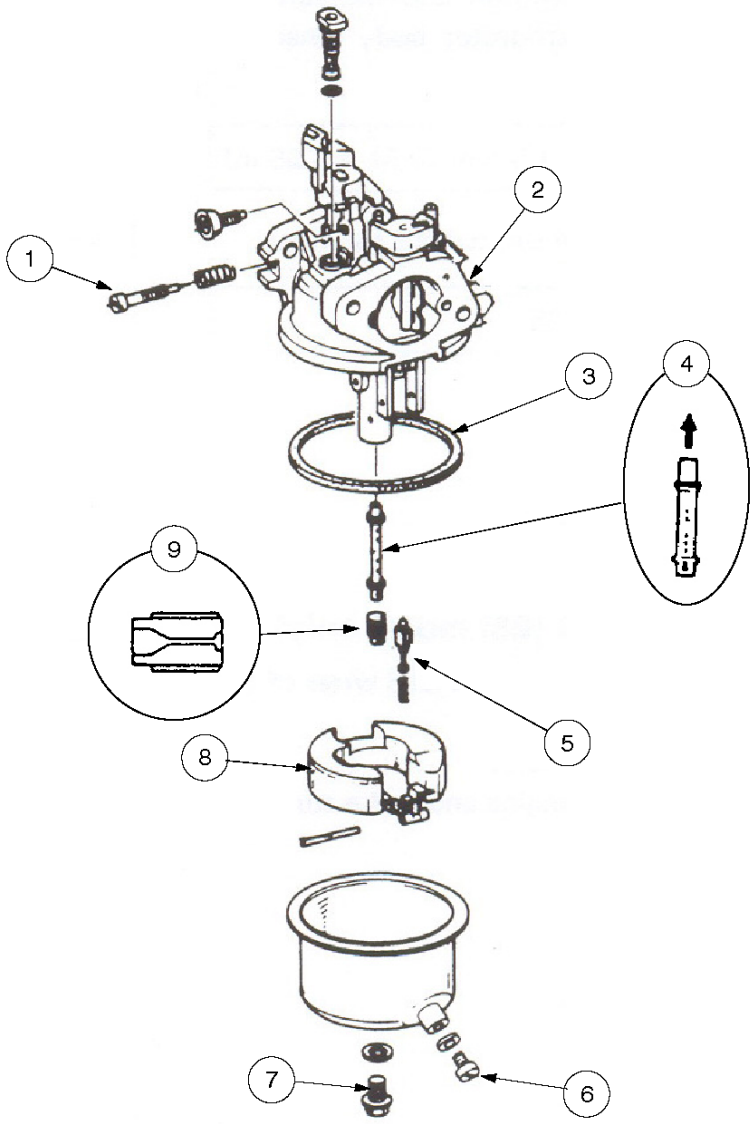
1. Remove the fuel tank, as described in the **Fuel Tank Removal** section.
2. Unlatch the anti-surge and governor springs (items 1 and 6).
3. Loosen the nut (item 8) holding the governor arm to the governor arm shaft.
4. Gently pull up on the governor arm (item 7) and remove it from the governor arm shaft (item 3).
5. Remove the governor arm from the anti-surge spring arm.

6. Rotate the throttle (item 4) and slide the anti-surge spring arm up and out of the throttle.
7. Disconnect the anti-surge spring (item 6) from the throttle.
8. Remove the three bolts securing the limiting screw bracket to the heat shielding and remove the limiting screw bracket.

12.3.1.1 Governor Service and Installation

1. Clean and inspect the governor assembly. Replace any defective parts.
2. Secure the limiting screw bracket.
3. Connect the anti-surge spring to the throttle.
4. Install the anit-surge spring arm on the throttle.
5. Install the governor arm on the anti-surge spring arm.
6. Connect the governor arm to the governor arm shaft and secure it with a nut.
7. Install the anti-surge and governor springs.
8. Reinstall the fuel tank, as described in the **Fuel Tank Service and Installation** section.
9. Adjust the governor speed as necessary (refer to the **Governor Adjustments** section).

12.4 Carburetor



No.	Description	No.	Description
1	Pilot Screw	6	Drain Screw
2	Carburetor Body	7	Set Bolt
3	O-Ring	8	Float
4	Main Nozzle	9	Main Jet
5	Float Valve		

FIGURE 49. CARBURETOR ASSEMBLY

12.4.1 Carburetor Removal

WARNING: Gasoline is highly flammable and explosive which can result in severe personal injury or death. Close the fuel shutoff valve and drain the carburetor before servicing the carburetor.

To remove the carburetor,

1. Remove the air cleaner, choke assembly, and governor assembly. (Refer to the **Air Filter Removal**, **Choke Assembly Removal**, and **Governor Assembly Removal** sections.)
2. Close the shut-off valve and drain the carburetor.
3. Press the hose clamps and remove the fuel line.
4. Remove the vacuum pull-off line.
5. Slide the carburetor back off the mounting bolts.

12.4.2 Carburetor Service and Installation

WARNING: Gasoline is highly flammable and explosive which can result in severe personal injury or death. Close the fuel shutoff valve and drain the carburetor before servicing the carburetor.

Before reassembly,

- Use compressed air to clean the internal passages and orifices of the carburetor body.
- Check the pilot screw head for wear or damage. The initial opening of the screws is 1-5/8 turns out.
- Use compressed air to thoroughly clean the drain screw.
- Use compressed air to thoroughly clean the main jet.
- Use compressed air to thoroughly clean the main nozzle before installing it.
- Check to see if the float valve is worn or if the float valve spring is weak.

During reassembly,

- Check the O-ring for correct installation.
- Check the float for smooth operation once it is installed.

To install the carburetor,

1. Slide the carburetor back on the mounting bolts.
2. Use the hose clamps to reinstall the fuel line.
3. Reinstall the vacuum pull-off line.
4. Reinstall the governor assembly, chock assembly, and air cleaner.
5. Open the shut-off valve.
6. Check the drain screw for leaks and repair, if necessary.
7. Check the set bolt for sign of leakage and repair, if necessary.

12.5 Fuel Cut-Off Solenoid

The fuel cut-off solenoid prevents fuel from entering the engine when the generator set is not operating. The fuel cut-off solenoid closes during shut down, starving the engine of fuel.

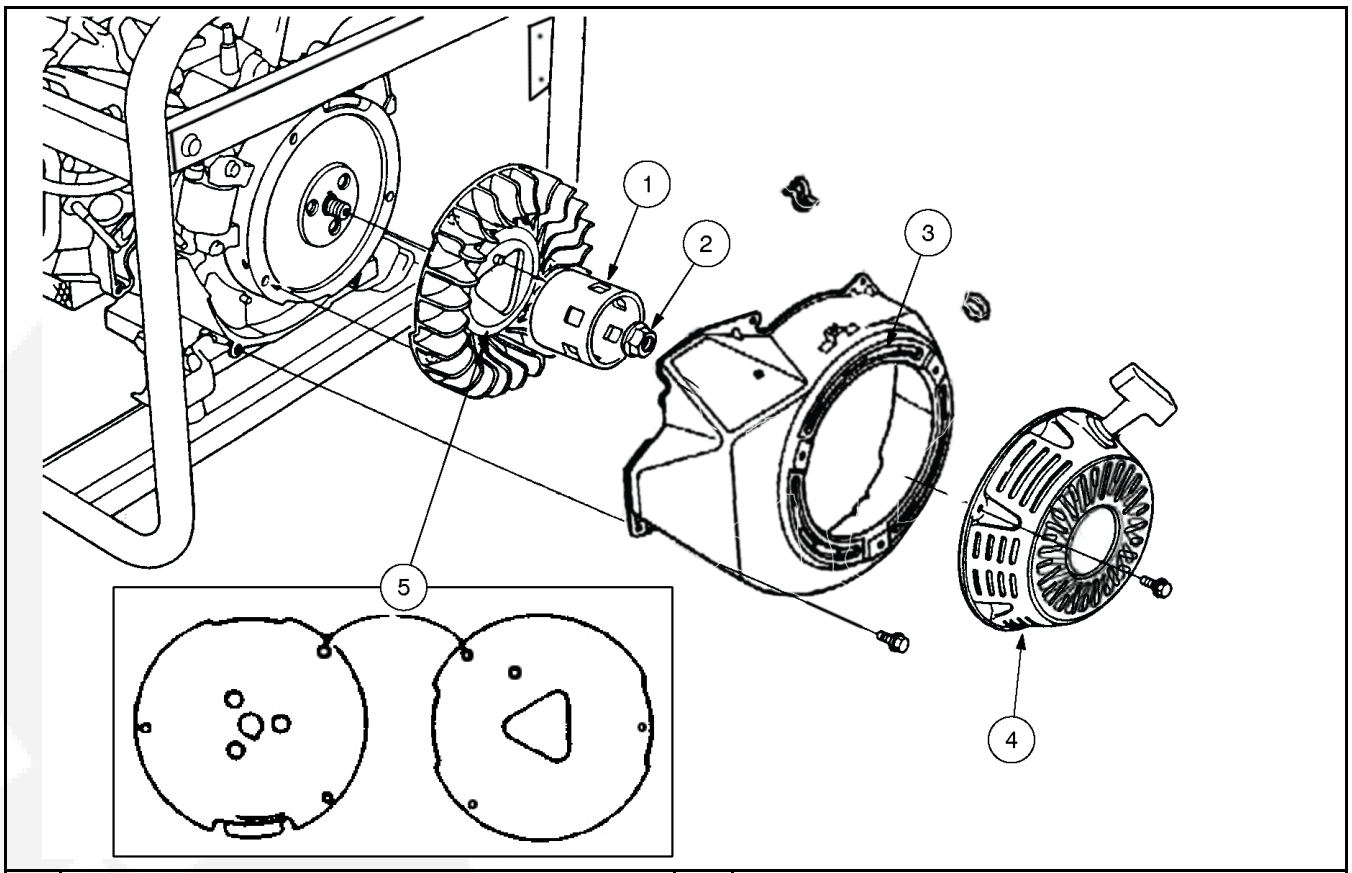
12.5.1 Fuel Cut-Off Solenoid Service

1. Disconnect the fuel cut-off solenoid leads from the control panel.
2. Remove the screws connecting the fuel cut-off solenoid to the carburetor.
3. Inspect the fuel cut-off solenoid for continuity between the double green wires and the solenoid valve. If there is no continuity, replace the solenoid.
4. Use the two screws to reinstall the fuel cut-off solenoid to the carburetor.
5. Reconnect the fuel cut-off solenoid leads from the control panel.

12.6 Starting System

12.6.1 Recoil Starter

The recoil starter allows for the manual start of the generator and is available on all portable models.



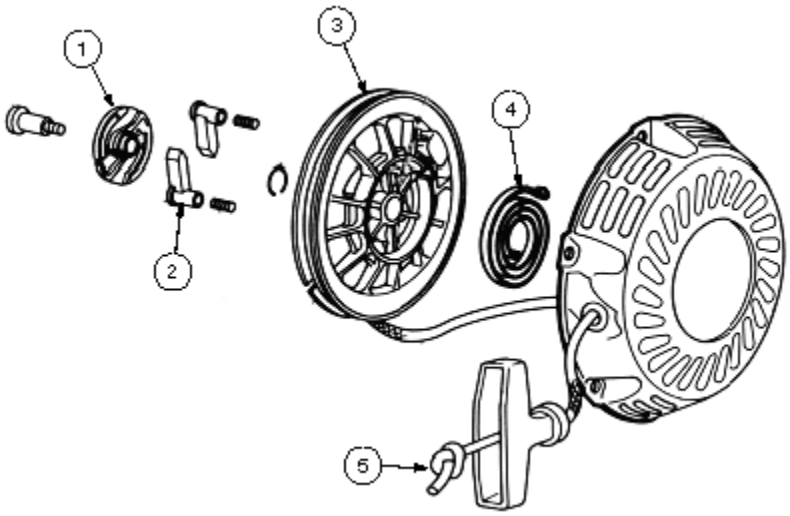
No.	Description	No.	Description
1	Recoil Drive Cup	4	Recoil Starter Assembly
2	Flange Nut	5	Cooling Fan
3	Fan Cover		

FIGURE 50. RECOIL STARTER / FAN COVER ASSEMBLY

12.6.2 Recoil Starter Removal

WARNING: Contact with sharp or moving objects can cause severe personal injury. Work carefully and wear protective safety glasses, gloves, and clothing when working on the recoil starter due to the possibility of sharp flying objects and rotating parts. Do not let the recoil spring snap.

1. Remove the three bolts on the front panel of the recoil assembly.
2. To gain access to the recoil ratchet and spring in the recoil starter assembly, carefully remove the bolt on the reel cover (see the following figure).



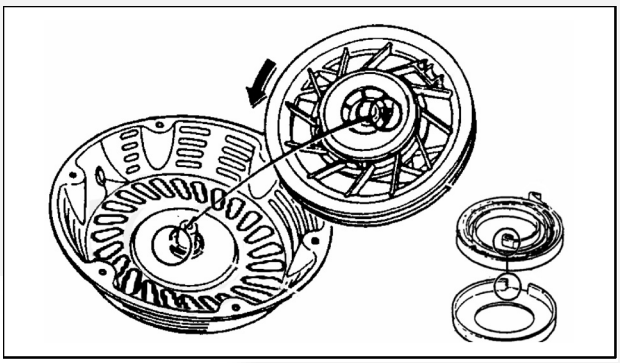
No.	Description	No.	Description
1	Reel Cover	4	Return Spring
2	Ratchets	5	Starter Rope
3	Starter Reel		

FIGURE 51. RECOIL STARTER ASSEMBLY

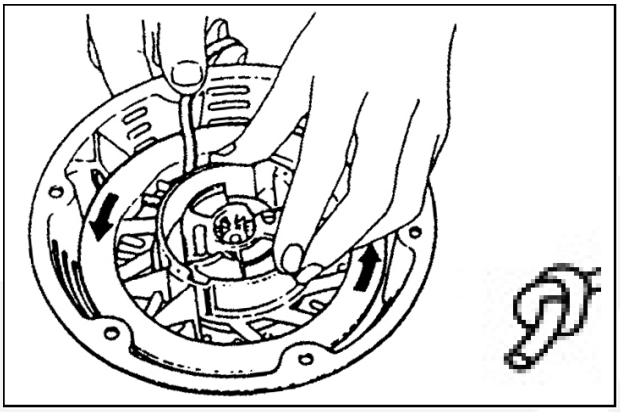
12.6.3 Recoil Starter Service and Reassembly

WARNING: Contact with sharp or moving objects can cause severe personal injury. Work carefully and wear protective safety glasses, gloves, and clothing when working on the recoil starter due to the possibility of sharp flying objects and rotating parts. Do not let the recoil spring snap.

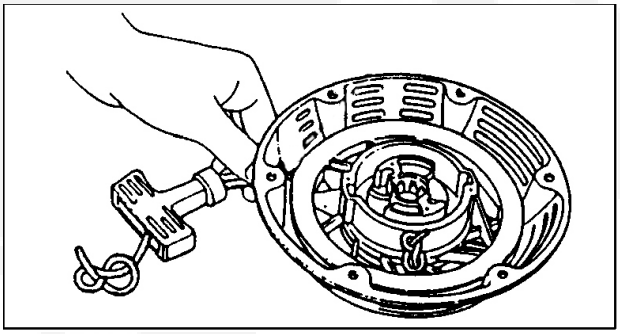
1. Hook the spring outer hook in the reel groove, and install the reel on the starter case, so that the spring inner hook is hooked to the starter case tab by turning the reel counterclockwise.



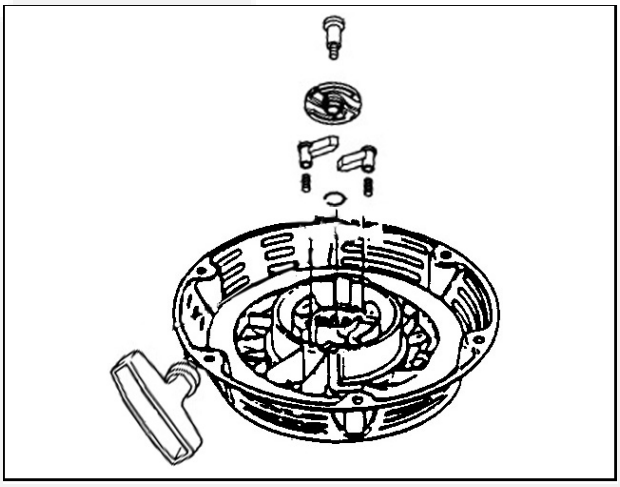
2. Feed the end of the rope through the hole in the starter reel, and tie the rope end. Wind the rope onto the direction shown, and wedge the rope end in the notch on the edge of the reel.



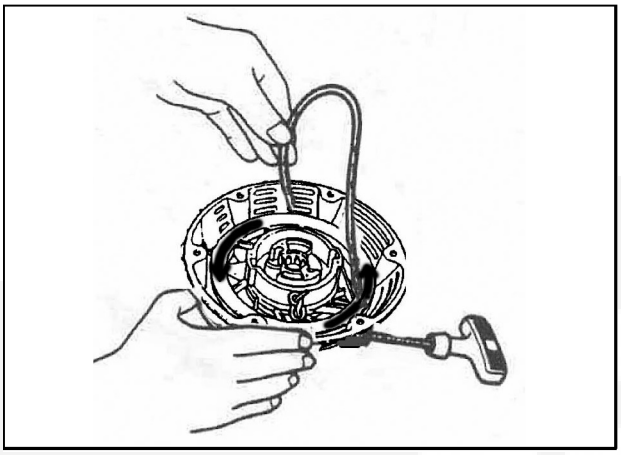
3. With a short length of the rope extending from the starter reel notch, pull the end of the rope out of the case, feed it through the starter grip, and tie a knot in the end of the rope.



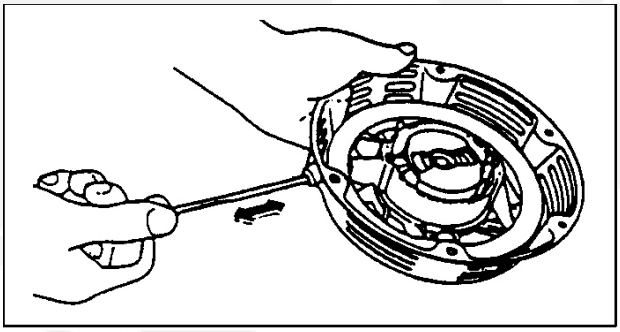
4. Install the friction plates, friction spring, ratchet pin, guide plate, and reel cover. Align the ratchet with the reel cover notch. Tighten the reel cover bolt.



5. Rotate the reel three full turns in the direction of the arrow.



6. Check the operation of the ratchet by pulling the starter rope out several times.



12.7 Ignition System

The ignition system consists of:

- The spark plug
- The spark plug cap
- The ignition coil and secondary wire
- The air gap (at flywheel)
- The cooling fan and fan cover
- The flywheel

12.7.1 Spark Plug

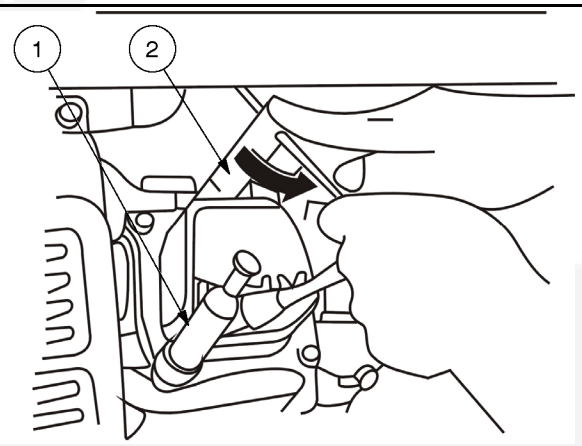
Refer to the **Maintenance Schedule** for scheduled spark plug maintenance. To ensure proper engine operation, the spark plug must be properly gapped and free of deposits.

If the engine has been running, the spark plug and engine will be very hot. Be careful not to touch the engine or spark plug.

⚠ *CAUTION: Improper installation of the spark plug could cause damage to the engine. Make sure that the spark plug is securely tightened.*

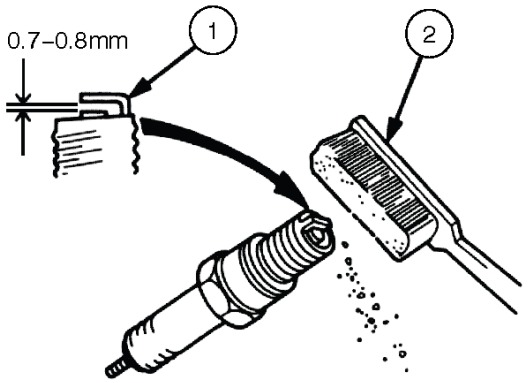
⚠ *CAUTION: Using spark plugs which have an improper heat range can cause poor performance and damage the engine. Only use the recommended spark plugs or equivilant.*

1. Turn off the generator set and allow it to cool off.
2. Remove the spark plug cap.
3. Clean any dirt from around the spark plug base.
4. Use the wrench supplied in the tool kit to remove the spark plug.
5. Visually inspect the spark plug. If the insulator is cracked or chipped, discard the spark plug. If it is to be reused, clean the spark plug with a wire brush.
6. Measure the plug gap with a feeler gauge. Correct as necessary by carefully bending the side electrode.
7. Verify that the spark plug washer is in good condition, and thread the spark plug in by hand to prevent cross threading.
8. After the spark plug is seated, tighten with a spark plug wrench to compress the washer. If installing a new spark plug, tighten 1/2 turn after the spark plug seats to compress the washer. If reinstalling a used spark plug, tighten 1/8-1/4 turn after the spark plug seats to compress the washer.



No.	Description	No.	Description
1	Removed Spark Plug Boot	2	Plug Wrench

FIGURE 52. SPARK PLUG REMOVAL



No.	Description	No.	Description
1	Side Electrode	2	Metal Brush

FIGURE 53. SPARK PLUG MAINTENANCE

12.7.1.1 Spark Plug Troubleshooting

Spark plugs must be in good condition and have proper gap for top engine performance. To replace the spark plug, see the **Spark Plug** portion of the **Maintenance** section of this manual.

If the engine misses or performance otherwise deteriorates, remove and examine the spark plugs for signs of the following problems.

- **Light tan, grey, or reddish deposits** - Normal
- **Soot Fouled** - This indicates a wrong spark plug heat range (too cold) or the duty cycle is too short for the engine to reach normal operating temperature.
- **Fuel Fouled** - This indicates a wrong spark plug heat range (too cold), there is faulty choke operation, there is an overly rich fuel mixture, or there is a dirty air filter.
- **Oil Fouled** - This indicates a malfunctioning crankcase breather, worn rings, or worn valve guides or seals. This may result from a generator that is overloaded or has overheated.
- **Burned or Overheated** - This is an indication of a leaking intake manifold gasket or a lean fuel mixture. This may result from a generator that is overloaded or has overheated.
- **Worn** - Replace the spark plug.

To check the spark plug,

1. Remove the spark plug.
2. Reconnect the spark plug cable and ground the side electrode to the bar metal on the engine.

NOTE: Do not touch the spark plug or cable during testing.

3. Crank the engine and look for a spark across the plug. If the spark is weak or inconsistent, replace with a new plug. If the problem persists, see the **Ignition Coil** section.

12.7.1.2 Spark Plug Cap

Measure the resistance of the spark plug cap by attaching an ohmmeter. The resistance should be 5 KΩ.

If the resistance is not as specified, replace the spark plug cap.

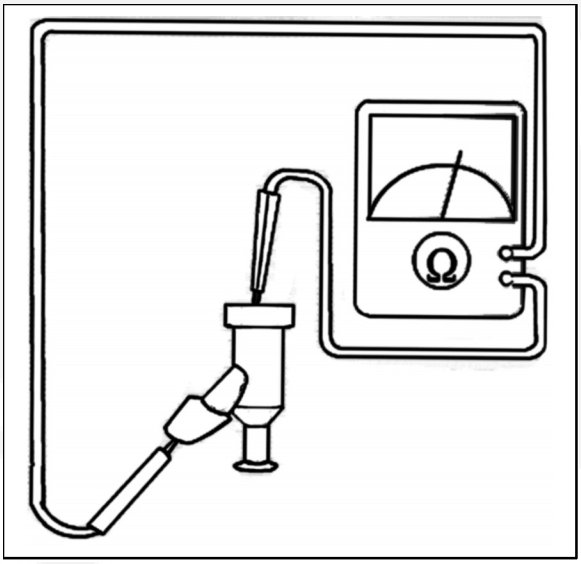


FIGURE 54. MEASURING THE SPARK PLUG CAP RESISTANCE

12.7.2 Ignition Coil

12.7.2.1 Ignition Coil Removal

1. To remove the ignition coil, you must first remove the cooling fan/flywheel shroud and all subsequent components. Refer to the **Fan and Fan Cover Removal** and the **Flywheel Removal** sections.
2. Remove the spark plug boot from the spark plug.
3. Remove the two bolts connecting the ignition coil to the engine block.
4. Disconnect the ignition lead from the control panel.

12.7.2.2 Ignition Coil Resistance

1. Measure the resistance of the primary coil by attaching one ohmmeter lead to the ignition coil's primary lead while touching the other test lead to the iron core. The primary side resistance value should be 0.8 - 1.0 Ω.
2. Measure the resistance side of the secondary side of the coil by removing the spark plug cap and touching one test lead to the spark plug lead wire while touching the other test lead to the iron core. The secondary side resistance value should be 5.9 - 7.1 ΩK.

☞ **NOTE: A false reading will result if the spark plug cap is not removed.**

3. If the resistance is not as specified, replace the ignition coil.

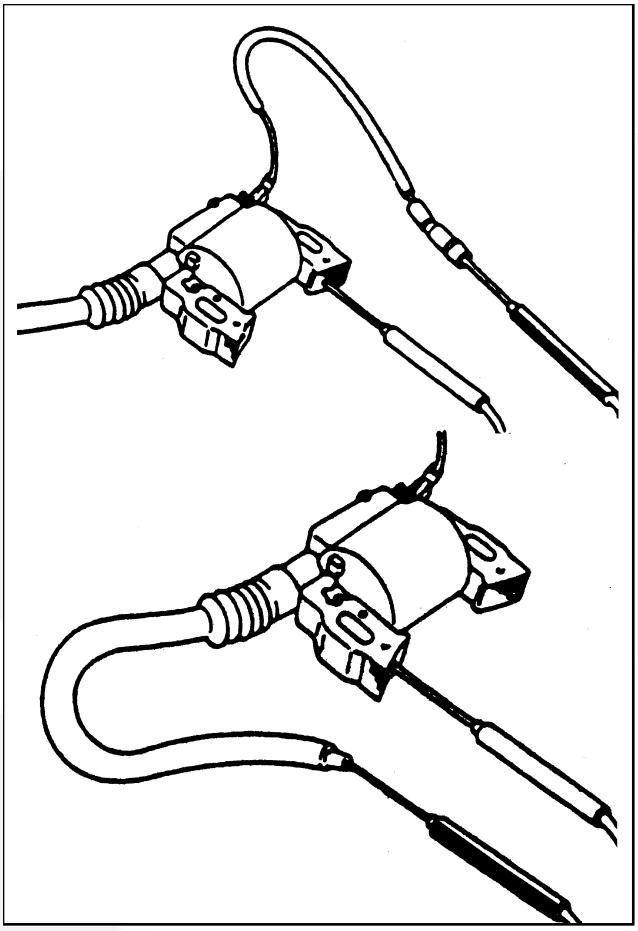


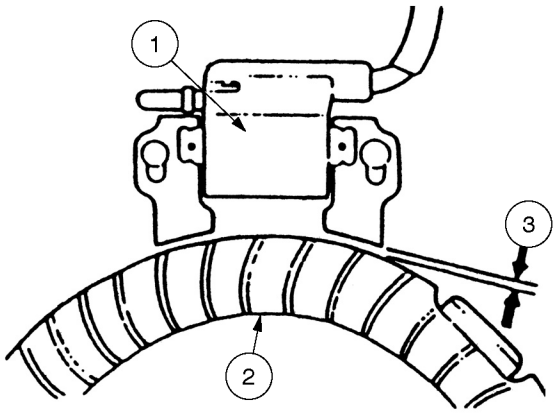
FIGURE 55. IGNITION COIL

12.7.2.3 Ignition Coil Installation

1. Use two bolts to secure the ignition coil to the engine block.
2. Connect the ignition lead from the control panel.
3. Check the spark plug lead for cracks or damage; replace if necessary.
4. Reinstall the spark plug boot.
5. Reinstall the cooling fan/flywheel shroud and all subsequent components, as described in the **Fan and Fan Cover Installation** and **Flywheel Installation** sections.

12.7.3 Ignition Coil Air Gap

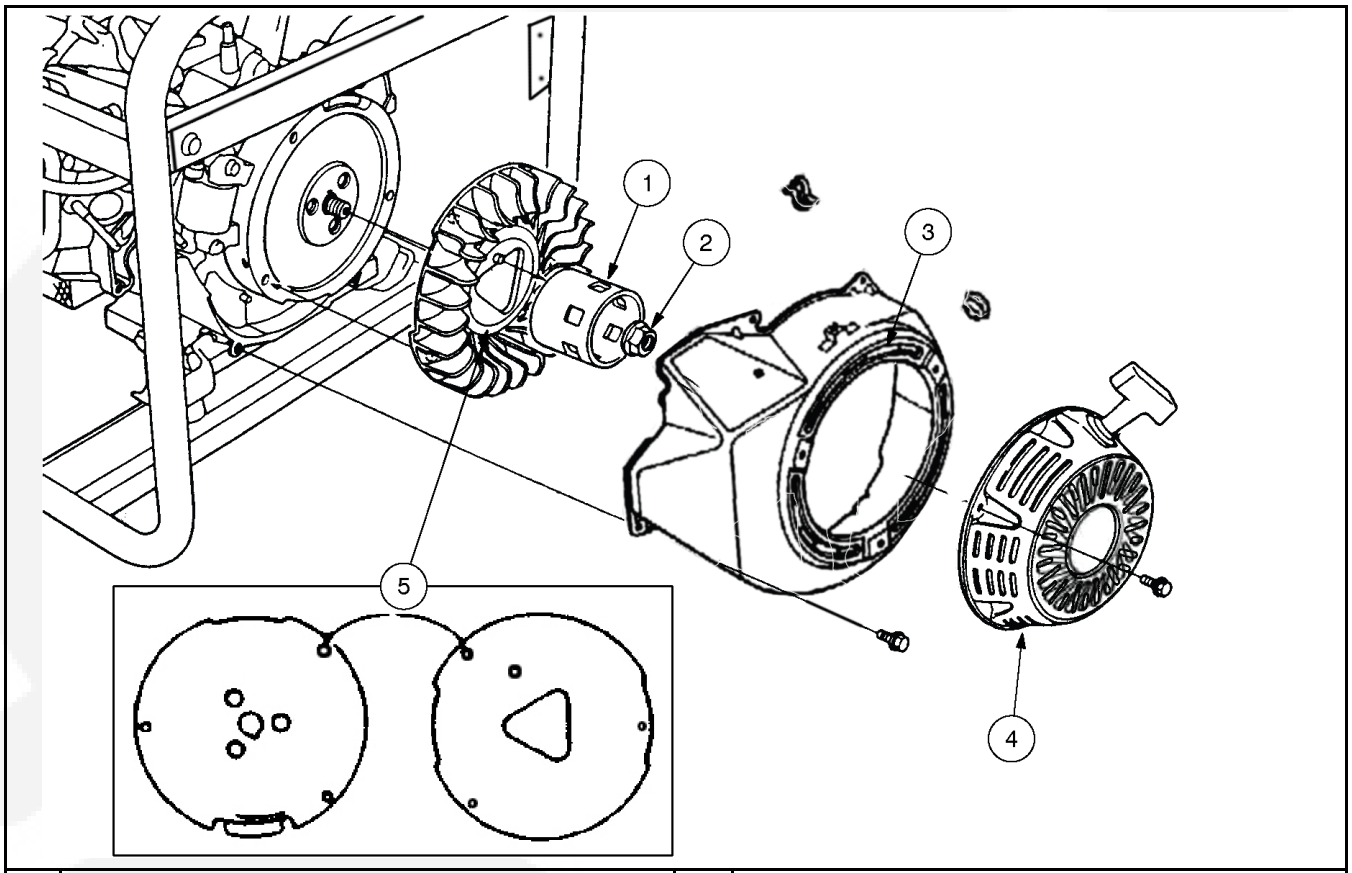
Use a thickness gauge to measure the air gap between the ignition coil and the flywheel. The air gap should be 0.4 ±0.2 mm (0.016 ±0.008 in).



No.	Description	No.	Description
1	Ignition Coil	3	0.4 ±0.2 mm (0.016 ±0.008 in)
2	Flywheel		

FIGURE 56. IGNITION COIL AIR GAP

12.8 Cooling Fan and Fan Cover



No.	Description	No.	Description
1	Recoil Drive Cup	4	Recoil Starter Assembly
2	Flange Nut (16 mm)	5	Cooling Fan
3	Fan Cover		

FIGURE 57. RECOIL STARTER AND FAN ASSEMBLY

12.8.1 Cooling Fan and Fan Cover Removal

1. Remove the fuel tank, air filter, check assembly, governor assembly, and the carburetor, as described in this manual.
2. Remove the four bolts connecting the shroud to the engine block.
3. Remove the fan cover, starter drive cup, and fan.

12.8.2 Cooling Fan and Fan Cover Installation

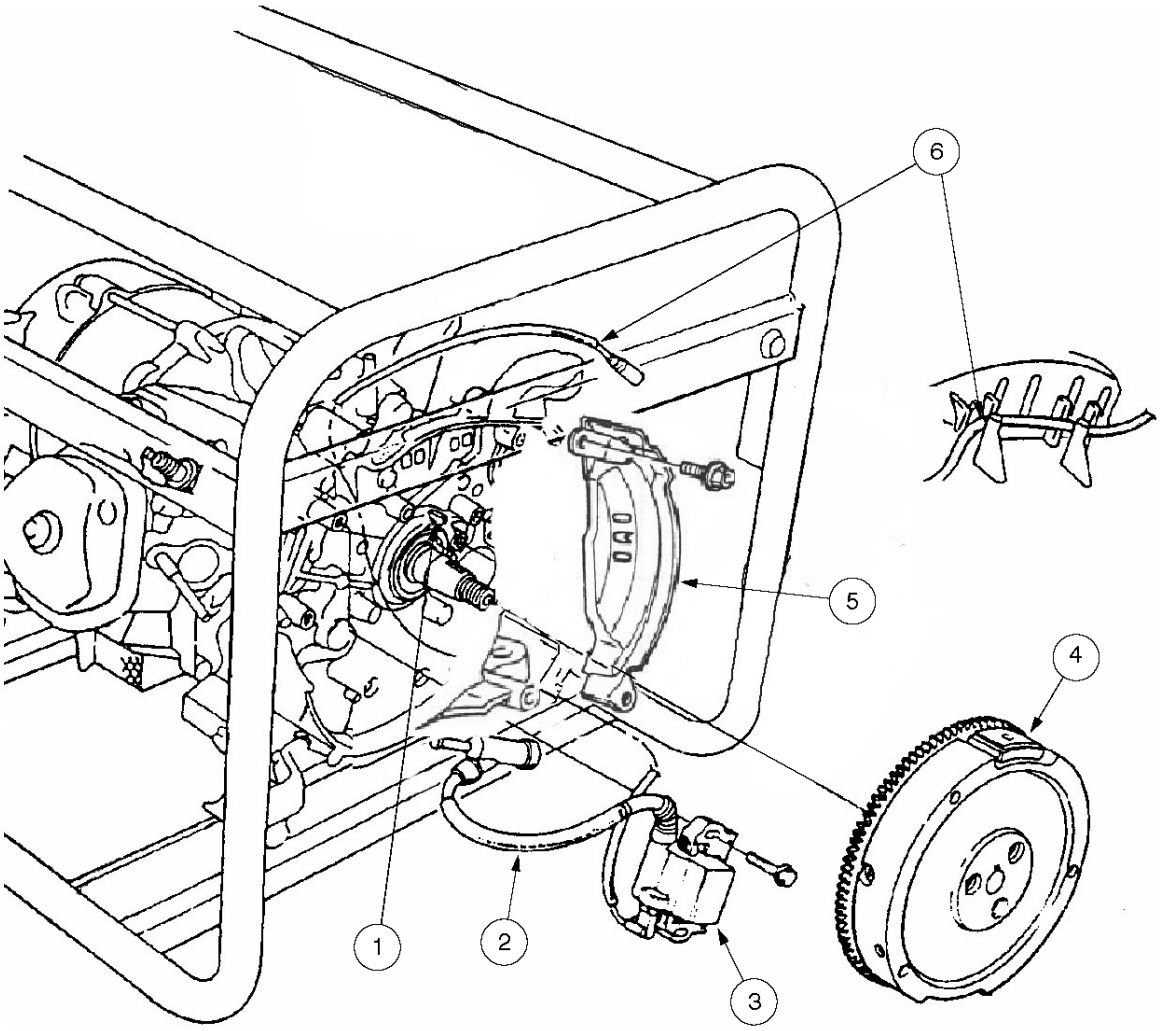
1. Install the fan by aligning the three lugs on the rear side of the fan with the small holes in the flywheel.

2. Reinstall the recoil starter pulley by aligning the hole in the pulley with the lug on the cooling fan.
3. Use the four bolts to reinstall the fan cover.

12.9 Flywheel

12.9.1 Flywheel Removal

1. Remove the fan cover and cooling fan (as described in the **Fan and Fan Cover Removal** section) and the ignition coil (as described in the **Ignition Coil Removal** section).
2. Use a puller to remove the flywheel.



No.	Description	No.	Description
1	Woodruff Key	4	Flywheel
2	Spark Plug Lead	5	Air Baffle
3	Ignition Coil Assembly	6	Spark Plug Lead

FIGURE 58. FLYWHEEL REMOVAL

12.9.2 Flywheel Installation

1. Install the flywheel on the generator. Use a lead hammer to seat the flywheel in place.
2. Check to make sure that the woodruff key is still in its slot in the crankshaft.
3. Reinstall the ignition coil as described in the **Ignition Coil Installation** section.
4. Reinstall the cooling fan and fan cover, as described in the **Fan and Fan Cover Installation** section.

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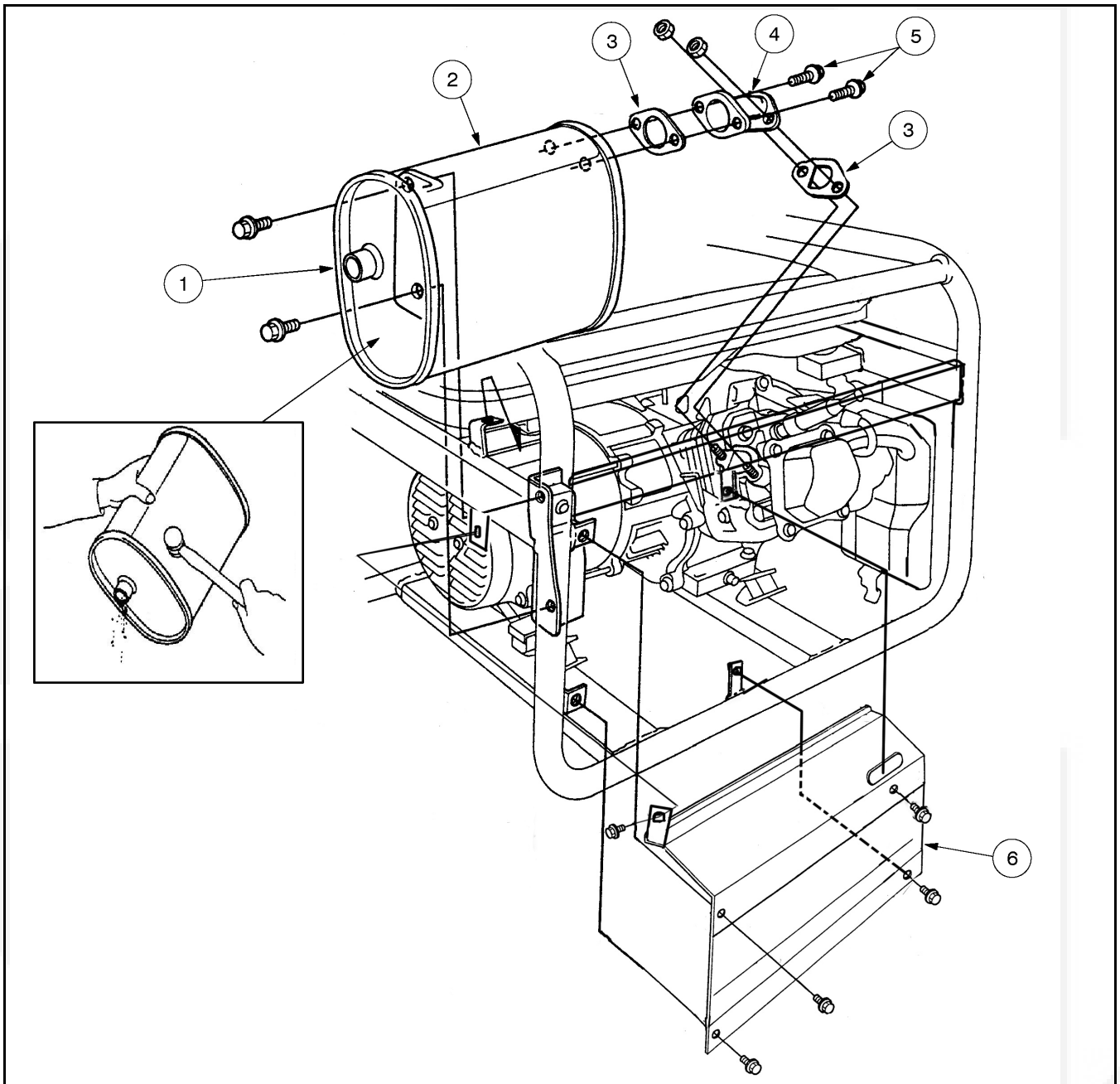
13 Intake / Exhaust System

This section includes service information on the intake / exhaust system, which includes:

- The spark arrestor
- The muffler
- The air cleaner

NOTE: **The failure to provide and maintain an approved spark-arresting exhaust system can be a violation of the law.**

13.1 Muffler



No.	Description	No.	Description
1	Muffler Exhaust Pipe	4	Exhaust Manifold
2	Muffler	5	Exhaust Pipe Bolts
3	Exhaust Flange Gasket	6	Heat Shield

FIGURE 59. MUFFLER ASSEMBLY

13.1.1 Muffler Removal

1. Remove the fuel tank, as described in the **Fuel Tank Removal** section.
2. Remove the two bolts securing the muffler to the exhaust manifold.
3. Remove the two bolts securing the muffler to the alternator.
4. Remove the four bolts securing the muffler heat shield to the frame.
5. Remove the exhaust manifold (item 4) by removing the two nuts connecting the exhaust manifold to the cylinder head.

13.1.2 Muffler Service and Installation

1. Use a plastic hammer to remove all carbon deposits from the exhaust pipe and muffler.
2. Discard the old flange gaskets and make sure you have new gaskets before proceeding with this installation.

NOTE: Always install new flange gaskets when reinstalling the muffler.

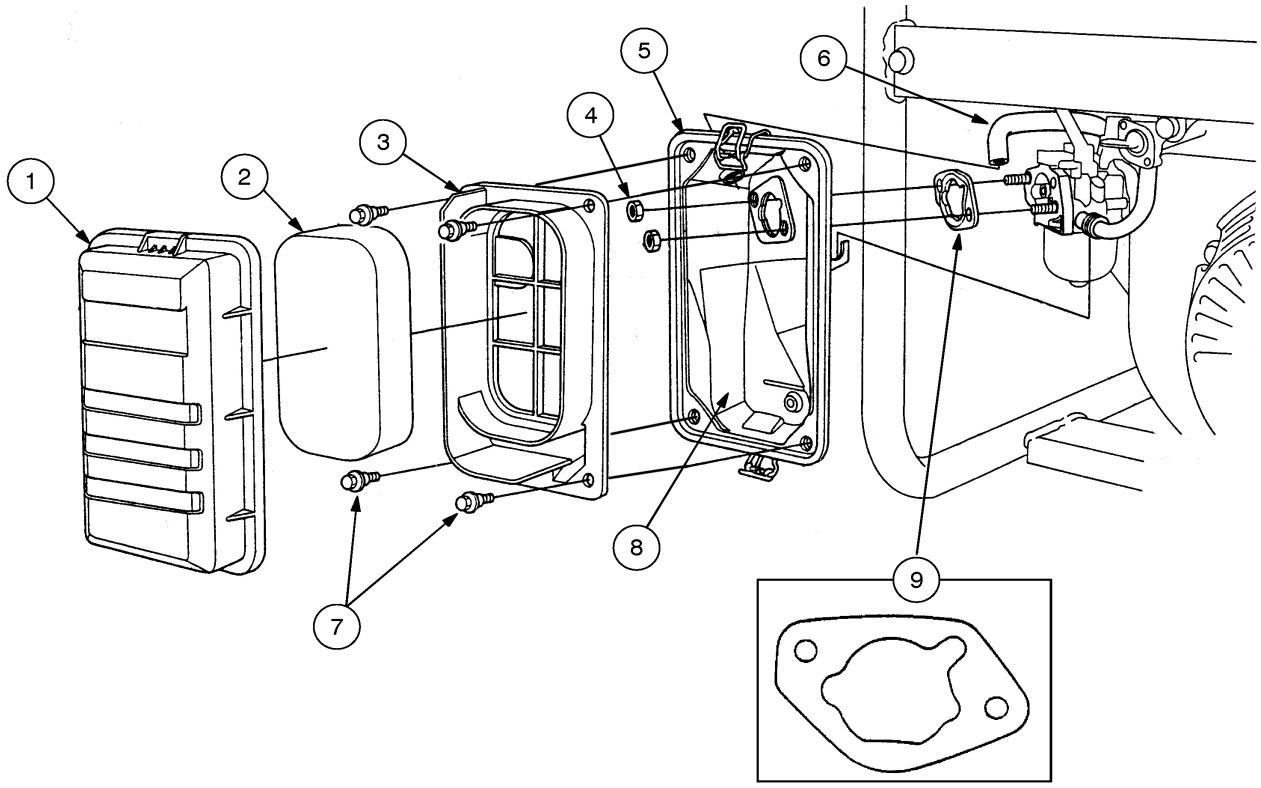
3. Use the two nuts to install the exhaust manifold and flange gasket on the cylinder head.
4. Use five bolts to install the muffler heat shield on the frame.

NOTE: To allow for proper alignment when connecting the muffler to the exhaust pipe, do not fully tighten the muffler bracket bolts to the generator until all other bolts have been fully tightened.

5. Use two bolts to install the muffler on the alternator.
6. Use two bolts to connect the muffler and flange gasket to the exhaust manifold.
7. Use two bolts to secure the muffler to the muffler bracket.
8. Reinstall the fuel tank, as described in the **Fuel Tank Service and Installation** section.

13.2 Air Cleaner

The generator has an air filter element. See the **Air Filter Maintenance** section. Refer to the table in the **Maintenance Schedule** section for scheduled air filter replacement. In dusty environments, the air filter should be inspected and cleaned more frequently.



No.	Description	No.	Description
1	Air Cleaner Cover	6	Breather Tube
2	Air Filter Element	7	Separator Mounting Bolts
3	Separator	8	Air Cleaner Case
4	Flange Nuts	9	Air Cleaner Gasket
5	Seal		

FIGURE 60. AIR CLEANER ASSEMBLY

13.2.1 Air Cleaner Removal

When facing the operator panel, the air cleaner assembly is located on the left side of the generator set.

To remove the air cleaner assembly,

1. Make sure the generator set is turned off.
2. Disconnect the spark plug wire.
3. Unlatch the spring clips and remove the air filter cover (item 1).
4. Remove the air filter element (Item 2).
5. Remove the four bolts (item 9) securing the separator to the air cleaner case and remove the separator (Item 3).

6. Remove the breather tube (item 6) from the air cleaner case (Item 8).
7. Remove the two nuts (Item 4) securing the air cleaner case to the engine.
8. Remove the air cleaner gasket (Item 7) from the engine.

13.2.2 Air Cleaner Service and Installation

1. Clean the air filter elements as described in the **Air Filter Maintenance** section.
2. Remove the seal (Item 5) from the air cleaner case.
3. Inspect the air cleaner gasket and seal. Make sure they are not damaged, broken, or bent. Replace if necessary.
4. Install the air cleaner gaskets on the generator.
5. Use the two nuts to secure the air cleaner case to the engine.
6. Make sure the seal is seated on the edge of the air cleaner case.
7. Use the four nuts to install the separator on the air cleaner case.
8. Install the air filter elements.
9. Install the air cleaner cover.
10. Reconnect the breather tube.
11. Reconnect the spark plug wire.

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14 Troubleshooting

14.1 Engine Won't Crank (Manual Start)

WARNING: ***Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.***

Possible Causes: Broken recoil, inoperative recoil, or locked engine.

Diagnosis and Repair:

1. If the recoil system moves freely, check the recoil systems operation (refer to the **Recoil Starter** and **Fan and Fan Cover** sections of this manual).
2. If the recoil system will not move, verify that the engine is unable to rotate. If the engine is unable to rotate, check for engine damage.

14.2 Engine Cranks But Won't Start

WARNING: ***Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.***

Possible Causes: Low battery voltage, low fuel level, defective battery connections, low oil level, defective starter motor, or low compression.

Diagnosis and Repair:

1. Verify fuel level, add fuel if necessary.
2. Verify that the fuel shut off valve is in the run position (see **Fuel System**).
3. Check to see if choke rod is open; move the choke rod to the Start position. After starting, move the choke rod to the closed, Run position (see **Choke Assembly**).
4. Verify correct oil level and condition; replace or refill as necessary (see **Engine Oil**).
5. The engine may be flooded, attempt to start the generator again in a couple of minutes.
6. Clean the air filter (see **Air Cleaner Maintenance**).
7. Verify battery voltage (12 VDC); replace as necessary.
8. Check condition of battery connections between the battery and the start solenoid; clean or replace as necessary.
9. Check the spark plug condition (see **Spark Plug**).
10. Verify carburetor operation, check to see if the linkages move freely and if the venturi is wetted after a start attempt (see **Carburetor**).
11. Check to make sure the fuel filter is clean and undamaged (see **Fuel System**).
12. Clean the fuel sediment cup (see **Fuel Sediment Cup Cleaning**).

13. Check for a faulty fuel cut-off solenoid. (see **Fuel Cut-Off Solenoid**).
14. Check the condition of the ignition coil and leads (see **Ignition Coil**).
15. Check for worn or damaged cylinder, piston, and/or piston ring. Check compression (refer to **Piston** in the **Engine** section).
16. Check for faulty oil alert system (see **Oil Level Switch**).

14.3 Engine Starts But Stops Suddenly

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

Possible Causes: Low oil, defective oil level switch, defective spark plug, defective fuel system, or overloaded generator.

Diagnosis and Repair:

1. The generator is overloaded, remove excess loads.
2. Check the oil level, add oil as necessary (see **Engine Oil**).
3. Check the condition of the spark plug, repair or replace as necessary (see **Spark Plug**).
4. Check to make sure the fuel filter is clean and undamaged (see **Fuel System**).
5. Clean the fuel sediment cup (see **Fuel Sediment Cup Cleaning**).
6. Check the resistance of the oil level switch, replace as necessary (see **Oil Level Switch**).

14.4 Unstable Speed

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

Possible Causes: Low or contaminated oil, poor fuel, blocked or faulty fuel system, blocked air intake, faulty ignition system, overloaded generator, low compression, or incorrect valve clearance.

Diagnosis and Repair:

1. Verify fuel level, add fuel if necessary.
2. Verify correct oil level and condition, replace or refill as necessary (see **Engine Oil**).
3. The generator is overloaded, remove some of the loads.
4. Clean the air filter (see **Air Cleaner Maintenance**).
5. Check to make sure the fuel filter is clean and undamaged (see **Fuel System**).
6. Clean the fuel sediment cup (see **Fuel Sediment Cup Cleaning**).
7. The governor is out of adjustment, readjust the governor (see **Governor Adjustments**). Incorrect valve clearance; readjust the valve lash (see **Valve Clearance**).

8. Verify carburetor operation (see **Carburetor**).
9. Faulty governor spring, replace the governor spring (see **Governor Service**).
10. Check spark plug condition (see **Spark Plug**).
11. Check the condition of the ignition coil and leads (see **Ignition Coil**).
12. Possible worn or damaged cylinder, piston, and/or piston ring. Check the compression (see **Piston** in the **Engine** section).
13. Incorrect valve clearance, readjust valve lash (see **Valve Clearance**).
14. Verify carburetor operation (see **Carburetor**).

14.5 Abnormal Exhaust Color

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

Possible Causes: Faulty fuel system, blocked air intake, contaminated oil, faulty compression seal, governor out of adjustment, overloaded generator, faulty breather assembly, or faulty carburetor.

Diagnosis and Repair:

White Smoke

1. Low engine temperature; normal during start-up.
2. Contaminated fuel; add clean fresh fuel.
3. Check to make sure the fuel filter is clean and undamaged (see **Fuel System**).
4. Clean the fuel sediment cup (see **Fuel Sediment Cup Cleaning**).
5. The governor is out of adjustment; readjust the governor (see **Governor Adjustments**).
6. When running at a high altitude, white smoke is normal during operation.

Black Smoke

1. The generator is overloaded; remove some of the loads.
2. Clean the air filter (see **Air Cleaner Maintenance**).
3. The governor is out of adjustment; readjust the governor (see **Governor Adjustments**).
4. Check spark plug condition (see **Spark Plug**).
5. Check the condition of the ignition coil and leads (see **Ignition Coil**).
6. Check for possible worn or damaged cylinder, piston, and/or piston ring. Check the compression (see **Piston** in the **Engine** section).
7. Verify the operation of the carburetor (see **Carburetor**).

Blue Smoke

1. The fuel is contaminated with oil; add clean fresh fuel.
2. Overfilled oil, verify oil level and drain excessive oil (see **Engine Oil**).

3. Faulty breather assembly, inspect and replace as necessary (see **Cylinder Head/Valves**).
4. Possible worn or damaged cylinder, piston, and/or piston ring. Check the compression (see **Piston** in the **Engine** section).

14.6 Low Engine Speed

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

Possible Causes: Faulty fuel system, blocked air intake/exhaust, governor out of adjustment, overloaded generator, or faulty receptacle and/or switch, or inadequate cooling.

Diagnosis and Repair:

1. Verify the fault by measuring engine speed using a tachometer (~3600 RPM) or by measuring the running frequency through the main power leads (~60 Hz).
2. The generator may be overloaded, remove some of the loads.
3. The governor may be out of adjustment, readjust the governor (see **Governor Adjustments**).
4. Check to see if choke rod is closed, move the choke rod to the Run position (see **Choke Assembly**).
5. Verify correct oil level and condition, replace or refill as necessary (see **Engine Oil**).
6. Possible bad fuel, add clean fresh fuel to the tank.
7. Clear any obstructions from the muffler (see **Muffler Service**).
8. Clean the air filter (see **Air Filter Maintenance**).
9. Check to make sure the fuel filter is clean and undamaged (see **Fuel System**).
10. Clean the fuel sediment cup (see **Fuel Sediment Cup Cleaning**).
11. The governor spring may be faulty, check the condition of the governor spring and replace as necessary (see **Governor Assembly**).

14.7 Low Power

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

Possible Causes: Overloaded generator, poor fuel, blocked or faulty fuel system, blocked air intake/exhaust, low compression, inadequate cooling, defective governing system, incorrect valve clearance, or faulty alternating system.

Diagnosis and Repair:

1. The generator is overloaded; remove some of the loads.
2. Verify correct oil level and condition; replace or refill as necessary (see **Engine Oil**).

3. Bad fuel; add clean fresh fuel to the tank.
4. The choke rod is closed; move the choke rod to the Run position (see **Choke Assembly**).
5. Clear any obstructions from the muffler (see **Muffler Service**).
6. Clean the air filter (see **Air Cleaner Maintenance**).
7. Check the condition of the cooling fan; clean as necessary (see **Starting System**).
8. Check the condition of the cooling fins on the cylinder block; clean as necessary.
9. Check to make sure the fuel filter is clean and undamaged (see **Fuel System**).
10. Clean the fuel sediment cup (see **Fuel Sediment Cup Cleaning**).
11. The governor is out of adjustment; readjust the governor (see **Governor Adjustments**).
12. Possible worn or damaged cylinder, piston, and/or piston ring. Check the compression (see **Piston** in the **Engine** section).
13. Incorrect valve clearance; readjust valve lash (see **Valve Clearance**).
14. Verify carburetor operation (see **Carburetor**).
15. Check the condition of the brushes and slip rings (see the **Generator Service** section).
16. Check the resistance of the rotor (see **Generator Service** section).
17. Check the resistance of the stator (see **Generator Service** section).
18. Possible worn or damaged cylinder, piston, and/or piston ring. Check the compression (see **Piston** in the **Engine** section).

14.8 No DC Output Voltage

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

Possible Causes: Defective diode, DC winding, brushes, rotor, stator, voltage regulator, circuit breaker, or receptacle.

Diagnosis and Repair:

1. Check to see if the DC circuit breaker is tripped and measure the voltage across the circuit breaker (12 VDC). Replace as necessary.
2. Check the voltage going to the DC terminals, inspect the terminal connections, repair or replace as necessary.
3. Check the continuity of the DC diode and verify the connections (see **Diodes** in the **Control Panel Service** section).
4. Check the resistance of the DC winding; replace as necessary (see **Generator Service**).
5. Verify the field excitation through the brush leads.
6. Check the condition of the brushes and the slip rings, repair or replace as necessary. (Section **Generator Service**).

7. Measure the resistance of the field winding through the slip rings, replace as necessary. (Section **Generator Service**).
8. Check the operation of the AVR (see **Voltage Regulator** in the **Generator Service** section).

14.9 No AC Output Voltage

WARNING: Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions section of this manual.

Possible Causes: Defective brushes, rotor, stator, voltage regulator, circuit breaker, or receptacle.

Diagnosis and Repair:

1. Check to see if the AC circuit breaker is tripped and measure the voltage across the circuit breaker (12 VDC). Replace as necessary (see **Control Panel Service**).
2. Check the continuity of the voltage selector switch; check the voltage on the lead connecting to pins 2 and 7 (12 VDC). Replace if necessary.
3. Check the voltage going into the AC receptacle; inspect the receptacle connections. Repair or replace as necessary (refer to the **Control Panel Service** section).
4. Check the resistance of the main winding, exciter winding, and rotor. Replace if necessary (see **Generator Service**).
5. Check the operation of the AVR (see **Voltage Regulator** in the **Generator Service** section).
6. Verify the field excitation through the brush leads.
7. Check the condition of the brushes and the slip rings; repair or replace as necessary (see **Generator Service**).

15 Service Checklist

After servicing, inspect and test the installation to confirm that the generator set will operate as intended. Check each of the areas below before putting the generator set into service.

DANGER: EXHAUST GAS IS DEADLY! THE INDOOR USE OF A GENERATOR SET CAN KILL QUICKLY. NEVER OPERATE THE GENERATOR SET IN ANY AREA WHERE EXHAUST CAN ACCUMULATE.

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness, severe personal injury, and death. Symptoms of carbon monoxide poisoning include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and sleepiness***
- ***Throbbing in temples***
- ***Muscular twitching***
- ***Vomiting***
- ***Inability to think coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET INTO FRESH AIR IMMEDIATELY. Then:

- ***Seek immediate advice from poison control, medical center, or 911. Be aware that:***
- ***CO symptoms can be mistaken for flu, dehydration, food poisoning, or other illness.***
- ***Injury or death can occur later when in fresh air and apparently recovering.***
- ***Call the fire department to determine when it is safe to re-enter the area.***

Operate the generator set OUTDOORS only. Stay away from and upwind of the exhaust outlet.

Make sure the exhaust will not enter windows, doors, vents, or air intakes of adjacent buildings, vehicles, or boats.

Never use the generator set inside a home, garage, crawl space, barn, shed, cabin, boat, boat house, RV, or tent; or in a confined outdoor space such as an alley, ditch, parking garage, or courtyard, or in any other space where exhaust can accumulate. Hazardous carbon monoxide levels from generator set exhaust can accumulate indoors even when windows and doors are open and fans are running.

Even when you use a generator set correctly, CO may leak into the home. ALWAYS use a battery-powered or battery-backup CO alarm in the home.

If you feel sick, dizzy, or weak after the generator set has been running, move to fresh air RIGHT AWAY. See a doctor. You could have carbon monoxide poisoning.

⚠ WARNING

Generator exhaust contains poisonous CO (carbon monoxide) that can cause serious injury or death.
- You cannot see, taste or smell CO.
- Operate only outdoors with exhaust directed away from people and building air intakes.
- Never operate generator inside any enclosed or semi-enclosed area. A hazardous CO level can occur even with open doors and ventilation fans.

15.1 Mounting

Examine all mounting bolts and supporting members to verify that the generator set is properly mounted on the frame. All fasteners should be tightened securely to prevent them from working loose when subjected to vibration.

15.2 Lubrication

If the engine oil was drained, fill the crankcase with oil of the recommended classification and viscosity. Refer to the **Engine Oil** section of this manual for specific recommendations and procedures.

15.3 Wiring

Verify that all wiring connections are tight and installed properly. Check each of these connections:

- Load wires
- Control wires
- Ground straps
- Battery cable(s), if present

15.4 Initial Start Adjustments

⚠ *CAUTION: Voltage/frequency-sensitive equipment such as VCRs, televisions, computers, etc. can be damaged by power line frequency variations. Some solid-state devices are powered whenever connected to an AC outlet, even if the device is not in actual operation. For this reason, disconnect all devices that are voltage- or frequency-sensitive before attempting any carburetor/governor adjustments. If disconnecting the devices is not possible, open the circuit breaker at the generator set.*

Start the generator set. With no load applied, listen for unusual sounds or vibrations. Warm up the generator set for at least 15 minutes at 50 to 75 percent of rated load and verify that the choke is completely open. If necessary, adjust the carburetor and governor as specified in the **Governor Adjustments** and **Carburetor Service and Installation** sections of this manual.

15.5 Exhaust System

While the generator set is running, inspect the entire exhaust system, including the muffler. Visually and audibly check for leaks at all connections, welds, gaskets, and joints. Shut off the engine and repair leaks immediately.

15.6 Fuel System

While the generator set is running, inspect the fuel supply and return lines, filter, and fittings for leaks. Check flexible sections for cuts, cracks, and abrasions; make sure they are not rubbing against anything that could cause damage. Repair all fuel leaks immediately.

WARNING: Leaking fuel creates a fire hazard which can result in severe personal injury or death if ignited by flame, spark, pilot light, cigarette, arc-producing equipment, electrical switch, or other ignition source. If fuel leaks are detected, shut off the generator set and correct the leak immediately.

15.7 Output Check

Apply a full load to make sure that the generator set can produce its full rated output. Use a load test panel to apply a progressively greater load until full load is reached.

15.8 Control

Stop and start the generator set several times at the set control to verify that it functions properly.

15.9 Mechanical

Stop the generator set and inspect it for leaking gaskets, loose fasteners, damaged components, and interference with other equipment. Repair as necessary.

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16 Wiring Diagrams

16.1 Wiring Diagram of EGMBB / P2400

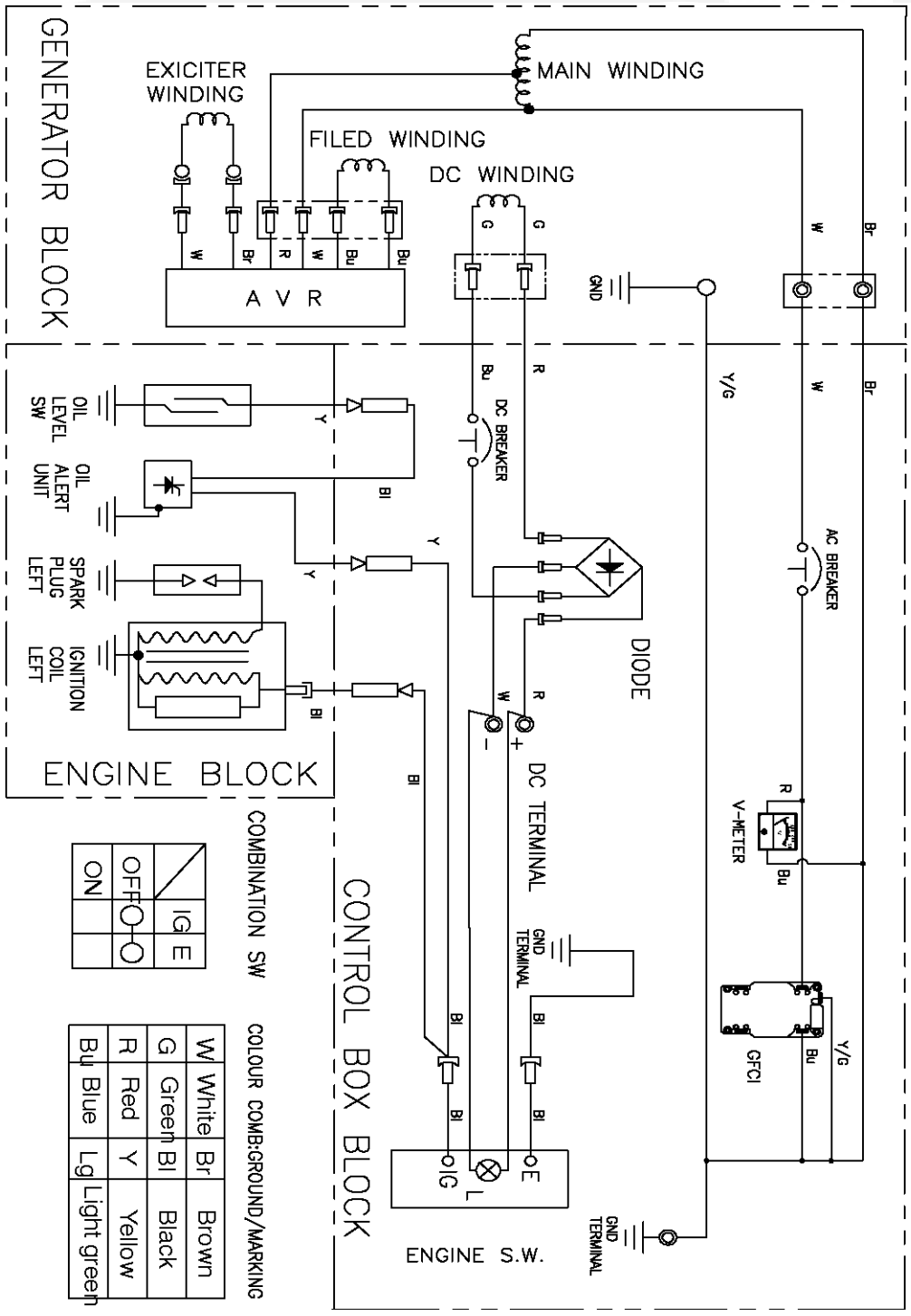

FIGURE 61. EGMBB (P2400) WIRING DIAGRAM

16.2 Wiring Diagram of EGMBG / P3500

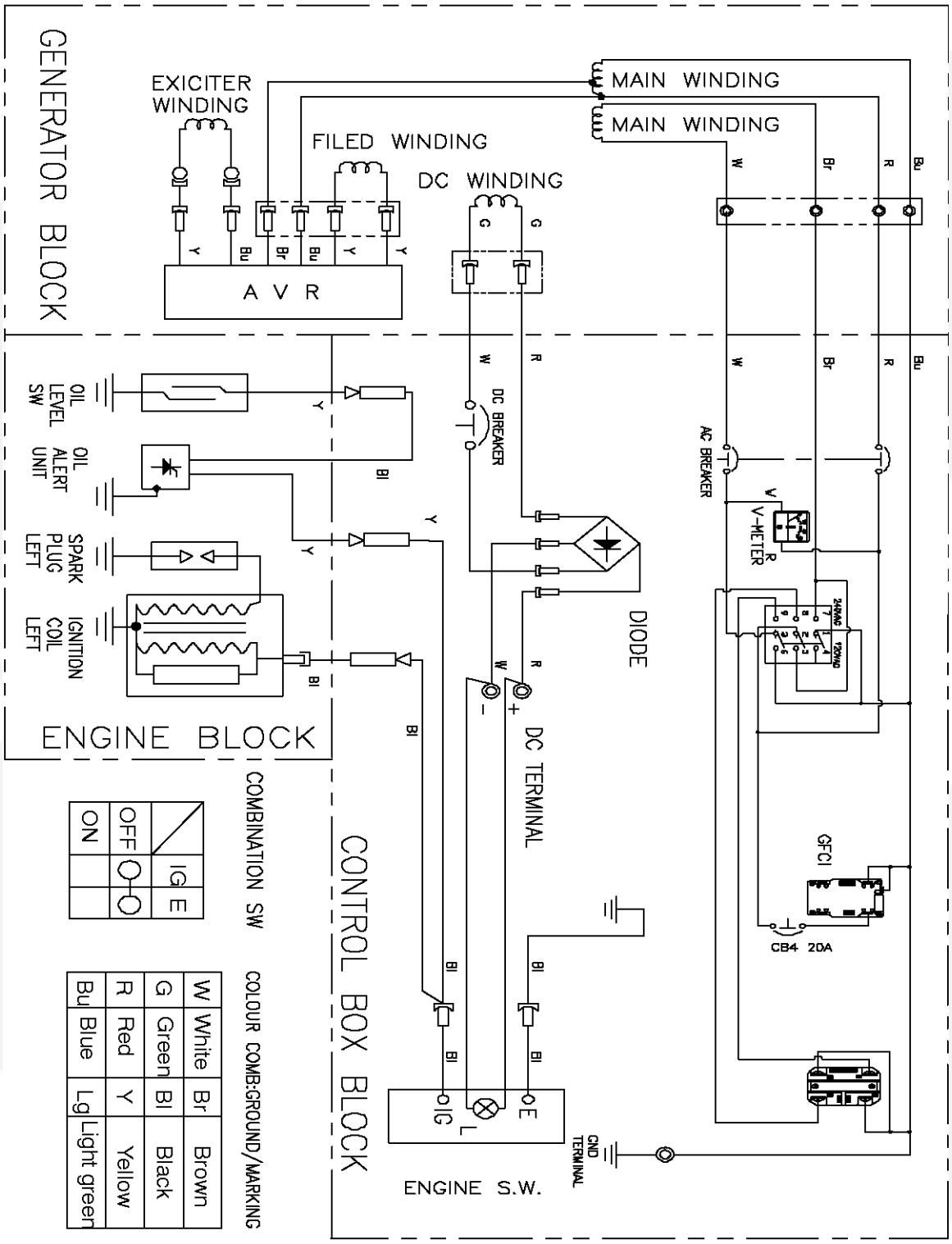

FIGURE 62. EGMBG / P3500 WIRING DIAGRAM

17 Maintenance Record

Record all periodic and unscheduled maintenance and service. Refer to the **Maintenance** section of this manual.

DATE	HOURS RUN	MAINTENANCE OR SERVICE PERFORMED

Record the name, address, and phone number of your authorized Cummins Onan service center.

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