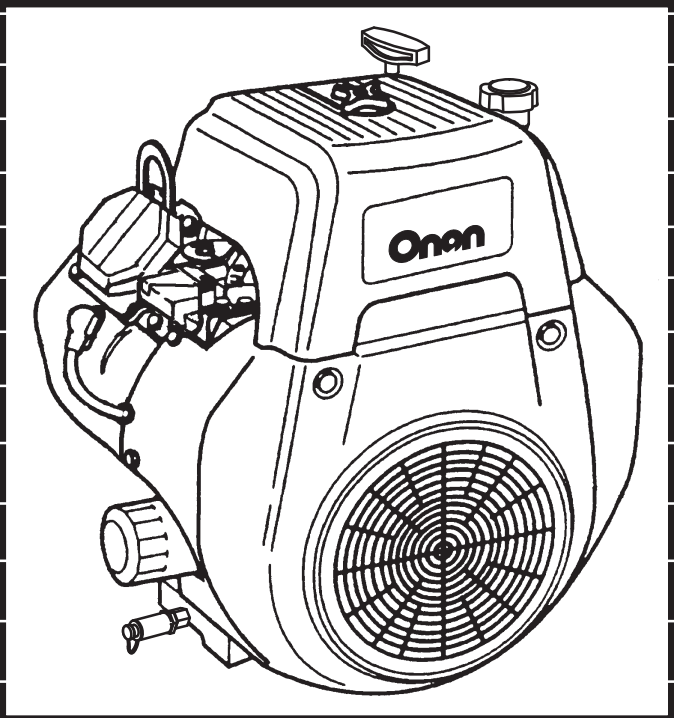
Onan

Engine

Operator's Manual

Performer Series OHV220



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Safety Precautions

Before operating the engine, read this manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.**

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

⚠ DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠ CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that can result in severe personal injury. Take care in following these recommended procedures. All local, state and federal codes should be consulted and complied with.

⚠WARNING ***This engine is not designed or intended for use in any type of aircraft. Use of this engine in aircraft can result in engine failure and cause severe personal injury or death.***

GENERAL

- Provide appropriate fire extinguishers and install them in convenient locations. Use an extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the engine are secure and accurately torqued. Keep guards in position over fans, driving belts, etc.
- If it is necessary to make adjustments while the engine is running, use extreme caution when close to hot exhausts, moving parts, etc.
- Used engine oils have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

BATTERIES

- Before starting work on the engine, disconnect batteries to prevent inadvertent starting of the engine. Disconnect negative (–) cable first.
- DO NOT SMOKE while servicing batteries. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by flame, electrical arcing or by smoking.
- Verify battery polarity before connecting battery cables. Connect negative (–) cable last.

PROTECT AGAINST MOVING PARTS

- Do not wear loose clothing in the vicinity of moving parts, such as PTO shafts, flywheels, blowers, couplings, fans, belts, etc.
- Keep your hands away from moving parts.

FUEL SYSTEM

- DO NOT fill fuel tanks while engine is running.
- DO NOT smoke or use an open flame in the vicinity of the engine or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel line must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping for flexible lines as copper will work harden and become brittle enough to break.
- Be sure all fuel supplies have a positive shutoff valve.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.

EXHAUST SYSTEM

- Exhaust products of any internal combustion engine are toxic and can cause injury, or death if inhaled. When operating the engine in a confined area, make sure the ventilation system is operating properly.
- DO NOT use exhaust gases to heat a compartment.
- Make sure that your exhaust system is free of leaks. Make sure that exhaust manifolds are secure and are not warped by bolts unevenly torqued.

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, a poisonous gas that can cause unconsciousness and death. It is an odorless and colorless gas formed during combustion of hydrocarbon fuels. Symptoms of carbon monoxide poisoning are:

- Dizziness
- Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of these symptoms, get out into fresh air immediately, shut down the unit and do not use it until it has been inspected.

The best protection against carbon monoxide inhalation is proper installation and regular, frequent inspections of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

KEEP THE UNIT AND SURROUNDING AREA CLEAN

- Make sure that oily rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and present a potential fire hazard.

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⚠WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

⚠ WARNING: ⚠

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

1. Introduction

ABOUT THIS MANUAL

This manual covers the operation and maintenance of the horizontal-shaft OHV20 Performer Series of engines. Each operator of the power equipment should study this engine manual carefully and observe all of its instructions and precautions. Proper use and periodic maintenance are responsibilities of the operator(s) and are essential for top performance.

MODEL IDENTIFICATION

Whenever contacting an dealer or distributor for information, parts or service, always provide the model number and the serial number marked on the nameplate of the engine.

Genuine Onan replacement parts obtained from an Onan dealer or distributor are recommended.

MODEL NUMBER

Genuine Onan replacement parts are recommended for best results. When ordering parts, always give the complete model and serial numbers appearing on the engine nameplate. See Table 1-1 for a breakdown of the engine model number.

TABLE 1-1. ENGINE MODEL NUMBER

P	220	GI	OHV	XXX	A
|	|	|	|	|	|
1	2	3	4	5	6

1. Model Letter – Performer
2. Number of Cylinders and Rated Horse Power
   A. “220” designates 2 Cylinders at 20 HP
3. Engine Fuel Type and Engine Type – Gas Industrial
4. Engine Type – Overhead Valves
5. Engine Specific Model Number
6. Model Nomenclature Revsion

IMPORTANT INFORMATION FOR CALIFORNIA ENGINE USERS

These engines meet the requirements of California’s Exhaust Emissions Standards for 1995 and later for Utility and Lawn and Garden Equipment Engines.

As a California user of these engines, please be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the engine label is prohibited.

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

California engine users may use Table 1-2 as an aid in locating information related to the California Air Resources Board requirements for emissions control.

TABLE 1-2. EMISSIONS CONTROL INFORMATION

Engine Warranty Information	The California emissions control warranty statement is located in the same packet of information as this manual when the engine is shipped from the factory.
Engine Valve Lash	See *Specifications.*
Engine Ignition Timing	See *Specifications.*
Engine Fuel Requirements	The engine is certified to operate on unleaded gasoline. See Fuel Recommendations in *Introduction*.
Engine Lubricating Oil Requirements	See Engine Oil Recommendations in *Introduction*.
Engine Fuel Mixture Settings	These engines have precision-manufactured carburetors which are not adjustable.
Engine Adjustments	See *Adjustments*.
Engine Emission Control System	The engine emission control system consists of internal engine modifications.

2. Description

FEATURES

Features of the Performer OHV220 engine are:

- Overhead valve arrangement enables high power, and low fuel and oil consumption
- V-twin, four stoke design
- Air-cooled and is gasoline fueled
- The light-weight and compact design make it easy to install and utilize for many applications.
- A steel crankshaft and high-load bearing offer durability.
- Pressure lubrication system and large capacity air cleaner enhance reliability of the engine.
- The combustion chamber shape, along with a tuned exhaust valve system, enhance the low exhaust emission and provides high torque at low speed.

Standard features include a fuel cut-off valve, a 12V–15 amp alternator and a pulse-type fuel pump.

The flywheel-type governor gear provides constant operation at the selected speed against load variations.

The carburetor is a down draft, float controlled fuel system with a fixed main jet. A fuel cut-off valve is provided to secure engine shut-down when the switch is turned off. Carburetors are calibrated for sure starting, good acceleration, low consumption and adequate output.

A throttle control solenoid (optional) automatically senses when the engine needs to run at full power and when it requires idle speed. The solenoid operates using a 15 second delay before dropping to idle.

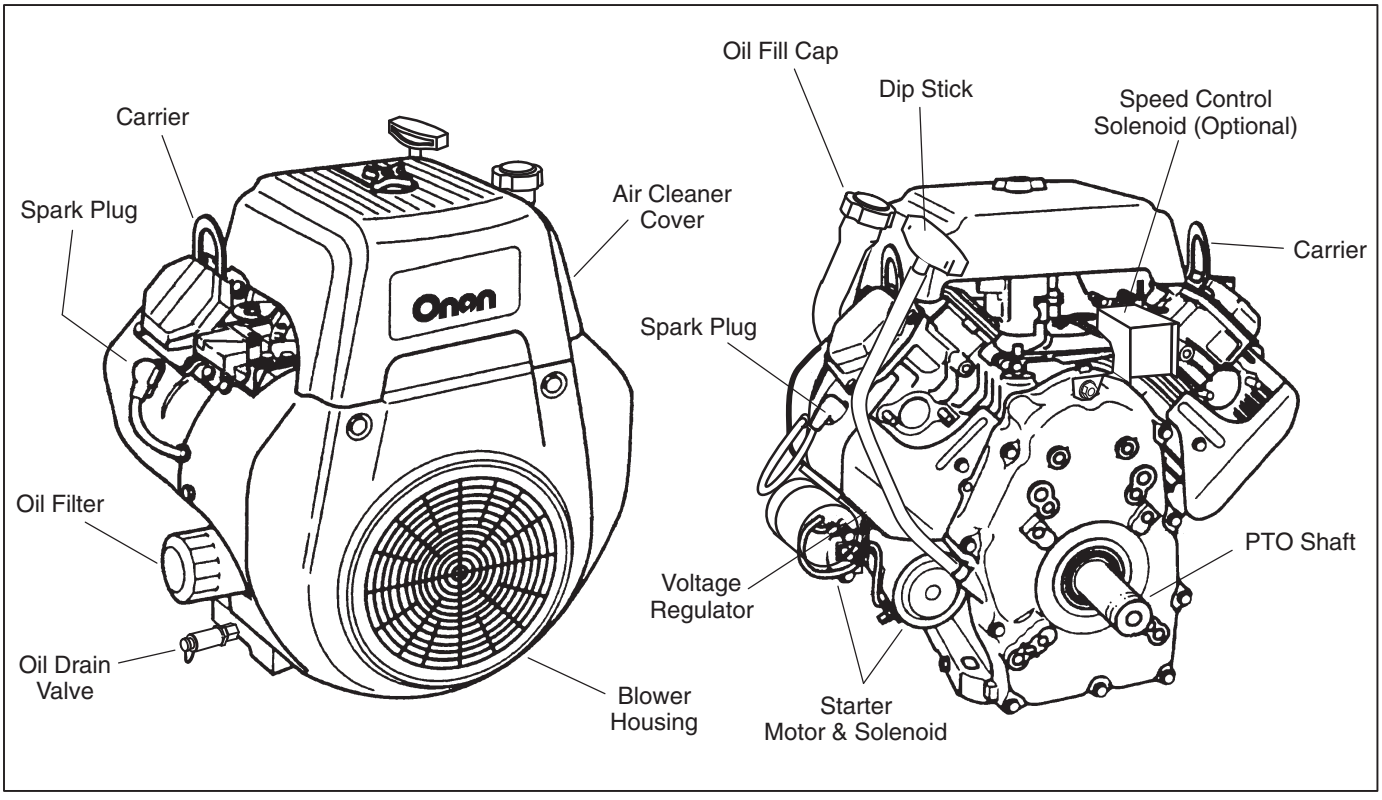

FIGURE 2-1. PERFORMER OHV22O ENGINE

PERFORMER OHV220 ENGINE SPECIFICATIONS

This Manual contains SI metric equivalents that follow immediately in parentheses after the U.S. customary units of measure.

Engine Type	4-Cycle, V-Twin Cylinder, Horizontal Shaft, Overhead Valve,
Rated Output	20.5 HP/3600 rpm (15.3 kW/3600)
Continuous Output	16.0 HP/3600 rpm (11.9kW/3600)
Bore x Stroke	80 mm x 65 mm (3.15” x 2.56”)
Displacement	653 cc (39.90 cu in)
Compression Ratio	8.3:1
Maximum Output	15.3 kW / 20.5 HP / 3,600 rpm
Maximum Torque	32.7 ft/lbs @ 2,200 rpm
Starting System	Electric Start
Carburetor	Horizontal Shaft, Float Type
Fuel	Unleaded Gasoline using a Diaphragm Pulse Pump
Lubrication	Full Pressure with Full Flow Spin-On Filter
Oil Type	Automobile Engine Oil; Class SE (See Table 3–1)
Oil Capacity	1550 cc (1.64 qt)
Charging System	12 volt 15 amp
Dry Weight	44 kg (96.9 lbs)
Dimensions (LxWxHx)	317 mm x 477 mm 475 mm (12.5” x 19.0” x 19.0”)
Direction of Rotation	CCW as Viewed from the PT shaft side
Cooling System	Forced Air Cooling
Ignition System	Flywheel Magneto (Solid State)
Spark Plug Type	NGK–BP6ES or BRP6ES (Champion – N9YC or RN9YC) Gap: 0.6–0.7 mm (0.023–0.027 in.)
Governor System	Centrifugal Fly Weight
Air Cleaner	Double Element Assembly

3. Installation

LOCATING

Locate the engine at least 1 meter (3.0 ft) away from buildings or other structures. Provide proper exhaust routing. Refer to *Exhaust Sytem* below. Do not use the engine near flammables or other hazardous materials such as trash, rags, lubricants, or explosives.

When determining the mounting location, make sure of the following:

- Gas and oil can easily be checked and supplied
- Spark plugs can be checked
- The air cleaner can be serviced
- Oil can be changed.

Carefully examine the engines position, the method of connecting it to a machine, and the foundation and support structure.

Locate the engine in a safe area on a stable. level surface free of small rock, loose gravel, etc.

⚠ CAUTION Operating the engine on an incline may cause seizure due to improper lubrication; even at maximum oil level.

EXHAUST SYSTEM

EXHAUST GAS IS DEADLY! Engine-powered equipment must never be operated inside buildings or other enclosed spaces.

If a long exhaust pipe is used, the internal resistance results in loss of engine power. The exhaust pipe ID must increase in proportion to exhaust pipe length. For example, if the exhaust pipe is:

less than 3.0 m (9.8 ft.) long —— pipe ID = 30 mm (1-3/16 in.)

less than 5.0 m (16.4 ft.) long —— pipe ID = 33 mm (1.3 in.)

It is the responsibility of the equipment operator(s) to check for exhaust leaks on a daily basis and to have all leaks repaired before continuing to operate the equipment.

FUEL

Fuel Tank

The fuel tank system must be provided by the customer. A fuel shut-off valve should be connected between the fuel tank and the fuel pump.

The fuel tank may be mounted up to 0.66 meters (2.0 ft) *below* the carburetor.

If the tank is mounted *above* the carburetor, a fuel shut-off valve must be connected between the fuel tank and the fuel pump.

Note: To prevent fuel from flooding the carburetor, the valve must be closed when the engine is not running.

Properly install fuel line connections by completely inserting the hoses onto fittings and securing with hose clamps.

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

Do not refill the fuel tank while the the engine is running. Do not overfill the tank.

Wipe away any spilled fuel and wait until it has dried before starting the engine.

Fuel Recommendations

Use clean, fresh unleaded gasoline having a minimum octane rating (Anti-Knock Index) of 87.

During some periods of the year only mandated “oxygenated” gasolines may be available. These are acceptable for use, but not preferable. Do not use gasoline or gasoline additives (de-icers) con-

taining methanol because methanol can be corrosive to fuel system components.

⚠ CAUTION ***Do not use gasoline or gasoline additives containing methanol because methanol can be corrosive to fuel system components.***

Avoid using highly leaded gasolines and lead additives because of the extra engine maintenance that will be required.

ENGINE OIL

Recommendations

Use premium quality motor oil. Look for the SAE (Society of Automotive Engineers) or API viscosity grade. Referring to Table 3-1 below, choose the viscosity grade appropriate for the ambient temperatures expected during the period of time until the next scheduled oil change.

TABLE 3-1. OIL VISCOSITY RATINGS

EXPECTED AMBIENT TEMPERATURES	SAE VISCOSITY GRADE
32° F (0° C) and higher	30
10° F to 100° F (–12° C to 38° C)	15W-40 (OnaMax)
0° F to 80° F (–18° C to 27° C)	10W-30 10W-40
–20° F to 50° F (–28° C to 10° C)	5W-30

Single-grade SAE 30 oil is preferable when temperatures are consistently between 50° and 90° F (10° – 32° C).

If multi-grade oil is used, oil consumption tends to increase if the ambient temperature is high.

Filling and Change Interval

After the first 20 hours of operation the initial oil and oil filter should be replaced.

Thereafter, change the oil every 100 hours of operation and change the oil filter every 200 hours.

Apply a thin coat of oil to the o-ring and install by tightening the oil filter about 3/4 turn after the seal has reached the crankcase surface.

The oil capacity of the crankcase is 1.55L (1.64 qt.).

After an oil change, run the engine, and recheck the oil level. The level may drop slightly as oil fills the filter.

When filling the the crankcase, keep the engine level up to the upper mark of the oil gauge. Check the oil with the oil gauge pushed all the way in its seat.

Check the oil level daily, before starting. Keep the oil level between the upper and lower level on the gauge.

⚠WARNING ***Crankcase pressure can blow hot engine oil out the fill tube causing severe burns. Always stop the engine before removing the oil fill cap or the oil gauge.***

STARTING BATTERIES

An engine equipped with an electric starter requires a starting battery. Prompt starting requires sufficient battery capacity and battery cable size. Neither cranking performance nor starter service life will be satisfactory with an undersized battery.

Use a battery rated 12V–30 amp or larger.

The customer must supply battery cables. Use the table below to select the proper cable for the positive side connection.

Connect a ground strap to the negative terminal. Use a flat strap 25.0mm (0.25”) wide.

TABLE 3-2. BATTERY CABLE SELECTION

		WIRE GAUGE		
CABLE LENGTH	CABLE DIA.	AWG(BS) BWG	SAE	JIS
Less than 1.5 m (4.5 ft)	7.3 mm (5/16 in.)	1	6	AV15
1.5 – 2.5 m (4.5–7.6 ft)	8.5 mm (3/8 in.)	0	4	AV20
2.5–4.0 m (7.6–12.2 ft)	108 mm (7/16 in.)	3/0	2	AV30

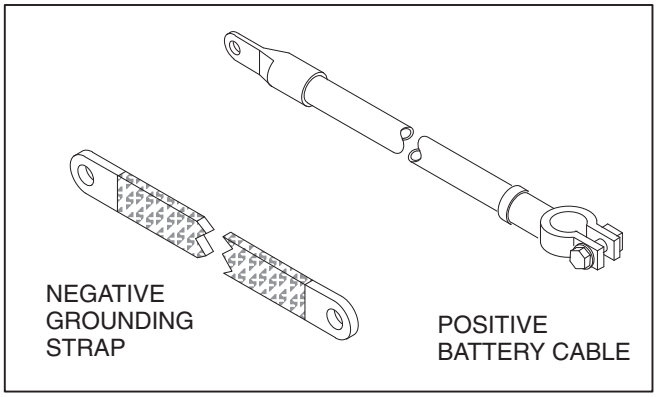

FIGURE 3-1. BATTERY CABLES

STARTER SWITCH

A customer supplied starter switch or key switch is recommended for the starter motor. See Table 3-3 for switch cable recommendations.

TABLE 3-3. SWITCH CABLE SELECTION

		WIRE GAUGE		
CABLE LENGTH	CABLE DIA.	AWG(BS) BWG	SAE	JIS
Less than 1.5 m (4.5 ft)	1.5 mm (1/16 in.)	14	16	AV1.25
1.5 – 3.0 m (4.5–9.8 ft)	1.9 mm (5/64 in.)	12	14	AV2
3.0–5.0 m (9.8–16.4 ft)	2.4 mm (1/10 in.)	10	13	AV3

WIRING

The engine is equipped with a wiring harness that connects with the accesssory. See Figure 3-3 and Figure 3-4.

1. Connect the positive [+] battery cable between the starter solenoid and the battery.

2. Connect the ground strap between the negative [–] battery terminal and a clean, bare metal grounding location on the engine.

3. Connect wires from starter key switch to starter solenoid and ground. (Figure 3-2)

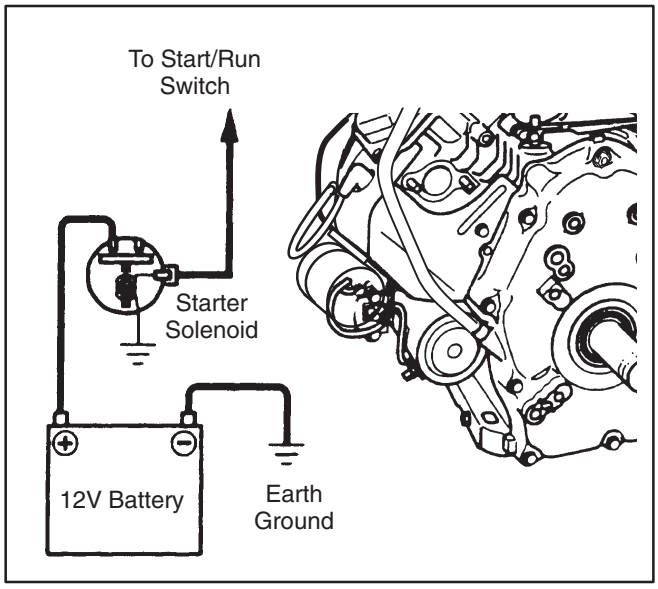

FIGURE 3-2. BATTERY WIRING

POWER TRANSMISSION

Belt Drive

If using a belt drive application, consider the following notes.

- V-belts are preferable to flat belts.
- The engine drive shaft must be parallel to the machine drive shaft.
- The engine drive pulley must be in line with the machine drive pulley.
- Install the engine pulley as close to the engine as possible.
- Span the drive belt horizontally, if possible.
- Disengage the load when starting the engine.
- Use a belt tension pulley if a clutch is not used.

Flex Coupling

When using a flex coupling, minimize run-out and misalignment between the drive shaft and the engine shaft. The run-out and misalignment tolerances are specified by the coupling manufacturer.

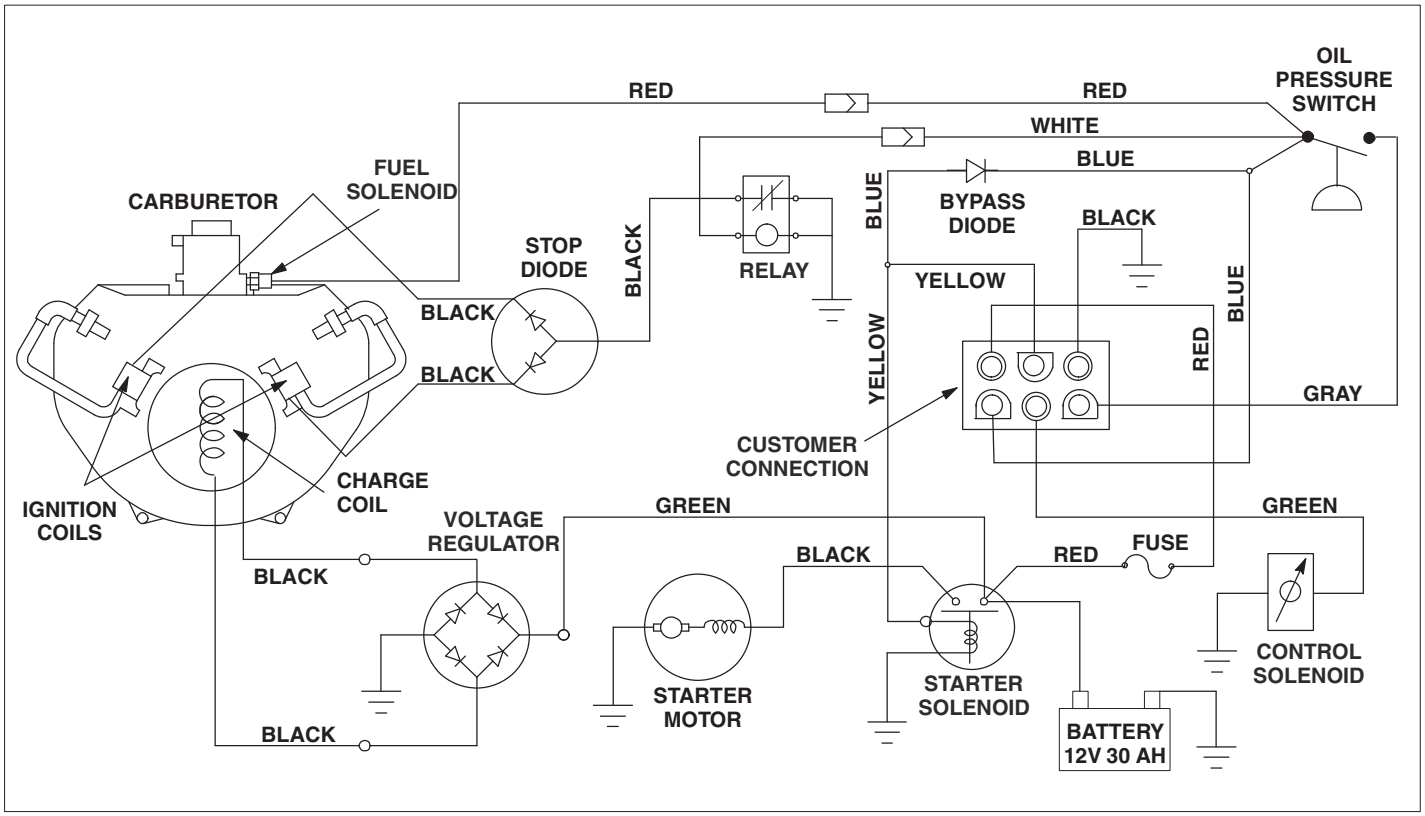

FIGURE 3-3. ENGINE WIRING DIAGRAM (6 PIN)

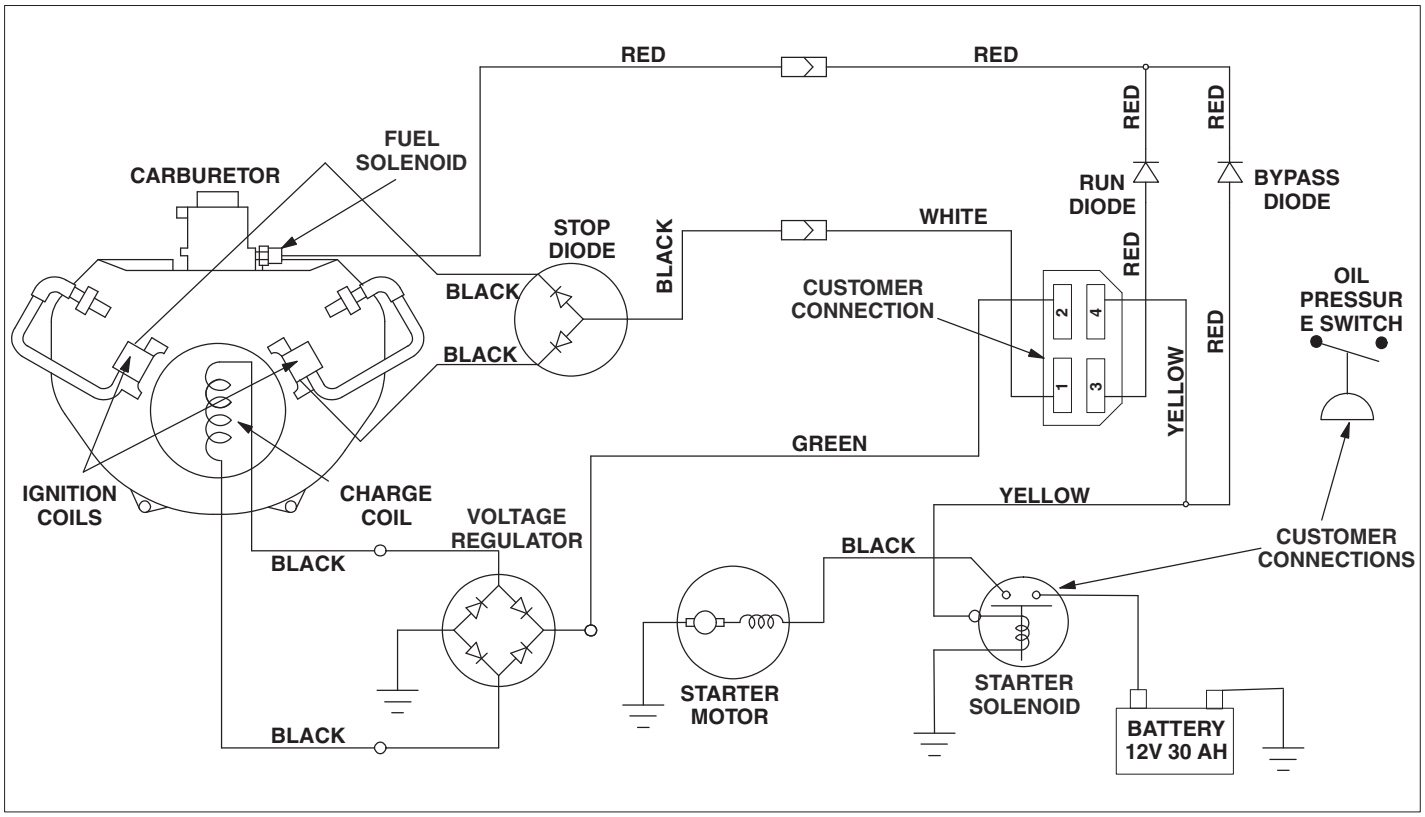

FIGURE 3-4. ENGINE WIRING DIAGRAM (4 PIN)

4. Operation

⚠WARNING ***EXHAUST GAS IS DEADLY!***

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness 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 THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the engine and do not operate it until it has been inspected and repaired.

Make certain the exhaust system is properly installed. Inspect it every time the engine is started and after every eight hours of continuous operation.

PRE-START CHECKS

Before the first start of the day and after every eight hours of operation perform the maintenance procedures in DAILY (8 HOUR) MAINTENANCE in *Section 5: Maintenance*.

Keep a log of maintenance and the running hours. Perform any maintenance that may be due. If the equipment has been in storage, return the engine to service as instructed under RETURNING THE ENGINE TO SERVICE in this section.

1. Inspect exhaust system for loose joints, rusty, worn or damaged areas. Do not operate engine until all leaks are repaired.

2. Check the fuel level and refill if necessary. Open the fuel shut-off valve (if equipped).

3. Make sure fuel hoses and connections are tight. Check for any indications of fuel leakage. Do not operate engine until all leaks are repaired.

4. Check and tighten any loose bolts or nuts.

5. Check the oil and refill, if necessary. Do not overfill.

   ⚠CAUTION ***Starting the engine without oil will cause severe engine damage. Always keep the engine oil level between the Full and Add marks on the dipstick.***

6. Wear snug fitting clothes when operating the engine. Loose articles of clothing could get caught in the engine or drive train.

⚠WARNING ***Moving parts can cause severe personal injury or death. Hot exhaust parts can cause severe burns. Stay clear of hot or moving parts. Make sure all protective shields and guards are secure in place before starting the equipment.***

STARTING

1. Move the choke lever to the full-choke position. On equipment with a solenoid operated choke, push the switch to its choke position. *In warm weather, however, or when the engine is warm, try starting without the choke or in the half-way position.*
2. Turn the ignition switch to START and hold it there until the engine starts. Do not crank for more than 5 seconds at a time.

   If the engine failed to start, set the switch to RUN and wait 10 seconds before the next attempt. See *Troubleshooting* if the engine does not start after several tries.

Never turn the switch to START while the engine is running.

3. After the engine starts, slowly push the choke to the full-open position. Pull it back, if necessary, to keep the engine running smoothly until the engine is at operating temperature.

   In colder weather, the engine will take longer to begin running smoothly with the choke open.

   Do not operate the equipment until the choke is fully open.

STOPPING

To stop the engine turn the switch to the STOP position.

ENGINE BREAK-IN

For top engine performance, new or rebuilt engines require a break-in period to obtain the ideal fitting of internal moving metal parts. To break-in the engine:

1. Run the engine at 2500 rpm, without a load, for 10 minutes.
2. Run the engine at 3,000 rpm for 10 minutes.
3. Run the engine at 3,600 rpm for 10 minutes.
4. Run the engine with a load of 8 HP at 3,600 rpm for 30 minutes.
5. Run the engine with a load of 16 HP at 3,600 rpm for 30 minutes.

Frequently check for oil leaks during break-in.

After the first 20 hours of normal operation, change the oil and oil filter. Refer to *Chapter 5: Maintenance* for procedures.

OPERATION IN DUSTY CONDITIONS

1. Keep the engine cooling fins and flywheel air inlet screen clean.
2. Perform air cleaner maintenance more often than normal—as required. See Table 5-1.
3. Change the engine oil and oil filter more often than normal. See Table 5-1.

HOT AND COLD WEATHER PRECAUTIONS

Hot Weather

Pay particular attention to the following items when operating the engine in temperatures above 100° F (38° C):

1. Keep the flywheel air inlet screen and cylinder cooling fins clean. Make sure that nothing obstructs air flow to and from the engine.
2. Check the oil level more frequently.
3. Change the oil and oil filter more often than normal. See Table 5-1.
4. Make sure the engine oil viscosity is appropriate for the ambient temperatures and change the oil if necessary. See Table 5-1.

Cold Weather

Pay particular attention to the following items when operating the engine in temperatures below freezing:

1. Make sure the engine oil viscosity is appropriate for the ambient temperatures and change the oil if necessary. See Table 5-1. If the temperature drops before you have the chance to change the oil, warm the engine by moving the equipment into a heated space before attempting to start the engine or change oil.

   ⚠WARNING ***EXHAUST GAS IS DEADLY! Never operate engine-powered equipment indoors without a proper exhaust system, ample fresh air ventilation and an operable carbon monoxide detector.***

2. Use fresh gasoline and fill the fuel tank after each day's use to reduce problems with moisture condensation if this is a gasoline engine.
3. Keep the battery in a well-charged condition.
4. After each use push the equipment throttle knob or lever to the middle of its speed range. Then, if ice forms on the linkage during storage it will be easier to start the engine.

OUT-OF-SERVICE PROTECTION

Protect an engine that will be out of service for more than 30 days as follows:

1. Run the engine until it reaches normal operating temperature then, shut-off the fuel supply and let the engine run until it stops.

2. Loosen carburetor bowl drain screw and drain remaining fuel.

3. If the equipment will not be operated for more than 120 days, add a fuel preservative (OnaFresh™) to the equipment fuel tank. Follow the instructions on the container label. Unless a preservative (stabilizer) is added, gasoline will deteriorate causing fuel system corrosion, gum formation and varnish-like deposits which can lead to hard starting and rough operation.

4. Drain oil from the engine while it is still warm. Refill with fresh oil and attach a tag stating the viscosity of the oil used.

5. To prevent rust in the cylinder bore, remove the spark plug and pour 30mL (2 tbsp. or 1 oz.) of SAE 30 oil in the opening. Turn the crankshaft several times by hand and reinstall the spark plug.

6. Clean the outside of the engine with an oiled cloth.

7. Perform air cleaner maintenance as instructed in Section 5: *Periodic Maintenance*.

8. Plug the exhaust outlet to prevent moisture, dirt, bugs, etc. from entering.

   ⚠WARNING ***Battery gas is explosive. Wear safety glasses and do not smoke while servicing batteries. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by flame, electrical arcing or smoking.***

9. Disconnect the battery (negative [**–**] cable first) and follow the battery or equipment manufacturer's storage instructions.

OnaFresh is a trademark of the Onan Corporation.

10. Cover the engine with a plastic sheet or canvas and store in a dry place.

RETURNING THE ENGINE TO SERVICE

1. Remove the cover and all protective wrapping and the plug from the exhaust outlet.

2. Check the tag on the oil base. Change the oil if the viscosity is not appropriate for the expected ambient temperatures. See Table 3-1.

3. Check the fuel filter and fuel lines to make sure they are secure and have no cracks or leaks.

4. Check that the choke, throttle and governor linkages move freely.

5. If so equipped, clean and check the battery according to the battery or equipment manufacturer's instructions and connect the battery cables (positive [**+**] cable first).

6. Start the engine. The initial startup may be slow and there may be smoke and rough operation for a few minutes until the oil in the cylinder burns off. If the engine does not start, clean or replace the spark plug as it may have been fouled by the oil added to the cylinder when the equipment was stored.

5. Periodic Maintenance

Periodic maintenance is essential for top engine performance. See Table 5-1 as a guide for normal periodic maintenance. Under hot or dusty operating conditions some maintenance operations should be performed more frequently, as indicated by footnotes in the table.

TABLE 5-1. ENGINE MAINTENANCE SCHEDULE

MAINTENANCE OPERATION	FREQUENCY					
	Daily or Every 8 Hours	Every 50 Hours	Every 100 Hours	Every 200 Hours	Every 500 Hours	Every 1,000 Hours
Clean Dust and Debris from Engine	X					
Check fuel leakage from fuel system. Retighten fasteners or replace parts if needed.	X[1]					
Inspect for Loose Hardware and Retighten	X					
Check Oil Level and Add to Full Level	X					
Change Engine Oil			X[2,4]			
Check Battery Fluid Level		X[5]				
Clean Spark Plugs		X				
Clean Outer Element of Air Cleaner		X				
Clean Fuel Strainer				X		
Replace Air Cleaner Assembly				X		
Inspect, Clean and Re-Gap Spark Plugs				X		
Change Engine Oil Filter				X[3,4]		
Clean Carburetor					X	
Clean Cylinder Head					X	
Adjust Engine Valve Clearance					X[6]	
Replace Spark Plugs					X	
Replace Fuel Lines and Filter						X

1 Check for oil, fuel and exhaust leaks, loose parts and unusual noises and vibrations.
2 Change oil and filter after the first 20 hours of operation as a part of engine break-in.
3 Perform more often when operating in dusty conditions.
4 Perform more often when operating in hot conditions.
5 See instructions for battery care provided by the equipment or battery manufacturer.
6 Must be performed by a qualified mechanic (equipment or Onan dealer).

Keep a log of maintenance performed and the run-time hours. Keeping a record of procedures will help you keep scheduled maintenance and provide a basis for supporting warranty claims.

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

DAILY (8 HOUR) MAINTENANCE

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

1. Inspect fuel lines and fittings for leaks. Repair leaks immediately.

2. Look and listen for exhaust system leaks while the engine is running. Look for cracks and severe rusting in the muffler and tailpipe. Have all leaks repaired before continuing to operate the equipment.

   ⚠WARNING ***Hot exhaust parts can cause severe burns. Allow the engine time to cool before servicing the exhaust system.***

3. Check the engine for dirt and debris and clean the flywheel air inlet screen and cylinder cooling fins 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. The equipment must be parked on a level surface and the engine stopped. To get an accurate reading, wait a minute or so to allow the oil to settle in the crankcase if the engine has been running.

   ⚠WARNING ***Crankcase pressure can blow hot engine oil out the fill tube causing severe burns. Always stop the engine before removing the oil fill cap.***

   If the engine is equipped with the long oil fill tube, turn the oil fill cap counterclockwise and lift it up. Wipe the dip stick clean, push it back into the oil fill tube until the cap seats. Withdraw it again to check the oil level.

CHANGING OIL AND FILTER

Change the oil and filter after the first 20 hours of operation. Thereafter, change oil every 50 hours and the filter every 200 hours.

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

1. Run the engine until it is warm. Stop the engine and disconnect the spark plug wires and the battery (negative [–] cable).

   ⚠WARNING ***Accidental starting of the engine can result in severe personal injury or death. Always disconnect the spark plug wires and the battery (negative [–] cable) before changing oil.***

2. Remove the oil fill cap.

   ⚠WARNING ***Crankcase pressure can blow hot engine oil out the fill opening causing severe burns. Always stop the engine before removing the oil fill cap.***

3. To drain oil from crankcase, loosen the drain valve then twist the outer casing to unlock. The valve is fitted with an adapter for a drain tube if desired.

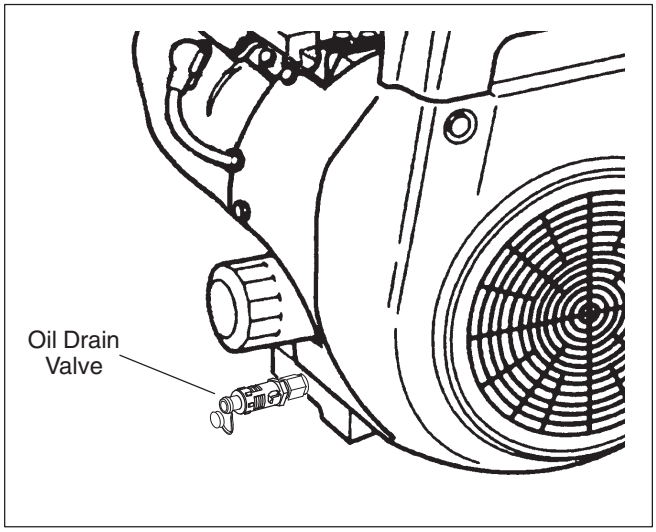

FIGURE 5-1. DRAINING THE OIL

4. Place a pan under the oil drain opening and open the oil drain plug. Close the plug securely after the oil has drained completely.

5. Spin off the oil filter, drain the oil and discard the filter according to local regulations.

6. Thoroughly wipe off the filter mounting surface.

7. Make sure the gasket is in place on the filter canister and apply a thin film of oil to the gasket.

8. Spin the new filter on by hand until the gasket just touches the mounting surface, then turn it an additional 1/2 to 3/4 turn. Do not overtighten.

9. Refill with class SE (API) or higher having an SE viscosity grade appropriate for the expected temperatures, as indicated in Table 3-1.

10. DO NOT FILL TO A LEVEL ABOVE THE FULL MARK ON THE DIPSTICK. Drain the excess oil if too much has been added. See Figure 5-2.

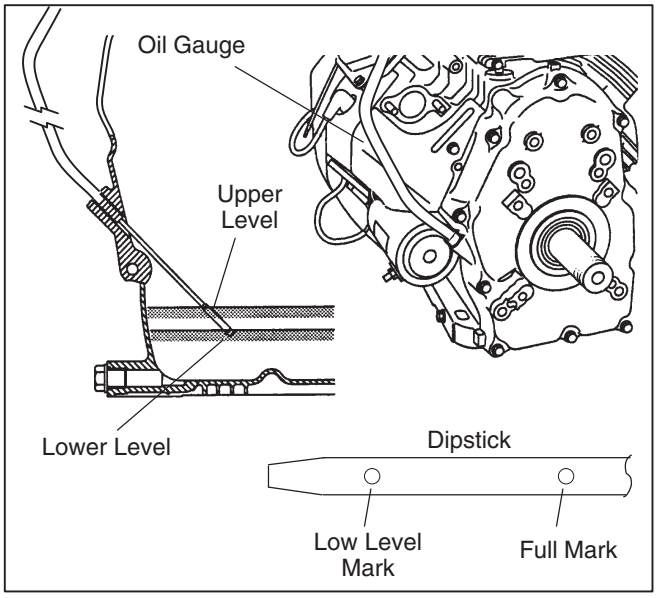

FIGURE 5-2. OIL LEVEL FILL

⚠ CAUTION ***Too much oil can cause high oil consumption, high operating temperatures and oil foaming. Too little oil can cause severe engine damage. Keep the oil level between the Full and Add marks on the dipstick.***

11. Reconnect the spark plug wires and battery.

12. Start the engine and run it for a short time while checking for oil leaks around the drain plug and oil filter. Do not overtighten: tighten only as necessary to eliminate leaks.

Used oil is harmful to the environment. Pour the used oil into a sealed container and deliver it to the nearest recycling center.

AIR CLEANER MAINTENANCE

Refer to Table 5-1 for scheduled maintenance on the air cleaner assembly. See Figure 5-3.

Outer Cover

To remove the air cleaner cover, rotate the wing nut counterclockwise and remove.

Foam Filter

Remove and wash the urethane foam in water and detergent. Squeeze the foam wrapper dry like a sponge. Rinse with clean water and allow it to dry. Coat the wrapper evenly with 14 mL (one tbsp.) of SAE 30 engine oil. Knead the oil into the wrapper and squeeze out the excess oil.

NOTE: Failure to adequately wring out excess oil from the wrapper may cause a drop in engine power due to a restriction of inlet air.

Install the foam wrapper over the paper air cleaner element by stretching it over the inner cover. Completely cover all exposed paper pleats. Replace the air cleaner assembly when it becomes torn or stretched.

Air Cleaner Element Replacement

To keep anything from entering the carburetor and engine while the air cleaner element is off, pull the choke knob to the full-choke position to close the choke plate in the carburetor. Remove the outer cover and wipe away loose dust and debris from the air cleaner assembly. Remove the air cleaner assembly. Wipe off dust and debris from the air cleaner base. Use forced air to blow off dust and debris from the paper element.

Reinstall the paper element on the engine. Replace the foam wrapper and outer cover. Secure with the wing nut.

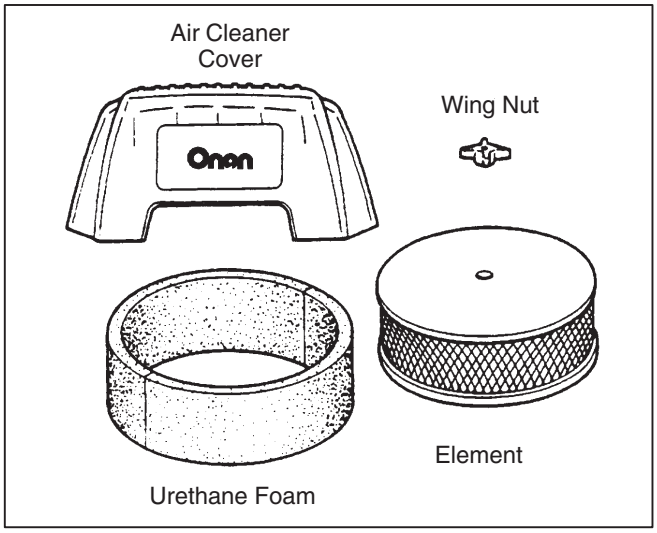

FIGURE 5-3: AIR CLEANER ASSEMBLY

SPARK PLUG MAINTENANCE AND REPLACEMENT

Refer to Section 2: *Specifications* for spark plug type and gap specifications. Check and clean spark plugs every 200 hours. Replace plugs every 500 hours.

To prevent crossthreading the spark plug, always thread it in by hand until it seats. If the spark plug is being reused, turn it with a wrench an additional 1/4 turn. If the spark plug is new, turn it an additional 3/8 to 1/2 turn. If you have a torque wrench, tighten a new spark plug to 11.8–14.7 N-m (120–150 Kg/cm) (8.7–10.9 ft/lb).

CHECKING BATTERIES

Every 50 hours or once a month check the fluid level of the battery. Refill with distilled water if levels are low.

⚠WARNING ***Battery gas is explosive. Wear safety glasses and do not smoke while servicing batteries. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by flame, electrical arcing or smoking.***

⚠WARNING ***If the battery is to be replaced, disconnect the negative cable first, and reconnect it last.***

6. Adjustments

CARBURETOR ADJUSTMENTS

These engines have precision-manufactured carburetors which are not adjustable.

Engine Speed Solenoid (Optional)

Normally, the engine speed does not require any adjustment. These instructions are for the equipment manufacturer in setting up and adjusting the equipment.

The *speed control solenoid* monitors the rate of the load and automatically adjusts the engine to the appropriate idle speed.

To adjust the speed control solenoid:

1. Run the engine with no load until the engine control times out (about 15 seconds) and energizes the solenoid.
2. Adjust engine to 2200 RPM by loosening the two slotted screws retaining the solenoid.
3. Slide solenoid forward to increase the speed, or backwards to decrease the speed.
4. Retighten the two screws.

Following reassembly of either the carburetor or intake manifold, realign the governor arm on the governor shaft BEFORE making speed adjustments to compensate for the slightly different alignment of parts.

Governor Adjustment

1. Loosen the hex bolt securing the governor lever to the governor shaft. (Figure 6-1)
2. Loosen the slotted screw securing the movement of the governor lever on the shaft.
3. Push the governor lever all the way to the high speed position (counter-clockwise) and tighten the slotted screw.
4. Move the governor arm to the idle position and hold against the low idle adjusting screw. Set the speed to 100 RPM less than the desired solenoid idle speed.
5. Turn the governor shaft fully clockwise and tighten the hex bolt.

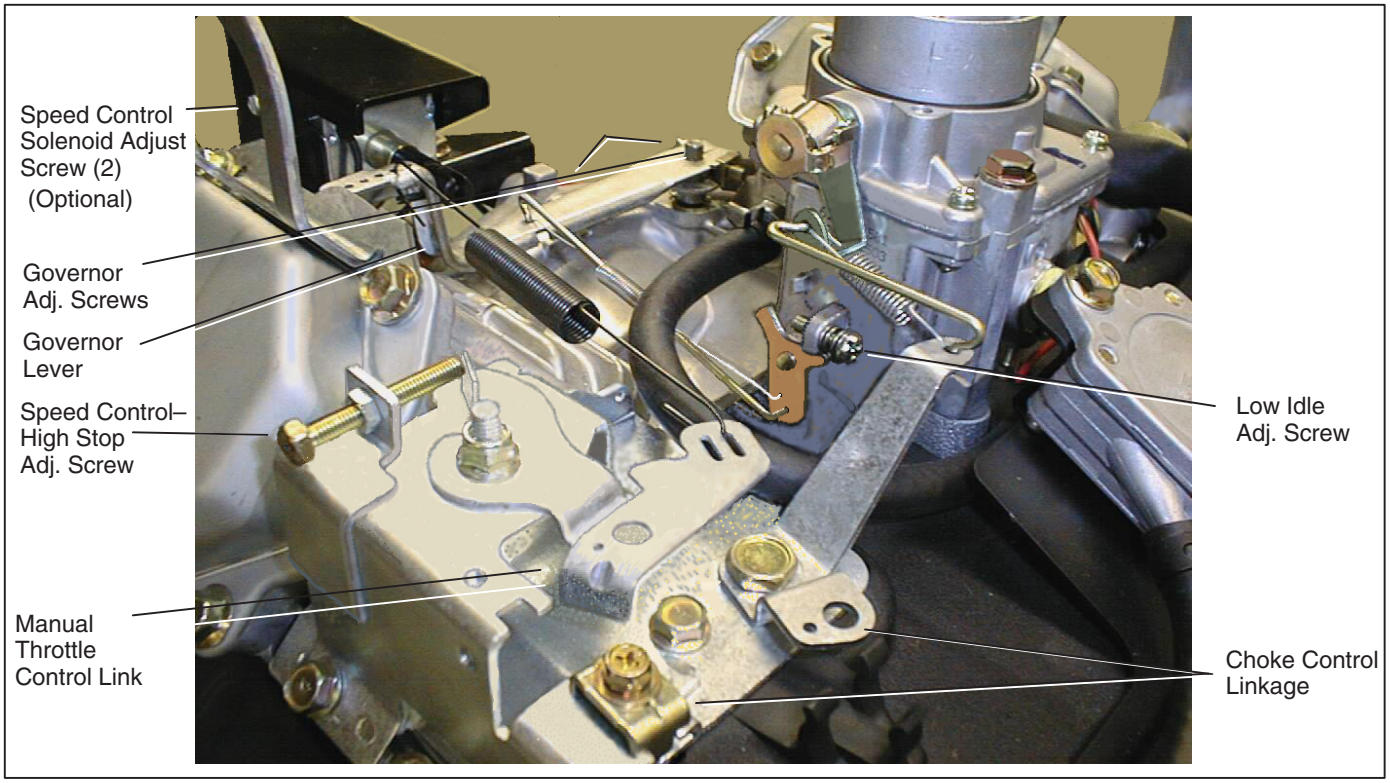

FIGURE 6-1. GOVERNOR AND SPEED CONTROL ASSEMBLY

Speed Control Adjustments

Engine speed adjustment must be attempted only by a qualified mechanic and the adjustments must be made using an accurate tachometer. It is recommended that low-idle speed be adjusted between 1800 to 2200 RPM and high-idle speed 3700 to 3800 RPM. Check in your welder manufacture‘s manual for exact speed settings.

7. Troubleshooting

Table 7-1 provides basic troubleshooting guidance. If you fail to resolve the problem after taking the corrective actions suggested, contact the equipment manufacturer or an Onan dealer.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the safety precautions on the inside cover page.***

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

TABLE 7-1. MINOR TROUBLESHOOTING

Problem	Probable Cause and Remedy
Engine Starting Engine cranks slowly or not at all	Poor battery connections. Clean and tighten the positive (+) and negative (–) battery connections at battery and engine. Battery is not fully charged. Recharge the battery. Electric starter is faulty. Check starter brushes and bearings. Improper engine oil. Change oil having the proper viscosity for the ambient temperature. There is a load on the engine. Remove load and retry. Back pressure. There is excessive back pressure due to a plugged or bent exhaust pipe.
Engine Starting Engine cranks but fails to start	Damaged spark plug(s). Check the spark plug gap. Check for a bad insulator on plug and replace if damaged. Clean carbon deposit from electrode. If wet, dry electrode. Fuel Supply. Check fuel supply and shut-off valve. Check fuel filter and clean if dirty. Check all fuel hoses for crimps and clogging. Check connections into carburetor for air leaking in. Fuel. Gasoline may have water mixed in or the gasoline grade is not correct. Carburetor problems. Carburetor is flooded and may have bad floats or the floats are stuck. Carburetor has varnish deposits built up and requires disassembly and cleaning. Governor and throttle linkage. Check linkage connections. Check tension in springs. Check governor, throttle and speed adjustments. The fuel cut-off solenoid is faulty. Check for loose or damaged wires and connectors. Check voltage levels at the connector to the solenoid. Replace harness or solenoid. Check air cleaner and service if dirty.

Problem	Probable Cause and Remedy
Engine Starting Electric starter does not operate	Key or start switch. Check wiring connections and switch. No continuity between the key switch and the starter. Replace wires. No continuity between the battery and starter. Replace cable. Low battery. Change or recharge battery. Starter solenoid is bad. Check voltages, clean, repair or replace. Starter motor is bad. Check brushes and wiring, repair or replace. Engine seizure. The crankshaft has seized or the piston and cylinder have seized. Check crankshaft bearings and bearing surface.[1]
Engine Starting Electric starter operates but engine does not start	Low fuel. Poor wiring connection or no continuity of ignition system. Check wiring connections and ignition coils for a short. Electric starter is bad. Slow cranking RPM is caused by low voltage at starter or worn brushes or bearings. Repair or replace.
Engine Overheats	Air flow is obstructed at inlet or cylinder baffle. Clean out debris in baffle. Improper engine oil. Replace oil. Lean air/fuel mixture. Check for plugged passages in carburetor. Excessive back pressure on exhaust. Check muffler and spark arrester. Engine is overloaded. Change to rated load.
Engine Idles Rough	Low idle speed. Adjust idle on carburetor. Air is mixing at air intake connection. Check, tighten or replace gasket.[1] There is blow-by on the head gasket. Replace the gasket.[1] Improper valve clearance. Adjust clearance.[1] Excessive clearance between valve stem and guide. Replace valve stem and guides.[1]

[1] *See the Engine Service Manual for these procedures.*

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