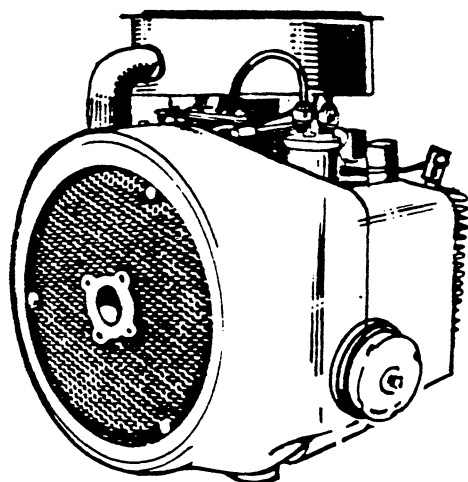




OPERATING AND MAINTENANCE INSTRUCTIONS



BG ENGINE



**GARDEN TRACTOR SERVICE
INDUSTRIAL SERVICE**



**FILE MASTER
DO NOT REMOVE**

ONAN

1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432
A DIVISION OF ONAN CORPORATION

Safety Precautions

It is recommended that you read your engine manual and become thoroughly acquainted with your equipment before you start the engine.

WARNING *This symbol is used throughout this manual to warn of possible serious personal injury.*

CAUTION *This symbol refers to possible equipment damage.*

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

Safety Codes

- All local, state and federal codes should be consulted and complied with.
- This engine is not designed or intended for use in aircraft. Any such use is at the owner's sole risk.

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.

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.

Batteries

- Before starting work on the engine, disconnect batteries to prevent inadvertent starting of the engine.
- 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.

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 lines 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.

Exhaust System

- Exhaust products of any internal combustion engine are toxic and can cause injury, or death if inhaled. All engine applications, especially those within a confined area, should be equipped with an exhaust system to discharge gases to the outside atmosphere.
- Do not use exhaust gases to heat a compartment.
- Make sure that your exhaust system is free of leaks. Ensure 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 might cause unconsciousness and death. It is an odorless and colorless gas formed during combustion of hydrocarbon fuels. Symptoms of carbon monoxide poisoning are:

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

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

Cooling System

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator pressure cap when coolant temperature is above 212°F (100°C) or while engine is running.

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.

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC-rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work—harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.

- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocution can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [-] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [-] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

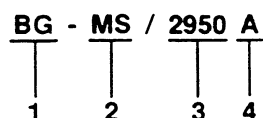
KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

GENERAL INFORMATION

ENGINE MODEL REFERENCE

Identify your model by referring to the MODEL and SPEC (specification) NO. as shown on the unit nameplate. Always use this number and the engine serial number when making reference to your engine.

How to interpret MODEL and SPEC NO.



1. Factory code for general model identification purposes.
2. Specific type:
S — Manual Starting
MS — Electric Starting
3. Factory code for optional equipment supplied.
4. Specification letter advances with factory production modifications.

If your engine needs service or repair, contact an Onan Service Center. Trained mechanics will assure expert repair service on your Onan engine.

These instructions contain the SI metric equivalents following immediately in parentheses after the U.S. customary units of measure.

SPECIFICATIONS

Engine Design.....	Opposed two-cylinder, four cycle, air cooled
Bore	3-1/4 inch (82.55 mm)
Stroke	3 inch (76.20 mm)
Displacement (cubic inch)	49.8 (816.22 cm ³)
HP—Garden tractor service	18
Oil capacity with filter change.....	4 pints (1.89 litres)
Oil capacity without filter change.....	3.5 pints (1.66 litres)

TUNE-UP SPECIFICATIONS

Spark plug gap025 inch (0.64 mm)
Breaker point gap021 inch (0.53 mm)
Valve lash	
Intake.....	.008 (0.20 mm)
Exhaust.....	.013 (0.33 mm)
Ignition timing (cold, static setting)	21° BTC

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.
2. Turn off the fuel supply and run the engine until it stops.
3. Drain oil from oil base while the engine is still warm. Refill with fresh crankcase oil and attach a tag stating viscosity used.
4. Remove spark plugs. Pour 1 ounce (2 tablespoons or 28 grams) of rust inhibitor or SAE #50 oil into the cylinders. Crank the engine over a few times. Reinstall spark plugs.
5. Service air cleaner as outlined in *MAINTENANCE* section.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Provide a suitable cover for the entire unit.
10. If battery equipped, disconnect and follow standard battery storage procedure.

RETURNING UNIT TO SERVICE

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperatures.
3. Clean and check battery. Measure specific gravity (1.260 at 77° F [25° C]) and verify level to be at split ring. If specific gravity is low, charge until correct value is obtained. If the level is low, add distilled water and charge until specific gravity is correct. **DO NOT OVERCHARGE.**
4. Check that fuel filter and fuel lines are secure, with no leaks.
5. Check carburetor, adjust if necessary.
6. Connect battery.
7. Start engine.

After engine has started, excessive blue smoke is exhausted until the rust inhibitor has burned away.

PRE-START INSTRUCTIONS

BEFORE STARTING

Be sure the engine is properly filled with oil and fuel.

Crankcase Oil: Fill the crankcase with an oil that meets the API (American Petroleum Institute) service designation SE or SE/CC. Do not mix brands nor grades of motor oil. Recommended oil numbers for expected ambient temperatures are:

TEMPERATURE
Below 30°F (-1°C)
Above 30°F (-1°C)

GRADE
SAE 5W30
SAE 30

CAUTION

Do not overfill crankcase. Overfilling causes the oil to foam and enter the breather system. Do not use service DS oil or damage to the engine could occur.

The engine uses an oil fill tube; fill to "Full" mark on the dipstick.

WARNING

Do not remove the dipstick while the engine is running. Oil may blow out the oil fill tube causing injury.

Refer to *PERIODIC SERVICE* section for recommended oil change intervals.

Recommended Fuel: Use clean, fresh, lead free or regular grade gasoline. Do not use highly leaded premium fuels.

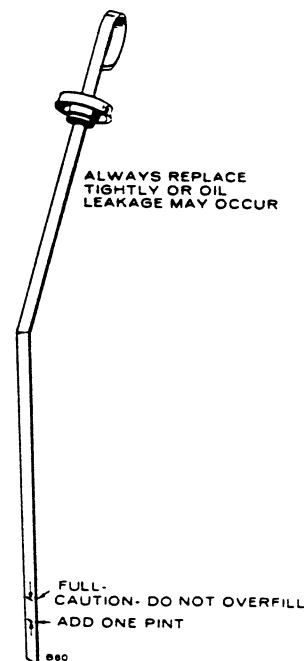
For new engines, the most satisfactory results are obtained by using nonleaded gasoline. For older engines that have previously used leaded gasoline, heads must be taken off and all lead deposits removed from the engine before switching to nonleaded gasoline.

STARTING

Most engines are equipped with a cable-controlled manual choke. Refer to the illustration for open and closed choke positions.

1. Turn the ignition switch on, pull the choke lever way out (for a cold engine) and push the start switch.
2. When the engine starts, gradually push the choke lever in until the engine runs smoothly.
3. Black smoke from the exhaust and a rough running engine usually indicate over-choking.
4. To stop the engine, turn the ignition switch to the "Off" position.

If the engine fails to start at first attempt, inhibitor oil used at the factory may have fouled the plugs. Remove the plugs, clean in a suitable solvent, dry thoroughly and reinstall. Heavy exhaust smoke when the engine is initially started is normal and usually caused by inhibitor oil.



CRANKCASE OIL FILL

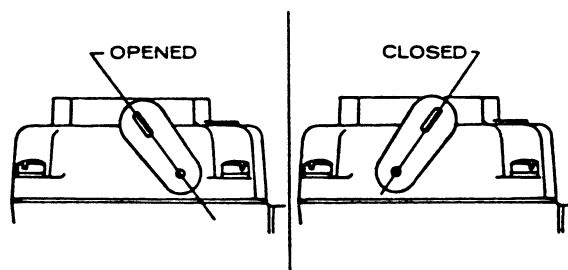
CAUTION

If lead deposits are not removed from the engine before switching from leaded to non-leaded gasoline, preignition could occur, causing severe engine damage.

WARNING

Avoid potential explosions. Never fill the fuel tank when the engine is running.

Inspection: Inspect the engine visually before starting. Check for loose or missing parts and any damage that may have occurred in shipment.



CHOKE OPEN

CHOKE CLOSED

OPERATION

BREAK-IN PROCEDURE

Controlled break-in is the ideal fitting of all internal moving metal parts. Using the proper oil and applying a conscientious maintenance program during this period helps assure satisfactory service from your Onan engine.

Maintain the proper cooling and lubrication during break-in. Run the engine at half load for the first three hours with intermittent periods of full load to control engine break-in.



Using the wrong grade and weight of oil and high engine operating temperatures during break-in can cause engine damage.

Check the oil level at least every five operating hours. Add oil to keep it at the proper level, but never overfill as overfilling may cause the oil to foam and enter the breather system.

HOT WEATHER OPERATION

When operating the engine in temperatures above 75°F (24°C), pay particular attention to the following items to prevent damage:

1. Keep the engine cooling fins clean and free of obstruction.

MAINTENANCE

Oil Level: Check oil level at least every 8 hours of operation. Check more frequently on a new or reconditioned engine as oil consumption is higher until the piston rings seat properly.

Oil Change: Change crankcase oil after the first 25 hours of operation; change every 50 hours after that. If operating in extremely dusty conditions, change oil more frequently.

Oil Filter: Replace oil filter every 100 hours; replace more often in dusty conditions. Tighten the filter finger-tight plus 1/4 to 1/2 turn.

Crankcase Breather: This engine uses a crankcase breather valve and "Pack" for maintaining crankcase vacuum. If the crankcase becomes pressurized as evidenced by oil leaks at the seals, clean baffle, valve, and pack in a suitable solvent.

Cooling System: Check and clean cooling fins at least every 50 hours. Remove any dust, dirt or oil which may have accumulated.

2. See that nothing obstructs air flow to and from the engine.
3. Ensure that you are using the proper grade and weight of oil for ambient temperatures. Check the oil level each time you fill the fuel tank.
4. Check the battery water more frequently than every 50 hours which is recommended under normal conditions. High temperatures cause faster evaporation.

COLD WEATHER OPERATION

When the engine is being used in temperatures below 30°F (-1°C), check the following items closely:

1. Use the correct grade and weight of oil for the temperature conditions. Change the oil only when the engine is warm. If an unexpected temperature drop occurs when the engine is filled with summer oil, before starting the engine, move it to a warm location until the oil will flow freely.
2. Use fresh fuel. Fill the fuel tank after each day's use to protect against moisture condensation.
3. Keep the battery in a well-charged condition.

Cartridge Air Cleaner: Check and clean air cleaner element every 50 hours. Clean by gently tapping element on a flat surface. Replace the element every 200 hours. Clean or replace more frequently in dusty operating conditions.

Air Cleaner Wrapper (Pre-Cleaner [if used]): Wash in water and detergent and squeeze dry like a sponge. Allow to dry, then coat evenly with three tablespoons (42.5 grams) of SAE 30 engine oil. Knead into and wring excess oil from pre-cleaner. Reinstall over cartridge.



Plugged or clogged cooling fins can cause overheating and engine damage.

Spark Plugs: Check, clean and regap spark plugs every 100 hours of operation. Replace spark plugs that show signs of fouling or electrode erosion.

Breaker Points: Check breaker points every 100 hours. Replace points every 200 operating hours. Replace points sooner if they are pitted or burned. See *ADJUSTMENTS* section.

ADJUSTMENTS

CARBURETOR

The carburetor has a main fuel (high speed) adjustment and an idle fuel adjustment. The main adjustment affects operation under heavy load conditions. Idle adjustment affects operation under light or no load conditions. Under normal circumstances, factory carburetor adjustments should not be disturbed. If the adjustments have been disturbed, turn needles off their seats, 7/8 to 1-1/8 turns to permit starting. Then, readjust them for smooth operation.



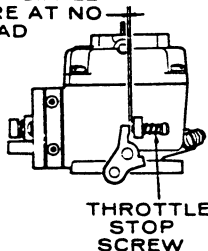
Forcing the needle against its seat will damage it. The needle does not completely shut off fuel when turned fully in.

Before final adjustment, allow the engine to warm up. Make the idle adjustment under no load. Open the main jet until the engine runs smooth under acceleration with no load. Slightly more fuel may be needed (open about 1/4 turn further) when a sudden load is applied.

Set the throttle stop screw (located on carburetor throttle lever) with no load connected and while running at a low speed setting. Turn the screw to give approximately 1/32 inch (.029 mm) clearance between the screw and pin.

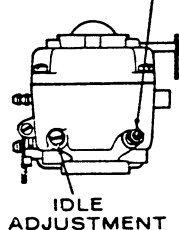
If the engine develops a "hunting" condition (alternate increase and decrease of engine speed), try correcting it by opening the main adjusting needle a little more. Do not open more than 1/2 turn beyond the maximum point of power.

LOW SPEED SET
ON GOVERNOR
LINKAGE- SMALL
GAP HERE AT NO
LOAD



SIDE VIEW

MAIN FUEL
(HIGH SPEED)
ADJUSTMENT



REAR VIEW

CARBURETOR ADJUSTMENT

BREAKER POINTS (Cold Setting) IGNITION TIMING

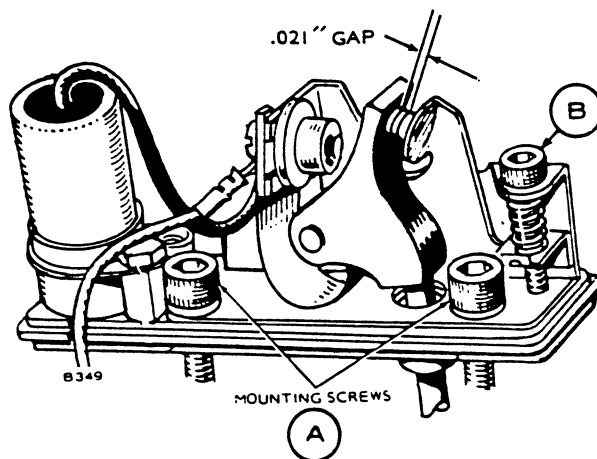
To maintain maximum engine efficiency, change the breaker points every 200 hours of operation. Proceed as follows:

1. Remove the air intake hose that connects to blower housing. This provides an access to view timing mark.
2. Remove spark plugs and rotate engine clockwise (facing flywheel) by hand until 21° BTC mark on gear cover aligns with mark on flywheel. Turn another 1/4 turn (90°) to ensure points are fully open.
3. Remove breaker box cover by loosening screw and lift off to remove.
4. Using an allen head wrench, adjust set screw (Item B) for .021 (0.53 mm) between points. Measure point gap with a flat thickness gauge. See illustration below.

Make sure feeler gauge is clean and free of any grease, oil or dirt.

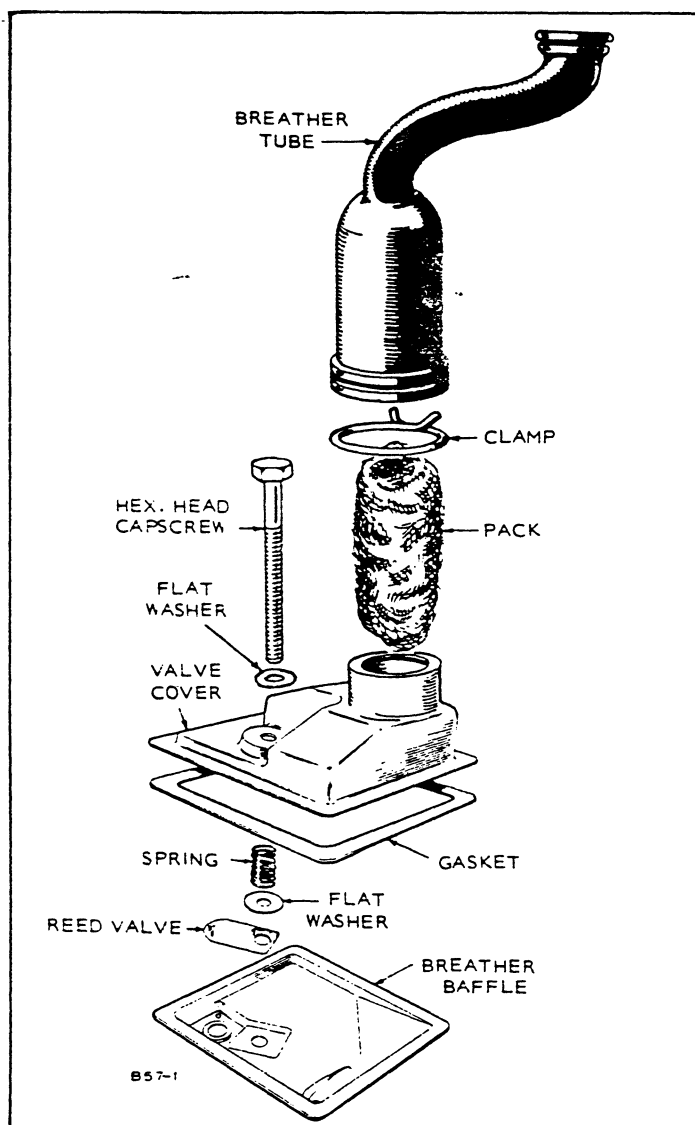
No other adjustment or alignment is necessary. Setting point gap accurately adjusts engine timing.

5. Replace breaker box cover and spark plug cables and air intake hose.

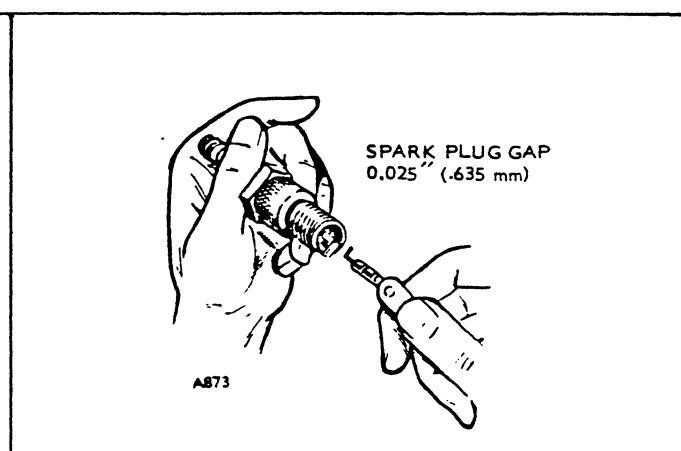


SETTING POINT GAP AND TIMING

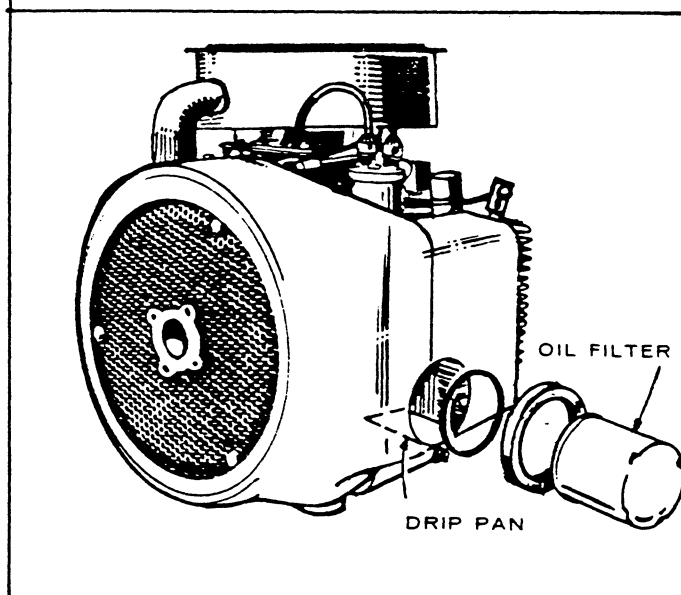
MAINTENANCE



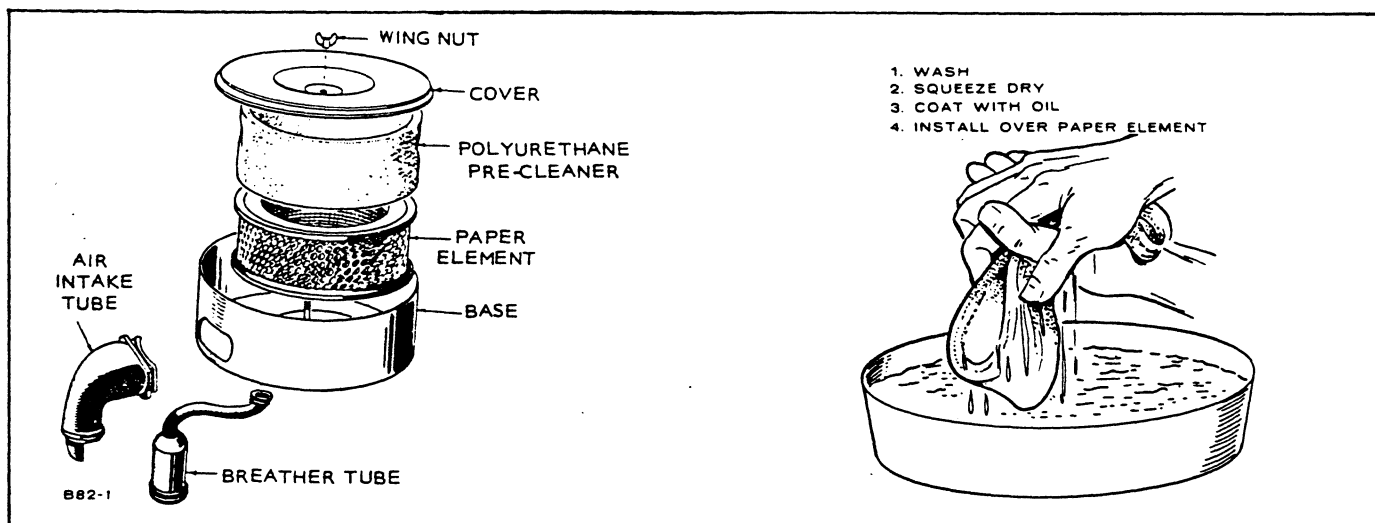
CRANKCASE BREATHER



SPARK PLUG GAP



OIL FILTER



AIR CLEANER

PERIODIC SERVICE GUIDE

Regularly scheduled maintenance lowers operating costs and lengthens the service life of the unit. Use the following schedule as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check the condition of the

crankcase oil, the filters, etc., frequently until the proper service time periods can be established.

For any abnormalities in operation, unusual noises from the engine or accessories, loss of power, overheating, etc., contact your nearest Onan Service Center.

PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS				
	8	50	100	200	400
Inspect Engine Generally	x ³				
Clean Breather Valve				x	
Check Oil Level	x				
Service Air Cleaner		x ¹			
Change Crankcase Oil		x ¹			
Replace Breaker Points				x	
Check Battery Electrolyte Level		x			
Clean Fuel System				x	
Check Spark Plugs			x		
Remove Carbon and Lead Deposits				x ²	
Replace Oil Filter			x ¹		
Check Valve Clearance		x ⁴		x ²	
Replace Air Cleaner Element				x ¹	
Inspect Valves, Grind if Necessary					x ²

x¹ - Perform more often in extremely dusty conditions.

x² - For detailed maintenance, contact an Onan Service Center.

x³ - Check for exhaust leaks, fuel leaks, etc.

x⁴ - Initial break-in check only.

RUNNING REPLACEMENT PARTS

Oil Filter	122-0406
Air Filter Element	140-1216
Wrapper for Above (if used)	140-1259
Spark Plugs	167-0241
Breaker Points (Top Adjust)	160-1183
Condenser (Breaker Box)	312-0196
Coil	166-0535
Carburetor	142-0568
Carburetor Base Gasket	145-0438
Carbon Removal Gasket Kit	168-0131

Onan recommends that all major service be performed by qualified service personnel. An engine service manual and complete parts catalog are available at additional cost. Contact your nearest authorized dealer or Onan Parts and Service Center.