2-CYCLE GTS 120 ENGINE SERVICE MANUAL

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TORO®

2-cycle engine

SERVICE MANUAL

TORO
The Toro Company — Outdoor Products Division
8111 Lyndale Avenue South, Minneapolis, Minnesota 55420

PREFACE

This service manual was written expressly for TORO Two-Cycle Rotary Mowers. All units with the model number 47PZ2, 47PD3, 47PE4, and 47PF5 engines have been taken into consideration.

The Toro Company has made every effort to make this service manual a useful tool for the service and maintenance of your TORO Rotary Mower Engine. To assure proper and effective performance, you are urged to read this manual carefully.

The purpose of this manual is to provide the Service Dealer with working guidelines of maintenance, troubleshooting, test, and overhaul procedures.

The Toro Company reserves the right to change product specifications or this manual without notice.

The Toro Company
Service Department

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I. GENERAL INFORMATION

SAFETY INSTRUCTIONS

Your rotary mower at the time of its manufacture, meets the blade safety requirements of the Consumer Product Safety Commissions Safety Standard for Walk Behind Power Lawn Mowers. A representative sample was tested and verified by an independent laboratory for compliance with the B71.1-1980 Specifications of the American National Standards Institute. However, improper use or maintenance by the operator or owner can still result in injury. To reduce the potential for injury follow these safety instructions.

This machine is equipped with a blade brake which is designed to stop the blade within 3 seconds when the control lever is released. Check to be sure the control and brake function correctly before each use of the mower. Repair any defective or damaged safety components before operation is commenced. To further reduce the possibility of injury, always stop the engine before leaving the operator's position.

This safety symbol means WARNING or CAUTION - PERSONAL SAFETY INSTRUCTION - Read the instruction because it has to do with safety. Failure to comply with the instruction may result in personal injury.

Before Operating

1. Operate your mower only after reading the Operators Manual. A replacement manual is available by sending the complete model and serial number to: The Toro Company, 8111 Lyndale Avenue South, Minneapolis, Minnesota 55420. Attn: Publications.
2. Never allow children to operate the mower or adults to operate the mower without proper instructions.
3. Become familiar with the controls and know how to stop the engine quickly.
4. Keep everyone, especially children and pets, away from the area of operation. Remove sticks, stones, wire and any other debris that might be picked up and thrown by the blade.
5. TAMPERING WITH OR DEFEATING A SAFETY DEVICE OR COMPONENT WHICH RESULTS IN NONCONFORMANCE WITH A SAFETY STANDARD, MAY RESULT IN PERSONAL INJURY. Each time before operating the mower, check for damage or abnormal wear. If a safety device, shield, or decal is defective or damaged, repair or replace it before operation is commenced.
6. Wear long pants and substantial shoes. Do not operate the mower while wearing sandals, tennis shoes, sneakers or shorts. Do not wear loose fitting clothing that could get caught in moving parts.
7. If long grass will be cut, set the height-of-cut in the highest position. After mowing, reinspect the area and remove all debris. Then lower the height-of-cut and mow the grass again.
8. Since gasoline is highly flammable, handle it carefully.
   A. Use an approved gasoline container.
   B. Do not fill the fuel tank when the engine is hot or running.
   C. Do not smoke while handling gasoline.
   D. Fill the fuel tank outdoors and up to about one-half inch from the top of the tank, not the filler neck.
   E. Wipe up any spilled gasoline.

While Operating

9. Cutting the grass with a rotary mower demands attention. Always maintain secure footing, balance and control.
10. Cut the grass during the daytime or when there is adequate artificial light. Cut slopes from side to side, but avoid slopes when the grass is wet. If possible, mow when the grass is dry for best results.
11. Keep face, hands and feet away from the mower housing and cutter blade while the engine is running. Stay behind the handle until the engine and all moving parts stop.
12. During operation the grass defector or complete bagging assembly must be installed on the mower.
13. Stop the engine and wait for all moving parts to stop before removing the bag, bagging assembly, or unclogging the discharge chute. If the chute must be unclogged, pull the high tension wire from the spark plug to prevent the possiblity of accidental starting. Use a stick to remove the obstruction.
14. If a solid object is hit by the blade or if the mower vibrates abnormally, stop the engine immediately. Disconnect the high tension wire from the spark plug to prevent the possiblilty of accidental starting. Then check the mower for possible damage, bent blade, an obstruction or loose parts. Repair the mower before using it again.
15. Stop the engine before adjusting the height-of-cut.
16. If a gravel driveway, road or path must be crossed, stop the engine so loose sand and

rocks are not thrown.

17. Before leaving the operator's position behind the handle, stop the engine and wait for all moving parts to stop. Do not walk in front of the mower while the engine is running. Disconnect the high tension wire from the spark plug if the mower will be unattended.
18. Do not touch any part of the engine while it is running or shortly after it is stopped because the engine will be hot enough to cause a burn.

Muffler is extremely hot. Keep children and pets away.

MAINTENANCE

19. Before the mower is serviced or adjusted, stop the engine and remove the key from the switch. Disonnect the high tension wire from the spark plug to prevent the possibility of accidental starting.
20. To assure the mower is in safe operating condition, keep all nuts, bolts and screws tight. Assure the blade capscrew is tightened to the proper torque.
21. If major repairs are ever needed or if assistance is desired, contact an Authorized TORO Service Dealer.
22. If the mower must be tipped when it is serviced or adjusted, drain the gasoline from the fuel tank.
23. If a guard, safety device or safety decal is damaged, replace the defective part(s) before operating the mower.
24. To reduce potential fire hazards, assure the mower is free of excessive grease, grass, leaves and accumulations of dirt.
25. The grass bag must always be in good condition; therefore, check it before each use to assure the bag is not torn or deteriorated. Always replace a defective grass bag.
26. Allow the engine to cool before storing the mower in any enclosure such as a garage or storage shed. Do not store the mower near any open flame or where gasoline fumes may be ignited by a spark.
27. Do not overspeed the engine by changing the governor settings. Recommended speed of the engine is 3000 rpm. To assure safety and accuracy, have an Authorized TORO Service Dealer check the engine speed with a tachometer.
28. At the time of manufacture the mower conformed to the safety standards in effect for rotary mowers. To assure optimum performance and continued safety certification of the mower, use genuine TORO replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in nonconformance with the safety standards.

MODEL AND SERIAL NUMBERS

The TORO Two-Cycle Rotary Mower has two sets of identification numbers. There is a model and serial number to identify the engine and a model and serial number to identify the chassis. The engine identification numbers are stamped into the blower housing behind the air cleaner. Model 47PF5 engines built for 1986 have the engine identification numbers stamped in the blower housing above the spark plug. Engine models 47PE4 and 47PF5 have serial nubmers that start with the number 1, 2 or 3. The number 1 indicates a zone start application. The number 2 indicates BBC application and the number 3 indicates commercial application.

The chassis identification numbers are located on a decal on the back of the mower housing, between the rear wheels.

In any correspondence concerning the mower, supply the model and serial numbers to assure that the correct information and replacement parts are obtained. Genuine TORO replacement parts may be ordered through your local TORO Authorized Service Dealer.

TWO-CYCLE ENGINE THEORY AND OPERATION

Theory

Two-cycle engines have special advantages which make their use more practical in certain applications. Two-cycle engines are lightweight with an excellent power to weight ratio and can be operated in any position. They are also notably easy to maintain and service because of their uncomplicated design.

The TORO Two-Cycle Engine used on the TORO Rotary Mowers is a third-port, loop scavenged design. This design name describes the path of the fuel/air mixture into the crankcase and combustion chamber, and the exhausting of spent gases.

In a loop-scavenge engine, a high pressure area is created in the crankcase by the downward movement of the piston. Pressurized fuel-air mixture rushes into the combustion chamber through the intake ports and is directed toward the cylinder head. This fresh mixture then strikes the cylinder head and loops down forcing burnt gases in the combustion chamber out through

the exhaust ports. The third port design engine has the carburetor mounted on the side of the cylinder. The passage from the carburetor into the crankcase is called the third port. All ports within the engine are opened and closed by the piston skirt as the piston moves up and down within the cylinder.

Operation

The piston closes all engine ports as it moves toward the combustion chamber (Figure 1-1). The moving piston creates a high pressure in the combustion chamber and a partial vacuum in the crankcase.

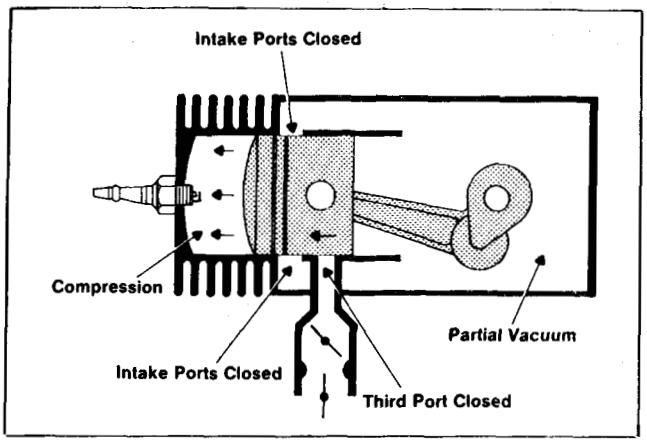


Figure 1-1

At a point slightly before top dead center (BTDC) of the piston travel, the spark from the plug ignites the fuel air mixture (Figure 1-2). Also, at this time, the third port opens allowing the fresh fuel/air mixture to rush into the crankcase to equalize the partial vacuum.

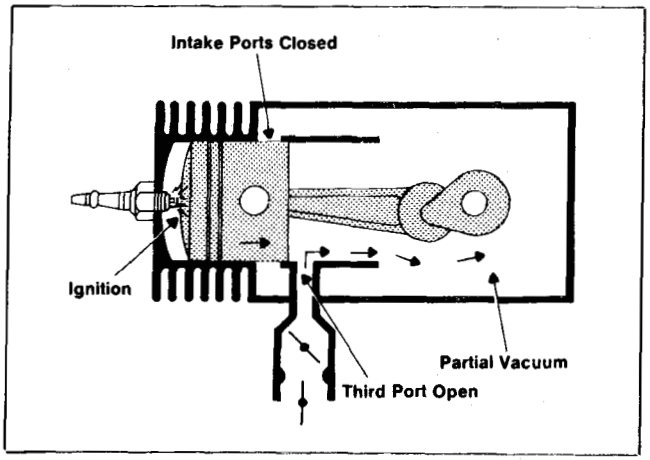


Figure 1-2

When the fuel is ignited by the spark plug, the expanding gases from the burning fuel in the combustion chamber force the piston down the cylinder, closing the third-port and increasing the pressure in the crankcase. At a point approaching the bottom of the stroke, the exhaust port opens and the burnt gases begin to be expelled from the combustion chamber (Figure 1-3).

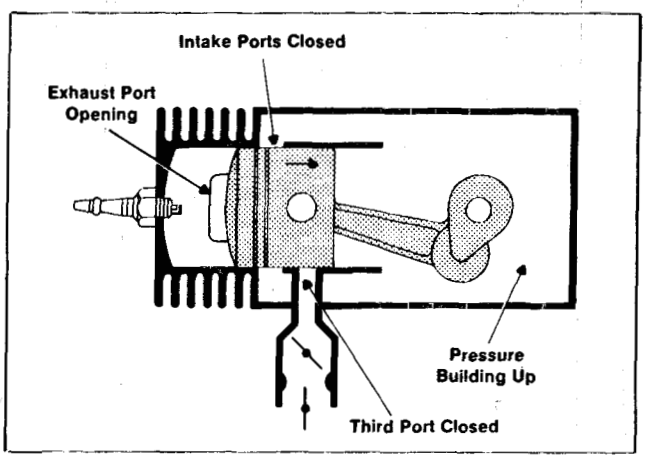


Figure 1-3

At a point of piston travel slightly before bottom dead center (BBDC)the fuel transfer ports, on the sides of the cylinder walls, are uncovered and the compressed fuel/air mixture in the crankcase is allowed to enter the combustion chamber where they help expel the burnt gases and charge the chamber for the following piston stroke (Figure 1-4).

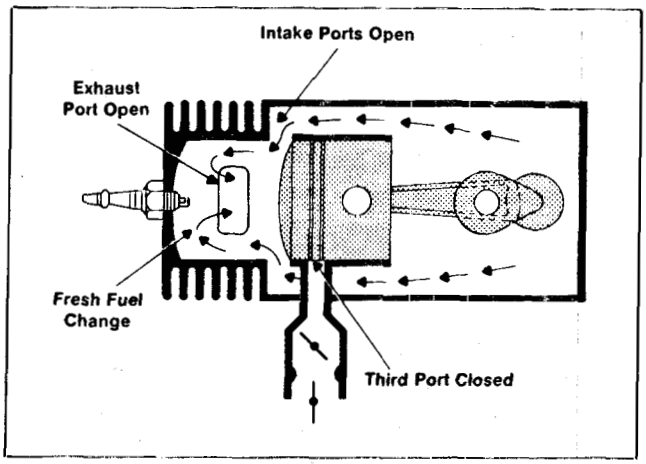


Figure 1-4

CARBURETOR THEORY AND OPERATION

Theory

The carburetor receives fuel from the tank and mixes it with air in the right proportions to provide a highly combustible mixture to the engine.

As the piston moves up on the compression stroke a partial vacuum is created within the engine crankcase, causing the greater atmospheric pressure to force air to flow through the carburetor into the cylinder. The velocity of the air increases as it flows through the carburetor venturi and the air pressure is reduced at this point to less than atmospheric pressure. The differences of pressure in the venturi of the

carburetor causes atmospheric pressure to push raw fuel from the float bowl into the air stream, where it breaks up into a fine spray, or becomes atomized, and mixes with the air stream (Figure 1-5).

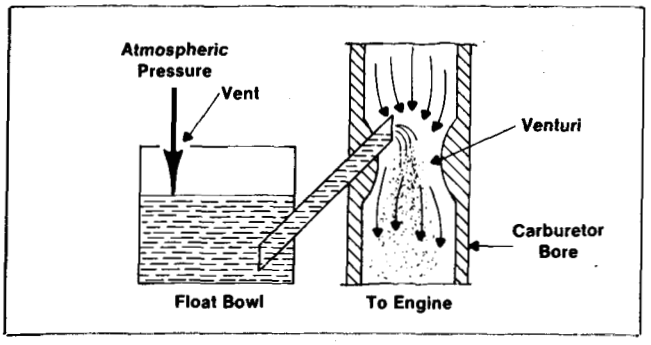


Figure 1-5

Operation

When starting the engine, an extra rich mixture is required. The choke plate is closed by the operator to provide an approximate 8:1 ratio of fuel to air for this rich mixture. Closing the choke plate further reduces the air pressure area in the venturi to increase the fuel drawn into the carburetor bore. In this condition fuel is drawn from the float bowl through the pilot system ports as well as the main discharge tube to achieve the proper starting mixture (Figure 1-6).

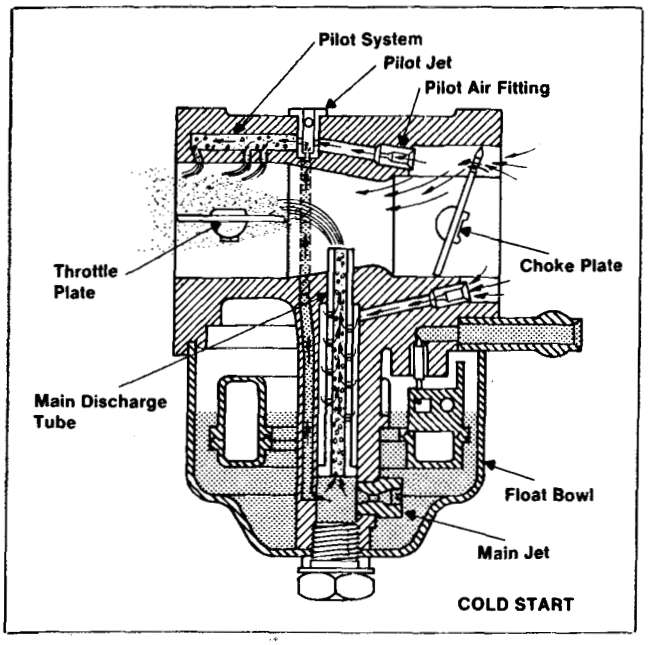


Figure 1-6

Fuel atomization becomes more efficient, due to heat, once the engine has reached normal operating temperature. As a result, the engine does not require the rich mixture it did for starting and the choke plate must be moved to the open position. The engine speed is now regulated by the throttle plate. In no load conditions a small portion of the fuel may be drawn from the main discharge tube, however the primary fuel supply is drawn from the pilot circuit. Air passing through the pilot jet from the pilot air fitting draws fuel out of the pilot jet orifice from the float bowl. This fuel pre-mixes with the incoming air, then is discharged into the carburetor bore where the fuel becomes atomized (Figure 1-7).

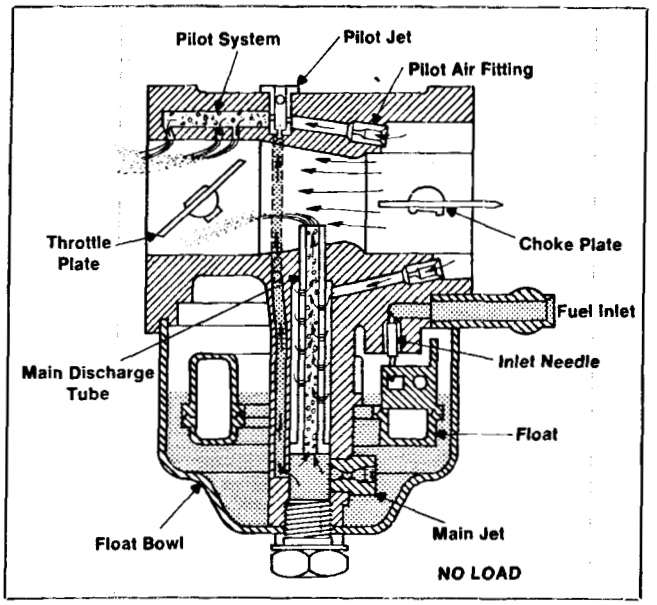


Figure 1-7

As the throttle plate is opened to compensate for loads the engine is being placed under, the main discharge tube becomes the main source of fuel. Opening the throttle plate increases the flow of air through the venturi and strengthens the low pressure area at the main discharge tube. Fuel discharge increases at the main discharge tube as it decreases from the pilot system. Air is drawn from the air correction jet through holes along the length of the main discharge tube. This pre-mixes air with the fuel before it enters the carburetor bore for more efficient atomizing of the fuel (Figure 1-8).

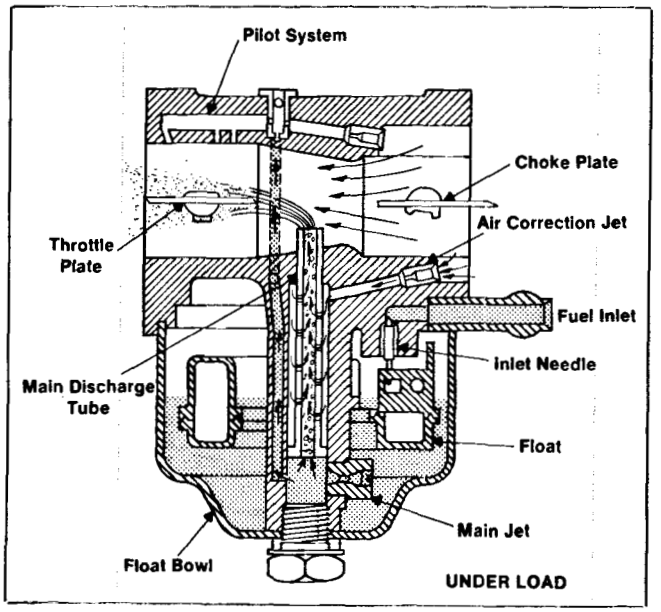


Figure 1-8

ENGINE SPECIFICATIONS

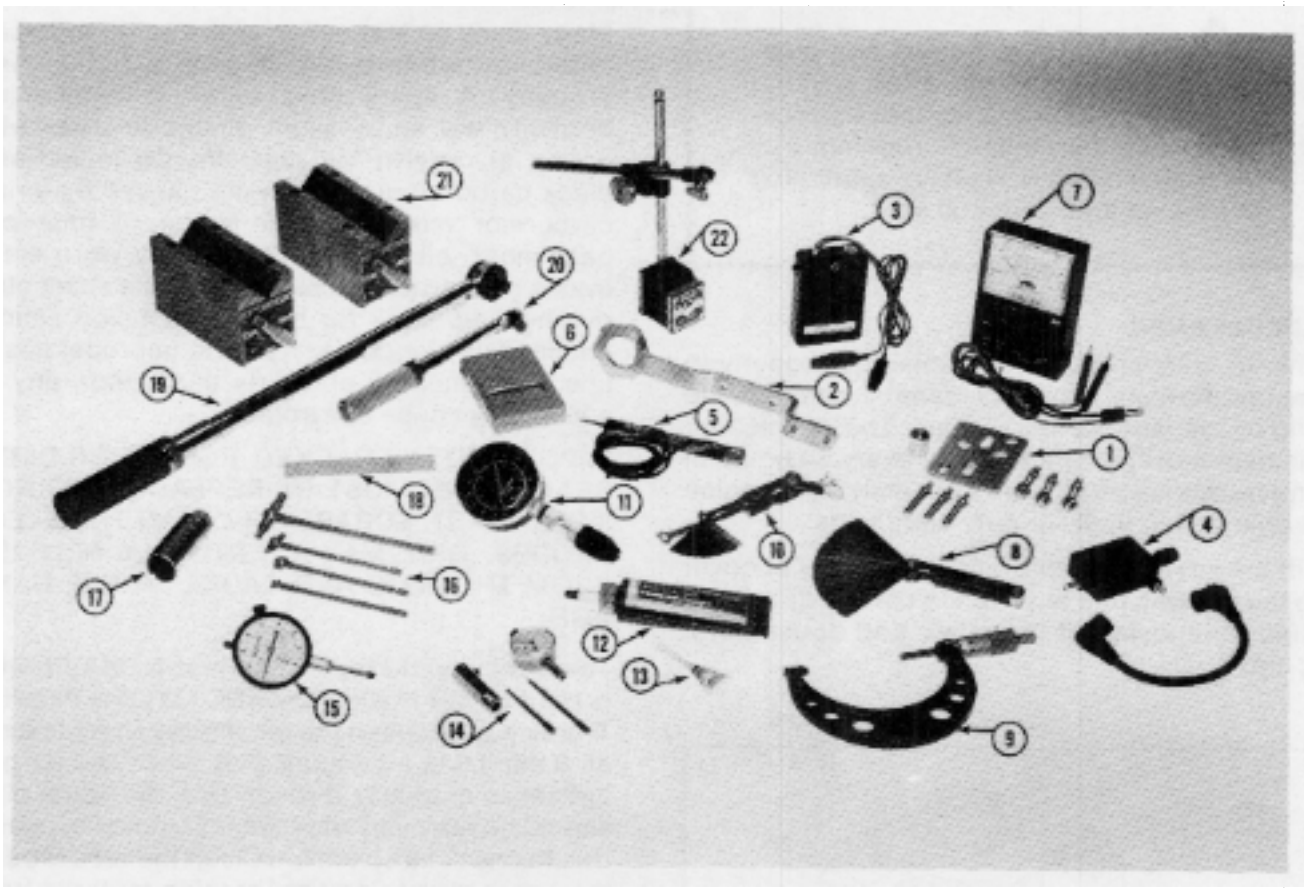
Model	47PZ2	47PD3	47PE4	47PF5
Type	2 cycle, single cylinder piston ported, air cooled	←	←	←
Rotation (viewed from output end)	Counter-clockwise	←	←	←
Displacement	121 cc (7.38 cu. in)	←	←	←
Bore	58 mm (2.28 in)	←	←	←
Stroke	46 mm (1.81 in)	←	←	←
Crankshaft	24.9 mm (.98 in) forged steel	←	←	←
Rated Output	3.5 Hp @ 3600 RPM	←	←	←
Torque	.73 kg-m (5.28 ft-lb) @ 3000 RPM	←	←	←
Compression Ratio	6:1	←	←	←
Compression	8.4 kps/cm^2 (120 psi) to 10.5 kps/cm^2 (150 psi)	←	←	←
Gas-Oil Ratio	50:1	←	←	←
Gasoline	Unleaded Regular	←	←	←
Oil	Toro 2 cycle oil	←	←	←
Fuel Tank Capacity	1.89 l (2 qt)	←	←	←
Air Cleaner	Two stage foam element	←	←	←
Carburetor	Mikuni BV-15 std. main jet #80	#76.3	←	←
High Altitude Jet	#77.5	#72.5	←	←
Governor	Mechanical Flyweight (3000 rpm ± 150)	←	←	←
Spark Arrester Muffler	Optional (PN 81-0200)	←	←	←
Starter	Recoil only	←	←	←
Spark Plug	NGK-BPMR6A	NGK-BPMR4A	←	←
Spark Plug Gap	.8 mm (.032 in)	←	←	←
Ignition Timing	22° ± 2° BTDC	←	←	←
Ignition Timing, Piston Position	1.76-2.51 mm (.069-.099 in) BTDC	←	←	←
Contact Point Gap	.35 mm (.014 in)	N/A	N/A	N/A
Ignition Coil Air Gap	.38-.50 mm (.015-.020 in)	←	←	←
Float Height Setting (Black Float)	* N/A	11/16"	* N/A	* N/A

*The black float may be used on these engines as a replacement. Part number 81-0970.

FASTENER TORQUE SPECIFICATIONS

Adapter Plate - Housing Capscrews (3/8 - 16 UNC)	2.9-4.6 Kg-m (21-33 ft-lb)
Blade Capscrew	6.2-8.3 Kg-m (45-60 ft-lb)
Flywheel Nut (M 10)	4.0-5.0 Kg-m (29-36 ft-lb)
Muffler Nuts (M 8)	90-120 Kg-Cm (100-140 in-lb)
Air Cleaner Lock Nuts (M 6)	60-90 Kg-Cm (70-105 in-lb)
Adapter Plate - Engine Capscrews (M 8)	90-120 Kg-Cm (100-140 in-lb)
Crankcase Capscrews (M 6)	80-95 Kg-Cm (70-110 in-lb)
Shroud & Muffler Capscrews (M 6)	40-70 Kg-Cm (45-80 in-lb)
Ignition Switch Mounting Capscrew (M 6)	80-115 Kg-Cm (90-130 in-lb)
Air Cleaner Mounting Capscrew (M 5)	17-26 Kg-Cm (20-30 in-lb)
Recoil Starter Cup Capscrews (M 6)	80-95 Kg-Cm (70-110 in-lb)
Recoil Mounting Capscrews (M 6)	35-65 Kg-Cm (40-75 in-lb)
Recoil Center Capscrew (use thread lock compound)	80-95 Kg-Cm (70-110 in-lb)
Spark Plug (M 14)	70-105 Kg-Cm (80-120 in-lb)
Throttle Plate Capscrews (M 6)	80-95 Kg-Cm (70-110 in-lb)

SPECIAL TOOLS LIST



ITEM	DESCRIPTION	PART NO.
1	Flywheel Puller	41-7650
2	Starter Cup Wrench	45-1390
3	Timing Tester	41-7900
4	Spark Tester	41-7890
5	Continuity Light	36-4050
6	Tachometer	42-2730
7	Ohmmeter (Multimeter)	—
8	Feeler Gauges	—
9	Micrometer	—
10	Spark Plug Gapping Tool	—
11	Compression Gauge	—
12	Threebond #1104 (Loctite #515)	505-80
13	Loctite #242 (Threebond #1342)	505-76
14	Timing Dial Indicator	—
15	Dial Indicator	—
16	Cylinder Gauge Set	—
17	Spark Plug Socket	—
18	Coil Gauge .38-.50mm (.015-.020 in)	—
19	Torque Wrench (ft-lb)	—
20	Torque Wrench (in-lb)	—
21	Magnetic "V" Blocks	—
22	Dial Indicator Stand	—

II. MAINTENANCE

CAUTION: To reduce potential accidents, never perform an adjustment or maintenance procedure while the engine is running. Pull the high tension wire off the spark plug to prevent an accidental start.

AIR CLEANER

The air cleaner must be maintained properly to ensure foreign materials cannot damage the engine or foul the carburetor. The air cleaner element must be cleaned after every 50 hours of engine operation, or more frequently if the engine is operated in dusty or dirty conditions.

Lift the cover tabs securing the air cleaner cover to the housing and remove the cover (Figure 2-1). Clean the inside of the cover and housing if it is dirty.

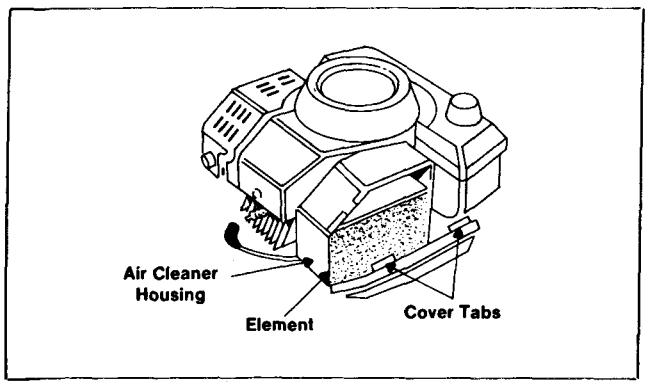


Figure 2-1

If the air cleaner element is dirty remove it from the housing for cleaning. DO NOT ALLOW DIRT TO ENTER BEHIND THE ELEMENT OR ENGINE DAMAGE WILL RESULT. Wash the element in a solution of liquid detergent and water. Squeeze the element to remove the dirt. Do not twist the element or the element may tear. Press the element in a dry rag until it is completely dry. Saturate the element with approximately five teaspoons of SAE 30 oil and squeeze to distribute the oil thoroughly.

The element must be dampened with oil to function properly. Replace the element and install the cover. Assure that the cover snaps in place and is seated securely on the air cleaner housing.

IMPORTANT: DO NOT OPERATE THE ENGINE WITHOUT AN AIR CLEANER ELEMENT OR EXTREME ENGINE WEAR AND DAMAGE WILL RESULT.

SPARK PLUG

Many times an inspection of the spark plug can determine whether the engine is functioning properly. A spark plug which is functioning normally will show slight electrode wear with brown or greyish tan deposits. Oil fouled and black carbon fouled plugs are caused by a rich carburetor mixture, weak spark, or improper gasoline to oil mixture. Excessively worn electrodes or a blistered insulator indicate spark plug overheating. Look for incorrect ignition timing, cooling fins clogged with debris, improper gasoline to oil mixture and dirty carburetor, any of which may cause this trouble.

IMPORTANT: A CRACKED, FOULED OR DIRTY SPARK PLUG MUST BE REPLACED. DO NOT SAND BLAST, SCRAPE OR CLEAN THE ELECTRODES. GRIT MAY EVENTUALLY RELEASE FROM THE PLUG AND CAUSE ENGINE DAMAGE.

The recommended spark plus is an NGK-BPMR6A or NGK-BPMR4A (Champion RCJ8Y). See Page I-5. The air gap between the electrodes should be set at .8 mm (.032 in) (Figure 2-2). Since the air gap increases gradually through use, the spark plug should be removed after every 25 hours of operation to check its condition. Clean the area around the spark plug to prevent foreign material from falling into the cylinder. Install the spark plug with the metal gasket and tighten to 70-105 Kg-Cm (80-120 in-lb).

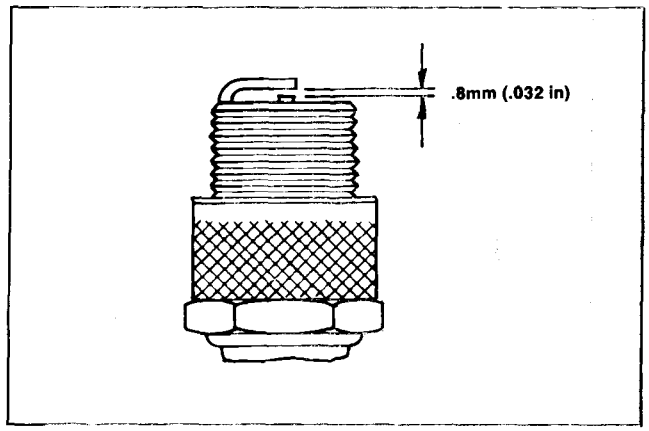


Figure 2-2

EXHAUST SYSTEM

One important part of the maintenance for all two-cycle engines is the cleaning or decarboning of the exhaust system. This is done to assure the unobstructed flow of exhaust gases and carbon particles from the combustion chamber. A severely carboned muffler, spark arrester screen or exhaust port will cause poor starting and low power output. To de-carbon the exhaust system,

remove the muffler from the engine by removing the two retaining nuts and the through bolt (Figure 2-3).

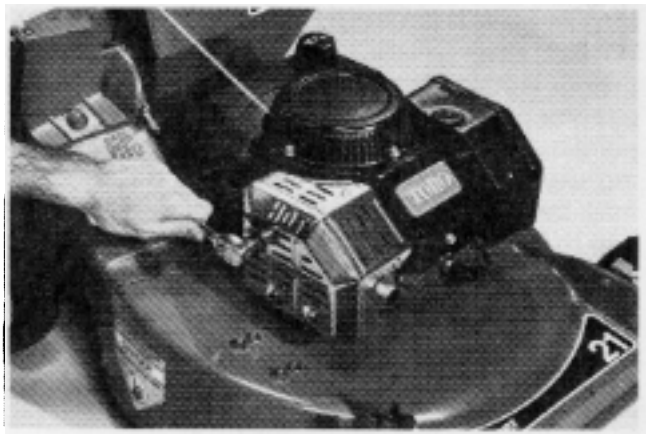


Figure 2-3

Check the cylinder exhaust port. If necessary, remove the carbon deposits from the port using a wooden stick. Also clean the small hole next to the exhaust port. This hole acts as a compression relief to lessen the force required to start the engine. If plugged, the recoil starter will be hard to pull (Figure 2-4).

IMPORTANT: WHEN REMOVING CARBON DEPOSITS, ROTATE THE CRANKSHAFT TO CLOSE THE EXHAUST PORT WITH THE PISTON. THIS WILL PREVENT LOOSE CARBON DEPOSITS FROM FALLING INTO THE CYLINDER. TAKE CARE NOT TO SCRATCH THE PISTON AND DO NOT USE A METAL TOOL TO REMOVE THE DEPOSITS.

Figure 2-4

Before installing the muffler check for cracks and leaks. Inspect the inlet and outlet for carbon buildup. Remove excessive deposits with a scraping tool and soak the muffler in solvent to remove wet oil deposits. Allow to air dry or dry with compressed air. Remove the muffler heat shield and tap the muffler body with a plastic hammer to loosen the carbon deposits. Blow all the loose carbon from the muffler using compressed air. Install the muffler using a new gasket and attach it with proper fasteners tightened to the correct torque. See page I-5.

DECARBONING CYLINDER HEAD

If the exhaust ports and muffler show signs of excessive carbon buildup, it may be necessary to decarbon the cylinder head. To accomplish this the entire engine must be disassembled to allow access into the combustion chamber. (See Disassembly Instructions Page IV-1.) Remove the carbon deposits from the piston and the cylinder chamber using a wooden stick. TAKE CARE NOT TO SCRATCH THE PISTON OR CYLINDER CHAMBER AND DO NOT USE A METAL TOOL TO REMOVE THE DEPOSITS.

IGNITION TIMING (MODEL 47PZ2 ONLY)

To check the timing it is necessary to remove the air cleaner to view the flywheel. (See Disassembly Instructions.) The flywheel has a group of three raised marks on its outer edge. The center mark corresponds to 22° BTDC and the others represent the tolerance of plus or minus 2°. Connect one lead of the timing tester to the engine frame (ground). (A timing tester must be used. An Ohmmeter or continuity light will not indicate the position of the contact points.) Disconnect the wire at the ignition switch under the fuel tank and connect the other tester lead to this wire (Figure 2-5). Turn the engine crankshaft in its normal rotation, counter-clockwise as viewed from the output end. The contact points should open, as indicated by the timing tester, when the pointer on the crankcase housing points to the center of the three marks on the flywheel casting. If the timing is wrong the flywheel must be removed and the contact points regapped or replaced.

Models 47PD3, 47PE4 and 47PF5 use solid state ignition systems and have their timing fixed at 22° BTDC.

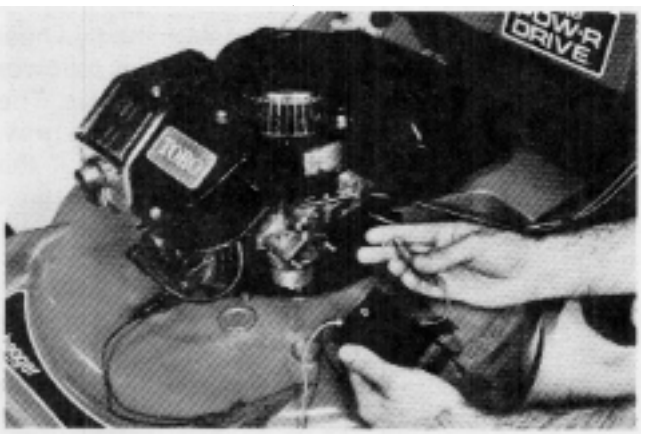


Figure 2-5

IGNITION TIMING (DIAL INDICATOR)

The ignition timing may be more accurately checked using a dial indicator. Remove the spark plug wire and spark plug and insert the dial indicator into the spark plug hole. Rotate the engine crankshaft until the dial indicator registers the piston at top dead center and "zero" the dial. Connect one lead of a timing tester to the engine frame. (A timing tester must be used. An Ohmmeter or continuity light will not indicate the position of the contact points.) Disconnect the wire at the ignition switch under the fuel tank and connect the other tester lead to this wire (Figure 2-6). Slowly rotate the crankshaft clockwise, as viewed from the output end, until the tester signals the contact points are opening. If the tester signals between 1.76 mm (.069 in) and 2.51 mm (.099 in) of piston travel, as read on the dial indicator, the engine is properly timed. If the timing is wrong the flywheel must be removed and the contact points regapped.

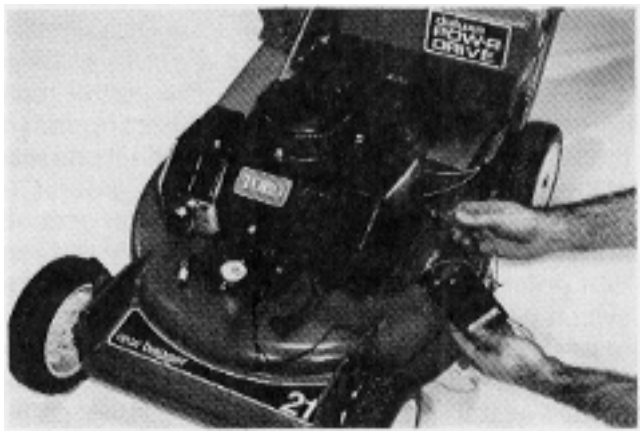


Figure 2-6

CONTACT POINTS AND CONDENSER MODEL 47PZ2 ONLY

The contact points and condenser do wear out through use and their performance level is affected by dust, moisture and corrosion. Inspection of these components requires removal of the flywheel.

(See Disassembly Instructions.) With the flywheel removed, inspect for wear of the cam follower and burning or pitting of the contact points. The surface of the contact points should have a grey, frosted appearance if wearing normally. If the contact points are cratered or have surface buildup they should be cleaned or replaced. The contacts can be cleaned with an electrical solvent and contact point sandpaper. Ensure that all dust and dirt is removed after sanding. Cratering of the points indicates the condenser may be faulty. Verify the condition of the condenser through tests with an ignition analyzer. If an analyzer is not available the condenser must be considered faulty and should be replaced. When installing new or reconditioned contact points ensure that the wiring is routed through the channel in the crankcase housing and under the ignition coil. FAILURE TO ROUTE THE WIRES PROPERLY MAY ALLOW THE WIRING TO CONTACT THE FLYWHEEL AND CAUSE A SHORT CIRCUIT. Adjust the contact points to .35 mm (.014 in) air gap, using a feeler gauge, with the cam follower on the high point of the timing cam (Figure 2-7). Check the timing using either method previously described. It may be necessary to readjust the contact point gap to obtain the timing specification.

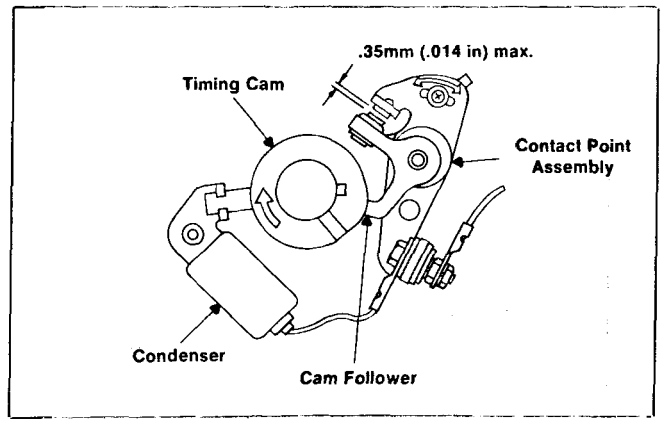


Figure 2-7

IGNITION COIL

Whenever the flywheel is exposed the ignition coil condition and air gap should be checked. Inspect the ignition coil for a cracked casing, loose laminations, damaged wires and overheating. The ignition coil air gap is .38-.50 mm (.015-.020 in). A non-metallic flexible gauge such as shown in the Special Tools Section should be used. To adjust, rotate the flywheel magnets away from the ignition coil and loosen the two ignition coil retaining capscrews. Insert the gauge between the coil laminations and the flywheel (Figure 2-8). Tighten the retaining capscrews to hold the adjustment.

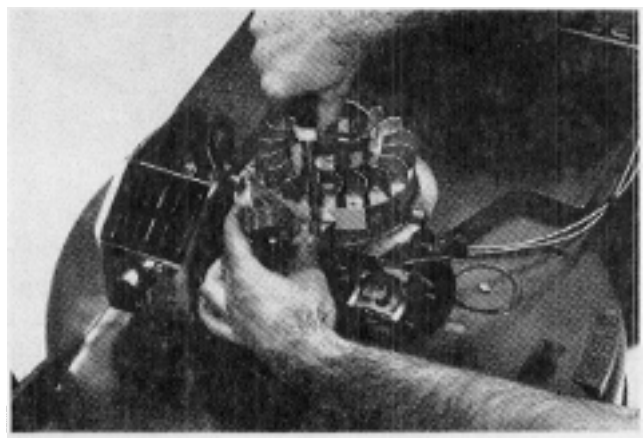


Figure 2-8

The ignition coil contains two separate windings inside the coil casing (Figure 2-9). Use an Ohmmeter to check the resistance levels of each winding. To check the primary winding, disconnect the ignition switch wire and connect the positive lead of the Ohmmeter to the ignition coil lead. Connect the negative lead to the engine frame (ground). The primary winding resistance is .82-1.1 ohms (Rx1 scale). To check the secondary winding, disconnect the high tension wire at the spark plug. Connect the positive lead of the Ohmmeter to the high tension wire. Connect the negative lead to the engine frame (ground). The secondary coil resistance should be 5800-7940 ohms (Rx1000 scale). The ignition coil must be replaced if the resistance levels are incorrect.

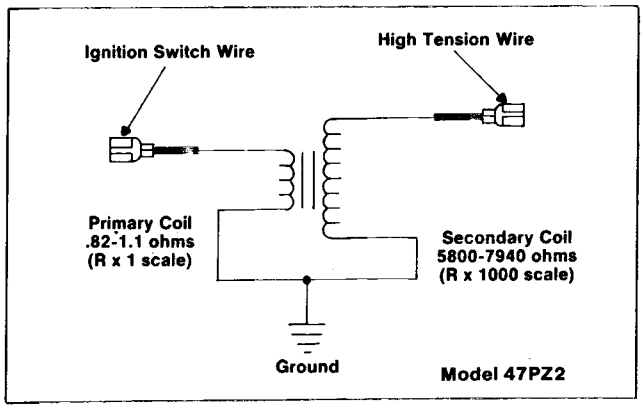


Figure 2-9

The ignition coil used on models 47PD3, 47PE4, and 47PF5 consists of the main coil, high tension wire and ignition kill wire (See Figure 2-10).

Testing of the coil may be completed with a Graham Lee ignition tester model number 31-SMXH. Instructions for testing are included with the tester.

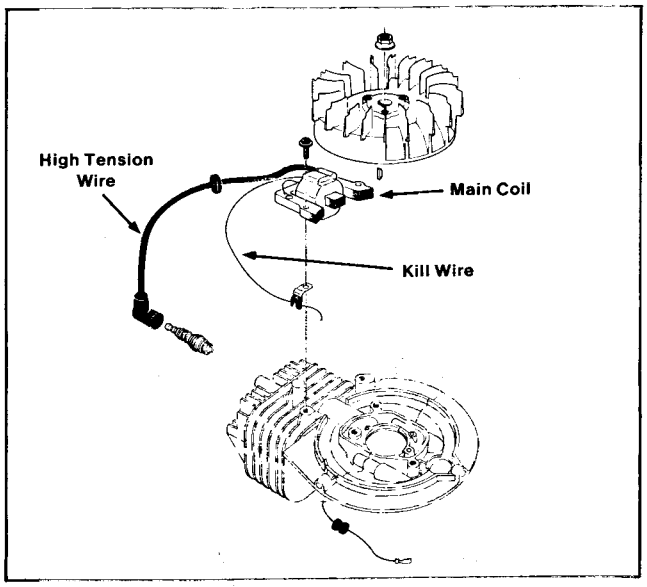


Figure 2-10

GOVERNOR

The governor linkage is factory preset to regulate the engine speed at 3000 ± 150 RPM. Check the adjustment of the governor if the engine is suspected of improper speed. To gain access to the governor linkage removal of the air cleaner is recommended. (See Disassembly Instructions.) Before adjusting the governor, inspect the control linkage for bent, broken and worn parts. Loosen the governor arm clamping bolt and use a screwdriver to spread the governor arm clamp (Figure 2-11).

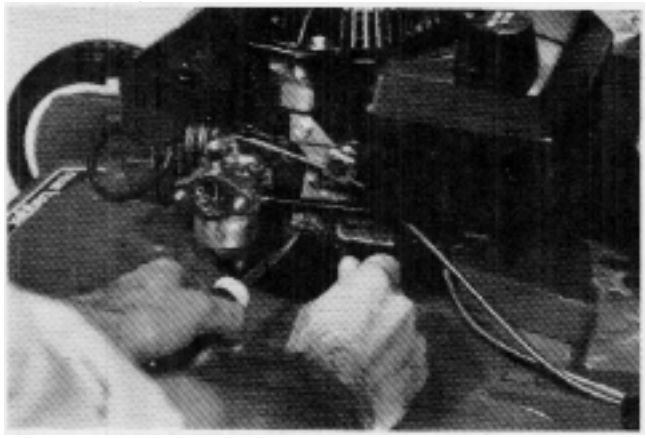


Figure 2-11

Adjust the governor by holding the governor lever to the right while turning the governor shaft to the right. Hold the adjustment and tighten the clamp bolt (Figure 2-12).

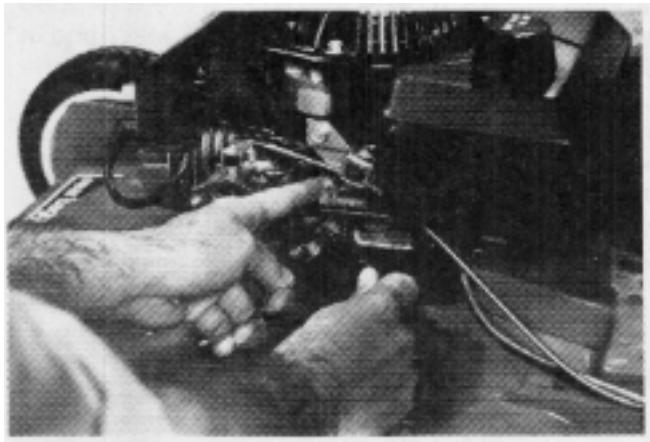


Figure 2-12

Connect the return spring to the center hole in the governor spring bracket. The center hole should goveron the engine speed at the recommended 3000 RPM. The top hole will raise the engine speed 150 RPM and the bottom hole will lower the engine speed 150 RPM. Engine speed can be verified using a tachometer such as listed in the Special Tools Section. (See page I-6).

GOVERNOR OPERATION

(Refer to Figure 2-13.) As load on the engine increases the engine speed will start to decrease. As the engine slows down the centrifugal force of the flyweights (1) will decrease. The governor return spring (4) will cause the governor collar (2) to move in direction (A). The governor arm (3) will also move in direction (A) causing the throttle to open until the centrifugal force of the flyweights are in balance with the governor return spring. As the load on the engine decreases the engine will speed up causing the flyweights to move out forcing the governor collar in direction (B). The collar will act against the governor arm moving it in direction (B) and also moving the throttle in direction (B). The engine speed will drop until once again the flyweight and return spring are in balance (Figure 2-13).

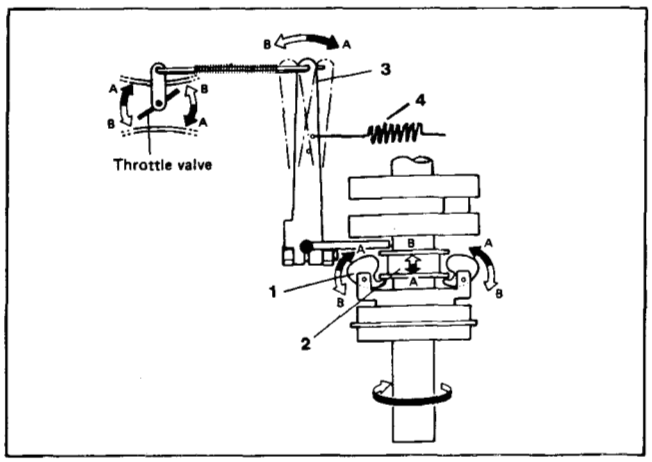


Figure 2-13

Models 47PD3, 47PE4 and 47PF5 are equipped with variable throttles. The linkage is described in (Figure 2-14). A mounting boss was added to the casting of the engine to accommodate the throttle linkage assembly. The boss does not exist on model 47PZ2 engines therefore the variable throttle linkage will not retrofit. Model 47PF5 engines will include a weld stud on the governor linkage for ease of reassembly (See Figure 2-15).

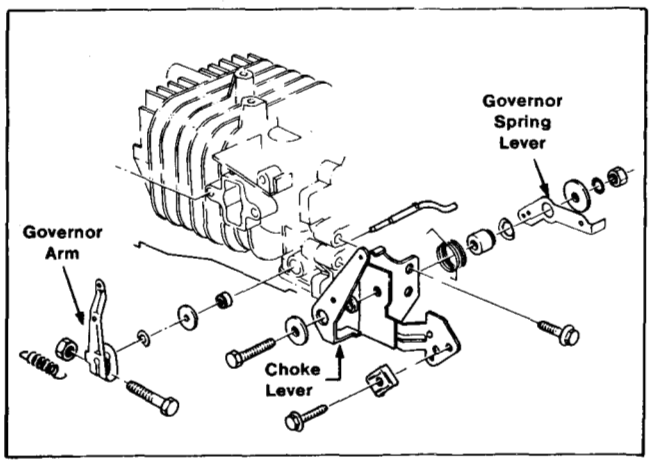


Figure 2-14

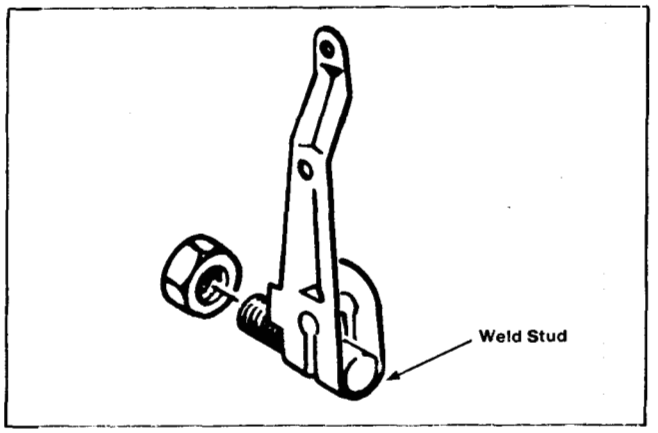


Figure 2-15

FUEL TANK

CAUTION: The gasoline in the fuel tank is explosive. Always drain or fill tank outdoors, away from fire and flame. Do not smoke when fuel vapors are present.

For the engine and carburetor to function properly the fuel supply must be clean. Stale, dirty and improperly mixed fuel will cause starting and running difficulties. To assure a clean fuel supply the fuel tank may be removed and flushed with fresh fuel. (See Disassembly Instruction.) A non-replaceable sintered bronze fuel filter is inset into the fuel tank outlet. In some cases, the filter can be cleaned by back flushing with solvent or by blowing low pressure compressed air through the fitting on the bottom of the fuel tank. Commercial engines have a replaceable inline fuel filter located between the fuel tank and carburetor. The replacement fuel filter is Toro Part Number 56-6360 (Figure 2-16). Periodically inspect the vent in the fuel tank cap. Remove any foreign materials which may plug the vent. The gasket inside the cap may be removed to permit further cleaning of the vent area.

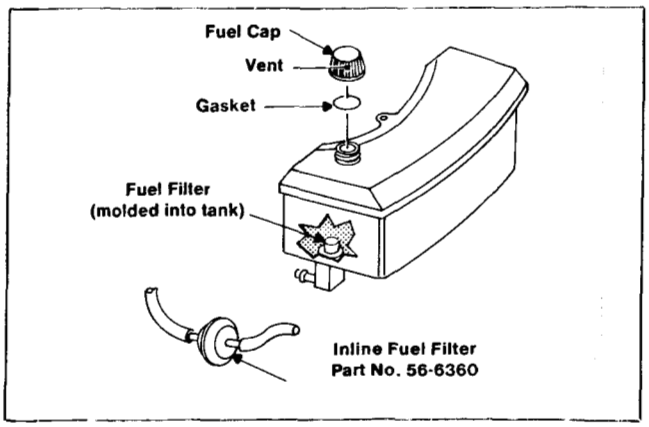


Figure 2-16

CARBURETOR

The non-adjustable carburetor has a number of small orifices which control the flow of fuel and air to obtain the proper combustable mixtures. If stale or dirty fuel enters the carburetor, deposits can form causing adverse changes to this combustable mixture. To clean the carburetor it must first be removed and disassembled. (See Disassembly Instructions.) Soak all metal parts in carburetor cleaner to remove deposits. THE BOWL SEAL, FLOAT AND NEEDLE VALVE SHOULD NOT BE CLEANED WITH CARBURETOR CLEANER OR DAMAGE MAY RESULT. Replace any damaged or questionable components before reassembly (Figure 2-17).

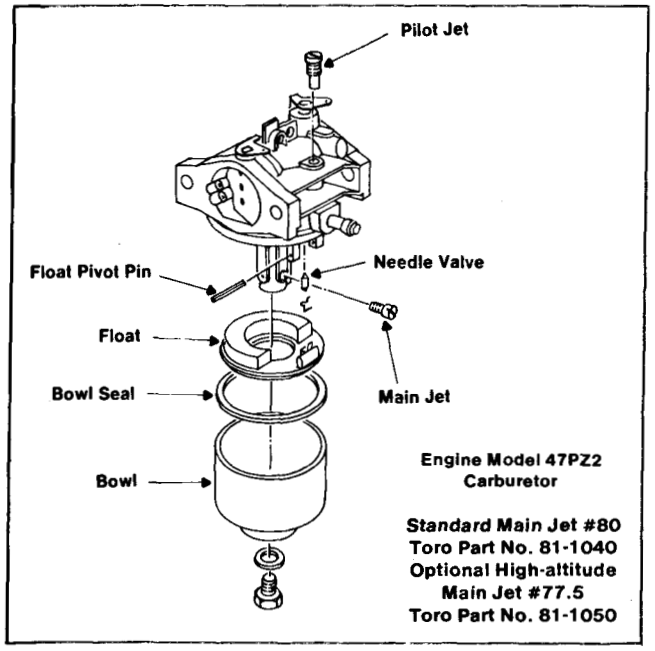


Figure 2-17

Carburetors used on models 47PD3, 47PE4 and 47PF5 (see Figure 2-18), use a metal choke shaft with a plastic bushing, an atmospheric vent tube and an alcohol resistant float. The floats used on 47PZ2 carburetors should be replaced with a 81-0970 float. This float is black and is equipped with a metal hinge. Correct float height is 17.5 mm (11/16 in). The standard main jet is a number 76.3 (part number 81-1940). There is a lean, number 72.5, main jet (part number 81-2340) available for high altitude conditions.

The standard main jet on 47PZ2 carburetors is a number 80 (part number 81-1040) with a high altitude (77.5 jet part number 81-1050) option.

Models 47PD3, 47PE4 and 47PF5 are also equipped with a heat deflector and insulator as shown in Figure 2-18). Model 47PZ2 was built without insulators or heat deflectors. This model may be fitted with a heat shield kit number 81-2210 to prevent hot restart problems.

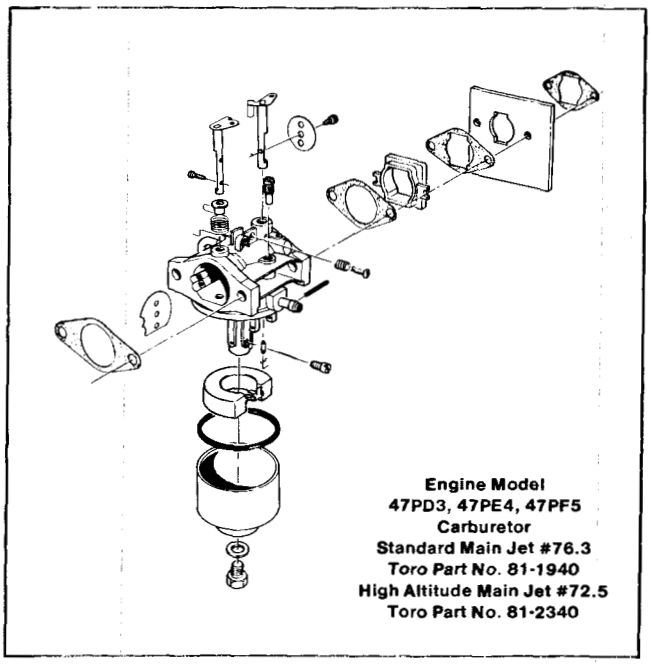


Figure 2-18

STORAGE

Drain the gasoline from the fuel tank. After the gasoline is drained, start the engine and let it run until all fuel is expended. Move the recoil starter a number of times to assure all fuel is expended. All gasoline must be removed to prevent gumlike varnish deposits from forming in the fuel system. Pull the high tension wire off the spark plug. Clean the area around the plug to prevent dirt from entering the cylinder when the plug is removed. Remove the plug from the cylinder head and pour two teaspoons of two-cycle oil into the spark plug hole. Pull the recoil starter handle slowly to distribute the oil inside of the cylinder. Install the spark plug and tighten to the recommended torque. DO NOT INSTALL THE HIGH TENSION WIRE ON THE SPARK PLUG. Pull the recoil starter slowly until a positive resistance is felt. This will ensure the combustion chamber is sealed by the piston to prevent any damage which might be caused by the environment. Clean the dirt and chaff from the outside of the cylinder, cylinder head fins and blower housing. The air cleaner assembly should be serviced as mentioned earlier in this section. For lawn mower storage instructions refer to the Operators Manual.

III. TROUBLESHOOTING AND TEST PROCEDURES

Generally all gasoline-powered products require some form of service or repair during their lifetime. The amount of time and expense involved in repairing a product can be greatly impacted by the amount of time required to initially determine the cause of the difficulty. Therefore, it is recommended to make these preliminary checks before proceeding to secondary troubleshooting procedures.

PRELIMINARY TROUBLESHOOTING

Ignition System

1. Check the ignition switch and wiring
2. Ensure the spark plug is the correct type
3. Check the spark plug for the correct gap, damaged and excessively carboned or burnt electrodes
4. Check the spark intensity.

Fuel System

1. Check the choke position and controls
2. Check the throttle (if so equipped) and governor mechanism
3. Ensure the fuel is fresh, clean and of the proper gas-oil mixture
4. Check the fuel filter.

Air Cleaner

1. Check for housing and element damage
2. Check for dirty element
3. Check for too much or too little oil in the element

Compression

1. Check the cylinder compression. (Refer to page III-2)

Crankcase

1. Ensure the crankcase is sealed. (Refer to page III-3)

Spark Intensity

The ignition system can be checked for spark intensity using the spark tester listed in the Special Tools Section of this manual (Figure 3-1).

Figure 3-1

1. Pull off the spark plug connector and remove the spark plug.
2. Inspect the spark plug for wear, carbon deposits and damage. (See Maintenance Section) Replace the plug if damaged, burnt, or fouled.
3. Check for the correct spark plug gap and adjust, if necessary, to .8 mm (.032 in) by bending the outer electrode. Do not pry against the inner electrode or the insulator may be damaged.
4. Attach the spark tester as shown and verify the tester gap is set at 4.2 mm (.166 in).
5. Pull the starter and observe for spark. THE SPARK MAY BE DIFFICULT TO SEE IN WELL LIGHTED AREAS.

CAUTION: Do not test for spark where gasoline has been spilled or inflammable vapors may exist. A fire could result.

6. If no spark is viewed, refer to the troubleshooting chart. (Page III-4)

ENGINE BRAKE AND IGNITION SWITCH

As a safety measure the engine is designed to stop within three seconds after the control bar is released. Release of the control bar grounds the magneto through the ignition switch to prevent ignition and allows the spring activated brake pad to engage the flywheel.

The engine brake and ignition switch are controlled by one common control cable activated by the control bar on the mower handle. To start the engine the control bar is raised and held against the handle. This pulls the brake pad away from the flywheel and simultaneously depresses the plunger on the ignition switch.

THE ENGINE BRAKE SYSTEM SHOULD BE MAINTAINED IN PROPER WORKING CONDITION OR INJURY MAY RESULT. To troubleshoot the engine brake and ignition switch:

1. Remove the fuel tank for ease of inspection. (See Disassembly Instructions page IV-1).
2. Ensure that the brake spring forces the brake pad against the flywheel when the control bar is in the 'STOP" position and that the pad clears the flywheel when the control bar is in the 'START" position.

3. Disconnect the wire leading to the ignition switch and connect a continuity tester to the switch wire and engine frame (Figure 3-2) with the control bar in the "STOP" position there should be continuity through the switch. With the control bar in the "START" position, there should be NO continuity through the switch.
4. Adjust the cable or replace the switch whichever is necessary to assure that the switch and brake assembly are functioning properly.

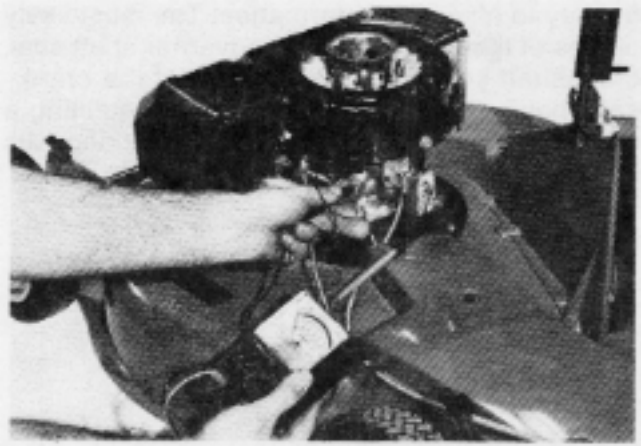


Figure 3-2

BBC APPLICATIONS

Engines equipped with a Blade Brake Clutch (BBC) mechanism, Models 47PD3, 47PE4 and 47PF5 with serial numbers that start with 2....., are fitted with an ignition kill switch that is mounted on the throttle linkage. (See Figure 3-3.) The ignition wire is connected to the kill switch terminal.

When the lift bail is released the BBC mechanism will stop the blade and leave the engine running. To stop the engine the throttle control is brought to the stop position which will bring the governor spring lever in contact with the kill switch grounding the ignition and stopping the engine.

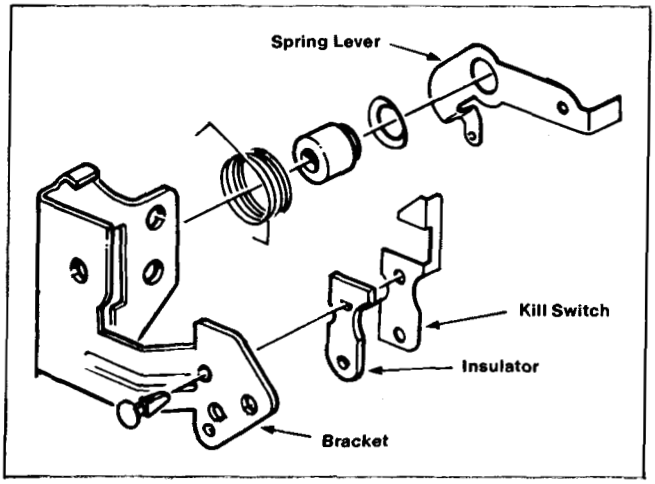


Figure 3-3

FUEL TANK

If the engine stalls or will not start there may be a fuel restriction or blockage. The fuel cap contains a vent which, if plugged, will prevent fuel from entering the carburetor.

1. Remove the fuel cap and inspect the vent. Clean if necessary.
2. Visually inspect the bottom of the fuel tank for dirt or other contaminants.
3. If dirt, water or other contaminants are present the tank should be flushed with a small amount of fresh fuel. This is most easily accomplished when the fuel tank is removed. (See Disassembly Instructions page IV-1).

CAUTION: The gasoline in the fuel tank is explosive. Always drain or fill tank outdoors, away from fire and flame. Do not smoke when fuel vapors are present.

4. To ensure the fuel filter is not plugged, remove the fuel lines and check the fuel filter for ease of fuel flow. In some instances, the filter may be cleaned by back-flushing with solvent or low pressure compressed air.

NOTE: The bronze sintered filter in the fuel tank is not replaceable, however the remote mounted in-line fuel filter found on commercial engines may be replaced using Toro Part Number 56-6360. See Figure 2-16.

TESTING COMPRESSION

A compression test of the engine can provide vital information on the general condition of the working parts within the engine. This test will indicate a worn cylinder, piston, or rings, and generally determine whether the engine is repairable or if it should be replaced.

1. Remove the spark plug and install a compression gauge into the spark plug hole (Figure 3-4).

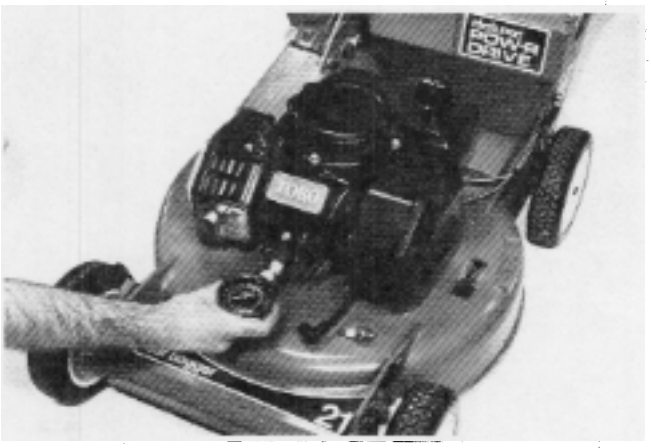


Figure 3-4

2. Pull the starter rope rapidly several times until the compression reading on the gauge stabilizes.
3. If the compression reading is below 6.5 kps-cm^2 (92 psi), cylinder, piston or ring damage should be suspected. A new engine should have 8.4 kps-cm^2 (120 psi) 10.5 kps-cm^2 (150 psi).

An engine with low compression must be disassembled and inspected for damage of the internal components. (See Disassembly Instructions.) Check all components to the specifications listed in the Service Data Section of this manual. Replace all parts which fall outside of these specificatons. The engine contains a cast iron cylinder liner, which is not replaceable. Special factory processes are required to install this liner.

CRANKCASE

The engine relies on a tightly sealed crankcase in order to function properly. The downward movement of the piston causes the crankcase to be pressurized. This pressure is required to expell the exhaust gases from the combustion chamber and to supply a fresh fuel mixture for the compression stroke. The upward movement of the piston on the compression stroke creates a vacuum to draw fresh fuel into the crankcase. In both instances a tightly sealed crankcase is the key to efficient performance. The most likely places of leakage are at the governor shaft seal, crankshaft seals and at the seam of the crankcase halves. The simplest means of detecting a crankcase leak is to check for wet, oily deposits around the seal areas.

ENGINE TROUBLESHOOTING CHART

The following troubleshooting chart lists the symptoms, causes and remedies of common engine malfunctions. Once the symptom has been determined, systematically eliminate the possible causes until the actual cause is found.

The possible causes have been arranged with the most easily inspected items to be checked listed first. Utilizing the chart in this manner will lessen the amount of time required to repair the engine and limit the possibility of incorrectly diagnosing the cause of the difficulty.

POSSIBLE CAUSES		SYMPTOMS: Fouls plugs	Will not turn	Will not start	Will not restart	Excessive smoke	Lacks power	Lacks speed	Runs erratic	Overheats	Surging	REMEDY
Spark Plug	Wrong type	x	x	x			x			x		Install correct spark plug, page I-5
	Improper air gap			x		x	x			x		Reset air gap .8mm (.032")
	Defective			x	x		x		x			Replace spark plug
	Fouled			x	x	x	x	x				Replace spark plug
Fuel	Oil-gas mix	x		x		x	x	x		x		Empty carb & tank — refill w/fresh mix
	Dirty, stale			x	x		x	x				Empty carb & tank — refill w/fresh mix
Fuel System	Vent plugged			x	x		x	x	x		x	Clean or replace cap
	Filter plugged			x	x		x	x	x		x	Back-flush filter or replace tank
	Line restriction			x	x		x	x	x			Check lines for restriction
Air Cleaner	Dirty filter	x		x	x	x	x	x			x	Clean or replace filter
	Excess oil	x		x	x	x	x	x				Squeeze excess oil from filter
Crankcase	Poor seal			x	x		x	x				Reseal crankcase and replace seals
Governor	Misadjusted						x	x			x	Readjust — See page II-4
	Broken spring			x	x							Replace spring
	Worn linkage						x	x	x		x	Replace worn parts
Ignition Switch	Misadjusted			x	x							Readjust — refer to page III-2
	Faulty wiring			x	x							Repair or replace
	Defective			x	x							Replace ignition switch
Exhaust System	Muffler plugged			x	x		x	x				Clean or replace — See page II-1
	Ports plugged			x	x		x	x				Clean all exhaust ports
Carburetor	Choke plate adj.	x		x	x	x	x	x	x			Check linkage and cable adjustment
	Throttle adj.	x					x	x				Check linkage and governor adj.
	Clogged jets			x	x	x	x	x	x	x	x	Clean carburetor jets incl. pilot jet
	Worn needle			x	x	x						Replace needle
	Bowl float			x	x	x						Replace cracked bowl float
Starter	Jammed, broken		x	x	x							Repair or replace starter
Ignition Coil	Misadjusted		x	x	x							Readjust — See page III-2
	Faulty wiring			x	x				x			Repair or replace
	Defective			x	x				x			Replace ignition coil
Flywheel	Broken		x									Replace flywheel
	Magnets weak			x	x							Replace flywheel
	Sheared key			x	x							Inspect keyway and replace key
Points	Misadjusted	x		x	x				x	x		Readjust — See page III-2
	Burnt, corroded			x	x							Clean or replace points
Condenser	Faulty wiring			x	x				x			Repair or replace
	Defective			x	x							Replace condenser
Engine	Clogged fins									x		Remove debris from engine housing
	Worn parts		x	x	x	x	x	x	x	x		Diagnose and replace worn parts
	Broken parts		x	x	x							Diagnose and replace broken parts
	Carbon build-up	x	x	x								Decarbon

IV. ENGINE REMOVAL, DISASSEMBLY, ASSEMBLY AND REPAIR INSTRUCTIONS

ENGINE REMOVAL

To remove the engine from the mower the air cleaner housing, recoil assembly and fuel tank must first be removed to disconnect the control cables. Remove the retaining capscrew, lockwasher, blade, blade adapter and self-propel components below the mower deck from the engine crankshaft. Remove the four capscrews that retain the engine to the mower chassis and remove the engine from the mower. The engine can then be placed in a support fixture for repair.

Most common repairs, however, can be accomplished with the engine in place on the mower chassis. Use the following procedures to disassemble the engine on the mower chassis:

ENGINE DISASSEMBLY AND REPAIR

1. Remove the high tension wire from the spark plug and drain the fuel from the fuel tank.

CAUTION: The gasoline in the fuel tank is explosive. Always drain or fill tank outdoors, away from fire and flame. Do not smoke when fuel vapors are present.

2. Remove the four retaining capscrews from the recoil starter and lift the starter from the engine. Disconnect the recoil rope from the rope handle stop for ease of handling.

RECOIL STARTER REPAIR

A. Remove the center capscrew from the recoil assembly and lift off the pawl retainer. Remove the center spring, pawl and pawl spring. Lift the rope pulley assembly from the recoil housing and remove the recoil spring and retainer (Figure 4-1).

B. Replace all worn or damaged parts before reassembling. Reassemble the recoil starter in reverse order. Use Threebond #1342 or Loctite #242 on the threads of the center capscrew during reassembly and torque to 80-90Kg-Cm (70-110 in-lb). On installation there should be sufficient spring pretension to hold the recoil rope taut in the rope pulley.

NOTE: Place a small amount of #2 grease on the recoil spring to prevent rust and corrosion.

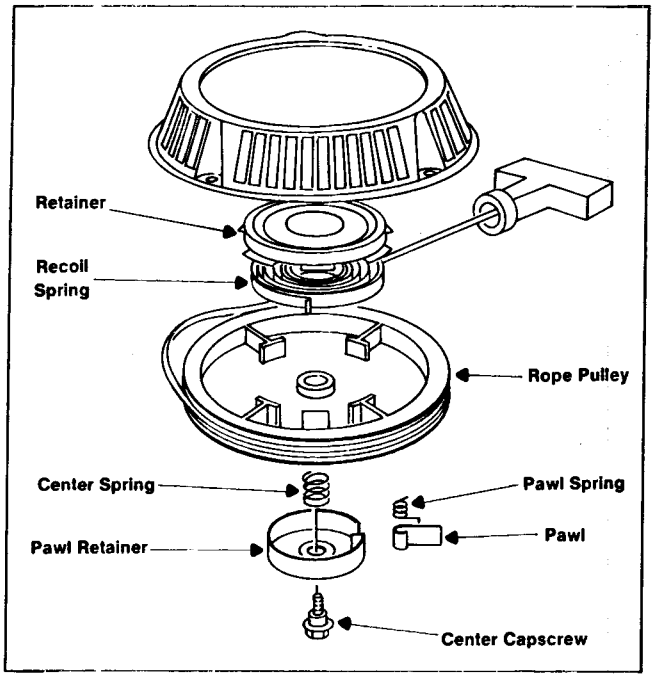


Figure 4-1

3. Disconnect the fuel line from the carburetor. Remove the fuel tank by lifting it from the mounting tabs of the blower housing.
4. Remove the capscrew, two nuts and lock washers which retain the muffler and remove the muffler from the engine. The heat shield may also be removed from the muffler. Discard the muffler gasket and remove any gasket material remaining on the engine or muffler.
5. Lift the retaining tabs of the air cleaner cover and remove the cover and filter element. Remove the capscrew, and two locknuts retaining the air cleaner housing and lift the housing from the engine.
6. Remove the remaining three capscrews from the blower housing and lift the blower housing from the engine.
7. Cage the spring activated engine brake by compressing and retaining the control bar against the operating handle. Remove the capscrew holding the ignition switch and brake assembly in place. Disconnect the ignition switch from the electrical lead and remove the switch from the brake assembly. Slowly lower the control bar to disengage the brake. The brake assembly may now be disconnected from the control cable for repair.
8. Use a starter cup wrench as shown in the Special Tools List to hold the starter cup while loosening the flywheel nut. Hold the

flywheel by hand and remove the three remaining capscrews retaining the starter cup to the flywheel. (It may be necessary to insert a screwdriver through the starter cup to hold the flywheel should the capscrews be extremely tight.)

IMPORTANT: DO NOT DEFORM THE STARTER CUP OR STARTER ENGAGEMENT DIFFICULTY MAY RESULT.

9. Use the flywheel puller listed in the Special Tools Section to pull the flywheel from the crankshaft.

   IMPORTANT: DO NOT PRY ON THE FLYWHEEL CASTING OR STRIKE THE CRANKSHAFT OR DAMAGE WILL RESULT.

10. Remove the capscrews retaining the contact point cover and lift the cover from the engine. Remove the small nut retaining the electrical wires to the contact point assembly. Remove the two ignition coil hold down screws and lift the ignition coil and wire harness from the engine.
11. Remove the two screws holding the points and condenser in place and lift the points and condenser from the engine. Remove the flywheel key from the crankshaft and slide the timing cam from the engine. There is a small locating pin for the cam. Take care so that this pin is not lost.
12. Loosen the clamping bolt on the governor lever and pry the clamping section of the lever apart with a screwdriver. Remove the lever, control rod and springs from the engine.
13. Disconnect the choke cable from the carburetor and slide the carburetor, spacer and gaskets from the mounting studs.

    IMPORTANT: DO NOT REMOVE THE CHOKE SHAFT SCREW OR THE THREADS MAY BECOME STRIPPED.

CARBURETOR REPAIR

A. Drain the fuel from the carburetor bowl by removing the bowl nut, washer and bowl. The bowl seal may be replaced using a seal pick if fuel leakage is noted on the carburetor bowl.
B. One end of the float pivot pin is purposely deformed to lock the pin into the casting legs. Visually determine which end is deformed and drive the pin from the opposite end. Remove the pivot pin, float, needle valve and spring retainer from the assembly.
C. The main jet and the pilot circuit jet can be removed for inspection using a flat blade screwdriver.

   IMPORTANT: NO OTHER PARTS ARE SERVICEABLE. DISASSEMBLY OF THE THROTTLE AND CHOKE PLATES IS NOT RECOMMENDED. THE SCREWS ARE FACTORY TORQUED AND LOCKED IN PLACE. IF NOT PROPERLY REASSEMBLED THE SCREWS MAY LOOSEN AND CAUSE ENGINE DAMAGE.

D. Reassemble the carburetor in reverse order. The caburbetor and work area should be clean to prevent contamination entering the small orfices in the carburetor body.

14. Remove the retaining capscrew, lockwasher, anti-scalp cup if applicable, blade, blade adapter, and self-propel components from the crankshaft. Remove the four capscrews retaining the engine to the mower chassis and lift the engine from the mower.
15. To gain access to the components inside the crankcase remove the four capscrews retaining the engine to the mower adapter plate and remove the adapter plate from the engine. Remove the six retaining capscrews holding the two halves of the crankcase together and separate the crankcase.
16. Remove the crankshaft and piston as an assembly. Remove the seals, bearing locating rings, and bearings from each end of the crankshaft. Slide the governor assembly from the crankshaft taking care not to lose the small locating pin for the governor flyweight collar.
17. To remove the piston from the connecting rod use a needle nose pliers and remove one of the wrist pin retainers. Slide the wrist pin out of the piston far enough to allow the piston to be removed from the connecting rod. The needle bearing may be removed from the connecting rod, however, there are no further serviceable parts on the crankshaft assembly.

    IMPORTANT: THE THREE PIECE CRANKSHAFT IS ASSEMBLED AT THE FACTORY TO PRECISION TOLERANCES. ATTEMPTING TO DISASSEMBLE THE CRANKSHAFT FURTHER WILL RESULT IN CRANKSHAFT DAMAGE.

18. The wrist pin and piston rings may be removed from the piston for replacement. The top ring is made of cast iron with a chrome plating on the outside diameter.

    IMPORTANT: USE CAUTION WHEN REMOVING THE RINGS. OVERSTRETCHING THE RINGS WILL RESULT IN DIFFICULTY DURING ENGINE REASSEMBLY.

19. Remove the governor shaft E-ring and flat washer and slide the governor shaft out of

the crankcase. Use a seal pick to remove the governor shaft seal.

NOTE: The cylinder contains a cast iron sleeve, however, this sleeve is not replaceable. The purpose of the sleeve retainer ring is to assist the manufacturing process and hold the cast iron sleeve in place to limit engine damage should the sleeve loosen during operation.

Engine Assembly And Repair

NOTE: Before attempting to reassemble the engine refer to the Service Data Specifications (page IV-4) and replace all parts which are outside the recommended values.

1. Ensure there are no burrs on the governor shaft which could cause seal damage and position the governor shaft through the hole in the crankcase casting. Use a liberal amount of #2 grease and install the governor shaft seal with the lip towards the inside of the crankcase. Position the flat washer on the governor shaft against the shaft seal and install the E-ring.
2. Install the two piston rings onto the piston. The chrome surfaced ring should be positioned at the top of the piston. There is a small letter 'R" stamped on the top side of each piston ring. This letter should face the top of the piston. If the piston ring is put in upside down it will not seat properly in the ring groove. Lubricate the wrist pin needle bearing with two-cycle oil and insert into the connecting rod. Position the piston over the connecting rod and insert the wrist pin through the piston, needle bearing and piston rod. Insert the spring retainers to lock the wrist pin in place.

   IMPORTANT: THE ARROW CAST INTO THE TOP OF THE PISTON MUST FACE THE EXHAUST PORT WHEN ASSEMBLED.
3. Lubricate the moving parts and friction surfaces of the crankshaft and piston with two-cycle oil. Rotate the piston rings until the ring gap aligns with the locating studs before attempting to push the piston into the cylinder. Insert the crankshaft and piston assembly into the cylinder.

   IMPORTANT: ASSURE THE ARROW ON TOP OF THE PISTON FACES EXHAUST PORT WHEN ASSEMBLED.
4. Lubricate the large end of the crankshaft with two-cycle oil and install the sliding governor collar. Insert the small locating pin into the crankshaft and slide the flywheel collar into position. Position the fly weights on the lip of the governor collar and locate the control shaft between the collar and the crankshaft assembly (See Figure 2-13 and 4-2). Lubricate the crankshaft bearings with two-cycle oil and install onto either end of the crankshaft. Insert the bearing locating rings into the slots of the crankcase housing to locate the bearings and crankshaft in position. Remove burrs from either end of the crankshaft and slide seals into position. To prevent seal damage on installation use a small amount of #2 grease on the inside diameter of the seal. Both seals should be installed with the lip facing into the crankcase assembly.

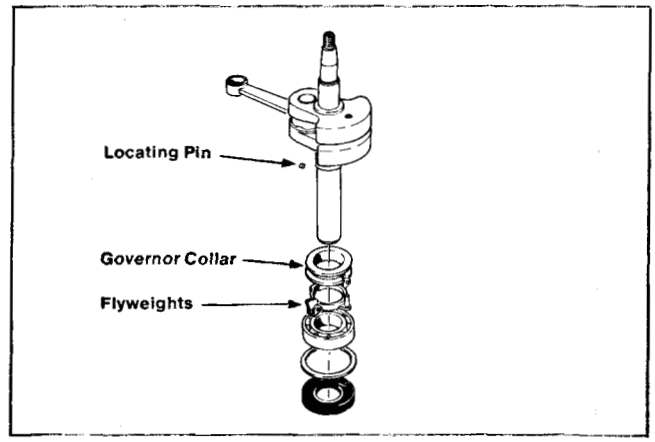


Figure 4-2

5. Assure both halves of the crankcase are clean and free of grease and old sealant. Apply a thin uniform amount of Threebond #1104 or Loctite #515 sealant to the mating surfaces and position of the crankcase halves together.
6. There are three different size capscrews on the model 47PZ2 to hold the crankcase halves together. (The capscrews on the 47PD3, 47PE4 and 47PF5 are all the same length). Starting on the governor control shaft side install the two medium sized capscrews at either end. Install one short capscrew and governor spring bracket in the center hole. Install the other two remaining short capscrews into the other side in the center hole and the hole nearest the large end of the crankshaft. Install the long capscrew in the remaining hole. Torque all capscrews evenly 80-95 Kg-Cm (70-110 in-lb). See Figure 4-3. Position the engine mower

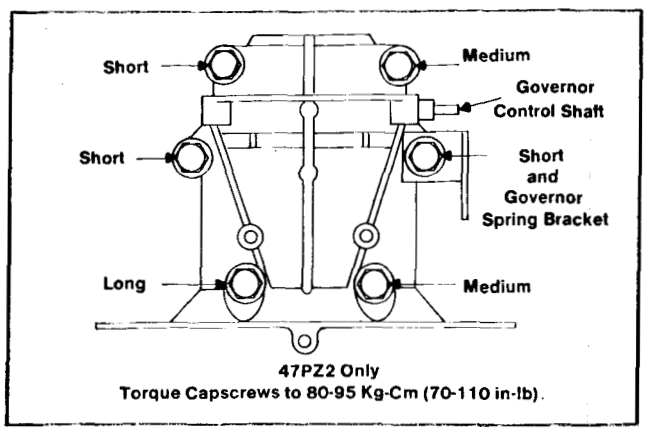


Figure 4-3

adapter plate with the dimple facing the spark plug end. Install the four retaining capscrews and torque to the proper specification.

7. Install the ignition cam and locating pin to the flywheel end of the crankshaft. Install the condenser and points in position. Rotate the crankshaft until the cam follower is on the high point of the cam. Adjust the point gap using a feeler gauge of the appropriate size to set the air gap at .35 mm (.014 in). (47PZ2 engine only.)

8. Install the ignition coil loosely on the mounting posts. Connect the double lead to the contact point assembly (47PZ2 engine only), making sure the wires are routed between the ignition coil mounting posts. The single lead should be routed along side of the crankcase housing through the hole in the casting. The ignition coil air gap setting will be adjusted later.

9. Place the gasket, spacer and the second gasket over the mounting studs of the carburetor. See Figure 2-18 for correct gasket and spacer placement. Slide the carburetor onto the mounting studs. Assemble the governor control lever, linkage and springs to the governor shaft and the carburetor throttle plate. Move the governor shaft to the right and rotate the governor shaft to the right. Tighten the clamp bolt to hold the adjustment.

10. Install the contact point cover (47PZ2 engine only), flywheel key and flywheel to the crankshaft. Install the starter cup with the capscrews and torque to 80-90 Kg-Cm (70-110 in-lb). Use the starter cup wrench to hold the flywheel from turning and tighten the retaining nut on the end of crankshaft to 4-5 Kg-m (29-36 ft-lb). Use the air gap gauge listed in the Special Tools Section and adjust the air gap between the flywheel and ignition coil laminations to .5 mm (.020 in) maximum.

11. Attach the engine to the mower chassis and install the blade components to the engine crankshaft. The blade retaining capscrew should be tightened to 6.2-8.3 Kg-m (45-60 ft-lb).

12. Cage the engine brake spring by lifting the control bar into the handle and retaining it in place. Install the ignition switch, brake assembly and brake pad on the engine. Release the control bar and connect the ignition switch wire. (47PZ2 and zone start models only.)

    IMPORTANT: CHECK FOR PROPER OPERATION OF THE IGNITION SWITCH AND BRAKE ASSEMBLY (See Troubleshooting Section page III-1).

13. Place the blower housing on the engine and attach with one capscrew in the front and another in the rear.

    NOTE: USE CAUTION IN ROUTING THE HIGH TENSION WIRE SO THAT IT DOES NOT BECOME PINCHED BETWEEN THE BLOWER HOUSING AND THE ENGINE.

14. Place the muffler and muffler gasket over the engine studs. Install the through-bolt, nuts and lock washers on the muffler and tighten to the recommended torque.

15. Connect the choke cable to the carburetor and clamp the cable in place on the blower housing. Install the air cleaner housing to the carburetor mounting studs using the appropriate nuts. Install the through-bolt and tighten the bolt and nuts to the recommended torque. Position the filter element in place and install the air cleaner cover. Ensure the cover snaps firmly in place.

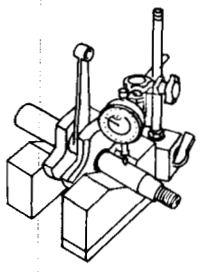
16. Slide the fuel tank into position and connect the fuel line to the carburetor. Attach the recoil assembly using the four capscrews required and route the starter rope through the handle stop on the mower handle.

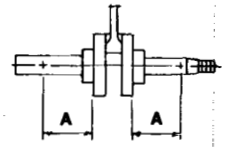
17. Install the spark plug and attach the high tension wire.

SERVICE DATA SPECIFICATIONS

Crankshaft Alignment

Place the magnetic "V" blocks under the crankshaft bearing support area. To level the crankshaft, shims must be added under the magnetic "V" block at the flywheel end. Rotate the crankshaft with the dial indicator positioned as shown and note the indicator fluctuations. Take readings on both ends of the crankshaft.



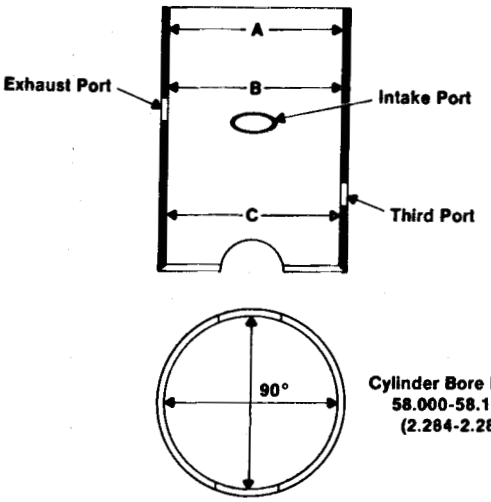


Measure at A 38.1mm (1.5 in) both ends

Total alignment difference between largest and smallest readings must be less than .05mm (.002 in).

Cylinder bore

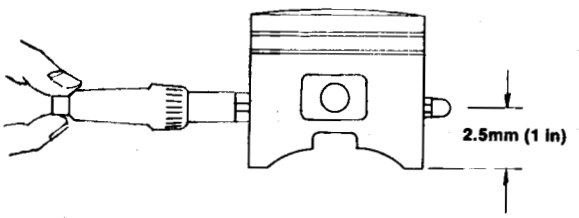
The cylinder bore is checked by measuring the cylinder liner at a total of six places using a cylinder gauge. Two measurements, 90° apart, must be taken at the approximate A, B and C elevations as shown. Readings larger than the listed specifications indicate an excessively worn bore and the cylinder block must be replaced. The cylinder liner is not a serviceable part of the engine.



Cylinder Bore Diameter
58.000-58.115mm
(2.284-2.288 in)

Piston to Cylinder Clearance

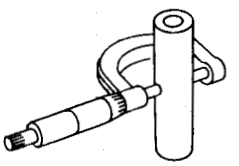
The piston is cam ground into a slightly oval shape to compensate for heat distortion during operation. The piston diameter is measured perpendicular to the wrist pin hole at a point above the piston skirt as indicated. Subtract the piston measurement from the largest cylinder reading to determine the clearance. Replace the cylinder block or the piston if the clearance is excessive.



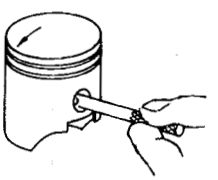
Largest Cylinder Diameter minus
Piston Diameter = .1mm (.004 in) or less

Wrist Pin - Wrist Pin Hole

The wrist pin and wrist pin hole must be properly fitted for efficient engine performance. Measure the wrist pin and check the diameter of the piston holes to be no more than the oversize dimension indicated.



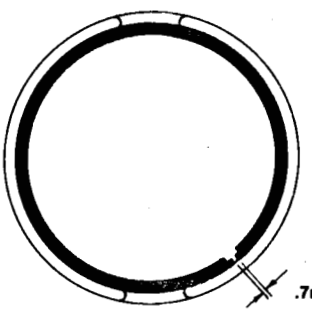
Wrist Pin Diameter
11.955-12.005mm (.472-.473 in)



Maximum Hole Diameter
.050mm (.002 in) Oversize

Piston Ring End Gap

Use the piston to position the piston ring at the most worn area of the cylinder liner. (The most wear will occur where the rings normally travel during operation or the area of largest diameter as measured earlier.) Use a feeler gauge to check the gap between the ends of the piston ring.

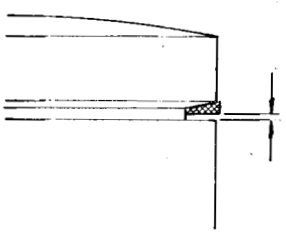


.7mm (.027 in)
max gap

Piston Ring Side Clearance

Decarbon the piston rings and grooves. Hold the piston rings into the grooves and use a feeler gauge between the bottom of each ring and groove to determine clearance.

IMPORTANT: The letter "R" must face the top of the piston.



.03-.15mm (.001-.006 in)

MAINTENANCE RECORD

DATE	OPERATING HOURS	AIR CLEANER	SPARK PLUG	EXHAUST SYSTEM	IGNITION	OTHER	PERFORMED BY

MAINTENANCE RECORD

DATE	OPERATING HOURS	AIR CLEANER	SPARK PLUG	EXHAUST SYSTEM	IGNITION	OTHER	PERFORMED BY