Manual Part No. 0E2081

SERVICE MANUAL

GTV – 990/760
V-TWIN
OHVI ENGINE

GENERAC®
POWER SYSTEMS, INC.

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FOREWORD

This manual has been written and published by GENERAC® POWER SYSTEMS, INC. to aid our dealers' mechanics, company service personnel and general consumers when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures for these products, or like or similar products, manufactured and marketed by GENERAC® POWER SYSTEMS, INC. It is also assumed that they have been trained in the recommended servicing procedures for these products, which includes the use of mechanics hand tools and any special tools that might be required.

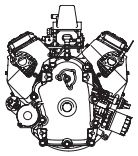
Proper service and repair is important to the safe, economical and reliable operation of the products described herein. The troubleshooting, testing, service and repair procedures recommended by GENERAC® POWER SYSTEMS, INC. and described in this manual are effective methods of performing such operations. Some of these operations or procedures may require the use of specialized equipment. Such equipment should be used when and as recommended.

We could not possibly know of and advise the service trade of all conceivable procedures or methods by which a service might be performed, nor of any possible hazards and/or results of each procedure or method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a procedure or method not recommended by the manufacturer must first satisfy himself that neither his safety, nor the product's safety, will be endangered by the service or operating procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. However, GENERAC® POWER SYSTEMS, INC. reserves the right to change, alter or otherwise improve the product at any time without prior notice.

Some components or assemblies of the product described in this manual may not be considered repairable. Disassembly, repair and reassembly of such components may not be included in this manual.

The engines described herein may be used to power a wide variety of products. Service and repair instructions relating to any such products are not covered in this manual. For information pertaining to use of these engines with other products, refer to any owner's or service manuals pertaining to said products.

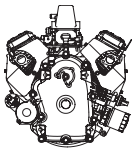


A WORD ABOUT SPECIAL TOOLS

Many of the procedures depicted in this manual require the use of special tools. Some of the tools required are available as Generac parts and are listed as such in this manual.

ATTENTION!

Generac Power Systems does not approve or authorize the use of these engines on All Terrain Vehicles (ATV's), go-carts, motorbikes, aircraft products, personal watercraft, or vehicles intended for use in competitive events. Use of these engines in such applications could result in property damage, serious injury (including paralysis), or even death.



If you do not understand any portion of this manual, contact Generac or your nearest Generac Authorized Service Dealer for starting, operating and servicing procedures.

Throughout this publication and on tags and decals affixed to the engine, **DANGER**, **WARNING** and **CAUTION** blocks are used to alert you to special instruction about a particular operation that may be hazardous if performed incorrectly or carelessly. Observe them carefully.

These safety warnings cannot eliminate the hazards that they indicate. Strict compliance with the special instructions while performing the service plus "common sense" are major measures to prevent accidents.

The following definitions apply to **DANGER**, **WARNING, CAUTION** and **NOTE** blocks found throughout the manual. *These safety symbols indicate the following:*

DANGER: After this heading you can read handling, installing, operating or servicing instructions that, if not strictly complied with, will result in personal injury.

WARNING: After this heading you can read handling, installing, operating or servicing instructions that, if not strictly complied with, may result in personal injury.

CAUTION: After this heading you can read instructions for handling, installing, operating or servicing the engine that, if not strictly complied with, may result in damage to equipment and/or property.

NOTE: After this heading you can read explanatory statements that require special emphasis.

These symbols indicate the following:

Points out important safety information that, if not followed, could endanger personal safety and/or property of yourself and others.

Potential explosion hazard.

Potential fire hazard.

Potential electrical shock hazard.

RULES FOR SAFE OPERATION

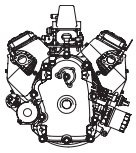
Study these RULES FOR SAFE OPERATION carefully before operating or servicing this equipment. Become familiar with the OWNER'S MANUAL and with the engine. The engine can operate safely, efficiently and reliably only if it is properly operated and maintained. Many accidents are caused by failing to follow simple and fundamental rules or precautions.

Generac cannot possibly anticipate every possible circumstance that might involve a hazard. The warnings in this manual and on tags and decals affixed to the equipment, are therefore, not all-inclusive. If you use a procedure, work method or operating technique Generac does not specifically recommend, you must satisfy yourself that it is safe for you and others. You must also make sure the procedure, work method or operating technique that you choose does not render the engine to be unsafe.

DANGER: Do not tamper with the engine governed speed. High operating speeds are dangerous and increase the risk of personal injury or damage to the equipment. Operating at low speeds with heavy load may shorten the engine's life.

BEFORE OPERATING

- Gasoline is highly **FLAMMABLE** and its vapors are **EXPLOSIVE**. Do not permit smoking, open flames, sparks or heat in the area while handling gasoline. Avoid spilling gasoline on a hot engine. Comply with all of the laws regulating storage and handling of gasoline.
- Store gasoline and other fuels only in containers designed and approved for the storage of such materials.
- Add gasoline in a clean, well-ventilated area. Wipe up any spilled gasoline immediately. If gasoline has been spilled, let it dry completely before starting the engine.
- Do not overfill the fuel tank. Always allow room for fuel expansion. If the tank is overfilled, the fuel can overflow onto a hot engine and cause a FIRE or an EXPLOSION.
- Allow at least two (2) feet of clearance on all sides of the engine, even while operating it outdoors, or you could damage the engine.
- Thoroughly inspect the engine for loose or damaged parts before each use. Do not use the engine until adjustments or repairs are made.
- Check the oil level in the engine before each use.



- Inspect the engine periodically. Repair or replace all damaged or defective parts immediately.
- Inspect fuel system frequently for leaks or damage. Repair or replace any damaged or leaking component immediately. Never attempt to change, alter or modify the engine fuel system in any way that might affect safety or compliance with applicable codes and standards.

WHILE OPERATING

- This engine was designed and manufactured for specific applications. Do not attempt to modify the equipment or use it for any application for which it was not designed.
- Generac Power Systems does not approve or authorize the use of these engines on All Terrain Vehicles (ATV's), go-carts, motorbikes, aircraft products, personal watercraft, or vehicles intended for use in competitive events. Use of these engines in such applications could result in property damage, serious injury (including paralysis), or even death.
- Engine exhaust gases contain DEADLY carbon monoxide gas. This dangerous gas, if breathed in sufficient concentrations, can cause unconsciousness or even death. Operate this equipment only in the open air where adequate ventilation is available.
- Do not insert any object through the cooling slots of the engine. You could damage the equipment or injure yourself.
- Do not operate the engine faster than the speed necessary to operate the equipment. Do not run the engine at high speed when not operating the equipment.
- This engine requires an adequate flow of cooling air for its continued proper operation. Never operate the equipment inside any room or enclosure where the free flow of cooling air into and out of the equipment might be obstructed. Without sufficient cooling air flow, the engine quickly overheats, damaging the engine or nearby property.
- Do not smoke around the engine. Wipe up any fuel or oil spills immediately. Never leave oily or fuel soaked rags around the engine. Keep the area around the engine clean and free of debris.
- Keep hands, feet, clothing, etc., away from moving parts of this engine.
- Never operate the engine (a) in the rain; (b) in any enclosed compartment; (c) if the engine speed changes; (d) if the engine sparks; (e) if flame or smoke is observed while the engine is running.
- Never work on this engine or handle any electrical device while standing in water, while barefoot, or while hands or feet are wet. DANGEROUS ELECTRIC SHOCK will result.

⚠ WARNING: ⚠

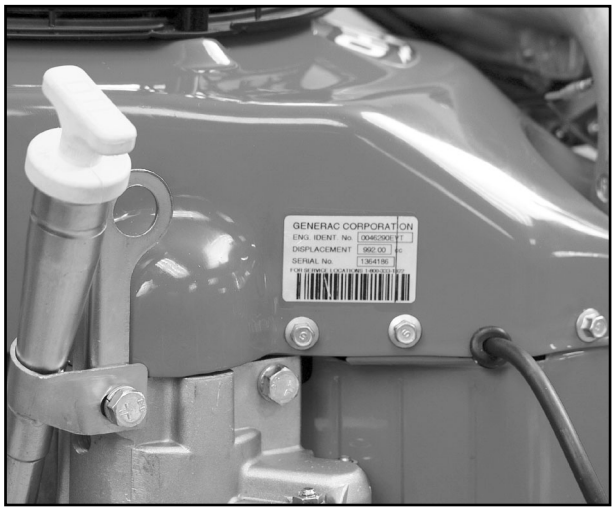
The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

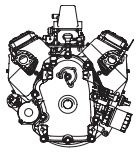
SERVICE INFORMATION

Service on this engine within and after the warranty period can be performed by any authorized service dealer. Service technicians are factory trained and capable of handling all service needs.

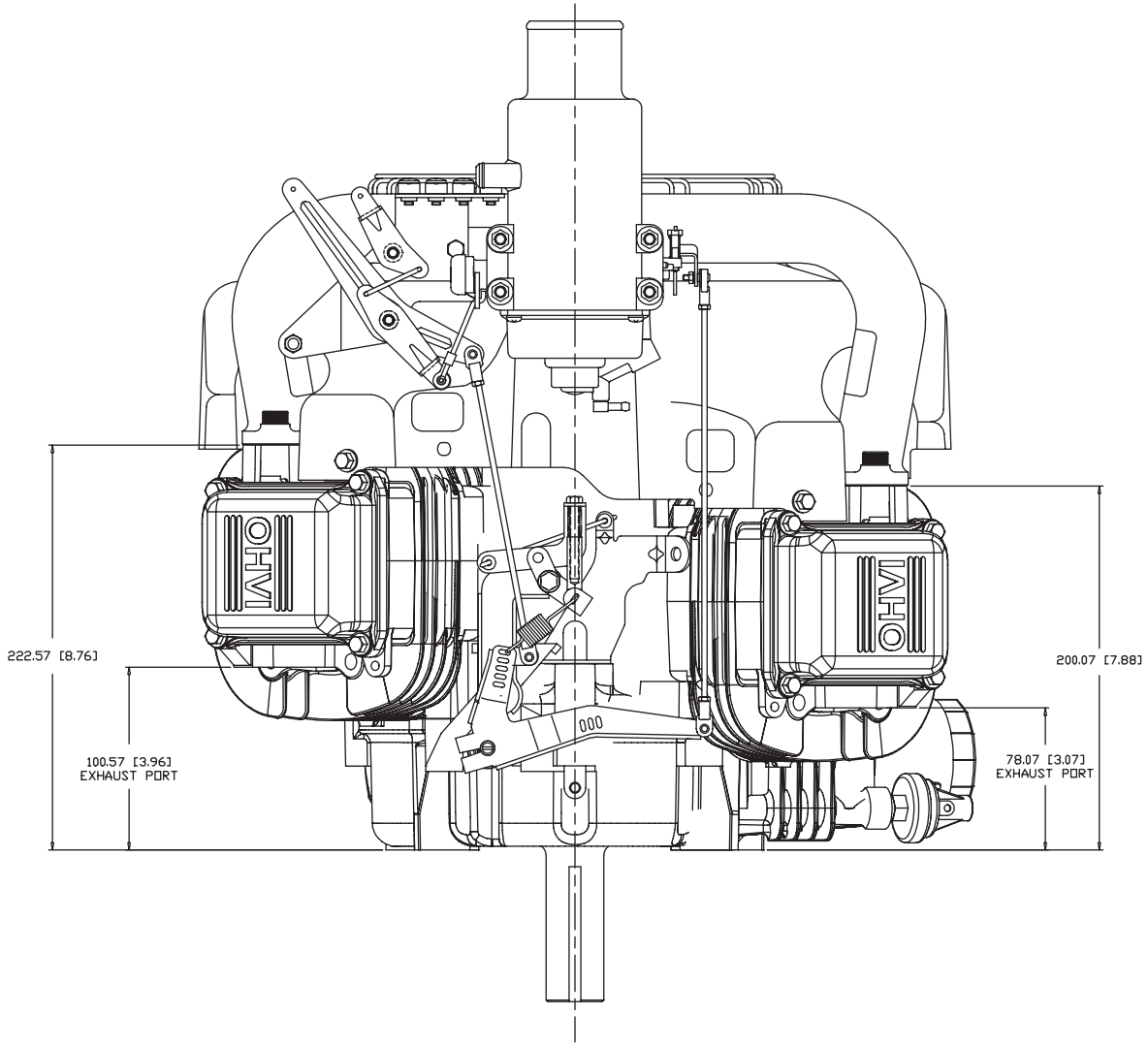
When contacting an authorized service dealer about parts and service**, always supply the complete model number and serial number** of your unit as given on its data plate decal. See the illustration below for the location of the decal.

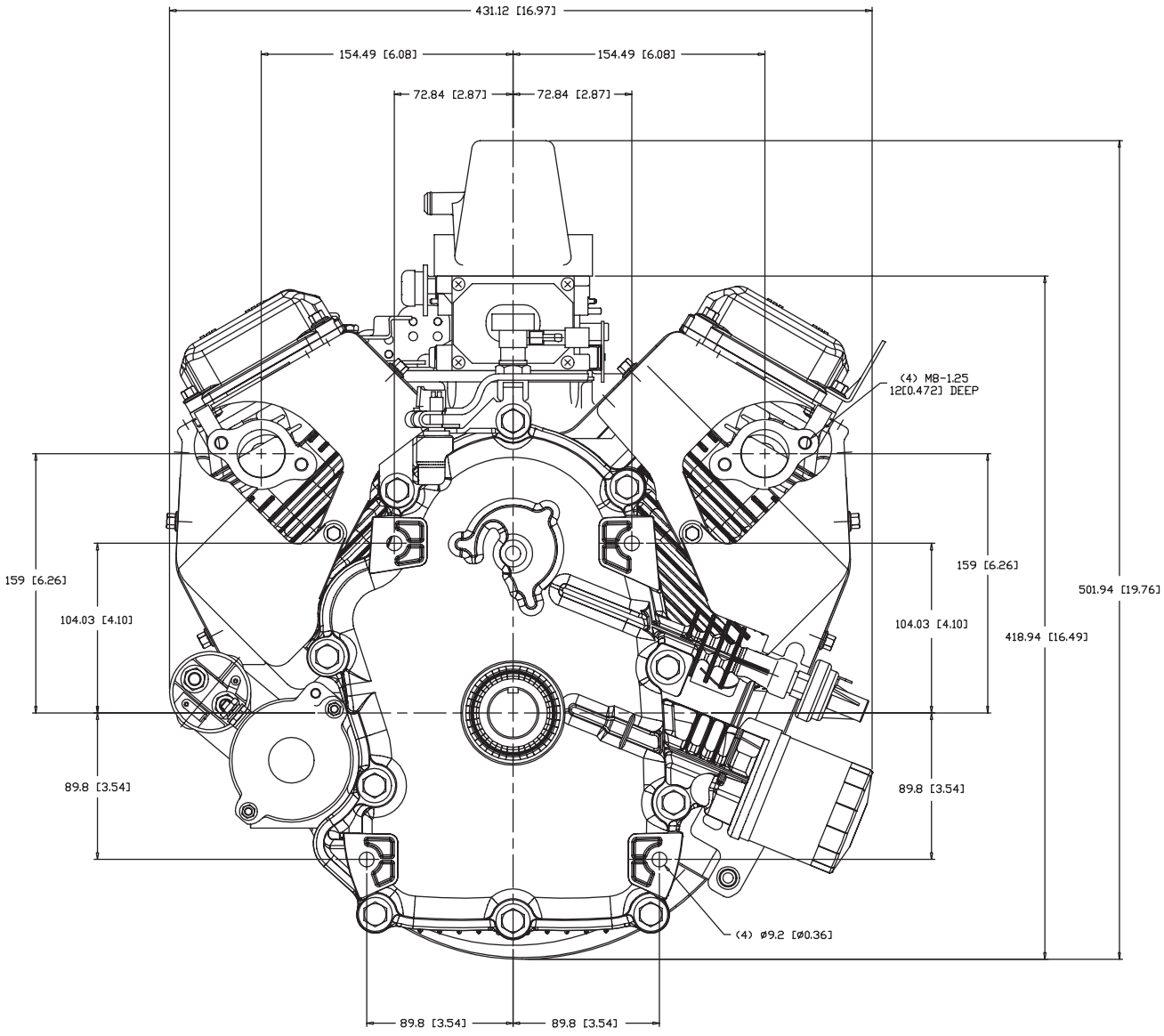
The warranty for this engine is included in the owner's manual.

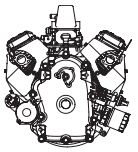


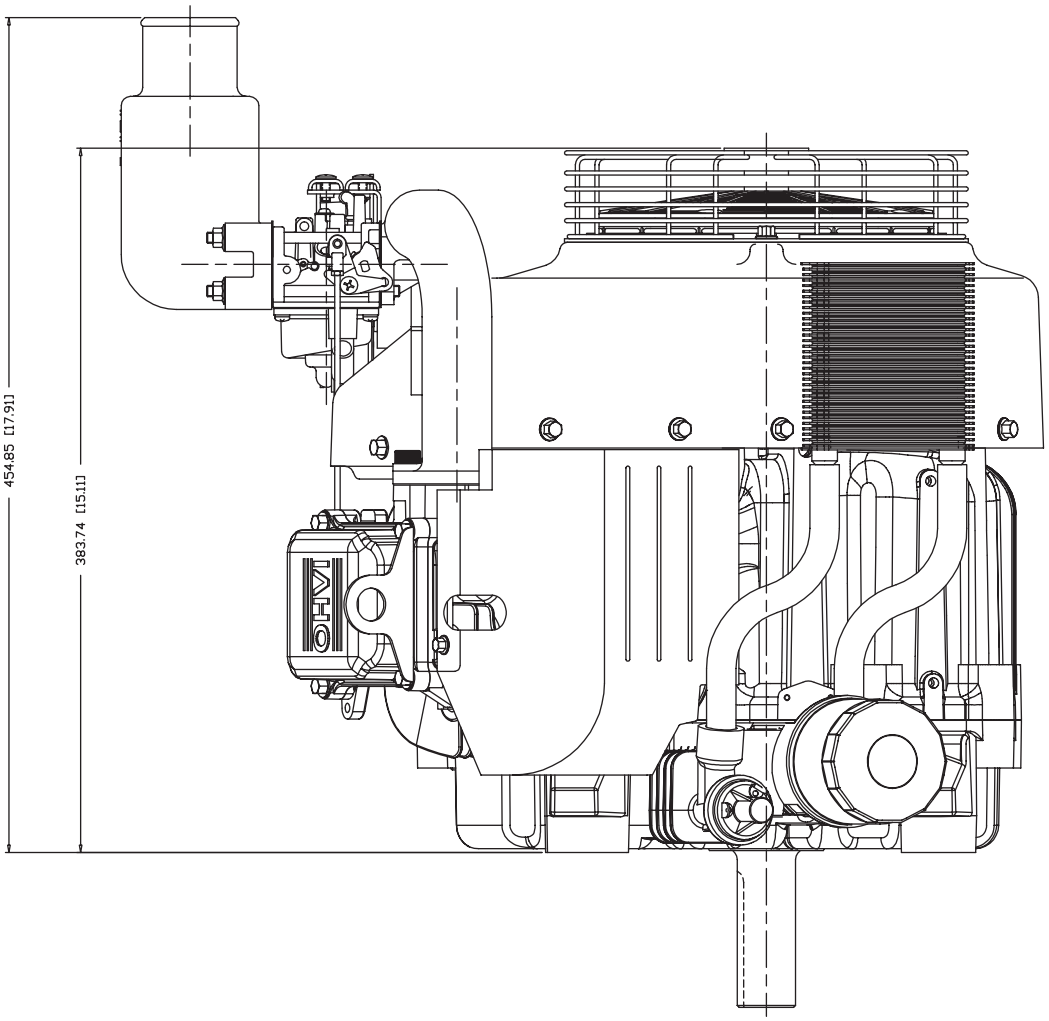


MODEL	GTV990 / 760
TYPE	AIR-COOLED 4-STROKE OHV
BORE X STROKE	90 X 78 / 90 X 60
DISPLACEMENT	992cc / 763cc
COMPRESSION RATIO	8.5 : 1 / 7.5 : 1
LUBRICATION SYSTEM	FULL PRESSURIZED W/LOW OIL PRESSURE SENSOR
IGNITION SYSTEM	ELECTRONIC BREAKERLESS
CYLINDER	CAST IRON SLEEVE
STARTING SYSTEM	ELECTRIC START
OIL CAPACITY	2030ml W/FILTER, 1750ml W/O FILTER
WEIGHT	45.4Kgf/100lbs




431.12 [16.97]
154.49 [6.08]
154.49 [6.08]
72.84 [2.87]
72.84 [2.87]
(4) M8-1.25
12[0.472] DEEP
159 [6.26]
104.03 [4.10]
89.8 [3.54]
159 [6.26]
104.03 [4.10]
89.8 [3.54]
501.94 [19.76]
418.94 [16.49]
(4) ø9.2 [ø0.36]
89.8 [3.54]
89.8 [3.54]

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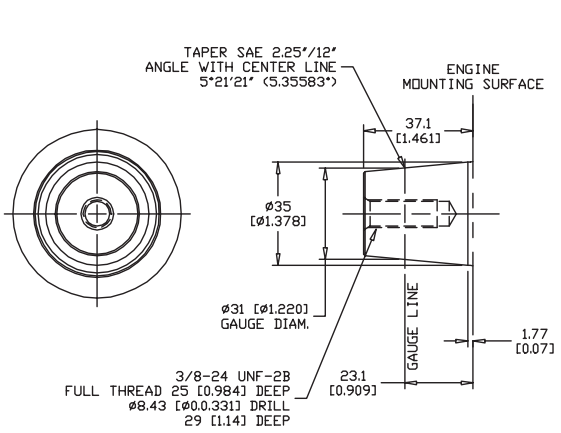
383.74 [15.11]


TAPER SAE 2.25"/12"
ANGLE WITH CENTER LINE
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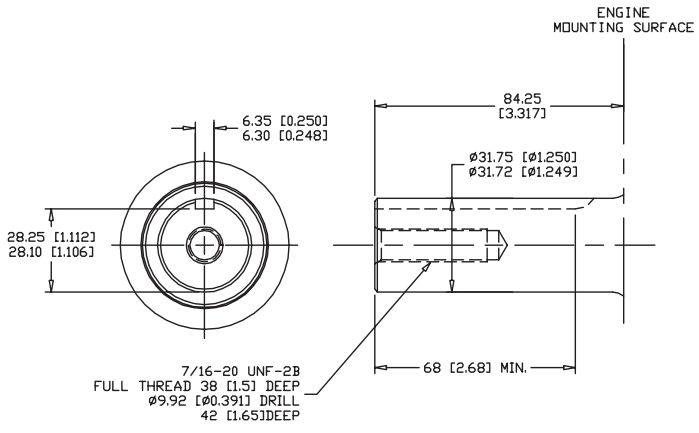
ENGINE
MOUNTING SURFACE
37.1
[1.461]
ø35
[ø1.378]
ø31 [ø1.220]
GAUGE DIAM.
GAUGE LINE
1.77
[0.07]
3/8-24 UNF-2B
FULL THREAD 25 [0.984] DEEP
ø8.43 [ø0.0.331] DRILL
29 [1.14] DEEP
23.1
[0.909]

P/N _____A


ENGINE
MOUNTING SURFACE
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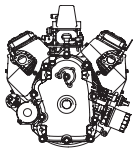
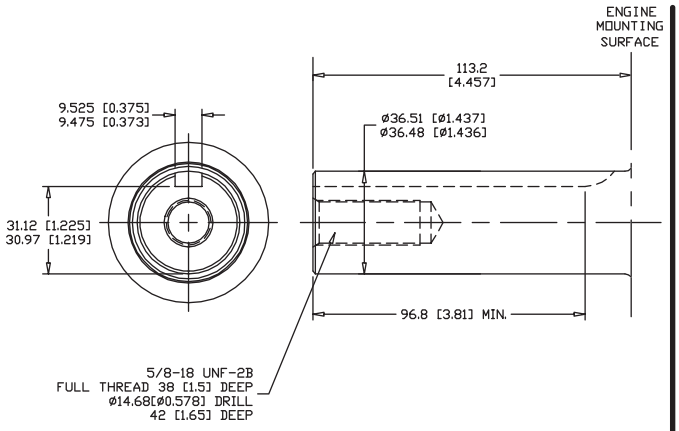
[3.317]
6.35 [0.250]
6.30 [0.248]
ø31.75 [ø1.250]
ø31.72 [ø1.249]
28.25 [1.112]
28.10 [1.106]
7/16-20 UNF-2B
FULL THREAD 38 [1.5] DEEP
ø9.92 [ø0.391] DRILL
42 [1.65]DEEP
68 [2.68] MIN.

P/N _____B





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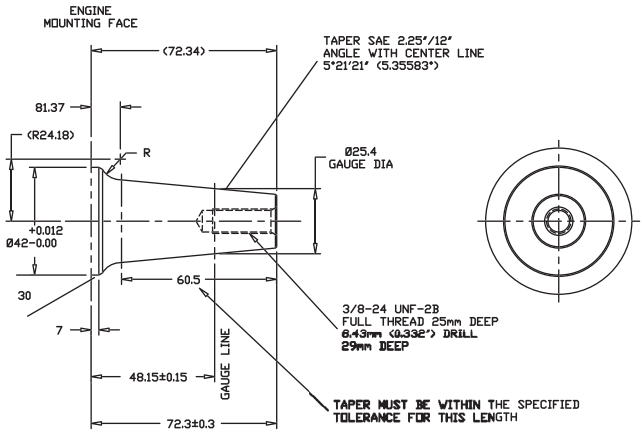

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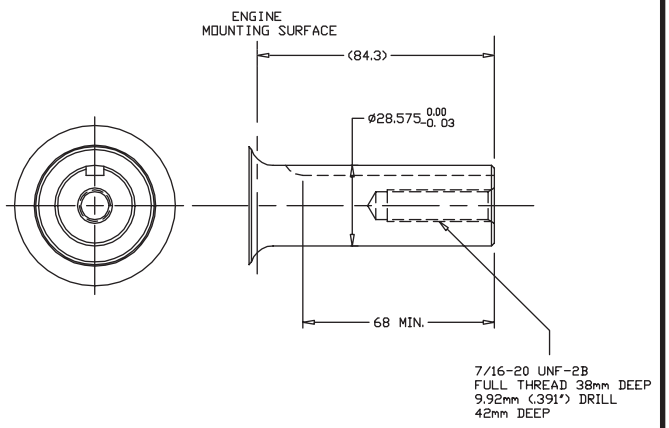

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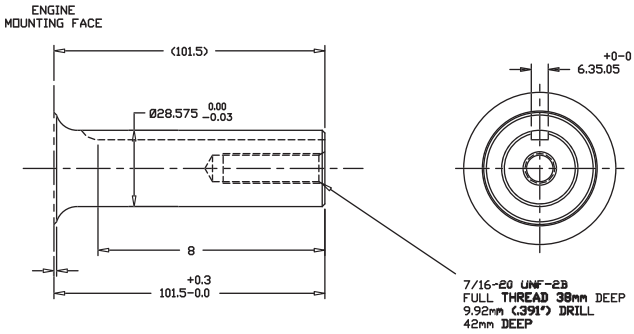

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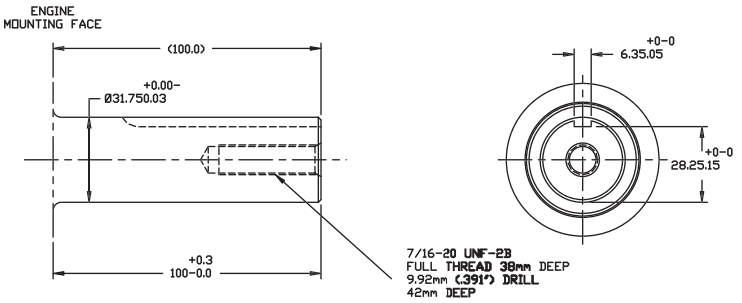

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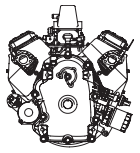
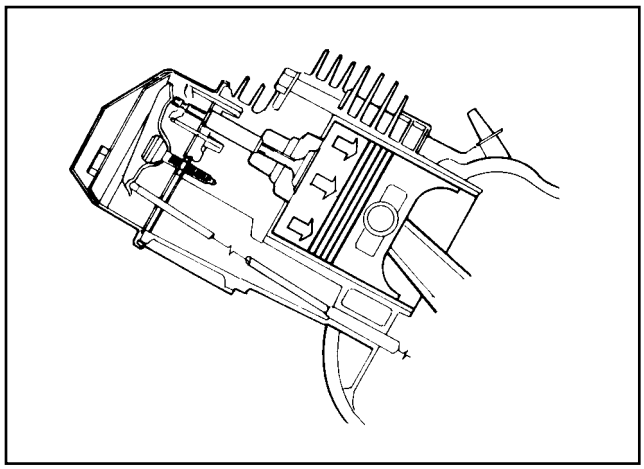


If the engine is to run properly, four (4) events must occur in the proper sequence and at the correct time. These events are (a) intake, (b) compression, (c) ignition and power, and (d) exhaust.

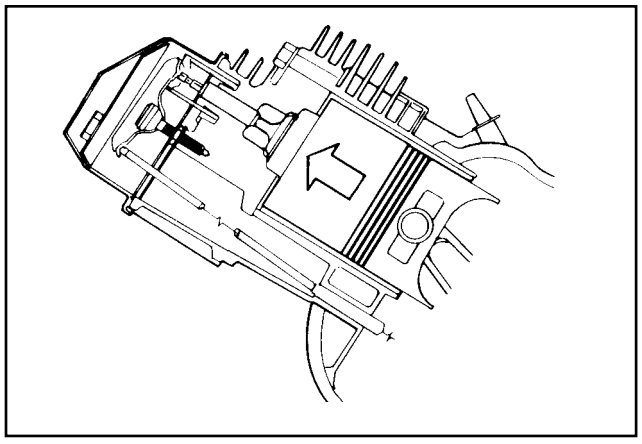
A INTAKE

The piston is travelling from top dead center (TDC) to bottom dead center (BDC). The cam has opened the intake valve. The piston's downward movement in the cylinder creates a partial vacuum in the cylinder. Air at atmospheric pressure is drawn into the cylinder through the carburetor and is mixed with fuel in the carburetor. The fuel-air mixture flows through the open intake valve into the cylinder. When the piston reaches BDC, the intake stroke is over.



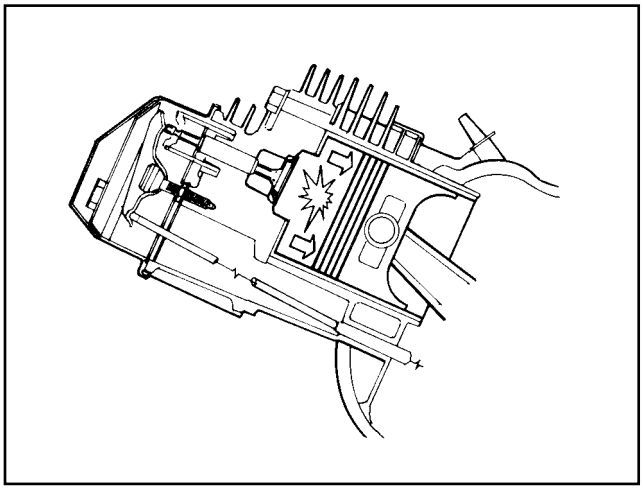
B COMPRESSION

As the piston reaches bottom dead center (BDC), both the intake and exhaust valves are closed. The piston moves upward toward TDC and the fuel-air mixture is compressed. Just before the piston reaches TDC, ignition occurs.



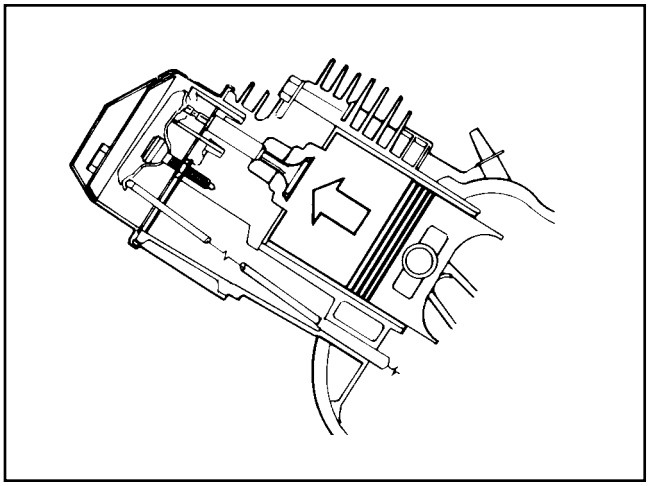
C IGNITION AND POWER

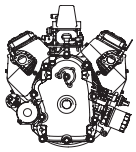
By the time the piston reaches TDC , combustion is already in progress. The intake and exhaust valves remain closed as the expanding gases of combustion force the piston downward.



D EXHAUST

The exhaust stroke begins when the piston has reached BDC and has started its upward movement. The intake valve is closed. The exhaust valve is open to let gases escape.





SECTION CONTENTS

MAINTENANCE SCHEDULE

	Every 8 Hours or Daily	Every 25 Hours Season	Every 50 Hours Season	Every 100 Hours Season
Check Oil Level	•			
Change Oil				Note 1
Change Oil Filter				Note 1
Service Air Filter		Foam Pre-Filter *if equipped*	Filter (Note 2)	
Replace or Clean Spark Plug				•
Clean Spark Arrestor Screen				•
Adjust Valve Clearance				Note 4
Retorque Head Bolts			Note 3	

NOTE 1: Change oil and filter after first 8 hours of operation and then every 100 hours thereafter. Change sooner when operating under a heavy load or in a dusty or dirty environment or in high ambient temperature.

NOTE 2: Clean more often when operating in dirty or dusty conditions. Replace canister style filter every 500 hours.

NOTE 3: Perform this task ONLY after first 50 hours of operation. Head bolts will NOT need further retorquing.

NOTE 4: Check valve lash and adjust if necessary after first 50 hours of operation and every 100 hours thereafter.

FUEL AND OIL RECOMMENDATIONS

GASOLINE:

We recommend the use of clean, fresh lead-free gasoline. A minimum of 85 octane is recommended. The use of lead-free gasoline results in fewer combustion deposits and longer valve life.

NOTE: Using a fuel additive such as STA-BIL® fuel stabilizer, or an equivalent, will prevent gum deposits from forming in the engine's fuel system.

NOTE: Some fuels, called oxygenated or reformulated gasolines, are gasolines blended with alcohols or ethers. Excessive amounts of these blends can damage the fuel system or cause performance problems. Do not use gasoline which contains Methanol. If any undesirable operating symptoms occur, use gasoline with a lower percentage of alcohol or ether.

It is also recommended that gasoline be purchased in small quantities, not more than a 30 day supply. FRESH gasoline minimizes gum deposits, and also will ensure fuel volatility tailored for the season in which the engine will be operated.

LUBRICATION:

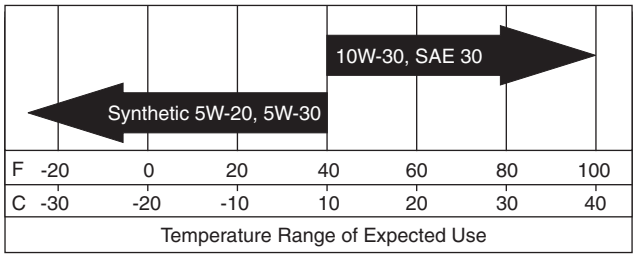
Oil has four purposes. It cools, cleans, seals and lubricates. During normal operation, small particles of metal from the cylinder walls, pistons, bearings and combustion deposits will gradually contaminate the oil. Dust particles from the air also contaminate the oil forming an abrasive mixture which can cause wear to all of the internal moving parts of the engine, if the oil is not changed regularly. Fresh oil also assists in cooling. Old oil gradually becomes thick and loses its cooling ability as well as its lubricating qualities.

RECOMMENDED OIL TYPE:

Using the proper type and weight of oil in the crankcase is extremely important. Check the oil before each use and change the oil regularly (see Figures 1-1, 1-2 & 1-3). Failure to use the correct oil, or using dirty oil, can cause premature engine wear and failure.

Use only high quality detergent oil rated with API service classification SF, SG or SH. The recommended oil weights include the following:

- During summer months: SAE 30. An acceptable substitute is SAE 10W-30. After first oil change, synthetic oil is acceptable.
- During winter months: SAE 5W-30, Synthetic 5W-20 or 5W-30. DO NOT USE SAE 10W-40.



CHANGE OIL:

The crankcase oil capacity is about 2030 ml (2.1 qt.) with the oil filter. Without the filter, the oil capacity is 1750 ml (1.8 qt.). Use no special additives. Make sure that the unit is level when filling with oil. DO NOT OVERFILL.

IMPORTANT: DO NOT OVERFILL. Check and maintain oil level regularly. Change oil and filter after first eight (8) hours of operation.

Thereafter, change oil and filter every 100 hours of operation. Change oil more often if engine is operated in dirty or dusty conditions or if engine is operated under heavy loads or in high ambient air temperatures.

Remove oil drain plug and drain oil while engine is still warm, Figure 1-2. Change oil filter (Figure 1-3) and replace drain plug.

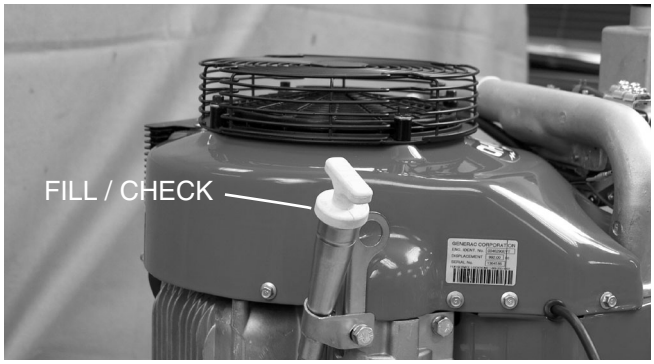


Figure 1-1. Oil Fill/Check

Remove dipstick and refill slowly with new oil of proper service classification and viscosity grade. Refill to full mark on dipstick. When checking oil level, dipstick must be all the way in for accurate readings.

Start and run engine to check for oil leaks.

CHANGE OIL FILTER:

Replace oil filter every 100 hours. Before installing new filter, lightly oil filter gasket with fresh clean engine oil. Screw filter on by hand until gasket contacts filter adapter. Tighten 3/4 to one full turn farther, Figure 1-3.

Start and run engine at idle for 30 seconds and stop engine. Recheck oil level and add if required. Restart engine and check for oil leaks.

Figure 1-2. Oil Drain

Figure 1-3. Oil Filter

CLEANING INTAKE SCREEN:

Grass particles, chaff or dirt can clog the air cooling system, especially after prolonged service in cutting dry grass or when operating in extremely dusty or dirty conditions. Continued operation with a clogged cooling system can cause severe overheating and possible engine damage. Figure 1-4 shows the areas to be cleaned. This should be a regular maintenance operation, or clean intake screen and oil cooler fins after each use.

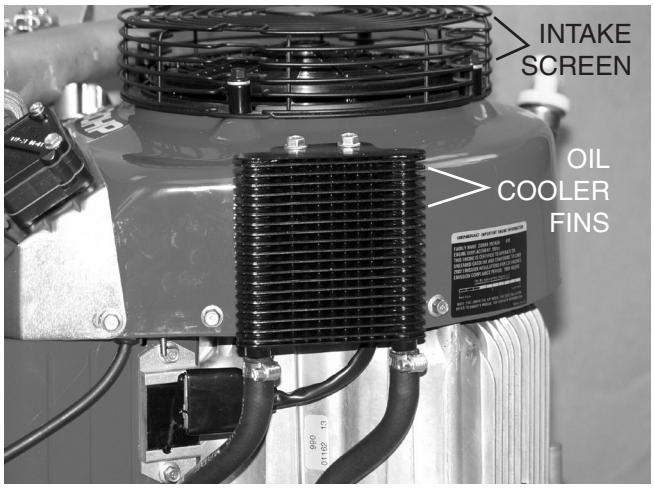


Figure 1-4. Clean Intake Screen & Oil Cooler Fins

REPLACE SPARK PLUGS:

Replace spark plugs every 100 hours of operation or every season, whichever occurs first. Replace spark plugs if electrodes are burned away, or the porcelain is cracked. Set spark plug gap at .76 mm (.030") for all models. Torque spark plugs to 20.0 Nm (180 in. lbs.).

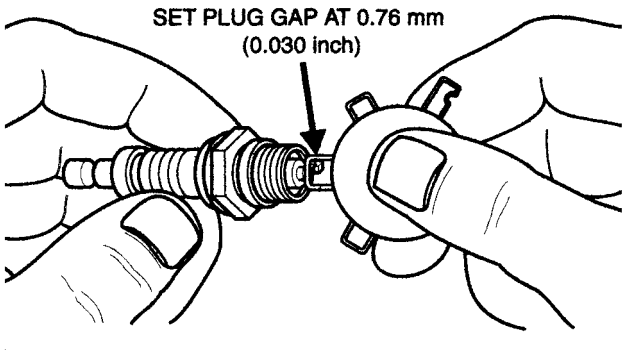


Figure 1-5. Setting Spark Plug Gap

Spark Plug Type	GENERAC Part No.	Champion Part No.
Resistor Plug	072347	RC12YC

AIR CLEANER MAINTENANCE:

WARNING: NEVER OPERATE ENGINE WITH AIR CLEANER ASSEMBLY OR AIR CLEANER CARTRIDGE REMOVED. FIRE MAY RESULT.

A properly serviced air cleaner protects internal parts of the engine from dirt and dust particles in the air. If air cleaner instructions are not carefully followed, dirt and dust which should be collected in the cleaner, will be drawn into the engine. These particles are highly abrasive and will cause the piston rings and cylinder bore to wear quickly. As the rings and cylinder bore become worn, these abrasive particles enter the crankcase and contaminate the oil, forming an abrasive mixture which will cause wear on all of the internal moving parts.

The air cleaner on every engine brought in for a check up or repair should be examined and serviced. If the air cleaner shows signs of neglect, show it to the customer before cleaning. Instruct the customer on proper care, to assure long engine life.

Note: Replace air cleaner gaskets and mounting gaskets that are worn or damaged, to prevent dirt and dust from entering engine due to improper sealing. Replace bent air cleaner mounting bracket if necessary.

SERVICE DUAL ELEMENT AIR CLEANERS:

Remove and service foam pre-cleaner every 25 hours or every season, whichever occurs first. Service cartridge every 50 hours or every season, whichever occurs first.

SERVICE CANISTER AIR CLEANERS:

Clean the air filter element(s) with compressed air every 50 hours or every season, whichever occurs first. Replace the air filter element(s) every 500 hours or if damaged.

Note: The air cleaner assemblies on some equipment may have been supplied by the equipment manufacturer. See the equipment manufacturer's owner's manual for service information specific to that product.

TROUBLESHOOTING

Most complaints concerning engine operation can be classified as one or a combination of the following:

1. Will not start
2. Hard starting
3. Lack of power
4. Runs rough
5. Vibration
6. Overheating
7. High oil consumption

Note: What appears to be an engine malfunction may be a fault of the powered equipment rather than the engine. If equipment is suspect, see equipment affecting engine operation.

SYSTEMATIC CHECK:

If the engine will not start and the cause of malfunction is not readily apparent, perform a systematic check in the following order:

1. Ignition
2. Fuel
3. Compression

This check-up, performed in a systematic manner, can usually be done in a matter of minutes. It is the quickest and surest method of determining the cause of failure. The basic checkup procedure is the same for all engine models, while any variation, by model, will be shown under the subject heading.

CHECK IGNITION:

If spark does not occur look for:

- Shorted ignition/kill wire
- Two closed diodes in ground wire harness
- Incorrect armature air gap
- Armature failure

CHECK IGNITION (ENGINE RUNNING):

If engine runs but misses during operation, a quick check to determine if ignition is or is not at fault can be made by installing a spark tester (Generac P/N OC5969) between the spark plug lead and each spark plug, Figure 1-6. A spark miss will be readily apparent when the engine is running. If spark is good but engine misses, check for a fouled spark plug.

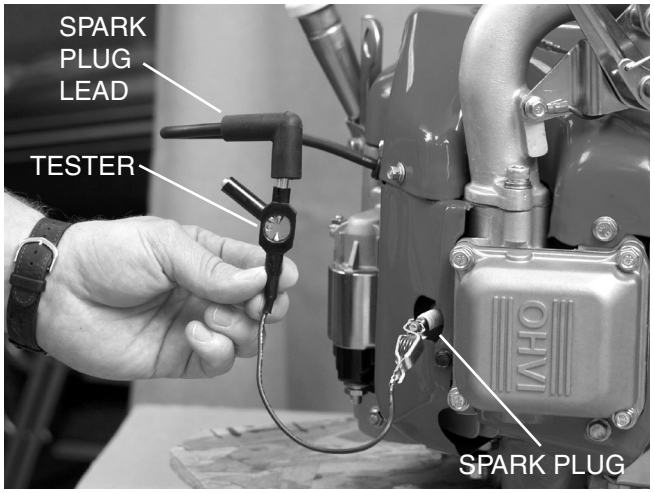


Figure 1-6. Running Check

CHECK IGNITION (FOULED PLUG OR OTHER CAUSES):

To check for a fouled spark plug or a non-functioning cylinder, attach the spark tester (Generac P/N OC5969) between the spark plug lead and each spark plug. Start and run engine at top no load speed. Now ground one spark plug, Figure 1-7. The engine should continue to run on the other cylinder. Repeat this test with the other cylinder. If the engine will not continue to run when making this test, the cylinder that is NOT grounded is not functioning and/or the spark plug is fouled. Install a new spark plug before proceeding. If miss continues, problem may be carburetion or compression. See Check Carburetion, Check Compression. Also see Cylinder Balance Test.

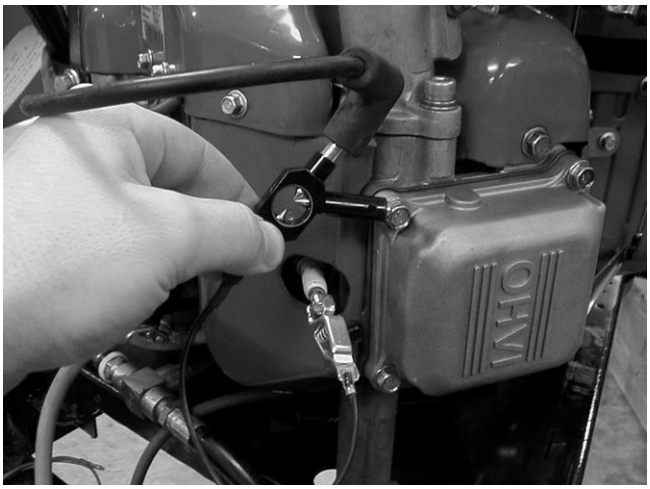


Figure 1-7. Checking For Fouled Plugs

CYLINDER BALANCE TEST:

If the engine is hard starting, runs rough, misses or lacks power, perform a cylinder balance test to determine whether both cylinders are operating to their full potential.

Tools Required:

1. Two Ignition Testers (Generac P/N OC5969)

Attach an ignition tester between the spark plug lead and each spark plug, Figure 1-6.

Start and run engine running at top no load speed and note spark at ignition testers. If the spark is equal at both ignition testers, the problem is not ignition related. A spark miss will be readily apparent. Now note RPM of engine. Ground out one cylinder by contacting ignition tester and a good ground on engine, Figure1-8. Note RPM loss. Then ground out the other spark plug and note the RPM loss. If the difference between the two cylinders does not exceed 75 RPM, the amount of work the two cylinders are doing should be considered equal.

If the RPM loss is greater than 75 RPM this indicates that the grounded cylinder with the least RPM loss is the weakest of the two cylinders. Look to that cylinder for a problem.

Example:

Engine RPM - Both Cylinders = 3400 RPM

Engine RPM - #1 Cylinder Grounded = 3300 RPM

Engine RPM - #2 Cylinder Grounded = 3100 RPM

Conclusion: #1 cylinder is weakest of the two cylinders.

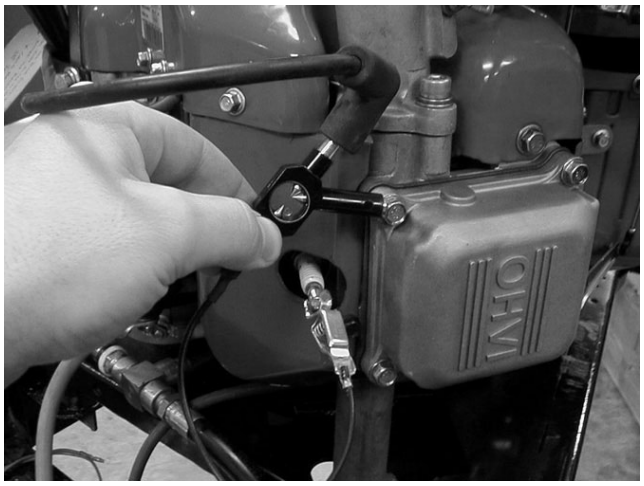


Figure 1-8. Cylinder Balance Test

The cylinder balance test will also detect a cylinder that is not functioning. When grounding out one cylinder there will be no RPM loss. When the other cylinder is grounded out the engine will stop.

CHECK FUEL:

The fuel pressure can be checked using a pressure tester kit for LP and NG systems.

CHECK COMPRESSION:

It has been determined through testing that a simple and accurate indication of compression can be made as follows:

Remove both spark plugs and insert a compression gauge into either cylinder (one cylinder at a time). Turn engine over with engine starter until there is no further increase in pressure. Record this reading. Repeat procedure on other cylinder and record that reading. The difference between both cylinders should not exceed 25%. More than 25% indicates loss of compression in the cylinder with lower pressure. See example.

EXAMPLE:

	Cyl. #1	Cyl. #2	Diff.
Eng. #1	165 PSI	160 PSI	5 PSI
Eng. #2	175 PSI	155 PSI	20 PSI

If compression is poor, look for:

- Insufficient valve clearance
- Loose cylinder head bolts
- Blown head gasket
- Burned valves, valve seats and/or loose valve seats
- Warped cylinder head
- Warped valve stems
- Worn bore and/or rings
- Broken connecting rods

CYLINDER LEAKDOWN TEST:

A cylinder leakdown tester may be used to test the sealing capability of the compression components of each cylinder and quickly identify the problem component.

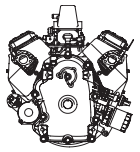
THINGS WHICH AFFECT BOTH CYLINDERS:

1. Carburetion
2. Crankcase vacuum
3. Ignition timing
   a. A partially sheared flywheel key will effect ignition timing and engine performance.

THINGS WHICH AFFECT ONE CYLINDER:

1. Spark plug
   a. A fouled spark plug may indicate that carburetor is out of adjustment.
2. Leak in spark plug wire
3. Head gasket
4. Intake manifold
   a. A leak at either end of the intake manifold will only affect one cylinder, not both.
5. Valves
6. Rings
7. Piston
8. Cylinder

NOTE: A twin cylinder engine will run well on one cylinder as long as the power required for the application does not exceed the power produced by the one cylinder.



EQUIPMENT AFFECTING ENGINE OPERATION

Frequently, what appears to be a problem with engine operation, such as hard starting, vibration, etc., may be the fault of the equipment powered rather than the engine itself. Listed are the most common effects of equipment problems, and what to look for as the most common cause.

HARD STARTING OR WILL NOT START:

1. Loose belt - a loose belt like a loose blade can cause a backlash effect, which will counteract engine cranking effort.
2. Starting under load - see if the unit is disengaged when engine is started; or if engaged, should not have a heavy starting load.
3. Check remote control assembly for proper adjustment.
4. Check interlock system for shorted wires, loose or corroded connections, or defective modules or switches.

ENGINE WON'T STOP:

1. Check equipment ignition stop switch.
2. Check for loose or disconnected equipment stop switch wire.
3. Check ground wire harness on engine.

   a. See Section 2 for test procedure.

VIBRATION:

1. Unit load out of balance - remove and balance.
2. Mounting bolts loose - tighten.

POWER LOSS:

1. Bind or drag in unit- if possible, disengage engine and operate unit manually to feel for any binding action.
2. Unit load has excess drag.

NOISE:

1. Engine coupling or pulley - an oversize or worn coupling can result in knocking, usually under acceleration. Check for fit or tightness.
2. Equipment needs lubrication.

SECTION CONTENTS

SPECIFICATIONS FOR GTV-990/760 OHVI V-TWIN ENGINE

MODEL SERIES GTV-990/760
ARMATURE AIR GAP ..... 0.20 TO 0.30 MM (0.008" TO 0.012")
FLYWHEEL NUT TORQUE FT. LBS. 150
FLYWHEEL NUT TORQUE NM 203

See Section 1 For Spark Plug Maintenance And Specifications

GENERAL INFORMATION

Generac GTV-990/760 OHVI V-Twin engines use a magneto ignition: an ignition armature with a self-contained transistor module (no moving parts). Two magneto ignition armatures are used, with a flywheel containing a permanent magnet.

NOTE: The magneto ignition system requires a minimum of 250 RPM to produce a consistent spark.

ARMATURES

ARMATURE TESTING:

The condition of the ignition armatures can be accurately diagnosed using an ignition tester, (Generac P/N 0C5969) as described in "Troubleshooting" in Section 1.

REMOVING ARMATURES:

1. Remove spark plug leads.
2. Remove intake manifold and cover intake ports.
3. Remove rotating screen and blower housing.
4. Remove armature screws and lift off armature(s), Figure 2-1.

   a. Disconnect stop switch wires at armatures.

Note:The flywheel does not need to be removed to service ignition except to check the flywheel key.

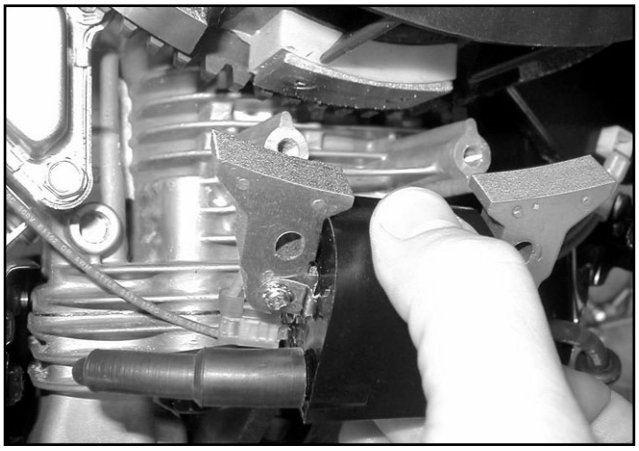


Figure 2-1. Removing Armature

INSTALL ARMATURES:

1. Turn flywheel so magnet is away from armature.
2. Install ground wire onto tab terminal on armature.

Note: Make sure wires are routed over armature mounting posts and away from flywheel.

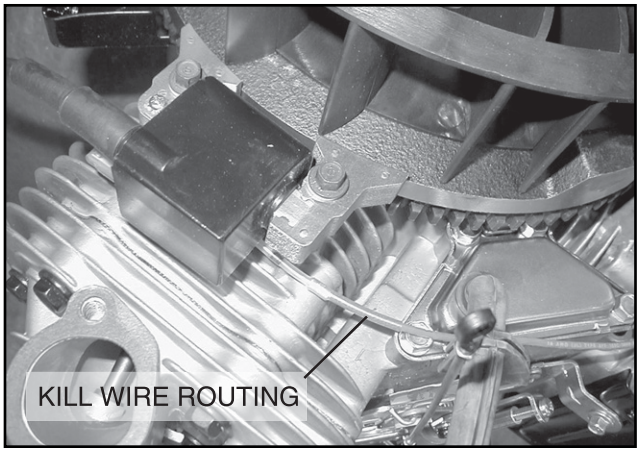


Figure 2-2. Installing Armature

3. Assemble armature to engine, Figure 2-2.

   a. Mounting holes in armature are slotted. Push armature away from flywheel as far as possible and tighten one screw to hold armature in place.

4. Repeat for second armature.
5. Adjust armature air gap.

ADJUST ARMATURE AIR GAP:

1. Rotate flywheel until magnet is under armature laminations.
2. Place thickness gauge, 0.20-.30 mm (.008"-.012") between magnet and armature laminations, Figure 2-3.
3. Loosen mounting screw so magnet will pull armature down against thickness gauge.
   a. Torque screws to 12.2 Nm (9 ft. lbs.).
4. Rotate flywheel to remove thickness gauge.
5. Repeat for second armature.

Note: Route armature ground wire over breather tube and away from the flywheel.

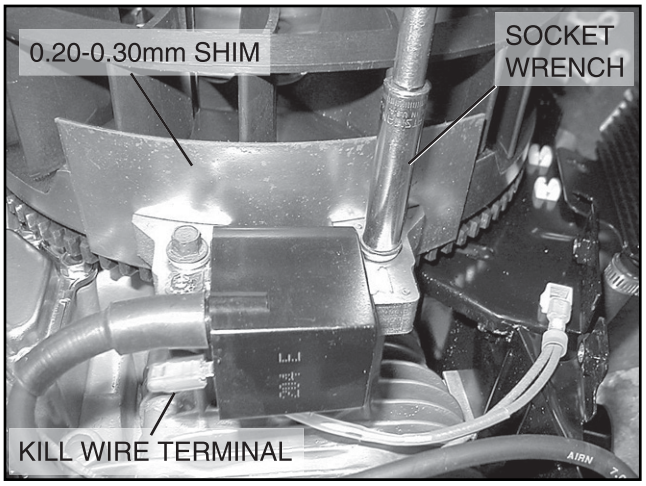


Figure 2-3. Adjusting Air Gap

FLYWHEEL

REMOVE FLYWHEEL:

1. Remove flywheel nut and washer, Figure 2-4.
2. Remove fan retainer and fan.
4. Reinstall flywheel nut. Turn nut down flush with top of threads.
5. Install flywheel puller.
6. Tighten puller screws equally until flywheel loosens, Figure 2-5.

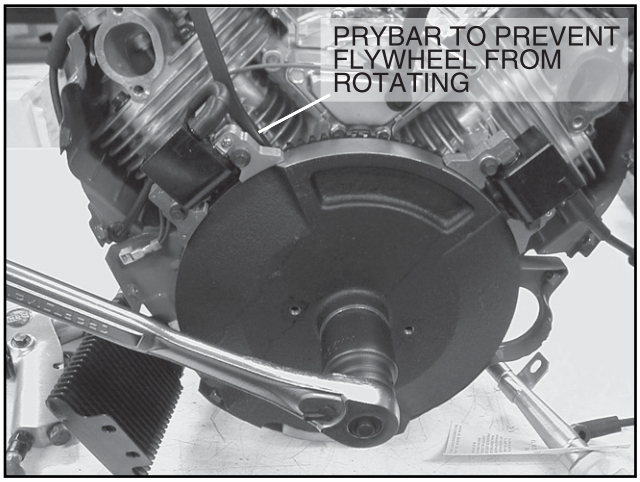


Figure 2-4. Removing Flywheel Nut

Caution: Flywheel puller bolts may damage lighting coil if turned in too far.

Caution: DO NOT strike flywheel with a hard object or a metal tool as this may cause flywheel to shatter in operation. Always use approved flywheel removal tools.

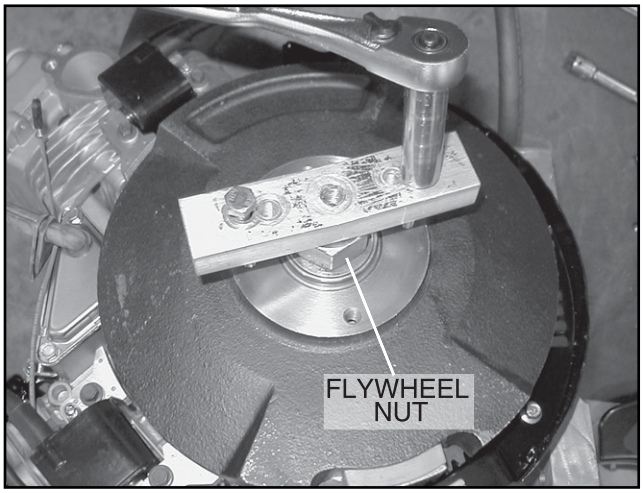


Figure 2-5. Removing Flywheel

INSPECT FLYWHEEL KEY, KEYWAYS, FLYWHEEL AND CRANKSHAFT:

Check flywheel key for damage. Check flywheel for cracks or keyway damage. Also check crankshaft keyways and taper for damage, Figure 2-6. Replace crankshaft, if damaged.

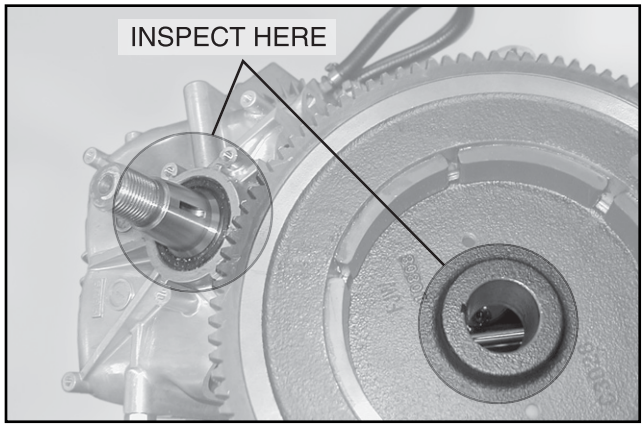


Figure 2-6. Check Flywheel And Crankshaft

INSTALL FLYWHEEL:

Note: CLEAN flywheel and crankshaft taper removing all oil, dirt or grease.

1. Insert flywheel key into crankshaft.
2. Align keyways and assemble flywheel to crankshaft.
3. Install washer and flywheel nut.
   a. Torque flywheel nut to 204.0 Nm (150 ft. lbs.), Figure 2-7.
4. Assemble fan and retainer to flywheel, Figure 2-8.
   a. Torque screws to 21.7 Nm (192 in. lbs.).

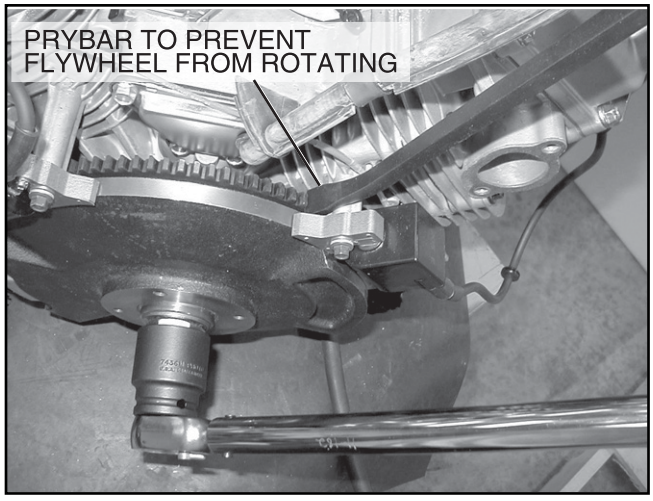


Figure 2-7. Torquing Flywheel Nut

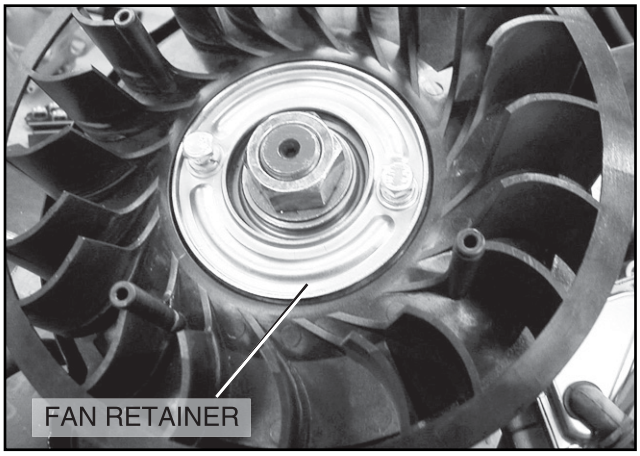


Figure 2-8. Installing Flywheel And Fan

ENGINE WIRING HARNESS

The engine wiring harness consists of a ground wire with a diode for each armature and a separate wire for the carburetor solenoid. The engine kill wires are connected to the wiring harness provided by the equipment manufacturer.

See "Typical 12 Volt Wiring Diagram", Page 6-3.

TESTING GROUND WIRES:

Use a Digital Multimeter (Figure 2-9) to test the ground wires.

The following test will be made with the meter in the Diode Test position.

In the Diode Test position, the meter will display the forward voltage drop across the diode(s). If the voltage drop is less than 0.7 volts, the meter will "Beep" once as well as display the voltage drop. A continuous tone indicates continuity (shorted diode) An incomplete circuit (open diode) will be displayed as "OL."

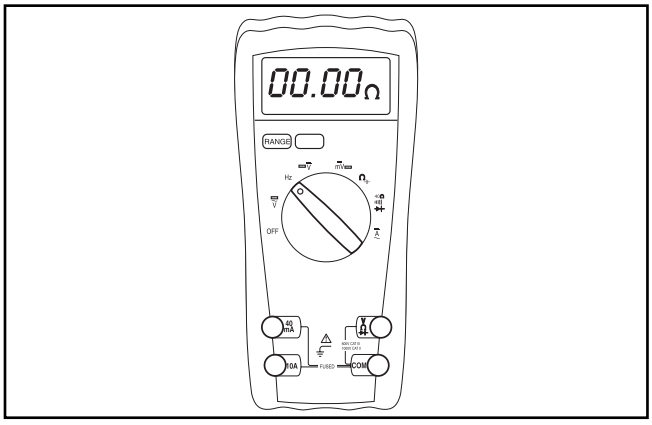


Figure 2-9. Digital Multimeter

1. Insert RED test lead into ⍱Ω→⊢ receptacle in meter.
2. Insert BLACK test lead into the "COM" receptacle in meter.
3. Rotate selector to →⊢ ıllll (Diode Test) position.
4. Insert RED test lead clip into connector "A" (Figure 2-10). Leave attached for remainder of test.
5. Touch BLACK test lead probe to terminal "B."
   a. If meter "Beeps" once, diode is OK.
   b. If meter makes a continuous tone, diode is defective (shorted). Replace ground harness.
   c. If meter displays "OL," diode is defective (open). Replace ground harness.
6. Now repeat test for terminal "C." Results must be the same.

See "Diode Failure Diagnosis" below.

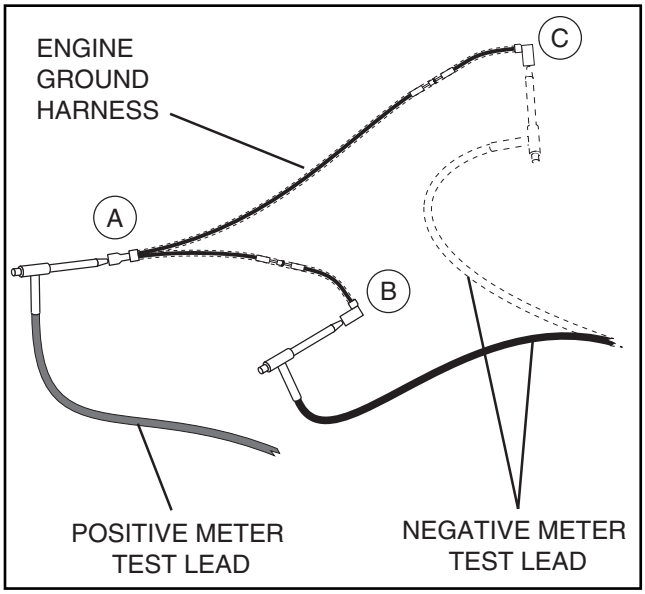


Figure 2-10. Testing Ground Wire

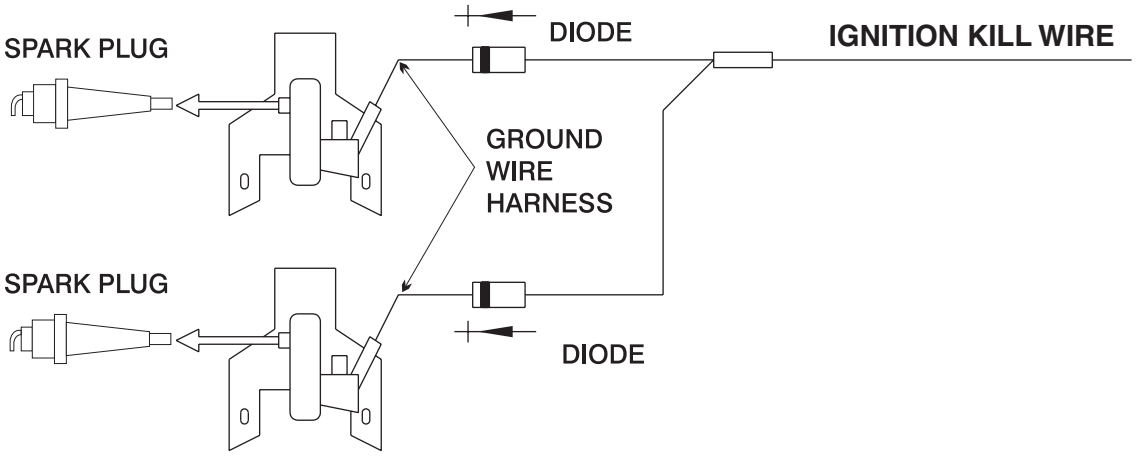


Figure 2-11. Engine Wiring Harness

DIODE FAILURE DIAGNOSIS

SWITCH ON	TURNED OFF	CAUSE
Engine Runs On 1 Cylinder	Shuts Off OK	1 Closed Diode
Engine Runs (Both Cylinders)	Only One Cylinder Shuts Off	1 Open Diode
Won't Run (No Spark)		2 Closed Diodes
Engine Runs (Both Cylinders)	Engine Won't Shut Off	2 Open Diodes

SECTION CONTENTS

CARBURETOR TYPES

There are four types of carburetors used on Generac OHVI V-twin engines:

1. Keihin two-barrel, side-draft on Models EVT-04198-0, EVT-04629-0, EVT-04629-1, EVT-04630-0, EVT-04741-0, EVT-04772-0, EVT-04797-0, 04807-0, 04861-0, 0D3358, 0E0038.
2. Deni two-barrel, side draft on Models EVT-04174-0, 04198-1, 04629-2, 04806-0, 0E3342.
3. Nikki two-barrel, side-draft on Models EVT-04712-0, EVT-04717-0, 04717-1, EVT-04739-0, 04857-0, 04858-0, 04862-0, 0D7675, 0D9033.
4. Nikki single-barrel, side-draft on Model 0D9708.

CARBURETOR REMOVAL - VERTICAL SHAFT

(Models EVT-04629-0, EVT-04629-1, 04629-2, EVT-04717-0, 04717-1, EVT-04797-0, 04806-0, 04857-0, 04858-0, 04862-0, 04861-0)

1. Unclip choke link from bellcrank and remove link from carburetor.
2. Disconnect fuel-shutoff solenoid by unbolting the ground wire from the manifold, and unplugging the power wire.

Note: Wires simply unplug from the solenoid on models 04629-2, EVT-04717-0, 04717-1, 04806-0, 04857-0, 04858-0, & 04862-0.

3. Disconnect breather tube.
4. Separate throttle link balljoint from carburetor by rotating the ball socket.
5. Disconnect the fuel line.
6. Remove the four nuts holding the carburetor and plenum to the intake manifold.
7. Remove the plenum, carburetor, and gaskets from the manifold, and discard the gaskets.

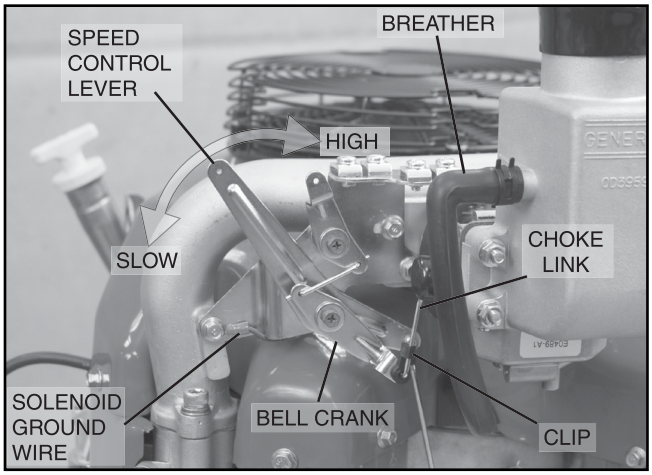


Figure 3-1.

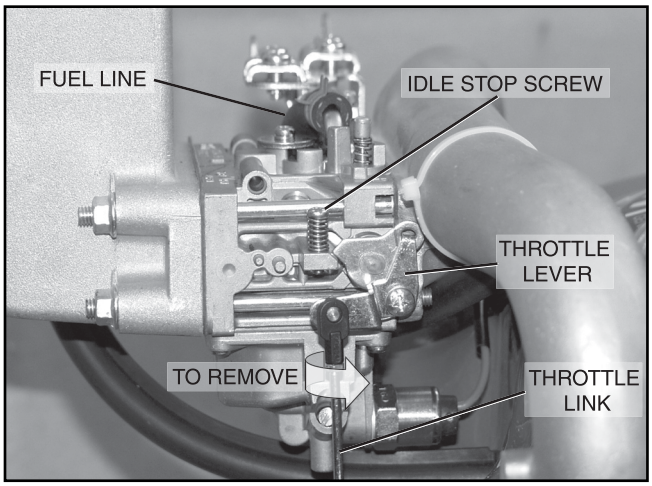


Figure 3-2.

CLEANING CARBURETOR

For cleaning purposes, the carburetor's float bowl may be removed. It is recommended that all jetting be left in place while cleaning the carburetor. Be sure to use a cleaner that won't damage rubber, neoprene, or plastic parts.

If the fuel-shutoff solenoid is suspected of being faulty, it is replaceable by simply unthreading it from the float bowl, and installing a new one in its place. It can be checked by applying 12 volts to it. If you hear it click, it is most likely working properly. If there is anything else wrong with the carburetor, it is recommended that the entire carburetor be replaced with a new one.

CARBURETOR INSTALLATION - VERTICAL SHAFT

(Models EVT-04629-0, EVT-04629-1, 04629-2, EVT-04717-0, 04717-1, EVT-04797-0, 04806-0, 04857-0, 04858-0, 04862-0, 04861-0)

1. Slide new carburetor gasket onto the studs.
2. Slide the carburetor onto the studs.
3. Slide new plenum gasket onto the studs.
4. Slide the plenum onto the studs.
5. Install the nuts on the four studs, and torque to 5.4 Nm (4 ft. lbs.).
6. Connect the fuel line.
7. Using a pliers, reassemble the balljoint on the carburetor.
8. Connect the breather tube.
9. Connect the fuel-shutoff solenoid.

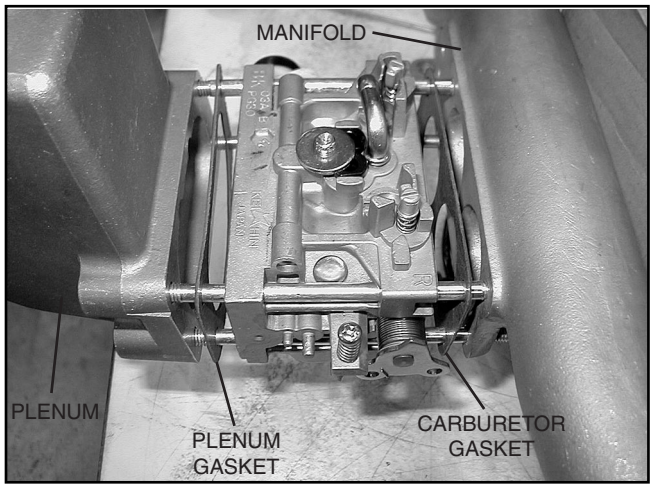


Figure 3-3.

10. Reinstall choke link in carburetor and clip the link into the bellcrank.
11. Perform a static governor adjustment.
12. Start engine and allow to warm up for 5 minutes.
13. Move speed control lever to slow speed position and hold throttle lever against idle stop screw.
14. Adjust stop screw to maintain ~1200 RPM idle.
15. Slowly move speed control lever to high speed position. Do not exceed 4000 RPM.

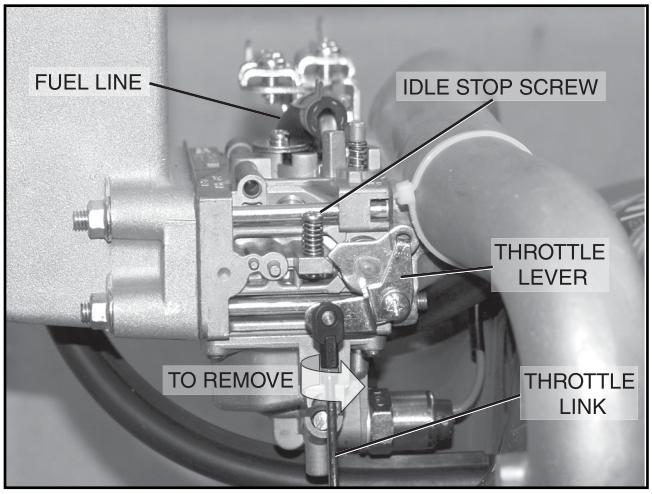


Figure 3-4.

Note: The high speed screw may need adjusting to reach the speed control stop without exceeding 4000 RPM.

16. With the speed control in the high speed position, adjust the high speed screw to obtain the desired engine speed.

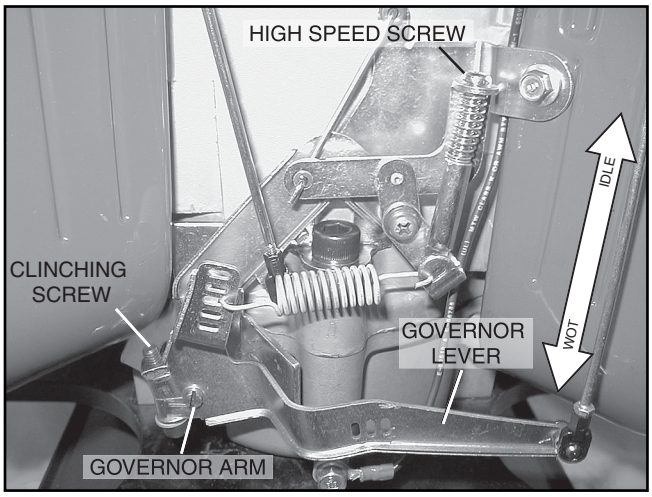


Figure 3.5.

STATIC GOVERNOR ADJUSTMENT

1. Loosen the clinching screw on the governor lever.
2. Hold governor lever in WOT position and rotate the governor arm clockwise.
3. While holding this position, re-torque the clinching screw to 11.3 Nm (100 in-lbs.).
4. Check to make sure that the throttle travels from WOT to IDLE. If it doesn't, the governor needs to be reset again.

FUEL PUMP

The fuel pump supplied with the engines is a pulse pump. It uses crankcase vacuum pulses drawn from the valve cover of cylinder #2 to pump the fuel. It is capable of priming at 12" (30.5 cm) max lift. The pump has a max outlet pressure of 1.5 psi.

If a fuel pump other than the one described above is used, the fuel line pressure at the carburetor inlet must not exceed 3 psi. Pressures in excess of 3 psi may cause an over rich carburetor mixture that would lead to engine damage.

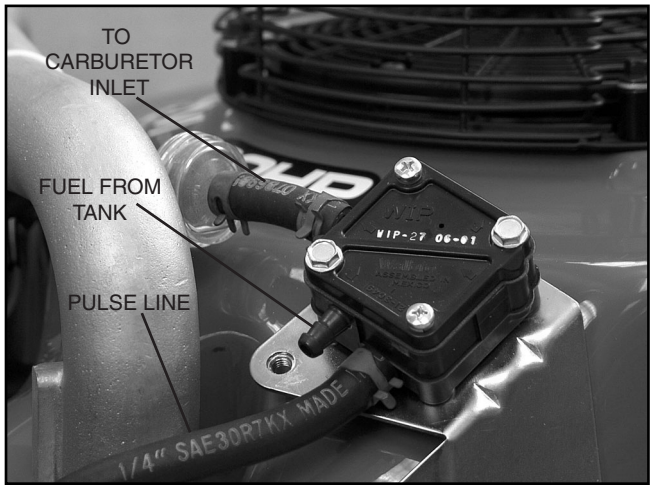
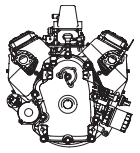


Figure 3-6. Fuel Pump

NOTES



SECTION CONTENTS

MECHANICAL GOVERNOR

DISASSEMBLE:

1. Drain the oil from the engine.
2. Remove any rust, nicks, or burrs from the crankshaft.
3. Remove the 4 oil cooler screws.
4. Disconnect the wiring from the oil pressure switch.
5. Remove the governor lever from the shaft.
6. Separate the ball joint on the swinging arm.
7. Remove all of the crankcase bolts and slide the crankcase cover off.

Note: Watch the swinging arm bracket so that it doesn't hook on the sheet metal.

8. Discard the crankcase gasket & oil passage seal.

GOVERNOR

Both the spool and the flyweights must move freely for the governor to work properly. Check for wear on the spool and flyweights. If wear is noticed, change the governor gear assembly (gear and flyweights), spool, and governor arm. Lubricate all moving parts when reassembling.

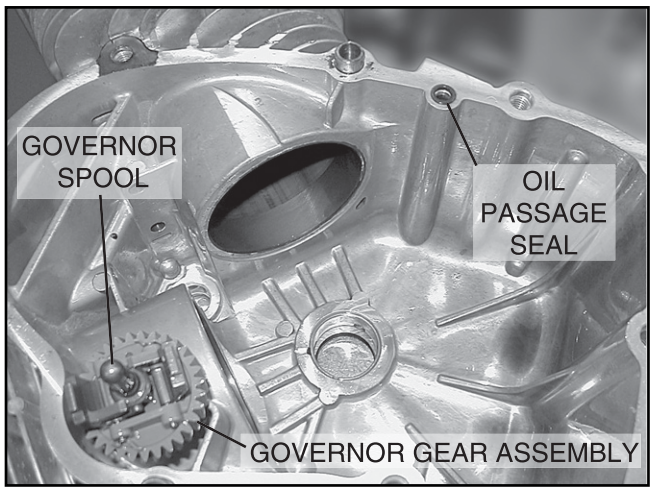


Figure 4-1. Governor Gear Assembly and Spool

1. Force gear assembly and governor spool off of governor shaft.
2. Remove any remaining plastic from the notch in the governor shaft.
3. Check that all the governor bearing parts (top plate, bearing, and bottom plate) are on the shaft, and that it moves smoothly.
4. Slide the new gear assembly and spool onto the governor shaft. Slide until the gear hooks into the notch in the governor shaft.

GOVERNOR ARM

If the governor arm does not move freely, or if the arm feels loose in the bushings, it may need replacing. If wear is noticed, change the governor arm, governor gear assembly (gear and flyweights), spool, and bushings as needed. Lubricate all moving parts when reassembling.

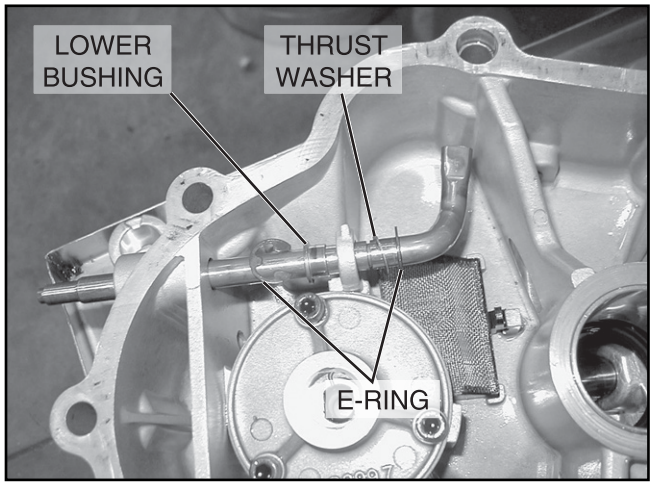


Figure 4-2. Governor Arm Assembly

1. Remove the e-clips.
2. Slide the arm down and out of the bushings.
3. Replace any parts that appear worn.

Note: The lower bushing is a slip fit, and the upper bushing is pressed in.

4. Slide the thrust washer part way onto the new governor arm.
5. Insert the governor arm in the lower bushing holder, and slide it part way in.
6. Install lower e-clip on the arm, and slide the thrust washer down to it.
7. Slip the lower bushing part way on to the arm.

8. Slide the arm in until the thrust washer is tight.
9. Slide the lower bushing down and into it's holder, then install the upper e-clip.

ASSEMBLE:

1. Clean any old gasket material from the crankcase and cover mating surfaces.
2. Be sure that the new oil passage o-ring is in place.
3. Put a new gasket on the crankcase.
4. Slide the crankcase cover back on the crankcase.

Note: Hold the governor arm in the counter-clockwise position while installing. Also, make sure that the swinging arm bracket goes in place.

5. Start all of the crankcase bolts, and then torque them to 35 ft. lbs., following the proper torque sequence.
6. Reconnect the ball joint on the swing arm.
7. Place the governor lever on the governor arm, with the spring in the 4th hole out.
8. Perform a static governor adjustment.
9. Reconnect the ground wire to the oil pressure switch.
10. Reattach the oil cooler to the blower housing.

STATIC GOVERNOR ADJUSTMENT

1. Loosen the clinching screw on the governor lever.
2. Rotate the governor arm clockwise and hold governor lever in WOT position.
3. While holding this position, torque the clinching screw to 11.3 Nm (100 in. lbs.).
4. Check to make sure that the throttle travels from WOT to IDLE. If it doesn't, the governor needs to be reset again.

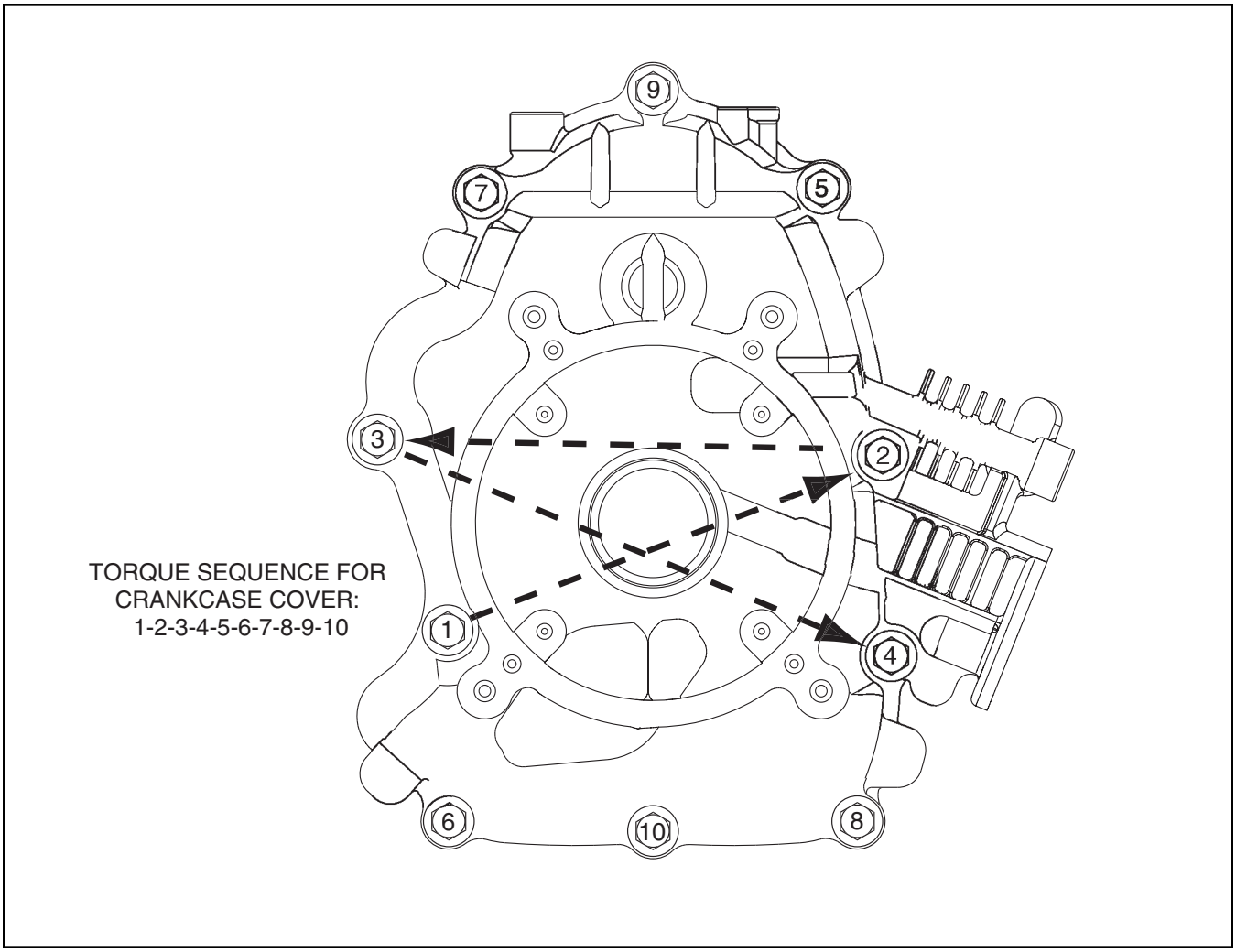


Figure 4-3.

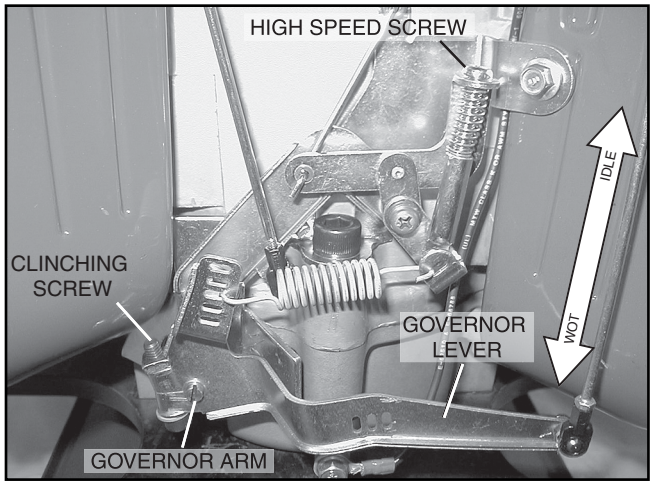


Figure 4-4. Static Governor Adjustment

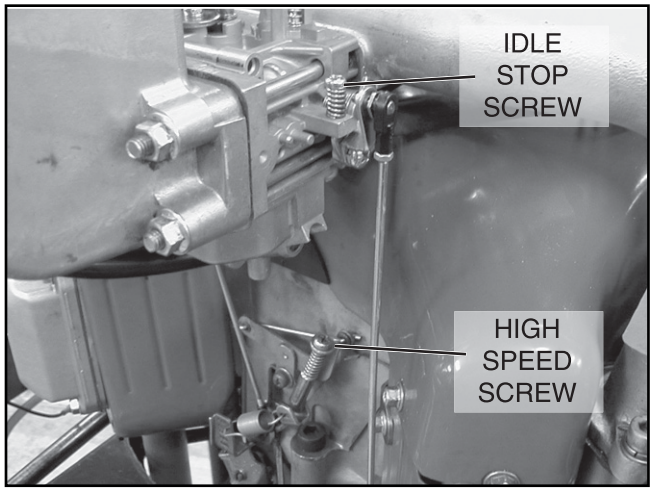


Figure 4-5. Dynamic Governor Adjustment

DYNAMIC GOVERNOR ADJUSTMENT

1. Start engine and allow to warm up for 5 minutes.
2. Move speed control lever to slow speed position and hold throttle lever against idle stop screw.
3. Adjust stop screw to maintain 1200 RPM idle.
4. Slowly move speed control lever to high-speed position. Do not exceed 4000 RPM.

Note: The high-speed screw may need adjusting to reach the speed control stop without exceeding 4000 RPM.

5. With the speed control in the high-speed position, adjust the high-speed screw to obtain the desired engine speed.

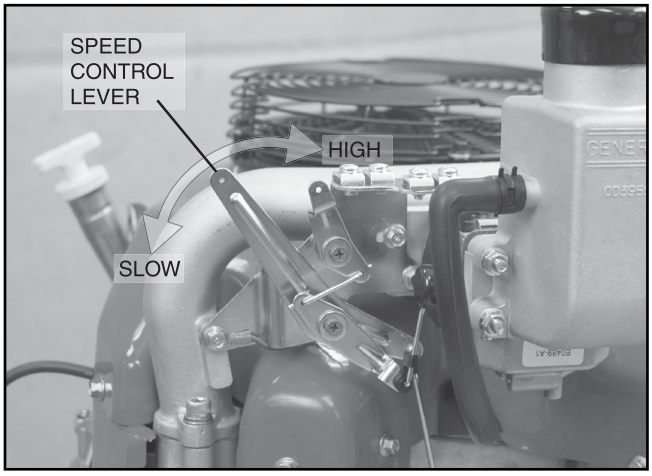
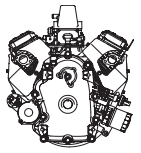


Figure 4-6. Dynamic Governor Adjustment

NOTES



SECTION CONTENTS

GENERAL INFORMATION

Compression testing information and procedures is described in "Troubleshooting" in Section 1.

Cylinders are numbered as shown in Figure 5-1.

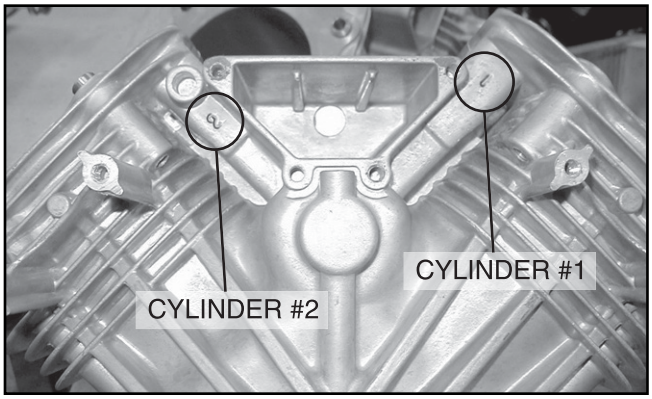


Figure 5-1.

REMOVE CYLINDER HEADS

Disconnect exhaust system from exhaust manifold. Remove exhaust manifold from engine. Disconnect choke and throttle control cables. Remove spark plugs.

1. Remove the parts depicted in Figure 5-2.

   a. Discard gaskets and valve cover seals.

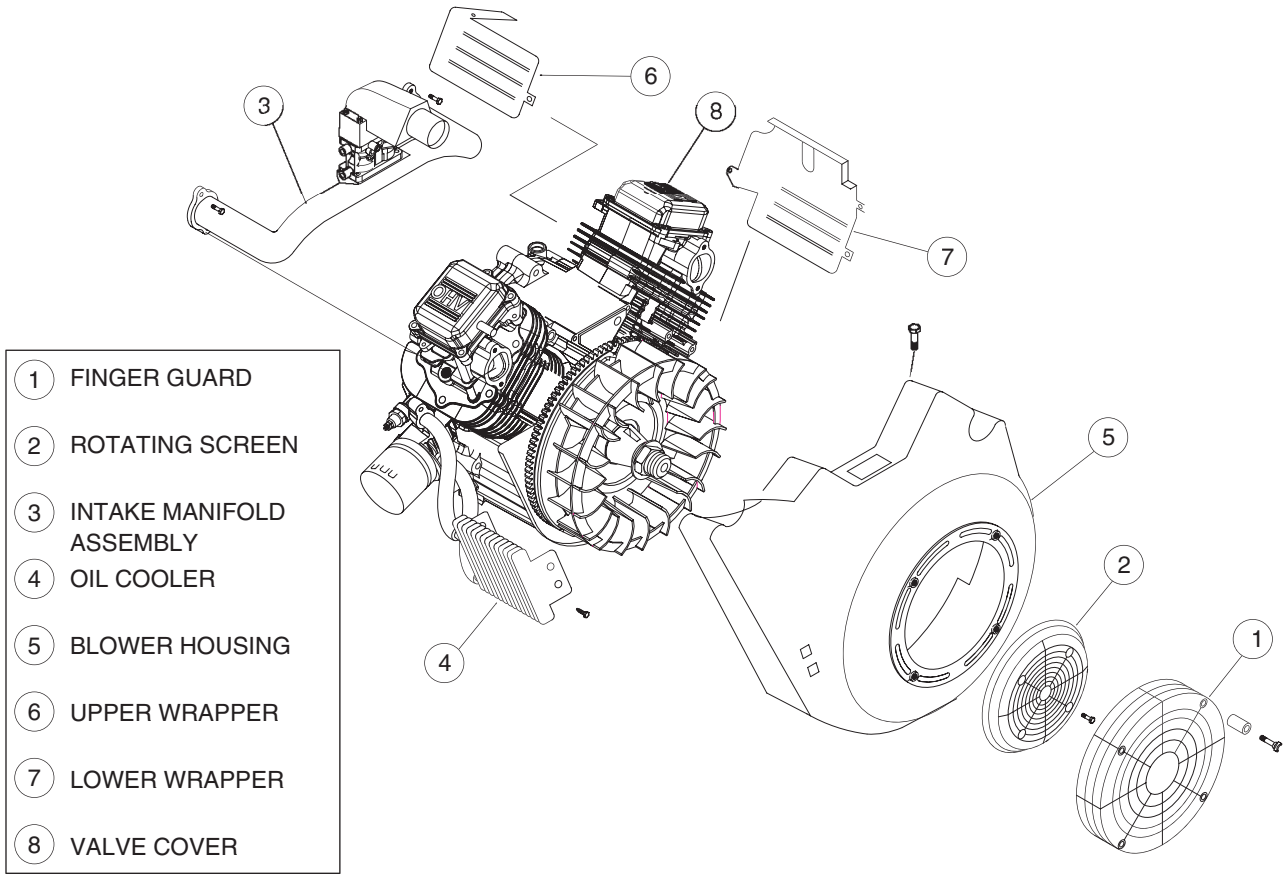


Figure 5-2.

Note: Mark components so that they may be reassembled in their original position.

REMOVE ROCKER ARMS:

1. Unlock jam nuts and remove two ball studs and rocker arm assemblies (see Figure 5-3).
2. Remove push rods and identify each.

Note: The valve push rods are aluminum. Mark push rods for identification to prevent interchanging.

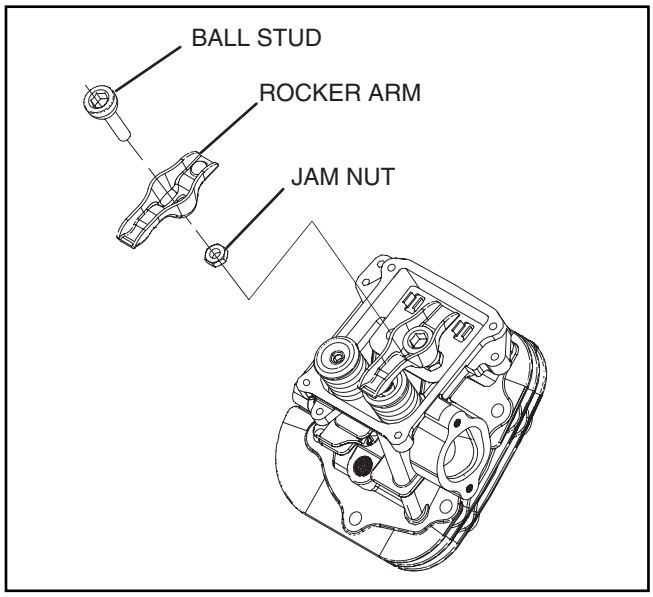


Figure 5-3.

3. Remove head bolts and cylinder head (Figure 5-4).
   a. Discard gasket.
4. Repeat Steps 1-3 for other cylinder head.

DISASSEMBLE CYLINDER HEAD

1. Place a shop rag or short section of rubber fuel line under valves inside combustion chamber to hold valve in place while compressing spring.
2. Hold down valve spring retainer by hand or with a valve spring compressor (Figure 5-5). Remove the following:
   a. Valve spring keepers
   b. Valve spring retainer
   c. Valve spring
   d. IN and EX valves
3. Remove and discard valve stem seals (Figure 5-6).

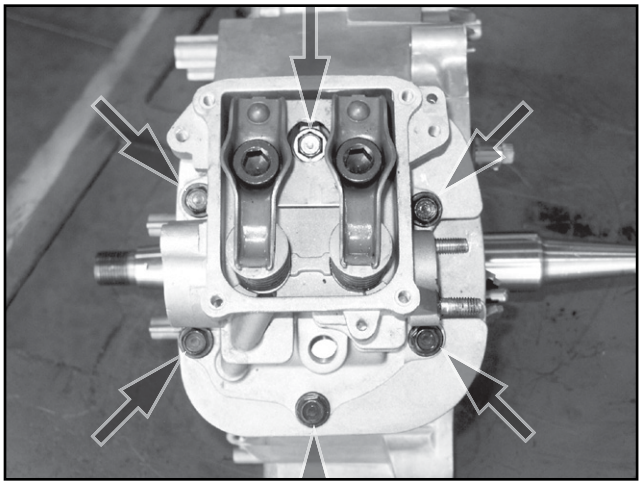


Figure 5-4. Remove Cylinder Head

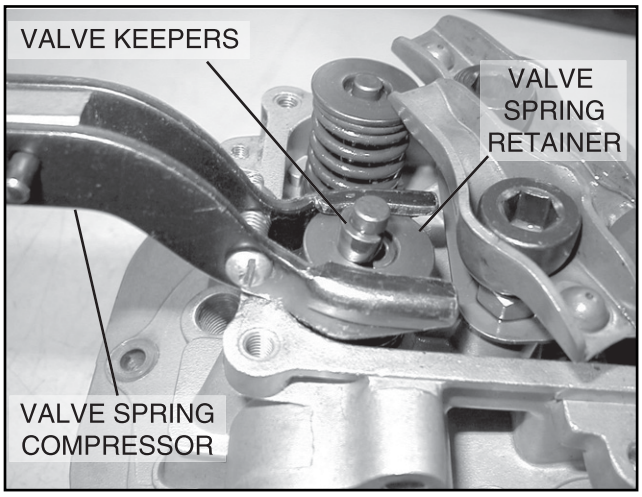


Figure 5-5. Removing Retainers

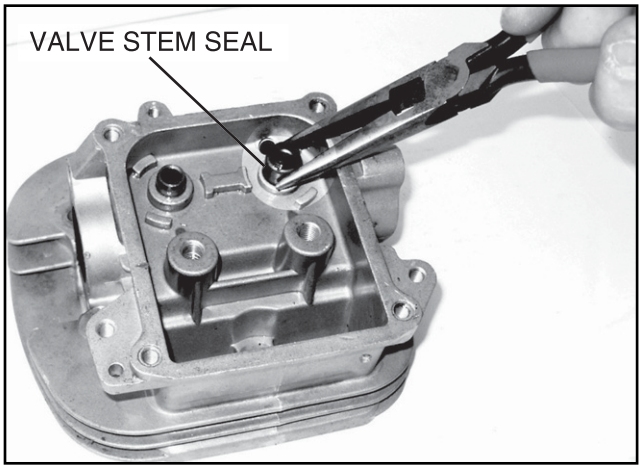


Figure 5-6. Removing Valve Stem Seals

INSPECT AND REPAIR

1. Check cylinder head (Figure 5-7). Be sure all gasket material is removed from surfaces before checking. Use a gasket scraper if necessary.

   a. Inspect cylinder head for cracks or damage.

   b. Use a surface plate or straightedge and check cylinder head mounting surface for distortion.

If mounting surfaces are distorted more than 0.1 mm (.004"), the cylinder head must be replaced.

Note: It is not recommended that cylinder head mounting surfaces be resurfaced.

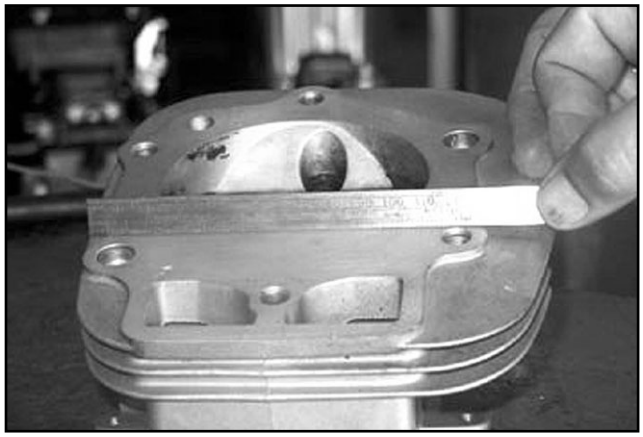


Figure 5-7. Check Cylinder Head Distortion

2. Clean the valve guides and measure their I.D. using a split ball bore gauge (Figure 5-8).

   a. Replace head if either valve guide measures 7.06 mm (0.278 in.) or more.

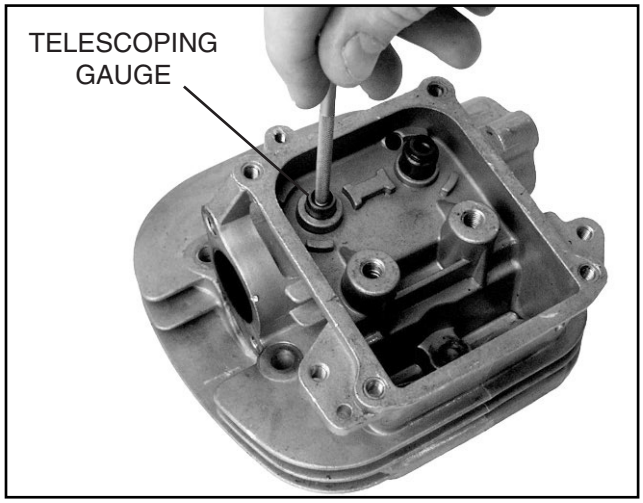


Figure 5-8. Check valve guides

REFACE VALVES AND SEATS:

1. Valve seats may be reconditioned using a valve seat cutter.

If valve seat is wider than dimension shown in Figure 5-9, a narrowing cutter should be used to ensure that contact area of valve seat is centered on face of valve (Figure 5-10).

   a. Use a 60° cutter to narrow seat from bottom and a 15° cutter to narrow seat from top (Figure 5-9).

Note: If valve seat is loose or cracked, replace cylinder head.

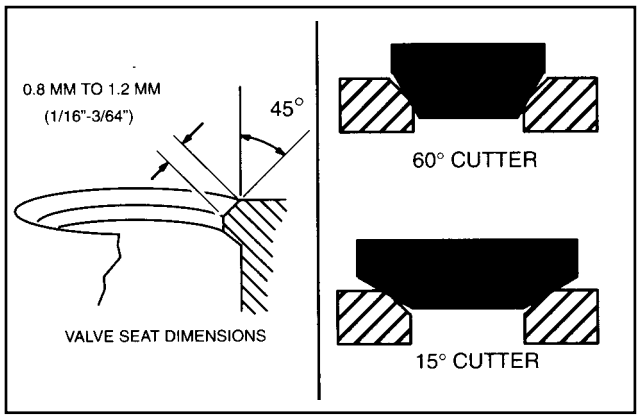


Figure 5-9. Valve Seat Dimensions

2. Valve faces may be resurfaced to 45°. See Figure 5-10 for dimensions for valves.

3. Lap valves and seats with a valve lapping tool and valve lapping compound.

Note: In most instances it is more economical to replace the valves than to reface them.

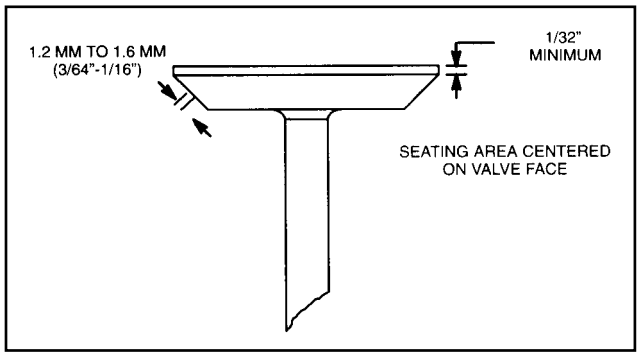


Figure 5-10. Valve Dimensions

4. Measure valve stem diameter at specified distance from end of valve, as shown in Figure 5-11.

Replace if less than 6.9 mm (0.272 inches), or if total clearance between valve stem and valve guide exceeds 0.12 mm (0.0047 in).

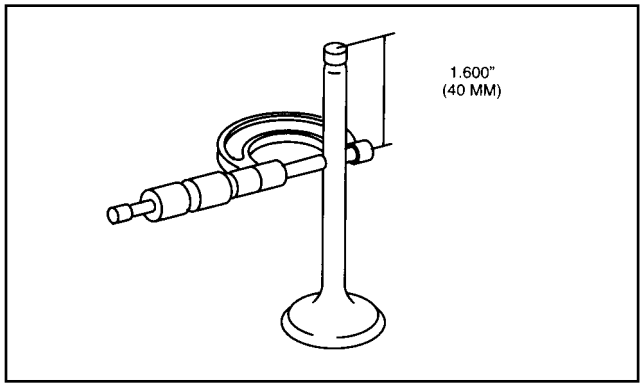


Figure 5-11. Measure Valve Stem Diameter

5. Check valve springs for free length (Figure 5-12).

   Replace if free length is less than 36.5 mm (1.437 inches).

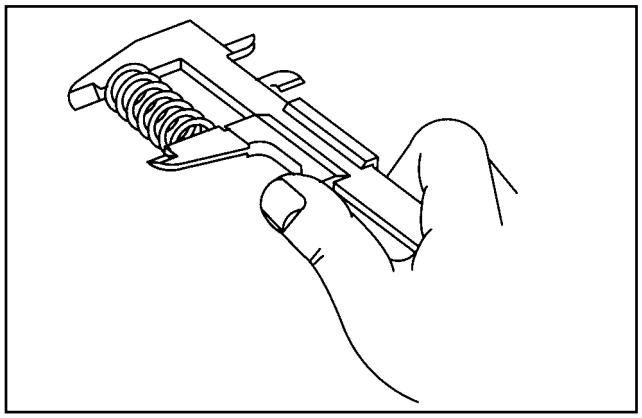


Figure 5-12. Check Valve Springs

ASSEMBLE CYLINDER HEAD

1. Install new valve stem seals.
   a. Oil inner surface and lip of valve stem seal.
   b. Press seal on to intake valve guide bushing until it bottoms (Figure 5-13).

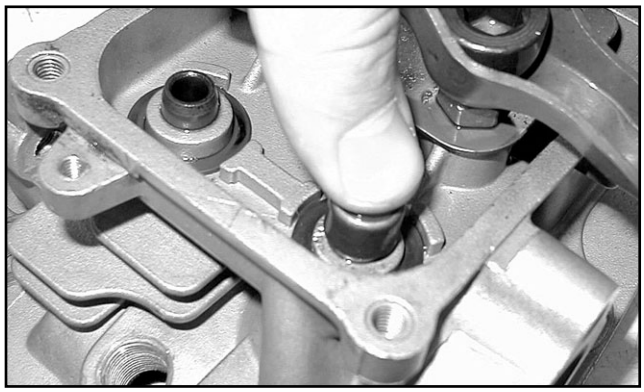


Figure 5-13. Install Valve Stem Seals

2. Install valves (Figure 5-14).

Note: Lightly coat valve stems with oil or Spectra Lube Red before installing valves. Be sure lubricant is not on valve face, seat or end of valve stem.

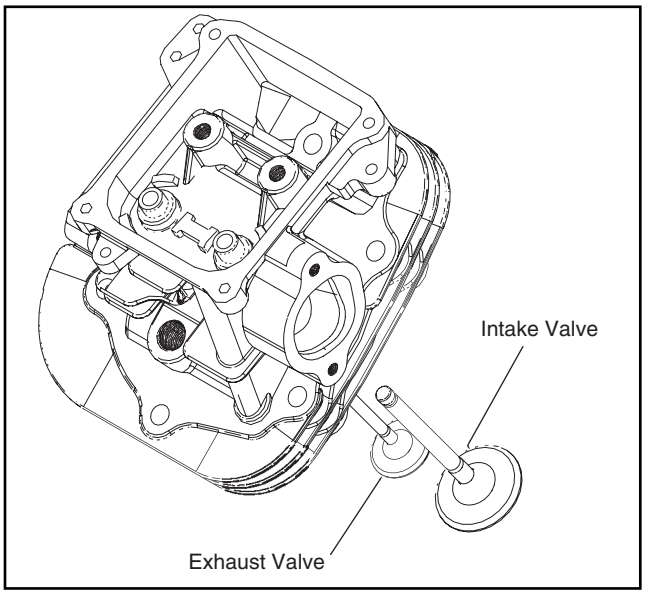


Figure 5-14. Install Valves

3. Place a shop rag or short section of rubber fuel line under valves inside combustion chamber to hold valve in place while compressing spring.
4. Install valve springs and valve spring retainers over valve stems.
5. Compress valve spring and install keepers (Figure 5-15).

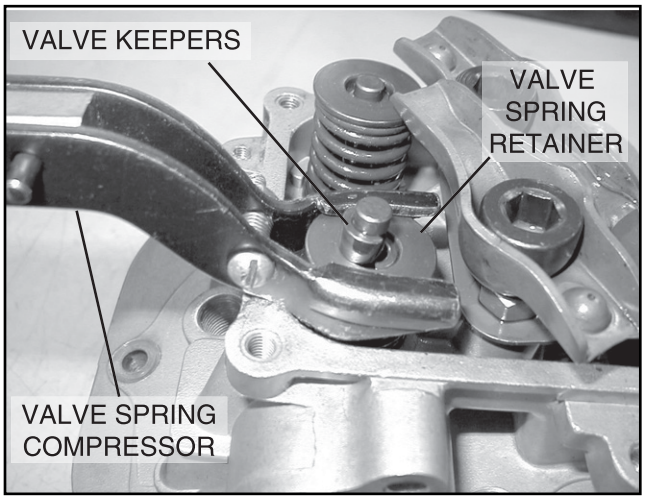


Figure 5-15. Compress valve spring and install keepers

6. Repeat procedure for other valves.
7. Set guide plate in place and loosely install rocker arm assemblies (ball stud, rocker arm and jam nut).
8. Repeat Step 7 for other head.

INSTALL CYLINDER HEAD

1. Install cylinder head with new gasket.
2. Torque head bolts in sequence shown to 29.9 Nm (22 ft. lbs.) (Figure 5-16).
3. Insert push rods into recess in tappets.

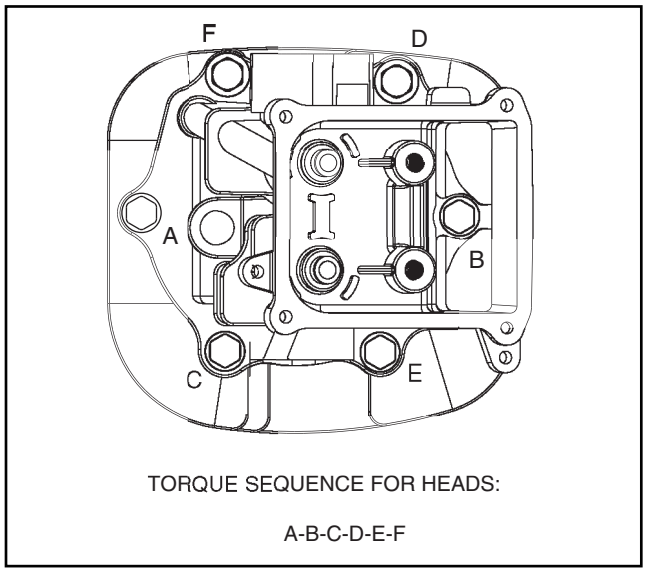


Figure 5-16.

ADJUST VALVE CLEARANCE

1. Set No. 1 cylinder at TDC, compression stroke.
   a. Adjust rocker arms and check clearance (Figure 5-17).

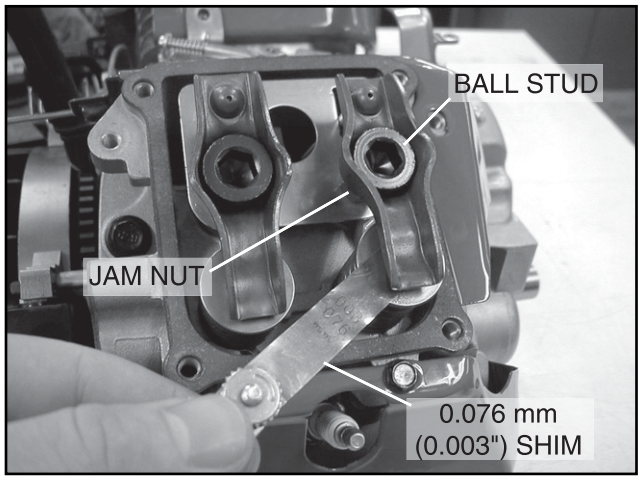


Figure 5-17. Adjust Valve Clearances

Valve Clearance (cold) IN and EX 0.0762 mm (.003").

   b. Torque jam nut and ball stud to 19 Nm (14 ft. lbs.).
2. Repeat for No. 2 cylinder.
3. Install valve covers with new gaskets, Figure 5-18.
   a. Torque nuts to 6.8 Nm (5 ft. lbs.).

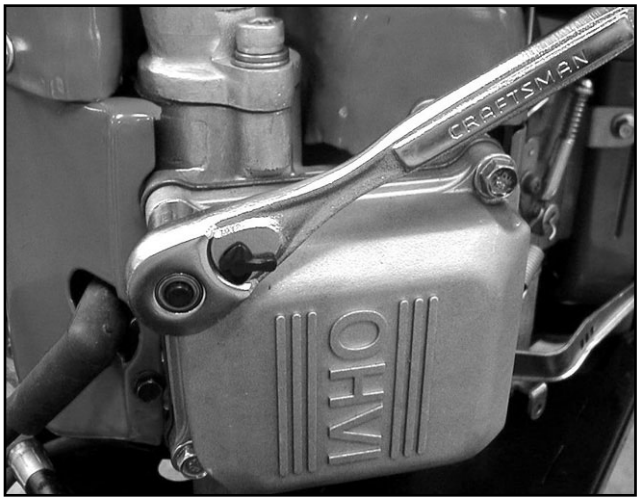


Figure 5-18. Install Valve Covers

REASSEMBLE

1. Install cylinder wrappers.
   a. Torque M5 screws to 2.8 Nm (25 in. lbs).
   b. Torque M6 screws to 4.5 Nm (40 in. lbs).
2. Install spark plugs.
   a. Torque to 20 Nm (180 in. lbs.).
3. Install exhaust manifold.
   a. Torque screws to 19 Nm (14 ft. lbs.).
4. Install blower housing.
   a. Torque screws to 4.5 Nm (40 in. lbs).
5. Install intake manifold with new gaskets.
   a. Torque screws to 19 Nm (14 ft. lbs.).
   b. Assemble governor link to carburetor.

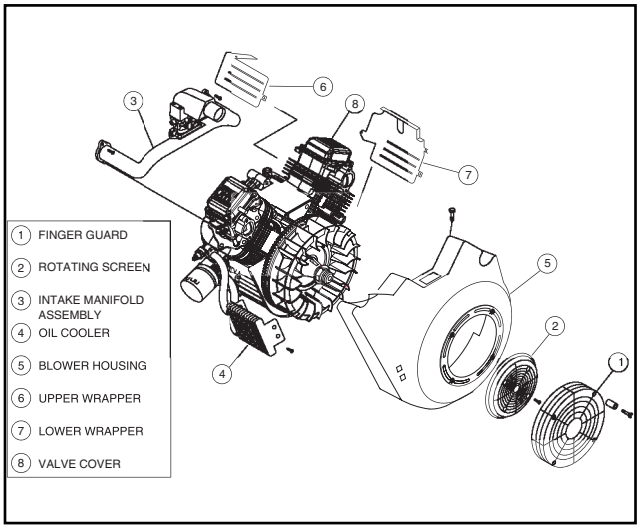


Figure 5-19. General Assembly

6. Install rotating screen.
   a. Torque screws to 1.9 Nm (17 in. lbs).
7. Install finger guard.
   a. If engine is equipped with hex head screws, torque screws to 4.5 Nm (40 in. lbs).
   b. If engine is equipped with finger screws, tighten screws by hand to approximately 1.3 Nm (12 in. lbs.).
8. Assemble air cleaner.

WARNING: Before starting or running engine, static adjustment of the governor must be completed! Failure to make the static adjustments first could result in engine overspeeding which may result in engine damage, property damage or personal injury.

STATIC GOVERNOR ADJUSTMENT

1. With governor lever clinching screw loose, push on governor lever until throttle is wide open. Do not bend governor link or distort governor lever.
2. Rotate governor arm clockwise as far as it will go (Figure 5-20).
   a. Torque clinching screw to 11.3 Nm (100 in. lbs).
3. Check to make sure that the throttle travels from WOT to IDLE. If it doesn't, the governor will need to be reset again.
4. Install throttle and choke control cables and check for proper operation.

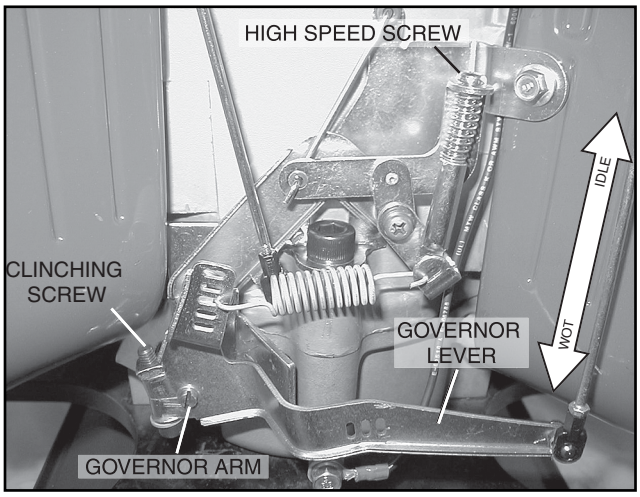
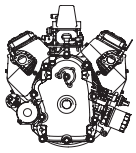


Figure 5-20. Static Governor Adjustment



SECTION CONTENTS

GENERAL INFORMATION

The starter motor uses a gear type engagement method, similar to an automobile starter. When the starter motor is activated, the pinion gear engages a ring gear attached to the engine flywheel and cranks the engine.

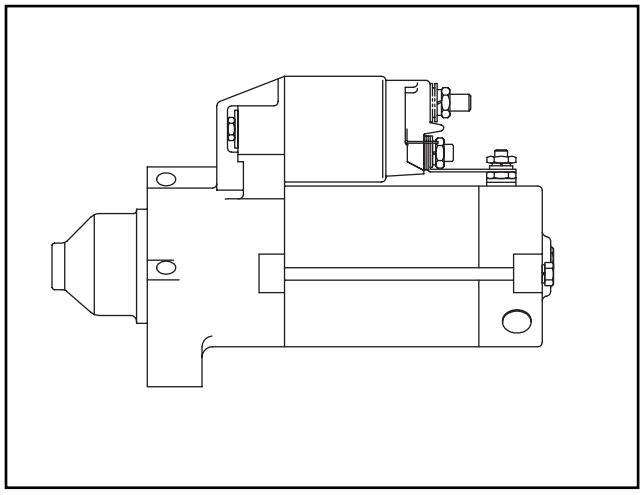


Figure 6-1. Starter Motor

TROUBLESHOOTING

NOTE: If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plugs and turning the crankshaft over slowly by hand, to be sure it rotates freely.

WARNING: DO NOT ROTATE ENGINE WITH ELECTRIC STARTER WITH SPARK PLUGS REMOVED. ARCING AT THE SPARK PLUG ENDS MAY IGNITE THE GASOLINE VAPOR EXITING THE SPARK PLUG HOLE.

ENGINE CRANKS SLOWLY:

a. Additional load affecting performance (see note above).
b. Discharged battery.
c. Faulty electrical connection (battery circuit).
d. Discharged battery (see alternators).
e. Dirty or worn starter motor commutator, bearing, weak magnets, etc.
f. Worn brushes or weak brush spring.
g. Wrong oil viscosity for temperature expected.
h. Battery leads too long or wire too small.
i. Battery too small.

ENGINE WILL NOT CRANK:

a. Faulty safety interlocks.
b. Discharged or defective battery.
c. Faulty electrical connections.
d. Faulty starter motor switch (open circuit).
e. Open circuit in starter motor.
f. Brushes sticking, etc.
g. Faulty solenoid.

STARTER MOTOR SPINS BUT DOES NOT CRANK ENGINE:

a. Sticking pinion gear due to dirt.
b. Damaged pinion or ring gear.
c. Battery faulty or damaged.
d. Incorrect rotation due to reversed motor polarity – all motors rotate counterclockwise viewed from pinion gear.
e. Damaged solenoid

STARTER MOTOR SPINS BUT WILL NOT STOP:

a. Defective starter switch.
b. Solenoid stuck engaged.

TEST EQUIPMENT

The following is a list of equipment recommended to test and repair starter motors.

DIGITAL MULTIMETER:

A digital multimeter (VOM) may be used to read volts, ohms, amperes and test diodes (rectifiers), Figure 6-2.

NOTE: The Digital Multimeter is equipped with two fuses to prevent damage to the meter in the event that the input limits are exceeded. If the meter displays a reading of 0.00 when testing DC output, check fuses in meter. Refer to VOM operators manual for procedure for checking fuses.

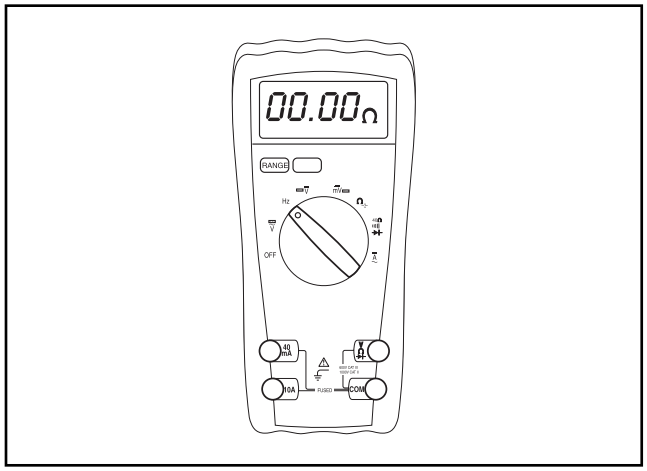


Figure 6-2. Digital Multimeter

TEST STARTER MOTOR

TESTING STARTER SOLENOID:

The solenoid is a normally open, electrically activated switch. With the keyswitch in the "START" position, the switch closes, allowing battery current to flow to the starter motor and crank the engine.

1. The solenoid may be tested while mounted on the engine.
2. A jumper test lead is required for this test.
3. Remove positive battery cable from battery. Then remove battery cable from stud terminal on solenoid.
4. Disconnect yellow wire from tab terminal on solenoid.
5. Keyswitch must be in "OFF" position.
6. Insert red test lead into VΩ→⊢ receptacle in meter.
7. Insert black test lead into COM receptacle in meter.
8. Rotate meter selector to →⊢ position.
9. Attach one meter test lead to each stud terminal on the solenoid (Figure 6-3).
10. Attach one end of jumper lead to positive terminal on battery.
11. Touch jumper wire to tab terminal on solenoid.
    a. An audible "Click" should be heard as the solenoid switch "closes."
    b. Meter should make a continuous tone (continuity).

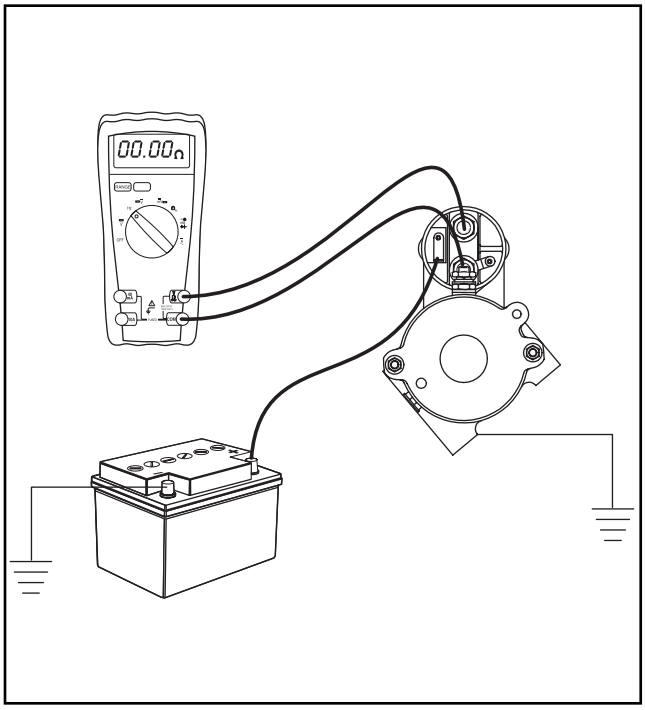


Figure 6-3. Testing Solenoid

BATTERY INFORMATION

A 12 volt battery is used to operate starter motors on Generac OHVI v-twin engines. For best starter life and performance, the battery should have a rating of at least 525 cold cranking amps at 0°F.

WARNING: Wear eye protection when servicing the battery. Avoid skin contact. If contact does occur, flush with cold water and consult a physician.

CAUTION: Before servicing battery, disconnect negative (-) battery cable and then disconnect the positive (+) battery cable.

WARNING: Batteries produce hydrogen, an explosive gas. Do not store or charge a battery near an open flame or devices which utilize a pilot light or can create a spark.

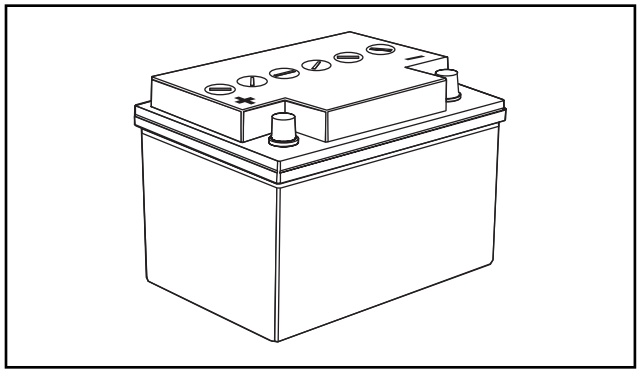


Figure 6-4. Typical Battery

INSTALLATION:

1. Before installing battery, connect all equipment to be operated.
2. Place battery in holder with flat base. Tighten holder down evenly until snug. DO NOT overtighten.
3. Connect positive terminal to positive post FIRST to prevent sparks caused by accidental grounding. Tighten connectors securely.
4. Connect negative terminal to negative battery terminal. Tighten connectors securely.

CHECKING BATTERY:

1. Physical check – clean if necessary.
   a. Corrosion
   b. Dirt
   c. Terminal and clamps (secure – good condition)
2. Bring battery to full charge.

WARNING: DO NOT exceed charge rate of 1/10 ampere for every ampere of battery rating. Consult battery manufacturer for maximum charge recommendations.

   a. Use a taper charge (automatically reduces charge rate).
   b. Fill non-sealed battery cells with distilled water after charging (for batteries that have been in service).

Note: If battery gets "Hot" to the touch or is spitting acid (gassing) excessively, unplug charger periodically.

3. With battery fully charged, check specific gravity readings of each cell with a Battery Hydrometer and record readings (Figure 6-5). All readings should be above 1.250 (compensating for temperature). If specific gravity readings varied 0.50 or if all cells read less than 1.225, replace battery.

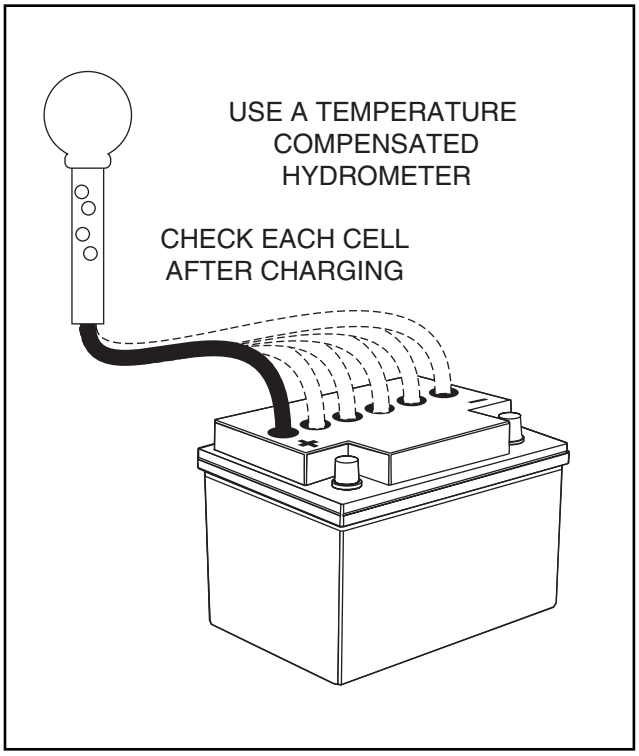


Figure 6-5. Checking 12 Volt Battery Cells

TESTING BATTERY:

Set a digital multimeter to read DC Volts.

Attach RED meter test lead to positive(+) battery terminal. Attach BLACK meter test lead to negative (-) battery terminal. With ignition switch "OFF," press starter button. If ignition switch and starter switch are the same switch, disconnect wires from spark plugs and ground ignition using two Ignition Testers. Turn switch to "START." Meter should display 9 volts or more while cranking engine. If less than 9 volts is measured, replace battery.

CAUTION: Do not crank starter motor for more than 15 seconds without allowing starter motor to cool at least 2 minutes.

BATTERY RECOMMENDATIONS:

The battery size recommended is 525 CCA@0.

BATTERY CABLE RECOMMENDATIONS:

These cable sizes are based on total length of cable from battery positive post to starter, plus ground return to battery negative post.

#4 AWG — 1.8 m (6 ft.) or less

#2 AWG — 3.7 m (12 ft.) or less

OPTIONAL WIRE HARNESS

Engines supplied with a wire harness have a Packard #2973422 five terminal female plug on the harness.

- Terminal 1 has a brown wire coming from it and is used to signal low oil pressure. When low oil pressure is detected, Terminal 1 becomes a ground. Otherwise it is open.
- Terminal 2 has a yellow wire coming from it and is used to kill the ignition. Connect this terminal to ground and the ignition will be shut off.
- Terminal 3 isn't used.
- Terminal 4 has a white wire coming from it. Connect this terminal to +12 V DC and the carburetor will allow fuel to flow. Turn off the +12 V supply, and the fuel solenoid will close, stopping the flow of fuel.
- Terminal 5 has an orange wire coming from it. This wire is used to start the engine. Supply +12 V DC to this terminal and the starter solenoid will engage. Turn off the +12 V supply, and the starter will disengage.

Figures 6-6 through 6-9 show the proper connections for the wiring harness and how it is routed.

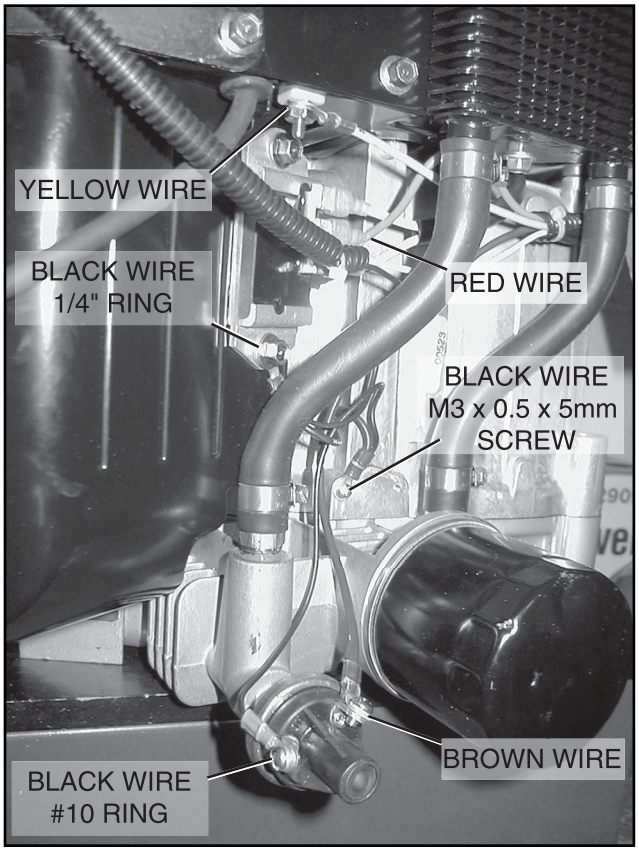


Figure 6-6.

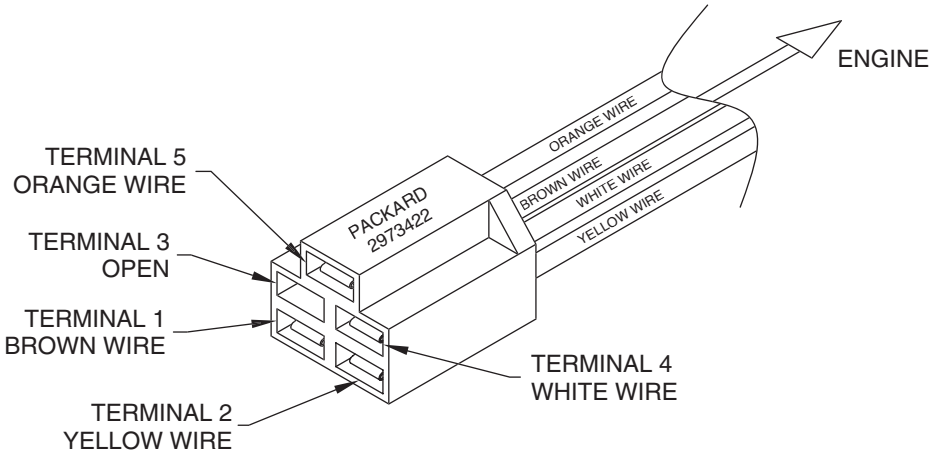


Figure 6-7. Optional Wire Harness Terminal Identification

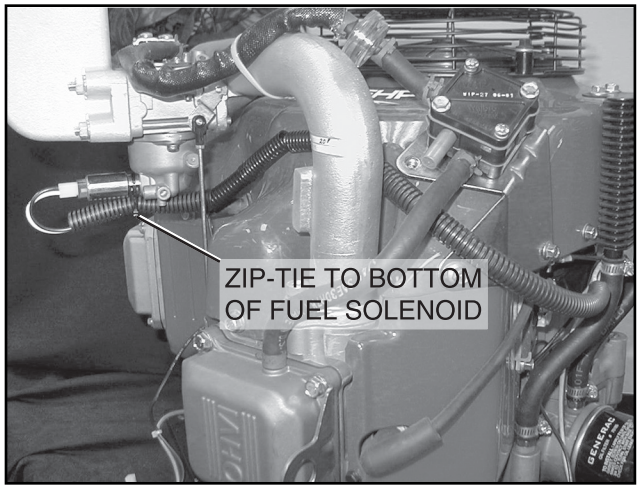


Figure 6-8.

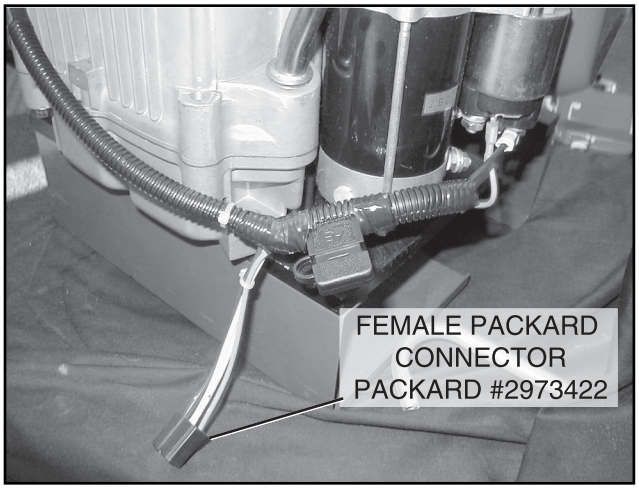


Figure 6-9.

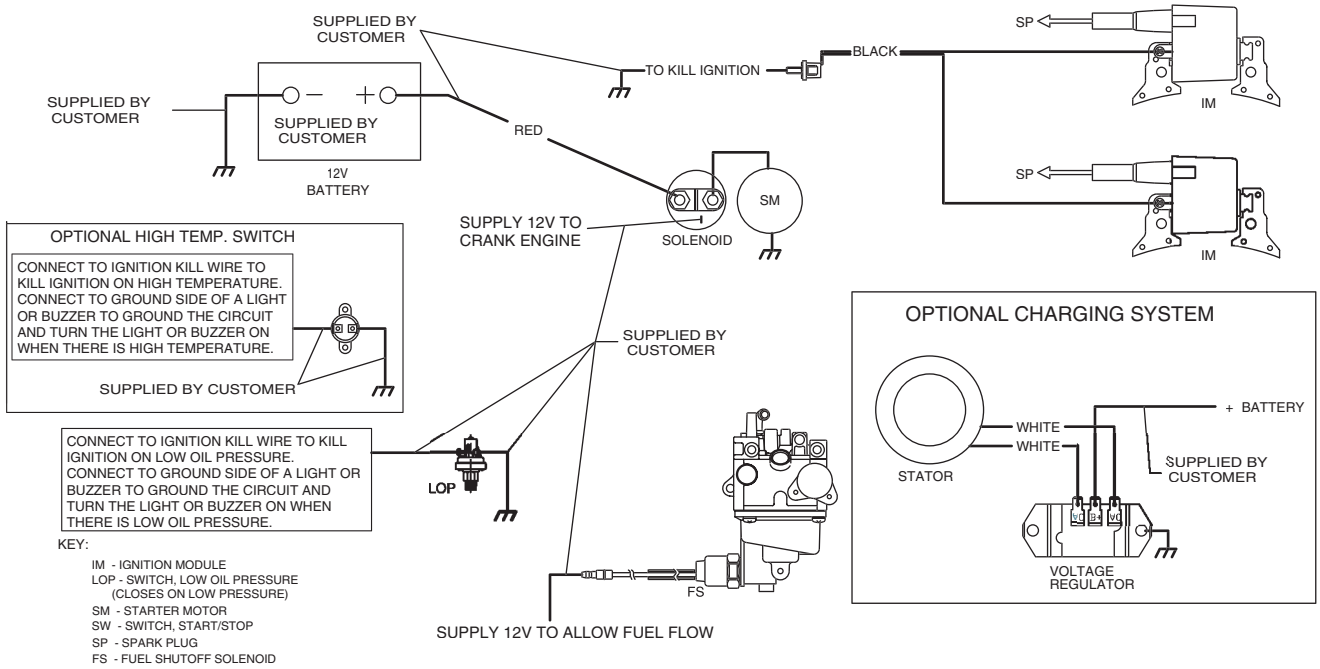
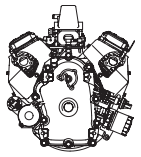


Figure 6-10. Typical 12 Volt Wiring Diagram

NOTES



SECTION CONTENTS

20 AMP REGULATED ALTERNATOR

The 20 amp regulated alternator system provides AC current through two output leads to the regulator-rectifier. The regulator-rectifier converts the AC current to DC, and regulates the current to the battery. The charging rate will vary with engine RPM and temperature.

The stator, regulator-rectifier and flywheel are NOT interchangeable with any other alternator system.

WHEN CHECKING THE ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

ALTERNATOR OUTPUT TEST:

Temporarily, disconnect stator wire harness from regulator-rectifier.

1. Insert RED test lead into V Ω ⇥⊢ receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to V~ (AC volts) position.

CAUTION: ATTACH METER TEST LEADS TO AC OUTPUT TERMINALS (WHITE WIRES) BEFORE STARTING ENGINE. IF STATOR IS GROUNDED (DEFECTIVE), AND METER TEST LEADS CONTACT CENTER DC OUTPUT PIN, ARCING MAY OCCUR WHICH MAY DAMAGE WIRING.

Figure 7-1. Testing AC Output

4. Attach RED and BLACK test lead probes to AC output terminals (white wires), as shown in Figure. 7-1. (Meter test clip leads may be attached to either AC output terminal.)
5. With the engine running at 3600 RPM output should be no less than:

26 Volts - 20 Amp System

6. If no or low output is found. check for bare wires or any other obvious defects. If "shorted" leads are not visible, replace the stator.

TESTING DC OUTPUT CHARGING WIRE:

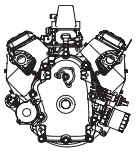
A simple test may be performed to test the DC output charging wire circuit. If a problem exists in the wiring it can be corrected before testing regulator-rectifier.

Leave stator wire harness disconnected from regulator-rectifier.

Equipment keyswitch must be in OFF position.

1. Insert RED test lead into V Ω ⇥⊢ receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to $\overline{V}$ (DC volts) position.
4. Attach RED test lead probe to DC output wire terminal, Figure 7-2.
5. Attach BLACK test lead probe to negative battery terminal.
6. Turn equipment keyswitch to ON position. Meter should display battery voltage.
7. If meter does not display battery voltage, check for blown fuse or broken or shorted wires.

Figure 7-2. Testing DC Output Wire



TESTING REGULATOR-RECTIFIER:

1. Using a digital multimeter, test the battery voltage while the engine is NOT running.
2. With the charging system properly connected, start the engine.
3. Bring the engine up to normal operating speed and test the battery voltage again.
4. If the battery voltage while the engine is running is greater than when the engine is stopped, the charging system is working.

Note: With the engine running, the battery voltage should be at least 13 Volts.

BATTERIES

Note: See Section 6 for battery size and cable selection information.

SECTION CONTENTS

DESCRIPTION

The Generac GTV-990/760 OHVI V-twins use a full pressure lubrication system with an oil filter. The gerotor type oil pump draws oil from a screened oil pickup in the sump and pumps the oil through the oil filter.

The filtered oil flows through an oil galley in the sump and is distributed to the main bearings, connecting rod bearings and camshaft bearings. Engine oil pressure will vary with oil viscosity, ambient air temperature differences, operating temperatures and engine load. Follow the oil recommendation on page 8-2 of this section.

Oil Pressure - @ 70° F (21 ° C):

15 - 50 psi (1.0 - 3.5 Bar)

A pressure relief valve limits the maximum oil pressure in the system.

PROTECTION SYSTEMS

LOW OIL PRESSURE SWITCH:

The engine is equipped with a low oil pressure sensor that closes the circuit between the terminals when the oil pressure drops below 8 psi. If one terminal is connected to the ignition kill wire and the other terminal is connected to ground, the engine will shut down on low oil pressure. If the engine shuts down by itself and the fuel tank has enough gasoline, check the engine oil level.

A delay built into the shutdown system on some engine applications allows oil pressure to build during starting. The delay allows the engine to run for about 10 seconds before sensing oil pressure. If the system senses low oil pressure during operation, the engine shuts down. The engine will not continue to run until 8 psi of oil pressure is reached. If you try to restart the engine within (five) 5 seconds after it shuts down, the engine may NOT start. The system needs 10 seconds to reset.

NOTE: If you restart engine after a shutdown and have not corrected the low oil pressure, the engine may run for about 10 seconds as described above, and then it will stop.

HIGH TEMPERATURE SWITCH (OPTIONAL):

This switch's (not shown) contacts close if the temperature should exceed approximately 140° C (284° F), initiating an engine shutdown. In certain applications, the equipment will automatically restart and the LED will reset once the temperature has returned to a safe operating level.

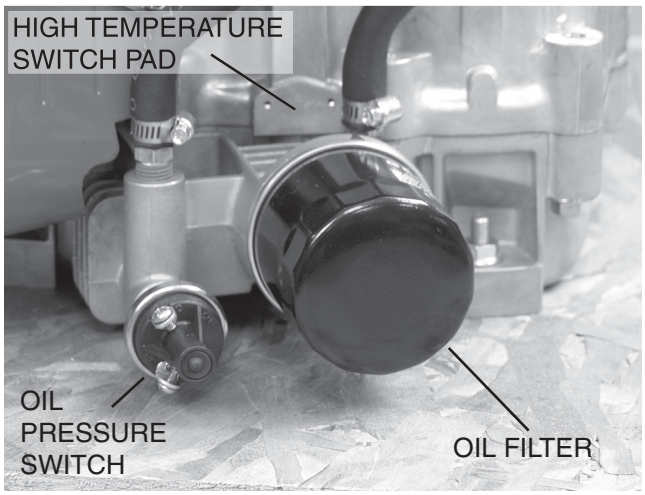


Figure 8-1. Engine Protective Devices

CHECKING THE ENGINE OIL LEVEL

The oil capacity of the GTV-990/760 OHVI engine is approximately 2 quarts. To check the engine oil level, proceed as follows:

1. Remove the dipstick and wipe it dry with a clean cloth.
2. Install the dipstick completely; then remove it again. The oil level should be at the dipstick "Full" mark. If necessary, add oil until the "Full" mark is reached. DO NOT FILL ABOVE THE "FULL" MARK.

Never operate the engine with the oil level below the "Add" mark on the dipstick. Doing this could damage the engine.

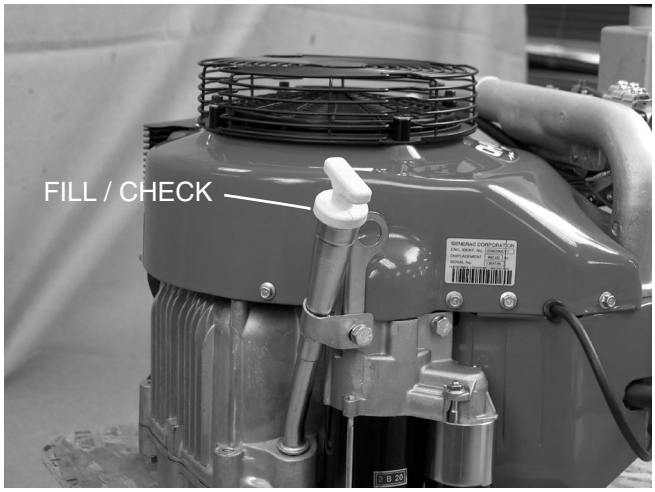


Figure 8-2. Location of Oil Fill/Check

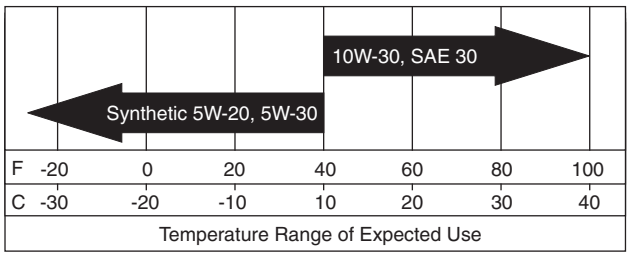
CHANGING THE ENGINE OIL AND FILTER

RECOMMENDED OIL TYPE:

Using the proper type and weight of oil in the crankcase is extremely important. Check the oil before each use and change the oil regularly. Failure to use the correct oil, or using dirty oil, can cause premature engine wear and failure.

Use only high quality detergent oil rated with API service classification SF, SG or SH. The recommended oil weights include the following:

- During summer months: SAE 30. An acceptable substitute is SAE 10W-30. After first oil change, synthetic oil is acceptable.
- During winter months: SAE 5W-30, Synthetic 5W-20 or 5W-30. DO NOT USE SAE 10W-40.



The crankcase oil capacity is about 2030 ml (2.1 qt.) with the oil filter. Without the filter, the oil capacity is 1750 ml (1.8 qt.). Use no special additives. Make sure that the unit is level when filling with oil. DO NOT OVERFILL.

⚠ Any attempt to crank or start the engine before it has been properly serviced with the recommended oil may result in an engine failure.

OIL CHANGE PROCEDURE:

Your engine is equipped with an oil filter. Change the oil and filter after the first eight (8) hours of operation. Change the oil and oil filter every 100 hours thereafter. If you are using this engine under dirty or dusty conditions, or in extremely hot weather, change the oil more often.

Use the following instructions to change the oil while the engine is still warm:

1. Clean the area around the oil drain plug, remove the plug and drain the oil completely into a suitable container (Figure 8-3).
2. When the oil is drained, install and tighten the oil drain plug.

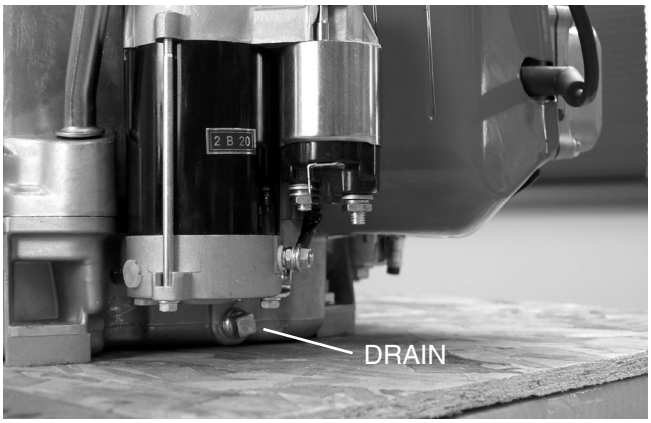


Figure 8-3. Oil Drain Location

Figure 8-4. Removal of Oil Filter

3. When changing the oil filter, use the following instructions:
   A) Locate oil filter (Figure 8-4).
   B) Place a suitable container beneath the oil filter and turn the filter counterclockwise to remove the filter.
   C) Coat the gasket of a new filter with engine oil. Turn the new filter clockwise until the gasket contacts the filter adapter, then tighten an additional 3/4 turn.
4. Remove the oil fill cap and insert a clean funnel into the oil fill opening. Fill the crankcase with the recommended oil until the oil level is at the full point on the dipstick. Approximately 2030 ml (2.1 qt.) are required when changing the oil and oil filter. POUR SLOWLY.
5. When the crankcase is filled to the proper level, install the oil fill cap. Start engine to fill oil filter, recheck/correct oil level.

OIL COOLER:

Some engines are equipped with an oil cooler. The oil cooler is mounted on the blower housing. Forced air from the flywheel fan flows through the oil cooler fins dissipating heat from the engine oil.

The oil cooler fins should be cleaned every 100 hours and checked periodically for debris and cleaned with compressed air or a soft bristle brush.

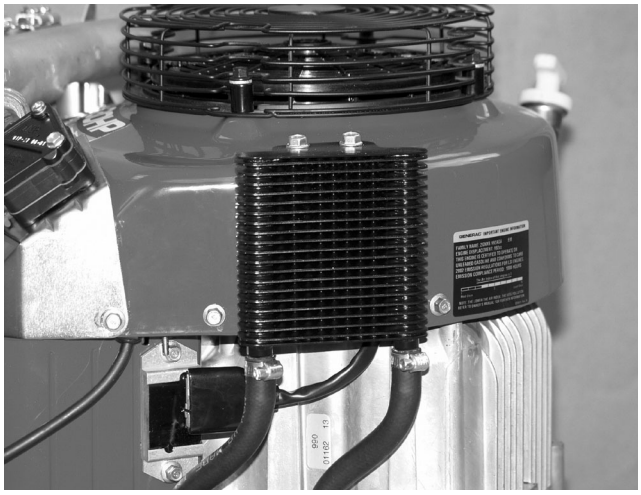
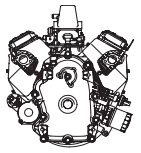


Figure 8-5. Oil Cooler

NOTES



SECTION CONTENTS

ENGINE DISASSEMBLY

Drain oil, remove oil filter and remove engine from equipment. Remove spark plugs. Remove flywheel, disconnect stop switch wires at armatures and remove armatures (see Section 2). Remove cylinder heads (see Section 5).

1. Remove the following parts (Figure 9-1):
   a. Breather Assembly b. Alternator
   c. Backplate d. Starter Motor
2. Remove crankcase cover/sump.
   a. Discard gasket and O-ring.

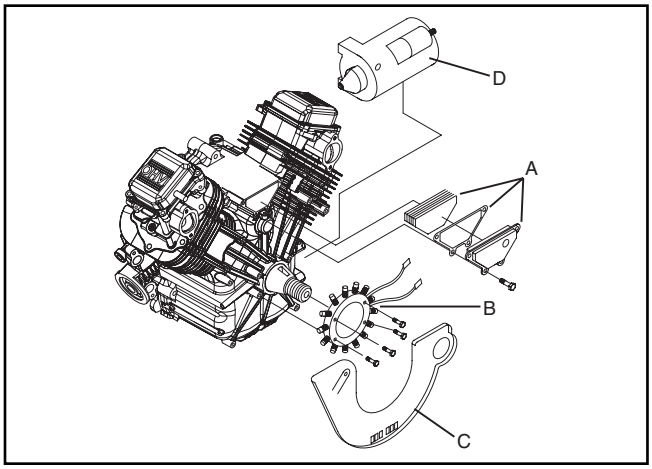


Figure 9-1. Remove Alternator, Backplate, Starter Motor

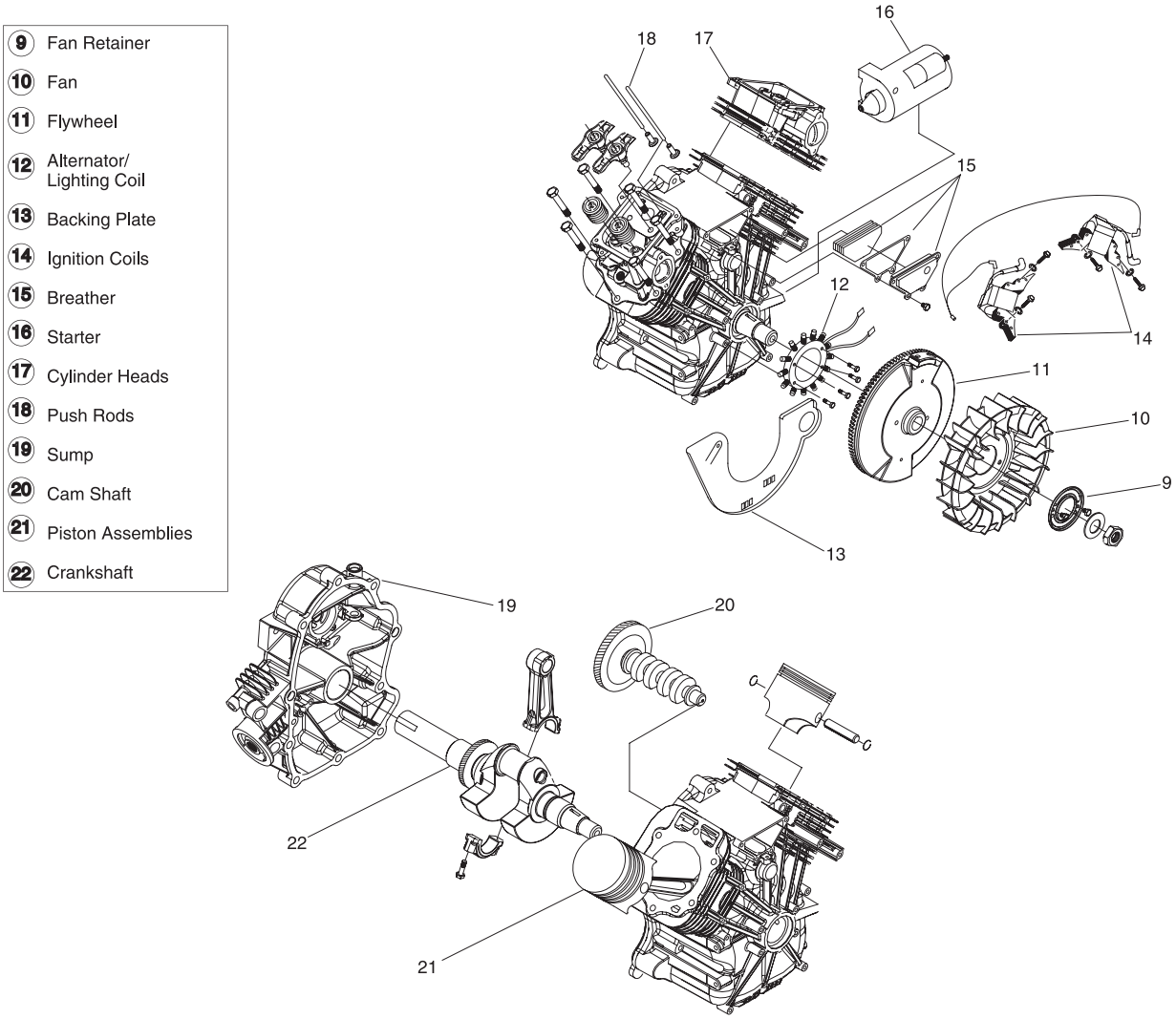


Figure 9-2.

3. Rotate crankshaft and camshaft until timing marks align and remove camshaft (Figure 9-3).

Note: If necessary, place the engine flywheel side down to prevent tappets from catching on the camshaft.

a. Remove tappets.

Note: Remove any carbon or ridge at the top of the cylinder bores to prevent breaking rings when removing piston and connecting rod assemblies.

4. Remove No. 2 connecting rod cap and push connecting rod and piston assembly out of cylinder (Figure 9-4).

a. Reassemble cap to rod to prevent interchanging.

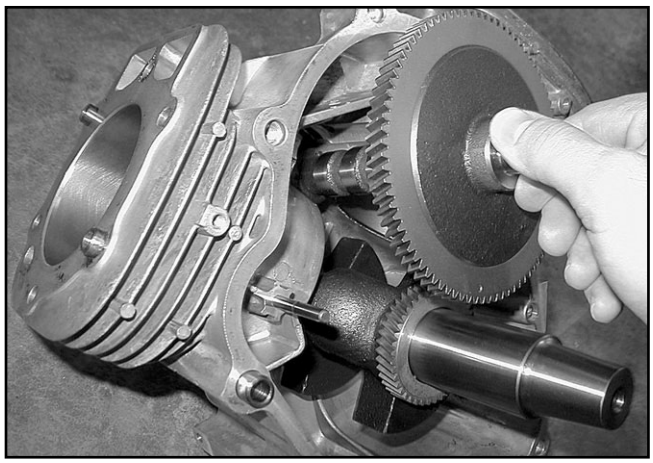


Figure 9-3. Remove Camshaft

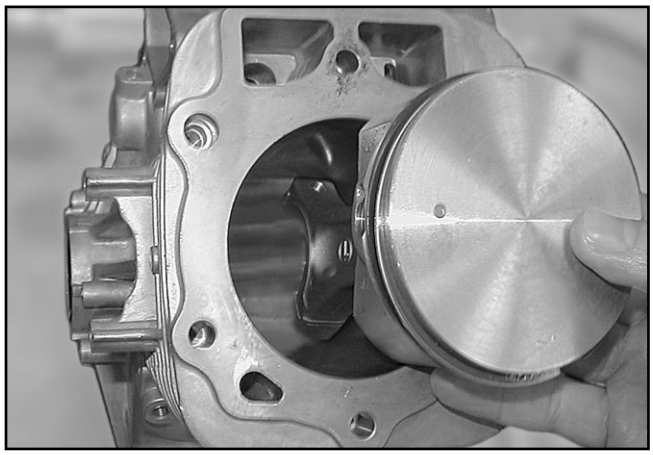


Figure 9-4. Remove Pistons and Connecting Rods

5. Repeat for remaining cylinder.
6. Remove crankshaft (Figure 9-5).

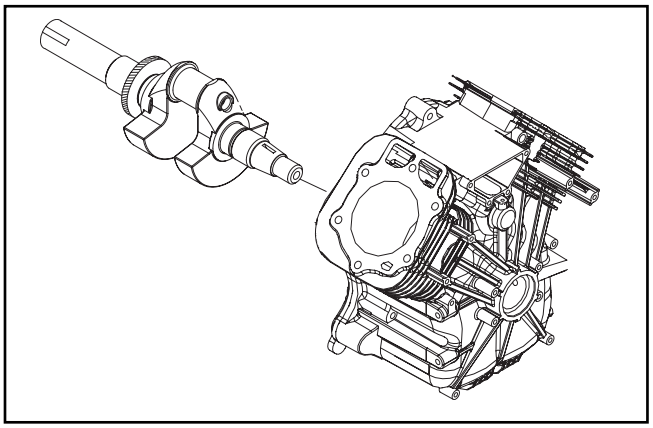


Figure 9-5. Remove Crankshaft

7. Remove oil pump from crankcase cover.

Note: Clean all surfaces of gasket material. Remove oil seals and thoroughly clean components in solvent. Organize components, keeping parts which are assemblies together.

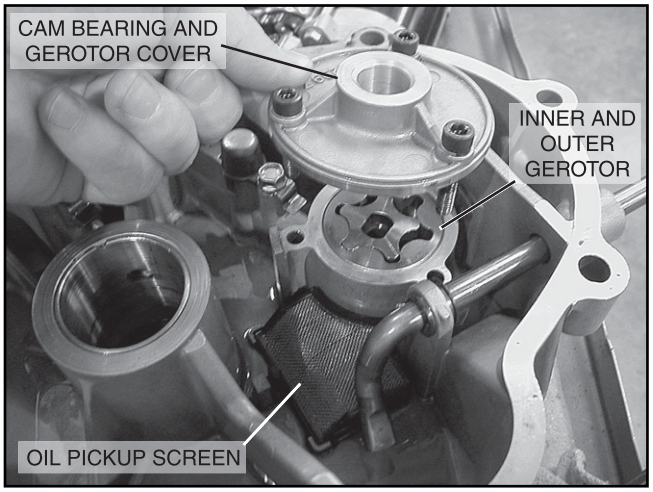


Figure 9-6. Remove Oil Pump

SECTION CONTENTS

CHECK CRANKCASE

Check crankcase for cracks, stripped threads or broken fins. Check cylinder bores for damage or scoring.

1. Check cylinder head mounting surface for distortion with a straight edge, Figure 10-1.

If mounting surfaces are distorted more than 0.1 mm (.004"), the crankcase must be replaced.

Figure 10-1. Checking Cylinder Head Mounting Surface

2. Check cylinder bores for wear using telescoping gauge and dial caliper.

Standard Bore Size: 90.00-90.025 mm (3.543-3.544")

a. Measure cylinder bore in 6 points at right angles as shown, Figures 10-2 and 10-3.

b. If cylinder bore is worn more than 0.075 mm (.003") or more than 0.035 mm (.0015") out of round, it must be replaced.

NOTE: If cylinder bores are within specification and show no signs of scoring or other damage, new piston rings may be installed providing the cylinder bores are reconditioned using a rigid hone with finishing stones, to restore the proper cross hatch angle in the cylinder bores. The proper cylinder cross hatch ensures proper lubrication and piston ring break in.

Refer to "Cylinder Finish (Cross Hatch)" below for correct procedure for installing cross hatch.

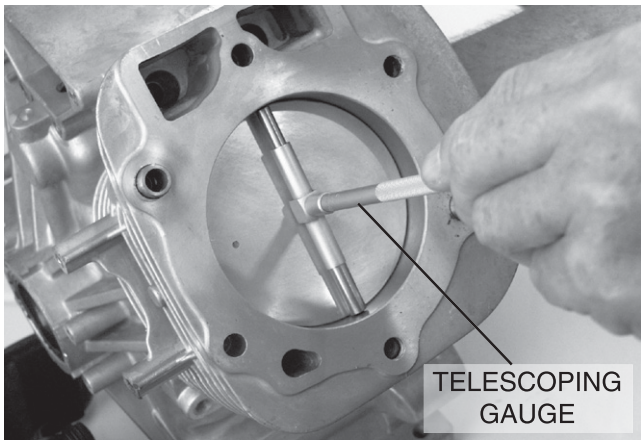


Figure 10-2. Check Cylinder Bore

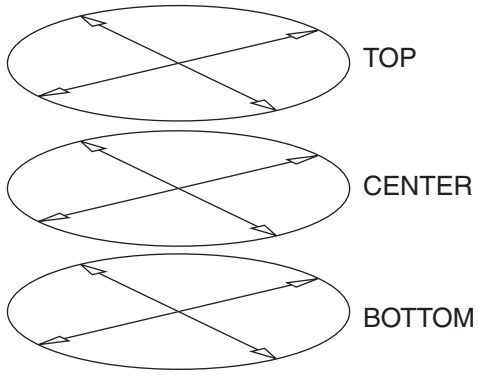


Figure 10-3. Measure at Six Points

RESIZING:

Note: Oversize kits are NOT available. DO NOT bore cylinder.

CYLINDER FINISH (CROSS HATCH):

Finishing stones are used when reconditioning a cylinder bore. The finishing stones will produce the correct cross hatch necessary for proper lubrication. The correct cross hatch angle is approximately 45 degrees, Figure 10-4.

It is recommended that the cylinder bores be reconditioned to restore the cross hatch when new piston rings are to be installed in a cylinder that is within specification. Be careful not to hone oversize or it will be necessary to replace the crankcase.

Honing is done with a variable speed 1 /2", portable drill and a honing fixture. See Page 10-5 for dimensions to make a honing fixture. Use two crankcase cover mounting screws to fasten the crankcase to the honing fixture, Figure 10-5.

Clamp honing fixture and crankcase securely in a vise at a convenient work height.

Place hone in middle of cylinder bore. Tighten adjusting knob with finger until stones fit snugly against cylinder wall. DO NOT FORCE. Cut a wood block and place inside cylinder to prevent hone from extending further than 3/4" to 1" (19 mm to 25 mm) below cylinder bore. Place hone drive shaft in chuck of portable drill and tighten. Be sure that cylinder and hone are centered and aligned with the drill spindle.

NOTE: To produce the proper cross hatch finish use a drill speed of approximately 200 RPM and 40-60 Hatch strokes per minute. Lubricate hone liberally to prevent build up on finishing stones.

NOTE: Automatic transmission fluid is an acceptable honing oil. Another acceptable honing oil can be made by mixing 4 parts No. 30 weight oil with 1 part kerosene.

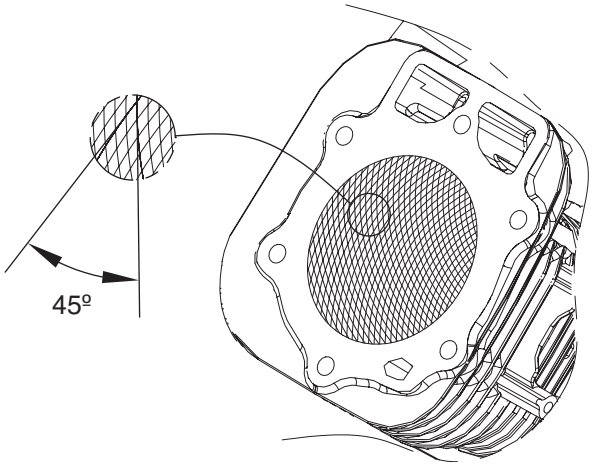


Figure 10-4. Cylinder Cross

CLEANING:

IT IS MOST IMPORTANT THAT THE ENTIRE CYLINDER AND CRANKCASE BE THOROUGHLY CLEANED AFTER HONING.

First wash the cylinder and crankcase carefully in a solvent such as kerosene or commercial solvent. Then thoroughly wash cylinder and crankcase using a stiff brush with soap and hot water. Rinse thoroughly with hot running water. Repeat washing and rinsing until all traces of honing grit are gone.

Honing grit is highly abrasive and will cause rapid wear to all of the internal components of the engine unless it is completely removed.

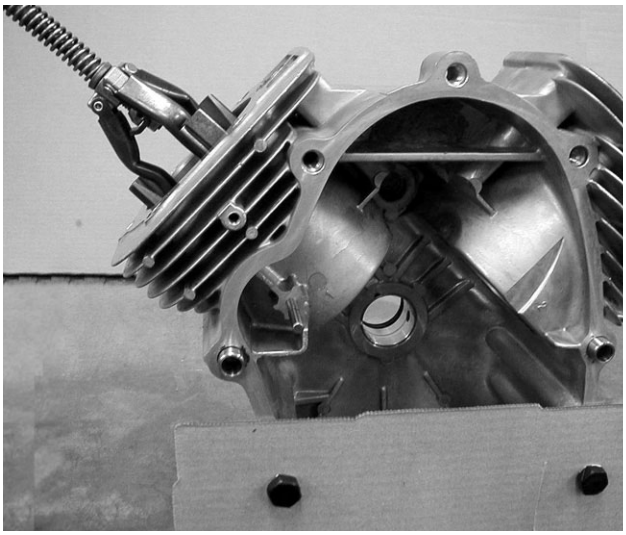


Figure 10-5. Honing Cylinders

NOTE: When cylinder and crankcase have been thoroughly cleaned, use a clean white rag or napkin and wipe the cylinder bore. If honing grit is present it will appear as a gray residue on rag. If any honing grit is evident, re-wash and rinse entire cylinder and crankcase and check again. When there is no trace of honing grit on rag, the cylinder is properly cleaned. Then oil cylinder bore to prevent rusting.

BEARINGS

CHECK MAG BEARING:

Check magneto bearing for damage. Damaged bearings must be replaced. If not damaged, check for wear using a telescoping gauge and caliper (see Figure 10-6). Measure at several locations. If the measured diameter is larger than 38.25 mm (1.506"), the bearing must be replaced.

The diameter of the crankshaft may also make it necessary to replace the bearing. See Section 11 for the crankshaft measurement details.

REMOVE MAG BEARING:

1. Remove seal.
2. Place crankcase flat upon a press and remove bearing using a bushing driver (Figure 10-7).

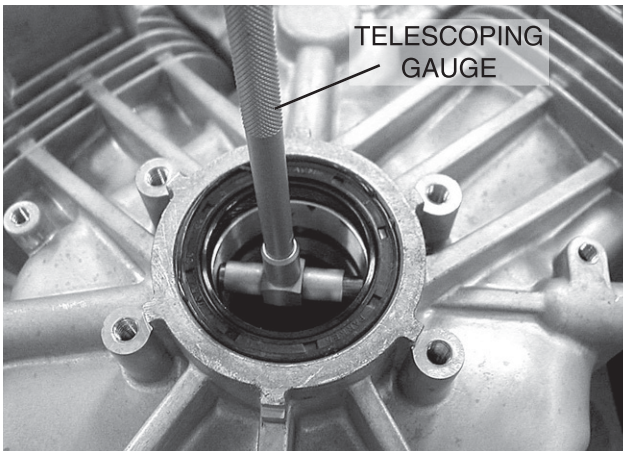


Figure 10-6. Check Mag Bearing

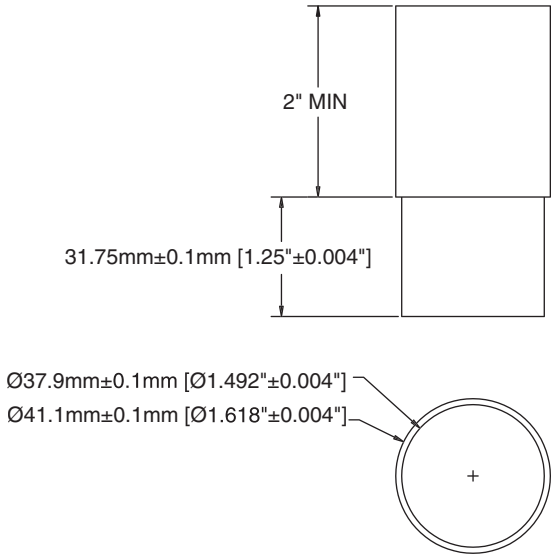


Figure 10-7. Mag Bearing Driver

INSTALL MAG BEARING:

1. Place Crankcase on a press, seal side down.
   a. Make sure that the crankcase is supported by the seal boss.
2. Set the new bearing in the crankcase with the notch up and the oil holes lined up with the passages in the crankcase.
3. Carefully slide the bushing driver into the bearing and press the bearing in until it is 0.25-1.27mm (.01-.05") below the surface.
4. Remove any material left in the oil passage.
5. Install new oil seal with sealing lip facing in.
   a. Press oil seal until flush with crankcase.

CHECK PTO BEARING

The PTO bearing must be replaced if it is damaged or if it measures larger than 42.25mm (1.663") in diameter (see Figure 10-8).

The diameter of the crankshaft may also make it necessary to replace the bearing. See Section 11 for the crankshaft measurement details.

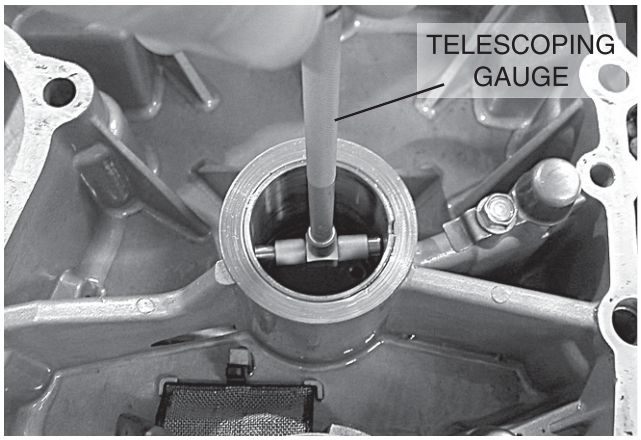


Figure 10-8. Check PTO Bearing

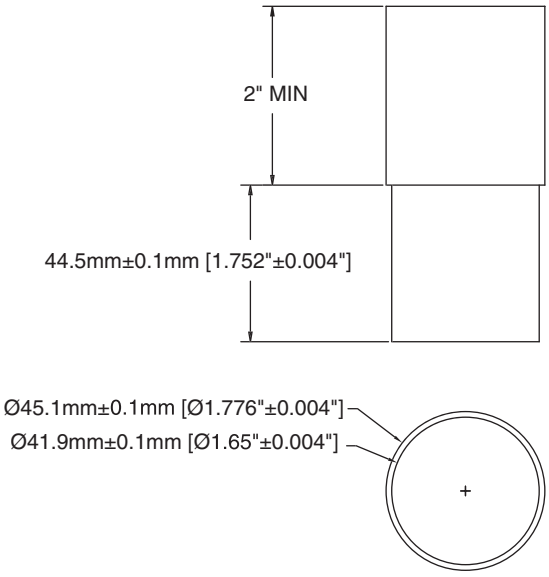


Figure 10-9. PTO Bearing Driver

REMOVE/INSTALL PTO BEARING:

The removal and installation procedure for the PTO bearing is the same as for the mag bearing. See Figure 10-9 for the bearing driver used in this procedure.

INSTALL PTO OIL SEAL:

Install a new PTO oil seal and press it in until it is 1.5mm (1/16") below the mounting surface.

CHECK CAMSHAFT BEARINGS

Use a telescoping gauge and caliper to check camshaft bearings. If camshaft bearings are worn, crankcase or crankcase cover must be replaced. (For vertical shaft engines, the gerotor cover must be replaced).

Mag Bearing Reject Dimension: 20.06mm (.790")

PTO Bearing Reject Dimension: 18.06mm (.711")

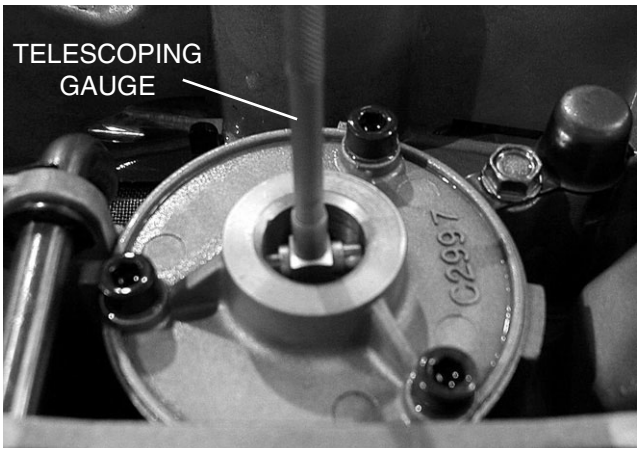


Figure 10-10. Checking PTO Side Camshaft Bearing

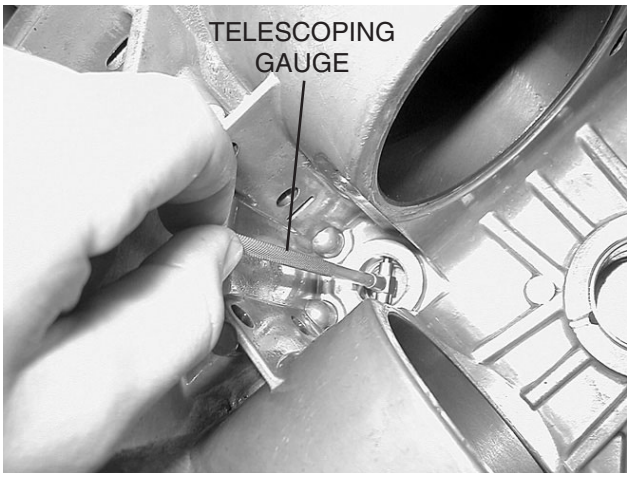


Figure 10-11. Checking Mag Side Camshaft Bearing

OIL SEALS:

Always install new oil seals whenever engine is disassembled for major servicing or when repairing bearings. Lubricate sealing edge of oil seal with clean engine oil before assembly. Always use the correct seal protector to prevent damaging oil seal.

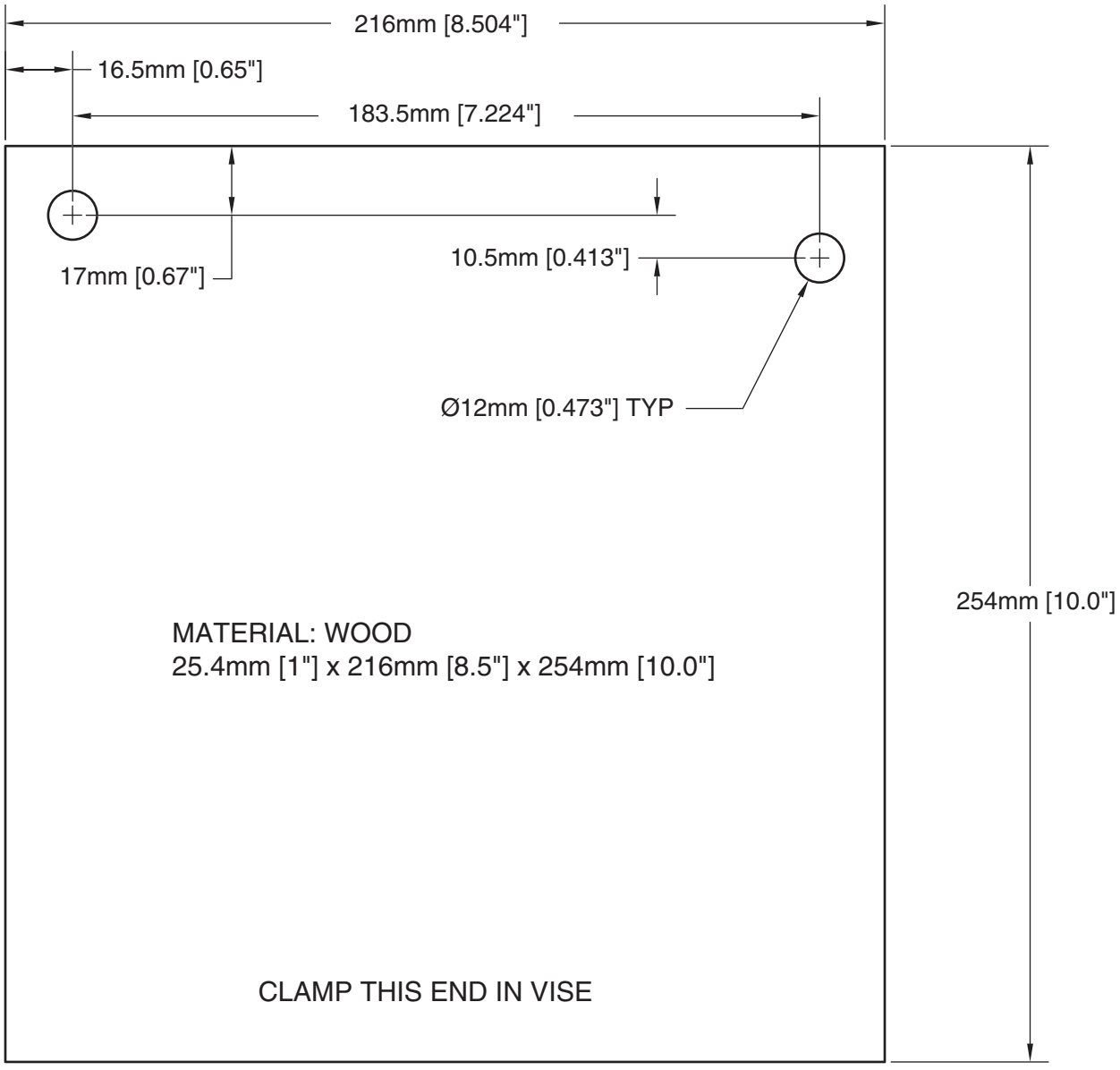
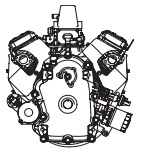


Figure 10-12. Honing Fixture

NOTES



SECTION CONTENTS

CHECK CRANKSHAFT:

Inspect crankshaft threads, keyways and timing gear for damage or wear. If threads, keyways or timing gear are damaged or worn, replace crankshaft. Check journals for scoring. If journals are scored, replace crankshaft. Check journals for wear. See crankshaft reject sizes.

Crankshaft Reject Sizes

Model Series	PTO Journal	Mag. Journal	Crankpin Journal
ALL	41.85 mm (1.648")	37.85 mm (1.490")	38.96 mm (1.534")

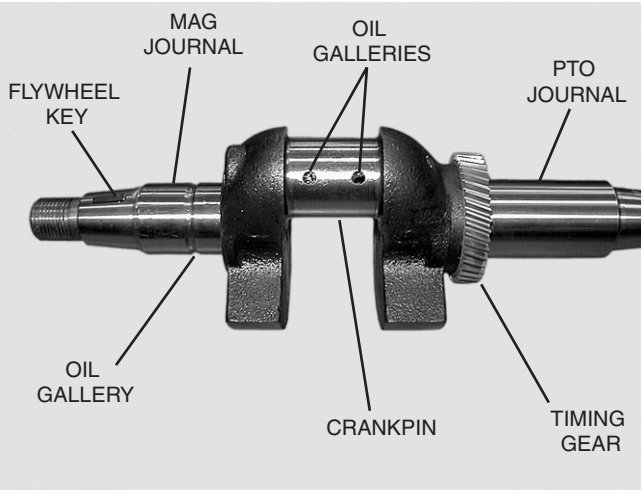


Figure 11-1. Check Crankshaft

CHECK CAMSHAFT:

Inspect gear teeth, lobes and journals for wear and nicks, Figure 11-2. Camshaft journal and lobe reject sizes are shown below. Replace cam gear if not to specification.

Camshaft Reject Size

PTO Journal	Mag Journal	Intake Lobes	Exhaust lobes
17.93 mm (0.705")	19.93 mm (0.784")	31.02 mm (1.221")	31.02 mm (1.221")

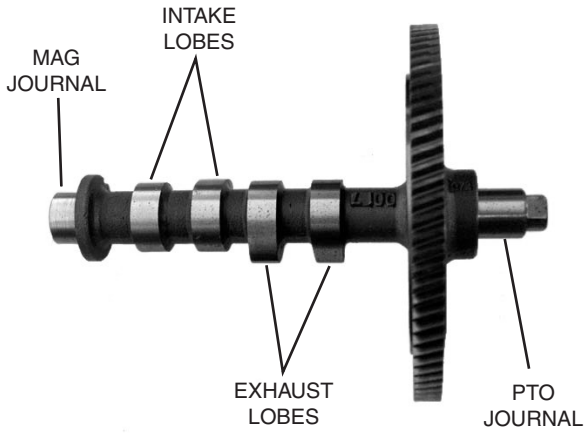
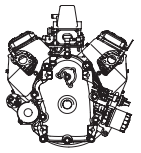


Figure 11-2. Check Camshaft

NOTES



SECTION CONTENTS

GENERAL INFORMATION

It is recommended that new piston rings be installed whenever the engine is disassembled for major servicing or overhaul, providing that cylinder bores are within specification.

Remove any carbon or ridge at the top of the cylinder bore. This will prevent breaking the rings when removing the piston and connecting rod from the engine. Remove the connecting rod cap. Push the piston and connecting rod out through the top of the cylinder.

Measure cylinder bores before checking pistons and rings. See Section 10. If cylinder bores are out of tolerance, it will not be necessary to check pistons and rings since a new crankcase and piston assemblies will be used.

If the cylinder bore is more than .075 mm (.003") oversize, or .035 mm (.0015") out of round, it must be replaced.

DISASSEMBLE PISTON AND CONNECTING ROD

1. Remove piston rings using ring expander.

   a. Then remove oil ring.

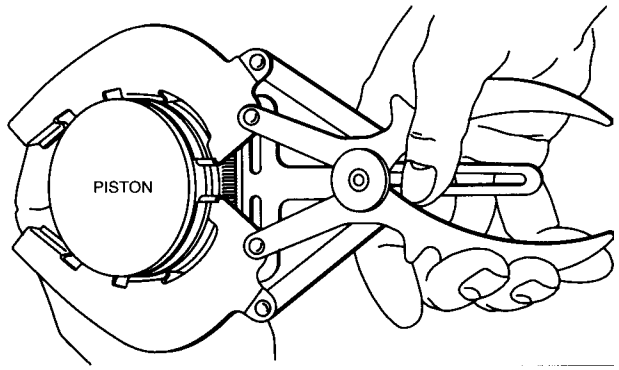


Figure 12-1. Remove Rings

2. Disassemble piston from connecting rod, Figure 12-2.

   a. Remove piston pin locks.

   b. Piston pin is a slip fit in piston and connecting rod.

Keep pistons and connecting rods together as an assembly. Do not mix.

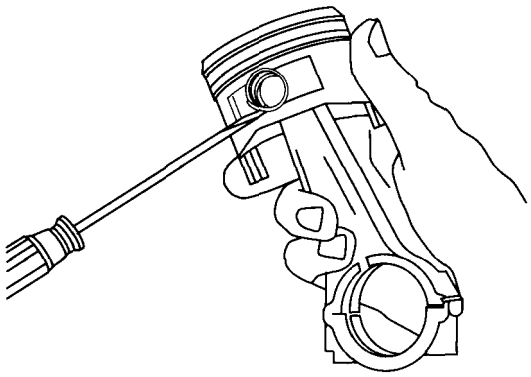


Figure 12-2. Remove Piston Pin Locks

CHECKING PISTON AND RINGS

If the cylinder is not going to be replaced and the piston shows no signs of scoring, the piston should be checked. Carefully remove carbon from ring grooves.

1. Check side clearance of ring grooves using new rings, Figure 12-3. If a 0.10mm (.004") feeler gauge for the compression rings or 0.20mm (.008") for the oil ring can be inserted, the ring groove is worn. The piston must be replaced.

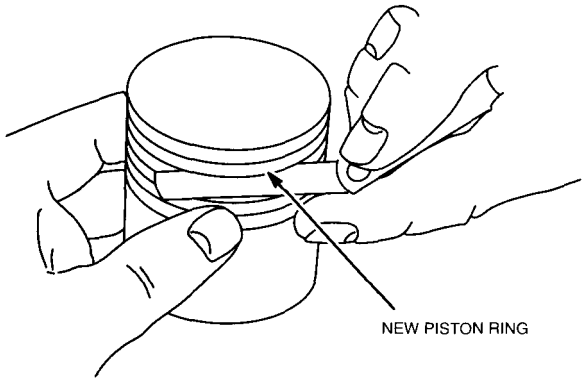


Figure 12-3. Check Ring Grooves

2. Check ring end gap, Figure 12-4.

   a. Clean carbon from end of rings and insert approximately 1" (25 mm) into cylinder.

Reject Dimension (compression rings): 0.51mm (.020")
Reject Dimension (oil rings): 1.15mm (.045")

   b. If gap is less than reject dimension, remove some material from the end of the ring to achieve the minimum gap.

3. Check piston pin bore, Figure12-5.

   a. Replace if greater than 20.03mm (.7886") or if it is .01mm (.0005") out of round.

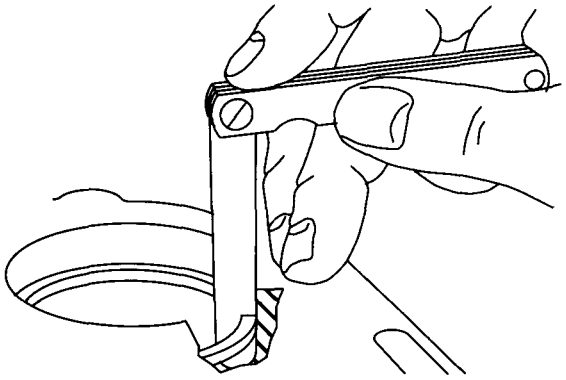


Figure 12-4. Checking Ring End Gap

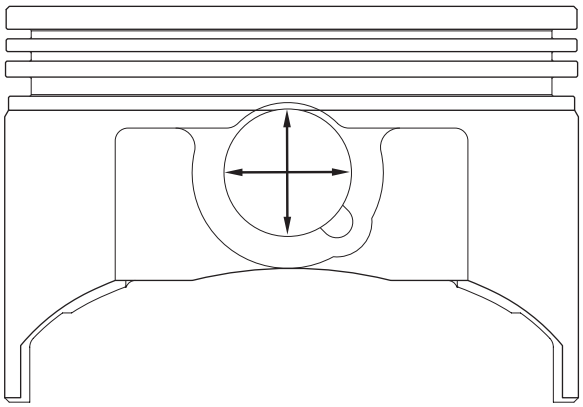


Figure 12-5. Check Piston Pin Bore

CHECKING PISTON PIN AND CONNECTING ROD

1. Check piston pin, Figure 12-6.
   a. Replace if less than 19.97mm (.7862") or if it is .01mm (.0005") out of round.
2. Check connecting rod bearings.

Note: If crankpin bearing is scored or worn the connecting rod must be replaced.

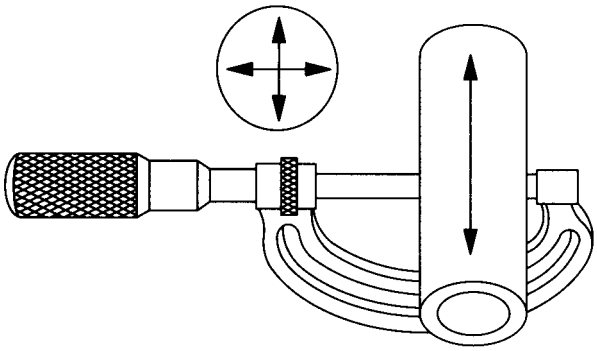


Figure 12-6. Check Piston Pin

CONNECTING ROD REJECT SIZE

Crankpin Bearing	Piston Pin Bearing
39.09mm (1.539")	20.05mm (.7894")

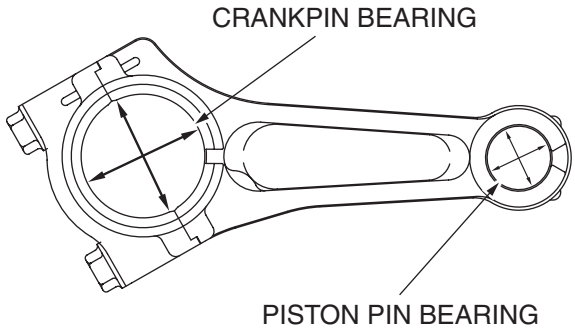


Figure 12-7. Check Rod Bearings

ASSEMBLE PISTON AND CONNECTING ROD

Lubricate parts with engine oil and assemble #1 piston and connecting rod, Figure 12-8.

1. Notch or casting mark on piston must be on flywheel side.
2. Number "1" on connecting rod must face PTO side (opposite notch or casting mark on piston).
   a. Install piston pin locks with needle nose pliers.

Lubricate parts with engine oil and assemble #2 piston and connecting rod, Figure 12-9.

1. Notch or casting mark on piston must be on flywheel side.
2. Number "2" on connecting rod must face PTO side (opposite notch or casting mark on piston).
   a. Install piston pin locks with needle nose pliers.

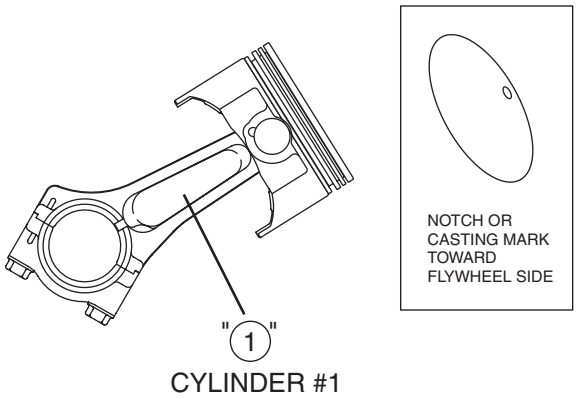


Figure 12-8. Assemble #1 Rod And Piston

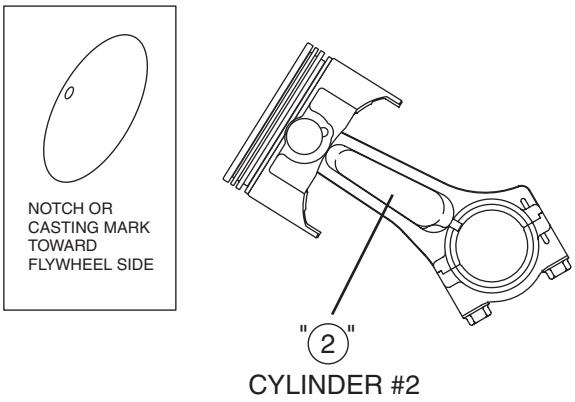


Figure 12-9. Assemble #2 Rod And Piston

ASSEMBLE PISTON RINGS TO PISTON

Install piston rings using ring expander when installing center and top compression rings.

1. Install oil ring expander.
   a. Install lower scraper ring.
   a. Install upper scraper ring.
2. Install center compression ring with chamfer up.
3. Install top compression ring.

Note: Top compression ring may be installed with either side up.

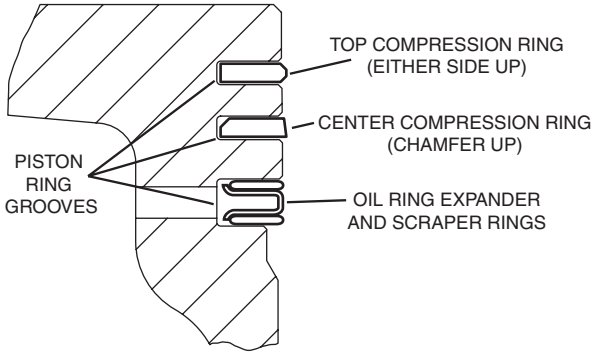
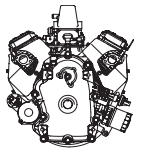


Figure 12-10. Piston Ring Installation

NOTES



SECTION CONTENTS

INSTALL CRANKSHAFT

Lubricate mag bearing and lips of oil seal with engine oil and install crankshaft.

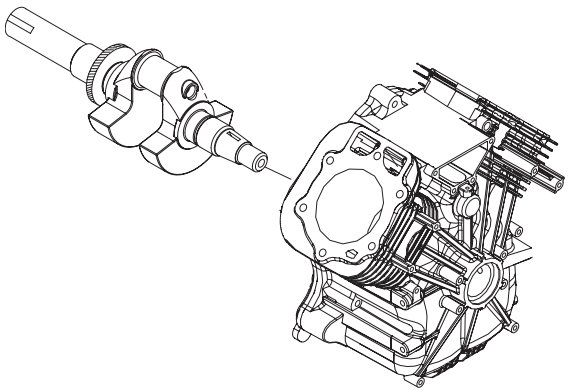


Figure 13-1. Installing Crankshaft

INSTALL PISTON AND CONNECTING ROD

Note: Install #1 piston and connecting rod first.

1. Oil piston rings, piston skirt, and compress rings with Ring Compressor, Figure 13-2.
   a. Rotate the top two compression rings so that the ring end gaps are on opposite sides of the piston.
   b. Place piston and ring compressor upside down on bench with projections on compressor facing up.
   c. Tighten ring compressor evenly until rings are fully compressed.
   d. Then loosen ring compressor very slightly so that compressor can be rotated on piston skirt while holding connecting rod, Figure 13-2.
   e. Remove connecting rod cap.

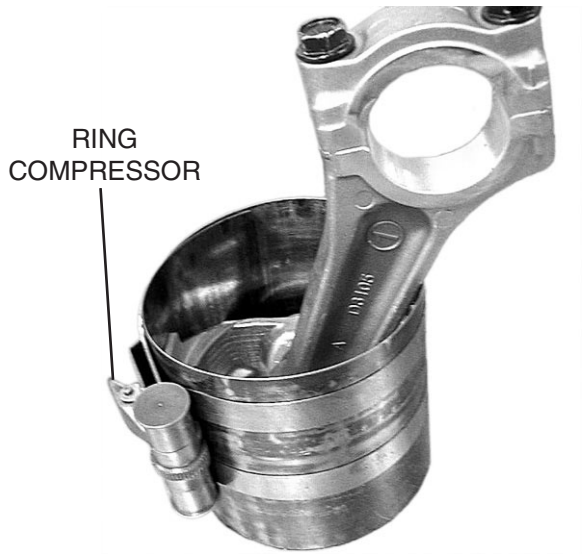


Figure 13-2. Compressing Rings

2. Lubricate cylinder bores and crankpin and rotate crankshaft until it is at bottom of stroke.
3. Install #1 piston with notch or casting mark towards flywheel side, Figure 13-3.
   a. Push piston down by hand until connecting rod is seated on crankpin.

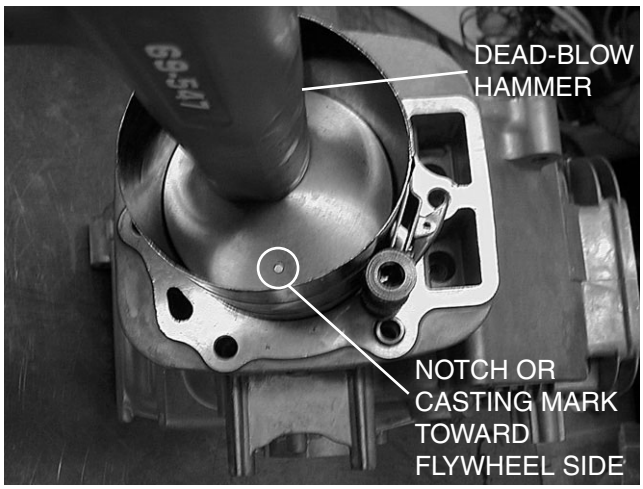


Figure 13-3. Installing Piston And Connecting Rod

4. Assemble connecting rod cap to rod with match marks aligned, Figure 13-4.
   a. Torque screws to 24.4 Nm (18 ft. lbs.).

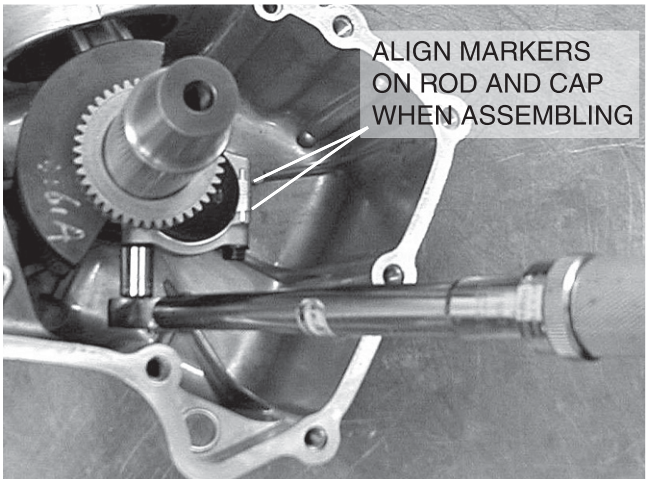


Figure 13-4. Torque Connecting Rods

5. Rotate crankshaft two revolutions to check for binding. Rod should also be free to move sideways on crankpin.

Repeat Steps 1-5 for #2 cylinder.

Note: The number 1 on #1 connecting rod and the number 2 on #2 connecting rod must be facing PTO side.

Important: Failure to use a torque wrench can result in loose connecting rod screws causing breakage or tight connecting rod screws causing scoring.

INSTALL CAMSHAFT

Lubricate tappets, cam shaft journals and lobes with engine oil.

1. Install tappets.
2. Align timing marks on cam shaft and crankshaft gear and install cam shaft, Figure 13-5.
3. Assemble governor spool to governor shaft.
   a. Make sure that spool engages flyweights.
   b. Install new "O"-ring in crankcase.

Figure 13-5. Installing Camshaft

INSTALL OIL PUMP

1. Lubricate gerotor and set in place.
2. Install oil pump cover.
3. Torque screws to 12.2 Nm (9 ft. lbs.).

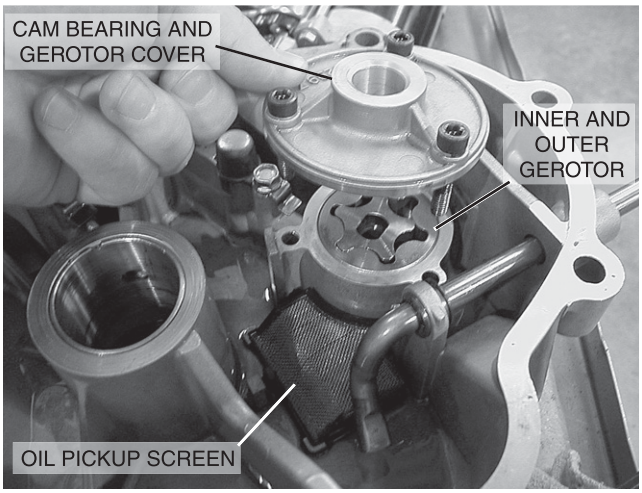


Figure 13-6. Installing Oil Pump

INSTALL CRANKCASE COVER

Lubricate PTO and cam gear bearing.

1. Rotate governor shaft so that the paddle rests against the cover, Figure 13-7.

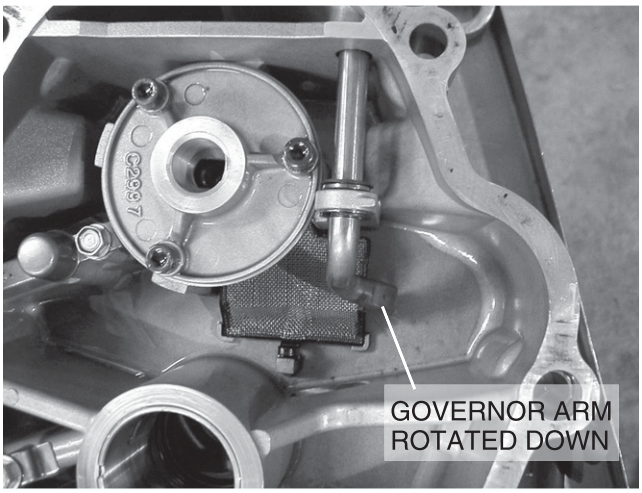


Figure 13-7. Rotating Governor Shaft

2. Install crankcase cover with new gasket.

Note: If the oil pump drive is not aligned, the cover will not slide completely on. Turning the crankshaft may align the oil pump drive.

3. Install governor support bracket.

a. The allen head crankcase bolt will need to be backed off.

4. Torque screws in sequence shown to 47.5 Nm (35 ft. lbs.), Figure 13-8.
5. Check crankshaft end play. If less than 0.05mm (.002") there may be an assembly problem.

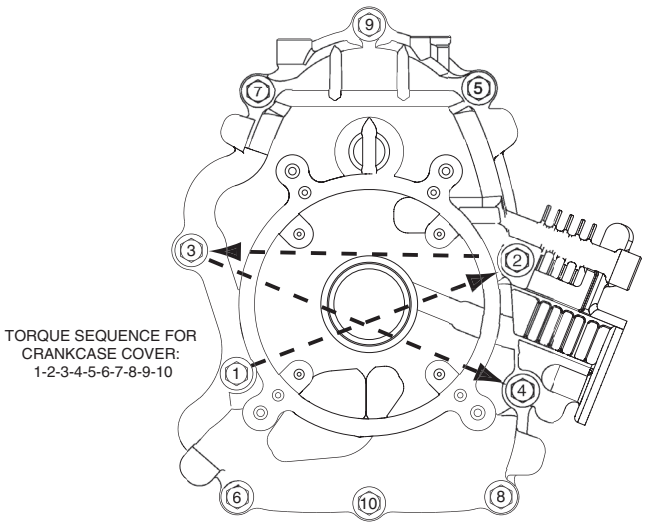


Figure 13-8

INSTALL ALTERNATOR AND IGNITION COILS

1. Install alternator, Figure 13-9.

   a. Torque screws to 12.2 Nm (9 ft. lbs.).

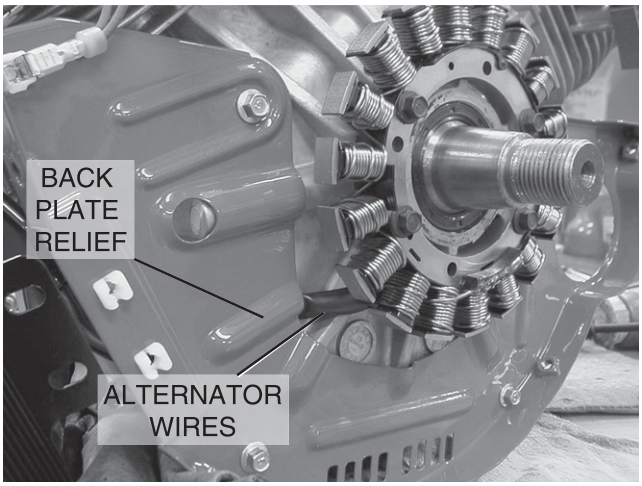


Figure 13-9. Install Alternator

2. Install back plate.

   a. Torque screws to 10 Nm (7.4 ft. lbs.).

Important: Route alternator wires through relief in back plate. DO NOT pinch wires.

3. Install starter motor.

   a. Torque screws to 24.4 Nm (18 ft. lbs.).

4. Assemble ignition coils to engine, Figure 13-10.

   a. Mounting holes in coil are slotted. Push coil away from flywheel as far as possible and tighten one screw to hold coil in place.

5. Repeat for second coil.

Note: The side shown in Figure 13-10 must face up on both coils or the engine will not function properly.

6. Install ground wire onto tab terminal on ignition coils.

Important : Make sure wires are routed over coil mounting posts.

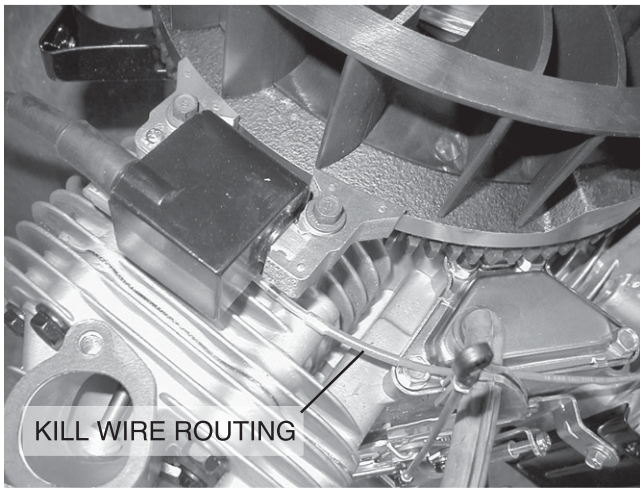


Figure 13-10. Install Coils

INSTALL BREATHER

1. Insert breather material.
2. Install breather assembly and gasket.
3. Torque bolts to 6.8 Nm (5 ft. lbs.).

INSTALL FLYWHEEL

Important: Clean flywheel and crankshaft taper removing all oil, dirt or grease.

1. Insert flywheel key into crankshaft.
2. Assemble flywheel to crankshaft.
3. Install washer and flywheel nut.
4. Torque flywheel nut to 204 Nm (150 ft. lbs.), Figure 13-11.

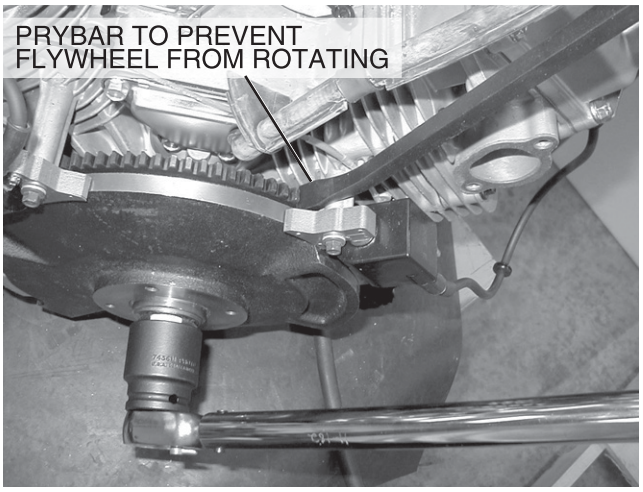


Figure 13-11. Torque Flywheel Nut

ADJUST IGNITION COIL AIR GAP

1. Rotate flywheel until magnet is under coil laminations.
2. Place 0.20-.30mm (.008"-.012") thickness gauge between magnet and coil laminations, Figure 13-12.

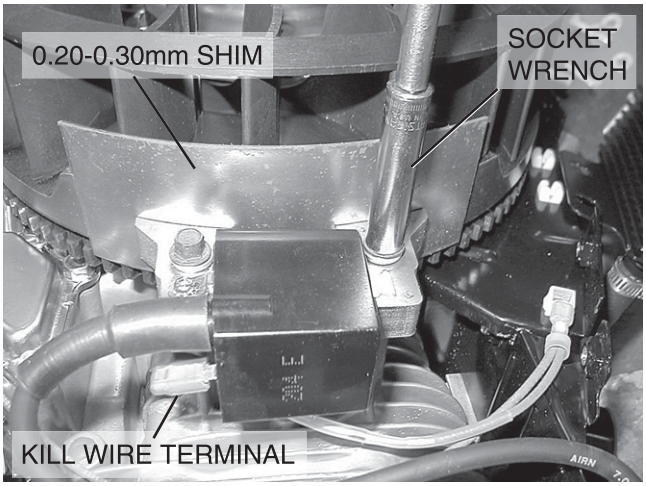
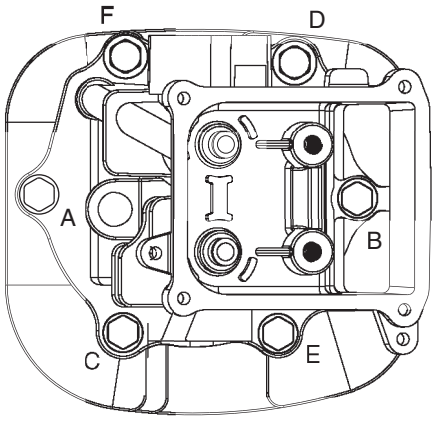


Figure 13-12. Adjust Air Gap

3. Loosen mounting screw so magnet will pull coil down against thickness gauge.
   a. Torque screws to 12.2 Nm (9 ft. lbs.).
4. Rotate flywheel to remove thickness gauge.
5. Repeat for second coil.

INSTALL CYLINDER HEADS

1. Install cylinder head with new gasket.
2. Lubricate threads of head bolts with oil.
   a. Torque head bolts in sequence shown (Figure 13-13) to 29.9 Nm (22 ft. lbs.).
3. Insert push rods into recess in tappets.



TORQUE SEQUENCE FOR HEADS:

A-B-C-D-E-F

Figure 13-13. Install Cylinder Head

INSTALL ROCKER ARMS

1. Lubricate rocker arms and ball studs with clean engine oil.
2. Assemble ball studs, rocker arms, jam nuts and guide plates to cylinder head, Figure 13-14.
   a. Make sure that the push rods are in the proper location on the tappets and the rocker arms.

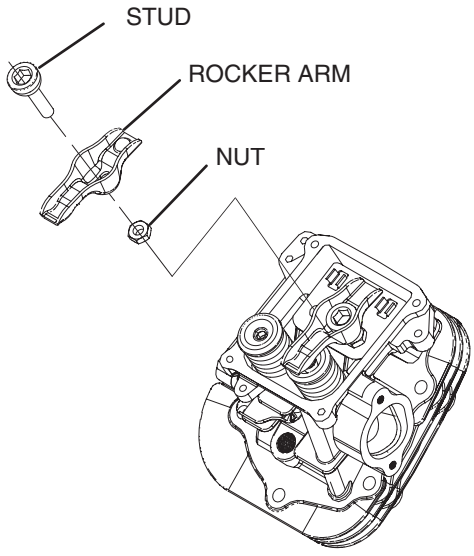


Figure 13-14. Install Rocker Arms

ADJUST VALVE CLEARANCE

1. Set No. 1 cylinder at TDC (Top Dead Center), compression stroke.
   a. Adjust rocker arms and check clearance, Figure 13-15.

Valve Clearance (cold) IN and EX 0.076mm (.003")

   b. Torque ball studs and jam nuts to 19 Nm (14 ft. lbs.).
2. Repeat for No. 2 cylinder.

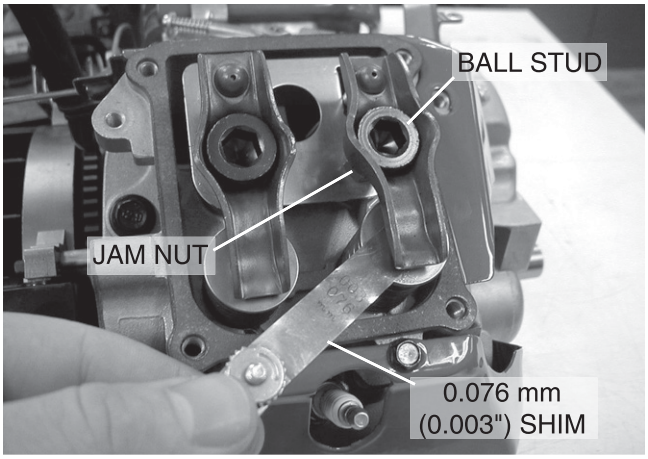


Figure 13-15. Adjust Valve Clearance

3. Install valve covers with new gaskets, Figure 13-16
   a. Torque bolts to 6.8 Nm (5 ft. lbs.).

Figure 13-16. Install Valve Covers

GENERAL ASSEMBLY

1. Install cylinder shields (wrappers).
   a. Torque M5 screws to 2.8 Nm (25 in. lbs.).
   b. Torque M6 screws to 4.5 Nm (40 in. lbs.).
   c. Connect ignition ground wire to ignition kill terminal in backing plate.

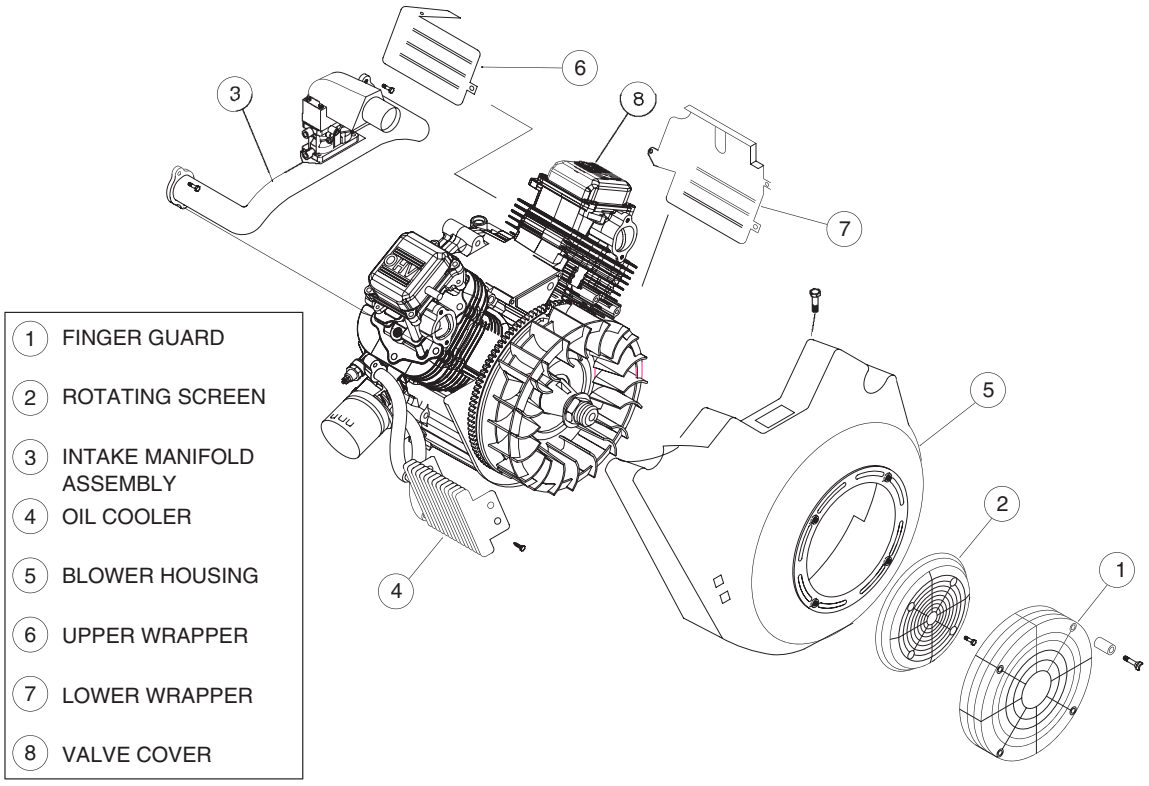
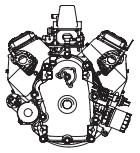


Figure 13-17. Install Blower Housing

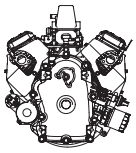


2. Assemble governor lever to governor arm. DO NOT tighten at this time.
3. Install speed adjust assembly.
   a. Torque screws to 6.0 Nm (53 in. lbs.).
4. Install exhaust.
   a. Torque screws to 19 Nm (14 ft. lbs.).
5. Install fan and retaining ring.
   a. Torque screws to 21.7 Nm (16 ft. lbs.).
6. Install blower housing.
   a. Torque screws to 4.5 Nm (40 in. lbs.).
7. Install rotating screen.
   a. Torque screws to 1.9 Nm (17 in. lbs.).
8. Install intake manifold assembly.
   a. Torque bolts to 19 Nm (14 ft. lbs.).
9. Install finger guard.
   a. If engine is equipped with hex head screws, torque screws to 4.5 Nm (40 in. lbs).
   b. If engine is equipped with finger screws, tighten screws by hand to approximately 1.3 Nm (12 in. lbs.).
10. Connect governor linkage and speed control linkage.
11. Install spark plugs.
    a. Torque spark plugs to 19 Nm (14 ft. lbs.).

ADJUST GOVERNOR

Note: Refer to Section 4, Page 4-2 for Static Governor Adjustment.

WARNING: BEFORE STARTING OR RUNNING ENGINE, static adjustment of the governor must be completed! Failure to make the static adjustments first could result in engine overspeeding which may result in engine damage, property damage or personal injury.

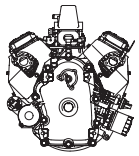


STANDARD AND REJECT DIMENSIONS

DESCRIPTION	STANDARD DIMENSION	REJECT DIMENSION
CYLINDER:		
Bore	90.00 – 90.025 mm (3.543" – 3.544")	90.10 mm (3.547")
Out of Round		0.035 mm (.0015")
Main Bearing	38.044 – 38.099 mm (1.498" – 1.5")	38.25 mm (1.506")
Cam Bearing	20.00 – 20.03mm (.787" – .789")	20.06 mm (.790")
CYLINDER HEAD:		
Valve Guide	7.005 – 7.020 mm (.2758" – .2764")	7.06 mm (0.278")
Valve Stem	6.945 – 6.98 mm (.2734" – .2748")	6.9 mm (0.272")
CRANKCASE COVER:		
Main Bearing	42.044 – 42.099 mm (1.6553" – 1.6574")	42.25 mm (1.663")
Cam Bearing	18.0 – 18.025 mm (.7087" – .7096")	18.06 mm (.711")
CRANKSHAFT:		
Crankpin	38.99 – 39.01 mm (1.535" – 1.536")	38.96 mm (1.534")
Magneto Journal	38.00 – 38.012 mm (1.496" – 1.4965")	37.85 mm (1.490")
PTO Journal	42.00 – 42.012 mm (1.6535" – 1.654")	41.85 mm (1.648")
CAMSHAFT:		
Magneto Journal	19.959 – 19.98 mm (.7858" – .7866")	19.93 mm (.784")
PTO Journal	17.964 – 17.982 mm (.7072" – .708")	17.93 mm (.705")
Lobes	31.239 – 31.479 mm (1.2299" – 1.2393")	31.02 mm (1.221")
CONNECTING ROD:		
Crankpin Bearing	39.06 – 39.07 mm (1.5378" – 1.5382")	39.09 mm (1.539")
Piston Pin Bearing	20.02 – 20.03 mm (.7882" – .7886")	20.05 mm (.7894")
PISTON PIN:		
Diameter	19.984 – 19.995 mm (.7868" – .7872")	19.97 mm (.7862")
Out of Round		0.01 mm (.0005")
PISTON PIN BEARING (PISTON):		
Bore	20.00 – 20.02 mm (.7874" – .7882")	20.03 mm (.7886")
Out of Round		0.01 mm (.0005")
PISTON RINGS:		
End Gap – Top & Center	0.25 – 0.5 mm (.0098" – .0197")	0.75 mm (.0295")
End Gap – Oil	0.38 – 1.15 mm (.015" – .045")	1.5 mm (.059")
Ring Side Clearance – Top & Center	0.04 – 0.09 mm (.0016" – .0035")	0.10 mm (.004")
Ring Side Clearance – Oil	0.012 – 0.18 mm (.0005" – .007")	0.20 mm (.008")

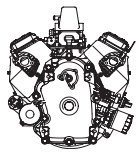
COMMON SPECIFICATIONS

Armature Air Gap	.008" – .012" (0.20 – 0.30 mm)
Crankshaft End Play	.002" – .015" (0.05 – 0.40 mm)
Spark Plug Gap	.030" (0.76 mm)
Valve Clearance (Cold)	
– Intake	.002" – .004" (0.05 – 0.1 mm)
– Exhaust	.002" – .004" (0.05 – 0.1 mm)



TORQUE SPECIFICATIONS

Alternator (to cylinder)	10.0 Nm (7.4 ft. lbs.)
Air Cleaner Support Bracket	5.4 Nm (48 in. lbs.)
Armature	10.0 Nm (7.4 ft. lbs.)
Back Plate	4.5 Nm (40 in. lbs.)
Blower Housing	4.5 Nm (40 in. lbs.)
Breather	4.5 Nm (40 in. lbs.)
Carburetor (to manifold)	5.4 Nm (48 in. lbs.)
Connecting Rod	24.4 Nm (18 ft. lbs.)
Crankcase Cover	47.5 Nm (35 ft. lbs.)
Cylinder Head Bolts	29.9 Nm (22 ft. lbs.)
Cylinder Wrappers:	
– M5 bolt	2.8 Nm (25 in. lbs.)
– M6 bolt	4.5 Nm (40 in. lbs.)
Exhaust Manifold	19 Nm (14 ft. lbs.)
Fan Retainer	21.7 Nm (192 in. lbs.)
Finger Guard:	
– Hex Head Screws	4.5 Nm (40 in. lbs.)
– Finger Screws	1.3 Nm (12 in. lbs.) (Approximately)
Flywheel Nut	204 Nm (150 ft. lbs.)
Governor Lever (clinching screw)	11.3 Nm (100 in. lbs.)
Intake Manifold	19 Nm (14 ft. lbs.)
Oil Pump	12.2 Nm (9 ft. lbs.)
Rocker Arm Jam Nut	19 Nm (14 ft. lbs.)
Rotating Screen Screws	1.9 Nm (17 in. lbs.)
Spark Plug	19 Nm (14 ft. lbs.)
Starter Motor	24.4 Nm (18 ft. lbs.)
Valve Cover	6.8 Nm (5 ft. lbs.)



NOTES