

# *SERVICE MANUAL*

## **KOHLER** Command PRO® HORIZONTAL CRANKSHAFT

**CH270**

**CH395**

**CH440**



**KOHLER**  
ENGINES



# Contents

---

Section 1. Safety and General Information.....

1

Section 2. Tools & Aids.....

2

Section 3. Troubleshooting.....

3

Section 4. Air Cleaner and Air Intake System.....

4

Section 5. Fuel System and Governor.....

5

Section 6. Lubrication System.....

6

Section 7. Retractable Starter.....

7

Section 8. Electrical System and Components.....

8

Section 9. Disassembly.....

9

Section 10. Inspection and Reconditioning.....

10

Section 11. Reassembly.....

11

---



# Section 1

## Safety and General Information

### Safety Precautions

To ensure safe operation please read the following statements and understand their meaning. Also refer to your equipment manufacturer's manual for other important safety information. This manual contains safety precautions which are explained below. Please read carefully.



#### WARNING

Warning is used to indicate the presence of a hazard that *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.



#### CAUTION

Caution is used to indicate the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage if the caution is ignored.

#### NOTE

Note is used to notify people of installation, operation, or maintenance information that is important but not hazard-related.

#### For Your Safety!

*These precautions should be followed at all times. Failure to follow these precautions could result in injury to yourself and others.*



#### WARNING



**Accidental Starts can cause severe injury or death.**

Disconnect and ground spark plug leads before servicing.

#### Accidental Starts!

*Disabling engine. Accidental starting can cause severe injury or death. Before working on the engine or equipment, disable the engine as follows: 1) Disconnect the spark plug lead(s). 2) Disconnect negative (-) battery cable from battery.*



#### WARNING



**Rotating Parts can cause severe injury.**

Stay away while engine is in operation.

#### Rotating Parts!

*Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate the engine with covers, shrouds, or guards removed.*



#### WARNING



**Hot Parts can cause severe burns.**



Do not touch engine while operating or just after stopping.

#### Hot Parts!

*Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running - or immediately after it is turned off. Never operate the engine with heat shields or guards removed.*



# Section 1

## Safety and General Information

 <b>WARNING</b>

<b>Explosive Fuel can cause fires and severe burns.</b>
Do not fill the fuel tank while the engine is hot or running.



### Explosive Fuel!

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

 <b>WARNING</b>

<b>Cleaning Solvents can cause severe injury or death.</b>
Use only in well ventilated areas away from ignition sources.



### Flammable Solvents!

Carburetor cleaners and solvents are extremely flammable. Keep sparks, flames, and other sources of ignition away from the area. Follow the cleaner manufacturer's warnings and instructions on its proper and safe use. Never use gasoline as a cleaning agent.

 <b>WARNING</b>

<b>Carbon Monoxide can cause severe nausea, fainting or death.</b>
Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.



### Lethal Exhaust Gases!

Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.

 <b>CAUTION</b>

<b>Electrical Shock can cause injury.</b>
Do not touch wires while engine is running.

### Electrical Shock!

Never touch electrical wires or components while the engine is running. They can be sources of electrical shock.

 <b>WARNING</b>

<b>Explosive Gas can cause fires and severe acid burns.</b>
Charge battery only in a well ventilated area. Keep sources of ignition away.

### Explosive Gas!

Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.

Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or gasoline vapors are present.

 <b>WARNING</b>

<b>Uncoiling Spring can cause severe injury.</b>
Wear safety goggles or face protection when servicing retractable starter.

### Spring Under Tension!

Retractable starters contain a powerful, recoil spring that is under tension. Always wear safety goggles when servicing retractable starters and carefully follow instructions in **Retractable Starter** Section 7 for relieving spring tension.

**Engine Identification Numbers**

When ordering parts, or in any communication involving an engine, always give the Model, Specification, and Serial Numbers, including letter suffixes if there are any.

The engine identification numbers appear on a decal, or decals, affixed to the engine shrouding. See Figure 1-1. An explanation of these numbers is shown in Figure 1-2.



**Figure 1-1. Engine Identification Decal Location.**

**A. Model No.** **CH 270**

Command Engine \_\_\_\_\_

Horizontal Crankshaft \_\_\_\_\_

Numerical Designation \_\_\_\_\_

270  
395  
440

**B. Spec. No.**

Engine Model Code \_\_\_\_\_ **CH270-0001**

Complete Spec Number  
(Incorporating Model No. with  
Variation No. of Basic Spec.)

**C. Serial No.** **3924895008**

Year Manufactured Code \_\_\_\_\_ Factory Code

<u>Code</u>	<u>Year</u>
39	2009
40	2010
41	2011

**Figure 1-2. Explanation of Engine Identification Numbers.**

# Section 1

## Safety and General Information

### Oil Recommendations

Using the proper type, weight, and a consistent brand of oil in the crankcase is extremely important. So is checking oil daily and changing oil regularly. Failure to use the correct oil, or using dirty oil, causes premature engine wear and failure.

#### Oil Type

Use high-quality detergent oil of **API (American Petroleum Institute) Service Class SJ or higher**. Select the viscosity based on the air temperature at the time of operation as shown in Figure 1-3.

#### RECOMMENDED SAE VISCOSITY GRADES

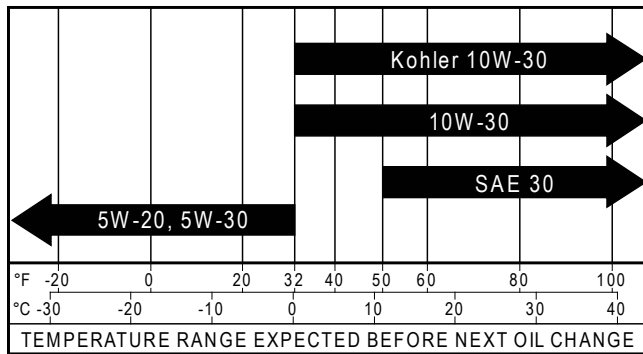


Figure 1-3. Oil Viscosity Grades Table.

**NOTE:** Using other than service class SJ or higher oil or extending oil change intervals longer than recommended can cause engine damage.

A logo or symbol on oil containers identifies the API service class and SAE viscosity grade. See Figure 1-4.



Figure 1-4. Oil Container Logo.

Refer to Section 6 - **Lubrication System** for detailed procedures on checking the oil and changing the oil.

### Fuel Recommendations



#### **WARNING: Explosive Fuel!**

*Gasoline is extremely flammable and its vapors can explode if ignited. Before servicing the fuel system, make sure there are no sparks, open flames or other sources of ignition nearby as these can ignite gasoline vapors. Disconnect and ground the spark plug leads to prevent the possibility of sparks from the ignition system.*

#### General Recommendations

Purchase gasoline in small quantities and store in clean, approved containers. A container with a capacity of 2 gallons or less with a pouring spout is recommended. Such a container is easier to handle and helps eliminate spillage during refueling.

Do not use gasoline left over from the previous season, to minimize gum deposits in your fuel system and to ensure easy starting.

Do not add oil to the gasoline.

Do not overfill the fuel tank. Leave room for the fuel to expand.

#### Fuel Type

For best results use only clean, fresh, **unleaded** gasoline with a pump sticker octane rating of 87 (R+M)/2 or higher. In countries using the Research Octane Number (RON), it should be 90 octane minimum. Leaded gasoline is not recommended and must not be used on EFI engines or on other models where exhaust emissions are regulated.

#### Gasoline/Alcohol blends

Gasohol (up to 10% ethyl alcohol, 90% unleaded gasoline by volume) is approved as a fuel for Kohler engines. Other gasoline/alcohol blends including E20 and E85 are not to be used and not approved. Any failures resulting from use of these fuels will not be warranted.

#### Gasoline/Ether blends

Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blends (up to a maximum of 15% MTBE by volume) are approved as a fuel for Kohler engines. Other gasoline/ether blends are not approved.



## Periodic Maintenance Instructions



### **WARNING: Accidental Starts!**

*Disabling engine. Accidental starting can cause severe injury or death. Before working on the engine or equipment, disable the engine as follows: 1) Disconnect the spark plug lead(s). 2) Disconnect negative (-) battery cable from battery.*

### Maintenance Schedule

Normal maintenance, replacement or repair of emission control devices and systems may be performed by any repair establishment or individual; however, **warranty repairs must be performed by a Kohler authorized service center.**

Frequency	Maintenance Required	Refer to:
<b>Daily or Before Starting Engine</b>	• Check oil level.	Section 6
	• Fill fuel tank.	Section 5
	• Check air cleaner and precleaner.	Section 4
	• Check air intake and cooling areas, clean as necessary. <sup>1</sup>	Section 4
<b>Yearly or Every 50 Hours</b>	• Clean or replace Quad-Clean™ precleaner.	Section 4
<b>Yearly or Every 100 Hours</b>	• Clean low-profile air cleaner element.	Section 4
	• Change oil.	Section 6
	• Clean cooling areas.	Section 4
	• Clean, set gap, or replace spark plug and set gap.	Section 8
<b>Yearly or Every 200 Hours</b>	• Replace Quad-Clean™ air cleaner element.	Section 4
	• Check and adjust valve clearance when engine is cold. <sup>2</sup>	Section 11
	• Service starter motor drive, if so equipped. <sup>2</sup>	Section 8
<b>Yearly or Every 300 Hours</b>	• Replace low-profile air cleaner element.	Section 4
	• Check fuel filters (tank outlet filter and in-line filter) and clean or replace if needed (if equipped).	Section 5

<sup>1</sup>Perform these maintenance procedures more frequently under extremely dusty, dirty conditions.

<sup>2</sup>Have a Kohler Engine Service Dealer perform this service.

### Storage

If the engine will be out of service for 2 months or more, use the following storage procedure.

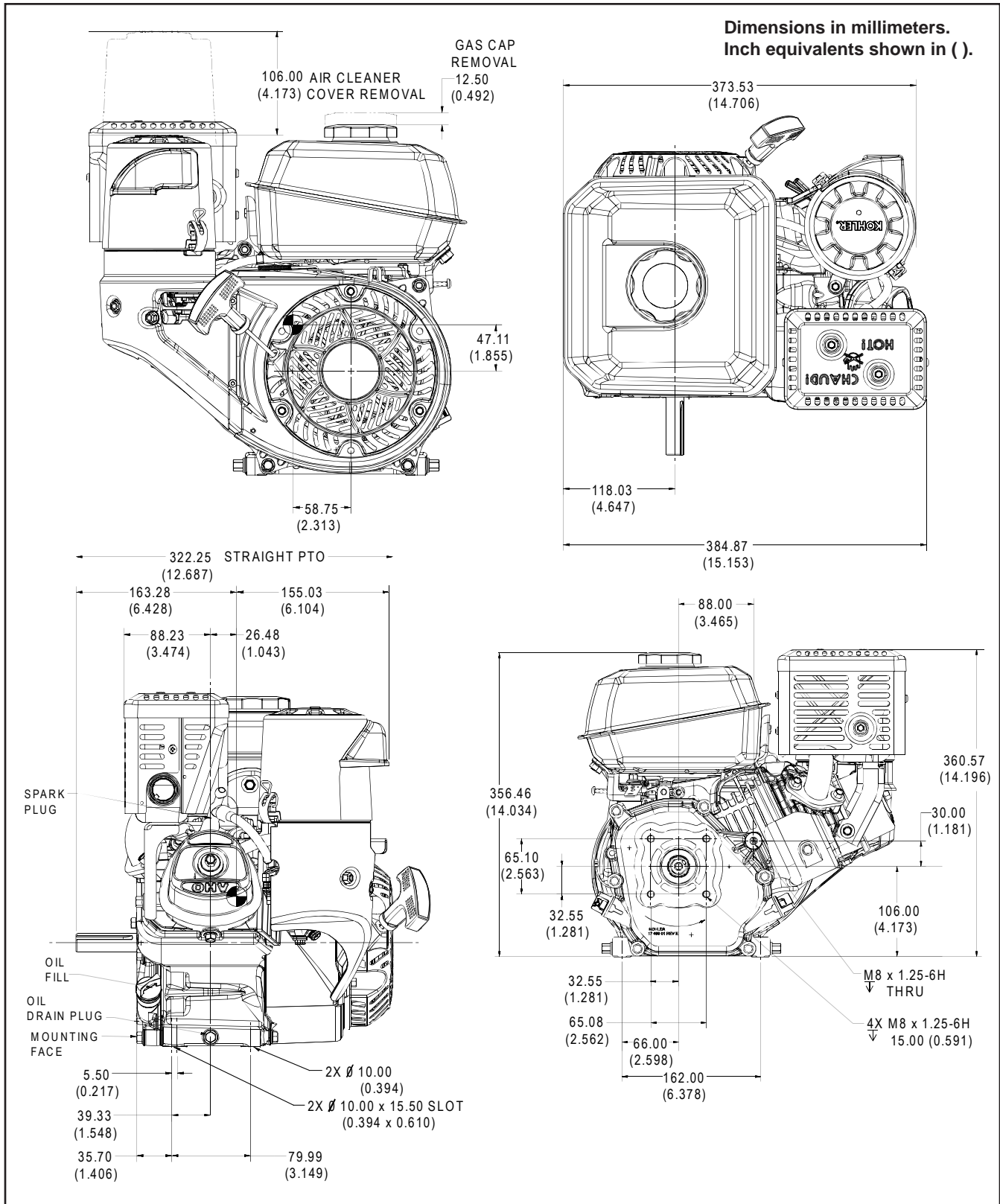
To empty the system, run the engine until the tank and the system are empty.

1. Clean the exterior surfaces of the engine.
2. Change the oil while the engine is still warm from operation. See **Change Oil** in Section 6.
3. The fuel system must be completely emptied, or the gasoline must be treated with a stabilizer to prevent deterioration. If you choose to use a stabilizer, follow the manufacturer's recommendations, and add the correct amount for the capacity of the fuel system.
4. Remove the spark plug. Add one tablespoon of engine oil into the spark plug hole. Install the spark plug, but do not connect the plug lead. Crank the engine two or three revolutions.
5. Remove the spark plug. Cover the spark plug hole with your thumb, and turn the engine over until the piston is at the top of its stroke. (Pressure against the thumb is greatest.) Reinstall the plug, but do not connect the plug lead.
6. Store the engine in a clean, dry place.

Fill the fuel tank with clean, fresh gasoline. Run the engine for 2 to 3 minutes to get stabilized fuel into the carburetor.

# Section 1

## Safety and General Information



**Figure 1-5. Typical Engine Dimensions-CH270.**

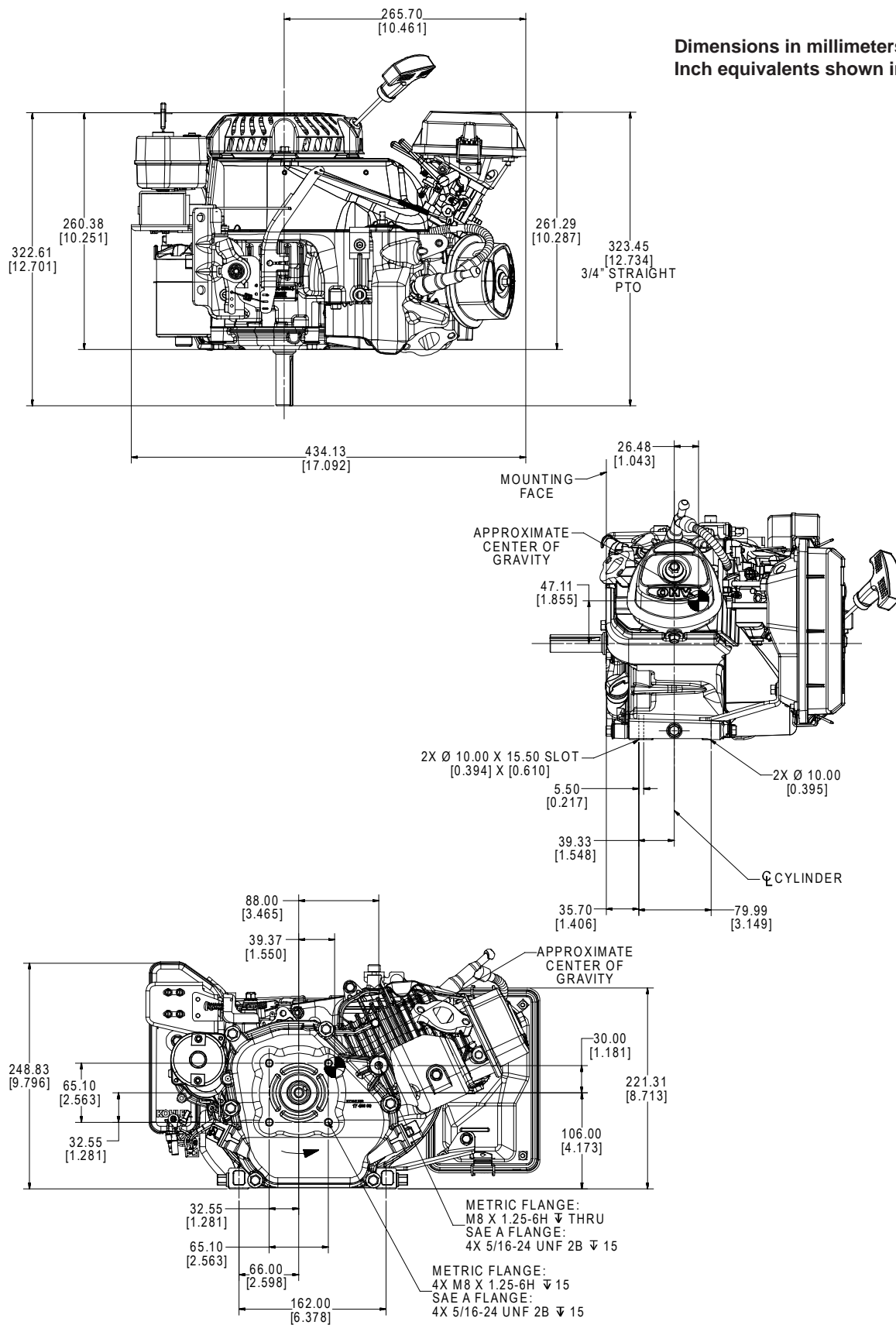


Figure 1-6. Typical Engine Dimensions-CH270 With Low-Profile Air Cleaner.

# Section 1

## Safety and General Information

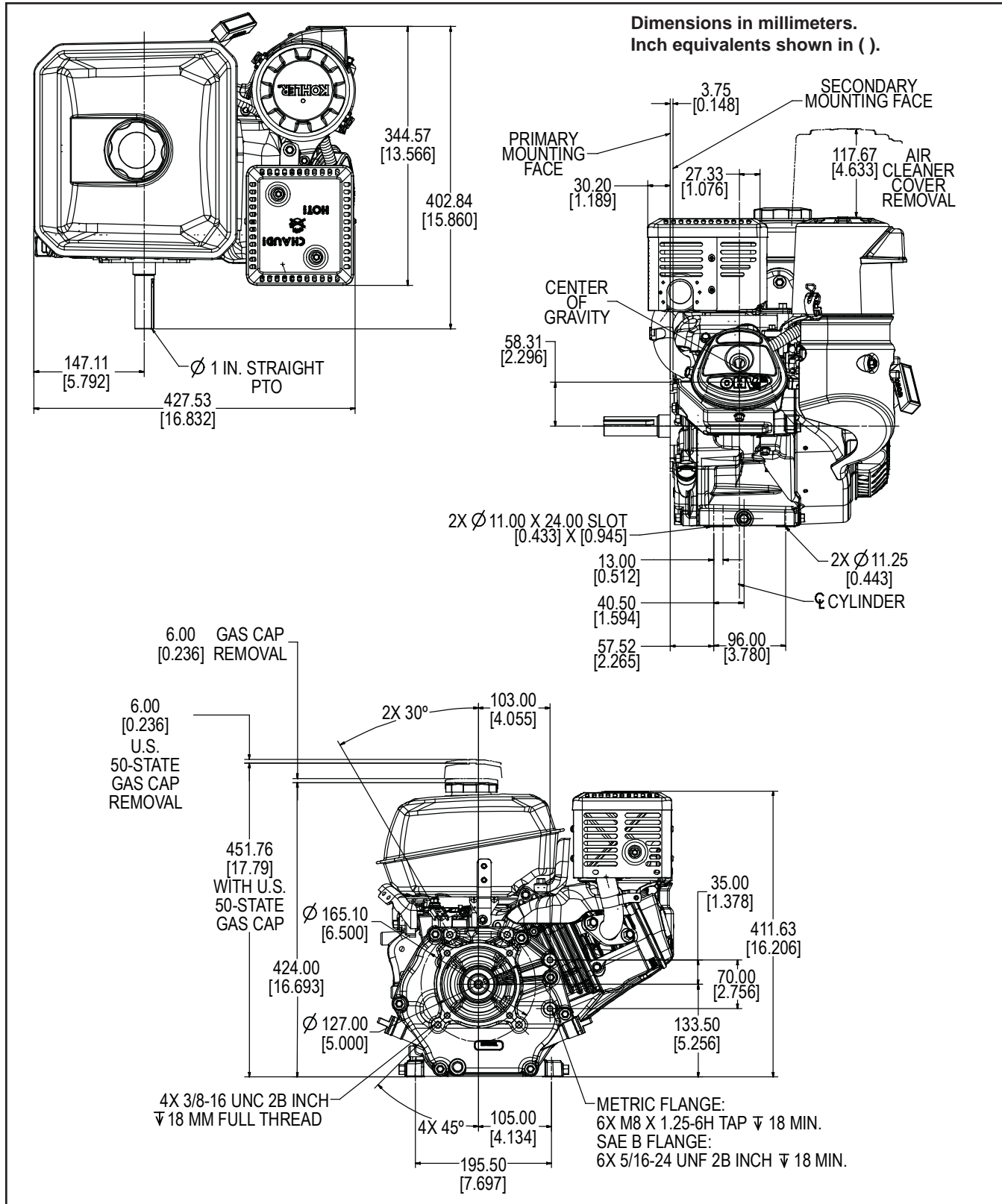


Figure 1-7. Typical Engine Dimensions-CH395.

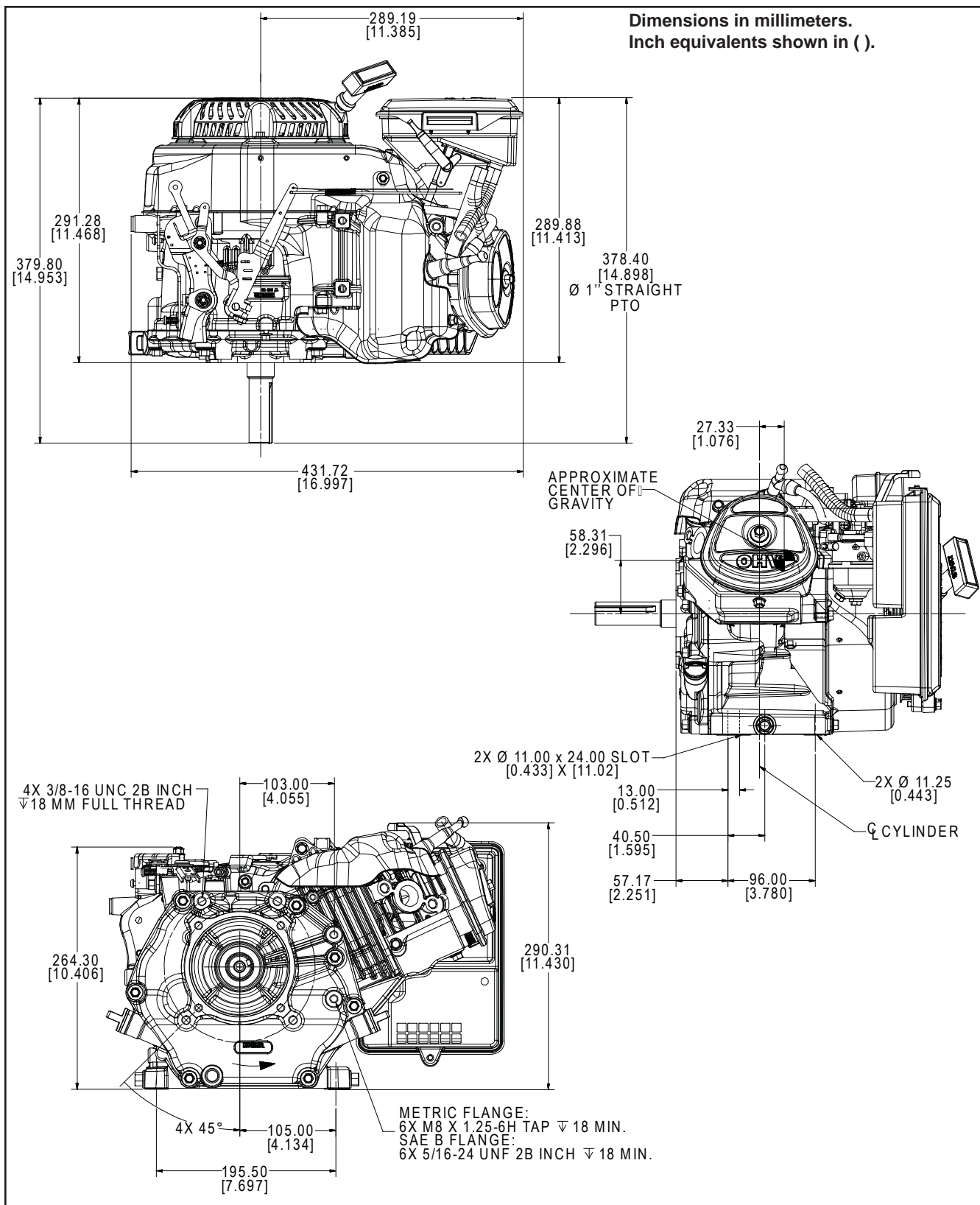


Figure 1-8. Typical Engine Dimensions-CH395 With Low-Profile Air Cleaner.

# Section 1

## Safety and General Information

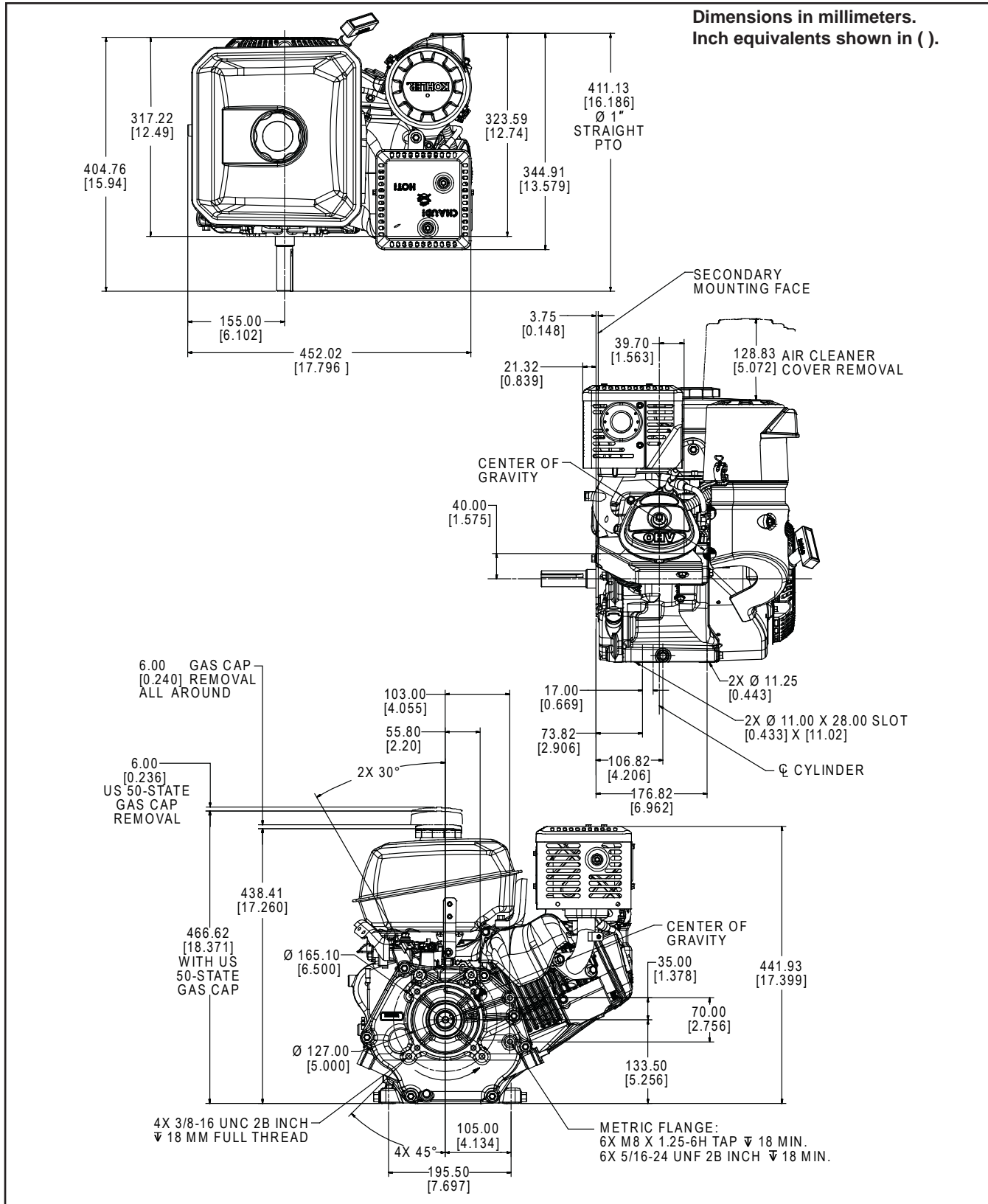


Figure 1-9. Typical Engine Dimensions-CH440.

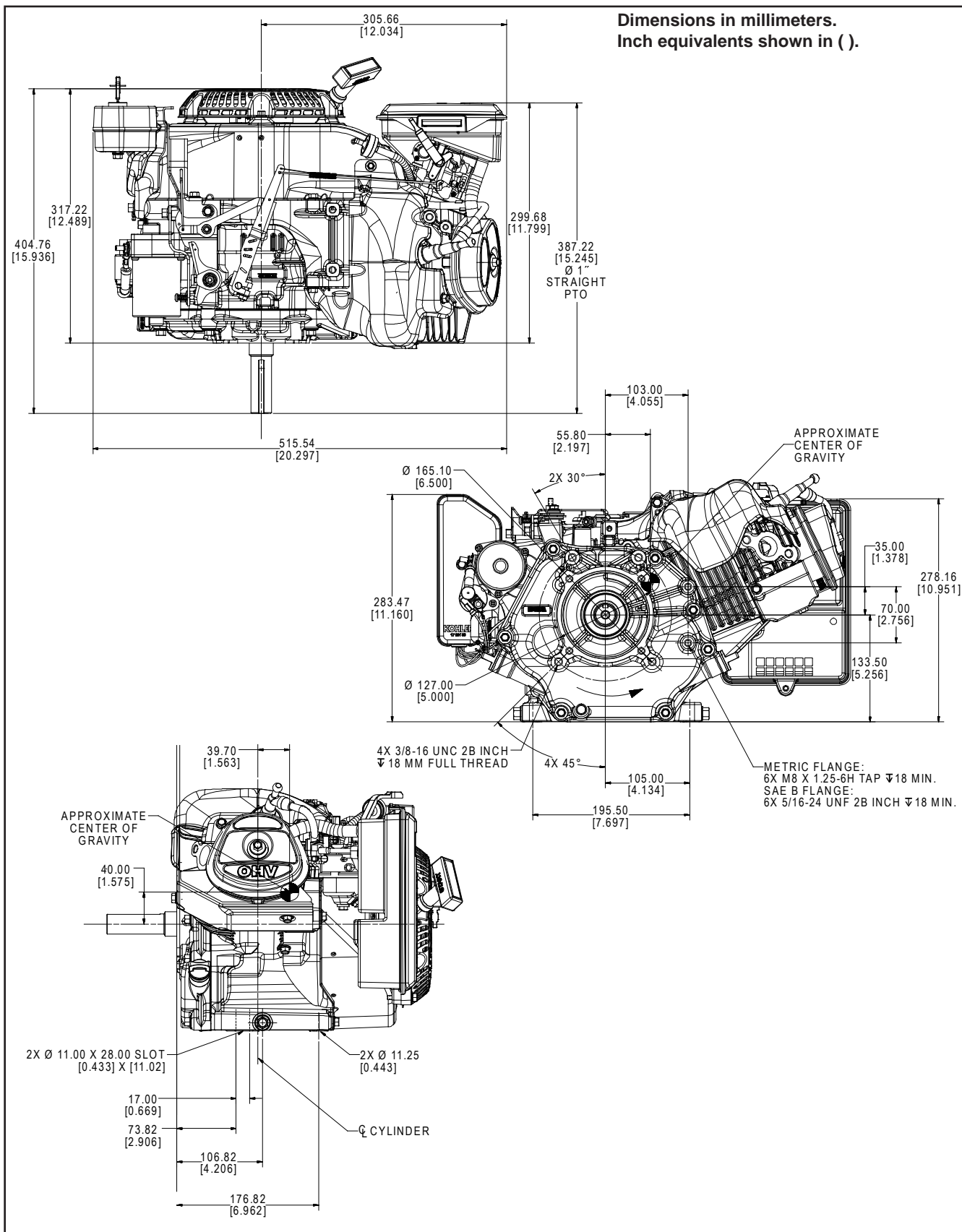


Figure 1-10. Typical Engine Dimensions-CH440 With Low-Profile Air Cleaner.

# Section 1

## Safety and General Information

---

### General Specifications<sup>1</sup>

#### Gross Power (@ 3600 RPM, exceeds SAE J1940 HP Standards)

CH270 .....	5.2 kW (7.0 HP)
CH395 .....	7.1 kW (9.5 HP)
CH440 .....	10.5 kW (14.0 HP)

#### Net Power (@ 3600 RPM, exceeds SAE J1940 HP Standards)

CH270 .....	4.4 kW (6 HP)
CH395 .....	6.4 kW (8.5 HP)
CH440 .....	9.0 kW (12.1 HP)

#### Net Peak Torque (@ 2600 RPM)

CH270 .....	12.7 N·m (9 ft. lb.)
CH395 .....	17.9 N·m (13 ft. lb.)
CH440 .....	26.8 N·m (20 ft. lb.)

#### Bore

CH270 .....	70 mm (2.8 in.)
CH395 .....	78 mm (3.1 in.)
CH440 .....	89 mm (3.5 in.)

#### Stroke

CH270 .....	54 mm (2.1 in.)
CH395 .....	58 mm (2.3 in.)
CH440 .....	69 mm (2.7 in.)

#### Displacement

CH270 .....	208 cc (12.7 cu. in.)
CH395 .....	277 cc (16.9 cu. in.)
CH440 .....	429 cc (24.7 cu. in.)

#### Compression Ratio

CH270 .....	8.5:1
CH395 .....	8.2:1
CH440 .....	8:1

#### Weight (Approx.)

CH270 .....	17.5 kg (38.5 lb.)
CH395 .....	27.8 kg (61.5 lb.)
CH440 .....	34.0 kg (75.0 lb.)

#### Oil Capacity (Approx.)

CH270 .....	0.6 L (0.63 U.S. qt.)
CH395 .....	1.1 L (1.16 U.S. qt.)
CH440 .....	1.3 L (1.37 U.S. qt.)

#### Fuel Tank Capacity

CH270 .....	4.1 L (4.3 U.S. qt.)
CH395,CH440 .....	7.3 L (7.7 U.S. qt.)

#### Angle of Operation - Maximum (At Full Oil Level) All Directions

CH270 .....	25°
CH395,CH440 .....	30°

### Air Cleaner

Quad-Clean™ Air Cleaner Base Mounting Screw Torque .....	8.0 N·m (71 in. lb.)
Low-Profile Air Cleaner Base Mounting Screw Torque .....	6.7 N·m (59 in. lb.)

<sup>1</sup> Values are in Metric units. Values in parentheses are English equivalents. Lubricate threads with engine oil prior to assembly.



**Blower Housing and Sheet Metal**

M6 Shoulder Screw Torque .....	10 N·m (89 in. lb.)
M6 Nut Torque .....	8.0 N·m (71 in. lb.)

**Camshaft**

Running Clearance

CH270 .....	0.007/0.043 mm (0.0003/0.0017 in.)
CH395,CH440 .....	0.016/0.052 mm (0.0006/0.0020 in.)

Bore I.D.

New

CH270 .....	13.991/14.009 mm (0.5508/0.5515 in.)
CH395,CH440 .....	16.000/16.018 mm (0.6300/0.6310 in.)

Max. Wear Limit

CH270 .....	14.018 mm (0.5519 in.)
CH395,CH440 .....	16.068 mm (0.6289 in.)

Camshaft Bearing Surface O.D.

New

CH270 .....	13.975 mm (0.55 in.)
CH395,CH440 .....	15.975 mm (0.63 in.)

Max. Wear Limit

CH270 .....	13.90 mm (0.547 in.)
CH395,CH440 .....	15.90 mm (0.626 in.)

Cam Lobe Profile (Minimum Dimension, Measured From Base Circle To Top Of Lobe)

Intake (New)

CH270 .....	31.966 mm (1.259 in.)
CH395 .....	32.544 mm (1.281 in.)
CH440 .....	33.266 mm (1.310 in.)

Exhaust (New)

CH270 .....	31.966 mm (1.259 in.)
CH395 .....	32.256 mm (1.270 in.)
CH440 .....	32.642 mm (1.285 in.)

Intake (Wear Limit)

CH270 .....	31.72 mm (1.249 in.)
CH395 .....	32.11 mm (1.264 in.)
CH440 .....	32.26 mm (1.270 in.)

Exhaust (Wear Limit)

CH270 .....	31.72 mm (1.249 in.)
CH395 .....	31.79 mm (1.252 in.)
CH440 .....	31.61 mm (1.245 in.)

**Carburetor**

Carburetor Stud Torque .....	10 N·m (89 in. lb.)
------------------------------	---------------------

Carburetor Primary Nut Torque.....	8 N·m (71 in. lb.)
------------------------------------	--------------------

Intake Cover Nut Torque .....	4 N·m (35 in. lb.)
-------------------------------	--------------------

Intake Cover Screw Torque.....	1.3 N·m (12 in. lb.)
--------------------------------	----------------------

# Section 1

## Safety and General Information

---

### Connecting Rod

#### Connecting Rod Screw Torque (torque in increments)<sup>1</sup>

CH270 .....	12 N·m (106 in. lb.)
CH395,CH440 .....	20 N·m (177 in. lb.)

#### Crankpin End I.D. @ 21°C (70°F)

##### New

CH270 .....	30.021/30.026 mm (1.1819/1.1821 in.)
CH395,CH440 .....	33.020/33.030 mm (1.3000/1.3004 in.)

##### Max. Wear Limit

CH270 .....	30.08 mm (1.184 in.)
CH395 .....	33.07 mm (1.302 in.)
CH440 .....	37.08 mm (1.460 in.)

#### Connecting Rod-to-Crankpin Side Clearance

##### New

CH270 .....	0.58/0.60 mm (0.023/0.024 in.)
CH395 .....	0.73 mm (0.029 in.)
CH440 .....	0.56 mm (0.022 in.)

##### Max. Wear Limit

CH270 .....	1.10 mm (0.043 in.)
CH395 .....	1.36 mm (0.054 in.)
CH440 .....	1.06 mm (0.042 in.)

#### Connecting Rod-to-Piston Pin Running Clearance

CH270,CH440 .....	0.008/0.025 mm (0.0003/0.0010 in.)
CH395 .....	0.006/0.028 mm (0.0002/0.0011 in.)

#### Piston Pin End I.D. @ 21°C (70°F)

##### New

CH270 .....	18.010/18.015 mm (0.7091/0.7093 in.)
CH395 .....	18.004/18.020 mm (0.7088/0.7094 in.)
CH440 .....	20.000/20.008 mm (0.7874/0.7874 in.)

##### Max. Wear Limit

CH270,CH395 .....	18.08 mm (0.712 in.)
CH440 .....	20.05 mm (0.789 in.)

### Crankcase

#### Governor Cross Shaft Bore I.D.

##### New

CH270 .....	6.000/6.024 mm (0.2362/0.2372 in.)
CH395,CH440 .....	8.000/8.024 mm (0.3150/0.3159 in.)

##### Max. Wear Limit

CH270 .....	6.037 mm (0.2377 in.)
CH395,CH440 .....	8.074 mm (0.7118 in.)

#### Oil Drain Plug Torque

CH270 .....	18 N·m (159 in. lb.)
CH395,CH440 .....	23 N·m (204 in. lb.)

Closure Plate Screw Torque..... 24 N·m (212 in. lb.)

### Crankshaft

End Play (Free)..... 0.0508/0.254 mm (0.002/0.010 in.)

<sup>1</sup> Values are in Metric units. Values in parentheses are English equivalents. Lubricate threads with engine oil prior to assembly.

**Ball Bearing Internal Clearance**

CH270 .....	0.003/0.025 mm (0.0001/0.0010 in.)
CH395 .....	0.005/0.020 mm (0.0002/0.0008 in.)
CH440 .....	0.006/0.020 mm (0.0002/0.0008 in.)

**Crankshaft O.D. (New)**

CH270 .....	24.975/24.989 mm (0.9833/0.9838 in.)
CH395 .....	29.975/29.989 mm (1.1801/1.1807 in.)
CH440 .....	34.975/34.989 mm (1.3770/1.3775 in.)

**Connecting Rod Journal O.D.**

**New**

CH270 .....	30.020/30.030 mm (1.1819/1.1823 in.)
CH395 .....	32.975/32.985 mm (1.2982/1.2986 in.)
CH440 .....	36.975/36.985 mm (1.4557/1.4561 in.)

**Max. Wear Limit**

CH270 .....	30.08 mm (1.1842 in.)
CH395 .....	32.92 mm (1.2961 in.)
CH440 .....	36.92 mm (1.4535 in.)

**Max. Taper** ..... 2.5 microns (0.0001 in.)

**Max. Out-of-Round** ..... 12.7 microns (0.0005 in.)

**Width**

CH270 .....	24.5/24.9 mm (0.9646/0.9803 in.)
CH395 .....	30.30/30.36 mm (1.1930/1.1953 in.)
CH440 .....	28.30/28.36 mm (1.1142/1.1165 in.)

**Crankshaft**

**Runout (Either End)** ..... 0.025 mm (0.001 in.)

**Cylinder Bore**

**Cylinder Bore I.D.**

**New**

CH270 .....	70.027/70.035 mm (2.757/2.757 in.)
CH395 .....	77.98/78.02 mm (3.0701/3.0717 in.)
CH440 .....	89.00/89.02 mm (3.5039/3.5045 in.)

**Max. Wear Limit**

CH270 .....	70.200 mm (2.764 in.)
CH395 .....	78.185 mm (3.0781 in.)
CH440 .....	89.185 mm (3.5112 in.)

**Max. Out-of-Round** ..... 12.7 microns (0.0005 in.)

**Max. Taper** ..... 12.7 microns (0.0005 in.)

**Cylinder Head**

**Cylinder Head Fastener Torque**

**Head Bolt - Torque in Two Stages**

CH270 .....	First to 12 N·m (106 in. lb.) Finally to 24 N·m (212 in. lb.)
CH395,CH440 .....	First to 18 N·m (159 in. lb.) Finally to 36 N·m (319 in. lb.)

**Max. Out-of-Flatness**

CH270 .....	0.08 mm (0.003 in.)
CH395,CH440 .....	0.1 mm (0.004 in.)

# Section 1

## Safety and General Information

---

### Flywheel

Flywheel Retaining Nut Torque<sup>1</sup>

CH270 .....	74 N·m (655 in. lb.)
CH395,CH440 .....	113 N·m (1000 in. lb.)

### Fuel Tank

Fuel Tank Mounting Nut Torque..... 24 N·m (212 in. lb.)

Fuel Tank Mounting Screw Torque ..... 24 N·m (212 in. lb.)

Fuel Tank Inlet Fitting Torque ..... 1.5 N·m (13 in. lb.)

### Governor

Governor Cross Shaft-to-Crankcase Running Clearance ..... 0.020/0.069 mm (0.0008/0.0027 in.)

Governor Cross Shaft O.D.

New

CH270 .....	5.955/5.980 mm (0.2344/0.2354 in.)
CH395,CH440 .....	7.955/7.980 mm (0.3132/0.3142 in.)

Max. Wear Limit

CH270 .....	5.942 mm (0.2339 in.)
CH395,CH440 .....	7.900 mm (0.3110 in.)

Governor Gear Shaft-to-Governor Gear Running Clearance ..... 0.022/0.134 mm (0.0009/0.0053 in.)

Governor Gear Shaft O.D.

New..... 6.016/6.028 mm (0.2368/0.2373 in.)

Max. Wear Limit..... 6.003 mm (0.2363 in.)

Governor Lever Nut Torque ..... 12 N·m (106 in. lb.)

Throttle Control Lever Nut Torque ..... 9 N·m (80 in. lb.)

### Ignition

Spark Plug Type (Champion® or Equivalent) ..... RC12YC

Spark Plug Gap..... 0.76 mm (0.030 in.)

Spark Plug Torque..... 22-27 N·m (195-239 in. lb.)

Ignition Module Air Gap ..... 0.254 mm (0.010 in.)

Ignition Module Fastener Torque ..... 10 N·m (89 in. lb.)

Oil Sentry™ Float Switch Screw Torque ..... 8 N·m (71 in. lb.)

Oil Sentry™ Module Screw Torque ..... 3.5 N·m (31 in. lb.)

Oil Sentry™ Wire Lead Nut Torque ..... 10 N·m (89 in. lb.)

### Main Bearing I.D. (Crankcase/Closure Plate)

New (Installed)

CH270 .....	24.992/25.000 mm (0.9839/0.9842 in.)
CH395 .....	29.990/30.000 mm (1.1807/1.1811 in.)
CH440 .....	34.990/35.000 mm (1.3776/1.3780 in.)

<sup>1</sup> Values are in Metric units. Values in parentheses are English equivalents. Lubricate threads with engine oil prior to assembly.

**Muffler**

Exhaust Screw Torque

CH270 (M8).....	24 N·m (212 in. lb.)
CH395,CH440 (M10).....	35 N·m (310 in. lb.)

Muffler Shield Screw Torque (M6) ..... 8 N·m (71 in. lb.)

Muffler Shield Screw Torque (M4)

CH270 .....	2 N·m (18 in. lb.)
CH395,CH440 .....	3.5 N·m (31 in. lb.)

Spark Arrestor Screw Torque (M5)..... 3.5 N·m (31 in. lb.)

**Piston, Piston Rings, and Piston Pin**

Piston-to-Piston Pin Running Clearance

CH270 .....	0.009/0.016 mm (0.0003/0.0006 in.)
CH395,CH440 .....	0.002/0.016 mm (0.0001/0.0006 in.)

Piston Pin Bore I.D.

New

CH270 .....	18.004/18.005 mm (0.7088/0.7089 in.)
CH395 .....	18.000/18.008 mm (0.7087/0.7090 in.)
CH440 .....	20.000/20.008 mm (0.7874/0.7877 in.)

Max. Wear Limit

CH270,CH395.....	18.05 mm (0.7106 in.)
CH440 .....	20.05 mm (0.7894 in.)

Piston Pin O.D.

New

CH270,CH395.....	17.992/17.995 mm (0.7083/0.7084 in.)
CH440 .....	19.992/19.998 mm (0.7871/0.7873 in.)

Max. Wear Limit

CH270,CH395.....	17.95 mm (0.7067 in.)
CH440 .....	19.95 mm (0.7854 in.)

Top and Center Compression Ring Side Clearance

New Bore

CH270 .....	0.04 mm (0.002 in.)
CH395 .....	0.07 mm (0.003 in.)
CH440 .....	0.045 mm (0.0018 in.)

Used Bore (Max.)

CH270 .....	0.15 mm (0.006 in.)
CH395 .....	0.11 mm (0.004 in.)
CH440 .....	0.10 mm (0.004 in.)

Top Compression Ring End Gap

New Bore

CH270 .....	0.325/0.400 mm (0.013/0.016 in.)
CH395,CH440.....	0.250/0.400 mm (0.010/0.016 in.)

Used Bore (Max.)..... 1.00 mm (0.039 in.)

# Section 1

## Safety and General Information

---

### Center Compression Ring End Gap

#### New Bore

CH270 .....	0.325/0.400 mm (0.013/0.016 in.)
CH395 .....	0.650/0.800 mm (0.026/0.032 in.)
CH440 .....	0.640/0.800 mm (0.025/0.032 in.)

#### Used Bore (Max.)

CH270 .....	1.00 mm (0.039 in.)
CH395,CH440 .....	1.50 mm (0.059 in.)

### Oil Control Ring-to-Groove Side Clearance

CH270,CH395 .....	0.05/0.19 mm (0.0019/0.0075 in.)
CH440 .....	0.09/0.15 mm (0.0035/0.0059 in.)

### Piston Thrust Face O.D.

#### New

CH270 <sup>2</sup> .....	69.970/69.960 mm (2.755/2.754 in.)
CH395 <sup>3</sup> .....	77.955/77.975 mm (3.071/3.070 in.)
CH440 <sup>4</sup> .....	88.955/88.975 mm (3.502/3.503 in.)

#### Max. Wear Limit

CH270 .....	69.82 mm (2.749 in.)
CH395 .....	77.82 mm (3.064 in.)
CH440 .....	88.82 mm (3.497 in.)

### Piston Thrust Face-to-Cylinder Bore Running Clearance

CH270 <sup>2</sup> .....	0.057/0.075 mm (0.002/0.003 in.)
CH395 <sup>3</sup> .....	0.033/0.067 mm (0.001/0.003 in.)
CH440 <sup>4</sup> .....	0.025/0.060 mm (0.001/0.002 in.)

### Rocker Arm

Rocker Arm Stud Torque ..... 13.6 N·m (120 in. lb.)

Rocker Arm Pivot Jam Nut Torque ..... 10 N·m (89 in. lb.)

### Retractable Starter

Retractable Starter Cover Screw Torque ..... 5.4 N·m (48 in. lb.)

Retractable Starter Center Screw Torque ..... 10 N·m (89 in. lb.)

### Valve Cover

Valve Cover Fastener Torque ..... 10 N·m (89 in. lb.)

### Valves and Valve Lifters

#### Intake Valve Stem-to-Valve Guide Running Clearance

CH270 .....	0.038/0.065 mm (0.0015/0.0026 in.)
CH395,CH440 .....	0.025/0.055 mm (0.0010/0.0022 in.)

#### Exhaust Valve Stem-to-Valve Guide Running Clearance

CH270 .....	0.085/0.112 mm (0.0033/0.0044 in.)
CH395,CH440 .....	0.040/0.07 mm (0.0016/0.0026 in.)

<sup>2</sup>Measure 21.8-22.2 mm (0.8583-0.8740 in.) above the bottom of the piston skirt at right angles to the piston pin.

<sup>3</sup>Measure 17.8-18.2 mm (0.7008-0.7165 in.) above the bottom of the piston skirt at right angles to the piston pin.

<sup>4</sup>Measure 29.8-30.2 mm (1.1732-1.1890 in.) above the bottom of the piston skirt at right angles to the piston pin.

Intake Valve Stem O.D.

New

CH270 .....	5.50 mm (0.217 in.)
CH395,CH440 .....	6.57 mm (0.259 in.)

Max. Wear Limit

CH270 .....	5.34 mm (0.210 in.)
CH395,CH440 .....	6.40 mm (0.252 in.)

Exhaust Valve Stem O.D.

New

CH270 .....	5.438 mm (0.214 in.)
CH395,CH440 .....	6.55 mm (0.258 in.)

Max. Wear Limit

CH270 .....	5.28 mm (0.208 in.)
CH395,CH440 .....	6.41 mm (0.252 in.)

Intake Valve Stem to Guide

New

CH270 .....	0.024/0.039 mm (0.0009/0.0015 in.)
CH395,CH440 .....	0.025/0.055 mm (0.0010/0.0022 in.)

Max. Wear Limit

CH270 .....	0.10 mm (0.0039 in.)
CH395 .....	0.13 mm (0.0051 in.)
CH440 .....	0.14 mm (0.0055 in.)

Exhaust Valve Stem to Guide

New

CH270 .....	0.098/0.112 mm (0.0038/0.0044 in.)
CH395,CH440 .....	0.040/0.070 mm (0.0016/0.0028 in.)

Max. Wear Limit

CH270 .....	0.12 mm (0.0047 in.)
CH395 .....	0.10 mm (0.0039 in.)
CH440 .....	0.11 mm (0.0043 in.)

Valve Guide Reamer Size

Standard Intake

CH270 .....	5.524 mm (0.2175 in.)
CH395,CH440 .....	6.608 mm (0.2602 in.)

Standard Exhaust

CH270 .....	5.536 mm (0.2179 in.)
CH395,CH440 .....	6.608 mm (0.2602 in.)

Valve Seat Width

CH270 .....	0.80 mm (0.0315 in.)
CH395 .....	1.10 mm (0.0433 in.)
CH440 .....	1.20 mm (0.0472 in.)






Nominal Valve Face Angle ..... 45°

# Section 1






## Safety and General Information

### General Torque Values

#### Metric Fastener Torque Recommendations for Standard Applications






Tightening Torque: N·m (in. lb.) + or - 10%						
	Property Class					Noncritical Fasteners Into Aluminum
Size						
M4	1.2 (11)	1.7 (15)	2.9 (26)	4.1 (36)	5.0 (44)	2.0 (18)
M5	2.5 (22)	3.2 (28)	5.8 (51)	8.1 (72)	9.7 (86)	4.0 (35)
M6	4.3 (38)	5.7 (50)	9.9 (88)	14.0 (124)	16.5 (146)	6.8 (60)
M8	10.5 (93)	13.6 (120)	24.4 (216)	33.9 (300)	40.7 (360)	17.0 (150)

Tightening Torque: N·m (ft. lb.) + or - 10%						
	Property Class					Noncritical Fasteners Into Aluminum
Size						
M10	21.7 (16)	27.1 (20)	47.5 (35)	66.4 (49)	81.4 (60)	33.9 (25)
M12	36.6 (27)	47.5 (35)	82.7 (61)	116.6 (86)	139.7 (103)	61.0 (45)
M14	58.3 (43)	76.4 (55)	131.5 (97)	184.4 (136)	219.7 (162)	94.9 (70)



**English Fastener Torque Recommendations for Standard Applications**

<b>Tightening Torque: N·m (in. lb.) + or - 20%</b>				
<b>Bolts, Screws, Nuts and Fasteners Assembled Into Cast Iron or Steel</b>				<b>Grade 2 or 5 Fasteners Into Aluminum</b>
	 <b>Grade 2</b>	 <b>Grade 5</b>	 <b>Grade 8</b>	 
<b>Size</b>				
8-32	2.3 (20)	2.8 (25)	-----	2.3 (20)
10-24	3.6 (32)	4.5 (40)	-----	3.6 (32)
10-32	3.6 (32)	4.5 (40)	-----	-----
1/4-20	7.9 (70)	13.0 (115)	18.7 (165)	7.9 (70)
1/4-28	9.6 (85)	15.8 (140)	22.6 (200)	-----
5/16-18	17.0 (150)	28.3 (250)	39.6 (350)	17.0 (150)
5/16-24	18.7 (165)	30.5 (270)	-----	-----
3/8-16	29.4 (260)	-----	-----	-----
3/8-24	33.9 (300)	-----	-----	-----
<b>Tightening Torque: N·m (ft. lb.) + or - 20%</b>				
<b>Size</b>				
5/16-24	-----	-----	40.7 (30)	-----
3/8-16	-----	47.5 (35)	67.8 (50)	-----
3/8-24	-----	54.2 (40)	81.4 (60)	-----
7/16-14	47.5 (35)	74.6 (55)	108.5 (80)	-----
7/16-20	61.0 (45)	101.7 (75)	142.4 (105)	-----
1/2-13	67.8 (50)	108.5 (80)	155.9 (115)	-----
1/2-20	94.9 (70)	142.4 (105)	223.7 (165)	-----
9/16-12	101.7 (75)	169.5 (125)	237.3 (175)	-----
9/16-18	135.6 (100)	223.7 (165)	311.9 (230)	-----
5/8-11	149.2 (110)	244.1 (180)	352.6 (260)	-----
5/8-18	189.8 (140)	311.9 (230)	447.5 (330)	-----
3/4-10	199.3 (150)	332.2 (245)	474.6 (350)	-----
3/4-16	271.2 (200)	440.7 (325)	637.3 (470)	-----

**Torque  
Conversions**

N·m = in. lb. x 0.113
N·m = ft. lb. x 1.356
in. lb. = N·m x 8.85
ft. lb. = N·m x 0.737

**Section 1**  
**Safety and General Information**

---

## Section 2 Tools & Aids

Certain quality tools are designed to help you perform specific disassembly, repair, and reassembly procedures. By using tools designed for the job, you can properly service engines easier, faster, and safer! In addition, you'll increase your service capabilities and customer satisfaction by decreasing engine downtime.

Here is the list of tools and their source.

**Separate Tool Suppliers:**

Kohler Tools Contact your source of supply.	SE Tools 415 Howard St. Lapeer, MI 48446 Phone 810-664-2981 Toll Free 800-664-2981 Fax 810-664-8181	Design Technology Inc. 768 Burr Oak Drive Westmont, IL 60559 Phone 630-920-1300
---	--	--

Tools	
Description	Source/Part No.
<b>Camshaft Endplay Plate</b> For checking camshaft endplay.	SE Tools KLR-82405
<b>Camshaft Seal Protector (Aegis)</b> To protect seal during camshaft installation.	SE Tools KLR-82417
<b>Cylinder Leakdown Tester</b> For checking combustion retention and if cylinder, piston, rings, or valves are worn.	Kohler 25 761 05-S
<b>Electronic Fuel Injection (EFI) Diagnostic Software</b> Use with Laptop or Desktop PC.	Kohler 25 761 23-S
<b>EFI Service Kit</b> For troubleshooting and setting up an EFI engine.	Kohler 24 761 01-S
Individual Components Available Pressure Tester Noid Light 90° Adapter Oetiker Clamp Pliers Code Plug, Red Wire Code Plug, Blue Wire	Design Technology Inc. DTI-019 DTI-021 DTI-023 DTI-025 DTI-027 DTI-029
<b>Flywheel Holding Tool (CS Series)</b>	SE Tools KLR-82407
<b>Flywheel Puller</b> To remove flywheel from engine.	SE Tools KLR-82408
<b>Flywheel Strap Wrench</b> To hold flywheel during removal.	SE Tools KLR-82409

## Section 2

### Tools & Aids

<b>Tools (Continued)</b>	
<b>Description</b>	<b>Source/Part No.</b>
<b>Hydraulic Valve Lifter Tool</b> To remove and install hydraulic lifters.	Kohler 25 761 38-S
<b>Ignition System Tester</b> For testing output on all systems, including CD	Kohler 25 455 01-S
<b>Offset Wrench (K &amp; M Series)</b> To remove and reinstall cylinder barrel retaining nuts.	Kohler 52 455 04-S
<b>Oil Pressure Test Kit</b> To test and verify oil pressure.	Kohler 25 761 06-S
<b>Rectifier-Regulator Tester (120 volt current)</b> <b>Rectifier-Regulator Tester (240 volt current)</b> Used to test rectifier-regulators.	Kohler 25 761 20-S Kohler 25 761 41-S
Individual Components Available CS-PRO Regulator Test Harness Special Regulator Test Harness with Diode	Design Technology Inc. DTI-031 DTI-033
<b>Spark Advance Module (SAM) Tester</b> To test the SAM (ASAM and DSAM) on engines with SMART-SPARK™.	Kohler 25 761 40-S
<b>Starter Servicing Kit (All Starters)</b> To remove and reinstall drive retaining rings and brushes.	SE Tools KLR-82411
Individual Component Available Starter Brush Holding Tool (Solenoid Shift)	SE Tools KLR-82416
<b>Tachometer (Digital Inductive)</b> For checking operating speed (RPM) of an engine.	Design Technology Inc. DTI-110
<b>Digital Vacuum/Pressure Tester</b> Used like a water manometer, but easier to transport and maintain.	Design Technology Inc. DTI-721-01
Individual Component Available Rubber Adapter Plug	Design Technology Inc. DTI-721-10

<b>Aids</b>	
<b>Description</b>	<b>Source/Part No.</b>
<b>Camshaft Lubricant</b> (Valspar ZZ613)	Kohler 25 357 14-S
<b>Dielectric Grease</b> (GE/Novaguard G661)	Kohler 25 357 11-S
<b>Dielectric Grease</b> (Loctite®)	51360
<b>Electric Starter Drive Lubricant</b> (Inertia Drive)	Kohler 52 357 01-S
<b>Electric Starter Drive Lubricant</b> (Solenoid Shift)	Kohler 52 357 02-S
<b>RTV Silicone Sealant</b> Loctite® 5900® Heavy Body in 4 oz aerosol dispenser. Only oxime-based, oil resistant RTV sealants, such as those listed, are approved for use. Loctite® Nos. 5900® or 5910® are recommended for best sealing characteristics. Loctite® 5910® Loctite® Ultra Black 598™ Loctite® Ultra Blue 587™ Loctite® Ultra Copper™	Kohler 25 597 07-S
<b>Spline Drive Lubricant</b>	Kohler 25 357 12-S

## Section 2

### Tools & Aids

---

#### Special Tools You Can Make

##### Rocker Arm/Crankshaft Tool

A spanner wrench to lift the rocker arms or turn the crankshaft may be made out of an old junk connecting rod.

1. Find a used connecting rod from a 10 HP or larger engine. Remove and discard the rod cap.
2. Remove the studs of a Posi-Lock rod or grind off the aligning steps of a Command rod, so the joint surface is flat.
3. Find a 1 in. long capscrew with the correct thread size to match the threads in the connecting rod.
4. Use a flat washer with the correct I.D. to slip on the capscrew and approximately 1 in. O.D. (Kohler Part No. **12 468 05-S**). Assemble the capscrew and washer to the joint surface of the rod, as shown in Figure 2-1.

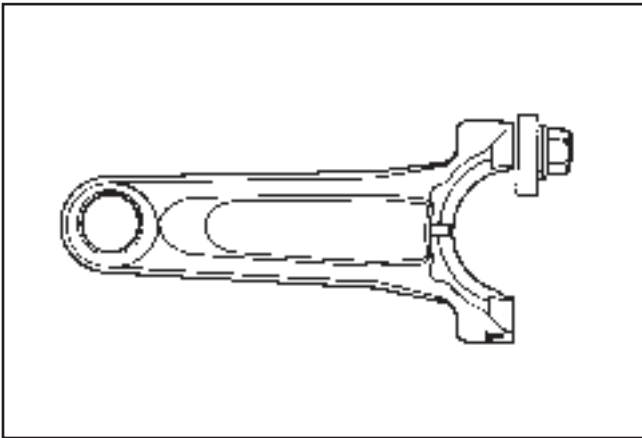


Figure 2-1. Rocker Arm/Crankshaft Tool.

# Section 3

## Troubleshooting

### Troubleshooting Guide

When troubles occur, be sure to check the simple causes which, at first, may seem too obvious to be considered. For example, a starting problem could be caused by an empty fuel tank.

Some general common causes of engine troubles are listed below. Use these to locate the causing factors. Refer to the specific section(s) within this service manual for more detailed information.

#### Engine Cranks But Will Not Start

1. Empty fuel tank.
2. Fuel shut-off valve closed.
3. Poor fuel, dirt or water in the fuel system.
4. Clogged fuel line.
5. Spark plug lead disconnected.
6. Kill switch in **OFF** position.
7. Faulty spark plug.
8. Faulty ignition module.
9. Low oil level.
10. Flywheel key sheared.

#### Engine Starts But Does Not Keep Running

1. Restricted fuel tank cap vent.
2. Poor fuel, dirt or water in the fuel system.
3. Faulty or misadjusted choke or throttle controls.
4. Loose wires or connections that short the kill terminal of ignition module to ground.
5. Faulty cylinder head gasket.
6. Faulty carburetor.
7. Intake system leak.
8. Low oil level.

#### Engine Starts Hard

1. PTO drive is engaged.
2. Dirt or water in the fuel system.
3. Clogged fuel line.
4. Loose or faulty wires or connections.
5. Faulty or misadjusted choke or throttle controls.
6. Faulty spark plug.

7. Low compression.
8. Weak spark.
9. Engine overheated-cooling/air circulation restricted.
10. Quality of fuel.
11. Flywheel key sheared.
12. Intake system leak.

#### Engine Will Not Crank

1. PTO drive is engaged.
2. Battery (if equipped) is discharged.
3. Faulty electric starter or solenoid (electric start).
4. Pawls not engaging in drive cup (retractable start).
5. Seized internal engine components.

#### Engine Runs But Misses

1. Dirt or water in the fuel system.
2. Spark plug lead loose.
3. Poor quality of fuel.
4. Faulty spark plug.
5. Loose wires or connections that intermittently ground the ignition kill circuit.
6. Engine overheated.
7. Faulty ignition module or incorrect air gap.
8. Carburetor adjusted incorrectly.

#### Engine Will Not Idle

1. Dirt or water in the fuel system.
2. Stale fuel and/or gum in carburetor.
3. Faulty spark plug.
4. Fuel supply inadequate.
5. Idle fuel adjusting needle improperly set.
6. Idle speed adjusting screw improperly set.
7. Low compression.
8. Restricted fuel tank cap vent.
9. Engine overheated-cooling system/air circulation problem.

## Section 3

# Troubleshooting

---

### Engine Overheats

1. Air intake/grass screen, cooling fins, or cooling shrouds clogged.
2. Excessive engine load.
3. Low crankcase oil level.
4. High crankcase oil level.
5. Faulty carburetor.
6. Lean fuel mixture.

### Engine Knocks

1. Excessive engine load.
2. Low crankcase oil level.
3. Old or improper fuel.
4. Internal wear or damage.
5. Poor quality fuel.
6. Incorrect grade of oil.

### Engine Loses Power

1. Low crankcase oil level.
2. High crankcase oil level.
3. Dirty air cleaner element.
4. Dirt or water in the fuel system.
5. Excessive engine load.
6. Engine overheated.
7. Faulty spark plug.
8. Low compression.
9. Exhaust restriction.
10. Incorrect governor setting.

### Engine Uses Excessive Amount of Oil

1. Incorrect oil viscosity/type.
2. Clogged, broken or inoperative crankcase breather.
3. Worn or broken piston rings.
4. Worn cylinder bore.
5. Worn valve stems/valve guides.
6. Crankcase overfilled.
7. Blown head gasket/overheated.

### Oil Leaks from Oil Seals, Gaskets

1. Clogged, broken or inoperative crankcase breather.
2. Loose or improperly torqued fasteners.
3. Piston blowby, or leaky valves.
4. Restricted exhaust.

### External Engine Inspection

Before cleaning or disassembling the engine, make a thorough inspection of its external appearance and condition. This inspection can give clues to what might be found inside the engine (and the cause) when it is disassembled.

- Check for buildup of dirt and debris on the crankcase, cooling fins, grass screen, and other external surfaces. Dirt or debris on these areas are causes of higher operating temperatures and overheating.
- Check for obvious fuel and oil leaks, and damaged components. Excessive oil leakage can indicate a clogged breather, worn/damaged seals and gaskets, or loose or improperly-torqued fasteners.
- Check the air cleaner cover and base for damage or indications of improper fit and seal.
- Check the air cleaner element. Look for holes, tears, cracked or damaged sealing surfaces, or other damage that could allow unfiltered air into the engine. Also note if the element is dirty or clogged. These could indicate that the engine has been under serviced.
- Check the carburetor throat for dirt. Dirt in the throat is further indication that the air cleaner is not functioning properly.
- Check the oil level. Note if the oil level is within the operating range on the dipstick, or if it is low or overfilled.
- Check the condition of the oil. Drain the oil into a container - the oil should flow freely. Check for metal chips and other foreign particles.

Sludge is a natural by-product of combustion; a small accumulation is normal. Excessive sludge formation could indicate overrich carburetion, weak ignition, overextended oil change intervals or wrong weight or type of oil was used, to name a few.

NOTE: It is good practice to drain oil at a location away from the workbench. Be sure to allow ample time for complete drainage.



### Cleaning the Engine

After inspecting the external condition of the engine, clean the engine thoroughly before disassembling it. Also clean individual components as the engine is disassembled. Only clean parts can be accurately inspected and gauged for wear or damage. There are many commercially available cleaners that will quickly remove grease, oil, and grime from engine parts. When such a cleaner is used, *follow the manufacturer's instructions and safety precautions carefully.*

Make sure all traces of the cleaner are removed before the engine is reassembled and placed into operation. Even small amounts of these cleaners can quickly break down the lubricating properties of engine oil.

### Basic Engine Tests

#### Crankcase Vacuum Test

A partial vacuum should be present in the crankcase when the engine is operating. Pressure in the crankcase (normally caused by a clogged or improperly assembled breather) can cause oil to be forced out at oil seals, gaskets, or other available spots.

Crankcase vacuum is best measured with either a water manometer or a vacuum gauge (see Section 2). Complete instructions are provided in the kits.

To test the crankcase vacuum with the manometer:

1. Insert the stopper/hose into the oil fill hole. Leave the other tube of manometer open to atmosphere. Make sure the shut-off clamp is closed.
2. Start the engine and run at no-load high speed (3400-3600 RPM).

3. Open the clamp and note the water level in the tube.

The level in the engine side should be a minimum of **10.16 cm (4.00 in.)** above the level in the open side.

If the level in the engine side is less than specified (low/no vacuum), or the level in the engine side is lower than the level in the open side (pressure), check for the conditions in the table below.

4. Close the shut-off clamp **before** stopping the engine.

To test the crankcase vacuum with the Vacuum/Pressure Gauge Kit (see Section 2):

1. Remove the dipstick or oil fill plug/cap.
2. Install the adapter into the oil fill/dipstick tube opening.
3. Push the barbed fitting on the gauge solidly into the hole in the adapter.
4. Start the engine and bring it up to operating speed (3400-3600 RPM or application specific).
5. Check the reading on the gauge. If the reading is to the **left** of "0" on the gauge, vacuum or negative pressure is indicated. If the reading is to the **right** of "0" on the gauge, positive pressure is present.

Crankcase vacuum should be a minimum of 4 inches of water. If the reading is below the specification, or if pressure is present, check the table below for possible causes and remedies.

<b>No Crankcase Vacuum/Pressure in Crankcase</b>	
<b>Possible Cause</b>	<b>Solution</b>
Crankcase breather clogged or inoperative.	Replace valve cover and recheck pressure. Breather is integral part of valve cover and cannot be serviced separately.
Seals and/or gaskets leaking. Loose or improperly torqued fasteners.	Replace all worn or damaged seals and gaskets. Make sure all fasteners are tightened securely. Use appropriate torque values and sequences when necessary.
Piston blow by or leaky valves (confirm by compression or cylinder leakdown tests and inspecting components).	Recondition piston, rings, cylinder bore, valves, and valve guides.
Restricted exhaust.	Check exhaust screen/spark arrestor. Clean or replace as needed. Repair or replace any other damaged/restricted muffler or exhaust system parts.

## Section 3 Troubleshooting

---

### Compression Test

A compression test is best performed on a warm engine. Clean any dirt or debris away from the base of the spark plug before removing it. Be sure the choke is off, and the throttle is wide open during the test. Compression should be at least 45 psi.

### Cylinder Leakdown Test

A cylinder leakdown test can be a valuable alternative to a compression test. By pressurizing the combustion chamber from an external air source, you can determine if the valves or rings are leaking and how badly.

The Cylinder Leakdown Tester (refer to Section 2) is a relatively simple, inexpensive leakdown tester for small engines. The tester includes a quick disconnect for attaching the adapter hose, and a holding tool.

### Leakdown Test Instructions

1. Run the engine for 3-5 minutes to warm it up.
2. Remove the spark plug and the air filter from engine.
3. Rotate the crankshaft until the piston (of cylinder being tested) is at top dead center of the compression stroke. Hold the engine in this position while testing. The holding tool supplied with the tester can be used if the PTO end of the crankshaft is accessible. Lock the holding tool onto the crankshaft. Install a 3/8 in. breaker bar into the hole/slot of the holding tool, so it is perpendicular to both the holding tool and crankshaft PTO.

If the flywheel end is more accessible, use a breaker bar and socket on the flywheel nut/screw to hold it in position. An assistant may be needed to hold the breaker bar during testing. If the engine is mounted in a piece of equipment, it may be possible to hold it by clamping or wedging a driven component. Just be certain that the engine cannot rotate off of TDC in either direction.

4. Install the adapter into the spark plug hole, but do not attach it to the tester at this time.
5. Connect an air source of at least 50 psi to the tester.
6. Turn the regulator knob in the increase direction (clockwise) until the gauge needle is in the yellow **Set** area at the low end of the scale.
7. Connect the tester quick-disconnect to the adapter hose while firmly holding the engine at TDC. Note the gauge reading and listen for escaping air at the carburetor intake, exhaust outlet, and crankcase breather.
8. Check the test results against the following table:

### Leakdown Test Results

Air escaping from crankcase breather .....	Rings or cylinder worn.
Air escaping from exhaust system .....	Defective exhaust valve/improper seating.
Air escaping from carburetor .....	Defective intake valve/improper seating.
Gauge reading in <b>Low</b> (green) zone.....	Piston rings and cylinder in good condition.
Gauge reading in <b>Moderate</b> (yellow) zone .....	Engine is still usable, but there is some wear present. Customer should start planning for overhaul or replacement.
Gauge reading in <b>High</b> (red) zone .....	Rings and/or cylinder have considerable wear. Engine should be reconditioned or replaced.

# Section 4

## Air Cleaner and Air Intake System

### Air Cleaner

#### General

These engines are equipped with one of two air cleaner configurations; the Quad-Clean™, a four-stage heavy-duty cyclonic air cleaner, or the low-profile air cleaner.

#### Quad-Clean™ Air Cleaner

##### General

These engines are equipped with a replaceable, high-density paper air cleaner element. Some engines are also equipped with a preoiled, foam precleaner which surrounds the paper element. See Figure 4-1. The system is CARB/EPA certified and the components should not be altered or modified in any way.

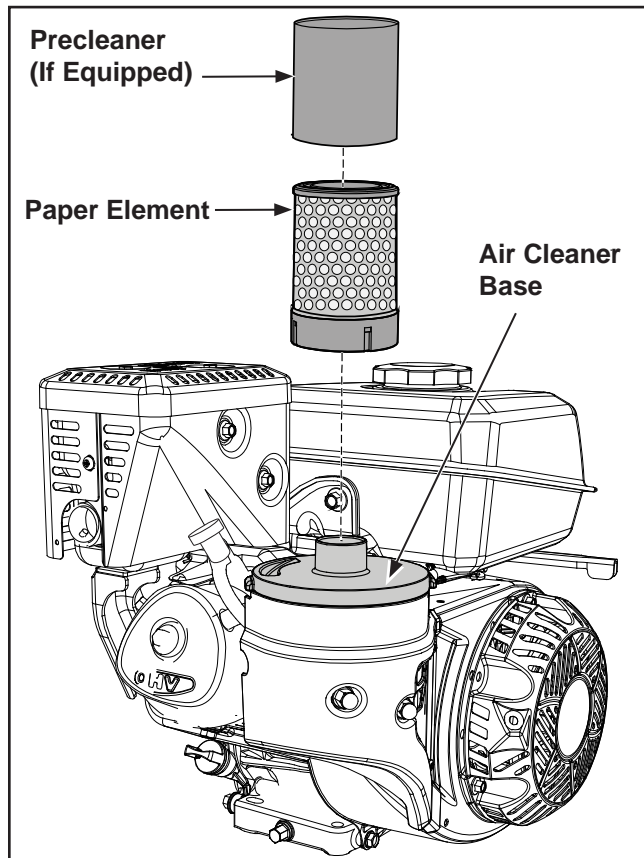


Figure 4-1. Air Cleaner Element and Precleaner.

### Service

Check the air cleaner **daily or before starting the engine**. Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

NOTE: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

#### Service Precleaner (If Equipped)

Wash the precleaner every **50 hours** of operation (more often under extremely dusty or dirty conditions).

1. Remove the air cleaner cover. Move the bails on the air cleaner cover down. Remove the latches from under the tabs of the air cleaner base. Lift and remove the air cleaner cover from the air cleaner base. See Figure 4-2.

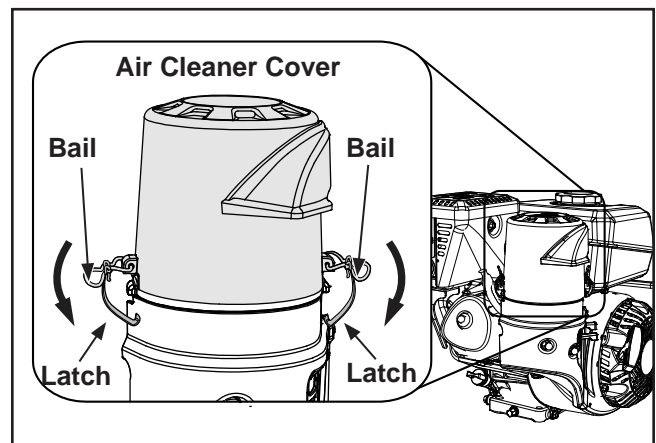


Figure 4-2. Air Cleaner Cover Removal.

2. Remove the precleaner from the paper element.
3. Wash the precleaner in warm water with detergent. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the precleaner to air dry.

## Section 4

### Air Cleaner and Air Intake System

4. Lightly oil the precleaner with new engine oil. Squeeze the precleaner to evenly distribute the oil and remove any excess.
5. Reinstall the precleaner over the paper element.
6. Position the air cleaner cover.
  - a. For Normal Operation conditions, see Figure 4-3.
  - b. For Cold Weather Operation conditions, see Figure 4-4.

NOTE: Running the engine in the Cold Weather Operation position of the air cleaner cover under normal conditions can damage the engine.

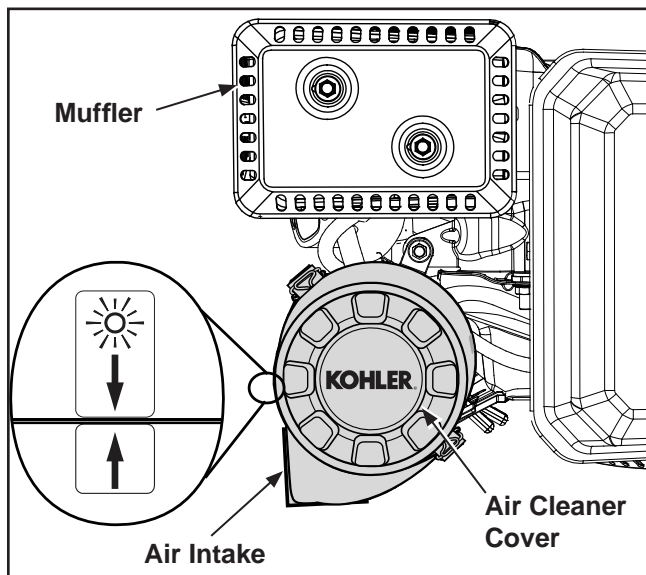


Figure 4-3. Normal Operation Position of Air Cleaner Cover.

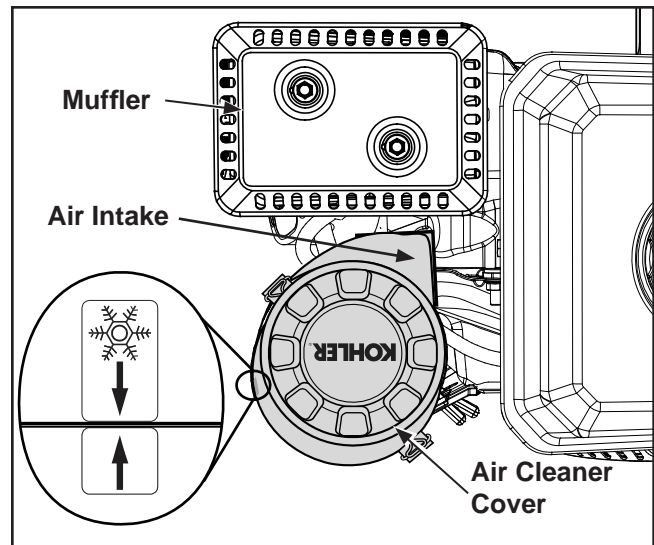


Figure 4-4. Cold Weather Operation Position of Air Cleaner Cover.

7. Reinstall and secure the air cleaner cover. Align the air cleaner cover latches with the tabs on the base. Place the latches under the tabs and lift up on the bails. See Figure 4-5.

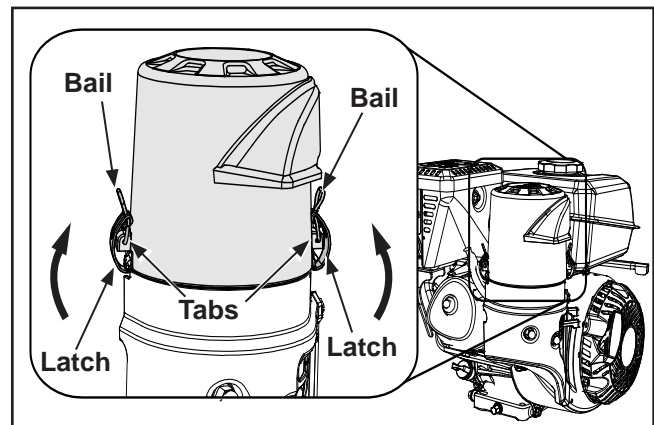


Figure 4-5. Air Cleaner Cover Installation.

#### Service Paper Element

Every 200 hours of operation (more often under extremely dusty or dirty conditions), replace the paper element.

1. Remove the air cleaner cover. Move the bails on the air cleaner cover down. Remove the latches from under the tabs of the air cleaner base. Lift and remove the air cleaner cover from the air cleaner base. Separate the precleaner from the element and service as outlined above. See Figures 4-1 and 4-2.

2. **Do not** wash the paper element or use pressurized air, as this will damage the element. Replace a dirty, bent, or damaged element with a genuine Kohler element. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.
3. When servicing the air cleaner, check the air cleaner base. Make sure it is secured and not bent or damaged. Check the air cleaner cover/housing for damage or improper fit. Replace all bent or damaged air cleaner components.
4. Slide the precleaner and paper element onto the air cleaner base. See Figure 4-1.
5. Position the air cleaner cover.
  - a. For Normal Operation conditions, see Figure 4-3.
  - b. For Cold Weather Operation conditions, see Figure 4-4.

NOTE: Running the engine in the Cold Weather Operation position of the air cleaner cover under normal conditions can damage the engine.

6. Reinstall and secure the air cleaner cover. Align the air cleaner cover latches with the tabs on the base. Place the latches under the tabs and lift up on the bails. See Figure 4-5.

### Low-Profile Air Cleaner

#### General

The low-profile air cleaner contains an oiled-foam element.

The low-profile air cleaner is shown in Figure 4-6. The system is CARB/EPA certified and the components should not be altered or modified in any way.



**Figure 4-6. Low-Profile Air Cleaner.**

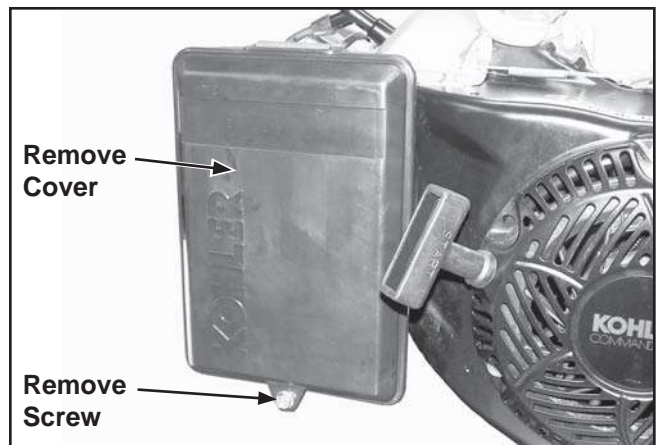
#### Service

Check the air cleaner **daily or before starting the engine**. Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all damaged air cleaner components.

NOTE: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

Every **100 hours** of operation, wash the foam air cleaner element (more often under extremely dusty, or dirty conditions). Every **300 hours** of operation (more often under extremely dusty or dirty conditions), replace the foam element.

1. Remove the screw at the bottom of the air cleaner cover, and remove the cover. See Figure 4-7.



**Figure 4-7. Remove Screw and Cover.**

2. Remove the foam element from the air cleaner base. See Figure 4-8.

## Section 4

### Air Cleaner and Air Intake System

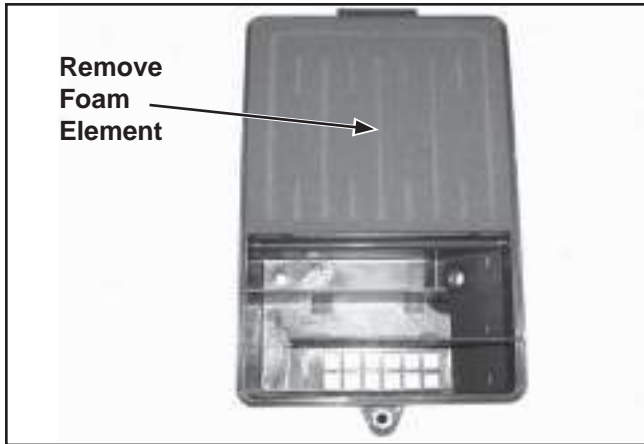


Figure 4-8. Remove Foam Element.

3. Wash the foam element in warm water with detergent. Rinse the element thoroughly until all traces of detergent are eliminated. Squeeze out all excess water (do not wring). Allow the element to air dry.
4. Lightly oil the precleaner with new engine oil. Squeeze the precleaner to evenly distribute the oil and remove any excess.
5. When servicing the foam air cleaner element, clean and check the air cleaner case and outer cover for damage, distortion, or an improper seal. Replace any components which are bent or damaged.
6. Install the element into the air cleaner base.
7. Reinstall the cover and secure with the screw.

NOTE: Do not operate engine without the air cleaner element; excessive piston and/or cylinder wear may result.

#### Air Intake/Cooling System

To ensure proper cooling, make sure the grass screen, cooling fan fins, and external surfaces of the engine are kept clean at all times.

Every **100 hours** of operation (more often under extremely dusty, dirty conditions), remove the blower housing and other cooling shrouds. Clean the cooling fins and external surfaces as necessary. Make sure the cooling shrouds are reinstalled. See Figure 4-9.

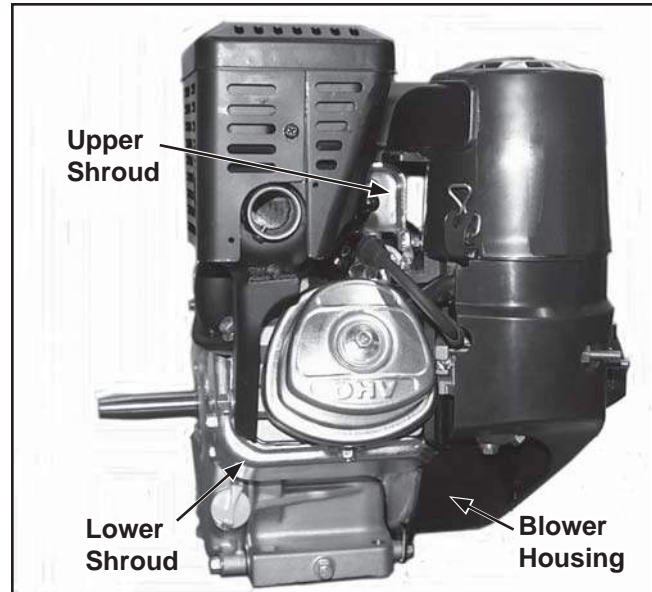


Figure 4-9. Engine Shrouds.

# Section 5

## Fuel System and Governor

### Description

This section covers the carbureted fuel systems used on these engines. The governor system is covered at the end of this section.



#### **WARNING: Explosive Fuel!**

*Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.*

### Fuel System Components

The typical carbureted fuel system and related components include the following:

- Fuel Tank
- Fuel Line
- Fuel Tank Fuel Filter
- In-line Fuel Filter
- Fuel Strainer Screen In Carburetor
- Carburetor

### Operation

The fuel tank outlet is located above the carburetor inlet, allowing gravity to feed fuel through the in-line filter and fuel line to the carburetor.

Fuel then enters the carburetor through a fuel shut-off valve and a fine screen/sediment bowl, and then to the carburetor float bowl. Fuel is drawn into the carburetor body and is mixed with air. This fuel-air mixture is then burned in the engine combustion chamber.

### Fuel Recommendations

#### General Recommendations

Purchase gasoline in small quantities and store in clean, approved containers. A container with a capacity of 2 gallons or less with a pouring spout is recommended. Such a container is easier to handle and helps eliminate spillage during refueling.

- Do not use gasoline left over from the previous season, to minimize gum deposits in your fuel system and to ensure easy starting.
- Do not add oil to the gasoline.
- Do not overfill the fuel tank. Leave room for the fuel to expand. See Figure 5-1.

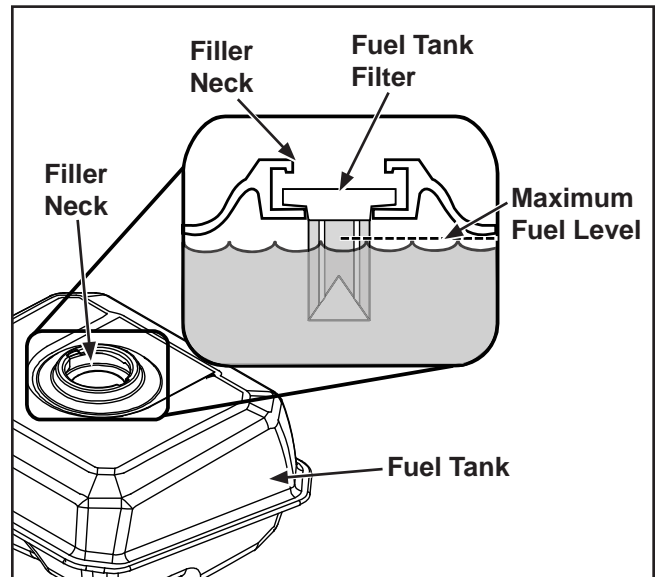


Figure 5-1. Maximum Fuel Level.

## Section 5

# Fuel System and Governor

### Fuel Type

For best results use only clean, fresh, **unleaded** gasoline with a pump sticker octane rating of 87 (R+M)/2 or higher. In countries using the Research Octane Number (RON), it should be 90 octane minimum. Leaded gasoline is not recommended and must not be used on EFI engines or on other models where exhaust emissions are regulated.

### Gasoline/Alcohol blends

Gasohol (up to 10% ethyl alcohol, 90% unleaded gasoline by volume) is approved as a fuel for Kohler engines. Other gasoline/alcohol blends including E20 and E85 are not to be used and not approved. Any failures resulting from use of these fuels will not be warranted.

### Gasoline/Ether blends

Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blends (up to a maximum of 15% MTBE by volume) are approved as a fuel for Kohler engines. Other gasoline/ether blends are not approved.

### Fuel Line

These engines use low permeation rated fuel lines, certified to comply with California and U.S. EPA evaporative emission requirements. Fuel lines that do not meet these requirements may not be used. Order replacement hose through a Kohler Service Center.

### Fuel Filters

#### Fuel Tank Filter (If Equipped)

A serviceable fuel tank filter is located under the fuel tank cap, in the filler neck.

**Daily or as required** clean filter of any accumulation as follows:

1. Remove the fuel tank cap and filter. See Figure 5-2.

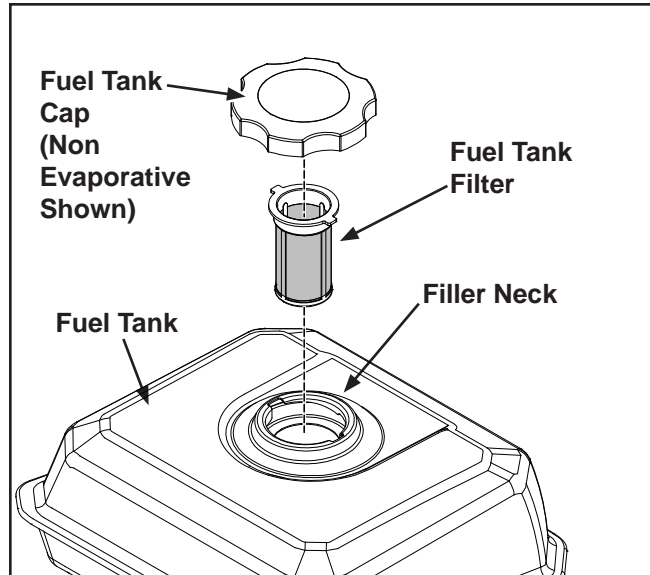


Figure 5-2. Fuel Tank Fuel Filter.

2. Clean the filter with solvent, replace if damaged.
3. Wipe the filter and insert it.
4. Tighten the tank cap securely.

#### Fuel Filter (If Equipped)

Most engines are equipped with an in-line filter. Periodically inspect the filter and replace **annually** or every **300 hours** with a genuine Kohler filter. See Figure 5-3.

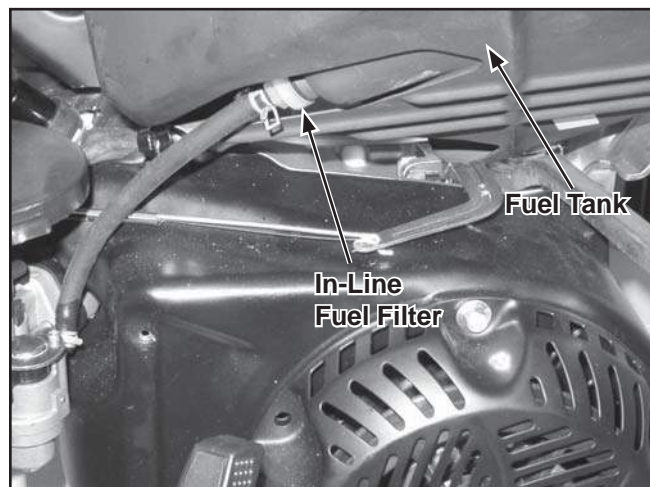


Figure 5-3. In-Line Fuel Filter.

#### Fuel Valve

These engines are equipped with a fuel valve and integral screen filter located at the inlet of the carburetor. It controls and filters fuel flow from the tank to the carburetor.



NOTE: Models with a low-profile air cleaner do not have the fuel valve.

Every 100 hours of operation clean fuel valve cup of any accumulated debris. If the screen becomes clogged or damaged replace it.



Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames.

1. Stop the engine.
2. Remove the securing hardware and the carburetor cover panel. See Figure 5-4.

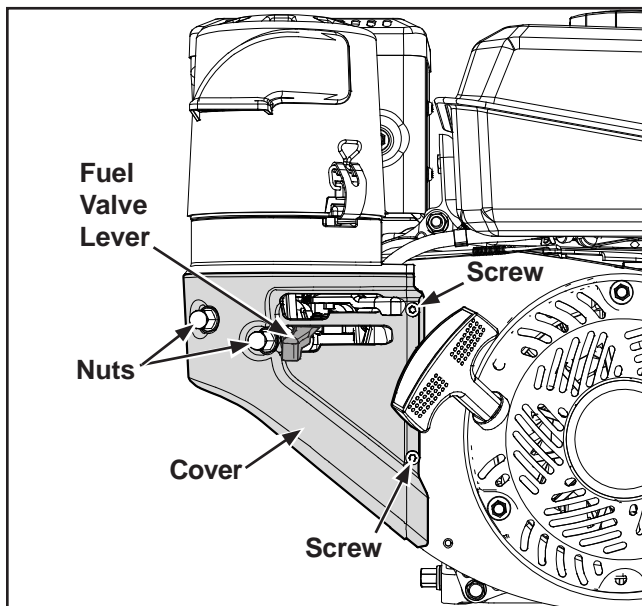


Figure 5-4. Carburetor Cover Panel.

3. Turn the fuel valve lever to the **OFF** position.
4. Remove the fuel valve cup. See Figure 5-5.

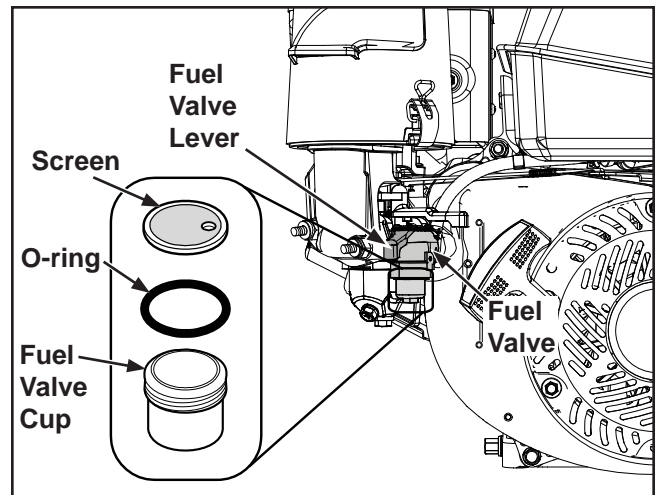


Figure 5-5. Fuel Valve Cup, O-ring, and Screen.

5. Clean the fuel valve cup with solvent and wipe it off.
6. Check the O-ring, replace if damaged. Check the screen for blockage or damage, replace if necessary. The new screen must be located on the pick-up tube as shown in Figure 5-6.

5

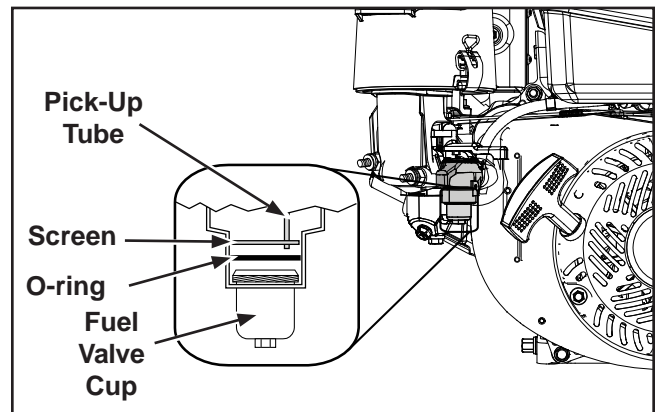


Figure 5-6. Pick-up Tube and Screen Orientation.

7. Place the O-ring on the screen followed by the fuel valve cup. Rotate the fuel valve cup until it is finger tight. Turn with a wrench 1/2 to 3/4 turn. See Figure 5-6.
8. Turn the fuel valve to the **ON** position and check for leaks. If fuel valve cup leaks repeat Step 7.
9. Reinstall the carburetor cover panel, using the hardware removed in Step 2 to secure.

## Section 5

### Fuel System and Governor

---

#### Fuel System Tests

When the engine starts hard, or turns over but will not start, it is possible that the problem is in the fuel system. To find out if the fuel system is causing the problem, perform the following tests.

#### Troubleshooting – Fuel System Related Causes

Test	Conclusion
1. Check the following: <ol style="list-style-type: none"> <li>Make sure the fuel tank contains clean, fresh, proper fuel.</li> <li>Make sure the fuel tank cap vent is clean and unobstructed.</li> <li>Make sure the fuel shut-off valve is open.</li> <li>Make sure the fuel shut-off valve strainer, and in-line fuel filter (if used) are clean and unobstructed.</li> </ol>	
2. Check for fuel in the combustion chamber. <ol style="list-style-type: none"> <li>Disconnect and ground spark plug lead.</li> <li>Close the choke on the carburetor.</li> <li>Crank the engine several times.</li> <li>Remove the spark plug and check for fuel at the tip.</li> </ol>	2. If there <b>is</b> fuel at the tip of the spark plug, fuel is reaching the combustion chamber.  If there is <b>no</b> fuel at the tip of the spark plug, check for fuel flow from the fuel tank ( <b>Test 3</b> ).
3. Check for fuel flow from the tank to the carburetor. <ol style="list-style-type: none"> <li>Disconnect the fuel line from the inlet fitting of the carburetor.</li> <li>Use an approved fuel container to catch fuel and hold the line below the bottom of the tank to observe fuel flow.</li> </ol>	3. If fuel <b>does</b> flow from the line, proceed to <b>Test 4</b> .  If fuel <b>does not</b> flow from the line, check the fuel tank vent, in-line filter threaded into tank, and fuel line. Correct any observed problem and reconnect the line.
4. Check the operation of fuel shut-off valve. <ol style="list-style-type: none"> <li>Remove the fuel sediment bowl under the inlet fitting of carburetor.</li> <li>Turn fuel shut-off valve ON and OFF and observe operation.</li> </ol>	4. If fuel <b>does</b> flow from the valve, check for dirt and water in sediment bowl and screen. Clean bowl and screen as needed. (Refer to the carburetor portions of this section.)  If fuel <b>does not</b> flow from the valve, check for a clog in the fuel shut-off valve or inlet elbow.

If the above tests/checks did not indicate a problem with fuel delivery or related systems, but the engine still does not start properly, refer to the following chart and check for a carburetor problem.

**Carburetor**

These engines are equipped with a fixed main jet carburetor. The carburetor is designed to deliver the correct fuel-to-air mixture to the engine under all operating conditions. The idle mixture is set at the factory and cannot be adjusted. The low idle fuel adjusting needle is also set at the factory and has a limiting cap. It normally does not need adjustment.

**Adjustments**

**General**

NOTE: Carburetor adjustments should be made only after the engine has warmed up.

NOTE: Certified engines have a limiter cap on the idle fuel adjusting needle. Adjustments can only be performed within the limits allowed by the cap.

**High-Altitude Operation**

Operating the engine with the wrong engine configuration at a given altitude may increase its emissions and decrease fuel efficiency and performance. To ensure correct engine operation at altitudes above 1219 meters (4000 ft), it may be necessary to have an authorized Kohler dealer install a special high altitude jet kit in the carburetor. If a high altitude kit has been installed, the engine must be reconverted to the original jet size, before it is operated at lower altitudes, or overheating and engine damage can result.

To obtain high altitude kit information or locate a dealer near you, call 1-800-544-2444 to find the names of the nearest Kohler Co. Service Centers or, access our web site at: [www.kohlerengines.com](http://www.kohlerengines.com) and click on the "Service & Dealer Locator" located in the upper right hand corner. The service center will need your engine specification number which is found on your Engine ID Label.

**Troubleshooting - Carburetor Related Causes**

Condition	Possible Cause/Probable Remedy
1. Engine starts hard, runs roughly or stalls at idle speed.	1. Low idle fuel mixture (some models)/speed improperly adjusted. Adjust the idle speed screw or the idle mixture screw.
2. Engine runs rich (indicated by black, sooty exhaust smoke, misfiring, loss of speed and power, governor hunting, or excessive throttle opening).	2a. Clogged air cleaner. Clean or replace. b. Choke partially closed during operation. Check the choke lever/linkage to ensure choke is operating properly. c. Low idle fuel mixture is improperly adjusted. Adjust idle mixture screw. d. Dirt under the fuel inlet needle. Remove needle; clean needle and seat and blow with compressed air. e. Bowl vent or air bleeds plugged. Remove low idle fuel adjusting needle. Clean vent, ports, and air bleeds. Blow out all passages with compressed air. f. Leaky, cracked or damaged float. Submerge float to check for leaks.
3. Engine runs lean (indicated by misfiring, loss of speed and power, governor hunting or excessive throttle opening).	3a. Intake air leak. Check if carburetor is loose or one of the intake gaskets is leaking. b. Idle holes plugged; dirt in fuel delivery channels. Clean main fuel jet and all passages; blow out with compressed air.
4. Fuel leaks from carburetor.	4a. Float damaged. See Remedy 2f. Replace float. b. Dirt under fuel inlet needle. See Remedy 2d. c. Bowl vents plugged. Blow out with compressed air. d. Carburetor bowl gasket leaks. Replace gasket.

## Section 5 Fuel System and Governor

### Adjusting Low Idle Speed

1. Start the engine and run at half throttle for 5 to 10 minutes to warm up. The engine must be warm before making final settings.
2. **Low Idle Speed Setting:** Place the throttle in the **idle** or **slow** position. Set the low idle speed to 1800 RPM ( $\pm 150$  RPM) by turning the low idle speed screw in or out. See Figure 5-7.

NOTE: The actual low idle speed depends on the application. Refer to the equipment manufacturer's recommendations. The low idle speed for basic engines is 1800 RPM ( $+ 150$  RPM).

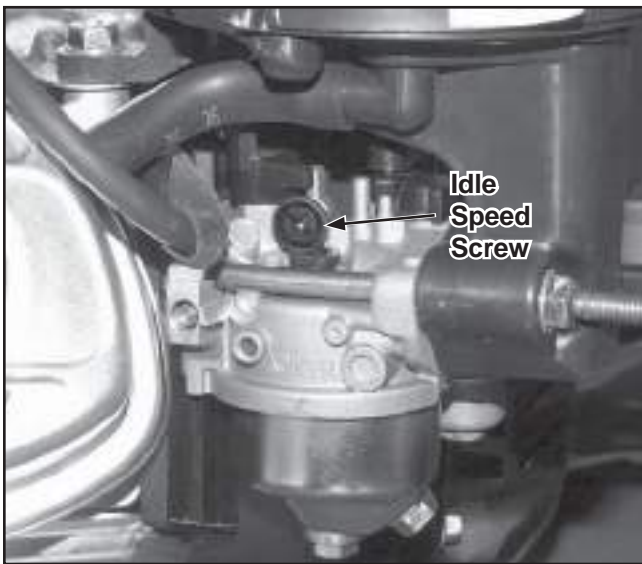


Figure 5-7. Carburetor Adjustments.

3. **High Idle Speed Setting:** Set the high idle speed by turning the high idle speed screw in or out. See Figure 5-8. **Do not** exceed 3750 RPM.

NOTE: The high idle speed is also specified by the equipment manufacturer. Set according to recommendations. The high idle speed for basic engines is 3600 RPM ( $\pm 150$  RPM).

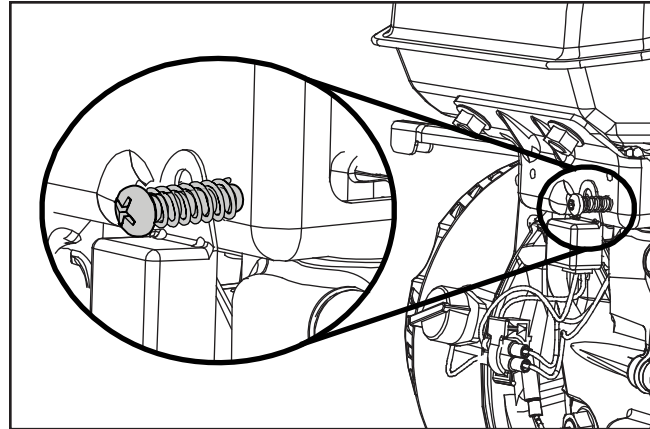


Figure 5-8. High Speed Screw.

### Carburetor Servicing

If symptoms described in the carburetor troubleshooting guide indicate a problem within the carburetor, the following steps can be used to remove the carburetor from the engine and provide the necessary service.

#### Carburetor Removal

1. Remove the air cleaner cover, filter element with precleaner, the carburetor cover mounting screws, and hex flange nuts from the mounting stud(s). See Figure 5-9.

NOTE: If the low-profile air cleaner is installed, remove the cover and element, remove the two hex flange nuts securing the base to the carburetor and one screw secured to the blower housing, and remove the base.

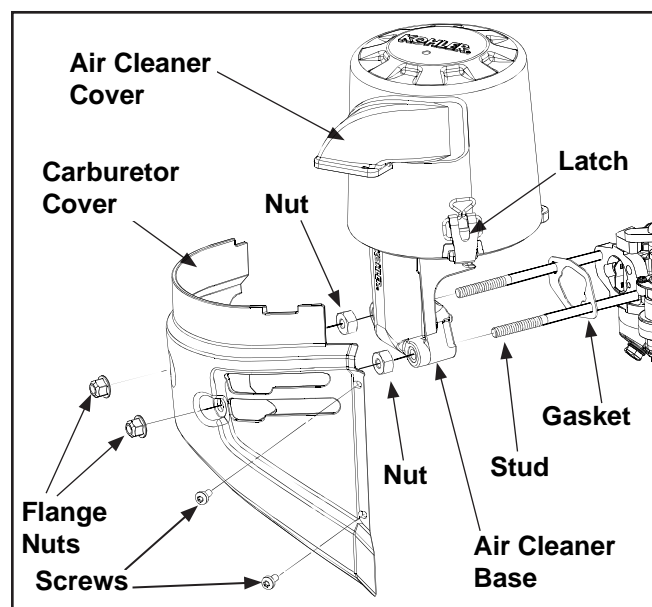
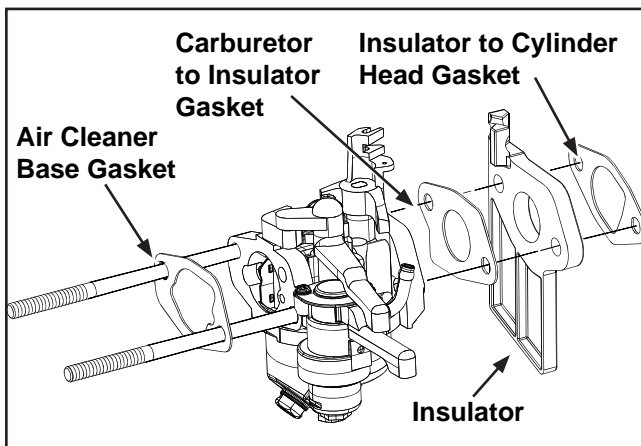


Figure 5-9. Removing Air Cleaner Assembly.

2. Disconnect the breather hose from the valve cover or air cleaner base. Remove the two nuts, the hex flange screw securing the base to the head, and air cleaner base from the mounting studs. See Figure 5-9.
3. Remove the gasket from the mounting studs.
4. Disconnect the fuel line from the carburetor inlet. Disconnect the choke link and spring at the carburetor end.

**NOTE:** After disconnecting the fuel line, pinching, clamping, or plugging the fuel line may be needed if the fuel tank is not empty.

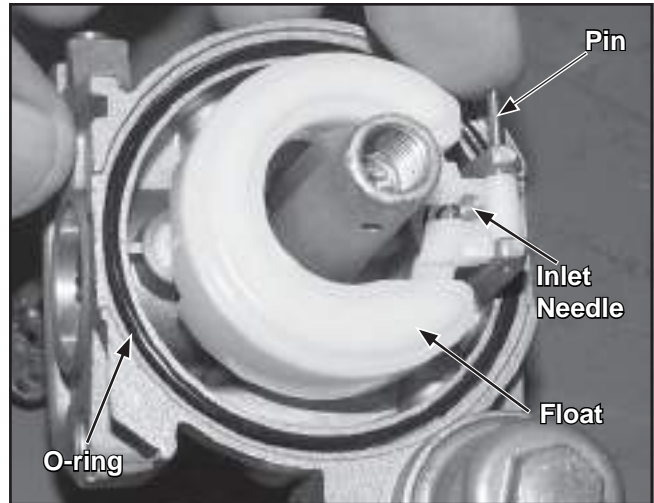
5. Slide the carburetor off of the mounting studs while disconnecting the throttle link and dampening spring.
6. Inspect the carburetor to insulator gasket, insulator, and insulator to cylinder head gasket, and replace as needed. See Figure 5-10.



**Figure 5-10. Carburetor Gaskets.**

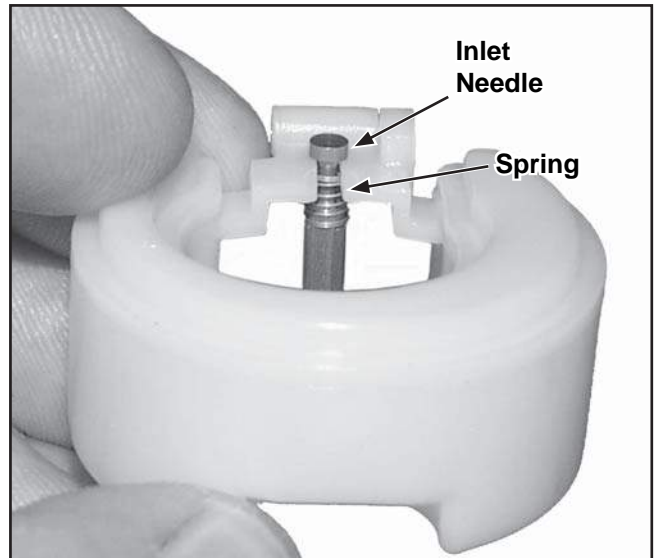
**Disassembly/Overhaul**

1. Clean the exterior surfaces of dirt or foreign material before disassembling the carburetor. Remove the center fuel bowl screw and carefully separate the fuel bowl from the carburetor. Transfer any remaining fuel into an approved container. Remove and discard the old O-ring(s).
2. Remove the float pin and lift out the old float and inlet needle. Discard all of the parts. The seat for the inlet needle is not serviceable, and should not be removed. See Figures 5-11 and 5-12.



**Figure 5-11. Removing Float and Inlet Needle.**

**5**



**Figure 5-12. Float, Inlet Needle, and Spring.**

3. Use an appropriate size flat screwdriver, and carefully remove the main jet from the carburetor. After the main jet has been removed, the main nozzle can be taken out through the bottom of the main tower. Save the parts for cleaning and reuse. See Figure 5-13.

## Section 5 Fuel System and Governor

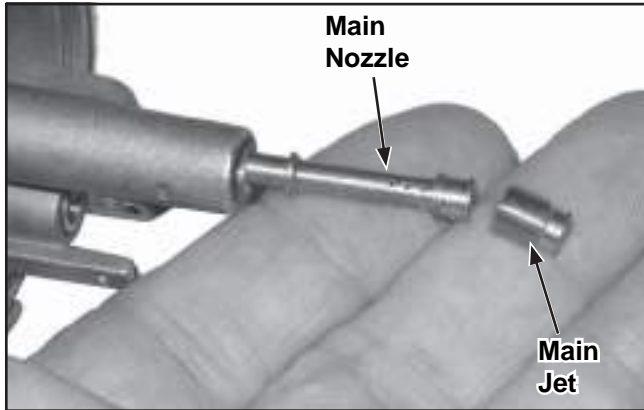


Figure 5-13. Main Jet Removal.

4. Remove the fuel shut-off fuel bowl, screen, and O-ring. See Figure 5-14.

NOTE: Models with a low-profile air cleaner will not have a fuel shut-off.

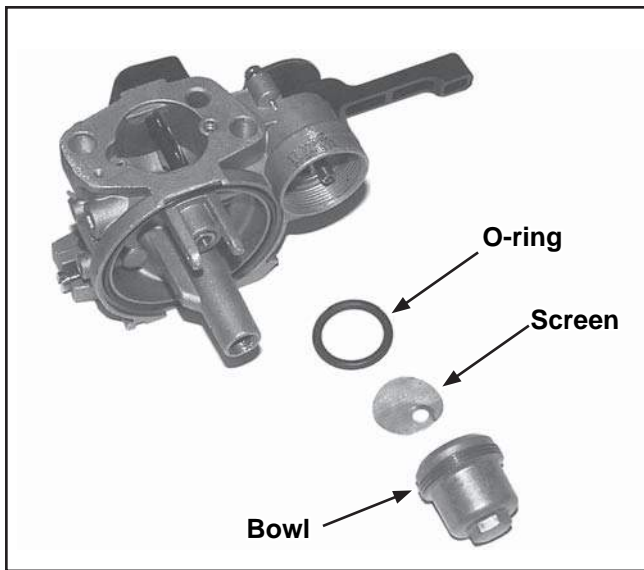


Figure 5-14. Fuel Shut-Off Bowl, Screen, and O-ring.

5. Remove the two screws, top plate, and fuel shut-off lever. See Figure 5-15.

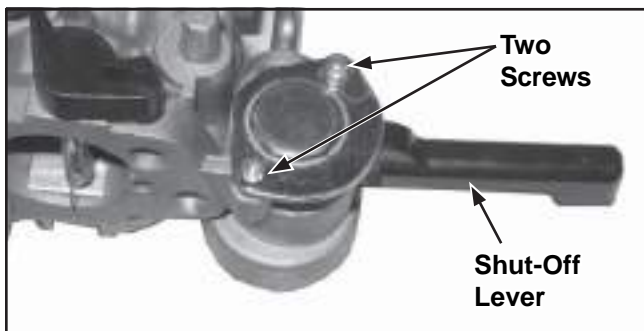


Figure 5-15. Fuel Shut-Off Lever.

6. Remove disc and wave washer. See Figure 5-16.

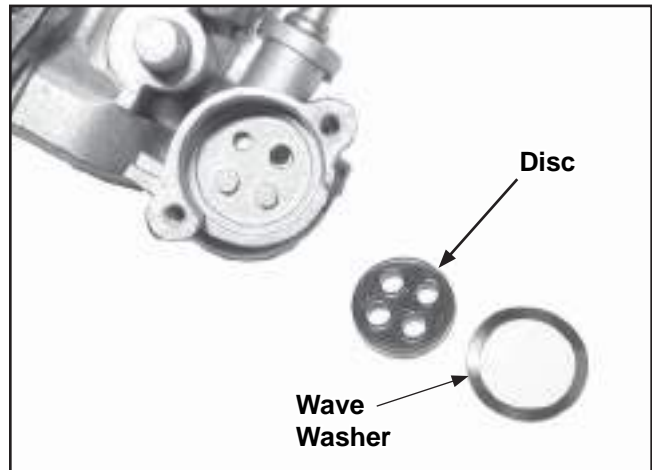


Figure 5-16. Fuel Shut-Off Disc and Wave Washer.

NOTE: The carburetor is now disassembled for appropriate cleaning and installation of the parts in the overhaul kit. Further disassembly is not necessary. The throttle shaft assembly, fuel inlet seat, and bowl chamber baffle, are non-serviceable items and should not be removed.

7. Clean the carburetor body, jets, vent ports, seats, etc., using a good commercially available carburetor solvent. Use clean, dry compressed air to blow out the internal channels and ports. Inspect and thoroughly check the carburetor for cracks, wear, or damage. Inspect the fuel inlet seat for wear or damage.
8. Clean the carburetor float bowl as required.
9. Install the fuel shut-off disc and wave washer into the chamber of the fuel shut-off. See Figure 5-16. Install the fuel shut-off lever and top plate, and secure with the two screws. See Figure 5-15.
10. Install the fuel shut-off screen and O-ring and install the bowl onto the fuel shut-off assembly. See Figure 5-14.
11. Install the main nozzle and the main jet into the tower of the carburetor body. See Figure 5-13.
12. Install the float and inlet needle down into the seat and carburetor body. Insert the new pivot pin through the float hinge. See Figure 5-12.

13. Hold the carburetor body so the float assembly hangs vertically and rests lightly against the fuel inlet needle. The inlet needle should be fully seated but the center pin of the needle (on retainer clip end) should not be depressed.

NOTE: The inlet needle center pin is spring loaded. Make sure the float assembly rests against the fuel inlet needle, without depressing the center pin.

14. Install the fuel bowl, with the O-ring(s) in place, onto the carburetor. Secure with O-ring on original screw. Torque the screw to 7.0 N·m (62 in. lb.).

### Carburetor Installation

Always use new gaskets when servicing or reinstalling carburetors. Repair kits are available which include new gaskets and other components. Service kit part numbers can be found in our free online parts lookup Kohler PLUS. Go to [www.kohlerplus.com](http://www.kohlerplus.com) and click **Enter as a Guest**.

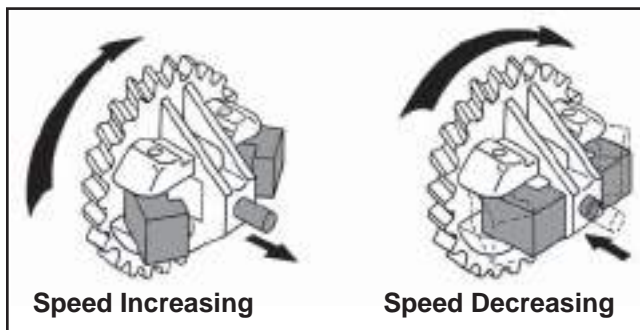
1. Reverse the steps in **Carburetor Removal** to install the carburetor to the engine.

### Governor

These engines are equipped with a centrifugal flyweight mechanical governor. The governor is designed to hold the engine speed constant under changing load conditions. The governor gear/flyweight mechanism is mounted inside the crankcase and driven off the gear on the crankshaft.

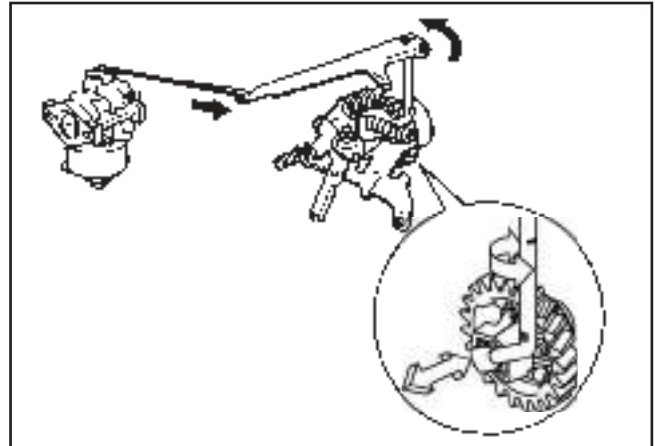
### Operation

Centrifugal force acting on the rotating governor gear assembly causes the flyweights to move outward as speed increases. As the flyweights move outward, they cause the regulating pin to extend from the governor gear assembly. See Figure 5-17.



**Figure 5-17. Action of a Governor Gear.**

The regulating pin contacts the tab on the cross shaft, causing the shaft to rotate when the engine speed changes. One end of the cross shaft protrudes through the side of the closure plate. Through external linkage attached to the cross shaft, the rotating action is transmitted to the throttle lever of the carburetor. See Figure 5-18.



**Figure 5-18. Typical Governor System.**

When the engine is at rest, and the throttle control is in the **FAST** position, the tension of the governor spring holds the throttle plate open. When the engine is operating (the governor gear assembly is rotating), the force applied by the regulating pin against the cross shaft tends to close the throttle plate. The governor spring tension and the force applied by the regulating pin are in equilibrium during operation, holding the engine speed constant.

When a load is applied and the engine speed (and governor gear speed) decreases, the governor spring tension moves the governor lever to open the throttle plate wider. This allows more fuel into the engine, increasing engine speed (this action occurs very rapidly, so a reduction in speed is hardly noticed). As the speed reaches the governed setting, the governor spring tension and the force applied by the regulating pin will again be in equilibrium. This maintains the engine speed at a relatively constant level.

The governed speed setting is determined by the position of the throttle control. It can be variable or constant, depending on the application.

## Section 5

### Fuel System and Governor

#### Initial Adjustment

Make this initial adjustment whenever the governor lever is loosened or removed from the cross shaft. To ensure proper setting, make sure the throttle linkage is connected to the governor lever and to the carburetor throttle lever (certain engine components removed for clarity of illustration).

#### CH270

1. Close the fuel shut-off valve.
2. Remove the air cleaner outer cover. Then either reposition the fuel tank to access governor shaft and lever joint, or disconnect the fuel line and remove the tank from the engine.

NOTE: Make sure the carburetor is mounted and secured in place when adjustment is being made/checked.

3. Loosen the governor lever mounting nut. See Figure 5-19.

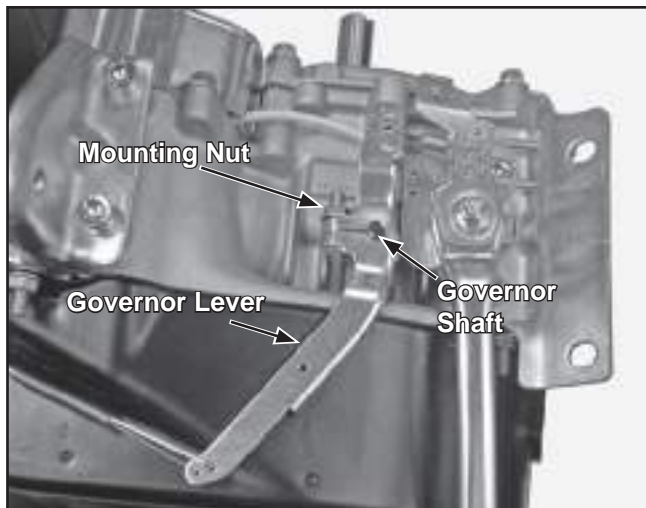


Figure 5-19. Governor Adjustment.

4. Move the governor lever clockwise until it stops.
5. Rotate the governor shaft clockwise until it stops.
6. Hold both in this position and tighten the governor lever nut to **12 N·m (106 in. lb.)**.

#### CH395, CH440

1. Close the fuel shut-off valve.
2. Remove the air cleaner outer cover. Then either reposition the fuel tank to access governor shaft and lever joint, or disconnect the fuel line and remove the tank from the engine.

NOTE: Make sure the carburetor is mounted and secured in place when adjustment is being made/checked.

3. Loosen the governor lever mounting nut. See Figure 5-20.

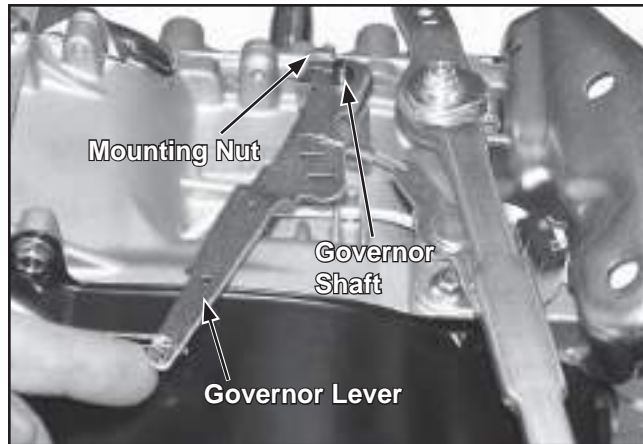


Figure 5-20. Governor Adjustment.

4. Move the governor lever counterclockwise until it stops.
5. Rotate the governor shaft counterclockwise until it stops.
6. Hold both in this position and tighten the governor lever nut to **12 N·m (106 in. lb.)**.



# Section 6

## Lubrication System

### General

These engines use a splash lubrication system, supplying necessary lubrication to the crankshaft, camshaft, connecting rod and valve train components.

### Oil Recommendations

Using the proper type and weight of oil in the crankcase is extremely important. So is checking oil daily and changing oil regularly. Failure to use the correct oil, or using dirty oil, causes premature engine wear and failure.

### Oil Type

Use high quality detergent oil of API (American Petroleum Institute) service class SJ or higher. Select the viscosity based on the air temperature at the time of operation as shown in the following table. See Figure 6-1.

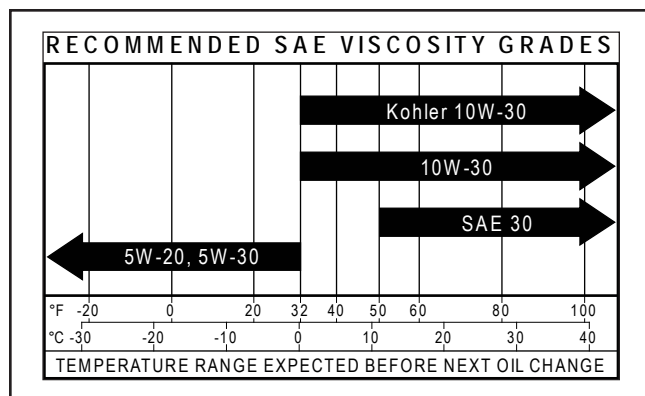
NOTE: Using other than service class SJ, or higher oil, or extending oil change intervals longer than recommended can cause engine damage.

A logo or symbol on oil containers identifies the API service class and SAE viscosity grade. See Figure 6-2.



6

Figure 6-2. Oil Container Logo.



The top portion of the symbol shows service class such as **API SERVICE CLASS SJ**. The symbol may show additional categories such as **SH, SG/CC, or CD**. The center portion shows the viscosity grade such as **SAE 10W-30**. If the bottom portion shows "Energy Conserving," it means that oil is intended to improve fuel economy in passenger car engines.

Figure 6-1. Oil Viscosity Grades Table.

## Section 6 Lubrication System

### Check Oil Level

The importance of checking and maintaining the proper oil level in the crankcase cannot be overemphasized. Check oil **BEFORE EACH USE** as follows:

1. Make sure the engine is stopped, level, and is cool so the oil has had time to drain into the sump.
2. Clean the area around and beneath the dipstick or the oil fill plug before removing it. This will help keep dirt, debris, and other foreign matter out of the engine. See Figure 6-3.

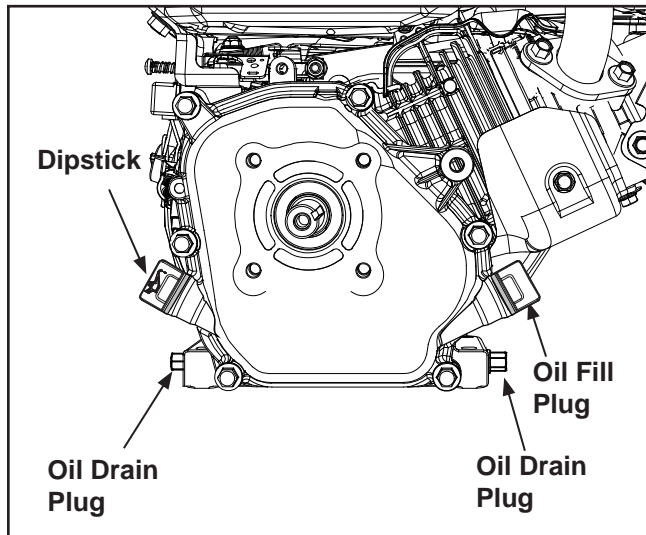


Figure 6-3. Location of Dipstick, Oil Fill Plug, and Oil Drain Plugs.

NOTE: The engine may be equipped with two dipsticks or an oil fill plug and a dipstick. These can be placed in either hole. See Figure 6-4.

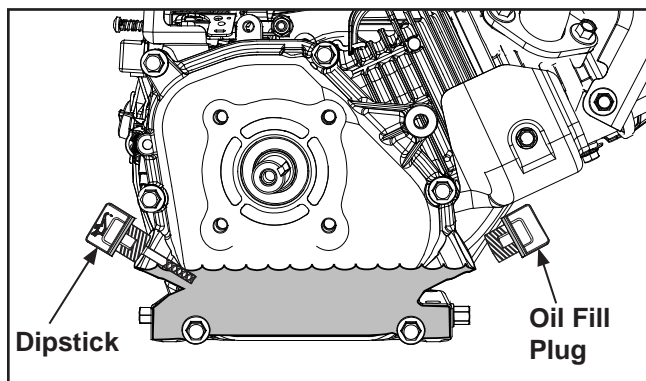


Figure 6-4. Location of Dipstick and Oil Fill Plug.

3. **Checking oil level with a dipstick.** Unscrew and remove the dipstick; wipe off oil. Reinsert the dipstick into the oil fill tube and rest the dipstick on the oil fill tube. Turn it counterclockwise until the cap drops down to the lowest point of the thread leads. **Do not** thread the dipstick cap into the tube. See Figure 6-5.

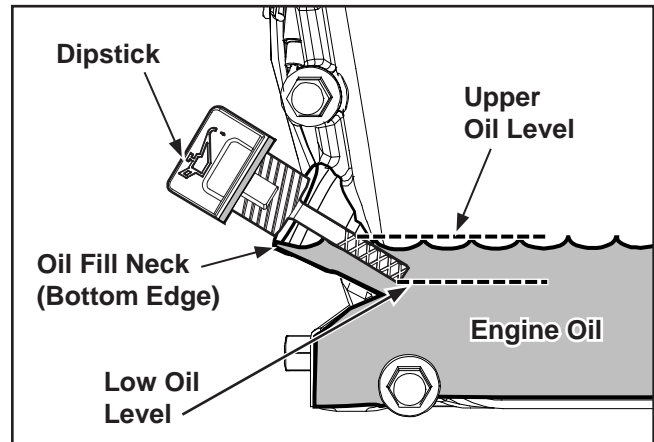


Figure 6-5. Dipstick Oil Level Check.

**Checking oil level with an oil fill plug.** Unscrew and remove the oil fill plug. The level should be up to but not over, the point of overflowing the filler neck. See Figure 6-6.

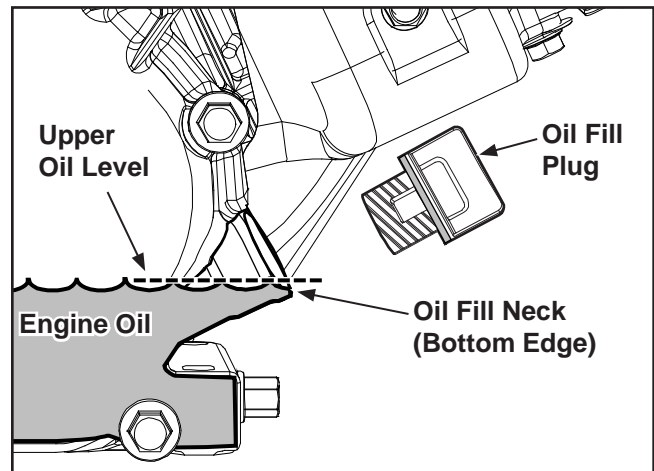


Figure 6-6. Oil Fill Plug Oil Level Check.

4. If the level is low, add oil of the proper type (Refer to Oil Type) to the correct level. Always check the level before adding more oil. See Figures 6-5 and 6-6.

NOTE: To prevent extensive engine wear or damage, always maintain the proper oil level in the crankcase. Never operate the engine with the oil level above or below the correct level.

### Oil Disposal

Protect and respect the environment. Dispose of oil at your local recycling center or municipal collection center in accordance with local ordinances.

### Change Oil

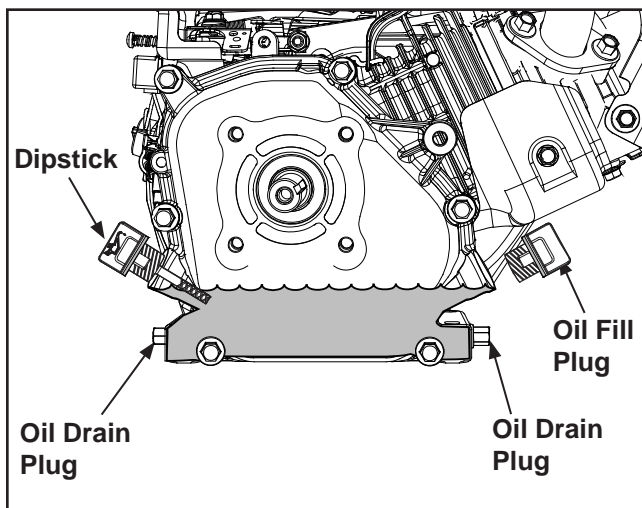
For a **new engine**, change oil after the first **5 hours** of operation. Thereafter, change oil every **100 hours** of operation.

For an **overhauled engine**, use **Kohler 10W-30** service class, SJ or higher oil for the first **5 hours** of operation. Change the oil after this initial run-in period. Refill with service class SJ or higher oil as specified in the Viscosity Grades table (see Figure 6-1).

Change the oil while the engine is still warm. The oil will flow more freely and carry away more impurities. Make sure the engine is level when filling, checking, or changing the oil.

Change the oil as follows:

1. To keep dirt, debris, etc., out of the engine, clean the area around the oil fill plug/dipstick before removing it. See Figure 6-7.

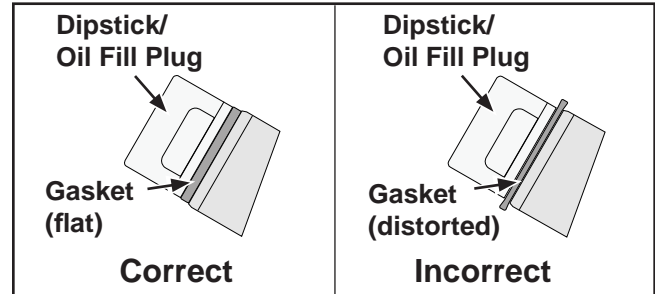


**Figure 6-7. Dipstick Oil Level Check.**

2. Remove the oil drain plug and the dipstick/oil fill plug. Allow ample time for complete drainage.
3. Reinstall the drain plug and torque to:  
CH270 18 N·m (159 in. lb.).  
CH395, CH440 23 N·m (204 in. lb.).
4. Fill the crankcase, with new oil of the proper type, up to the point of overflowing the filler neck. Refer to Oil Type. Always check the level before adding more oil.

5. Reinstall the dipstick/oil fill plug and tighten securely. See Figure 6-8.

NOTE: Over tightening the dipstick/oil fill plug will distort the gasket and may cause oil weeping.



**Figure 6-8. Dipstick Reinstallation.**

### Oil Sentry™

Some engines are equipped with an optional Oil Sentry™ switch. This switch is designed to prevent the engine from starting in a low oil or no oil condition. The Oil Sentry™ may not shut down a running engine before damage occurs. In some applications this switch may activate a warning signal. Read your equipment manuals for more information.

**Section 6**  
**Lubrication System**

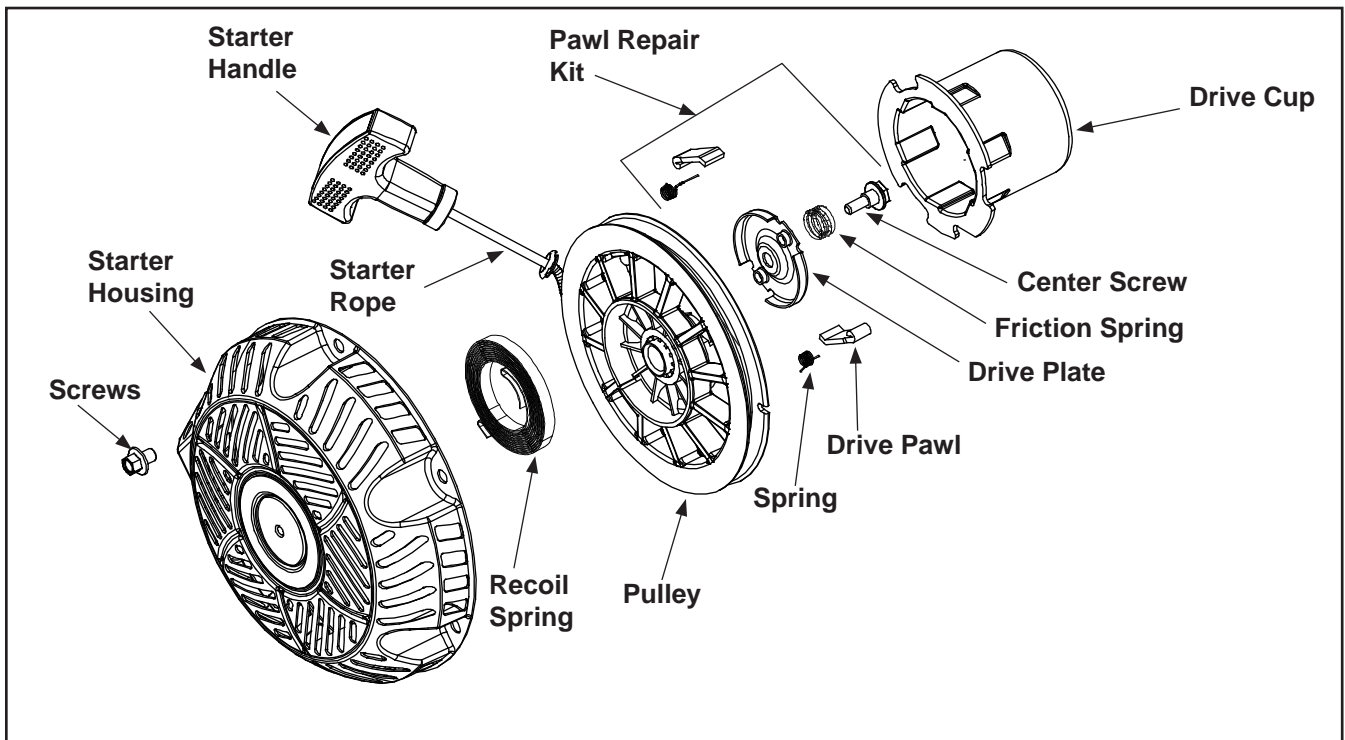
---

# Section 7

## Retractable Starter

**⚠ WARNING: Spring Under Tension!**

Retractable starters contain a powerful, recoil spring that is under tension. Always wear safety goggles when servicing retractable starters and carefully follow instructions in this section for relieving spring tension.



7

Figure 7-1. Retractable Starter - Exploded View.

### To Remove Starter

1. Remove the three hex flange screws securing the starter assembly to the blower housing.
2. Remove the starter assembly.

### To Install Starter

1. Align the retractable starter with the mounting locations on the blower housing, and install the hex flange screws. Leave the screws slightly loose. See Figure 7-2.

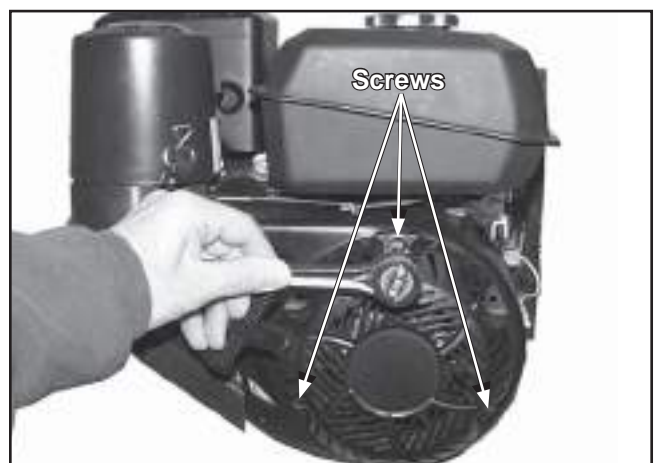


Figure 7-2. Installing Retractable Starter.

## Section 7

### Retractable Starter

2. Pull the starter handle out until the pawls engage the drive cup. Hold the handle in this position and torque the screws to **5.4 N·m (48 in. lb.)**.

#### Rope Replacement

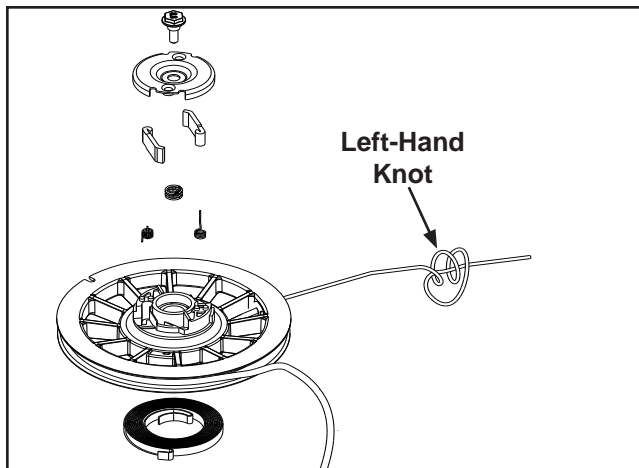
The rope can be replaced *without* complete starter disassembly.

1. Remove the starter from the engine blower housing.
2. Pull the rope out approximately 12 in. and tie a temporary (slip) knot in it to keep it from retracting into the starter. See Figure 7-3.



**Figure 7-3. Removing Starter Handle.**

3. Pull the knot end out of the handle, untie the knot, and slide the handle off.
4. Hold the pulley firmly and untie the slip knot. Allow the pulley to rotate slowly as the spring tension is released.
5. When all spring tension on the starter pulley is released, remove the rope from the pulley.
6. Tie a double left-hand knot in one end of the new rope. See Figure 7-4.

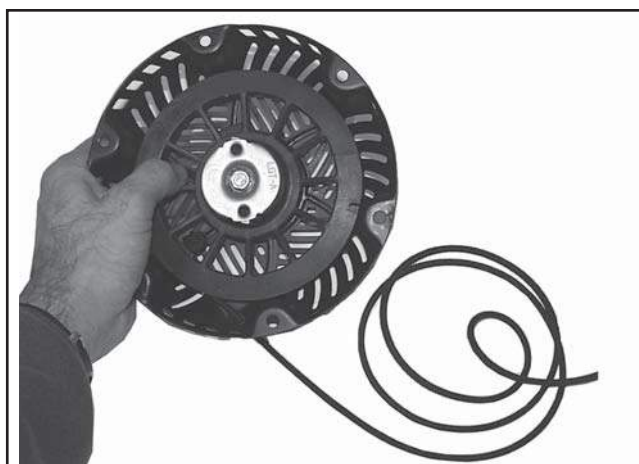


**Figure 7-4. Left-hand Knot.**

7. Rotate the pulley counterclockwise to pre-tension the spring (approximately 4 full turns of pulley).
8. Rotate the pulley until the rope hole in the pulley is aligned with the rope guide bushing of the starter housing.

**NOTE:** Do not allow the pulley/spring to unwind. Enlist the aid of a helper if necessary.

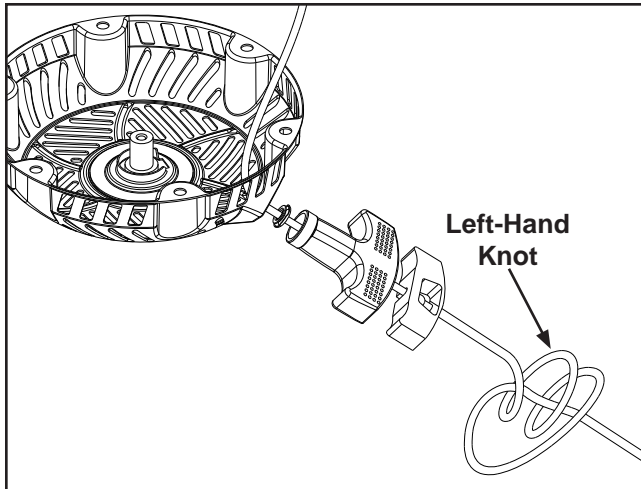
9. Feed the unknotted end of the rope through the rope hole in the starter pulley and rope guide bushing of the housing. See Figure 7-5.



**Figure 7-5. Installing Rope.**

10. Tie a slip knot approximately 12 in. from the free end of the rope. Hold the pulley firmly and allow it to rotate slowly until the slip knot reaches the guide bushing of the housing.

11. Slip the handle onto the rope. Tie a double left-hand knot at the end of the rope. See Figure 7-6.



**Figure 7-6. Handle Left-hand Knot.**

12. Untie the slip knot and pull on the handle until the rope is fully extended. Slowly retract the rope into the starter. If the spring is properly tensioned, the rope will retract fully and the handle will stop against the starter housing.

### Pawl (Dogs) Replacement

Only partial disassembly of the starter is necessary to replace the pawls. Pawl repair kits are available which include the following components:

Pawl Repair Kit	
Qty	Description
2	Pawl (Dog) Spring
2	Starter Pawl (Dog)

#### Disassembly

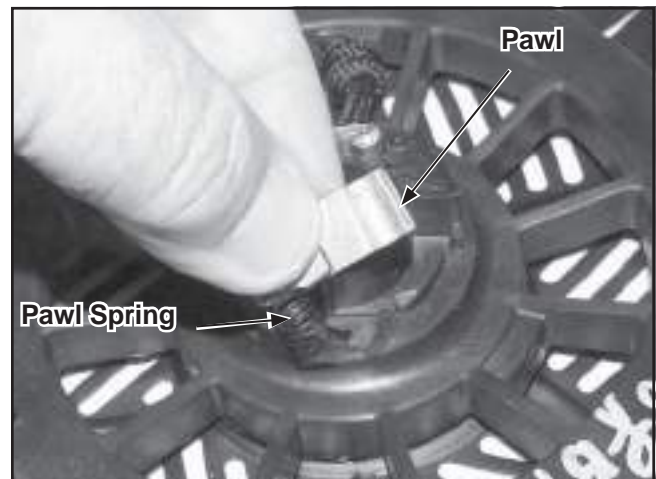


**WARNING: Spring Under Tension!**

*Do not remove the center screw from starter until the spring tension is released. Removing the center screw before releasing spring tension, or improper starter disassembly, can cause the sudden and potentially dangerous release of the spring. Follow these instructions carefully to ensure personal safety and proper starter disassembly. Make sure adequate face protection is worn by all persons in the area.*

1. Release coil spring tension by loosening the center screw approximately **1 turn**. Rotate the pulley against spring tension until the pulley rope hole with knot is adjacent to outlet in housing. Lift up the slack in the rope between the pulley and the housing, slowly allow the pulley to unwind, releasing the spring tension. Count the number of rotations for reassembly later.
2. Unscrew the center screw and lift off the drive plate. The center screw will be captured by the clip around the shoulder on the backside of the plate.
3. Note the positions of the pawls and pawl springs before removing. Remove parts from pulley.
4. Carefully inspect the components for wear, cracks, and/or damage. Replace all worn or damaged components. Use only genuine Kohler replacement parts. Refer to our free online parts lookup system [www.kohlerplus.com](http://www.kohlerplus.com) for the available service parts.
5. Install pawl springs and pawls onto pawl studs of pulley. All parts must be dry. See Figure 7-7.

7



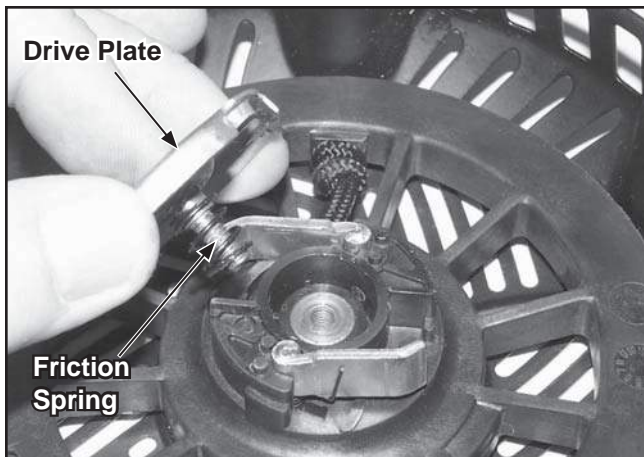
**Figure 7-7. Drive Plate and Pawl Details.**

6. Position the drive plate over the pawls, aligning the actuating slots in the plate with the raised sections on each drive pawl. Torque the center screw to **10 N·m (89 in. lb.)**. Rotate the pulley by hand and check operation. See Figure 7-8.

## Section 7

### Retractable Starter

---



**Figure 7-8. Center Screw and Drive Plate.**

7. Rehook the slack in the rope into the notch of the pulley and rotate the pulley counterclockwise (viewed from pawl side) to re-tension the spring (approximately 4 full turns).



# Section 8

## Electrical System and Components

This section covers the operation, service, and repair of the electrical system components. Systems and components covered in this section are:

- Spark Plugs
- Electronic Ignition System
- Battery and Charging System
- Electric Starter

### Oil Sentry™ Control System

Some engines are equipped with an optional Oil Sentry™ switch. This switch is designed to prevent the engine from starting in a low oil or no oil condition. The Oil Sentry™ may not shut down a running engine before damage occurs. In some applications this switch may activate a warning signal. Read your equipment manuals for more information.

### Spark Plugs

Engine misfire or starting problems are often caused by a spark plug that has improper gap or is in poor condition.

The engine is equipped with the following spark plugs:

**Type:** The standard spark plug is a Champion® RC12YC. Equivalent alternate brand plugs can also be used.

**Gap:** 0.76 mm (0.030 in.)  
**Thread Size:** 14 mm  
**Reach:** 19.1 mm (3/4 in.)  
**Hex Size:** 15.9 mm (5/8 in.)

### Spark Plug Service

Every **100 hours** of operation, remove the spark plug, check its condition and reset the gap, or replace it with a new plug as necessary. To service the plugs, perform the following steps:

1. Before removing the spark plug, clean the area around the base of the plug to keep dirt and debris out of the engine.

2. Remove the plug and check its condition. See Inspection following this procedure. Replace the plug if necessary.

**NOTE:** Do not clean spark plug in a machine using abrasive grit. Some grit could remain in the spark plug and enter the engine causing extensive wear and damage.

3. Check the gap using a wire feeler gauge. Adjust the gap to **0.76 mm (0.030 in.)** by carefully bending the ground electrode. See Figure 8-1.

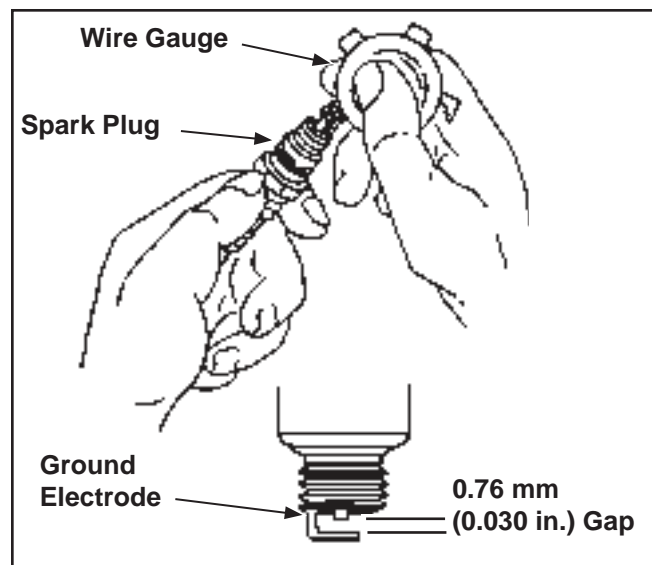


Figure 8-1. Servicing Spark Plug.

4. Reinstall the spark plug into the cylinder head and torque to **22-27 N·m (195-239 in. lb.)**.

## Section 8

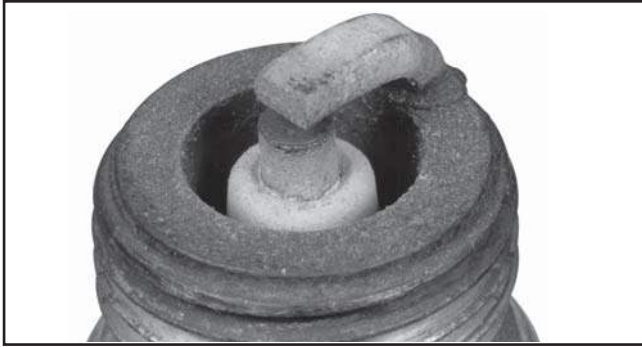
### Electrical System and Components

---

#### Inspection

Inspect the spark plug when it is removed from the cylinder head. The deposits on the tip are an indication of the general condition of the piston rings, valves, and carburetor.

Normal and fouled plugs are shown in the following photos:



**Normal:** A plug taken from an engine operating under normal conditions will have light tan or gray colored deposits. If the center electrode is not worn, a plug in this condition could be set to the proper gap and reused.



**Carbon Fouled:** Soft, sooty, black deposits indicate incomplete combustion caused by a restricted air cleaner, over rich carburetion, weak ignition, or poor compression.



**Worn:** On a worn plug, the center electrode will be rounded and the gap will be greater than the specified gap. Replace a worn spark plug immediately.



**Wet Fouled:** A wet plug is caused by excess fuel or oil in the combustion chamber. Excess fuel could be caused by a restricted air cleaner, a carburetor problem, or operating the engine with too much choke. Oil in the combustion chamber is usually caused by a restricted air cleaner, a breather problem, or internal engine wear.



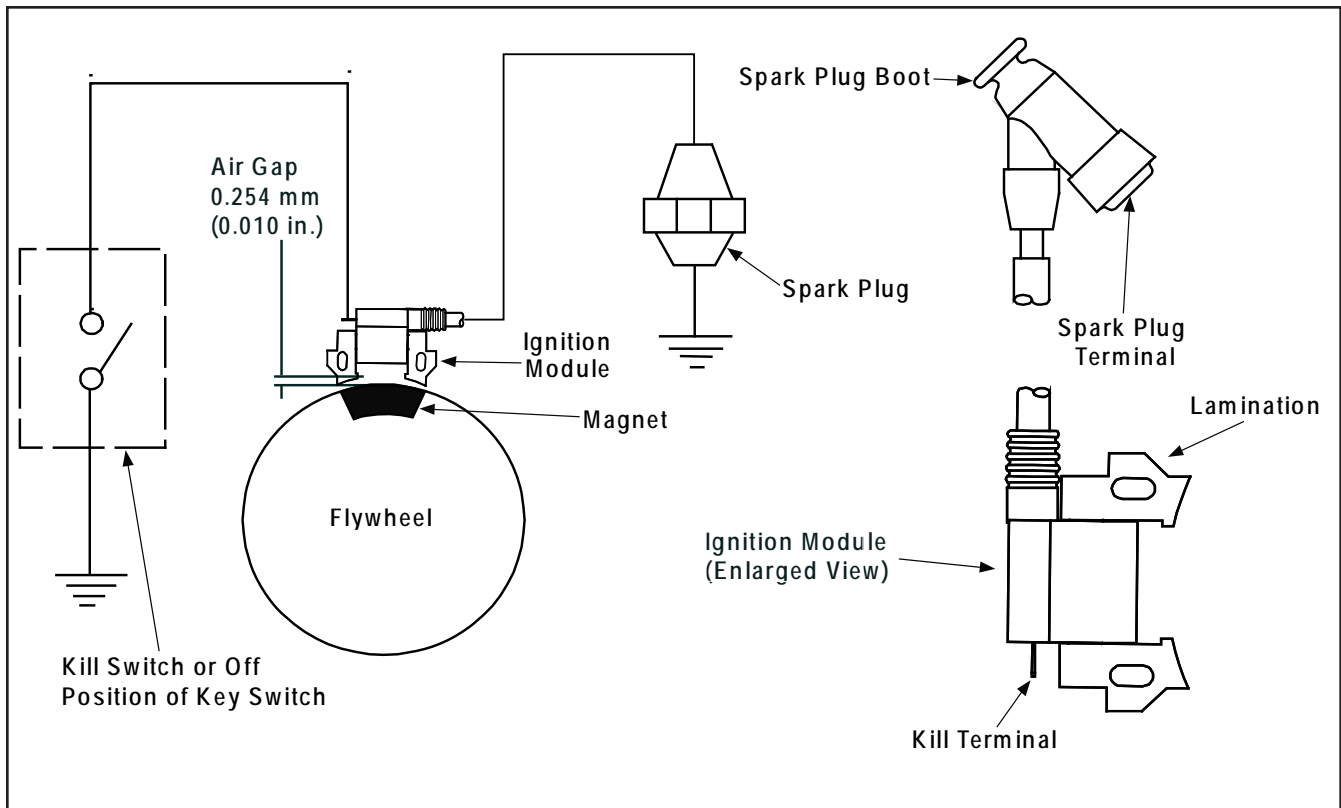
**Overheated:** Chalky, white deposits indicate very high combustion temperatures. This condition is usually accompanied by excessive gap erosion. Lean carburetor settings, an intake air leak, or incorrect spark timing are normal causes for high combustion temperatures.

### Electronic Ignition System

These engines are equipped with a dependable magneto breakerless ignition. In such a system, electrical energy is generated by the cutting of magnetic flux lines generated from the ignition magnet on the engine flywheel via the prescribed air gap as it passes the ignition module. This energy is transferred through the ignition module laminations and is then converted in the module electronics and stored in the module primary coil, as a current if it is an inductive discharge ignition (IDI) module, or as a voltage in a capacitor if it is a capacitive discharge ignition (CDI) module. The stored energy is transferred at the correct moment by triggering a semiconductor switch inside the module. The electrical break by the switch initiates the energy transfer by causing the collapse of the magnetic field at the coil primary. This includes a voltage at the coil primary that is amplified via transformer action at the coil secondary. The amplitude of the voltage at the coil secondary is sufficient to jump the gap at the spark plug, igniting the fuel air mixture in the gap and initiating combustion. Note that by design, these modules only will provide proper function if mounted in the correct orientation.

This system consists of the following components (see Figure 8-2):

- Magnets permanently affixed to the flywheel.
- Inductive discharge ignition module (IDI) mounted on the engine crankcase.
  - Includes a shut down (kill) terminal mounted at the side of the module.
  - Includes a secondary lead wire from the coil to a terminal inside a spark plug boot.
- External switch that connects to the shut down terminal and grounds the module to stop the engine.



**Figure 8-2. Inductive Discharge Ignition System.**

### Troubleshooting and Testing Ignition

#### Ignition and Oil Sentry™ Systems

Ignition problems are most often due to poor or loose connections, or connections that keep the shut down terminal shorted to ground preventing proper ignition operation.

Before beginning any test procedures, be certain all module terminal connections are correct and fit snugly. Make certain the shut down lead is not shorted to ground when the engine is attempting to crank or run. Proper ignition module air gap to the flywheel magnet must be maintained for best performance. Ensure crankcase oil is at the proper level. Refer to Section 6.

## Section 8

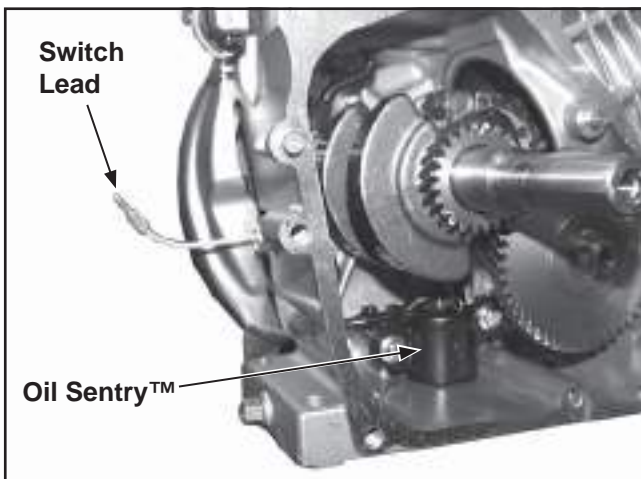
### Electrical System and Components

These modules are designed to be trouble free for the life of the engine. Other than periodic checking or replacing of the spark plug, no maintenance is required. The ignition module automatically controls the timing of the spark.

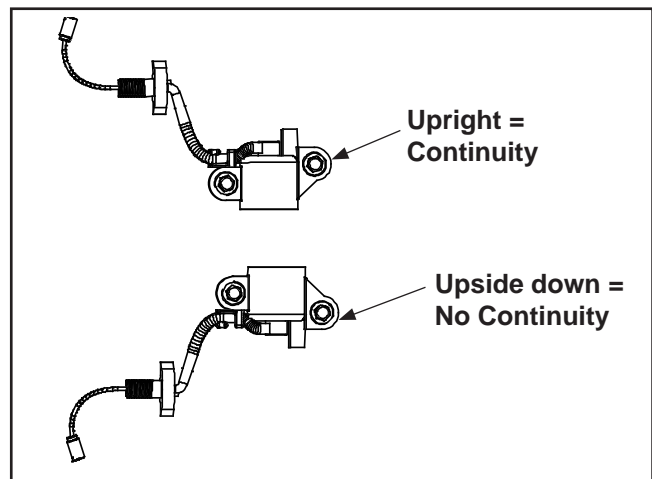
Mechanical systems do occasionally fail or break down, the following troubleshooting information is provided to help systematically determine the cause of a reported problem.

Problem	Test	Conclusion
<b>Engine Will Not Start</b>	1. Disconnect the cap from the spark plug and attach it to the terminal end of spark tester Kohler Part No. 25 455 01-S. Attach tester spring clip to a good ground, not to the spark plug. Turn ignition/key switch <b>ON</b> and crank the engine while observing the firing tip of the tester.	1. If tester is firing, ignition system is good. Install a new spark plug and try to start engine. If it still will not start, check other possible causes (fuel, compression, etc.). If tester does not fire, go to Step 2.
	2. On electric start engines, remove the starter cover panel. Locate the black/white kill lead coming from the ignition module inside the blower housing. Disconnect the bullet connector where the kill lead plugs into the harness. Repeat the spark test (Step 1).	2. If spark is now present, check for a shorted lead in the kill circuit or a faulty switch (Step 7). If there is still no spark, go to Step 3.
	3. Disconnect the bullet connector where the Oil Sentry™ control module joins the lead from the Oil Sentry™ float switch (yellow leads). Repeat spark test again.	3. If spark is now present, the control module or float switch is faulty. Test the control module (Step 4) and the float switch (Step 5). If there is still no spark, test the ignition module (Step 6).
	4. Set an ohmmeter to the Rx1 scale and zero the meter. Connect the black ohmmeter lead to the yellow Oil Sentry™ control module lead and touch the red ohmmeter lead to the black wire.	4. Continuity should be indicated. Replace Oil Sentry™ control module for any other results.
	5. Set an ohmmeter to the Rx1 scale and zero the meter. Connect one ohmmeter lead to the Oil Sentry™ float switch lead (yellow with green sleeve) and touch the other lead to a bare spot on the crankcase (ground). See Figure 8-3. Drain the oil from the crankcase and repeat the test. <ul style="list-style-type: none"> <li>a. If continuity was indicated with and without oil above, check if the insulation has been scraped off the float switch lead.</li> <li>b. With the float switch removed, connect one ohmmeter lead to the float switch lead terminal and connect the other lead to the mounting bracket. Test resistance with the switch in the normal position and inverted. Repeat test 2 or 3 times in each direction.</li> </ul>	5. With the oil at the proper level, no continuity should have been indicated. After the oil was drained, continuity should have been indicated. If test results are other than specified, remove the closure plate from the engine and remove the float switch for further testing (Steps 5a and 5b). <ul style="list-style-type: none"> <li>a. If the lead wire is bare, allowing it to short, repair with electrical tape or replace float switch.</li> <li>b. Switch continuity should be as indicated in Figure 8-4. If not, replace it.</li> </ul>

Problem	Test	Conclusion
<b>Engine Will Not Start</b>	<p>6. Set an ohmmeter to the Rx1K or Rx10K scale and zero. Connect one ohmmeter lead to the kill lead (black/white) terminal and connect the other lead into the spark plug cap.</p> <p>a. Remove the cap from the spark plug lead and test the resistance of the cap alone.</p> <p>b. If resistances are other than specified, remove the blower housing and remove the ignition module. With the kill lead and spark plug cap removed, test resistance from the small spade terminal to the core of the spark plug lead wire.</p>	<p>6. Resistance of the ignition module should be 13.5-18.0 K ohms.</p> <p>a. Resistance of the cap should be 4-6 K ohms.</p> <p>b. Resistance should be 9.5-12.9 K ohms. If resistance is not in this range, replace the module.</p>
	<p>7. Set an ohmmeter to the Rx1 scale and zero the meter. Test the ignition/key switch as follows.</p> <p>a. Trace the two black leads from the ON/OFF switch and separate them from any connections. Connect the ohmmeter leads to the switch leads, and check for continuity in both switch positions.</p> <p>b. On electric start engines, trace the four leads (red, red/white, black, black/white) from the key switch and separate them from any connections. Connect the ohmmeter leads to the black and black/white leads and check for continuity in all three switch positions. Then connect the ohmmeter leads to the red and red/white leads and test again in all three switch positions.</p>	<p>a. Continuity should be indicated when and only when switch is in the OFF position. Replace switch for any other results.</p> <p>b. Continuity should be indicated between the black and black/white leads only when the key switch is in the OFF position. There should be continuity between the red and red/white leads only in the start position. Replace switch for any other results.</p>



**Figure 8-3. Oil Sentry™ Function Check.**



**Figure 8-4. Oil Sentry™ Continuity.**

# Section 8 Electrical System and Components

## Battery Charging Systems

### General

These engines may be equipped with a 3 amp, 4 amp, 10 amp or 18 amp regulated battery charging system. Refer to the appropriate wiring diagram for troubleshooting and servicing your system.

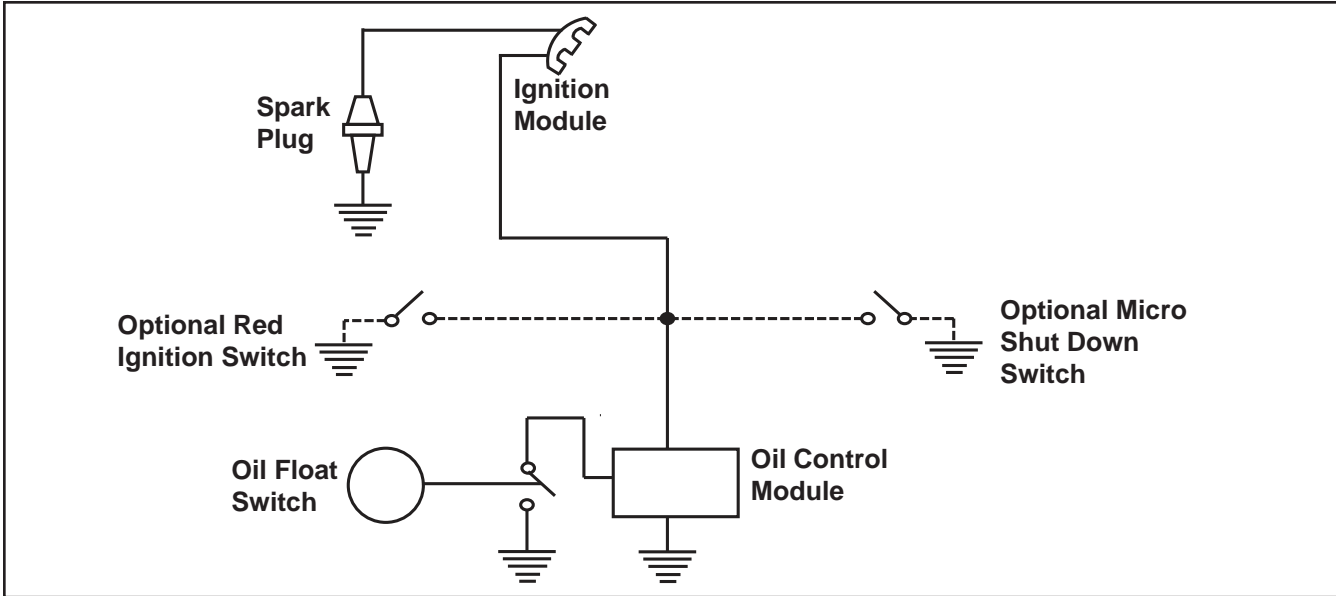


Figure 8-5. Wiring Diagram, Retractable Starter.

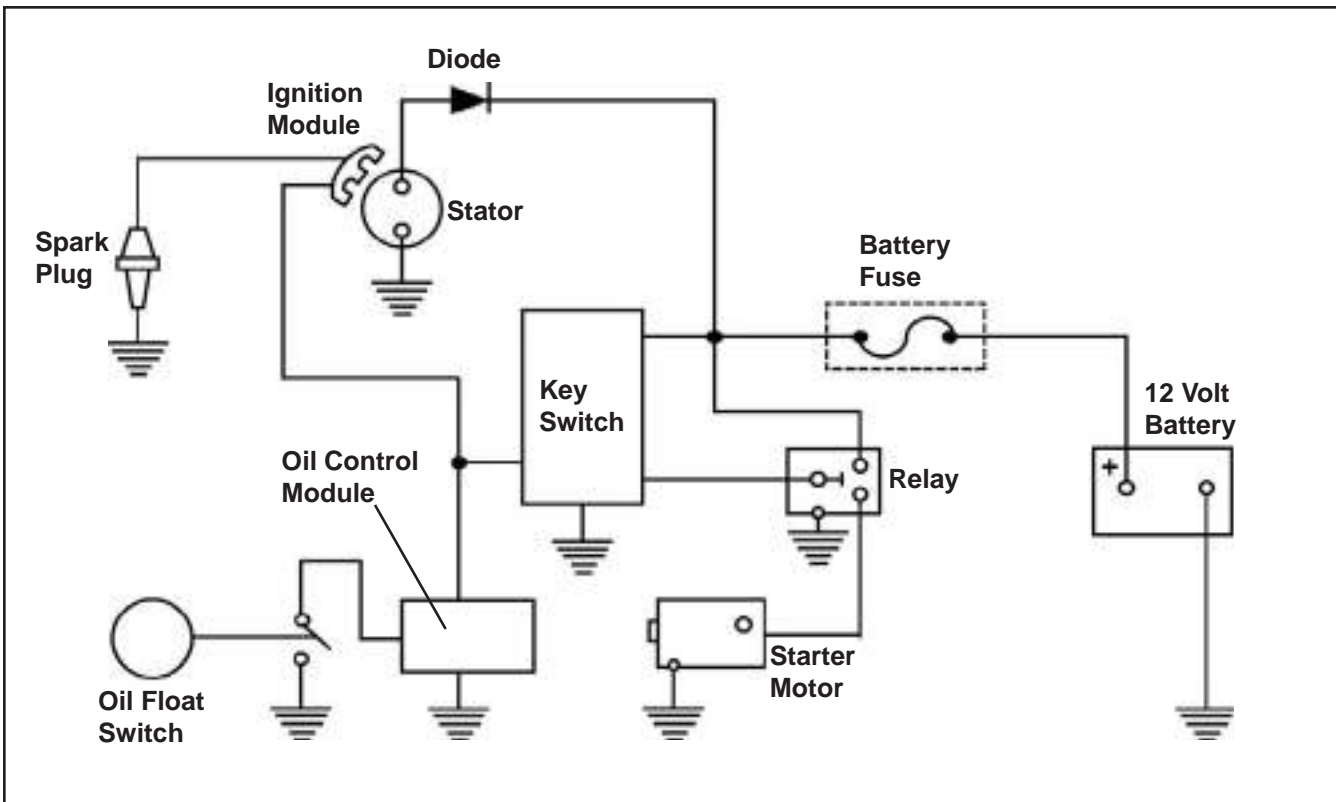
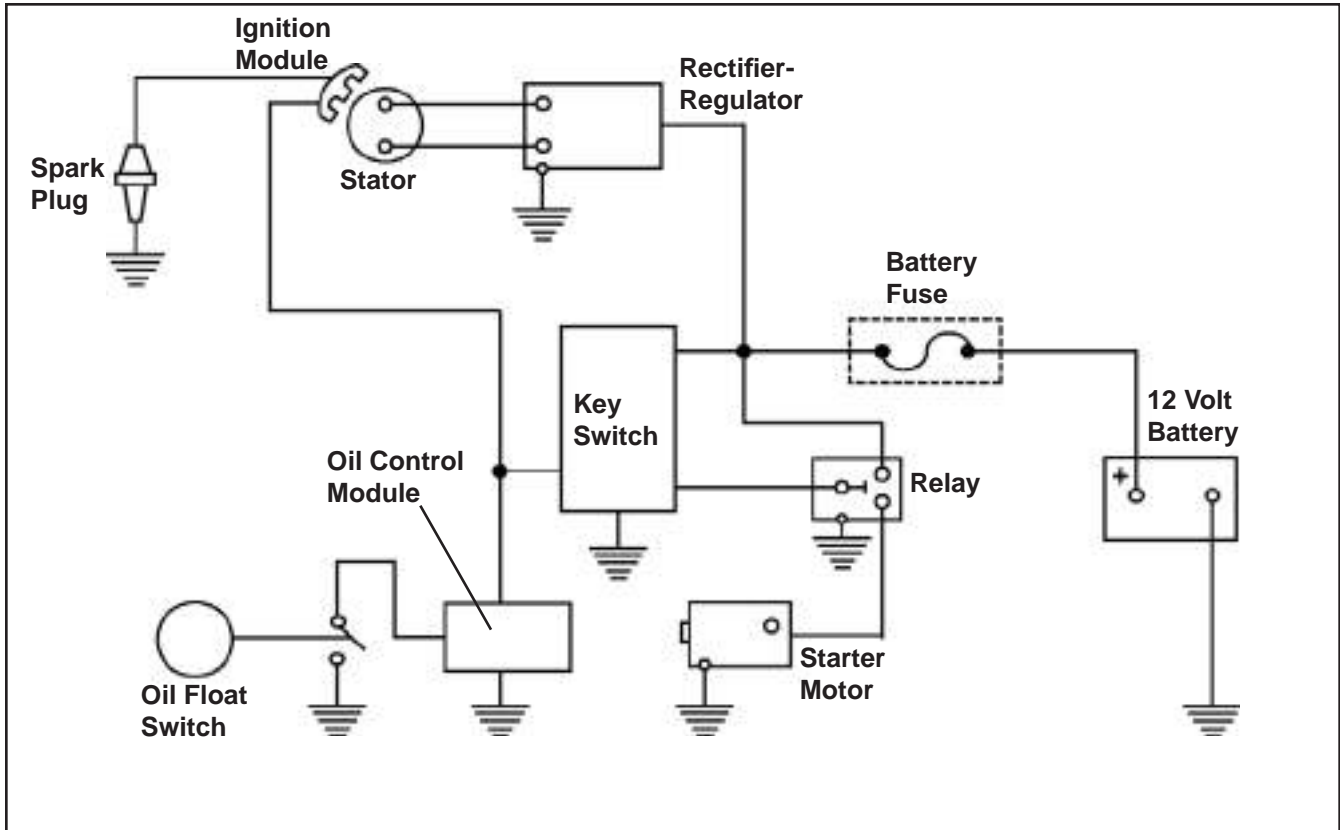


Figure 8-6. Wiring Diagram-3/4 Amp Charging System, Rectified Only.



**Figure 8-7. Wiring Diagram-10/18 Amp Charging System, With Rectifier-Regulator.**

NOTE: Observe the following guidelines to avoid damage to the electrical system and components.

- Make sure the battery polarity is correct. A negative (-) ground system is used.
- Make sure all ground connections are secure and in good condition.
- Disconnect both battery cables before doing electrical welding on the equipment powered by the engine. Also, disconnect other electrical accessories in common ground with the engine.
- Prevent the stator (AC) leads from touching or shorting while the engine is running. This can damage the stator.

### Stator

The stator is mounted on the crankcase behind the flywheel. Should the stator have to be replaced, follow the procedures in Section 9 **Disassembly**.

### Rectifier-Regulator

The rectifier-regulator is connected to the engine with a matching wiring harness containing a plug-in connector. Grounded through the wiring harness, the rectifier-regulator is secured to the equipment in a suitable location with two mounting screws. To replace it, disconnect the plug, and remove the two mounting screws.

NOTE: When installing the rectifier-regulator, push the wiring harness plug into the regulator receptacle until it locks into place.

The rectifier-regulator converts the AC voltage coming from the stator to DC voltage, while also monitoring and controlling the battery voltage. There are two different rectifier-regulators which are used; an 18 amp and a 10 amp assembly. Although externally similar, the internal circuits differ and the two should not be interchanged. See Figures 8-8 and 8-9.

## Section 8 Electrical System and Components

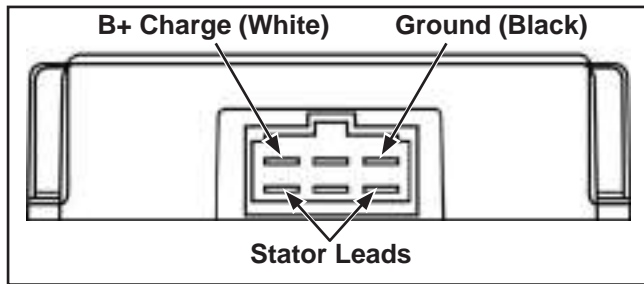


Figure 8-8. 18 Amp Rectifier-Regulator.

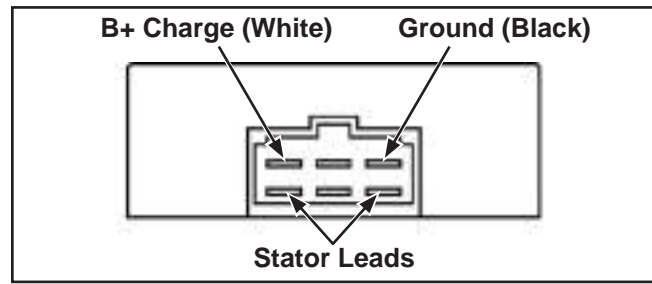


Figure 8-9. 10 Amp Rectifier-Regulator.

### Rectified Only (Non-Regulated) Systems

Some engines are equipped with a rectified only, non-regulated charging system, with output ranging from 3 amps to 4 amps. The rectifier is normally connected to the engine with a matching wiring harness and secured inside the control panel. Grounding is achieved through the wiring harness. The rectifier converts AC voltage coming from the stator to DC voltage only.

### Troubleshooting Guide

#### Battery Charging System

NOTE: Zero ohmmeters on each scale to ensure accurate readings. Voltage tests should be made with engine running at 3600 RPM - no load. Battery must be fully charged. Check the specific gravity of battery. If low, recharge or replace battery as necessary.

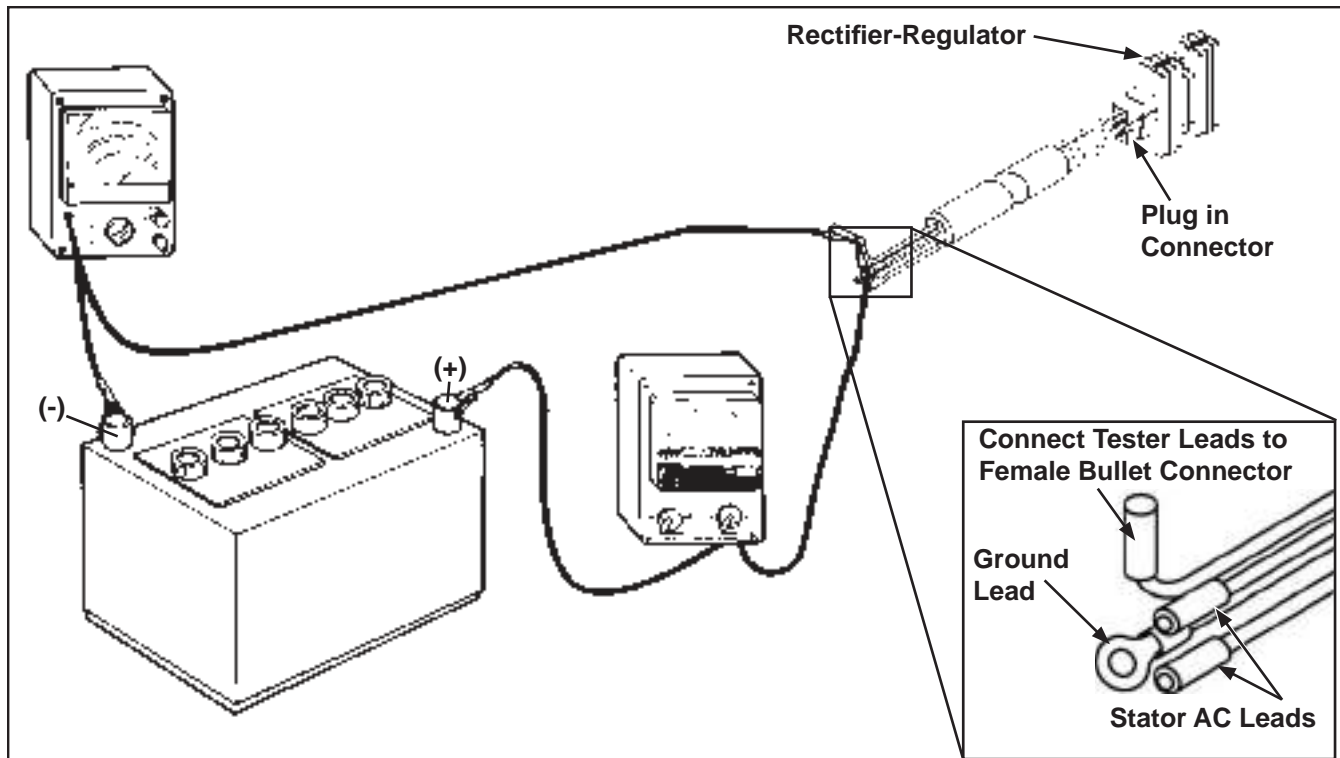


Figure 8-10. Connections for Testing Charging Systems.



Problem	Test	Conclusion
<b>No Charge to Battery</b>	1. Refer to Figure 8-10. Separate the bullet connector in the white lead from the rectifier-regulator. Connect an ammeter from the female terminal to the positive (+) terminal of the battery. Connect a DC voltmeter from the female terminal to the negative (-) terminal of the battery. Leave the other rectifier-regulator leads connected in the normal manner. Run the engine at 3600 RPM and read the voltage on the voltmeter.  If voltage is 14.0 volts or more, place a minimum load of 5 amps* on battery to reduce voltage. Observe ammeter.  *NOTE: Turn on lights (if 60 watts or more) or place a 2.5 ohm, 100 watt resistor across battery terminals.	1. If voltage is 14.0-15.0 volts and charge rate increases when load is applied, the charging system is OK and the battery was fully charged.  If voltage is less than 14.0 volts or charge rate does not increase when load is applied, test stator (Tests 2 and 3).
	2. Separate the bullet connectors in the AC (white) leads. Connect an AC voltmeter across the stator leads (female terminals). With engine running at 3600 RPM, measure the AC output from the stator.	2. If voltage is 20.0 volts or more, stator is OK. Rectifier-regulator is faulty. Replace the rectifier-regulator.  If voltage is less than 20.0 volts, stator is probably faulty and should be replaced. Test stator further using an ohmmeter (Test 3).
	3. With the engine stopped, measure the resistance from each stator lead to ground using an ohmmeter.	3. If the resistance is infinity ohms (no continuity), the stator is OK (not shorted to ground).  If resistance (or continuity) is measured, the stator leads are shorted to ground. Replace stator.
<b>Battery Continuously Charges at High Rate</b>	1. Perform same test as Step 1 above.	1. If the voltage is 15.0 volts or less the charging system is OK. The battery is unable to hold a charge. Service or replace battery as necessary.  If voltage is more than 15.0 volts, the rectifier-regulator is faulty. Replace the rectifier-regulator.

## Section 8

# Electrical System and Components

---

### Battery

#### General

A 12 volt battery (not furnished) with a minimum current rating of 230 cold cranking amps/18 amp hours should be sufficient for cranking most electric start engine models. The actual cold cranking requirement depends on engine size, application and starting temperatures. Cranking requirements increase as temperatures decrease and battery capacity shrinks. Refer to the operating instructions of the equipment this engine powers for specific battery requirements.

If the battery charge is not sufficient to turn over the engine, recharge the battery.

### Electric Starting Motors

Electric start engines in this series use an inertia drive starter.

#### Starting Motor Precautions

**NOTE:** Do not crank the engine continuously for more than 10 seconds at a time. If the engine does not start, allow a 60 second cool-down period between starting attempts. Release the switch as soon as the engine starts. Failure to follow these guidelines can burn out the starter motor.

**NOTE:** If the engine develops sufficient speed to disengage the starter but does not keep running (a false start), the engine rotation must be allowed to come to a complete stop before attempting to restart the engine. If the starter is engaged while the flywheel is rotating, the starter pinion and flywheel ring gear may clash, resulting in damage of the starter.

**NOTE:** If the starter does not crank the engine, shut off the starter immediately. Check the condition of the inline fuse and do not make further attempts to start the engine until the condition is corrected.

**NOTE:** Do not drop the starter or strike the starter housing. Doing so can damage the starter.

#### Troubleshooting Guide – Starting Difficulties

Problem	Possible Fault	Correction
<b>Starter Does Not Energize</b>	<b>Battery</b>	1. Check the specific gravity of battery. If low, recharge or replace battery as necessary.
	<b>Wiring</b>	1. Check fuse condition. 2. Clean corroded connections and tighten loose connections. 3. Replace wires in poor condition and with frayed or broken insulation.
	<b>Starter Switch or Relay</b>	1. Check the switch or relay operation. If starter cranks normally, replace the faulty components.
<b>Starter Energizes But Turns Slowly</b>	<b>Battery</b>	1. Check the specific gravity of battery. If low, recharge or replace battery as necessary.
	<b>Wiring</b>	1. Check for corroded connections, poor ground connection.
	<b>Transmission or Engine</b>	1. Make sure the clutch or transmission is disengaged or placed in neutral. This is especially important on equipment with hydrostatic drive. The transmission must be exactly in neutral to prevent resistance which could keep the engine from starting. 2. Check for seized engine components such as the bearings, connecting rod, and piston.

## Troubleshooting Guide - Electric Starting System

Problem	Test	Conclusion
<b>Starter Motor Does Not Operate With Key Switch</b>	1. Test battery on unit.  a. Connect a DC voltmeter across the battery terminals and read battery voltage (key switch <b>OFF</b> ).  b. Turn key switch to <b>start</b> position and read battery voltage again. Turn switch <b>OFF</b> .	1. a. Battery voltage should be at least <b>12 volts</b> . If low charge battery.  b. Battery voltage should not fall below <b>9 volts</b> during cranking. If it does, battery may be faulty or there may be a short in the starting circuit. Have battery load tested. If battery passes load test, check circuitry.
	2. Remove the electric starter cover panel and check the fuse inside the plastic holder. The fuse outside the holder is a spare.	2. If fuse is blown, check for a wiring problem (bare wire, short circuit). Correct problem and replace fuse. Try to start engine. If it still won't start, go to Step 3.
	3. Disconnect the blue relay lead. Be sure transmission is in neutral and PTO is <b>OFF</b> . Connect one end of a jumper lead to the positive terminal of the battery. Connect the other end to the terminal of the relay.	3. If relay engages and starter begins to crank, the key switch is faulty, or there is a wiring problem to/from the key switch. Check wiring and test key switch circuits with an ohmmeter.
	4. Use a known, good, fully-charged battery and jumper cables to test starter motor. Be sure the transmission is in neutral and PTO is <b>OFF</b> . Remove the heavy lead from the post terminal on the starter. Connect one end of the positive jumper cable to the post terminal and connect the other end to the positive terminal of the battery.  Connect one end of the negative jumper cable to the negative terminal of the battery. Touch the other end of the negative jumper cable to a bare surface on the crankcase or to the starter housing.	4. When negative jumper cable is touched to crankcase or starter housing, starter motor should operate. If it does, continue with Step 5. If starter does not operate, refer to the servicing procedures for the starter motor. Repair or replace as required.
	5. Disconnect the leads from the starter relay and remove it from the starter for testing.  a. Set an ohmmeter on the Rx1 scale and zero the meter. Connect one ohmmeter lead to the terminal of the blue lead from the relay. Connect the other ohmmeter lead to the relay mounting bracket.  b. With the ohmmeter still on the Rx1 scale, connect the leads to the two large post terminals.  c. Leave the ohmmeter leads connected to the large terminals. Connect a jumper lead from the positive terminal of the battery to the terminal of the blue relay lead. Connect another jumper lead from the negative terminal of the battery to the relay mounting bracket.	5. a. The resistance of the energizing coil should be at least 3.4 ohms. If the meter reading is less than 3.4 ohms, or an open circuit is indicated (infinity ohms), the relay is faulty and must be replaced.  b. The meter should indicate an open circuit (infinity ohms, no continuity).  c. When the circuit is completed, applying <b>12 volts</b> to the energizing coil, an audible click should be heard as the relay engages, and the ohmmeter should then indicate continuity between the large terminals. If the results are other than indicated, replace the relay.

## Section 8

# Electrical System and Components

### Starter Removal and Installation

Refer to the **Disassembly** and **Reassembly** sections for starter removal and installation procedures.

### Operation

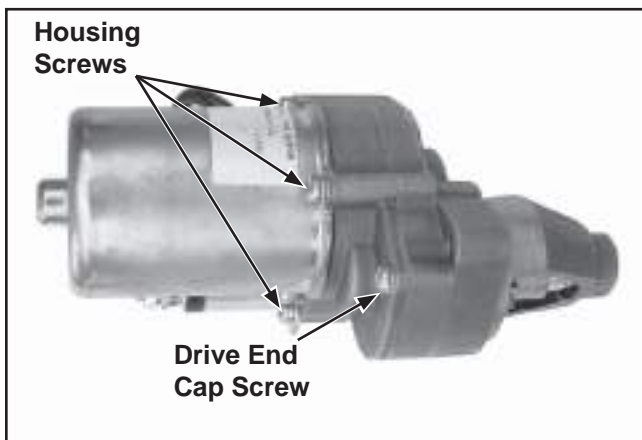
When power is applied to the starter, the armature rotates. As the armature rotates, the drive pinion moves out on the splined drive shaft and into mesh with the flywheel ring gear. When the pinion reaches the end of the drive shaft, it rotates the flywheel and cranks the engine. When the engine starts, the flywheel rotates faster than the starter armature and drive pinion. This moves the drive pinion out of mesh with the ring gear and into the retracted position. When power is removed from the starter, the armature stops rotating and the drive pinion is held in the retracted position by the anti-drift spring.

### Starter Drive Service

Every **200 hours** of operation (or annually, whichever occurs first), clean and lubricate the geartrain. If the gears are worn, or have chipped or broken teeth, the starter must be replaced.

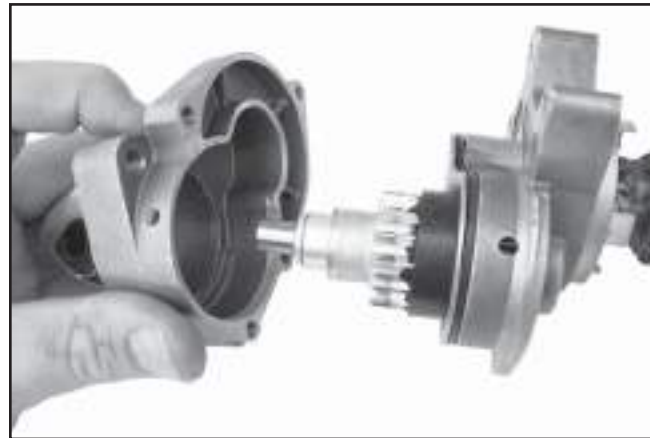
It is not necessary to completely disassemble the starter to service the geartrain. Service the starter as follows:

1. Remove the starter from the engine.
2. Remove the housing screws and the drive end cap screw. See Figure 8-11.



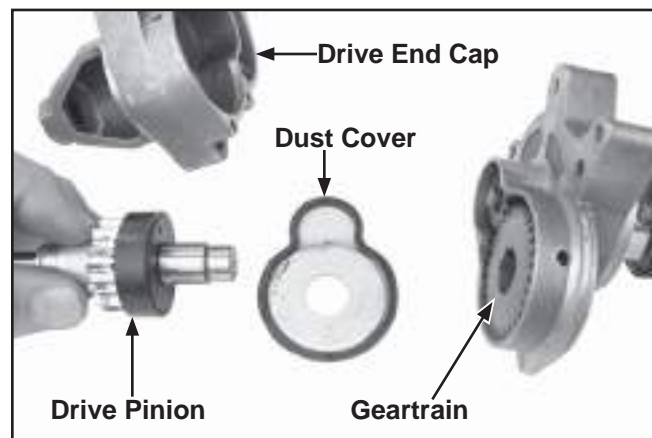
**Figure 8-11. Remove Housing and Drive End Cap Screws.**

3. Remove the drive end cap. The drive pinion will either remain in the geartrain or come out with the drive end cap. See Figure 8-12.



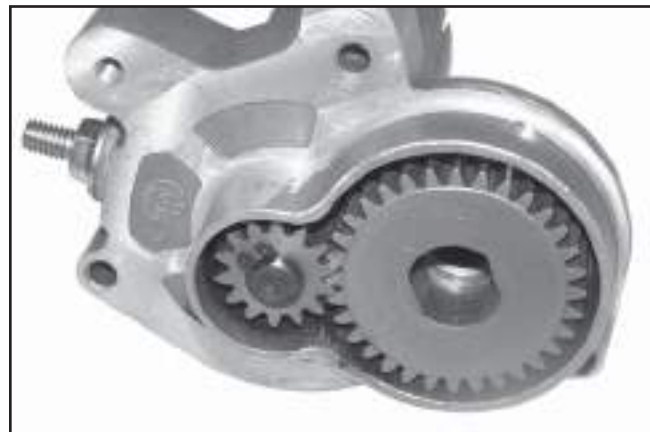
**Figure 8-12. Remove Drive End Cap.**

4. Remove the drive pinion and dust cover, exposing the geartrain. See Figure 8-13.



**Figure 8-13. Disassembled Drive Components.**

5. Inspect the gears for damage or wear.
6. Clean the gears as required.
7. Apply a small amount of Kohler electric starter drive lubricant, (see Section 2) to the geartrain. See Figure 8-14.



**Figure 8-14. Lubricate Geartrain.**

8. Reinstall the dust cover and insert the drive pinion into the geartrain. See Figure 8-15.

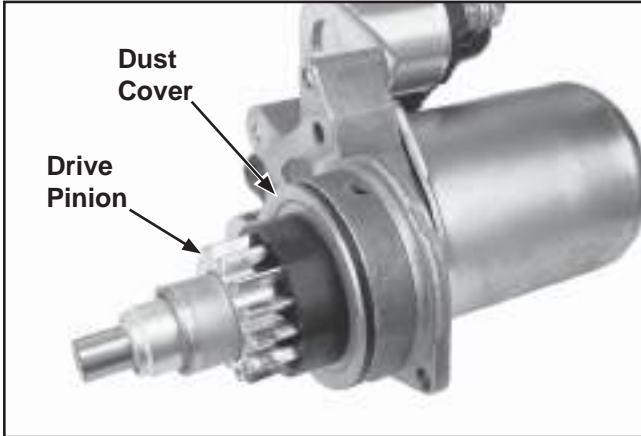


Figure 8-15. Reinstall Dust Cover and Drive Pinion.

9. Assemble the drive end cap onto the drive pinion. See Figure 8-16.

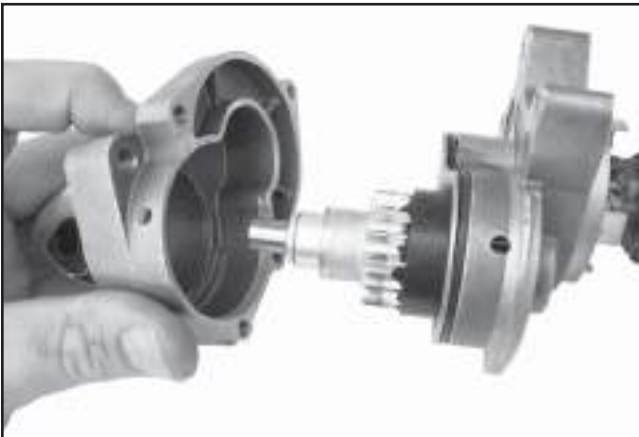


Figure 8-16. Reinstall Drive End Cap.

10. Reinstall and securely tighten the housing and drive end cap screws. See Figure 8-17.

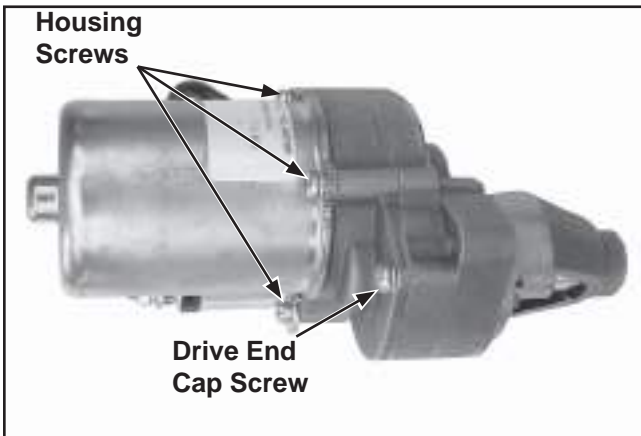


Figure 8-17. Reinstall Housing and Drive End Cap Screws.

**Section 8**  
**Electrical System and Components**

---

# Section 9

## Disassembly

### General

Clean all parts thoroughly as the engine is disassembled. Only clean parts can be accurately inspected and gauged for wear or damage. There are many commercially available cleaners that will quickly remove grease, oil, and grime from engine parts. When such a cleaner is used, follow the manufacturer's instructions and safety precautions carefully.

Make sure all traces of the cleaner are removed before the engine is reassembled and placed into operation. Even small amounts of these cleaners can quickly break down the lubricating properties of engine oil.

### Typical Disassembly Sequence

The following sequence is suggested for complete engine disassembly. The sequence can be varied to accommodate options or special equipment.

1. Disconnect spark plug lead.
2. Turn fuel shut-off valve to OFF position.
3. Drain oil from crankcase.
4. Remove muffler and heat shield assembly.
5. Remove air cleaner assembly.
6. Remove fuel tank.
7. Remove external throttle, governor and choke linkage.
8. Remove carburetor.
9. Remove retractable starter.
10. Remove blower housing and shields.
11. Remove electrical wiring, micro shut down switch & bracket, and fuel tank brackets.
12. Remove control panel and electric starter.
13. Remove valve cover/breather, rocker arms, push rods and cylinder head assembly.
14. Remove valves.
15. Remove ignition module.
16. Remove flywheel.
17. Remove stator.
18. Remove closure plate.
19. Remove balance shaft.
20. Remove camshaft and valve tappets.
21. Remove piston, connecting rod, and crankshaft.
22. Remove Oil Sentry™ system.
23. Remove governor assembly.

24. Remove crankcase and closure plate seals and bearings.

### Disconnect Spark Plug Lead

1. Disconnect the lead from the spark plug. See Figure 9-1.

NOTE: Pull on boot only, to prevent damage to spark plug lead.

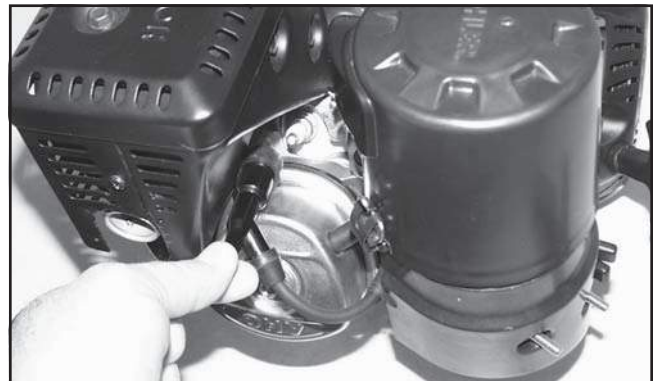


Figure 9-1. Disconnect Spark Plug Lead.

### Turn Fuel Shut-Off Valve to OFF Position

1. Push fuel shut-off lever to the left to close the fuel valve. See Figure 9-2.

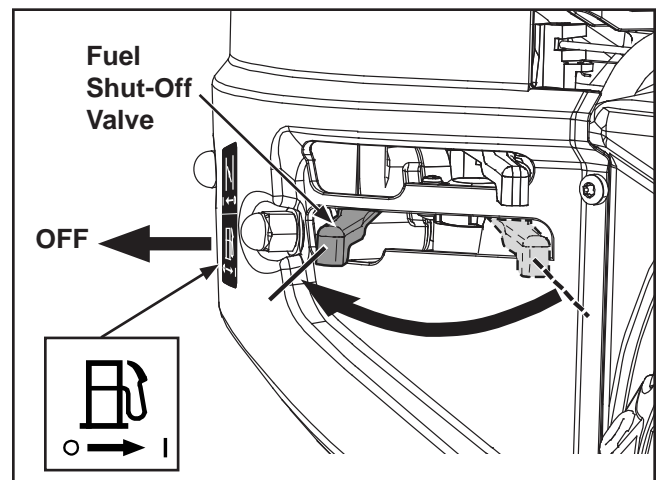


Figure 9-2. Shut-Off Fuel Valve.

## Section 9 Disassembly

NOTE: Models with the low-profile air cleaner do not have the fuel shut-off valve. Instead, turn off the fuel at the fuel supply.

### Drain Oil From Crankcase

1. Remove one of the oil drain plugs and one of the oil fill plugs. See Figure 9-3.

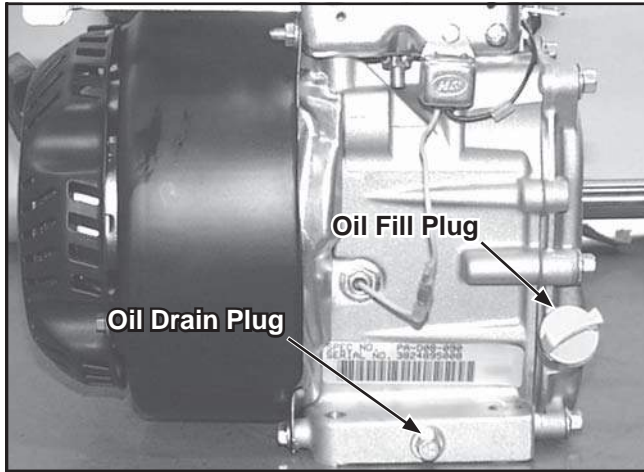


Figure 9-3. Oil Drain Plug.

2. Allow ample time for the oil to drain from the crankcase.

### Remove Muffler and Heat Shield Assembly

1. Remove the hex flange screws from the exhaust flange and muffler bracket. See Figures 9-4, 9-5, and 9-6.

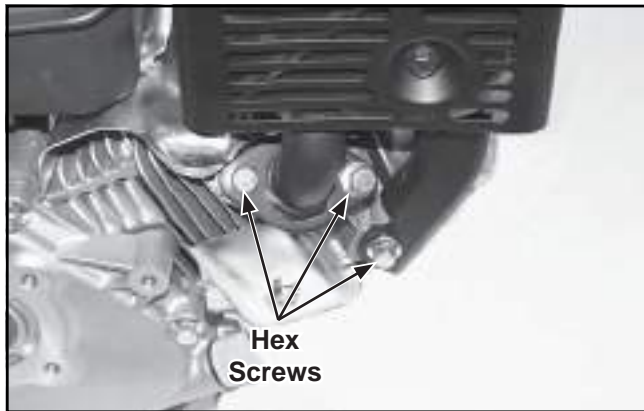


Figure 9-4. Removing CH270 Muffler.

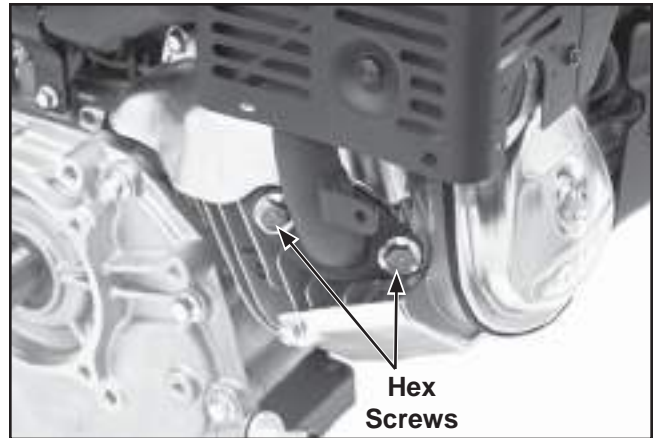


Figure 9-5. Removing CH395, CH440 Muffler Screws.

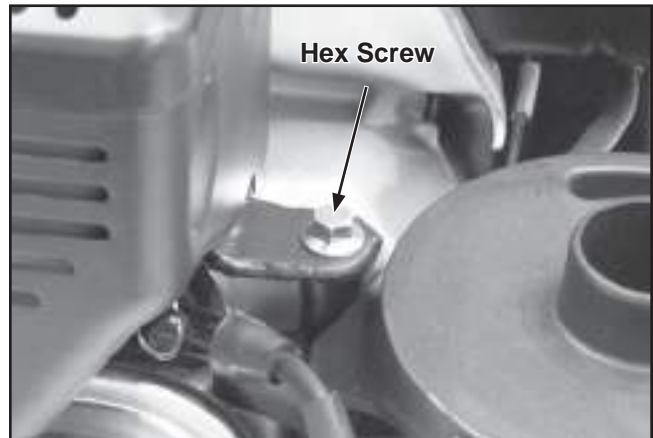


Figure 9-6. Remove CH395, CH440 Muffler Bracket Screw.

2. Remove the muffler assembly from the exhaust outlet.
3. Remove the exhaust gasket from the outlet.

### Remove Air Cleaner Assembly

Remove the air cleaner components from the air cleaner base as outlined in Section 4.

### Remove the Quad-Clean™ Base

Remove the air cleaner base from the engine as follows:

1. Remove the hex flange nuts and screws securing the carburetor shroud to the engine. See Figure 9-7.



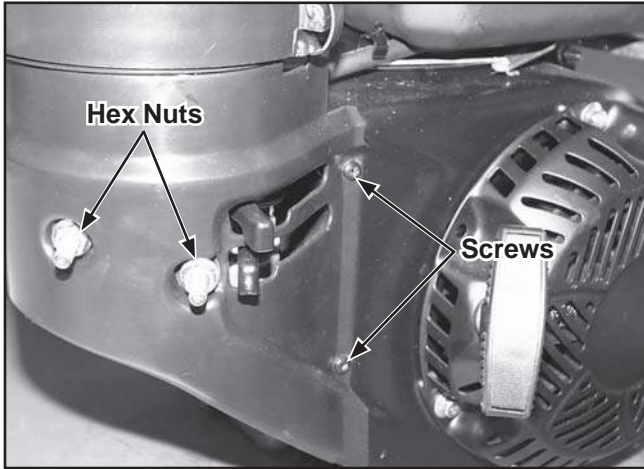


Figure 9-7. Carburetor Shroud Removal.

2. Remove the shroud.
3. Remove one hex flange screw and two hex flange nuts securing the air cleaner base to the carburetor. See Figure 9-8.

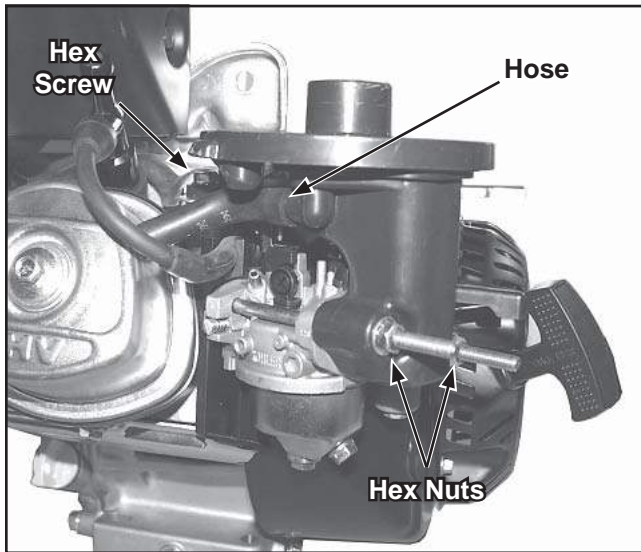


Figure 9-8. Air Cleaner Base Removal.

4. Disconnect one end of the breather hose from the valve cover or air cleaner base. See Figure 9-8.
5. Pull the air cleaner base off the studs.
6. Remove the air cleaner base gasket from the two mounting studs.
7. Loosely install two hex flange nuts on the studs (to temporarily hold the carburetor on the engine).

### Remove the Low-Profile Air Cleaner Base

Remove the air cleaner base from the engine as follows:

1. Remove one hex flange screw and two hex flange nuts securing the air cleaner base to the carburetor. See Figure 9-9.

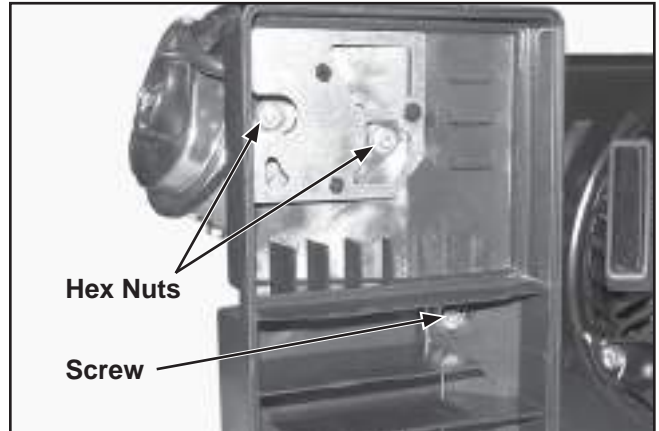


Figure 9-9. Remove Hex Nuts and Screw.

2. Disconnect one end of the breather hose from the valve cover or air cleaner base. See Figure 9-10.

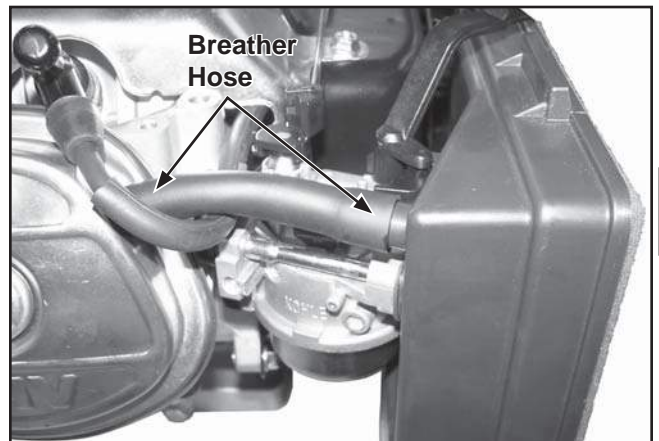


Figure 9-10. Disconnect One End of Breather Hose.

3. Remove the base.
4. Remove the air cleaner base gasket from the two mounting studs.
5. Loosely install two hex flange nuts on the studs (to temporarily hold the carburetor on the engine).

## Section 9 Disassembly

### Remove Fuel Tank (If Equipped)

NOTE: If no fuel tank is equipped, loosen the clamp and disconnect the fuel line from the inlet of the carburetor.

1. Ensure that the fuel tank is empty.
2. Loosen the clamp and disconnect the fuel line from the inlet of the shut-off valve. See Figure 9-11.

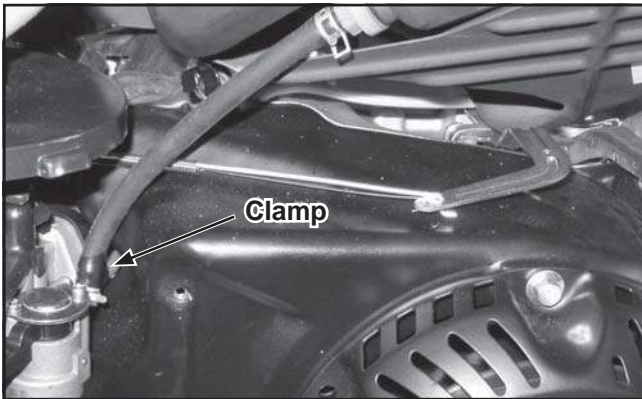


Figure 9-11. Disconnecting Fuel Line.

3. Remove two hex flange screws and two hex flange nuts securing the fuel tank to the engine brackets and remove the tank from the engine. See Figures 9-12 and 9-13.

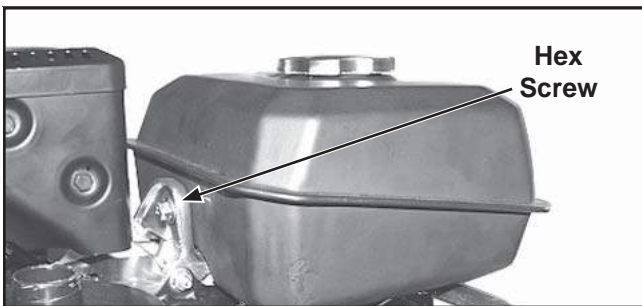


Figure 9-12. Fuel Tank Hex Screw Removal.

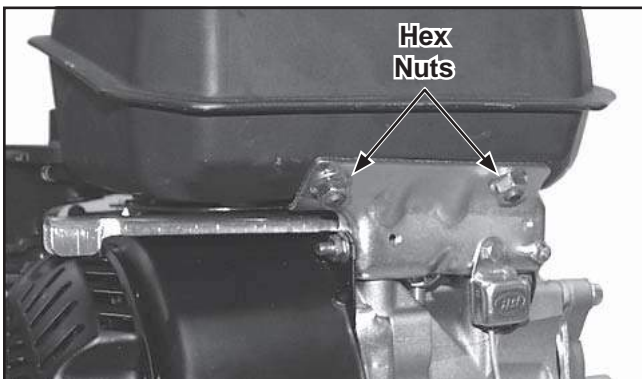


Figure 9-13. Fuel Tank Hex Screw Removal (PTO Side).

### Remove External Throttle, Governor and Choke Linkage

1. Mark which hole location the governor spring is in on each side. Remove the single hex flange nut and washer securing the throttle control lever to the crankcase. Unhook the spring and remove the lever. See Figures 9-14 or 9-15.

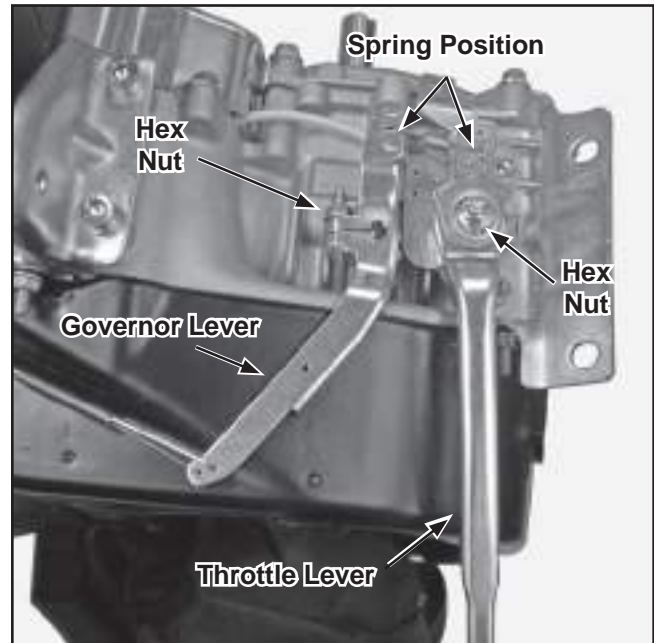


Figure 9-14. Removing CH270 Throttle and Governor Levers.

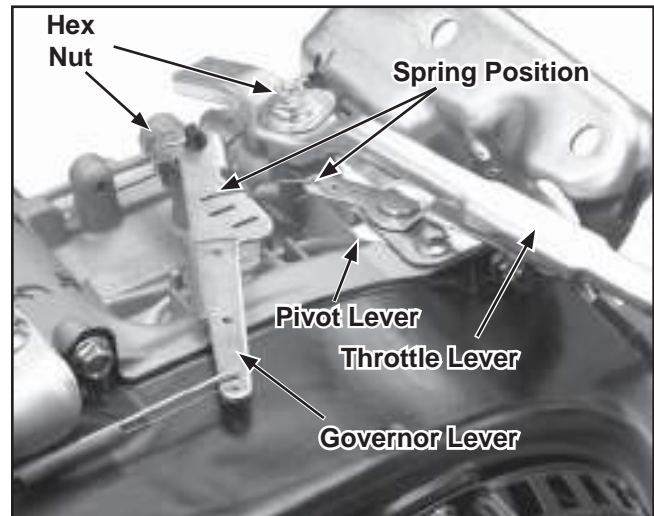
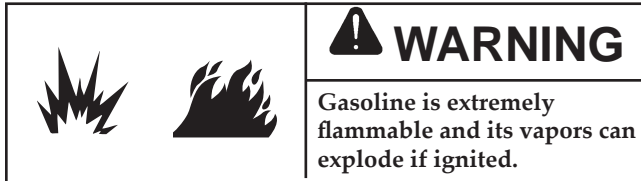


Figure 9-15. Removing CH395, CH440 Throttle and Governor Levers.

2. Loosen the hex flange nut securing the governor lever to the governor shaft. Lift off the governor lever and remove the carburetor throttle link and dampening spring. See Figures 9-14 or 9-15.

## Remove Carburetor



*Gasoline may be present in the carburetor and fuel system. Gasoline is extremely flammable, and its vapors can explode if ignited. Keep sparks, open flames and other sources of ignition away from the engine.*

1. Disconnect the throttle link and dampening spring from the carburetor. Remove the carburetor, carburetor gasket, insulator, and insulator gasket from the studs. See Figure 9-16.

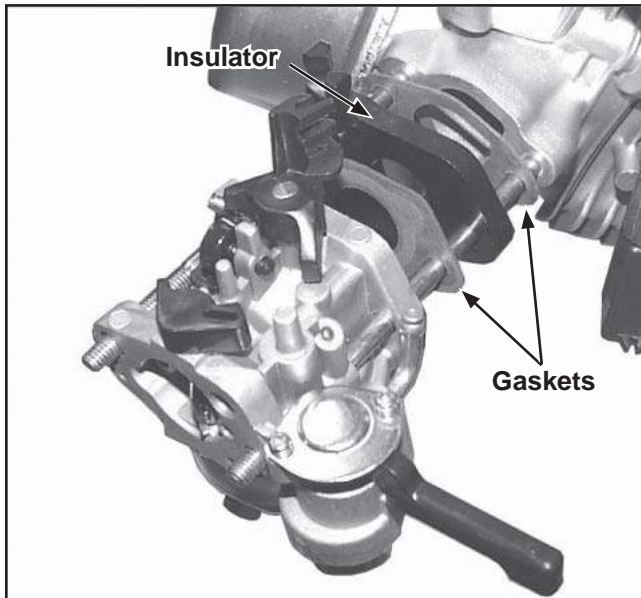


Figure 9-16. Carburetor Removal.

NOTE: To remove the carburetor without disturbing the governor lever mounting, pull the carburetor outward and off the mounting studs. Tilt the carburetor and disconnect the throttle link and dampening spring from the throttle lever.

## Remove Retractable Starter

1. Remove the three hex flange screws securing the retractable starter to the blower housing. Remove the starter. See Figure 9-17.

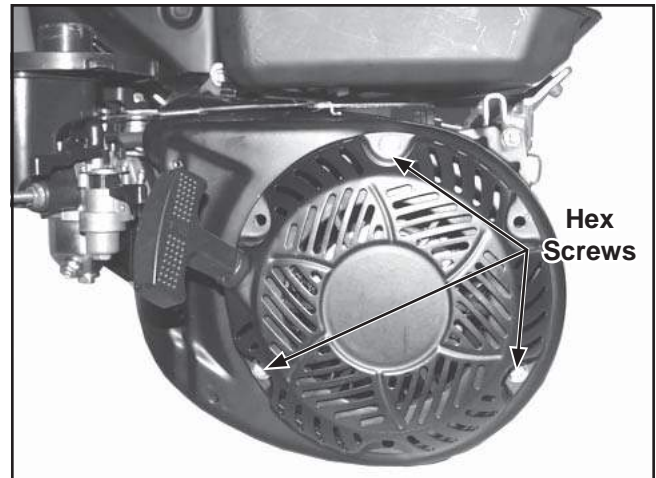


Figure 9-17. Removing Starter Mounting Screws.

## Remove Blower Housing and Shields

1. Remove the hex flange screws and two hex flange nuts (CH270 only) securing the blower housing. See Figures 9-18, 9-19, and 9-20.

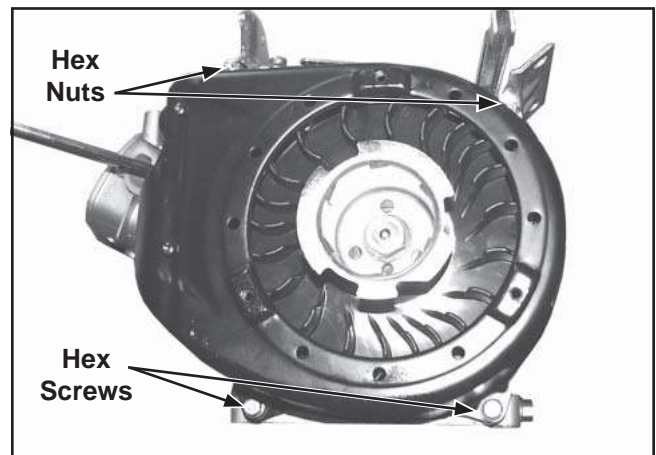


Figure 9-18. Remove CH270 Blower Housing Hardware.

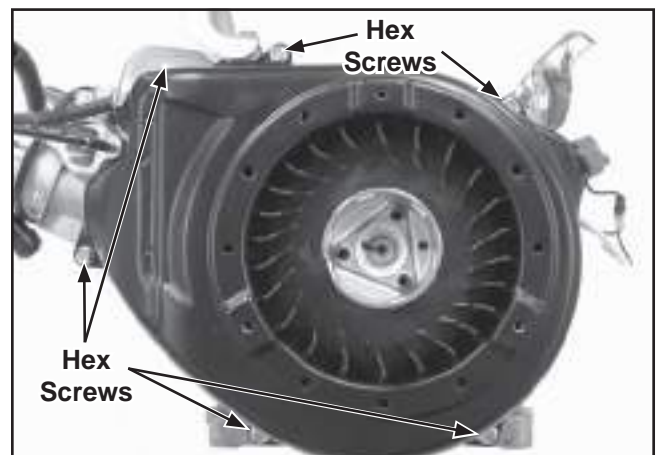
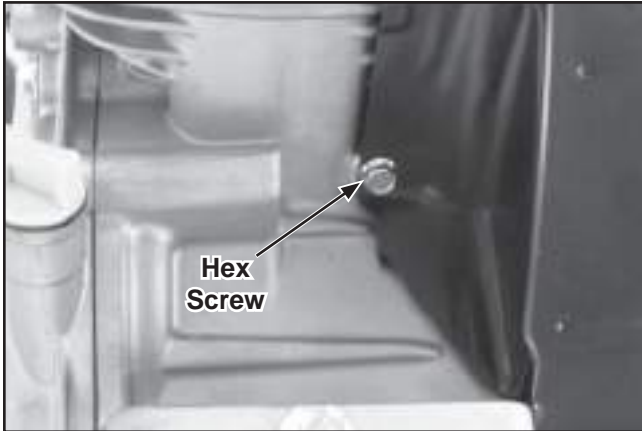


Figure 9-19. Remove CH395, CH440 Blower Housing Hardware.

## Section 9 Disassembly

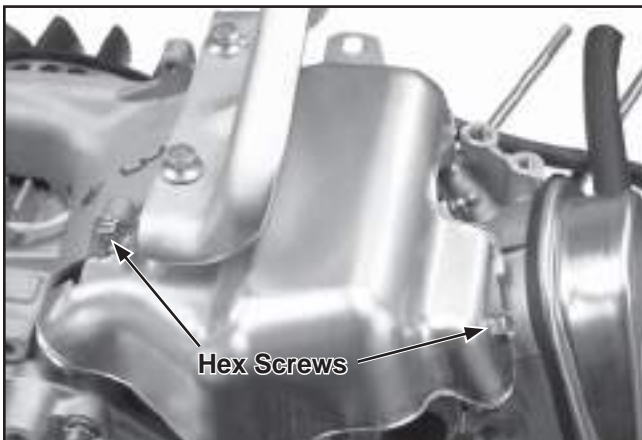


**Figure 9-20. Remove CH395, CH440 Blower Housing Hex Flange Screw Under Cylinder Head.**

2. Remove the blower housing.
3. Remove the hex flange screws securing the upper shield and remove the shield. See Figures 9-21 or 9-22.

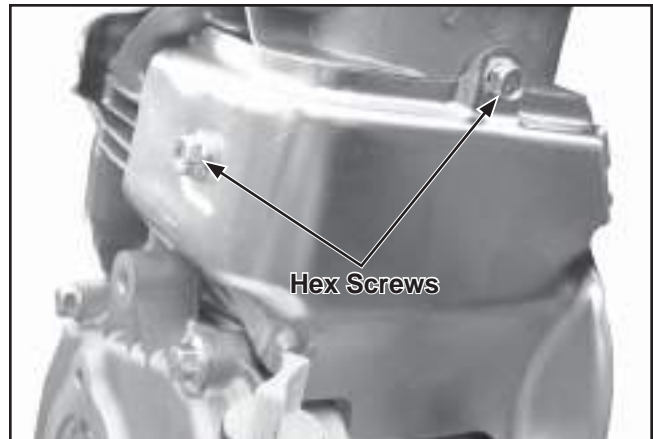


**Figure 9-21. Remove CH270 Upper Shield Hex Flange Screws.**

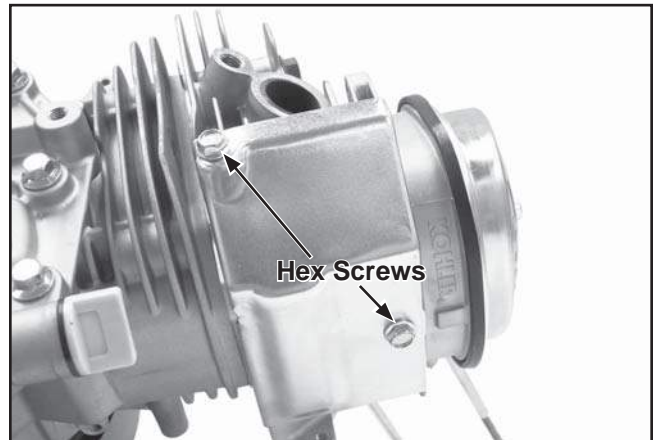


**Figure 9-22. Remove CH395, CH440 Upper Shield Hex Flange Screws.**

4. Remove the hex flange screws securing the lower shield and remove the shield. See Figures 9-23 and 9-24.



**Figure 9-23. Remove CH270 Lower Shield Hex Flange Screws.**



**Figure 9-24. Remove CH395, CH440 Lower Shield Hex Flange Screws.**

### **Remove Electrical Wiring, Micro Shut Down Switch & Bracket and Fuel Tank Brackets**

1. Disconnect the wiring harness bullet connectors for the Oil Sentry™ float switch and module. Remove the mounting screw securing the module to the fuel tank bracket. See Figure 9-25.

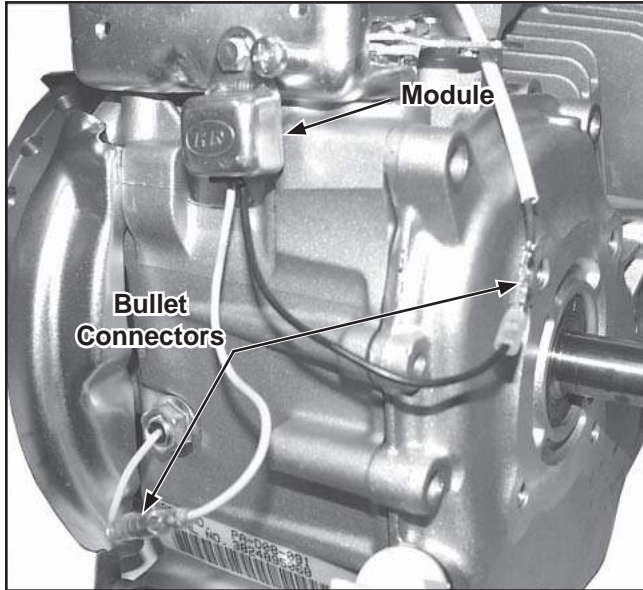


Figure 9-25. Disconnect Oil Sentry™ System.

2. Remove both fuel tank brackets by removing the two screws in each. Remove the threaded stud from the left bracket and remove the micro switch bracket. See Figure 9-26.

NOTE: For CH395 and CH440 it is not required and not recommended to remove the threaded stud and micro switch bracket.

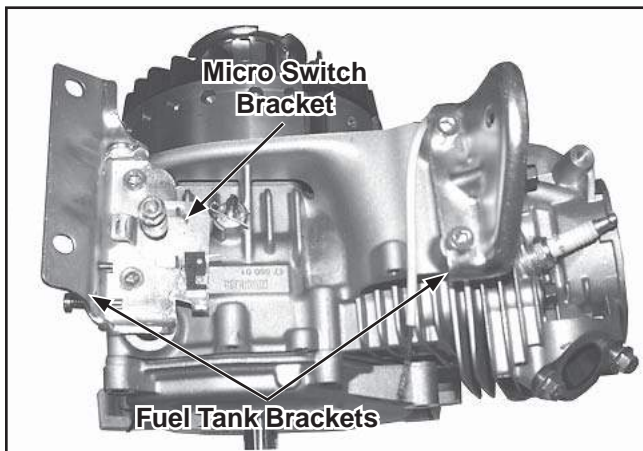


Figure 9-26. Fuel Tank Bracket Removal.

### Remove Control Panel and Electric Starter (If Equipped)

1. Disconnect the wires from the control panel to the starter, Oil Sentry™, ignition module, and the rectifier-regulator. See Figure 9-27.

NOTE: To ease reassembly, label wires for proper reconnection as wiring colors may not match.

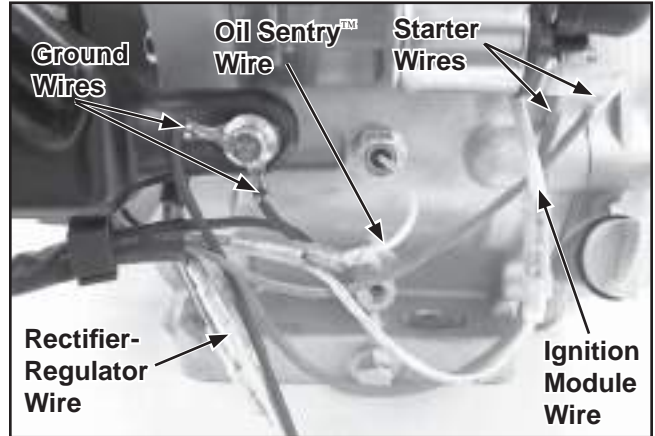


Figure 9-27. Disconnect Wires from Control Panel.

2. Remove the hex flange screws securing the control panel bracket to the crankcase, and remove the control panel. Note the two ground wires secured by one of the screws.

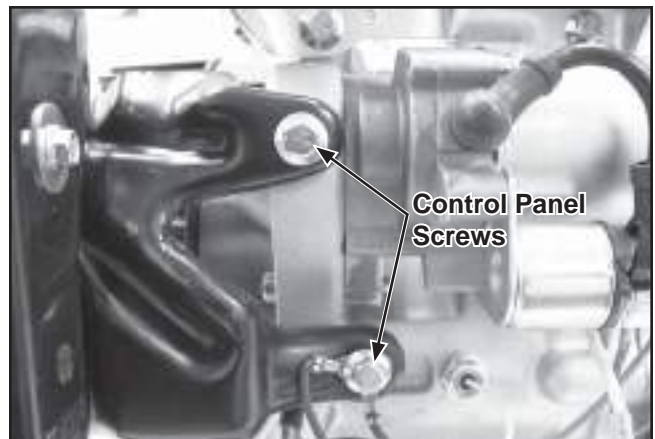


Figure 9-28. Remove Control Panel Screws.

3. Remove the hex flange screws securing the electric starter to the crankcase, and remove the electric starter.

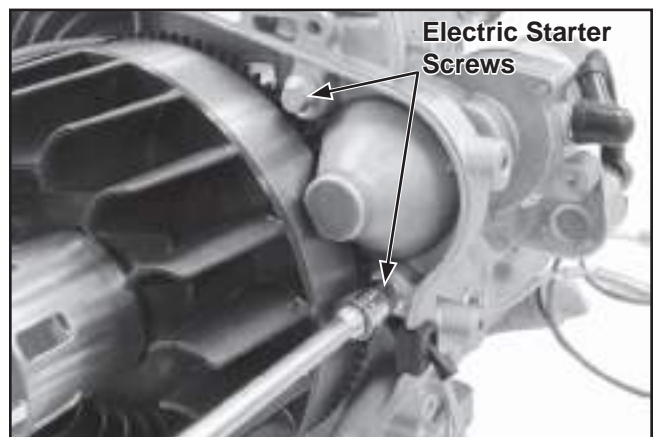


Figure 9-29. Remove Electric Starter Screws.

## Section 9 Disassembly

### Remove Valve Cover/Breather, Rocker Arms, Push Rods and Cylinder Head Assembly

1. Remove the hex flange screw and washer and remove the valve cover and gasket from the engine. See Figure 9-30. The breather assembly is inside the valve cover.

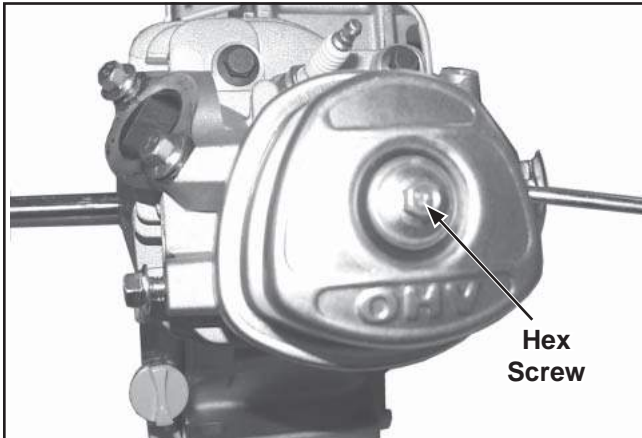


Figure 9-30. Valve Cover Removal.

2. Loosen and remove the rocker arm lock and adjuster nuts. Remove the rocker arms and push rods. See Figure 9-31.

NOTE: Mark the location of the push rods and any other part removed that will be reused.

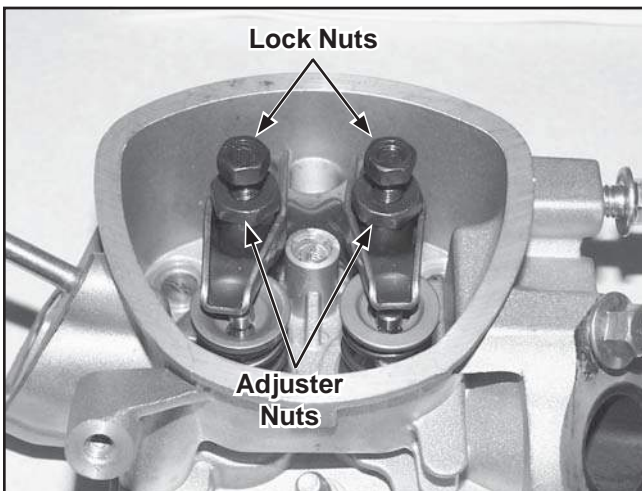


Figure 9-31. Rocker Arm Removal.

3. Remove the spark plug.
4. Remove the four hex flange screws securing the cylinder head. See Figure 9-32.

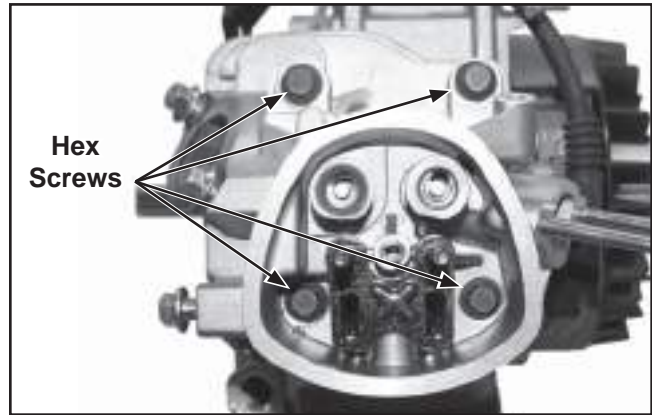


Figure 9-32. Remove Cylinder Head Mounting Screws.

5. Remove the cylinder head, dowel pins (2), and cylinder head gasket. See Figure 9-33.

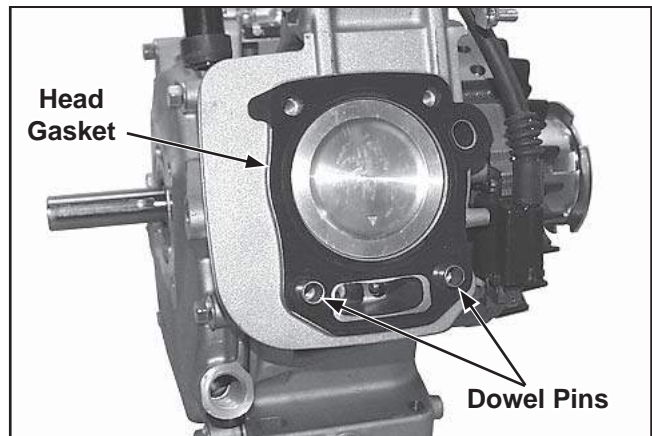


Figure 9-33. Remove Cylinder Head, Dowel Pins and Gasket.

### Remove Valves

1. Supporting the head of the valve from below, depress the valve keeper and valve spring until the keeper can be released from the valve stem. Remove the valve spring and valve from the head. Repeat this procedure for the remaining valve. See Figure 9-34.

NOTE: Mark the locations of any part removed that will be reused.

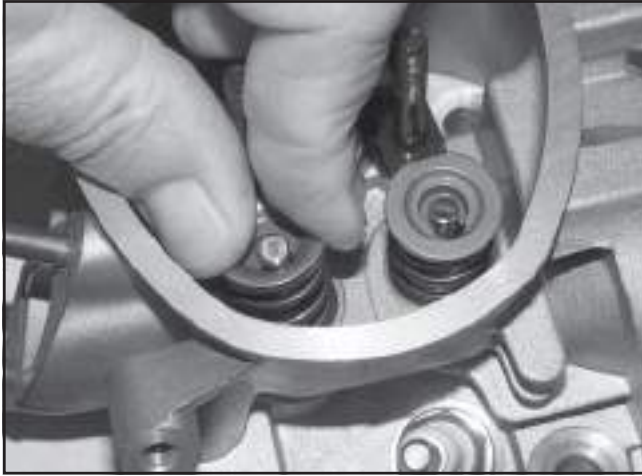


Figure 9-34. Valve Keeper Removal.

2. Remove and replace the valve stem seals whenever the cylinder head is serviced or disassembled. See Figure 9-35.

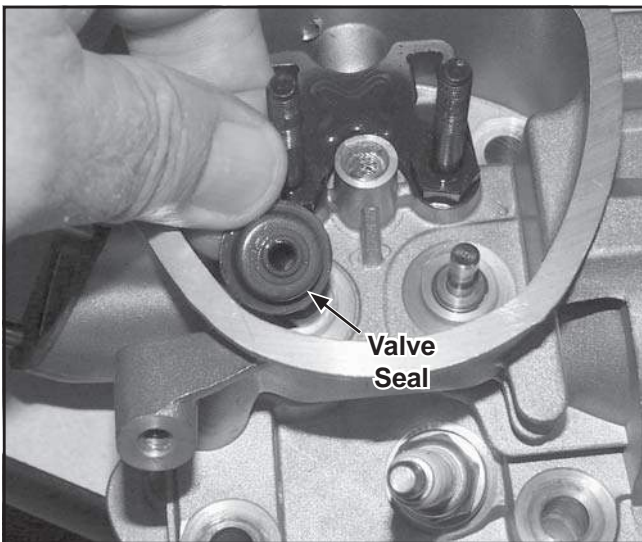


Figure 9-35. Removing Valve Stem Seal.

### Remove Ignition Module

1. Remove the two hex flange screws securing the ignition module to the crankcase. Remove the module. See Figure 9-36.

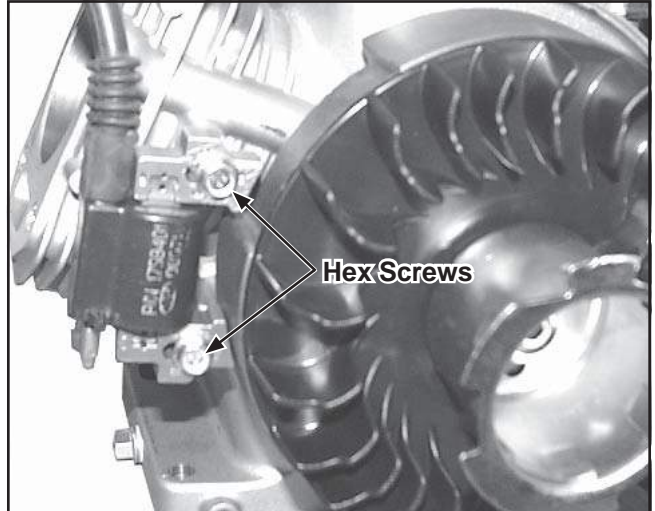


Figure 9-36. Remove Ignition Module Screws.

### Remove Flywheel

NOTE: Whenever possible, an impact wrench should be used to loosen the flywheel retaining nut. A flywheel strap wrench may be used to hold the flywheel when loosening or tightening the flywheel retaining nut.

1. Remove the flywheel retaining nut. See Figures 9-37 and 9-38.

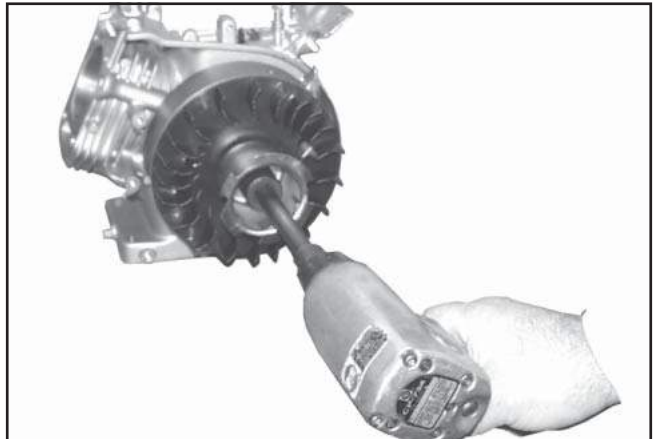
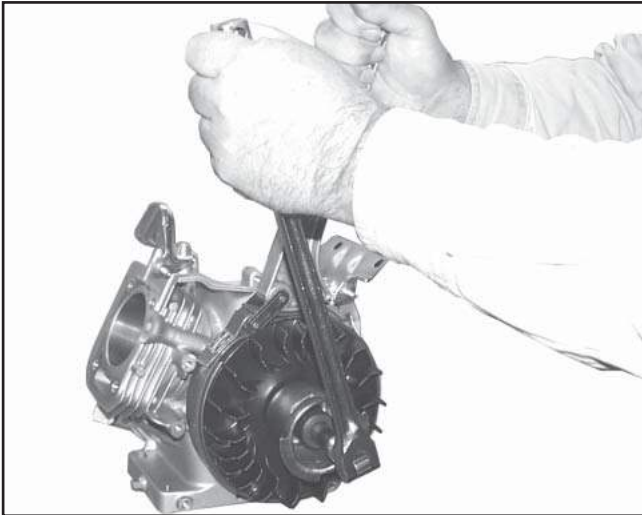


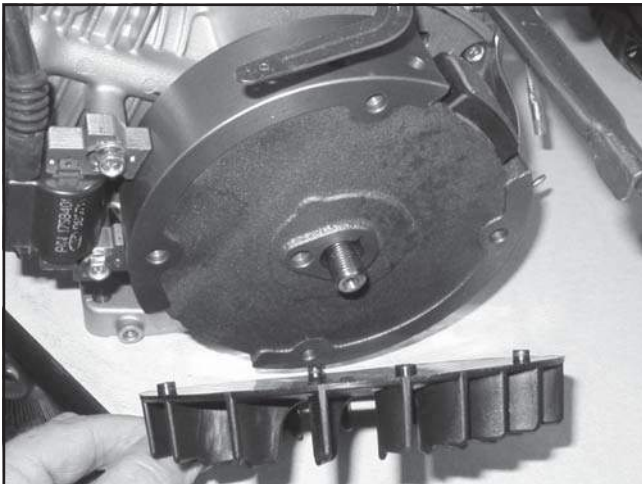
Figure 9-37. Removing Flywheel Nut Using an Impact Wrench.

## Section 9 Disassembly

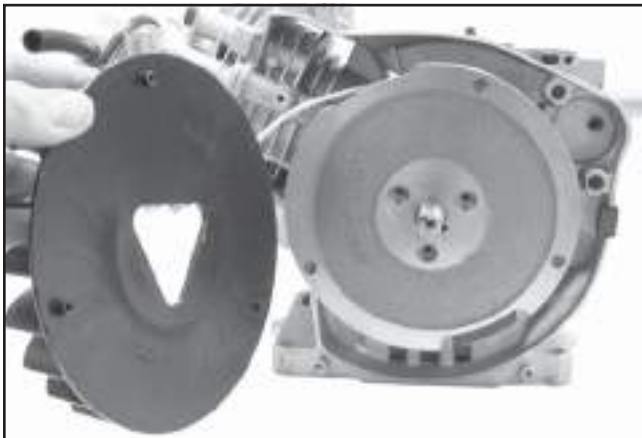


**Figure 9-38. Removing Flywheel Nut Using Strap Wrench.**

2. Remove the drive cup and fan from the flywheel. See Figures 9-39 and 9-40.

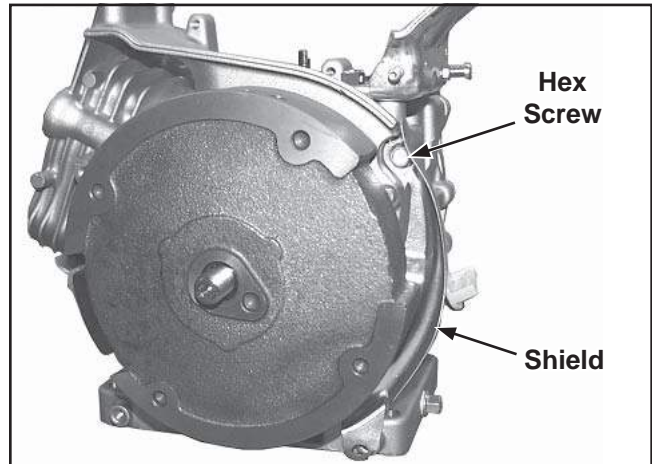


**Figure 9-39. Remove CH270 Flywheel Fan.**



**Figure 9-40. Remove CH395, CH440 Flywheel Fan. Note the Pin Pattern on the Fan.**

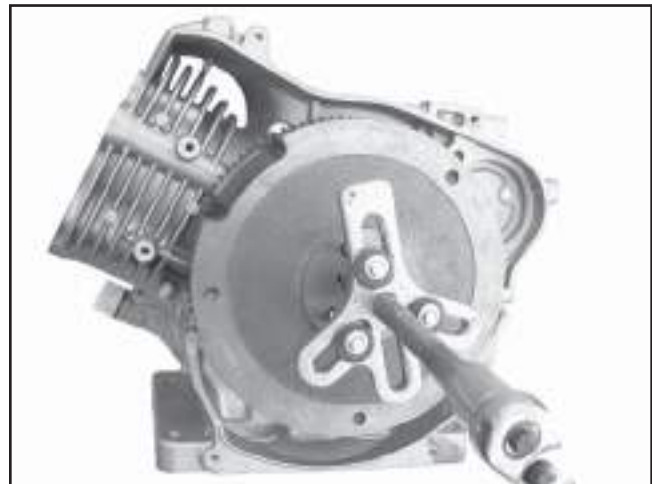
3. Remove hex screw and shield (CH270 only) on right side of flywheel (required for use of puller in next step). See Figure 9-41.



**Figure 9-41. Removing Flywheel Shield.**

4. Remove the flywheel from the crankshaft using a suitable puller. See Figure 9-42.

**NOTE:** Always use a puller to remove the flywheel from the crankshaft. Do not strike the flywheel or crankshaft as these parts could become cracked or damaged.



**Figure 9-42. Using Puller to Remove Flywheel.**

5. Remove the flywheel key from the crankshaft keyway.

### **Remove Stator (If Equipped)**

1. Remove the screw securing the stator wire bracket and remove the bracket. See Figure 9-43.
2. Remove the hex flange screws securing the stator to the crankcase. See Figure 9-43.



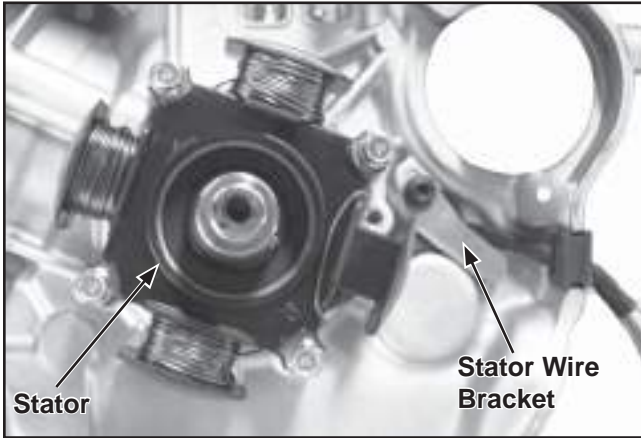


Figure 9-43. Remove Bracket and Stator.

### Remove Closure Plate

1. Remove the hex flange screws securing the closure plate to the crankcase. See Figures 9-44 and 9-45.

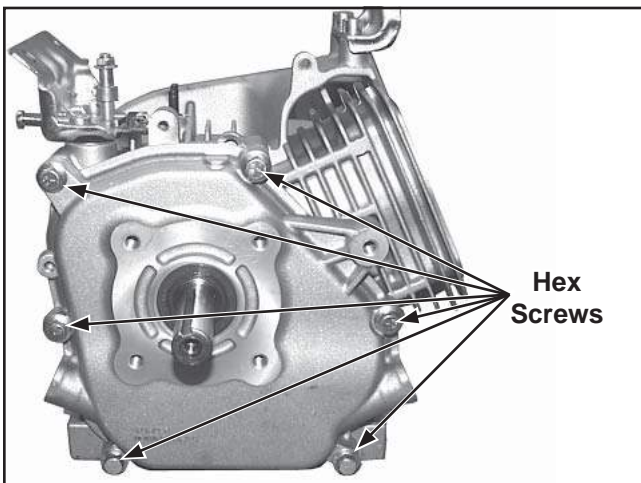


Figure 9-44. CH270 Closure Plate Mounting Screws.

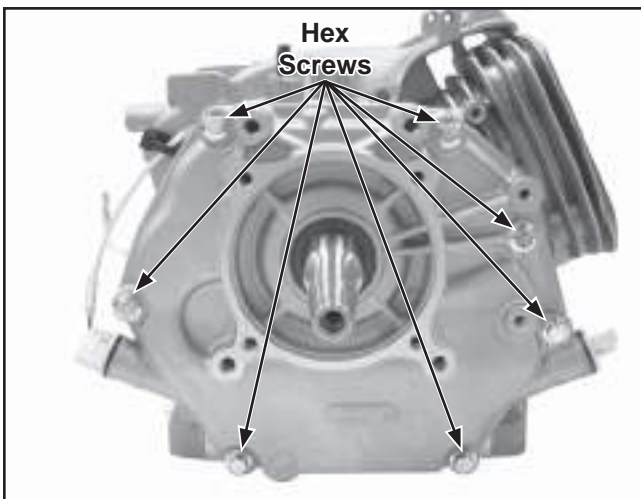


Figure 9-45. CH395, CH440 Closure Plate Mounting Screws.

2. Remove the closure plate gasket and dowel pins if required from the crankcase. See Figures 9-46 and 9-47.

NOTE: Do not pry on the gasket surface of the crankcase or closure plate, as this can cause damage and leakage.

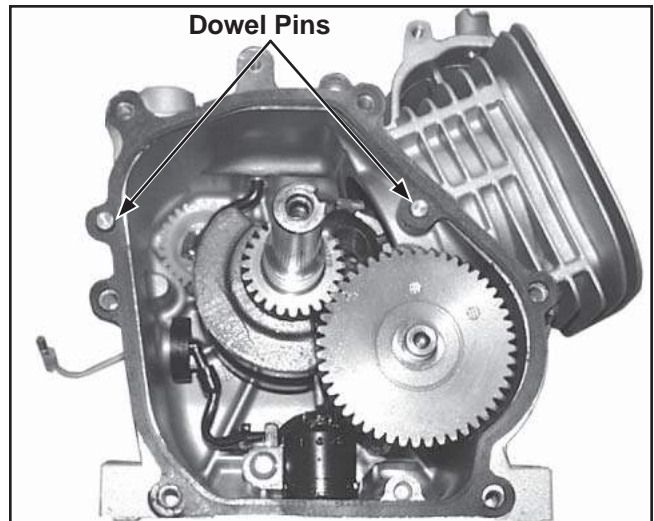


Figure 9-46. CH270 Closure Plate Gasket and Dowel Pins.

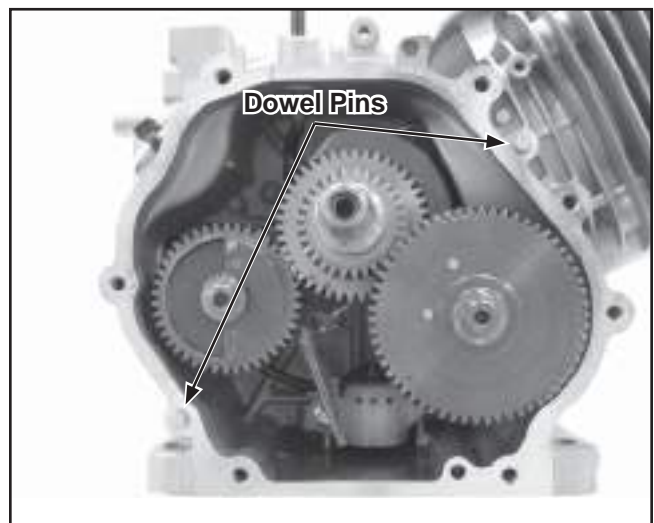


Figure 9-47. CH395, CH440 Closure Plate Dowel Pins.

3. Remove the shims from the crankshaft and camshaft.

### Remove Balance Shaft (If Equipped)

1. Remove the balance shaft by pulling it straight out of the crankcase. See Figure 9-48.

## Section 9 Disassembly

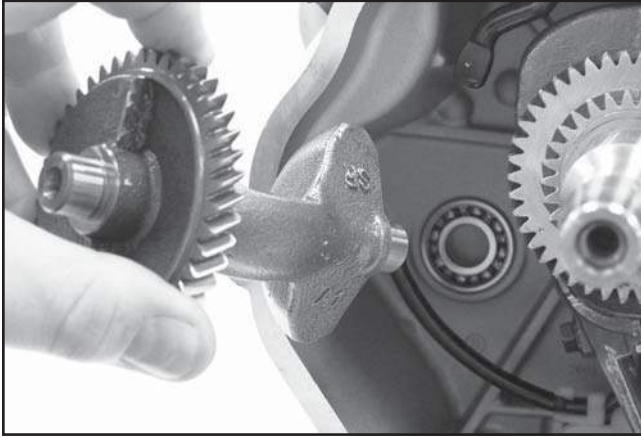


Figure 9-48. Balance Shaft Removal.

### Remove Camshaft and Valve Tappets

1. Remove the camshaft by pulling it straight out of the crankcase. See Figure 9-49.

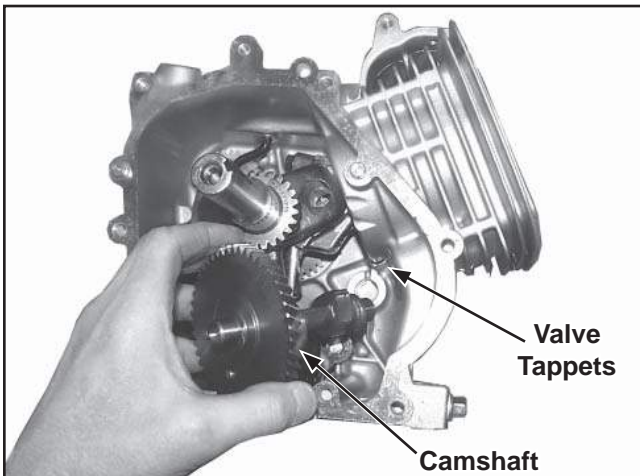


Figure 9-49. Camshaft Removal.

2. Remove the valve tappets by pulling them straight out of the crankcase. See Figure 9-49. Mark their positions.

### Remove Piston, Connecting Rod and Crankshaft

1. Remove the two screws securing the end cap to the connecting rod. Remove the end cap. Carefully guiding the connecting rod, slide the piston and connecting rod from the cylinder bore. See Figure 9-50.

NOTE: If a carbon ridge is present at the top of the cylinder bore, use a ridge reamer to remove it before attempting to remove the piston.

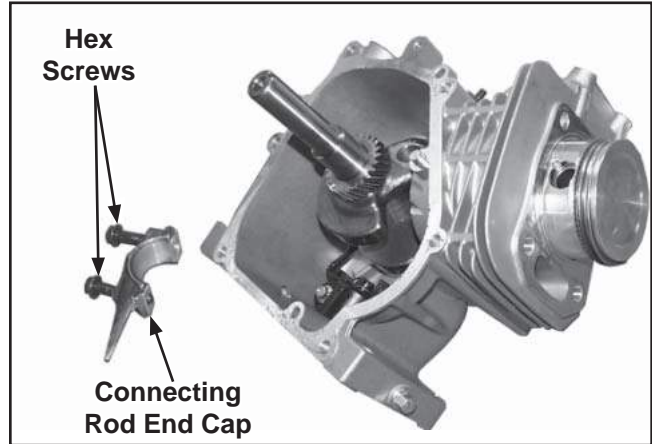


Figure 9-50. Removing Piston and Connecting Rod.

2. Remove the crankshaft from the crankcase. See Figure 9-51.

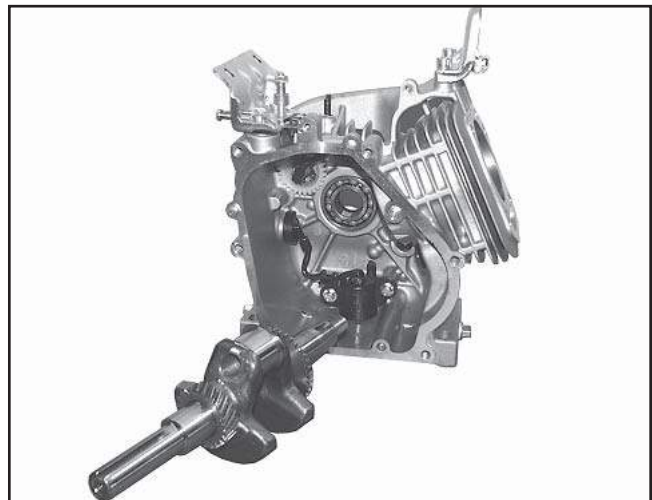


Figure 9-51. Removing Crankshaft.

### Remove Oil Sentry™ System

1. Remove the nut securing the Oil Sentry™ lead wire grommet assembly in the crankcase. See Figure 9-52.

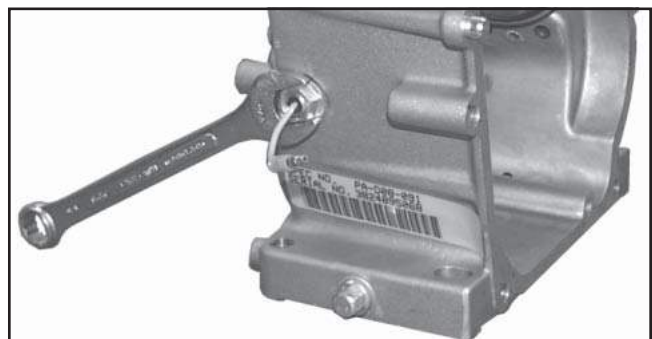


Figure 9-52. Removing Oil Sentry™ Wire From Crankcase.

2. Pull the grommet assembly from the crankcase on the inside.
3. Remove the two hex screws securing the Oil Sentry™ float switch to the crankcase. Remove the float switch assembly. See Figure 9-53.

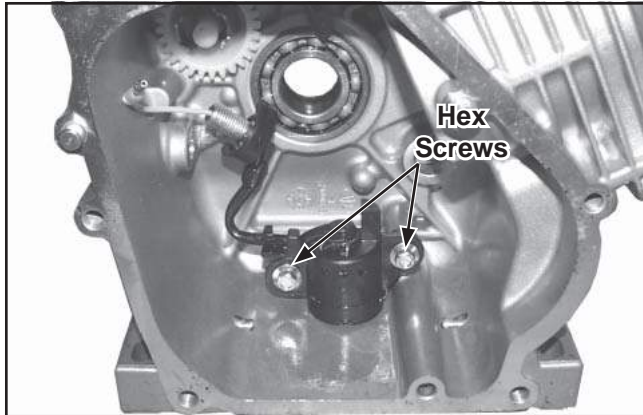


Figure 9-53. Removing Oil Sentry™ Float Switch.

## Remove Governor Assembly

### CH270 Governor Gear Assembly

1. Remove the cup and washer from the governor gear. See Figure 9-54.

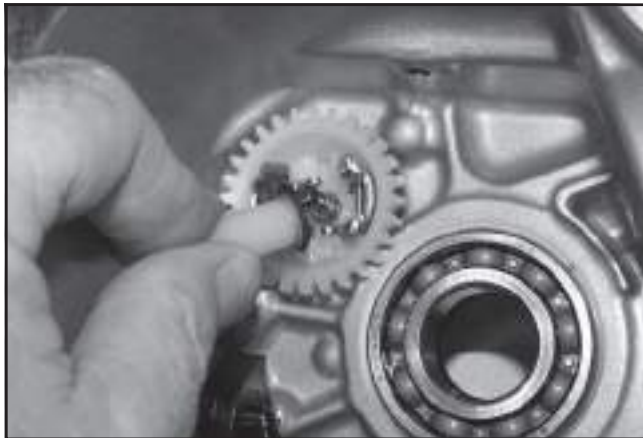


Figure 9-54. Removing Governor Assembly Cup and Washer.

2. Using a suitable drift, drive the governor gear shaft from the crankcase. See Figure 9-55.

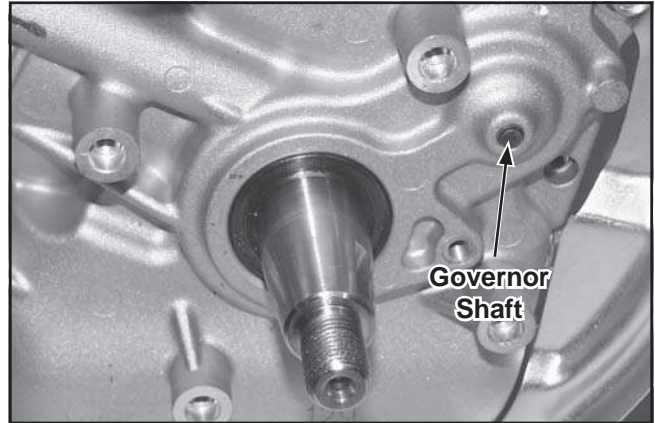


Figure 9-55. Remove Governor Gear Shaft.

NOTE: Mark the orientation of all parts as the governor assembly is removed. See Figure 9-56.

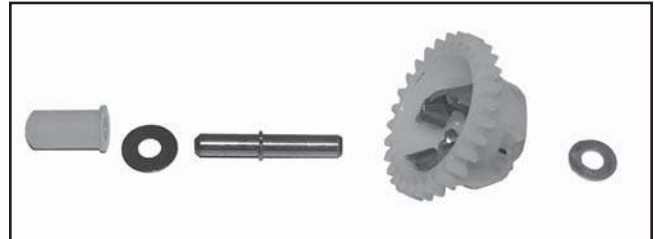


Figure 9-56. CH270 Governor Assembly Components.

3. Remove the hitch pin and washer from the governor cross shaft. See Figure 9-57.

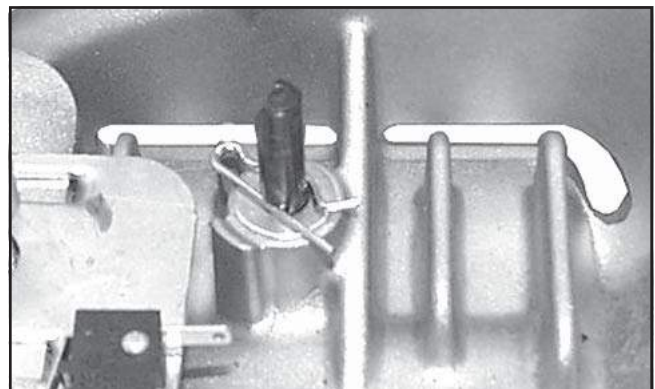


Figure 9-57. Removing Governor Cross Shaft Hitch Pin.

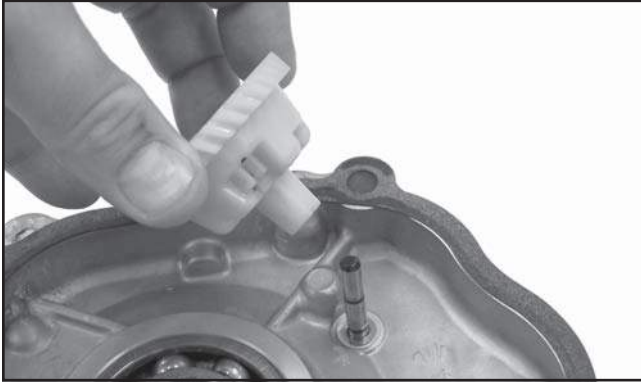
4. Remove the cross shaft from inside the crankcase.

### CH395 Governor Gear Assembly

1. The governor gear is located in the closure plate. To remove the governor gear, pull the governor gear off the shaft. See Figure 9-58.

NOTE: The governor gear shaft is pressed into the closure plate, and should not be removed.

## Section 9 Disassembly



**Figure 9-58. Removing Governor Assembly Cup and Washer.**

NOTE: Take note of the orientation of the governor gear components. See Figure 9-59.



**Figure 9-59. CH395 Governor Assembly Components.**

2. Remove the hitch pin and washer from the governor cross shaft. See Figure 9-60.



**Figure 9-60. Removing Governor Cross Shaft Hitch Pin.**

3. Remove the cross shaft from inside the crankcase.

### CH440 Governor Gear Assembly

1. The governor gear is located in the closure plate. To remove the governor gear, pry underneath the gear to lift it off the shaft. See Figure 9-61.

NOTE: Do not pry on the gasket surface of the closure plate, as this can cause damage and leakage.



**Figure 9-61. Pry Governor Gear to Remove.**

NOTE: Take note of the orientation of the governor gear components. See Figure 9-62.



**Figure 9-62. CH440 Governor Assembly Components.**

NOTE: The governor gear shaft is pressed into the closure plate, and should not be removed unless damaged.

2. If the governor gear shaft is bent or damaged, remove it by pulling straight out.
3. Remove the hitch pin and washer from the governor cross shaft. See Figure 9-63.

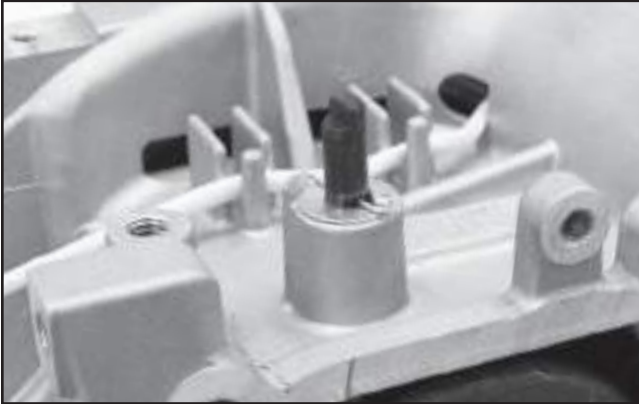


Figure 9-63. Removing Governor Cross Shaft Hitch Pin.

4. Remove the cross shaft from inside the crankcase.

### Remove Crankcase and Closure Plate Seals and Bearings

1. Remove the oil seal from the crankcase. See Figure 9-64.

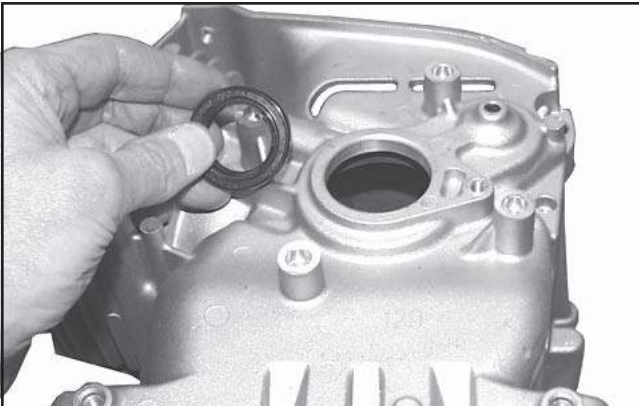


Figure 9-64. Removing Crankcase Seal.

2. Using a suitable press, push the crankshaft bearing from the crankcase. See Figure 9-65.

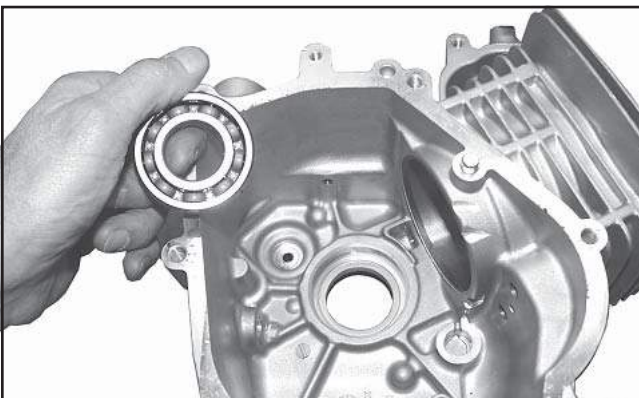


Figure 9-65. Removing Crankcase Crankshaft Bearing.

3. Remove the oil seal from the closure plate. See Figure 9-66.

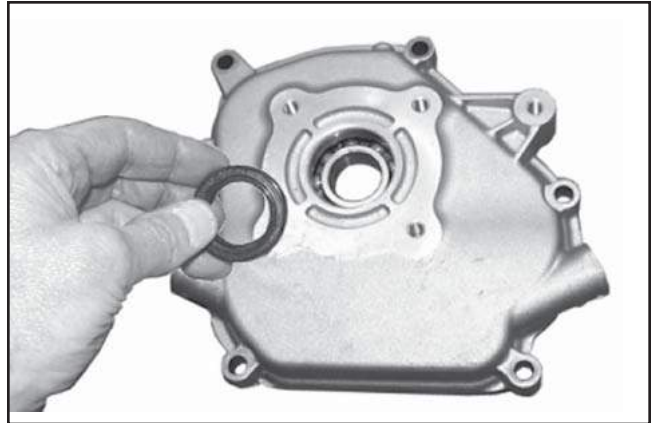


Figure 9-66. Closure Plate Seal Removal.

4. Using a suitable press, push the crankshaft bearing from the closure plate. See Figure 9-67.

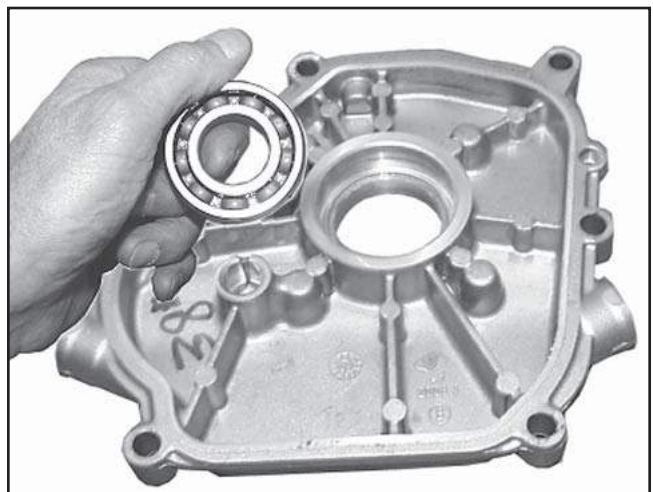


Figure 9-67. Closure Plate Bearing Removal.

NOTE: Inspect the bearings for signs of wear by rotating the inner race and examine for marring or cracks. Check to make sure the race moves easily and is not sloppy. If the bearing is tight and rotates smoothly, removal is not necessary. If you feel any roughness or chattering or the bearing is sloppy, it should be replaced.



# Section 10

## Inspection and Reconditioning

This section covers the operation, inspection, and repair/reconditioning of major internal engine components. The following components are not covered in this section. They are covered in sections of their own:

- Section 4: **Air Cleaner and Air Intake System**
- Section 5: **Fuel System and Governor**
- Section 7: **Retractable Starter**
- Section 8: **Electrical System and Components**

Clean all parts thoroughly. Only clean parts can be accurately inspected and gauged for wear or damage. There are many commercially available cleaners that will quickly remove grease, oil, and grime from engine parts. When such a cleaner is used, follow the manufacturer's instructions and safety precautions carefully. Make sure all traces of the cleaner are removed before the engine is reassembled and placed into operation. Even small amounts of these cleaners can quickly break down the lubricating properties of engine oil.

**Do not** scrape the gasket surfaces, as any scratches, nicks, or burrs can result in leaks. Use an aerosol gasket remover, paint stripper, or lacquer thinner to remove any gasket residue. Apply the solvent, allow time for it to work, and then brush the surface with a brass wire brush. Clean the surface with isopropyl alcohol, lacquer thinner, or aerosol electrical contact cleaner.

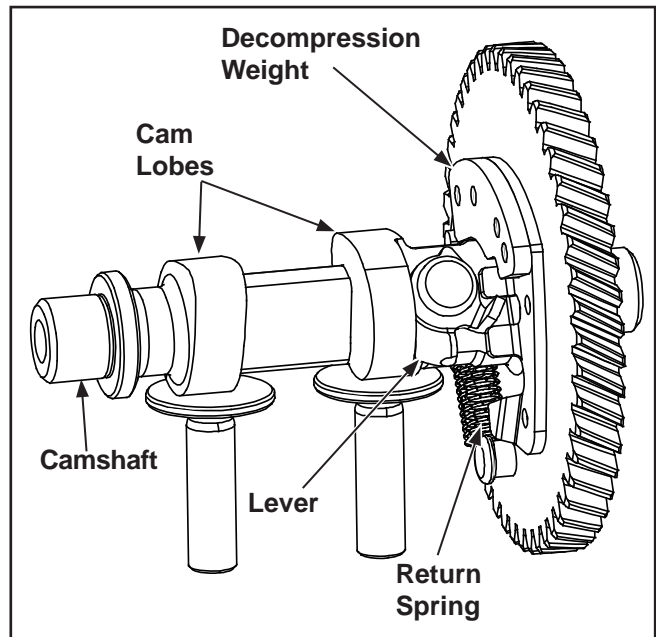
Refer to *A Guide to Engine Rebuilding (TP-2150-A)* for additional information. *Measurement Guide (TP-2159-B)* and *Engine Inspection Data Record (TP-2435)* are also available; use these to record inspection results.

### Automatic Compression Release (ACR)

These engines are equipped with an **Automatic Compression Release (ACR)** mechanism. ACR lowers compression at cranking speeds to make starting easier.

#### Operation

The ACR mechanism consists of a spring-loaded arm and sliding pin mounted to the camshaft. When the engine is rotating at low cranking speeds the arm holds the pin so it protrudes above the heel of the exhaust cam. This holds the exhaust valve off of its seat during the first part of the compression stroke. See Figure 10-1.



**Figure 10-1. ACR Operation Details.**

After the engine speed increases centrifugal force causes the spring-loaded arm to move outward causing the pin to retract. When in this position the pin has no effect on the exhaust valve and the engine operates at full compression and power.

# Section 10

## Inspection and Reconditioning

### Benefits

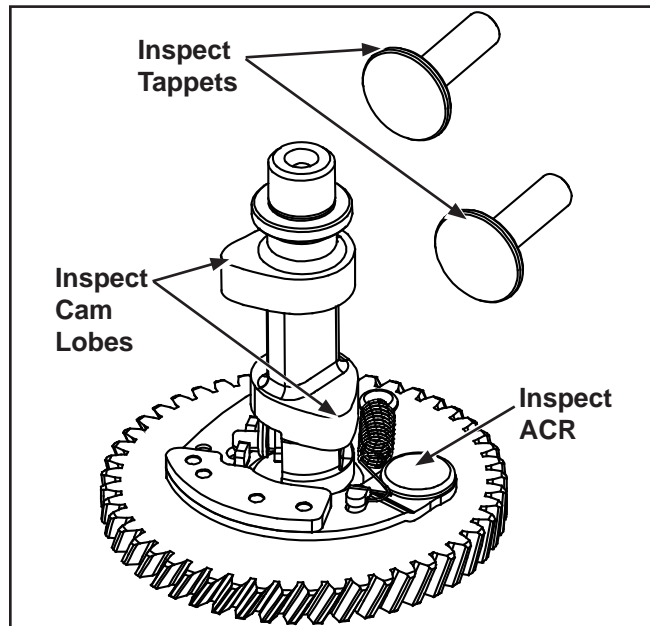
As a result of the reduced compression at cranking speeds, several important benefits are obtained:

1. Manual (retractable) starting is much easier. Without ACR, manual starting would be virtually impossible.
2. Electric start models can use a smaller starter and battery that are more practical for the application.
3. ACR eliminates the need for a spark retard/advance mechanism. A spark retard/advance mechanism would be required on engines without ACR to prevent the kickback that would occur during starting. ACR eliminates this kickback making manual starting safer.
4. The choke control setting is less critical with ACR. In the event of flooding, excess fuel is blown out the opened exhaust valve and does not hamper starting.
5. Engines with ACR start much faster in cold weather than engines without ACR.
6. Engines with ACR can be started with spark plugs that are worn or fouled. Engines without ACR are more difficult to start with those same spark plugs.

### Camshaft & Tappets

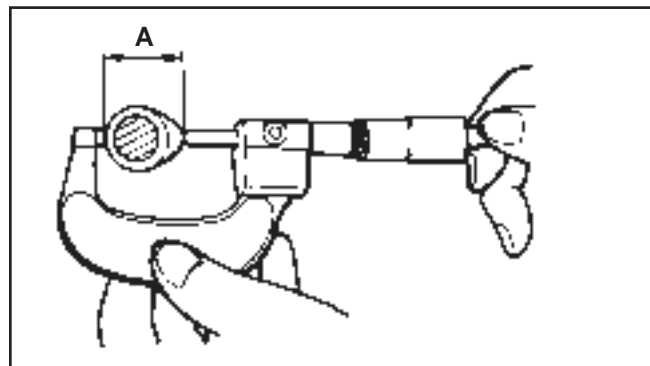
#### Inspection and Service

Inspect the gear teeth of the camshaft. If the teeth are badly worn, chipped, or some are missing, replacement of the camshaft will be necessary. If unusual wear or damage is evident on either lobe or the mating tappet, the camshaft and both tappets must be replaced. Check the condition and operation of the ACR mechanism. See Figure 10-2.



**Figure 10-2. Camshaft and Tappet Inspection Points.**

Measure the cam lobe profile, **A** and **B**, as shown in Figures 10-3 and 10-4 using an outside micrometer and compare with specifications listed.



**Figure 10-3. Cam Lobe Checking A.**

#### CH270 Cam Lobe Dimension A

Valve	Dimension A	Service Limit
INTAKE	28.263 mm (1.1127 in.)	27.585 mm (1.0860 in.)
EXHAUST	28.346 mm (1.1160 in.)	27.666 mm (1.0892 in.)

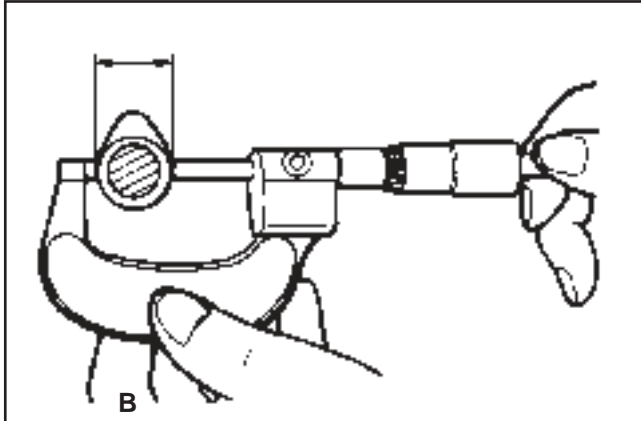
#### CH395 Cam Lobe Dimension A

Valve	Dimension A	Service Limit
INTAKE	32.544 mm (1.2813 in.)	32.110 mm (1.2642 in.)
EXHAUST	32.256 mm (1.2699 in.)	31.790 mm (1.2516 in.)



**CH440 Cam Lobe Dimension A**

Valve	Dimension A	Service Limit
INTAKE	32.266 mm (1.3097 in.)	32.642 mm (1.2851 in.)
EXHAUST	32.260 mm (1.2701 in.)	31.610 mm (1.2445 in.)

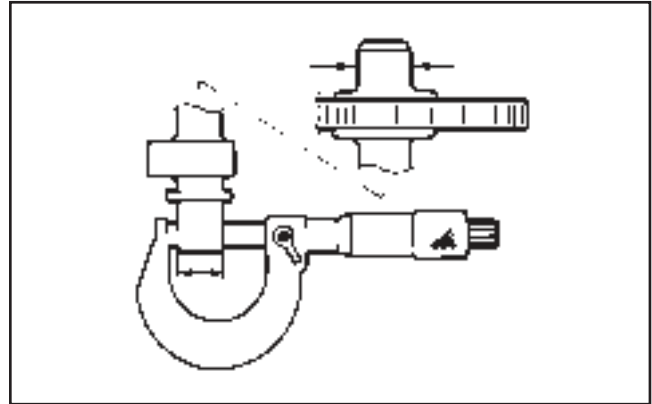


**Figure 10-4. Cam Lobe Checking B.**

**Cam Lobe Dimension B**

Engine Model	Valve	Dimension B	Service Limit
CH270	INTAKE	22.200 mm (0.8740 in.)	21.582 mm (0.8497 in.)
	EXHAUST	22.200 mm (0.8740 in.)	21.582 mm (0.8497 in.)
CH395	INTAKE	26.060 mm (1.0260 in.)	25.440 mm (1.0044 in.)
	EXHAUST	26.060 mm (1.0260 in.)	25.440 mm (1.0044 in.)
CH440	INTAKE	26.092 mm (1.0272 in.)	25.041 mm (0.9859 in.)
	EXHAUST	26.000 mm (1.0236 in.)	24.970 mm (0.9831 in.)

Measure the camshaft journals, which fit in the ball bearings, for wear using a micrometer. Compare with specifications listed. See Figure 10-5.



**Figure 10-5. Camshaft Journal Checking.**

**Camshaft Journal Specifications**

Engine Model	Dimension	Limit
CH270	13.975 mm (0.5500 in.)	13.900 mm (0.5470 in.)
CH395, CH440	15.975 mm (0.6289 in.)	15.900 mm (0.6260 in.)

**Crankshaft**

**Inspection and Service**

Inspect the gear teeth of the crankshaft. If the teeth are badly worn, chipped, or some are missing, replacement of the crankshaft will be necessary.

Inspect the crankshaft bearing surfaces for scoring, grooving, etc. Measure the running clearance between the crankshaft journals and their respective bearing bores. Use an inside micrometer or telescoping gauge to measure the inside diameter of both bearing bores in the vertical and horizontal planes. Use an outside micrometer to measure the outside diameter of the crankshaft main bearing journals. Subtract the journal diameters from their respective bore diameters to get the running clearances. Check the results against the values in Section 1, **Specifications and Tolerances**.

If the running clearances are within specification, and there is no evidence of scoring, grooving, etc., no further reconditioning is necessary. If the bearing surfaces are worn or damaged, the crankcase and/or closure plate will need to be replaced.

Inspect the crankshaft keyways. If worn or chipped, replacement of the crankshaft will be necessary. Inspect the crankpin for score marks or metallic pickup. Slight score marks can be cleaned with crocus cloth soaked in oil. If wear limits, as stated in Section 1, **Specifications and Tolerances** are exceeded, it will be necessary to replace the crankshaft.

## Section 10

# Inspection and Reconditioning

### Crankcase

#### Inspection and Service

Check all gasket surfaces to make sure they are free of gasket fragments. Gasket surfaces must also be free of deep scratches or nicks.

Check the cylinder bore for scoring. In severe cases, unburned fuel can cause scuffing and scoring of the cylinder wall. It washes the necessary lubricating oils off the piston and cylinder wall. As raw fuel seeps down the cylinder wall, the piston rings make metal to metal contact with the wall. Scoring of the cylinder wall can also be caused by localized hot spots resulting from blocked cooling fins or from inadequate or contaminated lubrication.

If the cylinder bore is badly scored, excessively worn, tapered, or out-of-round, resizing is necessary. Use an inside micrometer to determine the amount of wear (refer to Section 1, **Specifications and Tolerances**). See Figure 10-6.

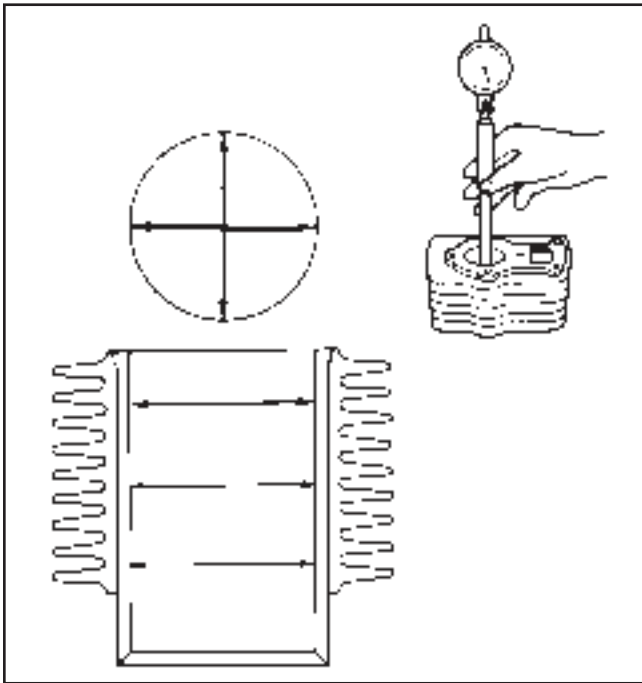


Figure 10-6. Measuring Cylinder Bore.

NOTE: A 0.25 mm (0.010 in.) oversize piston is available if resizing is selected. Initially, resize using a boring bar, then use the following procedures for honing the cylinder.

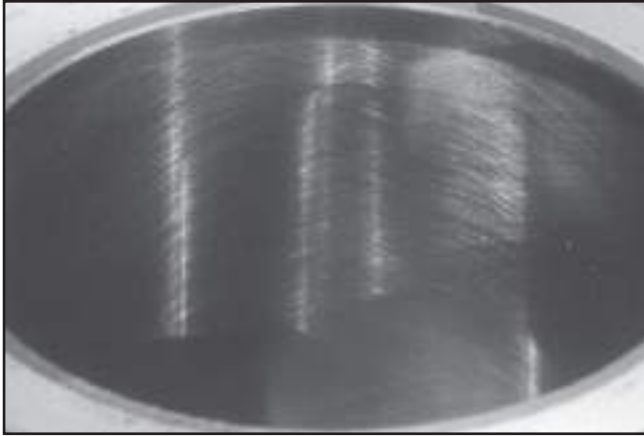
#### Honing

While most commercially available cylinder hones can be used with either portable drills or drill presses, the use of a low speed drill press is preferred as it facilitates more accurate alignment of the bore in relation to the crankshaft crossbore. Honing is best accomplished at a drill speed of about 250 RPM and 60 strokes per minute. After installing coarse stones in hone, proceed as follows:

1. Lower hone into bore and after centering, adjust so that the stones are in contact with the cylinder wall. Use of a commercial cutting-cooling agent is recommended.
2. With the lower edge of each stone positioned even with the lowest edge of the bore, start drill and honing process. Move the hone up and down while resizing to prevent the formation of cutting ridges. Check the size frequently.

NOTE: Kohler pistons are custom-machined to exacting tolerances. When over-sizing a cylinder, it should be machined exactly 0.25 mm (0.010 in.) over the new diameter (Section 1, **Specifications and Tolerances**). The oversize Kohler replacement piston will then fit correctly.

3. When the bore is within **0.064 mm (0.0025 in.)** of the desired size, remove the coarse stones and replace them with burnishing stones. Continue with the burnishing stones until the bore is within **0.013 mm (0.0005 in.)** of the desired size and then use finish stones (**220-280 grit**) and polish the bore to its final size. A crosshatch should be observed if honing is done correctly. The crosshatch should intersect at approximately 23°-33° off the horizontal. Too flat an angle could cause the rings to skip and wear excessively, and too steep an angle will result in high oil consumption. See Figure 10-7.



**Figure 10-7. Cylinder Bore Crosshatch After Honing.**

4. After resizing, check the bore for roundness, taper, and size. Use an inside micrometer, telescoping gauge, or bore gauge to take measurements. The measurements should be taken at three locations in the cylinder – at the top, middle, and bottom. Two measurements should be taken (perpendicular to each other) at each of the three locations.

#### Clean Cylinder Bore After Honing

Proper cleaning of the cylinder walls following boring and/or honing is very critical to a successful overhaul. Machining grit left in the cylinder bore can destroy an engine in less than one hour of operation after a rebuild.

The final cleaning operation should always be a thorough scrubbing with a brush and hot, soapy water. Use a strong detergent that is capable of breaking down the machining oil while maintaining a good level of suds. If the suds break down during cleaning, discard the dirty water and start again with more hot water and detergent. Following the scrubbing, rinse the cylinder with very hot, clear water, dry it completely, and apply a light coating of engine oil to prevent rusting.

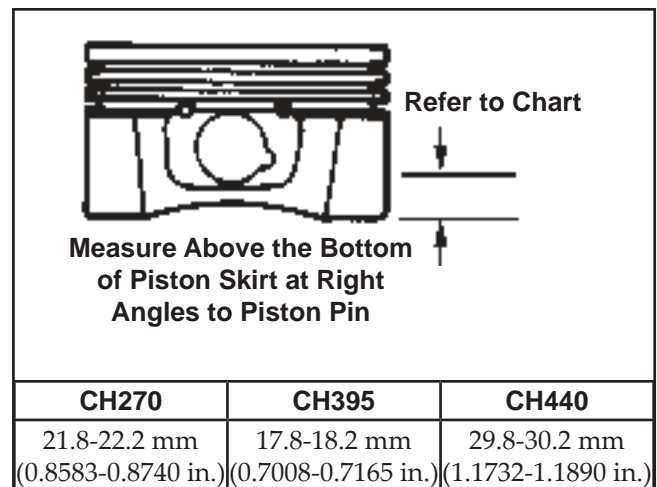
#### Measuring Piston-to-Bore Clearance

Before installing the piston into the cylinder bore, it is necessary that the clearance be accurately checked. This step is often overlooked, and if the clearances are not within specifications, engine failure will usually result.

**NOTE:** Do not use a feeler gauge to measure piston-to-bore clearance—it will yield inaccurate measurements. Always use a micrometer.

Use the following procedure to accurately measure the piston-to-bore clearance:

1. Use a micrometer and measure the diameter of the piston above the bottom of the piston skirt and perpendicular to the piston pin. See Figure 10-8.



**Figure 10-8. Measuring Piston Diameter.**

2. Use an inside micrometer, telescoping gauge, or bore gauge and measure the cylinder bore. Take the measurement approximately 7.0 mm (0.2760 in.) below the top of the bore and perpendicular to the piston pin.
3. Piston-to-bore clearance is the difference between the bore diameter and the piston diameter (Step 2 minus Step 1).

#### Flywheel

##### Inspection

Inspect the flywheel for cracks, and the flywheel keyway for damage. Replace flywheel if it is cracked. Replace the flywheel, the crankshaft, and the key if the flywheel key is sheared or the keyway is damaged.

## Section 10 Inspection and Reconditioning

### Cylinder Head and Valves

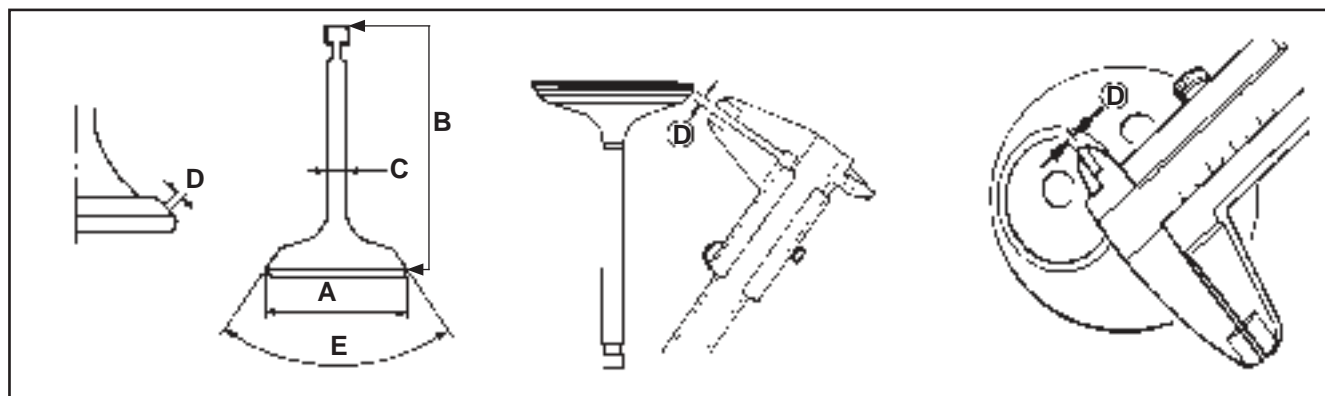


Figure 10-9. Valve and Seat Measuring Locations.

CH270 Valve Specifications			
Item	Dimension	Intake	Exhaust
A	Head Diameter	26.875-27.125 mm (1.0581-1.0679 in.)	24.875-25.125 mm (0.9793-0.9892 in.)
B	Valve Length	63.3-63.9 mm (2.4921-2.5157)	63.3-63.9 mm (2.4921-2.5157)
C	Stem Diameter	5.5 mm (0.217 in.)	5.438 mm (0.214 in.)
D	Face/Seat Width - Maximum	2.0 mm (0.079 in.)	2.0 mm (0.079 in.)
E	Face/Seat Angle	89.5°-90.5°	89.5°-90.5°

CH395 Valve Specifications			
Item	Dimension	Intake	Exhaust
A	Head Diameter	30.875-31.125 mm (1.2156-1.2254 in.)	26.875-27.125 mm (1.0581-1.0679 in.)
B	Valve Length	85.34-85.54 mm (3.3598-3.3677 in.)	85.19-84.99 mm (3.3461-3.3539 in.)
C	Stem Diameter	6.560-6.575 mm (0.2583-0.2589 in.)	6.560-6.575 mm (0.2583-0.2589 in.)
D	Face/Seat Width - Maximum	1.5 mm (0.059 in.)	1.5 mm (0.059 in.)
E	Face/Seat Angle	89.5°-90.5°	89.5°-90.5°

CH440 Valve Specifications			
Item	Dimension	Intake	Exhaust
A	Head Diameter	35.875-36.125 mm (1.4124-1.4222 in.)	32.875-33.125 mm (1.2943-1.3041 in.)
B	Valve Length	86.175-86.375 mm (3.3927-3.4006 in.)	86.341-86.541 mm (3.3993-3.4071 in.)
C	Stem Diameter	6.560-6.575 mm (0.2583-0.2589 in.)	6.545-6.560 mm (0.2577-0.2583 in.)
D	Face/Seat Width - Maximum	1.5 mm (0.059 in.)	1.5 mm (0.059 in.)
E	Face/Seat Angle	89.5°-90.5°	89.5°-90.5°

### Inspection and Service

After cleaning, check the flatness of the cylinder head and the corresponding top surface of the crankcase, using a surface plate or piece of glass and feeler gauge. The maximum allowable out of flatness is **0.1 mm (0.0039 in.)**.

Carefully inspect the valve mechanism parts. Inspect the valve springs and related hardware for excessive wear or distortion. Check the valves and valve seat area or inserts for evidence of deep pitting, cracks, or distortion. Check clearance of the valve stems in the guides. See Figure 10-9 for valve details.

Hard starting, or loss of power accompanied by high fuel consumption may be symptoms of faulty valves. Although these symptoms could also be attributed to worn rings, remove and check the valves first. After removal, clean the valve heads, faces, and stems with a power wire brush. Then, carefully inspect each valve for defects such as warped head, excessive corrosion, or worn stem end. Replace valves found to be in bad condition. A normal valve and valves in bad condition are shown in the accompanying illustrations.



**Normal:** Even after long hours of operation a valve can be reconditioned and reused if the face and margin are in good shape. If a valve is worn to where the margin is less than 1/32 in. do not reuse it. The valve shown was in operation for almost 1000 hours under controlled test conditions.



**Bad Condition:** The valve depicted here should be replaced. Note the warped head; margin damaged and too narrow. These conditions could be attributed to excessive hours or a combination of poor operating conditions.



**Leakage:** A poor grind on face or seat of valve will allow leakage resulting in a burned valve on one side only.



**Coking:** Coking is normal on intake valves and is not harmful. If the seat is good, the valve could be reused after cleaning.

## Section 10 Inspection and Reconditioning

---



**Excessive Combustion Temperatures:** The white deposits seen here indicate very high combustion temperatures, usually due to a lean fuel mixture.



**Gum:** Gum deposits usually result from using stale gasoline. Gum is a prevalent cause of valve sticking. The cure is to ream the valve guides and clean or replace the valves, depending on their condition.



**Stem Corrosion:** Moisture in fuel or from condensation is the most common causes of valve stem corrosion. Condensation occurs from improper preservation during storage and when engine is repeatedly stopped before it has a chance to reach normal operating temperatures. Replace corroded valves.



**Overheating:** An exhaust valve subject to overheating will have a dark discoloration in the area above the valve guide. Worn guides and faulty valve springs may cause this condition. Also check for clogged air intake, and blocked fins when this condition is noted.

### Valve Guides

If a valve guide is worn beyond specifications, it will not guide the valve in a straight line. This may result in burnt valve faces or seats, loss of compression, and excessive oil consumption.

To check valve guide-to-valve stem clearance, thoroughly clean the valve guide and, using a split-ball gauge, measure the inside diameter of the guide. Then, using an outside micrometer, measure the diameter of the valve stem at several points on the stem where it moves in the valve guide. Use the largest stem diameter to calculate the clearance by subtracting the stem diameter from the guide diameter. If the intake or exhaust clearance exceeds the specifications in the **Valve Specification** table, determine whether the valve stem or guide is responsible for the excessive clearance.

If the guides are within limits but the valve stems are worn beyond limits, install new valves.

### Valve Seat Inserts

Hardened steel alloy intake and exhaust valve seat inserts are press-fitted into the cylinder head. The inserts are not replaceable but can be reconditioned if not too badly pitted or distorted. If cracked or badly warped, the cylinder head should be replaced.

Recondition the valve seat inserts following the instructions provided with the valve seat cutter being used. A typical cutter is shown in Figure 10-10. Cutting the proper valve face angle, as specified in the **Valve Specification** table and the proper valve seat angle (89.5°-90°) will achieve the desired 0° (1° full cut) interference angle where the maximum pressure occurs on the outside diameters of the valve face and seat.

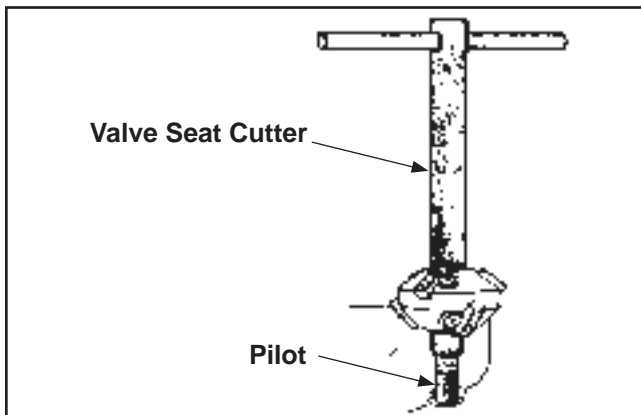


Figure 10-10. Typical Valve Seat Cutter.

### Lapping Valves

Reground or new valves must be lapped in, to provide fit. Use a hand valve grinder with suction cup for final lapping. Lightly coat valve face with fine grade of grinding compound, then rotate valve on seat with grinder. Continue grinding until smooth surface is obtained on seat and on valve face. Thoroughly clean cylinder head in soap and hot water to remove all traces of grinding compound. After drying cylinder head, apply a light coating of SAE 10 oil to prevent rusting.

### Valve Stem Seals

These engines use valve stem seals on the intake and exhaust valves. See Figure 10-11.

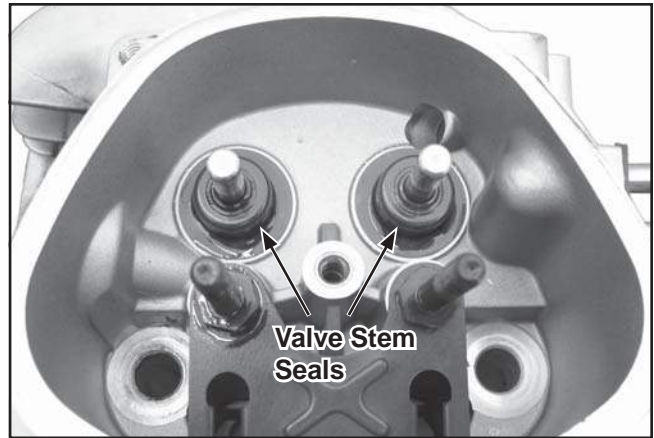


Figure 10-11. Valve Stem Seals.

Always use new seals when the valves are removed from the cylinder head. The seals should also be replaced if deteriorated or damaged in any way. Never reuse old seals.

### Pistons and Rings

#### Inspection

Scuffing and scoring of pistons and cylinder walls occurs when internal engine temperatures approach the welding point of the piston. Temperatures high enough to do this are created by friction, which is usually attributed to improper lubrication and/or overheating of the engine.

Normally, very little wear takes place in the piston boss-piston pin area. If the original piston and connecting rod can be reused after new rings are installed, the original pin can also be reused but new piston pin retainers are required. The piston pin is included as part of the piston assembly – if the pin boss in the piston or the pin are worn or damaged, a new piston assembly is required.

Ring failure is usually indicated by excessive oil consumption and blue exhaust smoke. When rings fail, oil is allowed to enter the combustion chamber where it is burned along with the fuel. High oil consumption can also occur when the piston ring end gap is incorrect because the ring cannot properly conform to the cylinder wall under this condition. Oil control is also lost when ring gaps are not staggered during installation.

When cylinder temperatures get too high, lacquer and varnish collect on pistons causing rings to stick, which results in rapid wear. A worn ring usually takes on a shiny or bright appearance.

## Section 10

### Inspection and Reconditioning

---

Scratches on rings and pistons are caused by abrasive material such as carbon, dirt, or pieces of hard metal. Detonation damage occurs when a portion of the fuel charge ignites spontaneously from heat and pressure shortly after ignition. This creates two flame fronts, which meet and explode to create extreme hammering pressures on a specific area of the piston. Detonation generally occurs from using low octane fuels.

Pre-ignition, or ignition of the fuel charge before the timed spark can cause damage similar to detonation. Pre-ignition damage is often more severe than detonation damage. Pre-ignition is caused by a hot spot in the combustion chamber such as glowing carbon deposits, blocked cooling fins, an improperly seated valve, or wrong spark plug(s).

See Figure 10-12 for some common types of piston and ring damage.



Figure 10-12. Common Types of Piston Damage.



Replacement pistons are available in STD bore size, and 0.25 mm (0.010 in.) oversize. Replacement pistons include new piston ring sets and new piston pins.

Replacement ring sets are also available separately for STD, and 0.25 mm (0.010 in.) oversize pistons. Always use new piston rings when installing pistons. Never use old rings.

Some important points to remember when servicing piston rings:

1. The cylinder bore must be de-glazed before service ring sets are used.
2. If the cylinder bore does not need re-boring and if the old piston is within wear limits and free of score or scuff marks, the old piston may be reused.
3. Remove the old rings and clean up the grooves. **Never reuse old rings.**
4. Before installing the new rings on the piston, place the top two rings, each in turn, in its running area in the cylinder bore and check the end gap. See Figure 10-13. Compare the ring gap to the measurements in Section 1, **Specifications and Tolerances**.

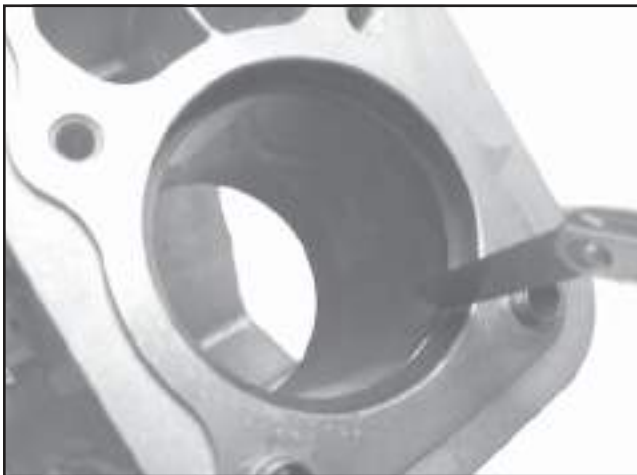


Figure 10-13. Measuring Piston Ring End Gap.

5. After installing the new compression (top and middle) rings on the piston, check the piston-to-ring side clearance. Compare the clearance to specifications listed in Section 1, **Specifications and Tolerances**. If the side clearance is greater than specified, a new piston **must** be used. See Figure 10-14.



Figure 10-14. Measuring Piston Ring Side Clearance.

### Install New Piston Rings

To install new piston rings, proceed as follows:

NOTE: Rings must be installed correctly. Install the bottom (oil control) ring first and the top compression ring last. See Figure 10-15.

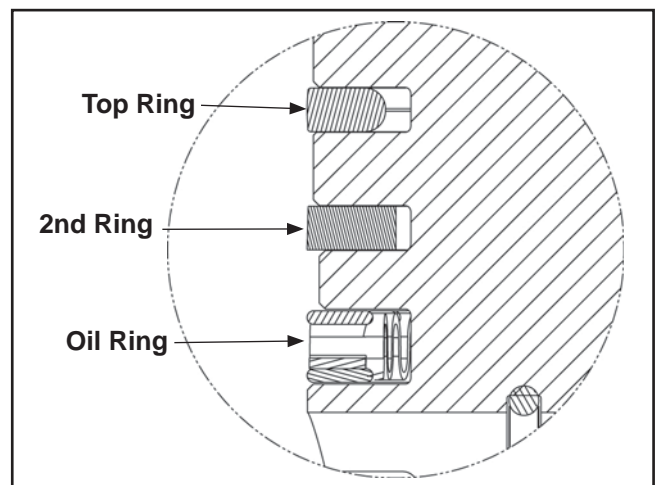


Figure 10-15. Piston Ring Positions.

Use a piston ring expander to install rings. See Figure 10-16.

## Section 10

### Inspection and Reconditioning

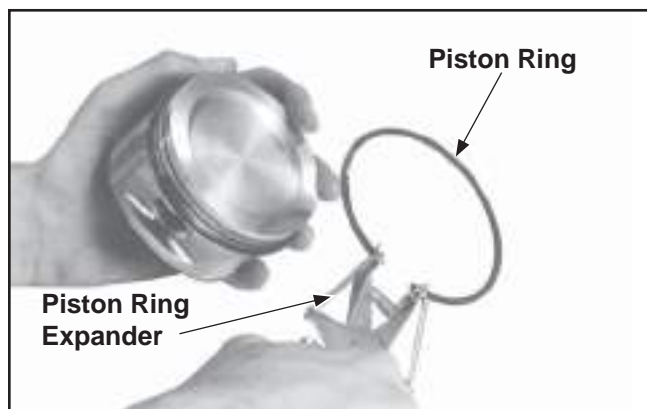


Figure 10-16. Piston Ring Expander.

1. **Oil Control Ring (Bottom Groove):** Install the expander and then the rails. Make sure the ends of the expander are not overlapped. See Figure 10-17.

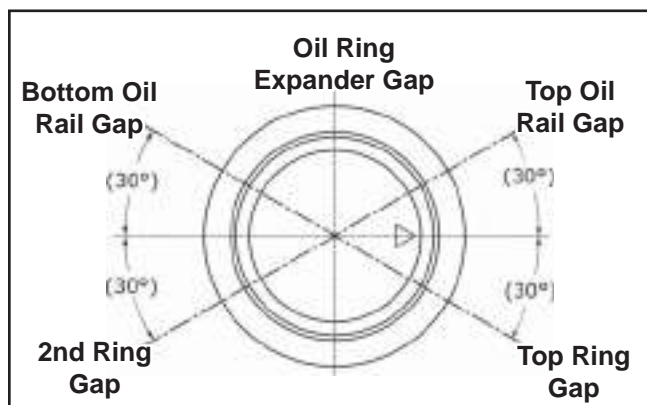


Figure 10-17. Piston Ring Orientation.

2. **Middle Compression Ring (Center Groove):** Install the center ring using a piston ring expander tool. Make sure the identification mark is up or the colored dye stripe (if contained) is to the left of the end gap. See Figure 10-17.
3. **Top Compression Ring (Top Groove):** Install the top ring using a piston ring expander tool. Make sure the identification mark is up or the colored dye stripe (if contained) is to the left of the end gap. See Figure 10-17.

### Connecting Rods

Offset, stepped-cap connecting rods are used in all these engines.

### Inspection and Service

Check the bearing area (big end) for excessive wear, score marks, running and side clearances (see Section 1, **Specifications and Tolerances**). Replace the rod and cap if scored or excessively worn.

Service replacement connecting rods are available in STD size and **0.25 mm (0.010 in.)** undersize. The **0.25 mm (0.010 in.)** undersized rods have an identification marking on the lower end of the rod shank. Always refer to the appropriate parts information to ensure that correct replacements are used.

### Closure Plate Assembly

#### Inspection

Inspect the main bearing surface for wear or damage. Refer to Section 1, **Specifications and Tolerances**. Replace the closure plate if required.

### Governor Assembly (Internal)

#### Inspection

Inspect the governor gear teeth. Replace the gear if it is worn, chipped, or if any teeth are missing. Inspect the governor weights. They should move freely in the governor gear.

### Breather Design

The breather system is designed to control the amount of oil in the head area and still maintain the necessary vacuum in the crankcase. The system includes an inner chamber in the valve cover containing a mesh filter, spring steel reed, and retainer.

When the pistons move downward, crankcase gases move through a passage to the inner chamber. In turn, air is pushed past the reed to the intake system. The upward travel of the pistons closes the reed and creates a low vacuum in the lower crankcase. This separates the oil from the airflow in the mesh filter. Any oil separated through the filter drains back into the crankcase through a small hole in the inner valve cover.

# Section 11

## Reassembly

### General

NOTE: Make sure the engine is assembled using all specified torque values, tightening sequences, and clearances. Failure to observe specifications could cause severe engine wear or damage. Always use new gaskets.

### Typical Reassembly Sequence

The following sequence is suggested for complete engine reassembly. This procedure assumes that all components are new or have been reconditioned, and all component subassembly work has been completed. The sequence may vary to accommodate options or special equipment. Detailed procedures can be found in subsequent subsections.

1. Install crankcase bearings and oil seals.
2. Install governor assembly.
3. Install Oil Sentry™ system.
4. Install crankshaft.
5. Install connecting rod with piston and rings.
6. Install balance shaft.
7. Install valve tappets and camshaft.
8. Install closure plate.
9. Install stator
10. Install flywheel.
11. Install ignition module.
12. Assemble cylinder head.
13. Install cylinder head.
14. Install push rods and rocker arms.
15. Install valve cover.
16. Install fuel tank supports and shut down switch with bracket.
17. Install carburetor.
18. Install engine shrouds and air cleaner base.
19. Install electric starter and control panel
20. Install blower housing.
21. Install retractable starter.
22. Install throttle link, governor lever, governor spring and throttle lever.
23. Install Oil Sentry™ module.
24. Install fuel tank.
25. Install carburetor cover.
26. Install muffler and heat shield assembly.
27. Install air cleaner element and cover.
28. Prepare engine for operation.

29. Testing the engine.

### Install Crankcase Bearings and Oil Seals

1. Make sure there are no nicks, burrs, or damage in the bores for the bearings. The crankcase (see Figure 11-1) and closure plate (see Figure 11-2) must be clean.
2. Use an arbor press to make sure the bearings are installed straight into their respective bores, until fully seated.

NOTE: Oil the bearings liberally with engine oil when installing.

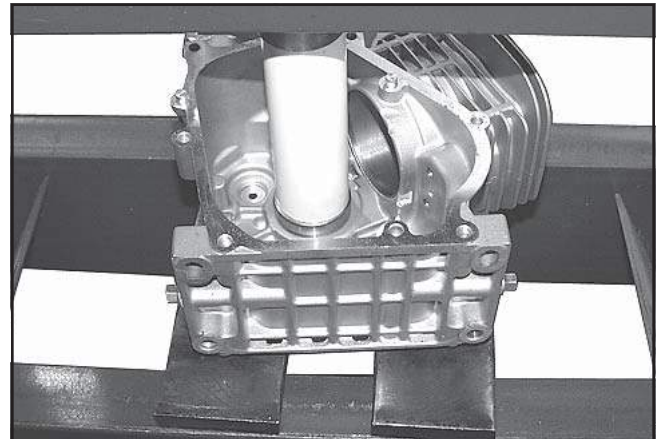


Figure 11-1. Installing Crankcase Main Bearing.

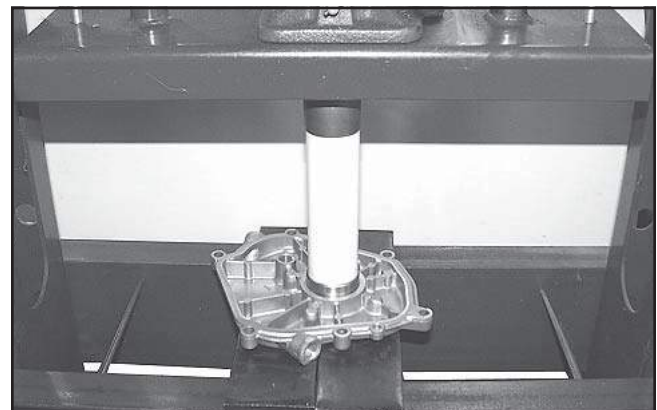


Figure 11-2. Installing Closure Plate Main Bearing.

## Section 11 Reassembly

NOTE: In steps 3 and 4 that follow, position the oil seals with the manufacturer's identification marks visible and facing you.

- Using an appropriate seal driver, install the oil seal into the closure plate to the depth specified below. See Figures 11-3 and 11-4.

Install to a depth of:  
CH270 5.5 mm (0.217 in.) from the outer surface  
CH395 7.0 mm (0.276 in.) from the outer surface  
CH440 8.2 mm (0.323 in.) from the outer surface

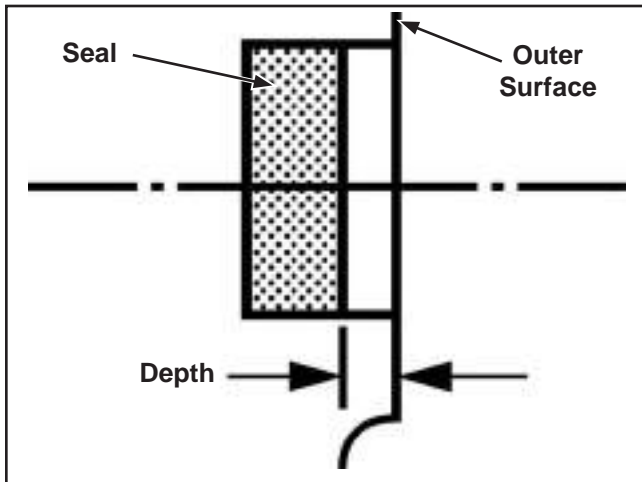


Figure 11-3. Closure Plate Oil Seal Installation Depth.



Figure 11-4. Install Closure Plate Oil Seal.

- Using an appropriate seal driver, install the oil seal into the crankcase to the depth specified below. See Figure 11-5.

Install to a depth of:  
CH270, CH440 0.0-1.0 mm (0.0-0.039 in.) from the outer surface  
CH395 2.0 mm (0.079 in.) from the outer surface

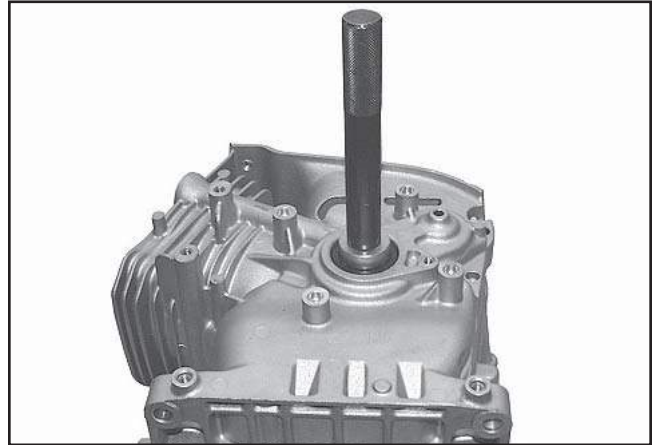


Figure 11-5. Install Crankcase Oil Seal.

- Apply a light coating of lithium grease to seal lips after installing.

### Install Governor Assembly

#### CH270

- Install the governor shaft through the gear and add the thrust washer to the shaft. See Figures 11-6 and 11-7.

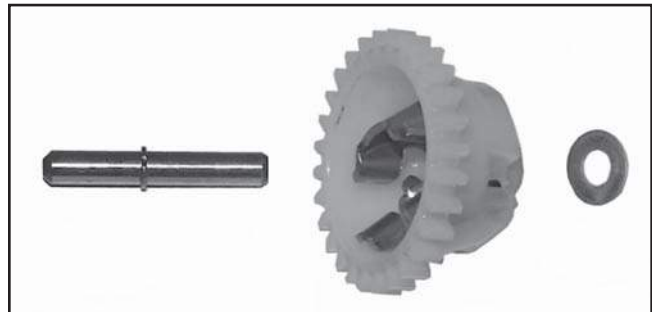


Figure 11-6. Governor Gear Assembly.

- Install governor gear assembly into the crankcase using a press, or a drift with light taps, until the tip of the shaft is 78.862 mm (3.105 in.) below the machined gasket surface of the crankcase. See Figures 11-6 and 11-7. Install the washer and cup on the shaft.

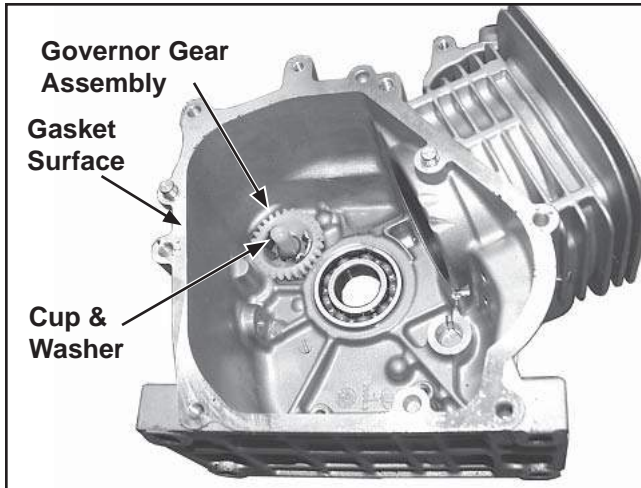


Figure 11-7. Installing Governor Gear Assembly.

3. Install one thrust washer onto the governor cross shaft and slide the shaft up through the inside of the crankcase. See Figure 11-8.

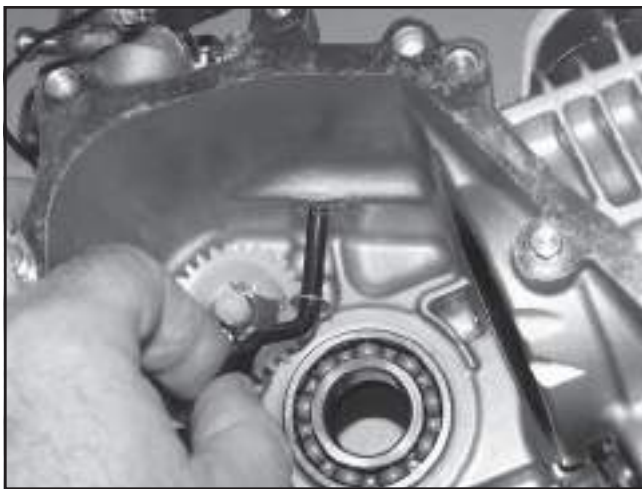


Figure 11-8. Installing Governor Shaft.

4. Install the second flat washer onto the shaft. Position the shaft so the flat index end of the shaft faces to the left (9 o'clock position) and install the hitch pin so the end of the pin comes in contact with the raised boss on the housing, limiting inward movement of the shaft. See Figure 11-9.

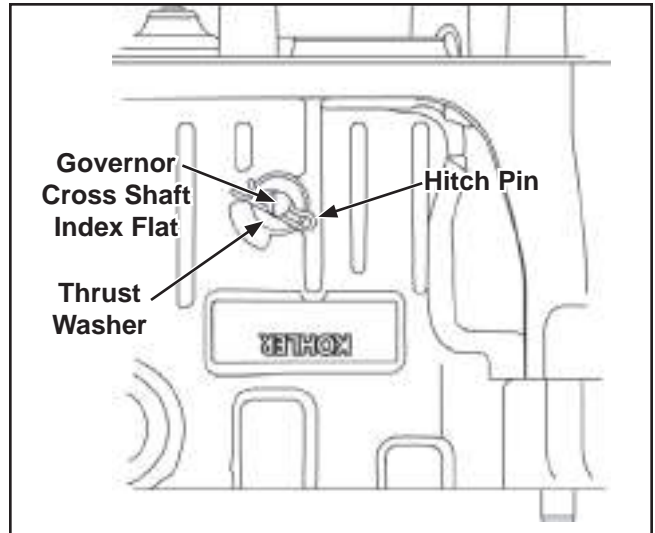


Figure 11-9. Installing Thrust Washer and Hitch Pin.

#### CH395

1. Assemble the governor gear pin into the governor gear so the pin rim is held in place by the weight retainers. See Figure 11-10.

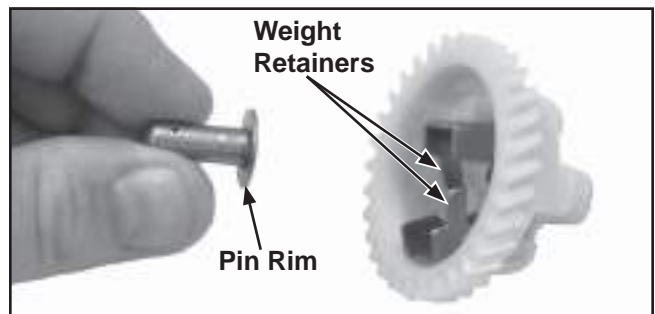


Figure 11-10. Governor Gear Assembly.

2. Place the thrust washer on the governor gear shaft in the closure plate. Push the governor gear onto the shaft. See Figure 11-11.

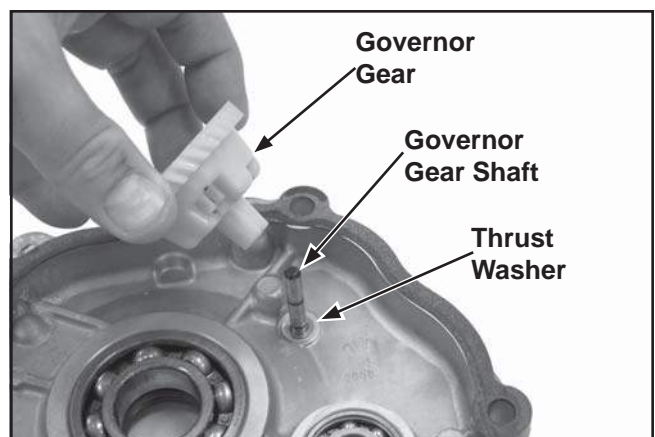


Figure 11-11. Install Governor Gear Assembly.

## Section 11 Reassembly

NOTE: The governor gear shaft is pressed into the closure plate and should not be removed.

3. Install one thrust washer onto the governor cross shaft and slide the shaft up through the inside of the crankcase. See Figure 11-12.

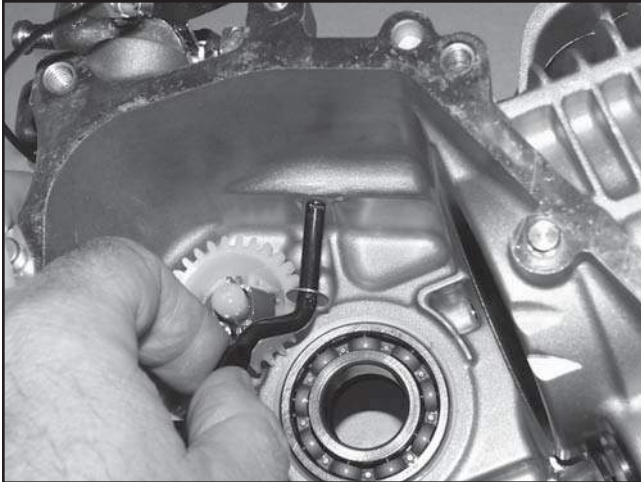


Figure 11-12. Installing Governor Shaft.

4. Install the second flat washer onto the shaft. Position the shaft so the flat index end of the shaft faces to the left (9 o'clock position) and insert the hitch pin from the PTO side. See Figure 11-13.

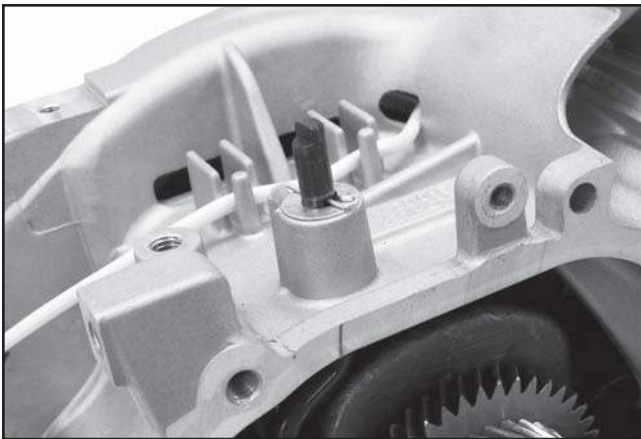


Figure 11-13. Installing Thrust Washer and Hitch Pin.

### CH440

1. If the shaft was removed in disassembly, use an arbor press to install the new shaft to a height of 16.025 mm (0.6309 in.) from the closure plate sealing surface. See Figure 11-14.

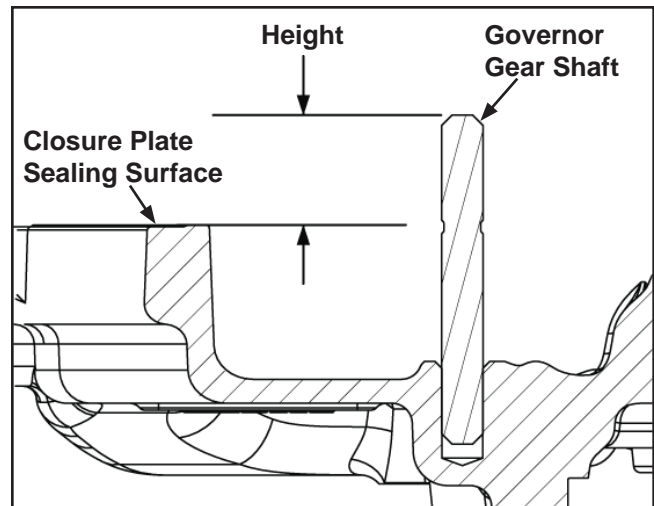


Figure 11-14. Install Governor Gear Shaft.

2. Place the washer onto the shaft, then place the governor gear onto the shaft.
3. Press a new ring onto the shaft about 1/8 in.
4. Pull the governor gear up until it makes contact with the ring, then place the pin in the cup, retaining the rim with the weights. See Figure 11-15.

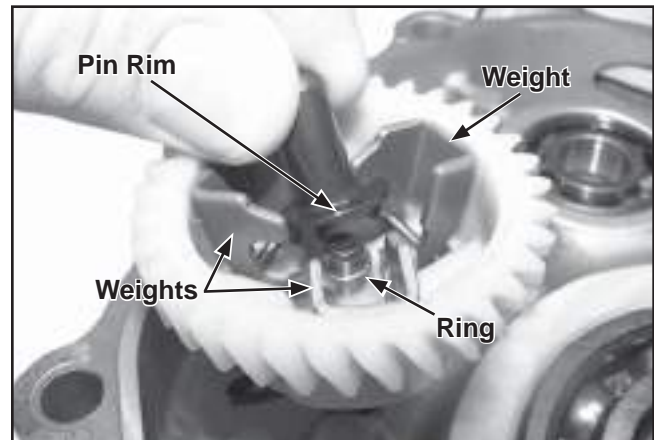


Figure 11-15. Install Governor Gear.

5. Push down on the pin, snapping the ring into the shaft groove.
6. Pull up slightly on the governor gear to ensure the assembly is installed correctly.
7. Install one thrust washer onto the governor cross shaft and slide the shaft up through the inside of the crankcase. See Figure 11-16.

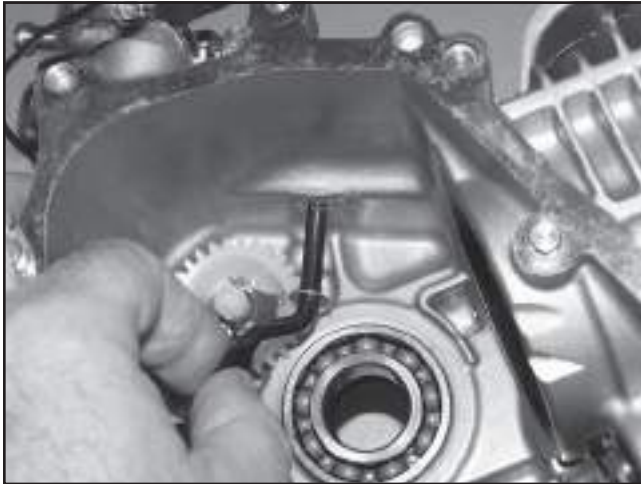


Figure 11-16. Installing Governor Shaft.

8. Install the second flat washer onto the shaft. Position the shaft so the flat index end of the shaft faces to the left (9 o'clock position) and insert the hitch pin from the PTO side. See Figure 11-17.

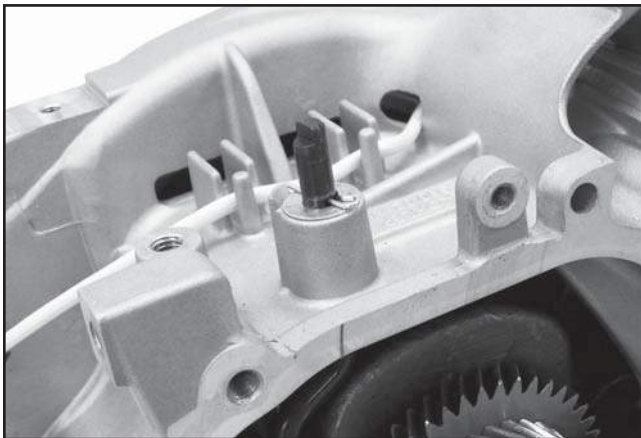


Figure 11-17. Installing Thrust Washer and Hitch Pin.

### Install Oil Sentry™ System

1. Mount the Oil Sentry™ float switch into the crankcase housing using two M6x18 hex flange screws and torque to 8 N·m (71 in. lb.). See Figure 11-18.

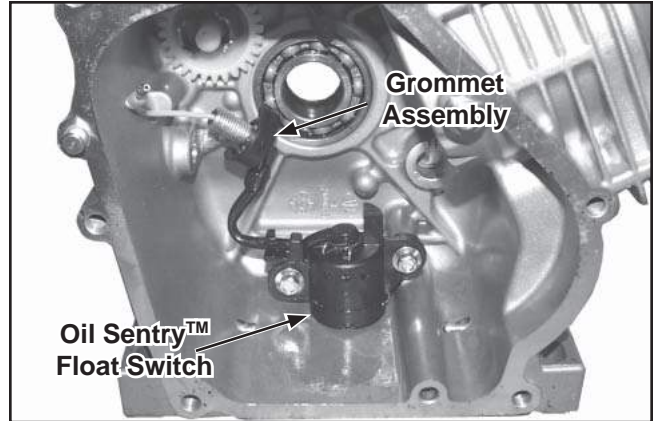


Figure 11-18. Oil Sentry™ Float Switch Mounting.

2. Route the wire lead grommet assembly through the crankshaft housing. See Figure 11-18.
3. Install the nut on the grommet assembly external stud and torque to 10 N·m (89 in. lb.). See Figure 11-19.

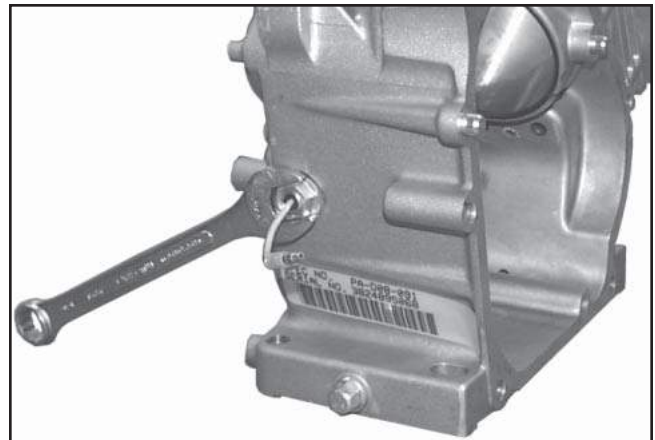


Figure 11-19. Oil Sentry™ Wire Lead Grommet Mounting.

### Install Crankshaft

1. Carefully slide the flywheel end of the crankshaft through the main ball bearing and seal. See Figure 11-20.

## Section 11 Reassembly

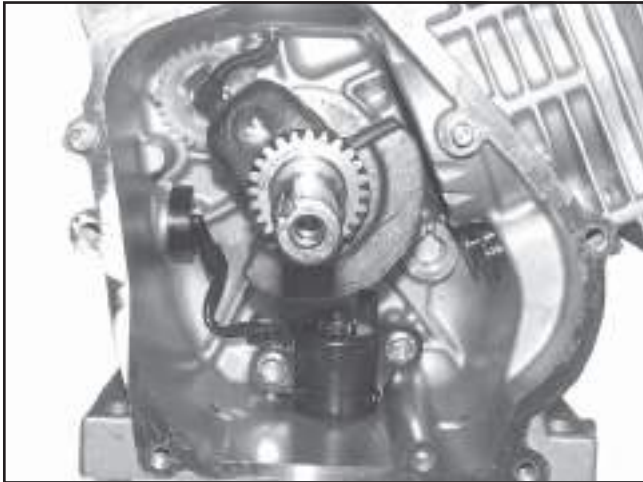


Figure 11-20. Installing Crankshaft.

### Install Connecting Rod with Piston and Rings

1. Make sure the following is correct before installing.
  - a. The locating mark on the piston is down. See Figure 11-21.

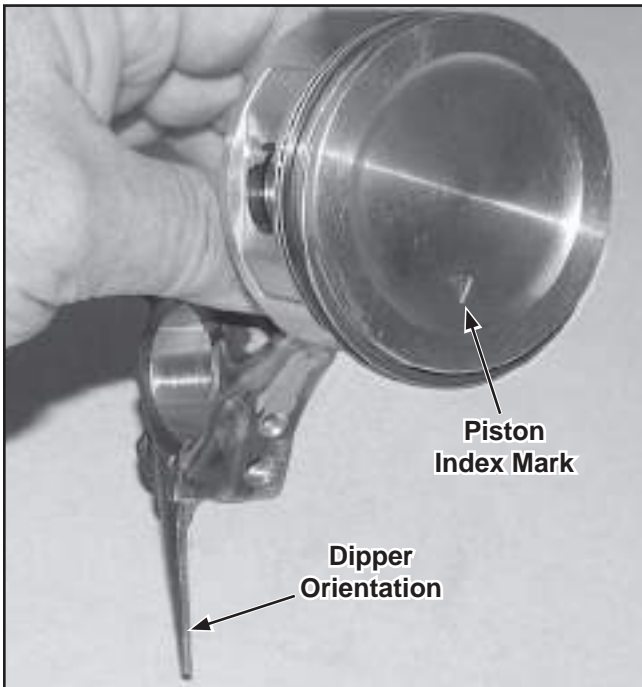


Figure 11-21. Piston/Connecting Rod Orientation.

- b. The connecting rod offset is down and oil hole is in the 4 o'clock position shown. Match marks should align as shown with dipper down. See Figure 11-22.

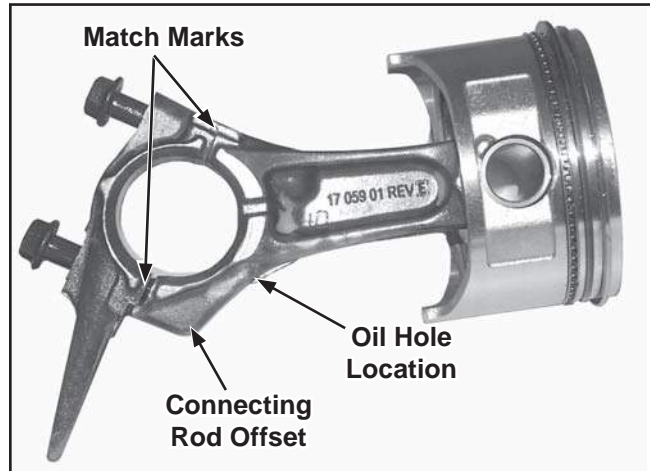


Figure 11-22. Connecting Rod Details.

2. Stagger the piston rings in the grooves as shown in Figure 11-23.

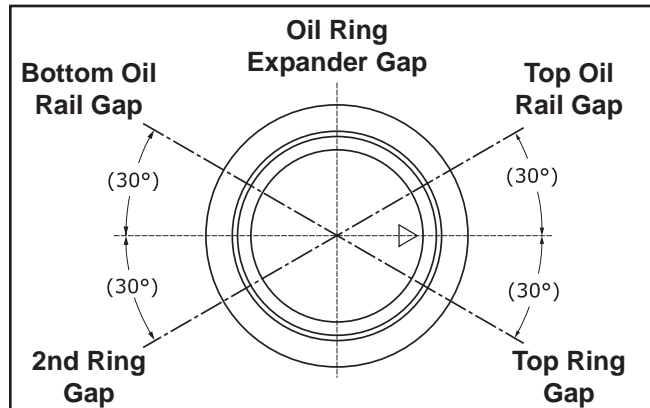
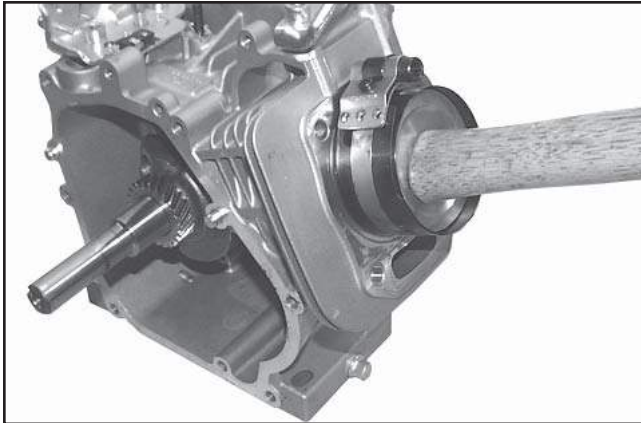


Figure 11-23. Piston Ring Orientation.

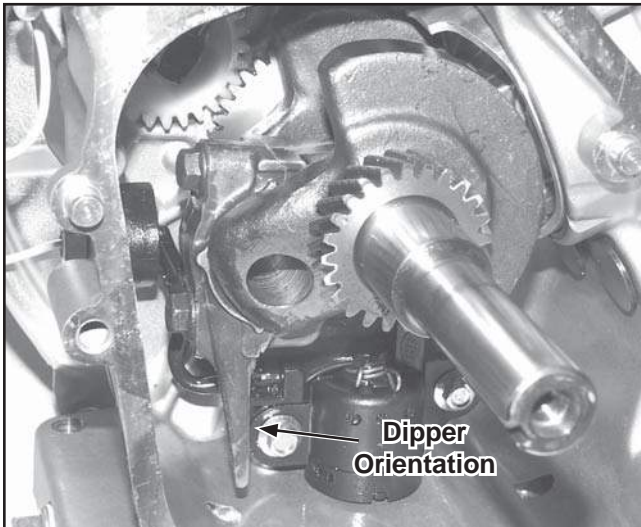
3. Lubricate cylinder bore, piston, piston pin, and piston rings with engine oil. Compress the rings using a piston ring compressor.
4. Lubricate the crankshaft journal and connecting rod bearing surfaces with engine oil.
5. Ensure "∇" stamping on piston is facing down toward the base of the engine. Use a hammer handle or rounded wood dowel and gently tap the piston into the cylinder as shown in Figure 11-24. Be careful that the oil ring rails do not spring free between the bottom of the ring compressor and the top of the cylinder.



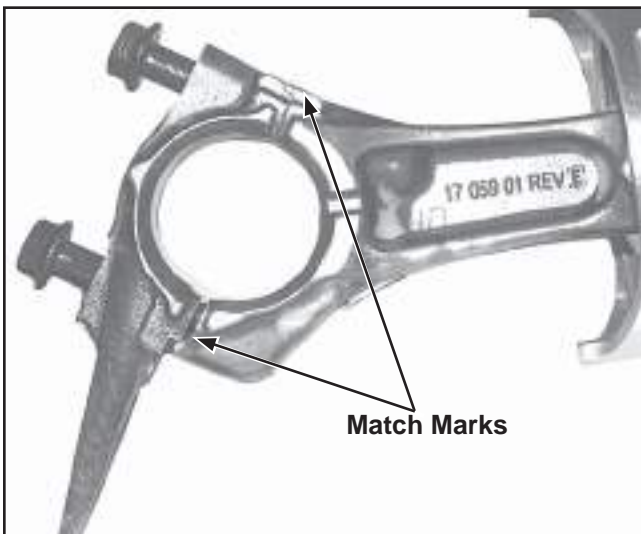


**Figure 11-24. Installing Piston Using a Ring Compressor.**

6. Install the connecting rod cap to the connecting rod so the dipper is down, and the match marks are aligned. See Figures 11-25 and 11-26.



**Figure 11-25. Rod Dipper Orientation.**



**Figure 11-26. Connecting Rod Match Marks.**

7. Torque both screws in increments to:  
CH270 12 N·m (106 in. lb.)  
CH395, CH440 20 N·m (177 in. lb.)

### Install Balance Shaft (If Equipped)

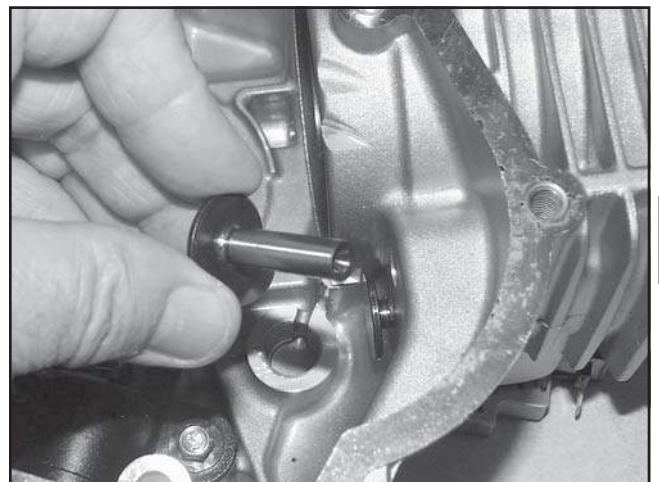
1. Position the crankshaft so the timing mark on the larger crankgear is in the 8 o'clock position.
2. Install the balance shaft, aligning the timing mark with the timing mark on the larger crankgear. See Figure 11-27.



**Figure 11-27. Aligning Timing Marks.**

### Install Valve Tappets and Camshaft

1. Lubricate the face and stem of each tappet with engine oil. Install each into their respective bores. See Figure 11-28.

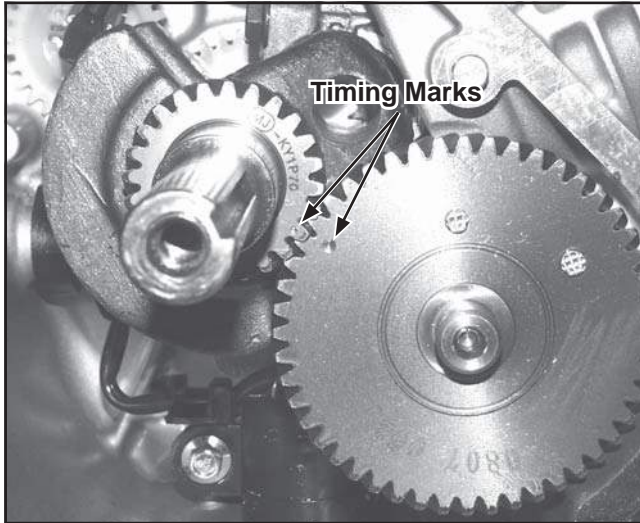


**Figure 11-28. Tappet Installation.**

2. Lubricate the camshaft bearing surfaces and cam lobes as well as the camshaft bore in the crankcase with engine oil.

## Section 11 Reassembly

3. Rotate the crankshaft to TDC so the timing mark (dimple) on the smaller crankgear is in the 4 o'clock position. Install the camshaft into the crankcase, aligning the timing marks on the two gears. See Figure 11-29.



**Figure 11-29. Aligning Crankshaft and Camshaft Timing Marks.**

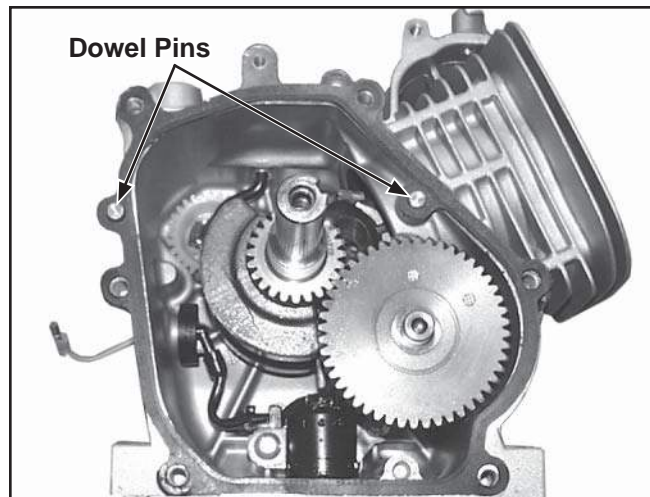
4. Install the original shims on the crankshaft and camshaft.

### Install Closure Plate

1. Check to make sure the sealing surfaces of the crankcase and closure plate are clean and free of nicks/burrs.
2. Install the two dowel pins into the locations shown in the crankcase. Install the new closure plate gasket (dry) onto the dowel pins.

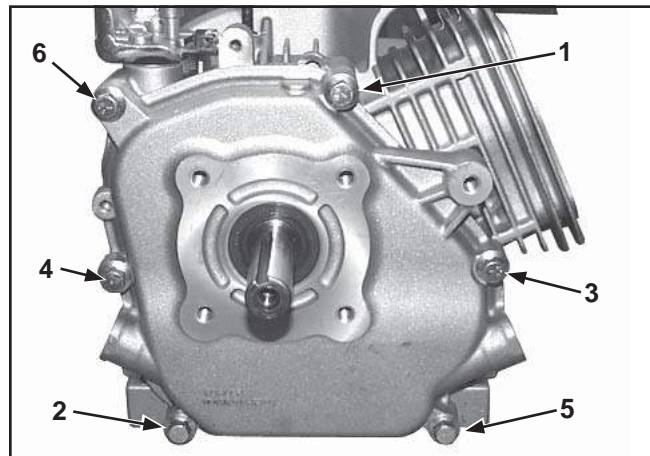
**NOTE:** Make sure the governor lever is against the cup on the governor gear assembly.

Completed assembly, before closure plate is installed, should look like Figure 11-30.



**Figure 11-30. Internal Details.**

3. Install the closure plate to the crankcase. Carefully seat the ends of the camshaft and balance shaft into their mating bearings. Rotate the crankshaft slightly to help engage the governor gear teeth.
4. Install the hex flange screws securing the closure plate to the crankcase. Torque hex flange screws to **24 N·m (212 in. lb.)**. See Figure 11-31 or 11-32 for the torque sequence.



**Figure 11-31. CH270 Closure Plate Torque Sequence.**

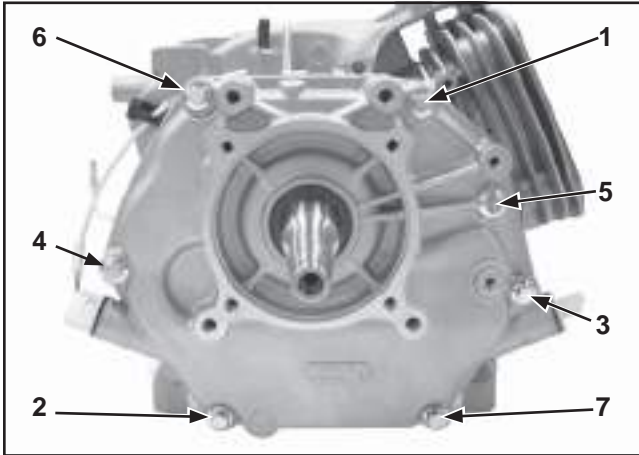


Figure 11-32. CH395, CH440 Closure Plate Torque Sequence.

### Install Stator (If Equipped)

1. Position the stator aligning the mounting holes so the leads are in the 3 o'clock position.
2. Install and torque the four hex flange screws to **10 N·m (89 in. lb.)** in the sequence of 1, 2, 3, 4 and then torque 1 again. See Figure 11-33.

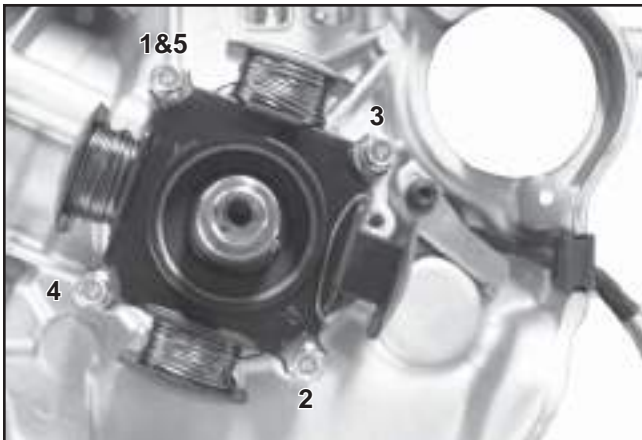


Figure 11-33. Stator Screws Torque Sequence.

3. Route the stator leads along the crankcase and out the notch on the side.
4. Position the bracket over the stator leads and install and torque the screw to **10 N·m (89 in. lb.)**. See Figure 11-34.

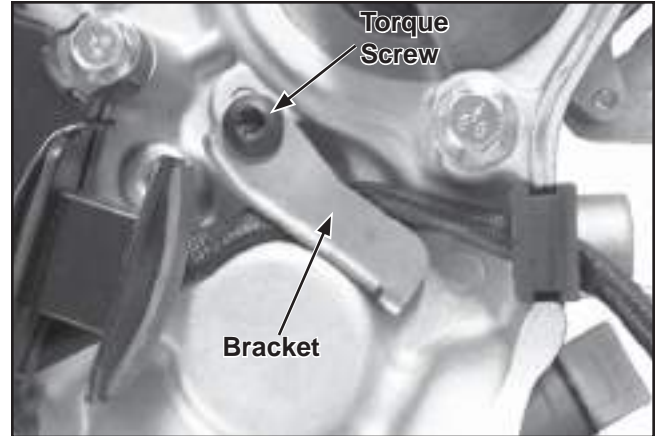


Figure 11-34. Install Bracket and Torque Screw.

### Install Flywheel

**! WARNING: Damaging Crankshaft and Flywheel Can Cause Personal Injury!**

*Using improper procedures to install the flywheel can crack or damage the crankshaft and/or flywheel. This not only causes extensive engine damage, but can also cause personal injury, since broken fragments could be thrown from the engine. Always observe and use the following precautions and procedures when installing the flywheel.*

NOTE: Before installing the flywheel make sure the crankshaft taper and flywheel hub bore are clean, dry, and completely free of lubricants. The presence of lubricants can cause over-stressing and damage when the flange nut is torqued to specification. See Figure 11-35.

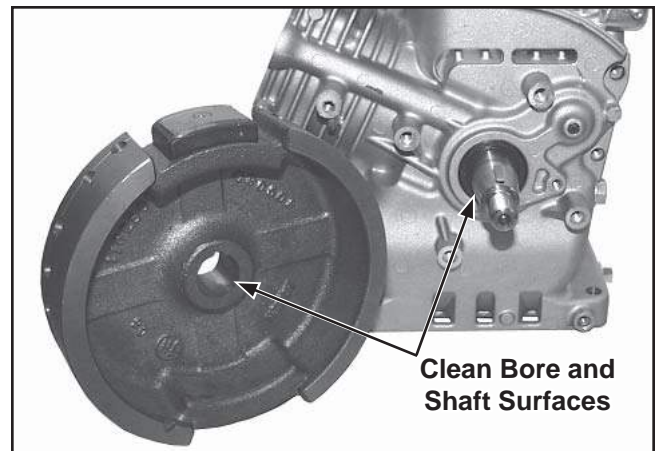
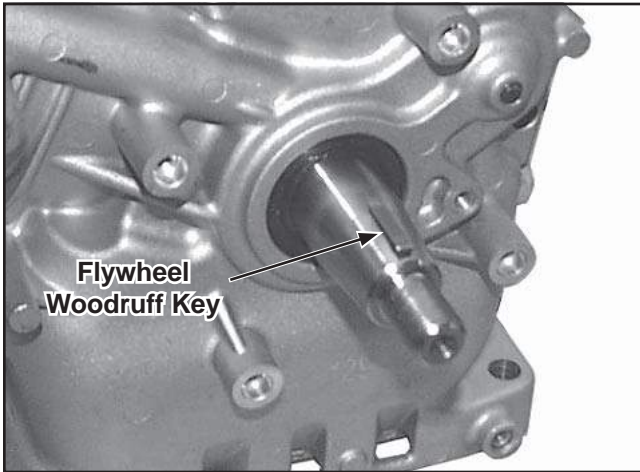


Figure 11-35. Clean and Dry Taper of Crankshaft and Flywheel Bore.

NOTE: In the following step, make sure the flywheel key is installed properly in the keyway. The flywheel can become cracked or damaged if the key is not installed properly.

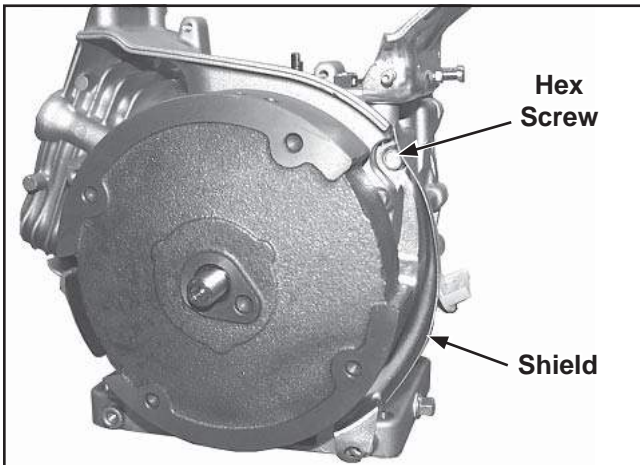
## Section 11 Reassembly

1. Install the woodruff key into the keyway of the crankshaft. Make sure that the key is properly seated and parallel with taper of shaft. See Figure 11-36.



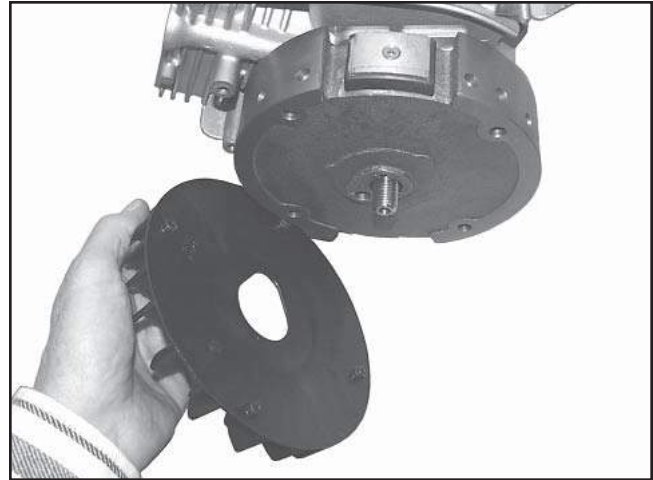
**Figure 11-36. Crankshaft Flywheel Key Position.**

2. Install the flywheel onto the crankshaft, being careful not to shift the position of the woodruff key.
3. Install flywheel shield and secure with one hex flange screw (CH270 only). See Figure 11-37.



**Figure 11-37. Install Flywheel Shield.**

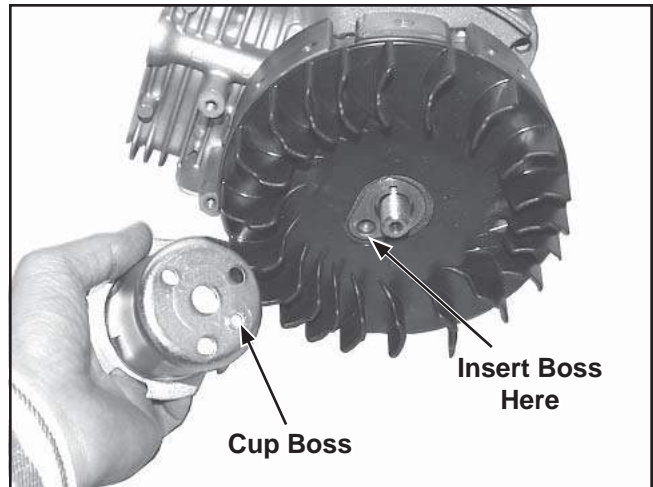
4. Install the fan bosses into the matching holes in the flywheel. See Figure 11-38.



**Figure 11-38. Install Flywheel Fan.**

5. Position the drive cup on the flywheel, engaging the boss on its base with the corresponding hole in the flywheel. Hold in position and install the hex flange nut. Finger tighten to keep cup indexed. See Figure 11-39.

NOTE: The CH395, CH440 has a boss on the fan and a hole in the drive cup.



**Figure 11-39. Install Drive Cup.**

6. Use a flywheel holding tool and torque wrench to tighten the flywheel nut. See Figure 11-40. Torque the hex flange nut to:  
CH270 74 N·m (655 in. lb.)  
CH395, CH440 113 N·m (1000 in. lb.)



Figure 11-40. Torque Flywheel Nut.

### Install Ignition Module

1. Turn the flywheel so the magnet is away from the location where the ignition module will be installed. See Figure 11-41.

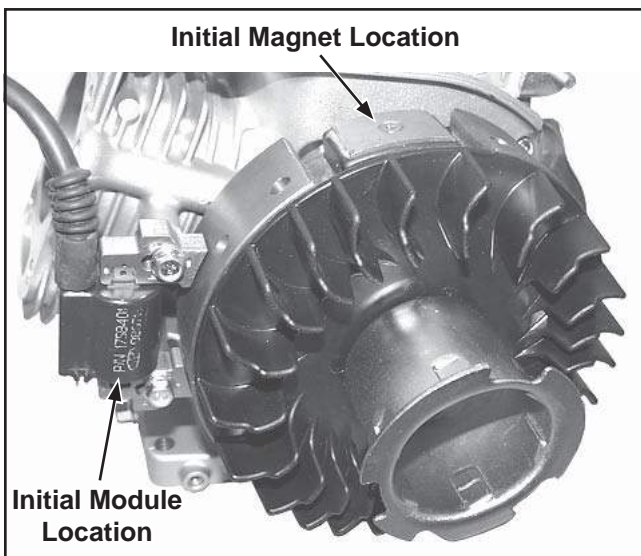


Figure 11-41. Install Ignition Module.

2. Install the ignition module loosely to the bosses with the two hex flange screws. Move the module as far away from the flywheel as possible, then tighten the screws just enough to hold it in position. See Figure 11-41.

NOTE: Ensure the ignition module is correctly oriented.

3. Rotate the flywheel until the magnet is under one leg of the ignition module. See Figure 11-42.

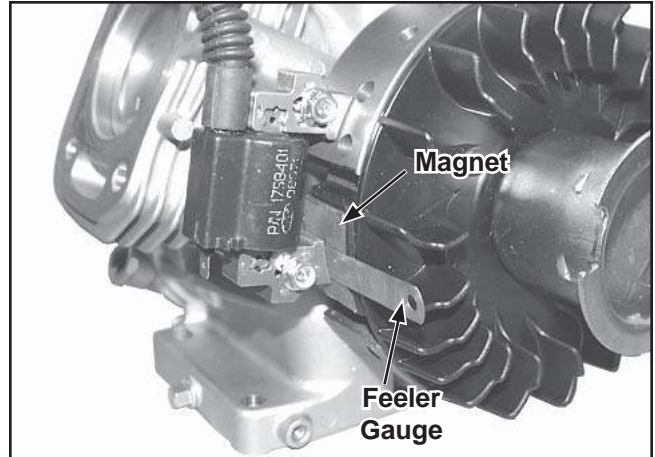


Figure 11-42. Setting Ignition Module Air Gap.

4. Insert a 0.254 mm (0.010 in.) flat feeler gauge between the leg of the module and the magnet. Loosen the nearest screw allowing the magnet to draw the module against the feeler gauge. Push against the module to hold the leg tight against the feeler gauge while tightening the screw. See Figure 11-42.
5. Rotate the flywheel until the magnet is under the other leg of the module. Loosen the nearest screw allowing the magnet to draw the module against the feeler gauge. Push against the module to hold the leg tight against the feeler gauge while tightening the screw.
6. Torque the first hex flange screw, then the second hex flange screw. Go back and torque the first hex flange screw one more time. Torque both module screws to **10 N·m (89 in. lb.)**.
7. Rotate the flywheel back and forth, checking to make sure the magnet does not strike the module.
8. Connect the kill wire to the ignition module bottom blade terminal and route the wire lead to the top of the crankcase. See Figure 11-43.

## Section 11 Reassembly

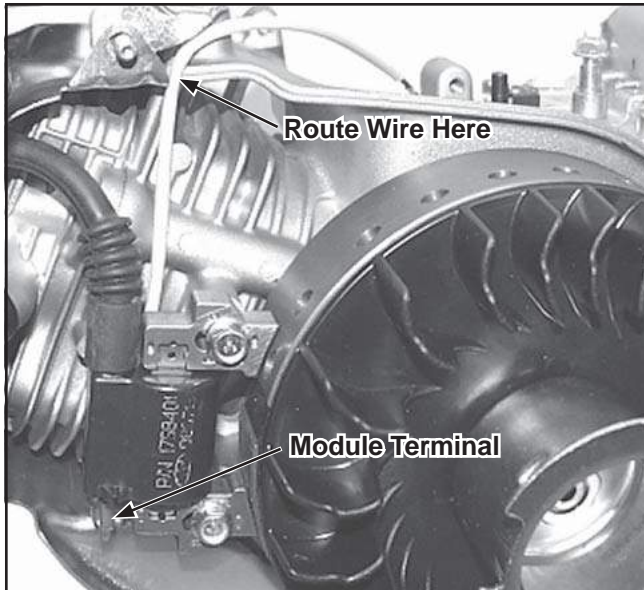


Figure 11-43. Connect Kill Wire To Module.

### Assemble Cylinder Head

1. Install the valves into their respective positions.
2. Install new valve seals on the stem of the valves. See Figure 11-44.

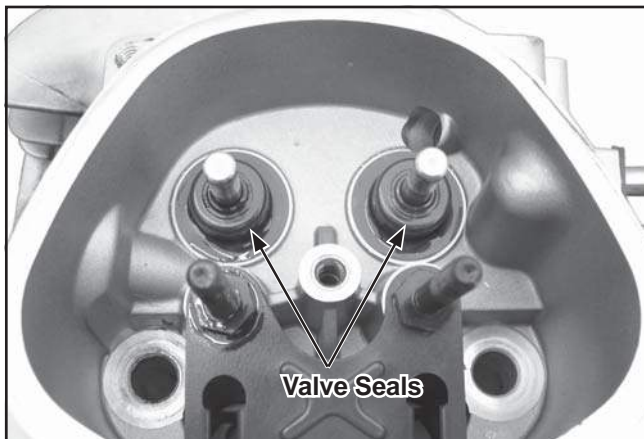


Figure 11-44. Valve Stem Seals.

NOTE: The engine utilizes valve stem seals on the valves. Always use a new seal when valves are installed in the cylinder head. Never reuse old seals.

3. Install the valve springs and retainers into their respective locations in the cylinder head. Support the valve heads from underneath. Using hand pressure, compress each valve spring and slide each retainer onto the valve stem to lock in place. See Figure 11-45.

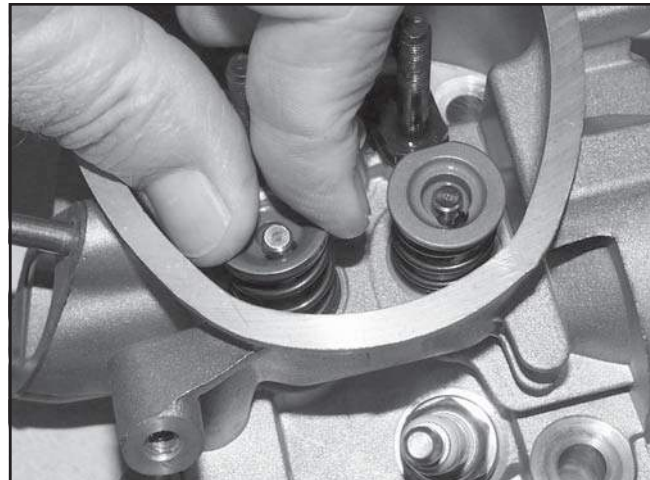


Figure 11-45. Installing Valve Retainers.

### Install Cylinder Head

1. Check to make sure there are no nicks or burrs on the sealing surfaces of the cylinder head or crankcase.
2. Rotate the crankshaft to position the piston at TDC on the compression stroke.
3. Install the dowel pins into the recesses around the lower cylinder head bolt holes. See Figure 11-46.

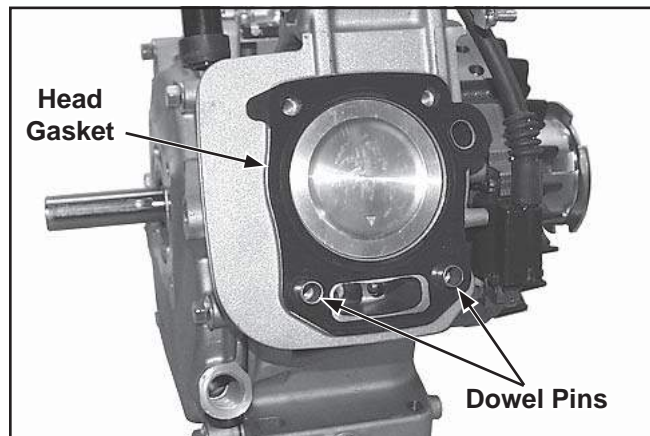


Figure 11-46. Installing Dowel Pins and New Head Gasket.

4. Install a new cylinder head gasket.
5. Install the cylinder head and start the four hex flange screws. Torque the screws in increments using the sequence shown. See Figure 11-47. Torque the hex flange screws following the table.

Model	Initial Torque	Final Torque
CH270	12 N·m (106 in. lb.)	24 N·m (212 in. lb.)
CH395, CH440	18 N·m (159 in. lb.)	36 N·m (319 in. lb.)

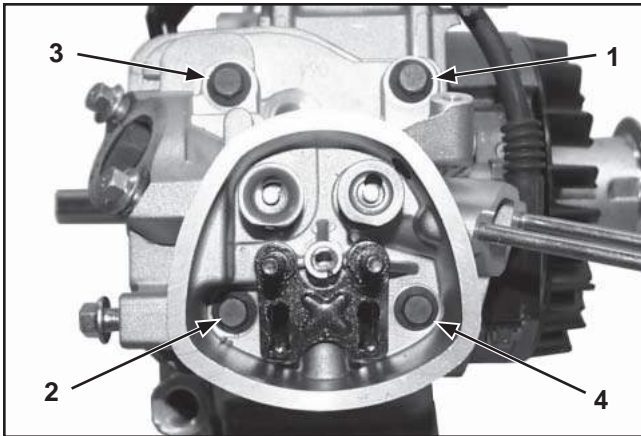


Figure 11-47. Cylinder Head Screws Torquing Sequence.

### Install Push Rods and Rocker Arms

NOTE: Push rods should always be installed in the original location.

1. Identify the proper position of each push rod. Dip the ends of the push rods in engine oil and install them in their respective locations, seating each into the tappet socket. See Figure 11-48.

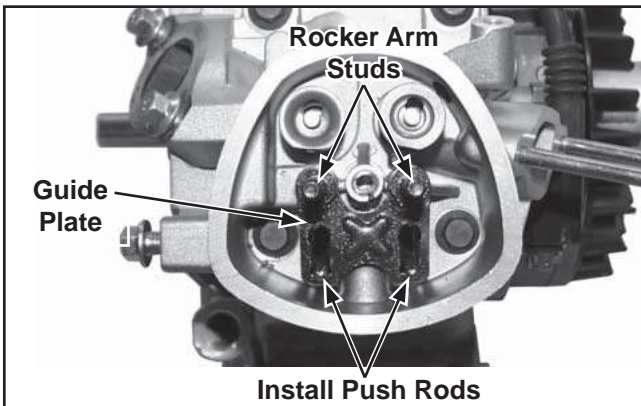


Figure 11-48. Installing Push Rods.

2. Install the push rod guide plate, aligning the holes for the rocker arm studs. Screw in the rocker arm studs and torque to 13.6 N·m (120 in. lb.).
3. Assemble the rocker arms, adjusters, and locknuts onto the studs and push rods. Finger tighten the rocker arm pivot jam locknuts. See Figure 11-49.



Figure 11-49. Installing Rocker Arms, Adjusters and Locknuts.

4. Adjust the valve tappet clearance as follows:
  - a. Make sure the piston is still at the top of the compression stroke.
  - b. Insert a flat feeler gauge between the rocker arm and the valve stem. The recommended valve to rocker arm clearance for both intake and exhaust is 0.076-0.127 mm (0.003-0.005 in.) (Cold). See Figure 11-50.

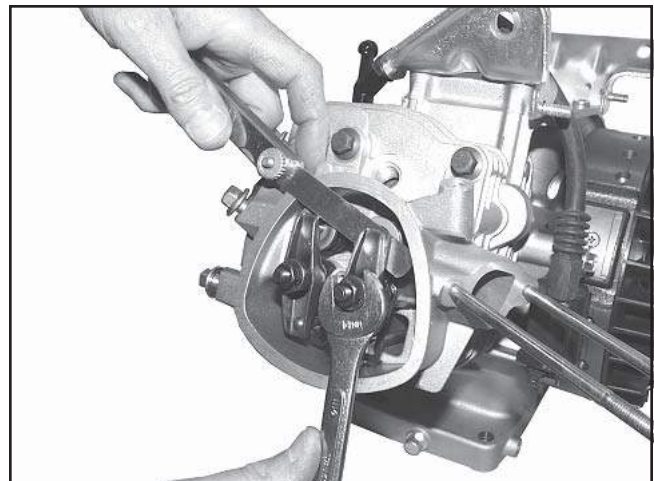


Figure 11-50. Adjusting Valve to Rocker Arm Clearance.

- c. Adjust clearance as required by loosening the locknut and turning the adjuster.

Turn **clockwise** to decrease clearance.

Turn **counterclockwise** to increase clearance.

## Section 11 Reassembly

- d. Hold the adjuster from turning and tighten the locknut. Torque locknut to **10 N·m (89 in. lb.)**. See Figure 11-51.

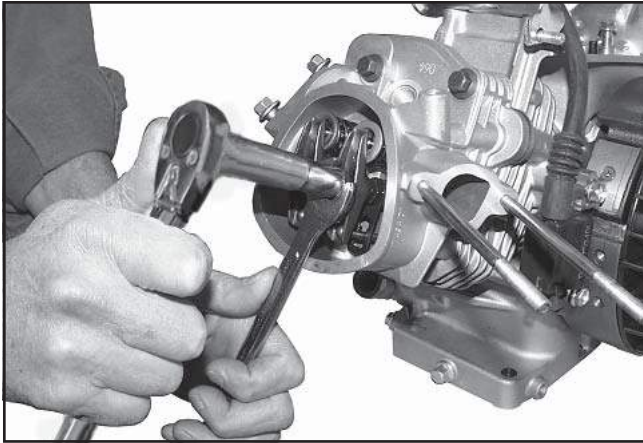


Figure 11-51. Lock Valve Tappet Adjustment.

- e. Recheck that the clearance is correct.
5. Set the gap of a new Champion® RC12YC or equivalent spark plug to **0.76 mm (0.030 in.)**.
6. Install the spark plug in the cylinder head and torque to **22-27 N·m (195-239 in. lb.)**. See Figure 11-52.

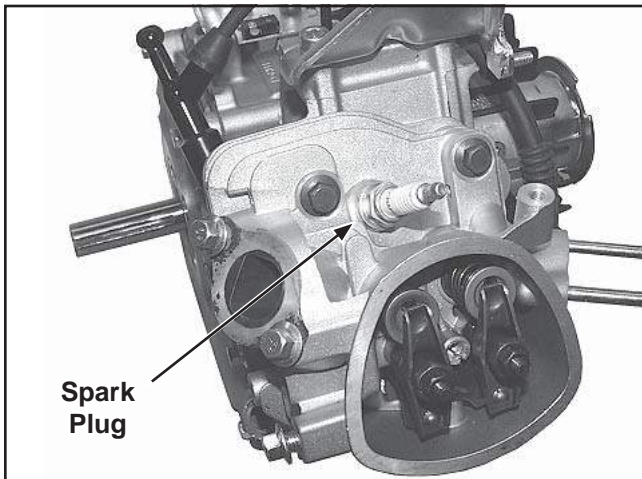


Figure 11-52. Installing and Torquing New Spark Plug.

### Install Valve Cover

1. Install a new valve cover gasket onto the valve cover.
2. Position the valve cover/gasket assembly on the head. Install the hex flange screw and torque to **10 N·m (89 in. lb.)**. See Figure 11-53.

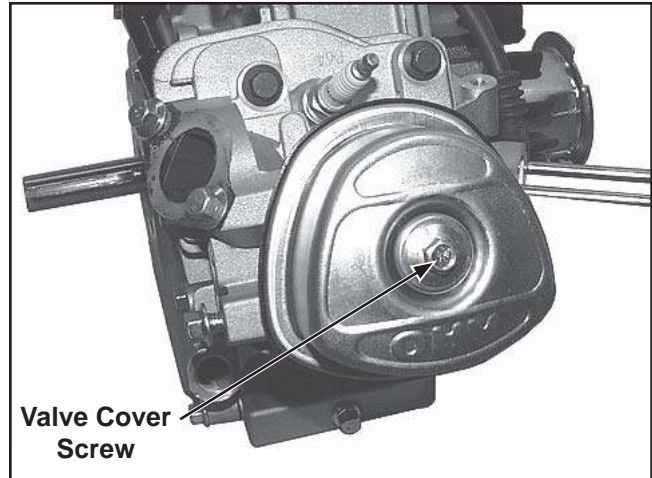


Figure 11-53. Torquing Valve Cover Screw.

### Install Fuel Tank Supports and Shut Down Switch with Bracket

#### CH270

1. Position both tank support brackets on the crankcase and loosely install with four hex head screws. See Figure 11-54.

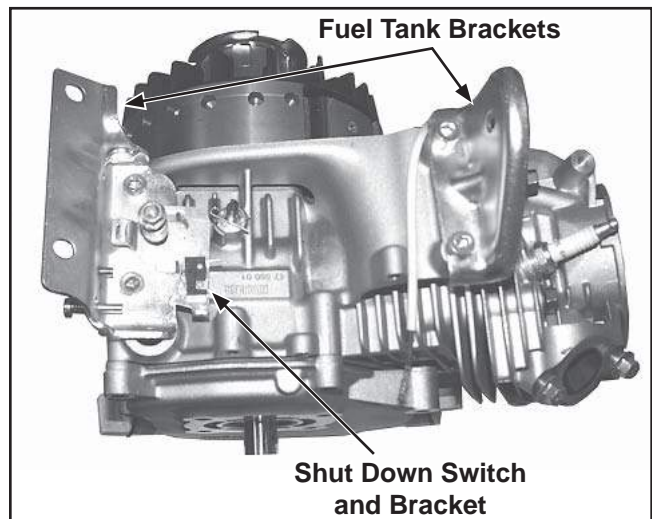


Figure 11-54. Install Fuel Tank Brackets.

2. Position the shut down switch with bracket on the tank bracket shown (see Figure 11-54) and install the threaded stud to secure.
3. Torque the tank support bracket hardware to **24 N·m (212 in. lb.)**.

#### CH395, CH440

1. Position both tank support brackets on the crankcase and install with four hex flange screws. See Figures 11-55 and 11-56. Torque to **24 N·m (212 in. lb.)**.



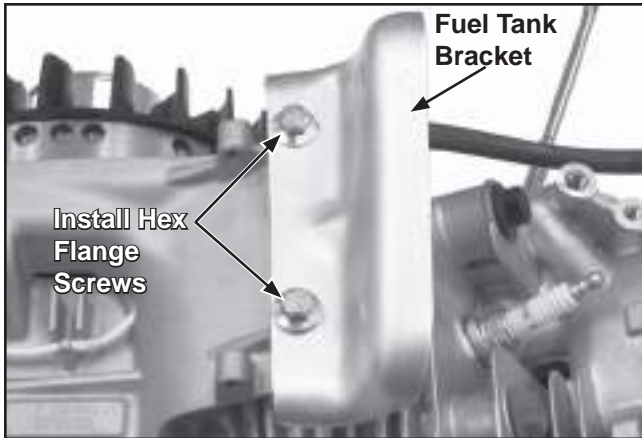


Figure 11-55. Install Fuel Tank Bracket.

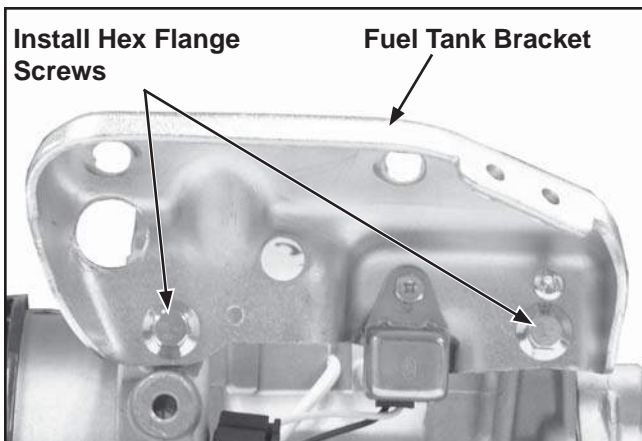


Figure 11-56. Install Fuel Tank Bracket.

NOTE: The threaded stud and bracket with shut down switch should not be removed.

## Install Carburetor

1. Install a new insulator to cylinder head gasket onto the carburetor studs, followed by the insulator and the carburetor to insulator gasket. See Figure 11-57.

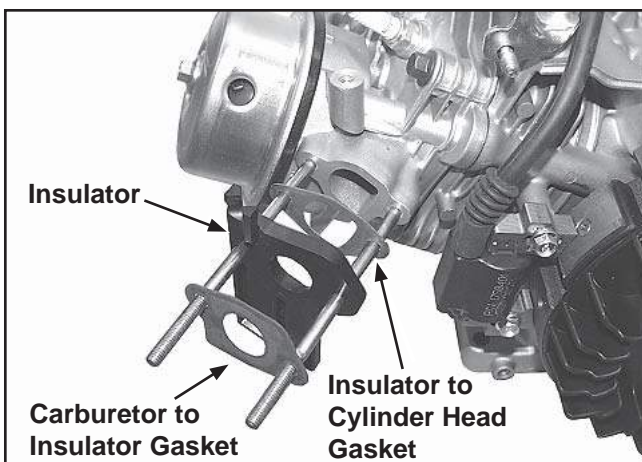


Figure 11-57. Carburetor Spacer and Gaskets.

2. Push the carburetor all the way onto the studs. See Figure 11-58.

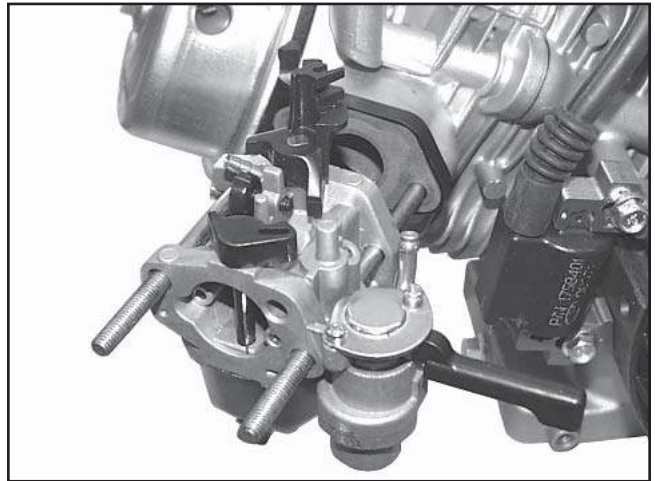


Figure 11-58. Install Carburetor.

3. Connect the throttle link and dampening spring into their respective holes in the throttle lever. See Figure 11-59.

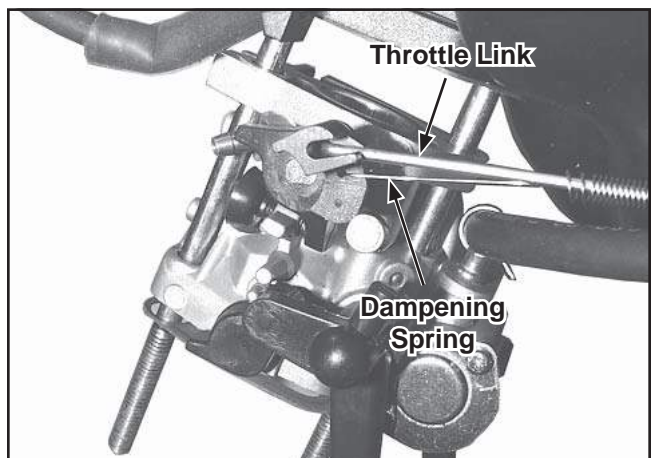


Figure 11-59. Install Carburetor Throttle Link.

## Install Engine Shields and Air Cleaner Base

### CH270

1. Install the upper shield on the cylinder, engaging the tab hole on the fuel tank bracket stud. See Figure 11-60.

## Section 11 Reassembly

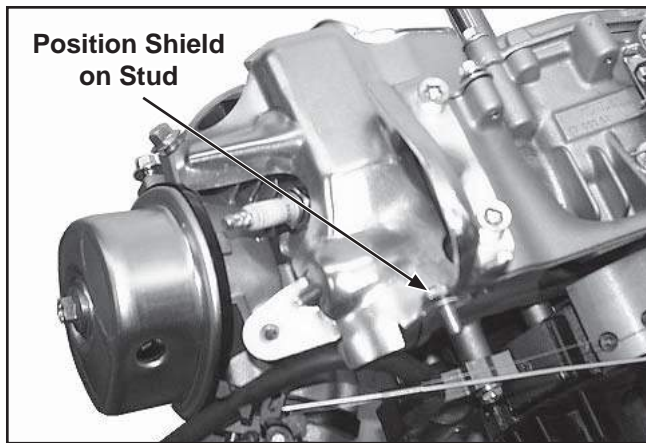


Figure 11-60. Position Upper Shield.

2. Install one hex flange screw in the rear of top air shield, but do not tighten at this time. See Figure 11-61.

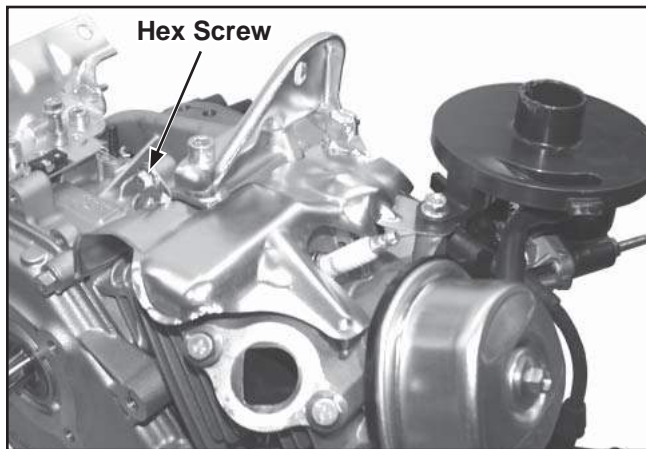


Figure 11-61. Upper Shield Hardware.

3. Install a new carburetor to air cleaner base gasket onto the carburetor mounting studs followed by the air cleaner base. Attach the breather hose onto the air cleaner base connection port. Connect the opposite end of the breather hose to the valve cover. See Figure 11-62.

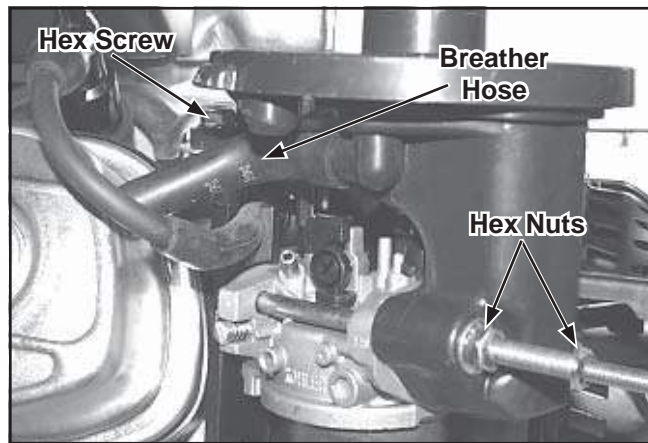


Figure 11-62. Air Cleaner Base Installation.

4. Secure the base with the two hex flange nuts on the mounting studs and one hex flange screw through the top heat shield into the crankcase housing. Torque hardware to 8 N·m (71 in. lb.). See Figure 11-62.
5. Install the lower heat shield and secure with two hex screws. See Figure 11-63.

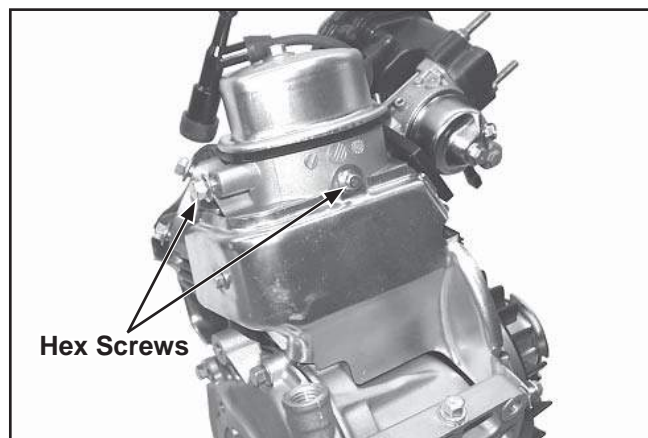


Figure 11-63. Cylinder Heat Shield Mounting Bolt Location.

### CH395, CH440

1. Install the upper shield on the cylinder and secure with two hex flange screws. Torque to 8 N·m (71 in. lb.). See Figure 11-64.

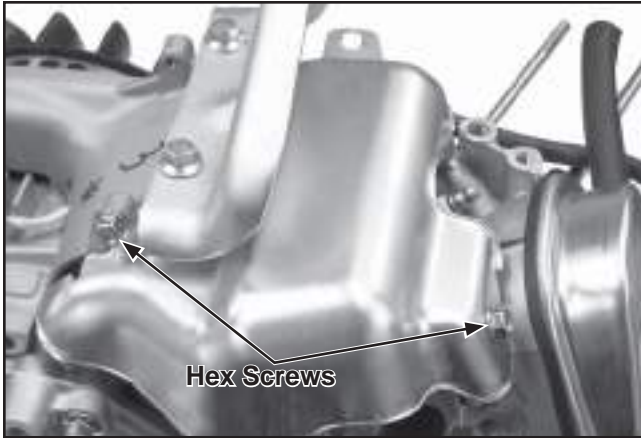


Figure 11-64. Install Upper Heat Shield.

2. Install lower shield on the cylinder and secure with two hex flange screws. Torque to 8 N·m (71 in. lb.). See Figure 11-65.

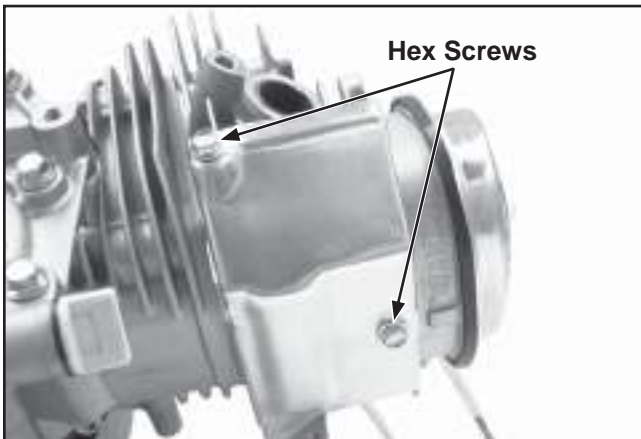


Figure 11-65. Install Lower Heat Shield.

3. Install a new carburetor to air cleaner base gasket onto the carburetor mounting studs followed by the air cleaner base. Attach the breather hose onto the air cleaner base connection port. Connect the opposite end of the breather hose to the valve cover. See Figure 11-66.
4. Secure the base with the two hex flange nuts on the mounting studs and one hex flange screw into the crankcase housing. Torque hardware to 8 N·m (71 in. lb.). See Figure 11-66.

NOTE: When securing the low-profile air cleaner, the hex flange screw is installed through the base into the blower housing. Torque to 6.7 N·m (59 in. lb.).

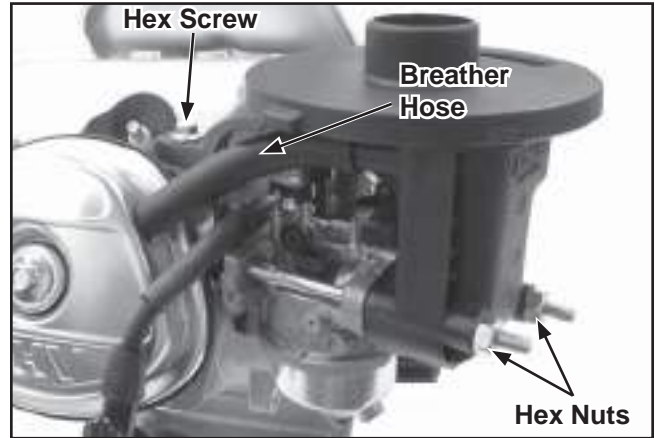


Figure 11-66. Air Cleaner Base Installation.

### Install Electric Starter and Control Panel (If Equipped)

1. Align and mount the electric starter onto the crankcase. Install and torque the two hex flange screws to 24 N·m (212 in. lb.). See Figure 11-67.

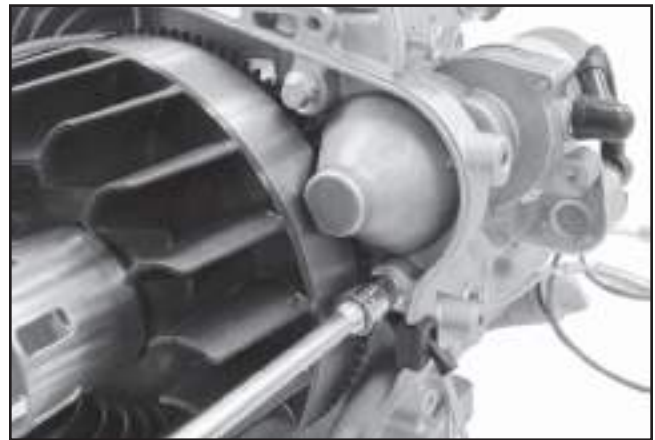


Figure 11-67. Align and Mount Starter.

2. Connect the electrical leads for the Oil Sentry™, ignition module, key switch, relay, and starter. See Figure 11-68.



Figure 11-68. Connect Electrical Leads.

## Section 11 Reassembly

3. Mount the control panel to the crankcase and secure with two hex flange screws. Ensure the ground wires are placed between the screw and the bracket. Torque the screws to  $24 \text{ N}\cdot\text{m}$  ( $212 \text{ in. lb.}$ ). See Figure 11-69.



Figure 11-69. Mount and Torque Control Panel Hex Flange Screws.

### Install Blower Housing

1. Position the spark plug lead in the molded clip in the carburetor insulator. See Figure 11-70.

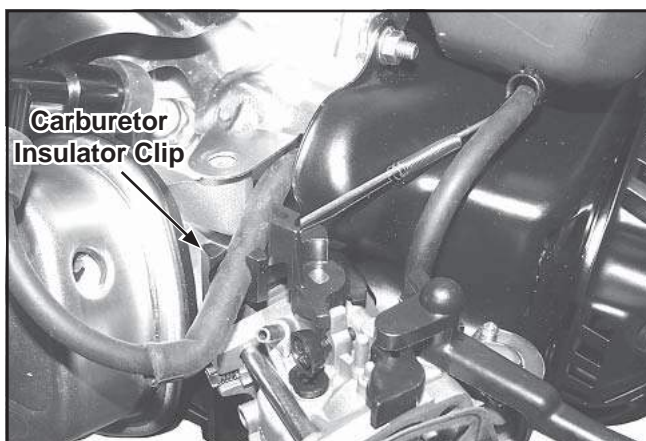


Figure 11-70. Spark Plug Wire Routing.

### CH270

2. Install the blower housing on the crankcase with two hex flange nuts and two hex flange screws. Torque nuts to  $8 \text{ N}\cdot\text{m}$  ( $71 \text{ in. lb.}$ ) and screws to  $10 \text{ N}\cdot\text{m}$  ( $89 \text{ in. lb.}$ ). See Figure 11-71.

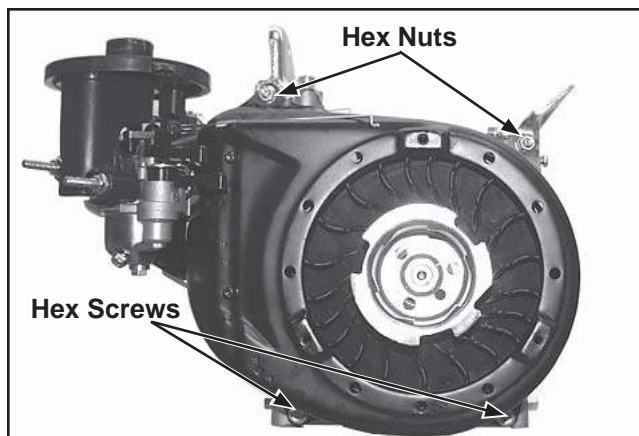


Figure 11-71. Installing Blower Housing.

### CH395, CH440

2. Install the blower housing on the crankcase with the hex flange screws. Torque screws to  $10 \text{ N}\cdot\text{m}$  ( $89 \text{ in. lb.}$ ). See Figure 11-72.

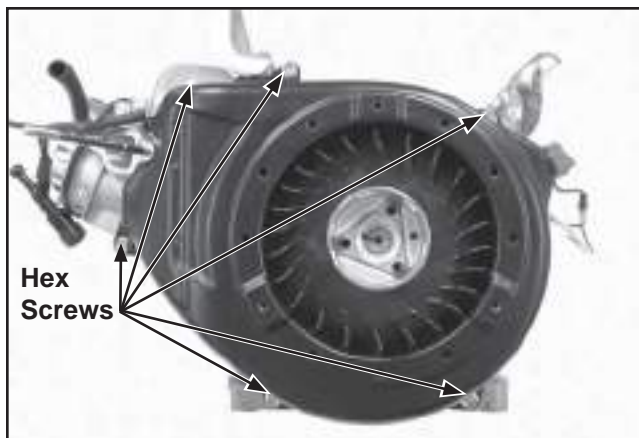


Figure 11-72. Install Blower Housing.

### Install Retractable Starter

1. Install the retractable starter on the blower housing using three hex flange screws. Finger tighten the mounting screws only. See Figure 11-73.

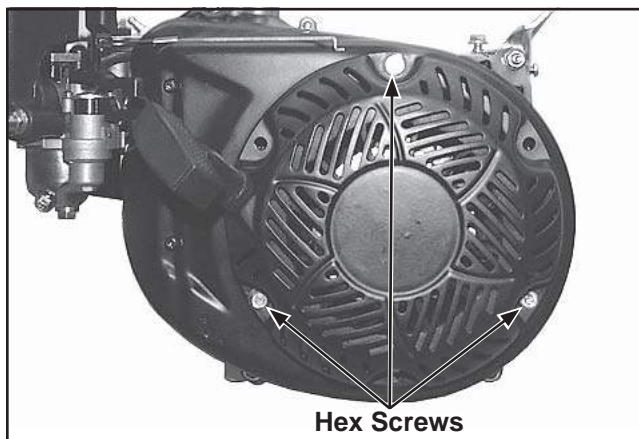


Figure 11-73. Install Retractable Starter.

2. Pull the rope handle to engage the pawls and center the starter to the drive cup. Hold in this position and torque the mounting screws to 5.4 N·m (48 in. lb.).

## Install Throttle Link, Governor Lever, Governor Spring, and Throttle Lever

1. Connect the throttle linkage and dampening spring to the arm of the governor lever as shown. See Figure 11-74.

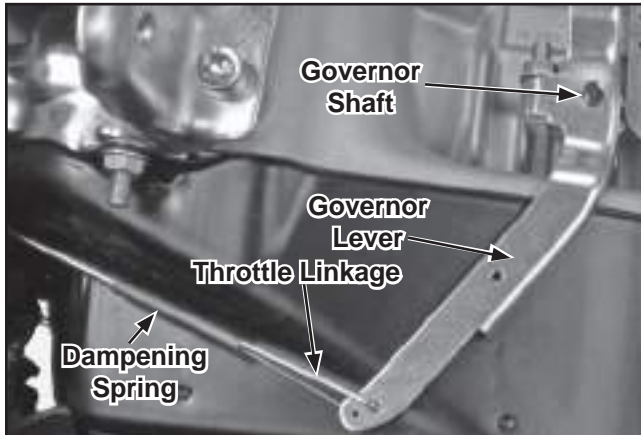


Figure 11-74. Governor Lever Installation.

2. Install the governor lever onto the shaft. Assemble the screw and locknut, but do not tighten. See Figure 11-75.

### CH270

3. Push the governor lever in the direction indicated in Figure 11-75 and hold against the stop. Turn the governor shaft clockwise until it stops. Tighten the hex flange nut on the governor lever clamp bolt to lock the lever on the shaft. Torque the nut to 12 N·m (106 in. lb.).

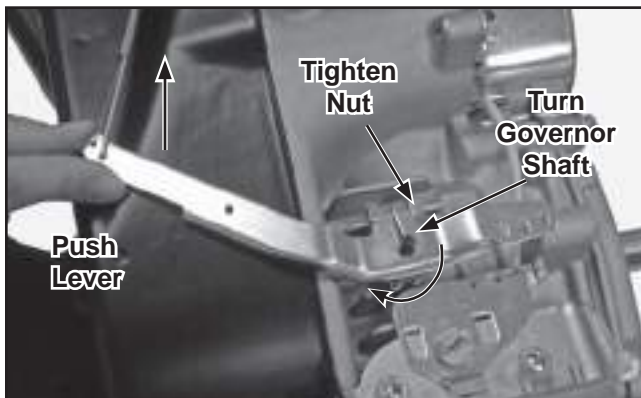


Figure 11-75. Governor Lever Adjustment.

### CH395, CH440

3. Push the governor lever in the direction indicated in Figure 11-76 and hold in this position. Turn the governor shaft counterclockwise until it stops. Tighten the hex flange nut on the governor lever clamp bolt to lock the lever on the shaft. Torque the nut to 12 N·m (106 in. lb.).

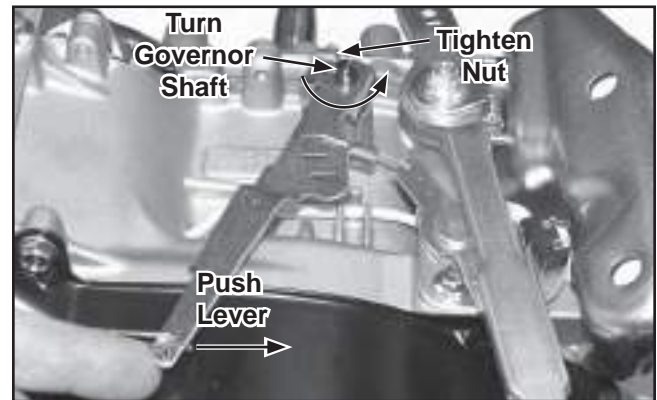


Figure 11-76. Governor Lever Adjustment.

4. Install the spring on the governor and throttle levers in the holes previously marked in disassembly. Install the throttle lever and a fender washer on the threaded stud of the fuel tank bracket. See Figures 11-77 and 11-78.

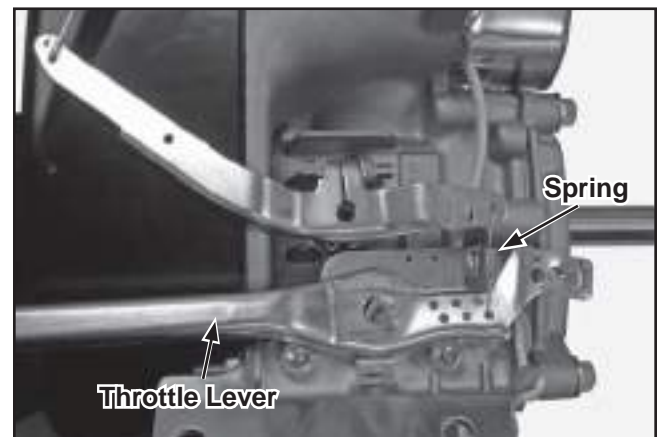


Figure 11-77. Install Throttle Lever for CH270.

# Section 11 Reassembly

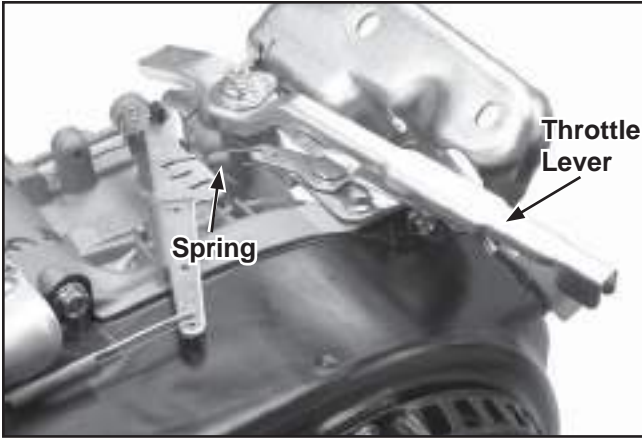


Figure 11-78. Install Throttle Lever for CH395, CH440.

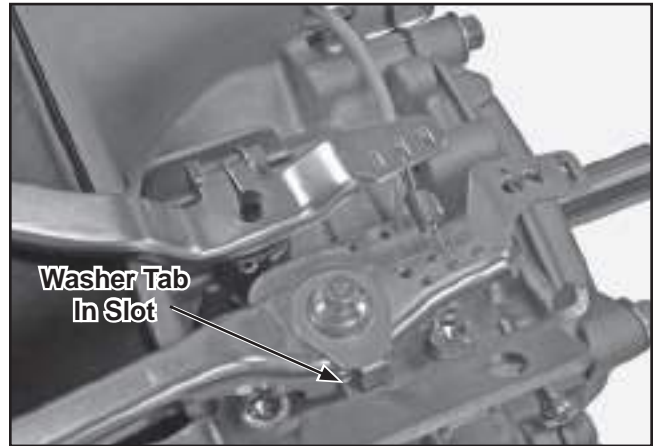
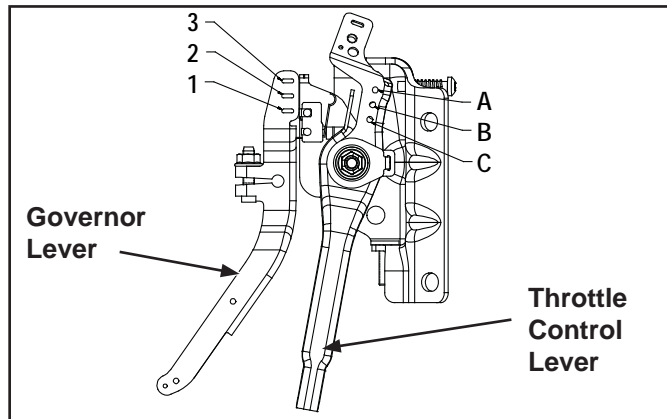


Figure 11-79. Throttle Lever Hardware.

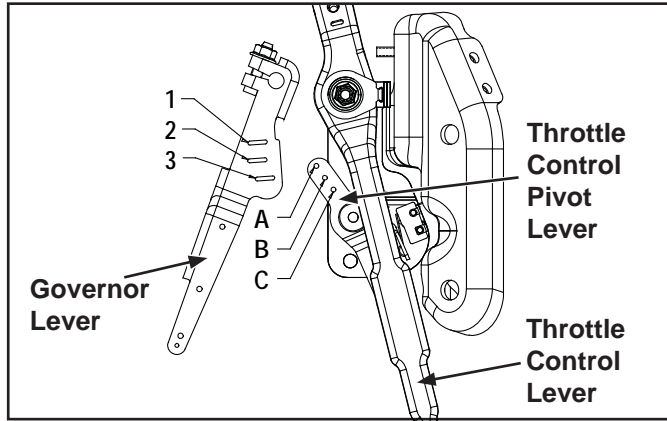
5. Install a nylon washer, wave spring, and tabbed washer (with tab engaged in slot) on the stud above the throttle lever and secure with a hex flange nut. Torque the hex flange nut to **9 N·m (80 in. lb.)**. See Figure 11-79.

## Governor Lever and Hole Position/RPM Chart



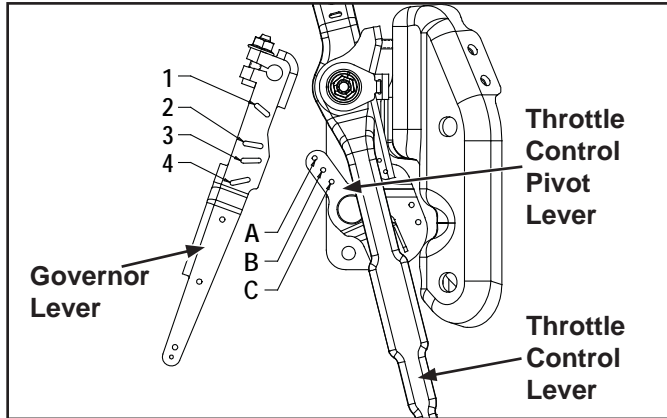
### CH270 Engines

Engine Speed RPM	8-12% Droop		5-8% Droop	
	Spring Color	Hole Combination	Spring Color	Hole Combination
3801-4000	Red	#3-A		
3601-3800	Red	#3-A	Yellow	#2-A
3401-3600	Red	#2-A		
3201-3400	Yellow	#2-A		
3001-3200	Yellow	#1-A	Black	#1-B
2801-3001	Yellow	#1-B		



CH395 Engines

Engine Speed RPM	7-12% Droop		3-8% Droop	
	Spring Color	Hole Combination	Spring Color	Hole Combination
3801-4000	Yellow	#2-B		
3601-3800	Yellow	#2-B	Purple	#1-A
3401-3600	Yellow	#2-B		
3201-3400	Yellow	#1-B		
3001-3200	Yellow	#1-B	Black	#1-B
2801-3001	Yellow	#1-B		



CH440 Engines

Engine Speed RPM	6-12% Droop		3-6% Droop	
	Spring Color	Hole Combination	Spring Color	Hole Combination
3801-4000	None	#2-B		
3601-3800	None	#2-B	White	#2-A
3401-3600	None	#2-B		
3201-3400	White	#3-A		
3001-3200	White	#3-A	Green	#1-B
2801-3001	White	#3-A		

## Section 11 Reassembly

### Install Oil Sentry™ Module

NOTE: If the Oil Sentry™ module is mounted inside the control panel, skip this step.

1. Install the Oil Sentry™ module and secure with one hex screw. See Figure 11-80. Torque the screw to 3.5 N·m (31 in. lb.).

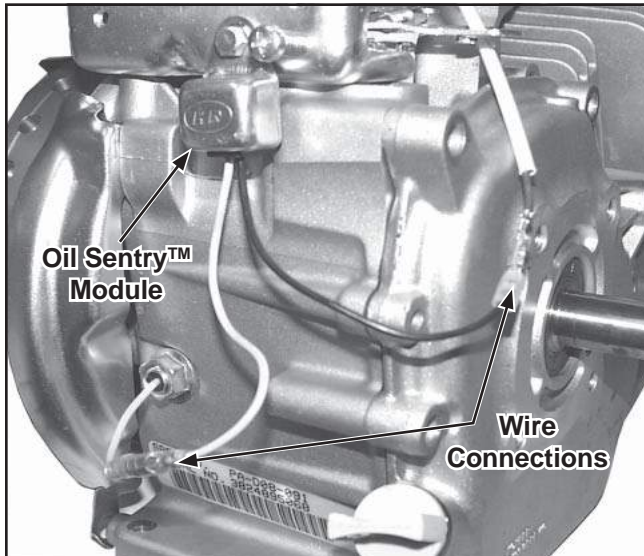


Figure 11-80. Reconnect Electrical Leads.

2. Connect the electrical leads for the Oil Sentry™ module. See Figure 11-80.

### Install Fuel Tank

1. Position the fuel tank on the mounting brackets. Secure with hex screws on the inner mounting bracket and on the PTO side strap. See Figure 11-81.

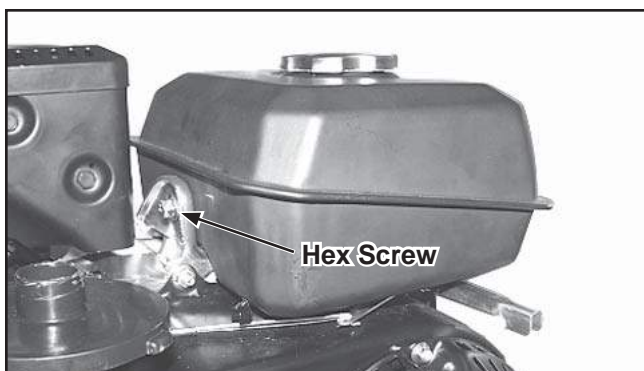


Figure 11-81. Installing Fuel Tank.

2. Install two hex flange nuts on the fuel tank studs. See Figure 11-82.

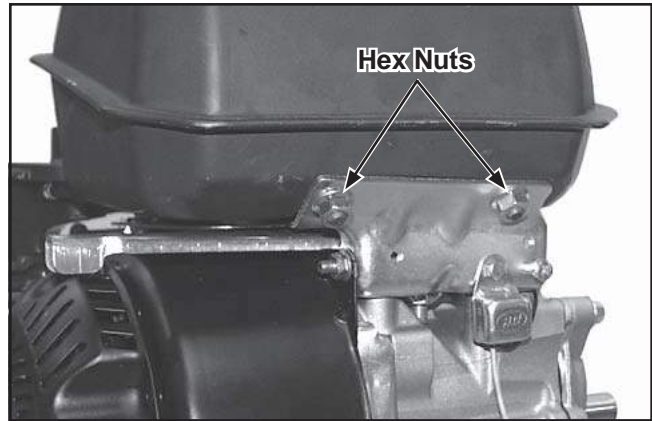


Figure 11-82. Installing Fuel Tank Hardware.

3. Torque the side strap screw to 10 N·m (89 in. lb.). See Figure 11-83.

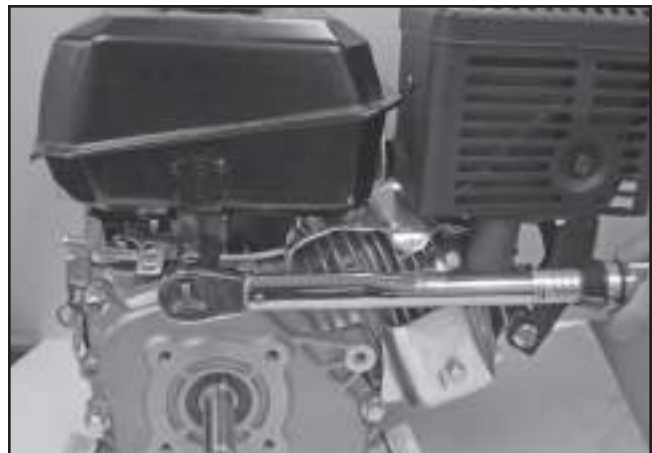


Figure 11-83. Torque Side Strap Screw.

4. Torque the remaining screw and nuts to 24 N·m (212 in. lb.).
5. Position the fuel line in the clip on the bottom of the tank. Connect the fuel line to the shut-off valve on the carburetor and secure with the clamp. See Figure 11-84.



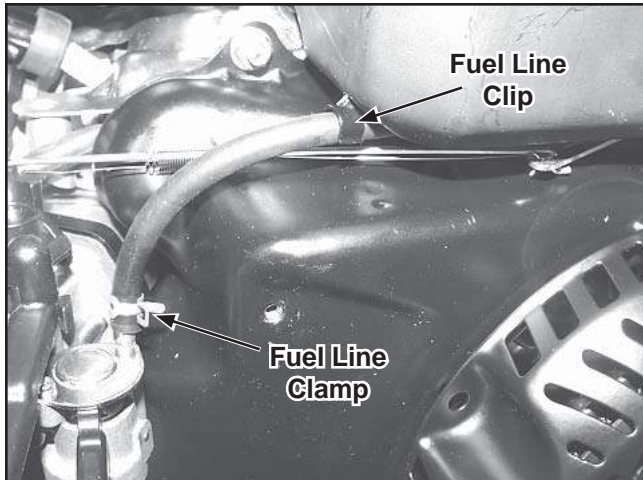


Figure 11-84. Connecting Fuel Line.

### Install Carburetor Cover (If Equipped)

1. Install the outer air cleaner cover onto the studs, over the carburetor. Secure with two hex nuts and two screws. Torque the nuts to 4 N·m (35 in. lb.) and the screws to 1.3 N·m (12 in. lb.) See Figure 11-85.

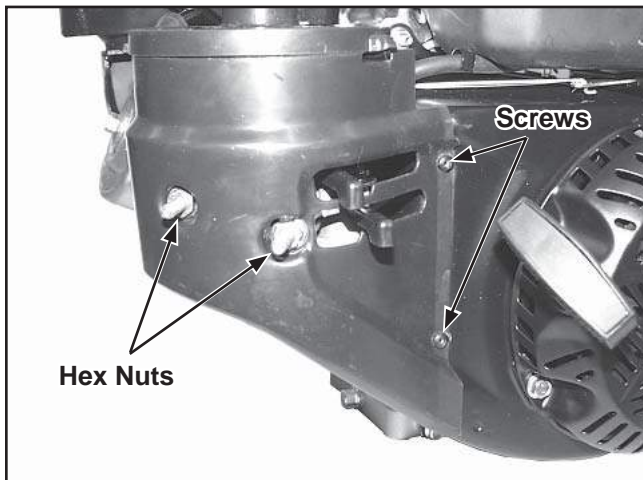


Figure 11-85. Installing Carburetor Cover.

### Install Muffler and Heat Shield Assembly

1. Install a new exhaust gasket onto the exhaust studs.
2. Position the muffler and heat shield assembly and install one hex flange screw in the support bracket and two hex flange screws in the exhaust outlet flange. See Figures 11-86, 11-87, and 11-88.
3. Torque three hex flange screws to:  
CH270 24 N·m (212 in. lb.)  
CH395, CH440 35 N·m (310 in. lb.)



Figure 11-86. Install CH270 Muffler/Heat Shield Assembly.



Figure 11-87. Install CH395, CH440 Muffler/Heat Shield Assembly.

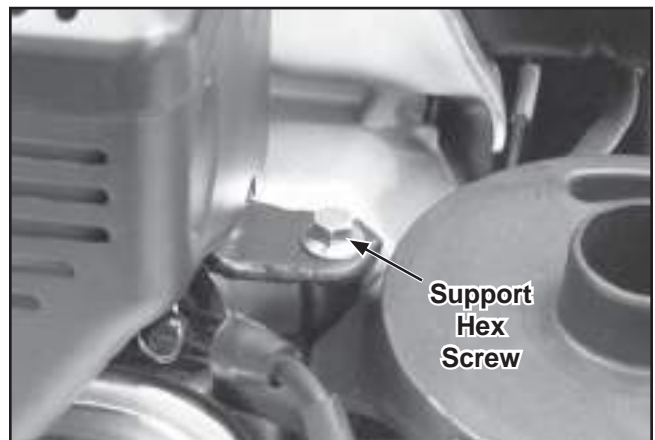


Figure 11-88. Install CH395, CH440 Muffler/Heat Shield Support Hex Flange Screw.

## Section 11 Reassembly

### Install Air Cleaner Element and Cover

#### Install the Quad-Clean™ Air Cleaner

1. Place the air cleaner element with precleaner onto the boss on the air cleaner base. See Figure 11-89.

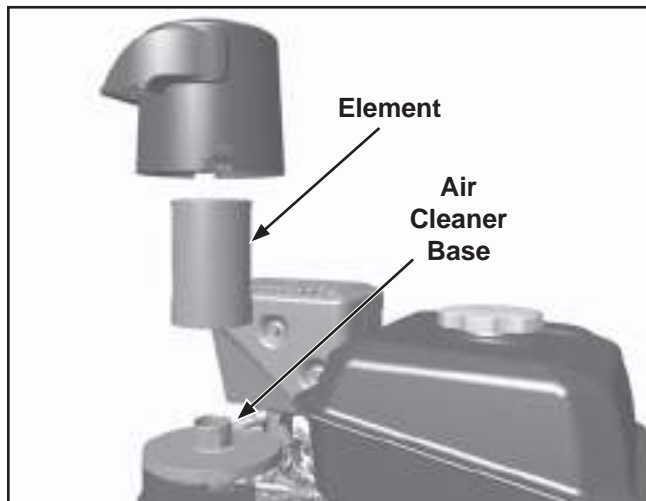


Figure 11-89. Installing Air Cleaner Element.

2. Position the air cleaner cover as required for seasonal operation and engage both cover clips to secure it to the base. See Figure 11-90.



Figure 11-90. Install Air Cleaner Cover.

#### Install the Low-Profile Air Cleaner

1. Place the foam element in the air cleaner base. See Figure 11-91.

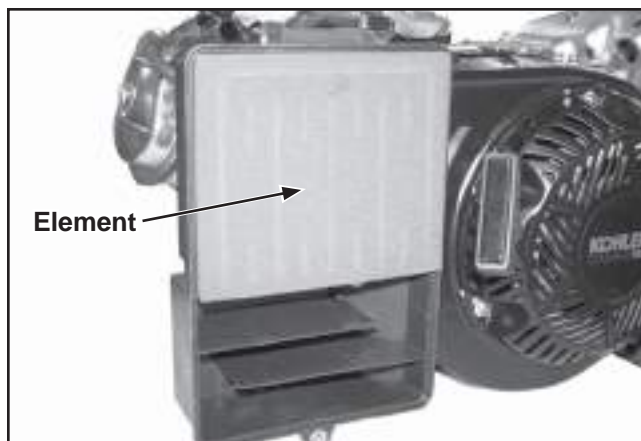


Figure 11-91. Install Foam Element.

2. Position the air cleaner cover onto the base and secure with the hex screw.

#### Prepare the Engine for Operation

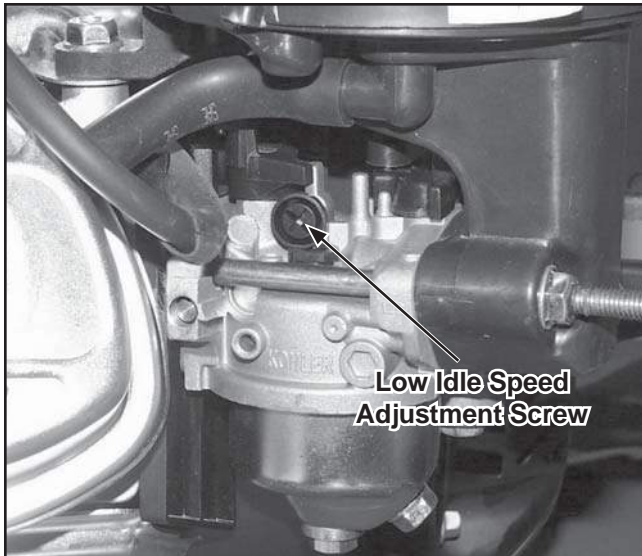
The engine is now reassembled. Before starting or operating the engine be sure to do the following:

1. Make sure all hardware is properly torqued.
2. Make sure the oil drain plugs, oil fill plugs and Oil Sentry™ wire lead bushing are tightened securely.
3. Fill the crankcase with the correct oil. Refer to the oil recommendations and procedures in the **General Information and Lubrication System** sections.

#### Testing the Engine

It is recommended that the engine be operated on a test stand or bench prior to installation on a piece of equipment.

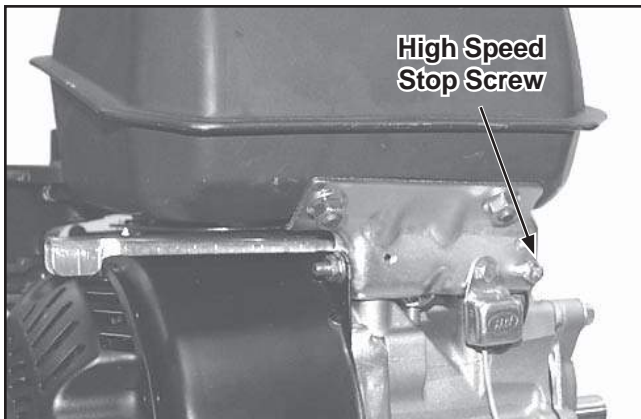
1. Set the engine up on a test stand. Check gas and oil levels. Start the engine and run for 5-10 minutes between idle and midrange. Adjust the carburetor settings as required. Low idle speed should be set to 1800 RPM ( $\pm 150$ ) or application specifications. See Figure 11-92.



**Figure 11-92. Low Idle Speed Adjustment Screw.**

2. The maximum no load high-idle engine speed is 3750 RPM.

Adjust the high speed stop screw as necessary.  
See Figure 11-93.



**Figure 11-93. High Speed Stop Screw.**

**Section 11**  
**Reassembly**

---





FOR SALES AND SERVICE INFORMATION  
IN U.S. AND CANADA, CALL **1-800-544-2444**

[KohlerEngines.com](http://KohlerEngines.com)

ENGINE DIVISION, KOHLER CO., KOHLER, WISCONSIN 53044

© 2011 by Kohler Co. All rights reserved.

FORM NO.: 17 690 01 Rev. D
ISSUED: 5/10
REVISED: 1/11



1717 690 01



50532 96539 4