SERVICE MANUAL

# KOHLER COMMAND CH11-16

## HORIZONTAL CRANKSHAFT


KOHLER ENGINES

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**Crankshaft**

End Play (Free) ..... 0.0575/0.4925 mm (0.0022/0.0193 in.)
End Play (Thrust Bearing with Shims) ..... 0.0500/0.5300 mm (0.0019/0.0208 in.)

Crankshaft Bearing I.D. (In Crankcase)
- Sleeve Bearing (Installed) - New ..... 44.965/45.003 mm (1.7703/1.7718 in.)
- Sleeve Bearing - Max. Wear Limit ..... 45.016 mm (1.7723 in.)
- Parent Material (No Sleeve Bearing) - New ..... 44.965/44.990 mm (1.7703/1.7713 in.)
- Parent Material (No Sleeve Bearing) - Max. Wear Limit ..... 45.003 mm (1.7718 in.)

Crankshaft to Bearing Running Clearance - New
- Sleeve Bearing ..... 0.030/0.090 mm (0.0011/0.0035 in.)
- Parent Material (No Sleeve Bearing) ..... 0.030/0.077 mm (0.0011/0.0030 in.)

Crankshaft Bearing I.D. (In Closure Plate)
- Sleeve Bearing (Installed) - New ..... 41.960/42.035 mm (1.6519/1.6549 in.)
- Sleeve Bearing - Max. Wear Limit ..... 42.048 mm (1.6554 in.)
- Parent Material (No Sleeve Bearing) - New ..... 41.965/42.003 mm (1.6521/1.6536 in.)
- Parent Material (No Sleeve Bearing) - Max. Wear Limit ..... 42.015 mm (1.6541 in.)

Crankshaft Bore (In Closure Plate) to Crankshaft Running Clearance - New
- Sleeve Bearing ..... 0.025/0.1200 mm (0.00098/0.00472 in.)
- Parent Material (No Sleeve Bearing) ..... 0.030/0.0880 mm (0.0011/0.0034 in.)

Flywheel End Main Bearing Journal
- O.D. - New ..... 44.913/44.935 mm (1.7682/1.7691 in.)
- O.D. - Max. Wear Limit ..... 44.84 mm (1.765 in.)
- Max. Taper ..... 0.022 mm (0.0009 in.)
- Max. Out-of-Round ..... 0.025 mm (0.0010 in.)

Closure Plate End Main Bearing Journal
- O.D. - New ..... 41.915/41.935 mm (1.6502/1.6510 in.)
- O.D. - Max. Wear Limit ..... 41.86 mm (1.648 in.)
- Max. Taper ..... 0.020 mm (0.0008 in.)
- Max. Out-of-Round ..... 0.025 mm (0.0010 in.)

Connecting Rod Journal
- O.D. - New ..... 38.958/38.970 mm (1.5338/1.5343 in.)
- O.D. - Max. Wear Limit ..... 38.94 mm (1.5328 in.)
- Max. Taper ..... 0.012 mm (0.0005 in.)
- Max. Out-of-Round ..... 0.025 mm (0.0010 in.)

Crankshaft T.I.R.
- PTO End, Crank in Engine ..... 0.304 mm (0.012 in.)
- Entire Crank, in V-Blocks ..... 0.10 mm (0.0039 in.)

**Cylinder Bore**

Cylinder Bore I.D.
- New
  - CH11-14 ..... 87.000/87.025 mm (3.4252/3.4262 in.)
  - CH15, CH16 ..... 90.000/90.025 mm (3.5433/3.5442 in.)
- Max. Wear Limit
  - CH11-14 ..... 87.063 mm (3.4277 in.)
  - CH15, CH16 ..... 90.063 mm (3.5457 in.)

### Engine Knocks

1. Excessive engine load.
2. Low crankcase oil level.
3. Old or improper fuel.
4. Internal wear or damage.

### 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.

### Engine Uses Excessive Amount Of Oil

1. Incorrect oil viscosity/type.
2. Crankcase overfilled.
3. Clogged or improperly assembled breather.
4. Worn or broken piston rings.
5. Worn cylinder bore.
6. Worn valve stems or valve guides.

## 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 overheating.

- Check for obvious fuel and oil leaks, and damaged components. Excessive oil leakage can indicate a clogged or improperly assembled breather, worn or 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 underserviced.

- Check the carburetor throat for dirt. Dirt in the throat is further indication that the air cleaner is not functioning properly.

- Check that 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 the oil has not been changed at the recommended intervals, the incorrect type or weight of oil was used, overrich carburetion, and weak ignition, to name a few.

## 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.

## Adjustment

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

### Emission Compliant Non-Adjustable Carburetors

In compliance with current government emission standards, carburetors on later production engines are calibrated to deliver the correct fuel-to-air mixture to the engine under all operating conditions, without external adjustments, except for low idle speed (RPM). See Figure 5-5.

**Figure 5-5. Emission Compliant Non-Adjustable.**

If running performance and troubleshooting indicates a problem which cannot be rectified by external means, or adjustment of the low idle speed (RPM) setting, carburetor disassembly and cleaning may be required. The basic disassembly and service procedures for these carburetors remain the same. Refer to pages 5.6 thru 5.10 as required.

### Adjust Carburetor

Low idle speed (RPM) setting:

1. Place the throttle control into the "**idle**" or "**slow**" position. Set the low idle speed to **1500 RPM** (±75RPM) by turning the low idle speed adjusting screw **in or out**. Check the speed using a tachometer.

   **NOTE:** The actual low idle speed depends on the application - refer to equipment manufacture's recommendations. The recommended low idle speed for basic engines is 1500 RPM.

Low Idle Fuel Needle with Limiter Cap Adjustment: Some emission compliant carburetors have a limiter cap on the low idle fuel adjustment screw. Adjustment is limited to the range established by the cap. Do not attempt to remove or adjust beyond the limits. See Figure 5-6.

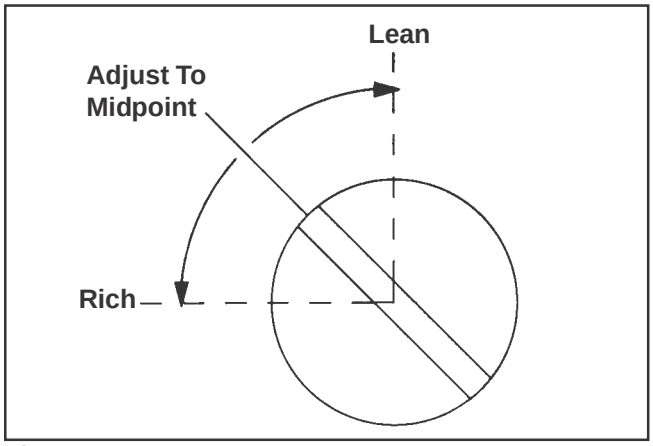


**Figure 5-6.**

## Adjustable Carburetors

The carburetor on these engines is designed to deliver the correct fuel-to-air mixture to the engine under all operating conditions. Adjustable model carburetors contain adjustment screws for the high and idle mixtures. If the engine is hard starting, runs roughly or stalls at low idle speed, it may be necessary to adjust, clean or service the carburetor.

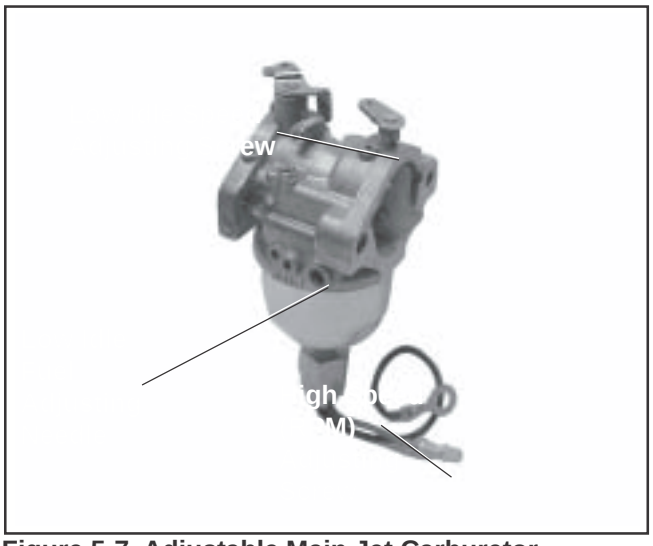

**Figure 5-7. Adjustable Main Jet Carburetor.**

4. Remove the dipstick and check the oil level.

   The oil level should be up to, but not over, the "F" mark on the dipstick. See Figure 6-3.

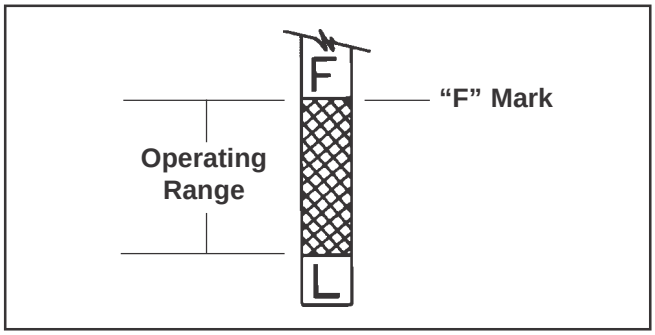


**Figure 6-3. Oil Level Dipstick.**

5. If the level is low, add oil of the proper type, up to the "F" mark on the dipstick. Always check the level with the dipstick before adding more oil.

   **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 below the "L" mark or over the "F" mark on the dipstick.

## Oil Sentry™

Some engines are equipped with an optional Oil Sentry™ oil pressure monitor. If the oil pressure gets low, Oil Sentry™ will either shut off the engine or activate a warning signal, depending on the application.

## Change Oil and Oil Filter

### Change Oil

Change oil after every **100 hours** of operation. Refill with service class SG, SH, SJ, or higher oil as specified in the "Viscosity Grades" table.

Change the oil as follows:

1. Run engine until warm.

2. Remove the oil drain plug and oil fill cap/dipstick. Be sure to allow ample time for complete drainage.

3. Make sure the engine is level when filling, checking, and changing the oil.

4. Reinstall the drain plug. Make sure it is tightened to**7.3-9.0 N·m (65-80 in. lb.)** torque.

5. Fill the crankcase, with new oil of the proper type, to the "F" mark on the dipstick. Always check the level with the dipstick before adding more oil.

6. Reinstall the oil fill cap/dipstick.

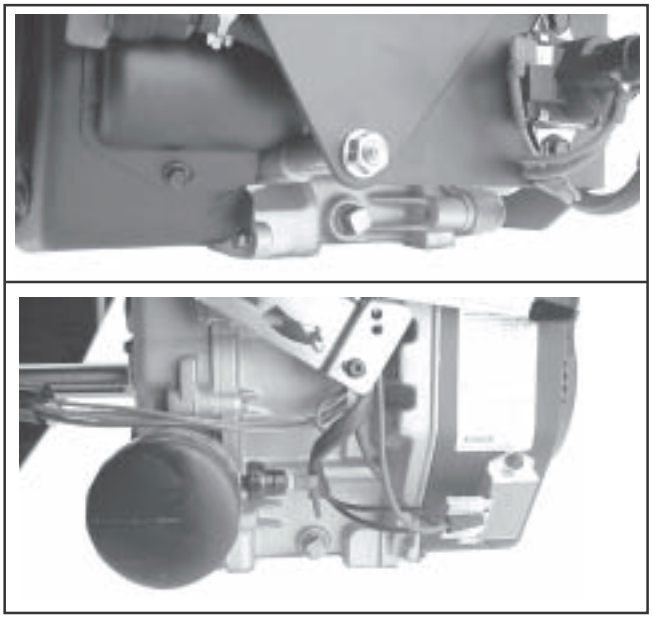

**Figure 6-4. Oil Drain Plug Locations, Oil Filter, and Optional Oil Sentry™ Switch.**

### Oil Filter

These engines are equipped with a full-flow oil filter. See Figure 6-5.

The oil filter helps remove sludge and other combustion by-products from the oil. It also extends the oil change interval and cools the oil.


**Figure 6-4. Oil Filter and Oil Sentry™.**

### Change Oil Filter

Replace the oil filter **at least every other oil change (every 200 hours of operation)**. Always use a genuine Kohler oil filter. Replace the oil filter as follows.

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## Electronic Magneto Ignition System, CH11-15 Engines

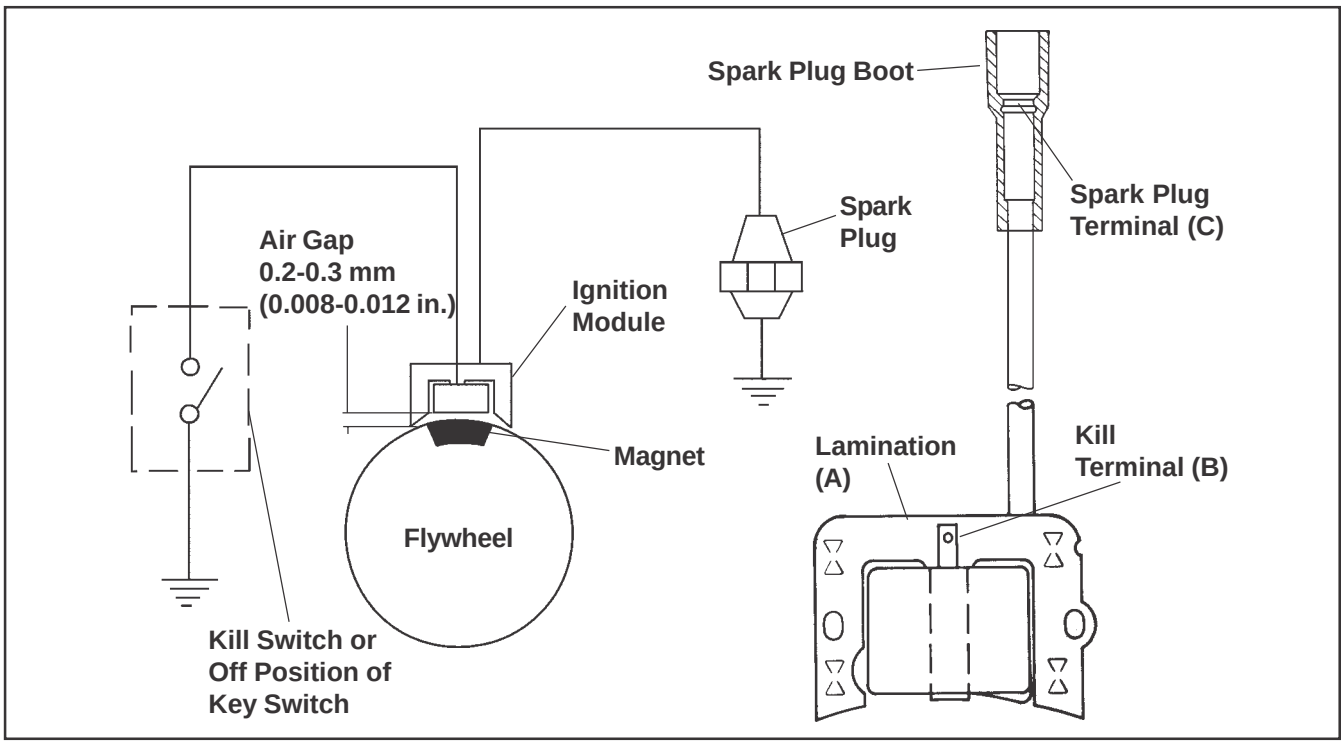


**Figure 8-3. Electronic Magneto Ignition System, CH11-15 Engines.**

These engines are equipped with a dependable electronic magneto ignition system. The system consists of the following components:

- A magnet assembly which is permanently affixed to the flywheel.
- An electronic magneto ignition module which mounts on the engine crankcase.
- A kill switch (or key switch) which grounds the module to stop the engine.
- A spark plug.

### Operation

As the flywheel rotates and the magnet assembly moves past the ignition module, a low voltage is induced in the primary windings of the module. When the primary voltage is precisely at its peak, the module induces a high voltage in its secondary windings. This high voltage creates a spark at the tip of the spark plug. This spark ignites the fuel-air mixture in the combustion chamber.

The timing of the spark is automatically controlled by the module. Therefore, other than periodically checking/replacing the spark plug, no maintenance, timing, or adjustments are necessary or possible with this system.

In the event starting problems should occur which are not corrected by replacing the spark plug, refer to the following Troubleshooting Guide for trouble analysis procedures.

### Retaining Ring Installation

1. Position the retaining ring in the groove in one of the inner halves. Assemble the other half over the top and slide on the outer collar.

2. Be certain the drive components are installed in correct sequence onto the armature shaft.

3. Slip the tool over the end of the armature shaft, so the retaining ring inside is resting on the end of the shaft. Hold the tool with one hand, exerting slight pressure toward the starter. Tap the top of the tool with a hammer until you feel the retaining ring snap into the groove. Disassemble and remove the tool.

4. Squeeze the retaining ring with a pliers to compress it into the groove.

5. Assemble the inner halves, with the larger cavity, around the spring retainer (see Figure 8-14). Slide the collar over them and thread the center screw in until resistance is felt.

**Figure 8-14. Assembling Larger Inner Half Around Spring Retainer.**

6. Hold the base of the tool with a 1 1/8" wrench and turn the center screw clockwise with a 1/2" or 13 mm wrench to draw the spring retainer up around the retaining ring. Stop turning when resistance increases. Disassemble and remove the tool.

7. Reinstall the dust cover.

### Starter Disassembly

1. Remove the drive components following the instructions for servicing the drive.

2. Locate the small raised line on the edge of the drive end cap. On starters with Style "A" commutator end caps, it will be aligned with a premarked line on the starter frame. The frame is not premarked on starters with Style "B" end caps. Place a piece of masking tape on the frame and mark a line on the tape in line with the raised line on the end cap. See Figure 8-17.

3. Remove the thru bolts.

4. Remove the commutator end cap with brushes and brush springs (Style "A"). Style "B" end caps remove as a separate piece with the brushes and carrier remaining in the frame.

5. Remove the drive end cap.

6. Remove the armature and thrust washer (if so equipped) from inside the starter frame.

7. Remove the brush/carrier assembly from the frame (Style "B" end cap starters).

### Style "A" End Cap Brush Replacement

1. Remove the brush springs from the pockets in brush holder. See Figure 8-15.

2. Remove the self-tapping screws, negative (-) brushes, and plastic brush holder.

3. Remove the hex flange nut and fiber washer from the stud terminal.

   Remove the stud terminal with positive (+) brushes and plastic insulating bushing from the end cap.

4. Reinstall the insulating bushing to the new stud terminal with the positive brushes. Install the stud terminal with bushing into the commutator end cap. Secure the stud with the fiber washer and hex flange screw.

5. Install the brush holder, new negative brushes, and self-tapping screws.

6. Install the brush springs and brushes into the pockets in brush holder. Make sure the chamfered sides of brushes are away from the brush springs.

   **NOTE:** Use a brush holder tool to keep the brushes in the pockets. A brush holder tool can easily be made from thin sheet metal. See Figure 8-16.

8. Install the frame with the small notch forward, onto the armature and drive end cap. Align the notch with the corresponding section in the rubber grommet. Install the drain tube in rear cutout, if it was removed previously. See Figure 8-49.

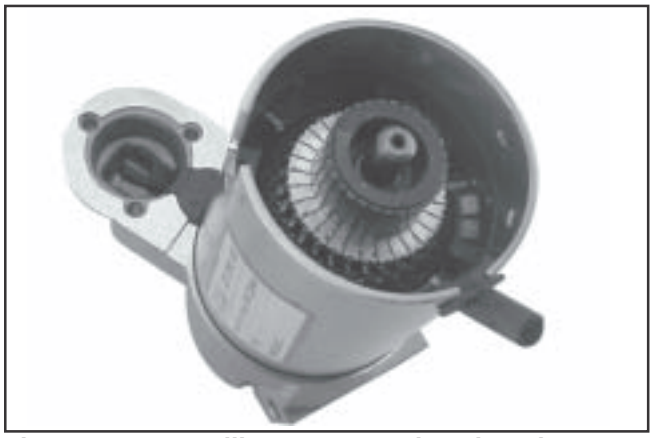

**Figure 8-49. Installing Frame and Drain Tube.**

9. Install the flat thrust washer onto the commutator end of the armature shaft. See Figure 8-50.

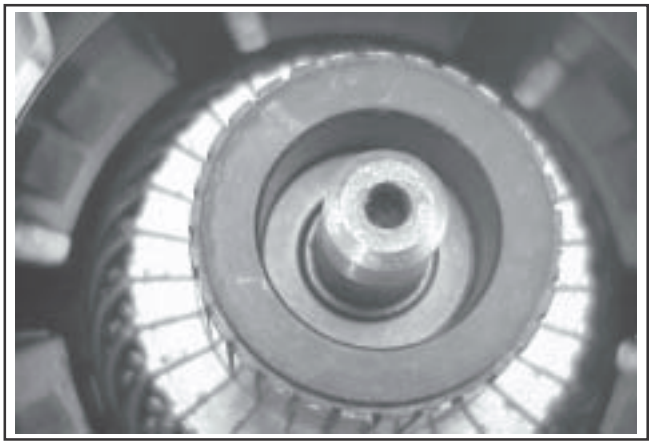

**Figure 8-50. Installing Thrust Washer.**

10. Starter reassembly when **replacing** the Brushes/ Brush Holder Assembly:

    a. Hold the starter assembly vertically on the end housing, and carefully position the assembled brush holder assembly with the supplied protective tube, against the end of the commutator/armature. The mounting screw holes in the metal clips must be **up/ out**. Slide the brush holder assembly down into place around the commutator, and install the positive (+) brush lead grommet in the cutout of the frame. See Figure 8-51. Save the protective tube, it may be used for future servicing.

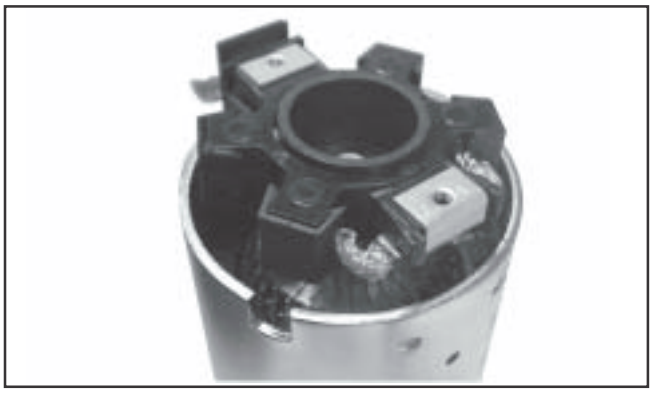

**Figure 8-51. Installing Brush Holder Assembly with Supplied Tube.**

Starter reassembly when **not replacing** the Brushes/ Brush Holder Assembly:

a. Carefully unhook the retaining caps from over each of the brush assemblies. Do not lose the springs.

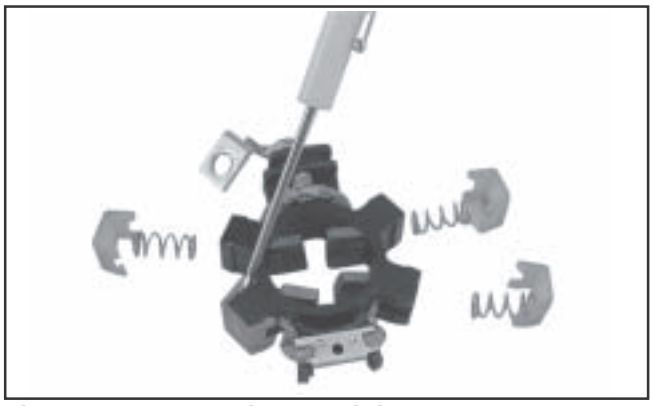

**Figure 8-52. Removing Retaining Caps.**

b. Position each of the brushes back in their slots so they are flush with the I.D. of the brush holder assembly. Insert Brush Installation Tool with extension, or use the tube described above from a prior brush installation, through the brush holder assembly, so the holes in the metal mounting clips are **up/out**.

c. Install the brush springs and snap on the four retainer caps. See Figure 8-53.

## Remove Valve Cover

1. Remove the five hex flange valve cover screws. Note the assembly orientation of any attached brackets (lift, fuel tank, muffler) and loose spacers if used. See Figure 9-22.

**NOTE:** The valve cover is sealed to the cylinder head using RTV silicone sealant. When removing valve cover, use care not to damage the gasket surfaces of cover and cylinder head. To break the RTV seal, hold a block of wood against one of the flat faces of the valve cover. Strike the wood firmly with a mallet. If the seal doesn't break loose after 1 or 2 attempts, repeat the procedure on the other side.

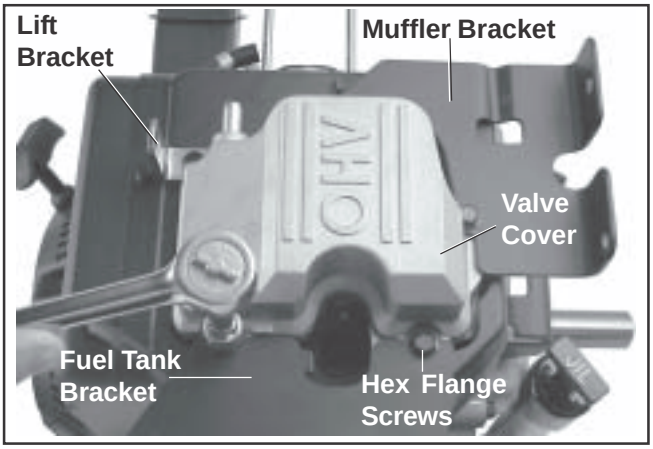


**Figure 9-22. Removing Valve Cover.**

## Remove Cylinder Head Baffle

1. Remove the hex flange screws securing the cylinder head baffle to the cylinder head. See Figure 9-23. Remove the baffle.

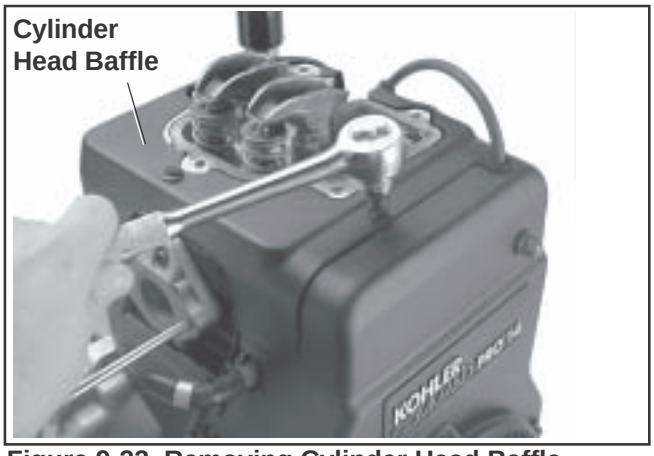


**Figure 9-23. Removing Cylinder Head Baffle.**

## Remove Blower Housing and Baffles

1. Remove the hex flange screws from the blower housing and baffles. Disconnect the wire harness from the key switch, if equipped. Remove the blower housing, intake tube and baffles. See Figures 9-24, 9-25, and 9-26.

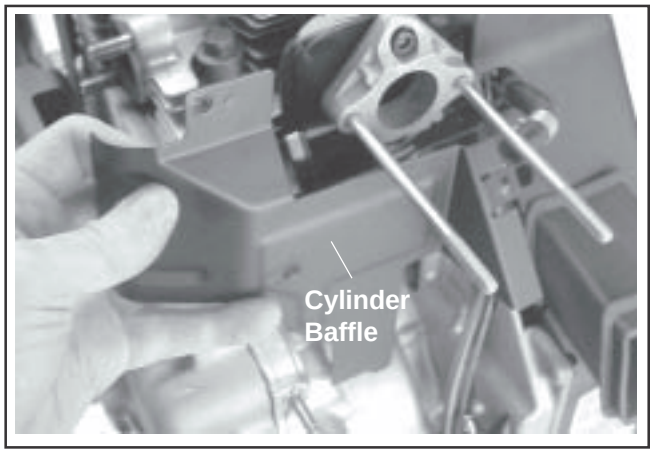


**Figure 9-24. Removing Intake Side Cylinder Baffle.**

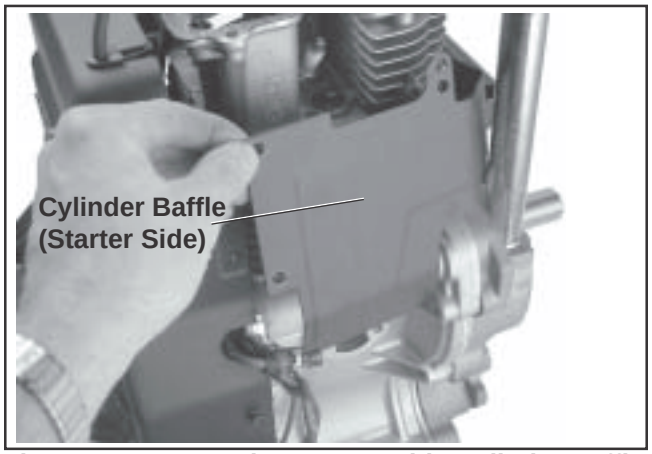


**Figure 9-25. Removing Starter Side Cylinder Baffle.**

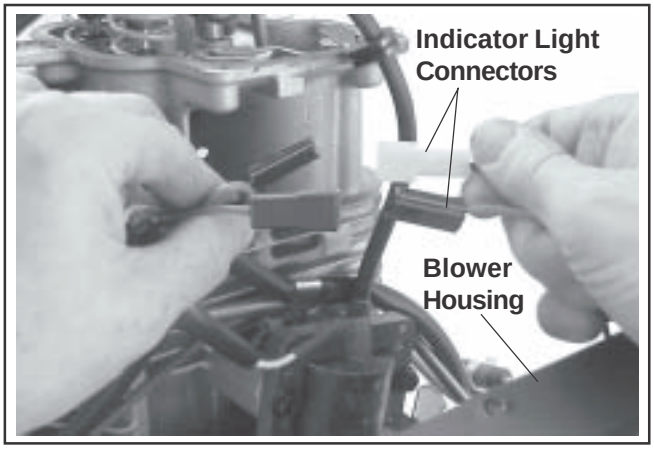


**Figure 9-26. Disconnecting Indicator Light Leads and Removing Blower Housing.**

## 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. With a micrometer, measure the diameter of the piston perpendicular to the piston pin, and up from the bottom of the piston skirt as indicated in Figure 10-2, based on the model involved.

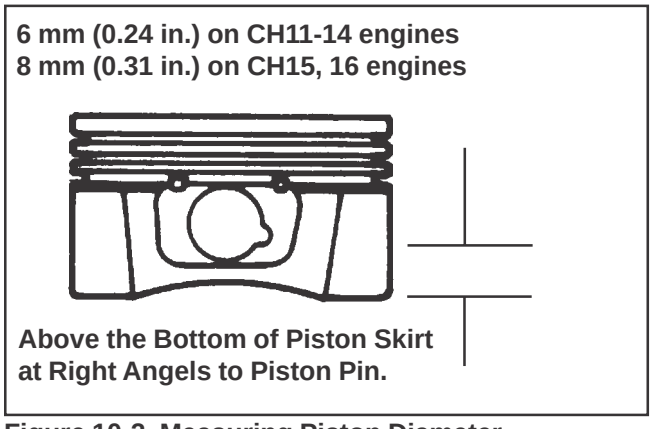


**Figure 10-2. Measuring Piston Diameter.**

2. Use an inside micrometer, telescoping gauge, or bore gauge and measure the cylinder bore. Take the measurement approximately **63.5 mm (2.5 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 cracked. Replace the flywheel, the crankshaft, and the key if flywheel key is sheared or the keyway damaged.

Inspect the ring gear for cracks or damage. Kohler does not provide ring gears as a serviceable part. Replace the flywheel if the ring gear is damaged.

## Cylinder Head and Valves

### Inspection and Service

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 guides. See Figure 10-3 for valve details and specifications.

4. Align the timing marks the camshaft gear and the smaller gear on the crankshaft. Lower the camshaft into the bearing surface in crankcase.

5. Make sure the camshaft gear and the smaller gear on the crankshaft mesh and the timing marks are aligned. See Figure 11-12.

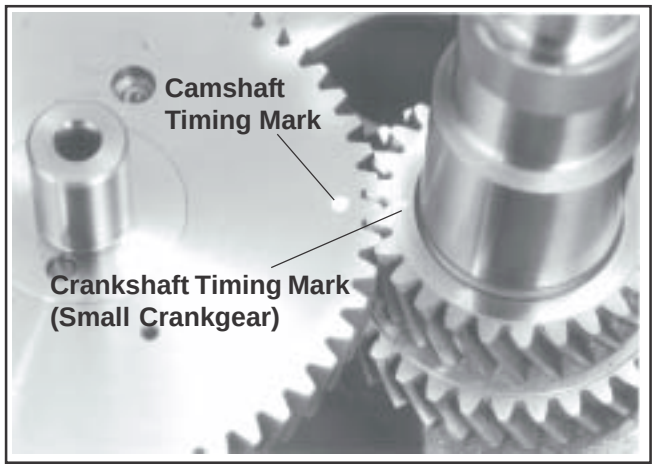


**Figure 11-12. Aligning Timing Marks on Crank Gear and Cam Gear.**

## Determine Camshaft End Play

1. Install the shim spacer, removed during disassembly, to the camshaft.

2. Install the camshaft end play checking tool (see Section 2) to the crankcase and camshaft. Secure the tool to the crankcase with the hex flange screws provided. See Figure 11-13.

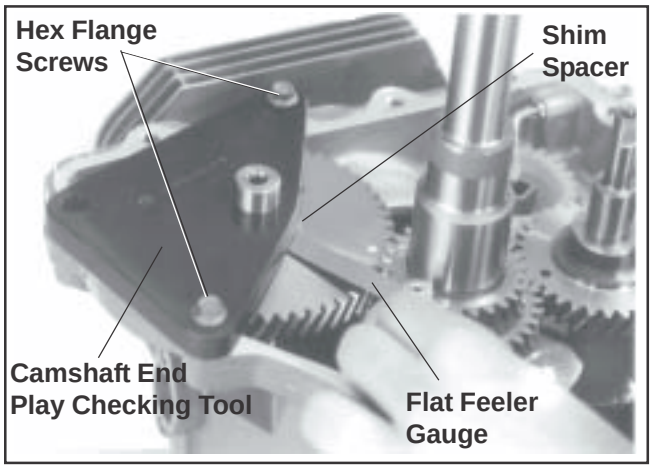


**Figure 11-13. Checking Camshaft End Play.**

3. Using a flat feeler gauge, measure the camshaft end play between the shim spacer and the end play checking tool. Camshaft end play should be **0.076/0.127 mm (0.003/0.005 in)**.

4. If the camshaft end play is not within the specified range, remove the end play checking tool and add, remove or replace shims as necessary.

   Several color coded shims are available:

**White:** 0.69215/0.73025 mm (0.02725/0.02875 in)
**Blue:** 0.74295/0.78105 mm (0.02925/0.03075 in)
**Red:** 0.79375/0.83185 mm (0.03215/0.03275 in)
**Yellow:** 0.84455/0.88265 mm (0.03325/0.03475 in)
**Green:** 0.89535/0.99345 mm (0.03525/0.03675 in)
**Gray:** 0.94615/0.98425 mm (0.03725/0.03875 in)
**Black:** 0.99695/1.03505 mm (0.03925/0.04075 in)

5. Reinstall the end play checking tool and recheck end play.

6. Repeat steps 4 and 5 until the end play is within the specified range.

## Install Oil Pressure Relief Valve

### Five-Piece Oil Pressure Relief Valve

1. Place the relief valve body in the cavity of the closure plate.

2. Insert the piston and spring into the body. See Figure 11-14.

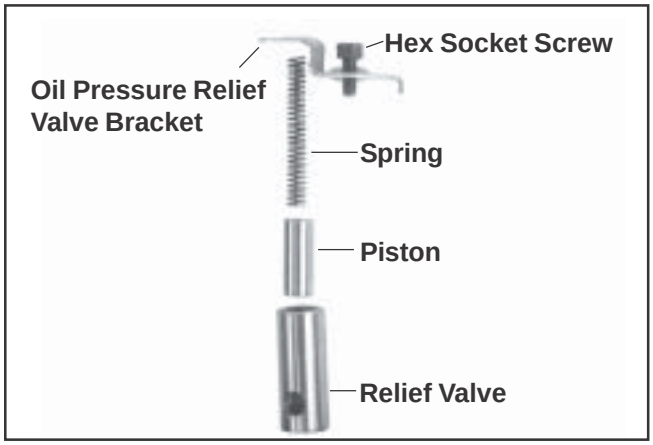


**Figure 11-14. Installing Oil Pressure Relief Valve Body, Plunger, and Spring.**

3. Install the bracket and hex flange screw. See Figures 11-14 and 11-18.

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