# EXPANDED INSTRUCTIONS FOR COMPLYING WITH SB-912-022/SB-914-011 USING OPTIONAL VALVE SPRING TOOL KIT

### Introduction:

These optional / expanded instructions have been designed to supplement the information found in Rotax Service Bulletin SB-912-022 / SB-914-011. These instructions fully explain the use of an optional valve spring compression tool and alternate (and recommended) rope method for securing the intake and exhaust valves.

These instructions should only be used in conjunction with the instructions and information found in Rotax Service Bulletin SB-912-022 / SB-914-011. Rotax Service Bulletin SB-912-022 / SB-914-011 <u>must</u> be read in it's entirety before proceeding. Pay particular attention to all warnings, cautions and notes found in the service bulletin. The procedures outlined in Rotax Service Bulletin SB-912-022 / SB-914-011 and these optional instructions should only be carried out by an experienced aircraft technician.

### **Overview:**

The instructions for the replacement of the valve spring retainers found in Rotax Service Bulletin SB-912-022 / SB-914-011 assumes the use of a standard Rotax supplied tool to compress the valve springs to remove the valve spring retainers. While the Rotax tool works very well, a simpler and less expensive device can be used in many engine installations where good access to the engine heads is available. These instructions cover the use of this simpler valve spring compression tool to accomplish the task at hand.

The instructions in Rotax Service Bulletin SB-912-022 / SB-914-011 also suggest the use of compressed air as a means to hold the engine valves in the head while replacing the valve spring retainers. When the valve spring retainers are removed for replacement, it becomes possible for a valve to fall free and drop down into the cylinder. If this were to happen, the cylinder head would have to be removed to retrieve the valve. Damage to the valve, piston, or cylinder could also result from the dropping of the valve into the cylinder.

There are two recognized methods of securing the valves in position in the cylinder head when this type of maintenance work is required. The first method uses regulated compressed air. With both intake and exhaust valves closed (piston on the compression stroke), regulated compressed air is fed into the cylinder through a spark plug hole. The higher air pressure in the cylinder holds both valves firmly in the shut position and prevents the valves from dropping into the cylinder when the valve cotters and valve spring retainers are removed.

The compressed air method is generally safe and effective, but requires additional equipment (compressed air source, air pressure regulator, special fittings). In addition, the care must be used when employing the compressed air method on engines fitted with a propeller. When feeding compressed air into the cylinder, it may be possible for the engine to turn over unexpectedly spinning the propeller through at least part of a revolution creating a safety risk.

The alternate and recommended method of securing the valves set out in these instructions is the rope method. Briefly, the rope method involves the placement of a short section of soft rope into the cylinder via a spark plug hole. The piston is then pushed up against the rope (on the compression stroke) and the rope is lightly compressed against the inside of the cylinder head and valves. The rope lightly holds the valves in place in the closed position while the maintenance work is performed. The rope method is recommended as it is simpler, does not require a compressed air source, and eliminates the possibility of unexpected propeller movement from the action of compressed air in the cylinder.

A version of these instructions with color photos is available for download at www.rotax-owner.com

## **Contents of Optional Valve Spring Retainer Replacement Tool Kit**



- 5. Molykote—GN assembly lubrication.
- 6. Bolts used to attach cross bar to cylinders.
- \* requires 3/8 in. drive power bar not supplied. (3/8 drive ratchet wrench is not suitable)



Special valve spring compression tool shown fitted to 3/8 in. drive power bar (not supplied).

Important Note: A 3/8 in. drive power bar is required. <u>A 3/8 drive ratchet wrench is not</u> <u>suitable</u>

## **Detailed Instructions**

## Step 1.— General Preparation

- Remove both top and bottom spark plugs from all cylinders. Both spark plugs must be removed to prevent damage to the spark plug or change in the spark plug gap as a result of contact with rope placed in the cylinder.
- Remove valve covers and discard O-rings.
- On each cylinder, remove the cap nut located on the bottom outside cylinder stud. (See Item #11—Fig. 1 of SB-912-022 / SB-914-011). Removal of this nut is necessary to allow clearance for the removal of the rocker arm shaft. IMPORTANT! ONLY REMOVE ONE CAP NUT PER CYLINDER!



# Step 2.— Individual Cylinder Preparation.

- (Repeat for this step in turn for each cylinder.)
- Find the compression stroke of the cylinder you are working on. The compression stroke can be recognized as the stroke where the piston is moving towards the head and <u>both</u> valves are closed. Use a small flashlight to look down the top spark plug hole to verify piston movement and valve position.
- Rotate the engine crankshaft to bring the piston to the Top Dead Center (TDC) position making sure both valves are closed. Again use a small flashlight and look down the top spark plug hole to verify that the piston is at the top of the stroke and that both valves are closed.



• Now turn the crankshaft the opposite way to move the piston away from top dead center (TDC) approximately two inches (50 mm). This will allow room for the rope to be fed into the cylinder.

- Insert approximately three feet (900 mm) of soft rope into the cylinder through the top spark plug hole leaving enough rope remaining outside the cylinder for easy removal. Twisting the rope slightly will help in feeding the rope into the cylinder.
- \* Once the rope has been placed in the cylinder do not move the piston to compress the rope against the valves. The rope has been placed in the cylinder at this time to prevent the possibility of the valves touching the piston as the next few steps are accomplished.
- \* At this point in the procedure enough space or "free play" is required between the piston and the valves to allow room for the valves to open and release some pressure on the rocker arm. This release of pressure is required for the removal of the rocker arm shaft.
- Lightly tap the valve spring retainers to loosen the cotters. Use a soft hammer or soft faced drift to prevent damage to components (See Fig. 3).
- Install cross brace tool across the top of the cylinder bank. Use the 6 mm threaded holes in the cylinders as shown in Fig. 4 and two (2) 6 mm bolts to secure the cross brace bar to the cylinders.





Step 3.— Removal of Rocker Arm Shaft. (Repeat for this step in turn for each cylinder.)

- Feed a short section of rope through the hollow rocker arm shaft as shown in Fig. 5.
- Fit special valve spring compression tool over valve spring retainers as shown in Fig. 6.



IMPORTANT! - When using the valve spring compression tool exercise caution to make sure the tool or power bar does not slip and damage the cylinder head.

- Using the installed cross bar as a leverage point, compress both valve springs with the special tool to release the pressure on the rocker arm shaft (See Fig. 7).
- Pull on the rope (see Fig. 8) to remove the rocker arm shaft and rocker arms. **Be careful not to drop the rocker arms!**



# Step 4.— Removal of Valve Spring Retainers.

- (Repeat for this step in turn for each cylinder.)
- Compress the piston against the rope in the cylinder.
  Note:
- \* Excessive force is not required!
- \* Be sure to move the piston towards TDC of the compression stroke as described in Step 2.
- Have an assistant compress the valve springs enough to adequately expose the cotters.
- Remove the valve cotters with a small pick or screwdriver (see Fig. 9). Be careful not to drop the cotters into the push rod tubes.
- Relax the pressure on the spring and remove tool and old retainers.



Important Tip: Use of a pipe extension on the power bar will add leverage and ease installation.



## Step 5.— Installation of New Retainers

(Repeat for this step in turn for each cylinder.)

- Apply a layer of thick grease to the new retainers and cotters. This will help to hold the parts in place during assembly (see Fig. 10).
- Install the new retainers on the valve springs. Make sure to install the retainers with the raised inner centering ring facing towards the springs.
- Reposition the valve spring compression tool.
- Have an assistant compress both valve springs again.
- Install the cotters.
- Release the compression on the valve springs.





As springs are relaxed use fingers to press valve / cotter assembly into retainer cone.

## Important Tip!

To prevent the cotters from being dislodged while relaxing the springs:

- ⇒ Rotate crankshaft to move piston slightly away from the rope in the cylinder.
- ⇒ Use your fingers to push the valve / cotter assembly into the cone of the retainer so that the cotters are seated in the retainer cone (see Fig. 11).

# Step 6.— Reinstalling Rocker Arm Shaft & Rocker Arms

(Repeat for this step in turn for each cylinder.)

• Apply Molykote-GN to shaft, rocker bores, contact areas of rockers and bearing surfaces of cylinder head see Fig. 12).



- Using tool supplied, have assistant recompress the valve springs.
- As the valve springs are being compressed, push the valve / cotter assembly inwards with your fingers (see Fig. 13). This will give extra clearance for the rocker arms & shaft.
- Slide the rocker arm shaft through the rocker arm bushings, insuring the rocker arms are installed in the correct position. (Rocker arms should line up with the valves and push rods.)
- Release compression on valves springs.

**IMPORTANT! - The rocker arm shaft is a slide fit.** <u>Do not force or hammer rocker arm shaft</u> <u>into place!</u> If the shaft will not slide in, you must be sure that the valve / spring assembly is compressed enough to allow the rocker arm "wiggle room" to line up the shaft.

- Lubricate and re-install the cap nut on the cylinder head stud. Tighten to 195 in•lbs (16.25 ft•lbs).
- Note: It may be necessary to push the rocker arm shaft flush with the bearing support surface on the <u>exhaust</u> side to allow re-installation of the cap nut
- Insure the rocker arm shaft is flush at the <u>intake</u> (inboard) side of the bearing support. This allows for adequate clearance for the valve covers (see Fig. 14). (Valve covers must not touch when re-installed.)
- Tap top of valve spring retainer with a soft hammer or soft faced drift to "set" the cotters.





- Turn engine crankshaft to move piston away from rope in the cylinder.
- Carefully remove rope from cylinder.
- Remove cross brace after both cylinders have been completed.
- Inspect the cylinder head / valve cover mating surface on the cylinder head for nicks, dents or other damage. The valve cover must seal tightly to the cylinder head for proper engine operation.
- Re-install valve cover with new O-rings. Torque valve cover retaining screw to 90 in•lbs.

### Important Tip:

Fit both valve covers loosely and insert a larger (0.012 in.) feeler gauge between the valve covers while tightening the retaining screws. This helps to maintain the required 0.008 in. gap between valve covers.

- Repeat Steps 2 through Step 6 on each cylinder head.
- Re-gap and re-install all spark plugs.
- Conduct engine test run as set out in Rotax Service Bulletin SB-912-022 / SB-914-011.

### **IMPORTANT NOTE:**

These instructions do not replace those set out in Rotax Service Bulletin SB-912-022 / SB-914-011 and should only be used as additional information to assist in the use of the special valve spring compression tool and valve retaining rope as described herein.